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On the cover

Aerospace experts say an orbiting vehicle using Shuttle technology could be air-launched from a B-747 as early as 1988. Manned or unmanned, the military vehicle could carry intelligence gear or nuclear weapons. See how it's designed on page 120 in this issue.

—PM painting by Ed Valigursky

Popular Mechanics

DECEMBER 1982

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LETTERS TO THE EDITOR

So fast we missed it going by

You would think that a 125-ton U.S. Navy ship doing over 100 mph would have caught your author's eye for inclusion in your article *The Fastest Boats On Water* (page 93, Sept. '82). The SES (Surface Effect Ship) 100B is listed in the *Guinness Book of World Records* as holding the fastest military ship record at a speed of 91.9 knots (105.7 mph).

The SES 100B utilizes a cushion of air beneath it that lifts the ship in the water. This significantly reduces drag and results in increased speed, improved stability in rough seas and greater cargo capacity.

We regret having

missed a spot in your fine painting of high-performance ships.

FRED SAXTON
DEPARTMENT OF THE NAVY
BETHESDA, MD.

We're sorry we overlooked it. To make up for it, here's a photo (below) of the SES 100B doing its thing.



The U.S. Navy's air-cushion SES 100B skimming the waves at a blistering 105.7 mph—a record for military vessels.

Speed kills?

I've been reading PM since the 1920s, but your September '82 article *PM's Long-Term Car Tests* (page 92) contained some of the worst stupidity I've ever read. Two-lane roads, rain, a dark night, and your writer brags about driving 75 mph—in security? Why do we have to read such crap?

H.G. LOUCKS
PORT ORCHARD, WASH.

Joe Oldham says he drove 75 mph over twisty blacktop in the rain at night. He was a potential killer!

J.E. WALTHOUR
FLINTSTONE, GA.

Joe Oldham replies: PM certainly doesn't advocate dangerous driving by anyone, but people should realize it is possible to drive fast in adverse conditions and still be safe. It all depends on the equipment under the driver and his skills in handling it.

Most accidents are caused not by speed itself, but by inept drivers who don't know how to handle their machines properly. PM Auto Editor Tony Assenza made this point in his article

*last month (see *Asleep At The Wheel*, page 86, Nov. '82). In addition to the vast amount of driver incompetence in this country, many people drive around with worn suspensions, sloppy steering and half-bald tires. It's no wonder that they're afraid to go more than 40 mph.*

Lighter, but still lethal

In your article *Auxiliary Space Heaters—How Safe Are They?* (page 132, Sept. '82), you stated: "Carbon monoxide is heavier than air, so you can't vent it with overhead fans. It seeks low spots and puddles in them."

This is just not so! Carbon monoxide is actually lighter than air and can be vented to the outside. This is routinely done by firefighters.

CAPT. WILLIAM KINGETER
NEWARK FIRE DEPT
NEWARK, N.J.

The statement you cite came from the Consumer Products Safety Commission, not our author. It's true, however, that carbon monoxide (CO) is slightly lighter than air. The danger to which the CPSC was referring is

that a temperature inversion frequently occurs, trapping CO near the floor and making overhead vents unreliable. Also, as the CPSC pointed out, people often plug the vents to avoid wasting heat, compounding the problem.

This is why gas heaters, as a result of CPSC urging, are now required to have an oxygen depletion sensor that shuts off fuel flow automatically if the oxygen content in room air falls below a safe level, indicating the presence of lethal CO.

For a real boost, try ours

In your August '82 issue, you showed how to make a radio antenna booster costing \$35 (*Build PM's Broadcast Antenna Booster*, page 28). I've been using an antenna booster on my portable radio for 10 years. It consists of a coil of wire laid on top of the radio and, even at today's prices, shouldn't cost more than a few bucks.

With my rig, I get stations as far away as Salt Lake City, Utah and Albuquerque, N.M. What can yours do?

AL HOROWITZ
TORRANCE, CALIF.

Electronics Editor Neil Shapiro replies: What you're doing is extending the electrical length of your present antenna, and on strong, distant stations, this will work fine. But PM's booster actually amplifies incoming signals and will pull in weak, faraway stations that your rig wouldn't. Give it a try—it's an amazing device.

Peace-loving chopper

You show bombers and battleships on your covers—and now an Army tank (Sept. '82). I read PM for peaceful things. If you must run military propaganda, bury it in the back pages!

LEN MINTY
TUNJUNGA, CALIF.

We chose the tank mainly to dramatize the tremendous lifting capacity of Bensen's new flying crane. Actually, the big copter is designed for many peacetime jobs, such as cargo hauling and heavy construction. **PM**

If you expect a truck to quickly pay for itself in work done and fuel saved, you've come to the place where somebody did it right.

For a great price: \$5998,* the new 1983 Toyota Standard Bed Truck delivers the goods. In the bed. Under the hood. And in driving comfort, too.

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Estimated Highway MPG. (26) EPA Estimated MPG.**** Add that to the electronic ignition system, 4-speed synchromesh transmission and power-assisted brakes, and you've got the goods to make the delivery easy. Normal maintenance an infrequent and simple affair. And durability something you can bank on.

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The new 1983 Toyota Standard Bed Truck. Once you

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TOYOTA

check it out, its price will convince you to drive it out.

* Manufacturer's suggested retail price. Dealer's actual retail price may vary. Price does not include tax, license, transportation, optional or regionally required equipment.

** Including occupants, equipment and cargo.

*** % HP in the State of California.

**** Remember: Compare this estimate to the EPA "Estimated MPG" of other gasoline-powered trucks with manual transmission. You may get different mileage depending on how fast you drive, weather conditions and trip length. Actual highway mileage will probably be less than the "Highway Estimate."

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EDITOR'S NOTES

John A. Linkletter

A Very Merry Christmas To All Of
Our 6,197,000 Readers From The Editorial
Staff Of Popular Mechanics!



Back row (everyone who's standing): Michael Lamm, Gary Witzenburg, Neil Shapiro, Tony Assenza, Michael Chotiner, Penelope Spangler, Peter Easton, Robin Nelson, Harry Wicks, Steven Fox, Joseph Truini and Joe Oldham.

Front row (everyone who's kneeling or sitting): John Linkletter, Douglas Quinn, Bill Hartford, Dennis Eskow, Shannon Kelley, Don Mannes, Sheldon Gallager, Ira Herrick, John Bostonian, Bill McKeown and Alan Andresen.

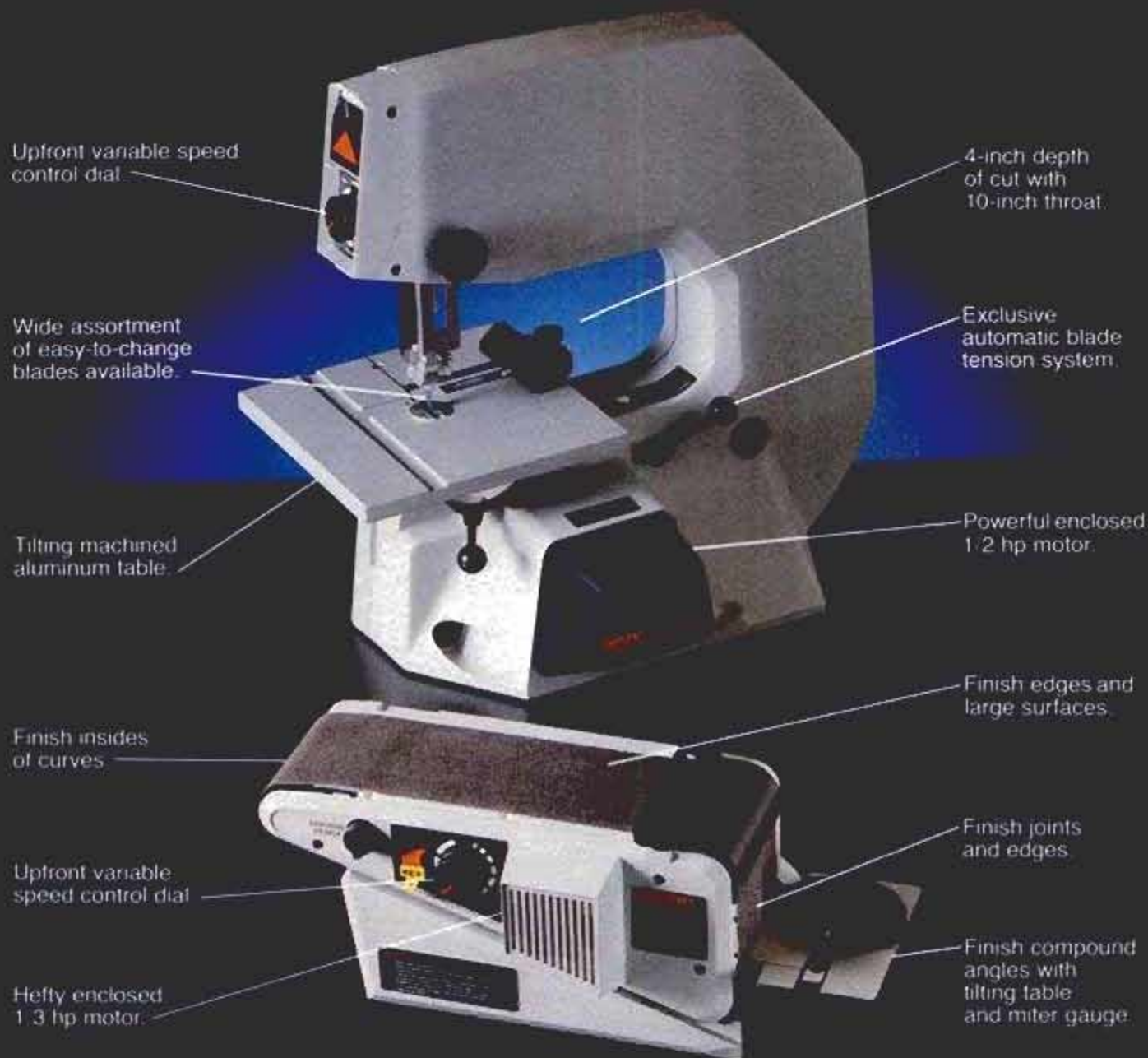
We're completing another great year at Popular Mechanics, thanks to all of you. And we're looking ahead to an even better year in 1983.

As ever, you were very much in our minds at our fall editorial conference (where the photo was taken). Every new idea, every suggestion, had to pass the ultimate test: Will our readers like it? We're confident that you will.

Thanks for being with us this year—and happy holidays.

PM

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THE PM GARAGE



Rack is for more than just luggage



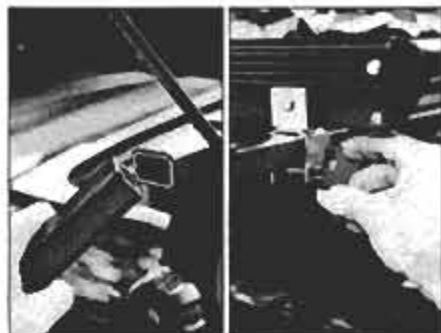
Basic Thule system consists of two super-strong load bars and gutter clamps; straddling carrier is additional.

Even though I own a big car—a Saab 900—I find that a roof luggage rack is a must. For me, selecting the right rack is always a major decision—one I have to make every time I get a new car. It's not that I'm a gypsy, carrying all my belongings on the roof, nor am I a jock whose car roof bristles with surfboards, bikes, kayaks and skis. If for no other reason, I need a rack for a place to throw that bale of peat moss—and other stuff—on the way home from the nursery, because I refuse to mess up my nice clean car. I am also reluctant to mess up my car body sheet metal with holes, so the permanent-mount type of rack is out—even though I know that nowadays a number of new cars look good with these racks, such as the Cadillac Cimarron with its fashionable deck lid luggage carrier.

My choice this time around was the Thule rack because it's one of the strongest around, clamps neatly to the Saab's small, streamlined rain gutters and is a complete system with attachments for carrying practi-

cally anything. The basic setup is the 1050 load carrier, which retails for about \$55. The four cast-aluminum base supports have good-sized tightening knobs (locking type and flat-black color optional), and the load bars are polyester-coated, galvanized steel tubes, rectangular in shape, with plastic cap ends. I got the rack accessory (TBH-6) as well (it's about \$45), which straddles the two load bars. It's got six cross bars plus two end bars that adjust for flat loads or flip up to cradle your luggage.

My next addition to the 1050 system will be for my derailleur: a bike carrier that holds lightweight two-wheelers upside down. Special clamps on the front load bar hold the handlebars and the bike saddle is secured to the rear bar. Maybe some-



Cast-aluminum base supports, with protective rubber, clamp to gutter and load bars are cut for appropriate overhang (left). Rubber caps go on ends. Rack (right) and other carriers attach to bars.

day I'll be ready for the kayak attachment! The Swedish-made Thule system is marketed by Eldon Group America, 175PM Tarrytown Rd., White Plains, N.Y. 10607.—B.H.



High-tech creeper has a metal frame, recessed wheels, removable tool tray.

man Co. Ltd., 80 Alpine Rd., Kitchener, Ont. Canada N2E 1A1. Montgomery Ward is among U.S. marketers; write to the manufacturer for others.—Paul Weissler

Silence, please

Squealing brakes don't necessarily mean you need a replacement. Frequently, brake squeal is just the result of the back of the plate vibrating against the caliper. When our Mustang race car got a case of the squeals, a 4-oz. squeeze tube of CRC's Disc Brake Quiet solved the problem. A liberal amount of the stuff



Compound applied to back of disc pads serves to quiet ear-piercing squealing.

goes on the outboard disc pad and a thin strip on the back of the inboard brake. Let it stand for about 10 minutes and reinstall the pads.

A tube costs \$3.50 at most auto parts outlets. For more information, contact CRC Chemicals USA, 885 Louis Dr., Warminster, Pa. 18974.

—T.A.

Getting the creeps

If you're always fumbling around for tools when you're working underneath a car, a new creeper with a roll-along tool tray is the answer. The tray attaches to either side of the creeper and moves on a caster, so it keeps up with you easily.

Instead of a flat wood frame, the

creeper has a steel frame in a cradle shape, so the body support area is very low to the ground (below the height of the casters at the corners). The frame has six crossbars for strength, and they are covered by a piece of wood paneling with a foam headrest at one end.

About \$30, it's made by J.C. Hall-

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IMPORTS & MOTORSPORTS



Customizer messes with Mercedes

Is nothing sacred? You'd think that the Mercedes-Benz 380 SEC—at \$53,570—is perfection itself just as it comes from the factory floor. But no car escapes the sharp eye of German customizing shops that are becoming as plentiful as breweries. The coupe hasn't even been out for a year (see *Driving Four New German Cars*, page 26, Feb. '82), and already the Styling Garage, located near Hamburg, has turned out a gull-wing version (but Mercedes won't allow it to carry the three-pointed star).

The Styling Garage is part of a Kalifornia kustom kar kraze in



This gull-wing SEC was created by a German custom car shop, the Styling Garage.

it's true, are nicely done, but many are tangerine-flaked cuckoo cars.

Meanwhile, the '83 Mercedes-Benz models, unsullied, are on sale here. It's a year of refinements. For fuel economy, the 380 SEC and the other two models with the aluminum, 3.8-liter, fuel-injected V8—the 380 SL coupe/roadster and 380 SEL sedan—get ignition system modifications to bring mpg to 18. The turbodiesels—300D sedan, 300CD coupe,

300TD wagon and 300SD S-class sedan—and 240D diesel have a 27-mpg city rating, and that's with automatic transmission. That puts Mercedes' corporate average fuel economy at 26.8 mpg. There's a new head restraint design, sculpted front seat backs for more rear legroom and other touches. Prices for '83 start at \$22,470 for the stripper; that's the stick-shift 240D.



Here's the real '83 Mercedes 380 SEC.

Germany. At auto shows, crowds gather to ogle punk Porsches; pin-striped, pearl-white Polos (pearl white is the season's hot color) and other *transformations fantastique*. Some,

a 320i that gives the enthusiast everything he deserves. Unofficial photos show that the successor is too evolutionary for us. But we'll be driving it soon and hope it measures up. The U.S.-version two-door arrives in mid-'83 with a four-door to follow.

Over in the motorcycle department, the old black (but beautiful) Bimmers have had a rough time with the fast and flashy Japanese competition. That's one reason for the exciting new engine that was spotted being tested in Austria. The four-cylinder is



BMW motorcycle runs tests with a brand-new, in-line, water-cooled dohc Four.

an in-line design of about 1,000-cc displacement. It's a radical departure from the horizontally opposed Boxer engines that have powered the bikes since the '20s. But, the big-displacement BMW will certainly retain one trademark: the drive shaft to the rear wheel.

BMW readies new 320i

Seems like yesterday that we waxed poetic about the superb 320i that replaced BMW's 2002, a cult car if there ever was one (see *Firsthand*

Report, page 90, Sept. '76). But in the six years it's been around, a lot of competition went gunning for it and hit the mark (see *PM Road Test*, page 88, Jan. '82). So, the time is now for



The new BMW has a more tapered nose, but rear angle shows changes are slight.

The option you can't see

Well, you won't be needing your air conditioner for a while. With winter coming, it's time for an option you don't know is there until it turns on automatically: a heated seat. You won't find it on any Detroit cars or Japanese imports. Mercedes-Benz offers coils in the seats of some of its models, but they're expensive. In the mid-price range, only Saab and Volvo offer this healthful feature. Sitting on a heated seat, you know that the future is here, especially when you think how recently used-car ads listed "R&H" as the two big options. Too young to remember? That meant radio and heater!

PM

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To find out more, see your local Armed Forces recruiter or write Armed Forces Opportunities, P.O. Box C 1776, Huntington Station, N.Y. 11746.

IT'S A GREAT PLACE TO START

HOMEOWNERS' CLINIC



Refinishing an old shower floor

We have a white metal shower stall of 1950 vintage. It has a 26 x 32-in. floor of smooth concrete that won't stay painted, though paint holds on the sides very well. There's a 5-in.-dia. drain in the center of the pan. We've tried enamel and epoxy paints, but they all peel or flake off quickly.

Is there any paint that will hold? Do you know of any fabric or other flooring that will hold and not mildew?—William S. Newman, Chapel Hill, N.C.

Yup, ceramic tile. First, remove the screen or strainer on the drain and plug the opening to prevent sludge and dirt from entering the drain (a large sponge with a string tied to it will probably work).

You'll have to remove the paint once again, preferably with a wire brush and paint remover. When you've gotten as much paint off as

possible, clean the pan with a product such as Sears' Concrete Cleaner Etcher. When the base is completely dry (at least overnight), set the tiles in a thin-set mortar mix, following directions on the container. When the tiles are set, proceed with grouting. If you use an unglazed tile, first apply a product such as Color Tile's Grout Release.

After grouting unglazed tile, seal the entire area to prevent mildew. Simply apply the sealer with a sponge. After removing the drain obstruction, you may need a longer-screw to fasten the strainer.

I've listed only the basics. Your local tile store can supply you with all the materials, including instructions on how to nip the tiles to fit around the drain. Remember, ventilate the work area and wear goggles and rubber gloves.

pushed in (gouged). Do I have to re-finish the entire top?—J.G. Jasonides, Port Huron, Mich.

I'm probably too late, but most reputable movers will send a pro to repair damage done due to their negligence. Harry Wicks, in his book *Furniture Refinishing*, states that a steam iron and a damp, clean cloth can often be used to return the "bent" fibers to shape. Follow these steps:

1. Dampen a clean cloth and place it over the dented area.
2. With the iron set on SYNTHETICS, place it on the cloth until the latter begins to dry. Chock to be sure you're not damaging the surface.

3. When the cloth is dry, check the dent to see if the fibers have returned to position. If not, repeat.

When steaming hardwood, make pinholes 1/4 in. deep in the dented area to permit more steam to enter the denser woods. *Note:* Excessive steaming can cause damage. Steam attacks both water-soluble glues and veneers, so don't use this technique when either is present. *Furniture Refinishing*, published by Grosset and Dunlap, sells for \$1.95.

Sealing wood food surfaces

What is the proper finish to seal new and unstained butcher-block tables which will be used for food preparation? I'm skeptical of the salad oils and boiled linseed oil mixtures which have been suggested, since they will probably turn rancid and taint the food. I also think they'll remain tacky to dust and will foster bacteria.—Bud Haak, St. Paul, Minn.

Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461 (212-SY2-1600), sells a product called Wood Bowl Seal. It is tasteless, colorless, stainproof and alcohol-proof to a high degree. It also withstands cleaning and washing. Although it may be brushed over old lacquer finishes if surfaces are scuffed with sandpaper, it isn't recommended for use over oiled wood surfaces, such as used salad bowls. Full directions are on the label. Ask for No. 22 WBS, which is \$4.25 a pint, plus shipping charges.

Don't use a salad oil, because it will turn rancid in time. Many professionals use mineral oil,

which is available at drugstores, for this task.

Repairing scratched tabletop

The moving man made a large scratch right in the middle of my 1 1/4-in.-thick tabletop. The scratch has depressed the finish, but not removed it. I can't tell whether only the finish is scratched or if the wood has been



Concrete block protectors, such as this Water Shield, create a moisture barrier and protect against mildew.

SERVICE TIP

Several products are available to combat moisture in basements. A new transparent liquid sealer, called Water Shield, is brushed, rolled or sprayed on concrete block walls to reduce moisture damage. The sealant (\$15.75 per gal.) is made by Geocel Corp., Box 398, Elkhart, Ind. 46515.

Another clear sealant is Thompson's Water Seal, available in 1-gal. cans for \$15. E.A. Thompson Co., 703 Market St., Suite 2007, San Francisco, Calif. 94103, makes it.

A specially formulated paint, available in a variety of colors, waterproofs concrete block walls. It's Drylok Ready Mix Sealer (\$20.75 per gal.) from United Gilsonite Labs., Scranton, Pa. 18501. **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 the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your orders to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

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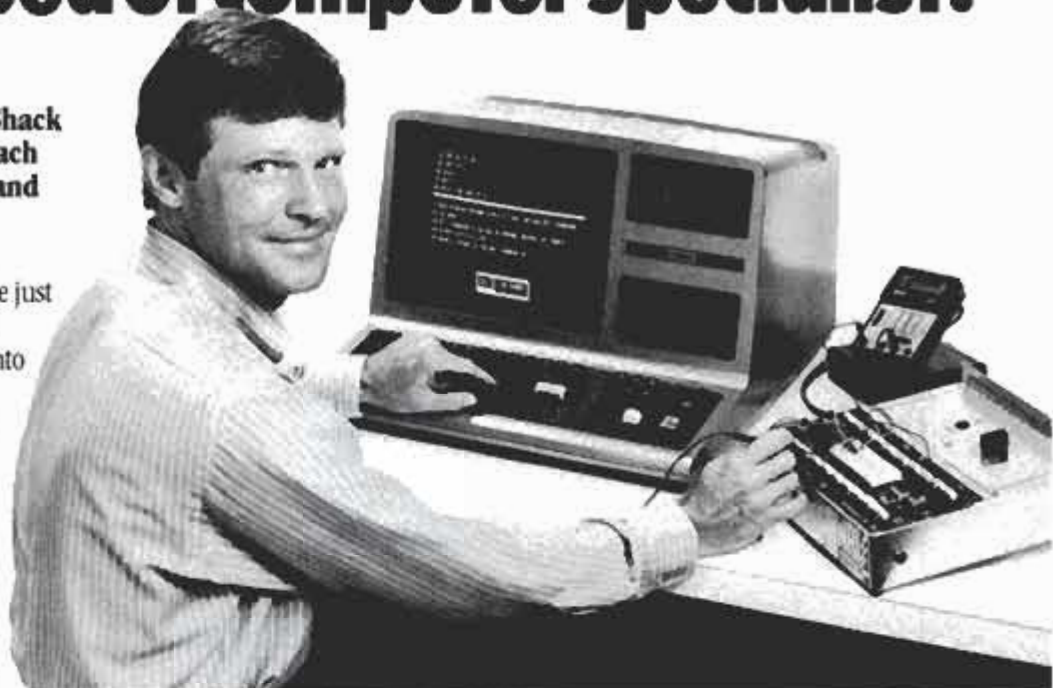
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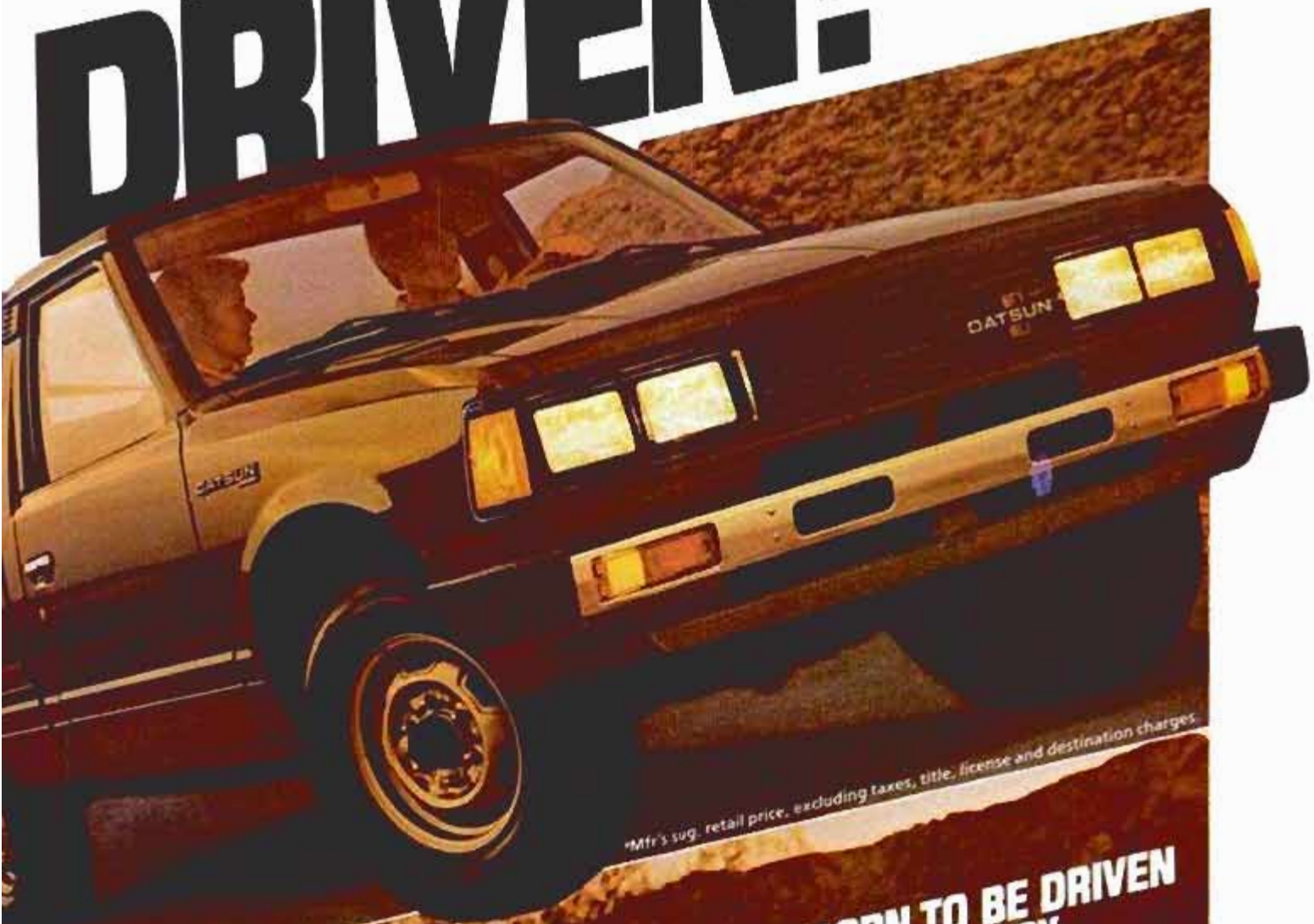
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MPG MPG

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ALL OUTDOORS

Gear that has tested the best

Looking back over a year of improved equipment for outdoorsmen, some old and new items stand out as particularly successful. They're the ones that a sportsman this season might consider adding to his duffel or presenting as a Christmas gift to family or friends.

This can be a warmer winter if you stock up on some of the latest innovations in insulation. Big news is the expanding use of synthetic down in better clothing and sleeping bags. Quallofil, Thinsulate, PolarGuard, Kodofill and Hollofil are trade names of down substitutes that don't get wet easily and can retain their heat-conserving properties.

Underwear using polyethylene fiber is another new product that takes advantage of nonabsorbent synthetics. Sweat evaporates through the material quickly before it can become cold and soggy.

Lifa is a brand developed for Norwegian fishermen that is available from Campmor, 810 Route 17N, Paramus, N.J., and other outlets. And everything from shoes and gloves to parkas, sleeping bags and caps is now made of expensive treated fabrics like Gore-Tex, which is designed to keep rain out but allow sweat to escape.

Fishermen have just seen the introduction of bait-casting reels that use internal magnets to calm down the spool overspeed that causes backlash and great frustration for anglers. Daiwa's Procaster Magforce was first on the market. Now they've expanded into a variety of freshwater and Sea-line saltwater models, and magnet-governed reels have been announced by additional manufacturers.

The biggest fishing-line news is from Du Pont with its introduction of Prime cofilament, a line reported to keep its strength and minimize stretch because it does not absorb water. Special new formulation is said to help it resist taking the curly set that makes line come off the reel in coils, and we look forward to testing it extensively.

For shooters, models like the new Winchester Stainless Marine shotgun

with its noncorrosive finish make possible storage on a boat without the old fear of deterioration from salt air. From U.S. Repeating Arms, the 12-gauge pump has a stainless steel barrel, triple-plated receiver, and can hold seven shells. Smith & Wesson, Browning and others are also offering rust-resistant guns and the Charter Arms AR-7 Explorer .22 take-down carbine and companion Explorer II auto-load pistol—favorites of ours—are also newly available in special finish.

Boatmen this year have jumped aboard the sailboards, and the stand-up sailing invention that started in the United States and took off in Europe is now booming back at home. We have tested single and twin-hulled models, and more variations are on the way.

For powerboatmen, bigger engines once again are in the works. Outboard Marine's eight-cylinder muscle machine topped 100 mph easily on the Molinari hull we tested, and guesses have put its power near 500 hp. Mercury officially offers a 300-hp outboard, but tuned for racing it has been challenging anything around.

The leading edge of hull development is still held by the offshore racers, where Cigarette and Scarab dominate when the going is rough but are threatened by catamaran and tunnel designs on calmer waters. Squadron XII is a name to keep an eye on, in particular.

Campers, particularly those who live out of their packs, are always looking for newer, better and lighter gear.

Lights that don't weigh less but do last many times longer are now powered with lithium batteries that can cost nearly \$20 for a D cell. Early Winter or the Yak Works, both in Seattle, Wash., are two mail-order sources.

No camper heads afield without a knife, and the new trend is to lock-back models that don't fold on your fingers. A new Wenger Swiss Army Knife, imported by Precise International, even has this feature.

Getting an edge on

With the popularity—and prices—of quality knives going up so rapidly recently, it's worth protecting your investment with proper care. Careful oiling and storage in a dry, safe place come first. Cleaning and wiping off moisture after use are important, even with stainless steel.

Recently Schrade Cutlery has introduced a Knife Care Kit (SAK-1) for about \$4.20 that has a rust eraser to remove spots and scratches, plus polishing cream, a brush to clean the inside and joint oil.

For sharpening, the Ellenville, N.Y., company has a \$6.70 Honing Kit (SAK-2) with a Schrade Double-Grit honing stone, honing oil and detailed instructions. For knives that are collectors' items or in everyday use, both kits are extremely worthwhile.



Keeping Schrade's Uncle Henry Fish Fillet Knife sharp is easier with new kits.

Salts of both sexes

Best news of the year for boating enthusiasts is the announcement that the U.S. Power Squadrons will now, for the first time, also make memberships available for women and families.

The excellent boat handling, safety and navigation classes of the squadrons have been open to everyone in the past. And now all graduates of the initial piloting and seamanship courses will be eligible for membership as well.

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SCIENCE WORLDWIDE



Science toys for stocking stuffers

With the holiday season upon us, stocking stuffers with a scientific bent are worth investigating. At hobby shops, for instance, you'll find Little Brown's *The Space Shuttle* (\$8.95).

PM photo: Steven Eskow



To build the *Space Shuttle*, you'll need patience and the tools depicted above.

You cut out and glue together over 120 authentic-looking cardboard parts to form an 18-inch-long model shuttle. It's fun for space enthusiasts, but requires too much concentration for children under 12. To build the kit, you need glue, clear tape, rubber bands, paper clips, a straightedge and an X-acto knife.

Edmund Scientific sells experiment kits called "Scientifics," which zero in on a specific area, such as how a prism works. The kits can be ordered for \$9.95, plus shipping, from Edmund, 7082 Edscorp Bldg., Barrington, N.J.

Another good one is a Micro-Mike pocket microscope from DuMaurier Co. Inc., Virginia Beach, Va. 23454. It'll provide hours of fun for anyone who spends a lot of time outdoors. The 20X magnifier is shaped like a cigar and fits neatly into a pocket. Kids especially should enjoy using it to look at plant roots, insects and other wonders of nature.

word on this controversial subject.

Loyola University (Chicago) theology professor Rev. Francis L. Filas has identified markings on a computer-enhanced image of the linen as an imprint of a Pontius Pilate coin placed over the right eye of the cloth's male figure.

Moreover, Filas found on the coin imprint a misspelling of "Caesar"—the use of a Roman "C" instead of the usual Greek "K." Filas says he has a coin with just such a misspelling in a Chicago bank vault. This past April, Duke University physician Alan Whanger confirmed that the markings on the Shroud were from such a coin. In a 14,000-word monograph, Filas concludes: "The identification of imprints of the right-eye coin, dated 29 A.D., conclusively dates the Shroud to the years near the death of Jesus Christ and locates the Shroud in the Palestine of Jesus Christ."

Thus, says Filas, the Shroud of Turin most probably is the actual burial cloth of Jesus.

Acid snow

According to a Cornell University study, three upstate New York lakes had high levels of acidity in their upper layers during the spring snow melt. Apparently, this melted "acid snow" tends to stay just under the ice of northern lakes. Acid snow, like acid rain, contains pollutants from highly industrialized areas. The Cornell researchers believe it may be a more serious threat to fish and smaller organisms than acid rain because of its tendency to stay in one level of the water.

Moon disappears

If you missed the total lunar eclipse earlier this year, you'll get a second chance just after midnight (EDT) on December 3. The entire lunar disc will be covered by the Earth's shadow for about two hours. This was an unusual year for eclipses—there were seven (three total lunar and four partial solar). This many eclipses have occurred in one year only 11 other times in the past 1,000 years. **PM**

Anti-obesity tune-ups

Elliot Danforth and other University of Vermont medical researchers who have been studying chubby lab animals report that overweight white rats burn calories more efficiently than do normal-weight rats. If later research shows such a tendency in humans, doctors may be able to dispense "thermogenic" drugs that "tune up" the human calorie-burning process. Thus, an obese person might lose weight without dieting or extra exercise.

Cleaning up with coal

The environmental group INFORM has been conducting regular surveys of utilities that have switched from oil to coal to produce electricity. In a recent report, INFORM notes that 11 of 16 plants which used scrubbing methods removed enough pollutants to meet stringent sulfur dioxide standards. Cleaned coal also weighs less than raw coal and is cheaper to transport.

More on the Shroud

We recently reported that one group of scientists has decided the Shroud of Turin is not the burial cloth of Jesus Christ ("Pure Science/Pure Art?," *Science Worldwide*, page 42, Aug. '82). But we hadn't heard the last



In photo, taken by Rev. Filas, letters are faded on 29 A.D. coin, but Pilate's staff is clear.

SATURN V

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Free movies, sports and special events with the Saturn-V deep fringe microwave receiver for homeowners outside the service area of local over-the-air pay TV stations (i.e. HBO, Showtime). The Saturn-V is a high technology microwave downconverter featuring State-of-the-Art electronics for general microwave usage. Receiving range is 65 miles line-of-sight of a local transmitting tower.

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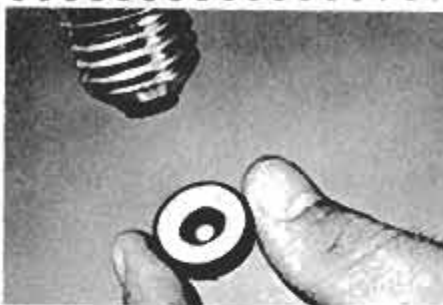
The Button is a solid-state micro chip diode. It converts AC current to DC current and extends the life of a bulb filament up to 100 times!

For example, a regular bulb rated for 750 hours would last for about 32 days if burned continuously. But, with **The Button**, that same bulb's life would be extended to 75,000 hours or 8 years. Less often used bulbs could last a lifetime! (Thomas Edison's winter home in Florida uses DC lighting. The original bulbs have been burning continuously since 1925 — and are still going strong!)

This amazing development works with any regular incandescent light bulb (not 3-way type). There is even a model for candelabra size bulbs. Just stick a **Button** to the bottom of a bulb and screw into socket.

The results are amazing. Bulbs burn cooler, and give a softer less glaring light. You save up to 30% on electricity and just think of the money saved on light bulbs!

The Button is absolutely ideal for lights that run 24 hours a day like exit signs and security lights. (Don't replace them until 1990!) Major hotels, restaurants and corporations are already using **The Button** and saving considerably on maintenance costs.



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If you're sold on the idea of saving money, **The Button** comes in packages of 12 for \$29.95 (plus \$2.45 shipping and handling). If you're still a bit of a skeptic (or don't have 12 bulbs), order a package of six for only \$15.95 (plus \$1.50 shipping and handling). Either way, you're covered by Baystar's guarantee of satisfaction or your money back in 30 days. Be sure to specify candelabra or regular size.

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PM PHOTO HINTS

Cheaper negative holders



Stationery and record departments can be treasure troves for the amateur photographer. Here, a plastic record rack is being used to hold negatives. The slots keep them separated and accessible.—A. Weber

Convenient safelight



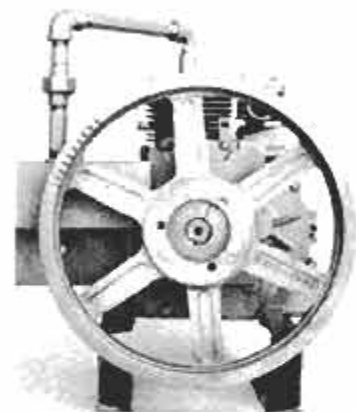
Try mounting a safelight from your darkroom ceiling. Use the kind with a swivel base. It will be out of your way and will direct light where you need it.—Bob Brightman

One-step filter



Cut down a broad-mouthed plastic jug and use it as a base to hold your darkroom funnel. Now you can filter solutions into trays through a cotton-filled funnel.—Louis Hochman

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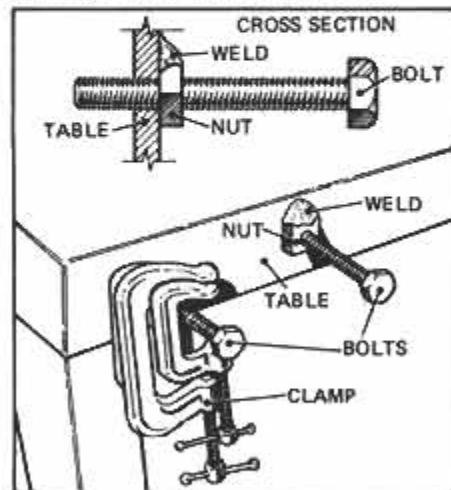
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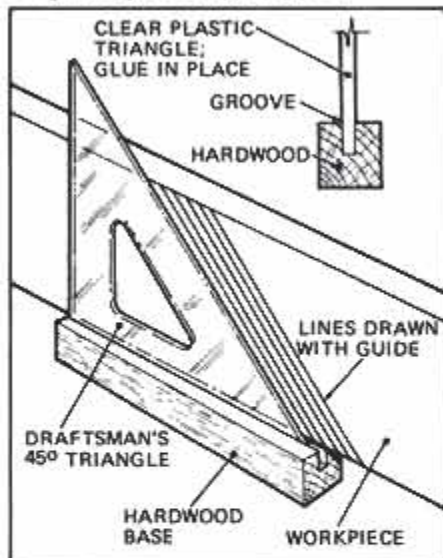
HINTS FROM READERS

Hangers for welding tools



Hang C-clamps, chipping hammers and other tools on a bolt turned into a square nut welded to one end of a metal welding bench. If you drill a hole through the table to receive the bolt, you can vary the bolt's length as needed.—Wayne G. Rivers

Impromptu shop square



Using a draftsman's triangle and a block of wood, you can create an extra shop square. Cut a groove in a perfectly square length of hardwood, as shown. If you cut the groove to provide a force fit, the triangle can be removed when desired. The wood strip provides a shoulder to butt against the workpiece (as you do with a try square).—Jay Wallace

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Check the Yellow Pages under Hardware for the SENTRY store nearest you.

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Merchandise shown in this advertisement is available from participating dealers only. Offer expires December 27, 1982. All Sentry dealers own their own stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores.



PM ELECTRONICS MONITOR



How to choose a new video game

One of the most popular gifts this year will be any of the home video game systems, which use the games we describe on page 92 (*New Video Games: More Flash and Dazzle!*). But how do you choose one of these machines? It's a complicated venture, and because they're expensive, you'll want to make certain you'll be satisfied with your choice.

Resolution

This has nothing to do with New Year's Eve: It's an engineering term that describes how much detail you can have on the screen. The more resolution, the finer and more colorful the games.

Magnavox's Odyssey 2 game has, at present, the least resolution. The figures it draws on the screen are blockier in appearance than those of the other units. For arcade-style gaming, this has its drawbacks. But some of the strategy games available from Magnavox for this unit, such as *Quest for the Rings*, are great fun to play. The Odyssey keyboard allows greater player manipulation of facts and figures than the other games.

The Atari Video Computer System (VCS) has very good graphic resolution. By the time you read this, the new Atari 5200 machine will probably be available. I haven't seen the 5200, but I understand it will accept today's Atari-style cartridges—and that resolution on newer cartridges will be improved. The current Atari offers respectable graphics and speed. In addition, cartridges from other manufacturers, made for the Atari, have been enlivening this market. The Atari system has, by far, the widest choice of games.

The Mattel Intellivision features superb graphics. Here, too, the secondary manufacturers are entering the market, so you can expect a big choice in cartridges soon. Right now, the strategy and sports games seem better than the arcade entries, but that may change.

The new Colecovision's graphics can only be described by one word—"fannntastic!" Coleco has licensed various arcade games, such as *Don-*

key Kong and *Cosmic Avenger*, from the coin-op people. And there's almost no difference between the home cartridge and the arcade game.

Controls

The device each system provides to move your little man or spaceship around the screen is more important than most people realize.

The Odyssey system features two built-in joystick controls. The "stick" is light and easy to move and hold onto. And, of course, the Odyssey 2 has a touch-sensitive keyboard, as well.

The Atari system features its famous—or infamous—plug-in joystick. These sticks take some getting used to, since they don't have much tactile response. If you never do feel comfortable with them you can buy various styles of replacement joysticks and controls.

The Intellivision and Colecovision both feature rectangular, handheld controls with small keyboards. On the thin Mattel unit, you tilt a disc in the direction of move-

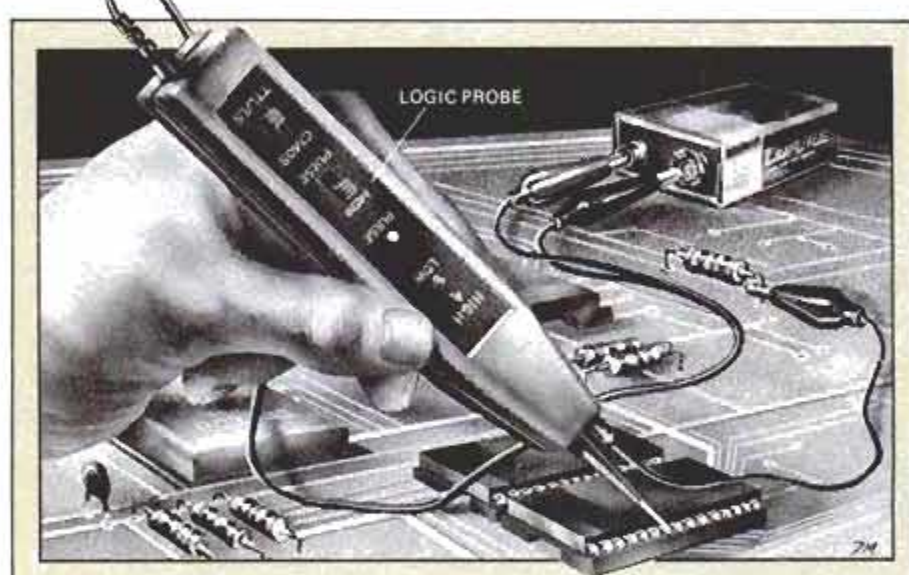
ment. The thicker Coleco unit sports a small joystick instead of a disc. The Mattel unit requires practice, but is easy to use for long periods of time. The Coleco controls, however, were found by most of our informal testing group (a few wild parties) to cause hand discomfort after a few hours—they're too thick for most people to hold comfortably for an evening of sipping, zapping and zipping.

Other features

Both the Odyssey and the Intellivision now have the power of speech using plug-in speech synthesizers. We found the Mattel version to be great fun, since the voice contributed directly to the games we were playing. And though we haven't heard the Odyssey's synthesizer yet, we have high hopes.

And Coleco has a great idea for its new machine—a device that will allow the system to accept just about any cartridge. Yes, with this add-on, you'll be able to use your old Atari or Mattel games in your Coleco machine.

So have fun—and don't shoot when you should have ducked! **PM**



Finding bad chips

You can troubleshoot digital electronic circuits with a logic probe. The probe, which is connected to a power source and the circuit ground, is touched to

pins on an integrated circuit (IC). You can interpret probe lights to tell if voltage is high or low. Instructions with most probes detail popular ICs.

GAS SAVER—U.S. PATENT ISSUED FOR LOW COST WATER/VAPOR INJECTOR

DENVER—The Copley News Service reported that a U. S. Patent has now been issued to Wm. Trevaskis, veteran electrical engineer, for his Vapor-Jet® water/vapor injector (Pat. #4,119,062).

Trevaskis has developed what can amount to a 15 cents per gallon "rebate" potential on gasoline by designing a low-cost injector for all domestic and foreign cars, vans, light trucks, and RVs.

People have noticed for years that their car runs better on a cool rainy day. Vapor-Jet® gives a constant rainy-day effect to the engine. The water injection principle was used during World War II to give combat aircraft increased power and speed.

Trevaskis' new Vapor-Jet® is one of the least expensive on the market (\$33.95 + \$3.00 shipping and handling) and can be easily installed even by a novice in 15 minutes.

The Vapor-Jet® has an unconditional 60-day guarantee. If for any reason you are not satisfied, you may return it within 60 days of the day you installed it for a \$33.95 refund.

How does the Vapor-Jet® System work?

Vapor-Jet® operates very simply with no moving parts to wear out. It uses engine vacuum to pull outside air through a reservoir containing a water/methanol mixture which is attached to the car under the hood. This causes the fluid to bubble and splash forming a mist of water droplets and vapor in the upper part of the reservoir. The mist is then drawn by vacuum through a hose which is connected to a manifold suction hose. The connection is made very simply by our patented injector nozzle which contains a regulator to allow the right amount of mist to pass into the combustion chamber.

Will Vapor-Jet® help eliminate engine ping and dieseling?

Yes. The introduction of this mist into the fuel mixture has a cooling effect that increases mixture density, extends the burning rate, and improves combustion efficiency. This has the same effect as increasing the octane of the gas which helps eliminate the engine-damaging ping that is a problem to many vehicles because of the low octane gas sold today.

The mist also helps remove the mileage-destroying carbon from the spark plugs and cylinder walls and keeps it removed. All of these effects together with the fact that water, when it turns to steam, expands 1700 times (the principle used in the steam engine) gives your car more horsepower (SAE Bulletins #690018 and #215).

How much mileage increase is expected?

Mileage improvement may vary due to vehicle, driving habits, geographical area, and weather conditions—but we guarantee your satisfaction or your \$33.95 refunded, no questions asked.

Vapor-Jet® can improve your mileage in three ways: First, moisture actually causes the gasoline to burn more efficiently.

Second, Vapor-Jet® also allows in many cases the possibility of spark advance without ping. This can also increase gas mileage.

Finally, by helping remove mileage-destroying carbon from spark plugs and cylinder walls, Vapor-Jet® helps restore and keep your car in fresh tune-up condition.

The removal of carbon from your engine can potentially have a money-saving benefit of longer engine life.

Will Vapor-Jet® fit all cars, and is it easy to install?

Yes. The same kit fits all cars and contains everything needed. It will work on fuel injection, cars with superchargers, rotary engines, and catalytic converters. It will work with leaded and unleaded gas, gasohol, or propane burning cars. Simple installation instructions with a diagram are included. Simply take an ice pick or drill and make a small hole through any intake manifold suction hose (i.e., PCV hose, etc.). Screw the injector nozzle into the

hole. Mount the reservoir. Use the hose to connect the reservoir to the injector nozzle.

Can Vapor-Jet® damage my engine or cause rust?

Absolutely not! Vapor-Jet® cools down the fuel air mixture giving a better burn and suppressing ping, thus extending your engine life. The mist that enters into the engine turns immediately into vapor. The excess exits out the exhaust similar to driving on a rainy day.

What is the purpose of the methanol V.I.M. (vapor injector mix)?

The reservoir measures 3½ × 5½ × 7½ inches and holds just under ½ gallon. A full reservoir should last 500 to 800 miles. Methanol (wood alcohol) is mixed with water mainly to prevent freezing and to aid in combustion efficiency. It is easily and cheaply found almost everywhere.

For purchase or further information, write or call Progressive Energy Corp., 3148 S. York, Englewood, CO 80110, (303) 762-1385, or call toll free (800) 525-8624. Dealerships available. (Offer void in CA.)

Enclose \$33.95 + \$3.00 shipping and handling.

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Carpport and potting shed (top) with storage shelves becomes a boat cover and workshop. Translucent cover gives solar heat, protection for all-year use.

Back-Yard Shelter In One Afternoon

Boat cover, garage, greenhouse, storage shed, camping shelter—name it, and you can custom-design and erect it quickly with the help of clever new clamps.

It started as a plan to build a quick winter cover for a small 12-foot skiff. We ended up with a 10 × 20-foot boat-house that's a greenhouse offseason—spring, summer and fall—plus a garage and storage shed with shelves, as well.

The construction method was so simple, moderately priced and easy that we just kept on going—like assembling an Erector set. Cost, with cover, was under \$500. Time? One busy afternoon—and it can be disassembled and stored away in less time and with equal ease.

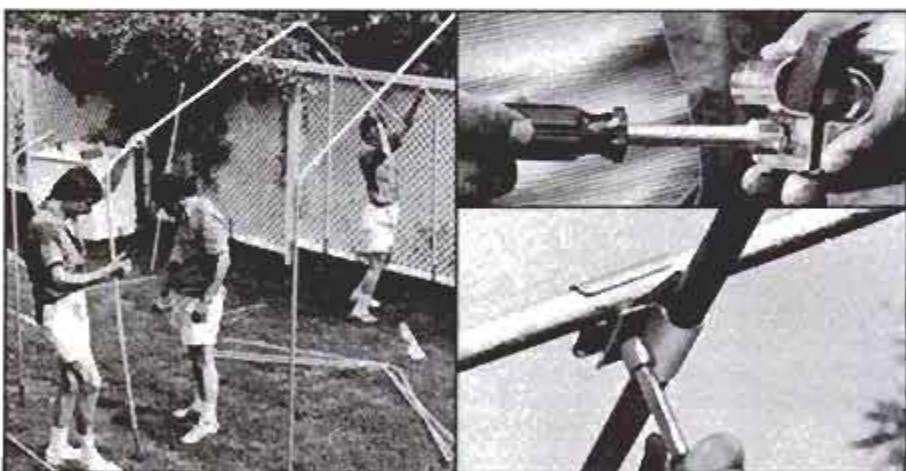
The secret ingredients were clever fittings called Kover Klamps (Box 1628, New Rochelle, N.Y. 10802). They hold together standard thin-wall electrical conduit. It's 3/4-inch-inside diameter EMT tubing that comes in 10-foot lengths and is available everywhere at electrical supply outlets and numerous hardware stores.

There are other devices similar to these clamps. But this one can be secured at any angle. The two metal pieces with rubber gasket in between are tightened with one simple socket wrench. Our only other tools were a metal cutter and tubing bender, plus a tape measure and level.

We had planned to rent them. But we quickly found that the system was so easy to use that, for \$28, we bought the tools so that we could build fast shelving for a basement storage room, as well.

A small boat in winter and a snowmobile in summer can be covered with one set of eight Kover Klamps (\$29.95), five

lengths of 10-foot tubing, eight couplings for straight runs and seven rubber crutch tips. This makes a custom-fitted shed. A large power or sailboat may mount a winter cover on deck with rubber crutch tips on the ends of the pipe uprights and the framing clamped to lifeline stanchions or tied down, just as a makeshift wooden



Prebent frames are quickly assembled and dropped into pipes driven in the ground for a firm footing. One nut is loosened so Kover Klamp can be swiveled and then tightened to hold two electrical-conduit tubing lengths together in any position.

frame would be. But come spring, bits of colored tape can color-code the uprights, ribs and ridgepole so that the complete set can be taken down, stored compactly and reassembled once again in the fall. Because the tubing can be curved and the Kover Klamps have no sharp edges, the cover ties snugly over the frame. Spots where chafing might occur can be protected with tape or carpet scraps tied on.

