

JANUARY 1981 \$1.25

# Popular Mechanics

PLANS  
INSIDE



3 OLD-TIME PENNY  
BANKS FOR YOU TO  
MAKE OUT OF WOOD

'81 IMPORTS:  
Amazing 54-mpg  
Toyota Starlet

PLUS  
Datsun 810's  
talking dashboard

New ski-gear  
designs for speed  
plus safety



FLY A  
HOMEBUILT WWII  
THUNDERBOLT

INSIDE: 21 PLANES YOU BUILD  
FROM PLANS & KITS

## 11 COMPLETE PLANS

- Solar greenhouse you can add to your home
  - 4 new shop tools to make
  - Modern hutch you can build
- PLUS:** Play cubes, coffee table  
...and more!

THE MYSTERY PLANE  
THAT ALMOST KILLED  
HOWARD HUGHES



HALF-SIZE P-47





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

17 mg "tar," 1.1 mg nicotine av. per cigarette, FTC Report Dec. 79

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



# STP Gas Treatment

## Costs more than gas-line anti-freeze. It should. It does more!

### All gasoline anti-freezes fight gas-line freeze.

**STP Gas Treatment fights gas-line freeze and a whole lot more. It's the Driver's Edge. It provides more protection for your fuel system. Removes water that can freeze gas lines. Inhibits rust that can cause problems. Cleans your carburetor. And keeps it clean to save you gas.**

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

### Removes water— fights gas-line freeze.

Water gets into your gas tank through condensation and, sometimes, by contamination at the pump. If it freezes in your gas line, that could mean a stalled car.

In cold weather, just one ounce could freeze up to ten inches of gas line!

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

### Inhibits rust.

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

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



(1 oz.)



UNTREATED TREATED

### Cleans carburetors and keeps them clean.

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

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

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



UNTREATED

TREATED

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

### Saves gas.

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



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

### Get the Driver's Edge.

If you demand more from your gas — and more than many gas anti-freezes even promise — join the millions of smart drivers who demand STP Gas Treatment. Keep it on the job — every mile, every fill, every season.

Because STP Gas Treatment **delivers**. Delivers so much more, the year round. *Satisfaction guaranteed or your money back.*

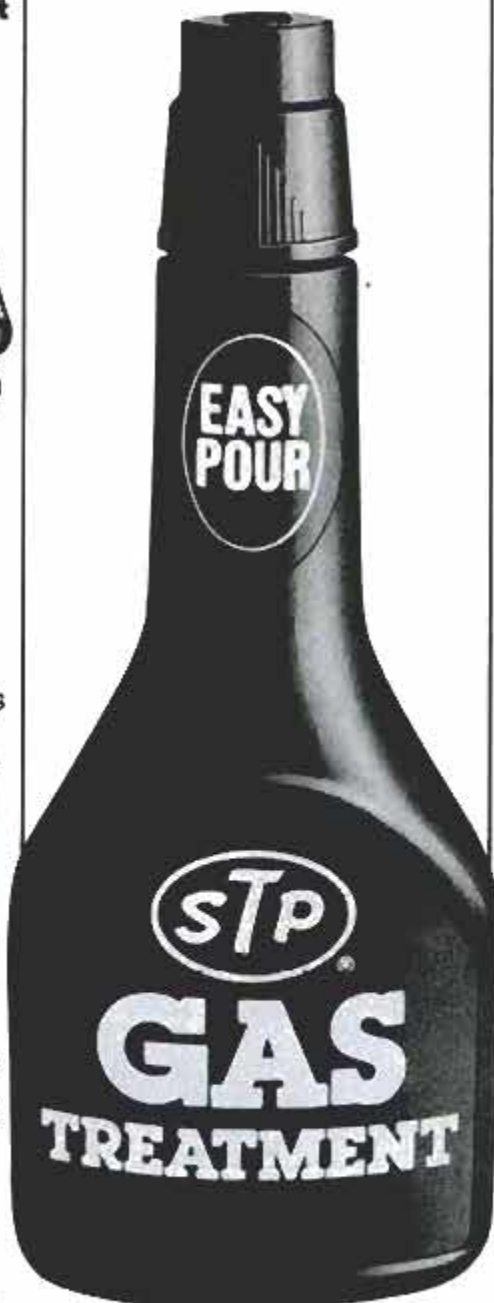
STP Gas Treatment **does it all**. Removes water, fights gas-line freeze, cleans carburetors, saves gas. That's why it **outsells them all**.

This One



NFQ7-E83-2T9D

**edge.**







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Standarden är kvalitet



Sinonimo di qualità



The Standard is Quality  
for Imports, too.



Check your Yellow Pages





### On the cover

Half-size replica of the famed P-47 Thunderbolt fighter shows the unmistakable lines of its awesome World War II ancestor. Story on page 74 tells how you can build it from plans at home, plus 20 other aircraft from plans or kits.

# Popular Mechanics

JANUARY 1981

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**Special Editorial Features:** Sheldon M. Gallager, editor

**Automotive:** Tony Assenza, editor; Michael Lamm (West Coast); Gary Wilzenburg (Detroit)

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

**Special Publications:** Clifford B. Hicks

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**Associate Publisher,  
Director of Advertising**  
Daniel J. Coleman

**Advertising Offices:**

**New York:** 224 West 57th St., New York, N.Y. 10019; (212) 262-4284

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

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

**Cleveland:** 221 Mercantile Center, 3659 Green Rd., Cleveland, Ohio 44122; (216) 292-7334

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

**Production Manager:** Ronald Tuosto

**Advertising Production:** Ronni Beth Siegel  
(212) 262-4800

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

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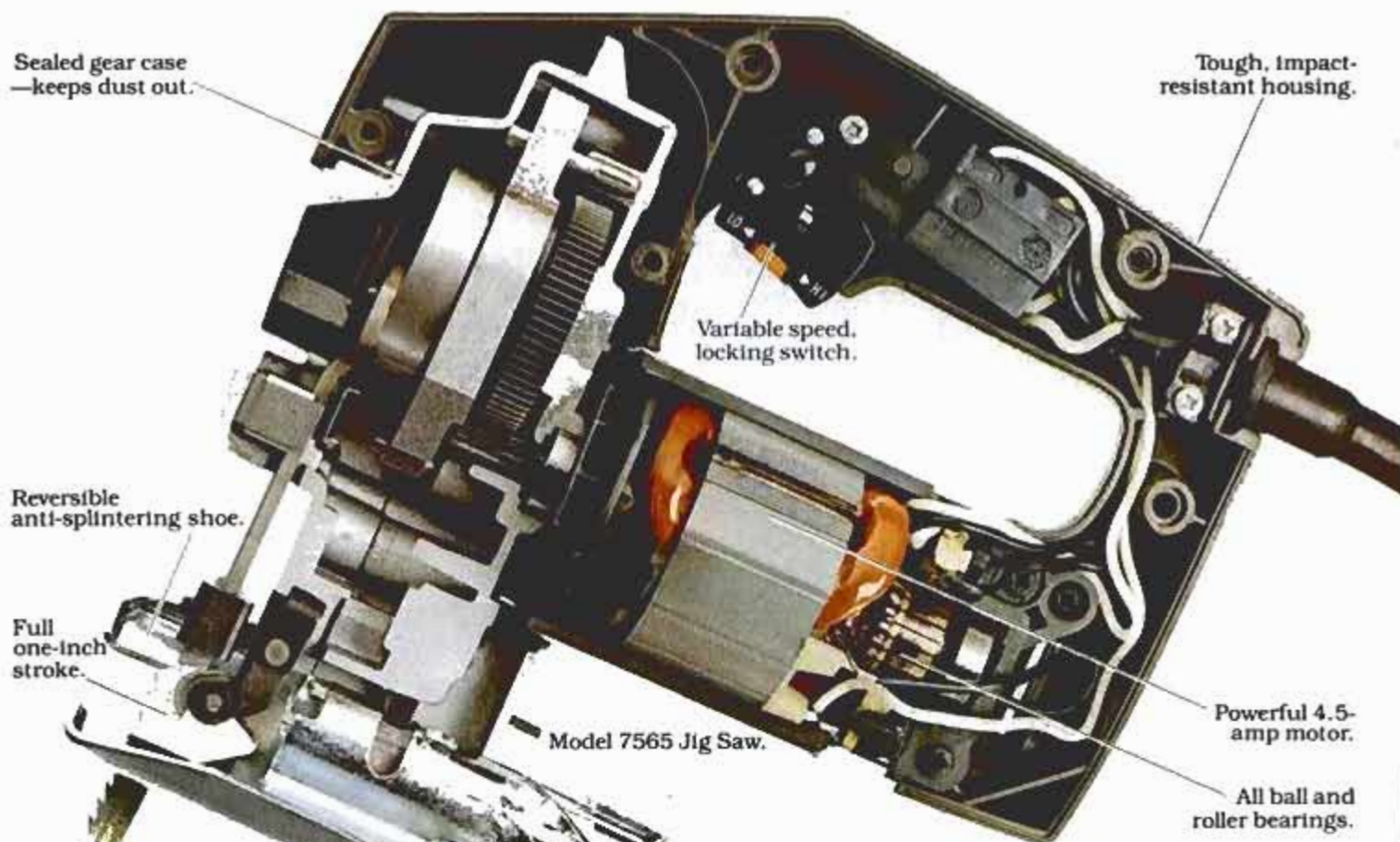
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# LETTERS TO THE EDITOR

## Call it Yankee ingenuity

No smart Yankee would hold a buck-saw as shown on your October '80 cover unless he wanted to take all the skin off the back of his hand!

H. CRAIG BARTLETT  
EASTHAM, MASS.

He can't possibly saw enough wood for winter as he's pictured.

EDGAR A. BAUERY  
ST. CLOUD, MINN.

The proper stance for using a bucksaw is to put one hand on the top of the frame near the strainer and the other on the frame just below the blade. In this position, the operator is behind the saw, giving him full advantage of a direct push away from his body and the ability to apply downward pressure.

LLOYD A. WATTS  
PORTSMOUTH, R.I.

Well, the question seems to be at least debatable. The model pictured, a former lumberjack, contends that the underhand grip is acceptable when the log is small, and the saw isn't cutting deeply enough to endanger the knuckles. It's just a way of varying your hand position to relieve fatigue. We did take pictures of the more conventional grip, but preferred the pose that was shown.

## Space-heater update

The article *Space Heaters: How to Choose from 31 Types* (page 102, Oct. '80) had some rather unfortunate errors. Four years ago, Kero-Sun introduced a new technology of kerosene heaters that are 99.9 percent efficient—30 percent higher than the figure given in your article.

Kero-Sun has eight models with outputs ranging from 7600 to 18,500 B.T.U./hour—a much greater range than that stated. I hope you will give your readers an opportunity to learn more about our kerosene heaters, and how they are helping Americans to cut their heating bills.

WILLIAM S. LITWIN  
PRESIDENT  
KERO-SUN INC.  
KENT, CONN.

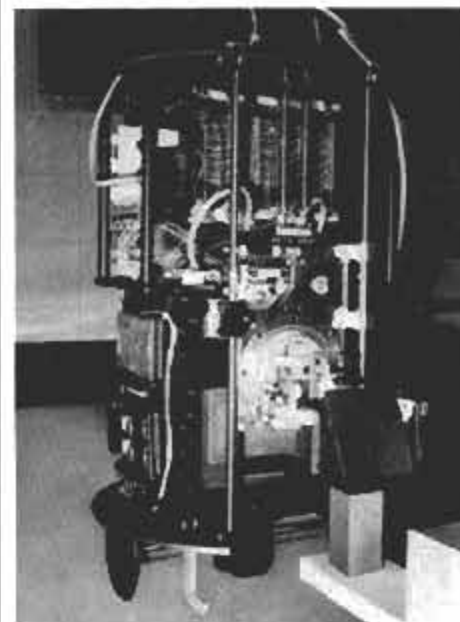
While the figures we gave were not intended to apply to any particular brand of heaters, we did obtain product literature from Kero-Sun as an aid in compiling our chart of rated outputs. In checking the literature,

we inadvertently picked 12,500 B.T.U./hour as representing the high-end figure. This referred to a lower-capacity unit. The correct maximum output should have been listed as 18,500 B.T.U./hour.

Our figure of 70-percent efficiency applies to vented kerosene heaters, where some heat is lost to the outdoors. It's true that unvented heaters can reach almost 100-percent efficiency because all of the heat is retained in the room.

## Will the real Newt stand up?

The article *Robots You Can Build Today* (page 16, Aug. '80) contains an error. The robot depicted in the lower right-hand corner of page 16 is not Newt, contrary to the caption. I am enclosing a photo of Newt, the



Newt, the robot, as he should have appeared, building a wood-block house.

robot project I've been working on for about five years.

RALPH L. HOLLIS  
YORKTOWN HEIGHTS, N.Y.

Sorry for the mixup. When you build a robot capable of checking photo captions, please let us know.

## Be careful how you use it

In the Sept. '80 issue (*Home Energy Guide*, page 149), Joseph Williamson advocates using polystyrene foam panels to insulate windows. The procedure as outlined constitutes a safety hazard. Polystyrene foam is

combustible and, when ignited, burns rapidly and gives off toxic gases in sufficient quantities to injure occupants of the house.

Minnesota building and fire-code statutes permit the use of polystyrene foam only if it is protected by 1/2-inch plasterboard or an appropriate spray-on, fire-resistive coating. The Fire Marshals Assn. of Minnesota supports the saving of energy resources . . . but in a safe manner.

HUGH O. STRAWN  
SECRETARY-TREASURER  
FIRE MARSHALS ASSN. OF MINNESOTA  
HOPKINS, MINN.

Yes, a wise reminder. Polystyrene foam, while excellent insulation, should indeed be protected against fire whenever used in the home. Readers should consult local codes for requirements in their areas.

## Results aren't all in yet

I am appalled! In *A Fireplace Boiler Helps the Sun Heat This New House* (page 117, Sept. '80), PM claims that the perlite insulation shown can attain an R-value equivalent to 70 in 3 inches. ASHRAE rates perlite at between 2.5 and 2.9 R per inch. I know how ASHRAE got its figures. Where did you get yours?

DAVE WHATLEY  
(NO ADDRESS GIVEN)

First, we were talking about ceramic insulation, which is different from straight perlite. It is perlite treated with sodium silicate, which is said to reflect radiant energy. Standard conductive tests on insulation do not take into account this added factor. The manufacturer says that tests made with the Probeye Infrared Scanner, which measures radiant heat loss, bear out its claims.

However, some experts in the field do have reservations about such claims. Heat-loss tests performed for the Department of Energy showed the material to have an R-value approaching that for untreated perlite (2.5 to 3.7 per inch). Other tests by the Canadian government produced similar results.

But these were purely conductive tests, not radiant. The manufacturer is currently working with the National Bureau of Standards and others to come up with a testing procedure that's fair and acceptable to all concerned. We will keep readers posted on developments. **PM**



'Tis the season  
to give  
something extra...  
Calvert Extra.



American Whiskey—A Blend • 80 Proof © 1987 Calvert Dist. Co. Louisville, Ky



# ALL OUTDOORS

## Best by test

Gear to go afield and afloat needs to be particularly functional and rugged. Satisfactory sport—and sometimes your survival, as well—can depend on it. Every year we keep a list of items that have worked particularly well—or badly—plus special places, good books and directories, and new equipment we haven't tried out yet, but which looks promising. So here are new additions,



Waterproof Canoe Camp Pak holds Shakespeare's Mini-Rod, new Peak 1 lantern and glasses with Burke Snuggler.

some old favorites and a few duds from the past 12 months.

Neatest new lamp we've tried is Coleman's Peak I Model 222 lantern. A lightweight brown miniversion of the big green standard model, it's less than 10 inches high, burns for 2½ hours with the light of a 75-watt bulb, and is a companion to last year's excellent little Model 400 backpack stove. It fits easily, we've found, into one of the Canoe Camp Pak waterproof boating bags made by Voyageur's Ltd. The Gardner, Kan., outfit also supplies waterproof, inflatable camera bags, flotation bags, extra-light life jackets and various other canoe and white-water kayak equipment.

For holding fishing tackle, the best new box we've seen is the No. 767 model from Plano Molding's extensive 44-choice line. The 56-compartment box can be opened flat or upright, has see-through, worm-proof trays, and is a particularly handy size for travel. For reels, track down the \$20 Fishing Reel Box, made by Suci Sporting Goods, Flint, Mich. With its foam-padded interior and particularly useful shoulder strap, it should make a good camera case, as well. And as you may have noticed, many tackle boxes with movable dividers are ideal for 35-mm slides.

Worst luck we've had this year is finding a durable, readable, easy-to-wear pedometer to measure distance hiked. A pedometer is a handy aid for outdoorsmen—but every one we've tested so far cancels its reading when brushed, is hard to read, or breaks far too soon.

## Under/over water photos

For years, we've been looking for the perfect outdoor camera. Latest contender is the Nikonos IV-A.

A couple of years ago we asked Nikon, "Why don't you put a meter for automatic exposures in your underwater Nikonos, where it's really needed?"

We were told then that there is no necessity for a built-in meter, there would be technical problems, and it's not in the works.

But here it is, and a neat, rugged and expensive package (\$567, plus \$565 for its strobe Speedlight) it turns out to be. Shutter speeds now go from 1/30 to 1/1000 second, and if these are outside the range of the lens opening, a red light in the finder blinks to indicate that the aperture should be adjusted. A hinged back has also been designed to make reloading much easier. Four different lenses are available, and the Nikonos flash automatically couples for correct exposure.

At 32 ounces, the camera is not a



Newest Nikon, waterproof Nikonos IV-A, now has a built-in automatic meter system that sets shutter for divers, outdoorsmen.

flyweight when out of the water, but for years photographers have admired the great durability of earlier models. A new built-in grip should make the IV-A even easier to handle. You can obtain high shutter speeds for action sports shots by opening up the aperture. While there is no provision for bracketing exposures, you can change the film-speed setting for various effects.

For the active sportsman—partic-

ularly a mountain climber, sailor, white-water rafter or diver—this new Nikonos is probably the best choice around. "Is a future model likely to have a built-in motor-drive film advance?" we asked Nikon. That's not feasible, we were told.

## Top ratings

Best high-performance offshore boat for 1981? We predict it will undoubtedly be the 27-foot Squadron XII, from Miami.

Most interesting marine development: the OMC Sea Drive, with its new approach to applying power to a boat.

Most helpful aid for camping meals: *Great Cooking Outdoors*, a Bantam paperback by Gale and Beverly Holsman. And the top flavor enhancer for outside or at home: Try the 40-pound-capacity Smokehouse electric smoke cooker from Mirro of Manitowoc, Wis.

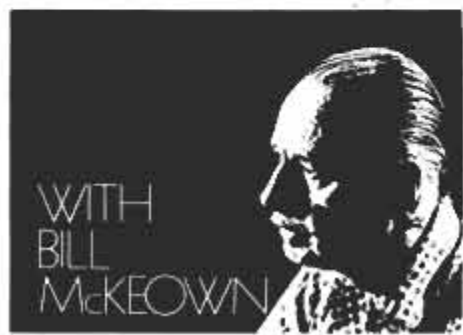
Neatest chef-knife set we've seen for the camper is the Kershaw Blade-Trader from Kai Cutlery USA, Lake Oswego, Ore. The Camp Kit set fits a carving, bread knife or saw blade interchangeably into a rosewood handle, while the deluxe model adds frozen-food, boning and dicing blades.

And if you don't wish to be bothered with carving game birds or cracking shellfish while camp-cooking, Sportsman Scissors are convenient poultry shears that are new from Normark in Minneapolis, the importer of the famed Rapala fishing lures and knives from Finland.

Best outdoor wear item of the year is Red Ball's waterproof Dry-fast insulated parka. Combining the virtues of really rainproof foul-weather gear with the warmth and light weight of fiberfill-insulated clothing, the hooded jacket doesn't get brittle in the cold, doesn't leak, and keeps you comfortable.

Outstanding new RV: VW Vanagon Camper.

PM





# Now NRI takes you inside the world's most popular microcomputer to train you at home as the new breed of computer specialist!

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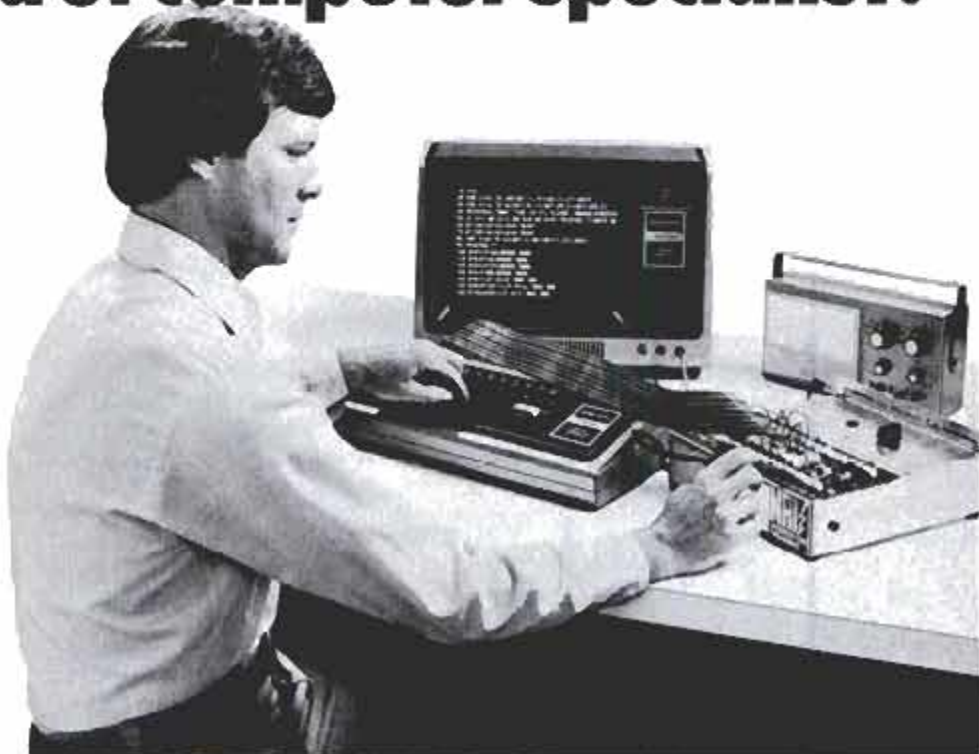
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# IMPORTS & MOTORSPORTS

## Plywood on wheels



Hustler is a wood-bodied do-it-yourself design that uses Austin Mini mechanicals.

The British are not exactly rushing back to wood as the best material for motor-car construction, but for one Englishman it's the stuff that dream cars are made of. The materials list for his Hustler includes two planks of 1 x 5-inch ash, each 10 feet long, for side members and several sheets of marine-grade plywood for body skin—and for matching wheel covers.

Designer William Towns foresees the end of an era of affordable personal transportation (already the average new car in the United States is selling for over \$9000), and the need to recycle used auto parts. So his car is designed to be easily put together with a kit of parts—window frames, glass, hinges, struts, lights, wipers and so on. Towns sells the kit in England for the equivalent of \$1500. A builder also needs Mini mechanicals, which are to the British what VW Beetle chassis are to do-it-yourselfers here: ubiquitous. Towns says with his design the home builder can put a 60-mpg car on the road for less than \$3000.

PM photo: Shari Hartford



His prototype, shown here, is not the \$3000 stripper model, though, reports British journalist F. Wilson McComb, who checked out the car at the London show for PM: Seats are leather, instruments are solid-state digital readout and all trim and accessories are first class, as befits an auto show car. The Hustler may not be the fastest, safest, most glamorous vehicle ever to set wheels on the M1 motorway, but in a world of shrinking resources, sky-high car prices and ever-increasing petrol prices, at least the ingenious do-it-yourselfer won't need the bus.

### Skirt watching

To see what shape the skirts will take this year and how popular red, white and blue will be, you'll have to journey to Buenos Aires later this month. Not for a fashion show, but for the first race on the 1981 Formula One calendar, the Argentine Grand Prix. Last year, the skirts along the sides of the ground-effect

Mario Andretti scores his only point of '80 season in last ride with Lotus at Watkins Glen; looks like he'll join Alfa for '81.

cars were so low they were touching the track and the fortunes of American drivers were also at rock bottom. At the U.S. Grand Prix in Watkins Glen, N.Y., in October, the last race of 1980, we watched Mario Andretti pick up his one and only point of the season, finishing sixth in the Essex Lotus; earlier, young Eddie Cheever went out after 21 laps, which gave him an 18th-place finish. No points. But this is international racing and there's a lot more to the show than rooting for the home team.

We were dazzled by Bruno Giacomelli's performance in the Alfa Romeo 179 V12, but Alan Jones won the race in his immaculate Saudi Williams FW07; he had already clinched the 1980 driving title at the Canadian G.P.

When and where can you next see these extraordinary cars and drivers—without leaving the country? March 15th at the U.S. Grand Prix West in Long Beach, Calif.

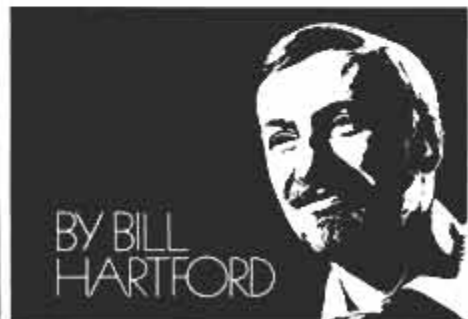
### New Cobra kit

If you can get your hands on a big-block Ford 427, do it now, because a Connecticut company has just the package to wrap it in. E.R.A.'s 427



Clone of the Shelby Cobra comes in kit form from E.R.A. Replica Automobile Co.

SC is the spittin' image of the original Carroll Shelby Cobra. The designers say you could have it ready for the road in 125 hours. We've seen it, and it's a gem. The kit (minus engine and drive train) is \$11,500. E.R.A. is at 608-612 East Main St., New Britain, Conn. 06051. **PM**



BY BILL HARTFORD





# DATSUN TRUCKS: MORE POWER THAN EVER BEFORE.



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**27**  
EST. MPG

**36**  
EST. HWY.

\*EPA estimates for comparison, standard 5-speed manual. Four by fours: **21** est. mpg, 29 est. hwy. Actual mileage may differ depending on speed, trip length and weather. Actual highway mpg will probably be less. California mileage lower.

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<sup>f</sup>Skyroof available Feb., '81.





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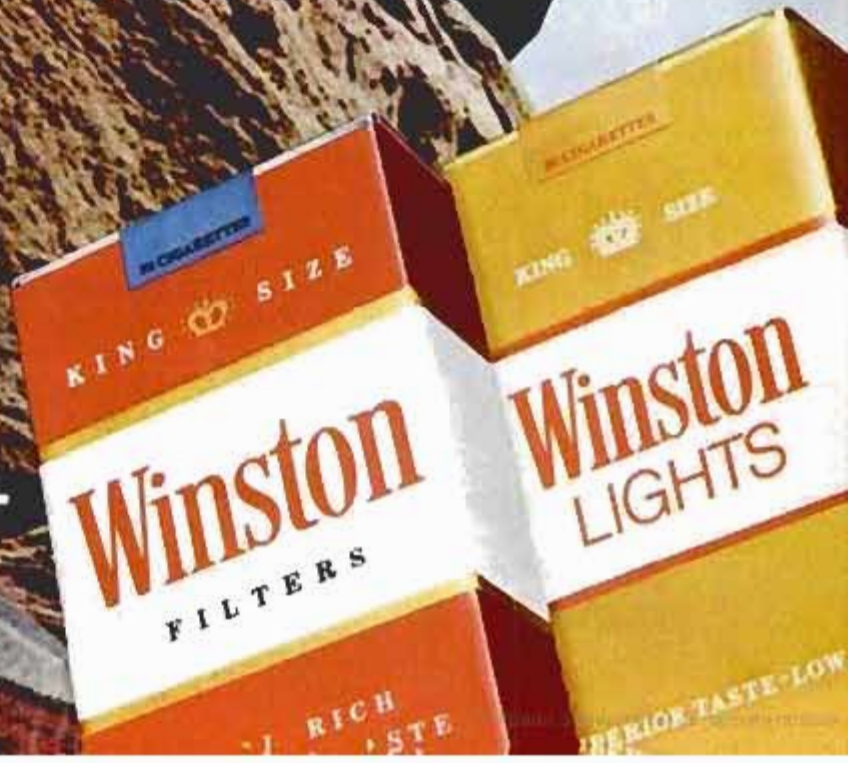
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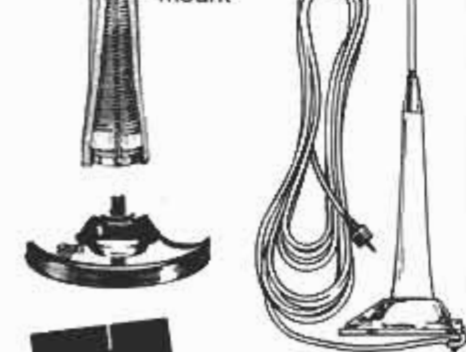


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## NOTES FROM THE EDITOR

John A. Spletter

**A**uto editors have a tough assignment. On the one hand, they must know—and tell readers—all the tricks for saving gasoline. On the other hand, there's still that visceral excitement of racing to write about. PM's Tony Assenza showed a fine sense of current priorities when he copiled a Mercedes to a *first* prize in a gas-mileage contest (page 93), then came in *sixth* (below) in a speedway event.

The man behind the mask is Auto Editor Tony Assenza, who is seated in the Formula Ford that he drove at Ontario (Calif.) Motor Speedway. The event was the Motor Sport Media Challenge, organized by the British School of Motor Racing. All contestants were auto writers and editors. Tony reported that in this first running of what will be an annual event, several drivers wound up out in the weeds around the track. Next year: "We'll be better."

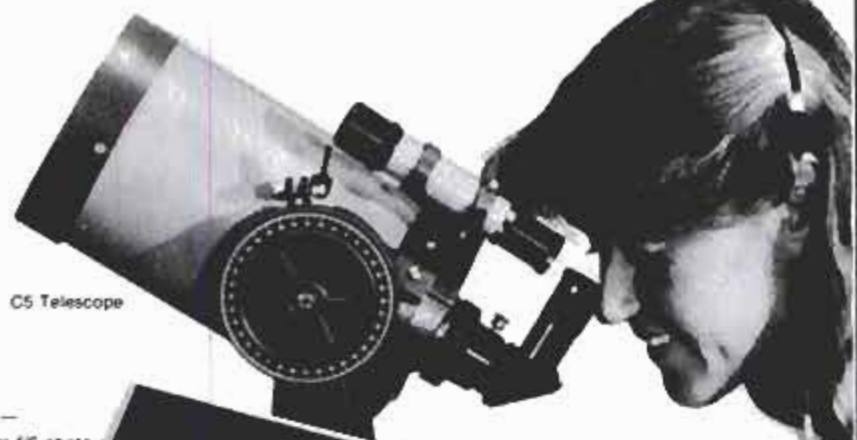


PM writer Charles Barton appears here as a Navy captain commanding a "Typhoon Tracker" Squadron on Guam.

The story on page 90, which brings to light little-known details of Howard Hughes's XF-11 reconnaissance airplane, comes to us from Charles Barton and is adapted from Barton's new book (due from Aero Publishers in May) on Hughes and his giant flying boat, familiarly known as the *Spruce Goose*. Few writers might take the legendary Hughes to task for technological failings during a test flight, but Barton knows whereof he speaks. At left is Naval Aviator Barton on Guam as commander of the Navy's Airborne Early Warning ("Typhoon Tracker") Squadron. Barton's squadron flew the radar-domed version of the Lockheed Super Constellation—an aircraft type familiar to Hughes, who occasionally used to "borrow" one from TWA (when he owned the airline). **PM**



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# APPLIANCE CLINIC

## QUESTIONS ANSWERED

### Garage-door opener

In the Apr. '80 issue we discussed a remote-control garage door that wouldn't close ("Remote Garage Door," page 20). Robert Rasmussen of Ludington, Mich., offers his solution to a similar problem:

"I found the trouble in the wired remote pushbutton. The contacts were feathering—that is, they were so close together that a little vibration would operate the opener in a very erratic way.

"If you examine the pushbutton, you will find that the stationary contact is one of the screws under which the wires are placed. I fixed my control by replacing the pushbutton. You might simply put washers under the screw."

### Linty clothes

My 1965 Kenmore automatic washer model No. C110.54050 still functions well, although it performs its cycles with a considerable amount of noise. However, the lint filter has completely stopped working. The filter is perfectly clean and the hose to the filter is clean, but throughout each wash, the filter remains absolutely dry so the lint clings to the clothes. Could you please tell me what action to take to get the filter functioning again?—Steven Provender, Burlington, Ont.

Your problem is in the recirculating water pump. The original pump was made of a white metal material. Over the years, detergent and bleach used in the wash water have eaten away at the lower impeller and possibly the housing of the pump. Thus, the water no longer circulates through the lint filter assembly.

The new replacement pumps are made of a plastic material that makes them resistant to bleaches and other laundry aids and also results in quieter pump operation. The part number for the recirculating pump is 200-53209. It's available from Sears Simpson Ltd., 222 Jarvis St., Toronto, Ont. M5B 2D8. The cost is \$18.55, but check to make sure the price hasn't changed before you order. The labor and trip charge to change the pump is about \$40.

### Toaster sensor

I have a Sunbeam self-lowering toaster. I'm not having any problems with it, but I've been trying to figure out what it is that senses when the toast is done and what causes it to

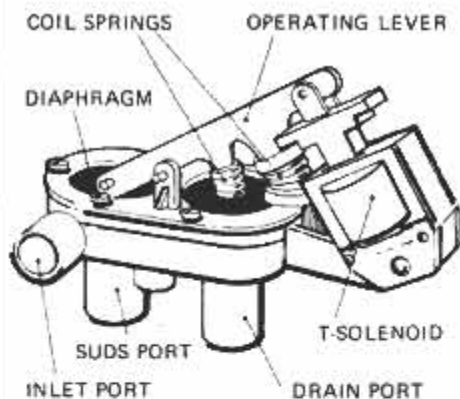
rise. Can you help me out?—A. Penington Sailer, Pipersville, Pa.

This is generally how most toasters work: When you put two slices of bread in the toaster, the slot marked "one slice" will depress the trip lever, causing the trigger level assembly to close the contact points. The elements will then heat up and the expansion of the center element wire will allow the bread lifter assembly to go down slowly under its own weight.

When the moisture has dried out of the bread, the thermostat senses the heat. This will cause the thermostat blade to snap to the "off" or open position. Then, as the elements cool, the wire in the center element will contract and force the lift-lever depression bar down. This in turn, forces the bread lifter assembly to slowly raise the toast.

### Extravagant miser

I have a Whirlpool automatic washer Model LTA-8805 with a Suds Miser system. During the pumping action of the soapy water from the washer into an adjacent laundry tub, some of



Water-cycling valve in washer drains soapy water into an auxiliary tub for reuse.

the water is expelled through the other drain hose and into the sewer. I have replaced the water-cycling valve. The valve seems to be functioning properly, yet the problem still exists. What should I do to save the water from being pumped into the sewer?—William Nixon, Pittsburgh.

Sounds like your problem is in the newly installed water-cycling valve. The valve is bypassing the water to the wrong discharge port. To check the valve, you'll have to remove it from the machine.

Check the upper spring for sufficient tension to close the suds port.

Check that the solenoid travel is sufficient to allow the operating level to seat the diaphragm at the suds port. Next check under the diaphragm. There may be foreign particles in the valve keeping the diaphragm from seating properly. Take the valve apart by removing the screws which hold the two casting halves to the diaphragm. Check the castings for a cracked or defective seat.

### Paint for microwave oven

We are the owners of a General Electric Jet 90-001 microwave oven that is rusting badly inside, along the bottom edge where the glass plate rests. In fact, it is almost rusted through in spots. General Electric sells an expensive special paint to repair it. However, I wonder if you can suggest a cheaper alternative. I thought of trying both epoxy and heat-resistant paints. However, I'm worried that these paints might emit toxic or contaminating fumes when the oven is operating. I'd appreciate your help.—Bill Huston, Abilene, Tex.

The paint on your GE microwave oven is a special FDA-approved paint designed for application in a food oven. It is nontoxic and is the only GE-approved paint to be used in the microwave-oven cavity. The paint is available in a spray can, part No. WB64X5009.

Sand the rusted area below the glass plate down to bare metal to determine whether there are any pinholes or deeply grooved slots in the metal cavity. If the rust has destroyed the metal to a point where you can see through the bottom, have an authorized service repair facility replace the oven cavity.

If there is only surface rust, sand the area well. Coat the metal with at least two coats of the special paint to retard the rust. After the paint has dried, apply a bead of RTV sealer (GE part No. WX6X100) around the lip that holds the glass plate in position. Next, insert the plate and wipe away any excess sealer from the glass. This action will seal the glass in the cavity and minimize chances of moisture getting under the plate to cause further rusting. **PM**

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



there ought to be  
a law against  
blah cigarettes!

Well, there is one.  
It's the KOOL law,  
whereby every cigarette  
has to deliver a sensation  
so refreshing that it goes  
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So, abandon those dull  
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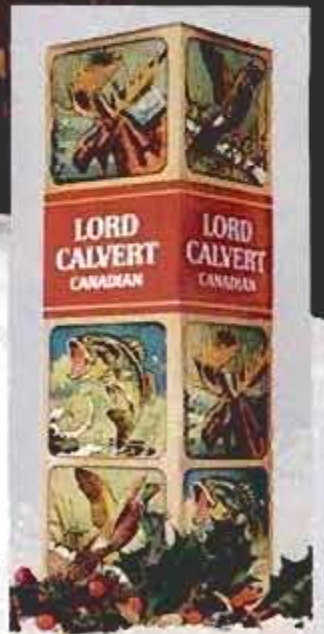
C'mon up!

Super Lights Kings, 7 mg. "tar", 0.7 mg. nicotine; Milds Kings, 11 mg. "tar", 1.1 mg. nicotine av. per cigarette by FTC method; Filter Kings, 16 mg. "tar", 1.3 mg. nicotine av. per cigarette. FTC Report Jan. '80.

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# IPM BRIEFS



## The impersonal touch

If you're in Coffeyville, Kan., and walk up to 2205 West 8th St., knock on the door and ask for a Swedish Parlor Massage—guess what you get? Wrong, it's not the lady. Parlor Products Inc. has given the world a fully automated massage table, covered in a wide variety of Naugahyde colors and available in coin-op or noncoin-op versions. We have no further comment.

## PM's Whatsit

This month we decided that you can't win 'em all. If you have no previous knowledge of this contraption, and can still divine anything more about it than its basic nature as a conveyance of some kind, go straight to the head of the class. Most of you, we're betting, will soon turn to the answer (next page) in sheer frustration.



## Waitin' for the Robert E.—surely you jest!



Sorry, folks, but this is what riverboats look like these days. This one supplies remote villages up along the Kuskokwim River near Bethel, Alaska, and was designed by Hover Systems Inc. of Media, Pa. The craft's weight is supported by fan-fed air under the hover skirt, and the Goodyear-tired drive wheels mounted forward and aft, are primarily to add maneuverability (lack of which is an inherent bugaboo in free hovercraft of all sizes).



## R.I.P. is o-u-t

Apparently the need for personal expression has spread from bumper stickers ("Warning: I brake for hallucinations") and T-shirts ("So many women/so little time") to burial monuments. The *New York Times* recently quoted Cliff Anderson, executive director of the Washington State Funeral Directors Assn. as saying, "Funeral directors aren't shocked by anything anymore."

One of the things that opens up headstones to free expression is a new etching technology that uses a rubber stencil carrying a design—decorative motifs, lettering, even portraits of the deceased. This is placed on the stone, which then moves on a conveyor belt under a sand-blasting machine which cuts the design through the stencil.

Some morticians venture that more expressive monuments are a sign of nervous times; others say it's simply a throwback to the Colonial era, when a person's profession or special skills were often a part of his epitaph.





Retirees Nakis (left) and Fawver pore carefully over an old Air Force B-47 operations manual . . .

## Taps for the B-47

At one time, the U.S. Air Force fielded more than a thousand B-47 "Stratojet" bombers as its main strategic air arm—capable of delivering the explosive equivalent of more than 60 billion tons of TNT. When it first flew, late in 1947, the B-47 both amazed and dismayed the Air Force: its performance was so hot, nothing in the fighter area—on either side of the Cold War—could touch it. But by 1965, the '47 was totally phased out of the Strategic Air Command's bomber fleet, replaced as the Sunday Punch by the larger, rangier B-52.

Most Stratojets were put in mothballs in the big warbird graveyard at Davis-Monthan Air Force Base, near Tucson, Ariz. By 1979, there was only one left in anything like flying condition, old No. 53-2104. The Air Force decided to give the plane to the Pueblo, Colo., Air Museum. Interestingly, it would be far cheaper to bring the six-engine bomber up to flyable status and let it make one last hop, than to knock it down, truck it to Colorado and reassemble it.

Pete Petroski of Tucson's Desertaire Parts made the winning bid on restoring 2104 and getting it out to the museum. Only problem was that B-47 pilots were not exactly standing in line. Petroski somehow managed to find two of them in the

## Whatsit revealed

This unique vehicle was cobbled up from an old, narrow-gauge steam locomotive. Caterpillar tracks were fitted; rubber-tire guide wheels were set out front beneath a cozy little shelter for the steersman (kept all the comfier with heat from the nearby boiler). A second crewman stayed back in the cab and fed the firebox. The rig was used to drag loaded sled trains out from Maine lumber camps. It can be seen at the Owls Head Transportation Museum near Rockland, Me. (special thanks to PM reader Bob Whittier of Duxbury, Mass.)



. . . and give old No. 2104 a walkaround . . .



. . . before the last Stratojet flight leaps off.

Tucson area, retired Air Force Col. George Nakis and Lt. Col. (USAF ret.) Robert Fawver. Between them—7000 B-47 flying hours.

But it had been literally years for both—and 2104 was vintage 1953, well over voting age. "We would have liked a refresher flight with a check pilot," Nakis allowed, "but there aren't any around. We had to be our own."

Nakis had kept a set of Air Force B-47 operating instructions from active-duty days. They pored over it, and when the time came, he and Fawver lifted 2104 off the Davis-Monthan runway at 123 knots, book speed for her weight, and bent her east for Pueblo.

So the sun set that night on the last flight of the first instrument of "massive retaliation"—a type of aircraft that had amassed some 1.8 billion miles over 3.5 million air hours. Asked if there had been anything wrong with the flight, retiree Nakis nodded somewhat wistfully. "Yes," he said. "It wasn't long enough."



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Now you'll never worry about accuracy again. Because the Sunwatch will keep you on time for the rest of your life. (Accurate to within 1 sec. per month.)

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The built-in computer on a chip will always display the correct time date and month. Also, it automatically adjusts the watch calendar for long and short months, leap years and its programmed until the year 2100!

### Easy to read

The natural side-view display lets you tell the time, day and date without twisting your arm into an uncomfortable position.

### Numbers always visible

Four varying light intensities are built into the viewing display, allowing the Sunwatch to adjust automatically to any light. This means you can always read it, even in the brightest sunlight.

### 10 Display functions

The Sunwatch is capable of displaying the following information: hours • minutes • seconds • months • date • day • leap year • speed calibration • AM/PM indicator • seconds count-off

### Extreme accuracy

Unlike other electronic watches using tuned crystals to control timing accuracy, the Sunwatch incorporates a unique, programmable, microcircuit synthesizer to make it the first watch in history that is accurate to less than 1 second per month. That's 5 times more accurate than the latest quartz Accutron.

### The Power Source

Tiny silicon power cells, which are constantly being energized by natural sunlight, daylight or an ordinary light bulb keep the Sunwatch energy storage system charged. Should the watch not be exposed to light, it will continue to operate for months on stored power.

**The most indestructible watch in the world**  
The workings of the watch: solar panels, energy cells, quartz crystal, computer on a chip, etc., are all permanently sealed in a Lexan module. This module is so unique it's protected by U.S. and foreign patents.

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There are no air spaces inside the Sunwatch. Therefore, it is not susceptible to high pressures such as might be encountered diving to great depths.

### The perfect watch for a lifetime

Imagine split-second accuracy for the rest of your life. Sunwatch is a virtually indestructible, beautifully styled, space-age timepiece, and it's available in three exciting finishes: Brushed stainless steel, Gold tone stainless steel, or a Durable black finish on stainless steel. All Sunwatches come with a matching stainless steel band with removable links and adjustable clasp.

### Made in the United States

The Sunwatch, designed by Roger Riehl, was being worn by its inventor nearly a year before the first electronic digital watch was even available to the general public. Since that time constant engineering evaluations and design improvements have been made on the Sunwatch to incorporate the latest in digital microcircuit and solar power technology. Thus the Sunwatch today represents state-of-the-art electronics technology. It is built to the same rigid standards practiced by the manufacturer in creating sophisticated computer microcircuits for the U.S. Government and other major users of these components.

### • A word about other "Solar Watches"

Roger Riehl, designer of the Sunwatch, states that there is no other completely solar powered watch on the market today. Claims of solar power by other watch manufacturers are based on the use of a small solar cell. Due to their limited size, these cells can be proven, in technical terms, to be of virtually no significant value in extending the life of a watch battery. For this reason, all other so-called "solar watches" must have replaceable batteries. The Sunwatch's power storage system, however, need never be changed and is, in fact, permanently sealed to withstand abuse and the elements.

### Unique and memorable gift

Available in a special gift box (see order form) the Sunwatch makes an ideal gift for special holidays, birthdays, graduation, Fathers Day, etc. Perfect for business people, commuters, teachers, athletes and sportsmen, who require split-second accuracy.

### Free custom engraving

At your request, each Sunwatch will be hand-engraved with the name you specify.

### Limited Warranty is your protection

The Sunwatch is covered by a 2 year limited warranty issued by Riehl Time Corporation (manufacturers of the prestigious Synchroner 2100) and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Riehl Time Corp., 53 S. Jefferson Rd., Whippany, NJ 07981. This warranty gives you specific legal rights, and you may have other rights which vary from state to state.

### 15 Day no risk trial offer

Order your Sunwatch today and use it for 15 days. Then, if you are not completely satisfied return it for full money back.

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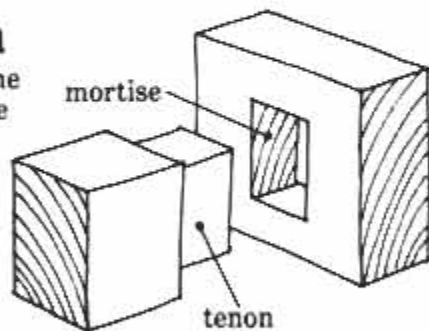


# Words woodworkers use

Newcomers to woodworking are often confused by the new vocabulary they must learn. For example, there is a *mortise and tenon* joint. A saw's cut is a *kerf*. If you shave off the edge of a board at a bevel, you give it a *chamfer*. There are *rabbit* and *dado* cuts. These words actually have long histories of usage in the English language, underscoring the fact that carpentry and joinery are parts of a time-honored tradition. —Mary Algozin

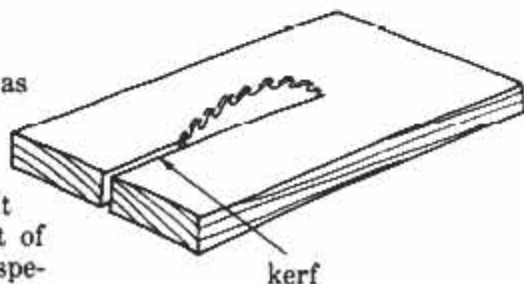
## mortise and tenon

(môr'tis/ten'ən) have kept the same meaning since they were first used in English. The joint consists of a hole (mortise), usually rectangular, cut in a piece of wood to receive the specially shaped end (tenon) of another piece of wood.



## kerf

(kurf) around 1000 A.D. was spelled *cyrf*. It was related to the word *ceorfan*, to carve, and meant to cut or stroke. It came to mean the result of cutting—the incision, especially when made by a saw.



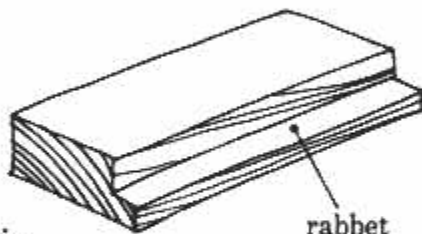
## chamfer

(cham'fər) comes from the French *chamfrain*, a groove or furrow, especially one cut in stone. It appeared in English in the 16th century and acquired its present meaning 100 years later. Today, it means a beveled edge or corner.



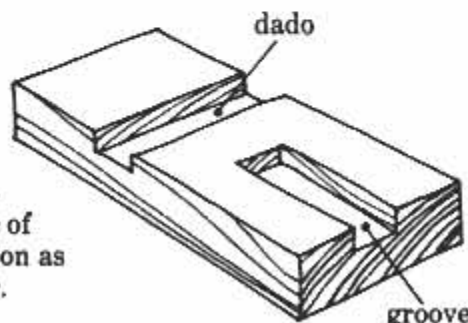
## rabbit

(rab'it) is a recess or cut made on the edge or end of a board. It's from the Old French *rabat*, meaning the act of beating back, the beating down of a price, or a recess in a wall.



## dado

(dā'dō) in English first meant the center part of a pedestal. Today *dado* is a U-shaped groove cut cross-grain to receive another piece of wood. Cut in the same direction as the grain, it's called a *groove*.



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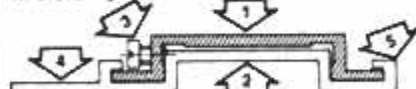
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PM1-1



# HOMEOWNERS' CLINIC

## QUESTIONS ANSWERED

### Getting relief

I have a 4-year-old, 40-gallon Rheem hot-water heater. I thought our dishwasher required 190° F. water, so I turned the setting to that temperature. During heavy use, the relief valve leaks. I've installed the fourth relief valve and turned the temperature down to about 154° F. Help!—Kenneth Wittmayer, Cedar Falls, Iowa.

In most cases, if a relief valve leaks, it is defective. But in your case, five defective valves in a row would seem to be out of the question. Incidentally, many hot-water heaters are set as low as 120° F. Although the higher temperature setting of your heater shouldn't produce a leak, it does waste energy.

Many homeowners don't realize that their hot-water relief valve is activated by pressure, as well as by temperature. Assuming that the thermostatic control on the heater is working properly and the temperature setting is compatible with the temperature rating of the valve, check the valve's pressure rating. The street pressure may be too high for the valve you are using. Your local water company can verify the pressure in your area.

### Chalking on bricks

My house is brick-veneered from the ground to a height of 6 ft. From there to the roof, it's covered with aluminum siding. The bricks are streaked with residue from the aluminum siding. How can I clean them?—Eddie Chin Sang, New York

The residue is the result of what is called chalking, the siding's method of cleaning itself (see "Painting Aluminum Siding," *Homeowners' Clinic*, page 30, Sept. '80).

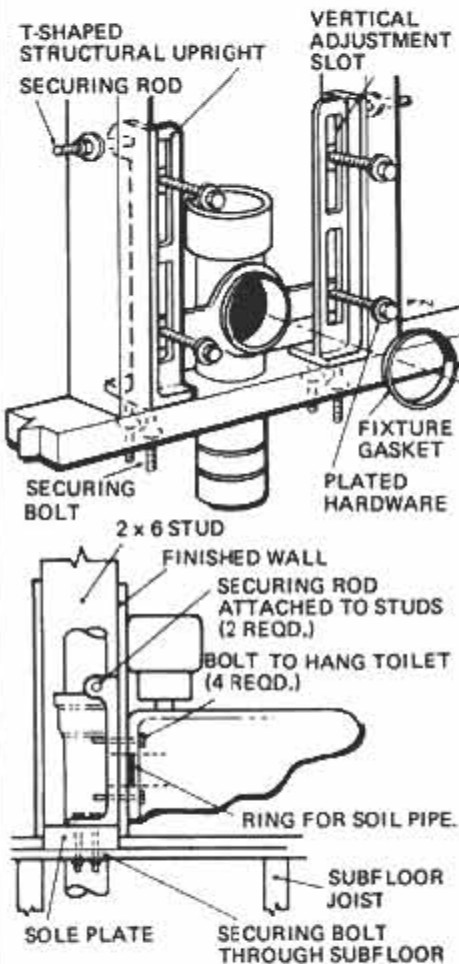
You can wash off the chalking on the bricks with water from a garden hose. You also might try using a water power-pressured rotary brush made for car washing. Adding a little detergent such as Tide to the wash water (1/4 cup per gallon) may expedite the cleaning.

### Wall-hung toilet

I'm installing a new bathroom from scratch in an old house that's located in a rural area. I'd like to install a wall-hung toilet, but I don't know the stud sizes needed, the method of fastening the fixture to the wall or how to connect the waste line.—A.T. Miller, Dauphin Island, Ala.

The actual anchoring of the toilet to the wall is done by a metal device called a carrier. It is fastened to the studs and the floor. As you can see in the drawing, 2×6-in. wall studs are required.

The carrier shown is by Josam and is definitely something that a skilled



Carrier for a wall-hung toilet is fastened to the wall studs and through the floor.

homeowner can install. Once in place, it not only supplies the four "hanging" bolts for the toilet, but it also has a ring for the lead bend or required soil pipe.

The drawing is intended as a guide only. Although I think that the soil-line hookup is a job for a professional plumber, knowing the procedure is helpful. The wall-hung toilet is a great help toward cleanliness. No

longer is awkward mopping around the base required. This carrier is made by Josam Manufacturing Co., Michigan City, Ind. 46360. Most plumbing supply houses stock such carriers. Before setting one in the wall, carefully check the offset required dimensions from the floor to the soil pipe for your particular fixture.

### Three-pronged question

The receptacles of my older home were wired with 12/2 (No. 12 wire in a double strand) Romex nonmetallic cable, using the two-slot, ungrounded-type receptacle. I would like to change to the newer three-slot, grounded-type receptacles to accommodate my three-pronged tools and appliances. Do you know of any objection to grounding these receptacles via a green jumper wire from the green screw to the neutral white wire?—Harry Coleman, Raceland, La.

Yup. The National Electric Code, your local code and any licensed electrician friends you may have will object vehemently. If you do as you suggest, you will have made it possible to run an appliance or light a lamp between your black (hot) wire and your green wire from the U-shaped hole. I'm afraid you need an electrician to pull (snake) either a new, properly grounded cable or a single, properly grounded wire to all switches and receptacles.

Although most of us take our electrical service for granted, it can cause a great deal of grief to a homeowner if improperly handled. You might check with your building department to see how far they'll let you go toward pulling your own cable. From there, regardless of the local code, I know I'd have a licensed electrician wire the circuits. It might be a bit costly now, but not when stacked against the possibility of fires or electrical shocks. **PM**

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



BY JOHN GAYNOR







## Build your own air compressor from PM's plans



Once you have an air compressor in your home shop, you'll wonder how you ever got along without it. You can spray paint with it. You can inflate swimming gear, toys, auto and garden tractor tires. More important, you can sandblast parts and rivets in metal seams. You can blow-clean fine mechanisms and, with PM's unit you can vacuum pump your car's airconditioning system prior to adding Freon—something you can't do with most ordinary air compressors. Finally, this unit features a filter/water trap—which is an optional extra on most commercial air compressors.

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**Compressor evacuates car's airconditioning system prior to adding new refrigerant (far left). At left, routine inflation of tires saves trip to gas station.**

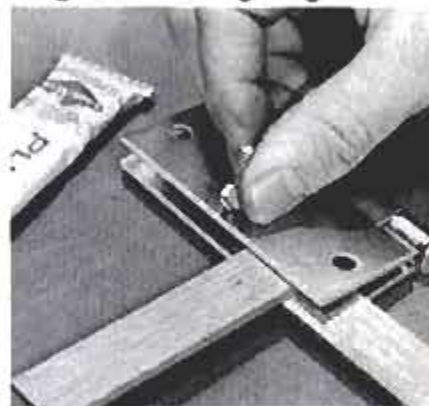
#### HOW TO ORDER PLANS

Send check or money order for \$5.95 to Air Compressor, Popular Mechanics Plans Library, Box 1014, Radio City Station, New York, N.Y. 10101. Allow two to three weeks for delivery; for first-class mail send 75 cents extra.

