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NC

Step-By-Step Manual
HOW TO REFINISH
ANY WOOD FLOOR

Popular Mechanics

BLIZZARD DISASTER

How We Learn From Air Tragedy

861,000-MILE REPORT

Pontiac Trans Am
Owners Bought Style—
Love Its Handling

3 Solar-Assisted
Home Water Systems
You Can Build

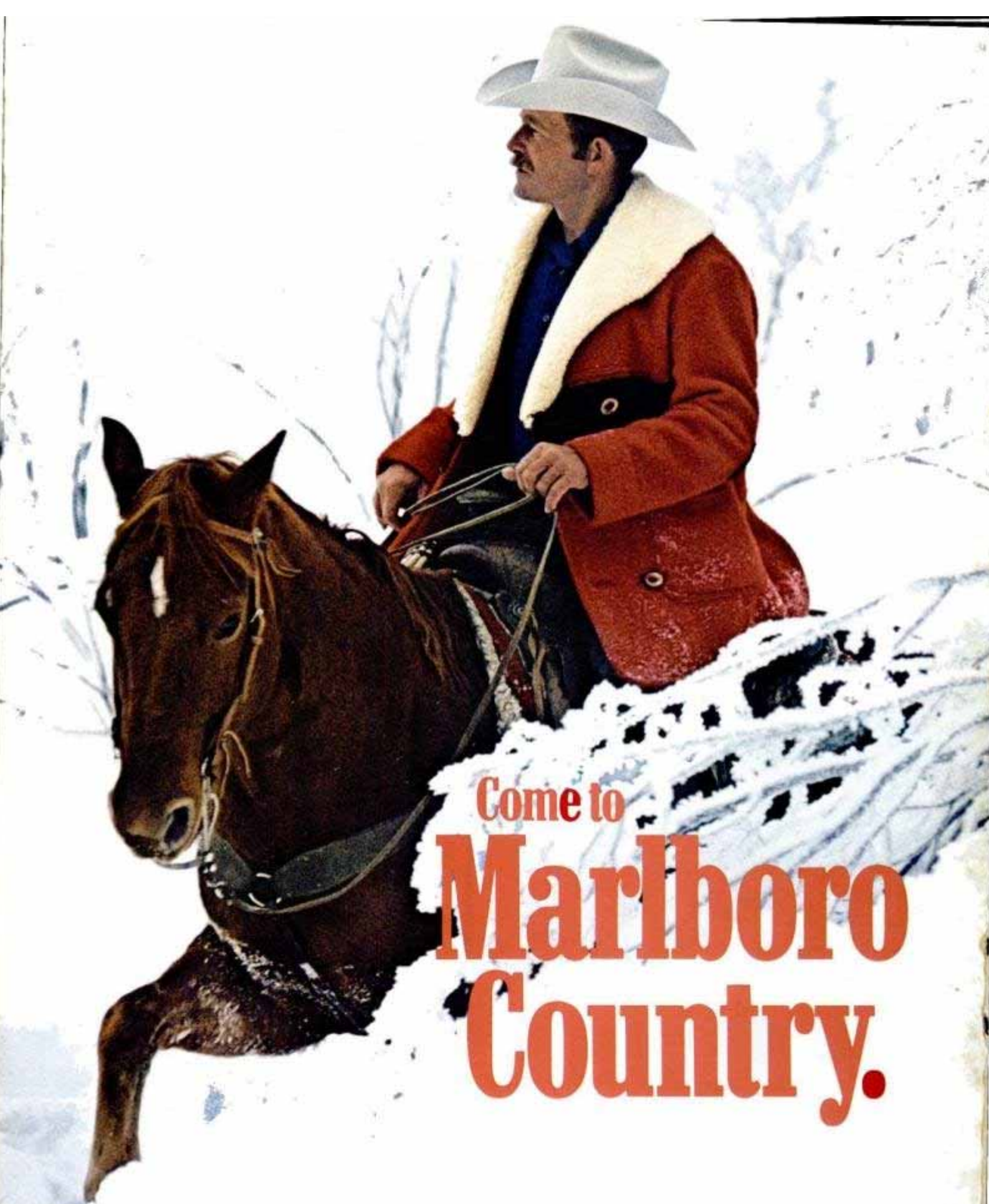
17 Kit Planes You Build
And Fly With No License

Discover The Versatile
Scroll Saw: A Master
Craftsman Shows How

Complete Guide To
Workshop Glues

PM Drives A
Coal-Burning
Car Of The
Future





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On the cover

Five people were saved, thanks to the most heroic rescue effort of 1982, in a winter air tragedy that reminded us how routine flight can still be a battle against the elements. Accounts of the rescue, which exposed the unreadiness of airports to handle nearby accidents, begin on page 80 in this issue.

—PM painting by Ed Valigursky

Popular Mechanics

JANUARY 1983

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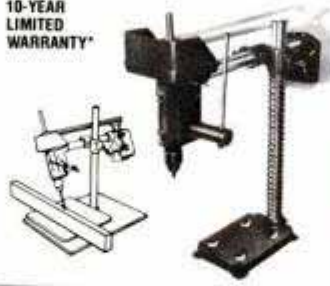
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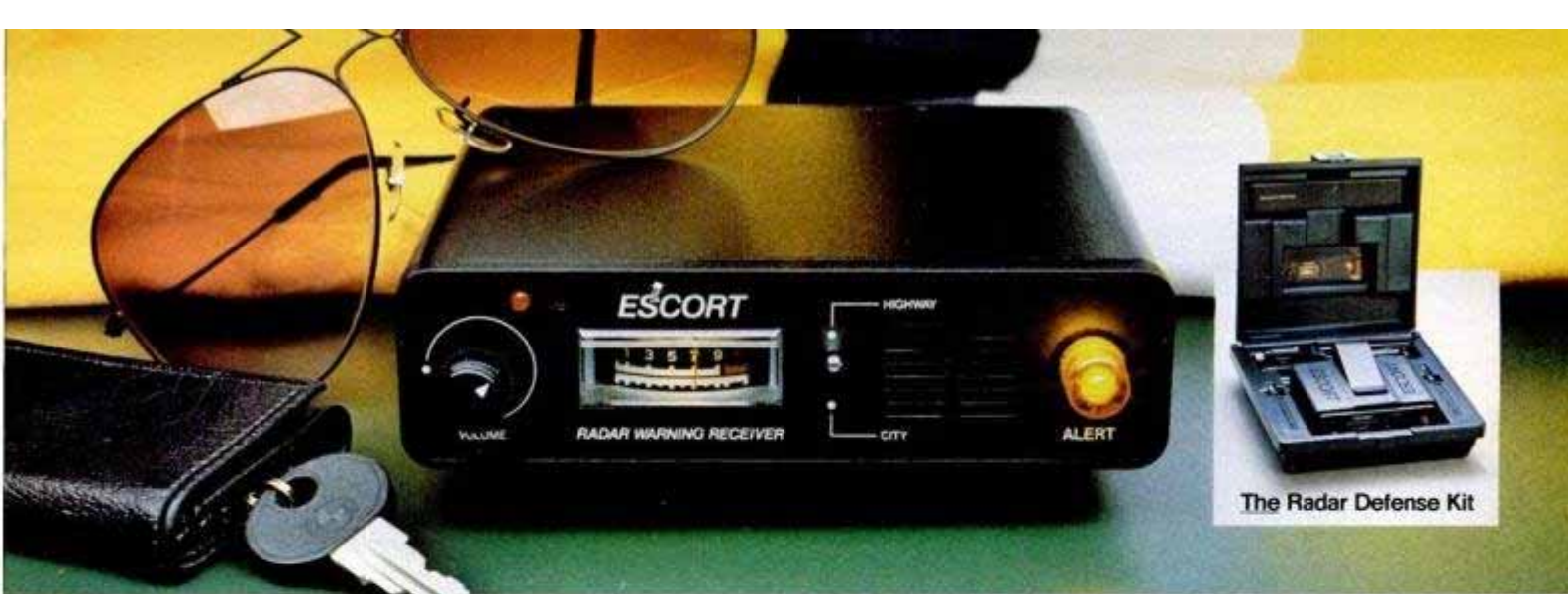
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LETTERS TO THE EDITOR



Blame the Navy (well, both of us)

In your October '82 *Letters* column (page 8), you explained how the Navy figures that 12-inch-thick armor plate on battleships actually has an effective horizontal thickness of 17.3 inches because the armor is inclined at an angle of 19°. Unless my high school trigonometry is awfully rusty, I think you'll find that a 19° tilt produces a horizontal thickness of only 12.8 inches, not the 17.3 you say.

In order to provide a projectile path of 17.3 inches, the armor plate would have to be inclined at more than 45°. Did the Navy goof—or you?

WILLIAM M. GIRARDEAU JR.
AUSTIN, TEX.

When I was in the Navy 40 years ago, they were better at this sort of tri-

angulation problem—or we would never have won World War II!

E. A. SIEGMAN
HAZEL CREST, ILL.

A lot of readers caught us up on this one. The explanation we gave came straight from the Navy, but we should have done our own homework, too.

What the Navy neglected to tell us is that their reasoning was based on the assumption that a projectile's steeply curving trajectory would cause it to strike the armor plate at a high angle of incidence—26.6° or more. This, combined with the 19° tilt of the armor, produces an angle greater than 45°—enough to create an effective path through the metal of 17.3 inches. Or so the Navy says.

Talking ashtrays?

After reading about those fancy electronic gimmicks we're about to get from Ford (*Detroit Listening Post*, page 24, Oct. '82), I'm convinced Detroit has reached the apex of insanity.

I don't need a car with voice-activated lights, turn signals, windshield wipers, radio antennas, ashtrays and all the other expensive nonsense that lasts about six hours after the warranty expires. And anyone stupid enough to need a satellite navigation system to tell him where he is shouldn't be on the road in the first place.

I do need a car that lasts, with simple controls that work and are easy and inexpensive to replace. Don't force me to pay for Rube Goldberg stuff nobody needs—because I won't.

RAY J. SALEK
BRIDGEWATER, N.J.

There are many who would agree with you, but it's important to recognize that Detroit is going through something of a growing-up period with the new-found marvels of electronics. When on-board computers were first put in cars a few years ago, mainly to control engine functions, it was quickly discovered that they possessed a lot more capacity than was being used. The result is that engineers have been

dreaming up clever and exotic ways to put this excess capacity to work.

But carmakers do listen to the opinions of their customers. If the public decides it doesn't want talking ashtrays and electronic road maps, Detroit will get the message.

Portable saw for southpaws

The old joke about left-handed monkey wrenches notwithstanding, your readers might like to know that there *is* such a thing as a left-handed portable circular saw. Being a lefty myself, I found the standard type difficult to handle and possibly dangerous because it puts the blade next to the operator, with the motor weight outside, making the tool awkward to control.

So I shopped around and found that Skil makes a left-handed model called the 551 Trim Saw. Though it's small (5½-inch blade), it has adequate capacity for most around-home jobs and sure is handy for us southpaws.

CARL HARTMAN
NEWPORT BEACH, CALIF.

Better maybe, but not new

I had a good chuckle over Ford's "Better Idea" for an automatic, self-dimming rear-view mirror (*Saturday Me-*

chanic Looks At The '83 Ford Cars, page 162, Oct. '82). My father was a Dodge/Plymouth dealer in Ohio in the '50s and had a '58 Dodge with a similar device. It would flip indiscriminately between the day and night positions, making chattering sounds like a machine gun. The slightest change in light level—even a passing cloud or bright neon store sign—would set it off.

Finally, Dad's temper got the best of him and he tore the mirror out. Ford will probably do the same.

DOUG LEVERS
RIALTO, CALIF.

Still a good project

Shipbuilders frequently experience frustrating delays, but I must have set a record. In the late '50s, I started making a model of a French warship you published plans for (*Modeling The French Chebec*, page 168, Nov. '58). I've worked on it on and off ever since, having had to put it aside many times for other, more pressing business.

Still, I was determined to finish it and finally have. The enclosed photo (below) shows the result. She's a beauty



PM's model of the Chebec, 17th-century French warship, built by reader Burkus.

and I'm really proud of her—even if she did take 25 years.

WILLIAM A. BURKUS
SOUTH BEND, IND.

Thanks for letting us know. A classic modelmaking project is always satisfying, no matter how long it takes. For others who may be interested, photocopies of the Chebec plans are available for \$12.50 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

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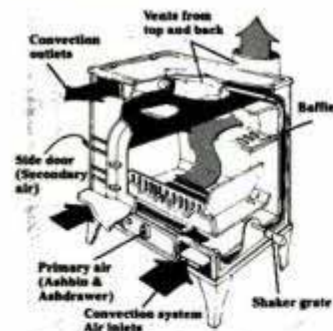
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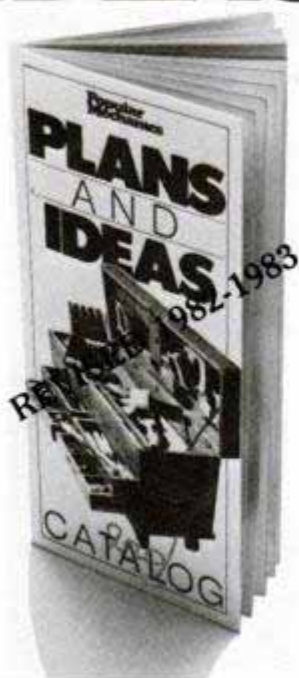
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EDITOR'S NOTES

John A. Littleton

Aerobatics in an ultralight? Most of us can think of 20 answers that add up to: No way. But for the daring, there is a new little plane built for



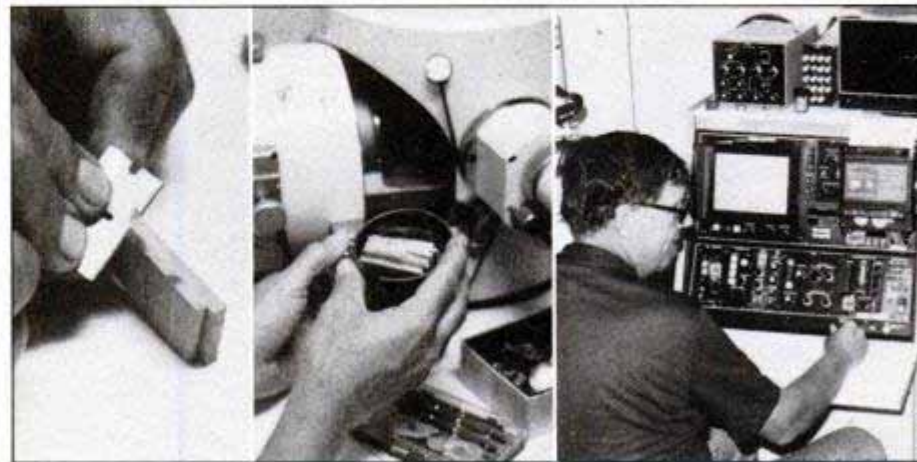
PM's Gallagher (left) gets away from his desk.

loops and other aerial hijinks (page 86). In addition, Shel Gallagher picked 17 sleek new kit ultralights for this month's article. They have wheel covers, trim-looking nose cowlings and other features of "real" airplanes. Best of all, a new FAA ruling assures you that you don't need a license to fly one. If you've dreamed of flying, now's the time to give it a try!

In our November article *Big Lift: Salvaging A 437-Year-Old Shipwreck* (page 96), we said that at about the time you were reading the article, the sunken *Mary Rose* would be brought to the surface. Right on schedule, the Tudor warship (right) appeared off the coast of Portsmouth, England, as the dramatic result of a \$10 million, years-long salvage operation.



What makes glue stick? To get the answer, we had some electron microphotographs taken for this month's article on adhesives (page 104). The pictures, which magnify glued joints some 480 times, help explain what goes on when you dab on glue and clamp two pieces of wood. Of course, there's chemistry involved. Chris Batich, engineering professor at the University of Florida, explained the process while colleague E. J. Jenkins snapped close-ups. **PM**



E. J. Jenkins cuts a super-thin cross section of two pieces of wood joined with adhesive (left). The sample, mounted in a specimen tray like that in center photo, goes into the photo chamber. Then Jenkins powers electron beam to take pictures (right).

PM photos: D.A. Perrine

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IMPORTS & MOTORSPORTS



The best-selling import—again

Ten years ago this month, when *Imports & Motorsports* first appeared in PM, and when you could buy a '73 Corolla for \$1,998, the best-selling import still was the VW Beetle.

But its days were numbered. By 1975 it was Toyota that was *ichiban*—that's *numero uno* to you Italian sports car fans—and the Japanese giant shows no sign of giving up that No. 1 ranking.

The Japanese carmakers have won over all of us: those for whom a car is a necessary evil, and those who love cars. Ten years ago few car nuts would consider buying Japanese (the exception was Datsun's 240-Z, \$4,106). Enthusiasts wanted sports cars and sporty sedans from Europe: Porsches and BMWs. And Toyota and Datsun (now Nissan) still didn't have cars the equal of Maximas and Cressidas to go



Toyota Corolla, shown here in the 1983 SR5 Sport Coupe body style, is still the best-selling nameplate among imports.

Now, they've got models for everyone, and they're not just economical and well-built: Japanese cars circa 1983 are exciting, innovative, better styled than they've ever been and a great bunch of handlers. Consider Toyota. With the Corolla nameplate alone, if you just need wheels, you can get a tame two-door (light-years better than the '73-vintage 1200 model), or you can go all the way and set up a hot, blackout, SR5 five-speed that'll knock off the competition's wheel covers. For '83, Corollas keep their 70 hp, but with an all-new, smaller, 1.6-liter, ohc Four that boosts mileage to 36/47 city/highway. Looking at the other Toyotas: Starlet gets an aerodynamic facelift and a 42/54 mpg rating. Fwd Terrels are completely redesigned; an intriguing six-speed, 4wd wagon is added to the line. Over \$10,000: The twin-cam Supra (see page 60) gets a five-hp boost to 150, and Cressida gets Supra's 2.8-liter twin-cam. Those are just Toyota's '83s. We haven't even mentioned Mazda, Mitsubishi (see page 70) and Isuzu. For the first time since 1962, when I started buying new cars, the top candidates for my next car are Japanese.



Wanna bet this new '83 Terrel 4wd runs Subaru's cult wagon into the bushes?

against family sedans, the likes of Volvo, Peugeot, Audi—even Mercedes with its \$7,000 220 models. What Toyota and Datsun, and fast-growing Honda and Subaru had a batch of were competent, \$2,000 to \$3,000 little cars that were well-built and thrifty.

Sportiest wagon

Just get a load of this Pininfarina hauler! It's in complete contrast to the snugly ugly Terrel station wagon above, which will attract the off-road crowd. Based on the Lancia Gamma and



Lancia wagon is a show car.

called the Olgiata, this wagon—the smoothest ever to grace an auto show stand—was recently shown in Paris. Too few attempts have been made to combine the practicality of the station wagon, or estate car as it's called in Europe, with high style and performance. Volvo's early '70s 1800ES sport wagon was a nice exercise, and Reliant's Scimitar is a successful, but aging, example. But for sport-wagon



Side-glass treatment of Pininfarina design disguises roof pillars of the Lancia.

styling, Pininfarina has hit it with this one. Too bad it's a one-off show car; I'd like him to design a pair of roof clips for my surf-casting rod.

Vest-pocket car

And you thought Le Car was small. Renault's 10-foot experimental city car takes its name from *Véhicule Econome de Systèmes et Technologie Avancés*: VESTA. The little mock-up manages a



VESTA is result of Renault and French government program for efficient cars.

.22 drag coefficient (not easy with such a short shape).

If it were readied for production, engineers predict it would weigh under 1,200 pounds, and with a small powerplant, maybe a two-stroke, three-cylinder turbodiesel, it could average 103 mpg at 55 mph.

However, it's a long-range project so don't look for PM's road test until along about 1990.

PM

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ALL OUTDOORS



Two-from-one marine power

It isn't often that there is a major breakthrough in marine design. But 25 years ago Volvo Penta, the marine division of the Volvo car company of Sweden, introduced a brand-new power package for boats—the first successful inboard/outboard drive. Now Volvo is adding a development that it hopes will start another trend.

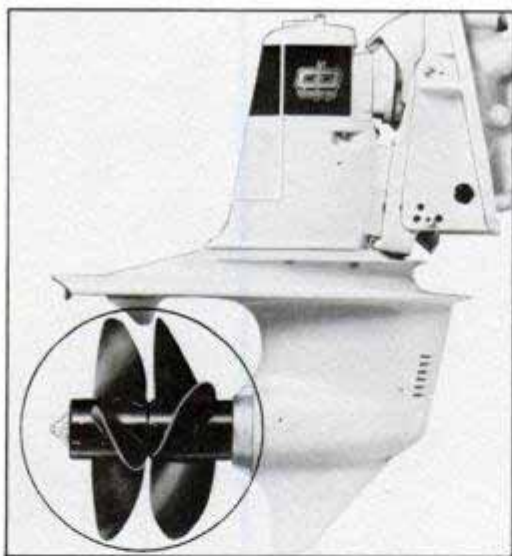
Volvo called its original sterndrive the Aquamatic. It was the creation of noted boat designer-engineer-racing driver Jim Wynne of Miami. By combining an inboard engine that could be positioned back at the stern with a steerable propeller system that could tilt up behind the transom, Wynne's invention offers advantages of both inboard and outboard power for planing hulls. Outdrives, I/Os and sterndrives are commonly used names for the invention.

Volvo's latest refinement is an Aquamatic with one engine driving two propellers that rotate in *opposite* directions. The second propeller is driven by the same shaft, but is of different diameter and pitch. Called Duoprop by Volvo Penta, the development is reported to boost prop thrust and efficiency up to 15 percent, and acceleration to 30 percent. Speed is claimed to increase several miles an hour on test boats, with up to 15 percent less fuel consumption because the increase in efficiency requires lower rpm.

Volvo's engineers point out that a single propeller rotates water backward in the form of a cylinder while developing axial

force that pushes the boat forward, plus radial force that tries to twist the craft in the opposite direction. Water friction and turbulence may cause a loss of 40 percent of available energy. Duoprop, with its counter-rotating props on the same shaft axis, should reduce these losses considerably, Volvo engineers feel. A pinion gear at the bottom of the single driveshaft turns fore and aft spider gears that drive the computer-developed, twin-prop setup.

Similar aircraft-propeller experiments have never proved very successful, but underwater prop performance may be more efficient. Several boats mounting Duoprop Aquamatic outdrives should be available this summer.



Two props may be better than one when they can counter-rotate on a Duoprop sterndrive.

Staying healthy afield

When you get a cut or sprain out in the boondocks, particularly this time of year in a cold weather region, you can be in a lot more trouble than back home near doctors and drug stores. A simple injury could turn into a survival situation if you are not properly prepared. Sporting goods stores now stock more complete first-aid kits for outdoorsmen, and mail-order outfitters like Early Winters, 110 Prefontaine Place S., and

The Yak Works, 2030 Westlake Ave., both in Seattle, Wash., have added medical and dental emergency packets to their offerings. (Both are also sources for long-life lithium batteries.)

The most extensive outlet we've found, however, is Indiana Camp Supply, Box 344, Pittsboro, Ind. 46167. Available from this supplier are such basic items as bandaging materials, nonprescription drugs and ointments, and snake bite kits, on up to supplies

you hope you never have to use—air splints, suture needles and gut, hemostats, forceps and scalpels. You may never need them, but if you or a family member is suddenly injured far from professional help, they could make the difference.

With such a collection of essentials in stock (including hard-to-find hypothermia thermometers that read down as well as up), you may have guessed that the president of Indiana Camp Supply, William Forgey, is a medical doctor. How to use elementary surgical equipment is well outlined in his *Wilderness Medicine*, \$5.95, one of a good selection. In addition to standard camping supplies, a broad assortment of trail and survival food is also offered.

Prescription drugs, of course, must be specified by a doctor and are purchased locally. Carrying a spare prescription may not work if you need it filled far from home when you suddenly come out of the woods with a three-day growth of beard. Discuss with your doctor any special drugs you might require to complete your expedition medicine chest.

Planning ahead is particularly essential for travelling outdoorsmen, and where you are going is part of what your doctor should know. Assume that any medicine he gave you several years ago for a trip to the tropics may have lost part of its potency from heat, humidity and age. And if you're heading into an area where malaria or other fevers occur, ask if you should start taking preventive medicines a couple of weeks before you pack your bags.

What it's worth

Owners of old boats and motors often wonder if they own a valuable antique. Price is determined, of course, by how badly someone wants to buy something. One way to find out is to join the Antique Outboard Motor Club, 759 Mary St., Clayton, N.Y. 13624. Dues are \$15, and include the club's journal, *The Antique Outboarder*. Another source is BUC International, 1881 Northeast 26th St., Fort Lauderdale, Fla. 33305. For \$98, collectors (and dealers) get three volumes of price guides with detailed listings of boats and motors from 1905 to 1982. **PM**

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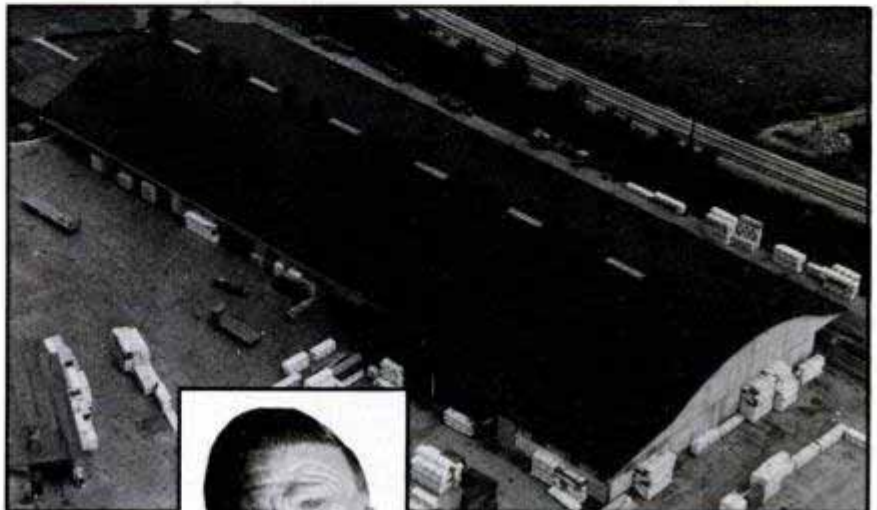
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DETROIT LISTENING POST



Spy photo shows P-car with aggressive 50-series tires.

Pontiac pocket rocket P-car!

As production of Pontiac's mid-engine, two-seat, plastic-bodied P-car nears reality, more details about it are becoming known.

Just one engine will be offered for '84: Pontiac's own fuel-injected 2.5-liter Four, mounted transversely above and in front of the rear wheels. Suspension will be four-wheel independent. Standard transaxle will be a four-speed manual, the only other choice a three-speed automatic—both borrowed from GM's compact X-cars.

Predicted performance is a very impressive eight seconds 0 to 60, along with highway fuel economy in the 40-mpg range. Starting price will be well under \$10,000, and Pontiac expects to build and sell nearly 100,000 of the little beauties in 1984 without sharing the car with other GM divisions.

First-year Ps will be coupes only, but an optional Targa roof will be offered in '85; a full convertible top is a later possibility.

Potential future improvements include a five-speed transaxle (incredibly, GM is still pondering whether to make its own!) and either turbocharg-



Yarn tufts glued to the body show engineers airflow over the rear engine deck.

ing or a fuel-injected V6 to turn it into a real pocket rocket. The P's engine compartment was redesigned late last year, in fact, to allow use of a wide vari-



Spare tire, radiator and brakes live in the busy front compartment of the P-car.

ety of powerplants, both larger and smaller than the 2.5, depending on fuel prices and buyer preferences.

Pontiac general manager and GM vice-president Bill Hoglund is counting on the P-car as a terrific image booster for his division and says it "could have a more dramatic impact than the advent of 'Wide Track' in 1959, the GTO or even the Firebird."

Divisions at GM

What we've been interpreting and reporting as confusion at General Motors over future product decisions may be partially that—and partially a deliberate effort to dehomogenize the five car divisions' lineups.

Both corporate and divisional executives have lamented the recent practice (of press and public) of thinking in terms of car lines or families instead of specific products. We speak of X-cars, J-cars, A-cars, for example, instead of Citations, 2000s or Century.

The implication, of course, is that all members of a family are alike, with similar styling and features and the same engineering strengths and weaknesses. Why buy the Chevrolet when, for a few dollars more, you can have the Buick version of the same car?

The reality? Much more difference than you would think. Aside from styling changes inside and out, there are considerable divisional differences in personality and driving character. Each division's engineering team develops and tunes its own acoustical packages for noise and vibration control. Each offers exclusive features and options that the others don't—from engines and transmissions to climate control and stereo.

But GM feels it must work to change this car-line mentality, and the short-term solutions range from wider price differentials (cheaper Chevys, better equipped and more expensive Olds and Buicks) to encouraging each division to pull away from the corporate identity and develop its own image.

Thus Chevy returns to its traditional

image of value for money with a little high performance mixed in. Pontiac becomes the "European" division with subtler styling and more driver-oriented cars like this year's 6000 STE and next year's mid-engine P-car two-seater. Olds retains its traditional conservative image, stressing diesel engines and a wide variety of middle-American Cutlasses.

Buick treads the line between big-car conservatism and Pontiac-style excitement with turbo V6 engines and a whole range of performance-oriented T-type models. Cadillac, likewise, tries to hold its long-time customers while courting the affluent young with Eldorado Touring coupes and small, BMW-like Cimarrons.

Long-term, the answer might lie in [\(Please turn to page 16\)](#)

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DETROIT LISTENING POST

(Continued from page 14)

more diversified product ranges. Instead of having its own version of almost everything, each division would pick and choose from GM's vast product supermarket.

Thus Pontiac, Olds and Buick will get variations of the coming N-body—based on the fwd J-car but stretched two inches and with room and structure to accommodate an optional V6 engine—to replace their current rear-drive Grand Prix, Cutlass Supreme and Regal for '85. But Chevy may hold out

another six months or more for an exclusive new "A-special" coupe (built off a stretched X-body) to succeed its Monte Carlo. Interestingly, Cadillac also is considering the 2-door N-car.

Rumors are strong that both Pontiac and Oldsmobile may drop its compact fwd X-cars (Phoenix and Omega) after '84, while Buick would keep its more expensive Skylark for one additional year and Chevy its cheaper Citation even longer.

Chevrolet also has plans to keep selling its popular rear-drive B-cars (Impala and Caprice) as long as there's a market for them. Pontiac dropped its

full-size Bs a year ago; Buick and Olds will follow suit after '85.