We used translucent plastic that has bonded-in filaments and great resistance to tearing. Supplied with grommets edges from Weathermate (Box 4447, Salem, Mass. 01970), the greenhouse cover with two separate end panels was just under \$100; a dark plastic of similar strength would cost approximately \$30 less.

For our carport boatshed, Pat Doyle,



Shaping conduit into a custom curve is simple with standard pipe bender, gives rounded shapes that won't chafe cover.

Lenny Bari and Sam Samela of Kover Klamps drove lengths of pipe into the ground about four feet apart along each side and bolted prebent conduit uprights to them, although the structure could also have been just set on the ground. The ridgepole had light fixtures fitted into it with wiring threaded through the tubing. Each segment was carefully leveled this first time up. Next time, the setup might be twice as fast.

One person can do it

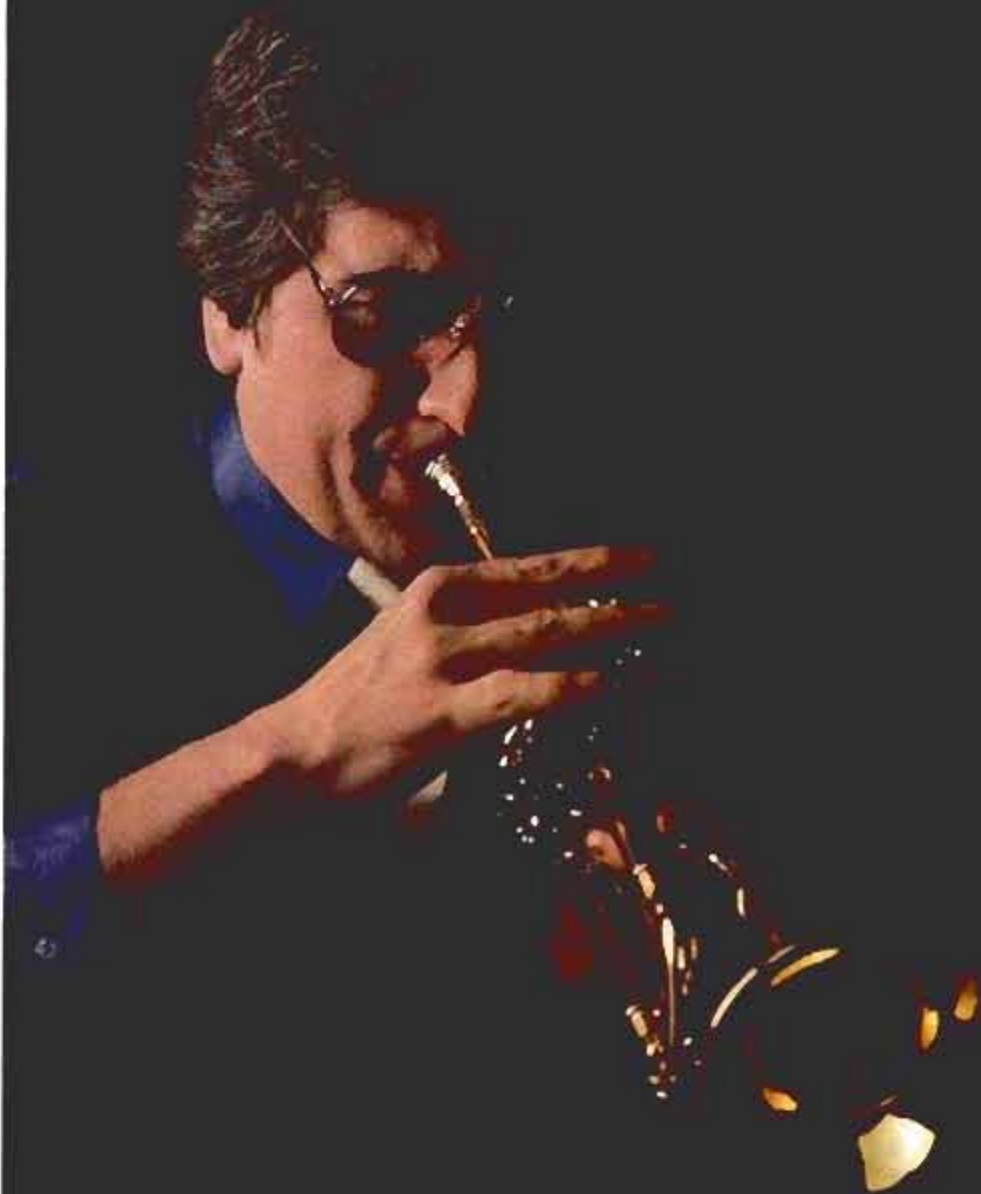
Because the frames are light, one worker can readily erect a boatshed or garage single-handed. One socket wrench tightens down the single nut that secures each Kover Klamp, and the framework gains rigidity as it is assembled. Diagonal members may be added for extra strength, if desired. Lengths of polyethylene line tie the cover in place.

The total cost, including eight sets of Kover Klamps, 42 lengths of tubing, couplings, tools and cover was \$485.

—Bill McKeown

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**KOOL
ULTRA**

New Machines To Skim The Snow



For this winter's snowmobile action, you can look for more performance from fewer brands.

BY BILL McKEOWN OUTDOORS EDITOR

Snowmobiling as a sport has been speeding up and settling down. This winter, more miles of trails than ever are available for the cold-weather rider. More resorts offer the simple instruction beginners might want, and more snowmo rental outfits stock an assortment of machines. Improved trail-grooming is taking many of the

bumps out of cross-country runs. Trail maps are available from the travel and tourist departments of a number of snow-belt states.

But no longer are over 100 brands of machines on the market, as they were just a few years ago. For the '82-'83 snow season, Bombardier is offering

(Please turn to page 62)

- 1** A single-seater for sporty driving, new Ski-Doo Citation SS has a two-cylinder, 22.5-cu.-in., twin-carb mill.
- 2** John Deere's new Snofire, for single or double riding, is direct-drive, free-air unit, has disc brakes, 339-cc mill.
- 3** Polaris Star, called lowest priced of full-sized machines, is rated at 37 mpg with its single-cylinder engine.
- 4** Both Indy Trail and Super Sport from Polaris use 432-cc, fan-cooled, oil-injected engines for lightness, speed.
- 5** Driving range of 190 miles is claimed for new John Deere Trailfire LX with its 436-cc engine, 7.75-gallon tank.
- 6** Ski-Doo Blizzards, by Bombardier, have special suspension and 497-cc power for 5500MX (left).

1 Million Famous LCD Quartz Calendar Watches To Be Sold For Only \$5 Apiece In Mammoth Publicity Drive

*All who wish to apply for a watch
should write to the company before
Midnight, December 31, 1982*

NEW YORK—One million famous LCD Quartz calendar watches will be sold as part of a publicity campaign for only \$5 apiece to the first one million persons who apply in writing to the company before Midnight, December 31, 1982.

These are the same nationally publicized LCD Quartz watches advertised in *The New York Times*, *TV Guide*, *Parade* and other leading publications, with a built-in computer so powerful it never needs winding and which is accurate to within seconds per month. Time and date are displayed in full Quartz digital mode; and a unique "backlight" allows viewing even at night or in total darkness.

These famous LCD Quartz calendar watches will not be sold at this price by the company in any store. To obtain one at this price, apply in writing to the company address (below) no later than Midnight, December 31, 1982.

Each watch carries a full one-year money back guarantee and will be replaced by the company, free of charge, if it ever fails to function.

There is a limit of two (2) watches per address at this price, but requests which are mailed early enough (before December 25) are permitted to order up to 5 watches.

To apply for an LCD Quartz calendar watch, mail your name and address *and this original printed notice* together with \$5 for each watch desired. Add only \$2 shipping and handling no matter how many watches you are requesting. NOTE: Specify model and color choice for each watch as follows: Men's Gold (Item #20710A), Men's Silver (Item #20720B), Ladies' Gold (Item #20730C), Ladies' Silver (Item #20740D). Mail to: **Delucca, Goldrich & Lord, Ltd., Calendar Watch, Dept. 114-3, Box 1020, Westbury, N.Y. 11595. (D20700)**



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**ONLY PICKUP WITH 5 yr./50,000 mi.
POWER TRAIN & RUST PROTECTION.†**

COMPARE DODGE RAMPAGE TO CHEVY AND FORD

	Dodge Rampage	Chevy S-10	Ford Ranger
Est. hwy. (EPA est. mpg)	42/28*	39/27*	36/26*
Drive/Transmission	Front wheel/4 spd. O.D.	Rear-wheel/4 spd. Dir.	Rear-wheel/4 spd. Dir.
Horsepower	99 max.	82 max.	74 max.
Maximum Torque	119 lbs./ft.	101 lbs./ft.	110 lbs./ft.
Galvanized Steel	340 sq. ft.	265 sq. ft.	50 sq. ft.
Standard Payload	1,145 lbs.	1,000 lbs.	1,200 lbs.
Power Brakes/Load Sensing Sys.	Standard/Yes	Optional/No	Optional/No
Seats	Deluxe Buckets	Bench	Bench
Color-keyed Carpeting	Standard	Optional	Optional

†Five years or 50,000 miles—whichever comes first—limited warranty includes power train protection (deductible may be required) and outer body rust-through protection. See dealer for details.

**RAMPAGE: WE'RE BUILDING
OUR TRUCKS LIKE
WE NEVER DID BEFORE.**



*Use EPA est. mpg number for comparison. Your mileage may vary depending on speed, distance and weather. Actual hwy. mileage will probably be less. (EPA est. lower.)

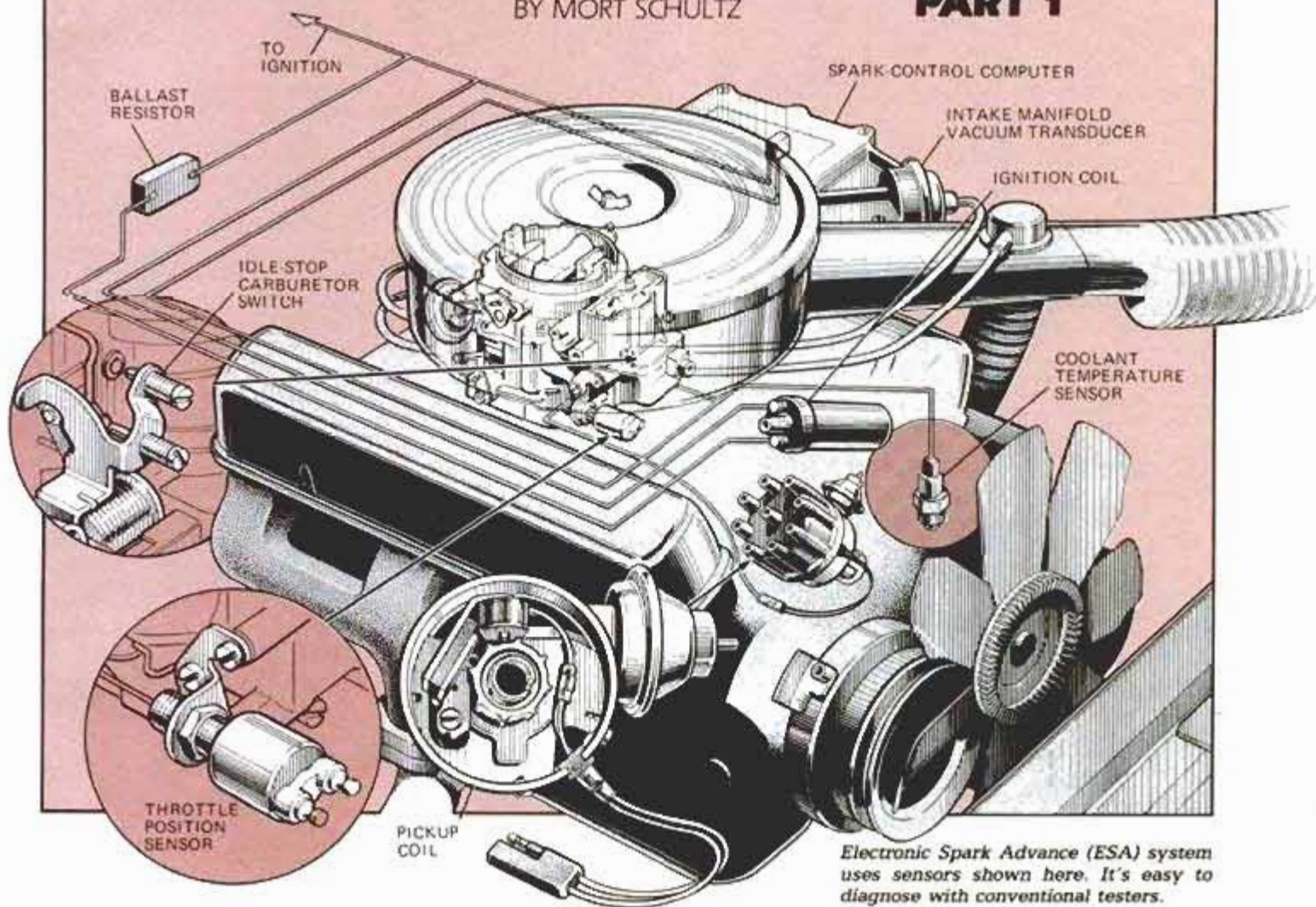
Buckle up for safety.

THE NEW CHRYSLER CORPORATION
QUALITY ENGINEERED TO BE THE BEST

Troubleshooting Chrysler's Electronic Ignition System

BY MORT SCHULTZ

PART 1



Electronic Spark Advance (ESA) system uses sensors shown here. It's easy to diagnose with conventional testers.

The GM and Ford computerized engine control systems, called Computer Combustion Control (CCC) and Microprocessor Control Unit (MCU), respectively, are not quite as suited to Saturday mechanic troubleshooting as the Chrysler system. They are products of the '80s, and most have not exceeded the five-year or 50,000-mile warranty period. Most owners of cars with CCC and MCU would, therefore, let dealers handle any problems.

The Chrysler system, on the other hand, came into existence back in 1976, and some cars built in the 1976-80 period are no longer covered by war-

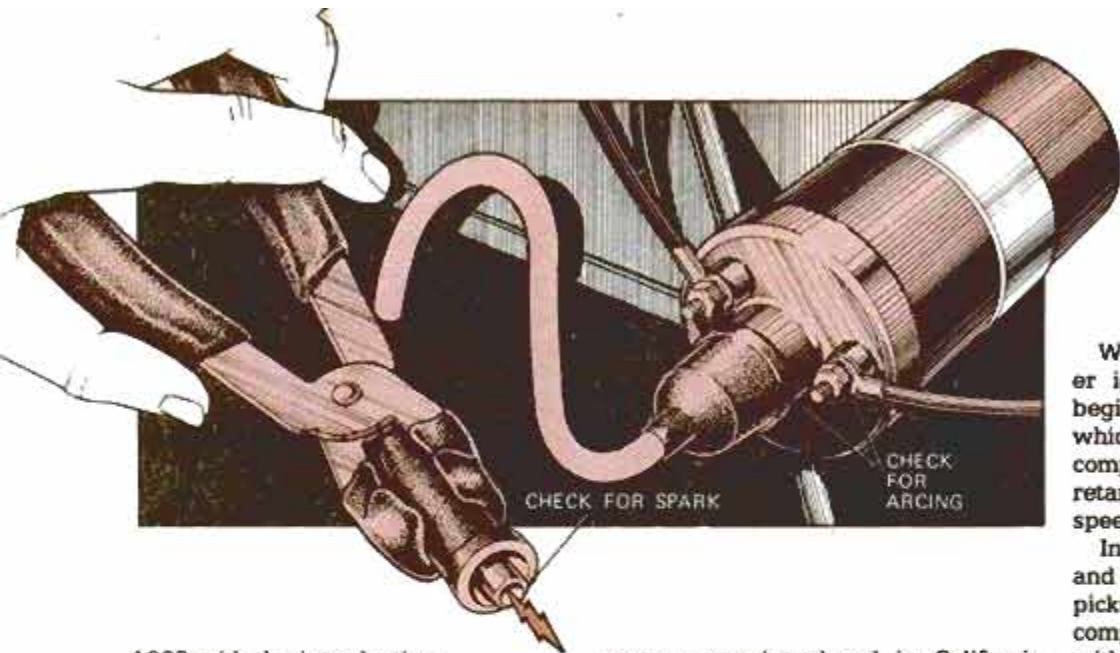
ranty. The Chrysler system we're talking about is an electronic spark control system, while the newer GM and Ford systems control a whole range of engine functions. (Chrysler also has a closed-loop, computerized engine control on some '79 and '80 California cars and most 1981 49-state cars, but we won't be discussing those here.)

Troubleshooting is not difficult. But, in addition to the fact that the Chrysler system is only a spark control system, there is another major difference between the Chrysler computer system on the one hand, and MCU and CCC on the other.

MCU (see *Troubleshooting Ford's Micro computer Control Unit—Part 1*, page 53, April '82 and *Part 2*, page 35, June '82) and CCC (see *Troubleshooting GM's Computer Command Control—Part 1*, page 49, July '82 and *Part 2*, page 35, Aug. '82) are self-diagnosing.

By making a single, simple "tap" into either system, you are able to get a visual indication of which subsystem, if any, has failed. These procedures are explained in the articles mentioned above.

The Chrysler computer system is not self-diagnosing and won't be until Feb.



To check for spark from the coil, disconnect the coil cable from the distributor, hold the lead near a ground and crank the engine. The spark should fire evenly and be a bright blue.

1983 with the introduction of engines having throttle body fuel injection. Therefore, when an engine performance problem strikes a Chrysler-built car having a computerized spark control system, you have to make a series of individual tests to determine (1) if any part of the system is at fault and (2) if so, which part.

This article and one next month will describe these tests, which are made with conventional instruments.

Before starting, let's establish the ground rules. Not all Chrysler vehicles with a particular engine are equipped with the system. You have to look for the lean burn or spark control computer on the air cleaner housing. The articles dealing with the Chrysler computer system will cover some of the following cars:

- 1976 models with 400-cu.-in. engines and four-barrel carburetors.
- 1977-78 models with 360-, 400- and 440-cu.-in. engines and four-barrel carburetors.
- 1977½ models (LeBaron and Diplomat) with 318-cu.-in. engines and two-barrel carburetors.
- 1978-79 models with 1.7-liter engines and 1978 models with 318-cu.-in. engines and two-barrel carburetors.
- 1979 models with 318-cu.-in. engines and two-barrel carburetors, and 360-cu.-in. engines with two-barrel carburetors.
- 1980 models with 360-cu.-in. engines with two- and four-barrel carburetors.
- The article will not deal with 1979 and 1980 cars built for sale in California.

Until 1979, the computerized system in these cars was called the Electronic Lean Burn system. Then, the name was changed to the Electronic Spark Advance (ESA) system. Since ESA is a more descriptive designation, we'll use that.

The system in 1976-80 Chrysler cars listed above controls only the timing of spark to the cylinders. In 1979, another

system was introduced in California having an electronic feedback carburetor (EFC). This system controls both the delivery of fuel and spark. Since 1981, the EFC system has become the standard Chrysler computerized engine control for passenger cars throughout the United States.

Although some phases of testing are the same for ESA and EFC, many aren't. Don't try to apply the tests described here to a car having EFC.

Sensing devices

In 1976-77 models, seven sensing devices are used, except in 1977½ LeBaron and Diplomat with 318-cu.-in. engines and two-barrel carburetors. They are a start-pickup coil, run-pickup coil, coolant temperature sensor, air temperature sensor, throttle position sensor, idle-stop carburetor switch sensor and intake manifold vacuum transducer.

The start- and run-pickup coils, which are also used in 1980 models with 360-cu.-in. engines, are located in the distributor. The start-pickup coil signals the computer that the engine is being cranked, and the computer establishes a fixed amount of spark advance.

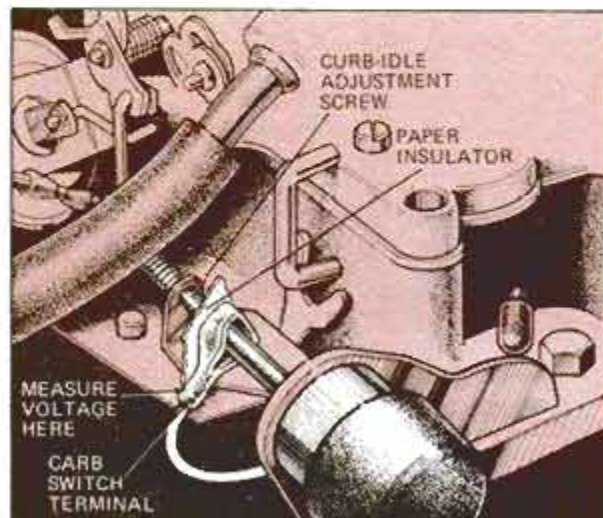
When the engine starts, the computer ignores the start-pickup coil and begins to monitor the run-pickup coil, which supplies basic timing data to the computer. The computer advances and retards timing according to various speed and load conditions.

In 1977½ LeBaron and Diplomat and 1978-79 models, there is no start-pickup coil. A bypass circuit within the computer allows start and run functions with a single pickup coil, which is in the distributor. Models with 1.7-liter engines have a Hall-effect pickup assembly instead of a coil.

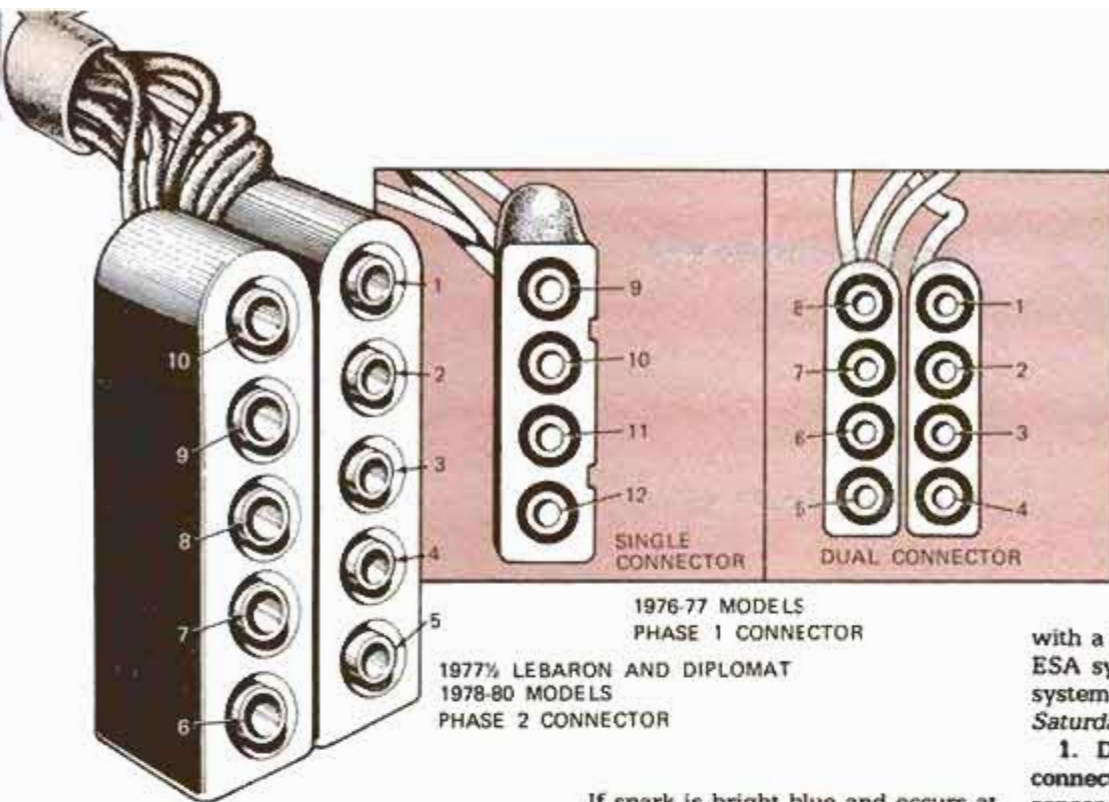
The pickup coil and Hall-effect pickup assembly sense when the engine is being cranked. During cranking, the signal sent to the computer energizes the "start" circuit, and the "run" circuit is bypassed. When the pickup coil or Hall-effect pickup assembly signal that the engine is running, the computer switches to the "run" circuit.

As for the ambient air temperature sensor, a change in basic timing from 10° BTDC to 20° BTDC in 1977½-1980 models made this sensor obsolete. The purpose of the sensor was to allow more advance while the engine was cold for improved driveability. But with the timing reset to 20° BTDC, the sensor would have advanced timing beyond limits, causing a spark knock.

The only other difference in sensors concerns the presence or absence of the throttle position sensor. Models that don't have it are those with 1.7-liter engines, some 1978 cars with 360-cu.-in. engines and two-barrel carburetors, and 1980 models with 360-cu.-in. engines and two- and four-barrel carburetors.



To check for continuity at the idle-stop carburetor switch, you must first slide a piece of paper, or other suitable insulator such as plastic, between switch and curb-idle adjustment screw.



Depending on what Chrysler model you have, you'll find one of these three connectors. Before you proceed with any testing, be sure that you are performing the right test for the particular connector. If you do a wrong test on that connector, you'll be led to incorrect conclusions.

When the system goes bloeey

Depending upon which part of the ESA system fails, the following problems can strike:

- Failure of the engine to start.
- A noticeable increase in fuel consumption, which is usually accompanied by high idling speed.
- Poor performance (hesitation, surging, missing, and so on).

In addition, other problems associated with improper spark timing can occur, including spark knock, loss of power and missing.

The remainder of this article describes how to test a Chrysler V8 engine with an ESA system that fails to start, but first you should determine if the ESA system should be blamed. Detach the ignition coil-to-distributor cap secondary ignition cable from the center tower of the distributor and position the cable terminal ¼ inch from a clean metal part of the engine. Crank the engine as you note the type of spark.

If spark is bright blue and occurs at constant intervals, the ESA system is not the cause of the no-start. Look for a damaged distributor rotor, distributor cap, ignition coil or fuel system.

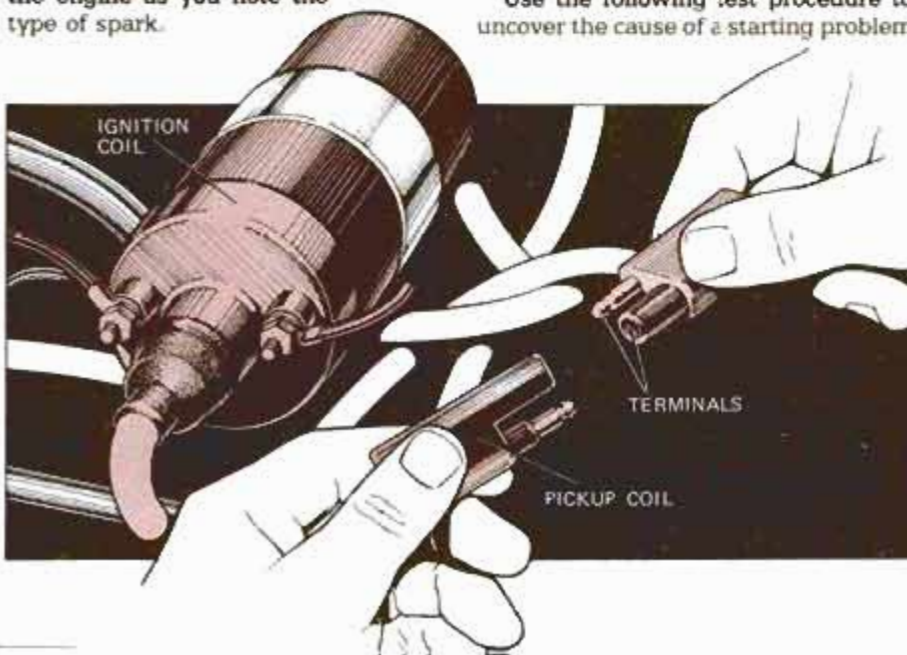
To test the ignition coil, slowly draw the cable terminal away from the engine ground as the engine is cranked to see if spark arcs from the ignition coil. It should *not*. If it does, the coil is faulty. Replace it. However, this is not a foolproof test.

If there is no spark at the cable terminal, or spark is weak or inconsistent, then there may be an ESA system malfunction that's keeping the engine from starting.

Before doing any tests, check the battery voltage and make a note of it. You'll need to know this to interpret some of the data you'll be getting as testing proceeds. The battery should be at full charge for these tests.

Testing a V8 engine ESA start mode

Use the following test procedure to uncover the cause of a starting problem



with a Chrysler V8 engine that has an ESA system (the 1.7-liter engine ESA system will be covered in next month's *Saturday Mechanic*):

1. Disconnect the wiring harness connector from the coolant temperature sensor. You'll find this near the distributor housing.

2. Slide a piece of paper between the idle-stop carburetor switch sensor and the curb-idle adjustment screw to keep them from touching.

3. Connect the negative lead of a voltmeter to ground. Connect the positive lead to the idle-stop carburetor switch sensor terminal. Turn the ignition switch to the run position and take note of the voltage reading.

The course of action you follow from now on depends on the voltage range that's recorded. The three ranges are:

- Less than five volts.
- More than 10 volts.
- Between 5 and 10 volts.

If voltage is less than five volts:

4. Turn the ignition switch off.
5. Pull the dual connector from the bottom of the computer.

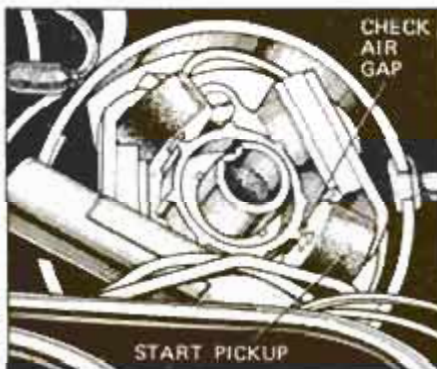
Important: To simplify matters, let's refer to these connectors as phase 1 and phase 2 connectors. Phase 1 is the connector used on 1976-77 engines. Phase 2 is the connector used on 1977½ LeBaron and Diplomat and 1978-80 engines.

6. Attach the positive lead of the voltmeter to terminal 4 of a phase 1 connector or to terminal 2 of a phase 2 connector. Attach the negative lead of the voltmeter to ground.

Check for resistance at the terminals of the pickup coil connectors that come from the distributor. Different model Chryslers will yield different values. Check text for values you should get from your car.

7. Turn the ignition switch to the run position and note the voltmeter reading. If this is not within one volt of the battery voltage reading, there is probably a fault in the wiring between the terminal and the ignition switch. If the reading is within one volt of battery voltage, proceed with testing.

With a 1976-77 engine (phase 1), turn the ignition switch off and disconnect the single connector from the bottom of the computer. Connect an ohmmeter between terminal 10 and the idle-stop carburetor switch sensor terminal. If there is continuity, unplug the dual connector again and check for continuity between terminal 2 and ground. If there is continuity here as well, the spark-control computer is probably faulty. Replace it. If there is no continuity, the wire between terminal 10 and the carburetor switch sensor may be the source of your trouble. If the car still won't start and you can't find a problem, proceed to the instructions below for voltage between 5 and 10.



The air gap between the start pickup and the reluctor should be checked using a nonconductive feeler gauge.

With a phase 2 connector, attach an ohmmeter to terminal 7 and to the idle-stop carburetor-switch sensor terminal. If there is continuity between these points check for continuity between terminal 10 of the dual connector and ground. If there is continuity between these two, the computer is probably malfunctioning.

If there is no continuity, the wire between terminal 7 and the carburetor switch sensor may be causing the no-start. If you can't find the cause, proceed to the section below for a voltage reading of between 5 and 10.

If voltage is more than 10 volts:

9. With a phase 1 connector, use an ohmmeter to check continuity between the terminal 2 of the dual connector and ground with the switch turned off. Lack of continuity indicates a bad ground connection.

With a phase 2 connector, test continuity between terminal 10 of the dual connector and ground.

If voltage is between 5 and 10 volts or if voltage was less than 5 volts but the above checks failed to find the problem:

10. Turn the ignition switch to the run position.

11. With a phase 1 connector, attach the voltmeter positive lead first to terminal 7 and then to terminal 8 of the dual connector. (Keep the voltmeter negative lead connected to ground.)

With a phase 2 connector, attach the voltmeter positive lead to terminal 1. You should get a voltage reading that is within one volt of the battery voltage you measured before. If not, do this:

■ If the voltage difference at terminal 7 of a phase 1 connector exceeds one volt, inspect wiring and connections between the terminal and ignition switch. If they check out okay, then the 5-ohm side of the electronic ignition ballast resistor may have failed.

■ If the voltage difference at terminal 8 of a phase 1 connector exceeds one volt, check wiring and connections between the terminal and ignition switch. If these are okay, either the ignition coil or the 1/2-ohm side of the electronic ignition ballast resistor may have failed. The primary windings of the ignition coil should then be checked for resistance.

■ If voltage at terminal 1 of a phase 2 connector exceeds one volt, check wiring and connections between the dual connector and ignition switch. If they pass inspection, test the electronic-ignition ballast resistor and ignition coil as indicated above.

12. If the voltage reading in test 11 is within the one-volt limit, turn off the ignition switch. With a phase 1 connector, attach one lead of an ohmmeter to terminal 5 and the other lead to terminal 6. With a phase 2 connector, connect the ohmmeter to terminals 5 and 9. However, with a phase two connector on a 1980 car connect the ohmmeter to terminals 3 and 9.

Resistance should be between 150 and 900 ohms. If it is not, do this:

■ For a 1976-77 model and 1980 model, find the start-pickup coil connector coming from the distributor. It's the larger of the two connectors you'll see there. The smaller connector is the run-pickup coil connector. Pull the start-pickup coil connector apart.

In a 1977 1/2-79 car or a '77 Diplomat or LeBaron, there is only one connector coming from the distributor. Pull it apart.

■ Using an ohmmeter measure resistance between the terminals of that part of the connector coming from the distributor. If resistance is between 150 and 900 ohms, there is an open or short circuit in the pickup coil circuit. If resistance is not between 150 and 900 ohms, the start-pickup coil in the dis-

tributor of 1976-77 and 1980 models is bad. In a 1977 1/2-79 model, the single pickup coil in the distributor is bad. Replace it.

13. If resistance between the phase 1 or 2 connector terminals mentioned in test 12 is between 150 and 900 ohms, connect one lead of your ohmmeter to ground and test for continuity at the two terminals of the pickup coil connector coming from the distributor. There should be no continuity at either terminal. If there is, replace the start-pickup coil in the distributor of 1976-77 and 1980 models, or the single pickup coil in the distributor of a 1978-79 model.

14. If you haven't yet found the reason for the no-start trouble, remove the distributor cap and make sure the air gap between the start-pickup coil tooth (1976-77 and 1980 models) or single pickup coil tooth (1977 1/2-79 models) and the reluctor is correct. Do this with a .008-inch plastic feeler gauge if the car is a 1976 model. Use a .006-inch plastic gauge for all other models. Adjust the air gap so the reluctor tooth, feeler gauge and pickup coil tooth just touch each other.

15. Disconnect meters, reattach all connectors and try starting the engine. Don't forget to reconnect the coolant temperature sensor and remove the paper between the idle-stop carburetor switch sensor and curb-idle adjusting screw.

If the engine still won't start, there may be a non-ESA reason for the trouble, or there may be a malfunction inside the computer.

Checking out the computer

Since replacing a computer is very expensive, you should take such drastic action only as a last resort. Make sure your car's current computer is no good before you buy a new one.

First, find a Chrysler service facility that will let you test-run a new computer module on your car. If the new computer cures all your problems, and you've already checked all the possible noncomputer maladies, chances are the old computer was the culprit.

Chrysler and other carmakers that use computers to control engine operation have found that most "bad" computers they receive from their service outlets aren't really bad at all. Usually, improper diagnostic procedures and an over-willingness to blame the black box have resulted in unnecessary replacement and high repair bills.

Don't fall into this trap. If the diagnostic techniques cited here don't work, your problem is probably not computer failure. The conventional diagnostic procedures you've been using for years—checking for compression, fuel delivery, vacuum leaks and so on—should uncover the source of trouble. **PM**

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CAR CLINIC



Corseted Courier

During cold weather, the five-speed transmission in my 1979 Ford Courier is difficult to shift until the transmission gets warm. First and second gears are the worst. Adjusting the clutch hasn't helped. Can you tell me what to do?—Richard M. Zinsky, Conneaut, Ohio

You'll probably have to live with the condition, Ford says stiff shifting in cold weather is a normal condition for the Courier five-speed. However, shifting will be even stiffer if the transmission isn't filled with the lubricant specified by Ford. The can of correct lube will state that the prod-

uct meets Ford specification ESP-M2C83-C. If you buy it from a Ford dealer, ask for part number D8DZ-19C547-A.

This lubricant—an SAE 80W formulation—is for Ford-built cars and trucks having standard three- and four-speed transmissions. It shouldn't be used in a manual transaxle, which requires Type F fluid that meets Ford spec ESW-M2C33-F.

Remember that you have to change oil in a Ford manual transmission after the first 7,500 miles; then at 30,000 miles and every 30,000 miles thereafter.

his '76 Seville. Your engine is fuel injected and has no fast idle adjustment, per se. Fast idle is controlled by a solenoid valve that works electronically as part of the engine control system. It's quite common to have these valves go bad. And your dealer should know about this valve. If he doesn't, ask him to replace the fast-idle solenoid valve. It's an expensive part, about \$75, but it will cure the problem.

Numbers racket

Can you clarify this cubic inch, liter engine displacement business for me? It's confusing.—John Quinn, Lake Worth, Fla.

Not only for you, John, but for a lot of us weaned on U.S. weights and measures, who are being asked to reprogram ourselves and think metrically. Try remembering the following:

■ To convert liters to cubic inches, multiply liters by 61.02. For instance, 2.3 liters is equivalent to 140 cubic inches (2.3×61.02).

■ To convert cubic inches to liters, divide cubic inches by 61.02. Thus, 350 cubic inches is equivalent to 5.7 liters ($350 \div 61.02$).

You may find your calculation doesn't coincide exactly with the en-

(Please turn to page 44)

A tail of two pipes

I had a freak accident in which one of the tailpipes of my 1981 Buick Century diesel broke off. In case you aren't familiar with the exhaust system in this car, two tailpipes come out of the muffler, one on each side, and curve around the rear tires. My question is this: Can I seal the broken pipe so exhaust is expelled only through the remaining pipe, or will I cause damage?—Donald J. Brannon, Allison Park, Pa.

As long as no exhaust comes from the broken pipe and leaks into the car through seams and holes in the underbody, you can get along with one pipe. No engine damage will result. Neither will performance be affected. However, tests done by General Motors established that a one-pipe setup could cost you as much as two miles per gallon in fuel. That's why the two-pipe arrangement was adopted in the first place.

But maybe you can have your cake and eat it, too. See if you can buy a pipe to clamp on the nub of the broken piece. To get the pipes together, use a pipe expander to spread the nub. Then coat the new pipe with exhaust system sealer, shove it inside the nub and clamp the two together.

Passing "de" buck

I live in a hilly area that has many curves. Going downhill on ice and

snow is more hazardous than usual because my 1976 Cadillac Seville engine stays at fast idling speed for a long period of time. I asked the dealer if something could be done to get fast idling to disengage quicker, but he said no. If I install an engine block heater and turn it on an hour before I take off to warm the coolant, wouldn't the high idling period be shortened?—Albert DeBuck, Wyckoff, N.J.

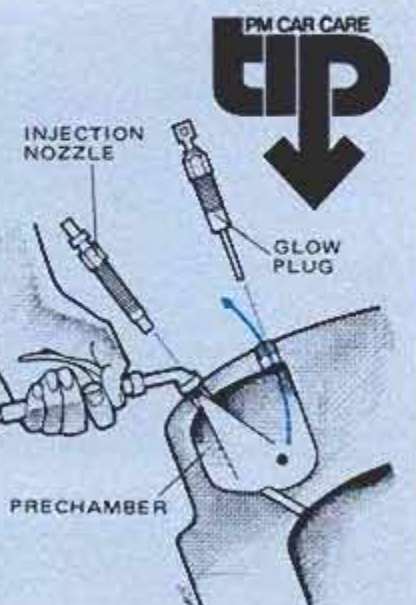
This is an easy one since our executive editor had the same problem on

Airing a problem

It sometimes happens that the tip of a burned-out diesel engine glow plug bulges, making it impossible to get the bad plug out of the engine without breaking off the tip and having it fall inside the prechamber. Doesn't this sound like a big problem—as if you must remove the cylinder head to extract the piece?

In 1978-79 GM passenger cars and 1980-81 pickups, you don't. These vehicles use pencil-type injection nozzles, which have a 3/8-inch diameter. You can blow a tip right out of the prechamber. After removing the fuel-injection nozzle, insert the rubber tip of an air hose firmly against the glow plug hole. Blow in compressed air until the broken tip flies out of the prechamber through the vacated fuel-injection nozzle hole.

Caution: Wear safety glasses. You can't do this with a 1980-83 vehicle or 1981 California truck.





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CAR CLINIC

(Continued from page 42)

gine designation given by the manufacturer. And since you're only computing to one decimal place, you might as well round off the conversion number to 61. For example, Ford rounds off the liter designation for its 302-cu.-in. engine to 5.0 liters when it is actually 4.95.

Horizon/Omni paint problem

I own a 1982 Dodge Omni that has paint peeling from the lower half of the body. I'm taking the car back to my dealer to have it repaired. My warranty will cover it. But I thought you would be interested in a recent article from the *Milwaukee Journal* concerning this flaw — Kevin Dier-Zimmel, Beaver Dam, Wis.

The article Kevin sent me quotes Tom Jakobowski of Chrysler's public relations department as saying that this problem applies mainly to '81 models and some '80s and early '82s. He states that paint may fail to adhere to metal when the lower part of the body is subjected to heavy doses of road salt. Jakobowski is also quoted as saying that if paint is defective

the car will be repainted, "regardless of mileage," for a period of up to two years from the date of delivery.

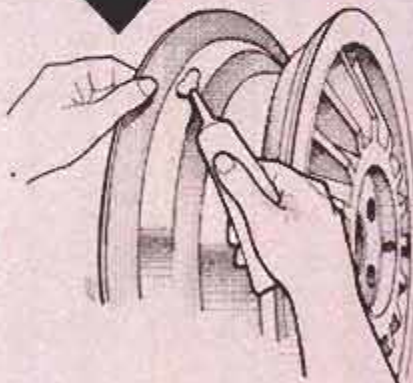
Sounds swell, doesn't it? But according to Joe W. McCormick, manager of owner relations at Chrysler, it's not true. McCormick acknowledges that the problem exists, but denies that there has been a warranty extension. He says, "As with any

other vehicle problem, we consider each individual case on its merits and make whatever adjustment is indicated in that particular case."

That leaves you with the job of asking your dealer to get a zone customer relations representative to look at your car and convincing him to make the allowance. If there's any change in this, I'll let you know.

PM CAR CARE

TIP



Just because a faulty cast-aluminum wheel causes a tire to lose air is no reason to discard the wheel, unless it's bent. You can seal the leaking area this way:

- Inflate the tire and dunk it in a tub of water to pinpoint the troublesome spot.
- Scribe chalk marks across the tire and wheel. Then remove the tire.
- Rub the spot with 80-grit sandpaper to clean off contamination and also to score the metal. Remove all sanding dust.
- Apply RTV (Room Temperature Vulcanizing) sealer to the spot thinly and evenly with a spatula.
- Let the sealer cure for at least six hours before mounting the tire. In putting the tire back on the wheel, be careful not to break the seal formed by the sealer. See that the two chalk marks line up. This assures wheel balance.

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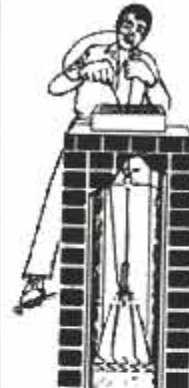
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A real oddball

Our car, a 1977 Pontiac Firebird with a 231-cu.-in. V6 engine, is using timing chains at an alarming rate. I've replaced three chains and gear sets in 60,000 miles. I asked the Pontiac dealer about this, and he said noisy timing chains have been a problem with this engine, but he doesn't know why. I feel the chain and gears aren't getting proper lubrication. So when we installed the fourth set, I drilled a 1/16-inch hole in the cap of the right oil gallery to allow more oil to reach the area. Will this prevent noise?—Richard Aungst, Stevensville, Mich.

Probably not, because lack of lubrication isn't the cause. If your engine is typical, the noise is a result of interference between the damper spring and engine front cover. Spring travel is restricted and can't take up the slack in the timing chain. A sloppy timing chain is a noisy chain.

You can quickly determine if this is happening after removing the timing chain cover by examining the inside of the cover for a worn spot. If the spot is there, carefully grind away the surface of the cover at this point. But don't overdo it. You don't want to grind right through the cover wall.

By the way, I wouldn't leave that

hole in the cap of the right oil gallery. You may be depriving other parts of the oil they need. Seal it up.

Ranger in danger

A few weeks after I bought a 1983 Ford Ranger, a steering problem developed that my dealer can't fix. When the vehicle hits a bump, the steering wheel shakes violently.—Robert P. Therriault, Seekonk, Mass.

Hang in there. Help is on the way, if it isn't already available. When I spoke to the truck engineers at Ford Parts and Service Div. about your problem, they told me they were trying to find a shock absorber with stiffer valving that would stop this feedback. Your dealer may now have a service bulletin authorizing him to install these new shocks, so ask him. If not, install heavier duty shocks yourself. However, you'll have to pay for them. When the service bulletin comes out, Ford will pay.

DO YOU HAVE A CAR PROBLEM?

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

Service Tips

■ Chrysler Corp. thinks it's found the reason why some of its rear-wheel-drive cars wander when operated over wavy road surfaces. It has to do with the steering center link being out of adjustment. Your dealer has technical service bulletin (TSB) 19-02-82 which details how to troubleshoot the situation.

■ You may never find out why your 1980-82 2.5-liter GM engine has a heavy ping if you don't remove the thermostat and look into the housing to see if one of the coolant passages is covered by metal flashing. This passage leads to the intake manifold. If it's covered, coolant can't get to all cylinders. Those not cooled overheat and cause fuel to detonate. Tell your dealer this procedure is described on page 78 of the July 1982 *Oldsmobile Service Guild*.

■ You don't have to put up with a cold-weather clunk or rattle in the front suspension of your 1981-82 Ford Granada or Mercury Cougar. Have your dealer check front suspension attachments for proper torque and replace the strut upper mount isolator bushings with new ones (part No. E2DZ-18198A), as explained in article 82-14-15 of TSB 82-14.

APPLIANCE CLINIC



Overheated stove incinerates dinner

Our Hardwick gas stove, model No. Z-9642-GW-41PA, serial No. 585H, has a problem with the oven thermostat control. When it's set below approximately 400° F., it operates properly. When the temperature is set higher, the oven burner usually remains on and incinerates the oven's contents.

Our local Hardwick representative says he can't get parts for this model due to its age. I wrote to the Hardwick Stove Co. and was given a Robertshaw Uni-line, Part VC-4400-014, for the oven control assembly, and a

local supplier's name. I replaced the part, but the problem persists. Any suggestions?—Thomas Keller, Edgecomb, Me.

Ask your local gas company to check the range's gas pressure. While the service technician is there, also have him check for proper flame adjustment on the standby and heater pilots. These pilot flames may have been adjusted improperly when the new thermostat was installed, or the new thermostat may be defective. The service technician can determine this.

terminals; turn the power back on. If you get 110 v.a.c. at this point, the bimetal is open or there is a poor connection at the terminal. If the bimetal is good, you'll get a reading of approximately 1 volt and the bimetal will start to warp and lift the plunger. If a new bimetal is needed, the part is No. 806756.

Lint leak

I have a Sears clothes dryer, model No. 110-76420110, which has a lint leak that I can't locate. I checked the front door seal and the flex tube that goes from the back of the unit to the wall duct. Then I took the unit apart and checked the drum seals and the seals on the duct that goes from the drum outlet to the unit outlet.

The seal, a strip of foam at the interface of the drum outlet and duct, was not completely seated, so I fixed it. The seal at the fan impeller seemed okay. The lint filter appeared to seat firmly. After checking all of the above, a layer of lint that covers the floor under and in front of the unit still builds up after a couple of weeks' use. I would appreciate any help that you could offer in solving this problem.—Lanny Porter, Phoenix, Ariz.

Most likely, your lint leak is on the pressure side of the dryer, the area from the blower housing to the exhaust duct piping to the outside. Disconnect the flex tubing from the dryer outlet and the wall duct. Stretch the tubing and look for cracks or punctures in the tubing.

Next, use a flashlight to look inside the wall duct to make sure the flap in the exhaust hood moves freely and that there's no lint buildup which is restricting the airflow through the hood.

If the tubing is at fault, replace the flexible tubing with rigid 4-in.-dia. aluminum duct (it comes in 24-in. sections and elbows). After fitting the duct, tape all joints.

PM

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

Spotted dishes

I have a Caloric dishwasher, model No. DUP 20419, with an automatic liquid rinsing-agent dispenser in the door. The rinsing-agent dispenser has stopped working, but the dishwasher functions normally otherwise. Since I live in a hard water area, our dishes come out of the dishwasher heavily spotted. Do you have any troubleshooting procedures to suggest?—Andy Woodard, Las Vegas, Nev.

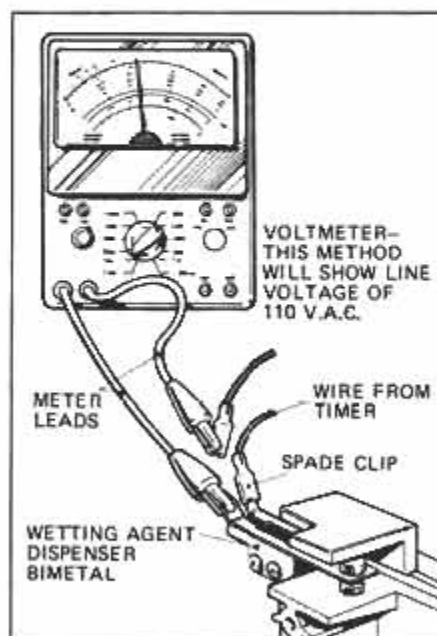
To check the wetting-agent dispenser, make sure the dispenser is full of liquid. Then turn off the water supply to the dishwasher and set the time to the beginning of the final rinse cycle. Start the dishwasher and let it run for a few minutes. Open the door; you should notice a few drops of blue liquid coming out of the dispenser.

If you don't see any liquid, check the wires on the bimetal trigger for the wetting-agent dispenser and the wires on the main heating element. To check these wires, remove the front panel from the dishwasher door and the access panel under the door. Important: Before removing these panels, disconnect the electrical power to the dishwasher. Check for a bad contact or a wire which has fallen off one of the terminals.

If the wires are okay, you'll need a voltmeter to check the voltage to the bimetal on the wetting-agent dispenser. If you feel uncomfortable working with electricity, have a service techni-

cian perform these tests. (The dishwasher should still be disconnected from power.) Connect the wires from your voltmeter as shown in the drawing below. Set the timer to the beginning of the last rinse and reconnect the power to the dishwasher. Lock the door. Your line voltage should read 110 v.a.c. If it doesn't, you may have a broken wire or a problem with the timer.

Next, shut the power off again. Put the meter leads across the bimetal



Attach the voltmeter as shown to check voltage to the wetting-agent dispenser.

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DETROIT LISTENING POST



More good stuff from Chrysler

Fall '83 should be exciting for Chrysler: The turbocharged G-24 sports car and the U.S. industry's first minivan will go on sale as '84 models. Both should be highly successful entries in a new car market that promises to be fast regaining most of its strength by then.

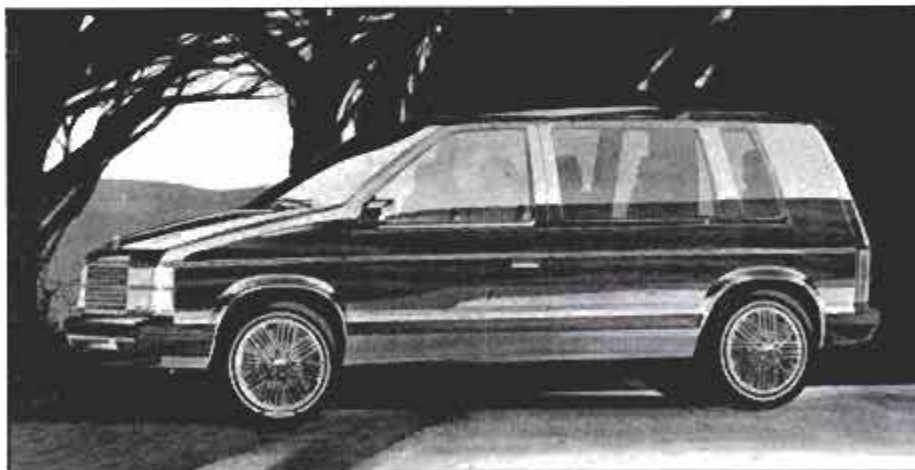
While the fwd, K-based G-24 will go up against the likes of GM's Firebird and Camaro, Ford's very quick V8 Mustang/Capri, and high-performance imports like Toyota's Celica Supra and Porsche's 944, Chrysler's T-115 little van will create a brand-new market segment and should have it all to itself at first.