Popular Mechanics is a publication of Hearst Magazines, a division of the Hearst Corporation.

## HINTS FROM READERS

### Hinge serves as gluing aid



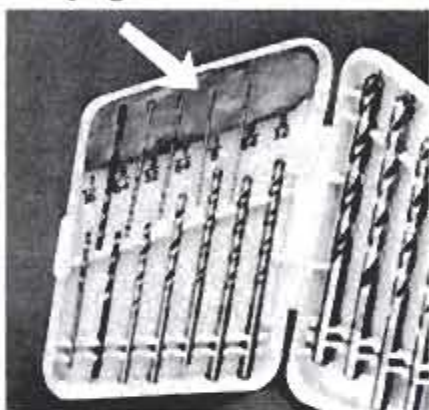
Lacking a clamp to hold small wood pieces together while gluing them, I improvised one using a 3/8-in. butt hinge. A properly sized bolt with wingnut lets you tighten the clamp firmly.

—Ken Patterson

### Cutting dowel plugs flush

Grind the teeth smooth on one side of a hacksaw blade and use it to cut dowel plugs flush with the surface of the workpiece. To create a handle, wrap one end of the blade with tape. Saw with the unground teeth on the waste side.—Lane Olinghouse

### Carrying small drill bits



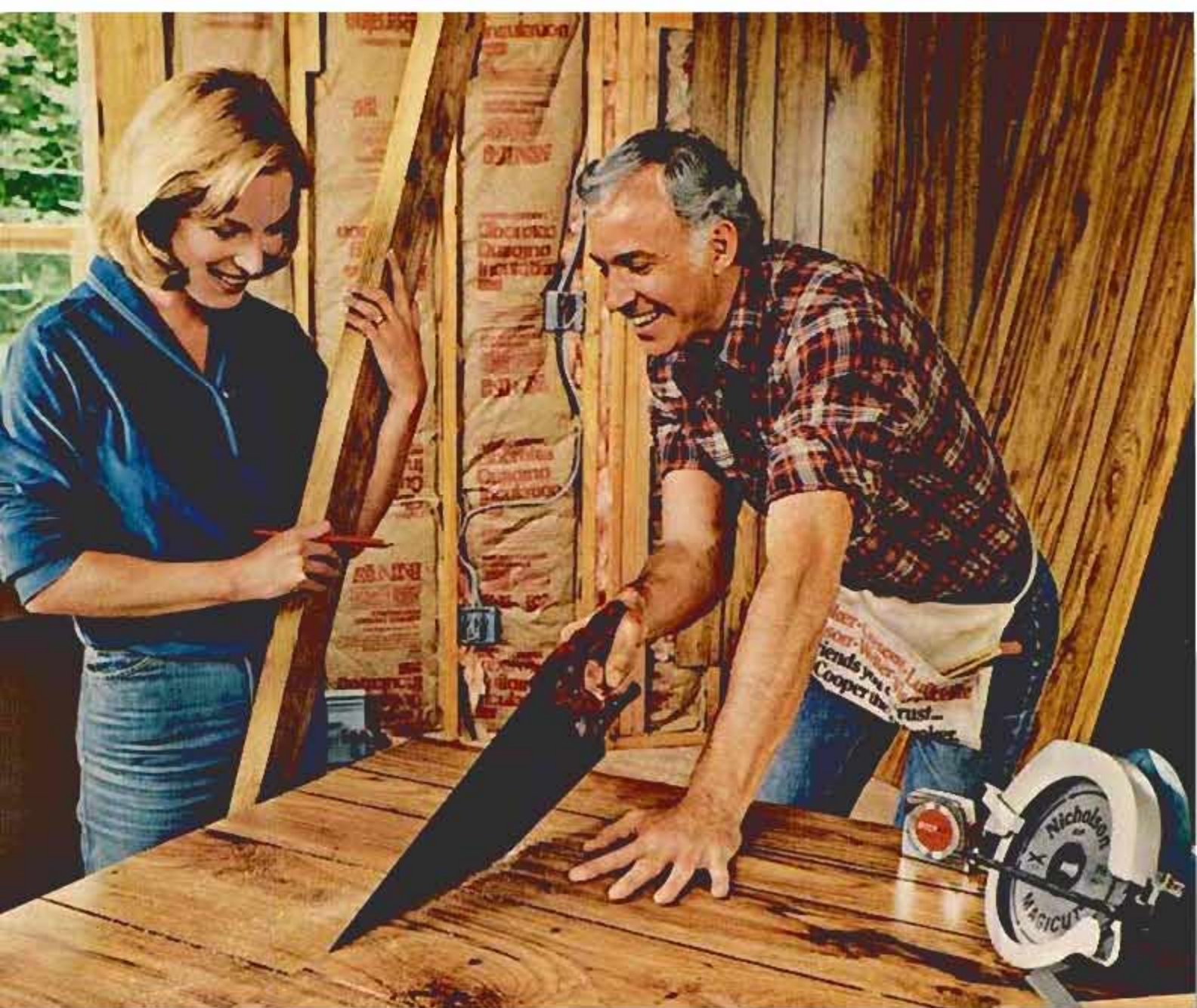
To conveniently carry small-diameter, wire-size drill bits in a fractional-bit case, press a layer of modeling clay at the top of the case (arrow) and embed the shanks of the small bits in it.

—Frank H. Day

### Holder for propane torch

I've nailed a fire-extinguisher holder to my workbench. It's handy for holding my propane torch.—Norman Laudermilch





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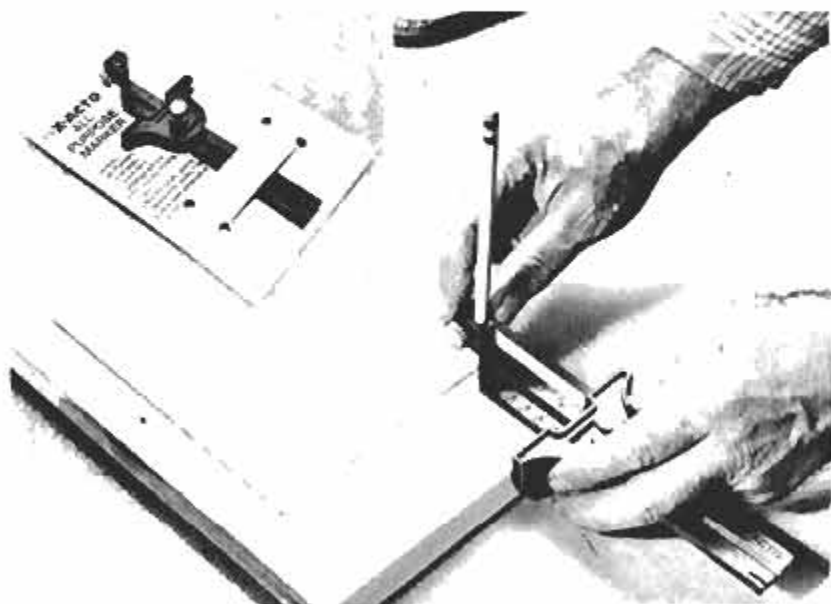
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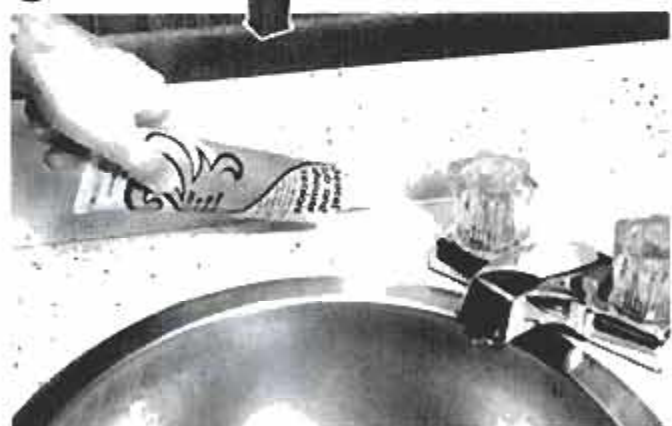
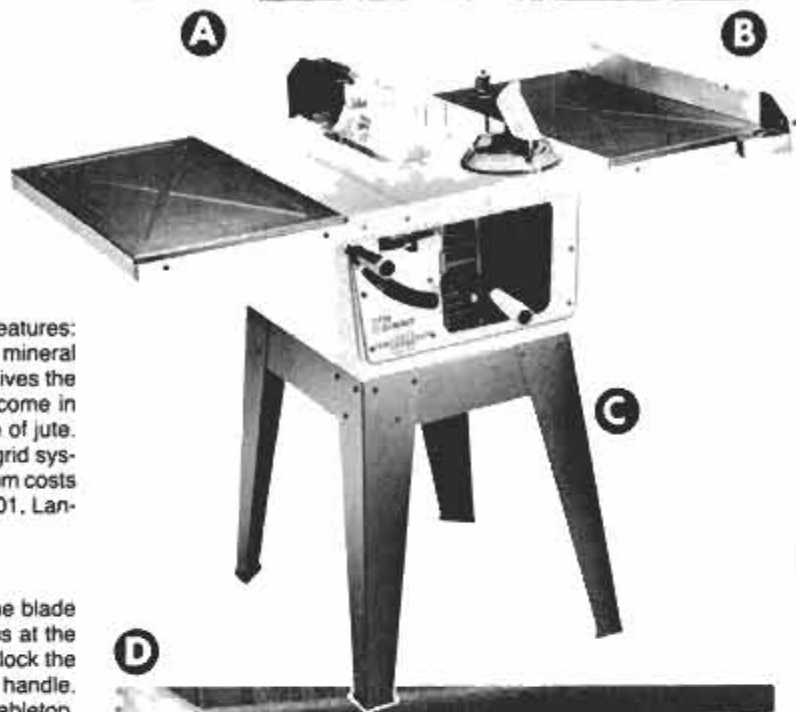


**A** You can use this T-square-shaped marker to draw parallel lines having any spacing up to 6 in. You clamp a pencil into the lock knob on the ruler and adjust the spacing by sliding the T and locking it in place. Pull along the work edge to draw a line. Change the T position to draw parallel lines. At art-supply stores, All-Purpose Marker is \$5 from X-Acto, 45-35 Van Dam St., Long Island City, N.Y. 11101.

**B** This new suspended ceiling offers two special design features: The panels, although made of washable and fire-retardant mineral wool, have the look of handwoven fabric; the recessed grid gives the ceiling a bold, three-dimensional look. The 2x2-ft. panels come in white for a soft linen look or in beige to give the appearance of jute. You can insert them conventionally in the slots of the metal grid system. Enough panels and custom black grid for a 10x12-ft. room costs \$150. The maker is Armstrong World Industries Inc., Box 3001, Lancaster, Pa. 17604.

**C** Instead of cranking up the blade to position, simply lift the blade handle of the Uppercut table saw until the 10-in.-dia. blade is at the desired height, then rotate the handle clockwise to securely lock the blade. You can fine-tune blade position with an adjacent handle. When you unlock the blade, it automatically drops below the tabletop. To cut a bevel, simply move the setting knob to the desired degree. A miter gauge with hold-down clamp is included with the unit. Model No. 7756 Uppercut table saw is priced at \$450. It's from the DeWalt Div., Black & Decker Inc., Box 4548, Lancaster, Pa. 17604.

**D** Use Geocel caulking sealant around tubs, showers and sinks. Its maker claims it will stay pliable and stretchable throughout its 20-year life expectancy, and won't crumble or crack due to the expansion and contraction of materials under it. According to the manufacturer, you can apply it in the tub area and take a shower on the same day without harming the seal. It will stay white, or you can paint it. An 11-ounce cartridge is \$4.50; a 5-ounce tube is \$3.20 at hardware stores and home centers from Geocel Ltd. Inc., Box 398, Elkhart, Ind. 46515.





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# How to service MacPherson struts on X-body, K-body and Ford cars

by Mort Schultz

It was just four years ago that cars manufactured overseas were the only ones using MacPherson struts. A true MacPherson strut incorporates a shock absorber, coil spring and top mounting in a single assembly, as opposed to a conventional shock absorber and spring system in which the two are mounted as separate units.

Since 1978, almost as many American-made as foreign-made cars have been equipped with MacPherson units; and as one model year gives way to another, the number will grow. In fact, by 1985, conventional shock absorbers in the front suspensions of new cars may be a thing of the past.

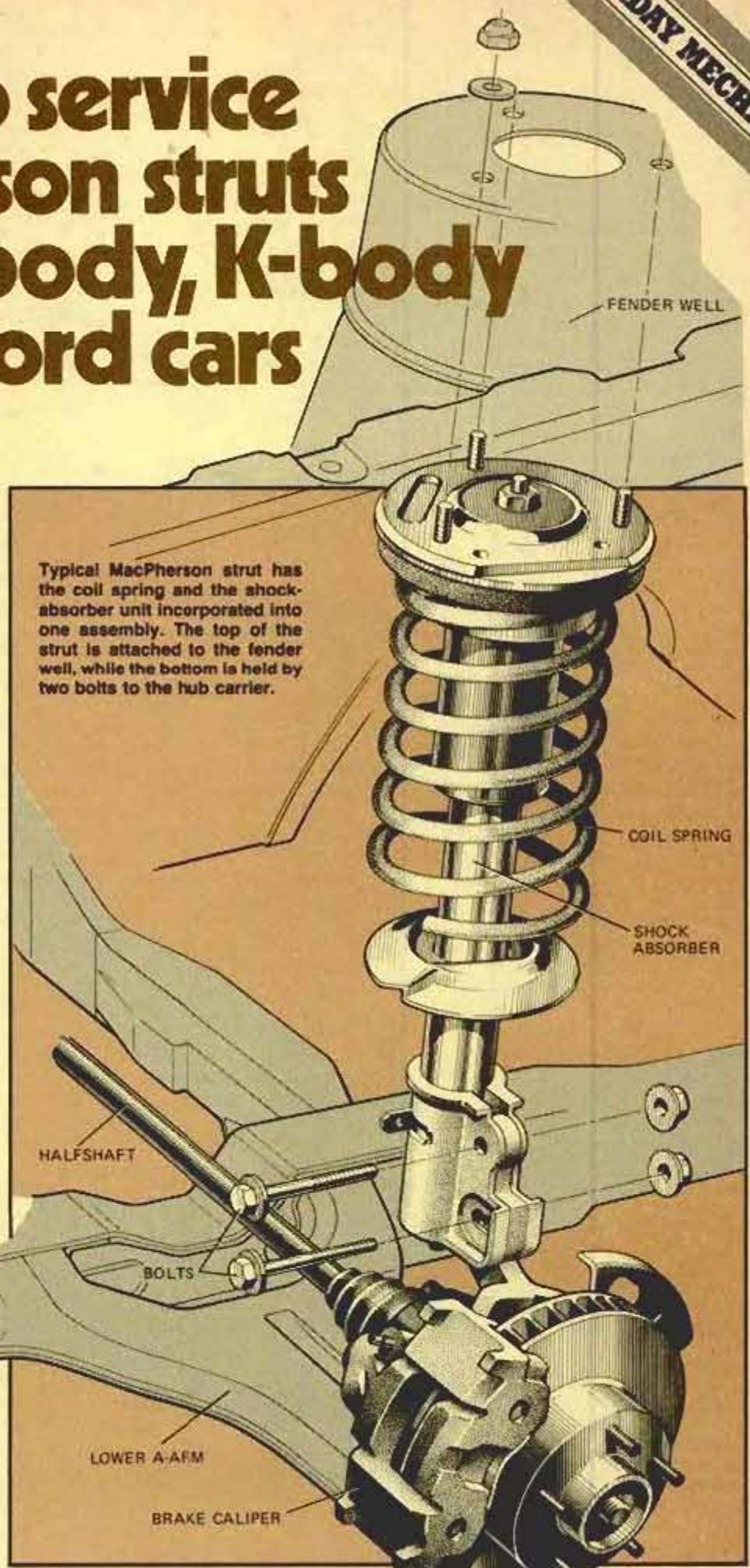
Yet, to many buyers of American-made cars, working on MacPherson systems remains an enigma. They want to know, "Can the Saturday mechanic troubleshoot and repair MacPherson units?" Yes, he can. This article, and one appearing next month, will show how.

MacPherson units fall into two general categories: those with shock absorbers that *can't* be repaired; and those with shock absorbers that *can* be repaired. Here, we will examine shocks that can't be repaired—if the shock absorber fails, it must be replaced.

Next month, we will discuss those MacPherson struts with shock absorbers that can be repaired. The nonfunctional shock absorber can be either overhauled, or its pistons and valves can be removed and replaced with a preassembled cartridge.

## Lineup of models

The following is a list of cars having MacPherson struts with shock absorbers that cannot be repaired,



Typical MacPherson strut has the coil spring and the shock-absorber unit incorporated into one assembly. The top of the strut is attached to the fender well, while the bottom is held by two bolts to the hub carrier.



and must be replaced if they fail:

- Buick Skylark.
- Chevrolet Citation.
- Dodge Aries and Omni.
- Ford Escort, Fairmont, Fiesta, 1979-81 Mustang and 1980-81 Thunderbird.
- Mercury 1979-81 Capri, 1980-81 Cougar XR-7, Lynx and Zephyr.
- Oldsmobile Omega.
- Plymouth Horizon and Reliant.
- Pontiac Phoenix.

These cars have two MacPherson units in the front suspension and two conventional shock absorbers in the rear suspension.

Cars we will discuss in next month's issue (those having MacPherson struts with shocks that can be overhauled) are listed below:

- Datsun (except the pickup truck).
- Dodge Challenger, Colt and Sapporo.
- Honda.
- Mercury 1971-78 Capri.
- Plymouth Arrow and Champ.
- Toyota Carina (1971-73), Celica (1971-80), Corolla (1967-80) and Tercel (1980).
- Volkswagen Rabbit, Scirocco and Super Beetle.

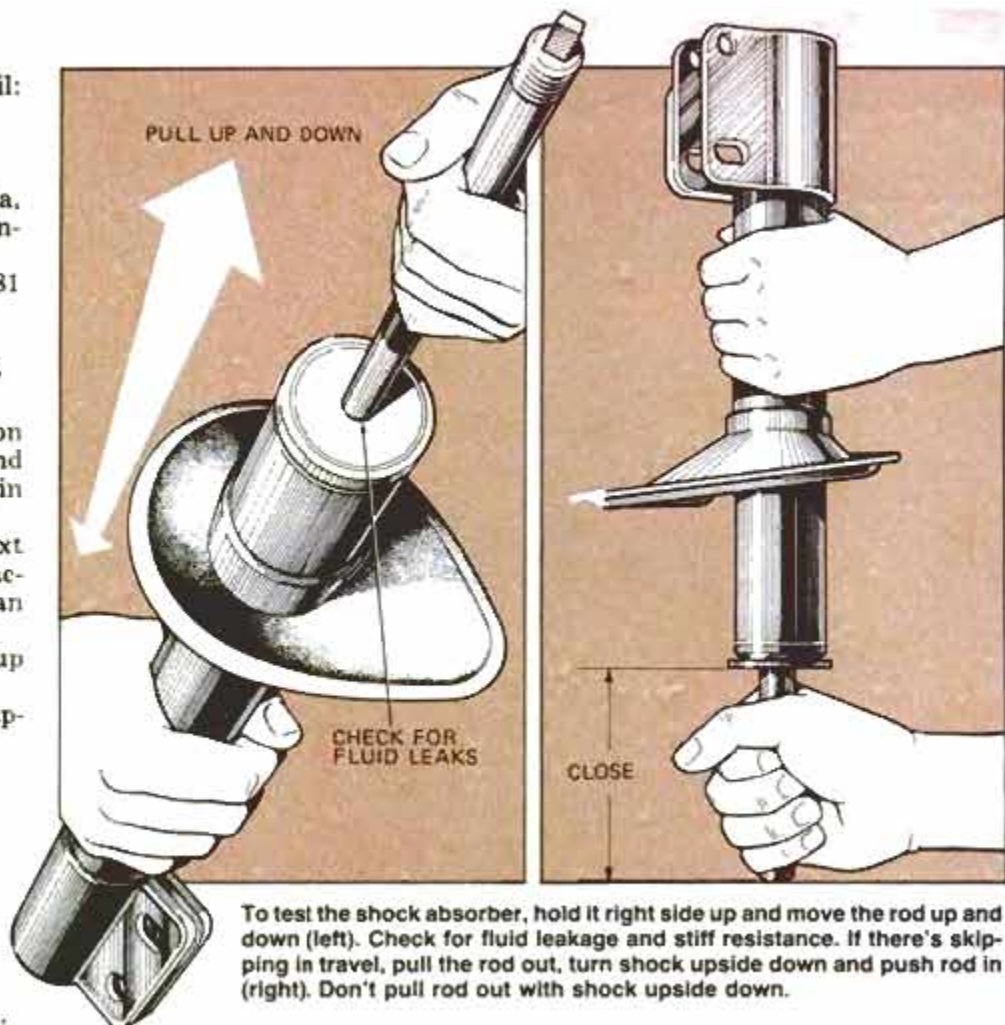
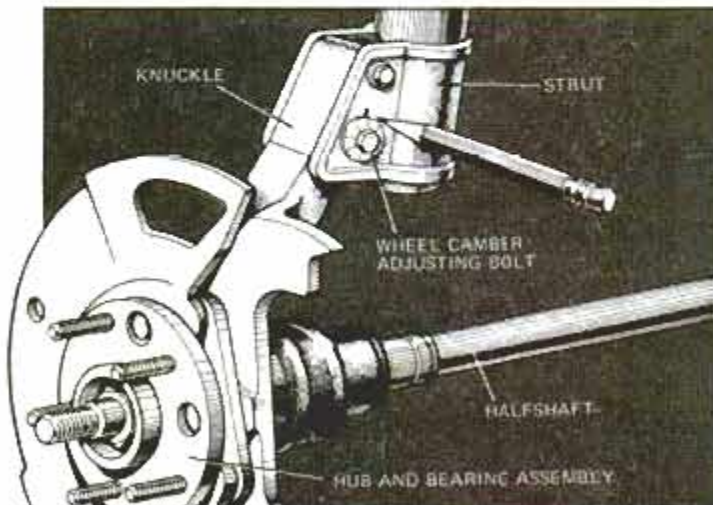
With two exceptions, these cars have two MacPherson units in the front suspension and two conventional shock absorbers in the rear suspension. The two exceptions are Datsun Z-models and Honda, which have four MacPherson units—two up front and two in the rear.

### Spotting a failed strut

When MacPherson-strut shock absorbers lose fluid or wear out, a car performs the same way as when conventional shock absorbers lose fluid or wear out. The ride becomes bouncy, and steering-wheel vibration may result when going over bumps.

One way to test MacPherson-strut shock absorbers is to bounce each

Before removing the strut on GM X-body cars, mark the position of the wheel-camber adjustment bolt. On GM cars, this is the lower mounting bolt. Once bolts are removed, you may need to use a pry bar to separate the strut from the hub assembly. After new strut is installed, line up the marks on bolt and knuckle and have a shop set correct wheel alignment.



To test the shock absorber, hold it right side up and move the rod up and down (left). Check for fluid leakage and stiff resistance. If there's skipping in travel, pull the rod out, turn shock upside down and push rod in (right). Don't pull rod out with shock upside down.

corner of the car up and down, let go, and see if the car comes to an instant halt. The most accurate way to determine if the unit has failed, however, is to remove and disassemble the MacPherson units and test the shock absorbers when you think the ride has become shoddy.

To test MacPherson-strut shock absorbers, remove and disassemble the strut (see following instructions) and proceed as shown.

■ Holding the shock absorber upright, pull its rod all the way out.

■ See if fluid is leaking from around the seal. A little seepage is normal, so don't discard a good shock. If the unit is faulty, fluid will flow from around the seal.

■ Still holding the unit upright, push and pull the rod all the way in and out several times, checking to see that movement is smooth and that there is resistance. If there is no resistance, replace or overhaul the shock.

Furthermore, if there is a skip in motion as you push and pull the rod, pull the rod out as far as it will go. Turn the shock upside down, and slowly push the rod all the way in. Turn the shock over again and pull the rod all the way out. Then turn it upside down again, and repeat the process, slowly pushing the rod all the way in. If, during this test, a skip in motion is still noticed, replace or overhaul the shock. Make sure you don't pull the rod out with the shock turned upside down; air may displace fluid, which will foul up a good unit.

It is necessary to replace only the shock absorber that is bad—not its mate on the other side. However, always test both shock absorbers. As often as not, shock absorbers (whether MacPherson or conventional) have a tendency to fail in pairs.

Incidentally, when buying a new shock absorber or other parts for a MacPherson strut, be sure to specify the car model on which it's to be used. Although struts of a particular group of cars may be disassembled and serviced the same way, it



doesn't necessarily mean that parts are interchangeable from model to model.

### GM and some Fords

The following procedure applies to GM X-body cars (Buick Skylark, Chevrolet Citation, Oldsmobile Omega and Pontiac Phoenix), Ford Escort and Fiesta, and Mercury Lynx.

1. Remove the MacPherson unit from these cars. Start inside the engine compartment and remove the top retaining nuts holding the strut in place.

2. Raise the car and place supports underneath, so the vehicle won't slip while you're working. Take off the wheel and tire.

3. Remove the clamp and shift the brake hose out of the way if the hose is held to the strut.

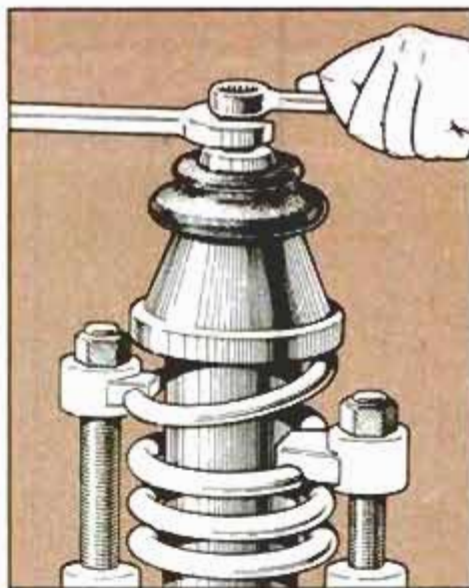
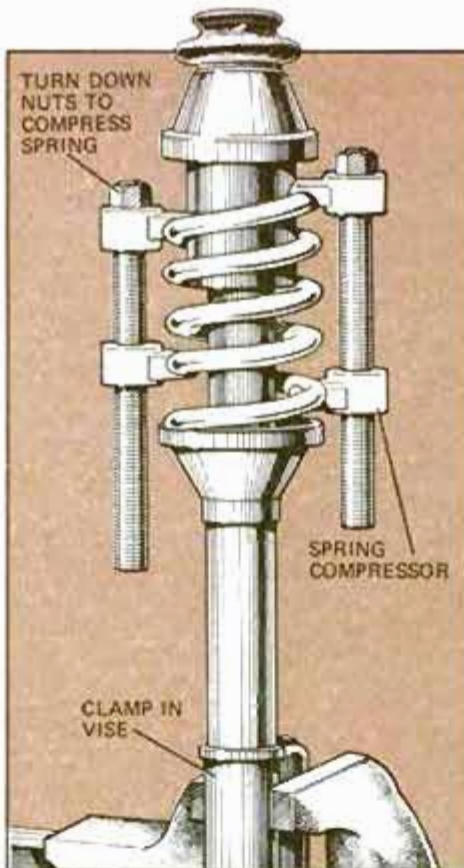
4. Remove the mounting bolts holding the lower part of the strut. If you are working on a GM car, the bottom bolt is a wheel-camber adjusting bolt. Before removing this bolt, make a pencil mark across the bolt head and onto the steering knuckle. The mark will be used to return the bolt to the correct position.

5. Maneuver the MacPherson unit from the car. You may have to wedge a pry bar between the frame and control arm and push down to free the strut.

Place the MacPherson assembly on your workbench. You will need a spring compressor, which sells for \$75 to \$120, to disassemble the unit. Instead of purchasing the tool, you can rent one. Call an auto parts dealer or tool-rental outfit in your area. Several we called charge about \$10 a day.

To disassemble a GM X-body, Escort, Fiesta and Lynx MacPherson strut, proceed as follows.

1. Place the spring compressor retractors on the spring so four or five coils are compressed. Don't extend the retractors more than 9 inches.



The only way to disassemble a MacPherson strut is with a reliable spring compressor. Clamp the strut in a vise first, and then use spring compressor (left). Once coils are compressed, remove the top mounting nut (above). While undoing the nut, make sure the compressor doesn't slip from the coils, which could cause an injury.

Beyond this point, there's a chance that the retractors will slip and allow the coil spring to fly off, causing injury.

2. Mount the unit in a vise. But before clamping the jaws of the vise against the housing, place thick rubber spacers on the jaws so the housing won't be scarred. Close the vise just tightly enough to hold the strut. You don't want to crush the housing.

3. Tighten the spring compressor so coils are pressed together enough to let you disassemble the top mount of the strut. If spring tension seems weak, which is improbable, the spring should be replaced.

4. Remove the top mount nut and other components, but as you do, make notes or draw a diagram illustrating the way in which the top mount assembly breaks down. The

top mount has to be reassembled in reverse order.

5. With the top mount disassembled, lift the coil spring and spring compressor (coupled together) off the shock absorber. Now test the shock absorber. If it's shot, replace it.

6. Assemble the unit by placing the spring into the lower seat of the shock-absorber housing. Be sure the spring is securely seated. Reassemble the top mount, tightening the nuts firmly. Then slowly release the spring compressor, so the top coil of the spring seats itself squarely in the upper spring seat.

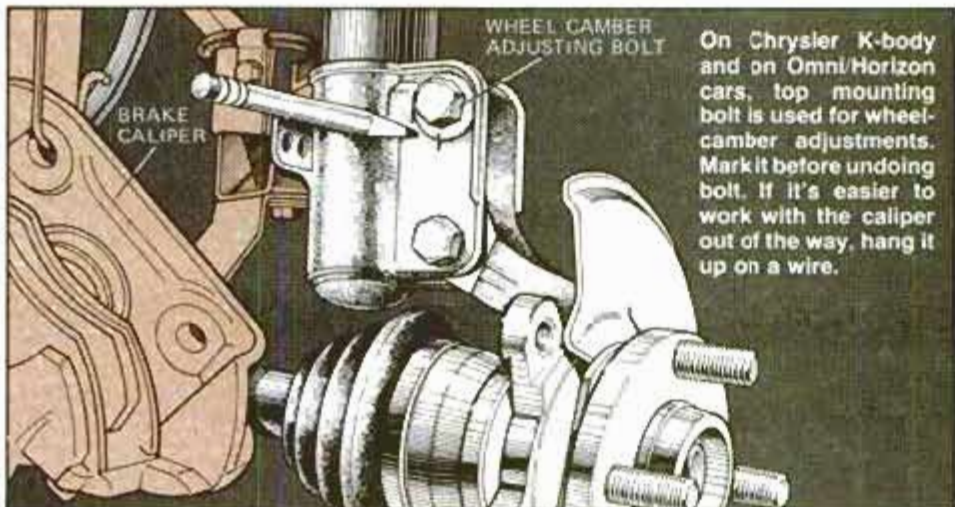
**Warning:** Don't attempt to do this job without a spring compressor. Improvising a tool can result in serious injury.

To reinstall the MacPherson strut in the car, position the threaded retainers of the top mount through the hole in the fender well, and align the lower mounting holes with their mating holes in the steering knuckle. Attach lower mounting bolts, tightening them by hand.

The Ford Escort and Fiesta and the Mercury Lynx require special replacement lower mounting bolts. Don't use old ones. You can get new bolts from a Ford or Mercury dealer by ordering part No. E800622-572.

Use a torque wrench to tighten top retaining nuts to 18 foot-pounds. This works out to about a one-quarter turn with a wrench after the nuts can no longer be turned by hand.

Now tighten lower mounting bolts



On Chrysler K-body and on Omni/Horizon cars, top mounting bolt is used for wheel-camber adjustments. Mark it before undoing bolt. If it's easier to work with the caliper out of the way, hang it up on a wire.



to 74-88 foot-pounds if you are working on an Escort, Fiesta or Lynx. This is equivalent to about 1½ turns after bolts are finger-tight.

If you're working on an X-body, tighten lower mounting bolts to 140 foot-pounds—about two turns after bolts are finger-tight. See that the mark you made on the wheel-camber adjusting bolt aligns with the mark you made on the steering knuckle, even if you have to exceed or undercut the torque specification a trifle. However, once MacPherson struts have been removed from any make of car, have front-wheel alignment checked on a front-wheel alignment machine.

### The rest of the Fords

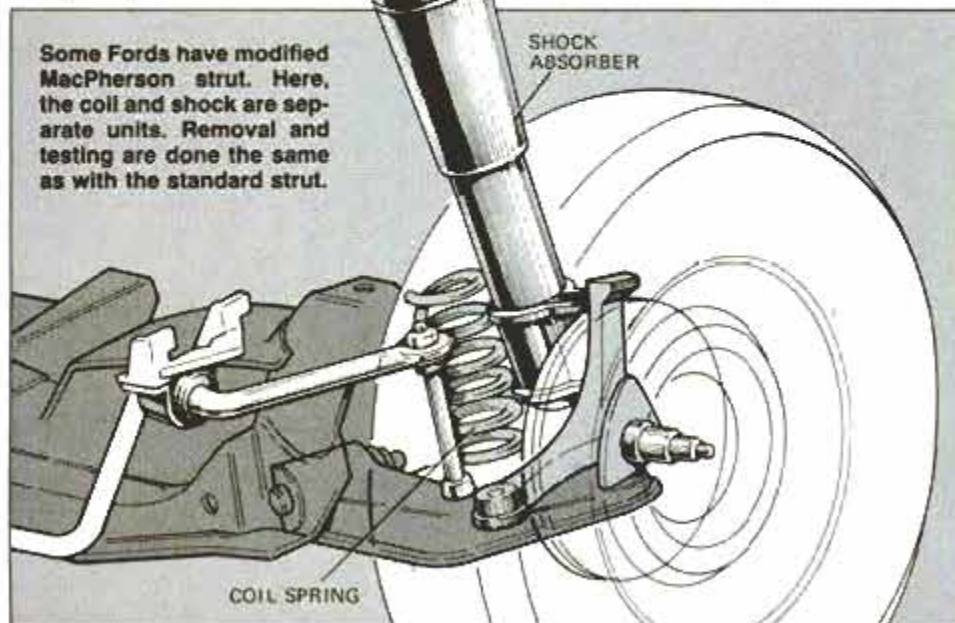
This information applies to Ford Fairmont, 1979-81 Mustang and 1980-81 Thunderbird, and to Mercury Zephyr, 1980-81 Cougar XR-7 and 1979-81 Capri. Mercury Capri models prior to 1979 use a type of MacPherson strut that can be repaired (see article next month).

Using the term "MacPherson" to describe units used in these cars is splitting hairs. They could just as well be referred to as conventional shock absorbers, since the spring and shock absorber are not coupled together in a single assembly. They are two separate units. However, Ford refers to them as "modified MacPherson-strut shock absorbers."

To remove shock absorbers, follow this procedure.

1. Unscrew the three retaining nuts holding the shock to the wheel well. Work from inside the engine compartment.

2. Raise and support the car, and remove the wheel and tire assembly completely.



3. Place a floor jack under the lower control arm and lift to compress the coil spring. This relieves pressure on the shock absorber.

4. Unscrew the two lower mounting bolts connecting the shock to the spindle. Remove the shock absorber.

To install the shock, hold the lower part of the unit against the spindle so holes in the mounting flange are aligned with holes in the spindle. Screw on the lower mounting bolts and tighten them by hand.

Extend the upper part of the shock so top retainer studs extend themselves through the holes in the upper mounting bracket. Screw on the three upper retaining bolts and tighten them to between 60-75 foot-pounds, which is about 1¼ turns after bolts are finger-tight.

Lower the car and tighten lower mounting bolts to between 150-180 foot-pounds, which is roughly equal to two turns after bolts are finger-tight. Be sure to have front-wheel alignment checked.

### Chrysler MacPherson struts

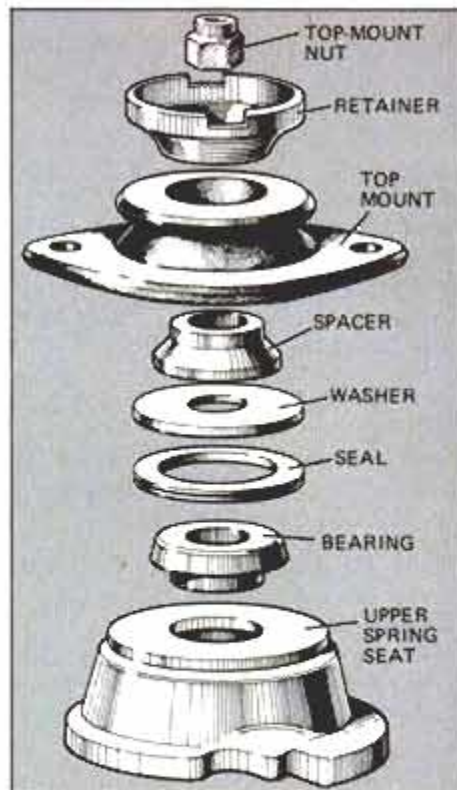
As we mentioned earlier, Chrysler Corp. models using MacPherson struts with shock absorbers that must be replaced upon failure are Dodge Aries and Omni and Plymouth Reliant and Horizon. Here is how to remove and disassemble units for testing and replacement.

1. Inside the engine compartment, find the cap over the upper mounting nuts. It's on the wheel well. Snap off the cap.

2. Unscrew the upper retaining nuts.

3. Lift and support the car, making certain it's held securely, and remove the wheel and tire.

4. Unscrew the lower mounting bolts, but before you do, draw a



To make it easier to reassemble the top mount, make a sketch and label the parts in the order of removal. Above is the top mount for Fiesta and the Escort/Lynx.

mark from the camber-adjusting bolt to the steering knuckle. The camber-adjusting bolt is the top bolt. Remove the strut from the car.

Take the unit to your workbench and mount it in a vise. Use a spring compressor to compress the spring (see page 39, under GM). When the spring pressure is relieved, hold the flat end of the shock rod with a wrench and loosen the top mount assembly retaining nut. Remove top mount assembly components, noting in what order parts come off. Then separate the shock and coil spring from one another, and test the shock.

Once the strut is reassembled, install it in the car by attaching top and lower retaining hardware (lower mounting bolts should be finger-tight).

Inside the engine compartment, tighten upper mounting nuts to 20 foot-pounds, which is equal to about one-quarter turn with a wrench after nuts have been hand-tightened.

Lower the car and tighten lower mounting bolts to 90 foot-pounds, the equivalent of about 1½ turns after bolts are finger-tight. See that the mark on the top lower mounting bolt (camber-adjusting bolt) lines up with the mark on the steering knuckle. Have the wheel alignment checked.



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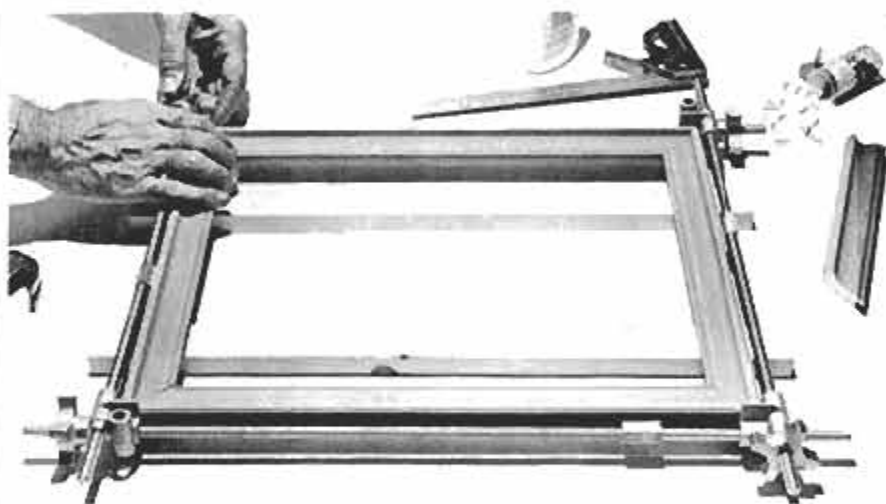
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# PM LOOKS AT A SUPER CLAMPING SYSTEM



Four-corner picture-framing setup uses two two-hole and two three-hole blocks. Threaded rods are extended with couplers. Stock 1/4-in. threaded rod is for big jobs.

Here's a quick and relatively painless way to upgrade your collection of shop clamps. Shopsmith offers a clever assortment of threaded rods, pressure feet, clamping jaws, junction blocks, knobs and the like, which combine into all sorts of clamping configurations. The result is a tool that lets you handle almost any clamping problem.

Called Maxi-Clamp, the system consists of more than 70 pieces. The parts break down into small components, as shown at left. This means that storage takes only a fraction of the space that would be required for the number of clamps the kit replaces.

We used the clamps for some out-of-the-ordinary tasks, like those shown on this page, and it was easy to think of other ways these clamps would pay for themselves. A pointed rod can be used as a pivot, with two blocks and a length of rod, to create a very effective beam compass. Or a length of rod and a pressure foot clamped to your workbench can serve as a bench dog, and so on.

The clamps are well made and should last for years if given reasonably good care. I know that these won't replace my collection of bar clamps, handscrews, C-clamps and the like, but I've found the kit to be a handy adjunct to my clamp collection. It's great to have these clamps available when you're faced with a difficult clamping problem.

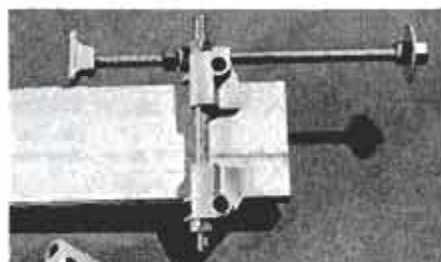
The kit costs \$69 from Shopsmith Inc., Dept. 3044, 750 Center Dr., Vandalia, Ohio 45377. Write to the maker for additional information and ordering details.—*Harry Wicks, Home and Shop Editor*



The complete kit has 72 components, enabling you to assemble a variety of setups.



Close-up of major parts: knob, three- and two-hole junction blocks, pressure foot, clamping jaw, coupler, rod, nuts.



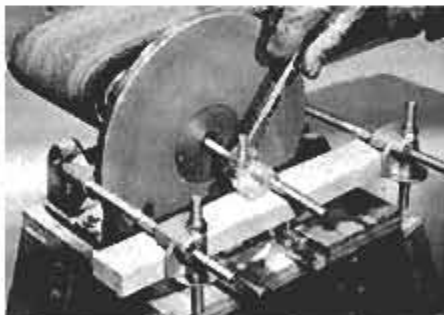
Bar clamps are made with two junction blocks, pressure foot, two rods and nuts. Other end gets same treatment. Inside nut is tightened to gain tension. Nuts and washer at end serve as "handle."



A simple "spreader" arrangement such as this pops a chair's glue joints apart safely when doing restoration work.



Unlike pipe clamp, which must be longer than the workpiece, Maxi-Clamps can be attached as shown to close a butt joint.



Stubborn disc is unfrozen easily using this customized "puller." Taking up on the nut bears the rod against the shaft, while end-rod jaws exert pulling motion.



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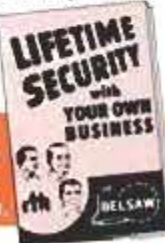
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# PM WORKBENCH

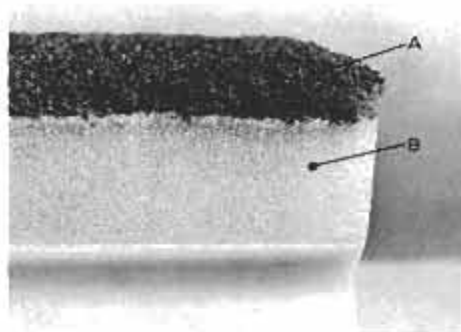
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## Drywall smoothing tool

The abrasive action of this drywall smoothing tool is fast, but allows little chance to dig too deeply. Since it's used wet, compound dust stays on the tool and doesn't get in the air. The spongy nylon mesh allows you to obtain a perfectly smooth surface.



Use wetted tool to work dried joint compound. Work it to a creamy consistency, then whisk lightly to smooth the surface.



Nylon mesh (A) is backed by urethane pad (B) for even pressure when smoothing.

but does not clog as readily as wetted sandpaper. After using it on a big taping job recently, I observed no delamination between pad and mesh. The drywall tool is available at paint and hardware outlets for \$4. It's made by Padco Inc., 2220 Elm St. S.E., Minneapolis, Minn. 55414.

—J.P.

## Heat-resistant gloves

These heat-resistant gloves will come to the aid of the fuel-conscious homeowner who has a wood-burning stove or a fireplace. Just slip on the



These heat-resistant gloves allow you to handle burning logs safely, comfortably.

Fire Handlers to feed a blazing fire, reposition a fallen log or adjust a hot damper. The 16-in.-long gloves are made of durable, fire-resistant leather with a thick wool lining. They contain no asbestos or synthetic materials and are longer-lasting than products that do, according to the maker. Washable gauntlet cuffs, extending to the elbows, protect against sparks and ashes. A pair of gloves is \$25. For nearest source, write to Wood Fires Forever, Box 507, Sunbury, Ohio 43074.

—H.W.

## Let it snow

A 24-page *Snow Almanac* has been published by Jacobsen Div., Textron Inc. The booklet contains snow statistics for 120 cities in the U.S. snow-belt; snow forecasts for the rest of this winter; a story, "The Legend of the Goddess of Snow, Crystallis"; and bits of history on significant snow events. Also included are winter recipes and snow-emergency procedures. The booklet is free from Jacobsen's Sno-Burst, Super Blitz and Imperial snowthrower dealers; or write *Almanac*, Jacobsen Div., Textron Inc., 1761 Packard Ave., Racine, Wis. 53403.—P.A.

## Stamp out theft

The latest antitheft tool to come into my shop is this well-made die stamp from Equipment Theft Information Program Inc., Box 571, Addison, Ill. 60101. The stamp comes with up to 10 digits, so you can personalize your tools and other metal property with your social security number. To make a 1/8-in.-deep impression, you simply rest the stamp flat on the article to be marked and rap the head of the tool with a hammer. The



Die stamp has a rugged rubber body. A hammer strikes the die which makes 1/8-in.-deep impression.

stamp, with 10 characters, is priced at \$54 postpaid; additional characters are \$2.70 each; blanks to make spaces are 96 cents apiece.—H.W.

## All-purpose paintbrush kit

You can tackle most home-painting jobs with this kit. It contains a dropcloth, painting instructions, brush-care tips and three polyester-filament brushes for interior oil or water-base paint and exterior house finishes. The brushes are a 4-in. wall type, a 2-in. enamel brush for trim



Kit contains three brushes, a dropcloth and a guide to painting and brush care.

and a 1 1/2-in. angular brush for corners and windows. The kit is \$7.50 at Pittsburgh Paint dealers. It's from PPG Industries, 1 Gateway Center, Pittsburgh, Pa. 15222.—H.W.

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





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PM-181



# SCIENCE WORLDWIDE



Three tons of coral, species like Butterfly fish (inset), are on view at the Smithsonian.

## The reef as solar collector

The developer of the world's first living coral-reef exhibit suggested recently that floating algae farms, scattered across tropical oceans, could yield a significant crop of energy.

Dr. Walter H. Adey of the Smithsonian Institution's National Museum of Natural History says algae growing on platforms in the sea could be harvested, taken ashore and converted cheaply into alcohol or methane.

Adey told PM that preliminary work on the idea is underway in St. Croix and Maine, where researchers are removing algae from rocks and coral with paint scrapers. He says he envisions a network of 30-foot-square fiberglass or plastic panels, kept continuously awash, as growing areas for algae. The crop would be harvested periodically by a "lawnmower" device, a barge that would suck panels aboard and scrape them automatically.

Adey's idea grew out of his research into reef systems, natural collectors of solar energy. Recently, this research led to the opening of the world's first living coral reef exhibit at the Institution in Washington, D.C. The reef and undersea life around it are kept alive in a 3000-gallon tank. A wave generator keeps water moving over the algal "lawn." In real reefs, algae capture animal waste and the sun's radiant energy, and convert them into new cells and oxygen. The algae, Adey says, play a major role in the productivity of the reef—which has been compared to

an oasis in the biological "desert" of the sea.

## Red-blooded—and weak

A mountain-climbing physician who has studied people living at high altitudes says some of his subjects are worn out and slow-witted, possibly because they have too many red blood cells.

Dr. Frank H. Sarnquist of the Stanford University School of Medicine says he found heavy concentrations of red cells among people living high in the Peruvian Andes. They apparently developed the extra cells to compensate for lower levels of oxygen. Red cells carry oxygen to the tissues, making normal brain and muscle functions possible.

Sarnquist hasn't proven his theory, but he says that one set of subjects with a "sludgy sort of blood" felt better after researchers took samples of their blood, removed some red blood cells, and replaced the samples.

## Mile-deep chemistry

Amid growing interest in tapping the Earth's heat, some scientists are taking a closer look at the hellish conditions a mile beneath the surface.

But they face a problem: Temperatures of 300° C. and pressures of more than two tons per square inch make it difficult to run chemical analyses. Under conditions like these, for one thing, platinum probes normally used to detect corrosive substances simply dissolve. So engineers have a hard time find-

ing out what chemicals are cooking underground. The lack of data means they must guess what kind of pipes to use in heat exchangers carrying hot water or steam from subterranean springs.

Now, researchers at the University of Pennsylvania are studying a new, tough class of electronic silicon chips. These chips can survive the heat and pressure, and transmit digital signals thousands of feet to the surface. The semiconductor studies, led by Dr. Jay Zemel, are aimed, in part, at taking chips out of their normal information-processing role and putting them to work in acquiring data for computers to analyze.

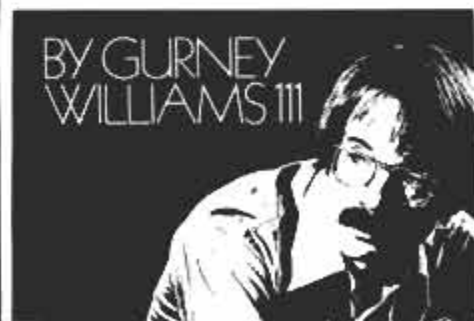
## Waiting for the monopole

Stanford scientists are hunting for the monopole, the hypothetical particle of magnetism that, theoretically, makes electric motors run and compass needles turn.

Using a small plastic and metal device costing less than many electric motors (\$2000), researchers at the Stanford Linear Accelerator Center (SLAC) are busy at a task familiar to modern physicists: waiting around. Their gadget is set up to snag debris from particle collisions within the 7000-foot-circumference Positron-Electron Project (PEP) ring.

But like hunters for quarks (hypothetical building blocks of all matter), SLAC's David Fryberger and other researchers are seldom rewarded with dramatic data. So far, their simple plastic detectors have shown only signs of pitting, possibly from a rain of neutrons within the ring. Under a microscope, a hole made by a monopole would look like a crater, Fryberger told PM.

The researchers are driven by the belief that monopoles *ought* to exist: If electricity is produced by the flow of particles—electrons—shouldn't there be particles producing magnetism? **PM**







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# CAR CLINIC

SOLUTIONS  
FOR MECHANICAL  
HEADACHES

BY  
MORT SCHULTZ



## Flood insurance

*My question is about a 1979 Oldsmobile Custom Cruiser station wagon with 5.7-liter diesel engine. I am concerned about the recent rash of bad publicity GM diesel engines have received concerning excess water entering the engine with diesel fuel and wiping out the fuel-injection pump.*

*I'd like to know if there is an after-market fuel filter that is compatible with my car that will block water.—Paul Stout, New Lenox, Ill.*

There is an electronic sensor system that does a far better job than a simple fuel filter. The electronic system, which has been developed by GM's AC Spark Plug Div., turns on a dashboard-mounted warning light if an excess amount of water builds up in the fuel tank. It includes a holding tank for more than three gallons of water filtered from the fuel, and makes provision for siphoning water from the fuel tank without having to remove the tank from the car.

This system is being installed on all cars and light trucks with diesel engines now being made by GM. It is also being offered as a retrofit to people who own 1978-80 diesel-powered Oldsmobiles and other 1980 GM cars with diesel engines. The system, available from dealers, is \$50, which doesn't include labor.

Regardless of cost, the diesel fuel electronic system is a worthwhile investment. As you point out, excess water in the fuel system can kill the fuel-injection pump, and that's a loss of about \$500.

When ordering the sensor system for your Oldsmobile, Paul, make sure you get the correct one. Part numbers differ, as follows:

- Cutlass coupe and sedan—22510592.
- The Cutlass station wagon—22510593.
- 88 and 98—22510594.
- Custom Cruiser—22510595.
- Toronado—22510596.

## Speaking about recalls

*I'm confused. In the last two Car Care Guides, you gave a rundown of*

*recalls by auto manufacturers to correct safety defects (Recalls, page 229, May '79 and page 231, May '80). My car, a 1976 Dodge Royal Monaco, was listed as needing a new accelerator pump and an EGR system modification. I contacted my dealer and Chrysler Corp. Both say, "No." You and the National Highway Traffic Safety Administration say, "Yes." So where do I go from here?—Gilbert E. Brown, Ballston Lake, N.Y.*

Yours is one of many letters with the same complaint, so let me explain what may be happening.

The primary purpose for presenting the list of recalls in *Car Care Guide* is to inform second and subsequent owners that their cars possibly possess safety defects. Unlike first owners, second and subsequent owners do not receive letters from vehicle manufacturers informing them that cars have been recalled.

Material for the PM recall list is provided by the National Highway Traffic Safety Administration (NHTSA). One piece of information the lists have omitted is serial numbers of the models affected by the recall. This may be causing confusion: Many vehicle recalls don't involve the entire line of cars—just a certain amount, which are identified by serial numbers. Neither PM nor NHTSA has ready access to these serial numbers.

So what do you do when you find

your car mentioned on the PM recall list? Call the NHTSA tollfree hotline number (800-424-9393) and describe the nature of the possible recall. Explain that you haven't received notification from the manufacturer. You will be sent a card. Fill it out, noting the vehicle identification number, and send it to the manufacturer. You will receive word whether or not the recall applies to your vehicle.

## More on recalls

*I am the owner of a 1977 BMW 320i, which is involved in a recall (NHTSA recall No. 78V-061). The reason for the recall is heat that causes vapor lock in the fuel pump, cutting off the fuel supply. As a result, the engine runs rough and stalls. The fuel pump is located beneath the rear of the car where it is exposed to exhaust heat.*

*I speak from experience about this problem. My car has stalled on several occasions, especially in traffic jams. One occasion involved me in a near-disaster in the middle of the Lincoln Tunnel between New York City and New Jersey. Luckily, a Volkswagen (of all cars) pushed me out of the tunnel, allowing me to avert a big towing bill.*

*The problem is that BMW has failed to apply the repair because of a parts shortage. An auxiliary fuel pump has to be installed on the right side of the fuel tank to remedy the condition, but the kits are back-ordered in Germany. So I've done some modification of my own that has averted further trouble and will, I hope, continue to avert it until my fuel-pump kit arrives from overseas. I've wrapped fiberglass insulation around the fuel pump. It seems to keep the heat off the pump.*

*I hope this suggestion aids other readers who own 1977 BMW 320i cars.—Paul Anderson, Summit, N.J.*

This recall also affects 1978 BMW 320i's. A company representative

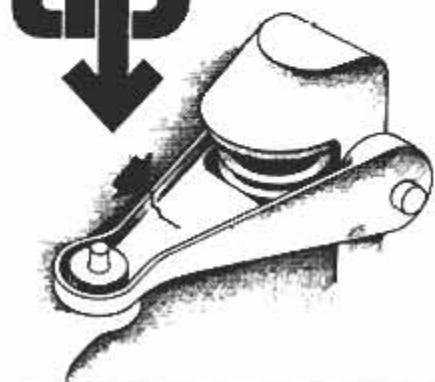
*(Please turn to page 58)*

## Keeping control

Control arms are often neglected when car steering and suspension parts are inspected. Yet they are critical. If a control arm breaks, a wheel can fly off the car. Control arms are susceptible to fatigue, damage in front-end collisions, damage during ball-joint replacement and possible manufacturing defects. So keep control arms in mind the next time you inspect the steering linkage and ball joints. Give them a close examination. If you see a crack in an arm, replace the part.