It looks like Pontiac will have exclusive use of its own hard-won P-car sportster for at least a year, maybe longer. Chevrolet is not terribly interested at the moment. Buick wants a more expensive sports car, based on the '85 fwd E-car (Toronado/Riviera/Eldorado) replacement, to compete against Mercedes' 380SL, Jaguar's XJ-S and Porsche's 928—and Cadillac is already lobbying to get in on that potentially profitable act.

If this all seems tougher to keep track of, you're not alone in your opinion.

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10.	Krazy Kong	\$16.95	\$14.95

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Ford forges on

We saw a very interesting convoy of cars on Interstate 94 near the Detroit Airport a few weeks ago. Running together with a spanking new Thunderbird (well before its public introduction) were a Toyota Supra, a Mazda RX-7, a Datsun 280-ZX and a BMW 633CSi, all high-performance, rear-drive sports cars and sport coupes and all sprouting identical stick-on radio antennas for car-to-car communication.

It was obviously a Ford engineering test trip comparing the new 'Bird, probably with the mid-'83 optional turbo-four-cylinder engine, to some pretty tough competition. If they're confident enough about the coming Turbo T-Bird to self-inflict that sort of comparison, it must be pretty good!

Chrysler/Shelby deal

Performance buffs will welcome the news that Chrysler chairman Lee Iacocca has inked a deal with former racer Carroll Shelby to collaborate on some hot new products. First out of the chute is a terrific-looking, fwd, Charger-based Dodge Shelby coupe, with aero aids front and rear, super handling suspension, port-injected 2.2-liter engine and unique silver-on-blue (or blue-on-white) paint scheme.

Iacocca called it "fast, fuel efficient, durable and affordable" (under \$10,000) and said that such exciting but practical products "will grab the new youth market." Shelby will also work on special parts for distribution through Chrysler's Direct Connection catalog.

You may remember him for his awesome Shelby Cobra sports cars and Shelby Mustangs in the '60s—and Iacocca, then Ford Div. general manager, as the guy who hired him to help build Ford's performance image.

What's next? Probably a turbo-charged Shelby version of the '84 G-24 sports car. Then, who knows? "We may do another Pantera someday," Iacocca says.

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Sealed with a vengeance

I'm totally confused about lubricating the suspension ball joints of my 1982 Ford F-100 pickup truck. I went to grease them, but found no grease fittings. Yet, page 185 of the 1982 Ford truck owner's guide calls for service. One dealer told me that these were greased-for-life fittings and didn't require servicing. Another dealer claims they should be greased every 15,000 miles. He says I should have grease fittings installed. Please straighten this out.—Bruce E. Montag, Aston, Pa.

The official word from Ford is that you do not grease lubed-for-life ball joints. That's why there are no grease fittings in the joints. Furthermore, there are no plugs that can be removed so you can insert grease fittings. The ball joints in your '82 F-100 are sealed, and that's that.

The instructions that are on page 185 of the truck owner's guide apply only to front axle spindle pins on F-250 and F-350 trucks—not to lubed-for-life ball joints.

Sweat box

Even with the heater of my 1981 Chevrolet Citation turned off, I get a continuous flow of hot air from the defroster vents. Since the car isn't air conditioned, it gets very uncomfortable, especially in warm weather. The dealer hasn't been able to stem the flow of heated air. Can you help?—L. Sisoyeff, Elmhurst, N.Y.

One of two conditions is likely:

1. The temperature door next to the heater duct may not be closing fully when the defroster is off because of a kinked control cable.

2. The rubber seal that's supposed to be around the temperature door may be missing, or the temperature door may be damaged in some other way.

Rejected lover

I love my 1979 Honda Accord in summer, but hate it in winter. Unless I warm up the engine fully before I drive off, it sputters and dies on the road. This occurs if the car sits idle for even half an hour. The problem has been with me since I bought the car, and no mechanic has come up with a solution. Please help. This is making my winters miserable.—Laura Laufer, Bloomfield Hills, Mich.

Put a smile on your face, Laura. Somewhere in the following lineup of possible causes for this problem is your answer:

■ First, fast-idle speed may not be adjusted properly. The specification called for is 2,800±500 rpm. However,

according to a buddy of mine at Honda, your mechanic should set this speed at the top end; that is, 3,300 rpm. The adjustment is made with the engine warmed up.

■ Second, the thermal sensor may be malfunctioning. This part, which controls choke and fast-idle operation, has a habit of getting coolant inside of it, which then corrodes and sticks. Have the sensor replaced. It's screwed into the head.

■ Third (maybe this should be first), you may be using an improper starting procedure. Are you pressing the gas pedal to the floor and releasing it slowly? Then, are you keeping your foot off

the pedal as you turn the ignition key? Finally, are you reacting to a false start? In other words, are you releasing the ignition key when it seems as if the engine is going? It sometimes takes as much as five seconds for your Honda engine to get running.

■ Fourth, you may have a weak choke-opener spring. The spring lets the choke plate close to less than 1/8 inch when a cold engine is started. This gives the engine a richer fuel mixture to keep it from stalling. Tension on the choke plate is maintained until the engine warms up.

Have your mechanic check the carburetor identification plate. If the fifth figure is A, B, C or D, he should replace the choke-opener spring with a new one, which has been strengthened. The part number for this modified spring is 16057-689-305. This fix applies to Preludes as well as to Accords.

Lockjawed lockup

I bought a 1979 Plymouth Volare with 318-cu.-in. engine and 28,000 miles on the odometer from a Chrysler dealer. A month later, the lockup torque converter stripped its splines. I would have chalked it up to fate, except I have a service record kept by the car's original owner showing converter problems.

(Please turn to page 22)

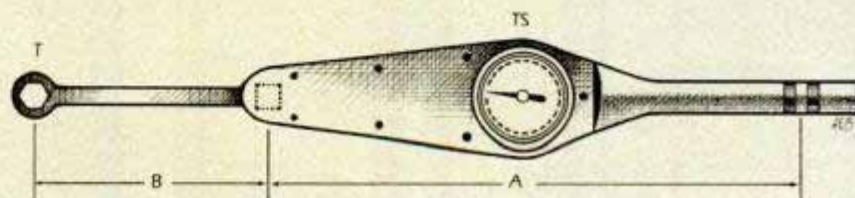
Let's torque this over

When you put an extension on your torque wrench, the actual torque force you apply is greater than the reading on the wrench. If you don't allow for this, you'll overtighten fasteners and may cause damage. To get correct torque with an extension requires that you do a little math (use the illustration as a guide):

$$\frac{\text{torque wrench length (A)} \times \text{desired torque (T)}}{\text{torque wrench length (A)} + \text{extension length (B)}} = \text{torque scale reading (TS)}$$

Example: Suppose you want 80 ft.-lbs. of torque. You've outfitted your 12-inch torque wrench with a 4-inch extension. Your torque scale reading should thus be:

$$\frac{12 \times 80}{12 + 4} = \frac{960}{16} = 60$$

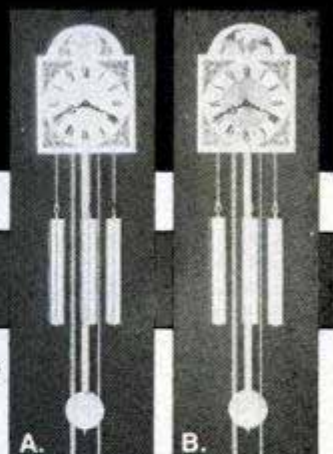


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CAR CLINIC

(Continued from page 20)

Also, several transmission shops have told me that this converter has been a pain, what with splines stripping and pumps pooping. The Chrysler Consumer Relations Board denies the allegation, saying that there hasn't been any abnormal trouble. Have you heard of problems and is there any talk of a recall?—Greg Endeman, Rogue River, Ore.

Yes, there have been serious problems with the '78 and '79 versions of the Chrysler lockup torque converter. No, I know of no plans for a recall. However you'll want to know about three significant service bulletins. If all redesigned parts mentioned in them are installed in a '78 or '79 lockup converter, essentially what you end up with is a 1980-82 version of the converter, which is a reliable unit. Here's a run-down as to what these bulletins advise:

■ No. 21-14-79 (6/25/79) describes the procedure of eliminating "abnormal torsional vibration" or "lockup torque converter transmission shudder." These are two distinctively different conditions.

"Abnormal torsional vibration" is described as a continuous drumming or

droning sound from the drive train up to approximately 45 miles per hour. This is due to the early engagement of the converter. The solution lies in replacing the lockup spring inside the

converter. This modification raises the converter lockup speed, which will solve the problem but will hurt gas mileage slightly.

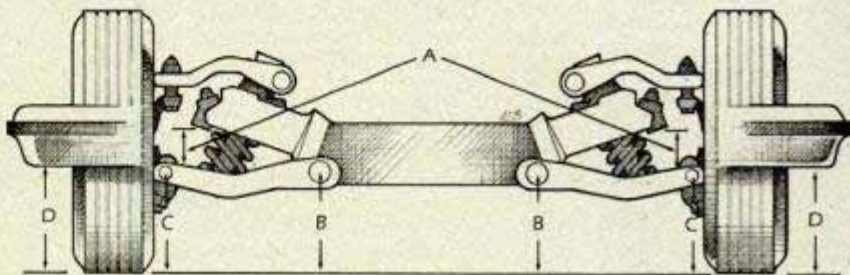
"Lockup shudder" is described as a

Know your As, Bs, Cs and Ds

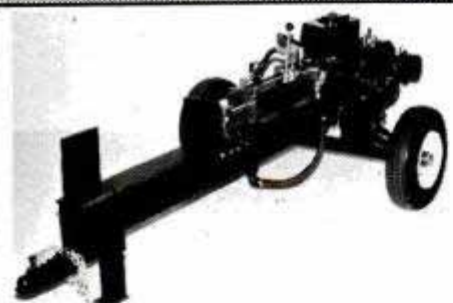
What happens when coil springs or torsion bars weaken and sag? This: Ball joints and control arms overload, front-end alignment goes out of whack, and tires and steering linkages wear abnormally. To find out how your springs are holding up, use a tape measure and this illustration, with thanks to TRW:

- Park on a level surface.
- Measure the distances between the lower control arms and frame (A). There should be no more than 1/4-inch difference between the two A measurements.
- Measure dimension B. The difference between the two Bs should be no more than 3/4 inch. Do the same for the two Cs.
- Measure the floor to bottom-of-the-bumper distance as shown by the Ds (make sure the bumper isn't bent). The difference between the two D measurements shouldn't be more than 3/8 inch.

If necessary, replace both springs or torsion bars—not just one.



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Built-in relief valve. 1/2" in-out ports. 1/2" cylinder ports.

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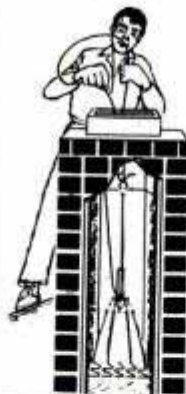
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Briggs	3 1/2	1/2"	Recoil	7030	\$ 95
Briggs	4	1/2"	Recoil, hor. pl.	7040	110
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Tecumseh	10	1"	Elec. cast sl.	70101	259

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hours of work is selling for over \$228 in the stores. I can sell my chaise lounge for anything I think my labor is worth. For once, the big manufacturing companies cannot compete with me or you on prices. You will find you will have more orders than you want!

Where can you buy the P.V.C. Pipe?

You can buy the P.V.C. pipe from any local hardware store to start. Plus I will supply you with the names and addresses of cushions and pipe manufacturers who will sell to you wholesale, plus I will supply you with my shop manual and six detailed shop drawings with pictures and measurements of six different designs.

Do you need my shop drawings

No, you don't need my shop drawings unless you want to save hundreds of hours of trial and error work and thousands of dollars that I had to spend before I finally

found the right design and measurements and tricks to the manufacturing of P.V.C. pipe furniture. I only wish that when I started, I could have bought these shop drawings and I would have gladly paid \$100 for just one of them.

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vertical shaking of the instrument panel and steering column. It may be caused by one or more of several conditions, including a rough road or a poorly tuned engine. But the bottom line is that it's also caused by a defective converter lockup valve body and pump. If so, the old parts should be replaced. The bulletin tells you what to replace with.

■ No. 21-10-79 Revision A (7/30/79) speaks about the tendency of some 1978-79 lockup torque converter clutches engaging when the transmission is shifted into reverse gear. This condition is characterized by engine hesitation or sluggishness when the car is accelerated in reverse. If this condition persists after the transmission oil cooler is reverse-flushed, a new pump should be installed.

■ No. 21-23-79 (12/10/79) is a discussion of your problem. Greg—what to do if the car won't drive when shifted into gear because of stripped splines. It seems that the trouble is confined to the A-904 transmissions having the lockup torque converter.

Mistaken identity

My 1977 Lincoln Mark V has developed a fluid leak in the brake hydro-boost power unit that's listed as part No.

2005 in the shop manual. The manual indicates that the same unit is used on the Granada, Monarch and big-size Ford, Lincoln and Mercury models. My local Ford-Lincoln service center says no way—that these parts are not interchangeable. If these parts were interchangeable, a hydro-boost that came off a wrecked Granada, Monarch or LTD would save me over \$300. Wrecked Mark Vs are hard to find. Am I being conned?—Blaine Kemmerer, Hayden Lake, Idaho.

It's no con, Blaine. You have to watch those part numbers in Ford Motor Co. service manuals. What often looks like a part that fits several models, because numbers are the same, is a part that fits only one model. You see, only a portion of the part number is given. In your case, the shop manual doesn't show the front halves of those part numbers, which are D7DZ for the Granada and Monarch, D7VZ for Ford, Mercury and Lincoln, and D7LY for the Mark V.

However, most hydro-boost leaks can be fixed by replacing the seals.

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

■ If you expect to prevent a repetition of a Honda brake vibration problem by doing a brake job, grind discs while they're on the car. Don't grind them on a remote brake lathe. You'll probably have to let a Honda dealer do the job since he, rather than an independent mechanic, is more likely to have a Honda disc brake grinder. On-the-car grinding assures that discs are machined absolutely parallel, a necessity with Honda.

■ Don't trust that hatchback door on a 1979-80 Plymouth Horizon TC 3, Dodge Omni 024, Ford Mustang or Mercury Capri. Those lift cylinders are suspected of being unreliable. If only one fails when you're beneath the door, the door can drop and injure you. There have been 30 such injuries reported, and the National Highway Traffic Safety Administration is investigating.

■ A stumble or hesitation of a cold 3.8-liter engine in certain 1982 Thunderbirds, Granadas, XR7s and Cougars can be corrected by installing a new accelerator pump rod (part No. E1PZ-9F687-A). In T-Birds and XR7s, a new accelerator pump diaphragm (part No. E2AZ-9B559-A) is also needed. Ask your dealer to check article 82-14-14 of service bulletin 82-14 to see if your car qualifies. **PM**

SCIENCE WORLDWIDE



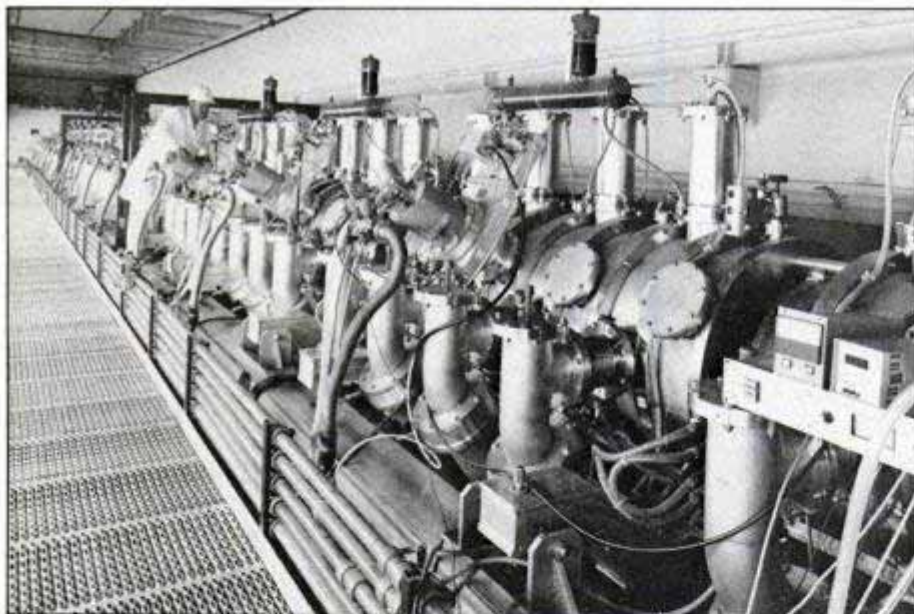
World War III: confined to the lab

Today's nuclear weapons are so awesomely powerful that few people can get past the horror to consider how the weapons work. I, for instance, have difficulty accepting the idea of the neutron bomb—a weapon emitting radiation that can take human life miles away while leaving intact buildings and even military tanks. Physicists also wonder how the bomb will behave.

To examine this—not to mention the physics of little-known energy outputs of high-powered H-bombs and A-bombs—physicists have developed several ways to simulate a nuclear blast. They are seeking information on how far the radiation goes at what wavelength.

The higher-powered weapons put out much of their energy at the X-ray wavelength, a phenomenon that's difficult to simulate without actually setting off a small bomb. But now the researchers at Lawrence Livermore Labs in California have a new device: the Flash X-Ray Facility. It's the biggest X-ray machine in the United States.

Using the facility's linear electron accelerator shown below, the researchers fire very high-energy particles at tiny metal targets such as tungsten. The resulting blast gives off X-rays thousands of times more powerful than a chest X-ray. The outward blast looks much like that created by a nuclear weapon.



Linear accelerator blasts small targets, simulating the explosion of a neutron bomb.

New lab tool: fingers

Genetic researchers, for years, have been seeking a way to rupture the cell walls of plants without damaging the DNA (the basic chemical of genetics) crammed inside the cell. Fancy lab equipment has been tried without success. But Jack Van't Hof and his colleagues at Brookhaven Labs have discovered something that works. Coat a plant cell with a chemical that hardens the nucleus. Then put the cell on a

microscope slide. Cover it with another slide and press the pair between thumb and forefingers and you'll crush the cell wall, leaving intact precious DNA molecules for further study.

Huffin' over puffins

Atlantic puffins—sometimes called sea parrots—nearly became extinct in a rash of 19th-century hunting. And, while a federal hunting ban raised puffin

population levels earlier this century, puffins never returned to some popular nesting grounds. In the premier issue of Cornell University's *Living Bird Quarterly*, however, ornithologist Stephen Kress reports the hatching of five pairs of puffins on Eastern Egg Rock Island off the Maine Coast. The hatchlings were from birds transplanted from other Atlantic nesting areas. Kress says the species is far from saved and needs legislative protection.

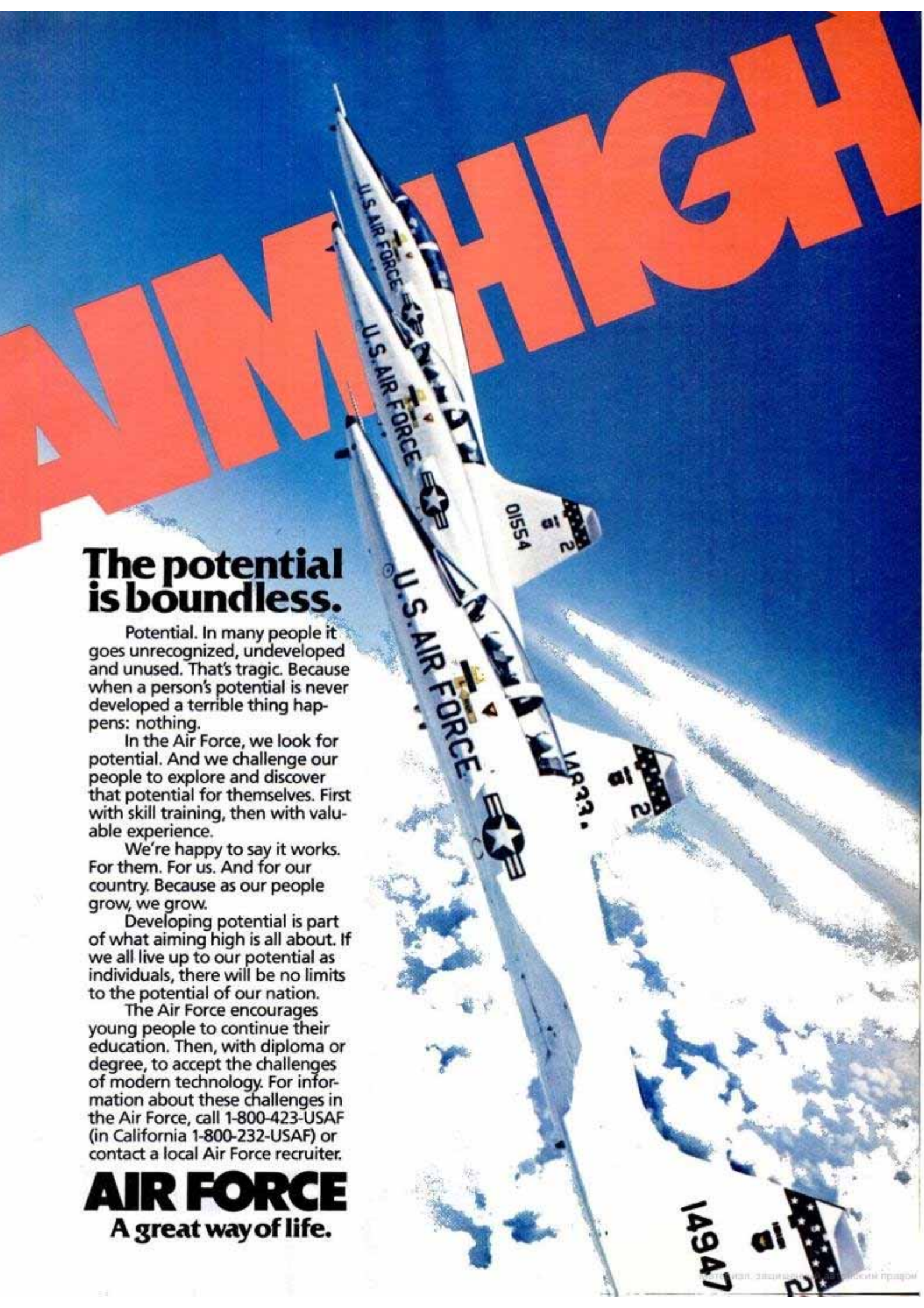
Brother rat, the drinker . . .

Some trained laboratory rats crave alcohol. Others can't stand it, regardless of training. Purdue University researcher Joseph Zabic thinks that it may be a natural body chemical—serotonin—that makes some rats hate alcohol. The same protein helps control blood pressure, sleep and other functions in people. When Zabic gave serotonin to lab animals, they usually refused alcohol. Even if alcohol was the only thing they were given to drink, the lab rats sipped only grudgingly when under the influence of serotonin. Zabic's research continues as he tries to find out if the chemical might have the same effect on humans.

Science from cradle to . . .

If you're worried about where America will get its scientists in the future, one answer might come from a new public school, New York's Manhattan Center for Science and Mathematics, which is graduating its first junior high schoolers this spring. By 1985, the center will be the only school in the country to teach science and technology from kindergarten through high school. Elementary schoolers use the school's greenhouse and experiment shops, while the junior high set is introduced to powerful microscopes and optical workbenches. By high school, students are exposed to computer programming, college-level math, chemistry and physics.

"Finding adequate texts has been the toughest job so far," says principal Cole Genn. The science department has produced its own textbook on space physics, nuclear measurement and other subjects—all for ninth-graders. **PM**



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on the engine and powertrain and against outer body rust-through.

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PM ELECTRONICS MONITOR



From the wilderness

This column is coming to you from a rustic setting, courtesy of the most modern technology. Sitting in the Troutbeck Executive Retreat in Ardenia, N.Y., I am surrounded by beautiful natural scenery wildly divorced from my usual view of New York City's sidewalks and traffic.

No matter where you find yourself, however, today's almost magical art of telecommunication can put you in touch with the rest of civilization. All you need is a telephone and a few assorted computing tools, a little knowledge and the will to be a kind of pioneer. Here is a step-by-step guide of how this column you are now reading was written, and could have been delivered—without paper or typewriter, with no need to commute via subway to a central office, no working in a typical office environment and without even having to leave the primal, Ardenian forest.

Troutbeck to you

The initial step was to hook up, via the telephone line, to a national computer network. This could have been accomplished with any of the many home computers equipped with a modem, which is a special telephone

attachment. Or, as I did, you can use a portable terminal which has no computing power of its own (I used the RCA Videotex Data Terminal, Model VP-3501).

First thing was to attach the terminal to the telephone jack; it plugs right in. Then I hooked a portable TV to it, just as you would a video game.

Next, I dialed the phone and made a local call to a nearby computer that is part of the Compuserve Information Service (CIS) computer network. Once on CIS, I used its primitive but useful word processing program to type in our words. Displayed on the little TV, the words could be listed, changed, read and reread and—most importantly—stored.

Out of storage

Once I got home, I used my personal computer and modem combination (an Apple II with a Hayes Micromodem II running the *Z-Pro* communications software) to access the network again. This time, instead of just reading the words stored there (called a "text file"), I "downloaded" them.

Downloading means that I used the computer to copy the words off the network storage and move them first into

the computer's RAM memory. From the computer's temporary RAM memory, I was then able to quickly store the text file (these very words) onto a floppy disc.

Processing

Now I had the words on a floppy disc, and the text file was completely within the "power" of the Apple II.

The first thing I had to do was to format the text—make certain the lines of type were the right length so that our Production crew could figure the space it would take in print. Then I touched up a word or two (maybe even three) here and there. To do that I used the *Wordstar* word processing software, rewriting the text file that the *Z-Pro* software had downloaded from the CIS network. When I was done, the text file was in perfect condition to hand in.

Final steps

At this stage, I was stymied somewhat by the fact that our office has not yet installed a computerized word processing setup (although we will soon have one). All I could do was to print out the text file and hand it in, much as if it came from a (sigh) typewriter.

However, soon, our offices (as many offices already do) will have the capability to accept text files transmitted by computer over the phone line—even from a forest retreat. And, such files will be sent from our office directly to the printer via phone. The end result will be that computers will have conquered distance. Indeed, in many businesses the idea of a centralized office may be rethought.

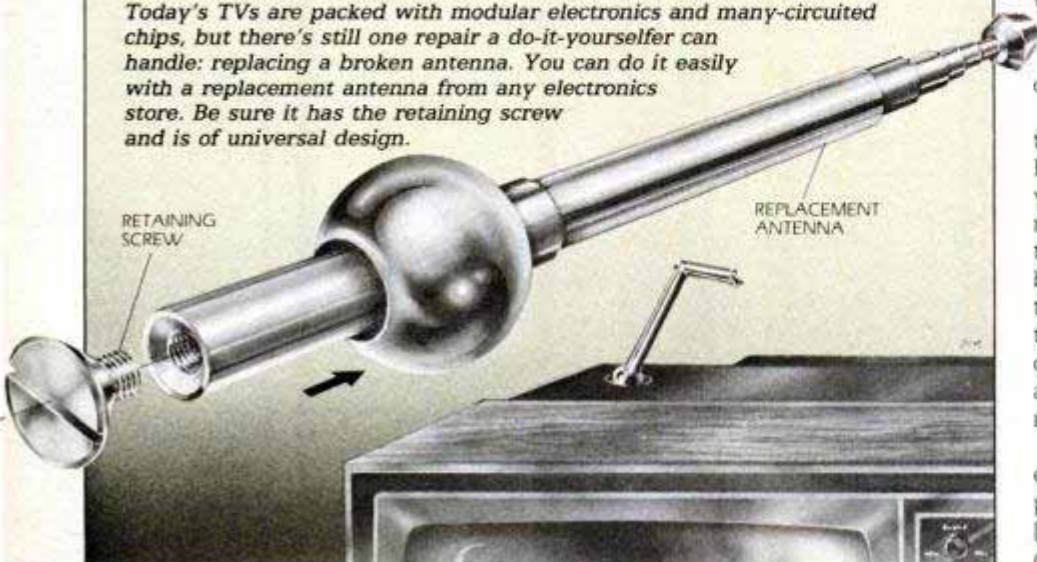
And, by businesses, I mean any firm that depends on memos or U.S. mail. By hooking up to a computer network, you get all the benefits of full electronic mail capability. Any sort of information that you can type on a typewriter can be, as this column was, "uploaded" to the computer network from a remote terminal. It can then remain in storage on the network and be "downloaded" again and again by computers and terminals from coast to coast.

In fact, read this column via computer. Go to the R ACCESS area of Compuserve and enter: TYP COL:PM (70001,1056). Have fun telecommunicating.

PM

Second-chance antennas

Today's TVs are packed with modular electronics and many-circuited chips, but there's still one repair a do-it-yourselfer can handle: replacing a broken antenna. You can do it easily with a replacement antenna from any electronics store. Be sure it has the retaining screw and is of universal design.