The T-115 is built on the versatile fwd K-car platform. It will be about 168 inches long and 68 inches high on a 112-inch wheelbase, seat seven people with some luggage (or five with a lot of cargo) and fit easily in the average garage. And, it is rumored, the T-115 will carry Chrysler's first 10-year anticorrosion warranty.

Chrysler Truck Operations general manager Joseph A. Campana says that most T-115s will be "space wagons" with windows and full trim. "The vehicle is more aerodynamic than existing vans," he added. "It is clearly much more carlike and, in fact, it really is a cross between a van and a car. Its ride and drive characteristics more closely resemble those of a passenger sedan than any van."

More small vans

By contrast, GM and Ford are going the alternate route with downsized, conventional, rear-drive vans. Like their S-10, S-15 and Ranger small pickup truck counterparts, these vans won't look much different from their



Chrysler's T-115 minivan will seat seven passengers and have front-wheel drive.

respective bigger brothers when they debut for the '85 model year. They will be more compact than mini in size, and they'll offer much improved fuel economy from their four- and six-cylinder engines.

GM's compact—the M-body—will have a 110-inch wheelbase with 173-inch overall length. That's the same wheelbase but five inches shorter in overall length than the company's smallest current G-van. Ford's van, called Sierra, will be larger still with 175-inch length on 119-inch wheelbase.

This will leave Chrysler's smaller T-115 unchallenged in the fwd van class—unless you count a new vehicle that Japan's Nissan might begin importing this spring. Based on the fwd Nissan Stanza, this one is reportedly more of a tall station wagon than a true van.

Is a Japanese minivan invasion on the immediate horizon? Not likely. The existing flock of Japanese vans, ranging from truly tiny to compact in size, all seat their forward occupants

way up front ahead of the engine: That won't go here.

But don't discount the possibility of Japanese-designed small vans being produced here in the not-too-distant future. GM and Toyota are already discussing such a venture.

Ford Tempo/Topaz

Ford's slick new fwd compacts are still on schedule for an April '83 introduction, probably as '84 models. The Ford version will be known as Tempo, the Mercury is Topaz.

It's been widely reported that these are stretched Escorts, and in a sense that's true. They will ride on stretched Escort floor pans, some Escort suspension and chassis components, and they will use the Escort 1.6-liter engine driving through Escort four-speed and five-speed transaxles. But the similarity ends there.

Almost no sheet metal, exterior or interior, is common, and styling is nicely rounded and highly aerodynamic (for sedans) instead of boxy and angular. And there will be a larger optional engine: Ford's new 2.3-liter HSC (High Swirl Combustion) pushrod Four, available with five-speed manual or three-speed automatic.

Wheelbase is reportedly in the 100-inch range, with overall lengths around 176. EPA city fuel economy

(Please turn to page 50)



Ford's Tempo/Topaz will debut in spring of '83, replacing current rear-drive Zephyr/Fairmont line. The boxy shape in Ford's lineup is being abandoned in favor of rounded aero line.

SMOKERS

U.S. GOV'T LATEST REPORT:

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**A whole carton of Carlton has
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...KINGS			...100's		
	TAR mg./cg.	NICOTINE mg./cg.		TAR mg./cg.	NICOTINE mg./cg.
Kent	12	1.0	Kent 100's	14	1.2
Winston Lights	11	0.9	Winston Lights 100's	12	0.9
Marlboro	16	1.0	Benson & Hedges 100's	16	1.1
Salem	14	1.1	Parliament Lights 100's	12	0.9
Kool Mids	11	0.9	Salem 100's	15	1.1
Newport	16	1.2	Marlboro 100's	16	1.1
TAR & NICOTINE NUMBERS AS REPORTED IN LATEST FTC REPORT					
Carlton Kings	Less than 0.5	0.1	Carlton Box 100's	Less than 0.5	0.1
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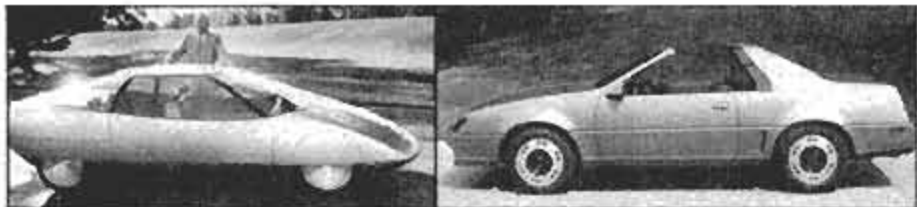
DETROIT LISTENING POST

(Continued from page 48)

should fall in the mid-20s with the larger engine, near 30 mpg with the standard 1.6; highway ratings should be in the low to mid-40s.

Ford's plastic concept car

Ford's Diversified Products Operations (DPO) just revealed a stunning Ford EXP-based, two-seat concept car called Flair. Styled and built by DPO's Plastics, Paint and Vinyl Div., and by



GM's Aero 2000 (left) and Ford's plastic LN-7 (right) are a peek at future concepts.

American Sunroof Corp. to showcase PPG-V's capabilities, the Flair features plastic body panels finished in a unique, clear urethane-covered acrylic gold that has to be seen to be be-

lieved. Its interior fabrics and finishes, as well as its removable Targa top and Bronze-tinted glass, also demonstrate the division's various high-tech products. It also features such interesting concepts as fiber-reinforced composite plastic wheels and springs.

GM's Aero 2000

Instead of paint and plastics, GM's new show car highlights the company's latest ideas in super aerodynamic design and electronics technology. Called Aero 2000, it's about J-car size but roomier inside and 600 pounds lighter. Its ultrasleek shape gives an outstanding drag coefficient of .230 as measured in GM's Warren, Mich., Tech Center wind tunnel.

Among its space-age electronic features are electronically generated instrumentation that reflects off the steeply raked windshield directly below the driver's line of sight; TV-like map and rear-view displays; and a console-mounted, single hand control that replaces the traditional steering wheel and pedals.

In unveiling the car, GM chairman Roger Smith said it represents "a glimpse of the shape of cars to come" and that many of its advanced features would be showing up in actual production cars in the future. You can see it at Disney's EPCOT center.

Smart suspensions

Of the many jobs envisioned for future car computers, one of the more useful will be control of suspensions for load compensation, adjustable ride and handling, even automatic adjustment of vehicle attitude (running angle) for improved aerodynamics at highway speeds. All three domestic carmakers and some suppliers are working on such intelligent suspensions for production applications. GM's prototype can be seen in the Aero 2000. And we recently spotted a Mercury Lynx with a prototype device to adjust its suspension for load.

But it's Mazda that'll be first with a dashboard pushbutton switch for normal/sporty shock settings. It's on the new 626 that goes on sale next month, so it's too late for Detroit to be first.

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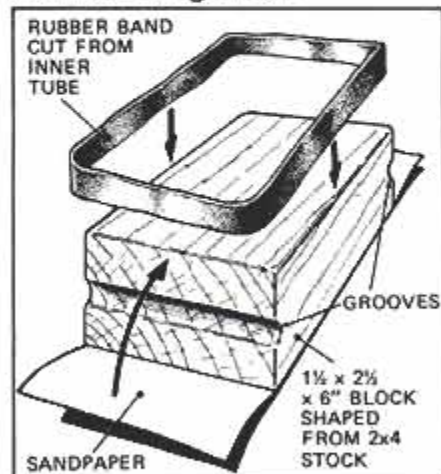
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HINTS FROM READERS

Hand sanding block



You can make a sanding block from a scrap length of 2x4. Cut the piece 2 1/2 in. wide x 6 in. long. Make grooves centered across the ends, using a coarse round file. Hold the sandpaper flat and secure it with a heavy rubber band or use several staples. —*Wayne Fugate*

THE HOME SHOP Machinist

A bimonthly magazine for the serious amateur machinist and the small commercial metal/machine shop.

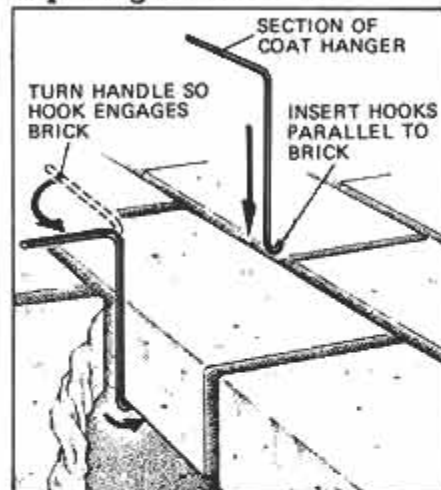
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Repairing a brick walk



Subsurface conditions such as an improperly compacted subgrade can cause a brick to sink. You can use two hooks made of coat hangers to raise such bricks, even when space is tight. Insert the hooks sideways on opposite sides of the brick. Maneuver the hooks beneath the brick, then lift it. Fill and tamp the area as needed to raise the replaced brick. —*Charles H. Hardy*

It's like having X-ray ears...

Tiny, powerful electronic "ears" let you hear whispers through walls, conversations 2 miles away.

The Dyna-Mike Transmitter

It's smaller than a quarter. But DYNA-MIKE will transmit every sound in a room to an FM radio tuned to the proper unused frequency, from ½ mile to 2 miles away.

If you're at a neighbor's home a block from your own, you can hear your baby's cry, or you can tell the instant your spouse comes home. If two of you are driving tandem in two cars, one or both of you can communicate with the other even if other cars drive between you.

DYNA-MIKE has as many uses as your imagination can think of. For a business conference, let the tiny microphone sit unobtrusively on the table or concealed on a shelf, and you'll be able to record every word. For businesses, you can put an FM receiver in a warehouse or remote office and "broadcast" instructions or orders to be filled.

Public speakers never had a better friend than the DYNA-MIKE. No wires or setup — just turn on one or more radios and your speech will come through with perfect fidelity. Put one on the front porch. If you hear a suspicious sound, turn on the radio and you'll hear the doorbell or the ring of the telephone.

Choose Your Model

New Horizons is introducing three models of the DYNA-MIKE supersensitive broadcast microphone. Model IC-18 is the world's smallest microphone — it's a miracle of electronic miniature power, with a high-fidelity range of 1800 feet. Introductory price is \$129.95 (two for only \$119.95 each).

Model X-18 is the longest-range microphone, with an unbelievable two-mile range. Introductory price is \$149.95 (two for only \$139.95 each).

Model X-3 is the most sensitive microphone. It broadcasts perfect-quality sound even from low-levels or whispers, up to 1,500 feet. Introductory price is \$99.95 (two for only \$89.95 each).

Each microphone is fully wired, complete with standard HC-1.35v. battery, good for 100 hours of continuous use and easily and inexpensively replaceable.

Of course you're protected by the New Horizon guarantee: use any DYNA-MIKE transmitter microphone for 30 days, with the right to return it for a full refund if you're not delighted.

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You'll hear it all.

Effortlessly, you can hear not just a baby's cries, but quiet breathing, through a concrete wall a foot thick. Put the SUPER-EAR earphone in your ear and place the speaker on the wall. That's all there is to it.

SUPER-EAR hears everything, and even more astounding, hears it clearly. It's as though the wall weren't there. If you're coming home late at night and think intruders are in your residence, let SUPER-EAR find out for you. Want to know if the meeting is over in the room with the closed door? SUPER-EAR will tell you in a second.

SUPER-EAR is undetectable from the other side of the wall. The quality of sound has amazing fidelity—good enough to record, and SUPER-EAR has its own built-in recorder jack.

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Use your SUPER-EAR for 30 days. If for any reason you're not delighted, the absolute New Horizons guarantee means you can return it for a prompt refund.



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The PHONE ANSWERER/RECORDER connects in seconds between any tape recorder and your telephone. When you're away it automatically delivers a message up to 20 seconds to anyone who calls: when you'll return, when to call back, where you are.

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PM12

THE PM WORKBENCH



Great set of legs



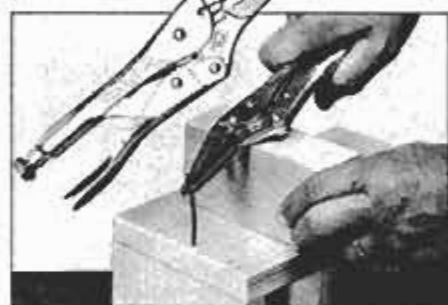
PM's tester, Rosario Capotosto, subjects Fas-Set's sawhorse legs to a stress test.

These sawhorse legs from Fas-Set are truly remarkable. Simply place a 2x4 crossmember between the jaws, then press down on the locking bar with your shoe. Jagged rim embossed holes in the jaws grip the crossmember firmly. No nails or screws are needed for the sturdy unit. The legs can be disassembled in seconds for storage.



Fas-Set also makes accessory log holders for sawhorses. They straddle the crossmember to hold logs for sawing. The legs are \$18.99 and the log holders \$10.99 (both per pair). Available through the Sears Roebuck tool catalog.—Rosario Capotosto

pliers. The longer, thinner jaws were more susceptible to breakage. After testing various designs and steel alloys, the problems were



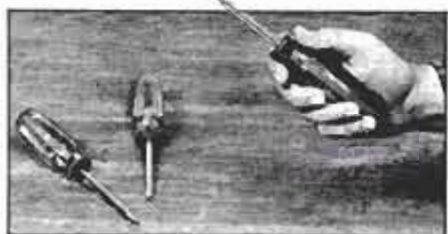
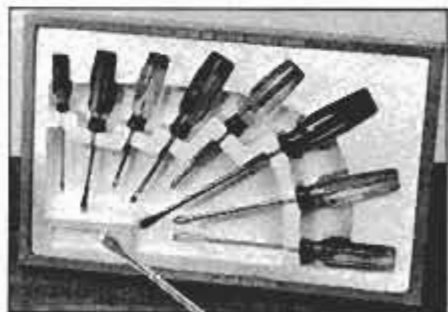
The 9NL has longer jaws for more leverage. Wire cutters are built-in bonus.

solved. The result is Model 9LN. Sold at hardware stores and home centers for about \$12.50.—H.W.

Get a grip on these

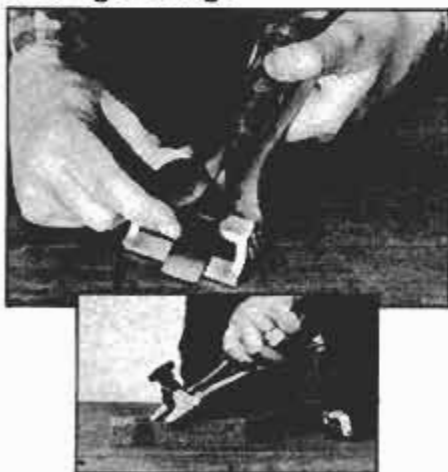
This set of screwdrivers is the latest in the Sears line. Larger handles provide a superior grip, and Sears claims their shape generates 25 percent more torque than its standard screwdrivers.

The set of eight costs about \$20 through the catalog. Ask for Sears Best Craftsman screwdrivers, stock No. 4159.—H.W.



Newest Sears screwdrivers have fully polished chrome vanadium round blades.

Getting an edge



Foolproof honing system lets you touch up plane irons and chisels with accuracy.

For many neophytes—and even some pros—maintaining the correct bevel when they sharpen chisels and plane irons is a tricky business. But

by locking a blade into the Blade Honer and adjusting the roller screw until the blade lies flat on the stone, you can't go wrong. Blade width capacity is 2 5/8 in.; the Honer is \$15.95 postpaid. Arkansas stones are also available.

It's from Leichtung Inc., 4944 Commerce Pkwy., Cleveland, Ohio 44128.—H.W.

New long nose is news

What I like about the new long-nose (9-in.) locking pliers from Petersen is that the tool has more reach and power than most pliers this size. They also have a great convenience feature—built-in, heavy-duty wire cutters.

The manufacturer, Petersen Manufacturing Co., DeWitt, Neb., 68341 says that the power of the Vise-Grip double lever action was initially a disadvantage for developing long-nose

Maybe the best fuel for your kerosene heater isn't kerosene.

Smell something funny around the house?

Don't blame your heater. Blame the kerosene that goes into it.

Even high-grade kerosene is often full of impurities that cause odors and smoke. And clog heater wicks.

But you can breathe a lot easier if you stop using kerosene and start using new Gulf Lite® Premium Fuel.

It's a clear, odorless fuel that puts out nothing but heat. No smell. No smoke. No soot. Because it's clay-filtered to screen out contaminants and has less than one-fourth the sulfur content of high-grade 1-K kerosene.

You'll find Gulf Lite in handy two-gallon cans at most major home and discount stores.

You'll also find it has a premium price.

But isn't it worth a little more to clear the air?

**Better
than kerosene**



23 FOR '83! FORD HITS NEW MPG PICKUP HIGH.



Ford does it again! Sets a new EPA gas mileage rating record for full-size six-cylinder pickups — 23 MPG.



The truck is Ford's fuel-saving FS model — a big, tough pickup with full comfort for three. The engine, Ford's 300 Six. This husky 4.9L powerplant is more than fuel efficient. It's the biggest — and best-selling — Six in any pickup.*

MORE '83 NEWS. New 6.9L pickup diesel, the most powerful diesel ever in heavy-duty F-250/350 pickups and 4x4's. Plus the 7.5L gas engine in pickups over 8,500 lbs. GVWR. See what's new in pickups — at your Ford Dealer!

*Based on R.L. Polk & Co. registrations, May 1982.

33 EST
HWY

23 EPA
EST
MPG

FS model with
4-speed over-
drive. Use for

comparison. Your mileage may differ depending on speed, distance and weather. Actual highway mileage lower. FS not available in California.

Get it together — Buckle up.

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FORD DIVISION



AMERICA'S TRUCK

**BUILT
FORD
TOUGH**

PM LOOKS AT...

Homelite's Newest Chain Saw



Despite weighing under 10 pounds, Model 240 cuts with a fury, and can be fitted with either a 14-, 16- or 18-in. bar.



PM's testers agreed that the saw has a good balance and is easy on user's back.

The latest chain saw from Homelite has a number of features you're sure to appreciate. Driven by a rugged, 2.4-cu.-in. engine, this saw can handle most heavy-duty cutting needs. Longer chain and bar life can be expected because automatic chain oiling feeds the proper amount of lubricant to the chain at the right time. The solid-state ignition promotes dependable starts in all weather.

Vibration-isolated mounting and relatively light weight ensure operating comfort and minimal fatigue.



The rubber-cushioned mounts effectively dampen any vibration which is transmitted to the chain saw's handles.

Model 240 accepts 14-, 16- and 18-in. Power Tip guide bars which reduce friction and increase cutting speed and power. The exclusive Safe-T-Tip antikickback device protects both you and the saw.

After a number of cutting sessions, we both feel that Model 240, pound for pound and dollar for dollar, is one of the best chain-saw buys around.—*Rosario Capotosto and Harry Wicks.*



All controls are within easy reach of trigger hand. You'll be more at ease using the 240.

SPECIFICATIONS—CHAIN SAW

Chain oiling: Automatic
Bar size: 14, 16 or 18 in.
Engine displacement: 2.4 cu. in.
Ignition type: Solid state
Antikickback device: Safe-T-Tip, standard
Weight: 9.7 lbs.
Vibration isolation: Standard
Handguard: Standard
Chain oil capacity: 7.2 oz.
Fuel capacity: 14.7 oz.
Prices: 14 in., \$249.95; 16 in., \$259.95; 18 in., \$279.95
Manufacturer: Homelite-TeXtron, Box 7047, Charlotte, N.C. 28217.

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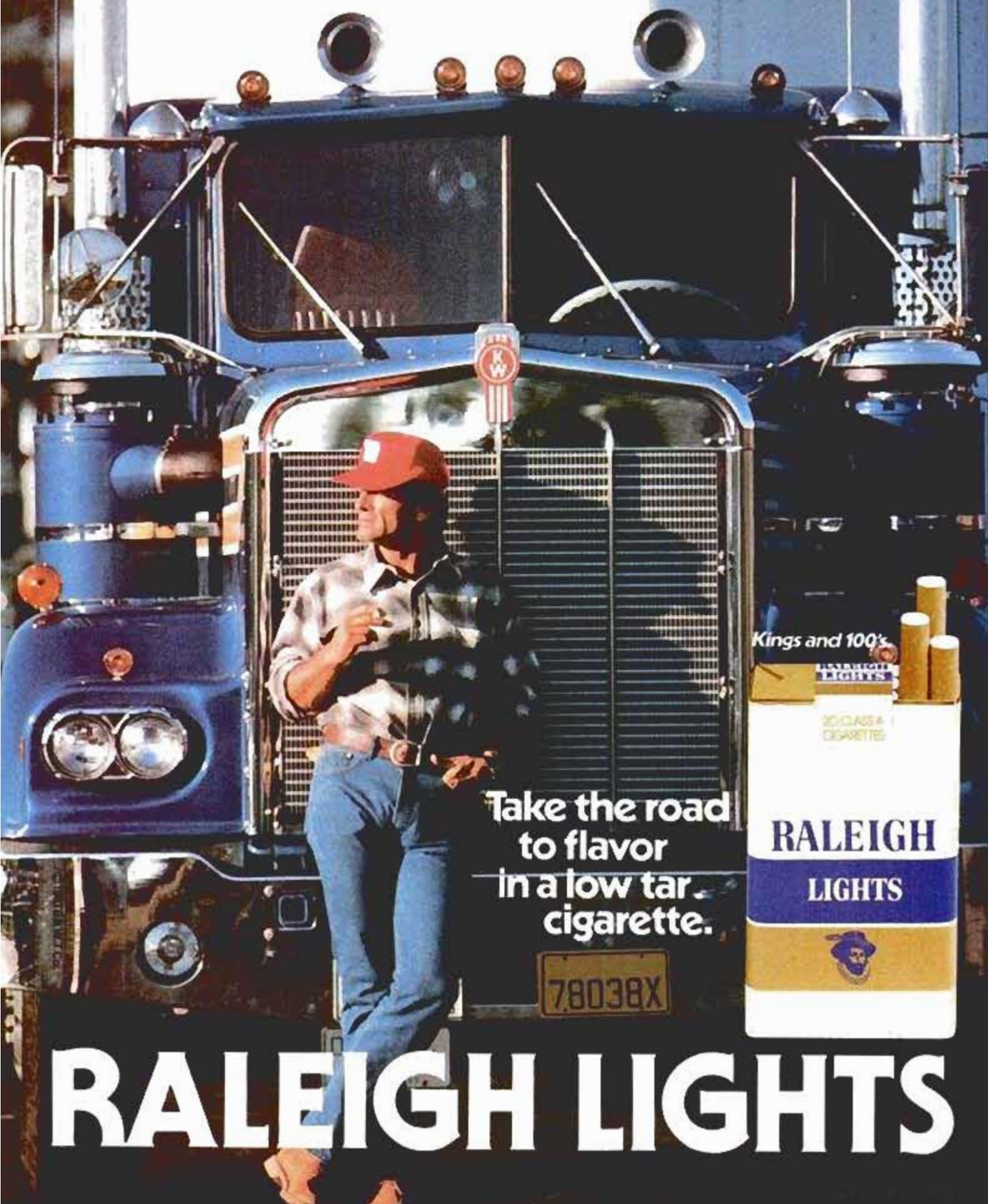
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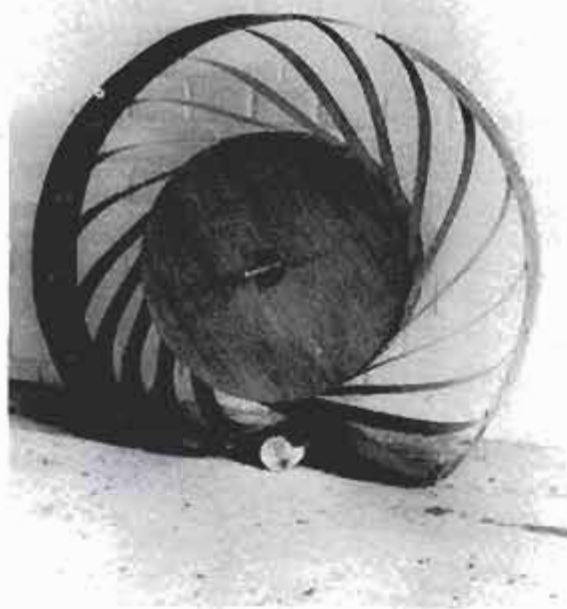
Lights Kings, 8 mg. "tar", 0.7 mg. nicotine;
Lights 100's, 9 mg. "tar", 0.8 mg. nicotine
av. per cigarette, FTC Report Dec. '81.



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in a low tar
cigarette.

RALEIGH LIGHTS

PM BRIEFS



PM's Whatsit

If true to form, 52 percent of the people who look at this object will find the words "perpetual motion" forming somewhere in their frontal lobes. They're wrong. Turn the page to see how this exotic arrangement is applied to something familiar.

It also sticks fingers together

Looking for a way to promote a new household glue product called Araldite, Ciba-Geigy Plastics & Additives Co. decided to try a new billboard idea in London. The company claims only nine retail-size packs of the glue were used to cement a special jig to a Ford Cortina (which weighs about a ton). The assembly was then hoisted 10 feet high by a crane and the jig bolted to support brackets. A pub crawler who parked his similar Cortina nearby and returned to the scene much later was said to have fainted in the street.



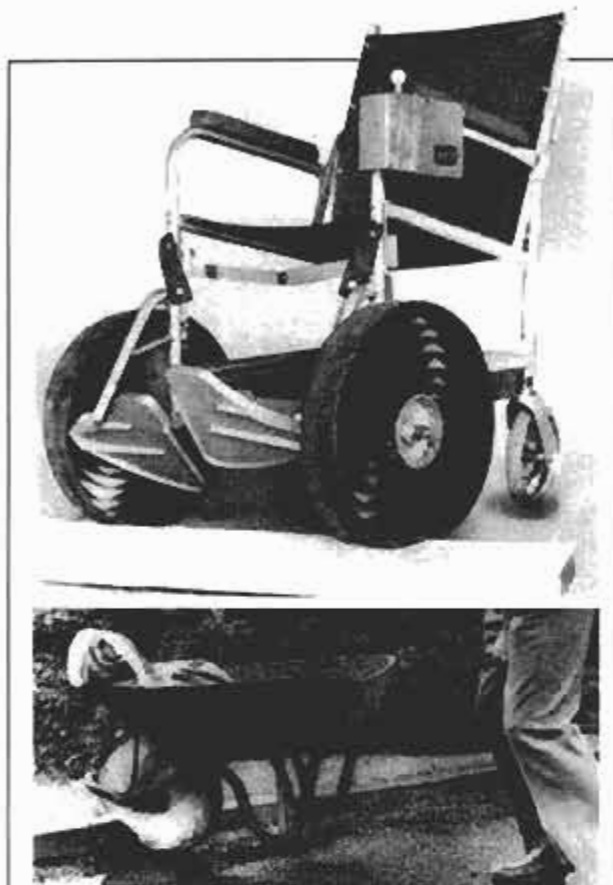
The guided light

Daniel Leahy is a 33-year-old Californian with a degree in art from San Jose State. After college, he initially opened up a custom furniture shop in San Jose. That was alright, but his life began to change when he got involved in a demolition job on an old theater in town. He found an 8-inch spot projector lens, took it back to his studio and used it as a paperweight. Then one day, for no particular reason, he took it outdoors and held it in the sunlight near a piece of wood.

"It struck a flame in less than a second," Leahy recalls. He began experimenting with making lines on the wood piece. It all led to a new medium—solar etchings, which now out-sell Leahy's furniture pieces—and a new career. One Leahy work is made from discarded 2 x 4s glued together; it weighs 1,400 pounds, is etched with an impression of San Jose at the turn of the century, and is on display at the public library. Price: \$10,000.



PM BRIEFS



Whatsit revealed

Dr. Sidney Jones calls his invention the Conformable Wheel. A flexible outer covering usually protects the spring steel assembly. Besides wheelbarrows and wheelchairs, Jones, a native of Malvern, England, sees agricultural, industrial and military vehicle applications for his brainchild. A normal wheel, says Dr. Jones, won't surmount an obstacle that exceeds one-third of its radius; the conformable model climbs barriers up to three-fourths of its radius.

Eagle's tops

An exact accounting of the blitz that preceded last summer's invasion of Beirut by Israeli forces may be some time in coming, depending on continuing tensions stemming from the action. Scuttlebutt has it, though, that Israeli F-15s were completely dominant in the air war over their closest rivals, the Mig-25 Foxbats flown on the Syrian side. Although the Israeli air effort was greatly enhanced—with a two-day, in-air kill score of as much as 80 to zero—by electronic and weapons systems of their own design (or major modification), the record apparently, once and for all, confirms that the McDonnell Douglas F-15 is the best fighter in the air today, as the company always claimed it was.



Two USAF Eagles over the Hampton, Va., Coliseum. Planes are from the first air defense squadron using F-15s.



Together again

The joined-bicycle system shown here gets a lot of second and third looks on the road, but it's entirely practical. The Instant Tandem mechanism, made of aluminum alloy and steel, permits the rear bike to have its own steering "feel" with proportionate lean for balance. Each rider can pedal (and gear) at his or her own pace, allowing one or the other to take a breather while underway. And if things just don't work out, it uncouples in less than a minute and you go your separate ways. Instant Tandem Co. is at 1307 Kirkland Ave., Kirkland, Wash. 98033.

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The *Torlite* window system has been used exclusively by industry both here and abroad for many years. Now **limited supplies** are available for public and private use. The *Torlite* window system installs in **five minutes**, using no nailing strips, screws or tools. *Torlite* is a totally new **100% optically clear** and tough film with no **cloudiness or haze**.

Even should you have storm windows, you can form another insulation barrier against **heat LOSS** and **SEAL OUT** cold air infiltration. The *Torlite* window system creates an **insulating pocket of air** inside your window area by keeping cold air **OUT** and keeping **IN** your heated room atmosphere.

Any type window, be it casement, bow, jalousie, steel, aluminum, wood can be made **100% air tight**. Trailers, factories, farms, apartment buildings, churches, hospitals, schools, motels and virtually every business can use this system to **realize substantial energy savings**.

No other window kit available on the market today offers the amount of window coverage and **energy savings** of the *Torlite* system.



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Orders to CANADA - check or money order must be made payable in U.S. DOLLARS and \$1.00 MUST BE ADDED TO COVER POSTAGE.

NEW MACHINES

(Continued from page 32)



Originally designed especially as a workhorse for the Scandinavian market, the Skandic 277 and 377 Ski-Doos with long tracks for flotation are popular here, as well.



Bombardier's snowmobile trailer, the Carry-Boose, has 10 cu. ft. of storage. Flat-bed Ski-Boose takes larger gear.



Large John Deere Sportfire has a heavy-duty, 436-cc engine with oil injection, CD ignition, plus long-travel suspension.



Fast and lightweight, the Moto-Ski Mirage Special with a 368-cc Bombardier-Rotax engine is one of nine models that include Futuras, Ultra Sonics, Sonics and Spirits.



The single-ski, twin-track Ski-Doo Alpine, with its extra reverse gear, is a popular utility trail and ranch machine.



Liquifire, from John Deere, is a big, 436-cc-powered, liquid-cooled machine with both heat exchanger and a radiator.

Ski-Doo and Moto-Ski models, and there are new snowmobiles from John Deere, Polaris and Yamaha. The five makes will service a market that now seems to be developing slowly but surely, and with fewer growing pains. Today's engines are quieter than in the past. Slide-rail suspension and adjustable springs provide a softer ride. Better brakes and kill switches are making the machines safer. Drivers now can buy more speed than they can sensibly use, so there is less incentive to race every other snowmo in sight. Drivers now know about the dangers of jumping, drowning, hitting wire fences, frostbite and excessive drinking. Most operators seem to travel more carefully. With well-maintained trails around, there's less temptation to criss-cross private property. And environmentalists have so many bigger battles to fight that they seem more willing to share the winter landscape with the fun machines.

This year, all the manufacturers are also producing "workhorse" machines with long tracks and increased flotation to tow heavy loads through heavy snow. Although the rigs can all take time off for fun, they are designed for the commercial use of loggers, utility linemen, emergency, rescue and trail-maintenance workers, and are favorites of ski resort operators, ranchers, game wardens and the overseas markets.

Ski-Doo's extensive new line starts off with the lightweight (285-pound) Elan with a single-cylinder Rotax 250-cc engine and bogie-wheel suspension. Also dual-purpose utility machines, the Nordik and Skandic are for commercial as well as pleasure snowmo markets. The Nordik has a long, 124-inch track and low-geared, 368-cc power, while the Skandic 277, with 269-cc engine, and the 377, with 368 cc, have rear cargo carriers and extra-long 139-inch tracks.

The Alpine, with a single steering ski

(Please turn to page 64)

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Here's what our users are saying —

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It tests what other testers won't. It measures tach on all ignition systems — including conventional, electronic, CD, GM's C-3 and C-4 systems (except IH vehicles with Prestolite ignition system). It measures volts — even on electronic modules in the newer cars. It measures ohms — even as low as .3 ohms for ballast resistors.

It checks the new computer controlled carburetors (such as GM Computer Command Control, Ford's EFI, etc.). It checks all the sensors for the Electronic Control Modules, such as throttle position, barometric pressure, engine coolant temperature, etc.

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High RPM



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NEW MACHINES TO SKIM THE SNOW *(Continued from page 62)*

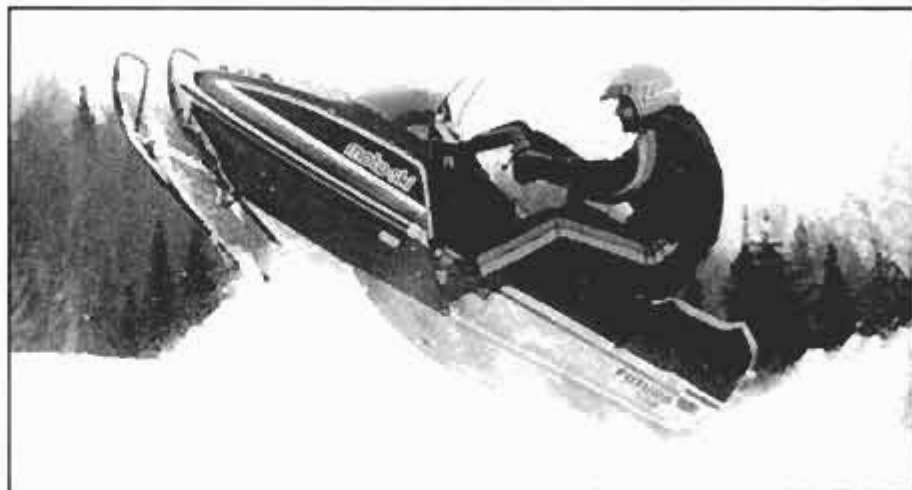
and twin 139-inch tracks using two forward gears and one for reverse, has a 498-cc engine for heavy-duty work. Light and agile, the Citation single-rider 3500, one-or-two 4500 and sporty SS use 269-cc and 368-cc engines. The Everest 500 and liquid-cooled L/C are luxury models with 497-cc and 463-cc engines. Four-way suspension and 497-cc power are features of the Blizzard 5500 MX, while the even speedier 521-cc 9700 has liquid cooling.

The Moto-Ski Spirit, Ultra Sonic, Sonic, and three models of Mirages and Futuras use 250-cc to 497-cc engines, including two rotary models.

Added to John Deere's 436-cc Trailfire LX, Sportfire and Liquifire, are new 339-cc Snofire and Sprintfire models with special direct-drive systems for lighter weight and improved durability.

Polaris Star, Sport, Super Sport, Indy Trail, Indy Cross Country and Indy 600 (called the fastest of production sleds) use power ranging from 244 cc to 597 cc.

Yamaha's new line includes the light Bravo, Enticer 300, long-track Enticer 340T, Excell III, SS440, SRV, and high-speed Vmax, with mills from 246 cc up to 535 cc. **PM**



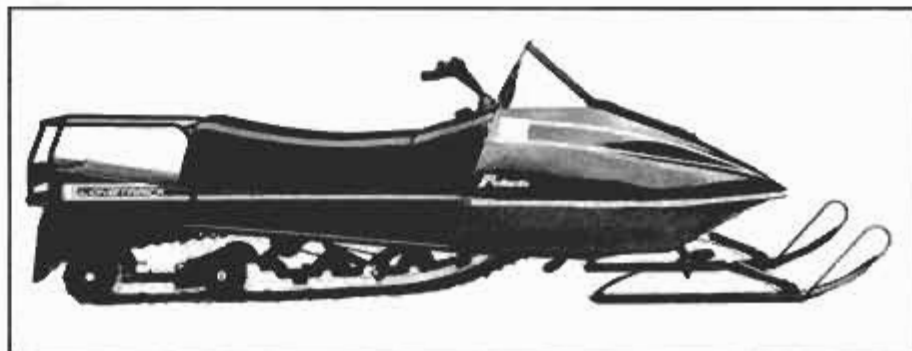
Newest in the Futura Moto-Ski line, the 300 is rated as a high-flotation, long-track machine with 368-cc, oil-injected, twin-cylinder engine, has adjustable disc brakes.



Yamaha's Bravo, at 291 pounds, is lightest in seven-model Yamaha line, has 246-cc engine and is one of least expensive.



Developed from marathon races, Polaris Indy Cross Country mounts liquid-cooled power, optional cooled brakes.



A workhorse for the international market, the Polaris Long Track is powered for pulling loads and maneuvering in deep snow of logging trails with a 148-inch track.

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Driving The '83 Mazda 626

Goodbye, frumpy old 626, and hello all-new, faster, front-wheel-drive wedge!

BY BILL HARTFORD MANAGING EDITOR



Five-door hatchback runs slalom with shocks on "sport" setting. Fold the rear seats (inset) for a station wagon.

Pressed in the driver's seat of the five-door hatchback, in the 100-mph groove on the banking of Mazda's high-speed test track, I slowly removed my hands from the steering wheel and folded them across my chest. I wasn't going anywhere—maybe just around again for one more lap. Like a Japanese stone lantern, the car was in perfect balance, and it would continue to defy gravity as long as I didn't lift my foot.

Balanced is the perfect word to describe the all-new 626. Balanced, but not bland. We put enough miles on the three models in the line to be sure that Mazda accomplished what it set out to do with its replacement for the original 626, introduced in 1978. That was to achieve the best balance of qualities for a mid-size family car: be roomy but lightweight, be fast enough yet fuel efficient, have sporty handling yet be smooth riding, and be good-looking and, at the same time, practical and comfortable.

Mazda didn't feel that in the old 626 it had an international, mid-size car that could go the distance—be contemporary right through to 1990. That probably won't convince owners of original 626s that they've got an out-of-fashion set of wheels. They've had few complaints and, in a PM survey, an extraordinary 97 percent said they'd buy another (*PM Owners Report: Mazda 626*, page 80, Dec. '79).

To build the car it wanted, offering improvements

(Please turn to page 68)



Two-door coupe has fast aerodynamics, drag coefficient of .34.



Four-door sedan is expected to be the best selling model in line.



Five-door hatchback is versatile, but rear headroom is tight.

Dickel's for Givin'. Dickel's for Gettin'.



This time of year, the best place to be is on the gettin' end of George Dickel whisky. For one simple reason. When you drink this Tennessee whisky, water need never pass your lips. It's that smooth.

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DRIVING THE MAZDA 626

(Continued from page 66)

over the original model in every category, Mazda styled a wedge-shaped body; went to front-wheel drive and four-wheel independent suspension; designed an all-new, more compact, lighter, higher horse-power, two-liter Four and applied a lot of original ideas for improved driver and passenger

calling the shots. Ignition is transistorized. Incredibly compact, the Four weighs only 328 pounds (vs. 385 for the old 626) and generates 83 hp at 4,800 rpm. Torque is 110 ft.-lb. at 2,500 rpm. The "square" powerplant (3.39-in. bore, 3.39-in. stroke) gives stick-shift 626s a respectable 0-to-60 time a shade under 12 seconds and a solid 100-mph top speed.

Along with performance and fuel



Dash setup provides fingertip switching and good visibility of gauges. Electronic instrument display is optional. Tach, tilt wheel are standard.

comfort. In the coupe, for example, the rear quarter windows swing open and closed by motor drive; and on all models there's an "active" vent in the center of the dash, with vanes that slowly and quietly oscillate back and forth.

Size and weight

I knew the new 626 was roomier at first sitting. Headroom, legroom and shoulder room gain about an inch over the old 626. However, headroom is limited in the rear of the five-door, especially sunroof models where a thicker roof is needed to accommodate the sliding panel (and Mazda is exploring a preproduction change to correct this shortcoming).

Compared to the old 626, only the wheelbase of the fwd models is the same: 98.8 in. Here's how other dimensions stack up: length, 177.8 in. (3.9 in. longer); width, 66.5 in. (1.2 in. wider); and height, 55.5 in (1.1 in. higher). Despite the slight scaling up in size, weight has been pared to between 2,400 and 2,500 pounds, depending on model, compared to 2,600 pounds. That helps fuel economy, of course, which Mazda estimates to be 29 mpg city and 41 highway, with the standard five-speed transmission.

Performance and economy

The new in-line Four is a single overhead-cam design that mounts transversely. Carburetor is feedback type with a new engine control computer



The standard seats can be adjusted six ways and have excellent lateral support.

efficiency, what you want from an engine, especially a Four, is smoothness and quiet.

Here, the engineers applied all their expertise (which is considerable, since Mazda's the only manufacturer making gas, diesel and rotary engines for production vehicles). Engine noise and vibration were reduced in the design stage by use of a spherically shaped cylinder block, short piston stroke, more rigid crankshaft, offset aluminum rocker arms, camshaft drive belt instead of chain, insulated exhaust manifold and attachment of radiator and engine to form a single mass for dynamic damping. Then, for good luck, the engine (and transaxle) is mounted, via silicone-liquid-filled rubber engine mounts, on a semiperimeter frame. Noise level of the new Four at open

throttle is better by a few decibels than the old engine, and at idle it's so inscrutably quiet you can almost hear the sound of one hand clapping.

Handling and ride

If you want ride comfort in town and handling stability on twisty roads, and you don't want to stop and change shocks along the way, order the two-door or five-door with Mazda's exclusive Electronic Variable Shock Absorber system (EVSA). It's so simple: Solenoids on the top of front and rear shocks rotate a valve in the shock body to change its damping characteristics. Just set the switch on the dash to nor-



Solenoid at top of front strut tower is secret of Mazda's smart suspension. All four shocks have adjustable valving, so soft or firm damping characteristics can be selected with a dashboard switch.

mal or sport. When you leave it on automatic you get a soft ride while poking around, but front shocks are automatically firmed up over 50 mph.

Steering is a precise rack-and-pinion setup, and the 626 turn radius, curb to curb, is 33.5 ft. Brakes are disc front and drum rear, and the 14-in. wheels take 165 SR-14 radials or optional 185/70s.

High comfort quotient

The 626s are a sporty bunch—in handling, styling and performance—but still offer comfort worthy of so-called luxury cars.

However, the 626 does it at a starting price of \$8,000. Even stripper 626s have split folding rear seat, remote releases for trunk and fuel filler door and other conveniences; then you can add nice touches like electric side mirrors, central door locking and cruise control.

Additional options are at your discretion: digital-display dash, a/c, electric sunroof, three-speed automatic transmission and so on. It's easy to tip the balance on the side of luxury, but with the new 626 you can do it without too much imbalance in the ol' checkbook. **PM**

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November, 1982, Philadelphia, Pa.—The U.S. Government announced recently that 1982 will be the last year for minting the copper Lincoln penny.

And already these vanishing historic coins are being hoarded by wise collectors and investors. Thus creating a severe shortage which, in turn, will have a dramatic impact on future value.

The International Mint, however, announced today that a limited number of 52-coin sets of valuable 95% copper Lincoln Memorial pennies are available for immediate acquisition by readers of this publication at the low price of just \$14.95 per set. The coins cover every date struck by U.S. Government Mints. Each coin is flawless in Brilliant Uncirculated condition. A deluxe album is included at no additional cost.

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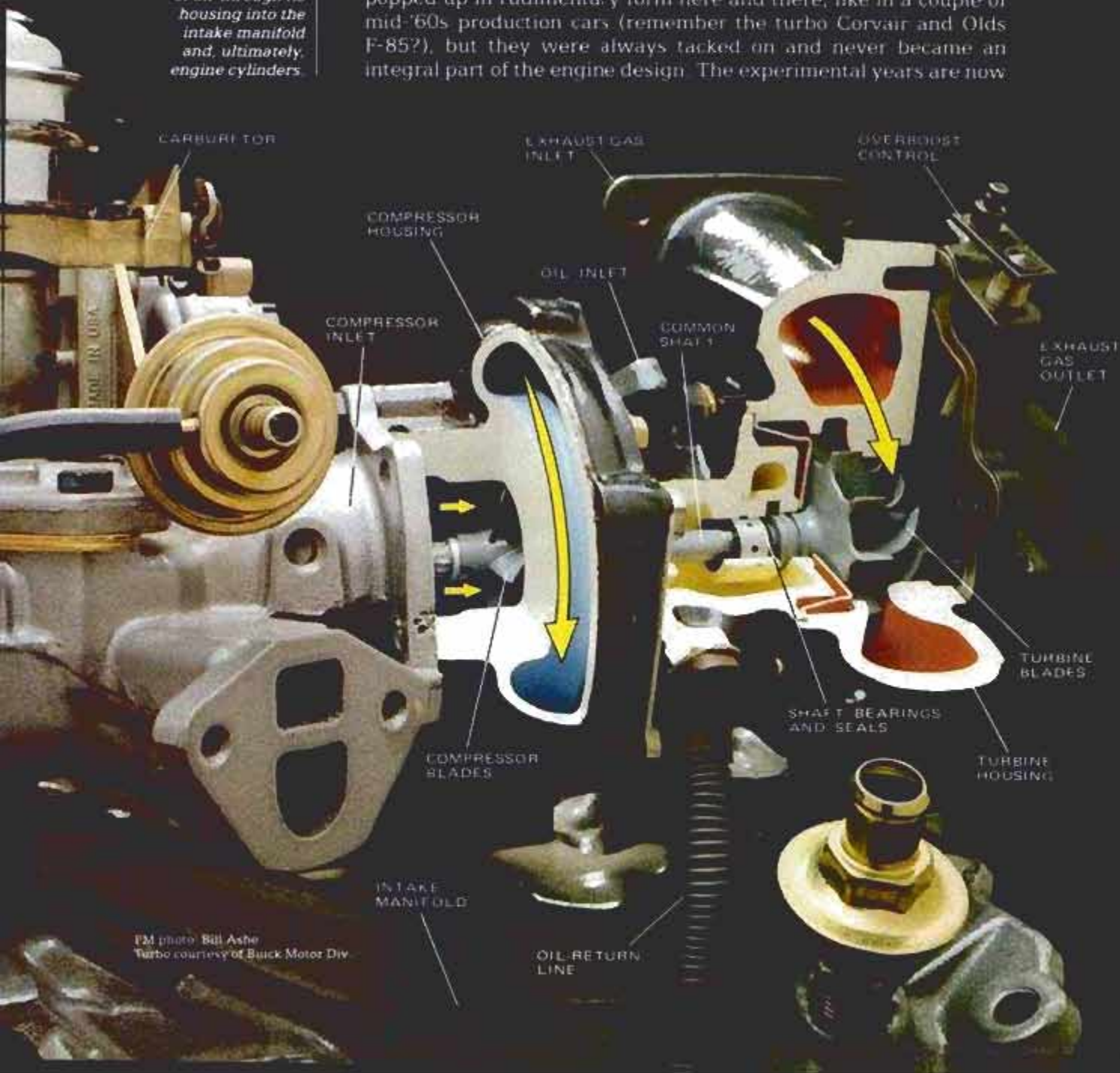
TURBOCHARGING

THIS TIME IT'S HERE TO STAY!

The on-again, off-again love affair with turbos is on again—this time with a vengeance. BY DON FULLER

Exhaust flow spins turbine at high speed. Compressor, on a common shaft, spins at same speed, forcing great gulps of air through its housing into the intake manifold and, ultimately, engine cylinders.

Turbochargers aren't new. They've been around since the early 1900s, spinning in a variety of applications—from giant, stationary diesel installations and aircraft motors to tiny blowers on motorcycles. But they've never been part and parcel of an internal combustion engine in a mass-produced automobile. True, they popped up in rudimentary form here and there, like in a couple of mid-'60s production cars (remember the turbo Corvair and Olds F-85?), but they were always tacked on and never became an integral part of the engine design. The experimental years are now



PM photo: Bill Ashe
Turbo courtesy of Buick Motor Div.

long gone, however, and today's turbocharged engines are more sophisticated than anyone in Detroit—or elsewhere—ever dreamed they could be.

They're more commonplace, too, as auto engineers struggle with the problem of getting decent acceleration from minuscule engines loaded to the gills with power-robbing accessories by American buyers. So far, turbochargers seem to be the golden answer to the questions that have plagued car manufacturers for the past decade. It's easy to think the primary intent of a turbocharger is to make a car go faster. Every factory turbocharged car that ever rolled across a showroom floor or a two-page magazine ad has been touted for its ability to get with the program when the throttle goes down. There's no denying that a turbocharger added to a car makes it faster. But it's not just because turbos are more speed equipment, stacked on the shelf alongside toilet-size carburetors and lumpety-lump camshafts. Traditional speed equipment increases power, but only at penalties in operating efficiencies. Any gains from a turbo are specifically because it *increases efficiency* of the total engine package.

A turbocharger improves efficiency

by utilizing energy—energy that would otherwise be lost—to drive a system that increases the engine's power. The improvement in efficiency comes specifically from the utilization of that energy.

The four-stroke, gasoline-burning, spark-ignition engine converts roughly one-third of the potential energy content of its fuel into usable power at the crankshaft. The rest is lost. Approximately one-third is dissipated to the surrounding atmosphere in heat rejection, just to keep the thing from melting itself into a lump. And, roughly, the final third goes out the exhaust pipe. Over the years, cars, as a whole, have become more efficient and, therefore, more economical. But their *engines* have not improved significantly on that one-third.

For two-stroke engines, the percentage is about one-fourth or less because, while they are more powerful on a displacement basis, they waste a terrible amount of fuel. Diesels are better, maybe around 40 percent or so, due largely to the higher compression ratio and the combustion process that burns slower and more completely.

For many years, aircraft engineers have been using some of this lost

energy, such as ducting cooling-system heat or exhaust-pressure waves to augment forward thrust. But aircraft are easier to deal with. They move fast enough to take advantage of these various forms of thrust and their engines run at fairly constant speeds. Turbochargers in aircraft go back to World War I.

Turbochargers have also become standard fare on trucks, boats, tractors, heavy equipment, stationary powerplants—anyplace the internal combustion engine could use more power and/or efficiency. One reason automobiles are among the last in line is that cars have a very particular requirement. They must operate over a wide range of speeds, and must have a certain level of response. In all other applications, these demands are not quite so severe.