PM CAR CARE

TIP





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#### **BANGOR**

Southard McCulloch  
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#### **BELFAST**

Pen-Bay Tractor Sales  
RFD #2

#### **E. MACHIAS**

John M. Archibald  
Route 1

#### **FARMINGTON**

Farmington Outdoor Power  
Route 4

#### **GARDINER**

Gardiner Feed & Garden  
Depot Square

#### **GUILFORD**

Herrick Brothers

#### **HOULTON**

Tingley Bros. Garage  
North Road

#### **LIMINGTON**

Pride's Small Engine Hospital  
Route 117

#### **LINCOLN**

St. Peter's Saw Shop  
Bangor Road

#### **NORWAY**

Schiavi Western Auto  
154 Main St.

#### **SKOWHEGAN**

Whittemore & Sons  
Waterville Road

#### **TOPSHAM**

Pelletier & Diemer  
Lewiston Road

### MASSACHUSETTS

#### **AMESBURY**

Merrow's Inc.  
Haverhill Road

#### **BILLERICA**

J.P. O'Connor Hardware Co.  
4 Tower Farm Rd.

#### **BROOKFIELD**

Rice & Gadaire Lumber Co.  
Central Street

#### **FRANKLIN**

Ormond's Inc.  
18 Cottage Street

### **NORTH READING**

Larking Lawnmower Service  
3 Washington St.

### **RUTLAND**

Overlook Services Inc.  
Overlook Road

### **SHREWSBURY**

Gauch Brothers Marina  
101 Hartford Pike

### **TOWNSEND HARBOR**

Shepherd's Sales & Service  
Main Street

### **WESTPORT**

Roland's Lawnmower & Saw  
699 State Road

### **WOBURN**

Star Sales & Dist. Corp.  
29 Commence Way

### NEW HAMPSHIRE

#### **BERLIN**

Louie Catello & Son  
680 Glen Ave.

#### **CLAREMONT**

Fleury's Small Engine Repair  
Thrasher Road

#### **CONCORD**

Dean Wilber's Inc.  
142 Manchester St.

#### **DERRY**

Miley Hardware  
Hood Plaza

#### **GREENVILLE**

Frost's Farm Service  
Mason Road

#### **MANCHESTER**

Standard Fence, Inc.  
92 Turnpike Rd.

#### **PLYMOUTH**

Gilman Outdoor Equipment  
Tenney Mt. Highway

#### **SOUTH TAMWORTH**

Bennett's Sales & Service  
Route 25

#### **WEST RUMNEY**

Shortt's Garage  
Route 25

#### **WOODSVILLE**

Ideal Welding Shop  
Forest Street

### NEW YORK

#### **ALDER CREEK**

American Sports Center  
Route 12

### **CROGHAN**

H & L Motors  
Main Street

### **FORT COVINGTON**

Vincellette Welding & Repair  
Water Street

### **HAILESBORO**

Payne Brothers

### **NORWICH**

Chenango Ford Tractor, Inc.

### **ONEIDA**

Oneida Body & Equip. Co.  
639 Fitch Street

### **PLATTSBURGH**

Rene Neveu & Son, Inc.  
93 Saily Ave.

### **SHERBURN**

Burton Matott

### **SYRACUSE**

Reliable Farm Supply  
2083 Park St.

### VERMONT

#### **BARRE**

Allen True Value Lumber Co.  
502 No. Main St.

#### **EAST HARDWICK**

Gebbies Service Station

#### **MONTPELIER**

Allen True Value Lumber Co.  
Granite Street

#### **ST. JOHNSBURY**

Allen True Value Lumber Co.  
Bay Street

#### **SWANTON**

Warren Fournier Home Center  
North River Road

### RHODE ISLAND

#### **BRISTOL**

J.T. O'Connell Supply  
267 Thames St.

#### **EAST GREENWICH**

Greenwich Hardware  
750 Main Street

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Of course, you don't have to wait for a blackout. A portable generator can be just as useful around a campsite. Or for running power tools outdoors.

But the time to think you might need a portable generator isn't while you're shivering in the dark, fumbling for a flashlight.

It's right now, at your McCulloch dealer.



**McCULLOCH GENERATORS**



# THE PM GARAGE

## CAPSULE REPORTS ON NEW AUTO PRODUCTS

### Better than tape

The standard remedy for a ruptured coolant hose used to be a length of black electrical tape wrapped around the leak. We've just found something that does a better job than tape. It's called Pipe and Hose Repair Tape and is made of self-vulcanizing rubber.

Each kit has two rolls of tape: reinforcing tape and fusion tape. First use the reinforcing tape on the leak and then wrap the fusion tape over it.

The fusion tape actually bonds to itself within 30 seconds. You can even feel it get warm as the chemical reaction bonds the tape to itself. This new wonder tape will hold up



Self-vulcanizing tape bonds to itself for repairing hoses and other pipes or tubes.

for thousands of miles of use after application.

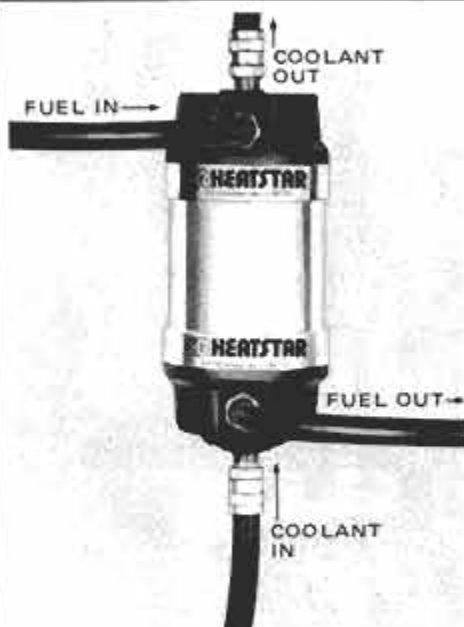
The tape is available for \$3.64 from AMP Special Industries, Valley Forge, Pa. 19482.—T.A.

### Diesel fuel heater

Commercial truckers with diesel rigs have been using diesel fuel warmers for years.

Fuel warmers prevent the waxing and gelling of fuel which occur in cold weather. Not only can this cause poor road performance, but it can eventually wipe out the sensitive metering units on the vehicle's engine.

The Heatstar V fuel warmer is the first to become available for passenger cars with diesels. It can raise the temperature from -18° F. to 76° F. at a rate of two gallons per minute. The unit uses a 185° F. coolant temperature.

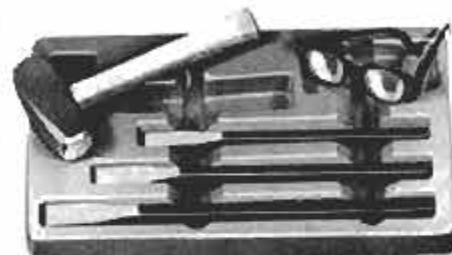


Fuel warmer prevents wax and gel buildup in diesel fuel in cold winter weather.

The cost is \$160 from CR Industries, 900 North State St., Elgin, Ill. 60120.—M. L.

### Heavy hitters

We've just made a welcome addition to our toolbox. It's a set of chisels from Mac Tools which comes in its own plastic tray. The set includes a 3-pound hammer and a pair of safety glasses—a must if you're working with striking and struck tools. Hand-forged of chrome-vanadium



Heavy-duty chisel set is made of chrome-vanadium steel, comes with hammer, tray.

steel, the chisels are sturdy enough to take even commercial service-shop abuse.

Part number is SCDH5SP. Price is \$45.95 from Mac Tools, 4380 Old Roberts Rd., Columbus, Ohio 43228.—T.A.

### Tire-pressure monitor

Now you can check tire pressure at a glance. A neat little gadget called Tire Pressure Monitor has a built-in plunger which, when threaded into



Air-pressure monitor tells you at a glance when the tire air pressure is getting low.

the valve stem, will indicate the relative tire pressure, instantly alerting you to a possible problem.

We've had them on several of our cars and they certainly seem to do the job.

The tab is just \$3.98 postpaid for a set of four. You can get them from Stanley International, 3503 Monogram Ave., Long Beach, Calif. 90815.—G.W.

### Changing your stripes

Duro's Easy Does It body filler has solved the age-old problem of knowing when to apply and when to sand.

Out of the can, the filler is a pink



New body filler turns colors to tell you when it's time to apply and when to sand.

color. Once it's properly mixed with hardener, it turns a light purple, telling you it's ready to be applied. After application, it turns a third color—green—telling you it is ready to be sanded.

It comes in pint, quart and gallon sizes from Woodhill Permatex, 18731 Cranwood Pkwy., Cleveland, Ohio 44128.—M.L.



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- Increases viscosity and anti-wear properties
- Promotes lubricating qualities
- Reduces oil consumption in many cars

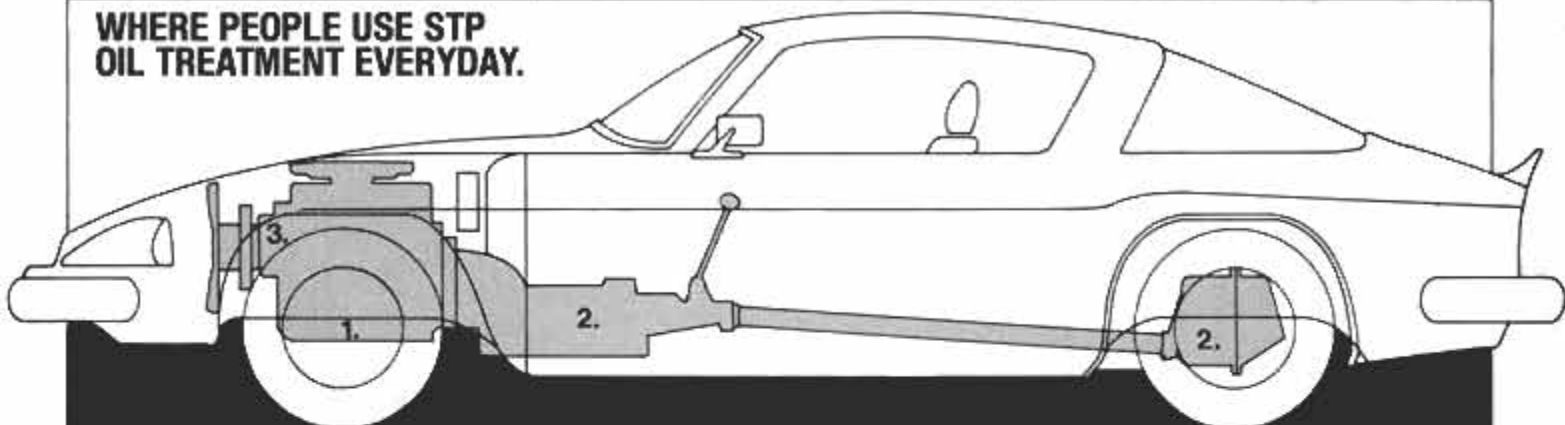


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Use STP Oil Treatment year 'round. Always change your oil at manufacturers' recommended intervals.

The first time you need oil and every time you change oil add STP Oil Treatment. It blends with all petroleum base, graphite and synthetic oils or greases.

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**1. Your engine's crankcase.** The first time you need oil and every time you change oil add STP Oil Treatment when the engine is running and warmed up. Use one can of STP Oil Treatment to 4 or 5 quarts of oil. Maintain 10% by volume.

**2. Manual transmission, gear boxes and differentials.** Add one part STP Oil Treatment to 10 parts regular lubricant. For trucks and tractors, add up to 1 part STP Oil Treatment to 6 parts of lubricant. (Not recommended for use in friction drives and wet clutches.)

**3. Power Steering.** Use 1 part STP Oil Treatment to 10 parts power steering fluid.

**Engine assemblies.** If you work on your engine, coat all moving engine parts prior to assembly with a mixture of 1 part STP Oil Treatment and 1 part motor oil.

**Extra uses:** Two cycle engines, motorcycles, outboards and lawn mowers. Add 1 part STP Oil Treatment to 10 parts recommended oil and then add to fuel as directed.

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**AROUND THE TRACK, AROUND THE WORLD...  
STP OIL TREATMENT IS NUMBER ONE.**



## CAR CLINIC

(Continued from page 50)

told me that by the time this article appears, the fuel-pump back-order situation will no longer exist. Check with your dealer or a regional office to see if the new pump has arrived. If the pump hasn't arrived, your suggestion, Paul, is worth a try.

### Jimmy has a shimmy

*Since I bought my 1980 Plymouth Horizon, I've experienced steering vibration at about 30 mph. No mechanic has been able to find the cause. They've checked front-end alignment, tire balance and steering linkage. Can you help me? I'm concerned that something will break loose and cause me to have an accident.—Jim Leach, Columbus, Ga.*

Some 1979 and 1980 Horizons and Dodge Omnis have been hampered at speeds of 25 to 35 mph by drive-line vibration that transmits itself to the steering.

The cause is excessive runout of the transaxle transfer shaft. You can verify the condition by road-testing the car. If the transfer shaft is causing the trouble, you will feel vibration both when the car is under acceleration and when it coasts.

Another malfunction that can cause vibration, other than the transfer shaft and what you mention, is constant velocity (CV) joint damage. This is most noticeable when the car is under acceleration—not when it's coasting.

If transfer shaft runout is verified, the ring gear and transfer shaft, transfer-shaft bearing cone and transfer-shaft bearing cup have to be replaced.

Details of the repair are outlined in service bulletin 21-09-80, which your dealer has on file or can get from his regional office.

### Fiat fortissimo

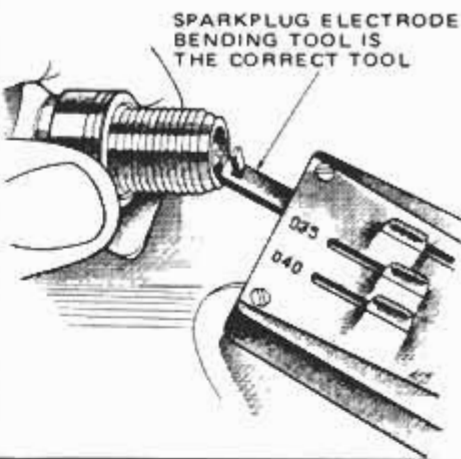
*About a year ago, I bought a new 1979 Fiat Brava with 2-liter engine and standard transmission. I took delivery of the car in Madrid, since I work here for the U.S. government. The car came with two catalytic converters—one installed and, believe it or not, one in the luggage compartment as a spare. (Maybe to keep the spare tire company?) But the spare converter isn't my problem. It's the one on the car.*

*Two months ago, the car started backfiring through the catalytic converter when I let up on the accelerator pedal to shift gears, and also dur-*

## Don't bend the rules



It is very important to use the correct tool when setting sparkplug gap, or when opening side (ground) electrodes to service plugs. The correct tool is called a sparkplug electrode-bending tool. It is usually part of a sparkplug feeler gauge. Using a makeshift tool, such as pliers, to bend the side electrode will damage the electrode and ruin a good plug.



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ing deceleration. Simultaneously, many little bluish-white balls blew out the tailpipe. I figured the leaded gas I'm forced to use (there is no unleaded here) finally killed the converter. I removed and replaced it with a straight pipe. But this hasn't stopped the backfiring, which is driving me up the wall.

If the trouble isn't being caused by the catalytic converter, what is causing it? Maybe I should reset the carburetor to some specification other than that recommended by Fiat. What do you say?—Randolph E. Whitmire, U.S. Consulate, Barcelona, Spain

I think your trouble stems from a defective electrovalve that controls the operation of the gulp valve. The gulp valve serves the same purpose in the Fiat as the positive crankcase vent (PCV) valve does in other cars. In other words, backfiring is probably not related to the trouble you had with the catalytic converter. Many Brava owners here in the States, who must keep catalytic converters on their cars and who have unleaded gas available to them, are also experiencing engine backfiring because of malfunctioning gulp-valve electrovalves.

The solution is to see that the

engine is tuned up to specifications recommended by Fiat and to replace the gulp-valve electrovalve (part No. 4412065).

By the way, that spare catalytic converter is supplied by Fiat to a car owner overseas who will eventually bring the vehicle to the States. The spare converter should be installed on your return.

### Sibling rivalry

Is there anything wrong with a car if you have dark black in the tailpipe? I don't know much about cars. I'm only 15. It's my sister's car.—Peggy Kober, no address given.

Tell you what, Peg. You show sis that the kid sister can come through in the clutch. Your sister's engine is running rich. Tell her to stop throwing money out the tailpipe, in the form of wasted fuel, by having the engine's fuel and ignition systems tuned up. Also have the mechanic check the choke system.

### GOT A PROBLEM WITH YOUR CAR?

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

### SERVICE TIPS

■ Chrysler Corp. says it will pay for parts and labor to correct problems with 1978-80 Omni and Horizon front-wheel bearings, automatic transaxles, distributors and oil pumps. The deal is good for 24 months or 24,000 miles from the time the vehicle was purchased new—a doubling of the warranty time. Any Chrysler Corp. dealer is authorized to make repairs.

■ General Motors warns you not to have both batteries of diesel-engine cars replaced at once, unless both are shot. Says GM, "Many dealers are replacing both batteries in diesel cars. Each battery should be charged and tested individually. Replace only the failed battery."

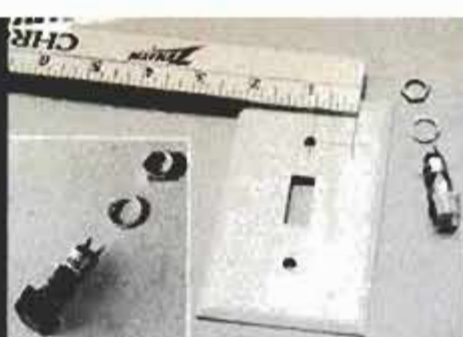
■ If your 1978 or earlier-model Ford or Mercury has FMX automatic transmission, replace the metal oilpan screen with a Dacron filter for better filtering. New retaining clips are needed. The filter is part No. D8AZ-7A098-A; the rear clip is part No. C8AZ-7A097-F; and the front clip is part No. C8AZ-7A097-E.

■ According to Chevrolet service bulletin 80-1-23, some models with 3.8-, 4.4- and 5.0-liter engines may knock during light throttle acceleration. The noise, which sounds like a main bearing, is probably excess hydrocarbons igniting in the exhaust manifolds because of air entering the manifolds by the AIR system. To verify the condition, set ignition timing to specification and remove the AIR system pump drive belt. Drive the car a short distance. If the knock subsides, the cause is exhaust combustion, which, says Chevy, "is a proper function of the 1980 emission system." **PM**





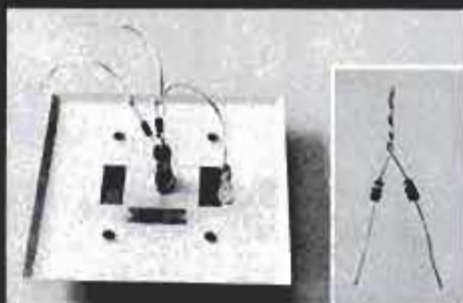
Conserve energy by adding an indicator lamp to a switch that controls an out-of-sight lamp (such as in an attic). It glows when the light is left on.



For a single-switch installation, remove wall plate and bore  $\frac{1}{8}$ -in. hole  $\frac{3}{4}$  in. from upper mounting screw. Radio Shack's No. 272-704 indicator lamp was used here.



After installing the indicator, test the lamp to be sure that it is connected correctly before you reinstall the switch plate.



To install an indicator lamp on a multiswitch plate, you need a diode between each switch and the lamp. Twist the diode leads together (inset), solder ends to light terminal (left) and connect them (right) so diodes have same polarity.



## Add a 'reminder' lamp to your light-switch panel

Most of us have at least one lamp in the house that isn't visible from its switch. Perhaps it's a ceiling fixture at the far end of the basement, a light in an attic or a yard light. With such lights, you don't always know when they're left on. One way to be sure is to install an indicator lamp at the switch.

Almost any type of neon indicator lamp will do the job, but it will require a series resistor to limit the current flow. If your selected neon lamp doesn't have a built-in resistor, you must add one externally, generally of 100,000 ohms. Radio Shack's No. 272-704 indicator lamp (\$1.70 for two) is shown here.

**Important:** Be sure to turn off the circuit breaker or pull the fuse before installing a lamp.

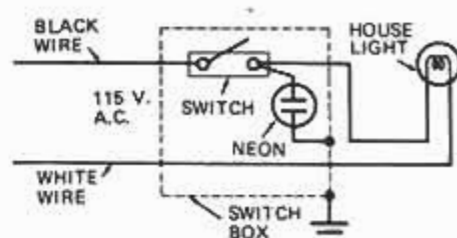
In a single-switch installation (top, right), attach the indicator lamp to the switch plate. Solder two wires to the indicator terminals (upper diagram at right). Attach one wire to ground, the other to the load side of the light switch. Then reinstall the plate, restore power and test the lamp. If it stays on continuously, regardless of switch position, it is connected to the wrong switch

terminal. If the neon lamp doesn't light at all, there is probably a poor ground connection.

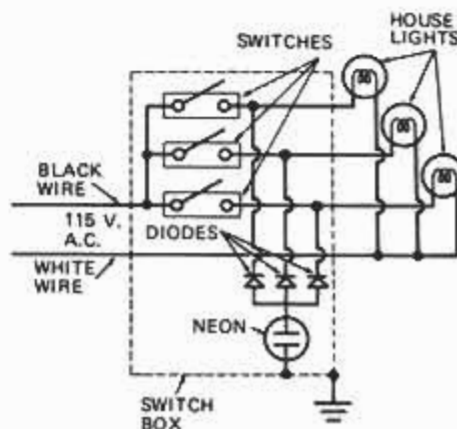
You need only one indicator lamp on switch boxes controlling multiple lamps to show when any one of the lamps is on (photo at top, left). However, you must install a diode between each switch and the indicator, as shown in the diagram (bottom, right). The diodes isolate individual circuits. They must be connected with the same polarity. Any diode with a 200-volt rating or higher will do. You can purchase an assortment of 50 or more for several dollars at an electronics supply store.

To install the indicator on a multiple-switch plate, turn off the power. Remove the plate and check available space. Make a pencil line on the wall below the switch box to indicate the lamp's mounting position. Replace the plate and mark this position on the plate.

Next, bore a hole in the plate and mount the neon lamp. Then twist the leads of the diodes together—two diodes for two switches, three diodes for three switches. Observe polarity (usually marked with a stripe) and solder the twisted ends



In single-switch application, solder two wires to lamp terminals. Attach one to ground, one to load side of the switch.



In switch boxes controlling two or more lights, you must use a diode between each switch and the indicator lamp, as shown.

to one terminal of the neon lamp. Solder several inches of insulated wire to the other end of each diode to make hookup easier. Also, solder a ground wire to the other terminal of the neon. Add insulating sleeving or tape any exposed connections. Make the remaining connections to the switches and to ground. Restore power and check each switch individually.—L.O. Rexrode



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# PM ELECTRONICS MONITOR

## Word-processing update

Since our article *PM Designs Your Personal Word Processor* appeared in our July '80 issue (page 78), we have heard from many readers who put the system together and saved anywhere from \$2000 to \$10,000 over commercial units. But there are a couple of new products we should mention.

The first is the Videx Videoterm, a plug-in board that gives the Apple II home computer an 80-column display, rather than 40 columns. This is the same display as that of more expensive word processors, so for \$345, it adds visual punch to our design.

The Videoterm board will interface with the Apple Pie word-processing software we described in the July article. When not being used for word processing, the board will also give an 80-column display of most other software, with only minor modifications.

The Videoterm also includes graphics, and if you need special character sets, Videx makes them available. Or you can program your own into ROM (read-only memory) chips with proper hardware.

In addition, since the article appeared, the Apple II has gone through a minor change. The new Apple II computers now feature a "revision seven" main printed-circuit board.

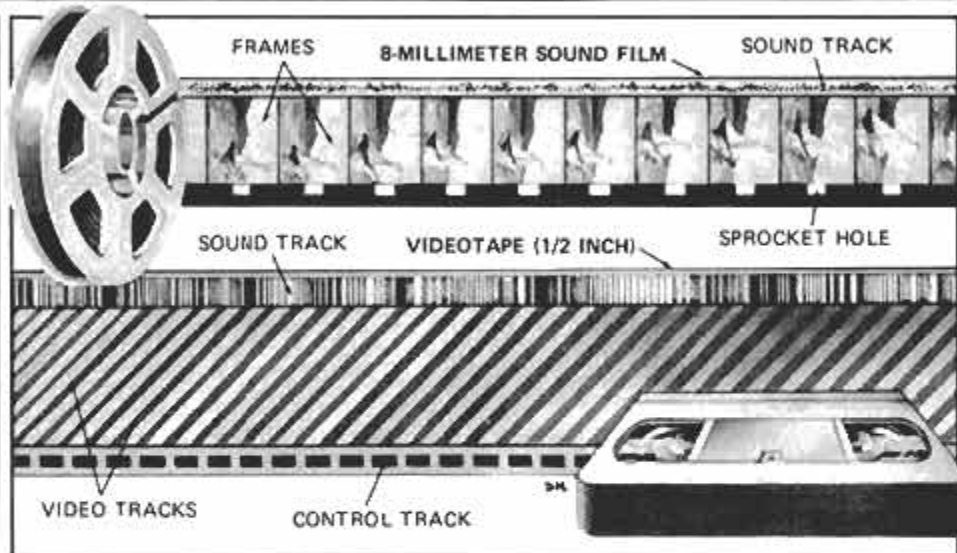
The Dan Paymar lower case adapter will not work with the so-called rev. 7 board. Instead, order Paymar's new Model II adapter. If you're in doubt as to which board your Apple has, ask your dealer—one of the Paymar boards (which are now priced at \$64.95) will work for you.

It may not have been made clear enough in the original article, but the Heath H-14 printer should be built in what the Heath instruction manual terms a "modified" manner. This is in addition to the special wiring we detailed.

The address for Videx is 897 Northwest Grant Ave., Corvallis, Ore. 97330. Dan Paymar's new address is 91 Pioneer Pl., Durango, Colo. 81301.

## See how they run

Was it some divine plan that brought the affordable quartz (digital) chronograph onto the market in coincidence with this country's running/jogging boom? It was to Texas Instruments, at least—the compa-



## Warning—videotape isn't movie film

Finding the picture and sound track on home movie film is easy—they are visible, as shown above. Videotape, on the other hand, looks blank. But if you could see the tracks on a VHS videotape machine, you would see them as very fine diagonal lines. They are recorded and played by a helically spinning head that tracks the diagonals.

Thirty frames (diagonal tracks) make up one second of videotape time. In freeze-frame mode, the helically spinning heads can build up a few hundred degrees of heat on a small area of the tape. This is why you should never allow a videotape machine to remain in the freeze-frame mode for a long time. The intense heat could damage the tape.

ny has packaged its inexpensive multifunction Sportswatch along with a copy of Dr. Ken Cooper's aerobics book (latest revised edition) in what TI is selling as a "fitness kit."

The package (\$19.95) also includes a chart for the jogger's daily logging of aerobic points as a result of timed running distances. It's a clever way of merchandising any quartz chronograph, of course, but the Sportswatch itself is what makes the package.

The one we tried kept accurate time to the second for better than two weeks. Its stopwatch capabilities compared favorably with much more expensive quartz timers. It's convenient to use while exercising—although the function buttons don't give any positive feel—and, so far, the plastic case seems impervious to perspiration.

Apart from a "backlight" that simply doesn't give adequate nighttime illumination to the liquid crystal display, the watch performs as advertised. At the price, it's a great gift for either a confirmed runner or someone whose general physical condition seems to call for a touch of the spur.

## Crystals washed up?

Liquid crystal displays, or LCDs, are familiar to almost everyone. They are the black-on-gray numeric dis-

plays that many watches now feature, instead of harder-to-read, red-hued light-emitting diodes (LEDs) which were so prevalent just a few years ago.

But just as the LCD took over from the LED, someday liquid crystals will also be replaced.

Right now, hydrated iridium oxide crystals are being looked at as new formulations for LCDs. These new crystals would not require a "refresh" current. Normal LCDs must now be "refreshed" many times a second—reenergized over and over again—to hold their display.

As the iridium crystals do not need this reenergizing, they could extend battery life and also make for simpler, and hence cheaper, circuitry.

LEDs led to LCDs and the LCD may soon give way to the ICD (iridium crystal display). **PM**





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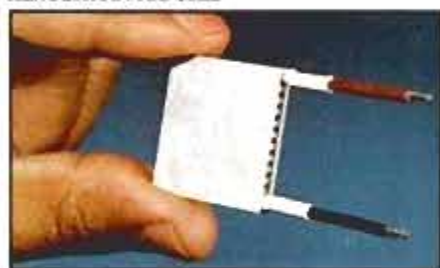
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tilting, bumping, vibration, (which causes failures to conventional compressors, motors and piping)...they're powerful (these modules have the same cooling power as a 10 lb. block of ice)...and they never wear out or break down. And for portable refrigeration where you require 12 volt DC. power, thermo-electric modules are the most efficient. These amazing heat pumps have not only gone to the moon, but have provided the breakthrough for Koolatron's truly reliable, lightweight portable refrigerators.

### THOUSANDS IN USE

Koolatron Industries Limited now has tens of thousands of these electronic fridges in use worldwide using these same powerful solid state modules. The reliability, performance and convenience of electronic refrigeration has now been dramatically tested and proven in all kinds of temperatures, conditions and environments from Australia to Alaska. Built to take it, these electronic modules are encased in tough, plastic insulated chests that are designed to be rugged and trouble-free. Non-rusting hinges and latches prevent corrosion in salt water environments. And with only one moving part (a small 12 volt fan) Koolatron portables seldom see a service depot. Koolatron's combination of space-age heat pumps and quality engineering have now led to a whole family of electronic portable refrigerators and food warmers that eliminate costly ice and provide "home refrigeration" convenience at sane and sensible prices.



**MODEL P10 - THE PERFECT CAR FRIDGE & FOOD WARMER**

**\$129. \$99.00**  
(In Canada \$139. \$109.00)  
**\$228. \$108.00**



Holds approx. 17, 12 oz. pop cans—refrigerates in air temps. up to 95°F. Also keeps hot foods hot (150°F) at the flick of a switch. Tough, blue Polypro plastic case. Ext. 16" L x 11" H x 11-1/2" W. Int. 11-1/2" L x 8" H x 8" W. with 10 litre capacity (0.4 cu. ft.) weighs 10 lbs. empty. Operates from supplied 12 volt power cord in vehicles or with optional 12VDC/110VAC power adaptor.

Koolatron's P10 not only makes a great car fridge but at a flick of a switch lets you bring home your favourite last foods "piping hot". Comes with a 9 ft. power cord that just plugs into your cigarette lighter. Amazingly easy to operate...one switch selects hot or cold. A second switch allows you to refrigerate normally or select maximum cold. With your engine off, you can operate several hours and still start your engine to recharge your battery. "A low battery" indicator warns you when it's time to recharge. With the power off, your P10 keeps everything hot or cold for many hours in its well insulated case.

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And with our optional 110 volt adaptor you'll find endless uses wherever house current is available...At your cottage... as a bar fridge...in your motel room for a midnight snack and drink or as a small office fridge. Use as an auxiliary home fridge when you're having a party. And it's a natural at drive-in movies, auto races and at sporting events.

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The P34 is our standard recreational size portable refrigerator. This new, improved model has a non-adjustable solid state thermostat which keeps your food at normal refrigeration temperature even in 95°F weather. It holds more than three times as much as the P10.

Imagine dry, dependable refrigeration with the size to match your travelling and camping needs. Fits into any boat, van or camper or back seat of your car. Plugs into your cigarette lighter receptacle and refrigerates over 40 lbs. of food (no space wasted by ice), yet it draws no more power than the P10. With our optional 110 volt adaptor, you'll find endless uses as a bar fridge, cottage fridge, office fridge. Your P34 has all the advantages of the P10 without the heating cycle or low battery indicator but with all the capacity needed for serious boaters, campers, hunters, fishermen and travellers.

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The same size, colour, weight and capacity as the P34 but includes food warming features, fully adjustable temperature control and low battery warning indicator.

The P34A is our top of the line portable. It heats, it refrigerates and with specially designed electronic circuit control (patent pending) it allows you to dial a complete range of temperatures from very cold to very warm.

Imagine the versatility. In season, refrigerate all your hunting, camping, boating and cottage provisions. Off-season, keep foods piping hot on your ice-fishing, skiing and snowmobiling weekends. You can even dial wine-cooling temperatures. Our low battery indicator warns you when you need a recharge and the sensing circuits efficiently control your power consumption to save on battery drain. This is our best of the line, recreational fridge and food warmer with all

**READ WHAT OUR CUSTOMERS SAY:**

"We took meat from Canada and ate it ten days later after thawing it in Florida. All our produce and drinks stayed unbelievably fresh and cool." SH, Hamilton, Canada

"The way I try to sell my refrigerator one would think I was on commission. We love our unit!" P.O.P., Houston, Texas

"The Koolatron is everything they say about it in its advertising. I personally bought one, tested it and found it so desirable that I gave it to my daughter and son-in-law who made a cross-country trek from Vermont to Oregon with their infant daughter. They told me that aside from their new Dodge van, the Koolatron was the most indispensable item of equipment they carried." K.M., New York, N.Y.

the bells and whistles for the discerning buyer who demands quality, size and complete versatility.

**SAVE \$30 IF YOU ACT NOW!**

By ordering off-season you can save a full \$30 off our regular prices. You save! We keep our plant operating at an efficient level.

**ORDER TODAY WITHOUT OBLIGATION!**

Simply complete the attached order form or phone collect and we'll rush you your portable on our no risk 21 day trial offer. Each unit comes with complete instructions and a written 1 year warranty. In the unlikely event you ever need service, we have major service centres in New York, Arizona and Canada.

When you receive your Koolatron, use it constantly for 3 full weeks without risk. If you ordered our optional 110 volt adaptor, plug it in, then use your portable immediately as a bar fridge or around the patio or pool. Next plug it into your car or RV. Take your family out for a weekend trip. Enjoy fresh home cooked food as you thumb your nose at those expensive restaurant stops. Then use it on your boat or in your office or let your son or daughter try it at their college dorm. If after you've thoroughly tested it, you don't agree that your Koolatron represents a major breakthrough that will save you time, money and bother for years to come, send it back for a full refund. You can't lose...we guarantee it.

So be among the thousands to discover that the ice age is over! Don't waste another dollar on ice...order your Koolatron with no obligation, today!

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For rush delivery, call "toll free" by asking your operator to dial us collect. Quote the Dept. No. in the coupon below to guarantee your \$30 saving.

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Save me \$30 with these off-season prices:

—Koolatron P10 at \$99.00 (\$109.00 in Canada)

—Koolatron P34 at \$139.00 (\$149.00 in Canada)

—Koolatron P34A at \$159.00 (\$169.00 in Canada)

—Koolatron 110V adaptor at \$29.95 (\$34.95 in Canada)

Please add \$8.00 for handling and delivery per unit

No charge for shipping adaptor if ordered with unit

Add \$3.00 for shipping adaptor only

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I understand that I may return any item undamaged within 21 days and receive a full refund if I am not satisfied.

I enclose my check or money order for \$ \_\_\_\_\_ or please charge it to my  Visa  Mastercard  American Express

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# DETROIT LISTENING POST

## Sneak preview

It's tough to keep secrets these days in Detroit. With the plethora of new cars coming on line, the closely guarded test tracks of the Big Two (Chrysler is very small these days) are beginning to look like freeways crowded with prototypes.

Below is Ford's Escort/Lynx-based sporty coupe. This front-wheel-drive notchback will share running gear and wheelbase with current E/L cars, but will be livelier and offer increased performance.

GM's Camaro/Firebird replacement for 1982 will be the front-engined, rear-drive F-cars. These cars will weigh about 700 pounds less than current Firebirds, will lose 7 inches in wheelbase, yet retain the



Ford's sporty coupe, based on Escort/Lynx platform, will make its bow by mid-year.



Firebird/Camaro replacement retains the look of current cars though it's smaller.



J-car, the Monza/Sunbird replacement, will be front-wheel-drive, three-door model.

interior space of the current cars. The standard engine will be the 2.4-liter Four,—V6 and V8 optional.

GM's J-cars, to be introduced in mid-1981, will be front-drivers and will share many elements with the X-cars. The base engine will be a 1.8-liter Four with a V6 option.

## Pontiac sports car

The Pontiac two-seat, mid-engine sportster—the P-car—is scheduled for 1983-model year introduction.

Sources say that the Budd Co. (which once built two-seat T-Bird bodies for Ford) will supply lightweight body parts of a composite plastic material. The car will be powered by a small, four-cylinder engine mounted transversely behind the passenger compartment. The overhead-cam, 1.8-liter job, which GM will begin importing from its Brazil plant for some of the front-drive '82 J-cars, will probably be used.

The P is targeted for a curb weight of about 1800 pounds. It will come in both utilitarian and flashy versions, ranging from \$10,000 to \$12,000. Pontiac's rival, Chevrolet Div., will likely have its own P version for '84.

## Cadillac J-car

By now, almost everyone knows that in a few months, GM's fwd J-cars are coming to Chevy and Pontiac dealers to replace the tired, old Monza and Sunbird subcompacts. And you may have heard that Cadillac Div., wary of having nothing but big, heavy cars to sell to an increasingly small-car-oriented public, will get a J-car of its own.

But outside of GM, no one knows much about that mysterious Cadillac small car—what it will look like, how much it will cost, or even when, exactly, it will become available. We do know it's code named J-7000, may be called "Cimarron," and probably won't even carry the Cadillac badge. Also, it will be very expensive compared to other J versions. Only urban-area dealers are likely to have it, and only about two per month. We'll keep you informed.

## Ford back in racing

Remember the Le Mans winning Ford GT-40? The semifactory-backed efforts of Carroll Shelby's Mustangs? The roar of a factory-modified Cleveland engine? If you're too young to remember, let's just say you missed some of the most wonderful racing hardware ever to come out of a factory. Ford pulled out of the grease and thunder of official factory-participation in racing some 10 years ago, allowing foreign marques like Porsche, BMW, Datsun and others to take top honors in GT and Makes series.

But now, Ford is back in the pits. Its first step is to organize a new department called "special vehicle operations." This department will be in charge of converting Mus-

tangs, Capris and Escorts into road-racing and rallying screamers.

The inspiration for this program came from Walter Hayes, Ford's director of public affairs. It was Hayes who first got Ford of Europe involved in the GT-40 program and the Cosworth, Ford-based DFV racing engine. If you know your racing, you're probably aware that the Cosworth has won 10 Grand Prix titles since its introduction in 1967.

Hayes has brought over Michael Kranefuss to run the new department. Kranefuss was director of motorsports for Ford of Europe and has been responsible for numerous Ford racing victories. The reason for this renewed interest is simple. Ford wants to recapture the youth market it lost when it withdrew from racing. No budget has been announced yet, but Ford says costs won't approach the \$25 million per year it spent in the late '60s.

## Chrysler and deTomaso

Chrysler hopes to boost its image and counter these GM and Ford plans, partly with the help of Italy's deTomaso, the specialty-car builder best known in this country for the deTomaso Pantera mid-engine sports car marketed by Lincoln-Mercury a few years ago.

With deTomaso's assistance, prototype K-car-based, two-seat sports cars (one version with mid-mounted engine) are currently being developed and evaluated for possible '83 introduction. Chrysler and deTomaso also plan to collaborate on very small two-seat commuters slated for '84-'85 release. A high-performance version of the K-car's 2.2-liter engine is also in the works. Peugeot of France also will contribute, supplying 1.6-liter, four-cylinder diesel engines for use in next year's Omni/Horizon subcompacts. **FM**



BY  
GARY  
WITZENBURG









# WHY NOT?

Have we lost our grip?  
Yep.

We never went in for clinging to notions like "thou shalt not step out in a pickup truck."

Especially, if it's called a Volkswagen. And looks this nice.

And has credentials to wow even the jaded set:

Like great mileage: EPA estimated **25** mpg, 35 mpg highway estimate. (Use "estimated mpg" for comparison. Mpg varies with speed, trip length, weather. Actual highway mpg will probably be less.)

Like being the only pickup in America with CIS fuel injection.

Like being the only pickup in its class with a fully unitized body, double-wall bed construction and balanced suspension system.

Like being a pickup that can out-accelerate even an MGB. With pure sports-sedan performance

(0 to 50 in 9.7) from that fuel-injected engine, plus front-wheel drive, and rack-and-pinion steering.

Like having an eye-opening array of optional luxury appointments in our LX model.

So, now that you know how impressive a Volkswagen Pickup is, maybe what's really funny is going to the lumber yard in one.

# VOLKSWAGEN DOES IT AGAIN





# NEW MOTORCYCLES

## THE MOST EFFICIENT MACHINES ON THE ROAD

Long gone are the days of kick starters and buckboard suspensions. Today's motorcycles are using advanced concepts to make them the most efficient, reliable and fastest machines on the road. *by Bill Stermer*

In the last five years, a quiet revolution has been taking place in the motorcycle industry. Most casual observers, and probably even most motorcycle riders, have been unaware of the innovative and sometimes radical technology that is being incorporated in the new breed of motorcycles.

These new motorcycles are better looking, more efficient, more reliable and safer than any that have come before. And, they're still relatively cheap to buy and maintain.

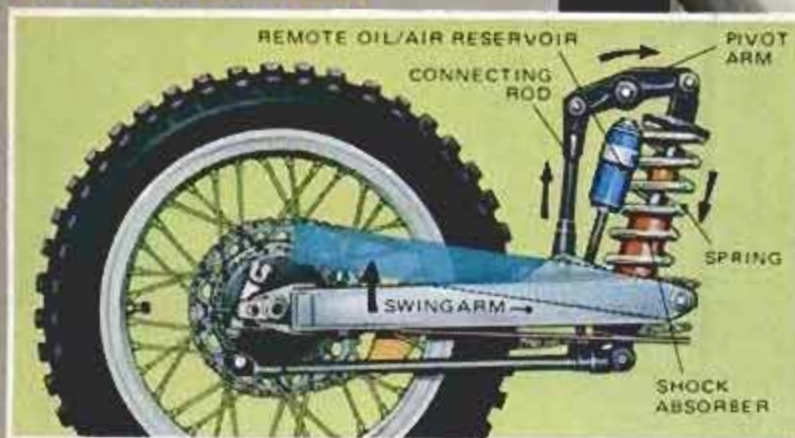
We have the Japanese manufacturers to thank for this. Unlike the American, British and Italian motorcycle



Honda's exotic NR500 road-racing motorcycle uses a V4 engine with a 20,000-rpm redline.

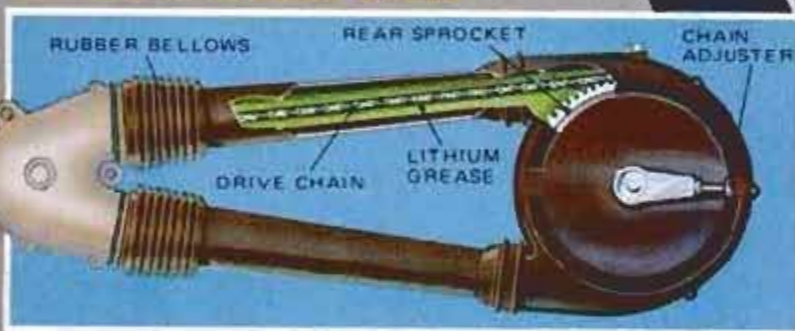


## KAWASAKI UNI-TRAK



The cantilevered single shock absorber with coil-over-spring system provides almost infinite damping rates.

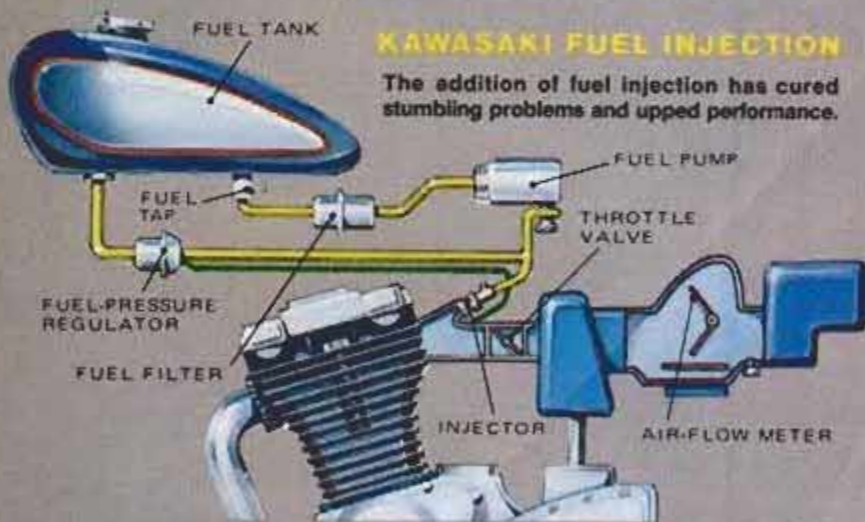
## YAMAHA ENCLOSED CHAIN



The sealed cover over the drive chain is filled with lithium grease. This extends the life of the chain and helps to keep the motorcycle clean.

## KAWASAKI FUEL INJECTION

The addition of fuel injection has cured stumbling problems and upped performance.



PM art: John B...

makers, who once ruled the two-wheeled market, the Japanese haven't been afraid to experiment. The results of these experiments have created motorcycles that are on the cutting edge of technology.

The following is a summary of the advances which have transformed motorcycles from simple, often unreliable machines into a truly sophisticated means of transportation, on a par with anything their four-wheeled counterparts have to offer.

## YAMAHA COMPUTERIZED MONITOR SYSTEM



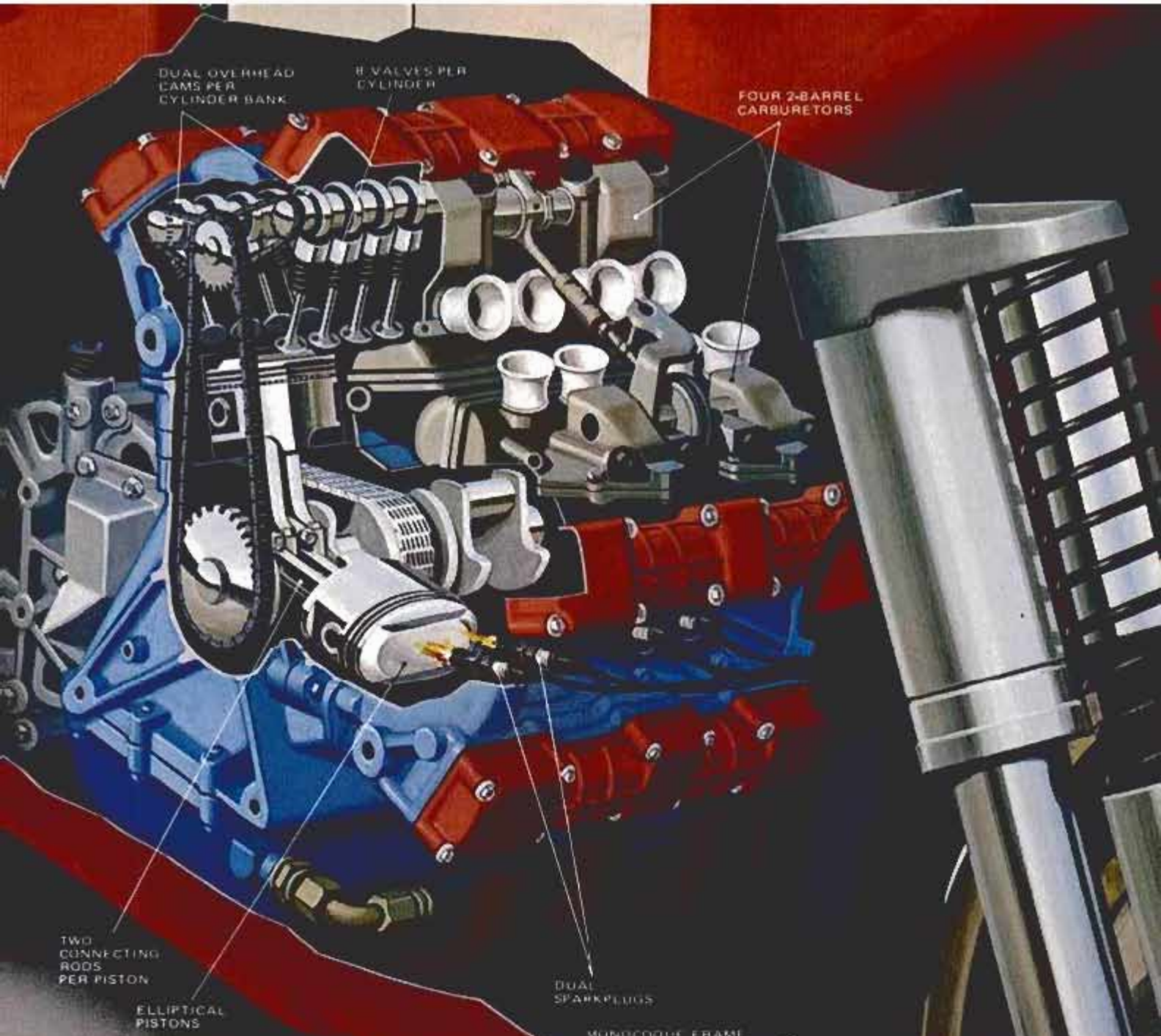
### Four-valve heads

Most internal-combustion engines introduce their air/fuel charge to the cylinder through a single intake valve, then discharge combustion byproducts through a single exhaust valve. Several high-performance Japanese motorcycles, however, are now breathing through four valves (two intake, two exhaust) per cylinder. This group includes several larger

(Please turn to page 161)

Microprocessors flash instantaneous readouts to the rider, showing critical engine and accessory functions.

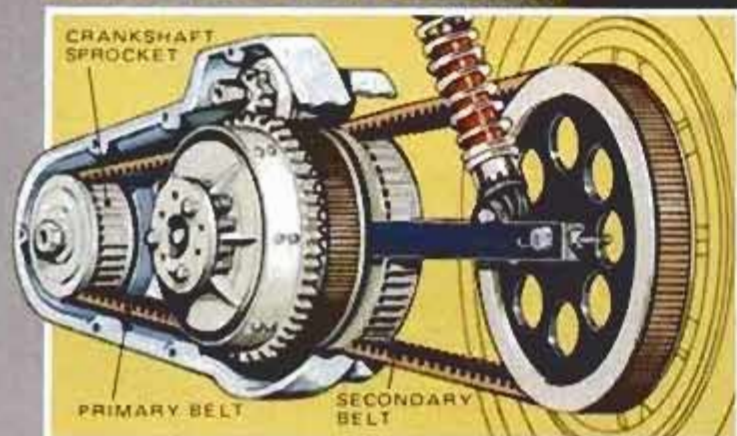




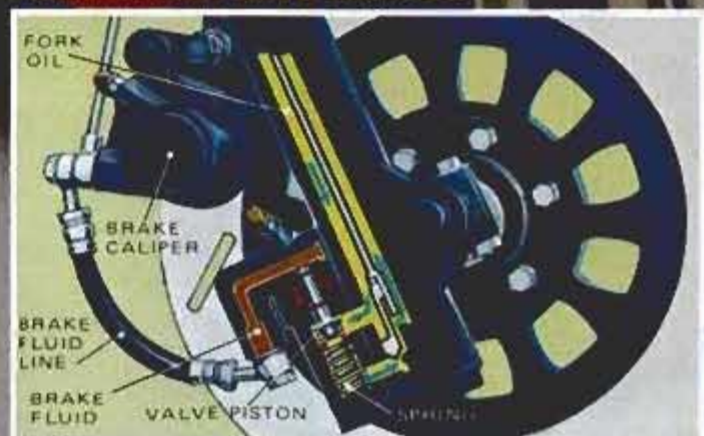
### HONDA NR500 GRAND PRIX ENGINE

Honda's racing powerplant displaces 500cc and produces an estimated 125 hp at 20,000 rpm.

### HARLEY-DAVIDSON BELT-DRIVE



### YAMAHA ANTIDIVE BRAKES



Harley's new Sturgis model (left, above) has eliminated chain drive and uses toothed belts, instead. Yamaha's Antidive Braking System (right, above) keeps bike from pitching during hard braking.

PM art: Jeff Mangiat



# 21 exciting new sports planes you can build

Here are the latest build-your-own flying machines, from famed warbirds to exotic ultralights.

by Sheldon M. Gallager

Wearing its familiar battle garb—checkered cowl and bold wing stripes—this half-size replica of the famed WWII P-47 Thunderbolt is the latest mini-fighter you can build from plans. It hits 195 mph, can perform exciting combat maneuvers.

**I**t screams in low over the field, looking so real you half expect it to let loose a murderous burst of machine-gun fire. But if it's on a strafing run, it's 40 years too late. Actually, it's an authentically scaled-down replica of the famous P-47 Thunderbolt, appearing much as it did over the battlefields of Europe and the Pacific in World War II. The mighty P-47 was the largest, heaviest single-seat fighter of its time, and saw heroic action in nearly every major theater of war, distinguishing itself as both a fighter-bomber and bomber escort.

The half-size reproduction shown here (photo at right) is one of the many new homebuilt sports planes unveiled at the annual fly-in of the Experimental Aircraft Assn. in Oshkosh, Wis. It was built by Gil Hallquist of Mesa, Ariz., at a cost of about \$8000. Powered by a 108-hp Lycoming, it has a top speed of 195 mph and is stressed to permit all the combat-type maneuvers you're ever likely to want to try. Gil's version sports the full bubble canopy of the later P-47D models (earlier models had a hump-backed fuselage with partial canopy that restricted rearward vision).

For added convenience, the mini-fighter has hydraulically retractable gear and a slightly deeper-than-scale fuselage to provide a roomier cockpit. Wingspan is 20 feet; length, 17½. Construction is fiberglass over foam for smooth-flowing contours with minimal metalwork. Plans are \$135 from War Aircraft Replicas, 348 South 8th St., Santa Paula, Calif. 93060. The P-47 is the third and latest in the W.A.R. series of

PM photos: Howard Levy





It looks like a Quickie, but isn't. The all-new, futuristic Dragonfly features a tandem-wing design, two-place, side-by-side seating, dual side-stick controls.



A little single-seater in classic biplane style, Der Cricket is aimed at economical flying. Taking VW engines from 45 to 60 hp, it cruises at 95 to 110 mph.



**It looks like...yes... the BD-5 flies again!**

Notice anything familiar about the two planes below? Though radically different from each other, both trace their bloodlines to the late BD-5, the promising little kit-built beauty doomed by financial woes. The two are clever modifications designed around the many partial BD-5 kits that were shipped to builders but never completed. The idea: Anyone with a half-finished BD-5 in his garage can convert it

to one of these updated models using new plans and parts being made available now. Both versions make use of the basic BD-5 single-seat fuselage. The Acapella (left) retains the original pusher prop, but with a shortened fuselage and more compact drive. Twin tail booms add a rakish look suggestive of a WWII P-38 fighter. Top speed approaches a brisk 300 mph with a 200-hp Lycoming. Other features: folding wings and retractable tri-gear. Conversion kits are to come soon. Meanwhile, an

With the slim looks of a fighter, new RV-4 at left is similar to earlier RV-3, but now offers two-place, tandem seating, dual controls and aerobatic performance. Powered by a 150-hp Lycoming, it tops 200 mph.

Needle-nosed EOS (below) is one of sleekest new single-place designs, has no compound curves to form despite streamlined shape. It gets 180-mph cruise from a small 55-hp VW engine.