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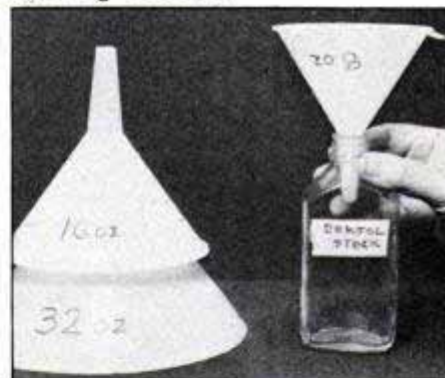
PM PHOTO HINTS

Clean mark



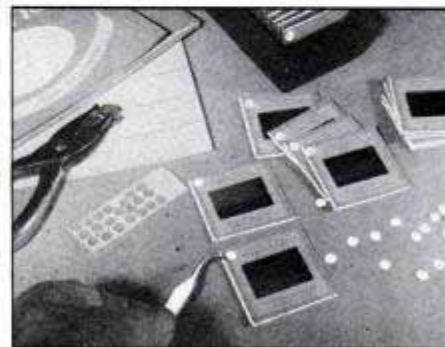
Laundry markers with felt tips won't smear on papers such as Kodak RC and Agfa BS-310. They're cheap and easy to find.—John McNarney

Money savers



Plastic funnels bought at supermarkets are just right for the darkroom and cheaper than from camera stores.—Robert Hertzberg

Punch it



A paper punch can be used to make labels for numbering slides. Punch out rounds from gummed address labels and paste the circles on the corners of the slides.—Louis Hochman



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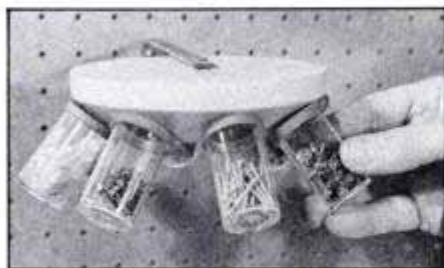
HINTS FROM READERS

Removing frame nails



To remove picture-frame nails easily, grasp them firmly with pliers and strike the pliers sideways with a hammer, preferably a plastic-faced or other nonmarring type. For removing stubborn nails, use locking-type pliers for a better grip.—*Walter E. Burton*

Small-parts organizers



Wood scraps, assorted hardware and plastic pill bottles will make these two small-parts organizers. For the bench-top organizer, use a $\frac{3}{4} \times 2\frac{1}{2} \times 8$ -in. base to which a $2 \times 2 \times 8$ -in. mounting block is fastened with two $\frac{3}{16} \times \frac{3}{4} \times 6$ -in. wood slats. Nail wood slats to base with 1-in. wire brads, then fasten to the mounting block with 1-in. No. 6 screws. Fasten lids with $\frac{1}{2}$ -in. No. 2 screws. The second organizer mounts to the wall with a 2×2 -in. metal bracket. The 8-in.-dia. wood disc is chamfered for easy bottle retrieval.—*Ken Patterson*

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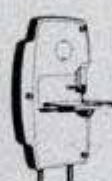
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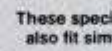
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APPLIANCE CLINIC



Icing on the refrigerator fan

We have a Signature (Montgomery Ward) Frostless refrigerator, Model UFO-1755-05B, serial No. 57-B47406. Periodically, the fan in the freezer ices up and stops. The repairman replaced the defrost-time and heating elements, but is at a loss as to what to do next. My husband checked the drain for blockage; there was none, but there was a huge chunk of ice in the fan area. Once removed, the problem was solved temporarily, but it has recently iced up again. Thanks for any help you could give us.—Mary J. Brown, Union, Ohio

Your refrigerator was manufactured by Frigidaire and the company has a service correction for your model refrigerator. A service technician or you may perform these steps:

1. Disconnect the electricity.
2. Remove the freezer floor to reach the evaporator and fan motor assembly.
3. Remove the two inboard screws that secure the fan orifice to the inner liner of the freezer compartment (see drawing).
4. Pull the drain pan toward the front, then raise the entire assembly from the left and support it in an upward position.
5. Clear ice from fan housing.

6. Locate and mark the boring position on the back liner (see drawing).

7. Bore a 1/4-in.-dia. hole through the line into the fan housing.

8. With a small triangular file, elongate the hole downward and flush with the formation of the fan housing to prevent water from being trapped.

9. Clean any debris that may have resulted from the boring and filing.

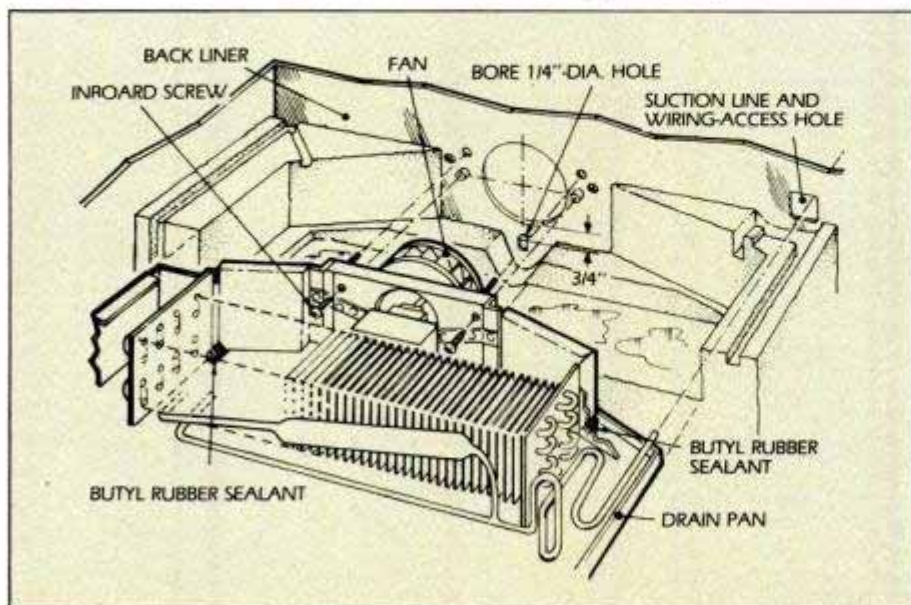
10. Reseal the lower left- and right-hand corner of the drain pan with a butyl rubber sealant (such as Permagum), to prevent any possible air bypass (see drawing).

11. Check the conditions of the door seals and the sealing compound located around the suction line and the wiring harness as they enter the freezer compartment in the rear of the structure. Reseal as necessary to prevent any possible air leaks. Also check the icemaker water and the electrical inlet tubes at rear for proper sealing.

12. Reassemble the drain pan and the fan motor.

13. Check the ohmic value (resistance) of the fan motor to be sure it has not been damaged. It should register about 36 to 41 ohms depending upon the manufacturer of the motor.

14. Plug the refrigerator back in.



After you remove the two inboard screws, pull the fan orifice out of the freezer compartment. This done, the exposed fan housing can be cleared of any ice buildup.

Disconnecting defrost

I have a 1970 Gibson side-by-side refrigerator-freezer named the Gibson Food Master. I'm unable to find the serial number, but it is described in the manufacturer's pamphlet as No. A99697, part No. G147795. Since it was new, the refrigerator-freezer has run almost constantly on automatic defrost—shutting itself off, then on again. With utility rates being what they are, is there any way by which I can disconnect the automatic defrost?—Gary E. Demoree, Huntington Beach, Calif.

According to the manufacturer there is no way you can disconnect the automatic defrost and still expect the refrigerator to function properly. If you should disconnect the automatic defrost system, ice will accumulate on the coils, there will be no air circulation in the refrigerator, and the freezer will run about 22° F.

New service

The Whirlpool Corp. has introduced a series of informative booklets about major household appliances for the benefit of consumers.

The appliance categories that are covered include washers, dryers, refrigerators, freezers, ranges, microwave ovens, dishwashers, trash compactors and room air conditioners. While the booklets will discuss the selection and use of appliances, they will deal with no specific brand name.

The first series of booklets—which is available now—discusses refrigerator defrost systems, appliances and electronics, and the basics of microwave ovens.

It is available free of charge and can be obtained by writing to the Appliance Information Service, Whirlpool Corp., Administrative Center, Benton Harbor, Mich. 49022.

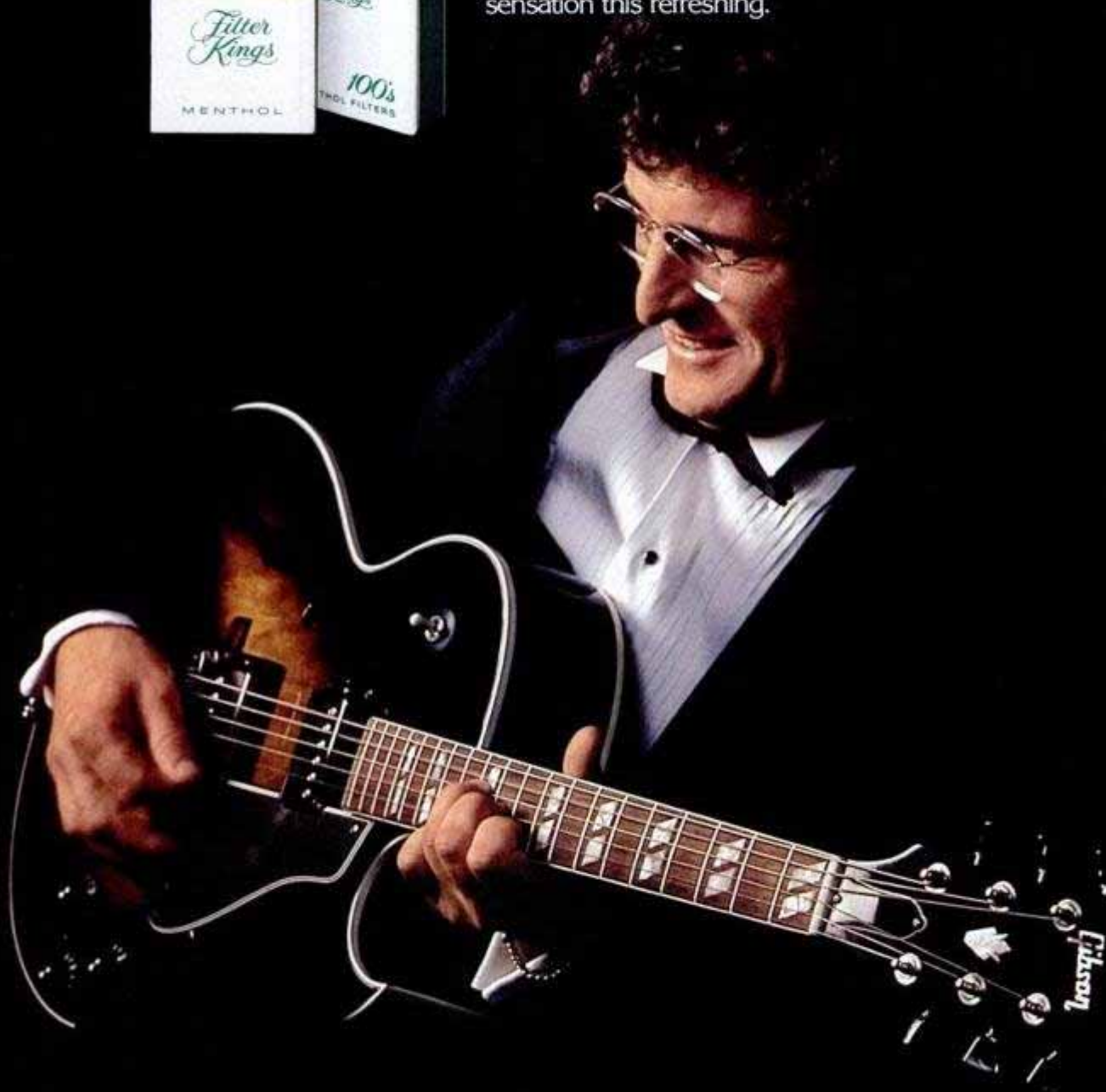
PM

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

There's only one way to play it...



Wherever the music
is hot, the taste is Kool.
Because there's only one
sensation this refreshing.



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

Kings, 16 mg. "tar", 1.1 mg. nicotine, Longs, 14 mg. "tar",
1.0 mg. nicotine av. per cigarette, FTC Report Dec. '81.

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HOMEOWNERS' CLINIC



Whole house fan

I own a Cape Cod home with a full rear dormer for the two upstairs bedrooms. My low-pitched roof restricts clearance so that I can't use a gable-end whole house fan. I'd like to have an airflow of 8,400 c.f.m. (cubic feet per minute), which is the volume of livable space, both upstairs and down. Can I install a permanent fan or window unit that would provide the airflow I want?—Bradford L. Patterson, Farmingdale, N.Y.

Brad, you're in the right church, but the wrong pew. Your 8,400 cu. ft. of livable space must be divided by 2, because you have a two-level house. (To help vent it, open the lower windows during the day, and the upper windows at night.) Thus, you're really only venting one-half the livable space at a time. Multiply this 4,200 cu. ft. by 30 (changes per hour for good summertime ventilation), and divide by 60 (minutes per hour). This accounts

for a required flow of 2,100 c.f.m.

A much simpler way of figuring required fan size is used by Sears. Sears' calculations use square feet of area. If I divided your house's volume of 8,400 cu. ft. by a room height of 8 ft., I'd arrive at 1,050 sq. ft. of house.

Sears' ceiling fan would fit in the space over your stairs in the upstairs hall. Although a 24-in. fan would do the job, I believe that I'd go for the 30-in. fan, since it runs at 510 rpm, as opposed to 660 rpm for the 24-in. fan. The smaller rpm is quieter, minimizes motor wear and saves electricity. However, the 30-in. fan requires air-discharge openings (gable-end and soffit vents) totalling 6.8 sq. ft. The 24-in. fan requires fewer openings.

Aside from the electrical work, which may be tricky, this is definitely a do-it-yourself job. You can bring in a licensed electrician after you've installed the fan and vents.

Wet sink

The stainless-steel sink on my 28-ft. boat isn't coated on the bottom. Each day, about a tablespoon of water condenses and collects under the sink. How can I stop this dripping so I could use the drawer for storage?—William E. Cotter, Little Falls, N.Y.

Ventilate the cabinet and insulate the sink. The cool stainless steel in contact with the warm, trapped air in the sink cabinet causes condensation. Bore ventilation holes or cut decorative patterns in the top and bottom of the cabinet. Glue screening to the rear of the vents to keep out insects. Next, coat the exterior of the sink to reduce temperature differences. Permatex Undercoat (part No. 117EA), for example, would work. It is sold at auto supply shops. Build up the coating to at least 1/4 in. thickness. If you can't remove the sink, wear a mask and ventilate while spraying.

Rotting floor

Excessive ground moisture around the crawl space, and a very humid climate seem to be rotting the floors in my 10-year-old trilevel house and causing them to sag. Adding 4-mil vapor barrier

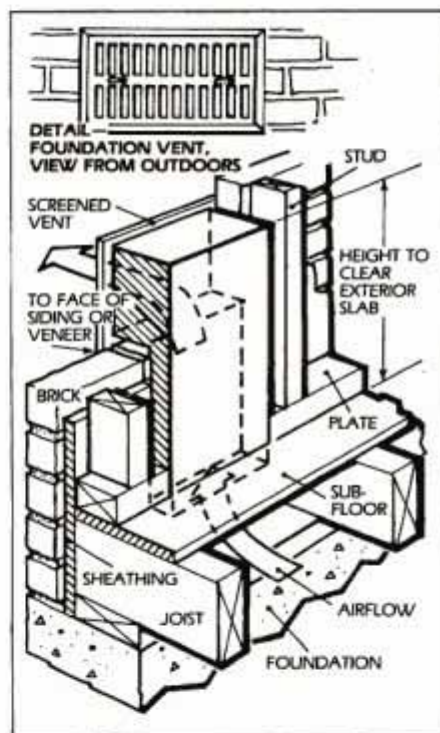
er didn't help, since newly replaced floor joists show evidence of rot and mold after one year. The crawl space is only vented on one side; the other house vents are either below grade or about a finished basement or outside concrete slabs. It's a great expense and effort to install additional vents. What can I do?—Ted Malamas, Culpeper, Va.

Ted, we ran a story in our March '80 issue that discussed the importance of venting your crawl space (*Protect Against Rot and Insects With Pressure-Treated Wood*, page 162). Even with pressure-treated wood, the odor from inadequately vented crawl spaces would justify the expense of adding ventilation, in my opinion. The FHA requires at least four foundation wall vents, one located near each corner. The aggregate net free ventilating area should not be less than 1/150 of the area of the space. The requirements can be reduced by adding a vapor barrier (ground cover), but that doesn't seem to apply in your case.

The builder of my home cut a 3-in.-wide slot between the studs, through the subfloor. He then ran a section of duct above my outside steps, and

installed an elbow through the brick veneer. On the outside, he fastened the ventilator, recessed in the veneer, to prevent leaks (see drawing).

You can also vent crawl spaces mechanically. Install a blower in a rear corner of the crawl space, with a duct connected to the opposite vent. Draw air in from the remaining vent, causing a circulating flow. Hook the blower to a humidistat set at about 55° F. When



One way to vent a crawl space when you can't install a standard through-the-wall vent: Cut and remove a section of sole-plate. Install a duct with an elbow in wall.

humidity rises above that, the blower turns on. You can also devise a pressure system in which a fan blows in from one vent, forcing air out the other vent. For either installation, I'd use a licensed mechanical engineer. **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowner's 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 order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Home
Gardening
Breakthrough!

At Last! A Rear-Tine Tiller
Especially for Small Gardens!

the 3½ HP TROY-BILT® "JUNIOR"

If your garden is 30'x50' or less, here's why it will pay you to get the full story about the Newest, Greatest Breakthrough in rear-tine tillers in over 50 years!...

- **SAVES YOU MONEY!** Goes for half the price of larger rear-tine tillers—which you don't need for your small-sized garden.
- **SAVES YOUR BACK!** Forget spading and raking! The "JUNIOR" prepares your garden in a fraction of the time!
- **SAVES HAND WEEDING!** It's adjustable to shallow depth perfect for chopping, uprooting and burying weed seeds—killing them. Simply guide the "JUNIOR" up and down each row.
- **SAVES GARDEN SPACE!** Narrow 14" tilling width allows you to plant your rows closer together. Grow more in less space!
- **EASY TO USE!** With its tines in the rear and engine out front, the "JUNIOR" is so well balanced you can handle it with JUST ONE HAND. Won't shake you to pieces like front-end tillers do!
- **EASY TO TURN & MANEUVER!** Because the "JUNIOR" is light and compact (but strong!) you can turn it and maneuver it in tight places with wonderful ease!

There's much more to know about this wonderfully different and better idea in small garden tillers...like how you can use it to build super rich soil, no matter what your soil conditions...or, how it can help you grow two, even three crops of vegetables where you could only grow one before!

So why not mail the coupon TODAY, and get all the exciting facts about the amazing new TROY-BILT "JUNIOR"...Plus our mid-sized PONY and large garden HORSE Models. We'll include prices, attachments and complete information about our special "OFF-SEASON" Savings discount now in effect!



WHY, for heaven's sake suffer any longer with a tines-in-front type of tiller that has no power to the wheels and shakes you to pieces? And why break your back with hoeing, raking and shovelling? The New TROY-BILT "JUNIOR" makes all your gardening chores faster and easier—increasing your gardening JOY! Send for full details TODAY!

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The BIG JOB tiller...for small, high yield gardens!



"Grow more in less space!"



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YES! Please send me complete information on the new JUNIOR and all other TROY-BILT Tiller Models ranging from the 5 HP PONY to the 8 HP "PROFESSIONAL" including details on prices and big "OFF-SEASON" Savings now in effect!

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THE PM GARAGE



Speedy test of electrical system

Here's a quickie test instrument that provides a pretty good indication of your electrical system's overall standing.

Called the Smart Lite, it's outfitted with red-colored indicators for easy



Smart Lite will perform efficient, quick voltage checks of your battery and charging system.

observation. Four of them check voltage at the battery. Since few of us have six-volt batteries, the 6-v.d.c. designation is virtually useless.

However, the other three indicators definitely come in handy for determining whether the minimum cranking voltage (9 volts) and static battery voltage (12 volts) are up to par.

You can also discover if the electrical system is overcharging (15 volts). The fifth indicator is an electrical continuity test light.

The Smart Lite—which is 8 inches long and weighs ½ pound, if that—costs \$19.95 and carries part No. BT-8121.

It's available from the manufacturer, Borroughs Tool & Equipment Corp., 2429 North Burdick St., Kalamazoo, Mich. 49007.

—Mort Schultz

Better brain bucket



Flush-fitting visor of Nava helmet keeps wind roar down, seals against drafts.

Nava Moto, an Italian maker, has introduced a new technique in helmet construction. Instead of the hand-laminated fiberglass in most better helmets, Nava uses single-strand Du Pont Kevlar woven into a mesh and impregnated with resin. The flush visor design makes the Nava super quiet. It's \$280 from Nava U.S.A., 5729 Ward Ave., Virginia Beach, Va. 23455.

—Joel Breault

Fan-belt adjuster

Although many cars have specific provisions for belt-tensioning, often you're on your own. A J-shaped tool would seem to be the way to handle problem adjustments. The hook end could grab against the edge of the accessory, and if the straight end had a hole to accept a half-inch ratchet or breaker bar, you'd be set. Well, I've just found that tool. And it was perfect to work on a classic problem: the Chrysler slant-six alternator. It's about \$7 at auto parts stores. From Lisle Corp., Clarinda, Iowa 51632.—Paul Weissler



The J-shaped tool allows you to adjust belt tension on hard-to-reach accessories.

Clean fingers



Thin plastic gloves keep hands clean, are cheap enough to throw out when used.

Filter Fingers is a clever new product that'll help you fight the never-ending war against grease. The thin, 1.5-mil plastic gloves resemble a plastic bag with fingers. Filter Fingers fit all hands, fit over shirt sleeves and are disposable. Each package contains six gloves; they fit either hand. Filter Fingers cost \$1.95 per pack by mail from Image, 16783 Beach Blvd., Huntington Beach, Calif. 92647.—Joel Breault

Practical putty

A+B Fast Set Epoxy Putty may be used to repair anything from leaking motor-home fuel tanks to boats. It adheres to metal, wood, fiberglass, porcelain and plastic. Clean the surface



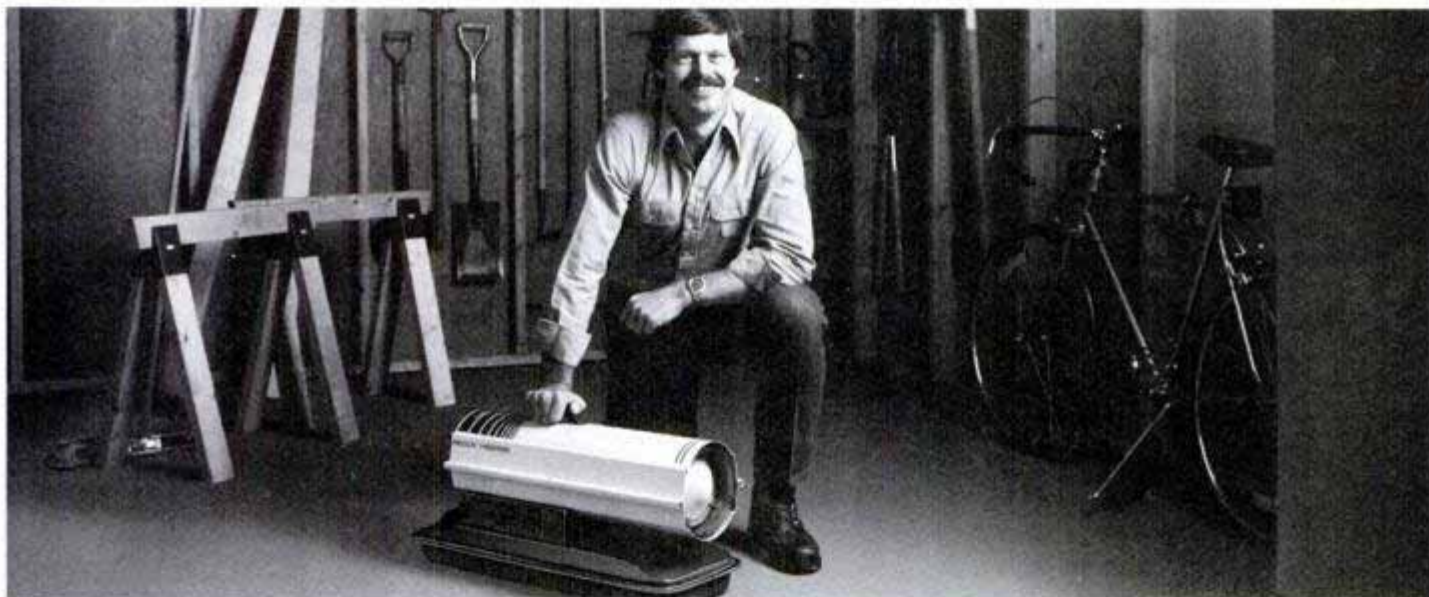
Two-part putty bonds to almost anything. It air cures or cures with heat gun.

to be repaired, cut equal parts of putty from the two bars of material and knead together. A half-pound package of A+B is \$4.70 postpaid from Applied Plastics, 612 Franklin Ave., El Segundo, Calif. 90248.—Joel Breault

Ken Anderson,
Super Bowl Quarterback
of the Cincinnati Bengals



Reddy Heater keeps Ken Anderson warm on the field...



in his unheated workshop, too.

You've seen Reddy Heater keep Pro Quarterback Ken Anderson warm on the sidelines on TV—in some of the coldest games in pro football history.

"It's like a portable furnace," says Ken. "It delivers a steady

blast of clean, hot air... lets me work in my shirtsleeves, even in sub-zero weather!"

Ken's not alone. People who work in unheated places like garages, construction sites, warehouses and greenhouses

are also big Reddy Heater fans.

With 5 models from 30,000 BTU, Reddy Heater is ideal for the big heating jobs. In fact, they deliver from 4 to 20 times more heat than small residential kerosene heaters.

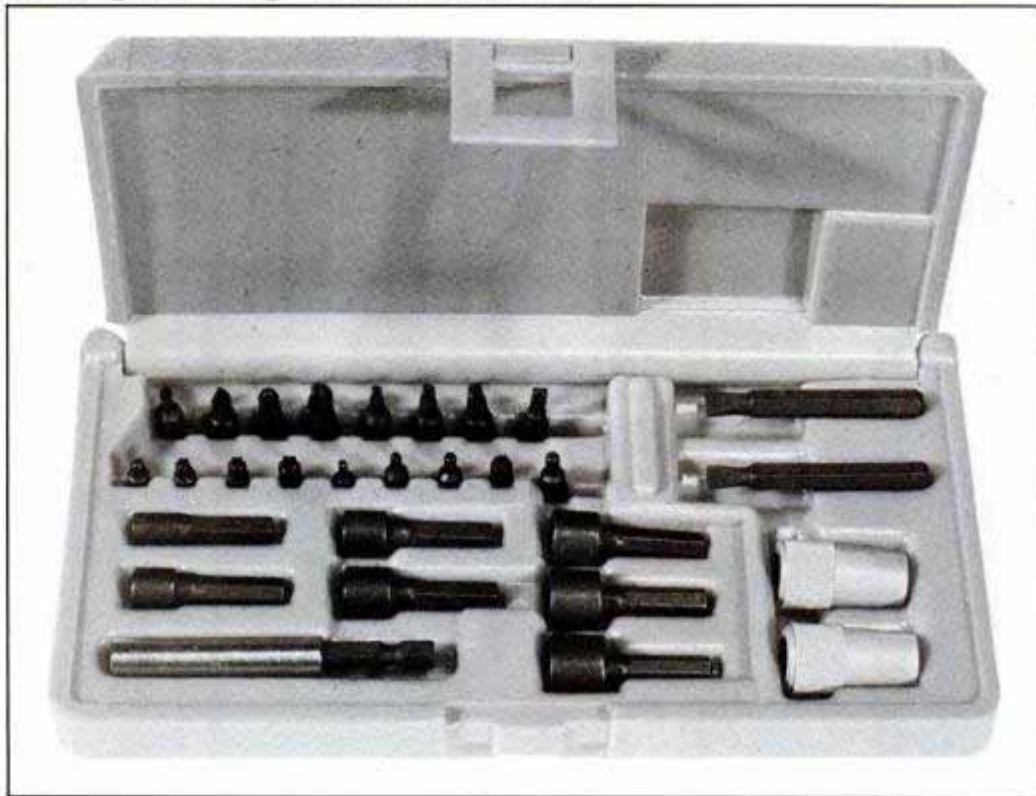


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For dealer nearest you, call toll free:
1-800-821-7700, ext. 129.

REDDY HEATER®
It's Like A Portable Furnace

Handy set of power driver bits

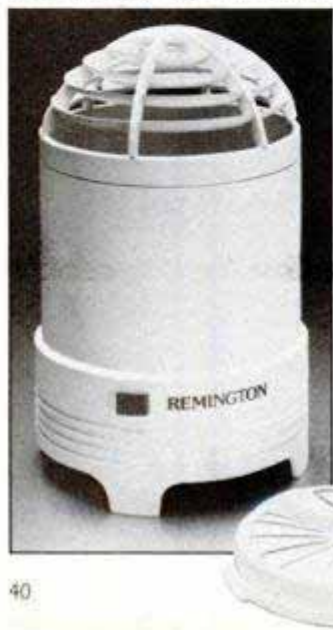


Sears has introduced a 30-piece set containing just about any screw or nut driving bit you need. The bits work in variable speed drills and drive almost all types of screws, nuts and bolts. The set includes four Phillips bits in varying sizes, two dif-

ferent slotted bits with finders, various hex bits and hex shank nut drivers, Torx bits, square drive bits, a clutch bit and a 1/4-in. magnetic driver for all bits. The set is \$26.99 at larger Sears stores and through the catalog; it's stock No. 9 25654.

Breathe easy with air purifier

Remington has a compact new appliance designed to cleanse unpleasant odors from the air. The Air Purifi-



er processes room air through a three-stage filter. The first stage is composed of electrostatically charged fibers that trap particles and contaminants. A second layer is made up of silica gel crystals with odor-absorbing properties. The final filtering agent is expanded polyurethane that traps any remaining particles. The motor produces 15 watts to exchange air at a rate of 4 cu. ft. per minute. The maker claims the unit (\$25) is both quiet and energy efficient. For information write: Remington, 60 Main St., Bridgeport, Conn. 06602.

Emergency light

The Code One sound-activated emergency light goes on at the tone of any UL-listed smoke alarm. Its yellow-tinted lens disperses light at a 45° angle to increase visibility through smoke. The battery-powered lamp also activates if removed from its wall bracket. About \$14.95, it's from Jameson Home Products, 2464 Wisconsin Ave., Downers Grove, Ill. 60615.



Tune tools with electronic tach



If you have any problems fine-tuning the carburetors on your outdoor power equipment, Echo's new digital tachometer may be the answer. The DET-102 is designed to monitor the rpm of both single- and multiple-cylinder engines. That means it'll be handy for tinkering with your gas-powered lawnmower, chain saw, snow blower and the like. All circuitry is solid state. The DET-102 sells for \$46.50 from Echo Inc., 3150 MacArthur Blvd., Northbrook, Ill. 60062. **PM**

CLEAN AIR ON DEMAND!

At last, clean "smoke, dust and pollen free" air in your home or office. The ZESTRON Negative Ion Generator cleans your air of harmful, irritating pollutants better than any other room ionizer.

If you've been in the mountains lately, you know how air is **supposed** to smell.

And perhaps you've captured that clean, fresh, invigorating atmosphere after a thunderstorm, or while standing near a waterfall.

That clean fresh air you enjoyed was rich in **negative ions**, Nature's own air purifiers.

THE ZESTRON IG-700

Pollution and civilization destroy natural air ions. A ZESTRON ionizer recreates 30 trillion of these ions every second. They clean the air of smoke, dust, solid pollutants, odors, bacteria and viruses which fall to the floor as dust.

A new solid-state pulse circuit breakthrough is used in the Zestron ionizer. This gives the greatest ion output (with no detectable ozone) at an extremely low price! Compare the performance and prices shown in the chart. The IG-700 clearly has the greatest ion output — yet sells at a remarkably low price.