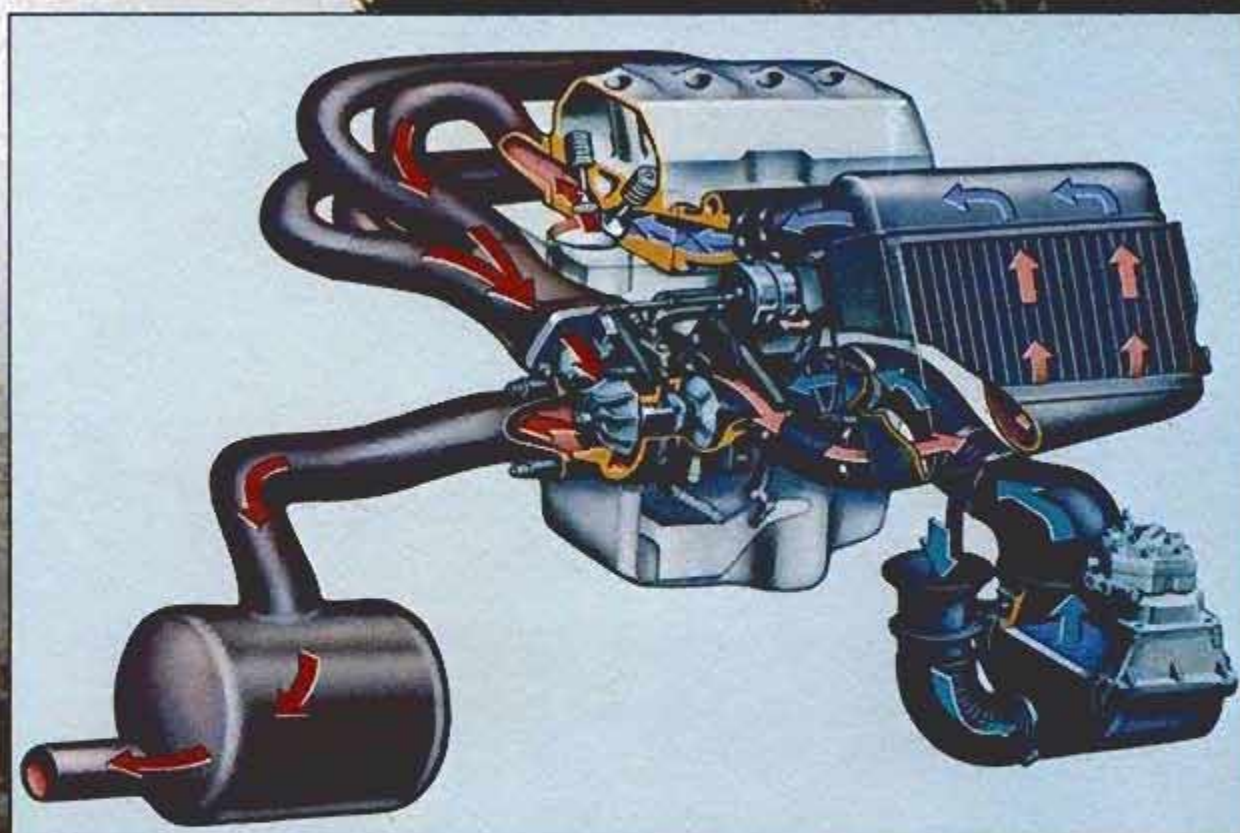
The turbocharger is part of the family of superchargers. The incoming air and fuel is the *charge*. If it is pressurized over normal atmospheric levels, it's *supercharged*. A supercharger is a compressor connected to the engine's intake. In vernacular, the term supercharger has come to mean (incorrectly, by the way) a compressor driven mechanically by the engine. Actually, it



TURBOCHARGED CARS AVAILABLE NOW

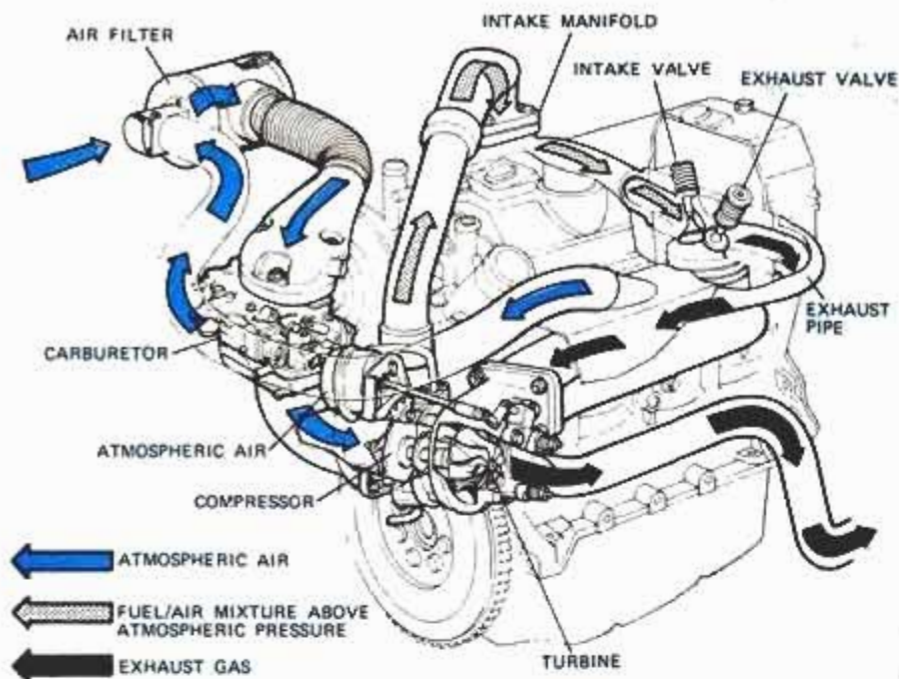
Car	Displacement (cc)	Hp @ rpm	Boost (psi)	EPA mileage (city)	Price (with turbo)	Price (without turbo)
Audi 5000	2,144	130 @ 5,400*	10.5	18	\$18,480	\$14,075
Audi Quattro	2,144	160 @ 5,500	12.3	17	35,000	NA
Buick Regal, Riviera	3,791	180 @ 4,000	8.0	18	10,366 (Regal) 15,906 (Riviera)	9,100 15,238
Datsun 280ZX Turbo	2,753	180 @ 5,600	7.3	21	17,299*	14,999
Fiat Spider 2000 Turbo	1,995	120 @ 6,000	6.0	24	14,995	12,290*
Mercedes-Benz 300D, CD, TD, SD†	2,998	120 @ 4,350**	11.0	27	30,000 to 37,970	NA
Mitsubishi Starion	2,555	145 @ 5,000	7.5	21	16,000	NA
Peugeot 505, 505S, 604†	2,304	80 @ 4,150**	8.7	27	14,000 to 20,000	12,575
Renault Fuego Turbo	1,565	107 @ 5,500	12.8	26	8,400	7,600
Saab 900 Turbo APC	1,985	135 @ 4,800	8.7	20	16,200	12,800
VW Rabbit, Jetta, Quantum†	1,588	68 @ 4,500**	10.0	43	8,900 to 12,500	7,400 to 11,000
Volvo GLT††	2,127	127 @ 5,400	6.0	19	15,495	14,255

*Gas turbo; 84 hp for turbodiesel. †Turbodiesels. **All models. ††GLT joined this month by 760 GLE turbodiesel. NA: Not applicable.



- Hot exhaust gases
- Ambient air
- Hot compressed air (before intercooler)
- Cool compressed air (after intercooler)

One of the most diabolical turbo applications ever seen is the tiny 1.4 liter motor installed at the rear of the flyweight Renault 5. In racing trim (left), the motor produces 250 hp, while the street version delivers 160 hp. Intercooling is part of the secret to the tremendous power output.



A draw-through turbo system places the carburetor upwind of the compressor. The fuel/air charge is compressed and heated before being fed into the intake manifold.

can take many forms. There are big, positive-displacement Roots blowers beloved by the drag race crowd, axial-flow superchargers that resemble the compressor section of a jet engine, vane-type superchargers similar to emissions-control air pumps, and centrifugal blowers like the Paxtons that were used on factory 312-cu.-in. Ford V8s in 1957 in an attempt to make a Thunderbird as fast as a Corvette. All of them were driven by belts, chains or gears from the engine, and therefore, while they added to the power, they

also consumed a significant amount of power just in their operation. Some big Roots blowers can absorb well over 100 hp. Overall, horsepower is increased, but efficiency takes a dive.

A turbocharger is a centrifugal supercharger driven by exhaust gases. The compressor section is identical in concept to all those old Paxtons; it's a centrifugal fan in an expanding spiral housing. On the other end of a common shaft is the turbine section, roughly similar in appearance to the compressor, except the flow of gases through

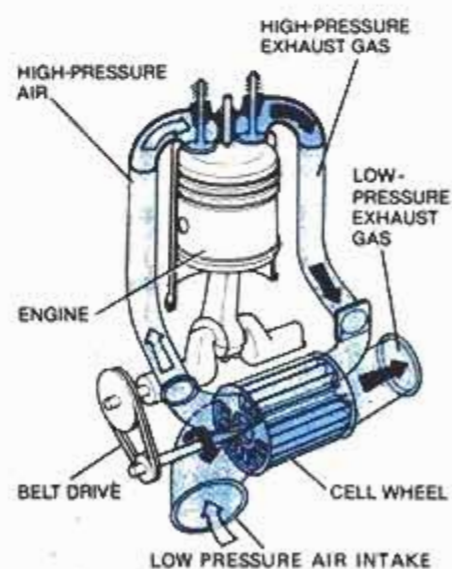
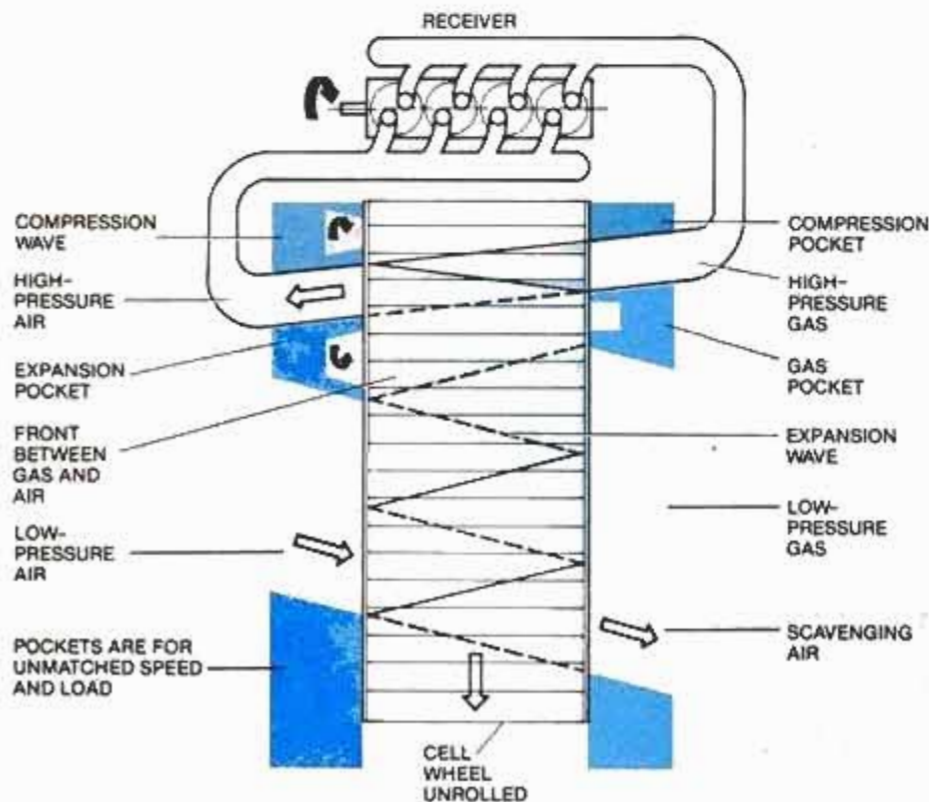
the two is directly opposite. In the compressor, air flows into the center, or eye, and is forced outward centrifugally around the spiral and through an exit under pressure. Exhaust gas, on the other hand, flows into the outer edge of the turbine's spiral and then inward, where it is forced against, and spins, the turbine wheel. It then flows out the center. On any type of spiral-shaped housing, the low-pressure side is always the eye and the high-pressure side the periphery.

As the exhaust gases spin the turbine, it, through the connecting shaft, spins the compressor, which pressurizes the intake. It's a supercharger, driven by an exhaust turbine—turbo-supercharger, shortened to turbocharger.

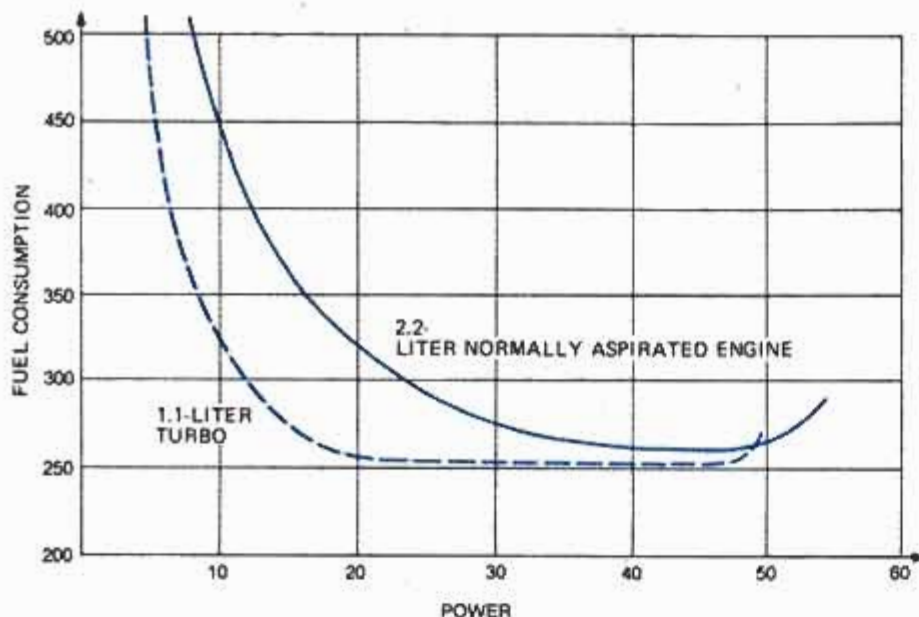
The compressor can be mounted upstream or downstream of the fuel source. Generally, with carburetors it works best to have the compressor draw the mixture from the carburetor, which means fuel and air pass through the turbo. If the turbo pressurizes the carburetor, in what is known as a blow-through design, things become considerably more complicated. The entire carburetor must be pressurized in order to make the float system work properly. This means elaborate seals for all the necessary linkages and lines.

Comprex supercharger

An interesting variation is the Comprex system. A finned rotor fits inside a cylindrical housing, with ports at each end. The rotor is driven by the engine, its speed always proportional to engine speed. Exhaust gases enter and leave at



The Comprex (above) is pressure-wave supercharger which uses a mechanical drive to turn a wheel with openings synchronized with exhaust valves. As detailed at left, pressure wave of exhaust gases on one side of the wheel compresses ambient air on other side. System has nearly instantaneous throttle response.



Power plotted against the fuel consumption of these two motors shows the advantages of turbocharging in gas economy. The 1.1-liter turbo motor, at any equivalent power, will consume less fuel than the 2.2-liter nonturbo motor.

one end of the housing, intake air at the opposite end. As the rotor turns, exhaust gas enters through its port and imparts pressure directly to the intake charge. The exhaust and intake air actually come into contact in the rotor with the intake air being pressurized. At the appropriate point, the rotor fins pass the outlet port for the intake air. Under pressure from the exhaust, it is forced out of the housing. However, before the exhaust gas can follow it into the intake tract, the fins have passed the port and the exit is closed. Next, the rotor's fins pass the exhaust outlet port, which is roughly opposite the intake inlet port, and the exiting exhaust gas pulls the next round of intake air into the rotor. This description concerns only one section of the rotor; the process is continuous and uninterrupted.

A pressure-wave supercharger exchanges energy from the exhaust gas directly to the intake charge, and it does this at the speed of sound—the speed of the pressure waves. As a result, response is claimed to be as quick as that of a naturally aspirated engine. With the boost imparted to the intake directly, the Comprex should not suffer from the lag of turbochargers and their need to accelerate the turbo before boost is available.

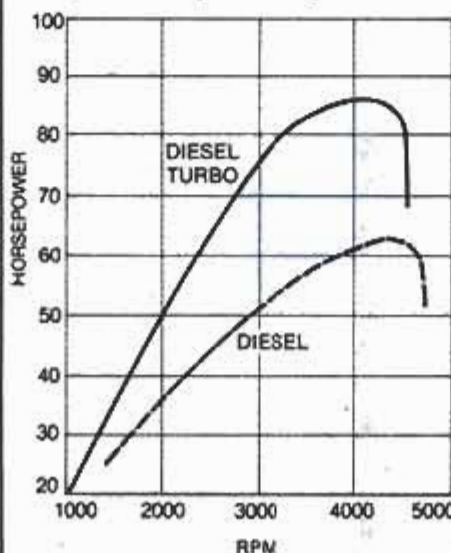
Ferrari tried the Comprex in the early part of the 1981 Formula One season, but it was abandoned in favor of turbochargers. However, the exact reasons for giving up on it are unclear, and may have had as much to do with necessary development time as anything inherent with the Comprex system. The Comprex, developed by Brown, Boveri of Switzerland, was originally designed for passenger car diesels, and may have more of a future adding accelerative

spice to diesel drivers' lives than winning races.

Power on demand

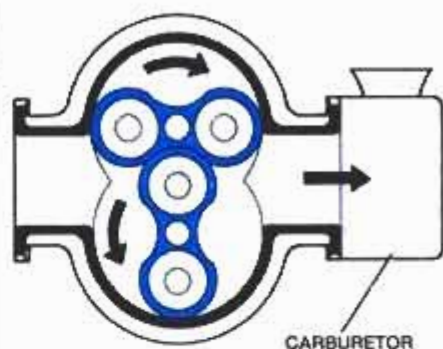
A turbo is attractive because it's essentially a demand system. It works only when you want it. And the request is made in the most elemental way. Step on the gas. Opening the throttle increases exhaust gas temperature and flow, which speeds the turbine and compressor and increases intake pressurization. At light throttle openings, the lower rate of exhaust-gas flow allows the turbo to idle along, more or less.

The intake manifold pressure is called boost. Usually, in this country, it's measured in pounds per square inch (p.s.i.). In Europe and Japan, it's in bars, and in Indy car racing in inches of



mercury. In other places, it may be measured in atmospheres, which is close to bars, but not the same. The approximate equivalencies for these quantities are: One bar equals 14.5 p.s.i., one inch of mercury equals 0.49 p.s.i., one atmosphere (normal atmospheric pressure) equals 14.7 p.s.i. This boost is over and above that of normal atmospheric pressure, which would register as zero in an intake manifold. Normally aspirated cars operate with a vacuum in the manifold. It requires some boost just to get back to zero when running.

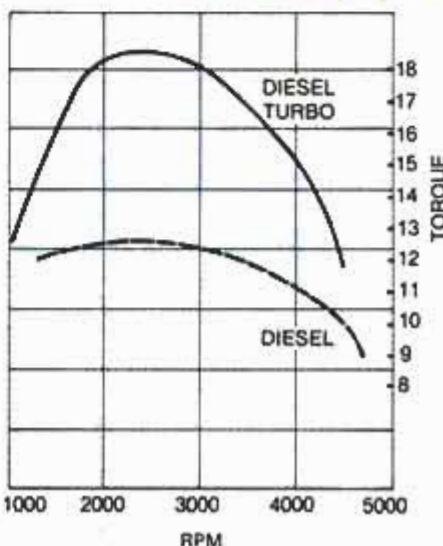
To generate these pressures, the turbine lives in a harsh environment.



The Roots-type, mechanically driven supercharger uses tightly fitting rollers to compress charge before firing it.

Exhaust-gas temperatures may reach as high as 1,500°F. Most automotive turbochargers have rotational speeds in the region of 125,000 rpm or more at maximum boost, and some of the new, smaller motorcycle turbos spin well over 200,000 rpm. Considering the temperatures, bearing speeds and requirements for fine balance, it's apparent that the turbocharger engineer has enormous concerns with materials, tol-

(Please turn to page 108)



Diesels take to turbos like ducks to water. The charts indicate the significant hp and torque increases between normally aspirated and turbo versions. Diesels can easily tolerate the extra heat and pressure that are inherent in turbocharging.

HERE'S THE ATOM AS YOU'VE NEVER SEEN IT!

The old atom—electrons spinning around a nucleus—is ancient history. Today's atom is a 'zoo' of tiny, swarming particles and more.

BY TERENCE DICKINSON

Remember the atom you learned about in high school? It had electrons whirling around a nucleus of protons and neutrons—like planets around a star. That's the way the atom looked to us 40 years ago this month, when Enrico Fermi set off the first controlled nuclear chain reaction in an underground lab at the University of Chicago. But in the four decades since that experiment, man has designed machines to smash, fuse and penetrate what was once thought to be the most basic building block of nature. And the new atom bears very little resemblance to the old.

Today, physicists probe the inner workings of the atom by accelerating protons and electrons to near the velocity of light in magnetic merry-go-rounds, miles in circumference. Monster machines, such as the main Fermilab ring near Chicago, have become science's cathedrals to the deepest secrets of matter and energy. And, in a survey of labs around the world, PM found physicists on the brink of discovering at least two new basic particles—"weakons" and "monopoles."

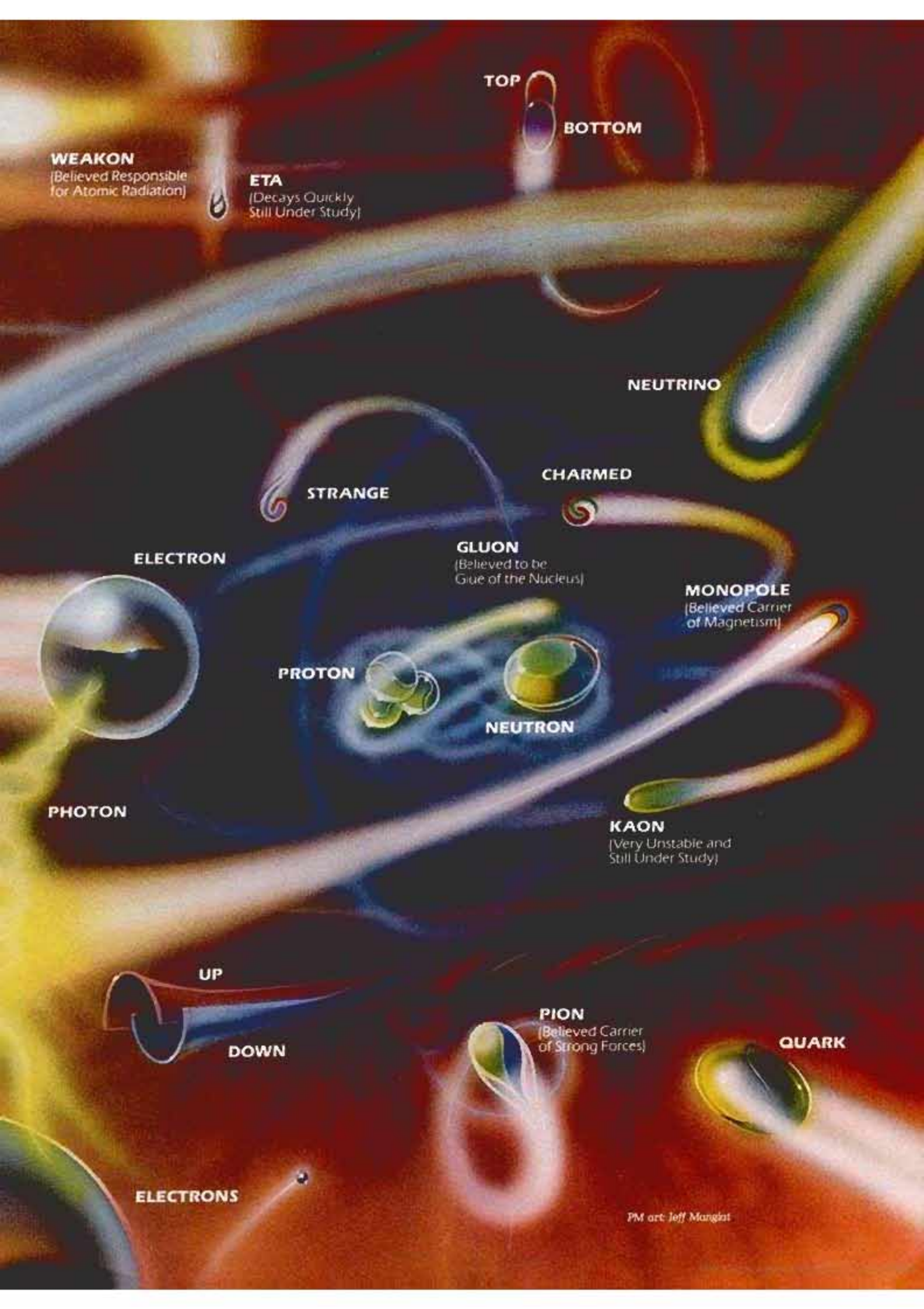
Inside the colossal particle smashers used today, nega-

Proton and electron collision (circled) makes ripples across liquid hydrogen in a bubble chamber. Trails across chamber indicate a particle, giving its mass and speed. In art, silvery electron transfers a photon to a similar particle of lower energy. The photon is a "wave packet," not quite tangible and yet not just theoretical. Deep in the atom, gluons are believed to hold together parts of a nucleus, including protons and neutrons. Right now, the basic unit of matter is the quark. All things in and around the nucleus seem to be a combination of quarks and antiquarks; up, down, top, bottom; charmed and strange.



MUON

(Sometimes Takes Electron's Place)



WEAKON
[Believed Responsible
for Atomic Radiation]

ETA
[Decays Quickly
Still Under Study]

TOP
BOTTOM

NEUTRINO

STRANGE

CHARMED

ELECTRON

GLUON
[Believed to be
Glu of the Nucleus]

MONOPOLE
[Believed Carrier
of Magnetism]

PROTON

NEUTRON

PHOTON

KAON
[Very Unstable and
Still Under Study]

UP

DOWN

PION
[Believed Carrier
of Strong Forces]

QUARK

ELECTRONS

PM art: Jeff Mangat

tively charged electrons and positively charged protons are guided precisely along magnetic runways to points where they collide or smash into other particles. New particles spew outward from the point of impact like shrapnel from a detonating grenade. The collisions take place at the focus of a recording machine, usually a bubble chamber filled with supercooled hydrogen. The track that a particle leaves as it sails across liquid hydrogen in the chamber reveals its charge and its mass.

So far, over 100 different elementary particles hidden in the atom have been coaxed to expose themselves in this type of experiment. In yet another kind of subatomic hunt, Euro-

pean physicists this year have been gazing into a nuclear "crystal ball" on loan from Stanford University, hoping to find "weakons," the particles theoretically responsible for some kinds of atomic radiation.

The other particle hunt we uncovered is taking place at Stanford, where noted physicist Blas Cabrera is searching for the basic particle of magnetism—the "monopole."

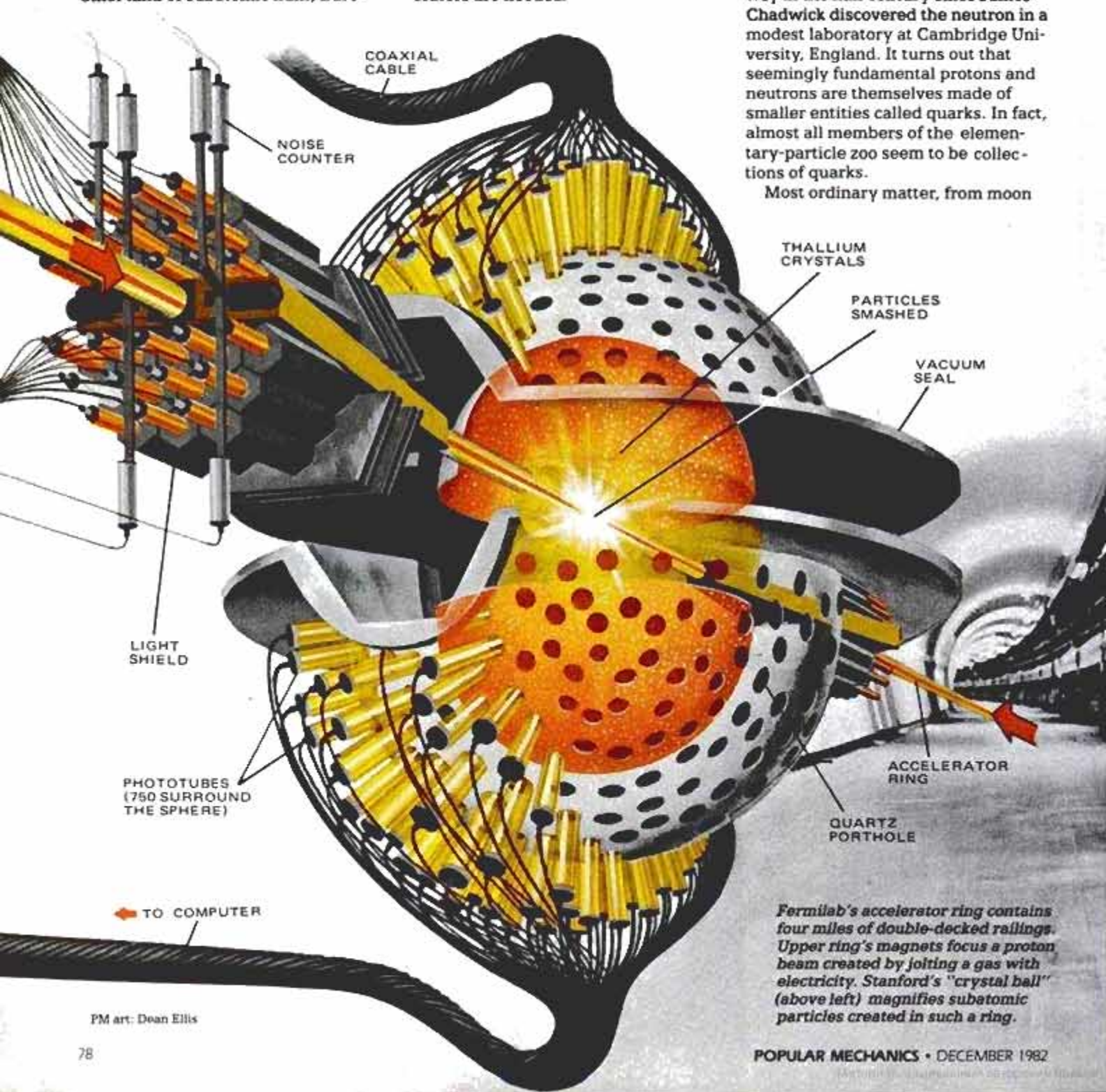
The \$2.5 million crystal ball weighs 35,000 pounds. Its 7-foot-diameter interior is crammed with sodium iodide and thallium crystals to magnify the faint light of quick-moving particles. To see even deeper into the atom, larger and more powerful accelerators are needed.

In addition to half-billion dollar price tags, billion-watt electricity consumption and sheer physical size may place an upper limit on the dimensions of the mammoth particle accelerators. The barrier will probably be reached in 1987 with the completion of the European atomic agency CERN's 17-mile-circumference, large electron-positron storage ring, which will cost at least \$500 million to build and \$200 million a year to run. The United States has been working, on and off, on a similar ring—Isabelle—at Brookhaven National Labs.

Ups and downs of quarks

Subatomic physics has come a long way in the half century since James Chadwick discovered the neutron in a modest laboratory at Cambridge University, England. It turns out that seemingly fundamental protons and neutrons are themselves made of smaller entities called quarks. In fact, almost all members of the elementary-particle zoo seem to be collections of quarks.

Most ordinary matter, from moon



Fermilab's accelerator ring contains four miles of double-decked railings. Upper ring's magnets focus a proton beam created by jolting a gas with electricity. Stanford's "crystal ball" (above left) magnifies subatomic particles created in such a ring.



PM photo by [unreadable]

Stanford lab worker checks vacuum seal on the equipment that detected what is believed to be a monopole, a basic unit of magnetism. It took Stanford's Blas Cabrera months to locate one monopole.

rocks to protoplasm, can be made from two kinds of quarks, named "up" and "down" in the curious nomenclature of particle physics. Also, while being accelerated experimentally, protons have increased in mass and then decomposed into other quarks, known as "strange" and "charmed." A recently detected fifth quark, called "bottom," and its still-theoretical and elusive mate, dubbed "top," may comprise even heavier particles. The picture is further complicated because each type of quark comes in three forms, referred to as "colors."

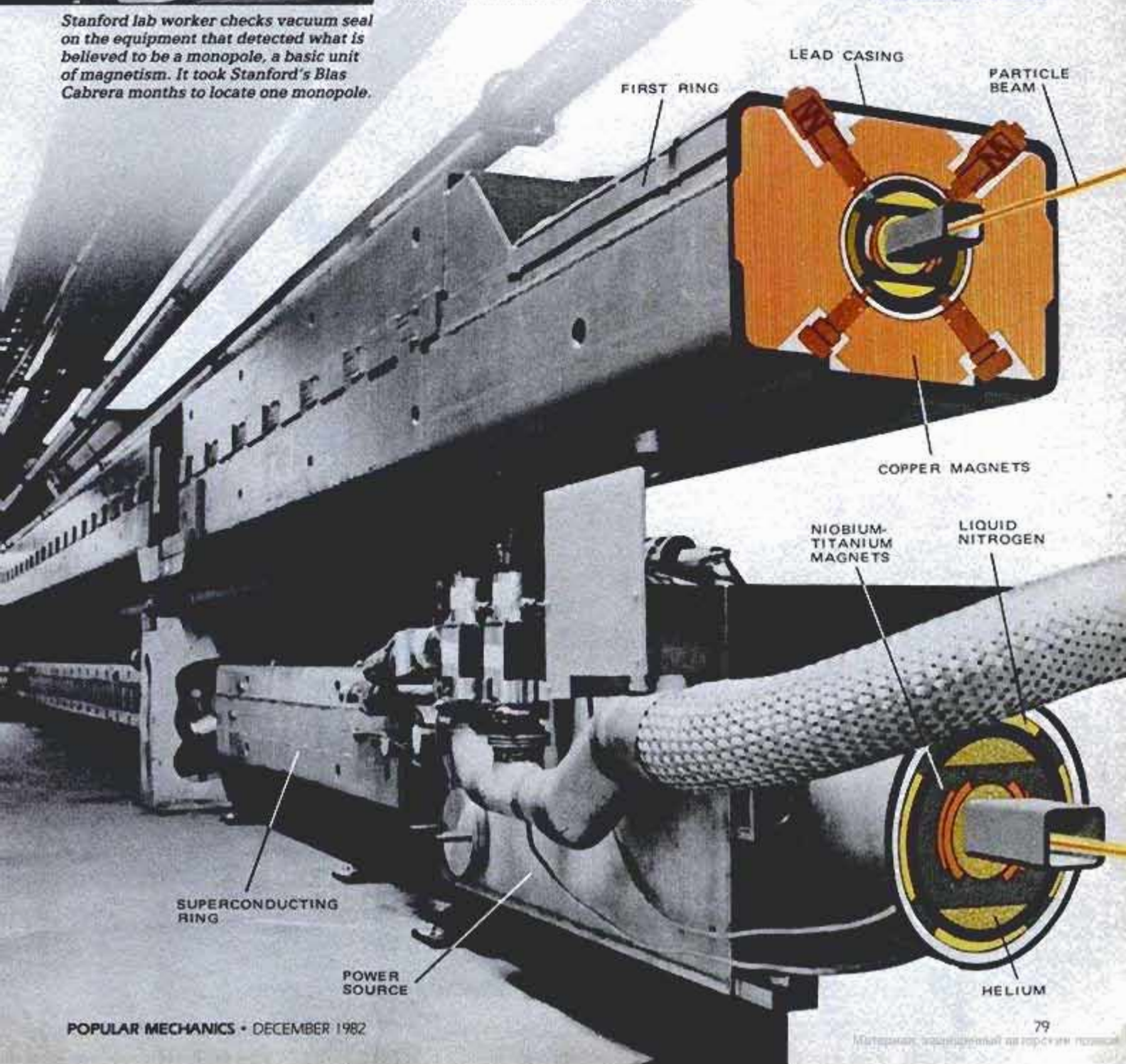
"The minimum number of these fundamental particles now seems to be at least 24—the six quarks, each in three colors, and six leptons," says physicist O. W. Greenberg of the Uni-

versity of Maryland. Leptons, Greenberg explains, include electrons, neutrinos and other "heavy" (high-energy) cousins. As the accelerators become more powerful, Greenberg predicts, more quarks and leptons will be detected.

Faced with the prospect of a fundamental particle proliferation, Greenberg and a group of like-minded physicists met recently to discuss the possibility that the quarks may, in fact, be made up of more elementary particles called "preons." Despite the appeal of this idea, Greenberg concedes "there is as yet no convincing evidence for the preons' existence."

The pendulum has swung back and forth several times on this question of ultimate simplicity, observes physicist

(Please turn to page 110)



NEW WINGS FOR OLD WARBIRDS

The heroic fighters and bombers of WWII still grace the skies, thanks to those who patch them up to keep a 40-year-old legend alive.

BY BUDD DAVISSON

World War II was 30 years gone, and the warhorse I was astride was far past its fighting prime. Still, I had a sense of battle about to begin, a battle that had been fought and won almost before I was born.

The 12 cylinders of the Rolls-Royce Merlin barked with the authoritative voice of 1,450 hp. It was a sight I had seen a thousand times in movies and a million times in my dreams. I was at the controls of a P-51 Mustang, the definitive World War II fighter, about to take off.

I checked all the trim settings, making certain rudder trim was set at 6° right. The manual said that without right rudder trim, the airplane would be very willing to make a 90° left turn off the runway under the influence of all that power and torque. I inched my left hand forward, the big throttle



Forty years later: F4U Corsair (foreground) teams up with two P-51 Mustangs, all original World War II fighters now fully restored to flying condition. Famous "bent-wing" F4U saw extensive action in the Pacific from carriers, later starred in TV series *Baa, Baa Black Sheep*. The 2,000-hp, 417-mph Corsair and 1,500-hp, 437-mph Mustang were two of the most devastating prop-driven fighters of all time.

ABOUT THE AUTHOR

Budd Davison, noted aviation writer and aerial photographer, has logged more than 3,500 flight hours in hundreds of different aircraft, ranging from World War II fighters and bombers to the latest in homebuilt sports planes and ultralights. He owns and flies a Pitts Special aerobatic biplane and is currently building a full-scale replica of a 1930s Wedell-Williams racer. The story he tells here is condensed from his new book, *The World of Sport Aviation* (Hearst Books, 242 pages, \$24).



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Color photos by the author



Saved from oblivion: P-40 at right lay on its back for 30 years on Amchitka Island in the Aleutians until it was rescued and restored—an example of how far enthusiasts go to save history. Above, a P-40 as it looked in dark days of Pearl Harbor when the immortal Flying Tigers in China brought the only bright news home. The “fearsome” shark’s mouth was a bit of psychological warfare—the Japanese, a fishing people, were known to dread sharks.



Dwindling ranks: The only four B-17s still regularly flying form up for rare family portrait. In foreground is “Sentimental Journey” operated by Arizona Wing of Confederate Air Force, a group dedicated to preserving aging warbirds. In rear is B-17 owned by Experimental Aircraft Assn. Four 1,200-hp Wright engines made the mammoth, 20-ton B-17 Flying Fortress one of World War II’s mightiest bombers.



Coming at you: Awesome power of P-51 Mustang is captured in nose-on view (shot, author admits, with a very long lens). The Mustang was the fastest, most versatile of all World War II fighters.



WARBIRDS

From war to peace: When Jimmy Doolittle's B-25 Mitchell bombers roared across Japan in historic raid on Tokyo in April 1942, it was a turning point in the war—the Yanks were coming. Weighing 13 tons, the 16 huge, 53-foot, twin-engine craft had accomplished the remarkable feat of taking off in less than 600 feet of deck space from the carrier *Hornet* in raging Pacific seas more than 600 miles off the enemy coast. Today, this magnificently refurbished B-25—one of only a few remaining—is content to thrill airshow crowds. Of the even heavier four-engine bombers, the only regularly flying survivors are two B-24 Liberators, one lone B-29 Superfortress and the four B-17 Flying Fortresses shown on preceding page.



Express elevator: The AT-6 Texan (or SNJ if you were in Navy) was widely used as a WWII advanced trainer. Since it was produced in large numbers (nearly 20,000) and suffered fewer losses than combat planes, it's still fairly easy to find and less costly than rarer, more exotic fighters. Though not fast, it's agile enough to give stomach-churning thrills like the straight-up zoom above.

Friendly enemies: The world's only airworthy Japanese Zero (foreground) gets peaceful escort from two old foes, an F6F Hellcat (center) and F4U Corsair (rear). The Hellcat was one of Grumman's famous "cat" series, which included the F4F (FM-2) Wildcat and F8F Bearcat, all carrier-based fighters along with the Corsair. (The Bearcat appeared too late in the war to see combat, but was one of the fastest prop-driven planes ever produced and is still flown today in air races.) The deadly Zero could out-fly early U.S. fighters like the P-40 and Wildcat, but soon met its match in the Hellcat and Corsair. (The heroic success of the P-40 and Wildcat was due largely to special tactics used to compensate for their technical inferiority.)





Endangered species: Two rare birds. FM-2 Wildcat (foreground) and TBM torpedo bomber, meet in fading sun. TBMs, made by General Motors, were same as Grumman's TBF Avengers. They saw widespread action in Atlantic and Pacific and were instrumental in sinking the world's two largest battleships, Japan's *Musashi* and *Yamato*. Wildcats were sole carrier-based U.S. fighters in first half of war, later giving way to the faster, more maneuverable Hellcats and Corsairs.

Wrecked British Spitfire (right), hero of the Battle of Britain, is being rebuilt by the Experimental Aircraft Assn. It will eventually look like restored Spit below.



handle feeling slick with nervous perspiration. The back of the bucket seat forced me forward with so much acceleration I forgot to breathe. The concrete was being sucked under me in a swath of blurred gray. It seemed I had been accelerating for an eternity when I felt the plane get light on its feet and whisper, "Take me, let's go, let's go flying."

A gentle tug on the stick made the world go away. I was in the air—I was flying a Mustang! Yes, some dreams do come true.

Aviation can be a very emotional thing, especially when it comes to warbirds. There's something about the combat planes of wars we've not experienced that makes men into boys. Today, their killing days behind them, warbirds exist as exciting monuments to men and deeds that should never be forgotten.

The artificial technological acceleration that occurs during any war was responsible for the birth and death of the propeller-driven fighter. In five short years, technology brought it to its absolute zenith, then killed it by developing the turbojet engine. The operational life spans of some of the warplanes we consider immortal, like the P-38 Lightning and P-40 Warhawk, were, in some cases, no more than two or three years before they were rendered obsolete by newer designs.

Accelerated extinction

The period right after World War II was like the end of the era of dinosaurs. Machines of war are not needed when there is no war. By 1946, smelters were going full blast, making once-proud fighters into beer cans and cooking pots. Salvage contractors were much more interested in the aluminum bones of a warbird than in the history it had just helped to write. In some places, such as India, the obsolete planes were just pushed into heaps and set on fire. On island fortresses, Navy and Marine Corps planes were dumped into the sea.

By 1950, the process of extinction
(Please turn to page 126)

PM OWNERS REPORT:

BY MICHAEL LAMM WEST COAST EDITOR

CHEVROLET S-10 PICKUP

"It's made in America and has fantastic qualities."

ALABAMA
ECONOMICS PROFESSOR

"It's a good little truck, acts and performs like a full size one, plus gets good gas mileage."

MASSACHUSETTS
AIR RESERVE TECHNICIAN

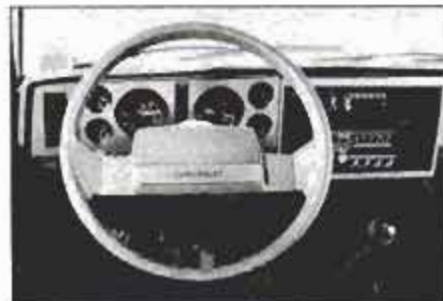
"Paint quality could have been better."

FLORIDA
NUCLEAR OPERATIONS
INSTRUCTOR



Chevy's S-10 broaches a whole new question of dimension. Chevrolet launched this mid-sized pickup as an in-between, neither big nor mini. As such, General Motors took a chance in putting the S-10 on the market. Who could say how the American public would accept a "3/4th-tonner"? After all, no one beat down the doors of Ford dealers for the Falcon pickup of the '60s.

GM's gamble has paid off, though, because the S-10 (and its cousin, the GMC S-15) have set sales records like no other truck in history. Introduced on Nov. 12, 1981, Chevrolet sold 110,290 S-10s in its first seven months, making this the hottest selling truck in the division's experience.



Ergonomics received high praise from most owners, but the shift levers fall off.

Nor does Chevrolet intend to rest on its laurels. The 1983 S-10 now offers four-wheel drive and an extended cab. Chevy will also unveil a diesel S-10 for mid-'83.

The division's new, smaller Blazer, as you probably know, shares all the S-10's basics, including its optional V6 engine. This is currently the most potent powerplant in the small pickup field. Ford, for example, in its similar-sized new Ranger series, offers only Fours, the most powerful of which lists 24 fewer horses.

Most owners chose the V6 option over the standard Four—80.6 percent—and the majority were glad they did. The fuel penalty with the V6 came to about three miles per gallon, both city and highway, and even at that the V6 logged 20.4/25.4, which isn't bad for any small pickup (but nowhere near the EPA maximum of 28/39 mpg for the S-10 Four with stick).

Commenting on V6 engine perfor-

A NATIONWIDE SURVEY BASED ON 2,361,548 OWNER-DRIVEN MILES



*"Transmission
grinds in reverse."*

IOWA
POLICE OFFICER

*"Good handling,
good ride,
comfortable and useful"*

ARIZONA
PROCESS ENGINEERING
MANAGER

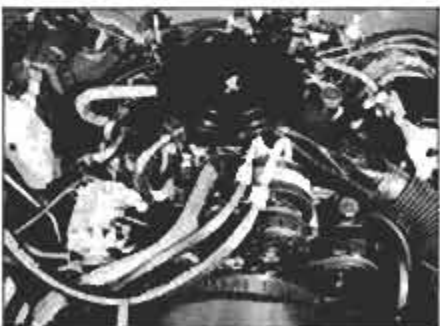
*"The automatic transmission
takes the joy out of this truck."*

MISSOURI
UTILITY WORKER

mance, a New Hampshire materials director told us, "The V6 gives good acceleration; I like the power-to-weight ratio." A California process technician echoed, "The V6 and four-speed give the S-10 a bigger payload capacity and more pulling power."

An Illinois industrial mechanic beamed, "It's a very snappy pickup and very easy to drive—really a great town runabout." A California retail clerk observed, "I think it's basically a very good idea to have a small truck with a V6 engine. It gives me nearly the same hauling capacity as a big pickup, plus the power of a Six, but with the economy of a small engine." A Louisiana helicopter pilot summed it up this way: "The V6 is

an ideal size engine. It combines performance and reliability with decent gas mileage." Fuel mileage and overall econ-



The V6 power and economy were big selling points for many owners.

omy, in fact, ranked as the S-10's best liked features, especially with the 1.9-liter Four.

Even so, we did note a few grumbles from owners with automatic transmissions.

A Texas electronics technician had this to say: "Although I have the V6, I wish it had more power to get the automatic going. Acceleration isn't up to snuff, nor gas mileage either." That opinion was expressed even more vociferously by owners of the Isuzu-supplied Four with automatic, and resulted in this irony: 46.5 percent of our respondents listed economy as a "specific like," while a different 11.5 percent put it down as a "spe-

(Please turn to page 136)

STEREO
Mitsubishi
System X-10

SPEAKERS
Advent Model 4002

MONITOR
JVC CX-610US

COMPUTER
Apple II +

VIDEO GAME
Colecovision

VIDEODISC
Pioneer Laser Disc
VP-1000

SWITCHBOX
Vitel Video Selector

VIDEOTAPE RECORDER
Zenith Video Director

MEDIA ROOM

ENTERTAINMENT CENTER IN YOUR HOME

You don't have to be a millionaire to turn your den into a media room. Here is how to hook up video, audio and remote-controlled components.

BY NEIL SHAPIRO ELECTRONICS EDITOR

A media room can bring a whole world of exciting entertainment into your own home. Setting up one of these rooms is a challenging but rewarding experience. It can be fun, too, choosing from the equipment on the market; it's like being a kid in a candy store.

The heart of any media room is a big-screen TV. Everything else is, more or less, an add-on to this. It is the large, breathtaking image on the big screen which brings a feeling of personal involvement to the viewer. You're no longer just a viewer when you watch a big-screen TV. You become almost a participant in the action.

Here are some of the items you should include in your media room. How they interconnect, and the special space requirements and hardware each requires will all influence the design of your room.

The big screen

Because it is the primary component of your media room, choosing a big-screen TV should be an exacting process. As mentioned in the story following this one (*PM Picks Best New Big-Screen TVs*), these sets are available in a wide variety of sizes and types.

The most popular big screens are the one-piece variety. These sets feature a curved screen and relatively high brightness levels. And they don't take up quite as much space as the two-piece units do.

If, however, you have the space for a two-piece set, you might enjoy the larger picture these sets can give you. There are even ceiling-mounted units, but they cost more. In these models, the projector, which is mounted on the ceiling, fires its TV image at a huge wall screen—up to 100 inches measured diagonally.

Seating and lighting are the main considerations when designing a room to fit around one of these video behemoths. All projection TVs show some image deterioration to viewers who are seated off to one side of the screen. So plan a seating layout where as many seats as possible face the screen directly.

None of the big-screen sets are as bright as even a regular 25-inch TV, but the one-piece units are usually the brightest. The two-piece units, with their giant screens, spread their light over a larger area and, so, are even dimmer. In designing your room, avoid any type of lighting which will shine or reflect directly on the screen. This includes windows. Many media rooms



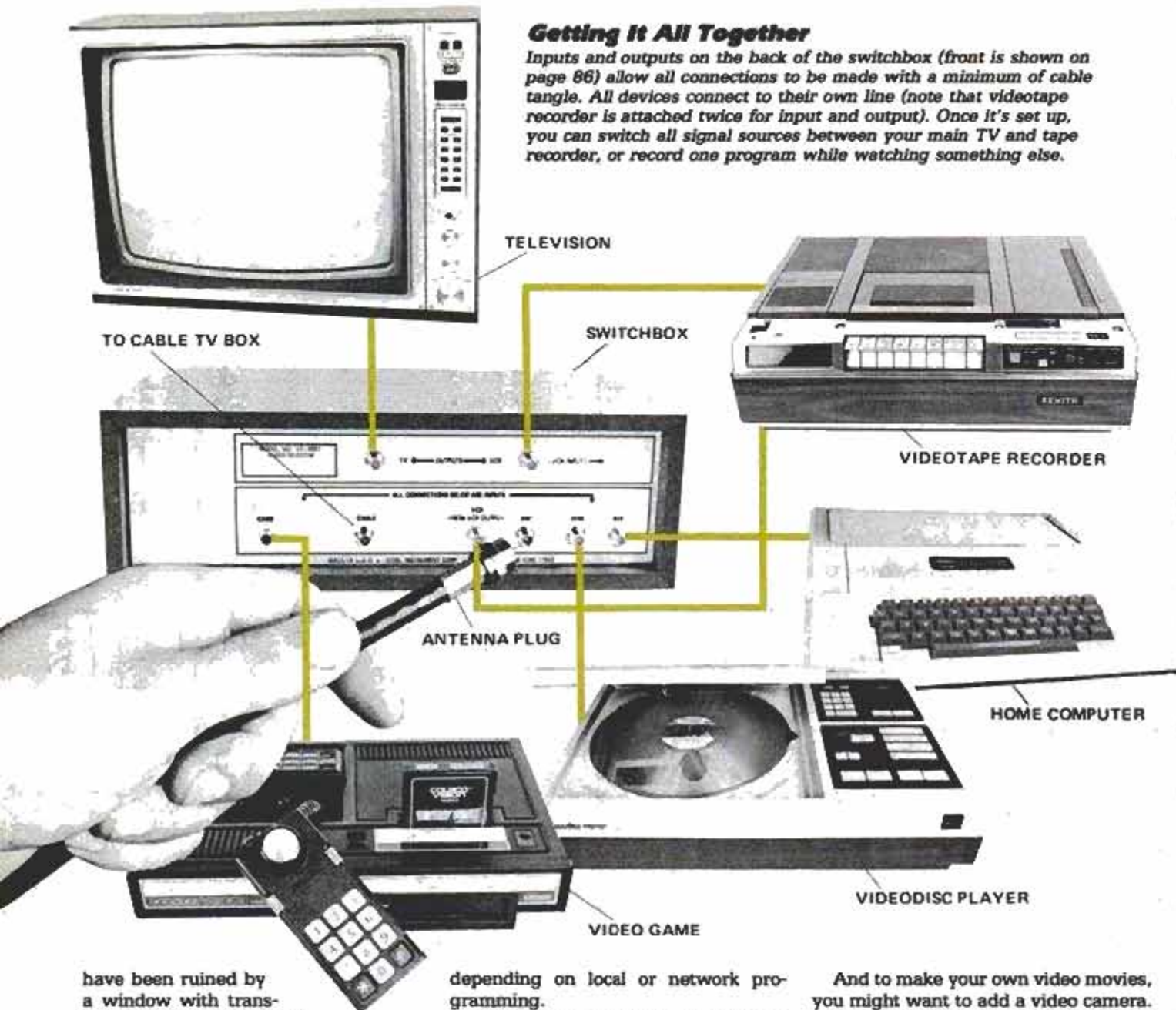
BIG-SCREEN TV
NEC PJ-6000

PM photos: Peter Tenzer Photographed at New York Video

Our media room above shows some of the many items that might go into your version. The big-screen TV is focal point of such a room and the videotape recorder is almost a necessity. A videodisc machine makes a fine addition. Games are popular and computers are making a move. Don't forget a switchbox or other such arrangement to help when it's time to run all the cables.

Getting It All Together

Inputs and outputs on the back of the switchbox (front is shown on page 86) allow all connections to be made with a minimum of cable tangle. All devices connect to their own line (note that videotape recorder is attached twice for input and output). Once it's set up, you can switch all signal sources between your main TV and tape recorder, or record one program while watching something else.



have been ruined by a window with translucent drapes that faced the big screen. This doesn't mean you'll have to watch your TV in total darkness. In fact, many one-piece sets allow just about normal room lighting. Just make sure the lighting is ambient in nature—subtle, no glare.

Record or play

Once you have a big-screen TV to create a theater-like atmosphere, you'll probably want to watch movies. Settling back in your own home with a bowl of popcorn and an Academy Award winner playing on the big set more than compensates for having to watch TV commercials in gigantic proportions.

A videotape recorder (VTR) is your next priority. And if you want to go the whole route, a videodisc machine is certainly a welcome addition to any entertainment center. Both units let you control your own video schedule, so you can watch whatever you want, without

depending on local or network programming.

A VTR can record from your TV and play back its own tapes and prerecorded tapes. There are two formats—Beta and VHS. You should base your choice on the various machines' features and the deal you can make. Both formats are good, but they won't play each other's tapes.

Some of the features found on most VTRs these days include pause, fast forward, reverse and slow motion. Other features, such as full remote, audio dubbing and programmability, are what set one VTR apart from another. Of these options, programmability is the most important; it allows you to record a TV show when you're not home. The best programmables let you record three to five programs during a (usually) two-week period. Full remote allows you to control nearly all your VTR's functions from your easy chair. Dubbing enables you to add sound to your tapes—particularly useful if you make your own tapes of events.