Twin tail booms give BD-5 fuselage a dashing new look in this 300-mph Acapella. It has folding wings, retractable tri-gear.



Reincarnation of the BD-5: In Scorchy, it gets a new name and a nose-mounted engine in place of original pusher-prop drive.

into pack is \$15 from Option Air Reno, Box 20085, Reno, Nev. 89515.

The Scorchy (right) departs from BD-5 practice and puts the engine and prop in the nose, which is said to eliminate problems of a long driveshaft to the tail. Gone, too, are the fuel-filled "wet" wings in favor of a single fuselage tank to simplify internal plumbing. The tricycle gear has given way to a classic taildragger stance, but the main wheels are still retractable. A 75-hp Revmaster VW conversion gives speeds up to 175 mph. Plans are \$55 from Harvey Mace, 30674 Pudding Creek Rd., Fort Bragg, Calif. 95437.



historic warbird reproductions. The other two, reported on earlier in PM, are the German Focke-Wulf FW-190 (page 54, Jan. '78) and the U.S. Navy F4U Corsair (page 76, Jan. '80).

Another reminder of the romance of yesteryear is Der Cricket, a little single-seat, open-cockpit biplane in the classic tradition of the '20s and '30s. Designed for low power and easy building, it takes VW engines of 45 to 60 hp, cruises at up to 110 mph and uses simple aluminum-skin construction. The tail is "all-flying"—the entire vertical and horizontal surfaces move on pivots, instead of having a separate rudder and elevator. The wings span 16 feet and are removable for road-

towing. Length is 15 feet. Cost to build: about \$2500. Plans are \$55 from Flight Level Six-Zero, Box 9980, Colorado Springs, Colo. 80932. Info pack is \$5.

For those who like companionship in their flying, there are half a dozen sleek, new two-seater styles to choose from.

One of the most exotic is the Dragonfly, a gleaming-white, futuristic canard design. At first glance it looks a lot like a wide-bodied version of Burt Rutan's famous tandem-wing Quickie, but it's not. Although wearing the familiar Rutan trademark on its nose—the forward wing that resembles a misplaced tail—it's actually an all-new concept offering two-place, side-by-side seating, along with the smooth-handling, stall-resistant characteristics of a canard configuration (for more on the canard principle and its effect, see ultralight report at right).

Made of composite foam-fiberglass-epoxy construction, the Dragonfly weighs only 590 pounds empty and gets a

*(Please turn to page 147)*

Rolling into a steep bank, the hot, new aerobatic Acro-Z shows its fiery colors. Designed to take engines from 155 to 180 hp, the single-seater hits 170 mph, withstands up to plus or minus 12 Gs, is aimed at competition-class aerobatics.



Racy looks, roomy comfort and agile handling are combined in this two-place, side-by-side Glasair. Built for engines up to 150 hp, it can do 230 mph, is stressed for sport aerobatics.



New low-wing Soneral 2L, a roomier, more docile version of the mid-wing Soneral racer, is a tandem two-seater with top speed of 200 mph. It takes 1700-cc or larger VW mills, is aerobatic.



From out of the past comes this homebuilt replica of the nostalgic 1924 Dormoy Bath tub. A 40-hp VW engine gives the tiny, 302-pound craft a "sizzling" top speed of 65 mph.



## New ultralights: Airplanes you can launch with your feet (but nobody ever does)

As everyone knew they would, ultralights have been quick to soar from the simple to the super-sophisticated. Those shown here, among the latest, offer design features little dreamed of in the motorless, hang-gliding days just a few years back.

Two unusual new shapes, the Eagle and Ibis, employ a tail-first "canard," a horizontal stabilizer stuck out ahead of the wing. Its principle is intriguing. The canard, set at a sharper angle than the wing, stalls out first at low speed. But instead of the entire craft stalling, the nose just dips slightly, automatically restoring speed and lift to the wing. The result is a gentle, controlled "mush," rather than a violent stall or spin.

The Eagle, powered by two 9-hp engines driving a single prop, cruises at 35 mph. A steering wheel is linked to wingtip rudders for turning. Pitch is controlled by weight shift—considered antiquated by some—but a complete three-axis system is coming. The craft, ready to fly, is \$3895 from American Aerolights, 700 Comanche Rd. N.E., Albuquerque, N.M. 87107.

The Ibis is a low-wing canard with upturned "winglets" and wingtip rudders resembling a Vari-Eze. It's powered by a 12-hp McCulloch, does 50 mph and has full three-axis control. Kits are about \$3000 from



Two canard-wing ultralights—Eagle (top) and Ibis (above)—put horizontal stabilizer ahead of main wing for added lift and control. Canard helps prevent stalls.

Composite Aircraft Technology, 4909 Looman Ave., Wichita, Kan. 67220. To no one's surprise, the Eagle and Ibis both have wheeled landing gear, but manage to maintain a foot-launchable status, thus exempting them from FAA regulation.

For those who want still more airplane in their ultralight, there's the Gypsy, a spinoff from the popular Weedhopper. Unlike many ultralights, it has a front engine with tractor prop, true aircraft controls and a real—if small—fuselage with wheels. It's powered by a 22-hp Chotia-460 engine with dual ignition, and cruises at 40 mph. A "bomb bay" opening in the cockpit floor permits foot launching—at least nominally—to keep the FAA happy.

A kit for the Gypsy is \$2995 from Weedhopper of Utah, Box 2253, Ogden, Utah 84404. An info pack is \$5. Also new are refinements in the conventional Weedhopper. These include add-on ailerons for improved roll control, extra-long soaring wings (34 feet instead of 28), and a rigid-wing model said to have slicker looks, better response and increased speed.

The familiar biwing Easy Riser—originally a simple, unpowered hang glider—now comes with a sleek, fiberglass cockpit pod that combines seat, engine and wheels all in one. Called the Easy Riser Aero, it has a 12-hp McCulloch and wingtip rudders with optional elevators. Foot-launchable, it

needs no license. Kits are \$1500 from Ultralight Flying Machines, 2960 Corvin Dr., Santa Clara, Calif. 95051.

One of the most ambitious new designs is the Puffin, a tiny, tailless flying wing with a fully enclosed, egg-shaped cockpit pod that makes it look like a bird trying to fly before it has hatched. Twin engines drive contrarotating props on concentric shafts. This cancels out prop torque, eliminating yaw problems, and enables the craft to fly on either engine alone if one quits. Since there's no tail, "elevons" in the wings function as both ailerons and elevators. For safety, the engines won't start unless the removable wings are securely attached. Kits are about \$3595 from Stewart Aircraft Corp., 11420 State Rte. 165, Salem, Ohio 44460. Like the Gypsy, the Puffin is foot-launchable through a bay in the pod. And for cold-weather flying, engine heat can be ducted into the canopied cockpit to keep you warm and cozy. How's that for sophistication in an ultralight!

If you wonder why so-called "foot-launch-



Easy Riser Aero has cockpit, engine and wheels all in one bolt-on fiberglass pod.

able" ultralights always manage to have wheels, it's not as nonsensical as it may seem. No one is fooling the FAA. It is well aware that such craft are rarely flown with leather-soled landing gear. The reasoning is simply that anything capable of being urged aloft on human underpinnings isn't likely to tangle with a wide-bodied 747.

So long as ultralights are handled safely, the FAA is content to let them alone. At the last EAA Oshkosh Fly-in, one allegedly foolhardy operator was asked to take his toy and go home. To its credit, the still-fledgling and often flamboyant ultralight movement is making a valiant—and largely successful—effort to police itself. Which, after all, is what the FAA—and everyone else—really want.—S.G.



Rigid-wing Weedhopper has shaped airfoil, instead of fabric, for better handling.



Reminiscent of early "flying bathtubs," Gypsy sports stubby fuselage, full aircraft-type controls, is foot-launchable.



Puffin, shown at far left without wings, looks like an egg on wheels, but it provides a fully enclosed cockpit with a canopy. Drawing above shows how it will look with wings. Note twin props, lack of tail.



# New back-country adventure by snowmobile

White drifts are unlocking wilderness that can be reached no other time of year.

by Bill McKeown OUTDOORS EDITOR

**A**t first they seemed to be noisy intruders, roaring through snowy back yards and racing over the drifts of open fields. They were unloved — except by those who had experienced the fun of driving them. Indoor types hoped they'd go away. Instead, snowmobiles have opened up a new sport in the northlands and, more recently, offered a chance to appreciate the real wilderness. In just a few years they've proved they're here to stay, have filled a need, and offer new challenges for winter outdoorsmen looking for action.

This year's dependable machines can now reach back country too steep for a helicopter to land on, too remote for an average summer hiker or winter cross-country skier to penetrate. Game and wildlife officers have found the careful driver will not frighten or harass wild animals, frequently may break out useful trails for them, and often can approach closer, for a look and a photograph, than would ever be possible during warmer weather. And then there are the woodland paths to follow, mountain peaks that can be reached, cold-weather camping safaris that make possible a safe, swift run back into remote valleys and canyons that may never have been seen before in winter.

Modern transportation can extend the sport into an almost year-round activity. North America's snow comes earlier in Canada and leaves later. Finland's cities and resorts above the Arctic Circle stretch some of the best snowmobiling into May. The frequent flights to portions of South America's almost unexplored Andes reveal scenery that rivals the Alps, and can offer fall and

West—in the  
Colorado Rockies



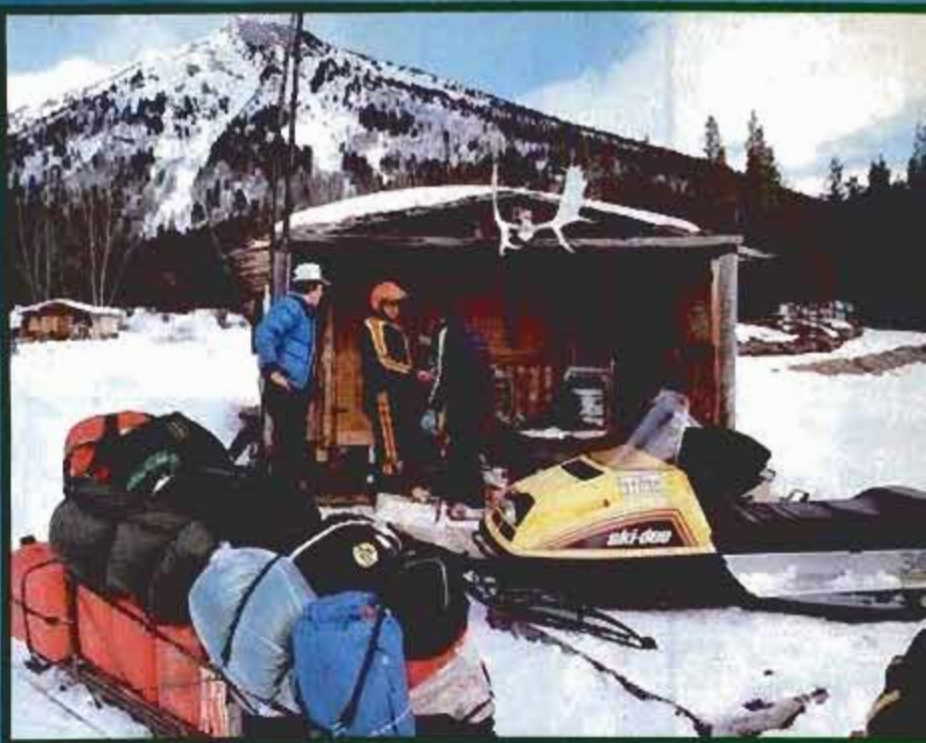
High above Crested Butte, the peaks around Irwin Lodge test the rider who wants to try a launch off a snow cornice (at top) or up and downhill open-field runs. The lodge is reached only by snowmobile in winter and has cross-country skis, snowshoes and 30 Ski-Doos.





## North—to British Columbia's mountain camps

Up where snowmobs are the winter mounts of the Royal Canadian Mounties and wildlife officers, the machines are unlocking wilderness that can be reached no other time of year. Hunters' cabins of spring and fall are now becoming base camps for snowmobile safaris from Fort St. John.



## South America—up in Chile's Andes

Sheer slopes dwarf a snowmobile out to test runs where a world downhill ski speed record was set at 124 mph above Portillo. South America's mid-year winter lets northern enthusiasts fly down to fill out almost 12 months of snowmo action. Chilean mountain troops also train on the machines.



While a Laplander admires a new Kawasaki, his reindeer apprehensively eyes a machine that might be his replacement. Snowmobile riders, cross-country skiers and bundled winter sightseers aboard reindeer-towed sledges share the trails of Finland's wooded hills north of Helsinki. Through forests far beyond the roads, a modern snowmobile driver can explore areas of northern Scandinavia that are almost unchanged since the Ice Ages.

## East—above the Arctic Circle of Finland's Lapland







Wilderness in northern British Columbia that once was unseen in winter now has been opened by snowmobiles. Supplies are stored by removable ladder high above visiting bears (upper left) and are packed aboard machines outside the log-cabin bunkhouse (above) for a safari of photographer-animal watchers and a cookout in the snow.

winter snow-machine adventure just when spring and summer are warming up the North.

For that something extra, as seen from the driver's seat of a snowmobile, here are four destinations.

#### North

Head up the Alaska Highway with your snowmo in tow, or fly into Fort St. John on the Peace River in northern British Columbia (you can rent a machine from Jack Philpot at Powercraft Sales if you don't bring your own). Or contact big-game guide Darwin Watson. After a long 4wd ride or a short flight into his base camp, you'll find machines lined up for the 14-mile run across frozen streams, along ridges and down snowy valleys deep in the mountains.

Here, where the drifts last late into spring, log cabins and bunkhouses are rustic headquarters for exploring.

You'll want cold-weather snowmobile clothes, boots, helmet, goggles and dark glasses, sleeping bag and toilet articles. Worthwhile are a flashlight, first-aid kit, nylon line, knife and a camera with film that can fit in a belt pack.

Less than half an hour from camp, a young moose may be browsing just off the trail.

Stop for pictures and the moose may eye your machine and pose briefly for pictures. Deer, bear, elk, caribou, wolves, and recently reintroduced bison (American buffalo) are among the wildlife the snowmobiler may see. To discourage roaming bears, heavy barbed wire covers the windows of the ranch dining kitchen, and food stores are stashed in a high cabin mounted on lodge-pole legs with a removable ladder. Living in the wilds with wildlife is still possible in British Columbia.

#### South

Far higher than the Rockies or Alps, South America's Andes puncture the clouds with peaks that dazzle any snowmo rider from the North. Daily Braniff flights leave the States for Santiago, Chile, and from there car or bus transportation heads inland to the steep slopes around the ski resort of Portillo. Here are the precipitous snow fields, where downhill ski-run records of up to 124 mph have been set.

Snowmobiles here get carburetor needle-valve adjustment to compensate for the high altitudes. Deep powder snow offers both challenge and exhilaration in long runs across the frozen lake beyond the ski resort and up a glacier face. By machine, a group can explore up toward the untouched summits of surrounding peaks and enjoy them during off-season months that are midsummer back up north of the equator.

#### East

Even the reindeer seem to understand the Finns' difficult language, but for visiting snowmobilers there is added excitement cruising over Lapland's rolling snowfields under late-evening sun above the Arctic Circle, and then retiring to saunas and sleep during the short hours when the sun goes down. Snow lasts into May in Scandinavia's far north, and the countryside is criss-crossed with the tracks of cross-country skiers who chose late spring for their late-season vacations.

The American snowmobile has found a home away from home in northern Europe, although it has been used more as a workhorse or work-reindeer than a sport vehicle so far.

Remote ski huts and cabins are kept supplied with snowmos imported from the

United States and Canada or locally built in Sweden. Rumors are that in the past the machines were used along the Finnish-Russian border when there had been a certain amount of rustling of reindeer herds.

For the Laplander, the domesticated reindeer pulls his sledge and provides him with steak, soup, cheese and a variety of other foods, as well as leather—benefits the snow machine is not likely to match.

Finland's winter resorts are only an overnight flight by Finnair from New York to Helsinki, with connecting flights to Rovaniemi exactly on the Arctic Circle. North into the Lapland region, the terrain does not pose the challenge of steep mountains or the problems of engine tuning for altitude, but offers high, rolling hills where the whiteout of a snowstorm or a cookout in a drift can add a fascinating foreign flavor to an American sport.

#### West

Challenges abound in the cold woodlands and high mountains of North America's snowbelt, but a special choice would have to be Irwin Lodge, located high above Crested Butte ski resort in Colorado's Rockies.

To the west and away from the ski tows and downhill schussers, Dan Thurman has built a ranch that can only be reached by snowmobile, where 30 machines wait for select visitors. Nearby mountain peaks are a short run from the 10,000-foot lodge, and cross-country skis and snowshoes can be strapped to machines for summit explorers who want to stretch their range.

By taking just a short flight from Denver, snowmo drivers have their own retreat for their own special adventure in the snow.



# NEW NOW



# OUTDOORS

## A mix 'n match pack



## Knife for life

Guaranteed against loss for one year and made to last most of a lifetime, the new Uncle Henry Bear Paw Lockback from Schrade Cutlery, Ellenville, N.Y. 12428, is \$34.95. Schrade also prints an Old Timer Knife Almanac that you can get free.



Zipped together, it's big enough for long-range hiking. Take Lowe's Liberty Pack apart, however, and the front pocket becomes a separate day pack, and the top turns into a hip pack that can be used alone or strapped to the day pack. The \$225 combination pack is made by Lowe Alpine Systems, Box 189, Lafayette, Colo. 80026.

## Clean fish overboard

To fillet fish without fouling up the cockpit of your boat, Tempress, 701 South Orchard, Seattle, Wash. 98108, has a \$195 Prime Cut Cleaning Station that allows you to do the messy work over the side. Made of light structural plastic, the unit has a deep-V cleaning tray, a fillet board and a bag to retain scraps. Mounted completely outboard of the craft, it folds down when not in use and can be removed, as well. A tail clamp holds fish in place for easy cleaning.

## On target without firing a shot

At a tournament match, up on a mountaintop or off on a safari far from home, a collimator can tell you if a gun's telescopic sight has been bumped out of alignment. Redfield's \$75 model has a choice of barrel spuds in 14 calibers at \$11 each. Fit the appropriate spud into the bore of the rifle or handgun, view through its telescopic sight, and any shift in aiming point can be corrected right on the spot.



## No-slips for ice and water

Creepers suitable for winter hiking and summer wader-fishing, the full-foot Ice & Stream Walkers from Covell Enterprises, Box 472, Greenwood Lake, N.Y. 10925 are \$20. They hook easily on all boots.

## Gauge for trigger pull

This force gauge can measure firearm trigger resistance with great accuracy for use by a gun club or gunsmith. The Hunter Spring Series L meter from Ametek, Hatfield, Pa. 19440 at \$250, can read in pounds, kilograms or newton units.



## Compact, portable heat

For a 20x20-foot cabin, an ice-fishing shack, a camp trailer or even a cold room at home, Aladdin's new Lassie Radiant Heater with automatic lighting and tip safety can provide warmth from 1½ gallons of kerosene for up to 20 hours. The Lassie is \$240; smaller Aladdin heaters range down to about \$150, with savings in operating costs estimated at up to 50 percent over comparable electric oil and gas heaters. No installation is necessary. Weights are from 10 pounds up to the 25-pound, 12,000-B.T.U. model shown at left.





REALISTIC STA-2200

# What's behind the new digital dials

There's more than one way to design a digital dial. We examine five popular receivers that use different ways to achieve the brightly lighted displays that tell you station frequency.

by Hans Fantel

**T**he technology of digital tuners and receivers is still so new that many audio fans have only a hazy notion of its whys and wherefores. At present, there are three different types of receivers with digital frequency displays: (1) Receivers with digital readout combined with conventional tuning circuits; (2) receivers with digital readout and servo-lock tuning; (3) true digital receivers with frequency-synthesized tuning circuits.

PM picked recent models of each type and put them through their paces to check out their characteristics. We found little difference in individual performance—but an

enormous difference in operating convenience. But before getting into details, let's clarify the basic function of all of these circuits.

The job of the tuning section in any receiver is to make a radio's circuit resonate at exactly the frequency transmitted by the radio station you want to receive. This resonance acts like an open door to radio waves arriving from the tuned-in station, allowing them to enter the receiver, while at the same time barring all other radio signals galloping through the sky. But that door of admission is extremely narrow (in order to make the receiver selective). Only if the station is tuned in

accurately, does the signal get inside the door without—so to speak—bumping into the electronic door posts.

Conventional tuners use a variable tuning capacitor to cover the whole frequency range and employ various kinds of tuning aids to help listeners attain tuning precision. In addition to meters, most receivers have some kind of automatic frequency control (AFC) or—in its more recent and more sophisticated form—"servo-lock" tuning.

The servo-lock—sometimes combined with digital frequency readout—works like this: You twirl the tuning knob—thereby rotating a





Receiver at left, the Realistic STA-2200 (Radio Shack), lets you store up to six stations in memory—or you can automatically scan the band to find stations.



HARMON/KARDON H/K 680



SONY V-45

A functional look characterizes this new H/K 680 receiver from Harmon/Kardon. It's least bulky of tested units and features such items as six channel presets.

A nonerasable memory is featured in this V-45 receiver from Sony. Even if the cord falls out of the wall outlet, you will not have to reprogram your favorite music.



KENWOOD KR-720

Servo-lock tuning in this KR-720 from Kenwood is accomplished with three meters: an LED signal-strength indicator, digital readout and a standard dial pointer.

New from Heathkit, the AR-1650 is easy to assemble and is fine example of audio engineering. It has bass, mid and treble controls for close to built-in equalization.



HEATHKIT AR-1650

variable capacitor—until you arrive in the vicinity of the station you want to hear. At that point, the servo takes over, completes the tuning process and locks the receiver in step with the transmitted radio signal.

True digital tuning goes a step farther. It takes the matter of tuning accuracy entirely out of the listener's hand. By using a frequency-synthesizer circuit, it makes sloppy tuning virtually impossible. Either the station is "right on the nose" or it won't come in at all. There's no in between.

The hardware, in this case, is as  
(Please turn to page 165)

PM photos: Steve Fay



# Driving the 1981 Toyotas...

## FIRSTHAND REPORT

by Gary Witzenburg  
DETROIT AUTO EDITOR



The Japanese carmakers have been doing a terrific job lately of anticipating their American customers' needs and desires, and of delivering the goods to satisfy them. And Toyota, the General Motors of Japan, continues to earn its long-held leadership role. It was Toyota that first popularized the five-speed manual transmission in low-priced cars to extract the most pep, economy and driving fun out of small-displacement engines.

It was Toyota that first hired a



group of American stylists to help put to rest the tradition of funny-looking Japanese cars. And it is Toyota that just took over fuel-economy leadership for gas-powered cars in this country with its truly amazing little Starlet. It boasts EPA ratings of 39 mpg city and 54 mpg highway.

The no-frills Starlet is available in only one model: a three-door liftback coupe. It's powered by a 1.3-liter version of the same long-tested four-cylinder engine that has powered Toyota's smallest cars for more than 15 years, coupled to a five-speed transmission. No frills or filigree, no Luxury Edition, no automatic transmission, few options and, as a result, no excess of what Ford used to call "road-hugging weight." With an overall length of 152.2 inches on a

*(Please turn to page 86)*



Toyota's brand-new Starlet (above) provides amazingly zippy performance and EPA fuel economy of 54 mpg highway.



Only available body style for the Starlet (above left) is three-door liftback. Its 1.3-liter, four-cylinder powerplant (above) produces 58 hp at 5200 rpm. Thanks to 1730-lb. curb weight and five-speed gearbox, it's fast and efficient.



Supra (above), Toyota's sportiest model, is available with a GT package which includes spoilers and very firm suspension. Cressida (below) has many styling changes, plus addition of a new, 2.8-liter, fuel-injected six-cylinder engine.



PM photos: David Gooley



# and the new Datsun 810

## FIRSTHAND REPORT

by Michael Lamm  
WEST COAST EDITOR



**Y**ou'd be hard pressed to find a nicer luxury sport sedan at any price. But it's the sticker that's the kicker. Price makes the Datsun 810 one of the very few automotive bargains left in this country.

In terms of engineering, workmanship, handling, standard equipment, and now styling, the 1981 Datsun 810 goes an easy 15 rounds with—and in some ways KOs—the BMW 320i, Audi 5000, Volvo GLE, Alfa Sport Sedan, Rover 3500 and Cadillac Seville. Yet the American public has never understood the Datsun 810, and I'm not sure Nissan understands it, either.

Back in February 1977, when the first 810 hit these shores, Nissan assured the assembled automotive press that here was a car to rival (in their words) the Volare, Granada and VW Dasher. I remember that statement because it sounded so ludicrous.

The 1977 Datsun 810 (which, by the way, cost \$5099 back then) behaved, felt and handled more like a junior Mercedes than a Granada. I wasn't alone in my opinion that Nissan had underrated the 810.

Datsun's efforts to advertise and promote the 810 haven't been spectacular, either. Thus, there were fewer 810s sold here in 3½ years (67,071) than there were Chevrolets in an average 10-day period in 1979.

As the dollar's value declined against the yen, prices for the 810 rose through the years. But so did those of all other cars; so, relatively speaking, the 1981 Datsun 810 still represents quite a bargain in terms of what you get.

Before I list the 810's many features, I should point out that it comes in two trim levels and two

*(Please turn to page 87)*



The Datsun 810 sedan uses a modified version of the 280ZX sports car's suspension which furnishes good handling.



Interior of the top-of-the-line Maxima version offers a host of standard features like power windows, power locks, six-way seats with lumbar adjustment, tilt wheel, full instrumentation, quartz clock and even a synthesized voice which reminds you to turn off your headlights. The 810's powerplant (left) is a 2.4-liter, fuel-injected Six that is derived from the 280ZX's 2.8-liter engine. It's rated at 120 hp at 5200 rpm.

PM photos: Mike Lamm and Chan Bush



# the '81 Toyotas

90.6-inch wheelbase, it weighs in at a scant 1730 pounds.

Startlingly, with everyone going to front-wheel drive to save interior space, Toyota has gone against this trend by sticking to conventional rear drive for the Starlet. It's not the roomiest little car around, but there is a surprising amount of front-seat stretch room for long-legged occupants. As you might expect, the interior is also on the stark side and has a definite utilitarian look that most of the Japanese carmakers have managed to get away from lately. But it does have standard high-back reclining front buckets, full carpeting, a tachometer, a water-temperature gauge and a trip odometer which may be easily reset.

Its aerodynamic body is best described as "efficient" in the VW Rabbit tradition—neither ugly nor pretty, but definitely faceless in the sea of look-alike little cars on the road today.

Most surprising (in view of the outstanding economy it delivers) is that the Starlet is genuinely *fun* to drive. The little engine is amazingly peppy going through the gears and will do 0 to 60 in a respectable 14 seconds. Those who enjoy driving and shifting gears for the sport of it will appreciate the smooth, sure, short-throw five-speed linkage, and frustrated Mario Andretti will love the Starlet's road-gripping handling in the twists and turns. Toyota has never been known for designing agile cornering into its cars, but the chassis engineers have done their job right on this one.

Front suspension is the usual MacPherson struts with precise rack-and-pinion steering, while a "four-link" live axle with coil springs holds up the rear.

## Luxurious Cressida

On the opposite end of the size and price scale is the new mid-size Toyota Cressida, available in luxury four-door sedan and wagon versions. In addition to a much-needed restyling, Toyota has massaged its largest U.S. cars to achieve higher levels of both luxury and fuel economy simultaneously.

A new 2.8-liter, fuel-injected six-cylinder engine has more torque and



The Cressida (above) is Toyota's most luxurious car. It comes in four-door and wagon bodies and is powered by a 2.8-liter, fuel-injected, six-cylinder engine. The Starlet's interior (right) is spartan, but livable. The Tercel (below) has new front-end styling and more rear leg-room. A four-door model has also been added to Toyota's 1981 line.



power to allow a lower numerical final-drive ratio for increased performance and efficiency. As before, a four-speed automatic with an overdrive top gear is the only transmission choice. EPA fuel-economy ratings are a very respectable 25 mpg city and 29 mpg highway.

Nearly anything would be an improvement in appearance over the old Cressida, but the new version is a *substantial* improvement with its clean, European-looking lines. Our only styling objection, in fact, is the grille design, which looks like the pattern on a herringbone suit.

Handling is also improved through suspension refinements. It's less soft and wallowy in the turns, and more nimble and responsive in the European-car tradition.

Standard equipment includes cruise control, power antenna, automatic air conditioner, fore/aft adjustable headrests, power windows and door locks and a quartz digital clock. Also standard is the industry's first electrically operated, automatic shoulder harness—controversial indeed, but an indication of what's to come under the passive restraint law that requires "passive" restraint systems in all cars by 1984.

## An upgraded line

Other Toyota models, the conventional Corolla series, the Corolla fwd Tercel, the mid-range Corona, and the Celica and Celica Supra sport models are all carried over for '81

(Please turn to page 118)



# the Datsun 810

body styles. The coupe, introduced in January 1979, has been discontinued, but the four-door sedan and wagon remain. Incidentally, the revamped 810 is the only new car Datsun has introduced this year.

In its basic form, the so-called Deluxe 810 carries a \$7600 price tag (\$7900 for the wagon). Then the super-accessorized luxury version, called the Maxima, retails right around \$10,000. (Final prices weren't set at press time.)

## Sporty sedan

All 810s share Datsun's reliable single overhead camshaft, fuel-injected, in-line Six. This is a 2.4-liter version of the 280ZX's 2.8 powerplant, an engine that's been going strong since November 1969. Deluxe 810s also borrow the 280ZX's manual five-speed overdrive transmission, although with different ratios.

From engineering and handling standpoints, Datsun 810 sedans and wagons have enough differences to merit separate discussions. The wagon uses a live rear axle, leaf-spring rear suspension and drum rear brakes—all very orthodox and all quite different from the 810 sedan.

The 810 sedan shares the Datsun 280ZX's four-wheel disc brakes and independent rear suspension, the latter being identical except for spring rates. With so much 280ZX in its system,

it's small wonder that the 810 sedan shows a much more sporting nature than the wagon.

The wagon's ride tends toward the soft side, the sedan's toward the firmer. Both tendencies are a function of shock and MacPherson-strut valving. I noted no harshness in the sedan, however, and both vehicles take graveled byways in stride, with minimal fuss and very little suspension noise.

Two days of tooling through the foothills and back roads of California's Gold Rush country provided an ideal test track to rigorously test the half-dozen differently equipped 810s provided by Datsun.

The sedan's cornering power, as in 1977, impressed me as comparable to the best sport tourers at any price.



The Datsun 810 wagon and sedan share the same 103.4-inch wheelbase, but have different suspensions. The sedan (below) uses an independent rear suspension which it shares with the Datsun 280ZX. The wagon uses a live rear axle. The sedan also has four-wheel disc brakes, while the wagon uses discs in front and drums in the rear. The cargo capacity for the 810 wagon with the rear seats down is 63.6 cu. ft. The sedan's capacity is 10.8 cu. ft.



The 810 sedan shows very little body roll in high-speed cornering on dry pavement. The standard steel-belted P195/70SR-14 tires adhere to the road very well. And as the car starts to drift—as it will if pushed hard—there's enough engine power to control the drift, and to counter the car's tendency to understeer. I noted no tuck-under of the rear wheels; the 810 sedan feels extremely stable through all types of turns and on various types of road surfaces (although I can't vouch for its handling in wet conditions).

Two of the Deluxe 810s I drove had nonassisted steering. The rack-and-pinion is very positive, but a little slow and heavy. Datsun's power steering, standard in all 810 Maximas and optional otherwise, is the

recirculating-ball type. It's quick, and its valving feels European—stiffer than we're used to in the States. This gives much better road feel.

## Slow off the line

Unfortunately, the 810 engine, with 120 hp, lacks that extra aggressiveness that a truly great sport sedan really needs. In the five-speed version, there's adequate acceleration.

But teamed with the three-speed automatic—and that's the only combination you get in the Maxima—performance does leave something to be desired. Twenty-five more ponies, as you'd get with the 2.8-liter ZX powerplant, would

(Please turn to page 118)



# Ski tech takes off

Goggles with powered fan

Plastic face mask

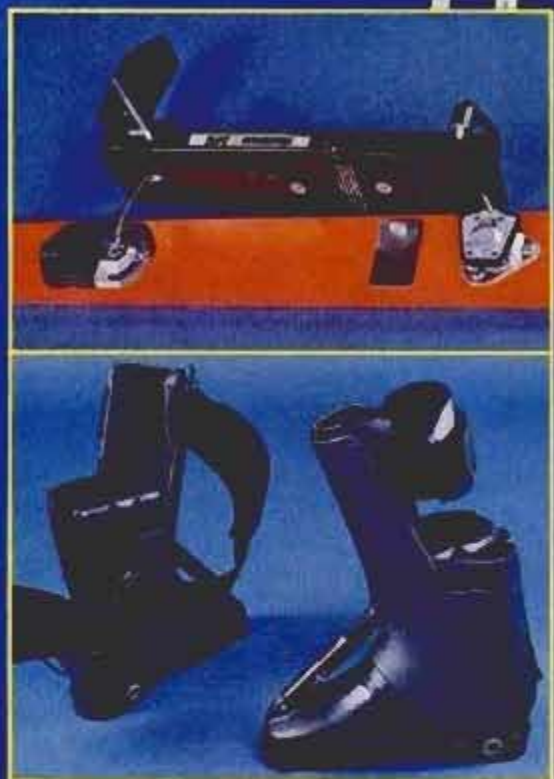
Neoprene ski suit

Aluminum poles with built-in shock absorber

Automatically retractable bindings

Aluminum honeycomb skis with split tail

Lever-action boots



Retractable binding (top—"locked" off ski for photo) uses sophisticated cable linkage to break away and snap back. Boot with "shock absorber" (see text) was designed by Porsche engineers.

PM photos: Steve Fay



The take-me-to-your-leader look reflects the state of the art in safer downhill gear, while the new trend toward all-terrain skiing moves in on the cross-country sport.

by John Ross

One look at the current costumes and accouterments of skiing is enough to convince anybody that Darth Vader has just stepped down from the silver screen for a chase scene on skis. But closer examination of what looks like a science-fiction snow job will show that skiing definitely has come to a turn in the trail. Snow technology has taken off.

Even the people whose lifts whisk skiers up to the mountain-tops have some surprises in store when their patrons come back down. Trail patrols at several resorts, for example, carry handheld radar guns to catch speeding skiers on the slopes. And one forward-thinking ski resort—world-famous Jackson Hole in Wyoming—even goes as far as to slap tickets on offending skis standing outside the base lodge during lunch breaks.

The "ticket" in this case signifies that the skier's bindings appear to be deficient. This concern for safety reminds skiers that even though "cold" technology has nearly reached the point at which equipment and accessories are virtually automated, even the most advanced gear

*(Please turn to page 111)*

Integration of binding and boot may be the next step in ski-tech hardware. The system shown is an experimental unit that is not in production as yet.



Ski bottoms (below, left) incorporate no-wax surfaces; newest is the mica type (left), but fish-scale has found wide acceptance. Pole baskets have been radically altered—some into "rakes." New lightweight, narrow bindings give full flex, while heel plate locks into boot for downhill steering control.





# The 'mystery plane' that almost

The XF-11 showed that a test pilot needs more than guts. And the temperament of the man who first flew it was definitely the wrong stuff.

by Charles Barton

Sunday, July 7, 1946, dawned clear over Los Angeles. This was the day when, despite objections among the military and some of his business associates, Howard Hughes would test-fly his controversial XF-11 photo-reconnaissance plane. His dream of being a major designer and builder of military airplanes had come to be centered on this airplane.

Just before World War II, Hughes had submitted a design for a radical twin-engine, twin-boom interceptor that lost out in a design competition with what became Lockheed's very

successful P-38. The decision angered Hughes. In his view, the Army Air Corps representatives at Wright Field had sat on his design long enough for Lockheed to incorporate some of his ideas into their own.

"So I backed into my shell," Hughes later told a Senate investigating committee in 1947, "and decided to design and build from the ground up, with my own money, an entirely new airplane which would be so sensational in its performance that the Army would have to accept it." This became the Hughes D-2, which he built and successfully flight-tested before it was destroyed in a fire caused by a freak lightning strike at its California desert hangar. Hughes pressed again for a military contract.

He got a commitment in 1943 for the development of a D-2 successor, a reconnaissance aircraft to be known as the XF-11. However, his haggling to recoup his developmental costs for the D-2 delayed signing

of the contract until mid-1944. At that point, Hap Arnold, Commanding General of the Army Air Forces, had to give his personal assurance to the Under Secretary of War that a long-range, high-speed, high-altitude, land-based, photographic reconnaissance airplane, stressed for active evasive action, was an "urgent military necessity."

As Hughes sat with a few of his engineers at breakfast that Sunday two years later, hydraulics engineer Dave Grant noted that his boss seemed excited but in control. Hughes's breakfast menu was interesting: banana cream pie a la mode from the company cafeteria.

## A beautiful plane

Out on the flight line at the Culver City plant of Hughes Aircraft, the twin-tailed plane sat high on its



The confident Hughes (left) put his reputation on the line with the XF-11. Although he was a superior pilot, his inattention to detail led directly to a flaming crash in Beverly Hills on July 7, 1946.



# killed Howard Hughes

tricycle landing gear while the Hughes flight-service people readied it. Viewed head-on, the closely cowed radial engines looked bigger around than the slim, needle-nosed, pod-like fuselage. As tapered extensions of the engine nacelles, the twin booms extended aft where twin fins and rudders bracketed a horizontal stabilizer and elevator assembly. Huge contrarotating double props on each engine were fitted with streamlined, bullet-shaped spinners that concealed the hub mechanisms.

It was a beautiful plane.

When Hughes arrived at the flight line, he first discussed the preliminary high-speed ground runs with Gene Blandford, his flight-test engineer. Hughes then spent the morning on taxi runs, including brief hops into the air. Satisfied, he taxied

in for final servicing before flight.

In typical fashion, Hughes told the crew to gas the plane to 1200 gallons without consulting Blandford. This was 600 gallons more than the engineer thought desirable, adding nearly 3600 pounds to the takeoff weight. However, Blandford believes that this extra weight represented no real danger. "The airplane had plenty of power. The extra gas just let him goof around longer than the 45 minutes called for by the day's test plan."

At about noon, Jean Peters, a budding Hollywood starlet Hughes had met just two days before and had invited to witness the test, arrived at the Culver City airstrip with war-hero-turned-actor, Audie Murphy, and Bill Cagney, brother of actor Jimmy Cagney. Hughes spoke with

them briefly before finally rejoining Blandford, who carefully

reviewed the test plan item by item.

The initial test plan didn't include landing-gear retraction. That was scheduled for the second flight. Nonetheless, Hughes intended to operate the landing gear immediately after takeoff so that he would be aware of its status from the beginning—another instance of his doing things his own way.

## A cage of lions

Flying, especially test flying, is like managing a cage full of lions. If you let one of them get out of control, others act up and problems multiply. That is why flight-test programs always avoid simultaneous or unnecessary operations. Each system, each item that could possibly cause trouble, is checked step by step.

It is not until those particular "lions" are under control that you bring another one into the cage.

Finally, the technicians and mechanics finished. Hughes had a last



Adapted from *Howard Hughes and His Spruce Goose* by Charles Barton; forthcoming from Aero Publishers.

## Los Angeles Examiner

### HOWARD HUGHES CRITICALLY HURT IN FIERY CRASH OF TEST PLANE

NEWS SEEKING Page 1  
MONDAY, JULY 19, 1948  
PAGE SEEN



#### Accident Occurs in Beverly Hills

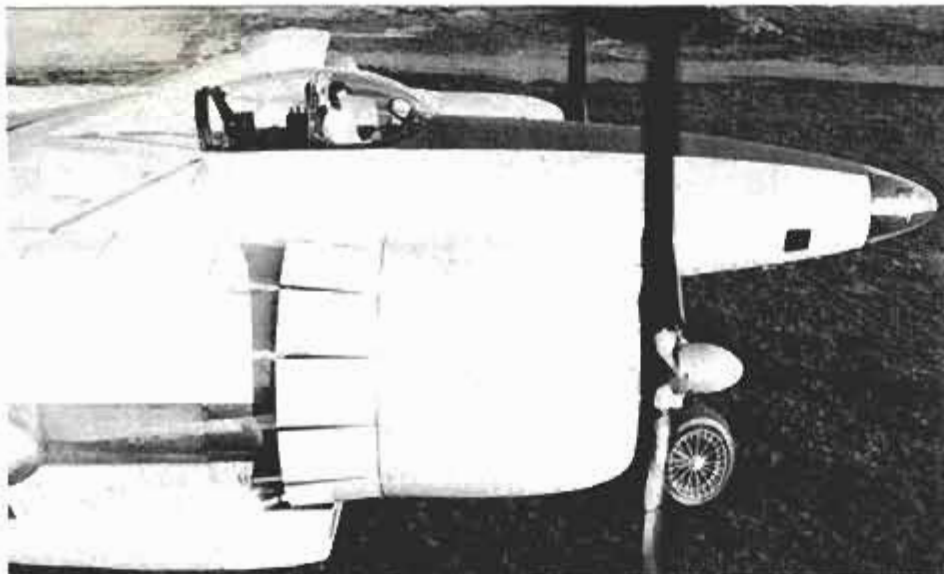
Plane From 1st Number in  
After 10 Minutes Flight

#### Arabs Accuse Truman of 'Irresponsible' Talk



Nine months after his brush with death, Hughes successfully flew a second XF-11 (above) with standard props. But the high-performance plane was already obsolete as the jet age thundered in.





In April 1947, Hughes took off in an XF-11 with conventional props for a successful flight.

word with his long-time associate and confidant, Glenn Odekirk, and walked under the plane to where a retractable ladder extended down about eight feet from the access hatch in the belly of the slender fuselage. So high did the plane sit on its landing gear (in order to provide ground clearance for the 17-foot-diameter props) that even the 6-foot, 3-inch Hughes did not have to stoop to walk under the fuselage.

Soon he was in the cockpit, with engines running, ready to taxi out. The small group of spectators on the ramp could see him clearly, his long-sleeved white shirt open at the neck, no tie, a wide-brimmed brown fedora pushed back from his forehead.

At the east end of the field, he turned into the wind, set the brakes and began a final checkout and warm-up. At one point, he throttled back to allow Gene Blandford to climb up and join him in the cockpit. Hughes was checking his instruments, controls and equipment and reviewing the emergency hydraulic procedures. As he did this, he asked Blandford a few questions, but they didn't do much talking.

Blandford climbed out. It was all Hughes's show now.

#### No radio check

Hughes lined up the plane on the runway and smoothly advanced the throttles to takeoff power. He released the brakes and the plane surged ahead. Observers on the ground clocked the time as 5:20 p.m. No one remembered him making a radio check.

As the takeoff roll started, Hughes checked the manifold pressure and adjusted the throttles with his left hand so that both engine instruments indicated the desired power setting. He was careful that

neither propeller exceeded the 2300-rpm maximum limit set for the first flight. Everything appeared normal.

Hughes felt the plane coming alive, ready for flight; still, he held it down. The nose wheel was still on the ground as he passed the speed at which he had hopped into the air on the taxi runs. This time he wanted plenty of margin above stall speed before he committed the plane to flight.

After approximately 30 seconds of ground roll, the airspeed read 150 mph. He eased back on the control wheel with the fingers of his right hand.

As the runway dropped away, Hughes moved the landing-gear control to UP and throttled back to climb power. The landing gear came free of the down locks and the red gear warning light came on as it was supposed to. Everything felt good.

As he climbed straight ahead, away from the field, the landing-gear warning light still gleamed red. "The gear should be retracted by now," he thought.

He continued his climb and started a wide left circle of the field. Sky conditions were clear in his vicinity, and within the limits of 10 miles' visibility in the usual Los Angeles haze, he could see no other aircraft. The plane handled well. All instrument readings were normal. It was just that damn red light.

At a comfortable altitude, he recycled the landing gear. The light stayed on. He put the gear down and then up again. Still the light indicated incomplete retraction.

#### The light goes out

On the next cycle, Hughes pushed sharply forward on the control wheel as the gear retracted. This

lifted him against the seat belt. The gear thunked into the up-locks. The light went out.

For about 40 minutes he continued circling his Culver City field at an altitude of about 5000 feet. The first 35 minutes of the flight were recorded by the flight-instrument photo recorders before they ran out of film. His maximum altitude was 5130 feet, and he appeared to have approached stalled flight on several occasions (as called for by the test plan).

After completing these tests, Hughes decided to fly low across the field, with gear extended so that the ground crew could visually check that all three of his landing gear did, in fact, appear fully extended. He descended in a left-hand pattern around Hughes Field. Reaching 2000 feet, he saw that his company-owned A-20 aircraft was also airborne.

Glenn Odekirk recalls that he watched Hughes take off, then followed him in the A-20, with Blandford, Murphy and Cagney riding in the converted bomber's six-seat passenger compartment.

Hughes wanted Odekirk to observe his landing gear and tried to fly close to him while climbing back to altitude. Unfortunately, Odekirk couldn't read Hughes's mind, and there was no radio contact between

### 'The airplane suddenly felt as if somebody had tied a barn door to the wing.'

the two planes. (The A-20 flight had been an afterthought and had not been coordinated with Hughes.) Odekirk stayed inside the left turn, above and to the rear. So it wasn't possible for him to see Hughes's landing gear at all.

Hughes, exasperated, picked up his mike and made a call on "B" channel to "any tower."

Dick M. Fischer, the controller on duty at Los Angeles Municipal Airport control tower, made quick reply: "Army 47155, this is Los Angeles Tower."

"Los Angeles Tower from 47155, how do you read me?"

"I read you R-5."

"47155 to Los Angeles Tower, this is a test ship out of Hughes Aircraft. Will you see if you can contact the A-20 that is on this flight with me and tell him I am having gear trouble? If you are unable to contact him, call Hughes Aircraft at Ashley

(Please turn to page 136)



## FIRSTHAND REPORT

by Gary Witzenburg  
DETROIT AUTO EDITOR



# Driving the 1981 Mercedes S-class



Handling and roadholding of 300SD are outstanding, especially for such a large car.

**A**uto editor Tony Assenza and I were on our way from Mercedes-Benz's North American headquarters in Montvale, N.J., to the famous Homestead resort in Hot Springs, Va., in a 1981 300SD. The technical briefing and introduction of Mercedes' new S-class sedans had been held the previous evening, but the usual reception and dinner were scheduled at the Homestead, some 450 miles away. This day-long trip was our ride-and-drive.

An unusual way to run a new-car preview for a group of motoring journalists? Yes, but the Mercedes folks had a point to make. While the new, big Mercedes fairly bristles with hundreds of changes and improvements, both major and minor,

the sum total of them all is better fuel economy and comfort over the long haul—and what better way to demonstrate those attributes?

To make things more interesting, they threw a competitive element into the trip. The winner would be the car that covered the distance in the least amount of time, but also with the *lowest fuel consumption*—and fuel economy would be double-weighted in the formula.

Being competitive sorts, we set out to win. We made no driver changes or stops of any kind. We

tried to keep constant throttle (not constant speed, which is what cruise control does) uphill and down, and cracked the windows a bit for extra ventilation, instead of running the airconditioning. We shifted to neutral and coasted downhill as much as possible.

It was a long, but not too uncomfortable trip. We averaged close to the national speed limit on three-quarters freeway and one-quarter curvy, hilly two-lane roads—at an astounding 31.39 mpg. The other turbodiesel 300SDs averaged from 53 to 62 mph and from 23.3 to 30.5 mpg, but on overall score we won handily.

More importantly, the point had been made: Even without the extreme techniques we employed, it is possible to make good time in a big Mercedes (at least in the '81 300SD) and still get impressive fuel economy. EPA ratings are not yet available, but Mercedes says the 300SD achieves 32.6 mpg and the gas V8 380SEL delivers a solid 23 mpg at a steady 56 mph, compared to 29.7 and 19.9 mpg for the corresponding 1980 models.

Before we describe how these significant gains were made, it's appropriate to delineate the somewhat confusing Mercedes-Benz lineup and number/letter names.

The smaller (mid-size) series consists of the lowest priced 240D sedan (powered by a 2.4-liter, four-cylinder diesel engine), the higher priced 280E sedan and 280CE coupe (2.8-liter, gas six-cylinder) and corresponding 300D and 300CD (3-liter, five-cylinder diesel) and, at the top, the 300TD station wagon (which for '81 gets the turbocharged five-cylinder diesel).

The convertible sports car and  
*(Please turn to page 128)*



PM photos: Rich Taylor

The rounded front end, chin spoiler and smaller overall dimensions of the 300SD and 380SEL serve to reduce aerodynamic drag, improve mileage and lessen wind roar.



Spacious cockpit is fully instrumented and also receives newly designed safety features for better occupant protection.



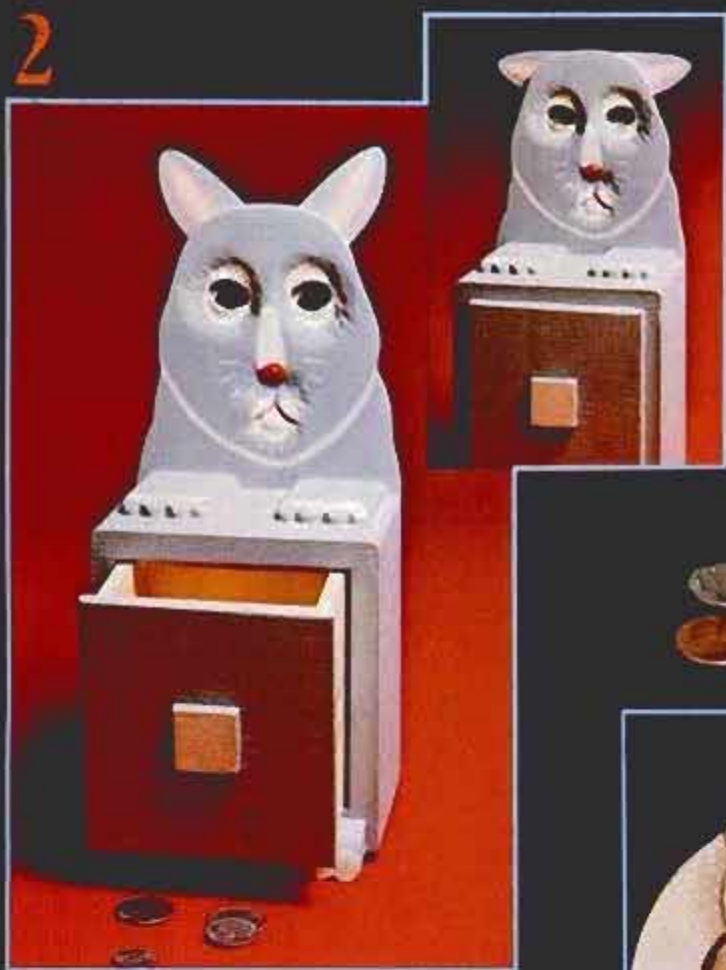
Turbocharged 3-liter, five-cylinder diesel engine combines 31 mpg with good acceleration for quick, safe passing.



# Old-fashioned banks you can make

Ears wiggle, eyes pop and tongues stick out. Designer David Kirk reveals tricks for building wooden versions of the old-time mechanical banks.

by Harry Wicks [http://www.woodgarden.com](#)



**1** A double-exposure photograph shows what happens when the handle is pulled. Eyes pop and the tongue slides out to receive the coin.

**2** This passive cat wiggles his ears when the drawer is pulled open in order to make a deposit.

**3** The author's favorite is this pixie-ish baboon with cupped hands. Drop a coin into his palms and his tongue darts in and out in a flash.



The idea of hand-fashioning a nostalgic "mechanical bank" is sure to appeal to many PM readers. Although toy banks have delighted children of all ages for centuries, the versions shown on these pages are new because they are fashioned completely of wood, not cast metal. This means that woodworkers can duplicate these banks.

With these banks, created by artist/designer David Kirk, all sorts of things occur when you make a deposit. When you push the crank, the funny-face man's eyeballs pop and he "swallows" the coin placed on his tongue.

The cat's ears and eyes roll up when the drawer is pulled open, and the saucy baboon sticks out his tongue when a coin rolls down his cupped palms.

The designer has given permission for PM readers to build one of their own (you cannot build and sell the banks), and we present complete building plans on the pages ahead.

If you want to get a bank fast without building one, you can order direct from David Kirk, 85 South St., 6N, New York, N.Y. 10038. Make certain you state which one you want, and include \$75 for each bank. Allow four to five weeks for delivery.

But, if you want the challenge of building a rewarding project, take the time to study the photographs and drawings. All information for building is shown, but you must comprehend how the parts go together to ensure that your toy bank will work properly. You'll be rewarded by your youngster's delight when he makes his first deposit.

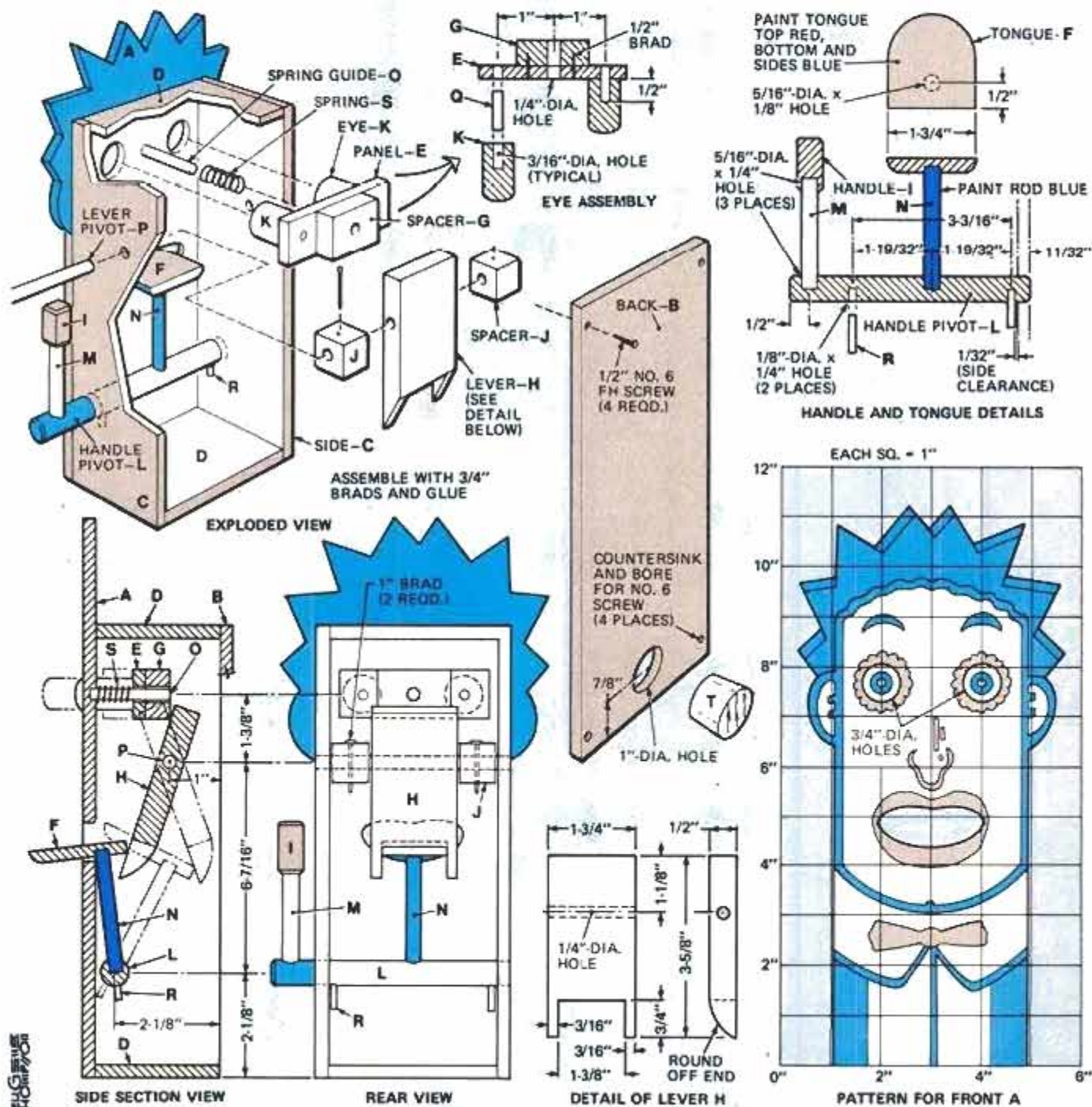
### General instructions

Because of the importance of the bank's movements, all fitting must be precise. To make certain it is, you must dry-assemble the parts and

*(Please turn to page 150)*

*(See materials lists at end of the story)*

## FUNNY-FACE MAN





# Room to grow: A handsome addition for any house

Besides a functional greenhouse, we give you plans  
for a gaily painted hutch and a cocktail table.

by Harry Wicks HOME AND SHOP EDITOR





One of the most desirable additions to a home today is a plan that provides for extra family living space, while also serving a second function. On a joint venture recently, PM and PPG Industries Inc. asked topnotch designer Shirley Regendahl to field such a challenge. We wanted to create a room that would provide dining space and a place to nurture plants in a garden or greenhouse-type atmosphere.