ION GENERATOR COMPARISONS

IONIZER	Ions/cc/sec. (at 1 meter)	PRICE
ZESTRON IG-700	1,904,000	\$ 99.95
Ion Cloud 9000	700,000	300.00
Energen 402B	550,000	149.70
Dail-An-Ion	540,000	189.95
Ion Breeze	500,000	399.00
Ion Fountain	360,000	129.95
Ionshpere	350,000	99.95
Ion Cloud 7000	350,000	119.95
Modulian	75,000	85.00
AirCare	72,000	149.95
Omega 700	63,000	245.00
JS&A Air Bubble	???	89.95
Orbit	???	99.95

WHAT IT DOES

The high-powered output of the IG-700 provides more negative ion benefit for you. It cleans a larger room faster and more thoroughly than lower-powered units. Under ideal conditions, a 40 by 40 foot room can be cleaned by a single IG-700.

HOW THEY'RE BUILT

Don't let the IG-700's low price mislead you. The unit is of the highest quality, designed by engineers with many year's experience in zero-defect

spacecraft design. The Zestron unit is totally electronic and does not make any noise. This unit is actually a home and office version of a large commercial air cleaning device costing over a thousand dollars.

Scientists claim that these amazing active ions are of great benefit to you and can actually make you feel alive, revitalized and alert while relieving depression, headaches and allergies. Negative ions promote sound sleep, learning and healing and even make plants grow better. In addition, hospitals use ionizers in burn units to destroy bacteria and reduce pain.

FREE TEST DEVICE

A free passive remote ion detector is included with each ionizer. This handy little device gives you independent proof of operation, and permits comparison with other manufacturers' ionizers.

Place the detector first close to a Zestron ionizer, then close to a competitive unit. You will see far less ion output from the competitive ionizer — in some cases no activity at all!

IG-700 SUPERIORITY

The IG-700 features adjustable output, which lets you set the output to your own preference. Some people prefer fewer ions at night, while a large smoke-filled room needs more ions than a small room with no smokers present.

The IG-700 has no moving parts and nothing to wear out or replace, unlike "perfume" filter-type air cleaners which require frequent replacement of expensive filters, and which emit no beneficial negative ions.

Scientific tests show that these noisy inefficient filter-fan units which emit chemical "citrus" odors are more like toys, and are no match for high-powered ionizers in thoroughly cleaning the air we breathe.

The IG-700 is a compact 2¼ by 2¼ by 6¼ inches. At 1.5 watts, it costs about 7 cents a month to run from standard house current.

The IG-700 features an operating-output level indicator that shows you the actual output level. Most competitive units simply indicate that the unit is plugged in.



ZESTRON IG-700

Please study the facts and figures on this page, and then order your Zestron IG-700. Try it for 15 days in your home or office. We predict that you will be delighted with the fresher air and more stimulating atmosphere it provides.

If you are displeased for any reason, however, you may return your unit within 15 days, and we will promptly refund your full purchase price.

HOW TO ORDER

Mail your name, address and phone number with your check or money order. Credit card holders may speed delivery by calling our Toll-Free number. The Zestron IG-700 Ion Generator is \$99.95 plus \$4.00 postage and handling. The price includes a FREE remote Ion Detector and Owners Manual.

ZESTRON IG-700 - \$99.95
plus \$4.00 postage and handling
(2 Units, \$94.95 each
plus \$3.00 postage and handling)

CREDIT CARD ORDERS ONLY

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Extension 877

North Carolina residents, call:

1-800-672-0101

Other information: (404) 587-2257

**CLEAN AIR
ENGINEERING**

Department PM1
110 Towergate Place
Atlanta, Georgia 30338

THE PM WORKBENCH



Tap and die kit in popular sizes

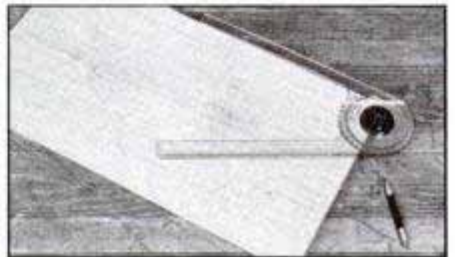
The Ace Hanson Home Threading Kit is a tap and die set for cutting five of the most popular thread sizes used in home workshops. The 12-piece set includes five taps and matching 1/8-in. hex dies, plus a 1/8-in. hex die stock and a T-handle tap wrench. The five tap and die sizes supplied are for cutting 6-32, 8-32, 10-32, 10-24, and 1/4-20 threads. The convenient hex-shaped dies allow threading in tight places with open-end, socket, or adjustable wrenches. Each kit has a "how-to" threading booklet. From Henry L. Hanson Inc., 220 Brooks St., Worcester, Mass. 01606, the set is \$26.99 at hardware stores.—Rosario Capotosto



Chuck the desired size tap into wrench and cut bolt threads in prebored hole.

Solving miter mysteries

The Mite-R-Gage, manufactured by Nowlin Inc., 961 East 21st Ave., Columbus, Ohio 43211, is made of Lexan resin and guaranteed not to break, crack or warp under normal use. The tool consists of a pair of legs which can be used to measure angles, check corners for squareness, align radial-arm or table saws, and to calibrate leveling tools. Complete with instructions, the Mite-R-Gage is available at hardware stores. The suggested list price is \$12.95.—H.W.



Adjustable Mite-R-Gage allows you to set and record any desired angle easily.



Mite-R-Gage is a durable tool with both simple and compound miter capabilities.

Mini indoor greenhouse



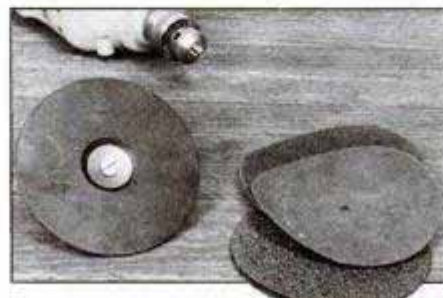
Vinyl sheet lifts off for easy care and watering. Side is zippered for venting.

Here is a new concept in indoor gardening: a miniature, steel-framed greenhouse fitted with a durable vinyl cover and topped with a lamp housing. The indoor greenhouse is designed to balance light, temperature, humidity and carbon dioxide levels to provide the ideal environment for plant growth. Hortecs provides a spray can of carbon dioxide mist with the easy-to-assemble unit. Plants may be permanently housed inside or rotated in and out, as needed. Available at nurseries, home centers, or direct from Hortecs Co. Inc., Box 416, Lake Forest, Ill. 60045. The greenhouse is \$39.95 for the complete package, plus \$2 for shipping.

—Rosario Capotosto

Tough abrasive disc kit

Industrial-quality Gemtex resin-fiber abrasive discs are now available to home woodworkers in kits. The multi-purpose sanding and grinding kit contains three long-lasting resin-fiber discs (claimed to last up to 25 times longer than conventional discs), and a drill accessory package. Replacement disc kits containing three 5-in. discs are also available. Discs are flexible enough for use on contoured surfaces such as auto bodies, fiberglass and wooden boats, yet tough enough to smooth welds and concrete. The kit with drill accessory costs about \$5.49; the replacement kit is \$2.95. Available at hardware stores or by mail from Spiracut Products, 4101 East Royalton Rd., Broadview Heights, Ohio 44147—J.T.



The kit includes backing pad, coarse, medium and fine-grain fiber discs.

Update

Walter Burton wrote us to correct some misinformation inadvertently edited into his October '82 story, *Build This Inexpensive Magnetic Lathe Chuck*. On page 78, we said that if aluminum wasn't available, steel or brass could be used for the front and back plates. Walter points out: "Brass would be okay for the front and/or back plate, but steel would be acceptable only for the back plate. The front plate should be made of nonmagnetic material."—M.C.

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

WORTH WRITING FOR

LOOKING FOR IDEAS ON HOME IMPROVEMENT, ENERGY, AUTOS, ELECTRONICS, TOOLS, AND MORE? CHECK THESE LISTINGS. THEN USE THE COUPON BELOW.

628 Looking For Bargains?

A unique bulletin service keeps customers informed of a variety of consumer products being liquidated via mail order at drastic price reductions. C.O.M.B. Company. Sample Copy . . . \$1.00

629 Get A Charge Out Of This . . . And Save Money

General Electric Rechargeable Batteries are designed to keep on charging and powering for up to four years. An eight-page, color brochure describes a full line of rechargeable batteries and chargers. Free

630 Going Overboard Over Outboards

Outboard Marine brings you catalogs from outboard leaders Johnson and Evinrude. These beautiful 32-page color catalogs highlight a full range of outboard motors, covering virtually every boating requirement. Also includes a Buyer's Guide and specifications. Free

631 Beautiful Wood Finishes

12-page, four-color booklet from Watco-Dennis shows how to create professional finishes the first time with all types of wood. Watco Danish Oil seals, primes, finishes, hardens, protects, beautifies and penetrates . . . in one application. Free

632 Warm The Home And Cool Fuel Bills

Consolidated Dutchwest believes that craftsmanship is what distinguishes an excellent stove from a good one. That's why each of its stoves is produced by hand . . . from casting to packing. 16-page, full-color brochure shows complete line, accessories and specifications. \$1.00

633 Intelligent Fuel Saver

Energy saving thermostats can cut heating costs up to 30%. Models for gas, oil, electric furnaces and heat pumps. Four-color brochure including chart with estimated savings for your area. From Honeywell. Free

634 The Sky Is Not The Limit . . .

It's only the beginning when you fly an ultralight aircraft. Eipper Aircraft shows you how in an information package that includes color photos, comparisons, specifications and accessories. \$4.00

635 Automotive Wonderland

Beverly Hills Motoring Accessories features their most innovative products for you and your automobile in an all new 4-color catalog. Each section brings you such products as cotton car covers, sheepskin seat covers, Nardi steering wheels, and a new, exclusive line of sportswear. \$2.00

636 Tools, Tips & Techniques

Shopsmith's 48-page catalog offers over 350 high-quality tools and supplies for woodworkers and handymen. Also includes "tricks of the trade" to help produce professional looking results. \$1.00

637 Backyard Shelters

Catalog from Kover Klamps describes how to build a greenhouse, car or boatport, utility and project shelter in one afternoon utilizing unique clamps and metallic tubing. Free

638 For Your Ears Only

State-of-the-art home and car speaker systems, speaker kits, raw parts and accessories are brought to you in a 44-page color catalog. Includes specifications, fully illustrated. From Speakerlab. Free

639 Making Wood Work

112-page illustrated catalog from The Woodworkers' Store™ lists products for all areas of woodworking, including inlays, veneers, mouldings, tools, specialty hardware. Also, practical instructions for installation and application. \$1.00

640 Make The Most Of Your Trip!

How to get there, what to see, where to rest and dine . . . Michelin Guides and Maps have the answers. Free brochure.

641 New Concept Kit Cars

Brochure shows a uniquely styled kit car that fits Pinto and Bobcat cars without much modification. Designed to be low cost, easy to complete and totally functional. From Autonique. \$3.00

642 Turn The Law Of Gravity Upside Down

Brochure from Gravity Guidance explains how gravity can work for you to achieve good health. The Gravity Guiding System® may be the answer to your back problems and become part of your fitness program. Designed for in-home use. Free

643 Need That Extra Pull?

Four-color brochure from Warn Industries describes a full line of truck winches, winching "extras", and other off-road accessories. Designed for full-size trucks, mini-trucks and four-wheel drive vehicles. Free

644 Getting Close To Heavenly Bodies

Descriptive, full-color brochures describe a full line of optical equipment, including: Astronomical Telescopes, Binoculars, Riflescopes, and Terrestrial Telescopes. From Bushnell, the world's largest marketer of sports optics. Free

645 Tow Your Motorcycle And 3-Wheeler

TUFF 'n LITE lightweight trailers are made to be rugged, easy to maneuver, and tow easily behind small cars and mini-pickups. New, patented independent suspension provides a smooth and stable ride. Brochure from Unique Functional Products. Free

646 From Bud To You

The Anheuser-Busch Brandwagon catalog contains sixteen color pages of clothing, glassware, sporting accessories, home furnishings and more. Most items sport a distinctive brand name or logo, including famous Clydesdale horses. Great gift ideas. Free

647 Living With The Sun

This beautiful, 48-page brochure is a consumer's guide to passive solar home design. From PPG Glass Div. \$1.00

648 For The Self Mover

From U-Haul, a 28-page moving guide offers tips for the do-it-yourself mover. Includes how to organize, pack and load for your move. Useful info for vacationers, also. Free

649 Be The Boss!

Computer Amusement's 20-page brochure gives full details on a business that can be full-time, part-time, or absentee. Computer Portrait System can be an ideal family business. Free

650 Room For Living, Growing, Energy . . .

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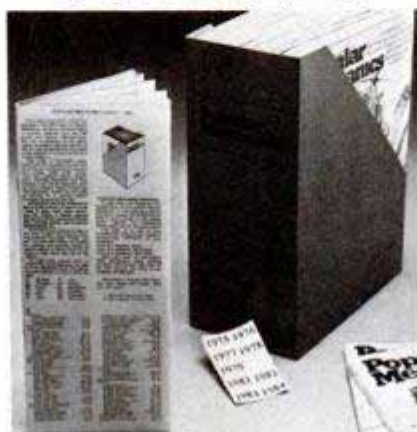
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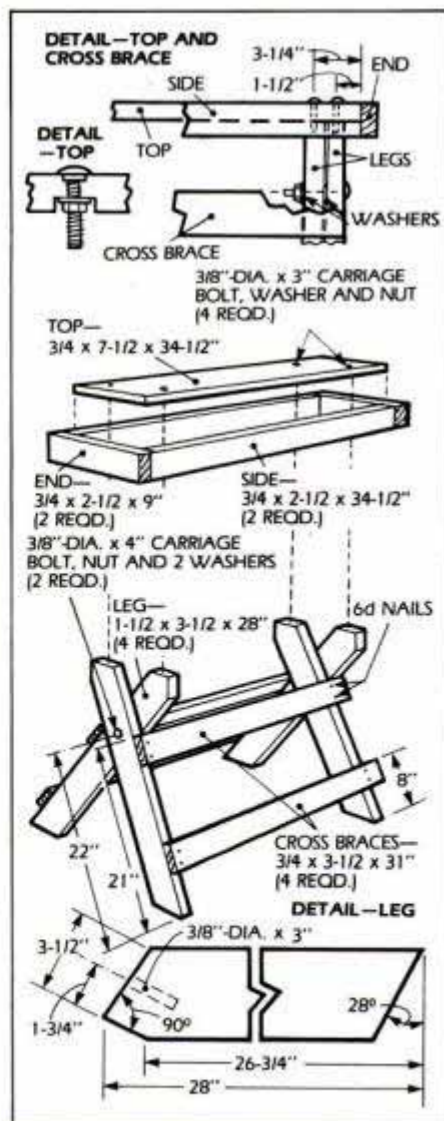
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HINTS FROM READERS

Folding sawhorse

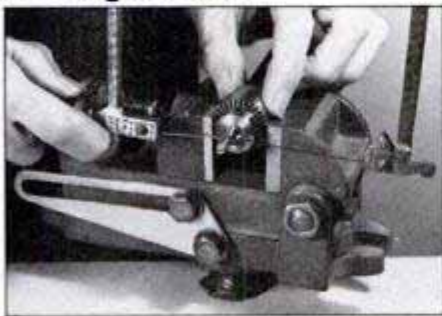
Storing sawhorses was always a problem until I built this folding pair. One sawhorse consists of a set of legs with cross braces, capped with a framed top. Join each set of legs with a 3/8-in.-dia. x 4-in. bolt. Be sure to insert a washer between the legs to permit the sawhorse to open and close easily. Construct the top section and position it on the completed set of legs. Bore four 3/8-in.-dia. holes through the top and into the legs. Fasten the four bolts to the top as shown. Reposition the top with bolts through holes bored in the legs. Lift off the top and fold flat for storing.

—P.F. Rinaldo



HINTS FROM READERS

Cutting it close



Holding a small screw with fingertips and vise while reducing its length is very difficult. To simplify the job, I use this technique: Insert the screw tip—the amount that you want to remove, less approximate width of saw kerf—in a three-jaw drill chuck. Tighten the chuck, then clamp it in a vise. Use a jeweler's saw to cut the screw close to the chuck jaws. If you work carefully with a fine-tooth blade the screw end will require little filing. You'll find that this stunt is effective on up to No. 6 screws.

—Walter E. Burton

Straws save brushes

If you toss an artist's paintbrush in a drawer to store it, chances are its bristles will be ruined. Protect them by slipping a soda straw over the handle so it covers bristles.—H.E. Moody

Tool holder



Protect your hands from hammer blows by clamping chisels and punches in your locking pliers. To keep the jaw serrations from gouging the metal, wrap rubber from an old inner tube or some foam rubber around the tool.—Wayne Fugate

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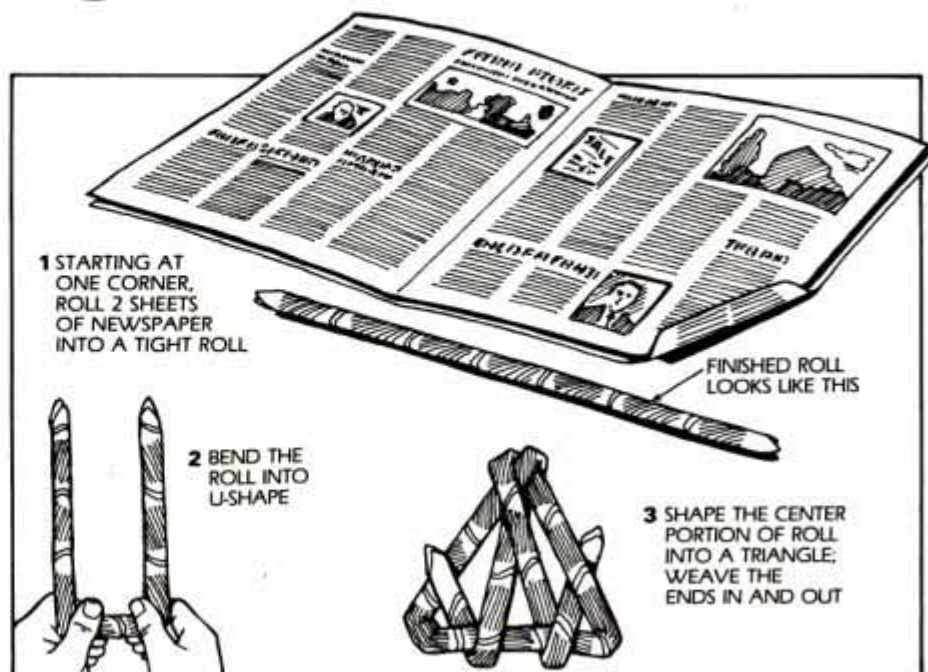
5 Energy-Saving Tips From Readers

Starting a fire without wood kindling

Reduce the use of your central heating system by using a stove or fireplace. Avoid chopping logs to make kindling by using old newspapers, rolled into a triangle shape. Use only papers printed with black ink. Don't use newspapers containing colored inks—the inks can be toxic.

First, roll two full sheets of newspaper tightly into a log shape. Next, begin to shape a triangle. Make the center of the paper the center of the triangle base. Finally, weave the two longest sides in and out of the triangle.

Stack four of these triangles in the fireplace or stove. When they are burning briskly, position your logs around the stack.—*Albert A. Rose, Surrey, B.C.*



Baking late helps heat the house

During cold weather I do as much baking as possible in the evening after dinner. The heat from the oven helps warm our family room and kitchen, which lets us lower our thermostat. Added benefits: The house smells good, and it's a simple job to re-heat food for next evening's meal. Cooking late also will reduce power usage at a peak time, 5 to 6 p.m.—*Constance Anderson, Miami*



Free insulation

My wife calls me cheap, but I say I'm practical. It all started when I installed a fold-away staircase into the attic for easier access to needed storage space. There I discovered that the so-called attic insulation was quite inadequate. A minimal amount was blown around in odd piles. In many areas the ceiling lath was perfectly visible between the joists. From that day on, I started to save all the styrene foam that came my way: egg cartons, vegetable trays, camera or television packing. In fact, I collected any clean material that wasn't used to package meat or fish (meat and fish trays always retained a smell).

Once or twice a month, now,

depending on my collection of styrene foam, I go to the attic to break up the free insulation and spread it in layers between the open joists. Eventually, I'll

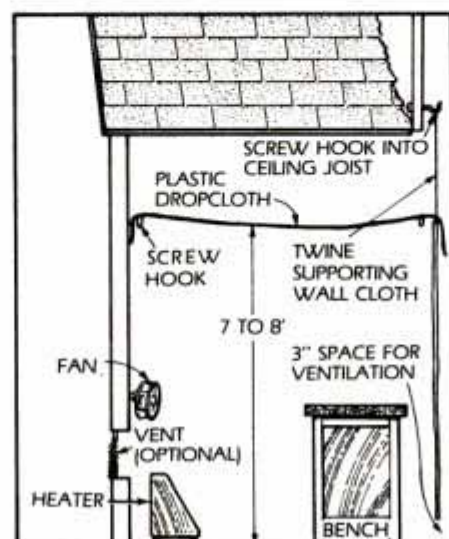


cover the entire attic floor with a sound, weather and temperature barrier—free of charge except for the small amount of time it takes to do the job.—*Frederick Hornik, Tamarac, Fla.*

Insulate your tub

It takes several gallons of hot water to warm our bathtub, and frequent additions on top of that to maintain the water at a comfortable bathing temperature. To reduce the heat loss from the tub, I blew builder's vermiculite into the hollow sides and between the tub and the floor, through the inspection port at the plumbing end of my tub. This did a good job of insulating the tub and keeping the water warm, thereby reducing the quantity of hot water required.

Holes found in the subfloor around the tub drain of some tubs may have to be closed to prevent the insulation from falling through the floor.—*M. Ray Tucker, Raleigh, N.C.*



No more frozen fingers

To conserve fuel in my heated but uninsulated garage workshop, I reduced the area requiring heat. I lowered the ceiling by hanging a plastic dropcloth from twine tied to screw hooks in the wall studs. I also hung a dropcloth wall in the same way.

A fan placed over the heater circulates warmed air.—*George N. Catlin, Grove City, Ohio*

Share your original home energy-saving ideas. PM will pay \$50 for each published idea. Include sketch or photo, if necessary, as well as your social security number (needed if payment is made). Submissions will not be returned unless accompanied by a self-addressed, stamped envelope. Send to: Energy-Saving, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

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FIELD CAMERAS

Get The Big Picture!

Field cameras can be your next step in photography. Never outdated, these portable wonders offer amazing versatility, as well as 4×5 or larger film sizes.

BY FRANK LUSK

PM photos by the author

A friend recently showed me his new, highly automated, heavily advertised 35-mm camera. Adorned with numerous state-of-the-art controls, displays and things that go "beep," it represents the current last word in 35-mm photography. It's fascinating, but even as cameras become almost totally automatic, the large format wooden field camera is enjoying an increase in popularity.

In the past few years, lighter and more compact versions of the folding field camera as well as trimmed-down, more portable studio cameras have been introduced.

Location photographers who want the stunning image quality of large-format photography, and the ability to control image focus and perspective, have

(Please turn to page 50)

CALUMET PORTA VU



Basic kit (above) features preformed parts which require light sanding before assembly (\$130). Add your own lens and tripod to use completed camera (right). We show it equipped with a 35-mm Schneider. The camera folds into a compact unit (inset right) for convenient portability.



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FIELD CAMERAS

(Continued from page 48)

found the field camera indispensable in the photography of architecture, landscapes, products and people. There are also the rewards that come from a more patient, contemplative approach to the craft of photography than is required in using automated, smaller camera systems.

The chief requirements of a field camera outfit (as opposed to a studio setup) are size, weight and versatility. Compromises are inevitable. The lightest, most compact field cameras are suitable for backpacking, but lack the durability and versatility of their cousins back in the studio. Few have bellows which can extend beyond 12 inches, a limitation when your tastes run toward telephoto or close-up photography. Others may not compress enough to permit the use of wide-angle lenses without accessory recessed lens boards. Their movements, rise/fall, shifts, tilts and swings may be limited owing to the fact that the cameras are able to fold. With outfits costing from hundreds to thousands of dollars, price may also be a source of compromise. Though lenses can cost more, your choice of camera will form the core of your field camera outfit.

The Porta Vu camera kit shown in the color photo was assembled in a few evenings, costs just \$125.95 (less lens), (Please turn to page 52)

Toyo-Field 4 × 5 AR

The Toyo-Field 4 × 5 AR, built of die-cast aluminum, weighs a bit over 5 pounds, offers 12 inches of bellows and an adequate range of camera movements. Closed, it's about as rugged as a camera can be. Even its ground-glass back is protected by a built-in focusing hood. Complete with a revolving back, it lists for \$785.



Deardorff 8 × 10 and 4 × 5

Deardorff & Sons has been producing folding, precision view cameras since 1923. More versatile than folding cameras they helped spawn, they're very much at home in the studio. The 4 × 5 model (right) has a bellows opening to 22 inches, can accept a 65-mm lens with recessed lens board, weighs 7 pounds. The 8 × 10 model (left) has a 30-inch bellows opening, weighs 12½ pounds. Hand-built of mahogany and brass, they list for \$1,650 and \$2,315 respectively.



Wista DX 4 × 5

The Wista DX 4 × 5 is a lightweight (4-pound) folding field camera possessing a more than adequate range of movements for field use. It will easily accept lenses as wide as 65 mm. Its 12 inches of bellows neatly fold into the compact package shown at left. Once you get the hang of it, it can be set up in seconds. Model shown is built of rosewood (ebony and cherrywood are also available), lists for \$575. An 8 × 10 model is available for \$795.



Basic outfit shown at right is the inexpensive portable field camera unit featured at the start of this article. The 135-mm lens on the Porta-Vu Kit camera is small enough to allow the camera to be folded. Also shown is a tripod, light meter, magnifier, focusing cloth, cable release, film and film holders.



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FIELD CAMERAS

(Continued from page 50)

yet possesses many features found in cameras costing much more. The instructions supplied are lavishly illustrated and easy to follow. All parts are preformed and require just a light sanding prior to assembly. The only problem I encountered was in having the film back (assembled in a dry New York apartment) freeze up on a trip to the warm humid tropics. This was quickly solved with a borrowed emery board to file the film rails.

The Porta Vu is a very basic camera, weighing under 3 pounds and measuring $10\frac{3}{4} \times 8\frac{1}{2} \times 5\frac{1}{2}$ inches when closed. With an accessory recessed lens board, lenses as wide as 65-mm can be used. If you've handled some higher priced cameras you'll find the Porta Vu's focusing a bit crude, but as I discovered on a recent canoe trip, it works handily.

To complete your field camera outfit you will need a lightweight yet sturdy tripod, focusing cloth, light meter, magnifier for checking focus, some film and appropriate film holders.

One major virtue of large-format cameras is that, by shooting one piece of film at a time, you can easily switch from one film type to another. All the cameras shown will accept a variety of film holders. Black and white, color, roll and instant films may easily be interchanged during a shooting.

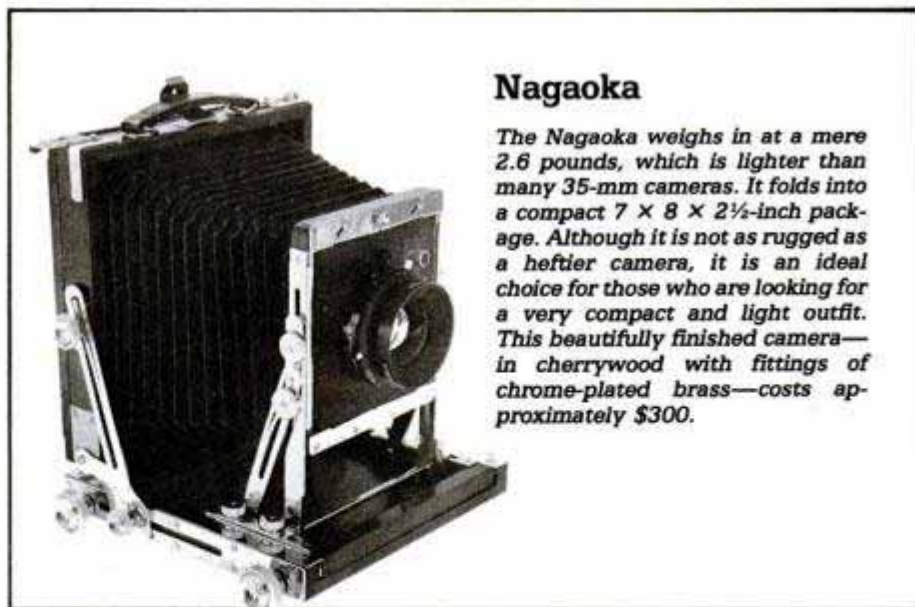
Your lens should be equipped with a cable release. And, gelatin or glass filters are very useful.

These cameras fold up to form nice neat boxes—the metal-bodied ones especially—so they can easily be stuffed into a knapsack or shoulder bag. Cameras such as the Linhof should be cradled in compartmentalized cases or bags so they can't twist about. The old vinyl bag I used on a recent trip has a built-in changing bag, a useful accessory for reloading film holders. However your equipment is packed, it should be protected from extremes in temperature, moisture, dust and shock. If you limit your accessories, your load will be light and you'll have more fun.

The following field cameras possess qualities you may find useful. They represent a cross section of what's available. They are well made, and extremely beautiful and functional. **PM**

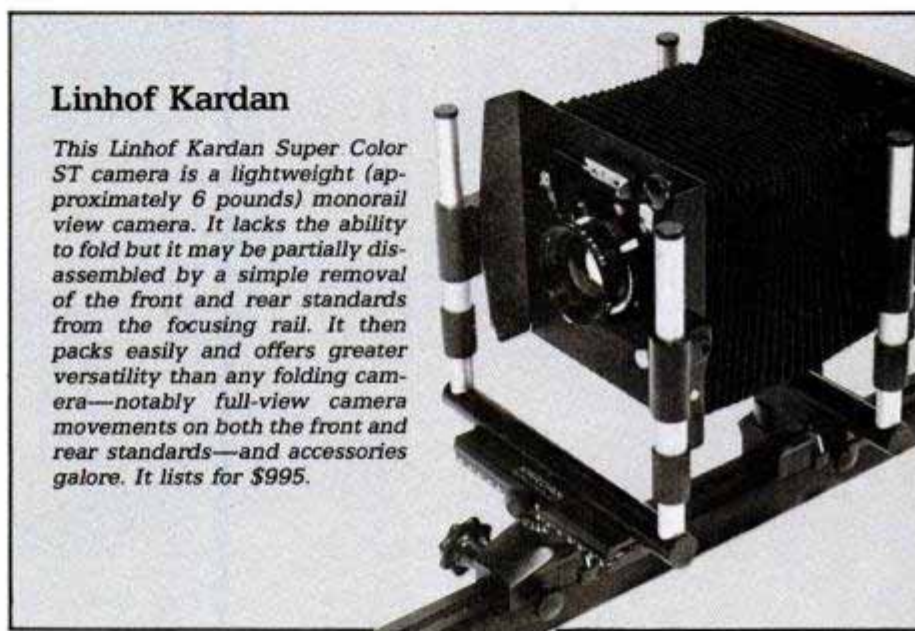
MANUFACTURERS LIST

- Porta Vu**, Calumet Photographic, 890 Supreme Dr., Bensenville, Ill. 60106.
Toyo-Field, Berkey Manufacturing Co., 25-20 Brooklyn-Queens Expressway West, Woodside, N.Y. 11377.
Nagaoka, Lens and Repro, 33 West 17th St., New York, N.Y. 10011.
Wista DX, Foto-Care Ltd., 170 Fifth Ave., New York, N.Y. 10010.
Deardorff, L.F. Deardorff & Sons, 315 South Peoria St., Chicago, Ill. 60607.
Linhof, HP Marketing, 216 Little Falls Rd., Cedar Grove, N.J. 07009.