And to make your own video movies, you might want to add a video camera. For most home VTRs, you'll be limited to shooting indoor events. But if you buy a more expensive portable VTR, you'll get a carry-along power supply and taping mechanism that's separate from the stay-at-home tuner section. Then you'll be able to tape Little League games, vacations and more.

None of the new videodisc machines can record. But it is far cheaper to build a library of prerecorded movies on disc than on tape.

There are now two competing videodisc formats. One is the laser-type; the other is CED (capacitance electronic disc). A third, called VHD, has been in the wings so long there is some doubt as to whether it will be released. The laser-type is more versatile, but the CED machine is cheaper, and it's starting to catch up with the laser's advanced technology.

You can buy a stripped-down CED machine, which is basically just a new

(Please turn to page 111)

Kloss Novabeam Model One is a two-piece unit. It features a 6 1/2-foot screen, digital tuning, 83 channels. It has four inputs (two for video, two for audio) and remote control.



A new breed of television receiver—the large-screen TV (or LST for short)—is getting bigger and better every day. If you want a movie-theater look, it's yours. But be forewarned: The price tag can be as enormous as the screen. Plan on spending anywhere from \$2,000 to \$5,000 per.

There are three types of big-screen TVs available. The first, and oldest, design is the two-piece system. It consists of a coffee-table-style projector and a separate screen. Unless it's ceiling mounted, this kind of system takes up the most space, and is usually recommended for larger rooms. Screens of this type have the greatest variety of sizes; they range from 4 to 10 feet, measured diagonally. Generally, a two-piece LST will be less expensive than the

NOVABEAM MODEL ONE



PM'S PICK: BEST NEW

BIG- SCREEN TVs

HOME VIDEO

A big-screen TV is a big-time expense. But if you're planning a media room, it's indispensable.

BY DAWN GORDON

ZENITH SN-4545P



Popping its top (right) is the Zenith SN-4545P TV. A rear-projection, 45-inch screen disappears into the cabinet when the set is off (above). Part of Zenith's Space Command series, it has a remote-control handheld transmitter (shown at top) that can be used as a telephone to answer phone calls without missing a crucial third-down play.



PM photos: Bill Ashe

other types due to its relatively simple design. The average price for a two-piecer is \$3,000.

The second type of LST is the one-piece system. On these models, the projector and screen are housed in the same cabinet. The unit projects the picture onto a mirror, which reflects the image up and onto a screen. These units require much less space than the two-piece systems because the screen and projector are in one housing, and because the screens are smaller—usually 50 to 72 inches, measured diagonally. Prices for these units range from \$3,300 to around \$4,000.

The last and most recently introduced type of LST is the rear-projection system. It's similar in design to the single-piece design. But instead of reflecting the picture onto a curved screen, the image is projected from the rear of the unit through a Fresnel screen. This type of LST takes up the least amount

of room, because there are no mirrors, the cabinet is slim and the screen is usually 45 inches. Prices are comparable to, or slightly higher than, the one-piece LSTs.

Where it goes

Like purchasing any other piece of furniture, you have to plan where you're going to put your new LST. Unlike aesthetic considerations that dictate furniture placement, large-screen TV positioning will depend on other factors. No matter what type of LST you buy, it should be placed away from sunlight or other extraneous light sources. LSTs aren't as bright as conventional TV sets, so glare tends to

wash out the picture, as well as reduce your viewing angle. Of course, placement will involve your seating plan, too. So remember that your seating distance should be twice the screen size measured diagonally. For example, if you have a 6-foot diagonal screen, you should sit at least 12 feet away.

Read the numbers

Two specifications you should know about are light output and viewing angle. The light output is measured in foot-lamberts. This spec isn't an indication of how much light the projector produces, but of how much light actually reaches you from the screen in a true room environment. As you might expect, the larger the screen, the smaller the footlambert figure. If you have to decide between two similar LSTs,



NOVABEAM 10 FOOT

Novabeam's model with 10-foot screen is a two-piece unit which, optionally, allows projector (left) to be mounted on the ceiling. Pioneer's LS-501

(right) is a one-piece unit with a 50-inch screen. The all-electronic tuning gives you 83 channels and features six inputs, three each for video and audio. The picture is bright at 120 footlamberts (manufacturer's specification). Mitsubishi MGA VS-515 (below) sports a contemporary-looking cabinet and optional shelves. This one-piece unit has a 50-inch screen and is cable-ready to receive 105 channels.



PIONEER LS-501

MITSUBISHI MGA VS-515



MITSUBISHI MGA VS-520UD



choose the one with the higher footlambert rating. Most 4-foot units (50 inches) have a figure of 120 footlamberts. The 6-foot LSTs range from 50 to 80 footlamberts. Believe it or not, this is quite bright; most screens in movie theaters reflect only about 14 to 16 footlamberts.

Some LSTs don't use a curved (high-gain) screen; they project the image directly onto a wall or a flat screen. These units have a lower footlambert rating, but they have a much greater viewing angle. The viewing angle is the LST's ability to produce similar brightness off the screen axis for viewers seated to one side of the screen. Make sure that the model you buy has at least a 90° viewing angle. This way, the whole family can enjoy the show without craning their necks toward the screen.

If you're going to shell out \$3,500 for a large-screen TV, it should have plenty

The MGA VS-520UD from Mitsubishi features a 50-inch screen as a part of its one-piece design. It offers remote control, as well as a video and an audio input.

of features to warrant the expenditure. Here's a list of what to look for.

■ **Wireless remote control:** Almost every LST has this feature. After all, if you can buy a \$350 12-inch color TV with remote control, these monster sets should have it as well.

■ **Digital cable-ready tuning:** This is definitely a worthwhile feature. Cable is already available in millions of homes, and it's expected to grow to huge proportions in the next few years. Most TVs with electronic pushbutton
(Please turn to page 138)

VIDEO GAMES

MORE FLASH AND DAZZLE!

New cartridges really put these machines through their video paces. The video arcade is closer to home than ever.

BY NEIL SHAPIRO ELECTRONICS EDITOR

This is the age of video games. The clear, glassy playing fields and coruscating colors of imaginary foes are as familiar to today's video athletes as the dirt and grass baseball diamond was to yesterday's sandlotters.

There are so many of the most popular machines—the Atari Video Computer System, Mattel's Intellivision, Magnavox's Odyssey 2 and the new Coleco entry, Colecovision—that many companies are springing up that do nothing but design and market games on cartridges that fit one or more of these four systems. And some of these companies are getting more action out of their cartridges than the people who invented the video games themselves. Right now, the market is booming for cartridges that fit the Atari system. We took a look at some new games from companies like Activision, Parker Brothers, Data Age and Imagic that all make the Atari system a wild machine.

Star Master, from Activision, is the most strategically sophisticated of all. Pictured at right, it uses two screen views.

Atlantis, from Imagic, takes the Atari system to new heights of fast, high-resolution animation.

And the market has a new twist: Mattel will soon be supplying cartridges for Atari and Coleco systems, as well as for their own. Coleco, in turn, plans the same. (See this month's *PM Electronics Monitor* for more hints on choosing one of these systems.)

One thing is certain. If you own a video game, you ain't seen nothin' yet!

PM



Atlantis from Imagic is made for various systems. This one is the Atari version.



Star Master is Activision's combo of good arcade action and strategic planning.

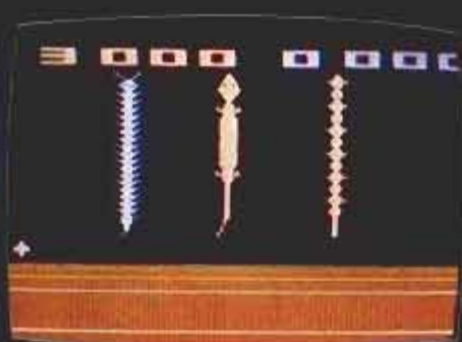
COLECO COLECOVISION



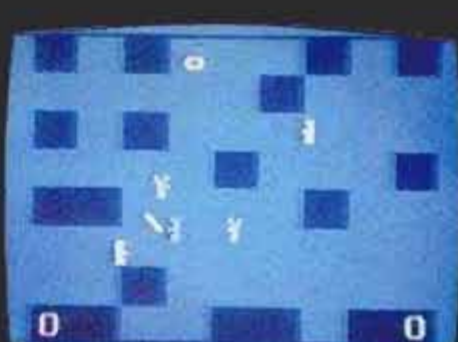
Donkey Kong from Coleco is indistinguishable from the real arcade version.



Frogger is Parker Brothers' hilarious entry into the market; it runs on the Atari.



Bugs from Data Age is fast-playing game with unusual graphics for Atari system.



Quest for the Rings from Magnavox has game board and pieces for Odyssey 2.

Odyssey 2 system from Magnavox (right) doesn't have as sophisticated graphics as others, but keyboard adds interest. The Atari VCS (below) is market leader. While graphics aren't as breathtaking as on Mattel or Coleco, many new companies supply cartridges that make it come close.

ATARI VIDEO COMPUTER SYSTEM



MAGNAVOX ODYSSEY 2



MATTEL INTELLIVISION



Colecovision (left) is a new system that features astonishing graphics that are as good as arcade. Intellivision from Mattel (above) has excellent graphics, now surpassed only by Coleco.

PM photos: Frank Lusk



Berzerk from Atari is faithful to the coin-op version. Fans of Evil Otto, rejoice!



Astromash from Mattel for Intellivision features very colorful, quick animation.



Star Strike for Intellivision is Mattel's way of letting you be a world-saver.

5 Tools To Make For Your Shop

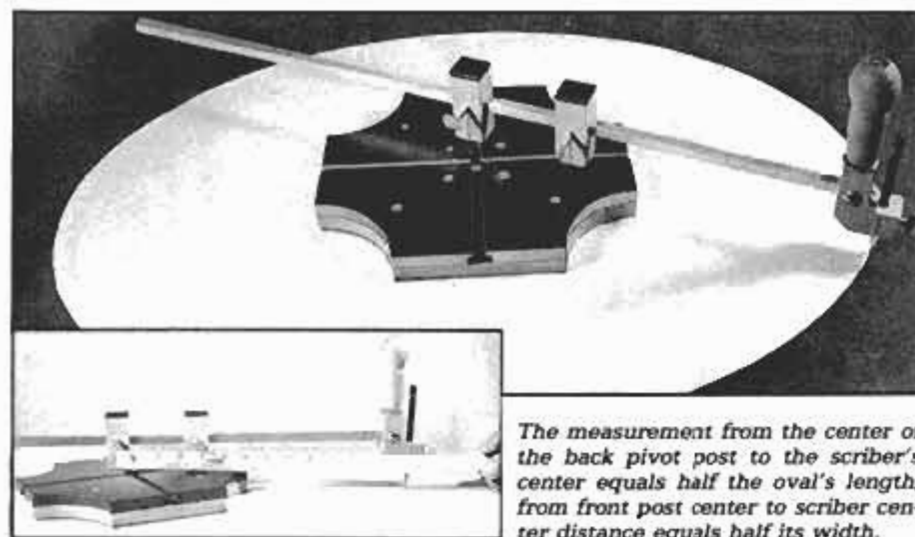
Great ideas for weekend projects from PM readers.

If you had to sum up—in a word—the appeal of working in the shop, it might well be "satisfaction." It comes from the enjoyment of making something you really want, and it beats having to settle for what you can find in a store. Satisfaction also comes from the challenge of problem-solving and pride of craftsmanship. Most workshopers will agree that while building projects for the

home is satisfying, building items for your own shop is the super trip.

Some tools let you do things you never thought you could, and dream up projects you might never have imagined. Others ease drudgery, improve accuracy, or are just plain fun to make.

Many PM readers/craftsmen like to share their tool designs with others. Here are some of their best ideas.



The measurement from the center of the back pivot post to the scriber's center equals half the oval's length; from front post center to scriber center distance equals half its width.

1 OVAL SCRIBING TRAMMEL/COMPASS

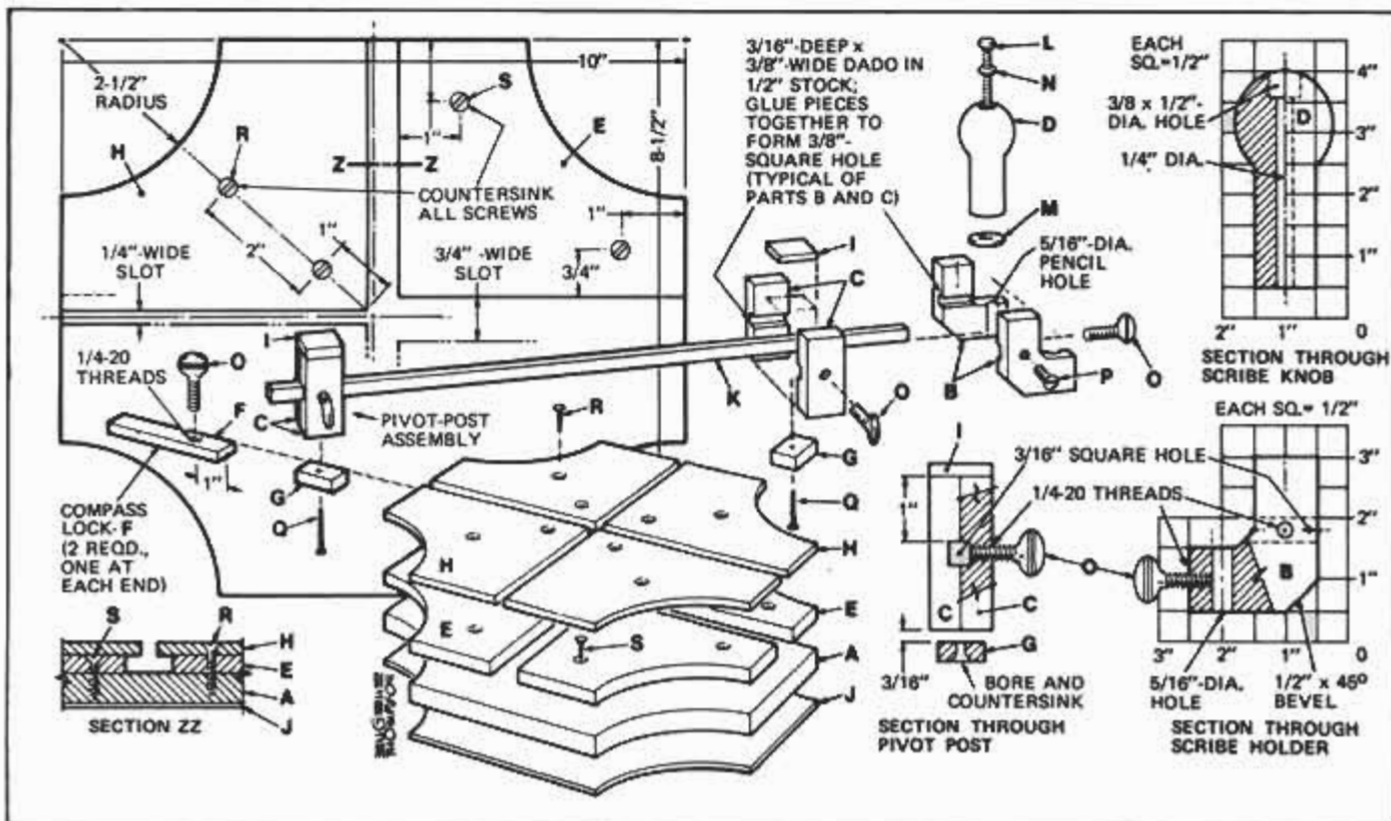
The old pencil, string and brad method for scribing circles and curves is just too inaccurate for craftsmen who want to do quality work—and drawing a symmetrical oval with that method is just about impossible. This homemade scribing trammel uses a 26-in. aluminum bar supported on sliding pivot posts to guide a pencil or scribing tool for ovals measuring up to 52 in. along the major axis. By sliding the forward post out of the way and immobilizing the rear post with the compass locks, it will scribe a circle with a diameter up to 52 in. The trammel can be used to make templates for tabletops and

(Please turn to page 131)

MATERIALS LIST—TRAMMEL

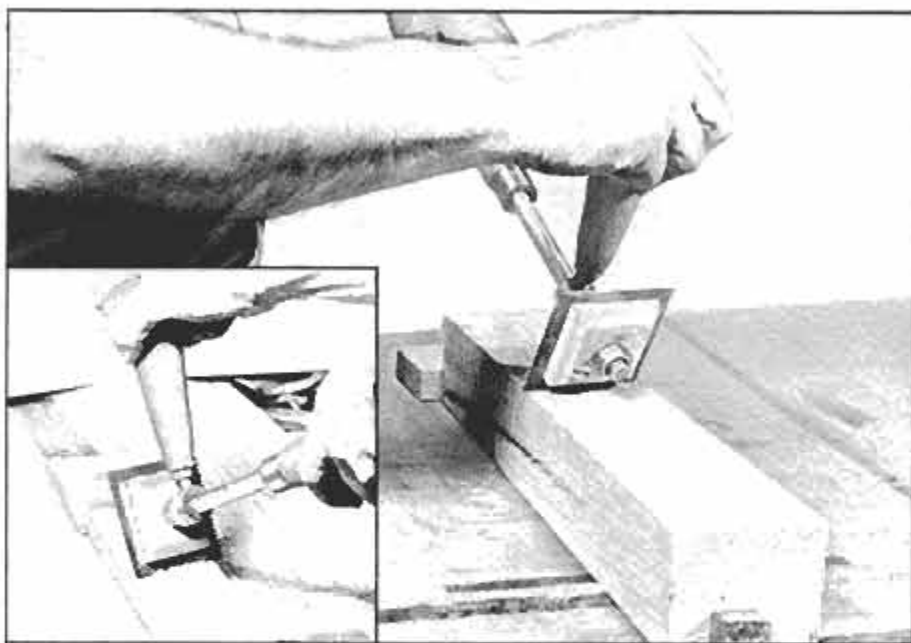
Key	No.	Size and description (use)
A	1	1/2 x 8 1/2 x 10' birch plywood (base)
B	1	1 x 2 x 2 1/2" birch (scribe holder)*
C	2	1 x 1 x 2 1/2" birch (pivot post)*
D	1	1 1/2"-dia. x 3" birch (scribe knob)
E	4	3/8 x 3/8 x 4 5/8" hardboard (groove guide)
F	2	3/8 x 3/4 x 3 5/8" hardboard (compass lock)
G	2	3/8 x 3/8 x 1 1/4" hardboard (guide slide)
H	4	3/8 x 4 1/8 x 4 7/8" hardboard (guide retainer)
I	2	3/8 x 1 x 1" hardboard (post cap)
J	1	8 1/2 x 10" rubber tread (sub-base)
K	1	3/8 x 3/8 x 24" aluminum bar
L	1	1/4"-dia. x 4" lag screw
M	1	1"-o.d. brass washer
N	1	1 1/2"-o.d. brass washer
O	5	1/4-20 x 1" thumbscrew
P	1	1/4-20 x 1/2" rh machine screw
Q	2	1 1/2" No. 10 rh wood screw
R	8	3/8" No. 10 fh wood screw
S	8	3/4" No. 10 fh wood screw

Misc.: Wood glue, cove base adhesive, 1" brads.
*Note: Part assembled from two pieces of 1/2" stock.



2 HAND SCRAPER

An old handsaw may be too worn for cutting wood, but you don't have to let such excellent steel go to waste. A 3×3-in. section of an old saw was cut with metal snips to make a blade for this scraper. It has three straight edges that reduce the frequency of sharpening and a fourth toothed edge that's great for reducing stubborn paint and varnish to tiny flakes. With the oversized knob mounted near the business end, exert great downward pressure and use the scraper with push/pull strokes. Turn the knob and loosen the carriage bolt in the shaft nut; rotate the blade to bring a fresh edge into position. The handle and knob were lathe-turned. Other parts are at hardware stores.—Robert Bessmer



You may have to tap the edge of a ring to make shaft nut that fits knob carriage bolt.

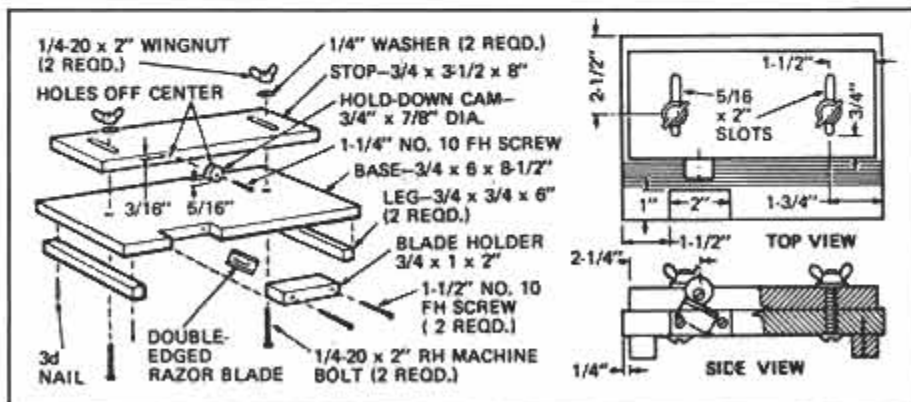
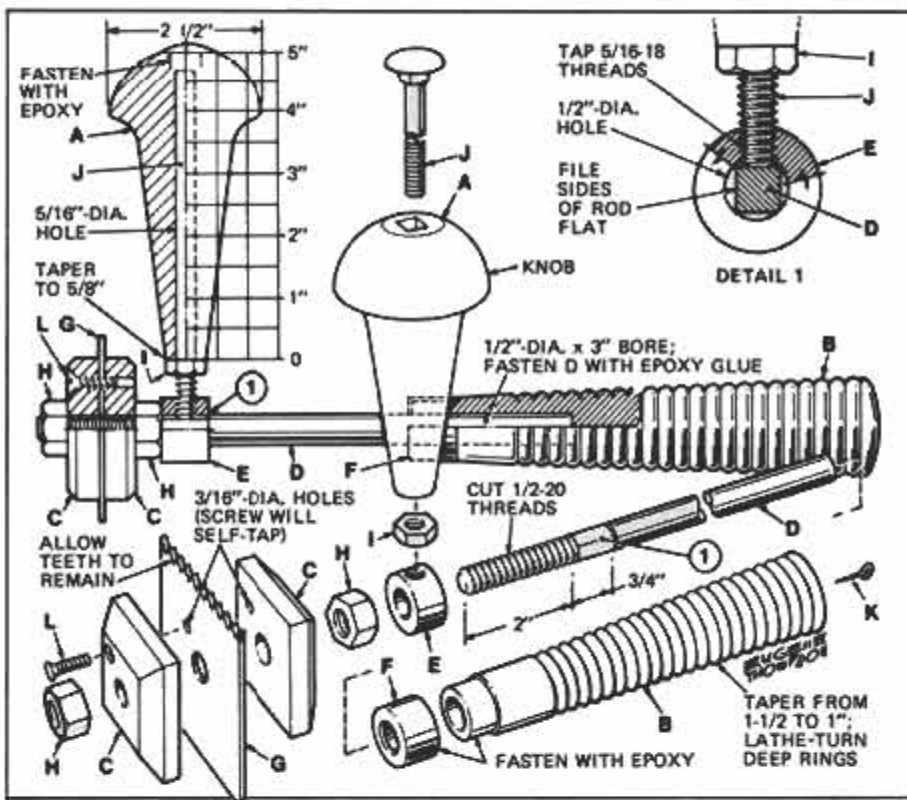
MATERIALS LIST—HAND SCRAPER

Key	No.	Size and description (use)
A	1	2½"-dia. × 5" birch/maple (knob)
B	1	1½"-dia. × 7½" birch/maple (handle)
C	2	½ × 2½ × 2½" birch/maple (blade holders)
D	1	½"-dia. × 9" steel rod
E	1	½"-i.d. × ¾ × 1"-dia. shaft nut
F	1	¾ × 1"-dia. brass pipe cap ferrule
G	1	3 × 3" piece from old handsaw (blade)
H	2	½-20 hex nut
I	1	¾-18 hex nut
J	1	¾ × 6" carriage bolt
K	1	Medium screw eye (hanger)
L	1	¼-20 × ¾" fh machine screw

Misc.: Epoxy, wood finish.



Deep, lathe-turned rings in the handle give positive grip for push/pull strokes.



3 BALSASLICER

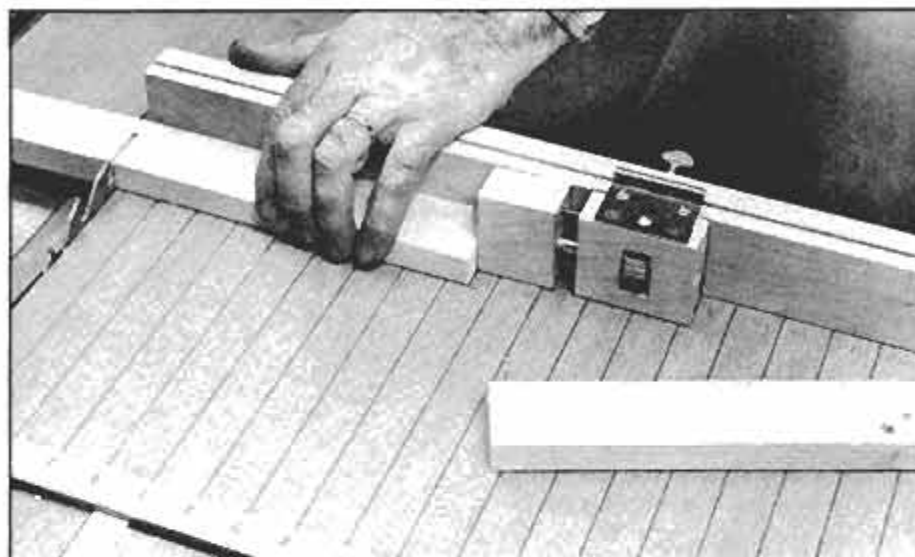
This balsa slicer, which can be made from ¼-in. pine or hardwood, is a boon to modelmakers. It's used the same way you'd use a table saw for ripping. Just set the sliding stop to the correct width, using measurement marks on the base, and lock it in place with the wingnuts. Set the hold-down cam for the balsa thickness and push the stock toward the blade.

Use a push stick to avoid injury as you complete the cut.—James O'Brien

4 MITER STOP

Crosscutting long stock on a table saw can be a clumsy operation. Since you must never use the miter gauge and rip fence simultaneously, duplicating a single length accurately is slow because each piece must be marked and lined up carefully with the saw blade.

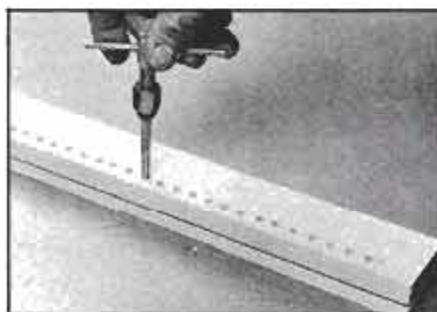
This homemade miter stop overcomes these problems and offers other benefits, as well. Since the base moves, there is no drag on the piece being sawed. The stop block enables you to make a single setting to repeat same-length cuts. It is hinged to flip conveniently out of the way, so you can trim a rough end square and then replace the stop block without needing to reset it. Large marks on the base indicating inches make it possible to cut approximate lengths quickly so they'll fit conve-



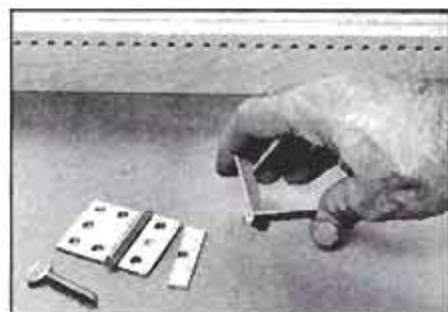
The stop block on this tool adjusts precisely for repeated crosscuts on a table saw. The hinge mount slides in a groove and locks securely in place with a thumbscrew.



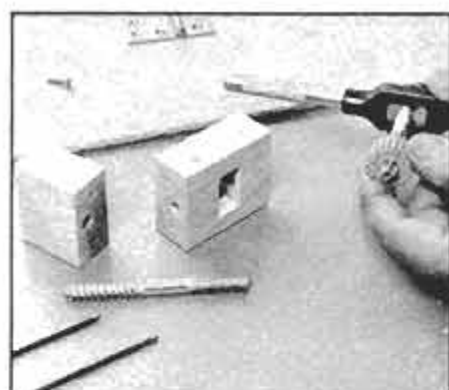
Swing the stop block up to square a ragged end without changing the setting.



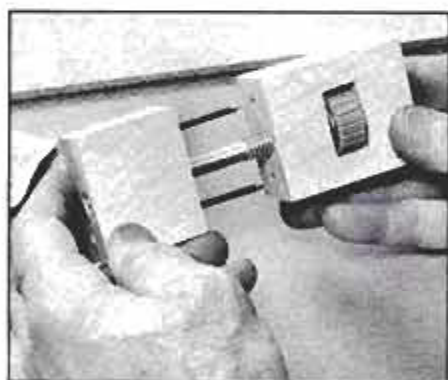
Bore holes in back stop $\frac{1}{4}$ in. deep with a No. 7 bit. Thread with a $\frac{1}{4}$ -20 tap.



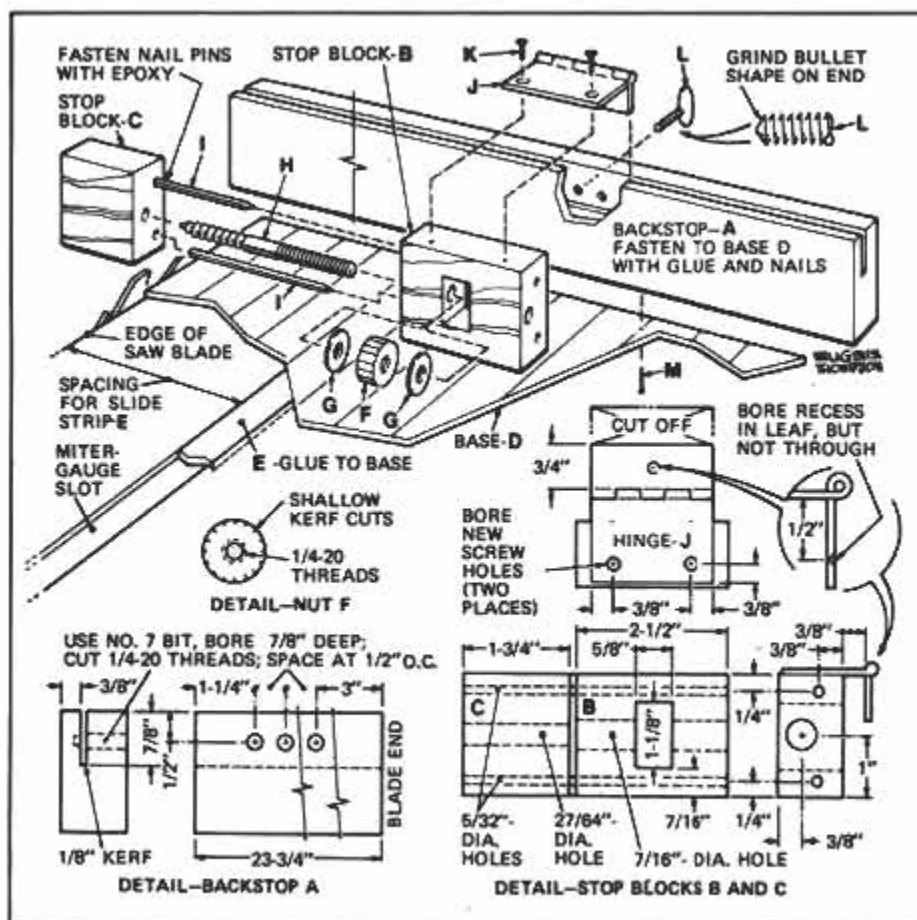
After cutting off half of one leaf, squeeze the hinge back gently to open it to 90° .



Use a $\frac{3}{8}$ -in tap to thread the hole in the dowel that serves as an adjusting nut.



Assemble stop block after epoxying pins and hanger bolt into smaller block.



niently between the stop and blade for finish cuts. Marks indicating fractions of inches on the back stop allow you to position the stop precisely without using a ruler. Since the back stop supports the stock up to the saw kerf, cuts are cleaner.

Cut a piece of $\frac{3}{4}$ " hardwood for size for the back stop, then cut a kerf into the top edge as indicated in the plan. Bore a series of blind holes in the back face, as shown. These holes need to be threaded only up to the kerf, but extra depth gives clearance for tapered lead end of tap.

MATERIALS LIST—MITER STOP

Key	No.	Size and description (use)
A	1	$1\frac{1}{2}$ " x 2 " x $23\frac{1}{4}$ " hardwood (back stop)
B	1	$1\frac{1}{2}$ " x 2 " x $2\frac{1}{2}$ " hardwood (stop block part)
C	1	$1\frac{1}{2}$ " x $1\frac{3}{4}$ " x 2 " hardwood (stop block part)
D	1	$\frac{3}{4}$ " x 11 " x $23\frac{3}{4}$ " lauan plywood (base)
E	1	18 " hardwood, thickness, width to suit (slide)

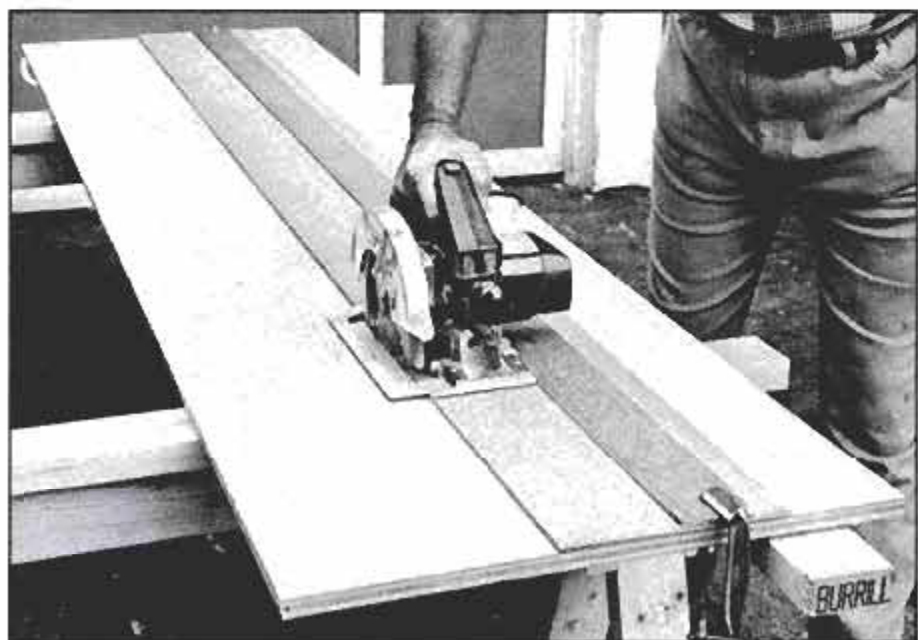
F	1	1 "-dia. x $\frac{7}{16}$ " dowel (nut)
G	2	$\frac{7}{16}$ "-i.d. x $\frac{1}{8}$ "-dia. washer
H	1	$\frac{3}{8}$ " x 4 " hanger bolt
I	2	3 " common nail with head cut off (guide pin)
J	1	Brainerd No. 8200XC 2 x $3\frac{1}{2}$ " hinge
K	2	$\frac{3}{4}$ " No. 8 fh screw
L	1	$\frac{1}{4}$ "-20 x $1\frac{1}{2}$ " thumbscrew
M		$\frac{3}{4}$ " box nails

Misc. Epoxy, wood glue, masking tape.

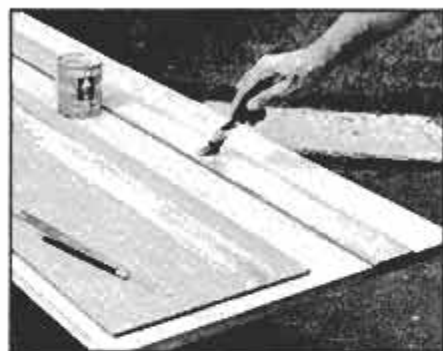
Glue and nail the backstop to a piece of $\frac{1}{4}$ "-plywood. Use your regular miter gauge set to 90° to trim the end of the

assembly true. Cut a hardwood strip to size for a slip fit in the saw table's miter-

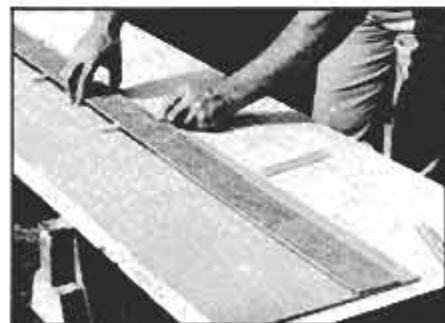
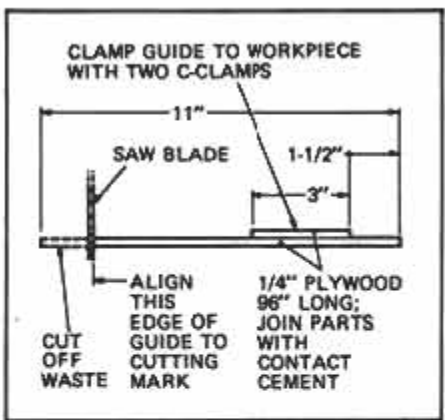
(Please turn to page 131)



The edge of this saw guide falls exactly at the blade kerf to save you from measuring twice—once for your cutting mark and again for the position of the straightedge.



Spread contact cement on bottom of 3-in. guide strip and $1\frac{1}{2}$ " in. from base edge.



Keep the glued faces apart with blocks. Remove one at a time to position strip.



Guide saw against 3-in. strip to trim the base and set guide exactly for your saw.

5 SAW GUIDE

This straightedge guide for a portable saw is really worthwhile. It eliminates the nuisance of back-setting the typical straightedge guide to allow for the distance between the blade and the edge of the base plate. But more than that, using it properly will guarantee straight cuts precisely on the cutting mark. The guide also helps to minimize surface chipping on crosscuts because the edge bears down on the kerf line.

The guide is constructed from lauan plywood to minimize cost. Start with a panel 14 x 96 -in. Cut off a 3 -in. strip from the long side of the panel. Glue it to the remaining piece with contact cement, $1\frac{1}{2}$ " in. from the edge. This creates a clamping ledge in the event that the saw's motor housing is too low to clear the clamps when they're positioned on the 3 -in. strip.

Place the left side of the saw shoe against the edge of the 3 -in. strip and use it for a guide as you trim off the stock to the right of the blade. This will tailor the guide base to your particular saw.

To use the guide, place the newly cut edge on your workpiece aligned with the cutting marks and secure it with two C-clamps.

If a workpiece is too narrow to hold with clamps, use a scrap of wood the same thickness as the work and drive several small finishing nails through the guide base and into the work. Allow the saw blade to reach full speed before starting your cut and guide the shoe on the edge of the 3 -in. raised strip.

One point to consider: The guide will be effective only with a blade of the same thickness as the one you used to make the guide.

If you change to a thinner blade, aligning the guide edge with cutting marks on the workpiece will result in a cut outside the marks. A thicker blade will cut into the guide and produce a cut inside the marks.

For smaller jobs, you may wish to make a second guide. A 4 -ft. model of similar design will come in handy.—Kenichi Sakumoto and F.H. Loudon



A Master Craftsman's

Five great jigs designed by a framing expert that you can make and use in your shop.

BY ADOLPH J. MAIER JR.

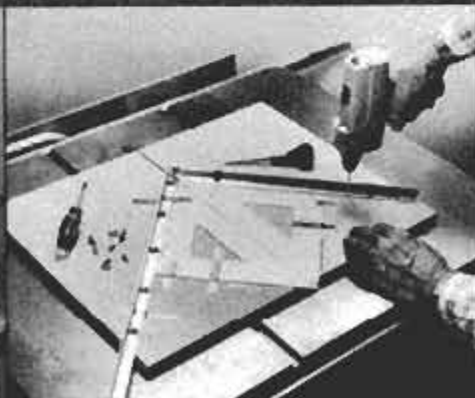
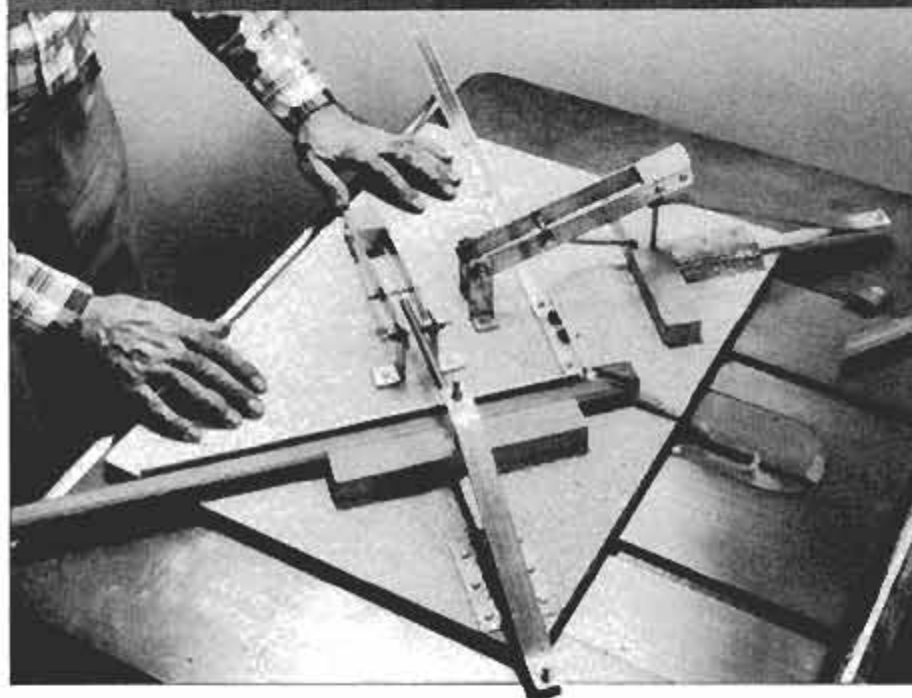
When I began making frames for the prints and photographs collected over the years, I used very few tools: a 10-in. table saw, a 4-

in. jointer, a shaper with about 30 cutters, a vacuum cleaner and some small accessories. Gradually, I designed and built additional

items to do the job faster and more accurately. Following are useful aids that have evolved as my work has progressed.

PM photos, prototype construction: Rosario Capotosto

MITER JIG HELPS MAKE PERFECT JOINTS



The miter jig (left) aids in mitering frame molding accurately. The jig's spring clamp applies tension to the sliding holding block to secure molding for the cut. To position the jig's aluminum angle guides (above), abut the long edges of two accurate 45°/90° triangles over the base centerline. Tape them firmly in place; then tape guides as shown. For clarity, the blade guard is removed in the photos.

The first item that I built was a miter jig. This aid ensures that frame members are mitered accurately on a table saw, so they will come together in a perfect joint. The jig consists of a base, two aluminum angle guides carefully positioned at 45° angles from the saw blade, and two clamping mechanisms that hold the molding being cut against the aluminum angles. This method of securing the molding as it passes through the saw blade eliminates stock drift and ensures its receiving an accurate 45° miter cut.

Each of the identical clamping mechanisms for the aluminum angle guides consists of a clamping block that applies even pressure to hold the molding against the aluminum angle, a spring tension clamp which works with a lever action to apply tension on the clamping block, and a clamp slide on which one end of a spring from the spring tension clamp is fastened.

To build the miter jig, first cut the ½-in. plywood or particleboard base. Two

guides of flat bar stock or hardwood, which are attached to the base, should fit snugly in the miter gauge grooves of the table saw. They should slide without binding.

Before locating the aluminum angle guides, make a 5-in. saw cut centered on the base. Then turn off the saw. With a carpenter's square placed flat against the blade but not in line with the (set) teeth, use a sharp, 4H pencil to draw a line from the end of the cut to the back of the base. Butt the long edges of two 45°/90° triangles over the centerline (see photo) and tape them firmly in place. Then, tape the aluminum angle against the short edges of the triangles. Bore pilot holes and fasten the angles in place with screws.

Use metal shears to cut out the 26-ga. steel slide hold; a hacksaw will cut ⅛-in. bar stock for the clamp slide and spring tension clamp. Cut the wood parts.

You can bend the slide hold to shape with it clamped between two hardwood blocks (of the same size) held in a machin-

ist's vise. One ¼ × 4 × 5-in. block should have a ¼ × 1½-in.-wide center groove. On the second block, center and temporarily tape in place the ¼ × ¾-in. flat stock used in the clamp slide.

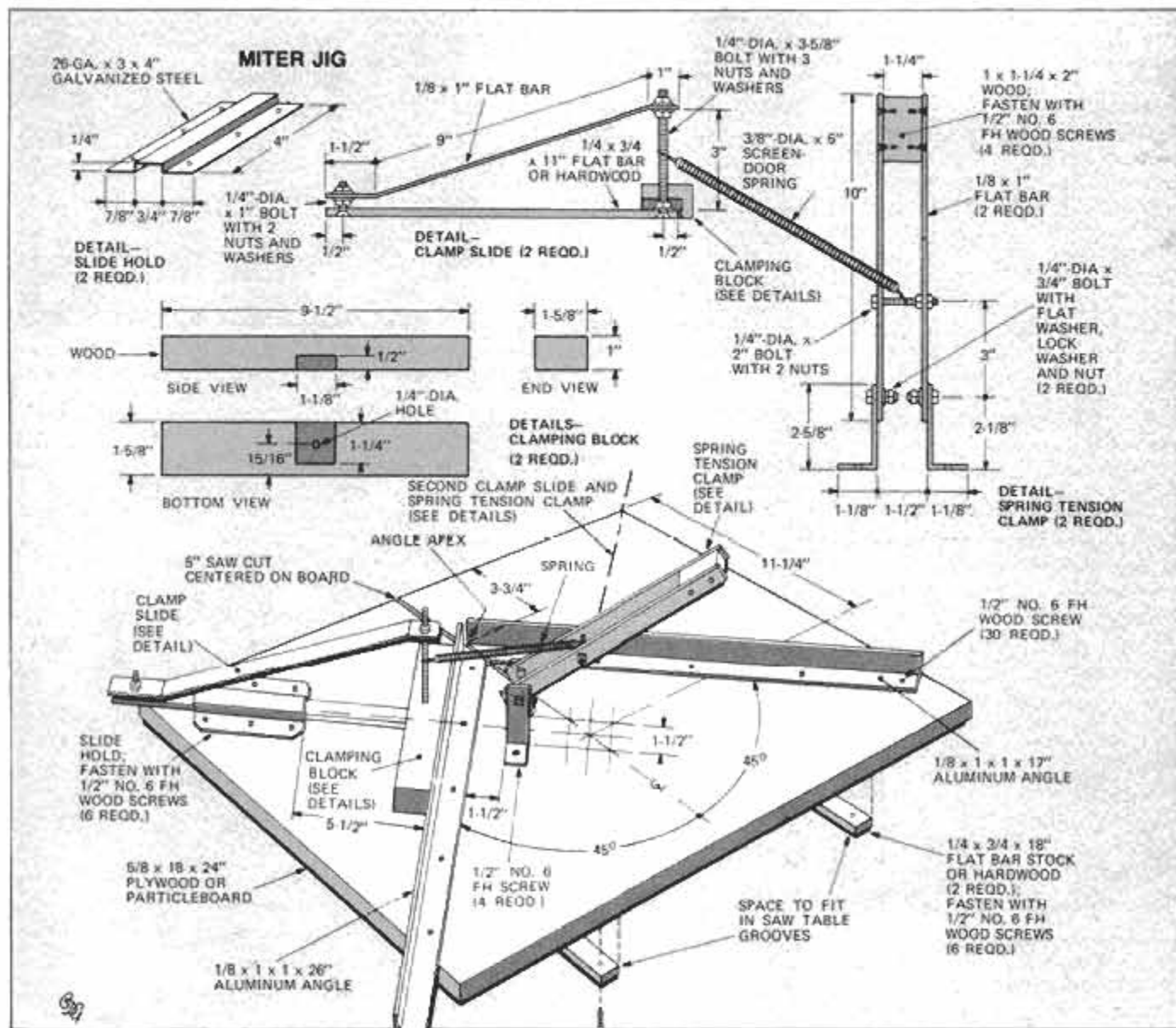
Bend the angles that hold the spring tension clamp to the base by clamping the stock vertically in the vise—shorter leg of the angle in the vise—up to the bend point. Apply pressure with a wood block to make the bend.

Assemble the spring tension clamps as well as the clamp slides and wood blocks. Locate the components on the jig base. Secure the clamp slide with the slide hold. Secure the spring tension clamp. Install the screen door spring.

To cut moldings, I have found it best to cut the frame molding to approximate length before making the miter cuts.

I make the first miter cut on the right (short aluminum angle) side. I measure and make the second cut on the left side. This longer angle lets me clamp a stop for cutting duplicate lengths on it.

Picture Framing Secrets



Making Frames From Scrap Molding

You can easily turn salvaged molding remnants into useful picture frames.

Simply cut a rabbet along the length of one edge, and you have picture frame molding that's ready to be cut to length. Most of the time, you'll want to rabbet the thicker portion of the molding, so the frame tapers outward (see top drawing at right).

In situations where you want to position the thicker portion of the molding outward, and the other edge isn't thick enough for a rabbet, you can form a rabbet by gluing to the back of the molding a 1/4-in.-thick strip of matching wood, set back 1/4 in. from the inside edge (see bottom drawing). The outer edge of this strip can be either flush with the molding or project

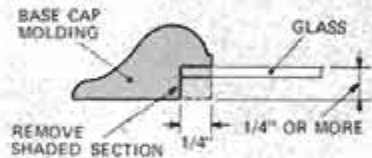


Photo framed with base molding shows rabbet being cut on circular saw. Final feeding is done with pusher stick.

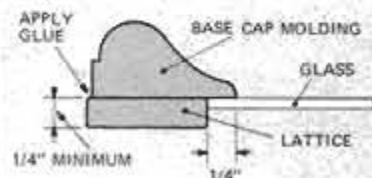
beyond it if you want to add an extra dimension.

Even purchasing new molding of suitable size and shape and converting it to picture molding will help to reduce frame cost.—Walter E. Burton

SECTION VIEWS



THINNER MOLDING EDGE OUTWARD



THINNER MOLDING EDGE INWARD

RIP GUIDE AIDS CUTTING

This guide lets you rip several pieces of stock to exactly the same width on a table saw. Molding from one piece can be used with molding that is made from another.

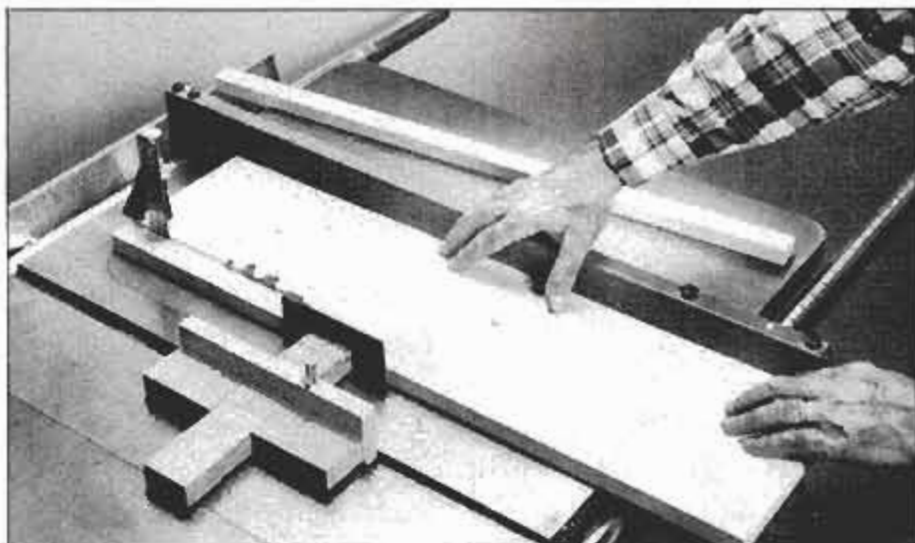
The guide is made of a wood block that fits snugly into the miter-gauge groove; a movable, dimensioned crosspiece with a guide pad of plastic-laminate-faced hardboard abuts the work, while hardwood blocks on both sides of the crosspiece guide it.

You can set the crosspiece to the width of the molding desired and lock it in place by tightening the wingnut. After securing the guide from the bottom with a steel bar, carefully apply an epoxy adhesive fillet to the wingnut's bolt to lock it.