The result is the room shown on these pages. A small greenhouse structure was added to an existing family room. To visually pull together the family and greenhouse areas, the designer used a refreshing,



Cube tabletop is painted with conventional latex paint, then covered with 1/4-in. glass.

effective color scheme. Decorating expense was kept down by using paint as the color medium, and by adding new slipcovers to the existing furniture.

By selecting a subtle blue and white paint combination, designer Regendahl successfully created a visually stimulating room that is, at the same time, a quiet, pleasant-to-live-in environment. A touch of bright green on the contemporary hutch adds spice.

The walls are painted with a latex flat wall paint, as is the cube table. Since the table has a glass top, an

PM photos: Hans Van Nes Studios.  
 Paints: Pittsburgh Paints, colors from the DesignaColor System: Dutch Blue P2100, Blossom White P2537, Eden Green D4394.  
 Fabrics: Cape Cod Stripe in navy from Waverly Fabrics, 58 West 40th St., New York, N.Y. 10018.  
 Chandelier: Georgian Lighting Studios, 22 West 19th St., New York, N.Y. 10011.



- 1 Bright and cheerful greenhouse is an easy-build addition that gives usable living space, as well as a working area for reviving house plants with the winter blahs.
- 2 Our open, contemporary-looking hutch is actually a secretary with its drop lid removed. Designer Shirley Regendahl puts it to use as a center for house plants.
- 3 A simple cube shape becomes an attractive coffee table when its top is painted in a checkerboard fashion, and then covered with a sheet of 1/4-in. float glass.



enamel finish is not required. Pittsburgh Paints' quick-dry gloss enamel was used for the dining chairs and for the secretary, which was transformed into a plant hutch.

The plank floors are painted with an alkyd floor and deck enamel in gloss white.

### Building the projects

To add the greenhouse, carefully lay out the portion of the existing wall to be removed. If in doubt as to whether or not it is a bearing wall, consult an engineer. Your peace of mind is well worth his fee. The engineer can help you lay out the open-

ing and will also calculate the header size needed for the newly created opening.

Remember, if you're removing a bearing wall, you must provide a temporary support wall. Build it about 1 ft. inside the existing wall. Using 2 x 4s, install the temporary wall so that it fits snugly—you should not have to nail either plate to the finished floor or ceiling.

Once your cutout has been determined, you can lay out for your footing and foundation walls. The footing should extend to a depth below the area frost line, and the foundation walls can be either poured or

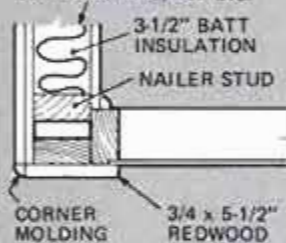
built of concrete block. Don't forget to place a vapor barrier beneath the crawl-space slab and to install an insect-proof ventilator in the foundation wall.

After cutting the wall opening, install the greenhouse framing as shown in the drawing. Make certain that you have completely water-proof joints throughout and then use a high-quality caulking where it is needed.

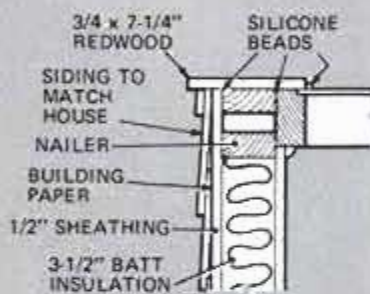
To avoid any chance of broken glass, close up the joints between the house wall and greenhouse before installing the greenhouse glass.

## GREENHOUSE ADDITION

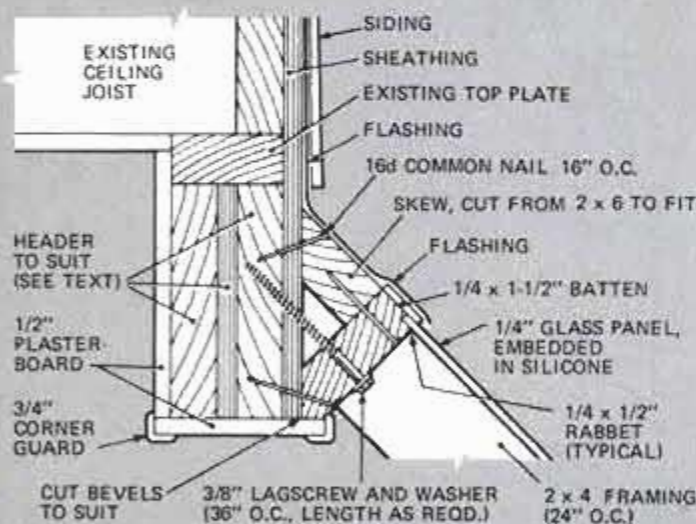
SIDE WALL,  
2 x 4 FRAMING, 16" O.C.



DETAIL 1



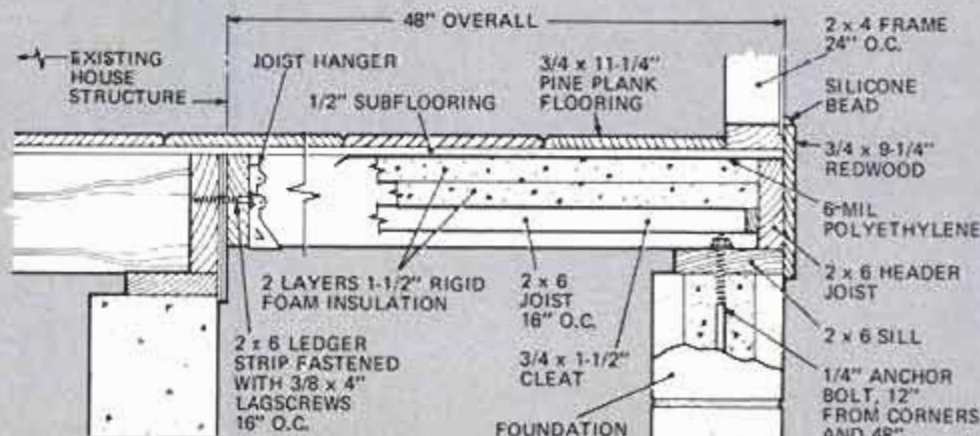
DETAIL 2



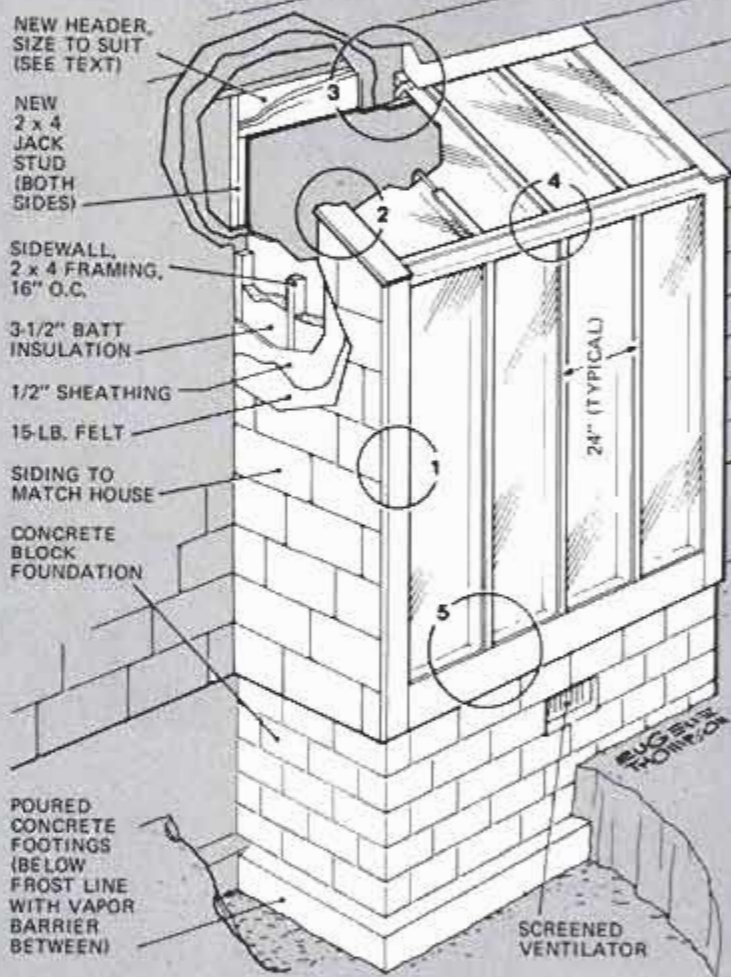
DETAIL 3



DETAIL 4



DETAIL 5





Because the greenhouse floor is painted, we used plywood subflooring followed by wide planks of common pine. To make the job easier, insulation should be installed between the floor joists before the subflooring is applied. Once the flooring goes down, it should receive a thorough sanding prior to sealing with shellac.

### Plant hutch

This piece of furniture is a lot easier to build than it looks. To simplify construction, we used 3/4-in.-thick plywood throughout. You can use A-D grade plywood, but try to lay out

the parts so any boat patches (on the D side) will be inside, where they will be hidden. If one or two do show, fill them carefully with several coats of wood filler and sand the patches perfectly smooth.

To ensure smoothly sliding drawers, use pine for the drawer sides (or a hardwood such as oak if you're willing to make the investment).

As you lay out all of the parts for cutting, remember that all exposed plywood edges should be covered to conceal the plies. The easiest way to hide those lines is with 3/4-in.-wide shelf edge or lattice available at the lumberyard. I prefer the former

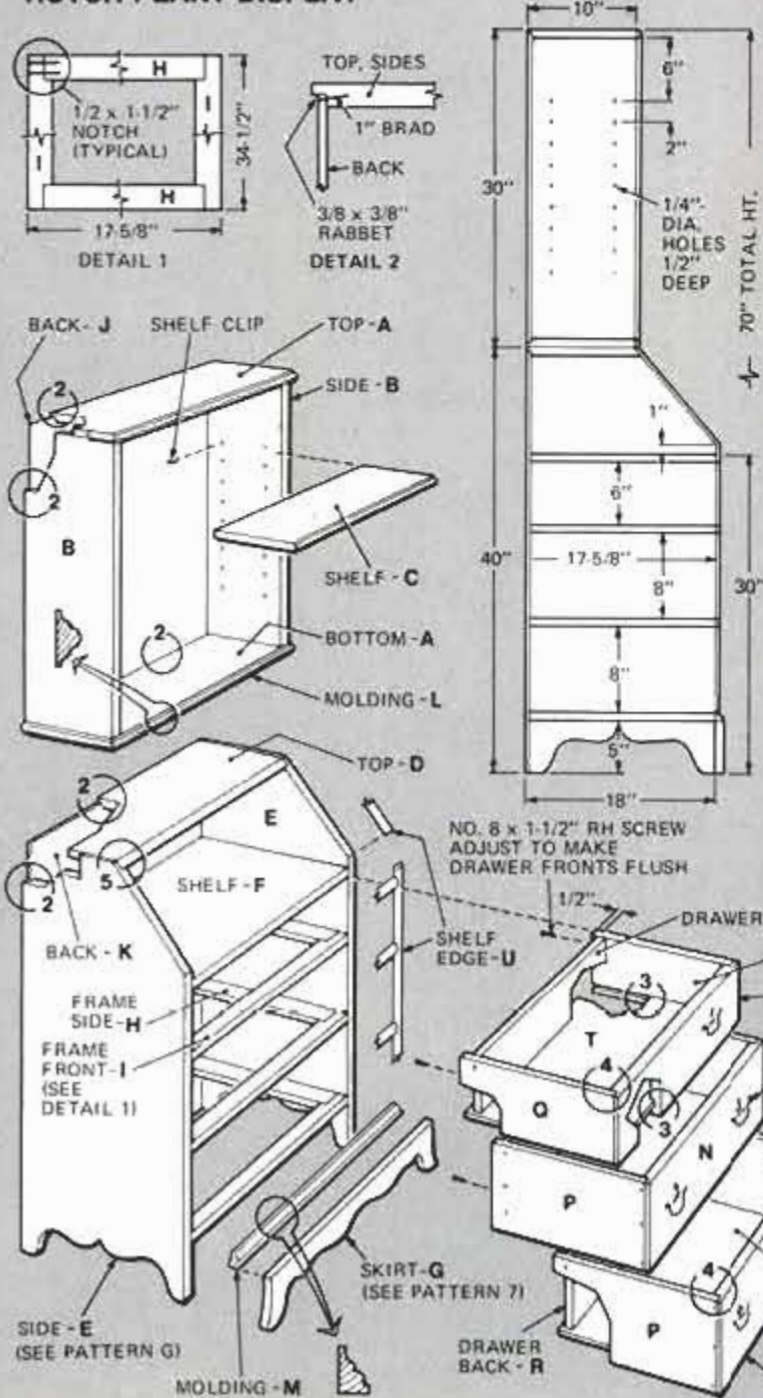
molding because it comes with two edges already slightly broken (rounded).

When the cabinet is assembled, check surfaces for smoothness and sand with 120-grit paper where needed. Dust the piece and seal with a pigmented shellac such as Bin or Enamelac. Sand lightly with 150-grit paper, dust, wipe with a tack cloth and apply the paint of your choice.

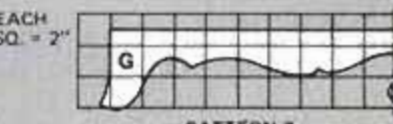
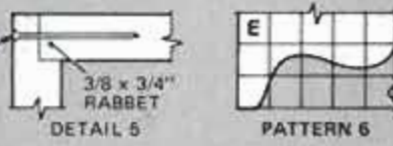
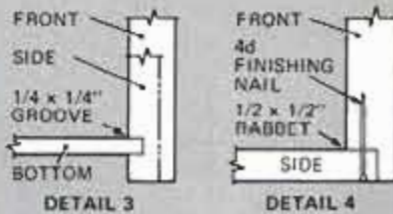
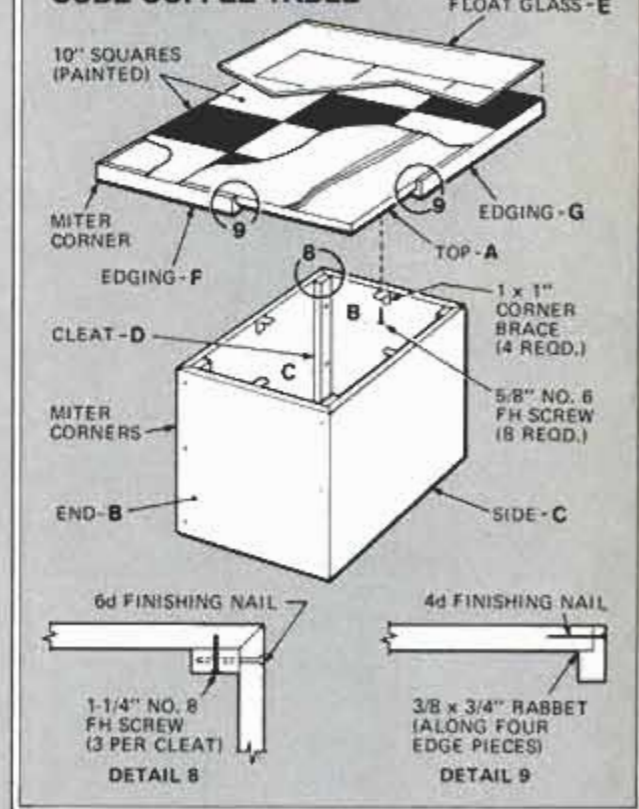
### The cube table

Build a box and you've got it made. This is a supersimple project, *(Please turn to page 160)*

## HUTCH PLANT DISPLAY



## CUBE COFFEE TABLE



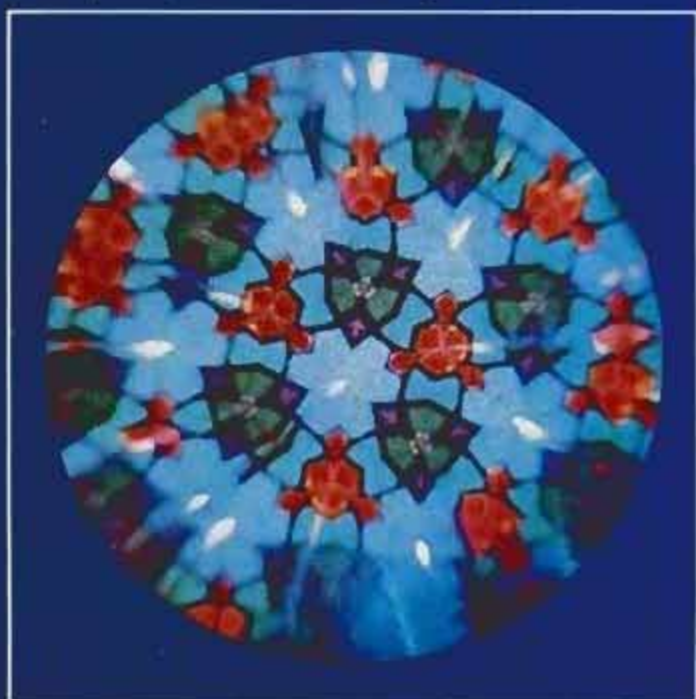
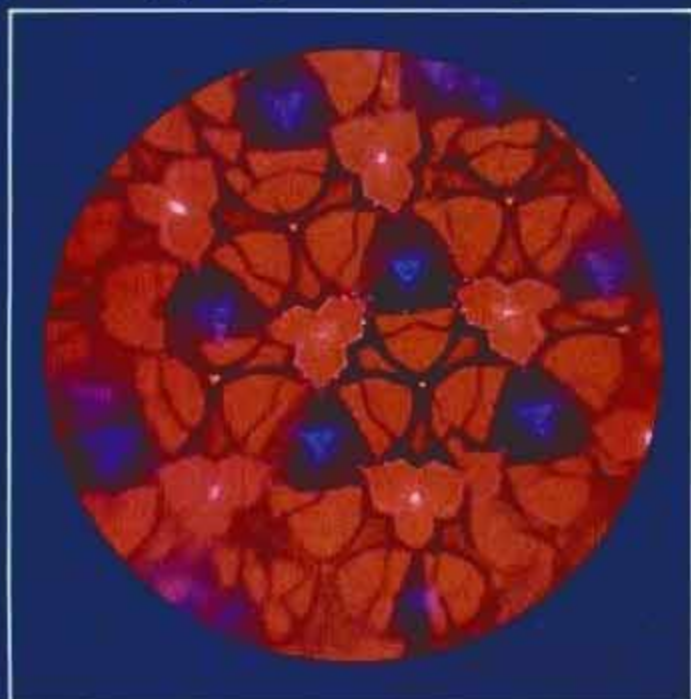


# Dazzle everyone with this



The kaleidoscope provides endless visual entertainment for a person of any age. A slight turn of the stained-glass wheels and

you can create infinite variations of brilliant color, as shown by the photos (below) which were taken through the tube.





# shopbuilt kaleidoscope

The brilliance of a thousand stained-glass patterns is yours by looking through this tube.

by Dan A. Robertson

**P**ut this color-filled tube to your eye, and in seconds you can experience countless patterns of fiery red, sunny amber or icy blue. You can use up to 18

different colors and patterns of glass in the kaleidoscope. Rotate the two color wheels independently or together to produce various effects.

The project is ideal for a person who is new to working with stained glass because all cuts are simple to make. An experienced glass artist will find the project a perfect one for utilizing those pieces of glass that pile up in a studio, but are too beautiful to throw away. If there are children around, consider making a

pair of scopes to avoid those "My turn, my turn!" arguments.

The kaleidoscope tube is a 1-ft. piece of plastic plumbing pipe (A) with an end cap (B). Bore the eyehole in the center of the cap and smooth the edges with fine (180-grit) sandpaper or steel wool.

The greater the number of colors you use (remember, you can pick up to 18), the more vibrant the designs. However, you can produce beautiful, glowing patterns by using only three or four related



Materials from top: 2-in. inside diameter plastic pipe and end cap, soldering iron, 50/50 solder, stained-glass scraps, copper spacers, bolt, washers, wood strips, wood block, mirror strips, acrylic circles, glazier pliers, pattern for stained-glass wheels, glass cutter and copper foil. You'll also use flux, cutting oil and PVC solvent cement.



If you can see through the glass, lay it on the pattern and score inside the inked lines with a sharp, oiled glass cutter. If the glass is too dark, cut a paper pattern for each piece and lay it on top of the glass so that it will act as a cutting guide.



Snap the glass immediately after scoring it, using a downward and outward motion. Use pliers to break off small pieces. Rub the edges of two pieces of glass together to dull any dangerously sharp edges.



Carefully center copper foil on the edges of each piece of glass and wrap it tightly. Then smooth the foil with a dowel or pencil. Foil won't stick to greasy glass.



After positioning the glass pieces on the pattern and fluxing the copper foil, run a smooth bead of solder along the edges of the pieces, using a 60- to 100-watt iron. Then solder a piece of copper tubing in the center to serve as a spacer.



Assemble the revolving unit; it consists of the two glass wheels, an acrylic disc, a wood block, a machine bolt and a nut.



Slide the mirrors into the tube so they form a triangle, mirror side facing inward. The three wood strips that hold the mirrors in place should fit snugly, but you should be careful not to scrape any of the backing off the mirrors as you position the wood.



Cement the end cap and acrylic eyepiece to one end of the tube and cement the glass assembly into the other end. Check that the parts are clean before assembling.

colors, such as violet, red, orange and yellow of different values.

Inexpensive scrap glass is available from stained-glass dealers. Also, keep your eyes open for colorful glass in your home, at work and on the beach. You can use glass pieces as small as 1x1½-in. in the scope.

Draw a full-size pattern of each color wheel on paper with a dark felt-tip pen. Lay a piece of stained glass over a section of one color wheel, with the smooth side of the glass facing up. Dip a sharp glass cutter into cutting oil or kerosene, then press the cutting wheel onto the glass along the inside of one of the inked lines.

(Please turn to page 126.)





# Build these playcubes... easy as 1, 2, 3

by Paul Levine

**S**torage has always been a problem in our house, with closets bulging and only one car fitting in a two-car garage. These attractive storage seats offer a partial remedy to the where-to-put-it problem by concealing many odds and ends. Topped with fabric-covered foam rubber, they also serve as extra seating when needed.

Each of the cubes, designed by architect Martin M. Bloomenthal, has a numeral graphic on its side. You might build a cube featuring your youngster's age or initial.

The basic box is constructed of 1x12-in. clear pine with a plywood

bottom and top. Begin work on the cube by cutting the side panels (A, see drawing) with mitered sides. Plow dados to accept the top cleats (E) and cut rabbets for bottom (C).

Next, use a table saw to cut grooves for the splines (D). Shape the numeral on the side panel with a router and straight cutter. To do it, first make a template of 1/8-in. hardboard using a numeral on the facing page. The finished numerals are 9 1/4 in. high. However, the template must be larger to allow for the difference between the bearing and the cutter diameter. I used a 1/2-in. straight mortising bit and a 3/16-in.

router template guide, so the template is 3/16-in. larger all around than the finished numeral.

Clamp the template rigidly to a side panel. Adjust the router so its cutter will rout the numeral to a 3/8-in. depth in the side panel. Remove the template and chisel corners square.

After cutting the bottom (C) and the corner splines (D), assemble the box with glue and clamps. Set it aside to dry. The next day, beef up joint strength by using 6d finishing nails spaced 6 in. apart on alternate sides of the miter joint. Set the nails. Cut top cleats (E) and base (F) and





Create template to suit your router shoe (see text), then clamp it to workpiece for routing out the numerals or letters.



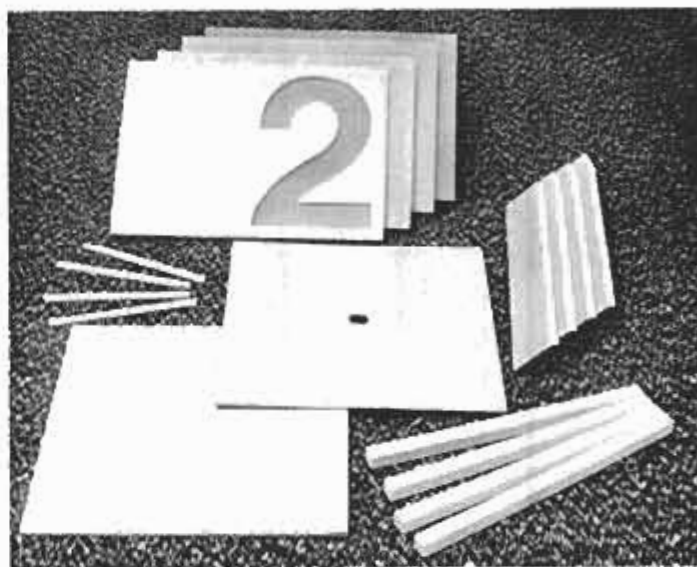
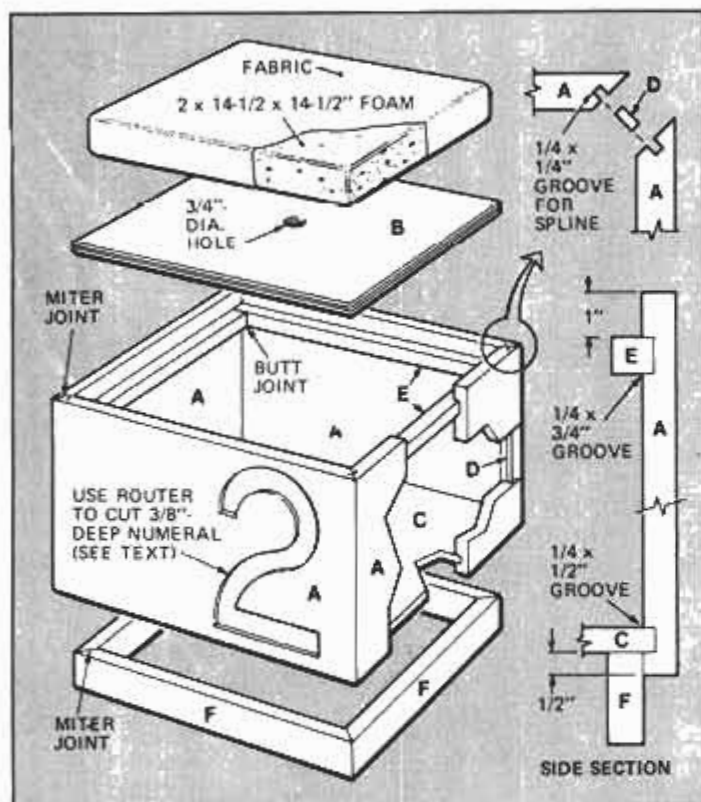
Since router cutter leaves rounded corners, use a chisel and hammer to make square shapes. Then sand the cutout.

glue parts in place. Cut the wood top (B) so it fits loosely and removes easily for access. Bore a 3/4-in.-dia. finger hole at the center.

Apply wood filler as needed and sand the cube with 120-grit abrasive paper. Dust and wipe with a tack cloth. Brush on two coats of 3-lb. cut white shellac, the first coat thinned 50 percent with denatured alcohol, the second coat brushed on as it comes from the can. If desired, paint the base black and paint the numeral to accent it.

Cut out a cushion of 2-in.-thick foam rubber. Sew a fabric slipcover to complement the cube. **PM**

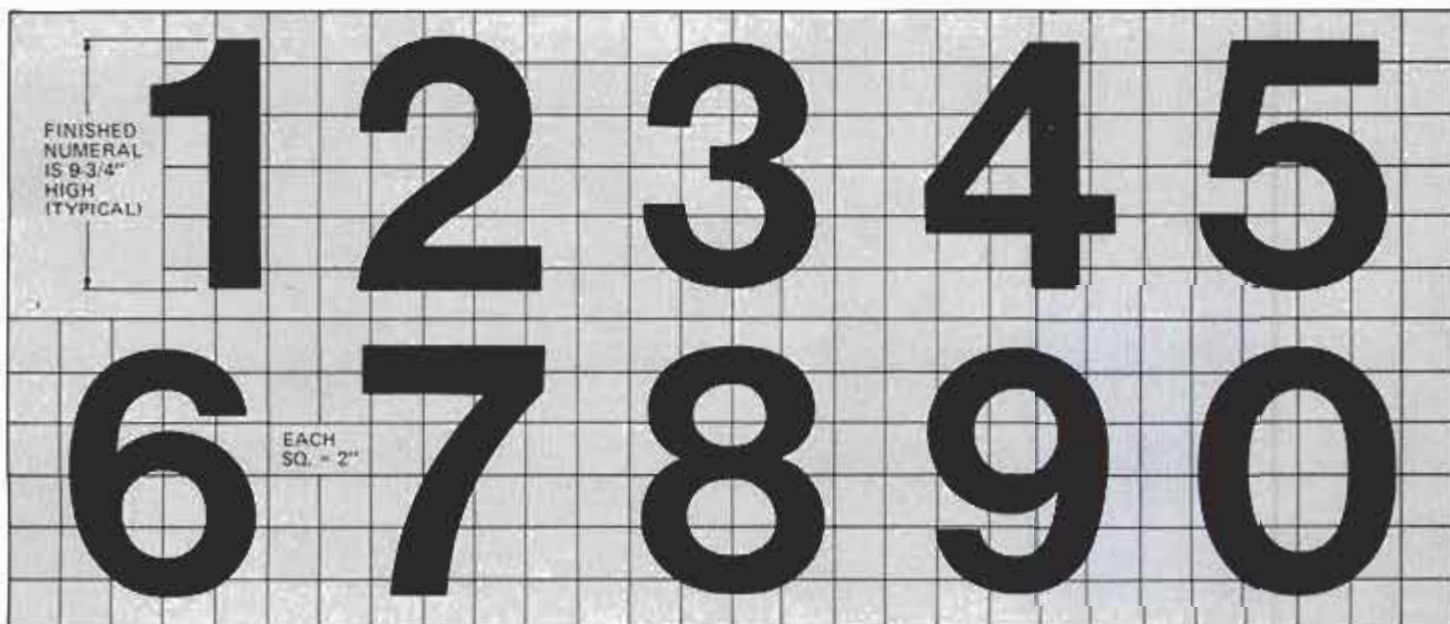
Below: Parts for one cube (viewed clockwise, starting at top left): sides, base strips, seat support cleats, bottom, splines, top.



#### MATERIALS LIST—PLAYCUBES

Key	No.	Size and description (use)
A	4	3/4 x 11 1/4 x 16" clear pine (side panels)
B	1	3/8 x 14 3/8 x 14 3/8" plywood (seat top)
C	1	1/2 x 15 x 15" plywood (bottom)
D	4	1/4 x 1/2 x 11 1/4" plywood (splines)
E	4	3/4 x 1 x 14" pine (top cleats)
F	4	3/4 x 2 x 14 1/2" pine (base strips)

Misc.: White glue, 1/8" hardboard for template, 6d finishing nails, wood filler, 3-lb. cut shellac, prime coat, paint, cushion fabric and 2 x 14 1/2 x 14 1/2" foam rubber.





# TECH FRONT LINES

## Night or day, modern optical gear leaves enemy no place to hide

The heat-sensitive battlefield device you see below is one of the latest in a set of enhanced-vision instruments so powerful they can penetrate smoke or detect buried land mines, night or day.

The infrared equipment is designed to work in the heat of battle—or in the dangerous, quiet darkness when it can detect the more subtle heat of fresh tire tracks, or the warmth given off by the body of an enemy hiding behind a tree.

Another class of electro-optical (E-O) devices, called image-intensifying systems, uses the faint light of a sliver of moon or other background illumination to make virtually invisible scenes clear enough to spot enemy tanks or troops.

Until recently, guerrilla forces operating at night held a distinct advantage over conventional forces. In Vietnam, American G.I.s coined the expression, "The night belongs to Charlie." U.S. troops had artillery, tanks, armed helicopters—but the enemy had the night.

No longer. Now technology has blown off the cover of darkness, capitalizing on portions of the electromagnetic spectrum previously unused on the battlefield.

Visible light—what we can see with the unaided eye—is a minute part of the spectrum. We cannot see ultraviolet light or anything in the infrared range.

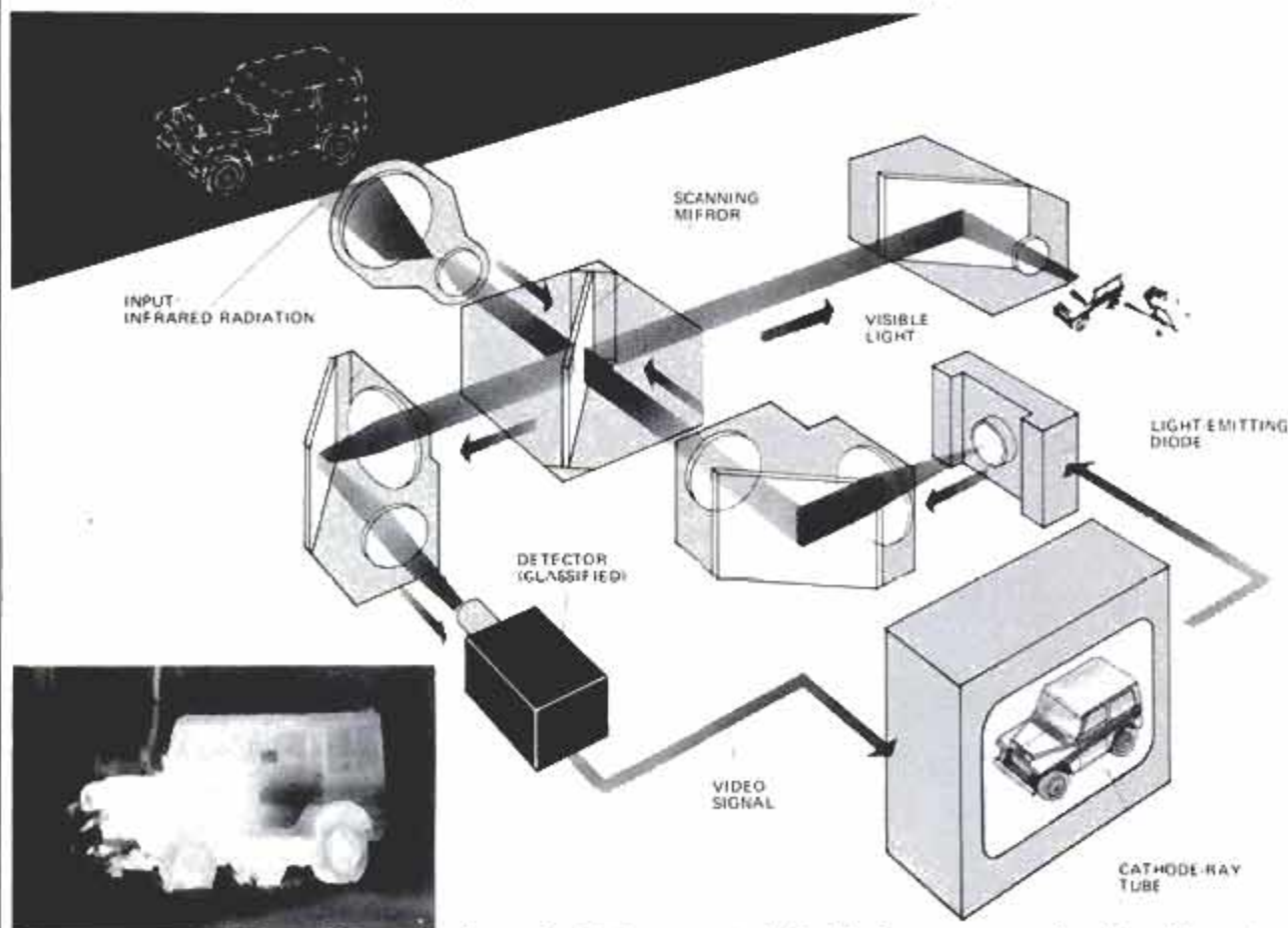
Near-infrared searchlights, using the part of the infrared spectrum closest to visible light, first came into use in the mid-

1940s. Soldiers equipped with special telescope lenses were able to see objects illuminated by an infrared beam invisible to the human eye. Soviet and NATO tanks are still equipped with near-infrared searchlights for night fighting. But the United States has abandoned all further research in this area. Even after an infrared searchlight has been turned off, enough infrared light is emitted to make the searchlight a target for some time. Because of this, the United States has opted for passive systems.

The advantage of today's devices: They don't advertise their presence, because they emit no

## MILITARY

radiation. While near-infrared instruments required a light in a spectrum close to what is visible to spot an object, new far-infrared equipment needs no light source. Instead, it picks up heat emitted from an object. An added bonus is that far-infrared can



Scanning scope picks up thermal pattern of vehicle, converts it for display on screen (inset) or through eyepiece.





**New image-intensifying systems can be worn by drivers for night passages along unlit roads, without headlights. The device works by amplifying ambient light.**

trons and radiated their energy into a visible image. The process was repeated through a second and third stage for image intensification of about 40,000 times.

Equipment in use today eliminates the blooming that plagued first-generation E-O devices.

Second-generation devices employ a microchannel plate (MCP) to achieve image intensification. The MCP is a wafer-thin slice of a large number of hollow glass tubes that have secondary-emission characteristics: They emit many electrons when struck by a single electron.

When a dim night scene is focused on a photocathode, it discharges electrons toward the inside of the tube. This forms an electron image that passes through the MCP. Each electron causes the MCP to emit thousands of electrons. They strike a phosphor screen, where they are converted to a visible display.

Second-generation E-O devices, thanks to MCPs, are cheaper and lighter. And, because their images don't bloom, they're usable where first-generation E-Os fail—in night goggles for pilots and drivers, for instance.

ERADCOM scientists have just come up with third-generation E-Os with higher performance at still lighter weight, capable of even more spectacular feats. They're so sensitive, we're told, they function in starlight.

spot active (near-infrared) emissions while remaining unseen.

These new thermal imagers use detector materials sensitive to thermal radiation when cooled to 77° K. (-321° F.). The detectors emit electrical signals proportionate to the temperature of the scene being scanned. Signals are then amplified and the output displayed on a cathode-ray tube (CRT).

### Hot on the trail

A tank commander can view a road with a far-infrared device and spot buried land mines, which have a different thermal emissivity from the road.

What if the enemy is hiding behind trees? According to Army Col. Frank L. Day, program manager for the XM-1 tank, "You just pick out the 'hot' trees and shoot." Thermal imaging is so accurate that an animal can easily be differentiated from a man. "I've spotted the difference between a buck and a doe on the screen," Col. Day says.

In a demonstration for PM, we looked at an empty road through the prying eye of a thermal imager. Using the CRT, we could see the relatively warm tracks of recently passed vehicles.

Research into far infrared and image-intensification devices in this country is centered at the U.S. Army Electronics Research and Development Command (ERADCOM) at Fort Belvoir, Va., near Washington. Efforts in electro-optics date back to 1965 when the first image-intensifying systems reached Vietnam in the form of Star-Tron scopes for both rifles and target acquisition.

First-generation scopes were very expensive—about \$10,000 each—and heavy, weighing almost as much as the M-16 rifles upon which they were mounted. Vehicles and men, when viewed through the scope, appeared as black objects against a hazy green background. A bright light from an explosion or tracers often caused "blooming." The view would be lost for minutes at a time.

First-generation image intensifiers focused the dim image on the front of a fiber-optics surface. The image passed through the fibers to the inner surface, a photocathode that emitted electrons. These were accelerated and focused on a phosphor screen that absorbed the elec-



**Image-intensifying device converts dim scenes into patterns of electrons.**



## ENERGY

### Cat on hot wood stove

A catalytic converter built into a new wood stove pulls more heat out of fuel and cuts down creosote and air pollution, according to its Warwick, R.I., maker.

Smoke from the Concord Converter made by Franklin Cast Products (1800 Post Rd., Warwick, R.I. 02886) passes through a 5½-inch-diameter ceramic honeycomb located above burning wood. In this three-inch-thick disc, hydrocarbons react chemically with palladium catalyst. The reaction lowers the flash point—the temperature at which smoke burns—from the usual 1300° F. to a range of 500° to 600°. Thus, smoke is oxidized within the glowing honeycomb, reach-

ing temperatures up to 1600° F. Result: more heat, less soot.

How much less? An engineer for the company tells PM that the stovepipe of one test model used last heating season in upstate New York required just a quick wipe with a cloth. Franklin president Larry Schwartz says the Concord achieves a maximum overall efficiency of 90 percent, about 35 percent higher than the best stoves now on the market.

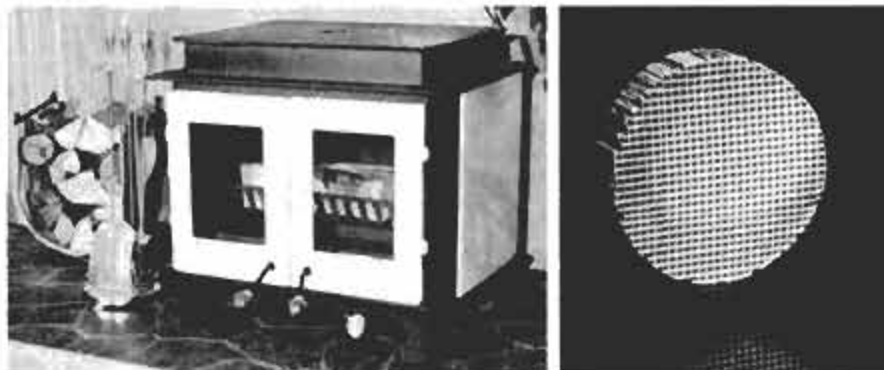
The stove does require some extra care. Improper fuels—garbage, particleboard, aluminum Christmas wrappings—can clog the converter; smoke is then automatically diverted through a vent in the back of the stove. Another caution: The converter will not tolerate coal. The problem is that sulfur from the coal coats the palladium catalyst, isolating it from smoke and preventing the reaction. The sulfur can be burned off with an acety-

lene torch. The cost of the stove may be a drawback: The suggested retail price is between \$1000 and \$1100.

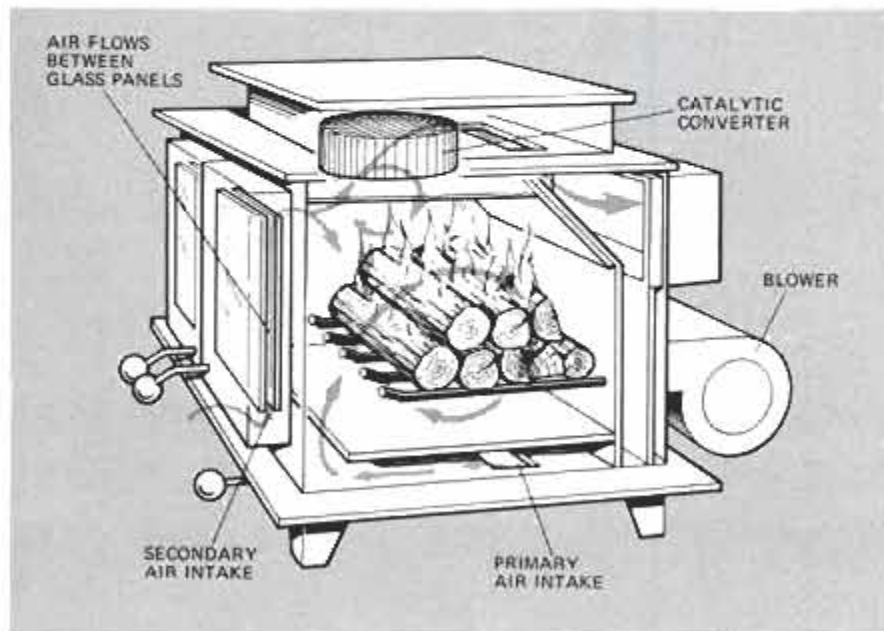
The catalytic converter made by Corning Glass Works, Corning, N.Y., is similar to converters on cars. But auto-emission converters have about 400 cells per square inch compared with just 16 cells in the stove honeycomb. Corning engineers emphasize that auto converters cannot be used in wood stoves.

Franklin was the first company to meet Corning standards for safety. But Corning tells us it would sell the device to any other manufacturer satisfying its design and safety criteria. Currently, there is no converter that can be adapted to existing stoves, Corning says.

How long will the honeycomb last? No one is sure. Franklin guarantees the part for one year and the rest of the stove for five years. But researchers on the stove think the converter should last a minimum of three to five years. A replacement converter costs about \$100 in today's dollars. Franklin says it planned a production run of more than 10,000 of the cat-converter stoves before the end of last year.



Beneath standard exterior, stove has a ceramic honeycomb (above, right).



Smoke is channeled through honeycomb where it burns, yielding heat bonus.

### Synthetic diesel

A Hauppauge, N.Y., company says it has developed a way to make synthetic diesel fuel from coal-derived alcohol—with no imported ingredients.

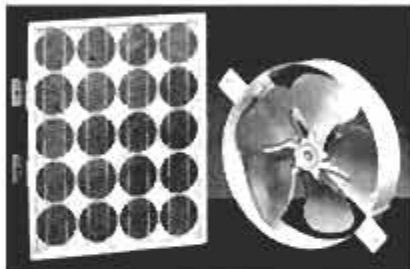
The 38-year-old company, United International Research Inc. (230 Marcus Blvd., Hauppauge, N.Y. 11787), also claims to have invented an additive farmers could mix with farm-produced alcohol to make a fuel for any diesel-powered machinery. Both the synthetic diesel, called Dieselite, and the additive should be available by the end of 1982, the company tells PM.

Golden-brown Dieselite fuel, lighter in color than regular diesel, will be pumped at a price competitive with standard-diesel prices, the company says. But actual prices for Dieselite and the amber-colored additive have not yet been set. The Long Island firm has joined with the First Mississippi Corp. of Jackson, Miss., in developing the fuels.



## PRODUCTS

### Sun-run fan



The \$320 Solar Breeze ventilates attics at up to 500 cu. ft. per minute and is powered by photovoltaic cells. It's from Photowatt International Inc., 2414 West 14th St., Tempe, Ariz. 85281.

### Satellite view



The GP-1000 Weather Satellite Earth Station picks up weather maps from satellites. It's \$5995 from Global Positioning Instrument, 1525 South East 16th St., Fort Lauderdale, Fla. 33316.

### Rangefinder



You can measure your home's height, width of a barn or distances with the \$9.95 Telefix sighter. It's accurate to within five percent. Box 357, Cathedral Station, New York, N.Y. 10025.

## AVIATION

### The wing's the thing

With his company poised to reap big profits in the light-transport market (opened up in the United States by airline deregulation), marketing exec Kaspar Schopel of West Germany's Dornier firm had this to say: "An almost total absence of light STOL designs of U.S. origin during the last 15 years has had some interesting results."

Especially for Dornier itself, which has been flying a modified version of its Skyservant—long a successful utility STOL design—as a test bed for what it calls its New Technology Wing. As a result of tests with the Dornier TNT experimental plane (drawing below), the company will introduce a 15-passenger STOL transport later this year, to be followed by a stretched, 19-seat version. These aircraft could put Dornier in a good position to approach burgeoning commuter airlines looking for fuel-efficient ways to capitalize on the mass abandonment of smaller cities, as a result of major airline-deregulation moves.

The new Dornier plane should cruise in the 220-mph range, and will be able to take off and clear a

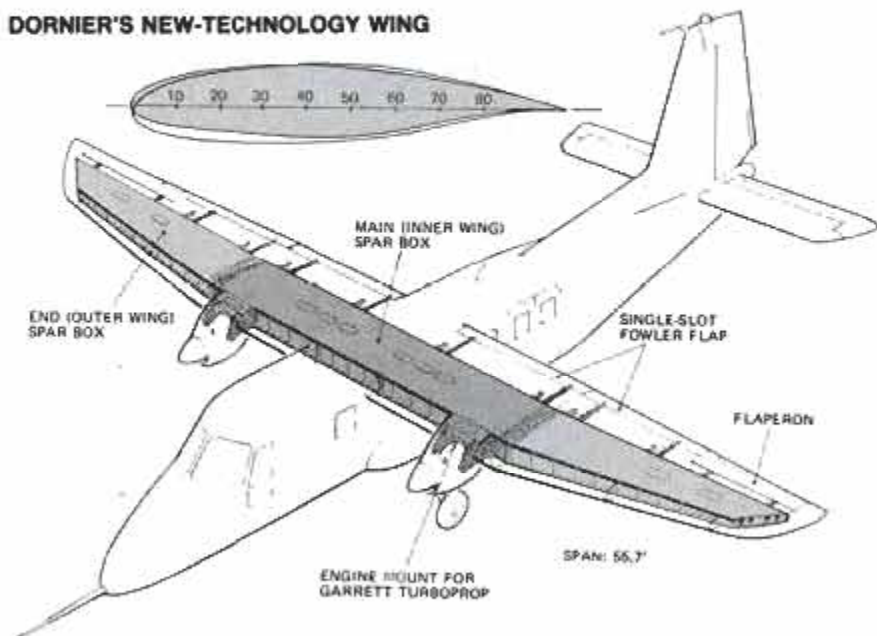
50-foot obstacle in a little more than 1700 feet. It will be powered by twin Garrett turboprops.

Part of the wing's novelty lies in its unique manufacturing process. The top and bottom of the main spar box are milled from 2-inch-thick aluminum sheets by computer-controlled machines; both transverse and longitudinal ribs are integrally milled, along with skin thicknesses down to 1/50 of an inch (90 percent of the metal is removed). So there are *no rivets* to disturb the airflow over that part of the wing. The outer wing boxes are made of graphite-reinforced plastics.

The aerodynamic profile, as well as smooth airflow, give the wing its outstanding performance. It is of "supercritical" design (see profile below)—and herein may lie a problem.

NASA has patented a supercritical wing designed by its Langley Research Center and is attempting to sign royalty-bearing agreements with foreign manufacturers who use the design (only computer analysis can determine the degree of similarity to NASA's wing). If the manufacturers decline, NASA will press litigation through international courts. As yet, Dornier hasn't been named, but a NASA spokesman admits, "We may not have realized how far along they were." Dornier says its wing grew out of a West German research program.

### DORNIER'S NEW-TECHNOLOGY WING



Dornier TNT experimental plane, showing the uniquely built spar box.



## AUTOMOTIVE

### Get the lead (gas) in?

The Ethyl Corp. recently set out to challenge popular wisdom about auto compression and leaded gasoline. Its research suggests the country could return to using leaded gas—without overloading the air we breathe.

Current belief is that it takes a low-compression engine, catalytic converter and unleaded gasoline to keep emissions down. It's also widely known that this system of keeping cars clean cuts fuel economy. As evidence of that, EPA mileage figures are always lower for cars in California, where emissions standards are stricter.

According to Ethyl, the use of catalytic converters and unleaded fuel is costing the United States about 1 million barrels of oil a day. As proof of its claim, Ethyl converted a 1980 Ford Fairmont by installing a Volvo 2.8-liter V6.

The engine was modified to run at high-compression ratios on leaded gas and very lean fuel/air mixtures. It was also fitted with a knock sensor to prevent detonation. Ethyl drove the car 2844 miles. Two production cars went

along in a convoy to provide a basis for comparison.

Ethyl's results showed a 22-percent mpg improvement over a stock Fairmont with a 3.3-liter Six, and a 9-percent gain over an Olds Omega with a 2.8-liter V6. Pollution levels were below that of the stock Ford engine.

Ethyl, a Ferndale, Mich., corporation, has a vested interest in the results: The company is the country's biggest supplier of lead additives. The findings have won support from others in the industry, such as Charles Heinen, who recently retired as director of research at Chrysler.

The implications are staggering. It appears that Detroit has been traveling down the wrong road in its search for economy and acceptable pollution levels.

Ethyl's calculations: In the refining process, it takes 105 gallons of crude to make 100 gallons of leaded gas. But it takes 114 gallons of crude to make the same amount of unleaded. At current rates of production, that's a difference of 1 million barrels per day.

Whether we return to the days of leaded regular gas is up to the government. Government standards determine not only how much pollution comes out the tailpipe, but also how much lead can go into the fuel in the refineries.

## INVENTIONS



### Like a bat out of hill

An automobile dealer in Honolulu has patented an airfoil suit with folding wings, enabling skiers to launch themselves from moguls and fly briefly over slopes.

When they are unfurled and zippered to the arms, the wings, invented by William G. Motter, can also be raised or lowered to control speed. (Patent 4,220,299.)

### Jogger's pacer

A battery-powered computer that a jogger can carry signals him when to make each stride, and displays the distance traveled and the elapsed time. The athlete adjusts the computer, invented by Talmadge R. Searcy, to record the length of his step, and turns a knob to set the desired rate of travel in minutes per mile. (Patent 4,220,996.)

### Snore score

Mark Twain once complained: "There ain't no way for a snorer to know how loud he snores." Now there is. A detector designed to eliminate snoring wakes the sleeper with an alarm when it detects snoring. It also displays a number each morning showing how many snores the equipment picked up.

Inventors Raymond C. Rosen, his wife Linda and Zoltan L. Sisko have found that sleepers become quieter after a couple of weeks of keeping score on their snores. (Patent 4,220,142.)



The electric gas station has arrived. The Electric Auto Corp. is currently setting up a network of fast-charge stations for its car, the Silver Volt

(inset). Drivers of any electric vehicle can plug in and get a recharge. The machine takes quarters—but it won't clean your windshield.



## ELECTRONICS

## The 400-watt midget

It's no secret that electronic devices are getting smaller every year. But the tendency is to think there are some components that cannot be miniaturized—power supplies, for example.

A hefty power supply has always required large filter capacitors and heavy metal windings. But now an audio company has shown that power supplies, too, can be tiny—and the implications stretch beyond the audio field to CBs and computers.

The Carver M-400 Power Amplifier is only seven inches on each cubical side and weighs nine pounds. But it delivers 200 watts per channel, or about 45 watts per pound.

Carver is less than enthusiastic about revealing all of the technology involved in its 400-watt "magnetic-field" amplifier. But best reports are that it stores electrical energy as magnetism, right in the coil of a small transformer—and so does not need big and bulky capacitors.

Furthermore, the amplifier senses exactly how much power each note requires and adjusts instantly. So, at normal listening levels, the amplifier just coasts. But if you need a 200-watt transient (one tremendously loud cymbal), you have it.

The \$349 unit is about one-quarter the size of its smallest competition.

## Read it like it is

Telecommunications involve a lot more than just voice broadcasting, as any shortwave listener or radio amateur will attest. Information can be sent by Morse code, radioteletype (RTTY) or even on slow-scan television (*Now Hams Get the Picture*, page 122, Mar. '80).

But receiving these nonvoice modes can be difficult and expensive. Morse code requires a deft listening proficiency, and radio-



Morse code and radioteletype messages are decoded by Robot 800. Unit sends both, and slow-scan TV images.

ROBOT  
800  
ON  
SLOW  
SCAN  
TV

teletype and slow-scan TV have always been very esoteric modes. But Morse and RTTY carry most broadcast material.