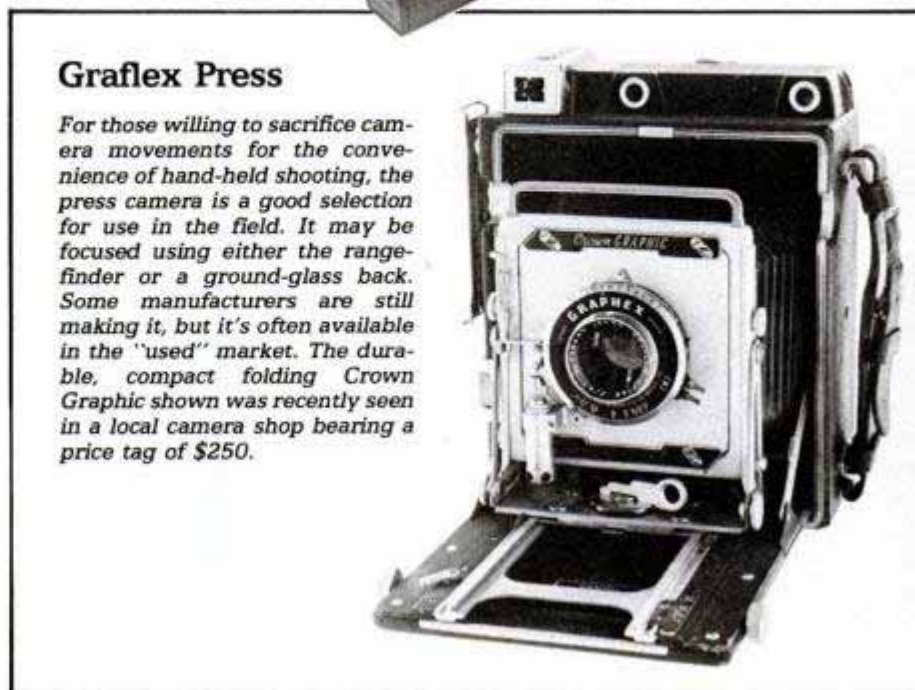
Nagaoka

The Nagaoka weighs in at a mere 2.6 pounds, which is lighter than many 35-mm cameras. It folds into a compact $7 \times 8 \times 2\frac{1}{2}$ -inch package. Although it is not as rugged as a heftier camera, it is an ideal choice for those who are looking for a very compact and light outfit. This beautifully finished camera—in cherrywood with fittings of chrome-plated brass—costs approximately \$300.



Linhof Kardan

This Linhof Kardan Super Color ST camera is a lightweight (approximately 6 pounds) monorail view camera. It lacks the ability to fold but it may be partially disassembled by a simple removal of the front and rear standards from the focusing rail. It then packs easily and offers greater versatility than any folding camera—notably full-view camera movements on both the front and rear standards—and accessories galore. It lists for \$995.



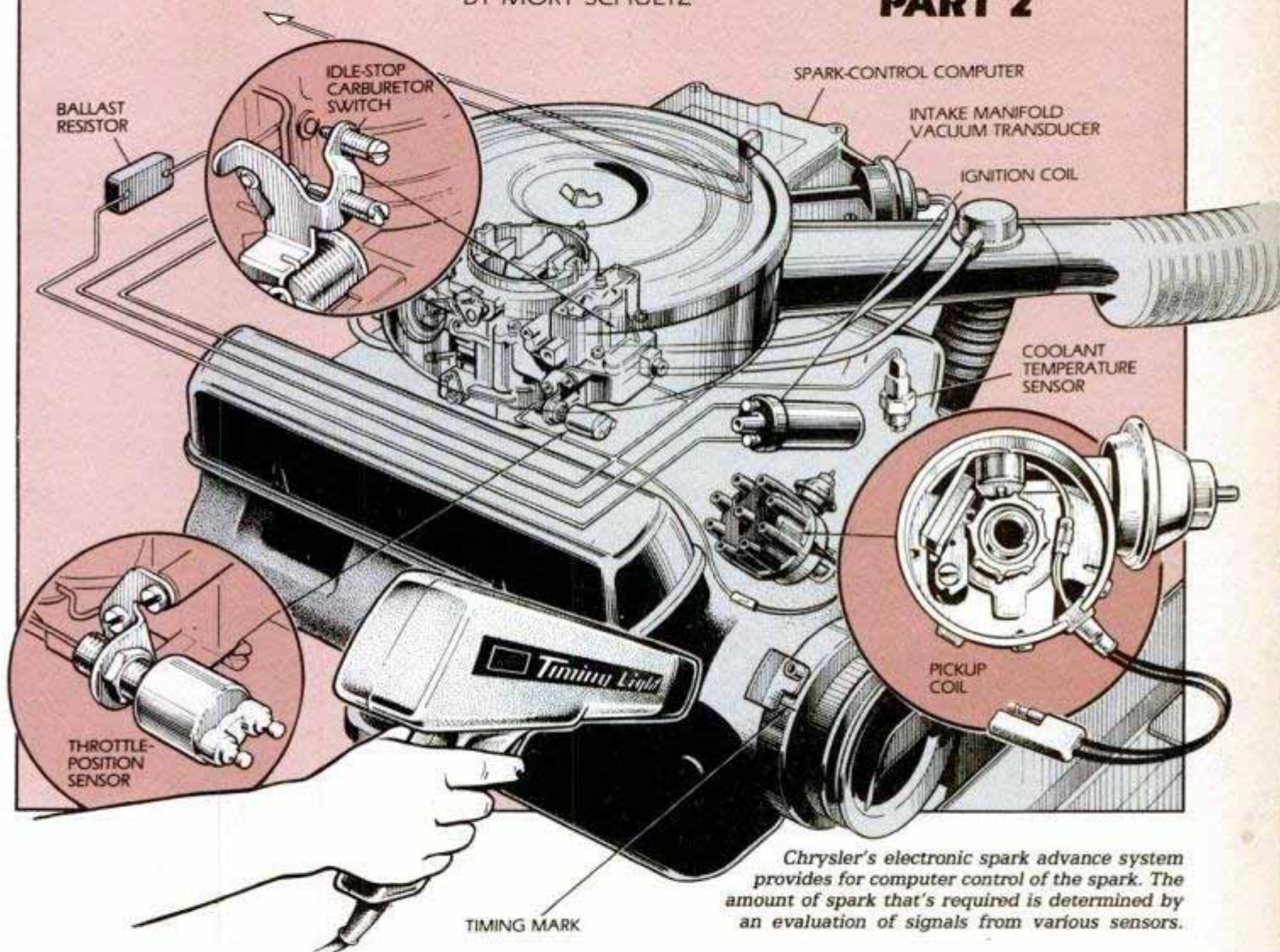
Graflex Press

For those willing to sacrifice camera movements for the convenience of hand-held shooting, the press camera is a good selection for use in the field. It may be focused using either the rangefinder or a ground-glass back. Some manufacturers are still making it, but it's often available in the "used" market. The durable, compact folding Crown Graphic shown was recently seen in a local camera shop bearing a price tag of \$250.

Troubleshooting Chrysler's Electronic Ignition System

BY MORT SCHULTZ

PART 2



Chrysler's electronic spark advance system provides for computer control of the spark. The amount of spark that's required is determined by an evaluation of signals from various sensors.

Our discussion of the Electronic Spark Advance (ESA) system installed in most Chrysler Corp. cars from 1976 to 1980 began in Part 1 last month. The ESA system in 1981 and newer cars is covered by a five-year/50,000-mile warranty that's still in effect for most owners. If a problem is being caused by an ESA unit, Chrysler will repair it at no charge if the warranty is current.

In Part 1, we outlined a troubleshooting procedure to uncover an ESA system part that's keeping a '76-'80

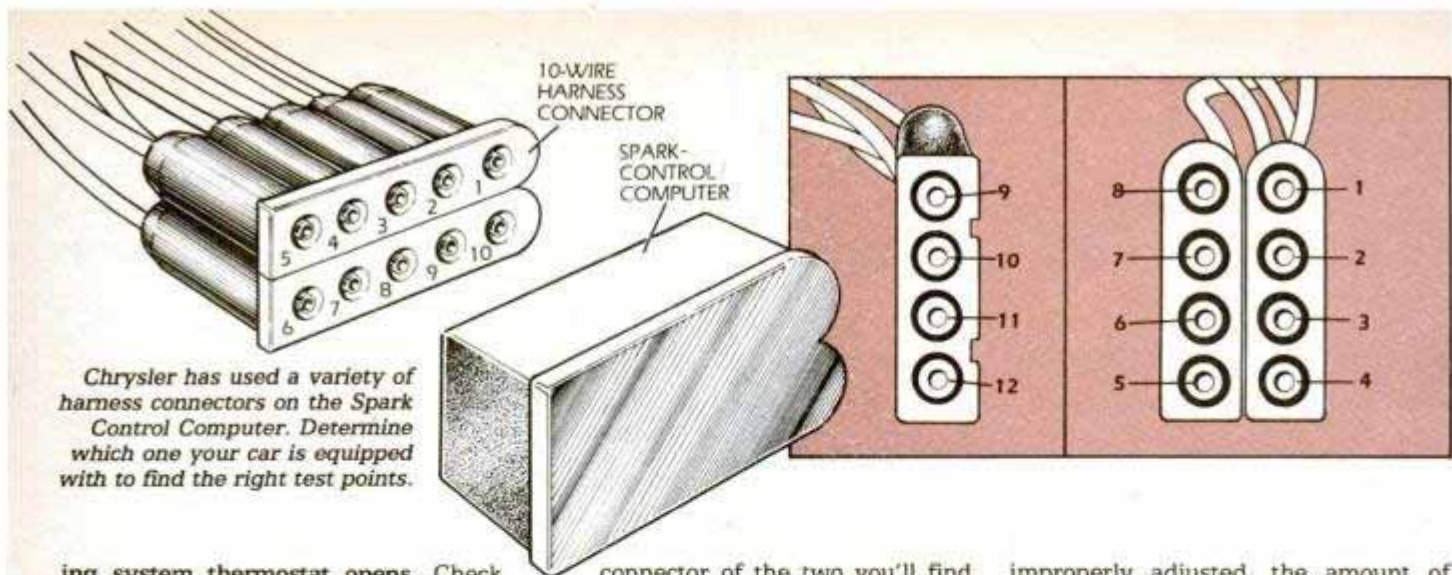
engine from starting. A malfunction can also cause an increase in fuel consumption and such problems as rough idling, persistent stalling, missing or bucking, noticeable loss of power, surging and pinging (spark knock).

Testing V8 ESA for poor fuel economy

The reason for poor fuel economy may be a bad coolant temperature sensor sending wrong signals to the computer, which keeps the engine idling at a higher-than-normal speed. To test

this sensor, take the following steps:

1. With the engine cold and the ignition off, connect an ohmmeter lead to a clean metal engine part (ground), such as the alternator brace.
2. Find the coolant temperature sensor. Two wires are attached to it: One is black, the other is another color—usually orange.
3. Hold the other ohmmeter lead against the black wire terminal. The ohmmeter should show continuity. If it doesn't, replace the sensor.
4. Warm up the engine, so the cool-



Chrysler has used a variety of harness connectors on the Spark Control Computer. Determine which one your car is equipped with to find the right test points.

ing system thermostat opens. Check this by squeezing the top radiator hose as the engine runs. When the 'stat opens, you'll feel coolant surging through the hose. Begin the test at once. If coolant gets above 225° F., the coolant temperature sensor may close and give an incorrect reading.

5. Turn off the engine and hold the ohmmeter lead to the terminal connected to the black wire. The other ohmmeter lead should still be connected to ground. The ohmmeter should not show continuity. If it does, replace the sensor.

Testing V8 ESA for poor operating performance

A bad run-pickup coil in the distributor or a defective computer can sometimes cause a problem best described as a "surge" that occurs when the car is cruising at a constant throttle position. This condition is very similar to a performance problem caused by a lean fuel mixture. The only simple way to distinguish between the two is by observing the ignition firing pattern on an oscilloscope. The alternative is to test the components until you find a malfunction. To test the run-pickup coil:

1. Warm up the engine.

2. Turn off the ignition and pull the dual connector from the bottom of the spark-control computer. The computer of a V8 engine is attached to the air-cleaner assembly.

3. Connect ohmmeter leads between terminals 3 and 5 if the computer has a phase 1 connector and between terminals 5 and 9 if the computer has a phase 2 connector. A phase 1 connector is used in 1976-77 models. A phase 2 connector is in 1978-80 models and in 1977½ LeBarons and Diplomats with 318-cu.-in. engines and two-barrel carburetors (see Part 1). The ohmmeter should read between 150 and 900.

4. If the ohmmeter shows that resistance is not between 150 and 900 ohms, trace leads from the distributor until you come to the pickup coil connector. If the car has two pickup coils (run and start), you want the smaller

connector of the two you'll find lying side by side.

Pull the connector apart and attach your ohmmeter to the terminals of that part of the connector on the distributor side. If your ohmmeter shows a resistance of 150 to 900 ohms, it indicates a poor connection or open short in wiring between the pickup coil connector and computer dual connector. Find and repair the problem. If the resistance is not between 150 and 900 ohms, the run-pickup coil in the distributor has gone bad. Replace it.

5. In doing the test described in Step 3 above, if you get a resistance reading of 150 to 900 ohms, again find and pull apart the pickup coil connector. Attach one lead to ground and touch the other, in turn, to each terminal of that part of the pickup coil connector on the distributor side. If the meter shows continuity, replace the run-pickup coil.

If there is no continuity, adjust the run-pickup coil air gap (see Part 1). Then, if the engine still fails to perform properly, the fault may be a defective spark-control computer. The only way to be sure is to install another computer. If the problem persists, you can't blame the computer.

The problem that "substitution testing" presents for the DIY mechanic is that electronic parts cannot be returned once purchased. Many independent mechanics send cars to dealer facilities when preliminary troubleshooting indicates a defective expensive electronic part. Most Chrysler dealers have an electronic machine that will quickly test the spark-control computer on many models.

Tips on the transducer

The ESA system has a throttle-position transducer attached to the carburetor so that its actuating rod moves in and out as the throttle plates open and close. It sends a signal allowing the computer to determine the throttle position. The computer then provides the most spark advance possible at that position, maximizing fuel economy.

If the throttle-position transducer is

improperly adjusted, the amount of advance will be incorrect causing spark knock or poor fuel economy.

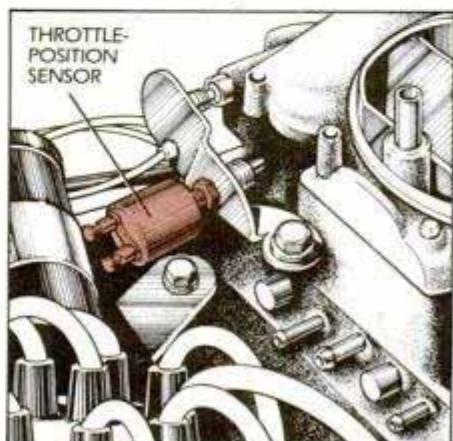
To adjust the transducer on 1977 models, first make sure the underhood temperature is below 135° F. Start the engine and wait two minutes. Then connect a jumper wire between the carburetor switch terminal and ground. Disconnect the electrical connector from the transducer. Check and adjust timing following directions on the vehicle information label in your engine compartment. Then reconnect the transducer connector and recheck timing.

If timing is now more advanced, loosen the transducer locknut and rotate the transducer clockwise until timing returns to the adjusted figure. Then rotate it an additional half turn clockwise and lock the adjustment.

If timing is at specification after reconnecting the transducer, rotate the transducer counterclockwise until the timing starts to advance beyond the specification. Then turn the transducer a half turn and tighten the locknut.

For 1978-79 cars, a special tool, Chrysler part No. C-4522, is necessary. It's an inexpensive gauge. If you invest in it, you can adjust the transducer and

Timing light is necessary to adjust the throttle position sensor properly on 1977 models. A special tool, Chrysler part No. C-4522, gauges the adjustment on 1978-79 throttle position sensors.



the transducer mounting bracket. Then adjust the transducer by rotating it until the gauge just fits; tighten the lock-nut.

If you still haven't found an ESA reason for poor performance, have a Chrysler dealer run your car through the series of timing tests outlined in the service manual. An adjustable timing light is needed. For the Electronic Spark Advance system to perform properly, timing at various engine speeds must meet each engine specification.

Omni, Horizon ESA troubleshooting

When a 1.7-liter engine won't start, first see if the ESA is at fault. Pull the ignition coil-to-distributor-cap secondary ignition cable from the distributor tower and hold its end 1/4 inch from a clean metal part of the engine. Crank the engine.

If the spark that jumps the gap between the cable terminal and ground is consistent and bright blue, the ESA is not causing the no-start condition. If there is no spark, or it's weak or inconsistent, measure battery voltage and make note of it. You'll need it for judging some test results.

Make sure the battery's specific gravity is 1.220 or more. The battery has to be strong enough to operate the starting and ignition systems for the tests.

Pinpointing the cause of a starting failure

Here's how Chrysler service engineering tells you to put your finger on the reason for a 1.7-liter engine starting problem:

1. Disconnect the primary ignition wire from the negative terminal of the ignition coil and connect a jumper wire to it.

2. If you've reattached it, again pull the secondary ignition cable from the

center tower of the distributor cap and hold its end 1/4 inch from ground.

3. Have someone turn the ignition on. Do not crank the engine.

4. Touch the other end of the jumper wire to a metal part of the engine for a moment. Watch to see if a spark jumps the 1/4-inch gap between the secondary cable and ground.

If there is no spark, reconnect wires and test voltage at the positive terminal of the ignition coil. Be sure the ignition key is on. If the voltmeter records at least nine volts, replace the coil. It's defective. If less than nine volts is recorded, there's ignition trouble, so check all wiring and connections, and the ballast resistor.

If there is spark, there may be a problem in the ESA system. To find it, do the following:

1. Turn off the ignition key and reconnect all wires.

2. At the base of the distributor cap, you'll find a connector with three wires leading into it from the spark-control computer. Pull this connector off and notice that it has three receptacles—from left to right, let's call them A, B and C. With the ignition key on, measure voltage at receptacle B and compare it to the voltage reading you got before.

If voltage readings aren't the same:

1. Turn off the ignition key and locate the 10-wire harness connector attached to the spark-control computer. Pull the connector off. Don't remove grease from the connector cavity.

2. Connect an ohmmeter between receptacle B of the three-receptacle connector and receptacle 3 of the 10-wire harness connector.

3. If there is no continuity, the wire between receptacle B and 3 is bad, so find the broken section and repair it.

4. If there is continuity, measure voltage between receptacles 2 and 10 of the 10-wire harness connector. If

voltage is not obtained, there's a bad or loose wire between battery and spark-control computer. If it is obtained, the spark-control computer is defective.

If voltage readings are the same:

1. Reconnect the 10-wire harness connector.

2. Pull the secondary ignition cable from the center tower of the distributor again and hold it 1/4 inch from a clean ground. Turn on the ignition key and momentarily touch one end of a jumper wire to receptacle A of the three-receptacle connector. Touch the other end to receptacle C.

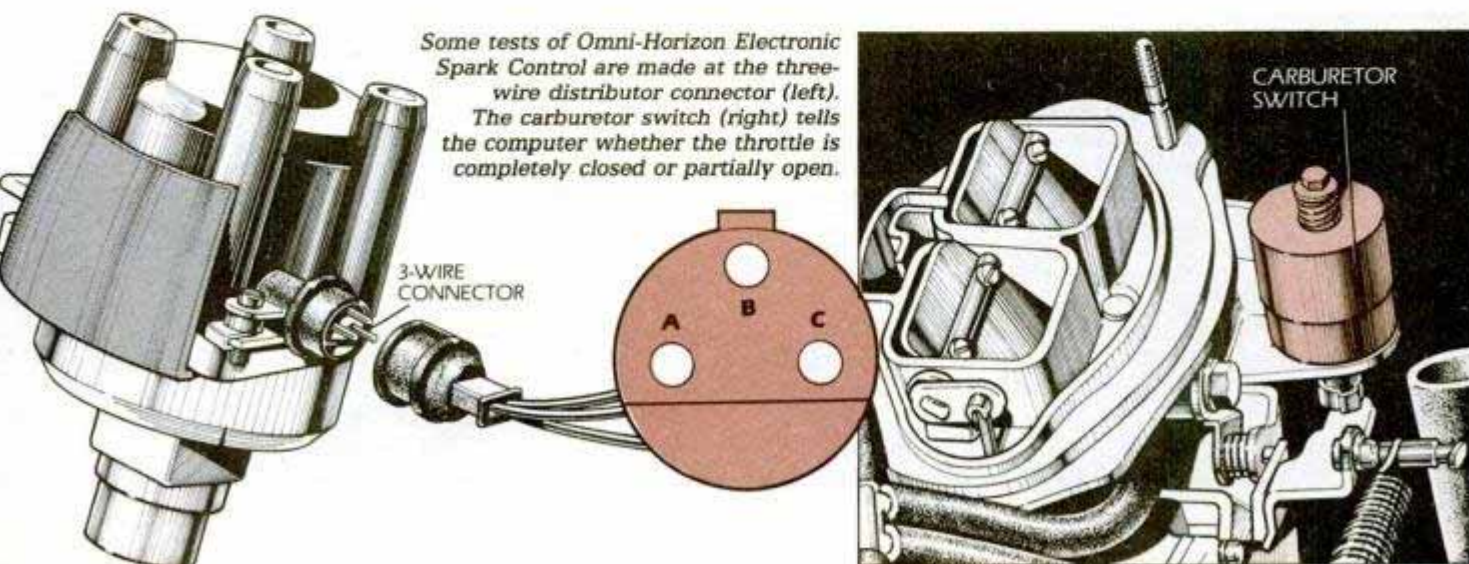
3. If a spark jumps the 1/4-inch gap, your starting problem is a defective Hall-effect pickup assembly in the distributor. Replace it.

4. If spark doesn't jump the gap, turn off the ignition key and pull the 10-wire harness connector off the spark-control computer. With you ohmmeter, test for continuity between receptacle C of the three-receptacle connector and receptacle 9 of the 10-wire harness connector. Then, check continuity between receptacle A of the three-receptacle connector and receptacle 5 of the 10-wire harness connector. If there is continuity in both cases, the spark control computer is probably bad. Replace it. If there is lack of continuity in one or both cases, there's a bad wire or loose connection in the wiring harness.

Testing switches

Two key switches in the ESA system of 1978-80 Omnis and Horizons are coolant temperature and carburetor switches. If either is defective, you'll get an operational problem. But before testing, see that ignition timing and idling speed are at specification. If one of these basic settings is out of whack, it may cause the problem.

To test the carburetor switch, found on the carburetor housing, and its circuit do this:



1. With the ignition key off, pull the 10-wire harness connector from the spark-control computer.

2. With the throttle completely closed, test continuity between receptacle 7 of the 10-wire harness connector and ground using an ohmmeter. Lack of continuity means that the wire between the connector and carburetor switch is bad or the carburetor switch is defective. Repeat the same test with the throttle fully open. There should be no continuity if the carburetor switch is working properly.

To test the coolant switch to the left of the cooling system thermostat housing, do this:

1. With the ignition key off and the engine cold, pull the wire off the coolant switch.

2. Connect your ohmmeter between the coolant switch terminal and ground. If there is a lack of continuity, replace the switch.

3. Reconnect the coolant switch wire and warm up the engine until the thermostat opens. Repeat the test. Now there should be no continuity. If your ohmmeter shows anything other than infinite resistance, replace the switch.

Important: Prongs on the computer to which the 10-wire harness connector is attached are supposed to have a heavy layer of grease to prevent corrosion. Don't wipe it off. If there isn't at least a 1/8-inch thick layer of the stuff, get a tube of Mopar multipurpose grease (part No. 2932524) from a Chrysler parts department. Lay a thick coating over the end of the harness plug and attach the plug to the computer.

As with the ESA system in V8 engines, timing at various speeds of the 1.7-liter engine has to meet specifications to avoid a performance problem. The last step in troubleshooting, therefore, is to have a Chrysler dealer use an adjustable timing light to check these phases.

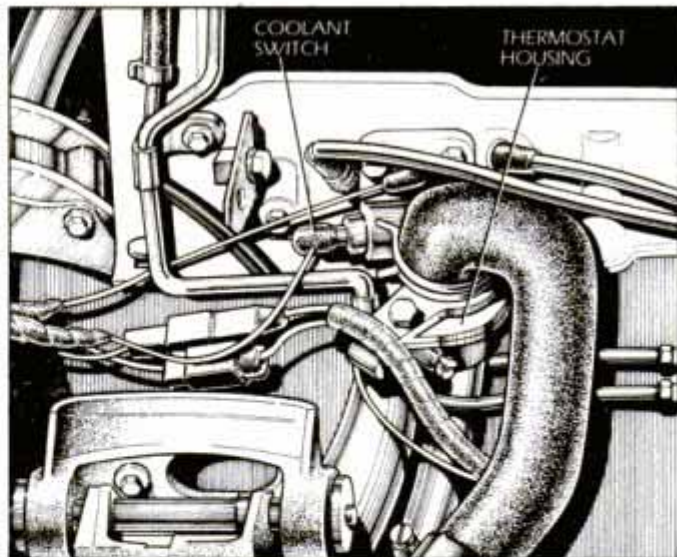
Keep it simple

Let me tell you about an experience I had while doing hands-on research at Chrysler for this article. Several cars were put at my disposal, each having a different problem. One, a 1979 Horizon, had an engine miss. I assumed it was caused by an ESA component failure.

With a few Chrysler technicians looking on (were they snickering, I wondered?), I tinkered and fussed for 20 minutes. Finally, I drew my head out from under the hood and sheepishly announced, "I need help."

Pete Gladysz, an engine electrical engineer, came to my rescue. "You can't take it for granted the problem is caused by electronic component failure," he said, "just because an engine

A malfunctioning coolant switch can sometimes result in excessive fuel consumption and an exceptionally high idle speed. This can happen if the temperature sensor "reads" the coolant temperature as too low, fooling system into thinking engine is in the cold-idle mode. Whenever this occurs, the computer ups the idle speed. If excessively fast idle is a problem, even after warm-up, check the coolant temperature sensor.



is electronically controlled. Most times it isn't."

And with that he handed me a Chrysler "Driveability Complaint Sheet," which mechanics at Chrysler dealerships are supposed to use when troubleshooting engine problems. "Do your readers who own Chrysler Corp. cars having ESA a favor and show them this," he advised.

So here's the list of problems you may have with your ESA Chrysler Corp. car and their usual non-ESA causes.

When you're troubleshooting, rule these things out first:

Hard starting, engine cold:

- Automatic choke stuck open.
- Fouled sparkplugs.
- Weak fuel pump.
- Defective ignition coil.
- Bad accelerator pump.
- Low engine compression.

Hard starting on engine restart:

Rough idling, engine cold:

- Vacuum leak.
- Defective sparkplug cables and/or sparkplugs.
- Incorrect slow- or fast-idling speed.
- Automatic choke stuck open.
- Damaged fuel evaporation control system.
- Incorrectly set intake and exhaust valves.

Rough idling, engine warm: All causes listed under rough idling, engine cold, plus automatic choke stuck partially closed and a sticking exhaust gas recirculation (EGR) valve.

Die-out after start (in N or P):

- Lean fuel mixture.
- Defective automatic choke.
- Incorrect fast-idle speed.

Cold engine die-out after shifting into gear:

- Vacuum leak
- Defective automatic choke.
- Incorrect fast-idle speed.
- Defective sparkplugs.
- Incorrect ignition timing.

■ Damaged automatic transmission torque converter.

Die-out after shifting into gear on engine restart: All causes listed under cold engine die-out after start, plus a bad fuel evaporation control system.

Die-out on the roll, engine cold or warm:

- With a cold engine only, defective automatic choke pull-off units (check linkage and vacuum break).
- Vacuum leak.
- Bad accelerator pump.
- Incorrect idling speed and/or a lean fuel mixture.

- Incorrect ignition timing.
- Damaged spark advance.

Heavy spark knock:

- Gasoline too low in octane.
- Air leak into intake system.
- Incorrect ignition timing.
- Inoperative EGR system.
- Carbonized or overheated plugs.
- Lean fuel mixture.
- Premature torque converter lockup.

Power loss, engine cold:

- Inoperative vacuum break.
- Fuel mixture too rich or too lean.
- Binding throttle valve linkage.
- Defective accelerator pump.
- Damaged spark advance.
- Stuck heat control valve or a restricted exhaust system pipe or muffler.
- Restricted catalytic converter.
- Damaged fuel evaporation control system vent solenoid or valve.

Power loss, engine warm: All causes listed under power loss, engine cold, plus premature EGR.

Engine miss:

- Air leak into the intake system
- Fouled sparkplugs or defective sparkplug cables.
- Premature EGR.
- Weak ignition coil.
- With a cold engine only, rich loading (check choke system, including vacuum break).
- Early torque converter lockup. **PM**

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Since our last report, we've turned in several test cars, wrapped up our tests on others and added a new vehicle to our test fleet.

As our test series progresses, we anticipate a constant turnover of vehicles so that we'll be able to report on many different types of cars during the year. At this time, we're awaiting delivery of a Chevrolet Camaro Z28, a Cadillac Cimarron, a Buick LeSabre and several other vehicles you've asked for. If there's a specific car you'd like us to report on, drop us a note and we'll do our best to secure one and test it. Meanwhile, here's what we've got going right now.