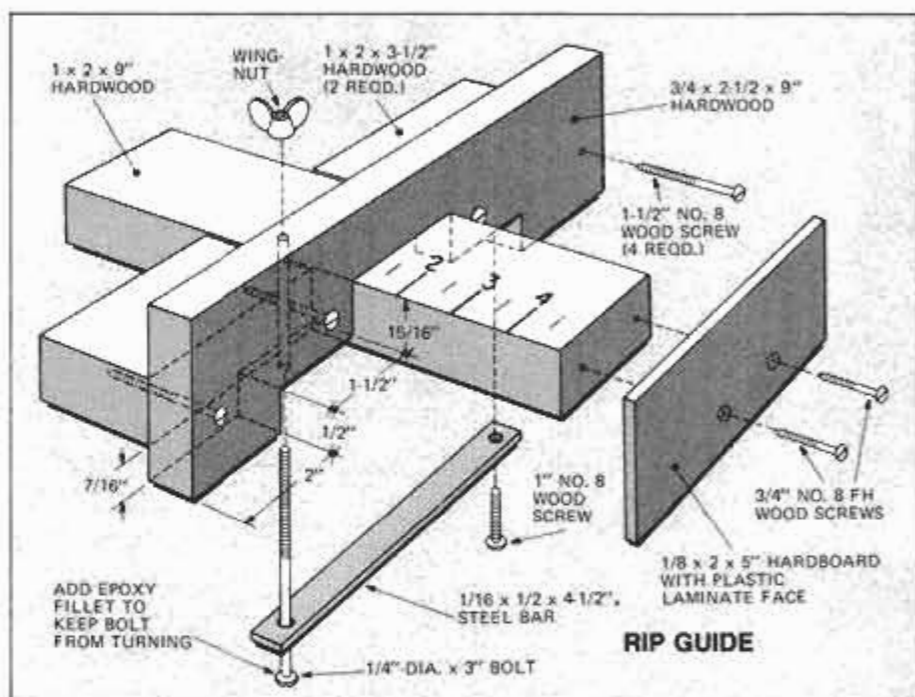
To make a cut, place the side of the board against the guide pad. Then move the fence firmly against the other side of the board. Back the fence away very slightly with the micro adjusting knob, so the board moves freely, and lock the fence in place. When the cut is complete, move the fence away and repeat the operation.



The standard method of ripping multiple pieces to the same width requires a push stick and antikickback-finger device.



Set the rip guide to produce a molding of the desired width. Adjust the rip fence so the work butts against the laminated guide pad, yet still is able to move freely.



SHAPER HOLD-DOWNS INCREASE SAFETY



Using spring tension, the hold-down and hold-in secure a frame strip in place for safe cutting on a shaper.

This hold-down and hold-in on rubber casters keep wood strips in place while they're being cut on the shaper. The hold-in rests flat on the shaper table and is held in place with clamps. Attach the hold-down to two 4x4-in. slotted angles with bolts and wingnuts. In turn, fasten the angles to the shaper fence with the bolts that came with the tool; or use 1-in.-long screws. On some models, you may have to add washers on these fasteners to raise the hold-down so it clears the shaper fence.

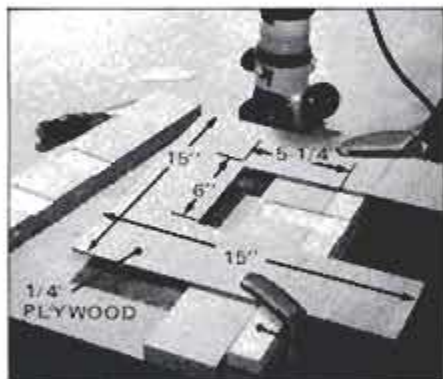
The slots in the brackets of the hold-down let you adjust it horizontally or vertically. To raise the hold-in, add a shim under it.

The holders are blocks of hardwood with rubber caster wheels. The wheels

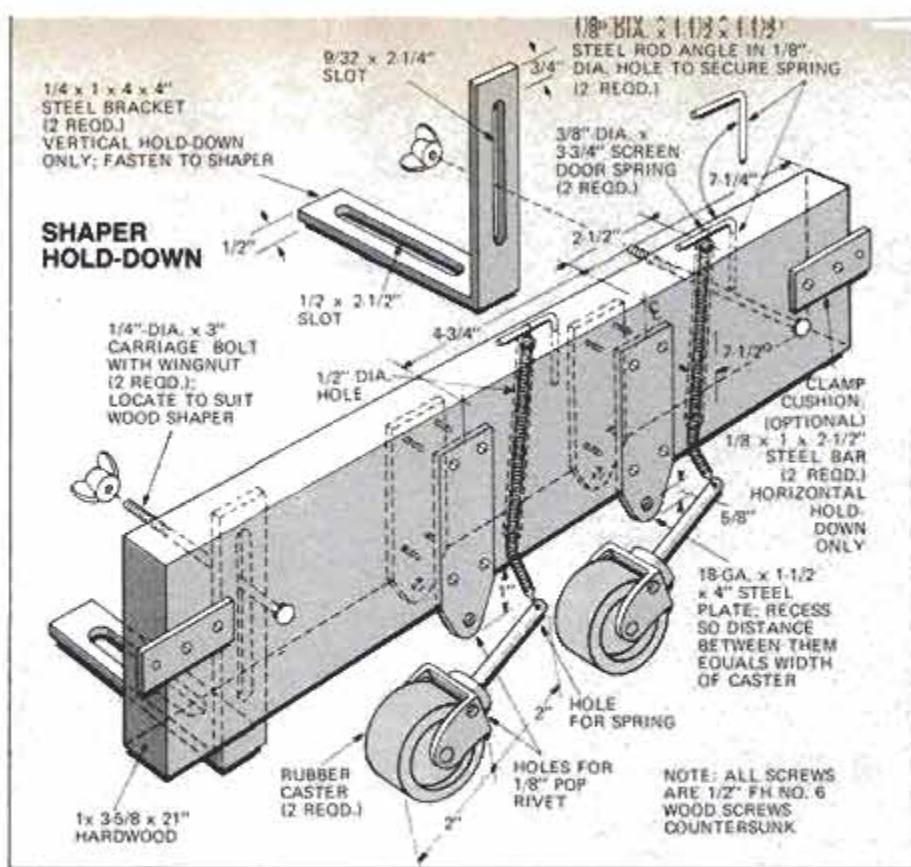
are cold-riveted to steel plates which are mortised into the wood block. A simple template (see photo, page 101) guides the router in cutting these mortises. A spring installed in the block at a 7½° angle and attached to the casters causes them to press against the work as it passes through the shaper. After you have bored holes for the springs, a straightened paper clip with a small hook shaped at one end can grasp the spring and guide it in place through the hole. The free end of the spring is secured by a steel angle installed in the wood block.

To use the holders, position them so the wood strip being cut stretches the springs about ½ in. Push the work past the cutter, using a push stick. When the end of the strip arrives at the rubber wheels, move

to the opposite side of the shaper and pull the strip completely through, exerting pressure in the direction of the fence to keep the strip from moving away and distorting the cut. Usually, the last few inches are distorted a bit. Allow for this by working with slightly overlength pieces and planning to cut them off when you make miter cuts.



Plywood jig guides router with 5-in.-dia. base and 1/2-in.-dia. mortise cutter as it plows mortises for caster plates. Alter jig dimensions to suit router shoe.



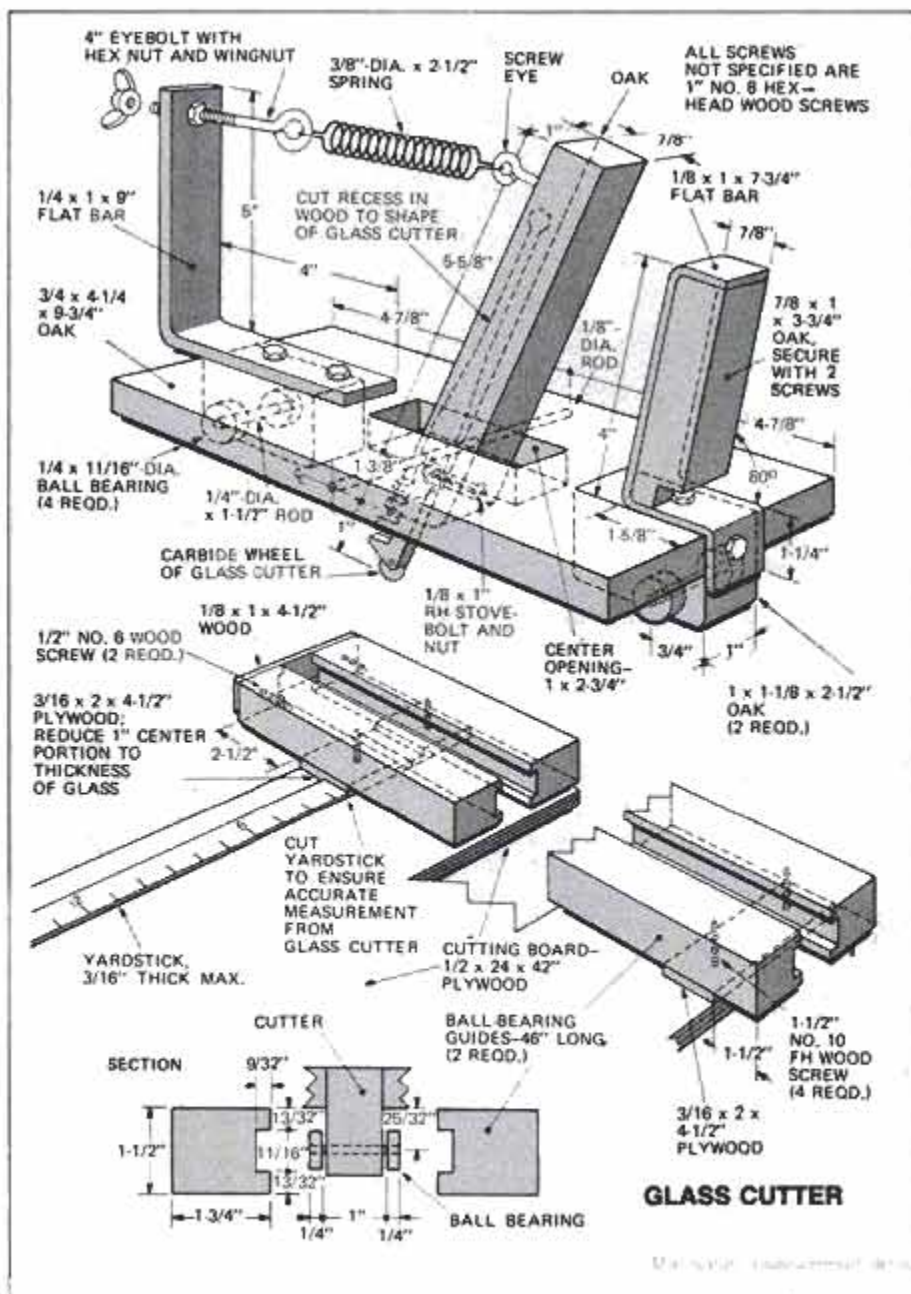
FASTER GLASS CUTTING

This glass cutting setup rivals the commercial rigs on the market. The cutter runs in a guide channel that is attached to a plywood cutting board. The guide channel lets you make a clean stroke with the cutter.

The base of the cutter is an oak block with a 1 x 2 3/4-in. center opening. The cutter rides on two pairs of ball bearings, each pair located on an axle installed in an axle block. The ball bearings I used were taken from old hand tools, such as screw guns and drills. The tool handle is made of flat bar stock bent in a metalworking vise and fastened over the rear axle block; an oak grip secured with contact cement then fits within the handle.

An angle secured over the front axle block contains an eyebolt and wingnut. The eyebolt is connected to the center by [\(Please turn to page 132\)](#)

Place glass on the cutting board and under guide channel. Cutter is moved from top to bottom in one clean stroke.



Create Your Own Circus Music

Bring back those nostalgic sounds with a mini-calliope built of at-hand materials.

BY GEORGE CAMPBELL

If the haunting sounds of the circus bring back happy childhood memories, or if you have a budding musician in the family, a miniature calliope could be the perfect shop project for you. This little pipe organ, made from readily available materials, whistles with air from hair dryers built into the cabinet.

Although the project seems complicated, many of the components are identical, so laying out and cutting parts isn't as time-consuming as you might expect. Building the calliope should take about 40 hours.

To begin, cut the cabinet and wind-chest compo-

nents—parts A through Q, T and U (see the materials list at the end of this story). Bore pilot holes for all screws connecting the cabinet parts with a No. 6 bit. Counterbore all pilot holes with a $\frac{1}{8}$ -in. bit to receive the plugs (V). Then lay out and bore guide holes in the keyboard base (E) and the rocker support (I).

A drill press or drill guide for your portable drill is a must for accuracy. Clamp together the top and bottom pieces of the wind chest (parts L and N) and bore them simultaneously so the holes will align. Use a depth stop to prevent boring through the bottom board. If you don't have a radial drill press or one with an adjustable table, bore the angled holes in the rocker support by using shims under the workpiece to establish the correct 5° angle.

Make a trial assembly of the chest. Once everything fits properly, sand and finish the cabinet and the screw hole plugs (V). I applied mahogany stain and finished the piece with varnish. When dry, remove wind chest, keyboard back (G), music rack (J), rocker support (I) and its cover (K).

Next, prepare the keyboard. Rip $\frac{1}{8}$ -in. strips from the type wood used for the

(Please turn to page 104)



When you depress calliope keys, air from internal blowers rushes into the pipes, producing tones that sound like an orchestra of flutes and whistles.

Now and them.



Competitive brand tar levels reflect the lower of either FTC method or Dec. '81 FTC Report.

SOFT PACK 100's FILTER, MENTHOL: 2 mg. "tar"; 0.2 mg. nicotine av. per cigarette by FTC method.

CONFIRMED
BY LATEST
U.S. GOVT.
REPORT ON TAR

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

NOW The Lowest

The lowest in tar of all brands.

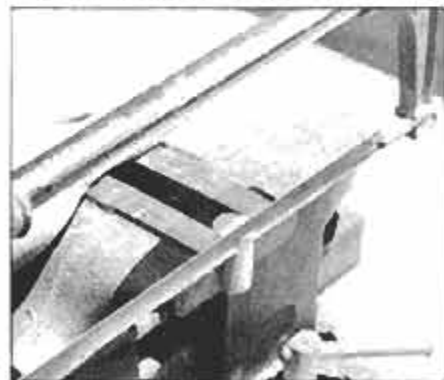
CREATE CIRCUS MUSIC

(Continued from page 102)

cabinet. Cut white keys (parts X₁, X₂, X₃ and X₄). Cut the black keys (Y) from 1/2-in. molding stock. Bore pivot holes as accurately as possible through the sides of the keys. Then bore 1/4-in. holes on the undersides of the keys for the guide pins (Z). Bore a 3/16-in. dimple at the back of each key.

Sand all the keys smooth, removing a total of about 1/32 in. from the width of each key to ensure proper clearance between them when they're in place. Install the guide pins and apply several coats of spray paint to the keys.

When the keys have dried, insert



Cut no more than 1/8 in. from the dowels used for flue stoppers. The flat plane forces air out through the sound hole.



If you don't have a band saw, use a table-mounted saber saw to cut keys. Good keyboard action requires accuracy.



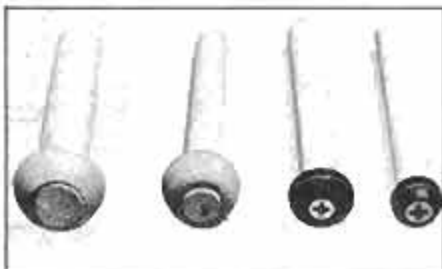
With the keyboard on the pivot rod and the wind chest and blowers in place, the keyboard must be leveled with adjustments to the guide holes.



When you cut the sound holes, try to cut slightly inside the layout marks, then file to create perfectly sized apertures.

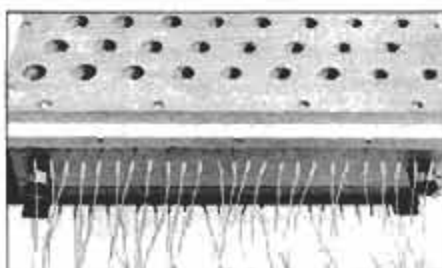


Round holes bored near the bottom of each pipe let air enter when keys are depressed. The 3/16-in. holes may have to be enlarged if pipe tones are weak.



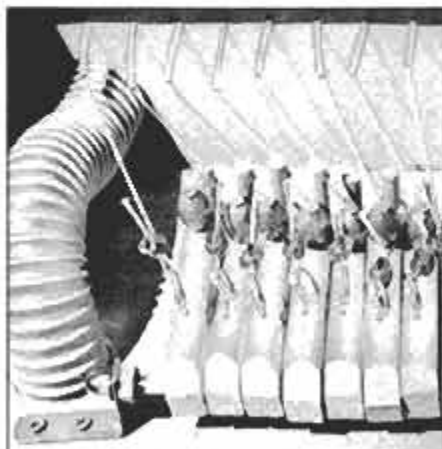
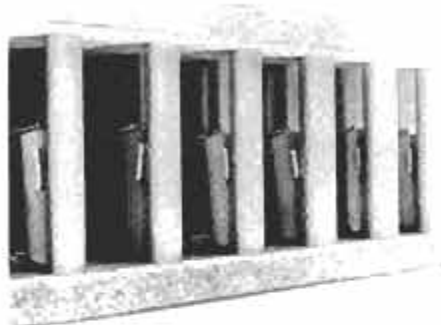
The flue plug, flue stopper and cork above are shown outside the pipe, parallel to correct positions within the tube.

The flue plugs at the left are used to tune the pipes. Four different sizes are needed to fit the varying pipe diameters.



With the pipes inserted, the air-release assemblies are shown (below) with the felt pads in place over air holes.

Assembled wind chest is shown above with the lines for air-release assemblies threaded through nylon tubing guides.



Rig the lines from the air-release assemblies to the rockers, using crimped split shots to maintain correct tension.

them through the keyboard back in order. Insert the pivot rod (BB) through the holes in the sides of the keys, slipping a felt washer onto the rod between each pair of keys. Between keys 12 and 13 (notes B and C), insert the center pivot support (CC). Attach the two end supports (DD2) and secure the assembly with the pivot rod nuts.

Attach a length of foam weatherstripping (EE) to the keyboard base and install the keyboard. Check that all keys move freely and make adjustments to the elongated guide holes where needed.

After the keyboard is set, install the two blowers (WW) in the cabinet. The General Electric hair dryers used in this

project are a common item in second-hand stores, but if you can't find that type, similar units or commercial blowers will work. Make sure the blowers you use are quiet.

Disconnect and remove the heating elements from the hairdryers. Hook up wiring through the switch (YY, see wiring diagram, page 114). Bring power cord wire through the $\frac{3}{16}$ -in. hole in the panel (B). Knot the wire on the inside of the hole to prevent strain on the con-

nections. Use solderless connectors on all twist connections and cover them with electrical tape for extra safety.

The rocker assembly

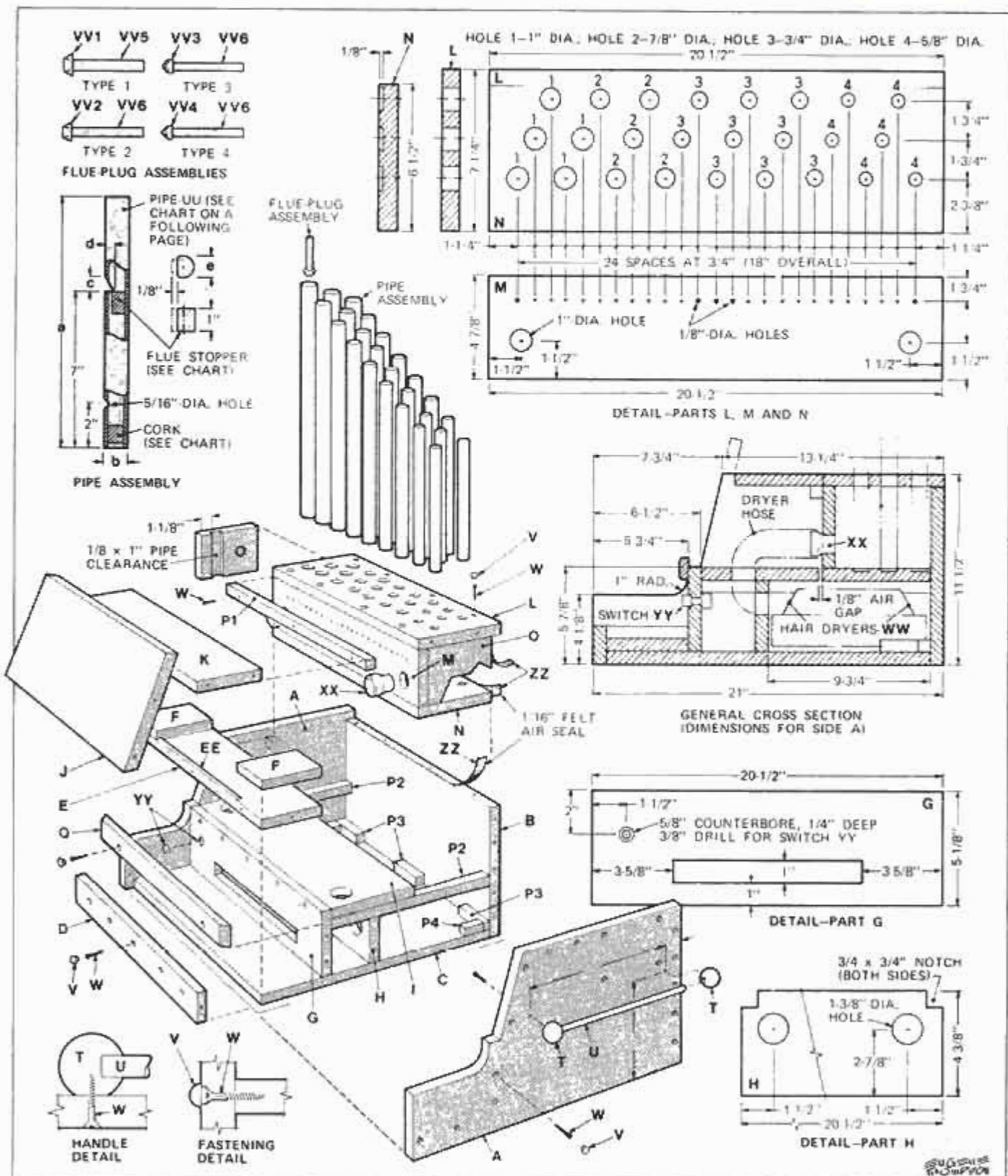
Next, begin work on the rockers. Cut the rockers (S) from $\frac{1}{2} \times \frac{7}{8}$ -in. molding. It's faster to bore pivot-rod holes and dimples before you cut the individual pieces. Sand the sides of the rockers smooth, then add the screw hooks (HH) and counterweights (II). Insert the piv-

ot rod (BB) through the rockers and attach the support brackets (DD1).

Cut the push rods (AA) and install the rocker support (I) in the cabinet, threading the air hoses through the $1\frac{3}{8}$ -in. holes. Attach the height adjuster assembly (R), then insert the push rods making sure they seat in the keys' dimples.

Mount the rocker assembly on the support (I). Adjust the height of the

(Please turn to page 107)



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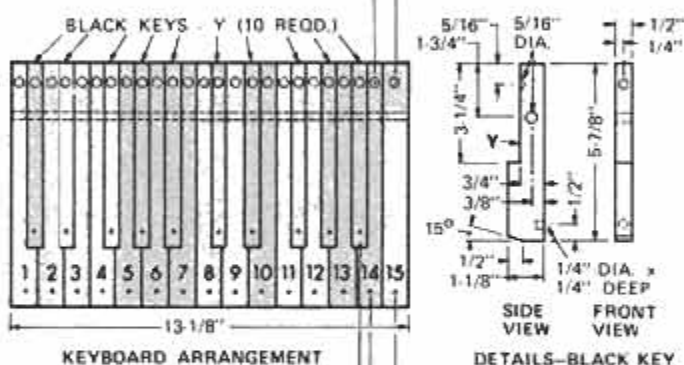
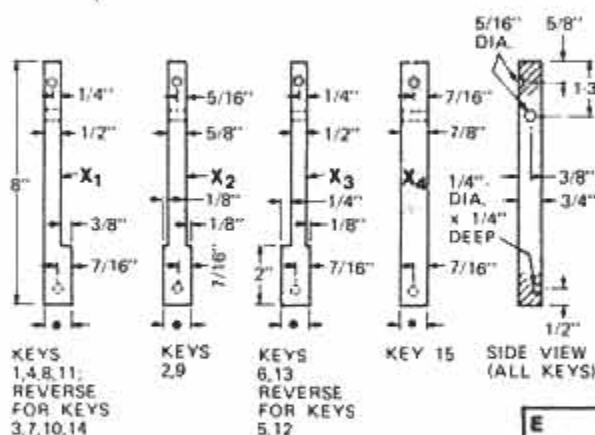
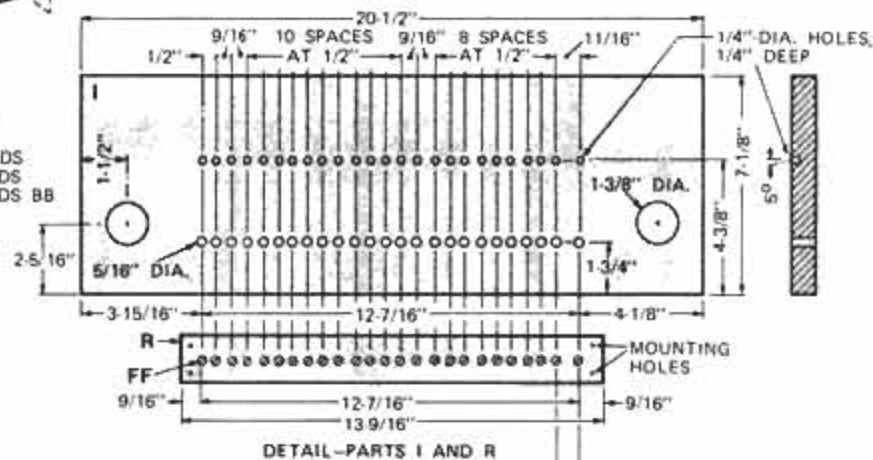
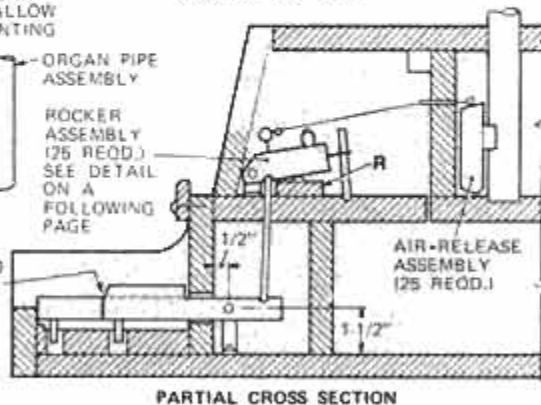
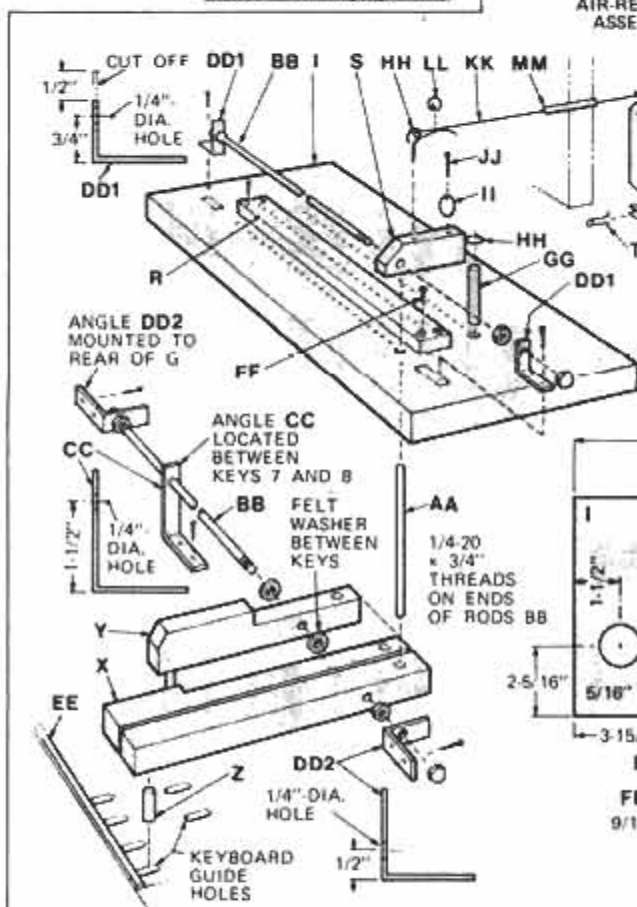
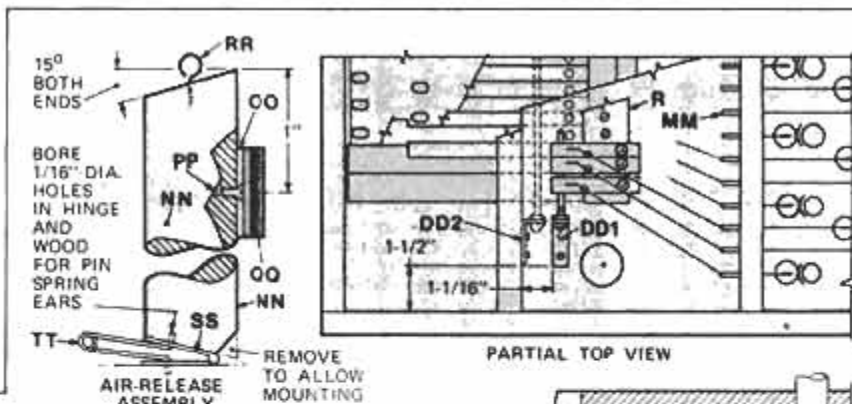
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CAROL



keys individually by screws (FF) to level the keyboard in the "up" position. You may have to alter the lengths of some of the push rods, as well. When the keyboard is level, the rockers should rest at approximately 15° from the horizontal plane. Finally, install the angled guide pins (GG). Establish the proper clearance by screwing the hooks (HH) in or out as needed. Check to see that the rockers are moving freely.

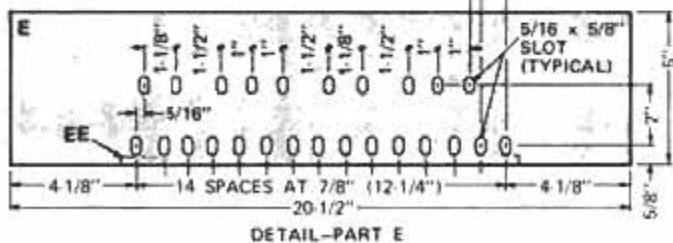
The next phase is forming the pipes:
(Please turn to page 114)



*CUT ALL KEYS 7/8\"/>

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SEE WIRING DIAGRAM ON A FOLLOWING PAGE



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TURBOCHARGING

(Continued from page 75)

erances and lubrication. The shapes of turbine and compressor wheels, and their spiral housings, are critical, for it is within these housings that the gases must do their work.

In designing an automotive turbo system, the compressor is selected to supply the desired quantity of air for the engine, considering displacement, operating speed and maximum power required. Then a turbine size and shape are matched to drive the compressor at the desired speed.

A delicate balance

The turbine should be large enough to provide enough boost at high revs to gain power, but also small enough so that the gases within will accelerate the turbine wheel quickly to provide good response; too slow a response is the traditional sore point of turbos. It's called boost lag, and it refers to the time between the instant the pedal goes down and the point where there's sufficient boost to deliver all that wonderful acceleration.

What is needed, obviously, is turbine acceleration at lower engine speeds without overboosting on the upper end. The most basic form of boost control is a simple pop-off valve in the intake which will open under pressure and release the excess to the outside. But a pop-off works only with a blowthrough carburetor, fuel injection downstream of the turbo, or a diesel. Otherwise, it also releases raw fuel into the atmosphere.

Another form of intake line valve is a restrictor operated by boost pressure. As boost increases, it closes off the intake and limits pressure reaching the engine.

Current technology on boost controls centers on wastegates. A wastegate is a valve located in the exhaust stream between the engine and the turbine. Held normally closed by a spring, it opens by a diaphragm working off either intake or exhaust manifold pressure. As the pressure reaches its selected level, the wastegate opens, thus diverting exhaust gas directly downstream and bypassing the turbine altogether. The turbine maintains speed and boost stays within a predetermined limit.

Some wastegates are separate devices mounted in the exhaust line; others are integral, built into the turbo itself. Some are operated by intake-manifold pressure, some by exhaust. Intake-pressure operation allows the wastegate diaphragm to stay cooler. But there seem to be some performance benefits from using exhaust-manifold pressure. Some wastegates are adjust-

able with a screw-operated preload on the spring that closes the valve. The more preload, the more boost stays in, the more horsepower. And the more chance of overboosting and blowing the engine. Appropriately, these adjustments have long been known as horsepower screws. Generally, separate wastegates are preferred for racing where adjustability and ease of servicing are important, while production turbo installations are tending increasingly toward integral wastegates for improved packaging, lower cost and easier assembly.

Even sophisticated wastegates are still just a part of the whole package. Ideally, a turbo should run at full speed all the time just so maximum boost is available when needed. But closing the throttle shuts off the intake side, loading the compressor and slowing the turbo. It must then be accelerated again, as with each gear shift. Some race cars have been designed with valves in the intake manifold that open when the throttle is closed, venting pressure to the atmosphere and allowing the turbo to maintain speed. But that's hardly acceptable for a street car. A superior solution is to divert pressurized air from the outlet to the inlet side of the compressor during closed throttle, thus recirculating the air and relieving the load against the compressor.

Power vs. response

The trade-off between maximum boost for high power and a higher compression ratio for good throttle response has been at the center of many turbocharger development problems. Since any supercharged engine must accept higher than normal combustion pressures, its compression ratio must, of necessity, be lower than that for a normally aspirated engine. But that hurts response, where turbos are already weak. As an example, the original Porsche 930 Turbo had a 6.5 to 1 compression ratio, chosen to allow a relatively high 11.4 p.s.i. boost. It made a lot of horsepower, no doubt about it. But response was very poor. High boost and high compression ratios together lead to preignition. General Motors first developed the knock sensor, an electronic accelerometer mounted to the engine block, for the Buick V6 turbos. At the onset of knock, the sensor signals, through a computer, the ignition to retard, thus keeping preignition in check.

One major contributor to preignition is poor gasoline. An engine with a knock sensor operating on poor-quality gasoline causes the ignition to retard prematurely, and power drops. For this reason, a turbocharged engine's power is dependent upon the quality of available gasoline. To allow for the worst

possible case, manufacturers have to design their systems to a state of tune and power output considerably less than optimal for the best conditions.

Saab's APC (Automatic Performance Control) recently available with the 900, skirts this neatly. Sensing intake manifold pressure, engine knock and rpm, it varies boost instead of the ignition curve, and allows the turbo to develop as much boost within limits as the engine is capable of handling on that particular fuel, of course. Compared to the previous Saab Turbo, compression has been increased from 7.2:1 to 8.5:1, with a resultant improvement in throttle response and fuel economy. Boost had been increased from 7.2 p.s.i. to 8.5 p.s.i. And test results prove the merit of the system.

All production turbo systems must be compatible with emissions controls. The current ideal utilizes electronic injection, an exhaust-gas oxygen sensor and three-way catalyst. Measures to limit emissions on normally aspirated engines work as well on engines with turbos. In fact, there may be an advantage for the turbocharged engine. For a given power output, it has a smaller displacement than a normally aspirated engine, and the resulting smaller volume of exhaust gas in the idling and partial load ranges mean fewer total emissions during those periods.

Integral part of design

All of the above is why a turbocharged engine must be seen as a complete package, not just as an engine with something else added on. Suppose an engineer decides he needs 150 hp to move a given car at a certain rate. He could achieve that with a normally aspirated engine of about four liters, or a turbocharged engine of about half that displacement. Assuming the power curves were matched correctly to the gearing, the engines would deliver identical performance at wide open throttle. The larger engine might have better response, but not significantly so if the turbo were designed properly. But very little driving is done at wide-open throttle. If someone drives *real hard*—let's emphasize that: *real, real hard*—he uses wide-open throttle maybe 20 percent of the time. Yet when the car is being driven at less than maximum output, most of the output of the larger engine is wasted. Larger pistons, or more of them, traveling a longer stroke, mean more friction losses. A larger displacement results in more pumping losses at idle and low to medium loads. All this adds up to worse fuel economy in most driving situations.

Turbos also work well with diesels. Since a diesel is unthrottled and fuel is injected into the combustion chamber, the turbocharger installation is simple

and direct. And diesels are inherently strong, so the additional load that is imposed by the turbo isn't particularly harmful.

That extra loading on internal components can mean some fairly serious design changes to an existing engine before it's ready for a turbo. Such details as forged pistons, rolled-fillet radii on crankshafts, better bearing materials, stronger head gaskets and higher quality valve material are common. Additionally, there may be jets to direct cooling oil at the undersides of pistons, separate oiling systems for the turbo and engine, oil coolers and sodium-filled exhaust valves. A lot of these things have been standard fare on trucks and race cars for years.

Critical intercooler

Intercoolers are integral to race-car turbo systems, but are only recently coming into production use. One effect of high pressure is more heat, well remembered from high school physics. But hot air is thinner and detrimental to horsepower. An intercooler is a radiator for the boosted air. On early 935 Porsches, the engineers were able to drop air temperature from around 300° F. to the neighborhood of 175° F. or so.

Intercooling is so critical that on many production-based race cars, the intercoolers are located in the nose, behind the grill, with radiators relegated to the rear fenders.

Not surprisingly, race and production engines operate at drastically different boost pressures. At the most, a race engine will have to run 24 hours. Understandably, these standards have little in common with street driving. As rough guesses, boost on an Indy car will be roughly from 23 to 30 p.s.i., depending upon how much each particular engine design is allowed. International Motor Sports Assn. (IMSA) road racers may be in the region of 20 to 25 p.s.i. or more, and it often is subject to continual adjustment at the driver's whim. Typical production car figures are much lower, in the range of 5 to 10 p.s.i. Generally, compression ratios are in the range of 7.0:1 to 8.5:1 for gasoline engines.

But there is a common bond. In all cases, turbocharged engines utilize otherwise wasted energy to boost power. That energy and its use is not necessarily free. But it *is* cheap. Properly used, turbochargers give us cars that go faster and use less fuel because the total packages are more efficient. Turbochargers make little engines act like big ones, but only when you want them to act big. It has taken turbocharging a long time to carve a permanent niche on production lines, but it is certainly here to stay.

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HERE'S THE ATOM AS YOU'VE NEVER SEEN IT!

(Continued from page 79)

Michael Kreisler of the University of Massachusetts. "Once we thought the atom was the most fundamental particle. Then we looked inside the nucleus and found the proton and neutron. Now we probe inside the proton and find the quark. There is no reason to believe that today is a particularly sacred time."

The four forces

Locating new particles turns out to be just half the battle. Next comes understanding particle *behavior*. For decades, it has been clear that four basic forces rule the way everything from quarks to galaxies interacts:

1. Gravity is the most pervasive force, acting to bind the universe on the scale of stars and galaxies.
2. Electromagnetism governs the way atoms combine to form molecules, producing such everyday substances as water, wood, skin and bone.
3. "Weak" nuclear forces control radioactive decay within the atom.
4. "Strong" nuclear forces keep the protons and neutrons inside the compact atomic nucleus. Within the protons, neu-

trons and other particles, the quarks are bound in clumps by a subatomic glue—appropriately called gluon—1,000 times more powerful than the strong force. The bond that keeps quarks together is so strong that it has prevented the detection of a single isolated quark, despite vigorous searches.

GUT research

When Fermi was opening the atomic era 40 years ago, it was assumed that a proton would last forever. But physicists are now in the process of changing their minds on that score.

A leading GUT theory, proposed by Harvard University's Sheldon Glashow and Howard Georgi, predicts, among other things, that protons fall apart over enormous intervals of time. No one has ever seen a proton decay, mainly because nobody was looking until recently. Arrays of detectors at the bottom of unused mines monitor swimming-pool-sized tubs of water or mineral oil. These tubs, protected from the interference of cosmic rays by cubic miles of rock, contain a billion trillion trillion protons. But since GUT predicts protons live almost that number of years, physicists expect to "see" only a few decays a year.

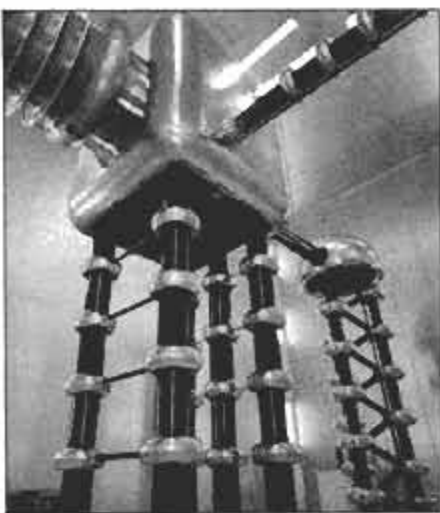
So far, no dying protons have been recorded, "but we are looking very carefully," says Maurice Goldhaber of Brookhaven National Laboratories, one of the first facilities to begin the extensive proton-decay quest.

Another GUT prediction, the existence of the magnetic monopole, may have been seen earlier this year, passing through a modest detector at Stanford University.

Created by the Big Bang that gave birth to the universe approximately 15 billion years ago, magnetic monopoles are bizarre in the extreme. Smaller than a proton, a magnetic monopole has a predicted mass that is 10 million billion times as great.

Blas Cabrera, the Stanford University physicist who conceived the monopole experiment, says: "The single event we have seen cannot be considered a definite discovery." Cabrera is seeking to confirm the monopole's existence with a device 50 times more sensitive. Such a detector could record the electrical wakes of passing magnetic monopoles frequently enough to rule out all other explanations.

Since grand unification theories predict both magnetic monopoles and decaying protons, if one or the other is unequivocally detected, the synthesis of the electroweak and strong nuclear forces wouldn't be far off. The elegance and simplicity that such an achievement would bring to the new atom would inspire physicists to dig ever deeper into the quarks—and quirks—at the very heart of matter and energy.



At the beginning of the Fermilab ring, a 20-ft.-high preaccelerator strips protons from electrons in hydrogen.

A recent step forward in understanding these fundamental forces was the theoretical unification of the weak nuclear force and electromagnetism. Both are now considered to be part of the same phenomenon, the amalgam called the electroweak force. Continued unification of nature's rule books into a single elegant theoretical synthesis has become the

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form of moviola. All it does is play movies—no reverse, no slow motion. Or, for more cash, you can get such goodies as slow motion, reverse and even random access. This last feature enables you to go directly from any one frame to any other frame on the videodisc. For watching movies, this degree of precision may be unnecessary. But for some special *interactive* video techniques, it's a must. This new interactive field is really coming along. We've seen laser videodiscs that teach you how to call the plays in a pro football game and others that teach kids everything from magic tricks to numbers.

You'll also want a videodisc capable of stereo sound if you're going to have a component stereo system.

Most people are familiar with the concept of component audio. The tuner is separate from the amplifier and the speakers are also separate. Now, the same concept is being applied to video equipment.

Component video

Many companies now offer video tuners. These pick up the video signals and feed them via cable to a monitor. Some of these tuners even have built-in audio sections so they also can be used as stereo music centers.

The monitors are usually high-resolution units capable of displaying a fine picture. Unfortunately, most big-screen sets have a built-in tuner, so your choices will be limited. Only a few two-piece LSTs and rear-projection models are compatible with these new video components.

Other add-ons

A media room with a big-screen TV, a VTR, a videodisc, a stereo—that's already a lot of transistors. But, never fear: there's always more you can add.

Almost every media room has at least one video game—maybe two or three of the top units (see *Video Games: More Flash and Dazzle!*, page 92). These games take on a whole new perspective when played on a giant screen. Imagine being Pac-Man!

Home computers are also carving a niche in many media rooms. Units such as the Apple II, the TRS-80 Color Computer, the Atari 400 or 800, the VIC-20 and others offer exciting color graphics.

End the snarl

Hooking up a media room can become almost a video game in itself. Wiring is complicated and the way some units interconnect is not always obvious. Because of this, a switchbox is a good investment.

A switchbox lets you hook a VTR, a videodisc, a video game and other units to a TV set. Some of the more complex units even let you switch your accessories between two TVs via front-panel controls. A switchbox even enables you to tape from the scrambled portion of a cable TV broadcast while you're watching another broadcast channel. We detail a typical switchbox on page 86.

When you run the cables, make certain they don't detract from the decor of your video palace. If you use shielded cables, run them close together in the walls or under rugs. If you're ambitious, you could try the method TV stations use to hide wiring. Build a floor above your normal floor with a raised, metal gridwork. Then you can route all cables easily between the grid and the floor.

And don't forget that you'll likely amass a few tons of videocassettes, videodiscs, game cartridges and tapes. Plan on adequate and attractive storage facilities for all of this software.

You'll find that your media room can be not only the most exciting spot in your home, but the most attractive as well.

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WORKSHOP MINICOURSE



Belt sander basics



1 Though the specifics for doing so vary from one brand to the next, the first step when changing belts is to eliminate tension, as is being done here (arrows).

I would be willing to bet that the belt sander is one of the most misunderstood—thus misused—power tools in the home workshop. Many beginning woodworkers have a tendency to ask the belt sander to do nonbelt sander tasks. It shouldn't, for example, be used to remove great amounts of stock better handled by a block plane.

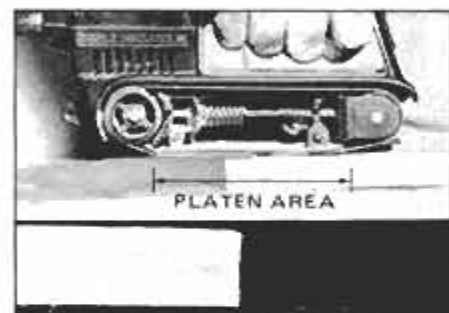
The belt sander can save you many hours of arm-wearying work. When used properly, it will also help you produce projects with a truly professional finish. Read the manufacturer's manual that comes with the tool. There are three reasons why:

1. To make sure you learn how to use the tool correctly.
2. To know what maintenance is—and is not—required.
3. To learn what accessories the manufacturer offers for use with the tool.

When you buy your first belt sander, make certain you purchase a variety of abrasive grits at the same time. For openers, you should stock 40, 60 and 80 grits for rough sanding—such as removing paint and the like. For general home and shop carpentry, lay in a healthy supply of belts in the 100- and 120-grit range. Finer sandpapers are not available in all belt sizes, so check this point with your dealer when you buy the tool. A final tip: To avoid overheating, clear the tool's air ports regularly, with compressed air. **FM**



3 With tension restored, sander is turned on. Belt is tracked using the tracking device provided on the tool.



5 To prevent rounding edges, always push tool so platen extends beyond edge. Closeup photo shows results.



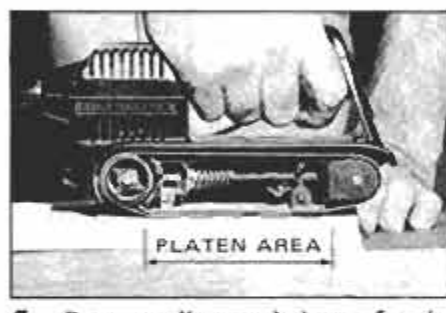
7 Because of belt sander's power, it's smart to clamp or tack-nail a stop strip to workbench to contain work.



2 Old belt is removed and new one is slipped over the wheels. Important: Arrows on inside belt surface must point in travel direction (arrow).



4 Sander should always be moved with grain (arrows). Belt sanding across grain can leave lasting scratches.



6 Poor sanding technique—for instance, stopping the platen short of the edge—will generally result in a dishod (concave) surface.



8 To sand odd-shaped pieces, gently clamp sander handle in vise. Don't overtighten or you'll break the housing.

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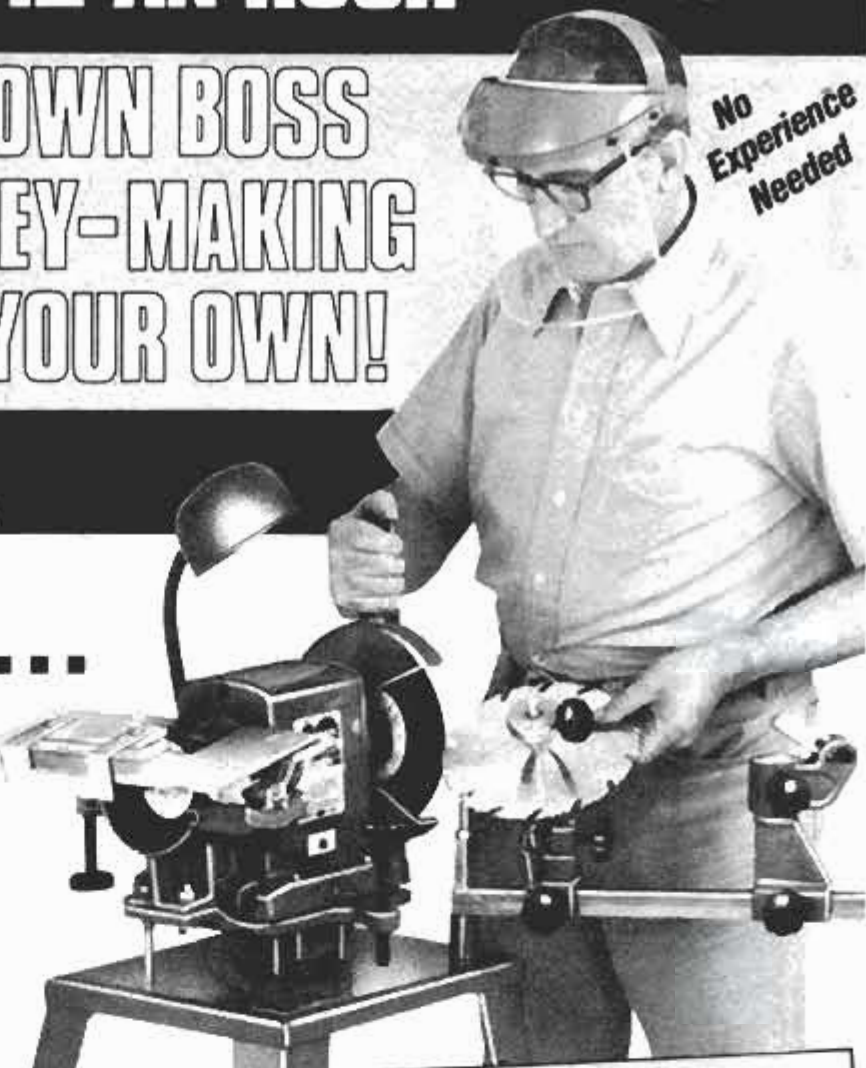
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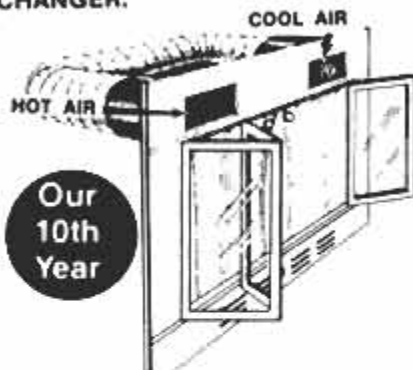


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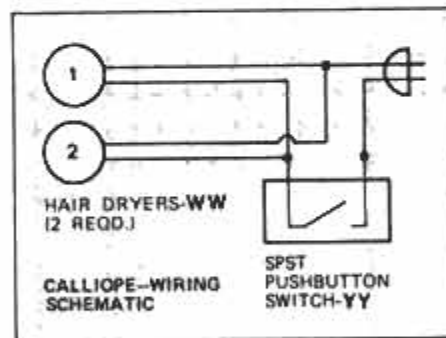
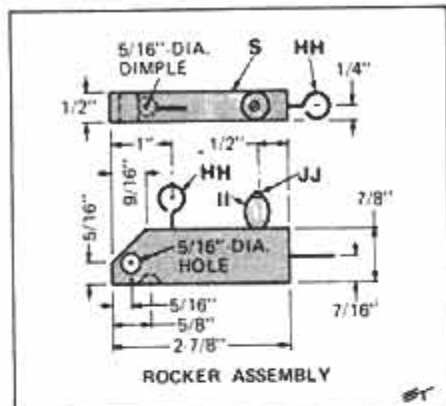
CREATE CIRCUS MUSIC

(Continued from page 107)

Carefully follow the specs in the chart at bottom, particularly those concerning the sound-producing (D-shaped) notches. Use a hacksaw to cut the aluminum tubing and remove all burrs with a mill file. Bore the round air hole near the bottom of each pipe with a 1/8-in. bit. Position a flue stopper of the correct size as noted in the chart and insert a cork in the bottom of each pipe as shown in the pipe-assembly detail. Test each pipe by blowing gently through the 1/8-in. hole. Each pipe should make a clear note. Adjust the flue stoppers to achieve the best possible tone with the least possible amount of air.

Air-release assemblies

Make the 25 air-release assemblies as shown in the detail at the top of page 107. Glue the felt pads (QQ) to the PVC discs (OO) with contact cement or other glue for non-porous surfaces. Fasten the hinge leaves (SS) to the bottom of the wind chest with brads that come in the hinge package. Form the springs (TT) by cutting the heads off 1 1/2-in. safety pins and bending 1/8-in. of each cut end with needle-nose pliers to create



"ears." Reassemble the wind chest, leaving off the top, and caulk all the joints with silicone sealant.