Now the new Robot 800 terminal makes it as easy as typing to send and receive these modes. The Robot 800 is a computer dedicated to communications—and it's not programmable for other functions. It takes speaker output from a station receiver, decodes both Morse code and RTTY, then prints the message, letter by letter and line by line, on the

screen of a home TV or monitor.

If you are a radio amateur, you can also transmit Morse and RTTY by attaching the Robot 800's output to the transmitter microphone jack and simply typing your message. In the transmitting mode, it will also send bulletin-board-type TV messages.

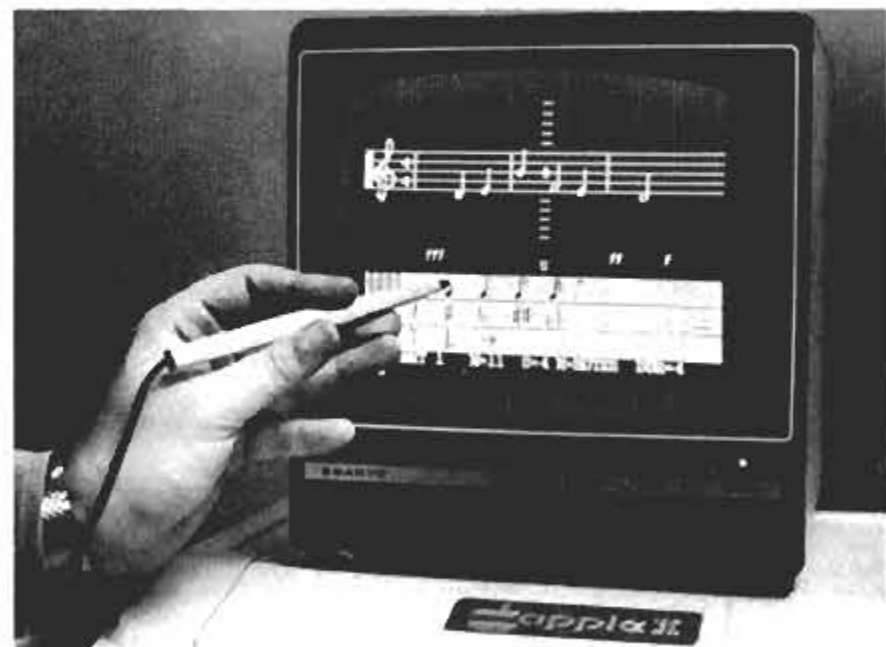
The \$895 Robot replaces thousands of dollars worth of RTTY equipment and makes the jumble of dit-dah messages intelligible to people who don't know code.

## Tin-pan Apple

They laughed when we sat down to play our computer. But not only did it sound like an organ; it also sounded like a clarinet, a tuba and a second organ—an odd ensemble playing a flawless synthesized harmony.

The MusicSystem (\$545 from Mountain Computer, 300 Harvey West Blvd., Santa Cruz, Calif. 95060) turns an Apple II home computer into a synthesizer capable of 16 waveforms that can simulate any music. The capability surpasses all but the most expensive professional gear.

Composing is done with a "light pen" right on the TV screen. You literally point it at a note and move it onto the staff, where you want it. The tunes can be played back through your stereo speakers or through headphones attached directly to the computer.



Electronic composer points a light pen at a note; computer displays it.

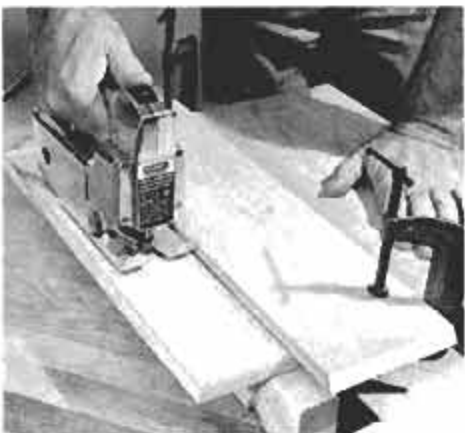


# WORKSHOP MINICOURSE

## USING A SABRE SAW

Last month, we pointed out that the sabre saw is one of the most versatile portable power tools. Its biggest advantage is its ability to cut curved, as well as straight lines. The more expensive models come with a tilting shoe that lets you make bevel cuts, too.

A frequently asked question is, "Which sabre saw should I buy?" I answer the same way that I do for all tools—portable or stationary: "Choose the tool that will handle the jobs you expect to do." For example, if you plan to use your sabre saw primarily for around-the-house carpentry tasks—where you can expect lots of cuts in walls and ceilings—I'd recommend a lightweight version, so your arms won't tire.



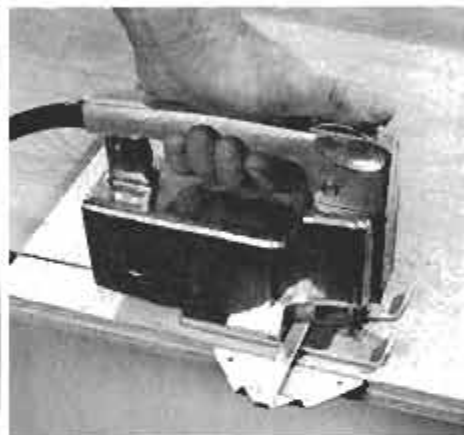
When workpiece can't be marred, use a wide board (which won't bow) and C-clamps, as shown. Again, make certain that straightedge is clamped so that the saw cuts on the waste side of the cutting line.

But if you will use a sabre saw in the shop most of the time, as I do, pick a heavier tool with a good-sized shoe. This will allow greater control and accuracy when cutting on the workbench or over a pair of sawhorses. Both saws shown (one a Rockwell, the other a Stanley) are professional models and so are rugged, as well as more expensive.

For many homeowners who plan to use the tool occasionally, a sabre saw in the \$40 to \$60 range should suffice.

### Cutting straight lines

For rough work, cuts can be made freehand. However, because of the vibration caused by the reciprocating blade, you are well advised to use some sort of guide against which the saw shoe can bear when making



When making a straight cut near an edge, use your rip guide. Position the guide so kerf will be on the waste side of line being cut. This way, if saw should leave work edge, it will drift into waste area.



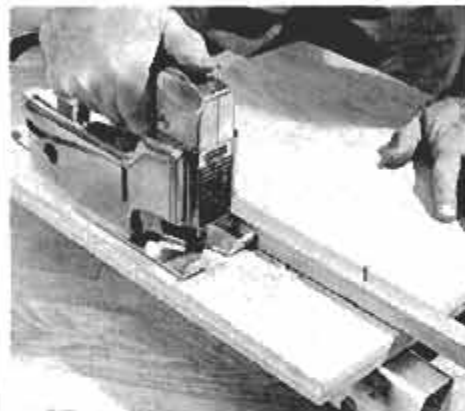
If your sabre saw makes bevel cuts (like the tool shown), the straightedge guide *must* be clamped on the side toward which saw pulls during a bevel cut. Use a rough-cut blade and a slow feed. To avoid any chance of injury to the hand holding the board in front of saw, clamp entire setup to sawhorses that work straddles.

any straight cut requiring accuracy.

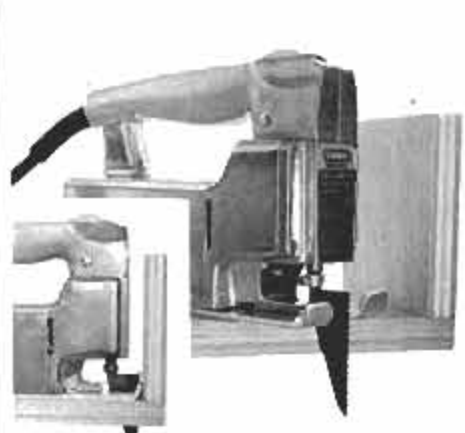
If the straight line is within the capacity of the rip guide that came with your saw, use it whenever possible (photo at top of this column). You will notice that the guide is designed to engage the workpiece edge *before* the blade enters the edge.

It's a good idea, when using the rip guide, to hold it against the work edge with one hand. If you let the saw travel into the waste area too frequently, you may have trouble picking up and following that line later—even with the guide.

For straight cuts on the interior of a panel of plywood, you can use a tacked-on wooden strip. To eliminate any chance of bowing, use a 4d finishing nail every 12 in. or so.



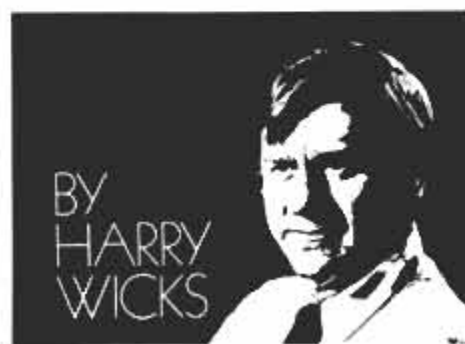
If holes in workpiece don't matter, use a wooden strip tacked on with 4d finishing nails. To do it, mark exact location of guide every 12 in. along work, then pull the strip to each mark as you tack-fasten. If inadequately nailed, the strip may bow.



This blade is designed to let you cut right up to a vertical or horizontal surface. It's useful for cutting flooring up to a wall, or a countertop up to a backsplash (inset).

Mark the guide's location from the cutting line in a number of places and pull the straightedge to it as you nail your way down the line.

To make interior cuts on smaller panels, it's best to use a wide board and clamps. Sight down the board edge first and toss aside any board with a bow.





## SKI TECH TAKES OFF

(Continued from page 89)



A one-piece ski boot? Kneissi produced this mock-up to show skiers that the idea has real possibilities.

still requires the careful checks and adjustments of simpler apparatus to keep it tuned and performing properly.

Downhill skiing's vital link in a package of necessary components is the binding. This curious contraption is as complicated as it looks because it must perform conflicting functions: The binding has to release whenever the forces of skiing (or falling) might cause injury—hence the terminology "release binding." It must also do what its name says—bind the skier to the ski. This latter function, referred to as retention, is obviously as critical to skiing as release.

Many anatomical variables and numerous environmental variations are involved in this slippery, high-speed sport. No two runs are ever the same. Participants also range widely in proficiency. Considerable research and development have gone into making adjustable ski bindings that release when they should, hold on otherwise, and provide a margin of flexibility in between—a characteristic that binding makers call elasticity.

Two basic types are available: the models that have separate release attachments for ski boots at toe and heel, and some less conventional designs that fit the boots to plates held onto the skis in a way that

(Please turn to page 112)

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## SKI TECH TAKES OFF

(Continued from page 111)

allows the plates to release with the boots. In general, the greatest possible number of release directions in toe/heel bindings, are three (left and right at toe; upward at heel), while with plate bindings, more release directions are possible.

Most plate bindings share the need with all toe/heel types for a means of keeping a released ski from sliding away downhill. The answer is a ski brake—"runaway straps" are unsafe and obsolete—which automatically deploys spring-loaded prongs at right angles to each ski's running surface when the boot disengages from the ski. The prongs catch in the snow and hold the ski.

## Retractable bindings

But the operating principle of the newest, most advanced plate binding does away with the brake by eliminating the need to get back into the bindings each time they release. It's a *retractable* ski binding, with two cables, one forward and one rear, extending from inside the plate and running on a system of tension-producing aluminum idler wheels.

The cables allow almost limitless angles of release. And when the force causing the binding to release is relieved, the ski simply *snaps back* of its own accord and fully engages with the plate to which the boot is attached. This recoiling device, dubbed the Burt binding by its American inventor, Burton Weinstein, is undoubtedly the state-of-the-art mechanism at this writing.

The eye-popping effect of a retracting mechanical binding in use on the slopes is one that probably will be with us in many future designs. For years, binding manufacturers have also toyed with the idea of magnetic bindings, although none has mastered the muddle of achieving needed elasticity, not to mention the prevention of magnetic shear.

Recently, a major European binding manufacturer, named Marker, showed the world its prototype of an electronic binding, which raised, among other queries, the as-yet-unanswered question: "What if the batteries go dead?" The answer may require very low electromotive forces to operate some sort of solenoid-and-lever combination. Backup batteries or a lockout device may also be involved.

At the moment, several binding makers are working on specific components. They do say that the use of tiny computer chips to calculate the



resolution of forces acting on the binding is almost a certainty.

In the meantime, as work proceeds on various prototypes in secret, the ski business is buzzing about another fascinating concept: integrating the binding with the boot. But any boot/binding combination has certain clear-cut obstacles to overcome. Carrying around ski-release systems in the soles of footwear exposes them to severe wear not normally found in skiing.

One major ski manufacturer recently stirred up a blizzard of interest in the concept of integrating the ski boot and binding with a molded mock-up of what such a combination might look like. But Kneissl Ski Co. of Austria stresses that its design (see page 111) is strictly for show and that the mock-up makes use of no mechanical principles. Meanwhile, Burt International already has a prototype of its binding contained in a boot (photo on page 89), a package that is intended for production in about five years.

#### How high the boot?

Ski boots have already undergone radical departures of their own and have come a long way since Robert Lange's company introduced the first plastic-shell ski boot in the mid-1960s. The most apparent and consistent progress in ski-boot design has been the rise of the boot top.

This year's models will actually reach the upper extremities of the calf muscle. Not merely special boots for racing, these "knee-high" models have flexibility enough for intermediate skiers. Why so high? The higher the boot, the greater the leverage on the ski edges, but that's not the whole story. Experts also say these radical new boots can reduce the fatigue of skiing, relieve foot pressure and permit better blood circulation for more warmth. Some even provide extra protection from lower-leg injuries, or so it's claimed.

#### Boots with shock absorbers

Today's ski boots are impressive examples of evolutionary engineering, especially in terms of adjusting their fit. Rear-entry designs, adjustable spring-loaded buckles, and exterior screws and levers that change the inner contours are almost common. One brand-new boot has a built-in air pump to fill bladders positioned at the ankles. And mechanically adjusted forward flex and forward lean are both available

(Please turn to page 114)

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## SKI TECH TAKES OFF

(Continued from page 113)

on certain of the new boot models.

The revolutionary new boots  
shown in our photo on page 88 are  
called "lever boots," and they come  
with shock absorbers fitted to the  
levers. This rear-entry model from  
Kastinger in Austria has a long  
extension that fits against the front  
of the lower leg and rises almost to  
the knee. This lever is held in place  
by a loose-fitting cuff. The idea is to  
produce the leverage of high-top  
boots. In addition, there's an auto-  
motive-type, spring-loaded shock  
absorber between the lever and the  
toe (designed, incidentally, by  
Porsche car engineers). That shock  
absorber not only makes these pup-  
pies an attention grabber, but it  
actually works, as well.

The working principles of this  
lever boot, patented by an American  
engineering professor named Dan  
Post, include tapping the natural  
rotary motion of a skier's lower leg  
when making a turn and transfer-  
ring it, through the lever, to the skis.  
The result is said to be greater edg-  
ing (steering effect) from less effort  
and little body motion. Also, the  
shock-absorber strut allows free  
hinging between the upper and lower  
boot. This is intended to eliminate  
the normal friction between plastic  
surfaces and permit the boot config-  
uration to return to a normal, neu-  
tral position after flexing forward or  
backward for each turn. If the lever  
concept does all this, its design  
opens up a whole new realm of what  
might be called mechanical boots.

## Future ski shapes

The newest composite skis are a  
far cry from the original laminated  
ski designed by Howard Head in the  
early '50s. Among the more exotic  
ski developments are graphite-fiber  
reinforcing for strength; aluminum  
honeycomb, channeled fiberglass  
and acrylic-foam cores for lightness;  
plus various construction, impreg-  
nation and lamination methods, us-  
ing materials like Kevlar for stiff-  
ness.

The latest design breakthrough in  
skis, however, is even more radical  
than the departure in the materials  
from which they are made: An  
American ski designer has actually  
changed one aspect of the basic  
shape of the ski. A V-shaped section  
has been cut out from the tail of a  
new production ski from Hexcel  
Sports (see color photos), an innova-  
tion that designer Hub Zemke says  
reduces skidding.

The tail has traditionally been the  
stiffest part of the ski. But the



greater flexibility of the narrow, V-cut tail sections when edging reportedly enhances the carving effect of the edges and reduces the chances of their not holding, particularly in packed, icy or rutted snow.

Some experts suspect that the split-tail concept is only the first step in the evolution of a new ski geometry. Some thought has been given, for example, to making each ski in the form of two runners joined only at the waist of the ski where the binding is mounted. A few years from now, a skier may look down and discover four ski tips, where formerly there were only two.

### Poles apart

When it comes to the shape of a ski-pole shaft, it has to be straight and true, right? Wrong. If you've watched a downhill race recently, you've undoubtedly seen the bent pole that the top competitors ski with these days. The aerodynamic configuration allows the pole, in effect, to wrap around behind the skier for decreased wind resistance.

This swept-back shaft is used almost exclusively in racing, but many other advances in poles are suited to recreational skiing. The standard grip, for instance, is giving way to a platform-type grip with an enlargement at its base, which the hand can push down against. The grip comes with a breakaway band that overlaps the back of the hand to assist in holding the pole.

The newest concept is a shock-absorbing handle employing a sturdy spring inside the platform grip. This innovation from a family company started by Ivor Allsop helps relieve the jolts and jars of poling. In addition, besides the lightweight aluminum alloys now used for making pole shafts, superlight graphite poles have begun to appear.

### New wrinkles in accessories

At the business end, pole baskets have gone from simple rings (that can snag) and snowflake patterns (that can't) to unusual cones, wedges, umbrellas and discs that reduce drag, both in and out of the snow.

While sharp pole tips are now being blunted to prevent injuries, the Scott pole company has a metal disc basket with a turned-under edge which replaces the tip altogether. It makes you wonder what the pole makers will think of next.

Advances in ski tech are not

(Please turn to page 116)

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## SKI TECH TAKES OFF

(Continued from page 115)

restricted to primary equipment. Accessories and clothing on the market today offer examples of intense technical ingenuity and a flair for the futuristic. In the category of electronic gear, for instance, today's skier can be wired from head to toe.

Stereo tape players that have headphones and special packs for skiing, electric gloves and socks, and even wearable ski-boot warmers are all available.

### Dry your damp boots

Emergency signal transmitters for skiing out-of-bounds are also becoming more prevalent as the new, long-lived lithium batteries extend service capabilities. A very practical electrical device that's new this year is Allsop's plug-in boot tree that dries damp ski boots overnight.

Other varieties of powered skiing apparatus include Smith's ski goggles with a tiny, built-in fan powered by a battery on the elastic headband to prevent fogging. Plastic face guards from Scott break the blast of chill winds and help ward off frostbite.

There are bumper blocks that mount on ski tips to prevent even a novice's skis from crossing and tangling up.

Underlying the bright colors and astronaut styling of ski clothes is a series of breakthroughs in synthetic materials.

Among the useful newer wrinkles is polypropylene long underwear that readily passes moisture out, but doesn't absorb it. In outerwear, such so-called "wicking" materials as Gore-Tex and Klimite, which make use of a breathing, bonded membrane, are revolutionizing the creation of warm, waterproof ski clothing.

Other materials coming into use in skiing include aluminized nylon to contain moisture, creating a vapor barrier inside outerwear garments.

Several manufacturers of diving wet suits are laminating closed-cell neoprene rubber between thin layers of nylon and Lycra for super-warm ski suits. Polyester pile linings, especially in caps and gloves, are providing insulation while creating a fashion look. Fiberfills, such as Hallofil, Thinsulate, Borglite and various other brands, have made major improvements in the insulating characteristics of lightweight ski clothing that gives both warmth and freedom of movement.

The tremendous level of technological development in downhill skiing equipment over the past 30 years or so has been equalled by cross-country skiing in a much shorter period. Less than 10 years ago, X-C, as downhill's Nordic equivalent is termed, had only a small, elite following in the United States. The basic gear was light-years behind the times and the sport was tied to wool-knickered tradition. Now all that has changed.

### From hickory to fiberglass

Hickory wood skis have given way almost completely to livelier fiberglass models. Some make use of composite materials and construction methods similar in sophistication to those of Alpine skis. These supple, skinny skis are almost as springy as archery bows.

However, unlike downhill skis, the critical area of experimentation and innovation has been the running surface, because of the necessity to alternately grip and glide.

A whole assortment of synthetic bottom coatings and running-surface configurations have been developed. Some—such as Trak's original fish-scale design—need no waxing in order to achieve both traction and slide. Improvements have been made on these patterned bottoms which now make use of different scallop shapes in different areas of the bottom. Other waxless bases have also come into being; the most efficient of these may be the mica bottom.

Of course, there have also been advances in the area of new synthetic waxes and waxed bottoms. The objective has been to make the wax stay on longer and work better in changing snow conditions. As with downhill skis, racing is in the forefront of experiments with waxing, as well as with ski shapes.

### Natural movement

Narrow, lightweight, high-performance skis are now mated with slender, lightweight bindings, some made entirely of space-age plastics. They are either 50 or 38 mm wide at the toe, as opposed to the former standard of 75 mm. The narrow bindings that couple with toe extensions built into the boots are intended to provide the most natural, unrestricted and efficient movement of the skier's legs while running in a prepared snow track.

Cross-country boots have been keeping pace with the technical advances in bindings, evolving to the point where many low-cut models made of synthetic materials look more like running shoes than ski

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boots. In fact, lasts for the latest generation of boots are the same as used for making running shoes.

In the plethora of poles on the market, widely available X-C shafts made of carbon-fiber graphite are strong, flexible and unbelievably light. The racing influence which stresses lightness and efficiency has transformed pole baskets into a mysterious assortment of shapes including saucers, rakes and even butterfly wings. Current theory holds that the ideal basket extends only in the wake of the pole. The virtue is that, without a forward horizontal protrusion, the basket won't dig into the snow as the skier levers the pole. A basket that catches in the snow slows the skier down and tugs on his shoulders, creating unnecessary strain and a chance of injury.

Competition in X-C skiing has spawned a wardrobe of skin-tight, space-cadet racing suits in a rainbow of colors and stripes. Modern synthetic materials make it possible to still keep warm with heat-holding, protective undergarments.

### Downhill, X-C are merging

One innovation that shows just how far the sport has come is the development of heel-holding devices (see photo on page 89). Normally the heel of the X-C boot must lift up as an essential part of striding on skis. But when sliding downhill, an X-C skier needs the stability for turns and stops that results when boot heels are laterally fixed.

Making grooved boot soles to fit into matching plates that perform the heel-holding function is a major step for one of the largest companies in the field. This commitment seems to provide the direction for the ultimate future of cross-country skiing: It may not be long before the downhill skier in the Darth Vader suit, speeding through a radar trap at one of the major ski resorts, will be wearing cross-country skis. **PM**

### SOURCES—SKI EQUIPMENT

- Allsop Inc. (Alpine poles), Box 23, Bellingham, Wash. 98225.
- Burt International Inc. (Alpine bindings), 8 South Smith St., East Norwalk, Conn. 06855.
- Fitzwright & Sine Manufacturing Co. (gopher neoprene downhill skiwear), 17919 Roan Place, Surrey, B.C. V3S 5K1.
- Flying Aces of America (Alpine skier's hat), 530 South Barnington, Suite 110, Los Angeles, Calif. 90049.
- Hexcel Sports (Alpine skis), 750 South Rock Blvd., Reno, Nev. 89502.
- Kastinger U.S.A. Inc. (Alpine boots), 15533 Northeast 90th, Redmond, Wash. 98052.
- Norrell Inc. (cross-country poles), Tracy Rd., Chelmsford, Mass. 01824.
- Nortur Inc. (cross-country skis), 2000 East Century Circle, Minneapolis, Minn. 55441.
- Scott U.S.A. (face masks), Box 1478, Clearfield, Utah 84016.
- Sport Optics (Smith Alpine goggles), Box 11, Ketchum, Idaho 83340.
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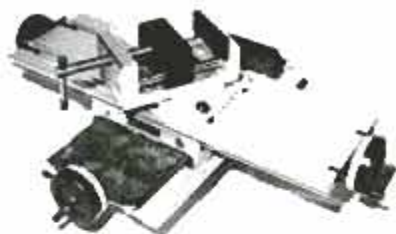
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## DRIVING THE 1981 TOYOTAS

(Continued from page 86)

most with substantial improvements.

All have steel-belted radial tires as standard, most offer really excellent stereo radios as options, and many come equipped with the new, brighter quartz-halogen headlamps.

Corolla Sport coupe and liftback have an innovative swiveling radio mount to allow equally easy access for both driver and passenger. A new four-door sedan model joins the fwd Tercel series. All Tercels benefit from improved front styling and rear legroom (but with a bit less front legroom, unfortunately), a revised engine for still-better fuel efficiency and (for the liftback) a new three-way sun/moonroof option.

The middle-of-the-line four-cylinder Coronas received a lot of attention this year to enhance their appeal. A larger 2.4-liter engine helps achieve both economy and performance improvements, a minor facelift freshens the styling, and reclining rear seatbacks provide more comfort for second-cabin occupants. New options include cruise control, the Cressida's four-speed automatic transmission, alloy wheels, stereo radio/cassette player (for the Luxury Edition liftback) and electric sunroof.

The sporty Celica gets the new 2.4-liter engine, the optional four-speed overdrive automatic and most of the same new options allotted the Corona, plus a sharp two-tone paint package that includes alloy wheels and white-letter tires. More importantly, the six-cylinder Supra becomes more appealing than ever as a high-performance sport/GT car. It features a new "performance option" that includes front and rear spoilers and special suspension, wheels and tires, giving it real racer-style handling to match its looks.

The new 2.8-liter, fuel-injected engine and a choice of five-speed manual or four-speed overdrive automatic round out the Supra package, along with new options such as a power sunroof, stereo radio/cassette player with graphic equalizer and two-tone paint.

## Toyota listens

What seems remarkable about Toyota is that its people are willing to listen, and to change the products according to what they hear. I've always hated Toyota's mushy handling and cramped front legroom, for example, while others have complained about nonsupportive seats and low-quality radios. Now we see

firmed-up suspensions, increased front-seat adjustment travel, firmer, more contoured bucket seats and quality sound systems popping up in the '81 models. We asked for it, we got it.

After the presentations and the ride and drive were over at this year's magazine writers' preview, they broke out some cold beer, sat us down and asked for our comments and suggestions.

Most automakers, especially the domestics, listen politely to people's opinions and then go right on doing things the way they always have. Maybe that's one reason why Toyota sales keep climbing and Detroit's have slumped so badly.

At any rate, I'll bet they change that herringbone Cressida grille next year. **PM**

## THE NEW DATSUN 810

(Continued from page 87)

make this the ideal budget BMW.

What the engine lacks in power, however, it makes up for in economy. According to Datsun, the five-speed Deluxe sedan logs 23 mpg city and 35 mpg highway, for a combined average of 27 mpg. The Maxima automatic's figures are 22/27/24.

## A talking dash

Datsun builds a terrific air conditioner, and I've got to tell you at least some of the goodies you get with the Maxima. A full count would fill a catalog, but following are just some of the highlights.

Among them are air, the automatic transmission, power steering, power four-wheel disc brakes, power windows, power door locks, power sunroof, power outside mirrors, power antenna, integrated AM/FM stereo tape with seek/search and digital readout, tilt wheel, cruise control, six-way front seats with recliners and adjustable lumbar support, styled alloy wheels, steel-belted radials, full instrumentation including tach, quartz digital clock with elapsed time and date, plus upholstery choices.

You'll find several storage bins inside the 810, including a huge, usable glove box, and map pockets in the doors and seatbacks. I appreciate the center-mounted emergency brake, which eases uphill starts with the five-speed. Instruments are logical and legible, but the Deluxe excludes some gauges.

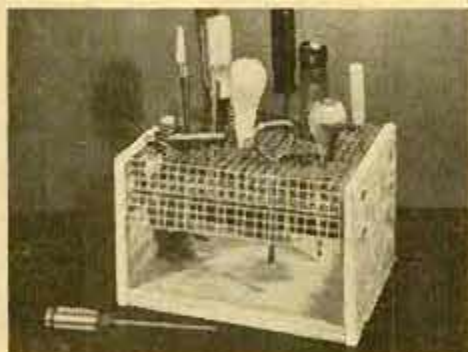
You get remote releases for the decklid and gas-filler door, with an override in case you don't want the trunk opened from inside the car.

The gadget I like best, though, is a

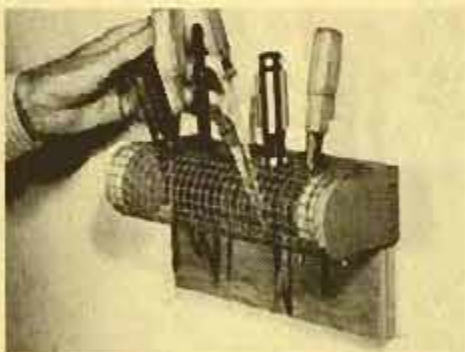
(Please turn to page 128)



# 4 great projects to make for your shop



Portable bench rack puts small tools within easy reach, and unclutters work area.



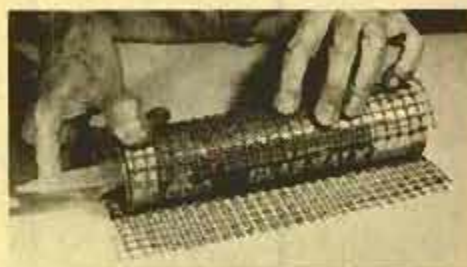
Wall rack uses hardware cloth formed into a cylinder and held by wood discs at ends.

## Quick-to-make tool holders from mesh

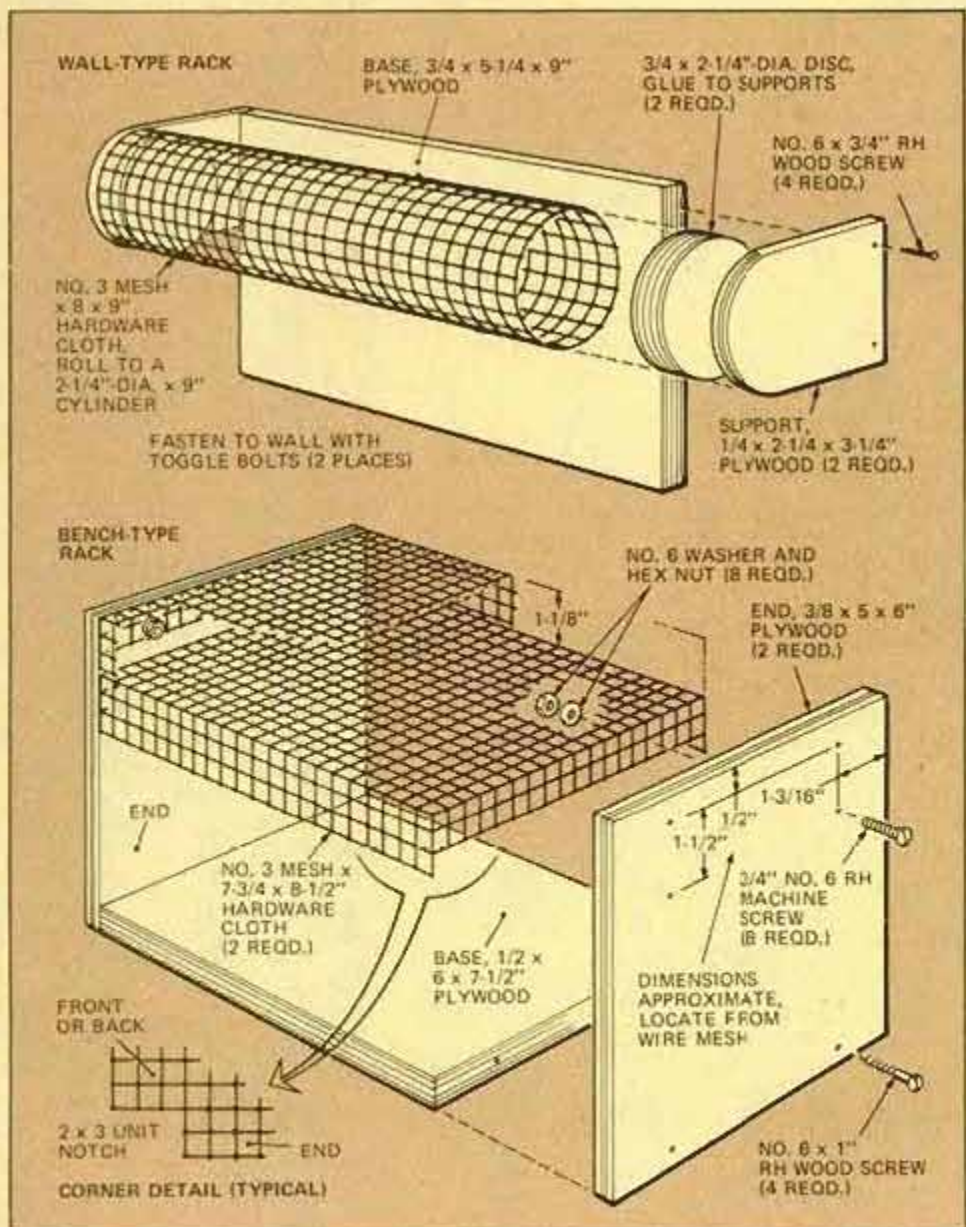
Inexpensive scraps of hardware cloth are ideal for making tool holders in a variety of shapes. The ready-made openings in the wire mesh save the work of boring holes in wood racks, and they accommodate a wide assortment of screwdrivers, punches, chisels, brushes and other slim-shanked tools.

Two easily made racks are shown here: one for use on a bench and one for wall mounting. Three-mesh, galvanized hardware cloth has three openings to the inch and accepts tools with shanks up to about  $\frac{3}{16}$  in. in diameter. Two-mesh cloth has two openings per inch and takes somewhat larger tools.

To keep tools neatly upright, you need two levels of mesh—one at the top and one underneath to catch the tips. In the wall rack, this is accomplished by rolling an 8 x 9-in. piece of mesh into a  $2\frac{1}{4}$ -in.-diameter cylinder. This looks attractive and allows



Easy way to shape wire mesh into cylinder is to roll it around a caulking cartridge.



you to insert tools at various angles. The cylinder is held at the ends by wood discs glued into a U-shaped bracket. The back of the bracket extends 3 in. below the cylinder to keep the tips of slanted tools from scratching the wall.

The bench rack is just a U-shaped wood stand fitted with two levels of mesh about  $1\frac{1}{2}$  in. apart. Bend the edges of the mesh down at  $90^\circ$  all around to add stiffness. Shape the pieces first before determining final dimensions for the stand. The mesh is held in place by small bolts and washers.—Walter E. Burton



## Trammel point for a hand grinder

**A**ttach this homemade trammel point to a high-speed hand grinder and you have a precision tool for cutting perfect discs from wood or plastic. The adjustable pivot point allows the grinder to swing in a smooth, preset arc. It also makes it easy to rout intricate, circular patterns in flat stock, such as those used for decorating cabinet doors, serving trays or wall plaques.

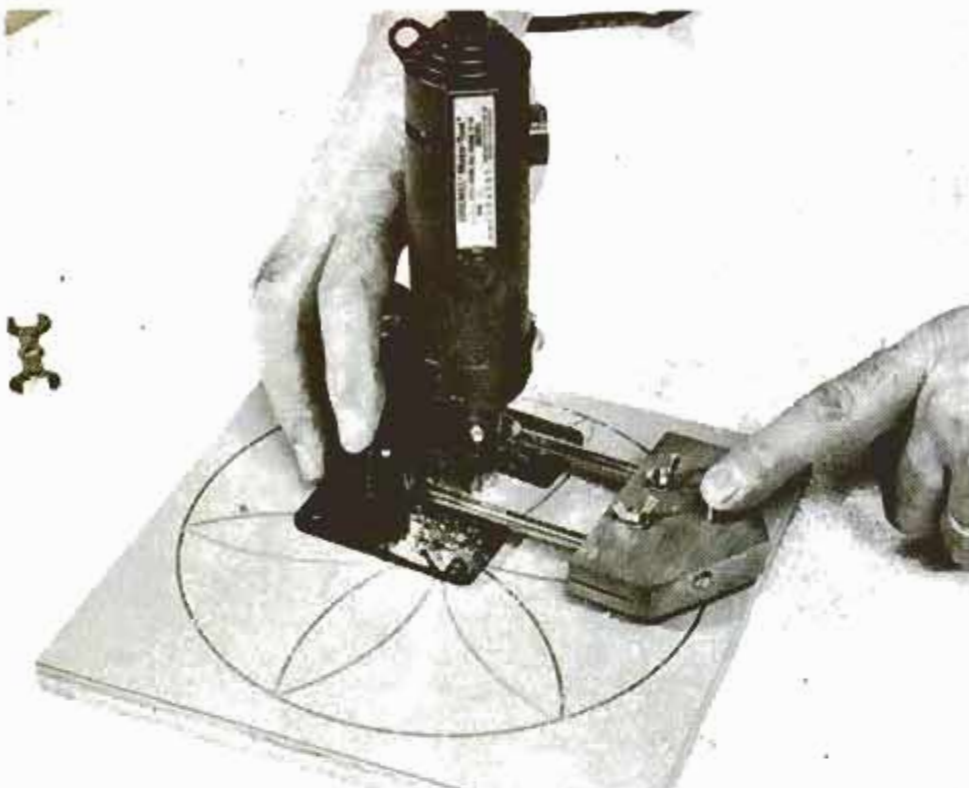
The striking geometric design at left, for instance, is made simply by setting the trammel point to the circle's radius, and sweeping the grinder in a series of intersecting arcs.

The pivot block is designed to fit the Model 229 accessory router base made for Dremel hand grinders. It clamps onto the two  $\frac{1}{4}$ -in.-diameter steel rails that come with the attachment and it can be adjusted to produce accurate circles up to 8 in. in diameter.

Start with a  $2\frac{1}{4} \times 3\frac{3}{4}$ -in. block of hardwood,  $\frac{3}{8}$  in. thick. Drill the two  $\frac{1}{4}$ -in. edge holes for the router-base rails, the two  $\frac{1}{8}$ -in. holes for the clamping bolts and the  $\frac{1}{16}$ -in. center hole for the pivot point. Then carefully cut a 1-in.-deep saw kerf into the edge so it splits the rail holes down the middle. This slit allows the block to compress so that it locks snugly on the rails when the wingnuts are tightened. Trim the corners off the block to form a V shape, as shown. A 4d finishing nail, inserted in the pivot hole, serves as a point.

When cutting, hold one hand on both the nail point and wood block to steady the assembly, while guiding the grinder with the other hand. Use scrap material under the work, especially when cutting completely through. Dremel's No. 193 cutter works well for making through-cuts. Veining cutters can be used for routing surface designs. When working with acrylic, don't cut any deeper than  $\frac{1}{32}$  in. on each pass or the tool will be subjected to strain and possible damage.

Where you don't want the trammel point to leave a mark on the work, use this trick: Glue on a pad of  $\frac{1}{4}$ -in. hardwood with newspaper in between the trammel and the work surface. Coat both sides of the newspaper with a small amount of white glue. Rest the trammel point on the pad. Later, the pad can be easily pried loose and the glue sanded off. On acrylic sheet, glue the pad to the protective paper and, afterward, peel it off.—*John E. Gaynor*



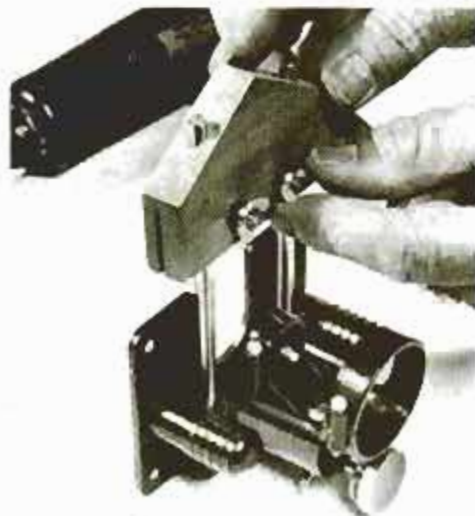
With this easily made trammel point for a Dremel hand grinder, you can cut circles in wood or plastic, and rout intricate patterns like the flower-petal design above.



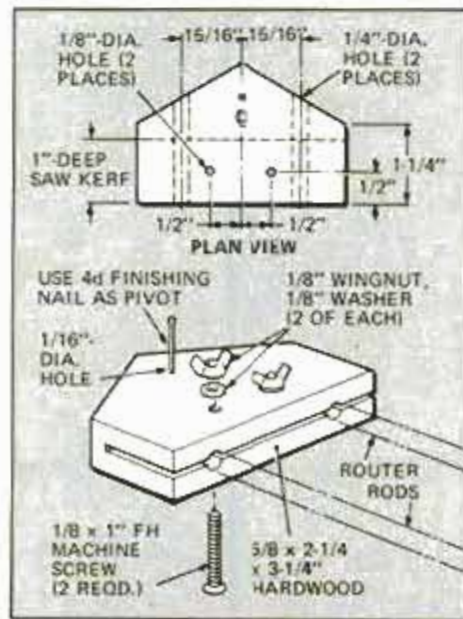
To avoid scratches when cutting acrylic, glue wood pad to protective paper to take the trammel point, then peel off the pad.



Edge silt is sawed in the trammel block, so block can be clamped securely on the router-base rails. Backsaw is best for this.



Trammel block slides on router-base rails and can be adjusted to form circles up to 8-in. diameter. Wingnuts lock it in place.





## Mini hand router

There are times when a full-size power router is just too big and bulky for easy use on small, delicate work. This mini hand router, with its see-through plastic base, is ideal for operations where a power router would obscure your view of the cutter and be awkward to handle.

You'll find the tool great for fine bottoming and relieving cuts, intricate pattern making, squaring rounded corners made by circular bits and the like. Cutting bits are made from ordinary  $\frac{1}{4}$ -in. Allen wrenches, which are of high-grade steel and can be custom-ground to many special-purpose shapes.

Make the router base from  $\frac{3}{4}$ -in.-thick clear plastic, such as Plexiglas or Lucite. Cut it to the claw-foot shape shown in the pattern below. Be sure that the back and sides are  $90^\circ$  square to each other so the router can be run along a guide bar, if desired. Bits are held in a steel block, a  $1\frac{1}{4}$ -in. length cut from  $\frac{5}{8}$ -in.-square bar stock. The block is bolted to a 3-in. length of  $\frac{3}{4}$ -in. angle iron which, in turn, is bolted to the plastic base.

Clamp the angle iron to the base,  $\frac{1}{4}$  in. from the back edge, and drill two  $\frac{7}{32}$ -in. holes through the metal into the plastic. Tap the plastic for  $\frac{1}{4}$ -20 roundhead machine screws  $\frac{1}{2}$  in. long and fasten the angle to the base. Clamp the bit-holding block to the angle iron and drill two  $\frac{7}{32}$ -in.



Easily guided by hand, minirouter, with see-through base, produces fine, precise cuts.

holes through the angle into the block. Tap the block for  $\frac{1}{4}$ -20 flat-head machine screws, countersink the holes in the angle so the heads will seat flush, and fasten the block to the angle.

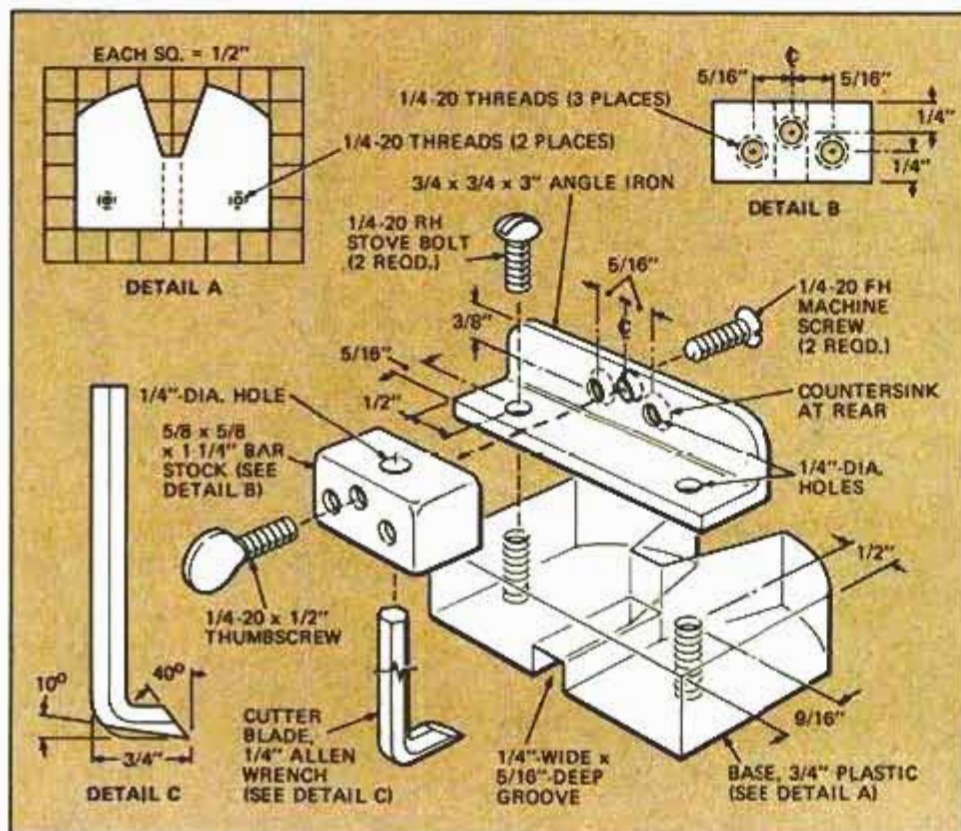
### Making the bit holder

Mark the center of the block and drill a  $\frac{1}{4}$ -in. hole through the block, angle iron and plastic base. This hole will accept your bits. To lock a bit in place, drill and tap the block crosswise for a  $\frac{1}{4}$ -20 thumb screw. Run the tap all the way through both the block and angle iron so the thumb screw can be inserted from either side. This will allow you to

reverse the screw for bullnosing operations.

With the assembly held upside down in a vise, hacksaw and file a flat slot in the plastic running from front to back across the bit-holding hole. Make the slot  $\frac{1}{4}$  in. wide by  $\frac{3}{16}$  in. deep. This allows the bit to be fully retracted up into the base.

To make a cutting bit, grind an Allen wrench so that  $\frac{3}{4}$  in. remains of the short leg. Slope the heel  $10^\circ$  downward toward the tip to provide chip clearance. Grind off the point at a  $40^\circ$  angle to form a cutting edge. Work slowly to avoid overheating the steel and, possibly, removing the temper.—Robert Bessmer



Router underside shows slot cut in base that allows cutter to be fully retracted.



Assembled router has bit locked in. Thumb screw can be inserted from front or back.





## Sabre-saw jig for circle cutting

**C**utting perfect circles with a sabre saw is easy with this simple jig. It holds the saw upside down, and a sliding pivot block adjusts for any diameter from 3 to 33 in. In addition, the stand turns a sabre saw into a stationary jigsaw for many other precision cutting jobs.

Start with a 12 x 13-in. piece of 1/2-

With the saw held upside down, it's easy to rotate the work on the adjustable pivot for automatic cutting of circles and arcs.



Saw rests in snug-fitting pocket on underside of stand, so blade is quickly and accurately aligned when it's inserted.

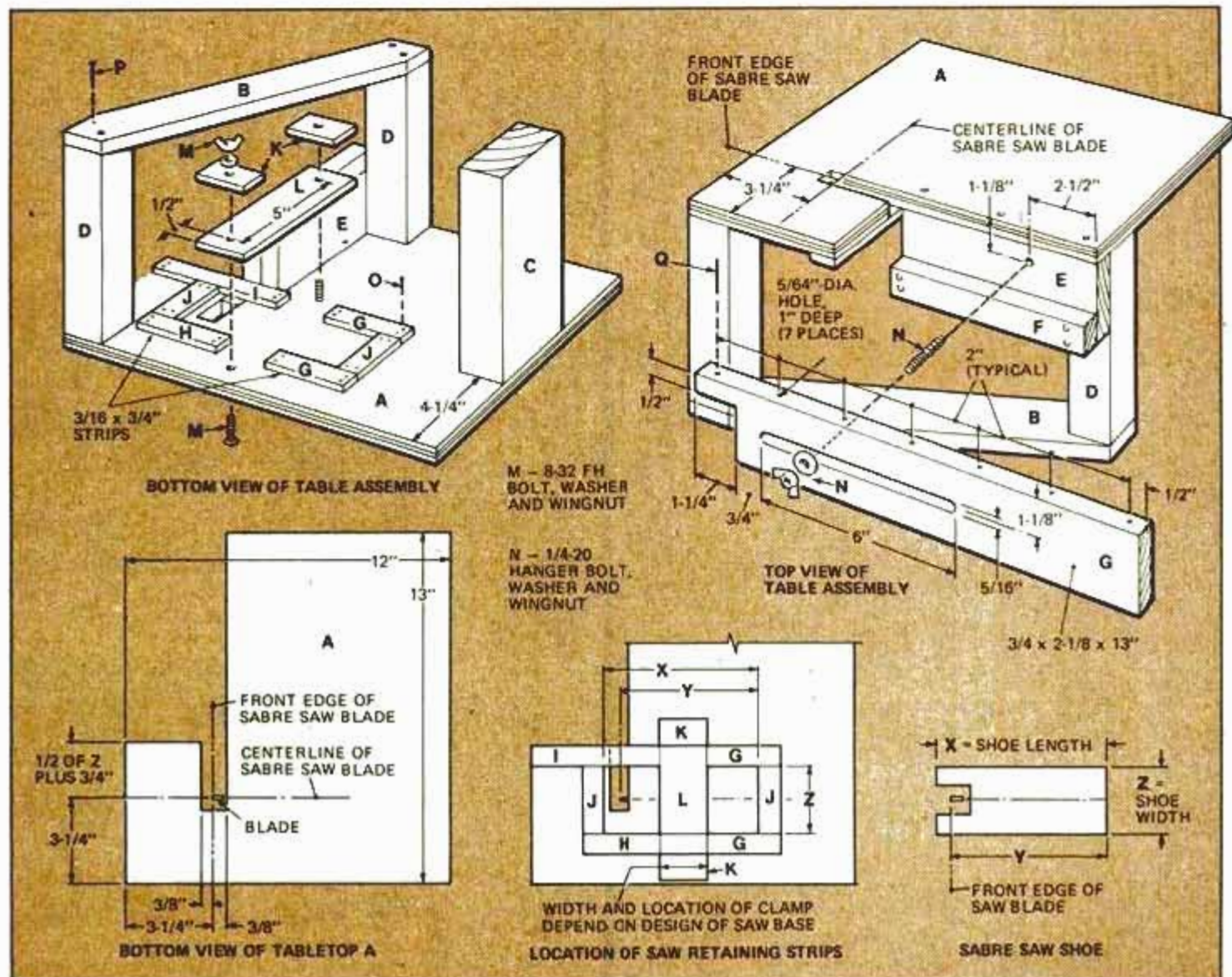


Sliding pivot block, locked by a wingnut, has many holes, so work can be positioned for cutting any size circles up to 33 in.

in. plywood and lay out the two intersecting lines on the top and underside. One line represents the centerline of the saw blade; the other is the blade's front edge. Other dimensions follow from these lines.

Cut out the corner and slot, then turn the piece over to mount the saw. Position the saw so the blade lines up with the marks, then draw around the shoe. The saw rests in a pocket formed by thin wood strips and is clamped in place by a strap across the shoe. Size the legs to allow finger clearance underneath for reaching the saw's on-off switch. Assemble with glue and nails.

To cut a circle, clamp the jig to a bench. Drill a 1/4-in. hole in the work's center and insert a nail through this into the appropriate hole in the pivot block. Slide the work up to the blade, lock the pivot block, then rotate the work. To start the cut within the work, drill a blade-entry hole on the cutting line and place the work over the blade and pivot.—*J. Hoogstraten*





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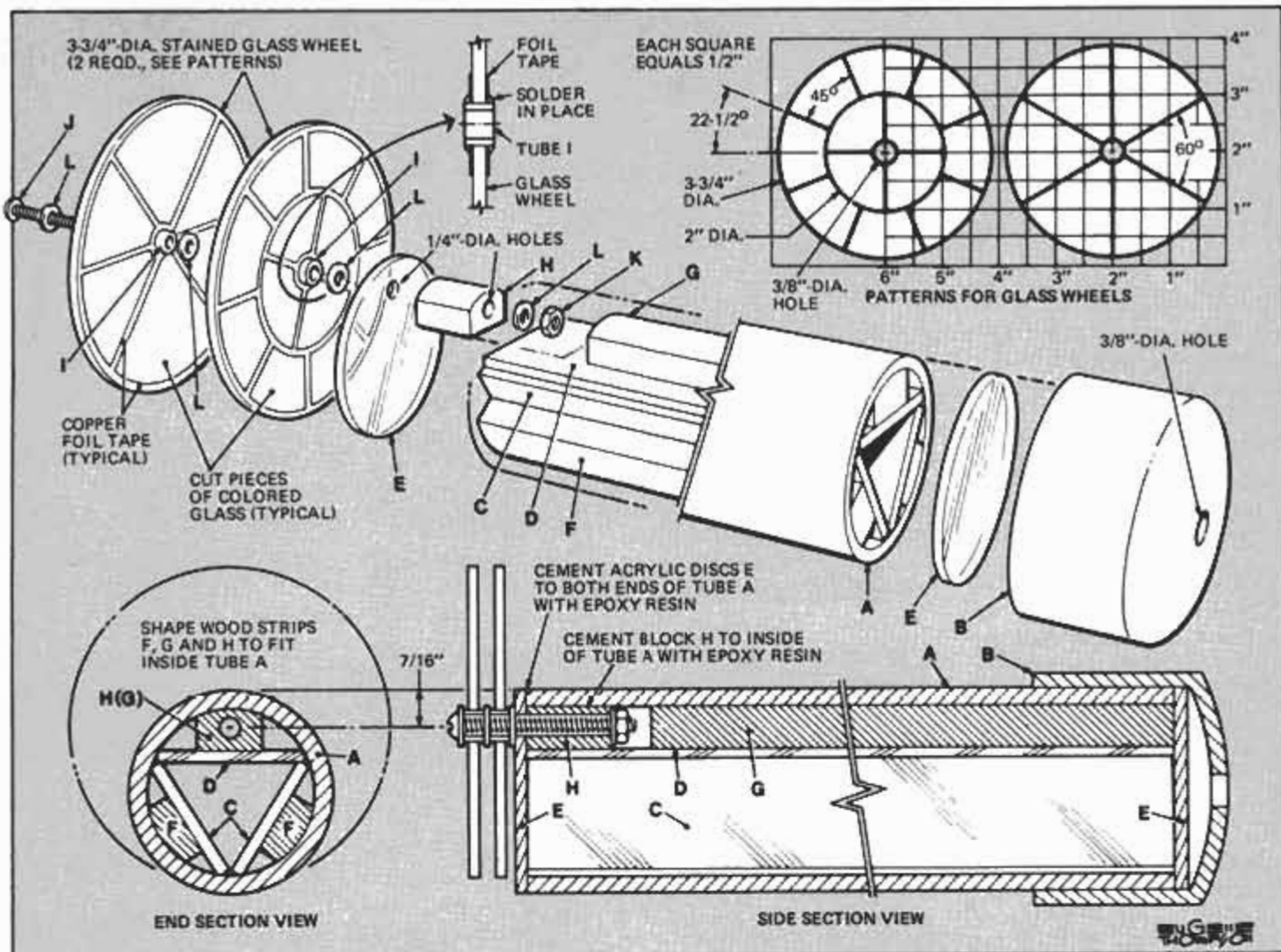


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## SHOPBUILT KALEIDOSCOPE

(Continued from page 101)

When you make the score, you should hear a slight hissing as the cutter travels over the glass, scratching a faint line into the surface. If the score is deep and there are tiny shards of glass along the line, you pressed too hard. The cut may be ragged. On the other hand, if you can wipe the line away with a finger, it was merely the cutter's trail in the oil on the glass. Press harder and try again. *Never* go over a scored line twice, however, or your cutter will quickly become dull.