Pontiac 6000LE

In our last report on the Pontiac 6000LE, we reported that our test car was delayed because of mechanical problems (*PM's Long-Term Car Tests*, page 92, Sept. '82). This was not accurate.

Before a GM division delivers a test car, the car gets put through the same pre-delivery checkup as that performed by a dealer for a regular customer. The check is to make sure the car is right before being handed over to the buyer or, in our case, the testers. Our test car was actually delayed because of a backlog of work at the facility that performs these pre-delivery checks in Pontiac's new-car prep center in Detroit, not because of a problem with the car itself.

The test car has accumulated a little



6000LE: It needs more than a Four, but the handling is great.



Alliance: It's economical, well-built and has superb ride quality.

over 3,235 miles now and has been remarkably trouble-free except for an electrical glitch right after we took delivery.

At 1,615 miles, all the lights in the interior of the car went on. This occurred on the New Jersey Turnpike at 60 mph one night on the way home from work. Yes, I was a little startled. However, the car continued to run fine, so I proceeded. No amount of knob twisting or fixture tapping would get any of the lights to go out. I had to disconnect the battery. When I took the car to a Pontiac dealer he did an amazing

job of finding an obscure short that traced back to the foot-operated parking brake rubbing against an electrical cable. The repair was performed under warranty. The car has not missed a beat since that episode.

After 2,100 miles, I complained to Pontiac about a clunking in the front end under acceleration and braking. The dealer replaced the engine cradle bushings and the clunk went away. The clunk was annoying, but in no way detracted from the fine handling of our 6000LE.

Handling has been this car's strong suit ever since we began our test. You'll remember that we ordered this car with the optional Y99 suspension package, consisting of higher-rate front and rear springs, higher-rate front and rear stabilizer bars, wider wheels, wider 205/70R13 radial tires and quicker, firmer steering.

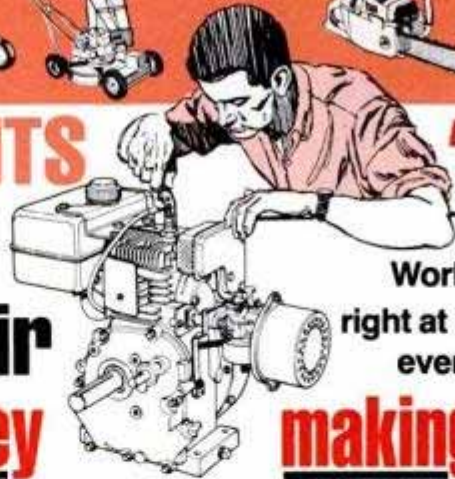
The result of this package, which cost \$46 extra, is a car that comes close to feeling and handling like a fine European sedan. If you've ever driven a European touring car with its taut, stable and extremely controllable feel, you'll know what I'm talking about. It certainly makes the 6000LE take on a different personality. It makes you want to drive it, not just be a passive passenger. It makes the car a lot more fun, too, and you'll find yourself enjoying your motoring a lot more.

One thing that won't make your driv-
(Please turn to page 62)



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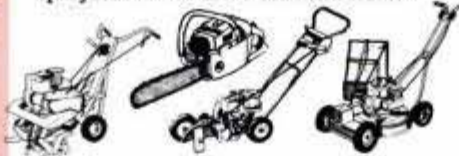
In just a short time, you can be ready to join one of the fastest growing industries in America...an industry where qualified men are making from \$10.00 to \$15.00 per hour...and that's just for labor. Parts, engines and accessories add even more to the profits.



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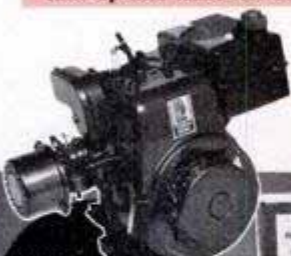
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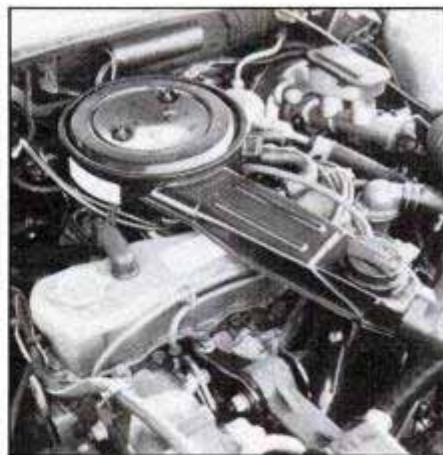
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PM LONG-TERM CAR TESTS

(Continued from page 60)

ing more fun is the standard 2.5-liter, fuel-injected, four-cylinder engine that comes in every 6000 model unless you order one of the optional-at-extra-cost engines. The engine puts out 90 hp at 4,000 rpm and feels brisk when you first begin driving the car. But after you get used to the rather deceptive off-the-line feel the 2.5 in the 6000 turns out to be rather blah in performance. My zero-to-60-mph times have been averaging a slow 16 seconds shifting the automatic transmission manually in the lower gears for more acceleration. Leaving the stick in DRIVE results in even slower times.

As it turns out, the 2.5-liter Four isn't too economical either. You have to run it hard to make the 6000 move out. I often found myself driving with my foot all the way down on most hills, and even in city traffic, just to keep up with the traffic flow. Obviously, foot-to-the-floor is not the most economical way to drive. As a result, I've been averaging around 18.5 miles per gallon—not the most economical car on the block. My low mileage figure was 16.8 mpg during the break-in period when we first got the car. The high has been a tankful



The 2.5-liter Four is adequate, but the car really needs the V6's forward motivation.

optional 2.8-liter V6 engine. Second, it did not have the handling suspension.

We managed 20.7-miles-per-gallon fuel economy with the V6 specifically because it didn't have to work so hard to move the car along. The additional power transformed the 6000 into a sprightly, agile road performer (zero to 60 in 12 seconds) as opposed to our four-cylinder powered test car, which is, at best lethargic. Owners felt the same as we do about their four-cylinder-powered 6000s (see *PM Owners Report*, page 90, Sept '82).

On the other hand, the V6 car with the standard suspension did not handle nearly as well as our test car with the Y99 setup. The suspension was softer, which some people may prefer. But the car bottomed out more easily on large road dips and, in general, just didn't have the stable feel of our test car. Yet, because of the V6 engine, we liked the two-door a lot more than we did the four-door.

If we were going to order another 6000 for a test, we'd order the V6 engine and the optional handling suspension. That would be the best of both worlds. In fact, the new Pontiac 6000STE just introduced for '83 has this setup standard. Pontiac also offers a 4.3-liter V6 diesel.

All the Detroit manufacturers have put a huge effort into better quality control the past few years and it shows in our Pontiac 6000LE. The 6000 is one of a group of GM cars known as A-bodies, which also include the Chevrolet Celebrity, Oldsmobile Cutlass Ciera and Buick Century. All of these cars are quickly gaining a reputation for very high quality—in fact, among the best made in this country. Our test 6000 is no exception. The fit and finish on this car is excellent. All the body panels align well, the paint has been carefully applied and there are no rough edges or loose ends. The GM A-bodies are setting quality standards in Detroit that others will be shooting for.

The interior on our test car has the



Pontiac 6000 interior is first rate. The seats are comfortable without being overly plush and there's plenty of room.

used up at the rate of 23.0 mpg. EPA ratings are 25 mpg city and 40 mpg highway.

During the course of our test with the 6000LE four-door, we had occasion to put 1,780 miles on another 6000, an LE two-door coupe. The two-door was a completely different animal. First, instead of the 2.5-liter Four, it had the

optional 45/45 seating, which is very comfortable. But we don't care for the velour upholstery. You can get vinyl seating, but you'll have to opt for the less luxurious 6000 model.

In general, our Pontiac 6000LE has performed well, been very comfortable transportation for five, and has done a good job in its intended role as an American family sedan. This is the size of car many of us will be driving in years to come. If our test 6000LE is any example, things won't be too bad.—*Joe Oldham*

AMC/Renault Alliance

I got behind the wheel of the Alliance after returning the omnipotent Mustang 5.0-liter HO. Talk about culture shock. Stepping from a 157-hp, 2,600-pound, manual four-speed rocket into a 55-hp, 1,980-pound flyweight with a slushbox is a little like being told to go fight Conan the Barbarian armed with a water pistol and one arm tied behind your back. I could see all those commuters I'd been drag racing to the Battery Tunnel finally getting their revenge.

The car is slow, getting 0 to 60 in 14 seconds with the manual five-speed and 17 seconds with the three-speed automatic. But what it lacks in power, it more than compensates in smoothness, driveability and superb fuel economy.

In daily stop-and-go commuter driving I've been getting a steady 25.9 mpg, and highway driving at elevated speeds yields 30.1 mpg. The EPA numbers for this car with the automatic are 31/39 mpg city/highway.

The bottom end of this 1.4-liter transverse Four is the same as that found on Le Car, but you would have a hard time believing it. Where Le Car's motor is raspy, noisy and not very economical, the Alliance's motor is extremely smooth and very refined. Our DL four-door is a 49-state version equipped with the single-point Bendix throttle body fuel-injection system. The California versions use a Bosch multi-point injection system.

Cold-start and cold-drive characteristics are quite good, with just a mild dead spot at the bottom end of the power band which disappears quickly.

After 1,757 miles, the car hasn't burned a drop of oil. Obviously, whoever is in charge of bolting and torquing things together at AMC's Lakefront plant in Kenosha, Wis., has done a good job. Not only is the engine tight, but so is the rest of the body. I've experienced only two areas of vibration. One is in the plastic around the floor-mounted shift console which sets up a resonant vibration at 75 mph. Another is a vibrating headliner molding above the

passenger-side front door which buzzes from time to time. I fixed the problem by tightening up all the screws in the molding. The vibration around the console is still with us.

The Alliance's single most wonderful attribute is the suspension. Each morning and afternoon it must cope with an accelerated suspension-destruction tester commonly known as the West Side Hwy. This was once an elevated highway but the elevated part and the highway part were torn down and now all that's left is a street-level, urban Baja littered with mountains of torched I-beams, huge slabs of steel-reinforced pavement about the size of a continental plate and the odd burned-out hulks of stolen cars. The Alliance seems not to notice.

It floats over the little bumps and deals with the big ones with authority, but never loses its directional stability, even at higher than normal speeds. The spring rates and shock-absorber calibrations seem just about perfect for this class of car. While the suspension is forgiving, it doesn't sacrifice road feel, steering response or tautness. Neither does the resiliency of the suspension sacrifice cornering ability. The car does lean a lot while you're trying to generate some G-force, but ultimate corner-

(Please turn to page 64)

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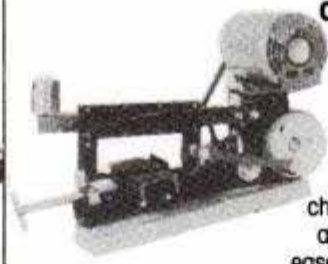
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PM LONG-TERM CAR TESTS

(Continued from page 63)

ing doesn't seem to suffer. We registered .71 G on a skidpad, a better than average number for most front-drive cars in its class and right up there with the Scirocco at .73 G. That .71 G would probably have been higher if the car had come shod with something other than the 175/70R13 Michelin XZX standard tire, but that's the best available right now.

As in most good French and German sedans, the seating position is quite high, making visibility very good all around. This is especially important in hand-to-hand commuter combat. The Alliance will insinuate itself into the slightest traffic opening due to the trim dimensions and great visibility will keep you from trying to occupy the same space with two objects.

The only real annoyance comes from constantly trying to keep the motor on the cam. In a manual-transmission-equipped car this would be easy. But with the automatic it seems to take forever to get launched, even when you shift manually.

Overall, though, it's been a very rewarding 1,700 miles. My only suggestion is to install a two-liter motor, and leave everything else alone. It's nearly perfect.—Tony Assenza

Toyota Celica Supra

The twin-cam Supra was an exciting and sexy unknown when we picked it up in March of '82 (see *PM's Long-Term Car Tests*, page 89, June '82). By the time we returned it last August we had 12,000 miles on the odometer and it had become a predictable and faithful friend. We have unanimous praise for this car, which must be ranked among the world's great production automobiles. Now that it's gone from our fleet, we all fondly recall the sheer joy of taking off in a car that does everything so well, and we overlook the minor bugaboos discovered before many miles were on it (see *PM's Long-Term Car Tests*, page 92, Sept. '82).

With its automatic transmission, all the power options and terrific reliability, I did at times consider the Supra just a marvelous appliance as I hurried from here to there with other things on my mind. What the Supra lacks is any idiosyncrasy. Maybe too much driving in any modern car of the caliber of Supra leads to fantasies about buzzing along, top down, in an old bug-eyed Sprite with anxieties about whether or not you're ever going to get where you're going. We'll remember the Supra as giving us no trouble, 21 miles per gallon and a standard of excellence we'll have with us as we drive other cars.

—Bill Hartford

PM BRIEFS

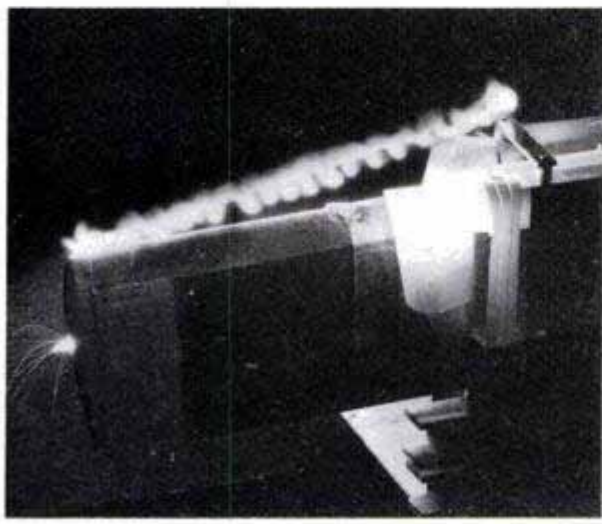


PM's Whatsit

This is one of those "Origin of the Species" contests, and we'll give you a big, fat clue: This same basic piece of machinery appeared before in PM; it was in June 1978, in a story we called *The Glory Days Of A Grand Old Lady* (page 89). You needn't dig that out if you can't divine the ancestry of this newest version, however; just turn the page.

Lightning Vs. Aircraft

This photo shows a bolt of electrical energy similar to a lightning strike hitting the section of a helicopter rotor blade. The test is one of a number being done at the Culham Laboratory in southern England, where a Lightning Studies Unit is evaluating the dangers to modern aircraft. Culham scientists say the average aircraft in commercial service will be hit once every year. Ordinarily, slight pitting and burn marks will be the only result of a strike on metal sections. Glass- and carbon-fiber composites, however, offer less protection from air strikes, and structural damage is possible. Strikes at the point of fuel vents or jettison pipes could be disastrous. Fortunately, studies at Culham and elsewhere have determined the optimum locations for fuel vents, regarding strike potential, and designers around the world follow these guidelines.



Would you buy a new car from an airline captain?

One of the more curious wrinkles in automobile salesmanship occurred recently as a result of a Chevrolet campaign. Trying to get the '83 model year off the ground, Chevy offered two free round-trip tickets on Eastern Airlines — anywhere the line flies — as an incentive to purchasers of new cars. As part of the deal, Eastern's captains were instructed to deliver details of the program via the cabin intercom — in effect, a car commercial — during flights.

Some of the jet jockeys made pretty good pitchmen. But, apart from the irony of one travel medium selling its customers on somebody else's, there came the unsettling thought that perhaps the calm, seasoned voice that had helped us weather rough air, lightning flashes and holding patterns would never be quite as reassuringly credible again.

PM BRIEFS



The curious flock for a peek at the Smile Shuttle's interior (note smoked-glass rear wall). Dashboard is part original DC-3, part assorted airplane graveyard reclamations.

Whatsit Revealed

A good many PM readers, undoubtedly, know that old DC-3s never die. This one was first converted to a motorhome on a bus chassis several years ago by a Californian named Smoky Roland. The current owner, Robert Pfeiffer, saw it in Mexico while on vacation; later heard Roland had it up for sale. Pfeiffer and his wife, Heike, came up with the "Smile Shuttle" idea, motif and modifications. So now the former Gooney Bird has evolved into a wingless version of an advanced flying object—complete with rocket motor lobes and a rather stunted vertical stabilizer. The Pfeiffers hope to make a going concern out of the 38-year-old fuselage by hiring it out as a promotional attraction. When not working, it is—as they say in California—a super unreal mobile crash pad.

Why won't he give someone else a chance?

It is becoming more and more conclusive to the aerospace medical types that the primary danger of supersonic flight is addiction. This is based on the case of one Brig. Gen. Charles E. (Chuck) Yeager (U.S.A.F. retired). On October 14, 1947, (then) Major Yeager was ordered to exceed the speed of sound in level flight over what is now Edwards Air Force Base. He did, and the rest is history. Yeager retired from the Air Force in 1975, but as a consulting test pilot to Northrop Corp., here is what he did exactly 35 years to the day after his first supersonic flight: Took a Northrop Tigershark (F-5G) fighter to 36,000 feet and hit Mach 1.45 in a checkout of handling qualities. The Tigershark is 179th on the list of different aircraft types in which Yeager has qualified; his flight hours now top 11,000.



Yeager in 1947 (top), and exactly 35 years later.

Foamula One

Before you jump in and fire up this Formula racer, be advised that it's made entirely out of foam-core posterboard. It's one of the winners in a contest sponsored by Primex Plastics, a New Jersey firm, to foster new uses of its art-and-craft product. John Sze, a Baltimore designer, built the car.



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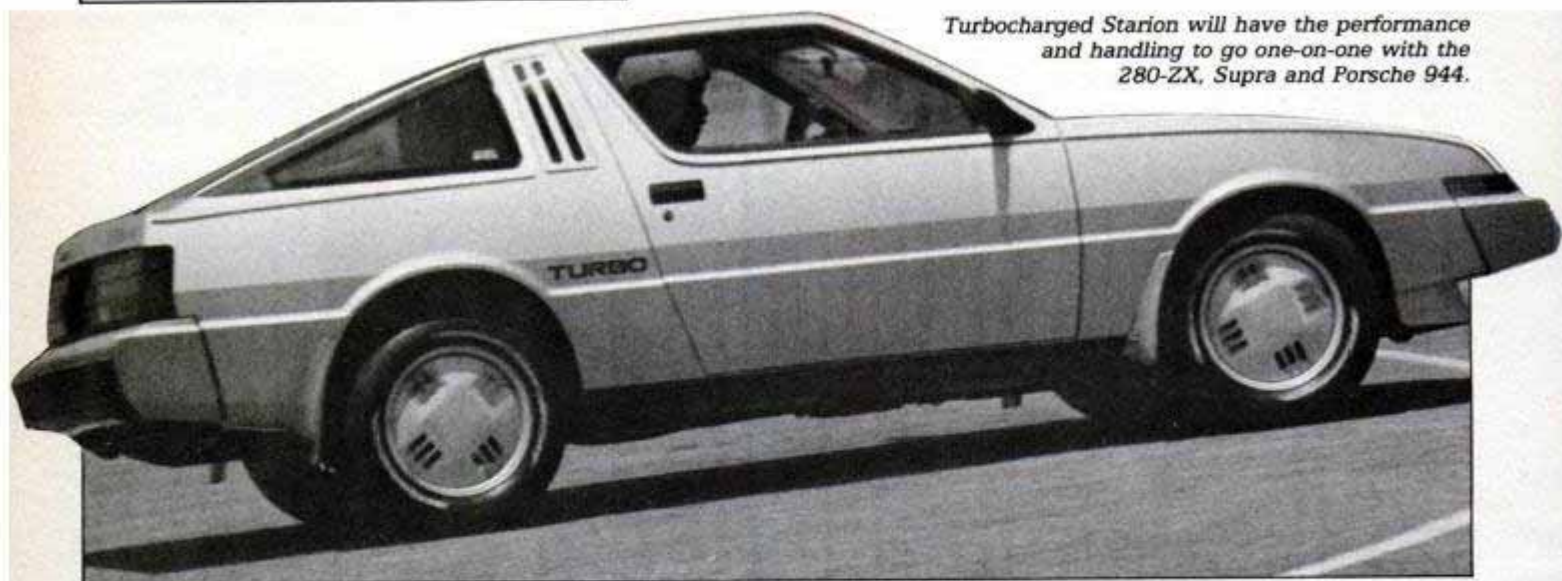
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Driving The Mitsubishi Starion, Tredia And Cordia

No, they're not newly discovered galaxies. But, they are the rising stars from Japan.

BY MIKE LAMM WEST COAST EDITOR

Mitsubishi has been selling cars in America for several years through Chrysler Corp., among them the Colt, Champ, Sapporo, Challenger and Dodge mini-pickups. Chrysler owns 15 percent of Mitsubishi.

Like Isuzu, Mitsubishi recently decided to enter the U.S. market under its own name. Mitsubishi will still supply Chrysler with captive imports (and will also sell turbodiesel engines to Ford), but you'll presently be hearing the name Mitsubishi for its own lines of vehicles. The huge Japanese industrial conglomerate recently began marketing 1983 cars and pickups through 72 exclusive U.S. dealers.

Mitsubishi's initial offering consists of three automobiles—the Tredia, Cordia and Starion—plus a line of small two- and four-wheel-drive pickups.

Starion the star

Mitsubishi's image leader is the Starion—a sporty, high-tech fastback. Features include a turbocharged, fuel-injected, 145-hp, overhead-cam, 2.6-

liter Four; five-speed overdrive gearbox; four-wheel disc brakes; fully independent suspension and a galaxy of electronic instrumentation. The Starion's leading rivals are the Toyota Supra, Datsun 280-ZX, and Porsche 944, all of which are also rear-wheel drive.

Starions are available in two equipment levels: standard and Luxury Sport (LS).

Even the standard Starion has a tremendous array of knickknacks, including variable-ratio power steering, electric windows, AM/FM stereo, alloy wheels, brake booster and variable intermittent wipers. In the LS, you also get digital and graphic-display instrumentation, air conditioning, six-way adjustable bucket seats, "Turbo" lettering and an upgraded sound system.

The Starion engine, like other Mitsubishi powerplants, uses the MCA Jet induction system and Dual Engine Stabilizers. MCA Jet means placing a third intake valve—a small one—in each combustion chamber to let in air only.



Starion (top) uses this 2.6-liter turbocharged Four, which delivers 145 hp.

This valve sets up a swirl that helps atomize and burn fuel more efficiently.

The dual stabilizers consist of two weighted longitudinal shafts, driven at camshaft speed, whose rotation helps cancel out the inherent vibrations common to all four-cylinder engines.

I noted strong engine performance without the usual turbo lag at low rpm. Power flows smoothly throughout the rev range, and the car has lots of accel-

eration. The Starion handles well, too. The ride is firm, but comfortable, and while there's a touch of understeer, hard cornering is predictable, with good tire adhesion. There are two optional performance packages that are available; one has bigger wheels and tires, the other controlling brake lockup and differential slip.

The Starion's suspension uses MacPherson struts fore and aft, with lower trailing arms in the rear and a de Dion axle. The LS has what I feel is an unat-

the Datsun 200-SX, Toyota Celica and Honda Prelude.

Tredias and Cordias share trim designations and quite a bit of equipment. Both have standard, Luxury (L) and Luxury Sport (LS) models.

Mitsubishi's 1,795-cc, ohc, transverse Four powers both cars. This engine, too, uses the MCA Jet and Dual Engine Stabilizer systems. The engine delivers a robust 82 hp at 5,000 rpm, so both of these cars move out very willingly and without any perceptible



Fastback Cordia has a 1.8-liter motor which drives front wheels. The engine delivers a decent 82 hp and can be coupled to a manual four- or five-speed or to an automatic.

Tredia shares same 1.8-liter motor with Cordia, but car is tailored more for the economy-minded driver than to racer. Gearbox options include four-speed manual or a two-speed automatic.



tractive and annoyingly active digital and graphic instrument display. Too much Pac-Man for me.

Tredia and Cordia

Mitsubishi's new economy sedan, the Tredia, shares its 1.8-liter engine, transaxles and floorplan with the equally new Cordia, a very sporty fastback coupe.

torque steer. In the Tredia, you can choose between a manual four-speed gearbox with an attached two-speed manual overdrive, or a new lockup automatic. The Cordia adds a five-speed to that selection. As in the Starion, there's an impressive array of standard equipment, particularly in the up-market L and LS versions.

Engineering follows conventional,

Mitsubishi's pickup is virtually identical to small pickup sold by Chrysler. This pickup offers a 2.3-liter turbo-diesel motor to bridge performance and economy gap.



Both of these fwd cars are designed for maximum fuel economy, and their preliminary EPA estimates range up to 33/50 mpg city/highway.

The Tredia competes with the Honda Accord, Mazda 626, Nissan Stanza and GM's J-cars. The Cordia's rivals include

modern practice, which means MacPherson-strut front suspension, independent rear, rack-and-pinion steering, 9.6-inch front disc brakes and unitized body construction.

An interesting Tredia/Cordia feature *(Please turn to page 72)*

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DRIVING MITSUBISHI

(Continued from page 71)

is their air-mix ventilating system. This lets the driver adjust the flow of hot and/or cold air so he can, for example, toast his toes while wafting cool breezes at his face. A little man lights up on a graphic display board to remind you what temperature air is flowing at which level.

Mitsubishi pickups

These are essentially the same small trucks that Mitsubishi has been supplying to the Chrysler Corp. since 1978, but with a number of important differences.

For example, there's a 2.3-liter turbodiesel available—the first offered in any U.S. mini-pickup. This engine



The 2.3-liter, turbocharged, four-cylinder oil-burner delivers an impressive 80 hp.

delivers 80 hp and comes standard with a five-speed manual gearbox. You have the option of ordering it with either two-wheel drive or part-time four-wheel drive.

Mitsubishi pickups offer two additional engines: the ohc 2.6 mentioned earlier for the Starion and a gasoline ohc 2.0. The 2.6 rates 105 hp; the 2.0, 90 hp. A four-speed manual and three-speed automatic complete the transmission choices.

Series include standard, SP and SPX versions. The SPX comes with a double-wall cargo box and considerable standard equipment.

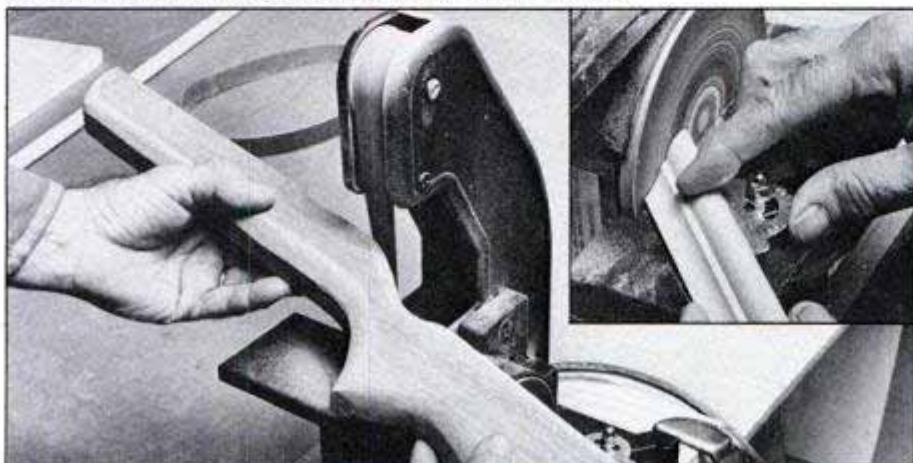
The turbodiesel impressed me by being fairly quiet and surprisingly strong. Again, there's no real turbo lag, and the five-speed with four-wheel drive makes for outstanding performance flexibility.

All these Mitsubishi vehicles show great care in assembly. They're beautifully put together and detailed. In my opinion, Mitsubishi should have no trouble making its own way in America.

PM

PM LOOKS AT...

Dremel's Disc/Belt Sander



The little sander can handle fairly large workpieces; belt platen is removed for contour work like this (above left). Adjustable miter gauge permits you to do accurate disc sanding at most angles (inset). The table can be tilted 45° when you desire.

Since I am accustomed to using mostly heavy, stationary equipment in my workshop, my first impression of this lightweight sander from Dremel was that it was not up to standards. It measures a mere 15 in. high, 10 in. wide and 11 in. deep, and the tool's gross weight is a feathery 11 pounds—quite a shift from the sanders that I normally work with.

But, after running the tool through a variety of sanding jobs my attitude changed. Its performance was more than satisfactory in rough shaping and finish sanding with both the belt and disc sanders. Internal sanding and some tool sharpening rounded out the usage test with good results.

Several noteworthy features include easy flip-over of the idler pulley for internal belt sanding; peel-off, pressure-sensitive sanding discs; and a pad-lockable power switch.

The Dremel Model 730 Disc/Belt Sander costs \$99.95 and is sold at home centers and hardware stores. It's manufactured by Dremel Div. of Emerson Electric Co., Racine, Wis.

—Rosario Capotosto

SPECIFICATIONS—SANDER

Electrical: 115 v.a.c., 50/60 Hz., 2.0 amps.
Sanding belt: 1 × 30"
Sanding disc: 5" diameter
Belt speed: 2,600 ft. per minute
Disc speed: 4,400 rpm



Spring-loaded idler flips forward readily to convert to the internal sanding mode.



The belt is laced through the opening in work for sanding the internal surfaces.



Inside of the workpiece can be sanded against either front or back of the belt.