Tie an 18-in. length of braided fishing line (KK) to the screw eye on top of

Specifications—Calliope Pipes And Internal Parts

Pipe No.	Length (a)	Outside Dia. (b)	NOTCH		Flue Stopper Dowel o.d. (e)	Cork Size	Flue-Plug Type
			Height (c)	Depth (d)			
1	21"	1"	3/8"	3/16"	7/8"	10	1
2	20 1/2"	1"	3/8"	3/16"	7/8"	10	1
3	19 1/2"	1"	3/8"	3/16"	7/8"	10	1
4	19 1/4"	1"	3/8"	3/16"	7/8"	10	1
5	18 1/2"	1"	3/8"	3/16"	7/8"	10	1
6	18 1/4"	3/4"	1/2"	3/16"	3/4"	9	2
7	17 1/2"	3/4"	1/2"	3/16"	3/4"	9	2
8	17 1/4"	3/4"	1/2"	3/16"	3/4"	9	2
9	16 1/2"	3/4"	1/2"	3/16"	3/4"	9	2
10	16 1/4"	3/4"	1/2"	3/16"	3/4"	9	2
11	15 1/2"	3/4"	3/16"	3/4"	3/4"	5	3
12	15 1/4"	3/4"	3/16"	3/4"	3/4"	5	3
13	14 1/2"	3/4"	3/16"	3/4"	3/4"	5	3
14	14 1/4"	3/4"	3/16"	3/4"	3/4"	5	3
15	14"	3/4"	3/16"	3/4"	3/4"	5	3
16	13 1/2"	3/4"	3/16"	3/4"	3/4"	5	3
17	13 1/4"	3/4"	3/16"	3/4"	3/4"	5	3
18	13 1/2"	3/4"	3/16"	3/4"	3/4"	5	3
19	12 1/2"	3/4"	3/16"	3/4"	3/4"	5	3
20	12 1/4"	3/4"	1/2"	3/16"	1/2"	3	4
21	12 1/2"	3/4"	1/2"	3/16"	1/2"	3	4
22	12"	3/4"	1/2"	3/16"	1/2"	3	4
23	11 1/2"	3/4"	1/2"	3/16"	1/2"	3	4
24	11 1/4"	3/4"	1/2"	3/16"	1/2"	3	4
25	11 1/2"	3/4"	1/2"	3/16"	1/2"	3	4

each dowel and thread each through its matching nylon tubing guide (MM). Mount the top of the chest and caulk all the joints.

Completing the calliope

Insert the pipes through the holes in the top of the wind chest. Manipulate the air-release assemblies by pulling on the lines until each pipe seats in the base and each felt pad seats over the round air hole. Glue felt strips to the back of the wind chest and install it in the cabinet. Be sure to tighten the screws enough to compress the felt and seal the chest.

Attach the air hoses of the dryers to the copper pipe reducers (XX) mounted to the front of the wind chest. Turn on the dryers. By pulling on the lines, you should be able to make each pipe sound in turn. If any pipe produces a weak

tone, enlarge the air hole to 3/8-in. dia.

Work in order, attaching the lines to the hooks on the rockers. Take two turns of the line around each hook, adjusting the line so it's tight, but doesn't lift the air-release assembly enough to let air enter the pipe. Crimp a split shot on the line to secure the adjustment.

Once all 25 lines are attached, test the action of the keyboard. If you find a sticky key (and you probably will at this point), loop a small rubber band around the base of the counterweight (II) and the rocker guide pin (GG).

Install the music rack (J), music stop (Q) and the rocker cover (K), then apply the screw hole buttons (Y). Finally, tune the pipes to a piano or other instrument, using the flue plugs in each pipe. Pulling the plug out lowers the pitch; pushing it in raises it.

Unimat 3

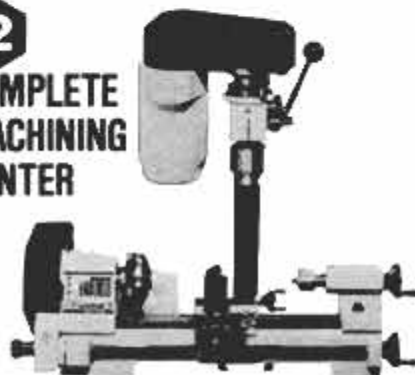
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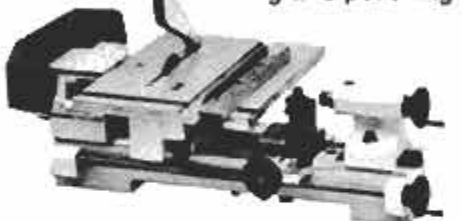
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MATERIALS LIST—CALLIOPE

Key	No.	Size and description (use)		
A	2	3/4 x 11 1/2 x 21" pine (cabinet sides)	CC	1 2 x 2" angle with two 1/2" No. 6 fh screws
B	1	3/4 x 10 3/4 x 20 1/2" pine (cabinet back)	DD ₁	2 1 1/2 x 1 1/2" angles with four 1/2" No. 6 fh screws
C	1	3/4 x 19 1/2 x 20 1/2" plywood (cabinet bottom)	DD ₂	2 1 1/2 x 1 1/2" angles with four 1/2" No. 6 fh screws
D	1	3/4 x 2 1/4 x 20 1/2" pine (cabinet front)	EE	1 1/4 x 1/4 x 13" self-stick foam weatherstrip
E	1	3/4 x 5 x 20 1/2" pine (keyboard base)	FF	25 3/4" No. 6 rh screws (keyboard adjuster screws)
F	2	3/4 x 3 1/4 x 4 1/4" pine (keyboard borders)	GG	25 1/4"-dia. x 2 1/2" dowel (rocker guide pins)
G	1	3/4 x 5 1/8 x 20 1/2" (keyboard back)	HH	50 1/16"-o.d. x 1" screw hooks
H	1	3/4 x 4 3/4 x 20 1/2" pine (internal baffle)	II	25 1/2-oz. egg-type fishing sinkers
I	1	3/4 x 7 1/4 x 20 1/2" pine (rocker support)	JJ	25 1" No. 4 rh wood screws
J	1	3/4 x 8 x 20 1/2" pine (music rack)	KK	50-lb. test headed fishing line (50')
K	1	3/4 x 5 1/4 x 20 1/2" pine (rocker cover)	LL	25 No. 5 split shot fishing sinkers
L	1	3/4 x 7 1/4 x 20 1/2" pine (wind-chest top)	MM	25 1/4"-o.d. nylon guide tube (at auto parts store)
M	1	3/4 x 4 3/4 x 20 1/2" pine (wind-chest front)	NN	25 3/4"-dia. x 3" dowel (air releases)
N	1	3/4 x 6 1/2 x 20 1/2" pine (wind-chest bottom)	OO	25 3/4 x 3/4" sections of 1"-dia. PVC (for pipes Nos. 1 to 10); 3/4 x 3/4" sections of 3/4"-dia. PVC (for pipes Nos. 11 to 25)
O	2	3/4 x 4 1/4 x 5 3/4" pine (wind-chest sides)	PP	25 1/2" No. 4 fh screws
P ₁	1	3/4 x 3/4 x 20 1/2" pine (top cleat)	QQ	25 1/8 x 3/4 x 3/4" felt
P ₂	2	3/4 x 3/4 x 13 1/4" pine (cleats)	RR	25 1/2"-long screw eyes
P ₃	3	3/4 x 3/4 x 3" pine (cleats)	SS	25 3/8 x 3/8" butt hinge; 3/4" brads (100)
P ₄	2	3/4 x 3/4 x 2 1/4" pine (cleats)	TT	25 1 1/2" safety pins
Q	1	1/2 x 1 1/4 x 20 1/2" pine (music stop)	UU	as reqd. Anodized aluminum tubing (organ pipes); 9' of 1" o.d.; 8' of 3/4" o.d.; 8' of 1/2" o.d.; 12' of 3/4" o.d. See Pipe Chart (page 114) for individual pipe sizes
R	1	1/2 x 1 1/2 x 13 1/2" pine (key height adjuster) with four 1" No. 6 rh screws	VV ₁	5 3/4"-dia. cone washers
S	25	1/2 x 3/8 x 2 1/4" pine (rockers)	VV ₂	5 3/4"-dia. cone washers
T	4	1 1/2"-dia. pine (ball-shape handle supports)	VV ₃	9 3/8"-dia. faucet washers with 3/4" No. 6 rh screws
U	2	1/2"-dia. x 11 1/4" hardwood dowels (handles)	VV ₄	6 Size 00 faucet washers with 3/4" No. 6 rh screws
V	60	3/8"-dia. screw hole plugs	VV ₅	5 1/2"-dia. x 3 1/2" dowel
W	75	1 1/4" No. 6 fh screws (cabinet screws)	VV ₆	20 3/8"-dia. x 3 1/2" dowel
X ₁	8	3/4 x 3/4 x 8" (white keys, Nos. 1,3,4,7,8,10,11,14)	WW	2 General Electric Deluxe cap-type hair dryers or equivalent
X ₂	2	3/4 x 3/8 x 8" (white keys, Nos. 2,9)	XX	2 3/4" x 1"-dia. copper pipe reducers
X ₃	4	3/4 x 3/8 x 8" (white keys, Nos. 5,6,12,13)	YY	1 S.p.s.t. pushbutton switch such as Selecta* S.S. 216-11 screw-turn or S.S.215-10 pigtail type; plug; 3 solderless connectors; lamp cord
X ₄	1	3/4 x 3/8 x 8" (white keys, No. 15)	ZZ	1 1/2" x 1-sq.-ft. felt
Y	10	1/2 x 1 1/4 x 5 3/8" (black keys)		
Z	25	1/4"-dia. x 1" dowel (keyboard guide pins)		
AA	25	1/4"-dia. x 4" dowel (push rods)		
BB	2	1/4"-dia. x 15" steel rod threaded		

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cabinets. The new line also includes corner cabinets, wall oven designs and microwave oven cabinets. Oak details are finished with clear varnish. The maker says this luxury is about one-third the cost of a comparable custom kitchen. The cabinets have full front frames which minimize wracking and misalignment during installation. For information, write to Merillat Industries Inc., Dept. PM, 2075 West Beecher Rd., Adrian, Mich. 49221.

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TECHNOLOGY UPDATE

It's all downhill from here

Recreation

Like any other sport in which speed is essential at the top skill level, skiing tends to pick up its technological advances from the racers.

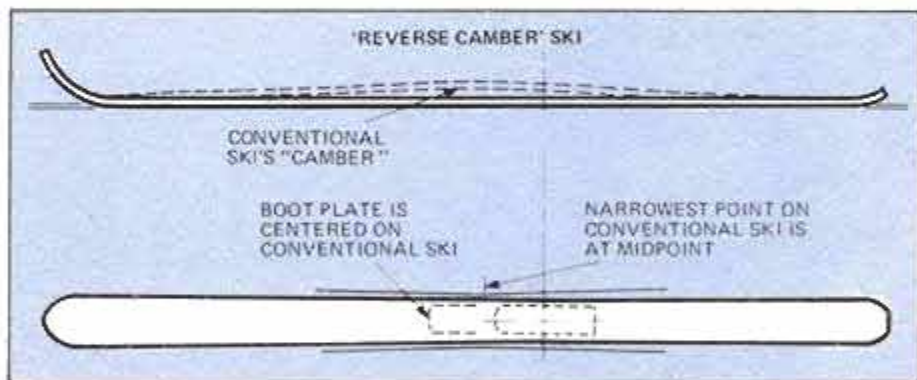
What generally follows is that a whole flock of recreational skiers arrives at the slopes equipped with racing tunics, racing goggles, racing suntan creams and racing skis. While this may boost the novice's psyche to the desired degree, he may often wonder why he tends to feel out of control on his expensive equipment.

The answer lies in the geometry of skis, which has evolved gradually, as most ski buffs know, from the barrel stave. Interestingly, the latest development from Kneissl, a top racing ski manufacturer, leans slightly back toward the familiar old barrel stave.

Kneissl's Blue Star OP ski, aimed specifically at beginners and casual skiers, has received a U.S. government patent on the basis of having "a reverse camber profile and a rear waisted sidecut."

To understand this, you have to remember that "reverse camber" was the original, ends-upward curvature of the barrel stave. With ski poles added as a steering aid, a slightly flattened barrel stave made the skis much easier to control. Then, a completely flat ski was given a central groove along the bottom to improve longitudinal stability even more. Later a slight upward bowing toward the center of the ski was found to add stability at speed and was generally adopted; this is what is known as conventional camber.

The net result of much of this refinement was a good, fast ski which made learning a difficult process. The GLM (Graduated Length Method) system, which starts a non-skier on skis that are as short as three feet and works him up to the traditional length of about six feet as his skills improve, was developed to overcome the difficulty. This tech-



In new Kneissl ski, "reverse camber" refers to the unbowed longitudinal profile. Moving "waist" and boot plate to the rear of midpoint gives added low-speed control.

nique is effective, but short skis also tear up the terrain, producing moguls—abruptly contoured bumps. These tend to throw even good skiers and often break conventional long skis.

The Kneissl development is a response to the need for an instructional ski of appropriate length—usually head height to 10 centimeters higher—that would provide stability at low speeds without carving undesirable and dangerous moguls into the slopes.

By reflattening and introducing a slight amount of "reverse camber" to the now-traditional, upwardly bowed ski, and moving the "waist" of the ski to the rear of the midpoint, Kneissl found that maximum control and maneuverability are available at slow speeds—under 15 mph. Essentially, the new design doesn't require as much downward pressure in order for the skier to carve reasonable turns.

The Blue Star OP is a foam-core, fiberglass ski with steel edges and construction details which are similar to the more conventional skis in the Kneissl line.

Plus, a variable tennis racket

The requirements of manufacturing sports equipment from modern composite materials has led companies like Kneissl, traditionally a ski maker, into other areas.

Another patent which was recently granted to the firm covers a tennis racket. Space within the grip allows an adjustable weight to be moved toward the throat of the racket or back to the butt.

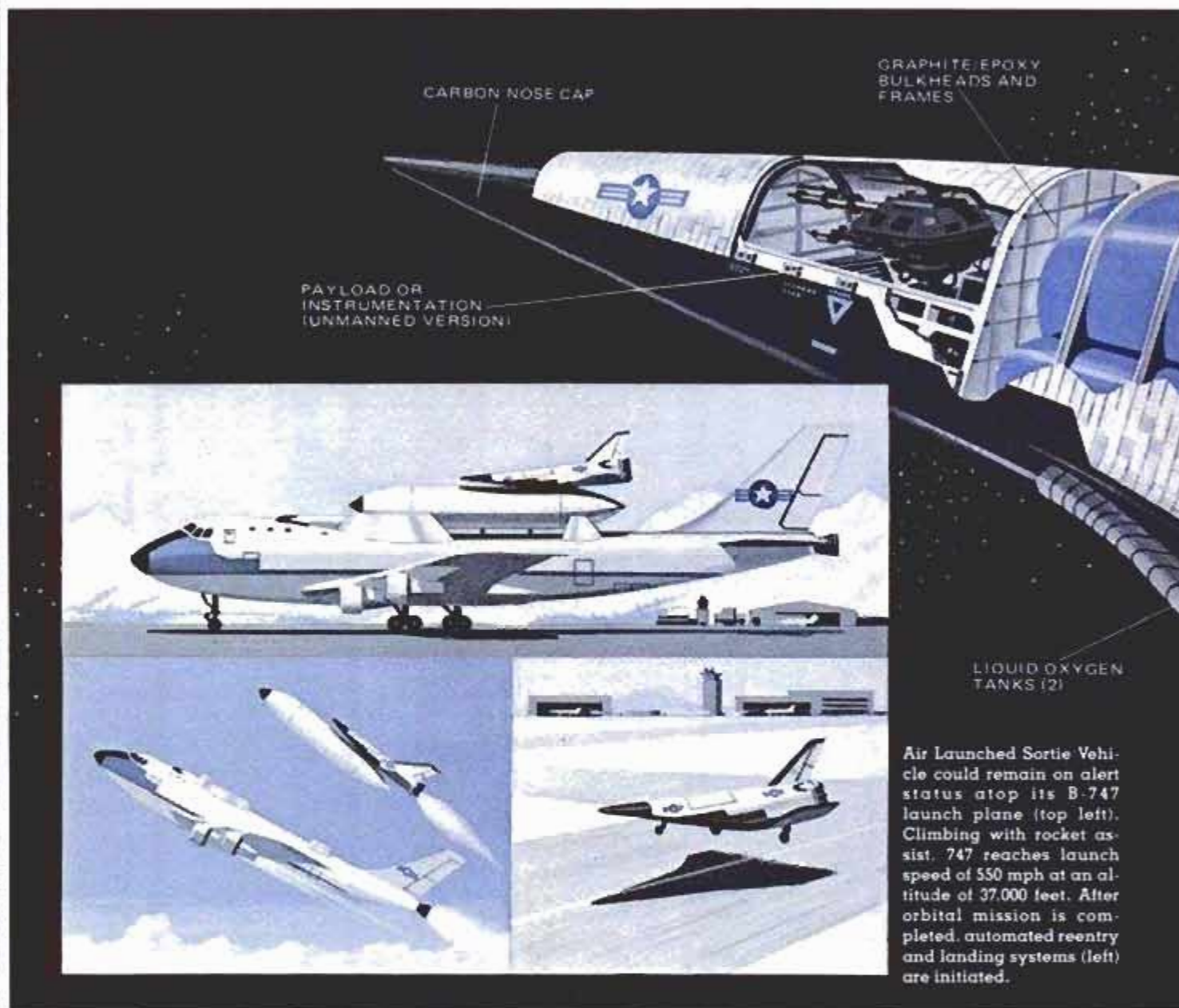
In tennis parlance, this means the racket will play both "head-heavy," for powerful strokes, and "head-light," for a finesse game requiring a more delicate touch. The suggestion here is that you can adjust the racket to the type of response you think it will take to handle any given opponent.

Pros have often been known to add weight—lead slugs, for instance—to racket heads for additional hitting power.

The suggested retail price for the graphite, Kevlar-reinforced racket is \$200. Kneissl Inc.'s address is Box 178, Ward Hill, Mass. 01830.



Kneissl Blue Star OP ski is a foam-core, fiberglass type with a patented profile.



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PAYLOAD OR INSTRUMENTATION (UNMANNED VERSION)

LIQUID OXYGEN TANKS (2)

Air Launched Sortie Vehicle could remain on alert status atop its B-747 launch plane (top left). Climbing with rocket assist, 747 reaches launch speed of 550 mph at an altitude of 37,000 feet. After orbital mission is completed, automated reentry and landing systems (left) are initiated.

Aerospace

Piggyback launch for military minishuttle

Ever alert for applications that could lead to orders for its B-747 aircraft, Boeing has concluded that the plane could serve as an airborne launch pad for an orbiting vehicle, employing Space Shuttle technology. The Boeing study, done under an Air Force contract, further concludes that such a spacecraft could fly its initial mission by 1988.

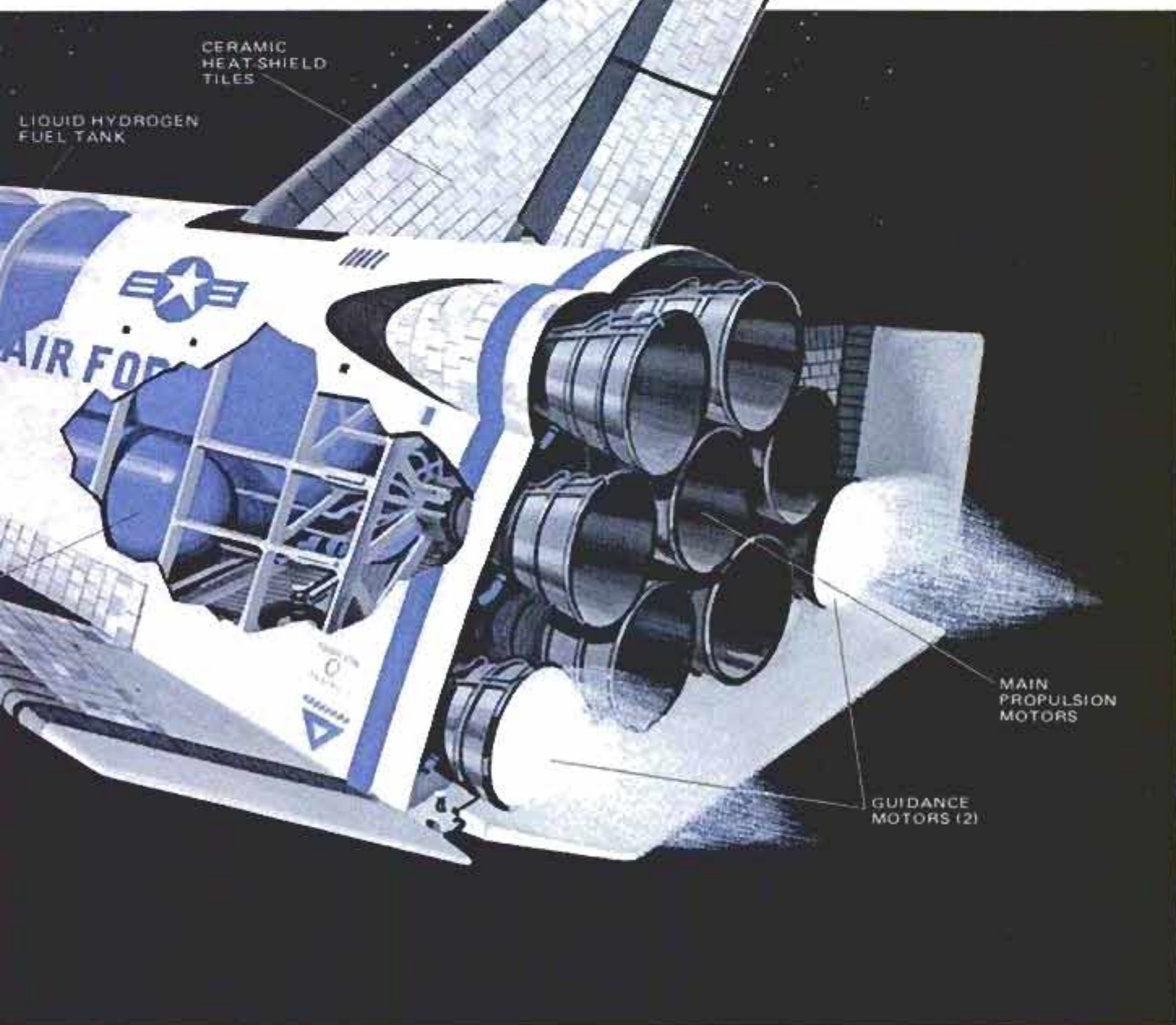
The concept is known as the Air

Launched Sortie Vehicle (ALSV). While much of the design would be derived from the Shuttle's proven systems, there would be differences. The much smaller ALSV could be launched from any military airfield (or commercial airport) capable of accommodating a B-747. It is estimated that the vehicle, placed into a low Earth orbit, could be over any point on the globe within 100 minutes of the launch plane's takeoff. Like the Shuttle, it could be recovered on command; automatic systems in the unmanned ALSV would initiate reentry and landing at predetermined sites.

This seems, at first, to add up to a

global reconnaissance vehicle, instantly available in times of escalating threats to national security. But there is nothing in the concept that rules out a weapons payload, instead of one for surveillance. Thus, the ALSV could become, in effect, an MX missile with the added dimension of retrievability from orbit *after* it has been fired at an enemy. The mobility of such a system, with a certain number kept on airborne alert, would be a plus. The problems of disarming live nuclear weapons for reentry and possible landing accidents would be its most serious drawback.

However, the system might also be



used to attack and destroy enemy satellites in orbit.

The orbiter would be mated with a single external fuel tank; this 275,000-pound combination would be fixed atop a 747 modified with a launch "ramp," plus fairings and pylons. The other major modification would place a single Shuttle rocket engine, plus liquid hydrogen and oxygen tanks, *inside* the 747.

From either a runway or airborne-alert position, the launch aircraft would climb to about 22,000 feet before lighting off its own rocket engine. As thrust develops, the 747 would climb rapidly to near 40,000 feet at a nose-up angle of approxi-

mately 60°. At this point, at a speed of about 550 mph, the ALSV and its fuel tank separate from the 747. The airliner pushes away from the orbiter as two guidance engines are fired to stabilize it and provide more separation. Then all nine modified RL-10 liquid hydrogen/oxygen engines ignite, boosting the ALSV toward orbit. These engines consume all the fuel in the external tank to provide orbital velocity; the tank is jettisoned and burns up in the upper atmosphere.

The remaining fuel on board the ALSV is sufficient for maneuvering and reentry. Although initially proposed as unmanned, the vehicle could be modified to carry a crew,

further enhancing its surveillance and antisatellite capabilities. A manned version could proceed against electronic defenses without requiring jammable command inputs to be relayed from ground stations or friendly satellites.

No doubt, other applications could be found for an operational orbiter with a 100-minute, rendezvous-anywhere capability. An empty version with limited life-support capabilities, for example, might simply stand by during manned orbital missions for possible use as a space "lifeboat."

Editor: Robin Nelson

Electronics

Super phone

Not too long ago, multiple extension telephones that could also be set up to function as a home intercom system were something you could only purchase from a single source. Today, however, electronic telecommunications technology is fair game for a number of growing companies, and the systems are far more advanced than most people realize.

Mitel, a Canadian manufacturer, has developed both single-line and two-line automatic switching systems that incorporate a number of advanced features. These designs are intended for in-home use and small businesses. In addition, the single-line system, which can serve as many as five extension telephones, can be installed by the homeowner even if he has no previous phone-installation experience.

Both systems interact with rotary dial, Touch-Tone or electronic telephones. The single-line system (see illustration below) consists of a master control unit plus up to five easily installed jacks and either a monitor or page unit for each phone on the line. Mitel calls it the TalkTo system. It takes advantage of the fact that most home phones operate on two wires known, respectively, as "tip" and "ring." With microproces-



Master control units for two-line (left) and single-line extension telephone systems from Mitel Inc. are pictured, along with the paging controls for individual sets.

sor controlled switching, the extra pair can be used, in standard quad-wire systems, for additional functions.

Once the master control unit is plugged into any 110-volt household outlet, it can be wired to phones in individual rooms. Monitor units permit hands-free response to incoming calls for a 15-second period, after which a button must be pushed to continue the conversation. (The units can also be set to function as nursery monitors.) Page units are used in

place of monitors on more sophisticated systems; they have additional circuitry which permits speed dialing of up to nine preprogrammed numbers.

These handy new devices can also switch calls to other extensions. Conference-type calls are possible, as well, via the page units, but privacy can be maintained on individual lines.

Single-digit intercom dialing, call holding (with music), and voice paging of all units simultaneously are among the features offered by the system.

Household hookups

The linkage of a TalkTo or similar system to a wide range of household devices has been shown to be practical. For instance, a smoke detector alarm can be rigged to initiate a call to the fire department; air conditioners or furnaces can be activated by telephone code, or a home security system, including burglar alarms and magnetic door locks, can be phone-linked. Controls of this type can be phone-activated from anywhere in the world. In addition, video and data systems for home computer use can be routed via the master control.

U.S. headquarters for Mitel Inc. is located at 5400 Broken Sound Blvd., Boca Raton, Fla. 33431.

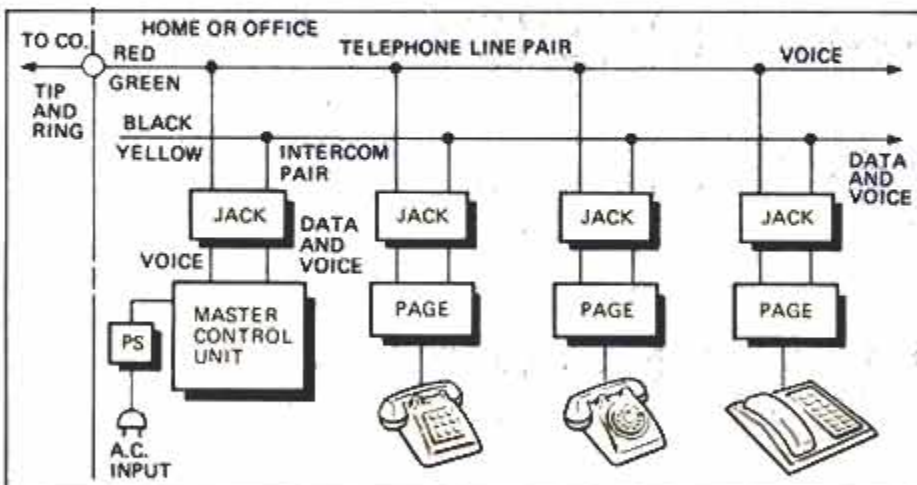
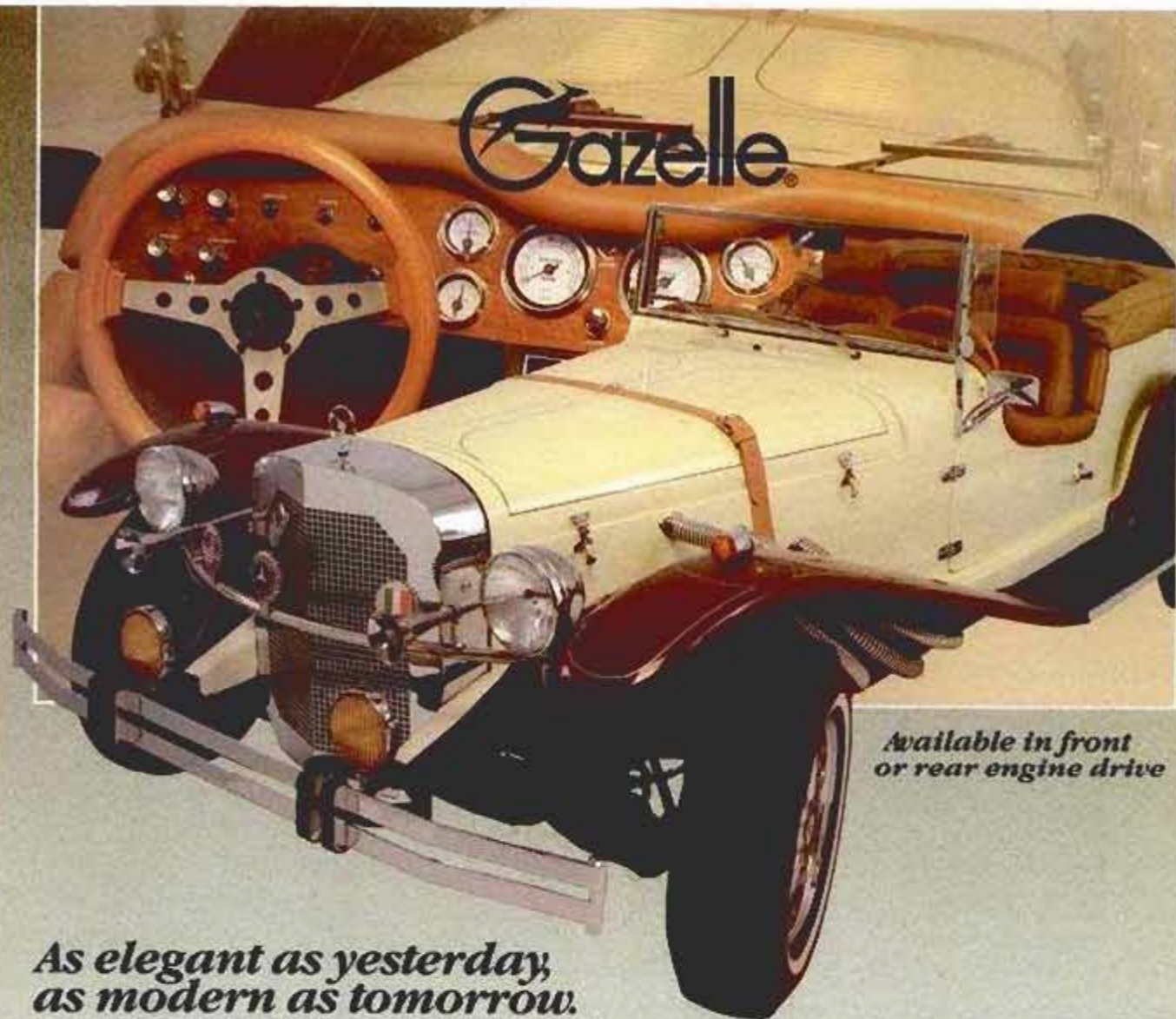


Diagram shows TalkTo system components which can be installed by a homeowner, using existing quad wiring. Power supply (PS) activates master control which routes calls to as many as five extension phones. Page (or monitor) units provide no-hands answering, hold, transfer, conference call and intercom functions.



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PM SOFTWARE MONITOR

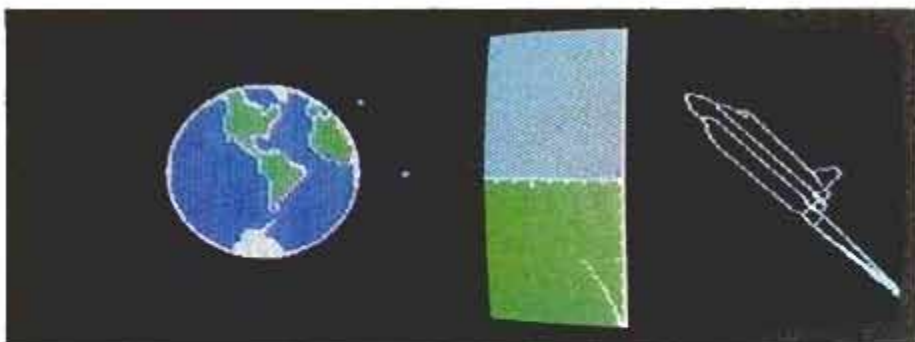


Computer games make great gifts



Animated, cartoon graphics enliven game of *Swashbuckler* (from Datamost). Player runs through menacing opponents by using keyboard commands. It's for the Apple II.

Go into any computer store and you'll see racks and racks of software in colorful packaging. On closer inspection, you'll see that games represent more than half the stock. The reason is simple: People like to play. They may have bought their computer for word processing or accounting, but they probably own a number of



PM's Science Editor has said that *Rendezvous* from Edu-Ware is "as good as the real space shuttle simulator." The game takes you from orbit (left) to outer space.

games, too. And that's good news for the holiday shopper who might want to buy a computerist a gift.

You may not know a word processor from a spread-sheet accounting package, but choosing a game can be almost as much fun as playing one.

The first thing to remember is that a game will only run on the computer, or computers, for which it is designed. Buying an Apple II game for someone who owns a TRS-80 would be as useless as buying a bustle for Pia Zadora.

Keep in mind, also, the tempera-



Pirate Adventure is one of Adventure International's puzzle games. All offer both text-only and graphic versions.

ment of the person for whom you're buying the software. Some games are very complex and time-consuming; others depend more on reflexes than gray matter.

Arcade games are very popular: The best ones are for the graphic-oriented computers such as the Apple II and the Atari 800. Arcade software, such as *Bandits* and *Rear Guard*, is a popular choice with just about any group.

Simulation games such as *The Shattered Alliance* offer the player the opportunity to control strategy and tactics on imaginary or historical battlefields. But these simulations

You rescue hostages via helicopter in *Choplifter*, above left, from Broderbund for the Apple II. War games such as *The Shattered Alliance* (middle) require very careful attention to strategy and tactics. This game is available for the Apple II, TRS-80 and Atari 800. *Bandits*, from Sirius Software for the Apple II (right), is one in a long line of arcade games available for various computers from many manufacturers.

usually take hours to learn and days to play.

Some games, such as *Swashbuckler* and *Choplifter*, defy description. They belong to a new form of animated games which are like open-ended cartoon shows.

Adventure games, like the Scott Adams series, are available in both graphic and text-oriented styles to fit all computers. If the gift's recipient likes to solve puzzles of any sort, he'll love to test his mettle with a computer adventure.

One final tip—buy from a store that will let you sit down with a computer and preview the game. Most package art bears little or no resemblance to what is on the screen.

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NEW WINGS FOR OLD WARBIRODS (Continued from page 83)

had run its course. The mighty air forces marshaled to defend liberty were no more. For the first 20 years after the war, few cared what had happened to those valiant warplanes. Even as late as 1961, when the Canadians sold all their newly rebuilt Mustangs, the prices were still in the \$1,000 range.

The ultimate artifact

If you look at the survival rate of World War II aircraft, it's easy to see why they're so rare. Take the P-47 Thunderbolt. Prior to VJ Day, more than 14,000 had been built. Today, only eight or ten are known to exist, and only three or four still fly. And the famous P-40 Warhawk of the Flying Tigers? An unbelievable 15,000 came out of Curtiss Wright's factory, but today, only eight or nine are still in the air. Germany built an astounding 34,000 Messerschmitt 109s between 1939 and 1945. Now, only one original Me-109 is still airworthy, though there are several Spanish versions flying.

Today, the warbird owner and re-builder must be an aerial archaeologist, knowing that the artifact he is trying to save is one of the most vulnerable known to man, much more fragile and easily destroyed than fossilized skulls or the fabled Clovis arrowheads. Restoring something as rare and intricate as a World War II combat plane is a truly heroic project that usually begins with a scavenger hunt in which the prize may be something as esoteric as an aileron for a Corsair or a canopy hinge bracket for a Mustang. This is how the aerial archaeologist gets his thrills.

Take Pete Regina, for example. In Israel, he ran across a wing for a very early, very scarce B-model Mustang. Then, in northern California, he found the rear 8 feet of a B-model fuselage. Six years and more than \$100,000 later, after scrounging pieces here and there and making many missing parts himself, Pete sat at the controls of his completed P-51B Mustang.

Then there's the story about John Paul's buried P-40. In any area of interest, whether it be antique cars, antique weapons or antique airplanes, you always hear rumors about the one decaying in a barn somewhere, or buried, or at the bottom of a lake. Most of these reports turn out to be old wives' tales.

John Paul heard such a story, only in this case, it was supposed to be a P-40 buried in a farmer's field. John was skeptical, but he located the farmer and started digging. At 9 feet, he hit a wingtip. After several days of excited excavating, he hoisted a P-40N Warhawk from a grave in which it had lain

since 1948. Surprisingly, the metal was not corroded at all, and the plane should be back in the air soon.

Amazing survival story

Other tales abound, like the ones about a Martin B-26 Marauder found in the tundra of Alaska and a Japanese Zero brought back from a Pacific island. One of the more amazing survival stories concerns a P-40 that had lain for 30 years on Amchitka Island in the Aleutians. When it was announced that the island was going to be used as a nuclear testing site, a man in the state of Washington wrote to everybody he could think of in an effort to save the plane. He got no response.

Then, about six months later, he got a call from the dock in his home town. "What do you want us to do with your airplane?" he was asked. Racing down to the waterfront, he found the P-40 sitting on a barge. Somehow (the details are not known), another Warhawk had been saved from oblivion.

There are some warbirds still to be found, too. There are half a dozen P-38 Lightnings perched on the icecap in Greenland. They were brand new when they ran out of fuel and had to belly-land on the ice. Lots of folks are trying to figure out how to get those planes back.

And then there are the Navy carrier planes sitting on the bottom of Lake Michigan. Some say there may be as many as 100, most of them fighters ditched in the waters off Chicago during carrier training exercises in the early 1940s. Since it's fresh water, they may have survived. The Navy just recently authorized a private search for the missing craft, so there's still some hope for their recovery.

There are other tantalizing rumors, too—about Spitfires in India, FW-190s in Rumania, Hawk 75s in Argentina... and the stories go on and on.

Superheroes of the skies

It's no secret that every flier who ever lived—and many a nonflier—has dreamed of being a fighter pilot. Somehow, it fits right in with wanting to be a fireman, a Texas Ranger or Robin Hood. The macho mystique of the fighter pilot—the brave hero battling the fearsome Red Baron—has been the thin basis for many very thin movies. Is there any difference between this and the Main Street scene in *High Noon* or *Shane*? It's the classic confrontation in which the good guy triumphs over the bad guy by virtue of his skill and daring.

This macho nostalgia has made the fighter plane the superhero of the warbird set. You have only to look at the

sleek lines of the P-51 Mustang, the fastest, most versatile fighter of the war, to understand why. You have only to stand on the ramp and listen to the staccato bark of the mighty Merlin V-12 to know the excitement these planes engender.

But getting into the warbird game is difficult, because the game is so small and the cost so big. Worldwide, there are probably no more than 100 to 120 fighters of all nationalities still flying—out of a total that exceeded half a million. And of those still in the air, fully two-thirds are Mustangs. The P-51 owes its survival to its enduring excellence.

Even after the war, as we moved on to the jet age, many underdeveloped nations bought large numbers of Mustangs. Our own National Guard used Mustangs up until the late 1950s.

More recently, partly because of the TV series *Baa, Baa Black Sheep*, the Chance-Vought F4U Corsair has gained a popularity almost equal to that of the Mustang. However, even with the recent return of some castoff Corsairs from Central America, the total flying population of F4Us is only 14 or 15. Grumman's famed "cat" series—the F4F Wildcat, F6F Hellcat and F8F Bearcat—is represented in the air by no more than six or seven examples. Of foreign warbirds, the British Spitfire is the most numerous, but still only six to eight are flying.

The Curtiss P-40, on the other hand, is an excellent example of what warbird restorers have done to save history. In the late 1960s, when MGM made the movie *Tora! Tora! Tora!*, they needed two P40s to represent the aircraft flown by Lieutenants Walsh and Taylor during the Pearl Harbor attack. So scarce were Warhawks at the time that MGM barely had enough spares to keep just two flying.

This situation has changed dramatically, however. In the last few years, the flying population of P-40s has increased to between 8 and 12 at any given time, and there are reportedly more than 20 now under restoration.

Own your own bomber?

Anyone thinking about private ownership of a bomber should question his sanity. Still, thanks to dedicated warbird believers, there are bombers flying today that otherwise would have vanished over the horizon like the dodo bird. The B-17 Flying Fortress, the Battle Queen, still reigns supreme in the hearts of those who remember the sacrifices made to stamp out tyranny. Though subsequently replaced by the even more awesome B-29 Superfortress, the B-17 was a marvelous flying

machine and amazingly low on maintenance.

Powered by four 1,200-hp Wright radial engines, the B-17 proved tremendously adaptable and soldiered on long after it was cashiered out of the military, doing all sorts of odd and sometimes dirty jobs. It was the B-17 that first brought effective firefighting right to the forest fire. "Have borate, will travel" was the slogan.

Unfortunately, when the B-17 was put into its civilian workclothes, it was stripped of all the refinements that made it a bomber—its top and bottom turrets, gun mounts and bombardier and navigator stations. Thus, to restore a B-17 today, you have to do a tremendous amount of scrounging for parts that were, at one time, nothing but junk.

The Spitfires and Hurricanes of the world owe their survival to the movie *Battle of Britain*, for which huge amounts of money were spent on tracking down the few remaining relics and making them airworthy. It was a similar movie acting job that helped to save the B-25 Mitchell, the twin-engine bomber used in Jimmy Doolittle's historic raid on Tokyo. Had it not been for the movie version of the book *Catch 22*, in which the Mitchell played a leading role, dozens of B-25s would have continued to sink in the dust at forgotten airfields.

The B-24 Liberator, the B-26 Marauder, the A-20 Havoc and the mighty B-29 Superfortress that dropped the atom bomb are represented by only one or two flying examples. And except for a few Spanish-built German Heinkel III, absolutely no Axis bombers still fly. In many cases, they don't even exist in museums.

Trainers make fun planes

Far more numerous today are the two-place training planes that taught our airmen how to fly in World War II. This is because some continued in military service long after the war, while others found use as crop dusters or simple sports planes almost anybody could buy and fly. The Air Corps designations used to denote the three different levels of instruction were PT for primary trainer, BT for basic trainer and AT for advanced trainer.

Boeing's PT-17 Kaydett (N2S in the Navy) was popularly known as the Stearman. A big, open-cockpit biplane, it was stable, easy to fly and—as many students proved—virtually indestructible. You could fly it through a house—and some greenhorn pilots did. Today, the Stearman is still used by many crop dusters and airshow stunt pilots and

(Please turn to page 128)

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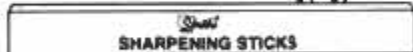
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NEW WINGS FOR WARBIRDS

(Continued from page 127)

may well outlive every other WWII-vintage aircraft.

Other primary trainers include the PT-22 Ryan and PT-19/23/26 Fairchild, both nice little low-wing, open-cockpit two-seaters that still exist in some numbers and make excellent flying toys. In basic trainers, the 450-hp BT-13/15 Vultee Valiant has survived in sizable numbers and many are currently being restored.

If you reached advanced training, you graduated to the AT-6 Texan (SNJ in the Navy). Of all wartime trainers, this superb North American design came closest to having the dashing looks of a real fighter and was not phased out of Air Force and Navy inventories until the 1960s. Thereafter, it was bought in large numbers by private individuals at bargain-basement prices of \$1,000 or so for use in aerobatics, smoke writing and sport flying. It's still used as a military trainer in some other countries, and we'll probably see the turn of the century before the last AT-6 is retired.

Getting into the game

You can jump into the warbird game and get your feet wet, or you can just as easily jump in and go clear over your head. The days of finding a Mustang in a barn and paying the farmer \$200 for it are long gone, though the fantasy persists. Today, warbird prices range from the barely manageable to the absolutely ridiculous. They start at about \$5,000 for a little warbug spotter plane that's seen better days and run on up to \$300,000 or \$400,000 for concours-level restorations of combat rarities like P-40s, Spitfires and top-dog Mustangs.

Restoring something as exotic as a P-40 or P-51 is such an enormous project it boggles the mind. Don't make the mistake of thinking that, just because a World War II fighter is 40 years old, its design is rudimentary. Nothing could be further from the truth. The combat planes of that time represented the pinnacle of propeller-driven technology. Their engines were massively complicated and their control systems equally complex.

The 1,450-hp Merlin of the Mustang is a V-12 with double overhead camshafts and a two-stage supercharger. The 2,200-hp Pratt & Whitney in the Corsairs, Thunderbolts and Hellcats has no less than 18 cylinders and 36 sparkplugs. Your local fix-it shop is going to be no help on one of these.

And assuming you can plunk down \$200,000 or so for the initial aircraft, how will you feel about a yearly maintenance bill of \$15,000 to \$30,000 and

direct operating costs (gas, oil, insurance) that can hit you for \$300 to \$400—per hour?

The affordable ones

The picture brightens, however, when you come to trainers. The primary types like the P-17 Stearman and P-22 Ryan can be had for about the price of a Cadillac (and are a lot more fun). They're also much less expensive to restore, maintain and operate than the combat birds. Even the AT-6 Texan, despite its hefty 650-hp engine, is well within the mechanical skills of the more advanced do-it-yourselfer—though its price is up in the Mercedes class.

Even more affordable are the little L-series spotter planes known as "Grasshoppers" because they could land and take off anywhere and were the eyes and ears of the infantry. Designated "L" for liaison aircraft, these mild-mannered, high-wing, enclosed-cabin taildraggers include the L-2 Taylorcraft, the L-3 Aeronca, the L-4 Piper (the classic J-3 Piper Cub wearing olive drab), and the L-5 Stinson Sentinel. Powered by 65-hp engines (except for the bigger 190-hp Stinson), they are easy and fun to fly and can be restored and maintained on a back-yard builder's budget. Even today, you can pick one up for about the price of a family car.

But can you fly it?

Most primary trainers and liaison planes are docile and forgiving of mistakes—as they were designed to be—and can be flown by anyone who has had taildragger (tail-wheel) experience. The big-engined combat birds are another story. Their flight characteristics are both exhilarating and demanding—that's their attraction. With 1,500 to 2,000 hp up front, they can't be expected to have the best of manners. They were, after all, made to be killers in a life-or-death arena.

Everything in a fighter happens quickly and without warning. While most sports planes will shudder and shake before reaching stall speed, a fighter will give you no such notice. It will fly right up to the edge of stall, then dump you on your back. Pour on too much power on takeoff and it will execute a rapid left turn and go cartwheeling off the runway. Misjudge your landing approach and it will drop you like a sack of cement.

Still, the most temperamental fighters were flown in combat by 19-year-old kids with no more than 200 hours of flying time. The answer is they were taught the military way and flew by the numbers, following correct procedures exactly. If this is done, almost anybody can fly a fighter.

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(Please turn to page 130)

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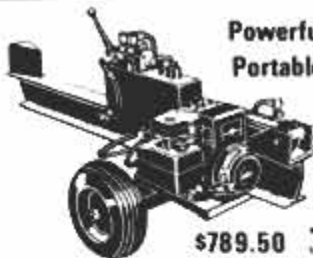
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(Continued from page 129)

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Where to see warbirds flying

There are many fine aviation museums throughout the country where you can see historic fighters and bombers. A few of these include the Smithsonian's famous National Air and Space Museum in Washington, D.C.; the U.S. Air Force Museum at Wright-Patterson Air Force Base near Dayton, Ohio; the U.S. Navy Air Museum in Pensacola, Fla.; and the Experimental Aircraft Assn.'s Paul H. Poberezny Air Museum in Franklin, Wis. This last museum, soon to be moved to new EAA Headquarters in Oshkosh, Wis., contains many warplanes in flying condition that can be seen performing elsewhere at airshows throughout the year.

In addition to these static displays, there are also some museums where you can actually see warbirds in the air. The following is a list of locations. (Note: Because some planes may not be flying at certain times, or may be away at airshows elsewhere, it's advisable to call ahead when planning a visit to find out what will be flying.)

■ **Champlin Fighter Museum, 4636 Falcon Circle Dr. (Falcon Field), Mesa, Ariz. (10:00 a.m. to 5:00 p.m. 7 days; \$3.50 adults, \$1.75 children; tel.: 602-830-4540).**

■ **Combat Air Museum, Topeka, Kan. (located on old Air Force base; 9:30 a.m. to 4:30 p.m. Mon. through Sat., 12:30 to 4:30 Sun.; \$1.50 adults, 75 cents children; tel.: 913-862-9649).**

■ **Confederate Air Force Museum, Harlingen, Tex. (located on Rebel Field at Harlingen International Airport; 9:00 a.m. to 5:00 p.m. Mon. through Sat., 12:00 to 5:00 Sun.; \$3 adults, \$1.50 children; tel.: 512-425-1057).**

■ **Kalamazoo Aviation History Museum, Kalamazoo, Mich. (located on Milham Rd. near municipal airport; 10:00 a.m. to 5:00 p.m. Mon. through Sat., 1:00 to 5:00 Sun.; \$3 adults, \$1 children; tel.: 616-382-6555).**

■ **Planes of Fame Museum, Chino Airport, Chino, Calif. (10:00 a.m. to 5:00 p.m. Mon. through Fri., 12:00 to 5:00 Sat., Sun.; \$3 adults, \$2 children, under 5 free; tel.: 714-597-5314).** **PM**

TRAMMEL/COMPASS

(Continued from page 94)

door and window arches. Start by cutting out rectangles for the base, groove guides and guide retainers. Use plastic laminate or hardboard for the slides and guides (GE Textolite was used here). Then cut the guide slides and compass locks from a single strip to ensure uniform width. Counterbore the screw pilot holes in the groove guides and lay them out on the birch base. Insert the compass locks in the grooves to achieve uniform groove width before snugging the mounting screws for the guides. When the guides are set, fasten the guide retainers.

Start making the pivot posts by routing a groove $\frac{3}{16}$ in. deep and $\frac{1}{8}$ in. wide perpendicular to the grain in $\frac{1}{2}$ -in. stock at least $6\frac{1}{2}$ in. wide. Then rip four $\frac{1}{2}$ -in. strips and two 2-in. strips. After cutting the strips to a length of $2\frac{1}{2}$ in., pair them up and glue them face-to-face to form a $\frac{3}{8} \times \frac{3}{8}$ -in. square hole 1 in. from the top of each piece. Check the fit of the aluminum bar in each piece before the glue sets, then tap holes in each for the thumb-screws and cut the scribe holder to its final shape. Tap holes for the scribe and scribe-locking screw. Cut and attach the post caps with glue and brads.

After the glue has set, bore pilot holes in the bottom of the pivot posts and attach the slides, leaving a $\frac{1}{16}$ -in. gap at the bottom of the posts. Check their fit and adjust the gap by trial and error.

Turn the scriber handle on a lathe and attach it to the scribe holder. Then glue a piece of rubber stair tread to the bottom of the base with cove base adhesive and cut the corners off the base assembly so they won't interfere with the scriber on tight circles and ovals. Finally, assemble all parts as shown and mark the exact vertical centers on the pivot posts and scribe holder.—Robert F. Bessmer

MITER STOP

(Continued from page 97)

gauge slot. Raise the blade to maximum height, then place the trimmed edge of the plywood base against the face of the blade. This should assure good right-angle alignment.

Drive two $\frac{3}{8}$ -in. tacks partly through the base and into the groove strip. Test-cut a piece of stock and check the end with a try square. If it checks out true, apply glue and secure the strip to the bottom of the base. If not, adjust as required by withdrawing one tack temporarily.

Cut off part of one hinge leaf as indicated, then insert it into the kerf in the backstop. Grind the end of a $1\frac{1}{2}$ -in., $\frac{1}{4}$ -20 thumbscrew so the tip is bullet-shaped. Insert the thumbscrew and tighten it against the hinge to make a center mark. Remove the hinge, then use a $\frac{3}{8}$ -in. drill

bit to make a recess in the leaf. Do not drill all the way through.

The two blocks that make up the stop should be made from a single piece of hardwood. Bore for the guide pins and hanger bolt, then cut apart to make up the two pieces. Use a $\frac{1}{2}$ -in. bit to bore the holes for the guide pins and a $\frac{3}{16}$ -in. bit for the hanger bolt hole. Glue them into the stop block assembly, as shown. Clip the heads off 3-in. common nails and use the shafts for guide pins. A bit of candle wax rubbed on the projecting ends will allow them to slide properly.