If the glass you're using is so dark that you can't see the inked pattern through it, make a duplicate pattern on stiff paper. Cut out the pattern pieces and lay one on top of the glass to guide your cutter.

To make a quick break, form fists with both hands and grip the glass so your thumbs straddle the score line with fingers under the glass. Move your hands in a down-and-out motion to snap it.

If the glass is stubborn, tap along the underside of the score line with the ball end of the cutter until the cut begins to run. If the glass is too

small to grip easily, use pliers to snap off unwanted parts.

Wash the glass with detergent and hot water, dry it, and then wrap copper foil around the edges of each piece so edges are centered on foil. Smooth foil with a dowel or pencil.

Lay the foil-wrapped glass on the pattern to check for fit. Then brush the copper with oleic-acid flux and solder the pieces together with 50/50 or 60/40 solid-core wire solder. Don't overdo the solder. Use enough to hold the wheels together, but don't make them unnecessarily heavy. Solder spacers (I) into the center of each wheel. Next cut the three mirror strips (C and D). Make the scores on the glass side, not on the silvered side. Then snap off the strips as you would any other glass.

Cut two clear-acrylic discs (E) to seal the ends of the tube. In one of the discs bore a 1/4-in.-dia. hole with a center that is 7/16 in. from the edge. To secure the mirrors inside the tube, cut three wood strips (F and G) and wood block H. Bore a 3/16-in.-dia. hole through H.

Make sure all glass, mirror and acrylic parts are clean. Then cement the acrylic disc without the hole to one end of the tube. Slip end cap B in

## MATERIALS LIST—KALEIDOSCOPE

Key	No.	Size and description
A	1	2" i.d. (2 1/8" o.d.) x 12" plastic plumbing pipe
B	1	2" i.d. plastic end cap
C	2	1/4 x 1 1/2 x 12" mirror
D	1	1/4 x 1 1/4 x 12" mirror
E	2	1/4 x 2 1/4"-dia. clear-acrylic disc
F	2	1/2 x 1/4 x 12" wood strip
G	1	1/2 x 1/4 x 10 1/2" wood strip
H	1	1/2 x 1/4 x 1" wood block
I	2	1/4 x 1/4"-dia. copper tube
J	1	No. 8-32 x 2" machine bolt
K	1	3/8" i.d. nut
L	4	1/2" i.d. washer

Misc.: 1 roll of 1/4-in.-wide copper foil tape, 1 roll of 50/50 or 60/40 solid-core wire solder, 18 pieces of colored stained glass, glass cutter, pliers, oleic-acid flux, flux brush, cutting oil, 60 to 100-w. soldering iron, PVC solvent cement, epoxy resin cement, contact paper, inked wheel pattern.

place. Slide the three mirror strips into the tube in a triangular shape, mirror sides facing inward. Carefully slide the wood strips in place. Position wood strip G under mirror D.

Slide the parts onto machine bolt J in the order shown above and secure nut K with epoxy resin. Apply epoxy resin to the open rim of the tube and to the wood block where it will be in contact with the tube. Position the wheel assembly and tape disc E in place until the epoxy hardens.

As a final touch, you might decorate the kaleidoscope with self-adhesive vinyl cut into simple shapes.





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**THE NEW DATSUN 810**

(Continued from page 118)

synthesized voice that speaks up when you forget to turn off your headlamps. From somewhere beneath the instrument panel, a young lady reminds you: "Please turn off your headlights; please turn off your headlights!"

One mid-year change might be the availability of a five-speed in the Maxima. I certainly hope so. Perhaps more important, however, is the promise of an 810 diesel. It's due



The heart of Datsun's talking dash is this black box. It contains a tiny disc and needle which plays a prerecorded voice.

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in late February. The 810 diesel is being EPA-certified now.

This really ought to be the year American drivers discover the 810. Datsun projects 20,000 in 810 sales during the 1981 model season—a modest figure when you consider all you get for the money. My opinion of the 810 hasn't changed; in fact, it's been reinforced. The car's still a fantastic bargain—just better looking than before.

**DRIVING THE 1981 MERCEDES**

(Continued from page 93)

sport coupe (previously 450SL and 450SLC) get the new 3.8-liter gas V8 engine and become the 380SL and 380SLC.

Which brings us to the all-new big cars, the S-class Mercedes, the 300SD (3-liter turbodiesel) and 380SEL (3.8-liter, overhead-cam, fuel-injected, gas V8) for 1981.

**Slippery bodies**

At first glance, these cars don't look much different from their 1980-model predecessors, the most obvious change being a new styling treatment around the headlamp/park lamp area. But look again. While the overall lengths are a bit shorter (thanks to more integrated

(Please turn to page 130)



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**DRIVING THE 1981 MERCEDES**

(Continued from page 128)

bumper designs), the wheelbases are longer. This moves the wheels out toward the ends of the body, creating more useful room.

The new bodies are also two inches narrower, flatter on the sides, lower at the front and taller at the rear. There is also a more gently sloping windshield and rear window, to punch a clean, wedge-shaped hole in the air. The result is a drag coefficient (C/D) of 0.36, fairly remarkable for a "notchback" sedan, and a 13-percent reduction in total wind drag, over the previous car.

Additional benefits of the longer wheelbases and slippery sheet metal are reduced side-wind sensitivity, less interior wind noise and improved ride smoothness. The 300SD now does the 0-to-60 test in 14.3 seconds, and the 380SEL achieves it in a fleet 11.2 seconds.

**New automatic four-speed**

The 300SD doesn't feel much different to drive from last year's version. It's a bit sluggish off the line, but then the turbocharger kicks in and gives very undiesel-like performance through the new four-speed automatic gearbox.

The longer, roomier and better-equipped gas-powered 380SEL gives better performance and proportionately poorer economy, as would be expected. Both cars provide the expected Mercedes attributes of outstanding road-gripping, handling and braking—in fact, far beyond what the average driver is ever likely to use or appreciate.

The turbodiesel five-cylinder engine (nationwide) is identical to last year's California version, with exhaust-gas recirculation to meet 1981's tougher emissions standards. The 3.8-liter gas engine, on the other hand, is completely new. It features a lightweight aluminum block, electronic fuel injection and idle control and a three-way emissions catalyst with exhaust-gas sensing and feedback.

A partial list of standard equipment on the 300SD includes automatic climate control airconditioning, power windows, halogen headlamps and fog lamps, variable-ratio power steering, stereo radio with cassette player, light alloy wheels and power four-wheel disc brakes. For a mere \$10,000 more, the 380SEL offers all that plus power-adjusted rear seats, leather or velour upholstery, a vacuum-operated "economy meter," metallic paint and a wonderfully complicated digital radio/cassette player. It's \$44,298.



# PHOTO HINTS

## Photo-timer stop



Reset a photo timer to an exact position by mounting a "stop" indicator on the timer face. Ours was made from a circular magnet. We forced a 1-inch dowel into magnet's hole, and added a cardboard pointer. The indicator marks desired setting.—Ken Patterson

## Identify your film

Shoot your name and address as the first picture on each roll of film to protect against the processor losing your mailer. A color name card will give color-accuracy checks.—B. Freer Freeman

## Silk for a warm hand



A silk glove liner is ideal to wear when shooting pictures at low temperatures. It fits closely so you can easily operate the camera. Sports shops sell them for skiers.—Bob Berger

## Protecting contact lenses

Do you wear contact lenses? Take proper darkroom precautions if you do. Some photographic chemicals can pit the glass of the lenses, causing dust contamination and eye irritation. Switch to regular glasses or a shop-type eye protector.—Larry Bihlmeier

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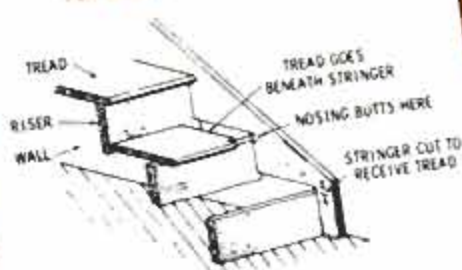
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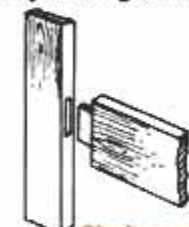
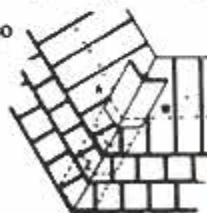
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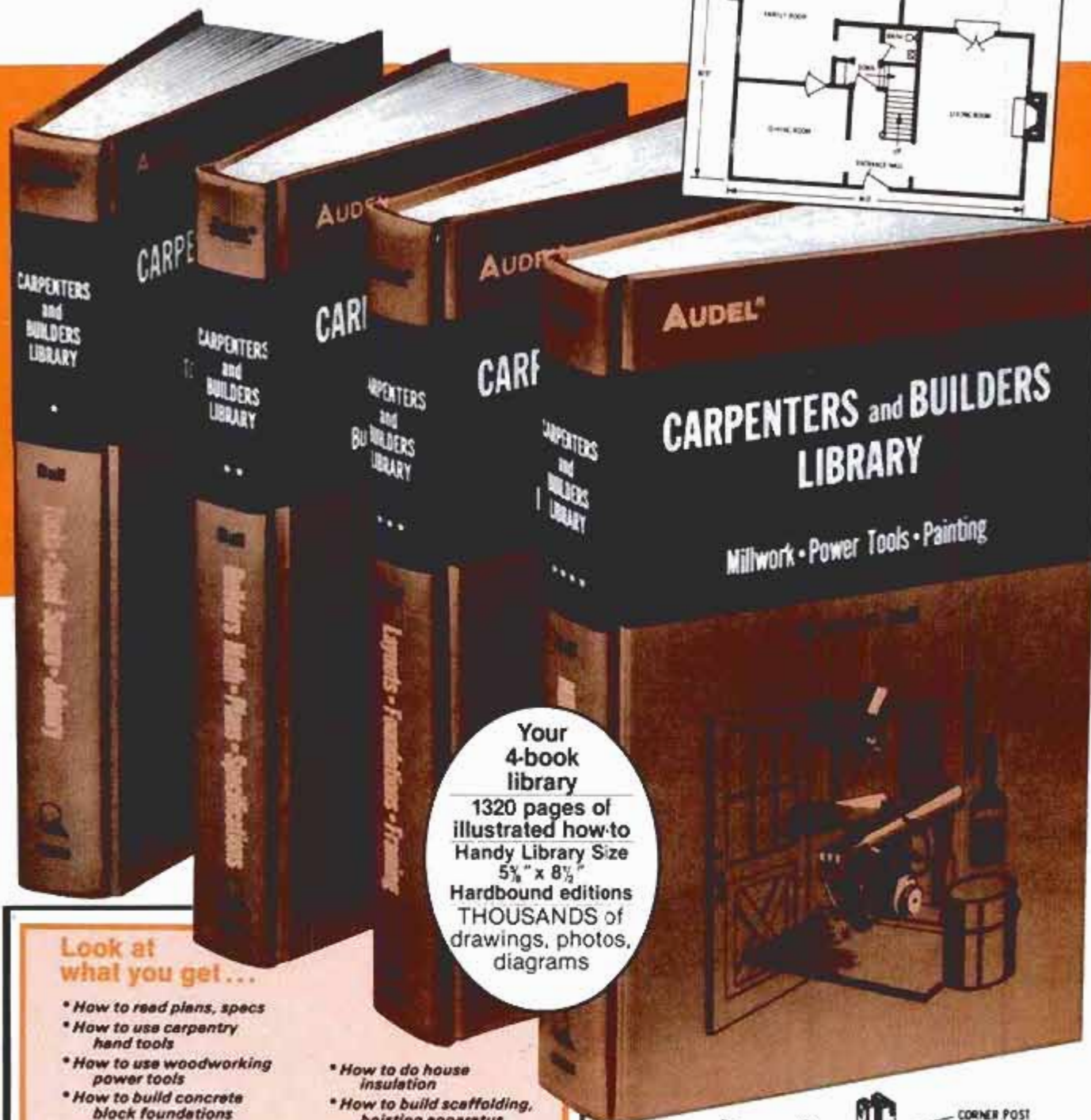
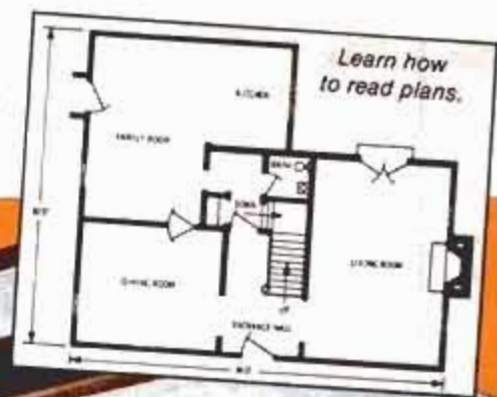


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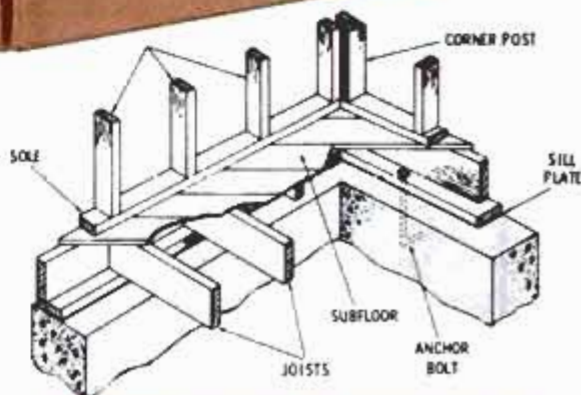
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## THE 'MYSTERY PLANE' THAT ALMOST KILLED HOWARD HUGHES

(Continued from page 92)

4-3361 and find out what frequency he is using."

### Critical time lost

Hughes didn't know it, but he had just lost critical time. He could have had instant contact with his home field from the beginning merely by switching to "C" channel, which was specially assigned to test flights and was being monitored. Now it was too late. As he finished talking with Los Angeles Tower, "the airplane suddenly felt as if someone had tied a barn door broadside onto the right-hand wing," as he later recalled.

He was two or three miles east of home field, heading north at approximately 5000 feet. He allowed the aircraft to turn right until it headed almost due east. Then he stopped the turn and forced the plane to make a 180° turn to the left. The aircraft was losing altitude rapidly all the while.

Odekirk and Blandford misinterpreted these maneuvers. They thought he was maneuvering to enter a left-hand pattern preparatory to landing at Culver City. They broke the A-20 off and made a short approach in order to land well ahead of the XF-11.

Hughes loosened his seat belt and kept his left hand on the control wheel while he moved about the cockpit, straining to see as much of the aircraft as he could through the canopy. Nothing he saw explained his problem, yet it felt "as if some giant had the right of the airplane in his hand and was pushing it back and down."

### Losing altitude

He had to hurry now. There was no time to refasten his seat belt. He took the control wheel with his right hand and with his left increased the manifold pressure to 50 or more inches of mercury and ran the props up to 2800 rpm. No help. He reduced the power to about the original setting and then tried full throttle and about 2200 rpm on the right engine. No help. He reduced power on the right engine. Still no help. By now he was down to about 2500 feet and thought of bailing out. No, probably too low for that now.

He had to hold full left rudder and full left aileron to keep the aircraft approximately level. This raised the spoilers on the left wing to their full UP position and caused further loss of lift. He could control the direction of flight, but not the altitude.

Now he was below 1000 feet, tail low, power on, still going down,

heading northwesterly above the rooftops and swimming pools of Beverly Hills. "Maybe a landing gear door or some other underside surface has torn loose and turned broadside to the wind," he thought.

He dropped the gear, thinking it might knock the offending structure loose, but as soon as the gear was down he knew that wasn't the problem. He was going to crash!

### A fiery end

Hughes planted his feet high on the instrument panel and attempted to flare into the roof of a house directly ahead, Hollywood-stunt-pilot style. He hit in a climbing attitude, tail down, right wing low. The right landing gear and engine crashed through the second story wall and roof, the left landing gear struck the peak of the roof, then the right wingtip struck the neighboring house. This sequence slewed the aircraft violently to the right and it hurtled sideways through the air, striking a power pole with its left side and smashing the pilot's canopy.

The remainder of the right wing crashed through the roof of the garage next door. What was left of the airplane struck the ground across the alley, then bounced and skidded sideways so that the left wing penetrated the rear of another house. Miraculously, no one on the ground was badly hurt.

### Breakage absorbs energy

This breaking of wings, landing gear and other peripheral parts of the airplane as they crashed through yielding structures on the ground dissipated much of the kinetic energy of the stricken craft. The center section finally skidded to a stop between two houses without directly suffering catastrophic impact. Flames burst out in an explosive flare as spilled gasoline from the XF-11 ignited.

A few doors down the street, Marine Sgt. William L. Durkin was dozing in the living room of a friend's house when he heard what sounded like a big diesel, then like a four-engine R5D (C-54 transport) passing within 15 feet of him on takeoff.

As the plane hit, Durkin was up and running. He reached the street and saw a ball of fire and black smoke boiling upward. He turned left and ran up the alley across the street, which divided the triangular

(Please turn to page 138)







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## THE 'MYSTERY PLANE' THAT ALMOST KILLED HOWARD HUGHES

(Continued from page 136)

block in two. Now he saw the tail section and a piece of the wing. That tail section sure didn't look right, but he still thought it was an R5D.

It was hotter than hell. The plane had broken a small gas main whose flames shot up about six feet, and the house and the plane itself were burning. It was difficult to see clearly because of the smoke. As Durkin circled the house, broken shrubbery slowed his progress. Out front, he saw a big radial engine with double props smoking on the front lawn and he thought, "That's funny. Two props."

The engine, torn loose from the left wing, had clipped a row of poplar trees about three feet above the ground and laid them out toward the street. These impeded Durkin's approach to the plane's nose and the left wing's leading edge because he was going against the slant of the branches.

### 'Nobody could live . . .'

Durkin crouched and tried to see if anyone was moving. The heat was intense. When he moved, his hot shirt burned wherever it touched his skin.

"I'm being stupid," he thought. "Nobody could live through that."

He started to get up. It was really hot then. He slipped slightly and felt panic rising. He dropped to his belly to collect himself. He decided to call out.

"Over here!" he yelled. He yelled again. The third time he heard a banging that he thought came from the cockpit. Actually, it was the sound of Hughes falling on the wing and then to the ground.

The plane had hit a couple of eucalyptus trees as it crashed and the blow from one had trapped Hughes's left foot in the cockpit. Another tree had split the canopy right down the seam.

### Canopy gives way

After Hughes got his foot loose, he stood up on the seat and threw his shoulder into the plastic canopy, which was so hot by this time that, even though it was more than an inch thick, it gave way, bending out without shattering. He then stepped out on the wing and collapsed. As he fell, he hit the leading edge and dropped to the ground. Durkin heard, but didn't see him.

"Somebody's stumblin' around in there," thought Durkin. He took a deep breath, put his hand over his nose and mouth, closed his eyes and jumped toward the sound. He land-

ed right on Hughes. Flames were burning a 10-inch strip of the man's clothing from above the armpit right down to his waist. Durkin took Hughes's wrist, lifted the arm clear, and with his own forearm brushed the fire out. Hughes's hand looked as though it had been stuck in a deep-fat fryer, all bubbly and horrible-looking.

Durkin yanked his burden a couple of feet before being stopped by the fallen trees. "Hell," he thought, "the accumulators, tanks and what-not are still going to go up on this thing, but with this damn brush, how am I ever going to get out of here?"

By this time, a crowd had collected and Durkin spotted a fireman through the smoke.

"Hey, give me a hand in here!" he yelled.

"Wait a minute 'til I get a hose," the fireman said.

The survivor propped up beside Durkin never spoke. His eyes were open, but Durkin didn't know if he was conscious or not.

### Help arrives

Durkin looked toward the wing and saw that the self-sealing rubber had started to go. The wind, which had been nearly calm, stirred and shifted.

Durkin thought he saw a big ball of fire coming right at him. Suddenly, he had the strength of 10 men. He picked up Hughes like he weighed two pounds. As he got his burden up, he felt a hand on his shoulder. It was the fire chief. He had come right in after all.

"You take him by the wrists," Durkin said. "Don't touch his hands. I'll take him by the ankles."

When well clear, they stretched him out on the ground. Durkin bent down. "How many people are in there?" he asked.

"I was by myself," the man said.

The ambulance took Hughes to the Beverly Hills Emergency Hospital. "I'm Howard Hughes," he said on arrival and then passed out.

### A close brush with death

He nearly died. The crash had occurred at 6:42 p.m. on Sunday, July 7. In the early morning hours of July 8, he suffered severe internal bleeding into the pleural space around his left lung, which had suffered contusions from severe crushing of the chest and was not functioning.

As Dr. Vern Mason, Dr. Lawrence  
(Please turn to page 140)



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## THE 'MYSTERY PLANE' THAT ALMOST KILLED HOWARD HUGHES

(Continued from page 138)

Chaffin and a team of nurses and technicians struggled to save his life, Hughes's blood pressure fell rapidly and he slipped into deep shock.

Swiftly, efficiently, they gave him two transfusions while administering a constant flow of pure oxygen, and drained 3400 cc of bloody fluid from the pleural space in three separate tappings.

Gradually, as the hours passed, Hughes's blood pressure rose and he began to come out of shock. Now the excruciating pain began.

They gave him injections of morphine. It was the start of a 30-year drug habit that eventually killed him, says Forest S. Tennant Jr. of the University of California's School of Public Health in Los Angeles. (Tennant compiled the Hughes medical history for the Federal Drug Enforcement Administration when authorities investigated a possible murder conspiracy by Hughes's aides after Hughes's death in 1976.)

### A reversed propeller

Transferred from Beverly Hills, Hughes spent 35 days in the Good Samaritan Hospital. During that time, Glenn Odekirk, who at Hughes's request stayed in an adjacent room with the door open between them the entire period, was the only person other than doctors and nurses allowed to see him.

Odekirk gave orders that nothing at the crash site was to be touched until he said so. A day or so after the crash he went to the site and marked the collars of the propellers at the hubs to show the blade settings before the wreckage was moved to the plant.

The right rear propeller was in a 14° reverse pitch.

### An explanation by Hughes

On July 11, Hughes prepared a statement that he asked Dr. Mason to pass to the Army Air Forces and release to the press.

"The front four blades of the propeller were trying to pull the airplane ahead, while the rear four blades were trying equally hard to push it backward," he said. "To make matters worse, these eight large propeller blades, whirling around fighting one another, created a dead drag on the right-hand side. This also destroyed the flow of air over the right wing and created a tremendous loss of lift."

During the investigation that followed, the Propeller Laboratory at

Wright Field concluded that all available evidence indicated that the pitch-change mechanism of the right rear propeller component failed due to fluid loss. The propellers had separate hydraulic systems for the front and rear components that were independent of the engines.

Loss of more than 40 ounces of fluid from either component would permit the blades in that component to go into reverse pitch and the propeller controls to become ineffective. Stops in the XF-11's propeller hubs were originally set to prevent reversing, but were reset during taxi tests after Hughes got too "hot" one day and damaged a wheel trying to stop on brakes alone.

### No fluid check

Seals on the rear propeller components were known to permit loss of fluid, probably to the engine gearbox, which was at a slightly reduced pressure for scavenging. Fluid failure (leakage of approximately four ounces per hour) had occurred with this propeller on test stands and on other airplanes. On July 7, Hughes knew his props were potentially reversible, but neither he nor his crew checked the hubs for fluid level before takeoff.

The propeller lab also noted for the record that Hughes took off on an approved 45-minute flight, yet flew for approximately one hour and 20 minutes: "He did not follow the approved flight-test program in that attention was concentrated on operation of the landing gear, which prolonged flight duration and was not scheduled until the second hour."

### Misleading indicator

A propeller-pitch indicator, included in the flight-test instrumentation, indicated positive pitch on all propellers, even though one set of blades was in reverse. This happened because the indicator was connected to the governor control mechanism, which functioned normally, and not to the actual propeller blades. This "normal" indication apparently helped deflect Hughes's attention from the true cause of his difficulties.

The XF-11's estimated single-engine ceiling, with the dead propeller feathered, was in excess of 30,000 feet. So Air Force technicians said that he should have been able to continue flight with the right propeller windmilling in any pitch if he'd pulled the right throttle all the

(Please turn to page 142)



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## THE 'MYSTERY PLANE' THAT ALMOST KILLED HOWARD HUGHES

(Continued from page 140)

way back and advanced the left one.

Gene Blandford tells it this way: "Sure, if he'd pulled his power off on the right side, his drag would have been reduced, but show me a pilot who figures he's got a broken panel sticking out on the right wing who's going to pull power off on that side. All engine and prop instruments indicated normal operation. As he applied power on the right engine with the rear prop on that side going into reverse, the front prop automatically tried to hold the rpm constant by going into a higher pitch."

### Faulty judgment

The final report of the Accident Investigating Board assigned primary blame to the propeller malfunction, but faulted Hughes for the way he operated the airplane and conducted the flight. In particular, he was criticized for not using the special radio frequency and facilities provided, for not being sufficiently acquainted with emergency operating procedures for the propeller, for retracting the landing gear, for not giving proper attention to the possibility of an emergency landing when sufficient altitude and directional control were available, and for failing to analyze and evaluate the problem by reducing power on both engines simultaneously in order to distinguish between structural and/or power failure. The Board was of the opinion that this accident was avoidable after propeller trouble was experienced.

Compounding Hughes's contribution to his own nearly deadly accident was the fact that on April 15, about three months before the first XF-11 flight, he had been taxiing the aircraft when the propellers suddenly reversed for no apparent reason. Frank Prinz, a service rep for the Hamilton Standard Propeller firm, was riding with Hughes at the time, but neither Glenn Odekirk nor Blandford was advised of this spontaneous reversal by Hughes (or Prinz) after the taxi test—which was specifically conducted to test operation of the props.

"Hughes didn't communicate very well," Blandford says. "He'd just get into his car after a test and drive away."

It was after that test that the prop-reverse was disconnected, but then ordered reconnected by Hughes after he subsequently blew a tire.

Hughes's aerodynamicist, Carl Babberger, says, "The airplane was designed with plenty of capacity to

take it. If he'd cut that engine, he could have come down nicely. He got spooked on that one."

It appears from accounts of all of Hughes's test flights—the Sikorsky S-43 amphibian crash on Lake Mead, the XF-11, and the later one and only flight of Hughes's giant "Spruce Goose" flying boat—that he was rather undisciplined as a pilot.

It was not his habit to use checklists, to file flight plans, to brief his crew and passengers or to make communications checks.

All agree that he was a superb pilot when it came to the actual operation of aircraft, and that he was very good at providing a test pilot's gut reactions to how a new plane felt and handled. But, according to Hughes's own flight-test engineer, Gene Blandford, he was too much an individualist and too undisciplined to provide the kind of hard data needed for quantitative testing.

### Miraculous recovery

Hughes appeared to make a remarkable recovery. Two months after the accident, although "still looking like a stretcher case," according to *Time* magazine, he flew his B-23 to New York on business. Two fingers of his burned left hand were stiff and a mustache covered scars on his upper lip.

Only nine months after the accident, Hughes found himself again in the cockpit of the XF-11—this one fitted with standard, four-bladed Curtiss propellers. In the interim, he had filed suit against Hamilton Standard, manufacturer of the first test plane's propellers—still trying to vindicate himself completely as a test pilot. And again he secured the personal intercession of General Arnold so that he could fly the second test over the strong objections of the Air Materiel Command.

On April 5, 1947, Hughes lifted the XF-11 off the runway and flew successfully, returning to an uneventful landing after 90 minutes. The aircraft was subsequently delivered to the Army Air Forces for testing and evaluation, and Hughes and his engineers let it be known that it met or surpassed every expectation.

But with the dawn of the jet age just a few years away in the skies of Korea, the XF-11 was destined to remain in obscurity. It left its mark only on the man who conceived it. The scars, both visible and invisible, remained with Hughes until the day he died.

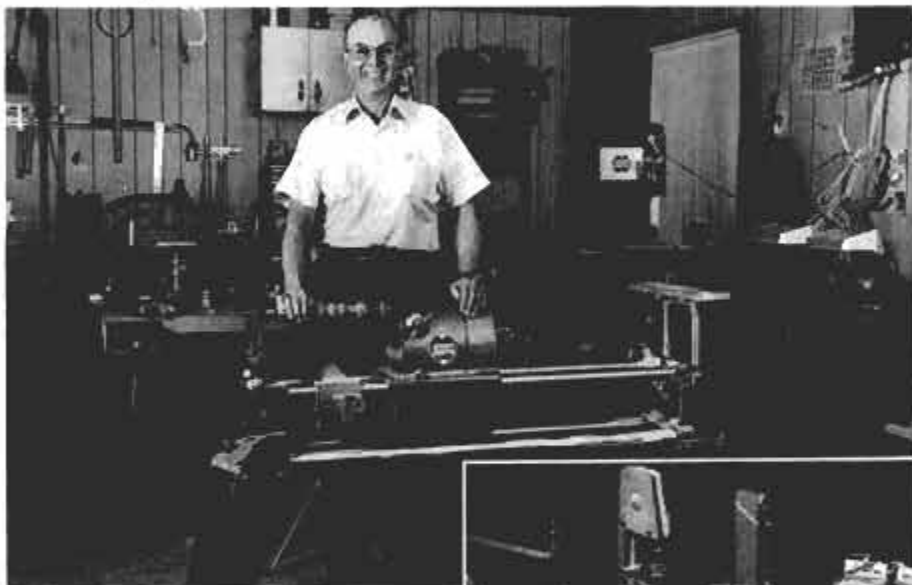


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— Jack McAlister,  
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—William Swallow

### Tightening screws in metal

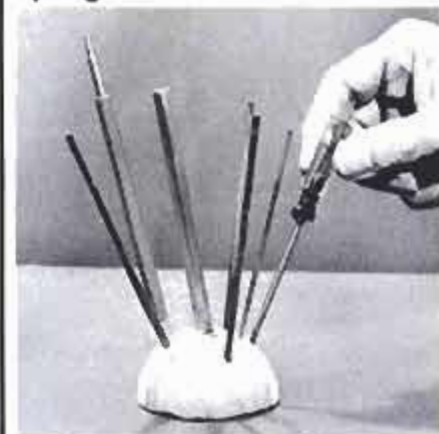
When a screw is loose in metal, such as on a lawnmower or in an aluminum window, you can use a length of thin wire or part of a paper clip to tighten the screw. Completely remove the screw and reinsert it with the wire running crosswise on the threads.

—Oscar Sowers

### Driving small nails

A 3x5-in. index card can help drive a tiny nail into wood. Punch the nail through one corner of the card. Grasp another corner and drive in the nail. Tear the card free before driving the nail home.—Lane Olinghouse

### Sponge holds small tools



Organize files, hobby knives, small screwdrivers and other small shop items by inserting them into half of a sponge-rubber ball that's glued upright to a shelf.—Ken Patterson

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## 21 EXCITING NEW PLANES

(Continued from page 76)

remarkable 155-mph cruise speed from a bitty 45-hp VW engine. Wingspan is 20 feet for the canard, 22 for the main wing. As in other tandem-wing designs, the elevators are in the canard. The main wheels are also built into the tips of the canard—a slick touch admittedly borrowed from Rutan's Quickie. Cost to build: about \$5000.

As evidence of its originality, the Dragonly walked off with the EAA's Outstanding New Design Award for 1980. Plans



Canard-wing concept takes to the water in this tandem, two-seat flying boat. Called the Merganser, it has 81-hp VW engine and estimated speed of 165 mph. Still experimental, it's slated to get folding wings and retractable gear for amphibious use.



New add-on power pod converts the Merganser sailplane into a motor glider for self-launch takeoffs. A 20-hp engine on pylon mount, it gives 120-mph speed and can be attached easily to existing fuselage. In background is regular unpowered model.

are expected to be \$175 from Viking Aircraft, 2449 Levante St., Carlsbad, Calif. 92008. An info pack is \$7.50.

### Canard-winged flying boat

What do you get when you cross a canard with a boat hull? You get a canard-winged flying boat. That's what yacht designer Peter Van Dine came up with, and it's called the Merganser. A rakish affair, with a hydroplane hull and two-place, tandem cockpit, it has a small canard wing on the nose and twin tail fins fitted with dual-purpose air and water rudders. A rear-mounted, 81-hp Revmaster engine with pusher prop gives it a speed of 165 mph. Hull length is 14 feet with a main-wing span of 17½. Folding wings for trailering and wheels for amphibious use may come later. Construction, not surprisingly, is foam-fiberglass sandwich,

(Please turn to page 148)

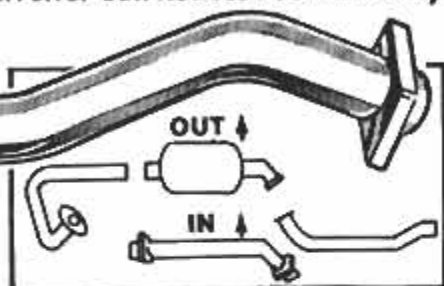
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75-early 77 (32-1/2" long) ...	55-2718R	\$23.50	77-79 LTD II, Thunderbird 302 w/dual conv.			77-79 Cougar 302 eng. w/dual conversion		
77-late-80 (22-1/2" long) ...	55-2717A	19.95	left side ...	55-2717A	\$19.95	left side ...	55-2717A	\$19.95
75-79 Apollo, Skylark, Skyhawk			right side ...	55-2718R	23.50	right side ...	55-2718R	23.50
6 & 8 cyl. ...	55-2718R	23.50	77-79 LTD II, Thunderbird			77-79 Cougar 351 eng. w/dual conv. L or R ...		
1980 Skylark ...	55-2719X	26.95	351 w/dual conv. R or L side ...			77-80 Bobcat V6 ...		
CADILLAC			75-77 Thunderbird 460 eng. w/dual conv.			6055MOBILE-Delta 88, Royal, 90, Regency, Cutlass, Cutlass Supreme		
75-76 DeVille Calais ...	55-2718R	23.50	left side ...	22-3287B	21.99	75-early 77 (32-1/2" long) ...		
77-80 DeVille Calais ...	55-2717A	19.95	right side ...	22-3286U	23.99	77-late 79 350, 400 eng. (22-1/2" long) ...		
75-78 Eldorado ...	55-2718R	23.50	75-78 Torino Elite ...	22-3300T	23.99	77-79 231, 260, 305 55-2717A		
76-80 Seville ...	55-2718R	23.50	75-78 Torino w/dual conv. left side ...			1980 Delta 88, 98, Regency, Cutless, Cutless Supreme 307		
CHEVROLET, Caprice, Impala, Belair, Monte Carlo, Chevelle, El Camino			right side ...	22-3252W	23.50	350 eng. (w/2-1/4" or 2-1/2" exch. extr. pipe) ...		
75-early 77 (33-1/2" long) ...	55-2718R	23.50	77-79 Mustang II V-6 eng. w/dual conv. ...			75-79 Toronado, Omega and Starfire V6 ...		
77-late 80 350, 400 eng. (22-1/2" long) ...	55-2717A	19.95	75-80 Mustang II 2.3, 3.4 4.2 litre ...			1980 Toronado 307-350 engine ...		
78-80 231, 350 ...	55-2717A	19.95	75-79 Granada Ghia ...			1980 Omega ...		
75-79 Camaro, Z28, Corvette Monza 6 & 8 cyl., Nova ...			1980 T-Bird ...			PLYMOUTH		
75-80 Monza, Chevelle, Vega 4-cyl. ...			1980 Fairmont w/200 engine ...			75-78 Fury, Grand Fury 400, 440 ...		
1980 Corvette ...			w/255 engine ...			75-79 400, 440 ...		
1980 Camaro, Z28 ...			LINCOLN			PONTIAC—Catalina, Bonneville, Grand Prix, Lemans		
1980 Citation ...			75-76 Town Car 460 eng. w/dual conversion			75-early 77 (32-1/2" long) ...		
CHRYSLER			left side ...			77-late 79 350, 400 eng. (22-1/2" long) ...		
75-79 New Yorker, Newport, Imperial, Cordoba ...			right side ...			77-79 231-301 ...		
DATSUN			75-77 Marquis 400 eng. w/dual conversion			1980 301 w/2-1/4" or 2-1/2" exch. extr. pipe ...		
75-80 All ...			left side ...			75-77 Astar 4-cyl. ...		
DODGE			right side ...			75-78 Firebird, Trans Am ...		
75-78 Monaco, Royal Monaco 400-440 eng. ...			75-77 Marquis 400 eng. w/dual conversion			79-80 Firebird, Trans Am (w/4-bolt flange on both ends) ...		
75-78 Volare Sports Custom 2-dr. ...			left side ...			1980 Firebird, Trans Am 301 (w/2-1/4" or 2-1/2" exhaust extr. pipe) ...		
Volare, Aspen, Diplomat			right side ...			75-79 Phoenix, Ventura (exc. 4-cyl.) ...		
75-76 6-cyl. ...			75-77 Marquis 400 eng. w/dual conversion			1980 Phoenix ...		
77-78 6-cyl. ...			left side ...			TOYOTA		
75-78 8-cyl. ...			right side ...			75-80 All ...		
1979 6-cyl. ...			79-80 Marquis 351 dual conv. ...			VOLKSWAGEN		
1979 8-cyl. ...			75-76 Town Car 460 eng. w/dual conversion			75-80 Rabbit ...		
FORD			left side ...					
75-78 LTD 302, single conv. ...			right side ...					
75-78 LTD, Custom 351, 400 ...			75-77 Marquis 400 eng. w/dual conversion					
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## 21 EXCITING NEW PLANES

(Continued from page 147)

like that used in boat hulls. Plans and kits will be available soon from Peter D. Van Dine, Box 8, Annapolis, Md. 21404.

### Tandem or side by side?

In the RV-4 and Glasair you have a choice of tandem or side-by-side seating. Both are fast, sporty, high-performance two-seaters stressed for aerobatics. Both are fixed-gear, low-wing taildraggers of nearly identical size, with wingspans of 23 feet and lengths of about 20. Both are powered by 150-hp Lycoming engines, have speeds in excess of 200 mph and can climb like rockets at 2000 feet per minute.



Ultralight or airplane? It's hard to tell. This quaint biplane, called the Fisher Flyer, uses stock wings from an Easy Riser hang glider mated to a conventional—more or less—fuselage. Not foot-launchable, it must be FAA-licensed as a true aircraft.



A roomy cabin plane in traditional high-wing style, this two-place K-Meyer Aero has side-by-side seating, dual controls, superb visibility. Designed for easy, economical operation, it uses 100-hp engine, cruises at 125 mph, can be built from kit.

But they have their differences. The RV-4, a two-place spinoff from Dick Van Grunsven's popular single-seat RV-3, is of all-metal construction and has a tandem cockpit. The Glasair is of molded composite construction and has a two-place, side-by-side cockpit. The RV-4 has the slim, graceful, fighter-like lines that a tandem arrangement makes possible, while the Glasair offers the roomy comfort and closer companionship of two-abreast seating. Both have dual controls.

Kits for the RV-4 will be about \$4500 from Van's Aircraft, 22730 South West Francis, Beaverton, Ore. 97006. An info pack is \$5. Glasair kits are \$7500 from Stoddard-Hamilton Aircraft, Box 1222, Issaquah, Wash. 98027. An info pack is \$7.50.

Another classy little two-seater is Monnett's Sonerai 2L, a low-wing version of the mid-wing Sonerai 2 racer of the early '70s (page 108, Aug. '74). Why the lowered wing? Its appeal is to the nonracing sport pilot. Lowering the wing results in a roomier cockpit by dropping the carry-through spar out of the way. It also improves downward visibility and makes for more docile handling (the mid-wing configuration, with a fast roll rate, was designed for quick turns in pylon racing at the expense of some stability).

The 2L has a tandem cockpit, takes VW engines up to about 80 hp and can do 200 mph. Folding wings permit road-towing on its own wheels. Construction is metal and fiberglass. Wingspan and length are both 18 feet, 8 inches. Plans are \$90, kits \$2500, from Monnett Experimental Aircraft, 955 Grace St., Elgin, Ill. 60120.

Also new from Monnett are a tiny, low-wing aerobatic single-seater, dubbed the Monex, and a power pod for the Monerai sailplane. The Monex, designed for supereasy building, is of all-metal, slab-sided construction with no tricky compound curves to form. It will have an 80- to 90-hp VW engine and a speed of 230-plus mph. Kits are expected to cost about \$4500.

The new power pod offers an easy way to convert the Monerai sailplane into a motor glider for self-launch takeoffs and sustained flight. It incorporates a 20-hp engine with pusher prop, weighs only about 50 pounds and gives speeds up to 120 mph. The basic Monerai kit is \$3590; the add-on power pod, about \$1000 extra.

For those who like the roomy comfort of a cabin plane, there's the K-Meyer Aero, a sporty, high-wing monoplane with two-place, side-by-side seating, dual controls, and the spacious layout and superb visibility that this traditional design offers. Aimed at easy handling and economical operation, it's powered by a 100-hp Continental, cruises at 125 mph and stalls at a tame 48 mph. Wingspan is 25 feet; length, 20. Construction is wood, metal and fiberglass. Kits are \$7500 from K-Meyer Aero, 45105 244th Ave. S., Enumclaw, Wash. 98022. An info pack is \$10.

### Airplane or ultralight?

Stick a pair of wings from an Easy Riser hang glider onto a conventional fuselage, and you have an intriguing hybrid that's half airplane, half ultralight. That's the Fisher Flyer, a quaint little single-seat, open-cockpit biplane that looks like something out of World War I. The idea: By starting with simple, ready-made wings, you eliminate much of the work and cost of building an airplane.

The craft cruises at a "brisk" 45 mph on a 30-hp engine and can take off and land in a pea-patch space of 150 feet. Wingspan is 26 feet; length, 14. Construction is fabric over metal. The cost to build the

Fisher Flyer is under \$2000. Plans are \$50 from Mike Fisher, Rte. 2, Box 282, South Webster, Ohio 45682.

Another no-frills, minimal aircraft designed strictly for fun flying—"no aerobatics," says its builder—is a replica of the famous 1924 Dormoy Bathub. A high-wing single-seater with a tiny, tub-shaped fuselage, it looks literally like the "flying bathtub" it was often called. It cranks out a respectable 65 mph from a 40-hp VW engine. Wingspan is 24 feet; length, 13½. Construction is wood, metal and fabric. Cost to build: a mere \$700. Plans are \$20 from Mike Kimbrel, 1333 Garrard Creek Rd., Oakville, Wash. 98568.

### Two hot single-seaters

If you doubt that a homebuilt sports plane can do nearly 200 mph on a modest 55 hp, consider the EOS. This super-sleek, needle-nosed, low-wing single-seater does just that. Fitted with a 55-hp VW engine, it cruises at 180 mph on 75-percent power and climbs at 1100 feet per minute.

The secret of its peppy performance lies in its slim, clean lines, low weight—only 1000 pounds gross—and drag-reducing retractable gear. Construction is metal and fiberglass and is said to involve no forming of compound curves, despite the craft's slippery-smooth streamlining. Wingspan is 26 feet; length, 16½. Plans are \$250 from EOS/SFA of California, 751 Fairway Lane, Anaheim, Calif. 92807. An info pack is \$25. Kits are to come later.

For homebuilt designer Chris Heintz, it's now four in a row in less than seven years. First it was the popular two-place Zenith (page 126, Mar. '74). Then came the single-place Mono-Z and novel three-place Tri-Z. Now it's the Acro-Z, a fast, nimble, low-wing single-seater designed for sport or competition aerobatics up to the advanced class. Of all-metal construction, it's stressed to a bone-jarring, head-spinning plus or minus 12 Gs, features full-span ailerons and all-flying tail for quick response, and has inverted fuel and oil systems for negative-G maneuvers.

You can take your choice of engines from 115 to 180 hp. The prototype, with a 150-hp Lycoming, has a top speed of 170 mph, a phenomenal climb rate of 2200 feet per minute and a fast roll rate of 180° per second. Wingspan is 19 feet, with the outer wing panels removable for road-towing. Kits are \$8900 from Zenair Ltd., 236 Richmond St., Richmond Hill, Ont. L4C 3Y8.

And the Acro-Z is just the beginning. Already on the horizon from the prolific Heintz are a new four-seater, a mini-version of the Mono-Z with 25-hp engine, powered glider and an amphibian, plus float kits to convert existing Zenair models into seaplanes. That's just a sampling of what's coming in the busy world of homebuilts. We'll keep you posted. **PM**



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(Continued from page 95)

make adjustments if needed. Take the time to test-fit all parts before the final assembly.

Finishing is easier if, before permanent assembly, you sand smooth all parts which will be exposed. Give

the assembled bank a final dusting, then wipe off with a tack cloth.

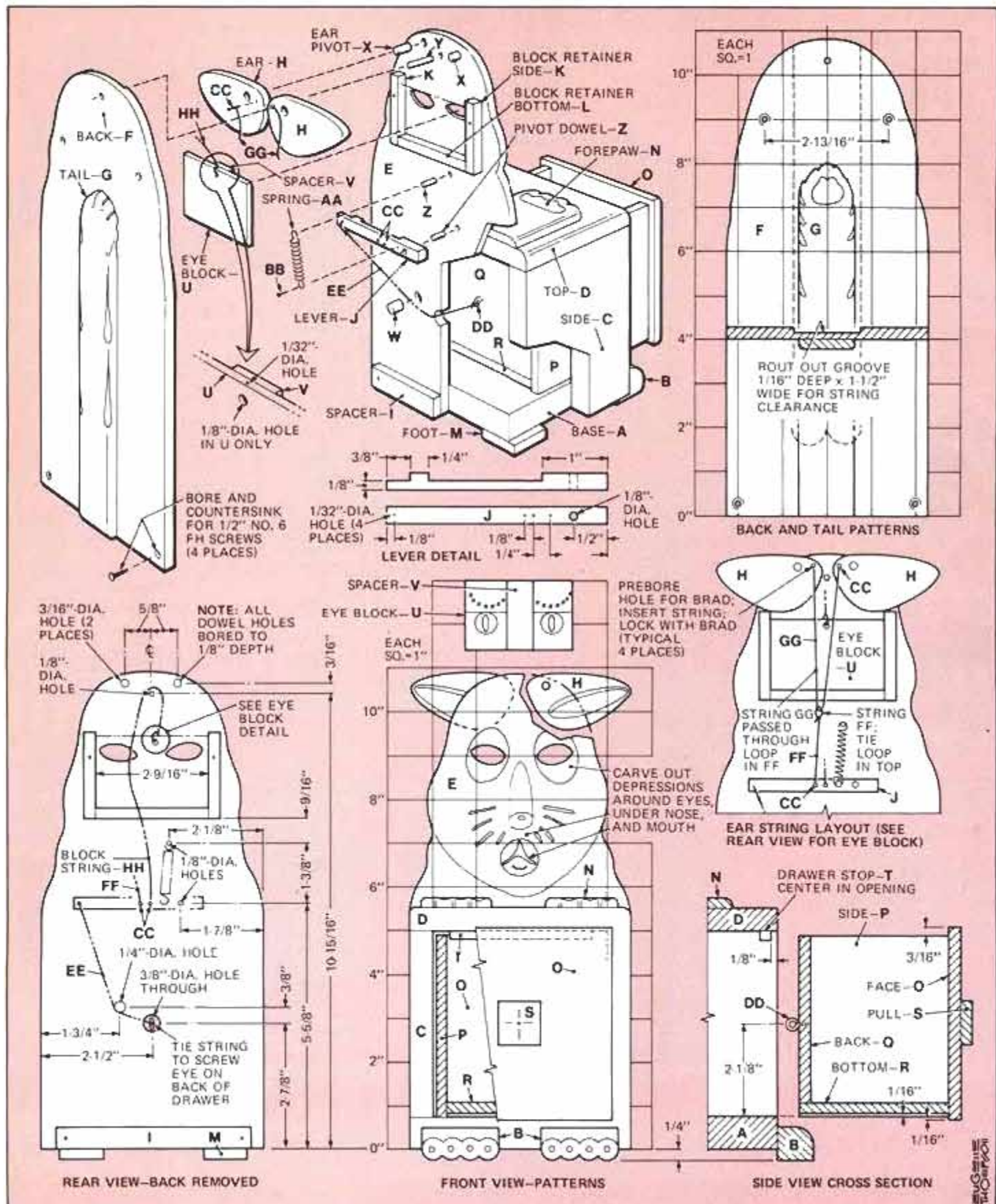
Next, seal all parts with a wash coat of shellac that has been thinned 50 percent with denatured alcohol. Apply a prime coat of paint to all painted surfaces. For superior results, tint the primer in the same shade as the finish coat, using pig-

ment from a tube. Allow the primer to dry overnight, and then proceed with the finish painting.

You will need an assortment of artist's brushes and small quantities of various latex paints for painting the banks.

Use the color photographs on page

(Please turn to page 152)





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Therma-Ray would like you to know how their radiant ceiling panel conserves energy and reduces heating costs. Informative brochure describes how easy to install system works to combine radiant heating with thermal storage to produce a sophisticated electrical heating system for home and office. Free.

## 374 A Classic Car Appearance

Classic Chemical offers a handy Car Care Guide explaining the why's and how's of maintaining the appearance of your car. Topics covered are washing and waxing, upholstery, lenses, windows and more. Free.

## 375 Fall Back, Spring Ahead

The new 1981 Spring Hill Nurseries catalog contains over 80 fact-filled, beautifully illustrated full-color pages of flowers, shrubs, trees and more. Also features new indoor plant section. Bonus of 5 free new miniature Gladiolus with your first order from the catalog. Free.

## 376 T-I-M-B-E-R

Pioneer Chainsaw has been cutting it for over 40 years. 4-color brochure offers a chainsaw for every need . . . for the homeowner, farmer or professional logger. Includes specifications and attachments for each model. Free.

## 377 Inside Story On Insulation

Here's an 8-page homeowner's guide to saving energy. Tells how and where to insulate for economy and comfort. Free from Owens-Corning Fiberglas.

## 378 Warm the Cockles of Your Hearth

C & D Distributors would like to introduce you to the warm world of stoves for your home. 16-page, full-color booklet displays their complete Hearth Mate line, including fireplace and free-standing models. Free.

## 379 Don't Be a Hack

Build this power hacksaw from this step-by-step plan and make hacksawing a lot easier and more accurate. Few tools are necessary. All steel parts are considered stock items. Power source can be any 1/2-hp electric motor (or larger). From Popular Mechanics Plan Library. \$3.75.

Popular Mechanics 1/81  
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Please see that I receive the items checked below

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| <input type="checkbox"/> 361 50¢ | <input type="checkbox"/> 366 10¢    | <input type="checkbox"/> 371 | <input type="checkbox"/> 376        |
| <input type="checkbox"/> 362     | <input type="checkbox"/> 367        | <input type="checkbox"/> 372 | <input type="checkbox"/> 377        |
| <input type="checkbox"/> 363 25¢ | <input type="checkbox"/> 368 \$1.00 | <input type="checkbox"/> 373 | <input type="checkbox"/> 378        |
| <input type="checkbox"/> 364     | <input type="checkbox"/> 369 \$2.00 | <input type="checkbox"/> 374 | <input type="checkbox"/> 379 \$3.75 |

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(Please send cash, check or money order made out to POPULAR MECHANICS. No stamps, please.)

Note: Popular Mechanics processes your requests for the above information and forwards these inquiries to the organization making the offer. Each company mails the material directly. Your order will be on its way to you within 90 days.

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Total money for priced items \$ \_\_\_\_\_

Service Charge \$ \_\_\_\_\_ .35

Total money enclosed \$ \_\_\_\_\_



## OLD-FASHIONED BANKS

(Continued from page 150)

94 and the artwork as guides for drawing in all details. When the latex paint has dried thoroughly, you should protect the paint with at least one coat of satin-finish varnish. Do not apply thick coats of paint or varnish, as you might impede the banks' action.

### Baboon bank

The baboon sticks out his tongue in "appreciation" when a coin is dropped into his hands; the weight of the coin on the balanced lever causes the action.

Facial-detail depressions around

his eyes, nose and mouth are made with a half-round carving chisel or a Speedball linoleum cutter (available at art supply stores). Draw the outline, then make shallow gouges.

The mechanism is actually quite simple. The tongue is made by shaping a half-round cove in a piece of thin dowel using a gouge or chisel. Bore a hole near the end to allow free movement over a small brad.

Glue the lever stick into an angled slot.

Next, add two washers for counterbalance by boring two small holes and inserting and bending over two brads.

A nail (with its point ground off) serves as the pivot. Two small wood

blocks with snug-fitting holes act as retainers to keep the parts in line. To install, insert the tongue through the mouth hole, then slide the pivot nail into place.

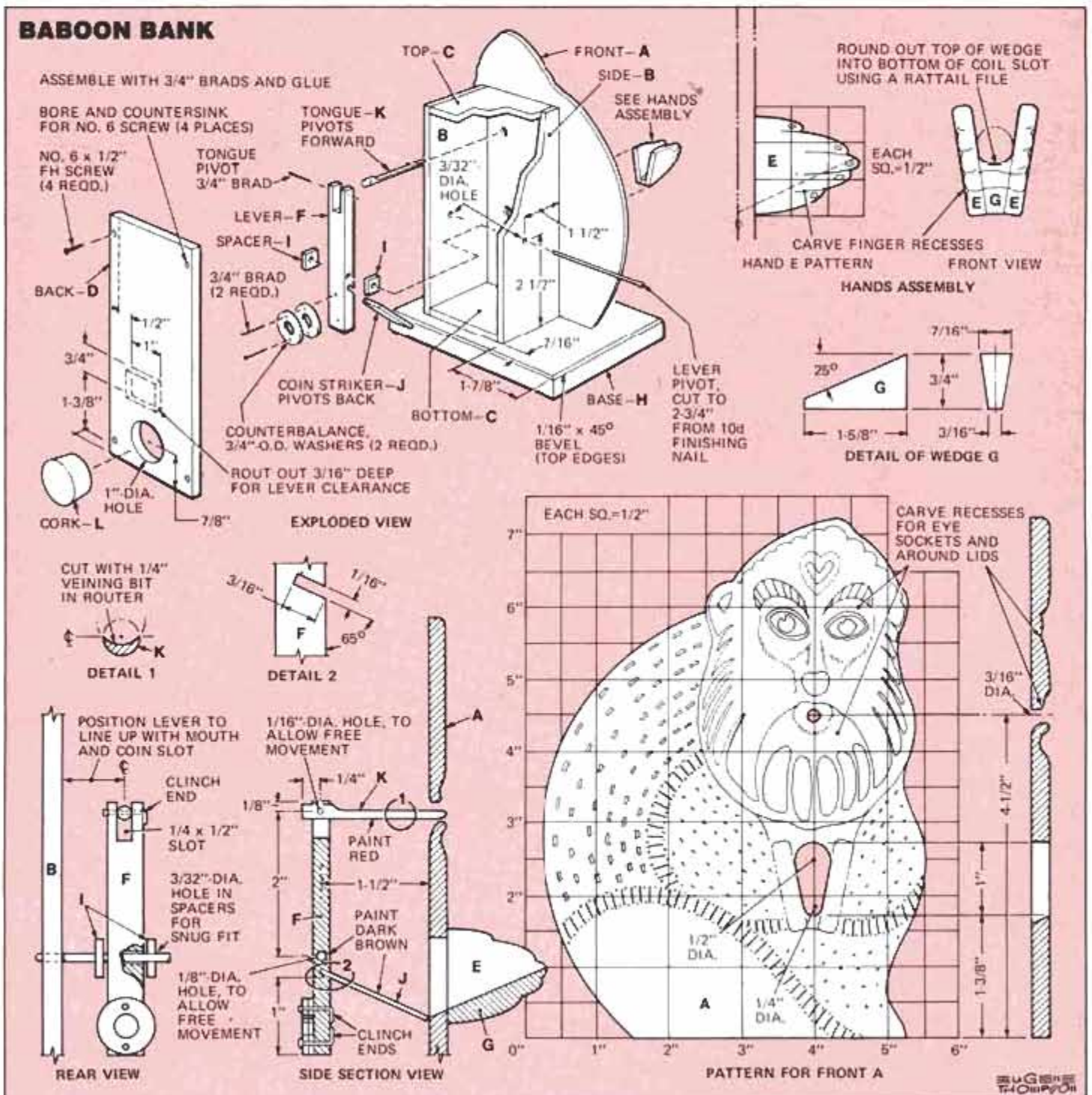
### Kirk's cat

The cat's eyes open and its ears perk up when you pull open the money drawer. When the drawer is shut, the eyes close and the ears droop.