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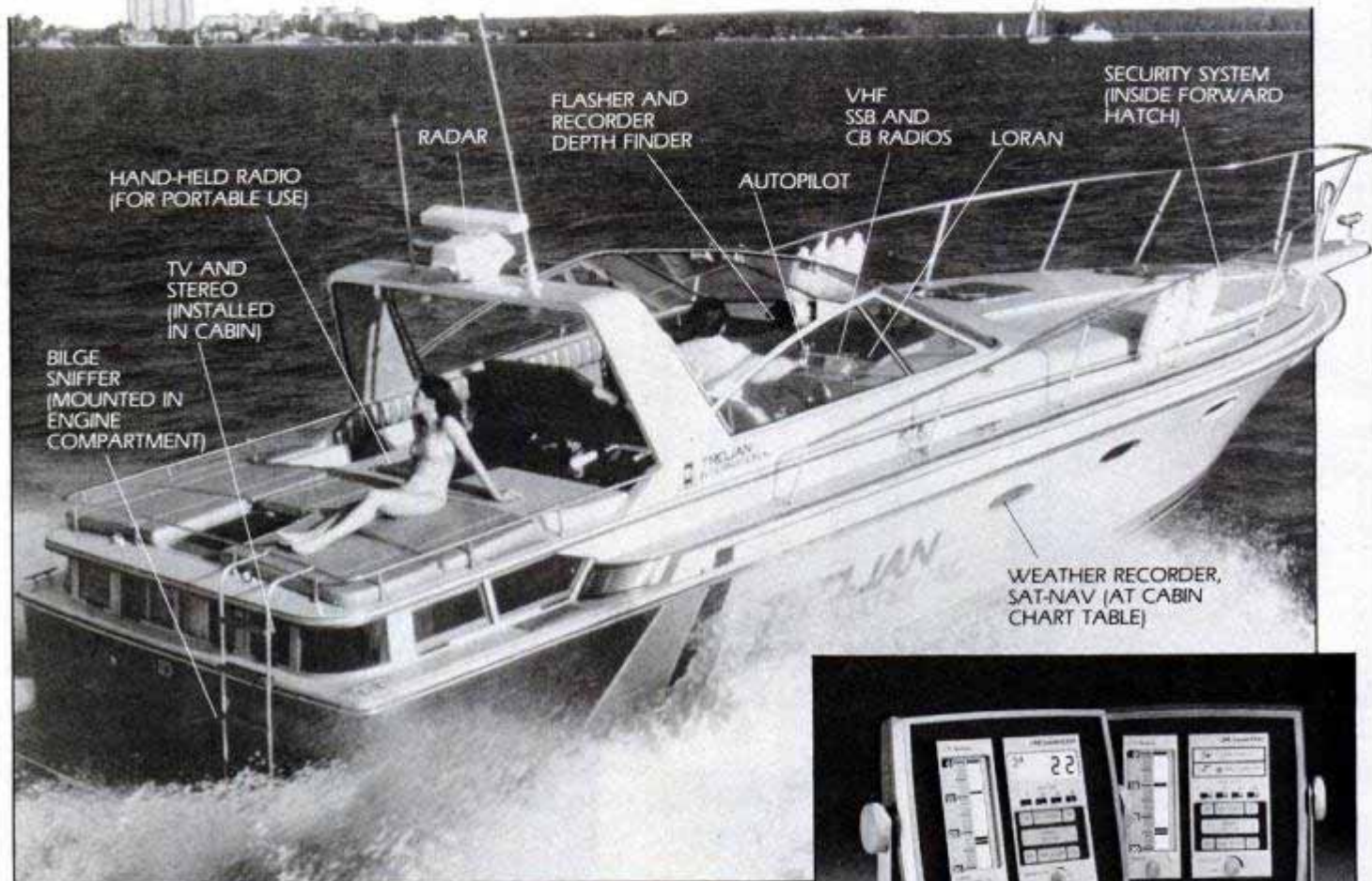
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Compact Electronics For Compact Boats

BY BILL McKEOWN
BOATING EDITOR



Nearly every electronic aid available is shown aboard Trojan's new International 10-Meter Express 33-footer. New from OMC Accessories (right) are the Tracker 2000 and 1000 finders that beep fish locations.



This spring, some little fishing skiffs and runabouts will be mounting gear that only big ocean liners could use a few years ago—plus a few electronic wonders not even invented then. For many centuries, boats have been cruising successfully without these gadgets, but the newest add a big bonus to small-craft safety and satisfaction. Now, tiny electronic components with their low current requirements, aided by large amounts of creative engineering, make it all possible.

No hull is too small. Thanks to self-contained batteries, even if you're floating in an inner tube, you can mount a depth and fish finder, as Humminbird Instruments demonstrated recently with one of its waterproof Techsonic models. Add a weather radio in one pocket of your fishing vest and a citizens band or VHF walkie-talkie in another, and you're wired up for action. If you're going to be reeling in fish with both hands busy, use a little headband radio with a voice-actuated boom mi-

crophone for talking with fishermen nearby, crew members on a boat, or cyclists and hunters ashore. Standard Communications in Los Angeles call theirs the Talkman; Coastal Navigator in Seattle offers the Shuttlecock.

The basics

Even a rowboat or canoe can use a portable radio—sometimes it's better than a banjo on a date. An experienced fisherman is likely to want a depth-sounding flasher, as well, that indicates bottom structure and fish. The fanciest around are the new Tracker 1000 and 2000 from OMC Parts & Accessories. They give both visual and audible signals of depth changes; the 2000 model also shows continuous digital readouts of the bottom. Fish-position blips are held for three seconds.

Depth finders have come a long way since Raytheon perfected the first Fathometer, and now you can get tiny digital-reading models that can fit in an instrument panel, run off dry-cell bat-

teries, operate at high boat speeds, and even sound or blink warnings if the water starts getting too deep or shallow.

Power boats

Once you add an outboard or inboard engine, there are more helpful electronic aids. Performance can be measured (and usually improved) by attaching a tachometer to give the rpm readings which show if your propeller is the right one for most efficient engine speeds. New averaging, digital models like OMC's Quartach are particularly easy to read.

If your powerplant should be large enough for a self-starter, you'll have a battery along that can also power a depth finder, a sniffer to warn if explosive gas fumes are collecting in the bilge, a speedometer with log-odometer of distance traveled, an electronic compass and automatic direction finder, as well as standard electrical equipment like lights, bilge pump and

winch. (And in a speedboat, don't neglect to have an emergency cut-off "kill switch" in case you are thrown away from the wheel while driving.)

Now, many small boats carry radio transceivers. VHF covers distances up to 50 miles for ship-to-ship, ship-to-shore, emergency Coast Guard messages and shoreline telephone calls. Then there's citizens band (CB) for contacting other boats nearby, and globe-circling single side band (SSB) for high-seas communication of unlimited range. A number of manufacturers are offering hand-held VHF models with synthesized circuits that require no crystals and handle 78 frequencies. Larger VHF's can scan the spectrum, work 100 or more channels and even serve as direction finders.

Fish finders

Popular bass boats may be only 14 to 18 feet long, but inch-for-inch overall, they probably have more electronics aboard than any other craft. Starting with basic electrics, a modern fishing skiff may have a 12/24-volt trolling motor next to the bow light, plus switches for remote control of the outboard or sterndrive engine tilt on the transom. One or more pumps and aerators will supply bait wells with air bubbles and water. Spotlights and panel lights are built in to aid the night fisherman.

As for electronics, you should have seen the 42 Ranger bass boats at last fall's world series of fishing, the Bass Masters Classic in Alabama. They had flasher depth sounders next to the trolling motors and had plugs for chargers to the deep-cycle auxiliary batteries. Back at the helm position, there was a Humminbird graph recorder fish finder, plus a flasher as one of the dash instruments. Trim controls were built into the throttle. Water-temperature and oxygen-concentration meters were also used. Some bass guides add various radios, water-color meter, directional fish-finder transducer, and an electronic low-voltage-drain portable refrigerator.

Large sports fishing craft can also mount commercial fishing refinements such as color-television-screen fish locators that show bottom structure and fish at full depth or in close-up, and can freeze-frame the image or record it on tape for future study.

Sailboats, cruisers

Now, exotic and expensive sailing instruments can show and record boat and wind speeds of up to 1/100th of a knot, and computers tested during America's Cup races have been able to compare hull designs and sail cuts and materials as a result. Offshore sailors

(Please turn to page 144)



With no power-line hook-up necessary, the Capree Cadet by Datamarine uses internal 9-volt battery to show speeds to 55 mph and tenths for trolling.

Bass fishermen now can tote along the advice of experts Bill Dance and Roland Martin, as indexed in the memory of the Basstronics Pro-Guide.



New Aqua Probe 540 digital depth indicator can be placed anywhere on a boat to repeat signals from an Aqua Meter or other brand. A depth alarm is built in.



Kenyon Marine 1000-Series (above) reads speed to 60 mph, distance to 9,999 miles in tenths, depths to 300 feet with audio/visual alarms. ALC-900 Loran-C (left), from the Apelco Marine Div. of Raytheon, can give the location, speed, headings of 50 waypoints from memory.

Scanning has been built in Ray Jeff's 550 VHF/FM radiotelephone to monitor all 55 channels.



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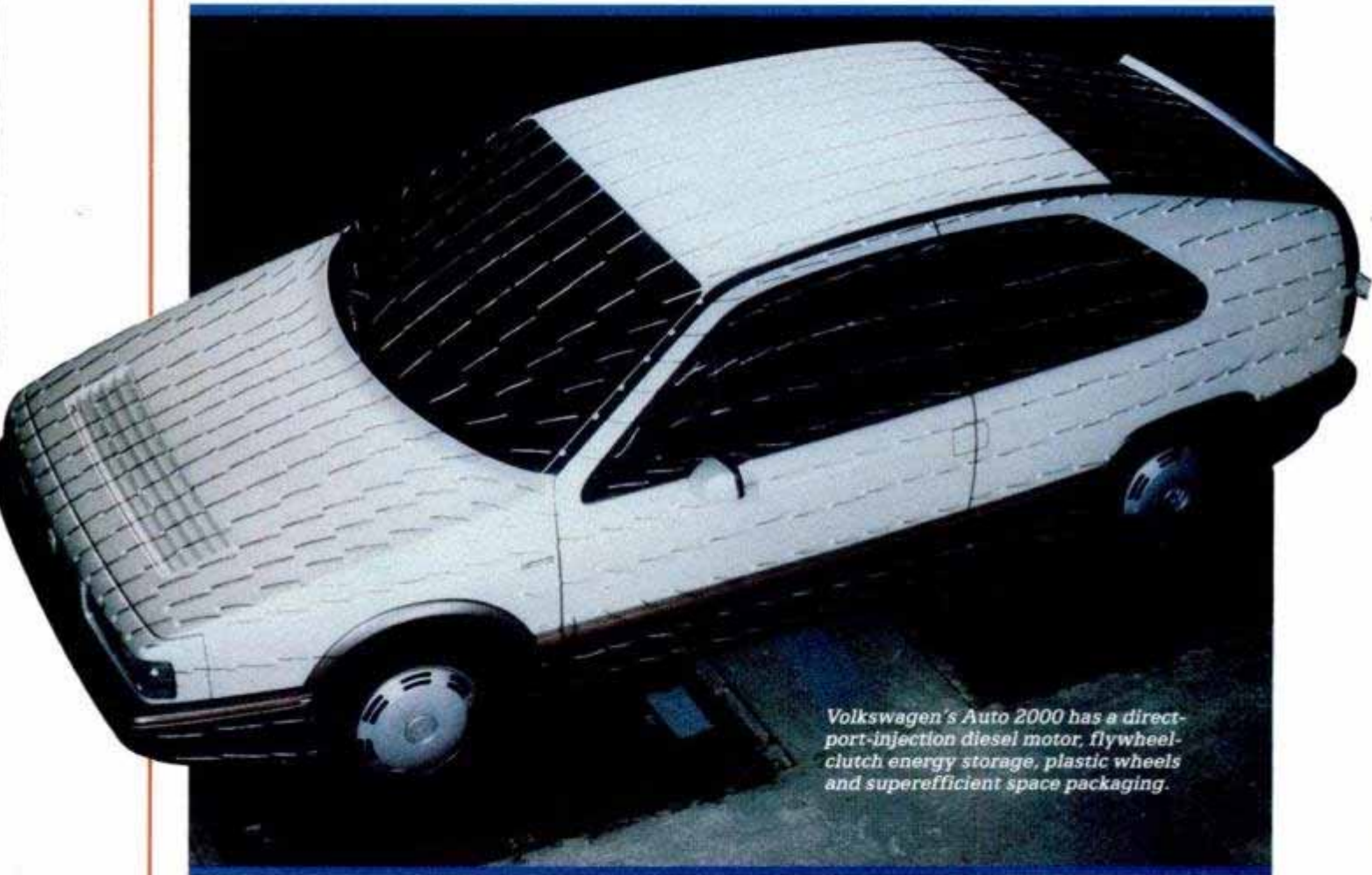
© Sears, Roebuck and Co., 1983

Tomorrow's Car

You may not see these cars in the showroom until 1990, but some of their features are right around the corner.

PM DROVE IT!

BY TONY ASSENZA AUTO EDITOR



Volkswagen's Auto 2000 has a direct-port-injection diesel motor, flywheel-clutch energy storage, plastic wheels and superefficient space packaging.

Predicting the future is dangerous business. And it's especially dangerous when you're dealing with cars. The job of future product planners is not an enviable one. They have to make decisions today on what you'll be buying 10 years from now, and they'll be gambling billions of dollars on their decisions. Very often, the design objectives are seemingly contradictory. It's a foregone conclusion that any future car will have to be as fuel efficient as possible. But it also has to be able to get out of its own way. It will have to be small and light to save fuel and use as few resources as possible to manufacture, but it also must carry adults in comfort and provide them with a certain amount of safety in a crash situation. And, as if that weren't enough, the car has to be affordable, ruling out exotic materials like carbon-fiber composites and magnesium. That leaves the engineers essentially with the conventional materials—steel, aluminum and traditional plastics—that they've always worked with, but they must craft them in unconventional ways to



Government-sponsored Research Safety Vehicle has "friendly" fenders to protect pedestrians. It also has headlight covers which are recommended as a safety item by one branch of the DOT, but deemed illegal by another branch. Ford's CRT displays (inset, top) are in one of its experimental vehicles. Car functions are controlled by touching the screen. Map locator is hooked up to satellite. Arrow indicates your position.

FM photos: Peter Tenzer

meet those specific new design goals.

The following are just a few examples of the ways these design goals are being met, and how they'll influence the car you'll be driving in the future.

Research Safety Vehicle

The object of the Research Safety Vehicle, as the name implies, is to provide occupants with as much safety as possible. Some thought was given to fuel economy and aerodynamics, but the RSV is largely an exercise in passive safety. The RSV's main mission in life is to sustain a 45-to-50-mph crash and allow the occupants to walk away from it. The project was a collaborative effort between the

NHTSA (National Highway Traffic Safety Administration); Calspan, an auto research firm; and Chrysler.

The front end of the RSV has a bumper made of high-density plastic filled with low-density, energy-absorbing foam urethane. This is a "friendly" bumper, too, in that it can hit a pedestrian at 20 mph and leave him with only a few bruises for his trouble. There are also longitudinal reinforcements in the engine compartment which absorb crash energy. These ribs are nothing more elaborate than thin-gauge, slotted, rectangular metal tubes that crush and compress rather than bend and deflect on impact. The idea here is that you want a structural member to deform at a giv-

en rate, rather than impale the object being hit or be pushed back into the firewall and impale someone in the passenger compartment. With that concept in mind, the RSV also has two latches on the inside of the fenders which hold the hood closed, in addition to the central latch at the front of the hood.

In an impact these latches keep the hood from popping open and force it to act as a deformable structural member. The rear and the doors are equally well protected with beams and deformable structures. The problem with the doors, however, is that they're bulky. They eat up all your elbow room and they're always poking you in the ribs.



Ford's hand-held transmitter will open car locks, sound horn, raise antenna, turn on headlights and pop open the trunk—all from a distance of 200 feet.



The driver is protected with an air bag mounted in the steering wheel, while the front seat passenger has a shoulder belt with a built-in air bag on the belt. The powerplant is a very conventional, transverse 1.7-liter Four.

There are three items on the car, however, which illustrate some of the contradictions which face engineers.

First is the issue of headlight covers. The DOT (Department of Transportation), which runs the NHTSA, does not allow any manufacturer to

(Please turn to page 118)

THE NEAR AND FAR FUTURE

The Honda City won't be the answer to everyone's transportation needs, but it's probably the best commuter/urban car around. Sitting on a tiny, 87.4-in. wheelbase, it provides an incredible amount of interior room for four, full-sized adults with head- and legroom to spare. Power comes from a 1.2-liter, 67-hp Combax (Compact Blazing-Combustion Axiom) Four that yields over 50 mpg at legal cruising speed. This combustion system allows a very high 10 to 1 compression ratio to be used with no-lead fuel. We'll probably see something like the City long before a coal-burning turbine. For more on that car, see the story.



PM photo: David Goolley

The near-future Honda City combines very small exterior dimensions with huge interior volume. Its long-stroke 1.3-liter Combax gasoline motor (right) provides ample torque and responsiveness for its size. Storage bins and shelves abound inside the City. Dash (right, below) is compact, but set within it, there's even an insulated, air-conditioned compartment to keep food cold.



Far future: GM's coal-burning turbine car (below) produces 100 hp and burns one ton in 6,500 highway miles. Engine idles at 30,000 rpm. At cruising speed, it spins at 55,000 rpm, but output shaft speed's geared down to 4,000.



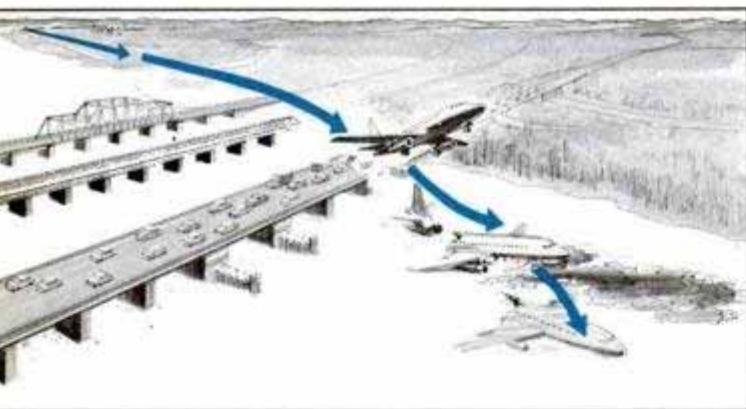
The Most Amazing Rescue Of '82



Woefully ill-equipped, flying nearly blind into a raging blizzard, two helicopter crewmen risked their own lives to pull air crash survivors from an ice-choked river.

BY JOSH EPPINGER

It had become a full-blown blizzard and when it hit the nation's capital, it paralyzed the city. The storm struck Washington, D.C., late on a bitter cold Wednesday afternoon in January, sending thousands of employees home early, and clogging the bridges spanning the ice-choked Potomac River with traffic.



Arrows show the flight path of Air Florida's Flight 90 after departing Washington's National Airport on Jan. 13, 1982. After striking the 14th St. bridge, the plane came to rest on river bottom. Park Police helicopter arrived minutes later.

The work day had begun ominously for paramedic Gene Windsor of the U.S. Park Police. He was driving toward Washington on Interstate 270 from his home in Monrovia, Md., for his 3:00 to 11:00 shift. The falling snow had slowed traffic to 20 mph. Suddenly, a car in front of Windsor's swerved out of control on the icy freeway surface, crossed three lanes and bounced up against the median divider. The 41-year old paramedic, a Park policeman for only 2½ years, desperately tried to slow his car, but it skidded unerringly on the ice into the swerving vehicle. Result: another one of many fender-benders that were to occur that day.

An exchange of addresses and Windsor was on his way. "I had a feeling of urgency," Windsor recalls. "I just wanted to get out of the storm and into the hangar."

His duty partner for the day, helicopter pilot Donald Usher, left his home early in Gambrills, Md., because of the storm. As a result, he arrived far ahead of time at the small trailer which adjoins the Park Police hangar on the D.C. side of the Potomac, astride the Anacostia tributary. A call to the National Weather Service confirmed Usher's hunch: "There's no way we're going to fly today." The ceiling was 200 to 300 feet; visibility, one-half mile; temperature, 24° and heavy snow falling.

The usual stuff of Usher's duty was covering summertime boating mishaps in the Potomac and neighboring lakes, plus surveillance, some medical missions and accident responses, and occasionally an aerial element in police raids.

At National Airport, across the river and 2½ miles west of the small hangar, the 74 passengers—about half of them from the Washington area—aboard Air Florida's Flight 90 to Tampa were getting restless. The Boeing 737 had already sat in the falling snow for two hours and Florida's warm weather seemed very far away. Near the rear of the plane, 23-year-old Priscilla Tirado looked out from her window seat, and then at her husband, Jose, a native of Madrid, who held their 2-month-old son, Jason, in his lap. The storm did not dim their feelings of anticipation; Jose was taking a construction job in Tampa, which offered an opportunity for them to live near her parents in Clearwater. At the last moment before the doors

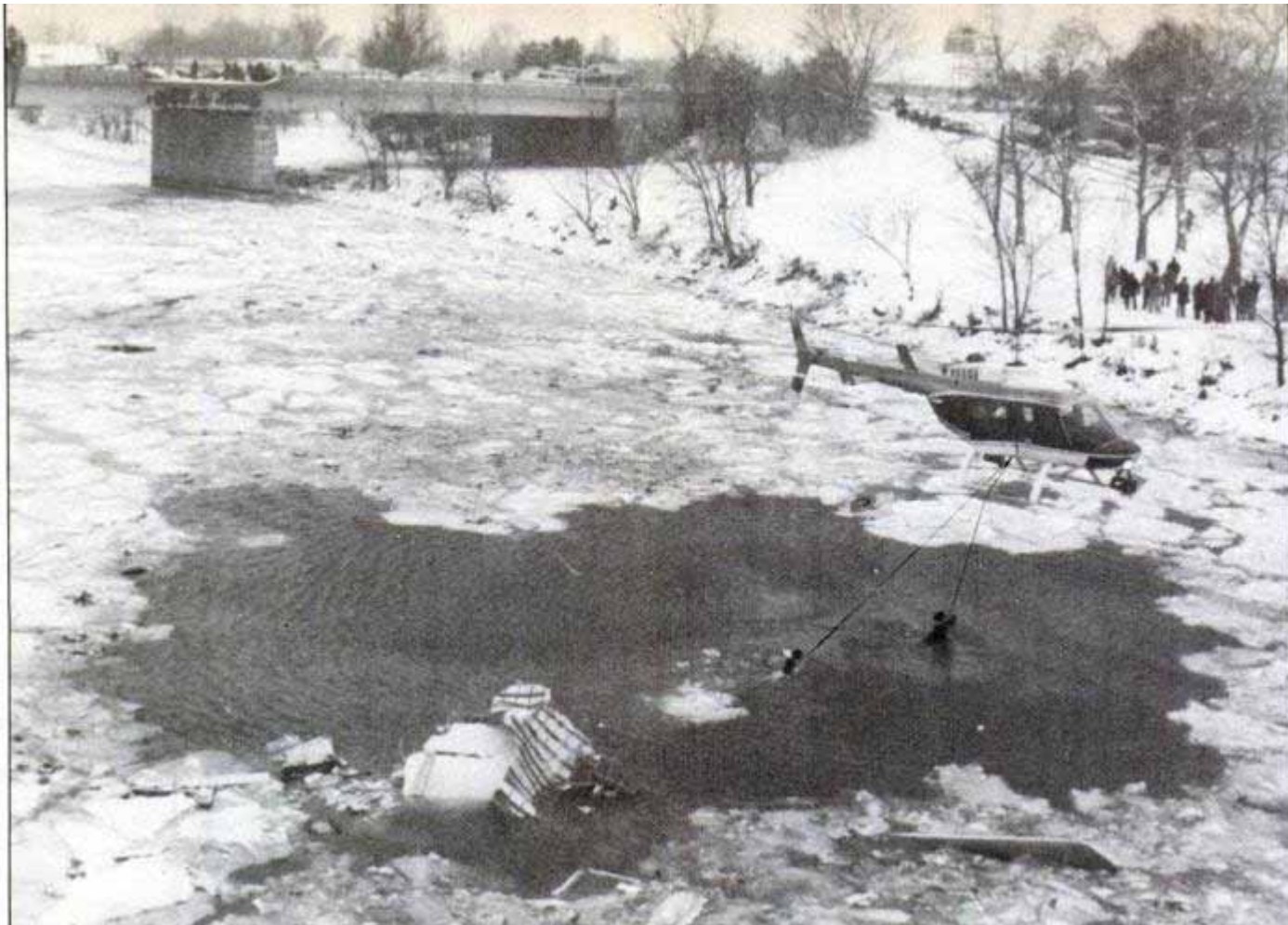


Pilot Don Usher holds the Bell LongRanger II right on the surface of the ice-choked Potomac, while paramedic Gene Windsor pulls survivor Pat Felch onto its skid.



Chopper's skid is actually below the surface of the water as crew struggles to get victims ashore to rescue group (right).





Eagle One works desperately in an attempt to get survivors out of water. Five are saved, but a sixth, the "Good Samaritan," is lost.

closed, Bert Hamilton, a purchasing officer with nearby Fairchild Industries, hustled up the aisle, passing seven of his already buckled-in colleagues to take a seat in the very last row. They were all heading for a meeting of the company's Space and Electronics Div. in Florida.

At the Congressional Budget Office on 2nd and D Sts., Lenny Skutnick, a 28-year-old office worker and father of two boys, was one of hundreds dismissed early from work. He joined a car pool for the ride to his rented townhouse in Lorton, Va. The car became snarled in the stampede of traffic near the 14th St. bridge. Skutnick squirmed as the car sat immobilized in the express lane.

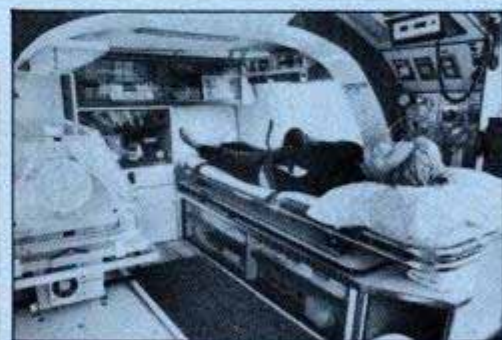
What happened in the next 20 seconds was to inextricably link all of their lives in a tragedy of startling human suffering, inspiring acts of heroism that pushed its participants to that thin edge between life and death.

Whirling through the core of the cataclysmic happenstance was a flying machine, one that was to rivet the attention of a nationwide television audience on a Park Police helicopter.

The drivers creeping past National Airport could barely see their way through the swirling snow. Some even pulled to the side of the road to clear their windshields of the sticky stuff. Out on Runway 36, the Air

(Please turn to page 140)

Upgraded rescue choppers could save lives



Experts' findings on the crash highlighted the unreadiness of major airports to handle emergencies, including lack of medevac copters. Ambulance kit for Sikorsky S-76 (left) and interior of Aerospatiale SA365N Air Ambulance (above) with built-in medical systems show range of available technology.

NEW RVs

For Offshore And On

More performance and economy are trends for the vehicles run for fun.

BY BILL McKEOWN
BOATING EDITOR



Light, full-service motorhome fittings (above) help Le Sharo do 22 mpg.



New Winnebago Le Sharo, a motorhome version of the Centauri van with its economical, front-wheel-drive diesel, should set new standards for recreational vehicle fuel mileage.

Long on luxury, the latest fifth-wheel travel trailer from Coachmen comes in 33- and 35-foot models, and the rear-kitchen, 40-foot model (left) with a picture window.

For pleasure travel along highways and waterways this coming year, there are improved cars, trailers and boats that can provide more for the money. Extras may include more performance, more speed, more comfort and convenience and, frequently, more fuel economy.

Lighter weight, afloat and on land, means less mass to push through the water or pull over the hills. And design changes for streamlining are further reducing



Catamaran-hulled "Popeyes" has been beating inboards in offshore racing with three of Mercury's 300 EFI outboards.

Photo: Needle Nose Race Team

The latest in special-purpose boats provide more varied action and capacity to carry bigger engines that can cruise faster and farther.



Designed for easier boarding by scuba divers, the 21-foot Divemaster from Answer Marine, Hialeah, Fla., adds handy transom ladders, platforms.



Grady-White's 190 Tarpon, with center control console and Chrysler power, is a 19-footer with optional converting top.

resistance to winds and waves. Smaller engines power many new models, but the attempt this year is to try to trim fuel consumption without cutting down overall size and convenience. Standing headroom inside a boat cabin or motorhome can add a large measure of comfort. And bigger boats tend to be safer if the water gets rough.

An impressive dry-land development is Winnebago's campaign to cut fuel costs and the gas-hog image



Panther's airboat uses aircraft or automotive engines.



Open-deck craft with cushioned comfort (top) is from Sea Sprite Boats of Crescent City, Ill.

The 29-foot kit houseboat by Fisher Craft of Byron, Calif., can be finished off easily at home.

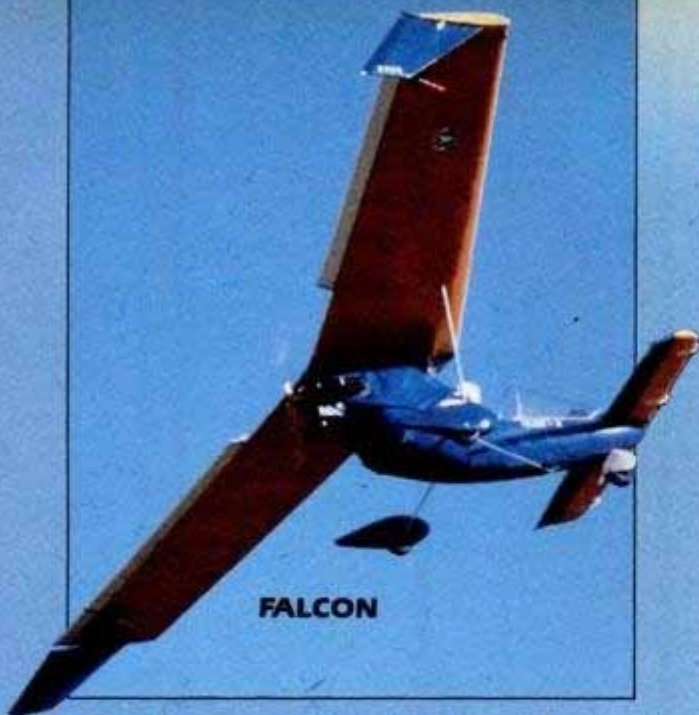


that big motorhomes have had. Using Renault's two-liter, turbocharged diesel with front-wheel drive, the company is introducing—a bit later than anticipated—a Centauri van (see '82 RVs, page 20, Mar. '82) with an estimated fuel consumption of 24 miles per gallon. Winnebago also has a Le Sharo motorhome rated at 22 mpg, and the Phasar from its Itasca Div. All three models are about 20 feet long, have standing headroom and will be appearing at dealers this

spring. Coachmen has been upgrading its big fifth-wheel trailers, and the 30- and 33-foot Sportscoach III motorhomes now have even more luxury accessories aboard. Fleetwood's Resort travel trailer is designed to provide basics at a bargain price, while the Wilderness Cimarron model adds extras for campers who want all the comforts.

Boat companies are offering more specialized mod-

(Please turn to page 115)



FALCON



Signs of the times: All decked out in slick new cockpit pods and flashy wheel pants, American Aerolights' Falcon (above) and Eipper's MX Super (right) look a lot more like airplanes than ultralights—a trend we'll see more of. At upper right, MX Super, first ultralight designed for aerobatics, streams smoke trails as it executes a loop in dramatic airshow routine. It has three-axis control, using spoilerons that serve as both ailerons and spoilers. Kit price: about \$6,500. Tailless Falcon, a futuristic new design, combines wingtip rudders with canard for pitch control. It's expected to sell for \$5,500 as a kit.