After the blocks have been separated,

use a $\frac{7}{16}$ -in. bit to enlarge the hole in the larger block to allow clearance for the machine-threaded section of the bolt. Make your own knurled adjusting nut from a piece of maple dowel. Cut a series of shallow kerfs around the edge and then bore a $\frac{1}{8}$ -in. hole through the center. Thread the hole and assemble the stop block with a knurled nut and washers, as shown. Attach the hinge.

A series of lines on the base, and inch marks on a strip of masking tape, will prove useful. Graduations $\frac{1}{8}$ in. apart may also be added at the back of the base near the back stop.—F.H. Loudon

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PICTURE FRAMING SECRETS

(Continued from page 101)

a spring. The spring applies tension to the cutter when the eyebolt is connected. The glass cutter is bolted to a vertical wood block cut to receive the cutter. The block

pivots on a rod secured to the cutter base.

To use the jig, align the left side of the glass to the dimension on the board's yardstick that you want the finished glass. Run the cutter from the top of the channel downward to score the right side of the glass. Place the scored side of the glass up

on the worktable with the excess hanging over the table. Grasp the edge of the excess firmly, raise the glass slightly and crack it sharply on the table.

Note: If you can't locate ball bearings in your area, a set of four, (1/4-in. i.d. x 1/16-in. o.d. x 1/4-in. thick) is \$12 postpaid from Arm-or Co., Box 290, Deer Park, N.Y. 11729.

SPRAY PAINTER'S 'THIRD HAND'

The accessory that pleases me most is the holder I use to paint picture frames. I devised it one day after a freshly painted frame—hanging precariously on a coat hanger—crashed to the floor.

The major parts of the holder are two pieces of wood held together by a carriage bolt, external tooth washer, flat washer and wingnut. The accessory hangs by a screw eye in the end of the shorter wood member. The longer member holds the picture frame impaled at the top and bottom of its rabbet on 4d finishing nails, their heads cut off.

The nails are installed in a pair of wood blocks. A drill press and sloping jig help bore holes for these nails to uniform depth. One of the wood blocks is stationary. The other block is secured in a sheet-metal slide positioned so the nails can secure the frame. Once the block is in position, you can apply tension to it by stretching a spring fastened to one end. The spring is covered by a rectangular aluminum tube to protect it from paint.

Begin painting the vertical frame members with both wood pieces of the jig positioned vertically. Swivel the jig to paint all sides of the vertical frame members. Next, loosen the wingnut and rotate the longer wood member so it is in a horizontal position. Then paint the remaining frame members.

I've built several of these jigs. After one frame is painted, I return the jig to the original position and hang it on a nearby nail until the frame is dry.

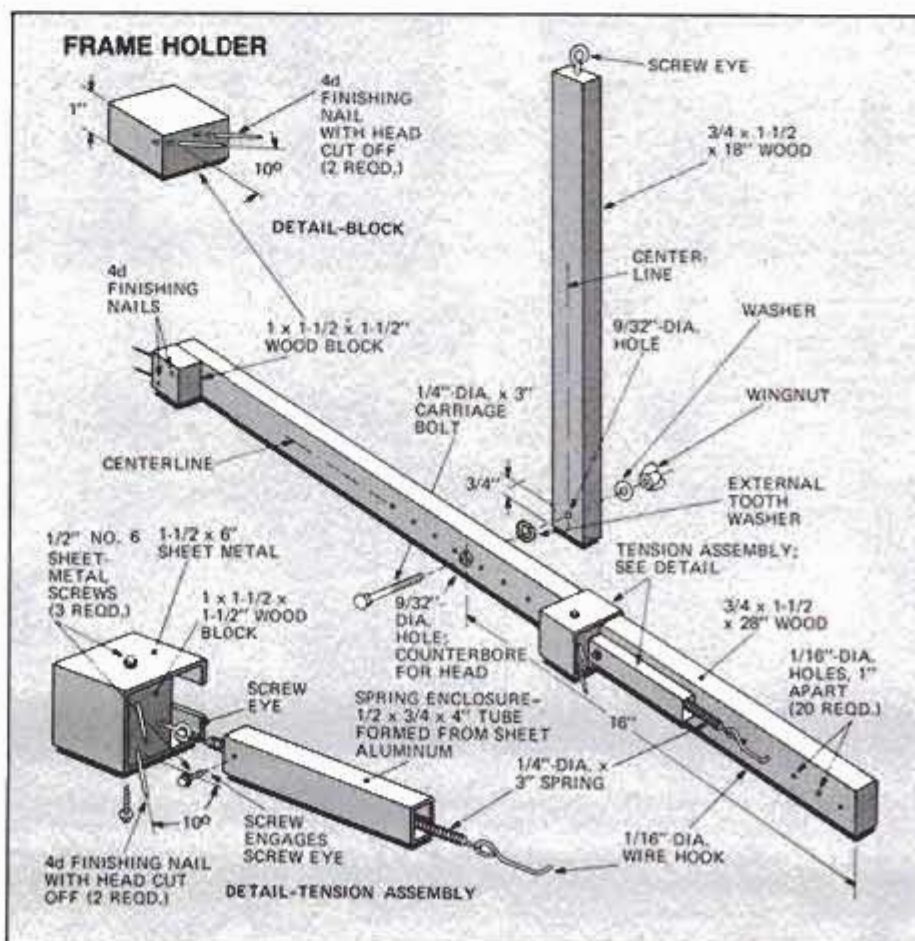
My paint booth consists of a 16-in., direct-drive fan with explosion-proof motor installed in the end wall of my shop. Two curtains on rods are attached to the ceiling joists. The leading edges of the curtains have vertical steel rods in the hem. When I am ready to paint, I extend the curtains and secure them with ties at the lower corners. Afterward, I push them back against the wall out of the way.

Selecting the right type of paint is sometimes a problem. However, if you're painting several frames in different colors, it's convenient to use spray paints. I've had luck antiquing frames using a solid blue with black glazing. A coat of solid gold, followed by a light spray of

(Please turn to page 134)



Fast and efficient way to spray-paint a frame is to impale it securely on the frame holder. The horizontal wood piece is then rotated vertically to paint the edges.



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PICTURE FRAMING SECRETS

(Continued from page 132)

either red, black or light green paint also works well.

One last tip: Although it is difficult for

me to buy mats or other framing supplies locally, an economical mail order source is: Herbert A. Japs, 126 Seventh Ave. N., Hopkins, Minn. 55343. (Ed. note: The company offers a catalog and book on framing for \$3 postpaid.) **FM**

Make A Rustic Frame From Novelty Siding

The contour of novelty (drop) siding used on houses and other buildings can be used to advantage in making rustic picture frames. Often you can find such siding in rural areas or purchase it from house-wrecking companies. The less paint on it and the more weather-beaten its appearance, the more handsome your frames will be, providing the wood is still sound.

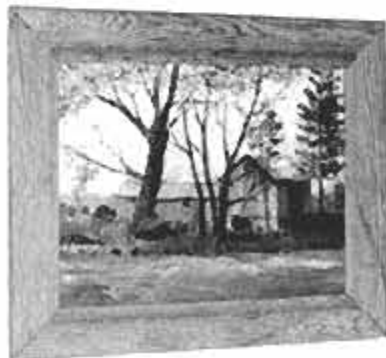
To make frames from siding, first rip both edges of the board, leaving about 2 in. of the flat surface and 1/4 in. of the curved portion. You may wish to vary these dimensions according to the over-

all size of the frame you're working with.

Second, cut a 1/4-in.-deep x 1/2-in.-wide rabbet in the frame back so the art can be mounted in place. You can cut the rabbet with a table saw, a radial saw or a router.

Third, cut mitered frame members to size. Assemble them with glue and two finishing nails per joint. Start one nail on each frame member of the joint. A miter clamp helps make good frame joints.

You can paint the newly cut edges to match the weathered surface. Usually, black, white and brown pigments are suitable. — *Ralph S. Wilkes*

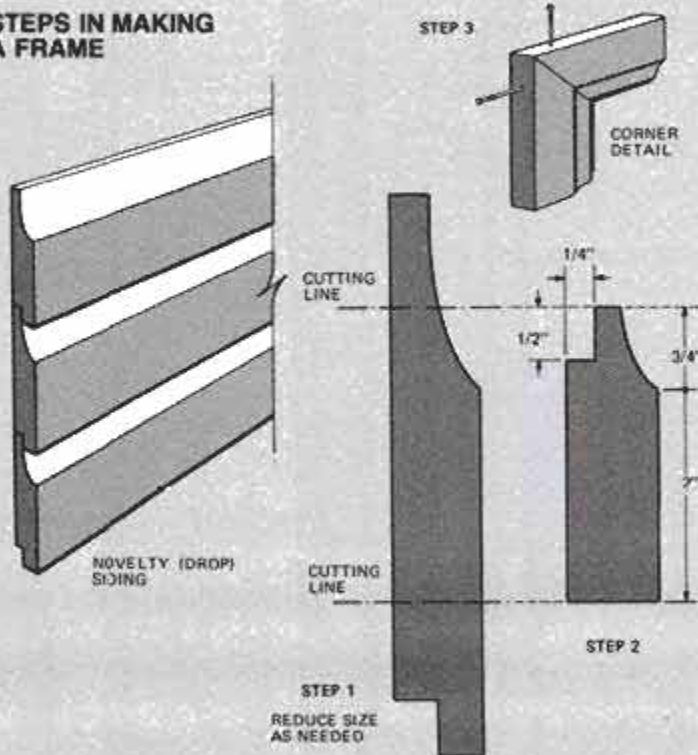


Frame created from drop siding is simple, perfect for country scenes.



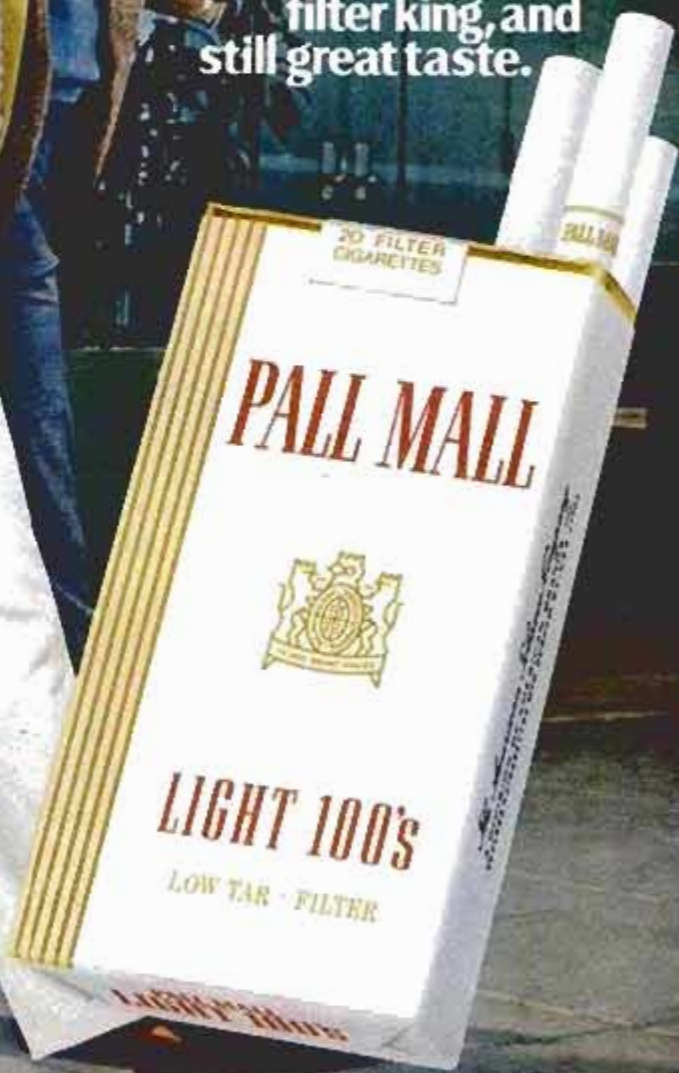
Paint newly cut edge to match frame's aged surface as closely as possible.

**STEPS IN MAKING
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OWNERS REPORT: S-10

(Continued from page 85)

cific dislike." Another complaint with the automatic had to do with the transmission's hunting and pecking between second and third range as the microprocessor searched for an ideal gearing. This usually happened around 25 to 30 mph, and it's a problem not confined to the S-10.

Nor were owners with manual gearboxes totally happy, either. An Illinois lab technician put his finger on the main problem when he wrote: "The shift lever [of the manual four-speed] is attached to the transmission with a pressed fitting. It comes off about every 500 miles, and my local Chevy service manager told me he's had a number of other S-10 owners with the same complaint. The tranny needs a threaded adapter."

The lever not only tends to work loose, but some owners told us it's hard to get the shifter into reverse.

An area of solid praise centered on general comfort. An Alabama pipefitter smiled, "It rides like a dream and drives like a sports car." An Ohio advertising executive: "I like the ride and comfort. The S-10 has the feel of a much larger truck." A West Virginia garage operator: "Great comfort and roominess on the inside; great sportiness on the outside." A Texas manager: "I'm 6-1, and head- and legroom are excellent."

Nearly 20 percent of the owners we surveyed bought the S-10 because it's American-made. That's significant because workmanship earned high praise, with 85.8 percent rating it *good to excellent*.

A Kentucky engineer commented, "Everything fits tight and works smoothly." A Louisiana forester: "Very good construction and workmanship for a utility vehicle."

A Chevrolet dealer mechanic from Illinois wrote this note on the back of his questionnaire: "I might be prejudiced,

but my S-10 was the first one we received in November 1981, and everybody commented how well the doors and fenders fit. Our new-car cleanup man said he felt it had one of the finest paint jobs he'd seen come through and, being a black truck, it would have shown imperfections."

And, on the topic of mechanical quality, a West Virginia designer volunteered this information: "I've driven 6,500 miles with no problems whatever, which proves that U.S. assemblers can do a superior job."

It turned out that 51.8 percent of the drivers we surveyed reported no mechanical troubles of any sort. That's a so-so showing, though, when compared with, say, the Ford Mustang, Isuzu and Datsun Maxima.

The S-10's most common mechanical problem had to do with the manual and automatic transmissions, as mentioned (28.8 percent). After that came the induction system—mainly poor running when cold and dieseling when hot.

And nearly seven percent mentioned spongy brakes—or at least that the pedal goes down too near the floor, which some drivers said made their foot hit the accelerator.

Of other items they'd like to see changed, owners suggested using less plastic, especially in the interior (an observation common to all modern cars)



Attention to detail like this nonskid bumper abounds through rest of vehicle. Workmanship earned high praise.



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and the hubcaps. A self-employed Californian sniped, "The plastic hubcaps are a joke. I have the Sport wheels, and I've lost one cap already. I won't even bother to replace it. What a sad commentary on America's biggest automaker."

But criticisms tended to be mostly minor and, as some owners admitted, nit-picking. The great majority expressed extreme pleasure and satisfaction with the Chevy S-10, and we feel it would be unfair to leave out the praise that owners heaped on this pickup.

For example, from a Michigan industrial supervisor: "Very good workmanship, panel alignment; no wind noise at speed; excellent ride and comfort; good gas mileage; good handling on the road."

A Nebraska traveling salesman exulted, "Chevrolet doesn't have to take a back seat to the Japanese with this truck. I drive 40,000 miles a year and appreciate the riding comfort and V6 power."

A Wisconsin motorcycle parts manager: "All body panels fit flawlessly. Paint is excellent, and dash components fit and

perform perfectly. The dealer made every effort to help me find the equipment and color I wanted."

And finally, from a West Virginia farmer: "We had a Luv before, which was a good truck, but it didn't compare with the S-10. For a farm and all-around vehicle, I think the S-10 is one of the best new trucks GM has ever developed. We've run it hard, and it really goes—will peg 85 mph in third without even winding tight. It's really a very fine vehicle. I can't say enough good things about it." **FM**

SUMMARY OF 1982 CHEVROLET S-10 OWNERS REPORTS*

Total miles driven 2,361,548	Specific likes:	Comfort opinion:	Number of vehicles owned:
Average miles per gallon:	Economy 46.5%	Excellent 50.3%	This pickup only 20.4%
1.9-liter ohv Four	Styling 40.4	Good 41.1	Two cars 62.8
In town 23.8	Ride 34.5	Average 7.8	Three cars 12.0
Long trips 28.9	Handling 33.9	Poor 0.8	Four or more cars 5.0
2.8-liter ohv V6	Comfort 23.1	Had any mechanical trouble?	Makes of other cars owned:
In town 20.4	Specific dislikes:	Yes 51.8%	Chevrolet 42.7%
Long trips 25.4	No complaints 20.9%	No 48.2	Oldsmobile 14.3
Engine choices:	Gas mileage lower than expected 11.5	What type of trouble?	Ford 13.0
1.9-liter ohv Four 19.4%	Transmission 9.1	Shift mechanism 16.0%	Pontiac 8.2
2.8-liter ohv V6 80.6	Not enough power 8.0	Transmission 12.8	Buick 7.2
Transmission choices:	What changes would you like?	Induction system 8.5	Age distribution of owners:
Manual four-speed 59.8%	No changes 16.8%	Oil leaks 7.4	15-29 years 29.3%
Automatic three-speed 40.2	Improved shifting 7.3	Brakes 6.9	30-49 years 44.4
Why did you choose this pickup?	Better gas mileage 6.6	Clutch 6.9	50-plus 26.3
Economy 47.5%	Better quality materials 6.0	Dealer repairs satisfactory?	Would you buy an S-10 again?
Size 29.0	Brakes feel soft 5.4	Yes 51.3%	Yes 84.0%
Styling 28.2	Workmanship opinion:	No 48.8	No 16.0
Made in America 18.5	Excellent 40.8%	Dealer service opinion:	Would you buy another Chevrolet product?
Engine power 10.2	Good 45.0	Excellent 26.5%	Yes 88.2%
	Average 10.7	Good 36.4	No 11.8
	Poor 3.5	Average 21.1	
		Poor 16.0	

*Percentages might not equal 100% due to rounding or insufficient data.

PM'S PICK OF THE BIG-SCREEN TVs

	PRICE/TYPE	SIZE	TUNING	BRIGHTNESS	FEATURES
KLOSS					
Nova beam Model 1	\$3,300/2-piece; ceiling mount about \$700 more	6.5 ft.	Digital, 83 channels	80 footlamberts	Remote-control comb filter, direct video output, fixed-level audio output
Novabeam Monitor	\$2,700/2-piece	6.5 ft.	No tuner	80 footlamberts	Same as Model 1, plus optional wired remote
Novabeam 10-ft. Monitor	\$3,200/2-piece	10 ft.	No tuner	16 footlamberts	Same as Model 1, plus optional wired remote
Novabeam 10-ft.	\$3,800/2-piece	10 ft.	Digital, 83 channels	16 footlamberts	Same as Model 1
Novabeam Model 2	\$2,000/2-piece	5 ft.	No tuner	Approximately 50 footlamberts	Portable (about size of a 19-in. TV, weighs 60 lbs.); needs no screen—you can use the wall; audio and video outputs
MITSUBISHI					
VS-450R	\$3,700/rear-projection	45 in.	Digital, 105 channels, cable ready	120 footlamberts	Remote control, external speaker outputs, stereo outputs, doors
VS-515	\$3,500/1-piece	50 in.	Same as above	120 footlamberts	Remote control, external speaker outputs
VS-520UD	\$4,000/1-piece	50 in.	Same as above	120 footlamberts	Remote control, external speaker outputs, on-screen time and channel, doors
NEC					
PJ-4500	\$3,200/rear-projection	45 in.	Digital, 105 channels, cable ready	120 footlamberts	Remote control, one video output, two audio outputs
PJ-6000	\$3,800/1-piece	60 in.	Same as above	80 footlamberts	Same as above, but only one audio output
PIONEER					
LS-501	\$3,300/1-piece	50 in.	Electronic, 83 channels	120 footlamberts	Remote control, audio output, comb filter
RCA					
PGR-100R	NA/1-piece	50 in.	Electronic, 83 channels	120 footlamberts	Remote control, comb filter, external speaker
PGR-200R	\$3,400/rear-projection	45 in.	Digital	100 footlamberts	Same as above
PGR-300R	\$3,600/rear-projection	45 in.	Digital, 83 channels	100 footlamberts	Same as above, plus doors
SONY					
KP-5025	\$2,800/2-piece	50 in.	Digital, 105 channels, cable ready	100 footlamberts	Remote control, one video output, one audio output
KP-7225	\$3,300/2-piece	6 ft.	Same as above	50 footlamberts	Same as above
KP-5040	\$3,800/1-piece	50 in.	Same as above	100 footlamberts	Same as above, plus electric door operation from remote control, remote antenna
KPR-4600	\$3,800/rear-projection	46 in.	Same as above	100 footlamberts	Remote control, remote switch between cabinet and antenna video/audio outputs
ZENITH					
SN-4545P	\$3,750/rear-projection	45 in.	Digital, 112 channels, cable ready	180 footlamberts	Remote control, screen disappears in cabinet, remote control use of telephone
PV 4535	\$2,700/rear-projection	45 in.	Digital, 83 channels	180 footlamberts	Remote control

BIG-SCREEN TV

(Continued from page 91)

tuning can receive mid-band cable channels, but you need cable-ready tuning to get the superband channels above that. Many cable-ready sets offer 105 channels or more. If you don't have a scrambled pay service like HBO, you won't need a converter box, and many cable companies will offer you a discount.

■ **Stereo sound:** Stereo TV broadcasting is still at least two years away, but video cassette recorders, videodisc players and FM simulcasts can give you the real thing if your LST is equipped for it. Many LSTs have two speakers. But for true stereo sound, the unit should have a separate audio amplifier for each channel. And the LST should also have stereo audio inputs—RCA jacks—for the source to be connected.

■ **Inputs and outputs:** If you own a

VCR and/or videodisc player, you probably know what a rat's nest of wires looks like. Many LSTs have multiple direct video inputs that allow you to connect different video sources and switch them at the touch of a button. This also eliminates the need for an RF switch box or A/B switch. Direct video inputs have another advantage. They bypass the RF modulator in the tuning section, giving you a higher quality picture. Video outputs are also convenient. They enable you to feed the output of any channel to an extra VCR. Last, but not least, is the provision for an audio output. This allows you to feed the mono or stereo audio portion to your stereo and through hi-fi speakers.

■ **Miscellaneous features:** There is an entire collection of electronic gadgetry on this year's sets. One rear-projection unit, the Zenith SN-4545P, has a screen which ascends electrically from the cabinet when it's turned on (see photo

on page 90). Other features you may run across are an on-screen channel readout and a special circuit that will prevent the kids from watching adult programs when mom and dad are out.

If all this sounds exciting, and you want to run to your local video store, wait. This is an expensive purchase, and you should buy from a reputable dealer. Perhaps the best establishment to shop in would be a store that specializes in LSTs. These stores have trained technicians who will deliver the units and install them properly in your home. It's a good idea to ask the salesperson if this service is included in the price.

Make sure the store is an authorized service center for the brand that you buy. If something malfunctions, they will be able to repair it. It's also a good idea to buy a service contract. Most in-home service contracts cost about \$200, and they take over where the manufacturer's warranty stops. **PM**

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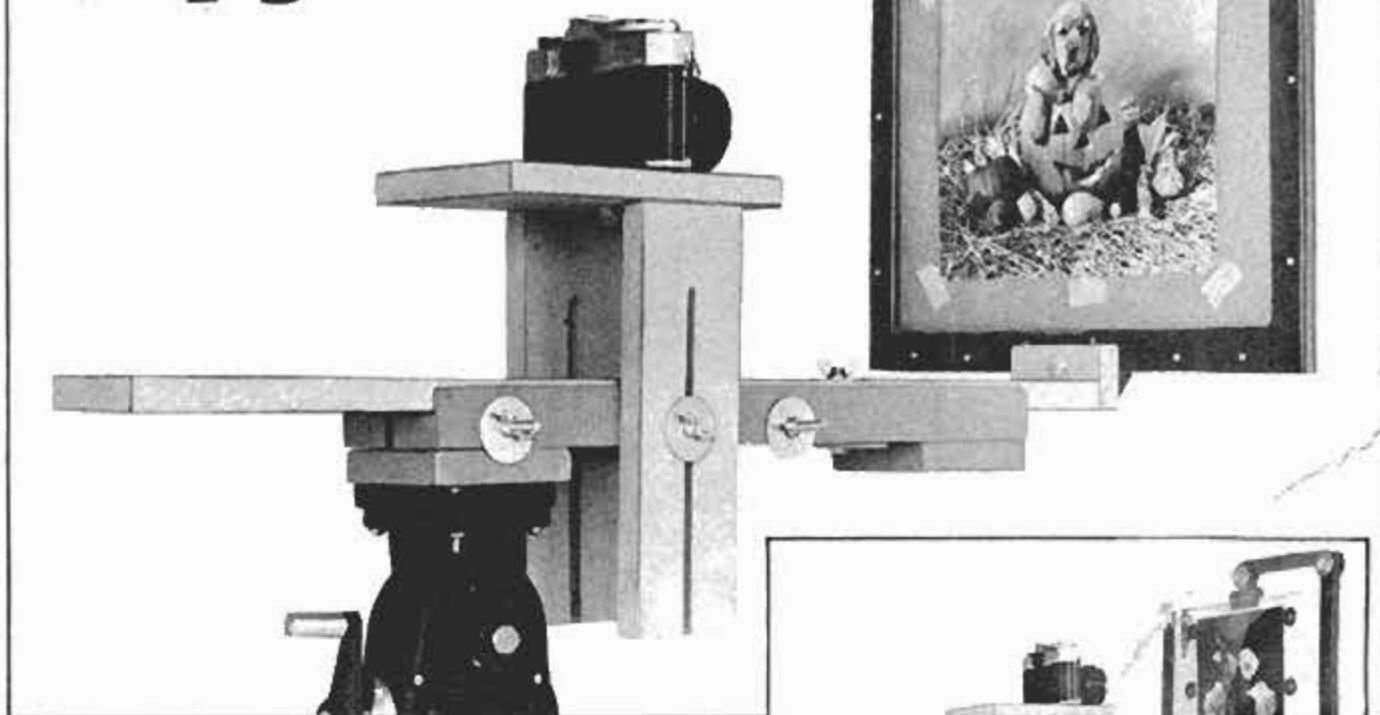
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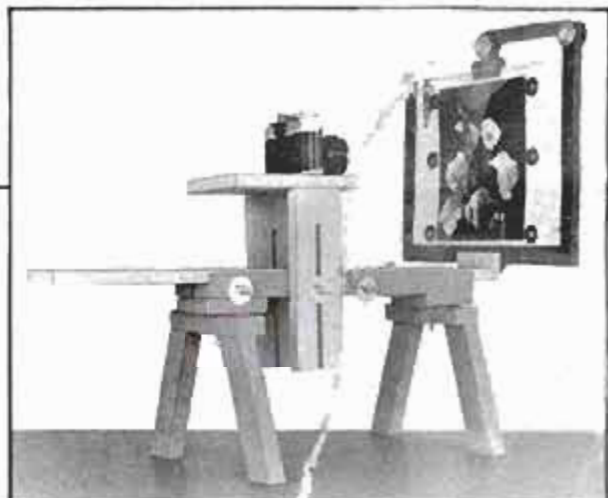
EH4

PM's Universal Copy Stand



PM's copy stand can be used with a tripod (above) or with legs you can build (right). Adjust the camera platform vertically or slide it along the base up to 22 inches from the material that's being copied.

With this unique copy stand, not only can you copy slides, but you can practice your still-life photography, as well.



BY FRED HAITZ

Here's a unique copying stand you can build to mount on a sturdy tripod or on its own legs. By adding an L-shaped bracket, it converts to a vertical copying stand to photograph subjects on a tabletop or floor. Slides, maps, pictures or drawings up to 16 x 20 inches may be copied. And provisions for numerous adjustments make it easy to line up and focus on the subject.

A tripod can be attached to either end of the stand. The location of the hanger bolts and fender washers that hold the camera platform is optional. You need only one set, about 7 inches from the rear end of the base. But you can use more if you want additional stability.

If you decide to build the legs, our measurements can be altered to suit your own needs. They can be made sufficiently long to raise the platform high enough so that you don't need a table.

If you want higher legs, you can add the optional hanger bolts mentioned above.

The slotted slides of the camera platform allow it to be raised or lowered and tilted forward or backward. And the slot on top of the platform enables the camera to be adjusted back and forth. The slot is T-shaped to allow side-to-side camera movement. If the cross-part of the T is about 2½ inches, the stand can be used for taking three-dimensional pictures (more on that later).

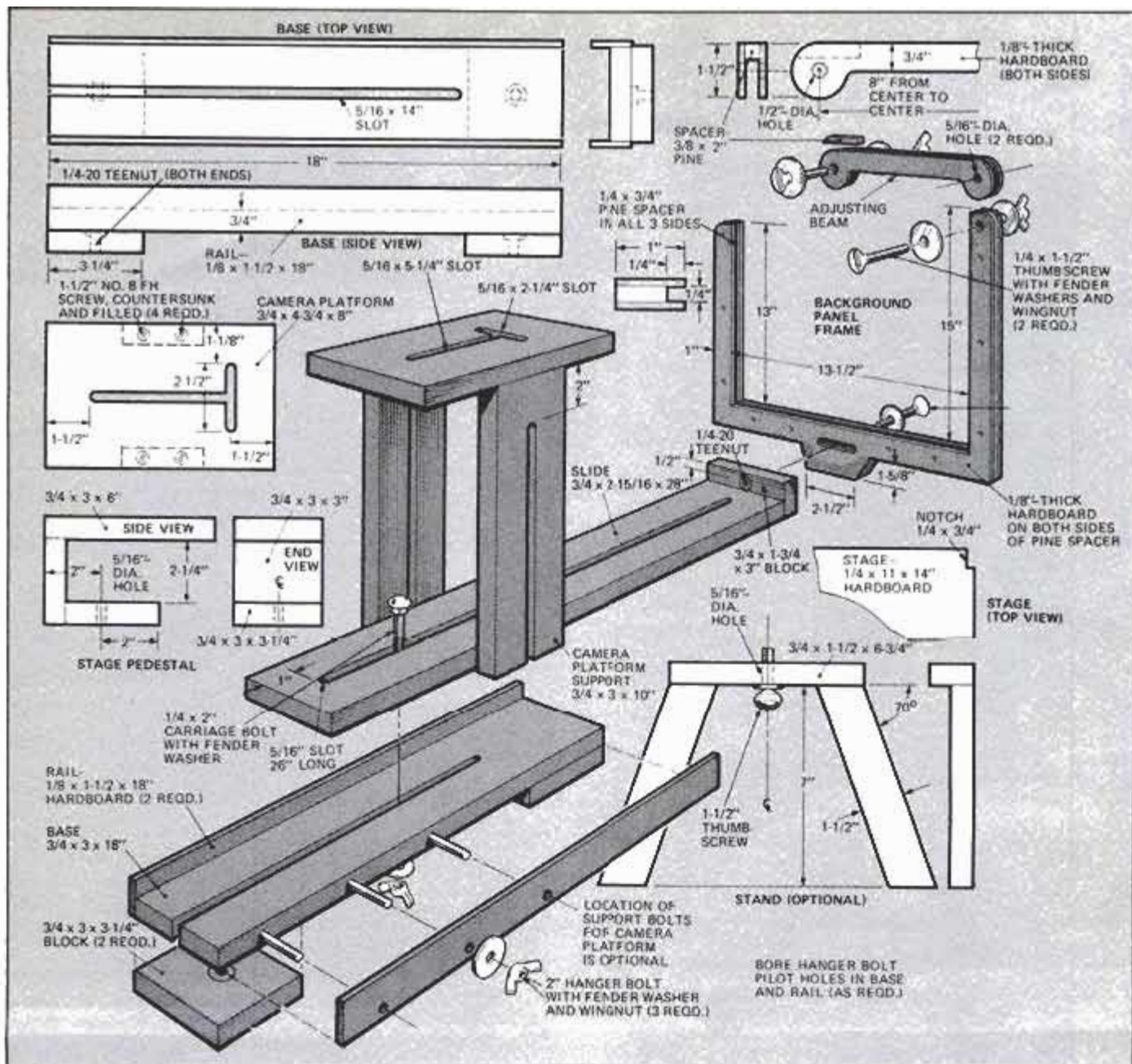
Photographic backgrounds are often very effective. The U-shaped background-panel frame with adjustable beam holds these backgrounds—anything from paper or cardboard to smoked glass or acrylic plastic.

The stage/pedestal arrangement can serve as a small tabletop or as a stand-off camera platform when the copy stand is being used vertically. (Accom-

panying photos show it being used either way.) The stage, made of hardboard, should be corner-notched so that it will fit closely into the U-shaped background-panel frame. The background panel helps to support the weight of the stage.

Occasionally, subjects must be arranged on the floor or on a tabletop. In these cases, convert to vertical operation by using an I-shaped bracket on the rear end of the slide. Purchase such a bracket from photo stores or build your own as shown in the photo on page 144. Then use the stage pedestal as a stand-off camera platform. If needed, extend the slide to clear your own tripod's legs or other obstacles.

If you want to copy slides directly, you may want to build the light-trap frame shown on page 144. You'll have to custom-shape the metal or cardboard tube to match the circumference of your own camera lens. This tube acts as a

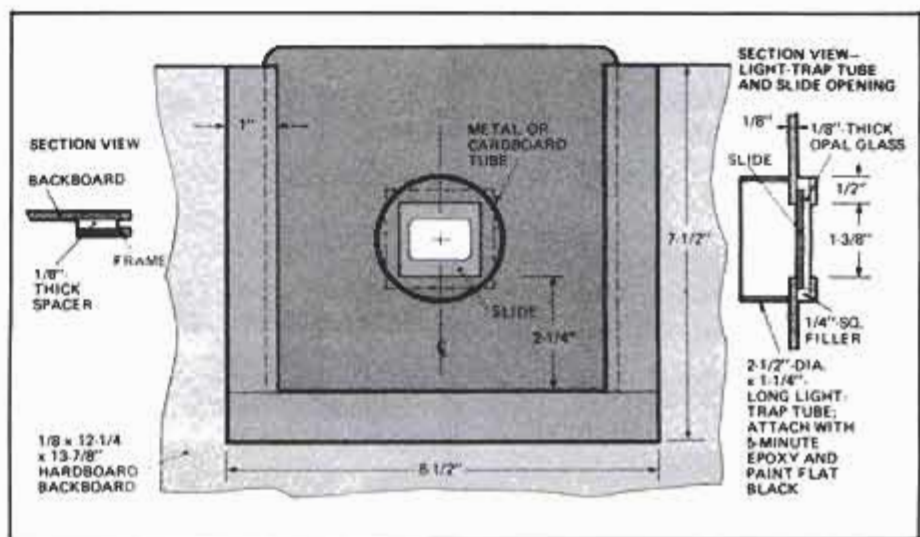


lens shade so that the copy stand's camera won't record reflections from the surface of the slide.

While the light-trap method is the most accurate means of slide copying, you can also achieve excellent results using rear projection. For this, just insert a $\frac{1}{8} \times 11 \times 14$ -inch piece of flashed, opal glass into the U-shaped background frame. Then project a slide from behind onto this translucent surface.

The projected image may be the entire slide or just an area. This technique can make close-up, detailed copies or one-to-one reproductions. You can determine approximate exposure with a light meter. The entire operation should be done in a darkened room. This is also a handy way to get black-and-white photos from a color slide: Just copy with black-and-white film.

Try this rear-projection method. If [\(Please turn to page 144\)](#)



Here's how all the parts of the copy stand fit together (top of page). Legs for the stand are optional. The diagram (directly above) illustrates how to build the light-trap tube for copying slides. It's impor-

tant that the opal glass should be no thicker than shown or the slide may not fit. To prevent that possibility, the thickness of a cardboard slide should be considered as standard.

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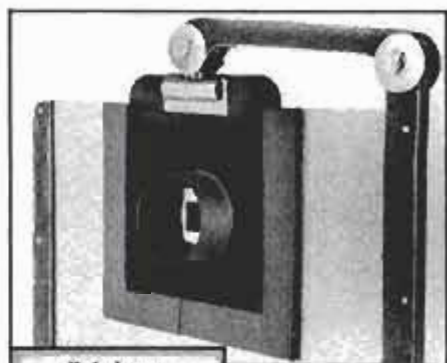
UNIVERSAL COPY STAND

(Continued from page 141)

you enjoy it and are satisfied with the results, there's no need to build the optional light-trap frame, though results will be better if you do.

If you live near a photo store or novelty shop that sells 3-D viewing glasses, you can also make stereopticon-style pictures. Take the first exposure. Advance the film and shift the camera laterally about 2½ inches (the T-slot mentioned earlier). Take the second shot. The two images will be almost, but not quite, the same. Through a viewer, they will appear in 3-D.

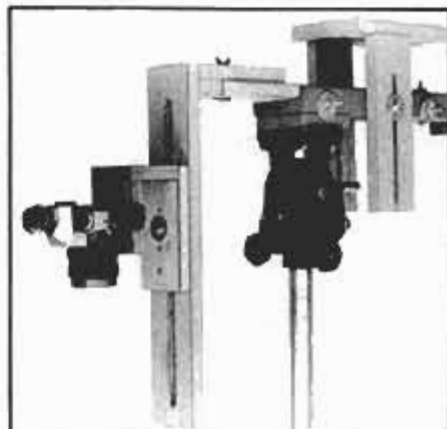
But for everyday use, you'll probably



The light-trap tube (above) holds slide and lets you move camera lens closer or farther away for exact focus. Make a test slide (left).

use the copy stand for standard photographic purposes. Try using the pedestal and stage combination to set up accurate shots of small objects, for instance. With the proper macro lens on your camera, many objects can be copied in an exact one-to-one ratio—objects besides other slides or photos.

You'll find that this little device not only adds to your photographic studio, it's almost a ministudio in itself. **PM**



L-shaped bracket above can be cut to any convenient length, depending on how far up the easel your support extends.

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Crosscut Saw Sharpening Tools

A two-man crosscut saw can make short work of felling trees and bucking logs, but only if it's properly conditioned. This involves more than just sharpening the teeth because not all the teeth do the same thing.

The tips of the triangular cutting teeth—positioned in pairs along the blade—must first be filed to a uniform arc. Then the cutting teeth must be set by alternately bending them a specified amount in opposite directions. Next, the rakers (the smaller double-pointed teeth which remove the waste left in the kerf by the cutters) must be filed shorter than the cutting teeth.

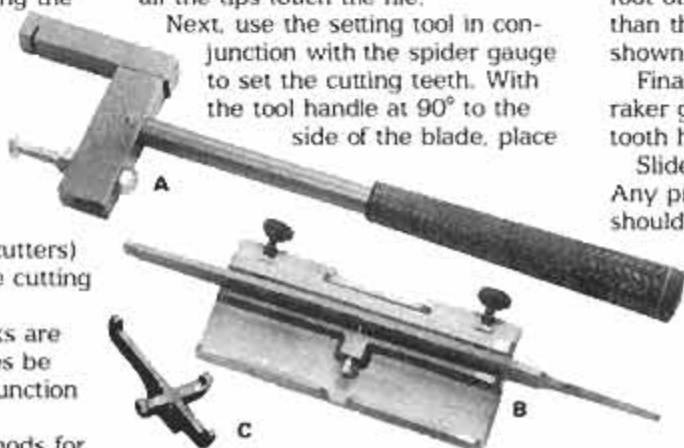
Only when these three tasks are completed can the tooth edges be sharpened to make the saw function properly.

While some makeshift methods for conditioning your saw can work, these simple but specialized tools from the Crosscut Saw Co. are a bet-

ter bet. Here's how they work:

The combination jointer-raker tool holds a file bent to conform to the blade arc by adjusting three screws. When the arc formed by the file matches the "averaged out" arc of the cutting teeth, file the cutters until all the tips touch the file.

Next, use the setting tool in conjunction with the spider gauge to set the cutting teeth. With the tool handle at 90° to the side of the blade, place



Crosscut saw sharpening kit includes a setting tool (A), jointer-raker gauge (B), and spider gauge for checking set (C).

the tool slot over the top of a tooth. Then adjust the set screw so it is .015 in. from the side of the blade and push down the handle. (An automotive feeler gauge works well for setting the stop.)

Check each tooth with the spider gauge to assure accuracy and uniformity. Adjust this gauge by filing the foot of the long leg .015 in. shorter than the other three. Then use it as shown in the photo.

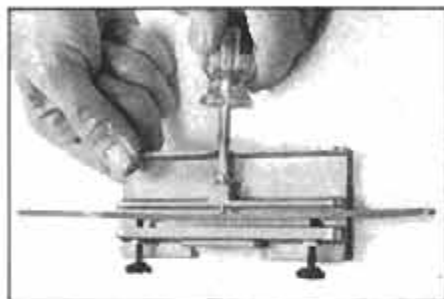
Finally, you must use the slotted raker gauge to determine the raker tooth height.

Slide it over each pair of rakers. Any projections above the filing pad should be filed off. Once these are filed uniformly, sharpen the cutters and "point up" the rakers.

For tools and information write: Crosscut Saw Co., 2 Leland Pl., Seneca Falls, N.Y. 13148.

Tools are available individually or in a three-piece kit for \$49.95 postpaid. A catalog is available free.

—Rosario Capotosto



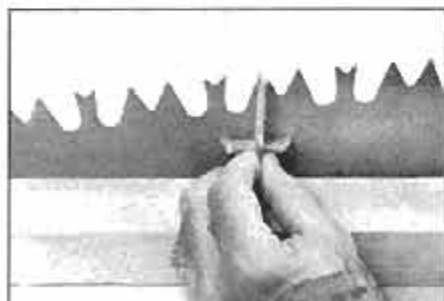
By adjusting three screws on the jointer-raker gauge, you can shape a file to conform to the arc of the saw blade.



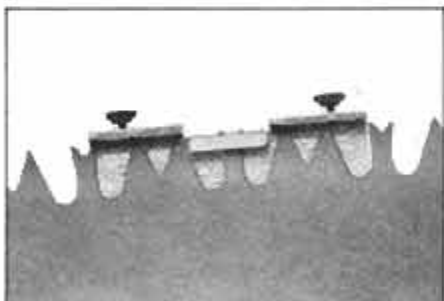
File cutting teeth to uniform arc by pushing tool opposite way from file tang.



Stop screw on the setting tool lets you set the teeth uniformly and precisely.



To check the set of cutting teeth, place spider gauge against blade. If gauge rocks up and down, set is too shallow. If it rocks side to side, set is too deep.



Put gauge on rakers with shim between gauge body (behind blade) and blade to keep them parallel, insuring accuracy.



File raker projections flush with plate, then remove gauge and sharpen edges.

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Ms. Susy G., Illinois



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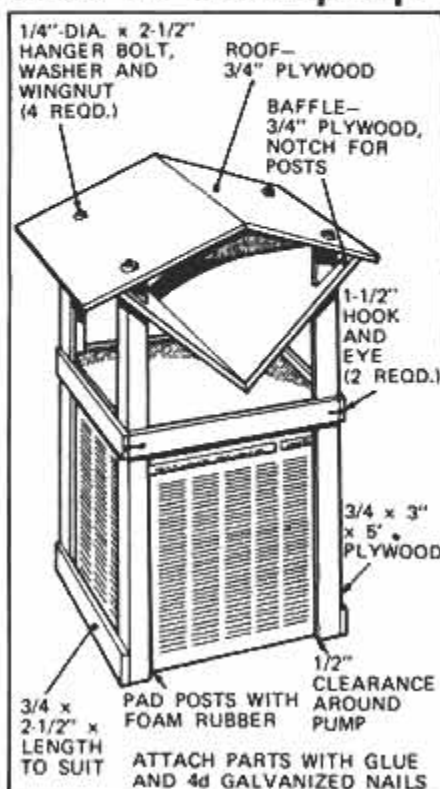
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5 Ways PM Readers Save Energy

Cover for a heat pump

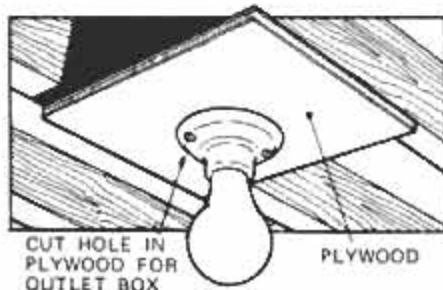


Build a plywood cover for your heat pump to keep snow from collecting. Make corner posts of two 3-in.-wide strips of exterior-grade plywood nailed and glued at right angles. Connect the posts at sides and back with bottom and

center rails, leaving space for noise-reducing foam-rubber padding. Attach a front center rail with hooks and eyes. Cut a plywood baffle, mitered along the joint edges; assemble it with glue and nails. Cut notches for the posts and install the baffle. Cut and assemble a roof, securing it to the posts with hanger bolts, washers and wingnuts.—*Victor G. Johannson, Etowah, N.C.*

Getting maximum light

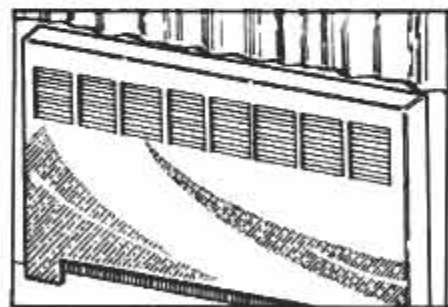
Without making any permanent changes, you can get the maximum illumination from bare lamps hanging in your basement or attic by installing reflectors above the lamps. Cut a square piece of scrap plywood with a hole in its center for access to the outlet box. Paint the wood white (semigloss or



gloss), then nail the panel to the joists, set the nails, fill the holes with wood putty and touch up with paint.—*Roger G. Steintl, Thurmont, Md.*

Let the heat flow freely

Drawing draperies at night helps keep cold air from entering the house. Yet floor-length draperies can also keep heat from wall radiators from circulating into the room. I've solved this problem by shortening my draperies and curtains to sill height. Baseboard heaters, too, should stand free of furniture



or other obstacles that might impede the flow of warm air.—*Victoria M. Willis, Middletown, R.I.*

Stop turbine in winter

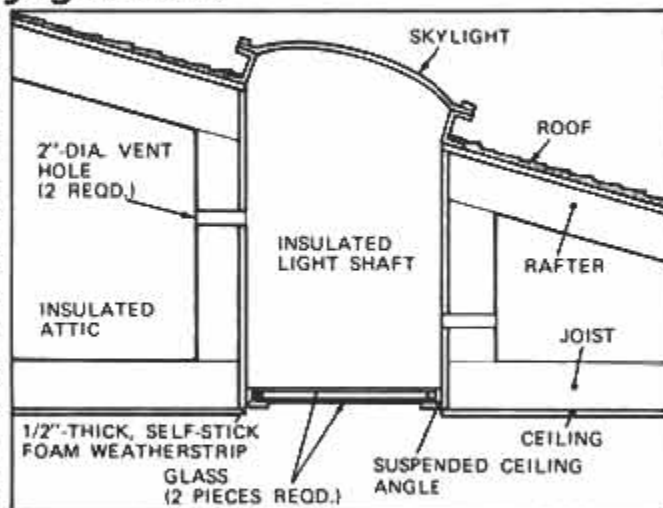
A wind turbine placed on the top of a house pulls hot air up and out of the house in the summer months, taking a load off the air conditioner. However, in cold winter months wind turbines still pull hot air, thereby increasing fuel con-



sumption. To stop the action of my wind turbines in winter, I slip plastic garbage bags over the units and their braces, and fasten the bags tightly around the throats with duct tape. A 26-gal. bag fits snugly over a 12-in. unit.—*Don Farris, Estill, S.C.*

Preventing skylight drafts

During the past winter the ceramic floor that is under our bathroom skylight seemed colder than normal. I corrected this problem by installing a window panel in the light shaft to eliminate the draft. Here's how you can do it: Cut two 2-in.-dia. vent holes on opposite sides of the light shaft into the attic. This lets air circulate. Attach suspended ceiling angles on opposite sides at the bottom of the light shaft, recessed 1/2 in. into the shaft. Measure and cut two pieces of glass to size. Maneuver the first piece in place. Seal the perimeter with adhesive-



backed weatherstripping. Position the second piece of glass. This creates a dead air space to prevent heat from escaping or cold air from entering.

—*Robbin Roberts, Plymouth, Minn.*

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Thanks to some fancy international negotiations, C. O. M. B. Co. has been able to acquire the entire remaining inventories of these AKAI Mini Component Systems from Japan. The 1983 models may be in the works, but these are brand new, PERFECT condition, factory warranted 1982 models! Now you can enjoy the incredible quality of AKAI at an incredible HALF PRICE! Centered around the 45 watts per channel power of the STEREO INTEGRATED AMPLIFIER,

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The QUARTZ SYNTHESIZER TUNER features memory preset of up to 20 separate broadcast stations. It can also be used to seek out broadcasts automatically at a touch with scan tuning.

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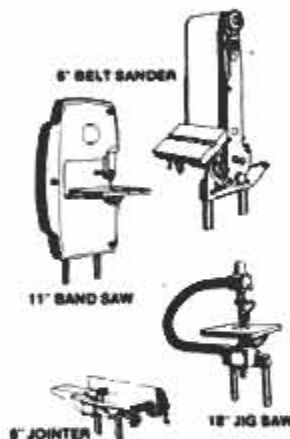
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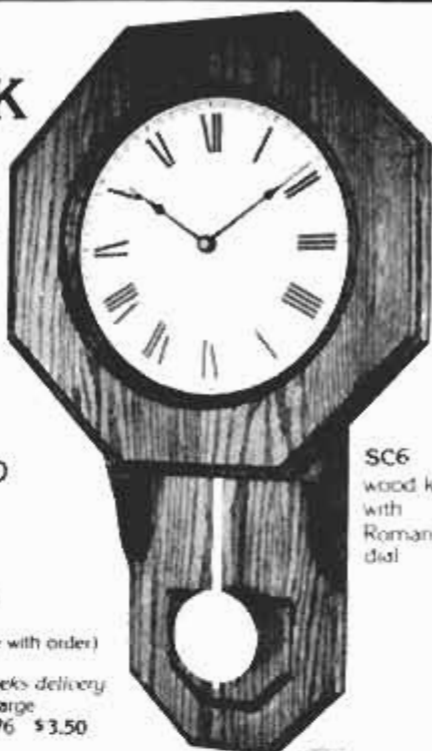
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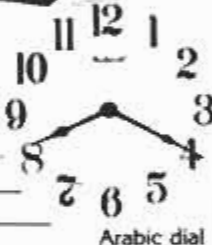
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David Haenke, Caulfield, Mo.

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a happy New Year - I know I will.

Jeff Connaway, Council, Id.

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Walter Smith, Grants Pass, Or.

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John S. Szelest, Methuen, Ma.

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I recently ordered one of your Monster Mauls and can say that it is the best tool I have ever used to split any and all sizes of wood. I used it to split an oak tree that was 42 inches in diameter. Thanks. Second Letter: Shortly after I received my maul which had a catalog with it, showing your stove kits, I decided to order the round door kit and try it. I installed the kit on a 42 gal. water storage tank and put it in our fireplace. The stove paid for itself in one month (January) and our heat pump has only been on one morning. (It was 14°F). We are heating all of our living area in an 1800 sq. ft. house and haven't been this warm since we have lived in the house. I'm still amazed at how well the stove works and keep kicking myself for not

trying it sooner. P.S. I have since built two other stoves. One for my brother and my grandfather. My brother is heating his 2200 sq. ft. log house with a 20 gal. stove in a fireplace with a built-in blower system.

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Gene Chase, Trails End Farms, Lawrence, Kan.

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My first order to you was the Monster Maul. Then the Lift N Saw and Woodstove Tools. Shortly afterwards I ordered the Log Tote and 30H Heater Kit and accessories. I am really pleased with the high quality and workmanship of your products. I believe they are the best made. I only regret that I did not know of the Sotz Corporation sooner. I wanted to praise you for maintaining the quality on each item.

George E. Cowart, Watkinsville, Ga.

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Ralph Deitrick, Mountainburg, Ark.

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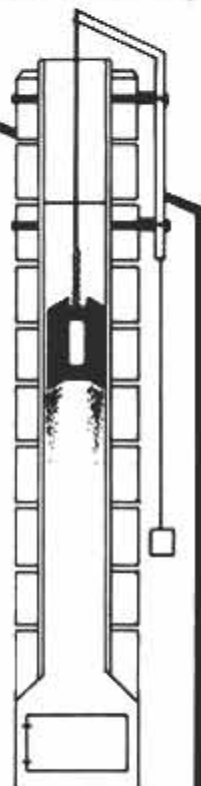
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PRECISION BALL BEARING SPINDLE for commercial service, \$12.50 add'l.

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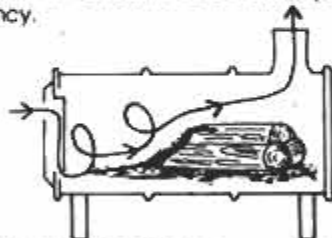
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BARREL STOVE'S UGLY

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Dick Metter, Jersey Shore, Pa.

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Gerald Fulkroad, Millersburg, Pa.

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David A. Hojnacki, Monroe, Mi.

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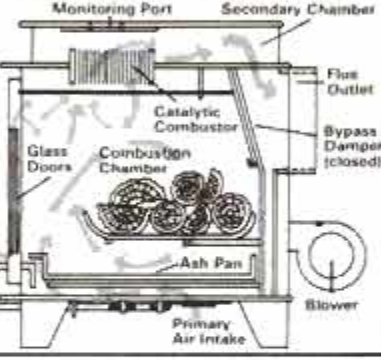
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