The facial details are carved in the same manner as described for the baboon.

A strip of wood glued to the bottom front of the money box serves as a drawer stop, preventing damage to the mechanism. This stop must be

(Please turn to page 156)





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or more. Work part time, full time, right at  
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*"I worked in various industrial jobs for years, and always wondered if I could make money for someone else, why I couldn't do it for myself. So after losing my regular job, I opened my Foley sharpening shop in the basement of my home. I only had a minimum of cash to start with, but Foley financed the balance. My shop will gross over \$40,000 this year, and I like the feeling of running my own shop without answering to someone else."*

**William Wescott  
Willoughby, Ohio 44094**



**Husband and  
wife have a  
going spare  
time shop**

*"I'm a construction foreman, and my wife is a nurse's aide. Our Foley shop fits in nicely with our regular jobs, and we earn extra money. Our sons help out too, so ours is a real family business."*

*"I'm still too young to retire, but when I do I'll have a very good business built up. Foley equipment helps us to do good work and brings customers back with more jobs on a regular basis ... we have a lot of repeat business the year around."*

**Victor Kosloski  
Sturgis, Michigan 49091**



**Glad he  
chose Foley  
for his saw  
shop**

*"I worked as a carpenter all my life, but when a back injury forced me to quit I decided to go into sharpening full time. I'm very proud of my shop and glad my choice was Foley equipment ... it is superb. I made over \$48,000 last year, and this year it will go more than \$50,000."*

**Victor Johnson  
Lincoln, Nebraska 68507**

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Owning your own business brings you a sense of independence. You're the boss, setting your own work hours. Your own effort builds the business for yourself and your family. You can achieve great satisfaction and profits, if you choose and manage your business wisely. That's why so many men, just like you, are cashing in on the big profits to be made in this fast-growing service field.

The sharpening business allows you to get started with only a minimum investment, requiring little space and effort for a successful operation. It lets you build and expand as fast, or as slowly as you like. You pocket most of the money you take in, because there are exceptionally high profits with no investment in merchandise.

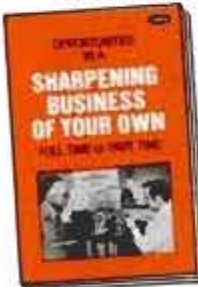
If you need only \$200 or \$400 extra income each month, a sharpening business is ideal for spare time. The additional dollars can be SPENT for more of the good things of life. Or they can be SAVED in a rainy-day fund that the family can bank on.

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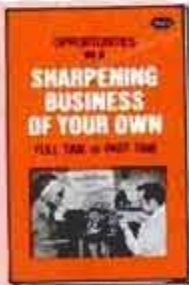
business. It can be yours just for the asking.

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**AREA CODE** \_\_\_\_\_ **PHONE NO.** \_\_\_\_\_

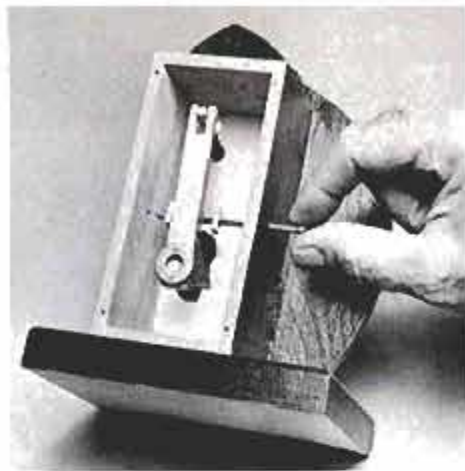




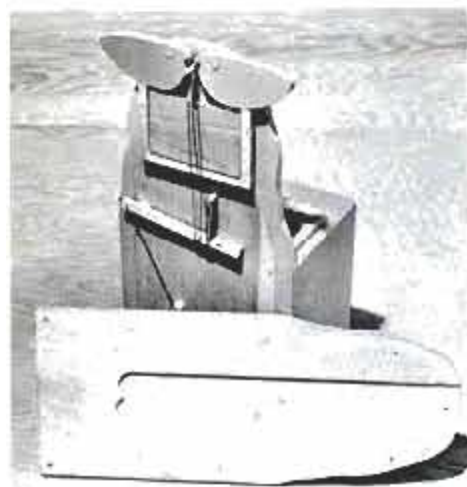
Saw out the openings for eyes, nose and mouth, then gouge out depressions using a small carving chisel or linoleum cutter.



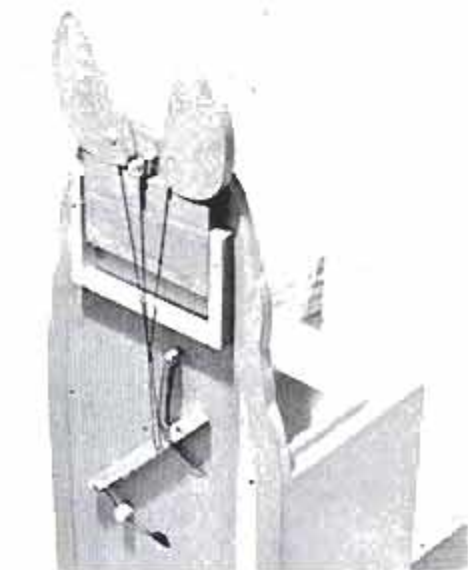
Baboon parts, ready to assemble. Pivot is finishing nail with its point ground off.



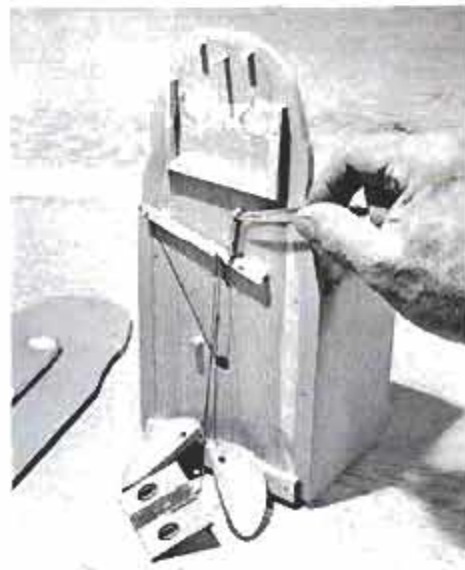
Tongue must be inserted through the mouth hole, while nail is pushed in place. Wood retainers must be snug fitting. Two hands are actually needed for this step, but for photo clarity, just one is shown.



View of cat bank innards. When drawer is closed, eyes and ears are "down."



Eyes rise along with ears when drawer is pulled open. String EE, fastened to drawer back, pulls lever to cause reaction.



Eye block and ears are connected to lever bar with strings. Coil compression spring is attached to both the lever and peg.

## OLD-FASHIONED BANKS

*(Continued from page 152)*

attached after all other assembly is completed.

Attach the string to the back of the drawer, then pass its end through the hole in the cat's body.

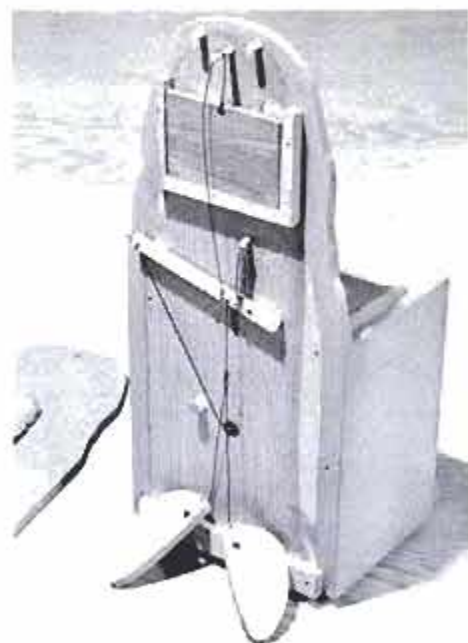
Begin assembly by attaching the strings for the ears, eye block and drawer to the lever bar. Then secure a coil spring to the bar and to a small peg.

Next, set the eye block into its channel, with the string looped over the top center peg. Follow by inserting the ears over the two outer pegs. Test the operation; if it works properly, attach the back cover panel with four small screws. The back panel must have a slight depression routed out down the center. This provides clearance for the strings.

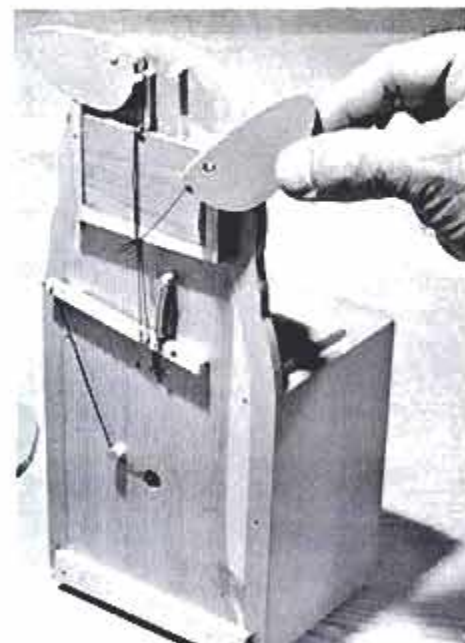
## Funny-face man

Place a coin on his tongue and push back on the lever; his tongue

*(Please turn to page 158)*



Eye block is set into a channel with the string looped over the top center peg.



Ears fit over pegs. Strings should be taut enough not to sag when parts are at rest.

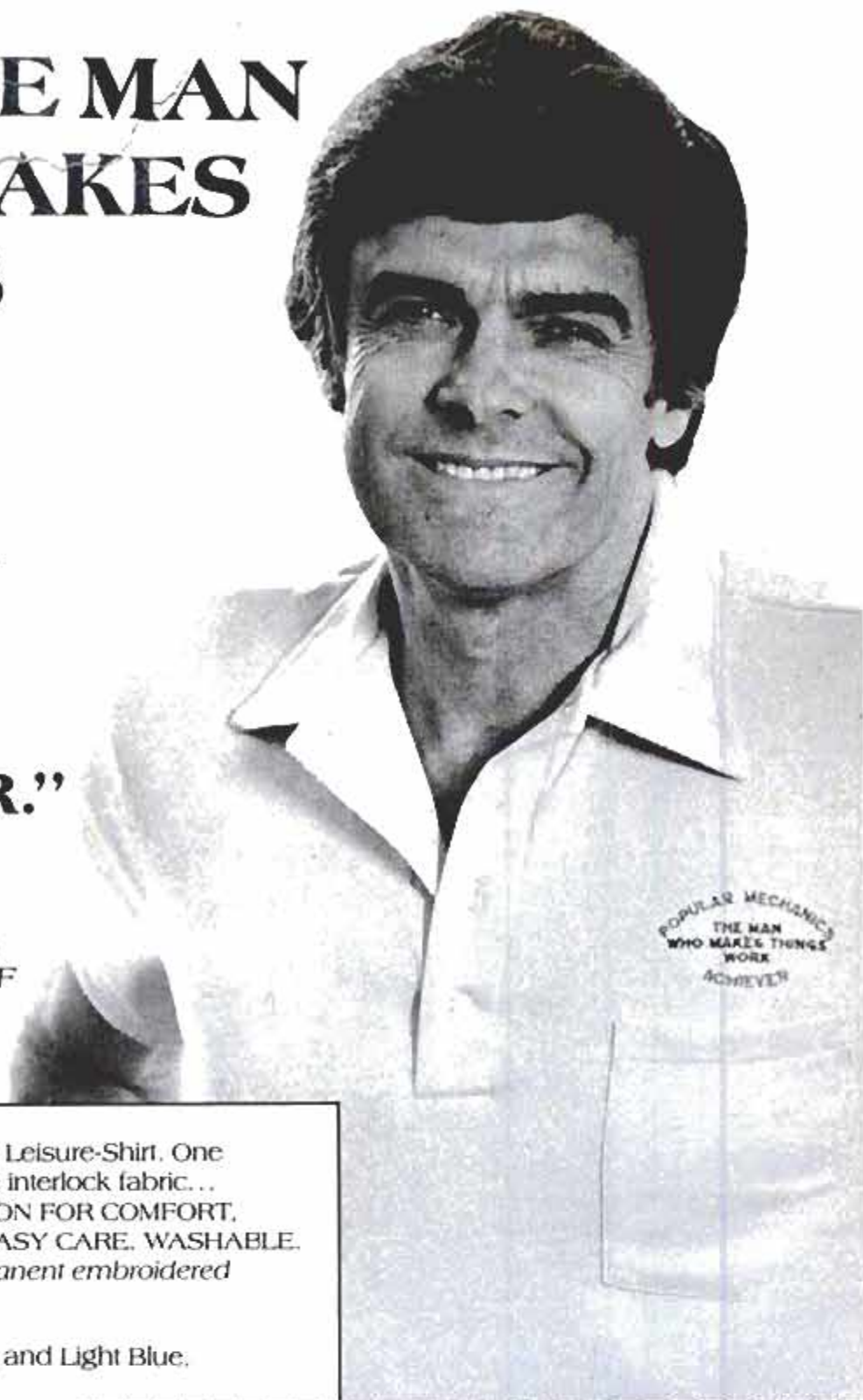


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Color		How Many	What Size
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NAVY			
LIGHT BLUE			



## OLD-FASHIONED BANKS

(Continued from page 156)

moves in, swallowing the coin, and his eyes pop way out.

Make up the components, then bore the required holes in all the parts. Glue the lever into the main dowel and insert the main dowel through the holes in the body sides. Then insert the tongue unit into the center hole of the dowel. Also, press two pieces of 1/16-in. round stock into the holes near the side panels as retainers.

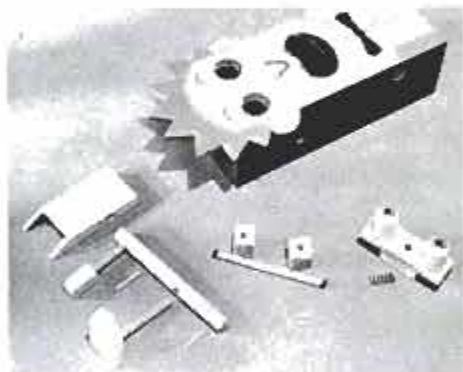
Remember, you don't glue them in permanently until after the unit is tested.

Drop the coil spring over the peg, then drop in the eye block. The main block, which pushes the eyes, is activated by the thrust of the back edge of the tongue. This is assembled within the box.

Insert the dowel through one wall of the box, then insert a spacer

block, the main block and the second spacer block. When the main block and spacers are in place, bore a small hole through each spacer.

Then insert small nails and bend the projecting ends over slightly with a pair of needle-nose pliers. Finally, attach the back.



Funny-face working parts. Clamp body sides together and bore holes through before assembly for proper alignment.

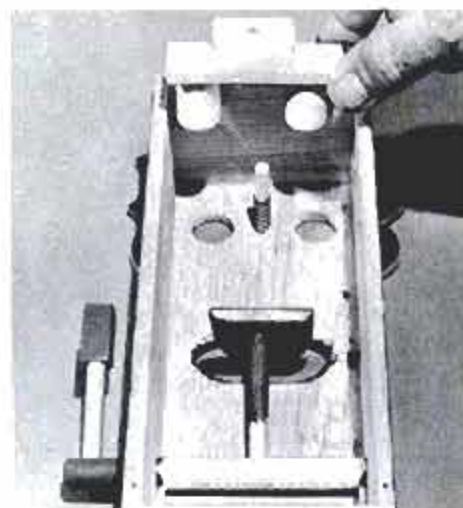
### MATERIALS LIST—FUNNY-FACE MAN

Key	No.	Size and description (use)
A	1	1/4 x 6 x 12" pine (front)
B	1	1/4 x 3 7/8 x 9 1/8" pine (back)
C	2	1/4 x 2 1/2 x 9 1/8" pine (side)
D	2	1/4 x 3 7/8 x 2 1/2" pine (top/bottom)
E	1	1/4 x 1 x 3" pine (eye panel)
F	1	1/4 x 1 3/4 x 1 7/8" pine (tongue)
G	1	1/2 x 1 x 1 1/2" pine (spacer, eye)
H	1	1/2 x 1 3/4 x 3 5/8" pine (lever)
I	1	1/2 x 1/2 x 1" pine (handle)
J	2	3/4 x 3/4 x 3/4" pine (spacer, lever)
K	2	3/8"-dia. x 1 1/8" dowel (eye)
L	1	1/2"-dia. x 5" dowel (pivot, handle)
M	1	5/16"-dia. x 2 1/4" dowel (dowel, handle)
N	1	5/16"-dia. x 2 1/2" dowel (dowel, tongue)
O	1	1/4"-dia. x 1 1/8" dowel (spring guide)
P	1	1/4"-dia. x 4" dowel (pivot, lever)
Q	2	3/16"-dia. x 3/4" dowel (dowel, eye)
R	2	1/8"-dia. x 3/4" dowel (dowel, pivot stop)
S	1	3/16"-o.d. x 3/4" spring
T	1	1 1/8"-dia. x 1" cork for 1"-dia. hole

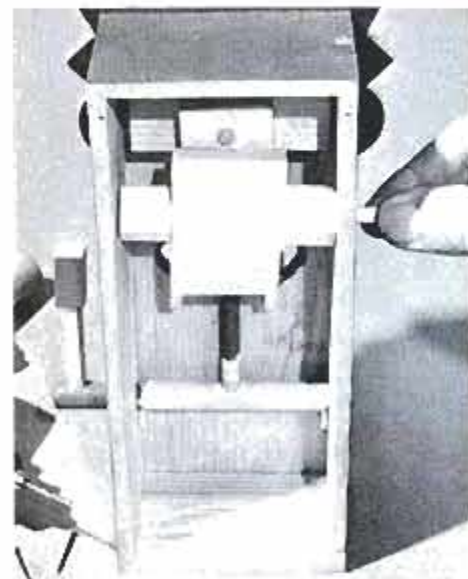
Misc.: No. 6 x 1/2" f.h. screws (4), 1" brad (2), 3/4" brads as needed, white glue; paint colors as desired.



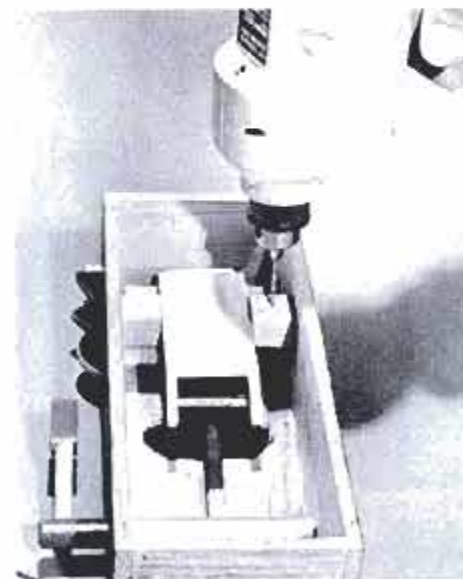
Retainer pegs are pushed into holes with a screwdriver blade. Use glue sparingly.



The eye block slides on a dowel peg; the spring is expansion-type, which keeps eyes in recessed position until activated.



The pivot dowel is pushed through the spacers, as well as through the main block.



Spacers and dowel are retained with two nails. Holes for this are bored in place.

### MATERIALS LIST—KIRK'S CAT

Key	No.	Size and description (use)
A	1	3/4 x 3 3/4 x 4" pine (base)
B	2	3/4 x 3/4 x 1 3/4" pine (hind paw)
C	2	1/2 x 3 3/8 x 5" pine (side)
D	1	1/2 x 3 3/8 x 5" pine (top)
E	1	1/4 x 5 x 10 3/4" pine (cat front)
F	1	1/4 x 4 1/2 x 10 3/4" pine (back)
G	1	1/4 x 1 1/4 x 8" pine (tail)
H	2	1/4 x 1 1/4 x 2 1/2" pine (ear)
I	1	1/4 x 1/2 x 4 1/2" pine (spacer)
J	1	1/4 x 1/4 x 3 3/8" pine (lever)
K	2	1/4 x 1/4 x 2 1/8" pine (side retainer, side)
L	1	1/4 x 1/4 x 2 3/8" pine (side retainer, bottom)
M	2	1/4 x 1 x 1" pine (rear foot)
N	2	1/4 x 1 5/8 x 2 3/8" (forepaw)
O	1	1/4 x 4 1/8" wide x 4 3/8" high pine (drawer face)
P	2	1/4 x 3 3/8 x 4 1/8" pine (drawer side)
Q	1	1/4 x 3 3/8" wide x 3 1/8" high pine (drawer back)
R	1	1/4 x 3 3/8 x 3 3/8" pine (drawer bottom)
S	1	1/4 x 1 x 1" pine (drawer pull)
T	1	1/4 x 1/4 x 3 1/4" pine (drawer stop)
U	1	1/8 x 5 1/8 x 2 1/2" plywood (eye block)
V	1	3/32 x 3/8 x 1 5/8" plywood (eye block spacer)
W	1	1/4"-dia. x 3/8" (dowel, guide for drawer string EE)
X	2	3/16"-dia. x 3/8" (dowel, ear pivot)
Y	1	1/8"-dia. x 1/2" (dowel, guide for slide string, HH)
Z	2	1/8"-dia. x 3/8" (dowel, lever pivot and spring post)
AA	1	3/16"-dia. x 1/8" spring (contracted length)
BB	1	1/2" wire nail cut to 1/4" for spring post
CC	4	1/2" brads cut to 1/4" for string pins
DD		small screw eye
EE		string from DD to J
FF		string from J to GG
GG		string from H to H
HH		string from J to U

Misc.: 1/2" brads, 4d finishing nails, 1/2" x No. 6 f.h. screws (4), string.

### MATERIALS LIST—BABOON BANK

Key	No.	Size and description (use)
A	1	1/4 x 6 x 8" pine (front)
B	2	1/4 x 2 1/4 x 5 1/2" pine (side)
C	2	1/4 x 2 1/4 x 2 3/8" pine (top, bottom)
D	1	1/4 x 2 5/8 x 5 1/2" pine (back)
E	2	1/4 x 1 1/2 x 1 1/2" pine (hands)
F	1	1/4 x 1/2 x 3 1/2" pine (lever)
G	1	3/8 x 3/4 x 1 1/2" pine (wedge)
H	1	3/4 x 4 1/2 x 5 1/2" pine (base)
I	2	1/8 x 1/2 x 1/2" plywood (spacer)
J	1	1/16 x 1/2 x 1 5/8" pine (coin striker)
K	1	3/16"-dia. x 2" dowel (tongue)
L	1	1 1/8"-dia. x 1" cork for 1"-dia. hole (cork)

Misc.: 3/4"-o.d. washers (2), 3/4" brads as required, 10d finishing nail, No. 6 x 1/2" f.h. screws (4), white glue; paint colors as desired.



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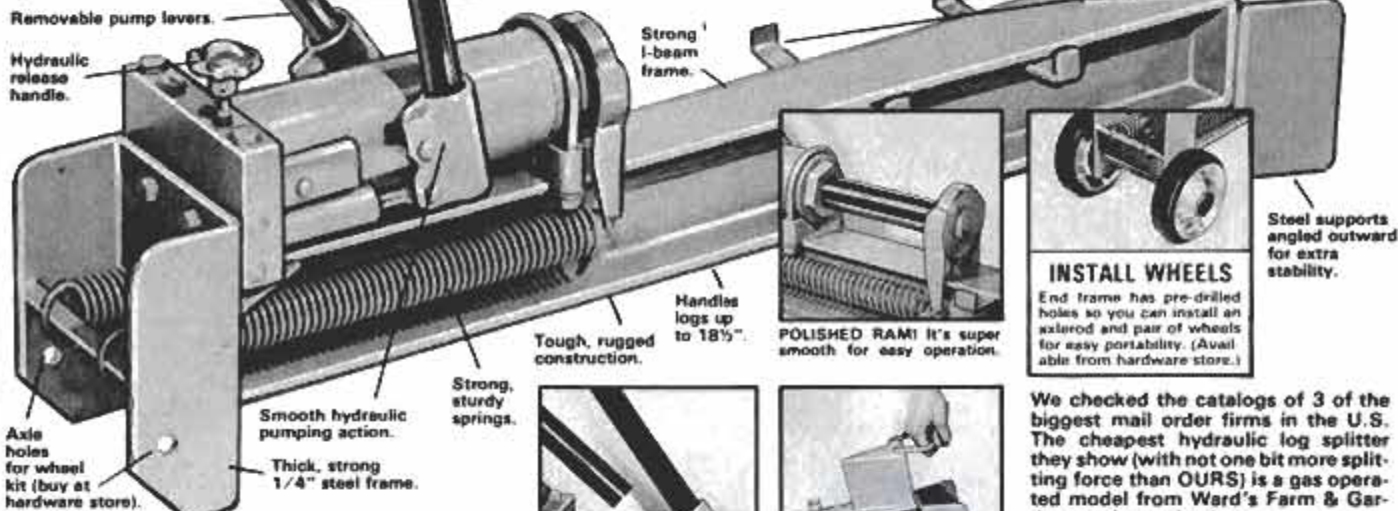
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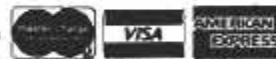
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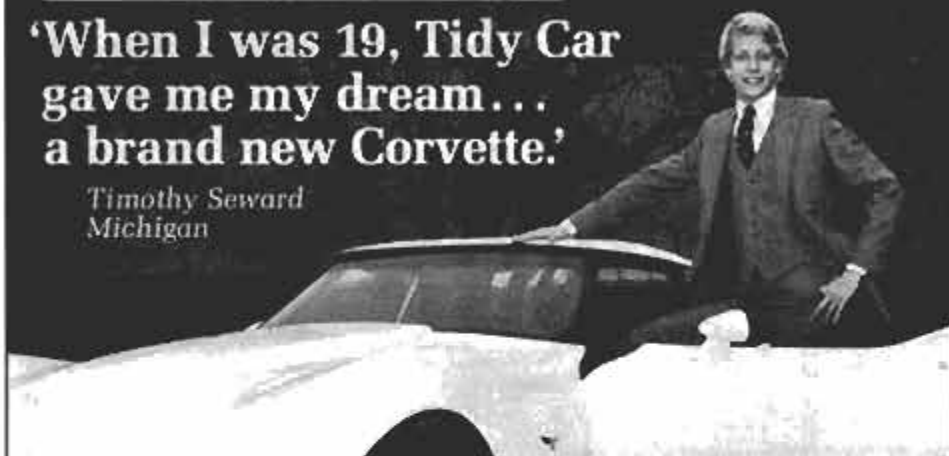
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## ROOM TO GROW

(Continued from page 99)

and details on how the table goes together can be seen in the drawing. Again, use plywood to simplify construction. Its A side, of course, should be placed to the outside on all surfaces.

The top is also of plywood and its edges are thickened using strips of 1 x 2 pine furring as shown. If greater table weight and stability are desired, reinforce the underside with 3/4-in. plywood strips cut to fit between the outer edge of the top and the cube base. Either way, finish by covering all edges with 1/4-in.-thick pine lattice.

Finish the table using the same procedure as for the hutch.

To paint the checkerboard design, after sealing, first apply a background of white latex paint. When it is thoroughly dry, carefully lay out the checkerboard pattern using chalk or a soft pencil. Then accurately apply wide masking tape to the top. Press down all tape edges.

When all tape is in place, check your mathematics—that is, make certain that all the squares are of equal size.

When you are satisfied that they are sized right, paint in the blue squares. Wait until the paint is absolutely dry before you remove the masking tape.

Latex paint is okay for the top, as long as you protect it with glass. If you don't use glass, it's best to apply enamel instead. **PM**

### MATERIALS LIST—PLANT HUTCH

Key	Amt.	Size and description (use)
A	2	3/4 x 10 x 36" plywood (top and bottom)
B	2	3/4 x 10 x 28 1/2" plywood (sides)
C	2	3/4 x 9 x 34 1/4" plywood (shelves)
D	1	3/4 x 10 1/2 x 35 1/4" plywood (top)
E	2	3/4 x 18 x 40" plywood (sides)
F	1	3/4 x 17 1/2 x 34 1/2" plywood (shelves)
G	1	3/4 x 5 x 37" plywood (skirt)
H	6	3/4 x 1 1/2 x 15 3/8" pine (frame side)
I	6	3/4 x 1 1/2 x 34 1/2" pine (frame front)
J	1	1/4 x 29 1/8 x 35 1/8" plywood (back)
K	1	1/4 x 29 1/8 x 36" plywood (back)
L	as req'd.	3/8 x 7/8" molding (top, bottom & sides)
M	as req'd.	7/16 x 3/4 x 36" molding (front panel)
N	2	3/4 x 7 1/8 x 34 3/8" pine (drawer front)
O	1	3/4 x 5 1/8 x 34 3/8" pine (drawer front)
P	2	1/2 x 7 1/8 x 17 1/8" pine (drawer side)
Q	1	1/2 x 5 7/8 x 17 1/8" pine (drawer side)
R	2	1/2 x 7 1/8 x 33 3/8" pine (drawer back)
S	1	1/2 x 5 1/8 x 33 3/8" pine (drawer back)
T	3	1/4 x 16 7/8 x 33 3/8" plywood (drawer bottom)
U	30'	1/4 x 3/4" lattice (shelf edge)

### MATERIALS LIST—CUBE TABLE

Key	Amt.	Size and description (use)
A	1	3/4 x 29 1/4 x 39 1/4" plywood (top)
B	2	3/4 x 17 1/4 x 18" plywood (end)
C	2	3/4 x 17 1/4 x 28" plywood (side)
D	4	3/4 x 1 1/2 x 17 1/4" pine (cleat)
E	1	1/4 x 30 x 40" (float glass)
F	2	3/4 x 1 1/2 x 30" pine (edging)
G	2	3/4 x 1 1/2 x 40" pine (edging)

Misc.: 1 x 1 corner brace (4); 3/8" No. 8 th screw (8); 1 1/4" No. 8 th screw (12)



models by Honda and Suzuki, and Suzuki's little GS250.

Contrary to what you may believe, the primary benefit of a four-valve head is not an increase in valve area. Total valve area is meaningful only when the valves are fully open. Instead, as the valves travel from fully closed to fully open, it is fuel flow that matters—and flow is determined by valve circumference. A four-valve system allows for a much longer perimeter, although the total valve area remains similar to that of a two-valve system.

At the high end of the rpm scale, four-valve systems are also superior, in that two small valves can be made lighter than one large one. They require lighter valve springs, and the net results are less reciprocating valve-train inertia, and the possibility of a higher redline.

Finally, a four-valve system allows the sparkplug to be located more centrally in the cylinder. This can result in a more even flame propagation across the piston crown and, consequently, cleaner and more complete combustion.

### Liquid cooling

While the swing to liquid cooling has not exactly been a tidal wave, the movement has gained momentum in both exotic factory-team motocross bikes and in standard-production road machines. Through the 1980 season, three standard-production, water-cooled road machines were available: Kawasaki's KZ1300 six-cylinder and Honda's GL1100 Gold Wing and CX500. The first two machines are considered state-of-the-art tourers, favorites of the long-distance sorts who load their machines with saddlebags, fairings and trunks, carry a passenger and pull a tent trailer behind. The Honda CX500 is an intermediate-sized package that leans more into the sport-bike market. Each machine is equipped with a driveshaft.

The prime benefit of liquid cooling to these long-distance machines is that their engines can be built to closer tolerances than an air-cooled one, since they operate within a more controlled heat range and undergo less internal expansion and contraction. This contributes to longer engine life and longer service intervals. The oil-change interval for a liquid-cooled CX500 is 7500 miles; it is 2500 miles for many air-cooled bikes.

Liquid cooling is useful not only for prolonging engine life on the big cruisers, but also for preserving precious horsepower on the pistol-quick

racing iron. The exotic Japanese formula road racers all use liquid-cooling systems, as do the factory 125-cc motocrossers. Despite the additional weight of water pumps, radiator and hoses, motocross riders find that their machines maintain performance levels through a 40-minute contest, while air-cooled bikes wilt, losing power and races.

### Belt drive

Many early motorcycles used automotive-type V-belts to transmit the power from their engines to their rear wheels. However, chain-drive systems soon took over as engines gained power and drive belts slipped or broke.

Belt drive is now staging a comeback, thanks to Gates, a company in Denver that has developed the PolyChain. Currently, PolyChains are going around in circles on only the 80-cu.-in. Harley-Davidson Sturgis, which uses belts for both primary and secondary power transfer, and the mid-sized Kawasaki KZ440-D1, which uses a drive belt only from the gearbox to the rear wheel.

PolyChains are toothed belts composed of polyurethane plastic surrounding tough Kevlar cords. A layer of polyurethane covers the teeth, which are composed of polyurethane overlaid with a woven nylon fabric. A testimony to the belt's strength is its narrowness; the H-D's primary unit is just 1.16 inches in width, and its drive belt is 1.50 inches.

Gates claims these belts will last 25,000 miles, which is significantly longer than the lifetime of a roller chain. Both the chain and belt, however, cost about the same to replace. Drive chains require lubrication every few hundred miles, and an adjustment about every 500. Also, the newly sprayed-on oil often splatters the rear of the motorcycle and rider when riding. The PolyChain, however, requires only a few adjustments during its life, and it never needs lubrication. As an added bonus, belts run more quietly than drive chains, since they don't involve metal-to-metal contact.

### Electronic fuel injection

Motorcycles, like automobiles, have had to meet EPA emissions standards. Manufacturers have coped by setting carburetion well to the lean side. Unfortunately, many street bikes are now cursed with off-idle flat spots and with stutters when the throttle is abruptly opened. Kawasaki chose to deal with the problem by equipping one of its

KZ1000 models, the Z-1 Classic, with electronic fuel injection (EFI).

In a much-simplified explanation, EFI consists of a Bendix-designed electronic control module with four injector nozzles. An electric fuel pump maintains constant pressure to the nozzles, which are electronically controlled on/off devices. By varying their "on" duration anywhere from 1.5 to 6.0 milliseconds, EFI differentiates engine idle from full-bellow drag-strip runs. Precise measurement is assured by a combination of the rider's input at the throttle, an airflow meter between the air filter and a plenum chamber, and two temperature probes that notify the device of the engine's temperature.

Kawasaki did not add EFI to significantly boost either performance or economy. They merely wanted to reduce the hesitation and sluggishness caused by lean carburetion. A ride on the Z-1 Classic confirms that not only have they accomplished this, but that quarter-mile times for the Classic are back to pre-EPA levels.

### Air suspension

If you have viewed a motocross race recently, you've probably been amazed to see these machines repeatedly jumping off dirt mounds at more than 50 mph, flying nearly 100 feet through the air horizontally while dropping 10 or 12 feet vertically, and landing under control, without crushing their suspensions or bucking their riders into the weeds. Or perhaps you have observed big street machines striding down the highways, their front-fork tubes sliding effortlessly to absorb potholes and freeway seams. These machines function as comfortably and controllably as they do because they are literally riding on air.

The problem with conventional, spring-type, front-fork suspension systems is that the spring's compression rate is linear. A force of, say, 40 pounds may compress a fork one inch; an 80-pound force will compress it two inches, and so on. The extra force needed to compress that last inch of travel is equal to the amount needed to compress the first inch. If the suspension tends to use its travel too soon, and to bottom too easily, the rider may replace his fork springs with stiffer ones. This may keep the suspension from bottoming as easily, but now the rider finds the ride to be unduly harsh over small bumps.

Air-assisted suspension is the answer. Because air is a gas, its volume and pressure are directly relat-

(Please turn to page 162)



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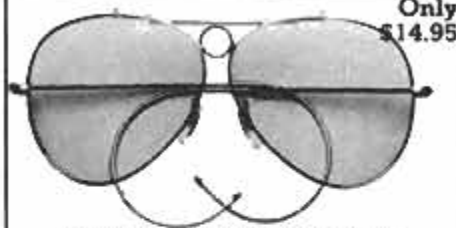
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## NEW MOTORCYCLES

(Continued from page 16)

ed. If you compress an airtight container until its volume is halved, its pressure will double. On a street motorcycle with six inches of travel in its air-assisted front suspension, 50 pounds of force may be required to compress the suspension three inches. But in halving the volume, the air pressure has doubled. The next 50 pounds will compress the fork only an additional 1.5 inches. And that last 1.5 inches will require 100 more pounds.

This is progressive springing, and the benefit is that the suspension will easily absorb small bumps, providing a soft, cushiony ride, yet it will deal sternly with larger bumps, progressively resisting compression and premature bottoming. By varying the amount of air pressure and oil in the fork (thereby changing the volume of air space), it is possible to adjust the suspension precisely for a soft but very controllable ride.

### Monoshock suspension

In the highly competitive world of motocross racing, new models, with long lists of refinements, appear each year. Invariably, these changes are made in the name of more usable power, lighter weight or improved suspension. The monoshock system is aimed at this last item.

As its name suggests, the monoshock is a suspension system that uses one spring/shock absorber unit, rather than the usual two, at the rear of a motorcycle. Yamaha pioneered the modern system, mounting the single large suspension unit up under the fuel tank where it attaches to the frame backbone at the front, and to a triangulated section at the rear composed of the swing arm and associated bracing. Kawasaki has followed suit with a system it calls Uni-Trak.

The biggest advantage of the monoshock system is that the single shock body can be made to carry more oil than a twin-shock unit, dissipating heat more quickly and resisting the heat-induced viscosity loss that causes the suspension to "fade." A remote reservoir can be added to increase oil capacity on either system.

The monoshock also eliminates any inconsistencies that develop within the action of each shock/spring unit, thereby causing a lack of precision in handling from the imbalance. Since it is located within the motorcycle's frame, the monoshock is not exposed to damage to which external twin shocks are vul-

nerable. And usually, monoshock units are infinitely adjustable for both damping characteristics and spring preload.

### The Honda NR500 racer

Honda has long been known as an engineering company that is unafraid to place its name on radical test equipment. In the 1960s, its five- and six-cylinder, four-stroke racing machines won many important road races and made the competition appear positively Stone Age. After a long absence, Honda was back in 1980, turning heads and whetting appetites with a revolutionary racing machine designated the NR500.

The NR first appeared late in 1979, a drastic departure from the liquid-cooled Yamaha and Suzuki 500s with their square-Four, two-stroke engines. The NR500's liquid-cooled V4 is a four-stroker with a redline in the giddy 20,000-rpm range. It's helped by the machine's lack of a flywheel. Highly unusual elliptical pistons, which allow more room for the eight valves per cylinder, anchor to the crankshaft with two connecting rods apiece. Twin sparkplugs fire each cylinder, which breathes through a two-barrel carburetor.

In its original version, the NR500 sported a radical front suspension that featured an upside-down spring/shock unit located ahead of the conventional fork tubes. Three small radiators cooled various sections of the engine. The frame was of monocoque construction, and the wheels were an unheard-of 16 inches.

With all its exotica churning, the NR500 was expected to be another plum on Honda's rich tree. Unfortunately, the machine was not competitive. After disappointing appearances in 1979, the NR500 faced further delays in 1980. Whenever it did appear, its times were relatively slow and it usually withdrew with mechanical problems.

Extensive changes are being made to the carburetion and lubrication systems. The three radiators are becoming one. The odd-sized 16-inch wheels have been replaced with more conventional 18s. A frame builder has been commissioned to supply a standard tube-type frame for the bike.

Whether or not the NR500 ever becomes competitive in any form, its use as a test bed by Honda will be invaluable. After all, it incorporates many of the features that have given motorcycling the techno-wallop and advantage it enjoys over its four-wheeled brethren.



elegant as the concept. A quartz crystal generates the needed frequencies within the tuning circuit. The literally rock-steady molecular vibrations of quartz are currently the most accurate practical timing means available. The tuning error in frequency-synthesized tuners is always zero.

You can usually spot a frequency-synthesized tuner by what it doesn't have. Most of them have no tuning knob. Instead, they have a pushbutton that starts the digital circuits scanning up and down the frequency scale. When the number of the station you want to hear flashes on the readout, you just take your finger off the button and the station is automatically tuned in. Or you can use the so-called Auto-Scan mode found on most of these receivers. This seeks out the next sufficiently strong station on the dial at each touch of the button.

To make this even easier, most frequency-synthesized tuners offer still other options. By storing the frequencies of your favorite stations in computer-type memories, the frequency synthesizer can be quickly switched to any of those stations. A touch instantly brings in the station you want precisely on frequency.

### Comparison tests

PM tested five receivers with digital frequency readouts representing the three different tuning methods—conventional, servo-lock and frequency synthesis.

To toughen the test, we put all the receivers in a basement with only a minimal antenna, reducing incoming signal strength to simulate fringe conditions. We also compared their abilities to separate a weak, distant station from a strong, nearby station that happened to be on a neighboring channel.

We discovered that, in terms of performance, the similarities among the five models prevailed over their differences. All five clearly pulled in stations whose signal strength registered little more than halfway on most of their signal-strength meters. And they all managed to separate two close-neighboring stations on the dial, even though the Kenwood, according to its specs, has less selectivity than the others.

Since we were interested only in spotting possible performance differences of the tuner section, we checked sound quality with a pair of AKG earphones to minimize differences stemming from the amplifier section. Again, all five models were similar in tonal quality.

It thus seems that the three different tuner types—conventional, servo-lock and frequency synthesizer—are equally capable of excellent results with little to choose among them.

Frankly, this surprised us—but it shouldn't have. It's exactly in accord with engineering theory: It doesn't matter *how* accurate tuning is accomplished, as long as it is accurate.

### Convenience varies

Yet in terms of operating convenience, the differences are immense. It takes quite a bit of knob wiggling to get a weak station properly zeroed in on the conventional tuner (Heathkit), and the digital readout doesn't help much. Even after the proper number lights up, you still have to rock the knob back and forth to get the tuning meter centered. If you're careless or in a hurry, you'll still get fuzzy reception.

The servo-lock on the Kenwood definitely makes things easier. Just watch the lock indicator light up, and you know you're on the beam.

But the frequency synthesizer wins, hands down. One touch and there's your station—right on the preset. On the Sony and Realistic, there is an additional scanning mode that automatically samples each of the preset stations for a brief time (5 seconds on the Realistic, 3.5 seconds on the Sony), so you can hear what they broadcast. A single touch then stops the scan.

You just can't beat this for ease and convenience. Besides, there's something deeply satisfying about it. It's the kind of technical finesse that makes you feel right at the leading edge of audio engineering.

In addition to their digital dials, the five receivers all offer other interesting features. A brief summary of each follows.

■ **HARMON/KARDON H/K 680, \$599.** This receiver is in line with the simple, functional look of the new H/K lines of components. Six memory buttons tune in preset AM or FM stations without resorting to the AM/FM selector switch and it's possible to scan. This is not only the least cluttered of all five units; it's also the least bulky.

■ **HEATHKIT AR-1650, \$780.** This is both the powerhouse of the lot, at 125 watts per channel, and the most massive. It weighs 66 pounds and occupies a space some 21¼ inches wide. It's available only as a kit, with a silver faceplate. An additional \$20 over the list price secures an attractive black plate. For another

\$55 you can insert a Dolby FM module board.

Despite its many features, the AR-1650 organizes a lot of controls logically. An interesting option: Two tape decks can be played simultaneously. This offers entertainment possibilities beyond normal amplifier use. Similarly, just as the two-tape potential obviates the need for a mixer, the three tone controls (bass, mid and treble) go a long way toward making an equalizer less necessary. This is about as nice a piece of engineering as you'll find in one audio package, and one of the most attractive nonsynthesized tuners to boot.

■ **KENWOOD KR-720, \$329.** Servo-lock tuning in this receiver is accomplished with three visual aids. The three-LED signal-strength meter glows brightest when full reception is achieved; a digital readout linked to the tuner confirms the actual AM or FM frequency; and a large, standard, dial pointer has a centerline and two arrows to show on-station tuning or which way adjustment is off. The power meter lights up LEDs going left and right outward from a "0" center.

■ **REALISTIC STA-2200, \$600.** Both the cosmetic and functional aspects of this receiver are very pleasing. One feature permits you to sample several seconds of each of the six stations in the memory. A rear-panel hatch hides a 9-volt battery used to assure the uninterrupted working of the digital clock, and the safety of the memorized tuner settings.

A small panel on the front slides open to reveal clock setting, memory, meter LED off and display dimmer controls. LOW and NORMAL power-meter settings allow output monitoring at moderate and loud levels. Bass and treble controls have variable turnover points at 150 or 300 Hz and 3 or 6 kHz, respectively, to make possible minimal or maximal alteration of mid-range response, along with the top and bottom of the sound.

■ **SONY STR V-45, \$420.** Among the top features here is the nonvolatile memory: Set it for whatever AM and FM stations you want, yank the power cord and—voilà!—the memories don't evaporate. Sony claims a memory life of several years. The scanner will settle for several seconds on each of the eight settings, allowing hands-off sampling of that number of programs when the button is touched. Three-position variable muting is a nice touch, especially for radio stations neither too close nor too far to be at one extreme of the signal-strength meter. ■■



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# HINTS FROM READERS

## Dowel-holding jig



Make a jig for holding dowels while sanding, sawing or boring holes in them. Fasten four large wingnuts to a block of wood with screws. Bore holes for the screws in a straight line along the center of the block, spacing the two center holes 2 in. apart. Attach the wingnuts. Position dowel between wings. You can make saw cuts between the center wingnuts. —Ken Patterson

## Eyelets protect holes



Reduce wear on bolt holes in wooden knock-down furniture by gluing metal eyelets in the holes. Eyelets are available at leathercraft and hobby stores or at shoe-repair shops. —Walter E. Burton

## Recycling grocery bags

Paper grocery bags, when wetted and wrung dry, make excellent heavy-duty shop rags for cleaning spills. —Lane Olinghouse

## Transporting long stock

When I transport long lengths of gutter, molding or pipe, I attach a roof carrier to my van, and strap on a section of extension ladder. Its rungs, spaced every foot, give firm support to the stock. —Steve Meyers

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How did such an unusual generator get built? Here is the story:

The TC25G began as one of many components, of a unique low-cost wind generator — the TC25 Helius Rotor. It was during the development of this new rotor that our engineers discovered there was no inexpensive, low rpm generator to be found anywhere, that was suitable for small windpower converters — or, for that matter, for water wheels, pedal power, solar engines, fuel powered generators, or any other small energy needs.

It was tempting at the time to turn to "small" automotive alternators — which need several thousand rpm to generate the kind of voltage we wanted. They are large, heavy and also require an efficiency-killing step-up pulley to achieve the necessary rpm to generate power from a small water wheel or windmill.

Meanwhile, the price of oil and other fuels was just starting to skyrocket. Many energy-conscious people had made up their minds not to take these price hikes lying down. More and more people were thinking seriously of switching to free renewable energy sources — solar, wind, water — simply because it had begun to make good economic sense. Needing to produce exactly the right product for the growing boom in home-sized alternate energy products, Thermax engineers started from scratch to design the perfect small generator. It had to be inexpensive, light, and operate efficiently at low rpm (which no other small generator could do).

The result was the TC25G permanent-magnet dc generator — which may be exactly the generator you've been looking for, if you ever tried to build a small water wheel or windmill.

Later, at the Energy Lifestyle Show, visitors who tried our demonstration generator were so amazed by its sensitivity that some even looked underneath to see if there was a trick to it! Many energy buffs bought generators on the spot.

At first, Thermax sales personnel were surprised that so many customers were attracted by the generator alone and didn't want to buy the whole windmill kit. Even without advertising, inquiries kept coming from do-it-yourself energy enthusiasts who really wanted to build their own power systems, not Thermax's or anyone else's.

So here you are — the ideal small dc generator, with plans (if you need them) to build several different renewable energy converters. Now you can start generating your own free, natural energy!

## THERMAX CORPORATION

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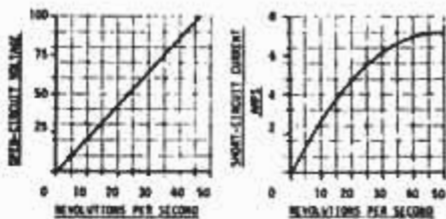
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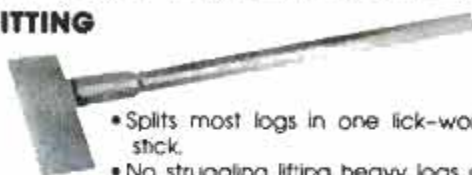


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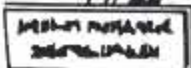
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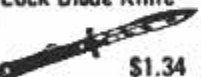
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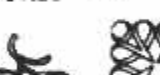
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## BURGLAR ALARMS & HOME PROTECTION

**FINEST** Equipment! Save! **FREE CATALOG!** AAS, 186-B Oxnour Road, Birmingham, AL 35209



# Would you buy a \$5 bill for \$2.85?

Imagine that you're walking down the street. You see a man offering to sell \$5 bills for only \$2.85.

Would you buy from him?

Probably not!

Most people would hurry right on by with a look of suspicion. "Impossible," they would say! "How can he sell \$5 bills for only \$2.85?"

But . . . the people who did stop to buy would get a great bargain!

It's the same way in the liquidation business. Many people can't believe the low mail order liquidation prices we offer on a wide variety of consumer products. Our prices are even *better bargains* than those \$5 bills for only \$2.85.

But the people who DO believe . . . and DO order . . . are "tickled pink" at the huge savings!

Terrific, money-saving bargains have made us one of the largest authorized mail order liquidators of consumer products in the nation!

In just a minute or two, I'll tell you how YOU can easily be one of the fortunate individuals who receive confidential bulletins about our latest mail order liquidations.

But first . . . you're probably wondering, "Just what is a liquidator?"

In the case of our firm, the C.O.M.B. Company, a liquidator is a company that helps a manufacturer quickly dispose of large inventories of factory-perfect (or sometimes slightly blemished) merchandise to the public at "sacrifice" prices.

"Ridiculous," you might say! "Why would a manufacturer want to do that?"

For many reasons! Here are just a few:

1. Last year's models
2. Overproduction
3. Large contract cancellation
4. Going out of business
5. Closing of branch factory
6. Bankruptcy
7. Economic recession
8. Urgent need for operating capital
9. Insurance claim repossession

In most cases, they can usually gain a tax advantage by "writing off" their losses on their tax reports.

Now for some examples of the big bargains we have liquidated in the past:

- Harley Davidson motorcycles. Regularly over \$1100. We liquidated 500 of them at only \$550.
- 17-ft. Whitewater canoes. Regular \$409. We liquidated hundreds at \$159.
- Car and truck tires from a bankrupt manufacturer. We liquidated almost 5000 at below manufactured cost.
- English-made 10-speed bikes. Regular \$295. We liquidated over 2000 at \$119.
- CB radios. We liquidated over 28,000 of 4 different brands at below dealer cost.

- Admiral 25" console color TV's. We liquidated more than 2000 sets at below dealer cost.

- Shakespeare 15-ft. bass boats. Regular \$900. We liquidated over 1500 at \$388.

- Electric airless paint gun. Swiss made for a division of Sherwin Williams. Regular \$119.95. We liquidated over 10,000 at only \$47.

- Pioneer chain saws. Regular \$539. We liquidated over 3000 at only \$166.

- 10 x 14-ft. tents. Made for a giant U.S. mail order firm to sell at \$139.95. We liquidated hundreds at \$69.

- Synthetic motor oil by Union Carbide. Regular \$4 a quart. We liquidated over 400,000 quarts at around \$1 a quart.

- Moulinex La Machine Petite food processor. Regular \$49.95. We liquidated many thousands at under \$19.

- 12-speed, 3/4 h.p. drill presses. Regular value over \$500. We liquidated more than 8000 at \$198.

That gives you some idea of the big bargains we offer customers. But if you're still not convinced, here are some more examples of products we liquidated at *below dealer cost*:

- AMF Snowmobiles
- Tappan Microwave Ovens
- Panasonic Microwave Ovens
- Shakespeare Fish/Depth Finders
- G.E. Kitchen Appliances
- Quasar Video Tape Recorders
- Fairchild Video Games Systems
- Pflueger Rods and Reels
- Rockwell Power Tools
- Fishing Motors
- Snark Sailboats
- European Mopeds
- SBE Police Scanners
- Genuine Leather Luggage
- Home Computer Systems
- Emergency Home Power Generators
- European-made Shotguns
- Fishing Motors
- Home Pinball Machines
- And more . . . **MUCH, MUCH MORE!**

See anything you like so far? You could have saved a bundle of money at our low liquidation prices!

Maybe you've seen our "Must Liquidate" ads in home handyman magazines and farm magazines. Or in hunting, fishing and veterans magazines. Or in airline, fraternal or gardening magazines.

In 1980 alone, our big ads appeared in more than 150 different publications!

But here's a surprise for you!

Most . . . yes, **MOST** . . . of our wonderful liquidation offers *never, never* appear in magazines!

Why not?

Because a lot of our liquidations are of very limited quantities. Too limited for use in national magazine ads. And . . . because we prefer to **SAVE** many of our liquidations for all our friends around

the nation who are on our mailing list.

Now . . . **YOU** can be one of the privileged individuals who receive advance news of these sensational, money-saving offers! Now **YOU** can receive our exclusive "SURPLUS CONFIDENTIAL" bulletins!

Each bulletin is like a wonderful surprise package! You never know what exciting products to expect. But one thing sure. The bargains will be sensational.

On "big ticket" items, you can easily save **HUNDREDS** of dollars. Even on low price items you can save up to 50% and more!

There will be products for recreation, travel, hunting, fishing. For the kitchen, yard, home entertainment. For your car, home workshop, office. And **MORE!**

Here's all you have to do to get on our mailing list for the **NEXT SIX ISSUES**:

Just fill in the coupon below and mail it with your check or money order for \$10. Members of Mastercharge, VISA, American Express can phone in their orders 24 hours a day, 7 days a week by calling Toll-Free: 800-228-2606. (In Nebraska, 800-642-8777.)

We'll take care of the rest. Soon you'll be receiving exclusive, confidential reports about wonderful mail order liquidations you can order from us at **BELOW DEALER COST!**

Exciting liquidations keep coming our way all the time. Now we can keep them coming **YOUR** way. Every few months we'll put together the **BEST** of our latest closeouts . . . with pictures and all details . . . and mail them out to you.

Now, just in case you're still undecided. In case you're wondering if this is a good deal. Let us "sweeten" it for you!

After we receive your order, we'll send you a certificate worth \$10.00 off any purchase of \$50 or more.

Better send your order **TODAY**. Before you forget about it. Because the **NEXT** bulletin might have exactly what you're looking for. At a **HUGE** savings!

C.O.M.B. Co. / Authorized Liquidators

Dept. B-403-55555  
3258 Minnehaha Avenue S.  
Minneapolis, Minn. 55408

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# 2WD TO 4WD WITHOUT STOPPING.

## AND CHEVY OFFERS MORE WAYS TO GO 4-WHEELIN' THAN ANYONE.

New Chevy trucks take an important step ahead for '81. With new lean looks. New interior comfort. And now for the first time ever, a revolutionary new system on 4-wheel-drive Chevy trucks lets you shift into 4WD without stopping. Simply shift from 2WD to 4WD HI at speeds under 25 MPH and keep right on moving. And you can shift back to 2WD without leaving the cab. This new system is standard on all 4WD Blazers, Suburbans, and half- and three-quarter-ton pickups. It includes new automatic locking front hubs



The big shift for '81



4WD Chevy Blazer



4WD Chevy Suburban



4WD Chevy LUV

and a new, lightweight transfer case. And remember, Chevy offers more kinds of rugged 4-wheel-drive trucks than anyone. Including the sleek new Chevy LUV with independent front suspension and manual locking hubs. Plus Chevy Chassis-Cabs, Crew Cabs and Bonus Cabs with conventional 4-wheel drive. So make your choice and get into free-wheelin' four-wheelin' today.





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