KOLB ULTRASTAR



Moving and storing an ultralight are easy with Kolb's folding-wing UltraStar (left). For trailering or parking in a garage, wings swing down and back along the fuselage—much like those on some carrier-based Navy fighters of World War II. Setup and breakdown take only 5 minutes. Weighing 220 pounds, UltraStar has conventional airplane tail, full-span ailerons and three-axis control with stick and rudder pedals. Pedals also steer tail wheel. Kit price: about \$3,600.

New Swallow (near right, facing page) sports streamlined engine cowling—another hint of things to come. It has three-axis control and is sold in both licensed and unlicensed versions. Sleek, enclosed-cabin Hawk (far right) looks like real airplane, but, at 249 pounds, actually qualifies as unlicensed ultralight. It has full aircraft controls, even flaps, is \$5,495.

MX SUPER

NEW LITTLE KIT PLANES ANYONE CAN FLY

New FAA regulations make it legal for anyone to fly an ultralight without a pilot's license. Now the fun begins.

BY SHELDON M. GALLAGER

Ultralight fanciers can now relax—they won't have their toys taken away after all. Ever since the FAA warned two years ago that unlicensed ultralights might be limited to a maximum weight of 155 pounds, makers have been dreading the outcome. Such a severe weight restriction would have put many ultralights out of business, at least as license-free fun planes.

Now the word is out and almost everyone is smiling. In an unexpectedly benevolent move, the FAA has decreed that single-place ultralights may now weigh up to 254 pounds without requiring either pilot licensing or N-number registration (two-place models will continue to require licensing, as previously determined by the FAA). Ironically, ultralight makers had been desperately pushing for a 220-pound weight allowance—and not really expecting to get it.

The new FAA ruling thus has historic significance. It not only legalizes 90 percent of all current ultralights, but will certainly inspire many exciting new designs with even more dash and dazzle. More importantly, it signifies that the FAA has given its official blessing to a new form of rec-



SWALLOW



HAWK

reational flying requiring little investment and no formal training. It means that virtually anyone can now fly his own back-yard airplane with only simple skills and at less cost than owning a family car—a dream that began with the Piper Cub in the early 1930s, half a century ago. The ruling may thus have a long-range impact on American lifestyles that goes far beyond its immediate accommodation.

Enforcing safety—subtly

But the FAA isn't just being kind. Along with the seemingly lenient 254-pound weight allowance go two important additional provisions. To qualify for unlicensed operation, an ultralight must have a top speed of no more than 55 knots (approximately 63 mph) and a stall speed of no more than 25 mph—restrictions that tend automatically to assure the docile performance that untrained pilots can handle safely. Also, by limiting speed while allowing greater weight, the FAA is encouraging manufacturers to put the added poundage into beefier airframes and better engineering, rather than bigger, more powerful engines.

This subtle form of enforced safety is actually the key to the FAA's formula. It is notable, in fact, that the new weight limit applies only to the bare, empty airframe, not to accessories that improve the reliability and usefulness of the aircraft. Such nifty embellishments as floats for water operation, pilot enclosures for added comfort and crash protection, and sophisticated instrumentation for safer flight control will

(Please turn to page 130)

KASPERWING



New ballistically deployed parachute, developed for use on FlightStar and other ultralights, is shown in ground test below. Ejected by explosive charge from top of wing

(center), chute opens in 1.5 seconds (right). It can be activated at altitudes as low as 150 feet for safe recovery of both plane and pilot if an emergency occurs.



FLIGHTSTAR



AND NOW COME COCKPITS!



WITCH



Ingenious swivel wing is feature of Witch (above). Wingtips fold in, then you merely pull a pin on the centerpost and the entire wing assembly rotates fore and aft for easy trailering and storage. Craft weighs 200 pounds, has three-axis control, is \$5,800. Streamlined cowling will be optional extra.

Looking more like real airplanes than ever, new ultralights are now sprouting cockpits for sleek appearance, pilot comfort, added crash protection.

1. Rakish-looking twin-tailed Vampire sports bullet-shaped cockpit pod and will eventually have canopy for full enclosure. A highly sophisticated design, it has folding wings with full-span flaps and spoilers, is kit priced at \$6,950.
2. Optional cowling and teardrop wheel pants add dashing looks to V-tailed Hummer, a non-foot-launchable design that's now legal for unlicensed use under new FAA ruling. Kit price is \$3,895.
3. The canard-wing Ptiger, essentially a Pterodactyl Ptraveler with slick new fuselage, uses canard for pitch



For all-weather comfort, Kasperwing's fully enclosed cabin (facing page) is made to fit new or existing models, will sell for \$300 to \$400 as an optional add-on. The basic Kasperwing kit, with 23-hp mill, is \$4,450. Below: The Red Baron would feel at home in this nostalgic biplane called Aeroplane XP. Design is based on standard Easy Riser wings, but has full tail instead of wingtip drag rudders, plus spoilerons for roll and glide control. The kit is about \$4,500.

- control, wingtip spoilerers for roll and yaw.
4. One of cleanest new designs, Invader gets remarkable 55 mph from 14-hp golf-cart mill, is built from \$60 plans. Estimated cost, with engine: \$1,600.
5. Scout has plane-like profile, standard three-axis control, can be built to meet either licensed or unlicensed requirements. Plans are about \$100.
6. An enclosed cabin with clear-plastic windows gives twin-engined Hummingbird all-weather comfort. Prices range from \$6,250 to \$11,312.
7. Mitchell B-10, a favorite for years, now has optional cockpit pod. It can be built from plans (\$95) or kit (\$3,990).



AEROPLANE XP

SOUPED-UP SOUND FROM 7 NEW SPEAKERS

The newest loudspeakers bend the rules of physics just as often as they obey them. We became aware of this when PM looked at seven new speakers. Our survey turned up some startling shapes and some even more unusual applications of the laws of acoustics and electromagnetics. Six of the models are currently in showrooms, where they are becoming popular, affordable examples of innovative engineering. One of the seven designs is very expensive, very unusual, and would pass for a prop on a science fiction movie set. But what all these models have in common—and maybe the only thing—is uncommon musicality and beauty of sound.

BY CHRISTOPHER GREENLEAF

Tweeters that burn at 1,500° C., speakers that fire at the ceiling and more: They're new designs that take you from living room to concert hall.

B&W LM-1 comes in a panel-mount version for auto sound at \$530 the matched pair, or in a larger, sealed home version for \$595. Ohm's Walsh 2, shown here in walnut, is \$595 a pair; other optional veneers are also available. Boston Acoustics makes its A-200 very wide, but shallow: The shape helps the highs reach your ears. Price is \$750 a pair.

Boston Acoustics A-200

Acoustic Design Triad

Acoustic Design's little Triad has made a satisfying attempt to coax a healthy quantity of high-



HIGH-FREQUENCY TRANSDUCER

INVERTED CONICAL SURFACE

WOODEN BRACES

ACOUSTIC INSULATION

SUB-BASS ACTIVATOR

OVERLOAD PROTECTOR

Ohm Walsh 2

B&W LM-1

PM photos: Bill Ashe

quality sound out of three small, almost cute packages. Two matched satellites each contain an ultralight, polymer dome tweeter and a 3-inch midrange driver in a sealed enclosure. The bass unit—a mini-subwoofer—marries a 5½-inch, long-throw woofer with an acoustic suspension enclosure only 13¼ inches wide and 8 inches deep. The trio of little boxes fits tidily on shelves, tables, even mantles. Solid walnut sides and a fine walnut veneer on top make for an attractive look.

The listening tests included very low bass and high volume. There wasn't a hint of honk, boom or breathiness coming from these noise boxes.

Allison 7

The company that brought forth the Allison 1 through 6 has finally introduced the long-awaited Allison 7, 8 and 9. Despite family resemblances, there are some radical departures from the earlier,

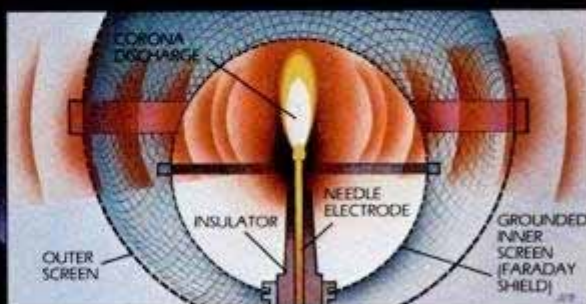
(Please turn to page 116)



Allison 7



Magnat Plasma Tweeter



Fantastic transient response characterizes the Magnat Plasma tweeter (above). Text details how the 1,500° C. corona discharge makes sound. Cost: \$3,500 for a pair.

The Allison 7 speaker takes up very little room, since it's designed to stand against the wall. It costs \$450 for a pair. The Triad from Acoustic Design pairs the first mini-subwoofer with two small satellites; the whole system is priced at \$450. Koss intends the M-80 Dyna-Mites to fit just about anywhere. A pair is \$260.



Acoustic Design Triad

Koss M-80 Dyna-Mite

Solar Systems And Heat Pump Combine To Cut Energy Bills

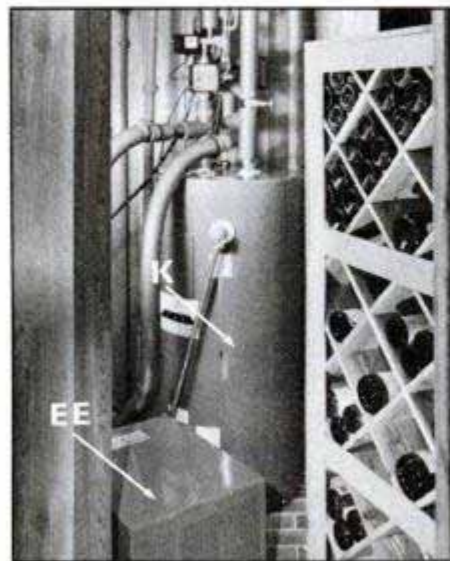
PM investigates three alternative methods of heating water.

BY DAVID A. WARREN

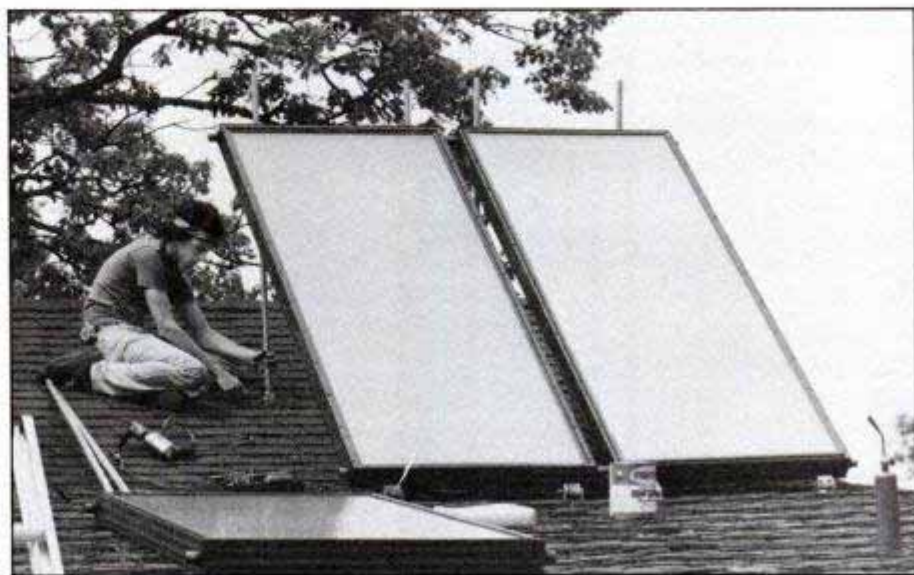
Approximately 15 percent of my home electric bill goes to heat water. Yours could be higher. And while this cost may not break the bank, it is a continuing year-round expense—and a considerable one. Many people looking to save on energy costs find themselves in a morass of new and innovative water-heating products. Some of these work, some don't; others have such long payback periods that it hardly matters whether they work or not.

I decided to investigate three alternatives, so I installed the solar-assisted, heat-pump water-heating system presented here. I'm in the process of monitoring the results and this information will be presented in PM's September 1983 Home Energy Guide. While we don't have complete data at this writing, we estimate we've saved about 300 to 400 kilowatt hours per month during the time the system has been in operation.

The first component I installed was one of the new hot-water heat pumps. These air-to-water devices are touted to cut the cost of heating water dramati-



Hot-water tank (K) accepts both solar preheated water and heat pump (EE) preheated water. (Note: Letters on photos match those on drawing, page 94.)



Roof-mounted collector panels consist of narrow tubing that runs back and forth under double-glazed panels. Potable water pumped through tubing is heated by the sun.

cally, whether you live in Alaska or Alabama. They operate by removing some of the heat from the surrounding air and using it to heat water.

Next, I added two separate systems that heat water with solar energy. The first consists of three collector panels mounted on the roof. The second makes use of two porcelain-lined tempering tanks suspended from the trusses in my attic. Potable water circulates through both systems and each operates independently of the other. Because of the experimental nature of this project, both were installed; most people would use one or the other.

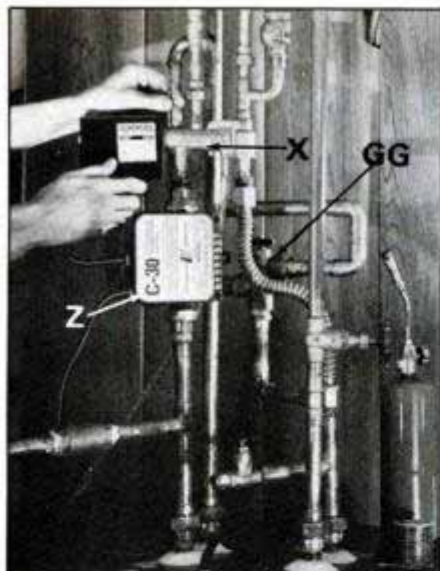
Keep in mind that going solar in the northern latitudes is not always economically beneficial. Since my home is in northern Illinois, I plan to use the solar parts of this system primarily during the summer months. You'll save more with a year-round system, but there are several benefits to a warm-weather-only system: To begin with, summer is the time of year when many utilities raise their rates because of the huge increase in demand. In my area, this rate increase is about 19 percent. Second, summer is also the time when my family uses more hot water: We shower and launder clothes more frequently during hot, sticky weather.

Architect: Mark Elmore
Plumbing consultant: Bruce Toussaint
Construction: David J. Warren
PM photos: David A. Warren
Technical art: Fred Wolff



Tempering tanks (O) have 30-gal. capacity each and are hung from roof trusses or rafters with perforated metal strapping. The condensation tray (N), which drains to the outside, is a safety feature.

Supply line for tanks (photo at right) goes from softener to bypass valve (I). Sweat-joint copper tubing using flux, solder, propane torch. Photo shows controls for regulating water-salt mixture.

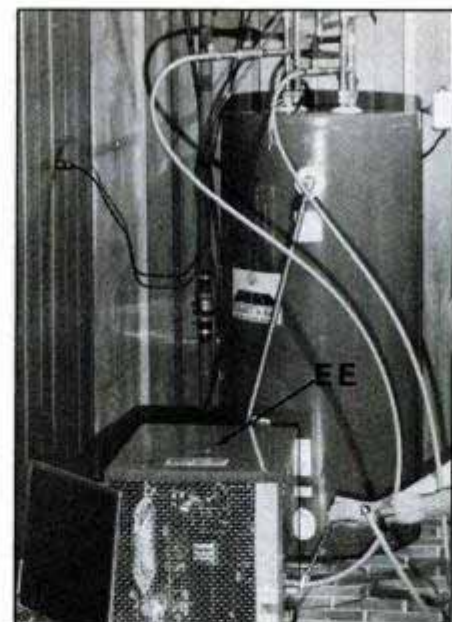
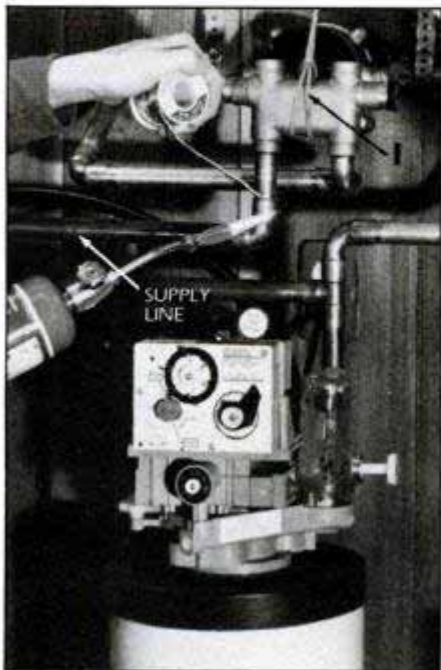


Solar panel system is regulated by circulating pump (Z) that feeds the collectors; drain-down valve (X) that empties the collectors when temperature drops to prevent freezing; and tempering valve (GG) that mixes cold water with hot when collector water is too hot.

The last advantage is strictly an investment consideration. Our summer-only system eliminates the need for a closed-loop arrangement which requires antifreeze, to keep the circulating fluid from freezing, and a heat exchanger, to remove heat from the toxic antifreeze line and apply it to a second line containing potable water. The antifreeze, additional plumbing and heat exchanger add substantially to the start-up costs and simultaneously reduce the overall efficiency of the system by some 15 to 20 percent.

How the system works

The drawing on page 94 gives the layout for the entire system. The best



Heat pump (EE) is connected to hot-water tank by flexible plastic tubing. When outside temperature falls to the point where solar collectors don't generate enough heat, heat pump activates itself.

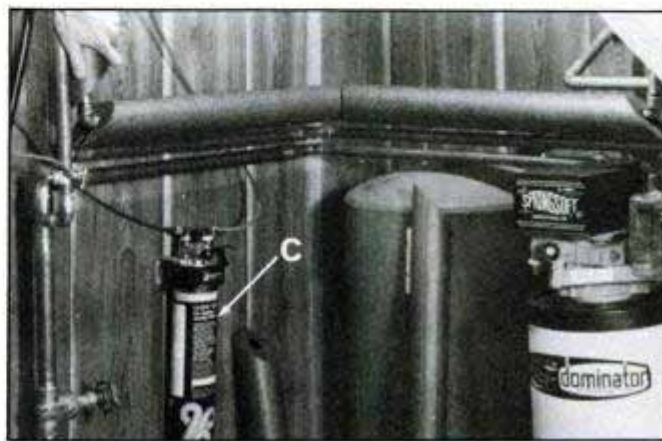
way to understand it is to follow the water, step by step, as it moves through the various components.

To begin with, we have a 267-ft.-deep well that supplies water with very high mineral content to a pressure tank (L).

This hardness is not only a problem for everyday home use, but also presents a distinct liability for the new installation. The minute iron and other mineral particles suspended in the water could raise havoc with the small, narrow tubes in the collector panels, the heat pump, circulating pump and the many valves in the system. To prevent this, the minerals are removed by a water softener (E). This device exchanges salt for the minerals in the water, thus protecting the components farther down the line.

But there are a couple of drawbacks to using the softening system. First, many physicians today discourage the use of excess salt because it is believed to contribute to high blood pressure,

Cover all pipes carrying hot water with insulation, as shown at right. This material has a slit for easy application; just cut it to size and tape it in place. The water filter (C) extracts the unsoftened, salt-free water and removes existing bad-tasting minerals from it. Water then goes to a separate faucet in kitchen for drinking and cooking.



Record-Keeping Procedure

Because of the experimental nature of this solar-assisted heat-pump system in my all-electric home, I wanted to figure out how much money I would save by using it.

My local utility, Commonwealth Edison, was extremely helpful in this pursuit. It agreed to install special metering and recording equipment (designated R in the drawing) to keep a round-the-clock tab on electrical use for my hot-water system. A water-flow meter was also installed to record the gallons of hot water we used during all the test periods. This recording equipment not only registered the kilowatts per hour required to heat all the water, but also provided information on time-of-day use. The latter is especially important because many utilities offer lower rates between 10 p.m. and 9 a.m. By taking advantage of this, you save money.

Our record-keeping program covers five separate periods. For the month of April, we recorded the electrical use of the 40-gallon electric water heater installed when the house was built. Then we removed the old tank and replaced it with the system shown here.

During May, June and July, we recorded water and electrical use for the new system while it was utilizing only the two 30-gallon tempering tanks in the attic, and the heat pump. In August and September, we recorded the usage while the solar collectors and heat pump were operating.

In September, the tempering tanks were drained to prevent freezing. But if your climate allows you to operate them longer before draining, you're bound to achieve greater savings. The solar-collector system drains down automatically, depending on the temperature of the water inside the panels. For details, see the main text.

During October and November, we relied primarily on the heat pump for heating water. But during December, January and February, we expect the outside temperatures to chill the basement to the point where the heat pump will no longer be efficient. When it stops operating, the electrical resistance element in the hot-water tank will take over.—D.A.W.

and second, salt treatment of the water is an added expense.

To offset both of these concerns, we diverted the hard water to two places before it went to the softener. The first was the outside spigots that provide water for gardening and lawn care. The second diverted water to a separate faucet at our kitchen sink. Water here passes through a charcoal filter (C) that removes particles as small as one micron (1/25,000th of an inch). This improves the taste of the water we use for drinking and preparing food, without adding salt.

Water out of the softener goes to the cold supply line (G) for the rest of the house, including the baths, laundry, dishwasher and so forth. The other side of this tee is the beginning of the water

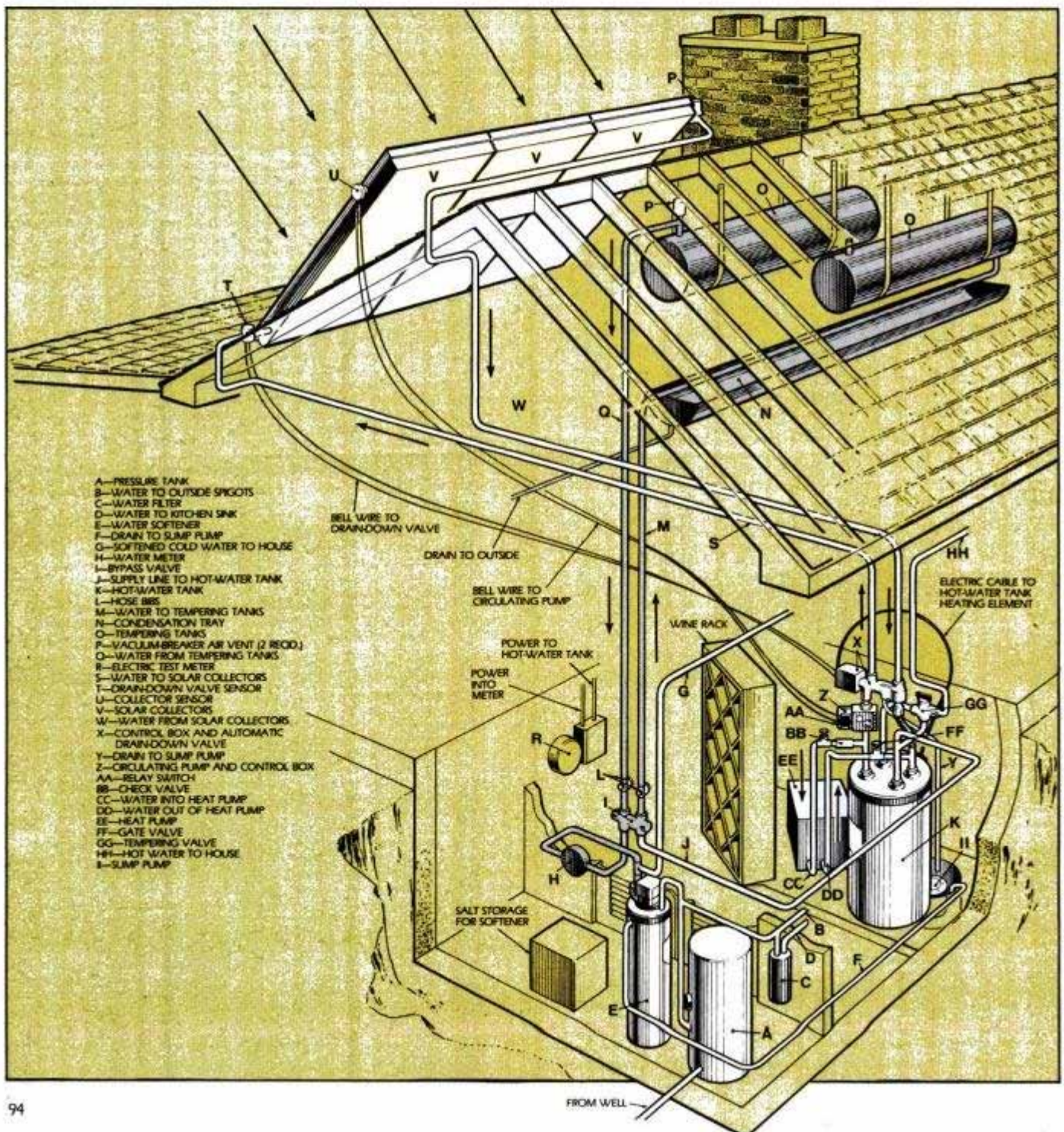
supply to the hot-water tank. At this point, we installed a water meter (H) so we could measure how much hot water was being used during our test period.

From the meter, the water travels to a specialized bypass valve (I) that diverts it to the tempering tank system. This manual valve is opened or closed, depending on the time of year. During the summer the attic gets extremely hot, often reaching 120° F. and higher. Water circulating through the tanks is preheated before it goes to the hot-water storage tank. Because the temperature of our well water is a consistent 55° F., using the tempering system makes sense only when the temperature in the attic is consistently (and considerably) higher than 55° F. In loca-

tions further south, its benefits would be greatly increased.

When the temperature falls below the useful point, the valve is moved and the tempering system is bypassed. The tempering system is drained for the year by attaching a garden hose to each hose bib (L)—situated just above the bypass valve—running the hose to the sump pump and opening the valve.

With the tempering tanks out of service, the water goes directly to the storage tank (K) where it enters the top and goes through an internal tube to the bottom of the tank. Near the bottom of this special solar hot-water tank is a sensor that monitors the temperature of the entering water. It is connected to another sensor (U)—through the circulating pump control box (Z)—mounted



on the solar collectors on the roof. Together they regulate the circulating pump that supplies the collectors with water. If the temperature of the water inside the tank falls below that of the water inside the collectors, the pump will force the collector water down into the tank.

While two solar collectors will often suffice in other parts of the country, we

installed three 3 × 8-ft. units. They are angled at 42°, corresponding to our latitude. This angle is a good average for summer solar efficiency. If you are going to employ your system all year round, add 5° to the collector angle to compensate for seasonal shifts in the sun.

If, at some point, the collectors cannot meet the demand for hot water,

then a relay (AA), mounted on the pump control box, will immediately switch power to the heat pump which will heat the water until the demand subsides. Then, the heat pump will kick off and the water will go back to being preheated by the solar collectors.

Do keep in mind that when the heat pump is operating, it is drawing heat (Please turn to page 138)

How To Build The Wine Rack Door

While I was planning the installation of a heat-pump water heater in a small room in my basement, it occurred to me that the device would create a good environment for wine storage—dark, cool and dry. The darkness was already there, and the heat pump would pull heat, as well as moisture, from the air. Such features are costly in factory-made wine storage units.

I hinged the rack so it would serve as a door for the mechanicals room, but you can build yours in a fixed position if you prefer. I used red cedar stock because it is attractive, lightweight and durable. It also matched the redwood paneling I used to finish the room.

Begin construction by edge-joining enough cedar stock to yield all the boards required. When the glue is dry, cut the dividers to the size given in the materials list. Their length dimensions include some waste; the precise length will be determined later. Next, mark the length centerline for each divider on one edge of each board. Then take the six long dividers (D) and stack them flat on top of each other so these marks will all align straight up and down. For accuracy, lay out the notch positions on the

edges of all boards at once. Start by straddling the centerline with the first notch, then move toward each end of the pile, laying out the notches on 8-in. centers.

Stack the other dividers (B and C) together in a similar way. But keep in mind that these boards do not have a notch at the centerline. Begin the notches 3 3/8 in. away from the centerline in both directions. Maintain the 8-in. centers. Once all the notches are marked, unstack both piles and transfer the edge marks to the board faces. Cut the notches as shown in the drawing with a dado head in your table or radial-arm saw. It's best to make the notches slightly wider than the thickness of the boards for easier assembly.

Test-assemble the dividers on a flat surface, then cut the rack sides, top and bottom and tack-nail them together. Square this "case" assembly and install a temporary brace across one corner to make certain the case remains square. Next, center the case on top of the divider assembly and trace the outline of the inside perimeter onto the top edges of the dividers. This scribing method assures the best possible fit. Remove and disassemble the case and dividers. Transfer



Create wide boards needed for rack by edge-joining red cedar stock. To save time, clamp together three sets of boards at once. Space the bar clamps about 6 in. apart; don't apply glue between individual sets. Wipe off excess glue and let it dry. Leave boards clamped overnight.

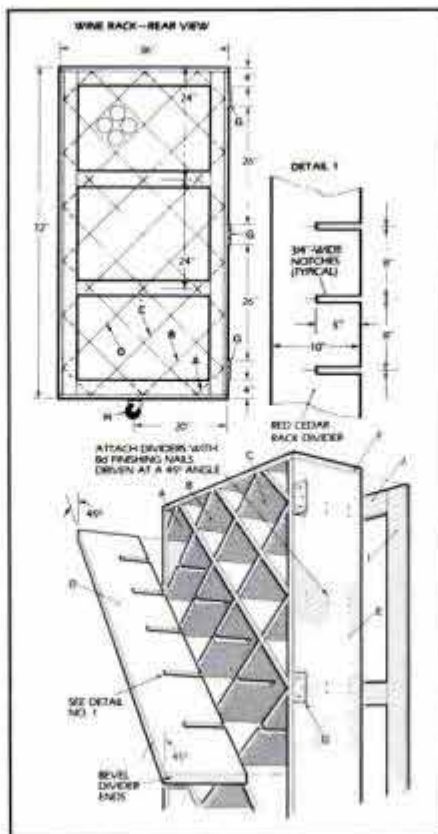
the marks from the divider edges to their surfaces and cut the appropriate 45° bevel on each end.

Reassemble the case with glue and 8d finishing nails. Then slide the case over the dividers. Nail the dividers in place with 8d finishing nails driven through the case and into the ends of the dividers. Keep the front edge of the dividers flush with the front edge of the case. Two nails for each board end is enough. To prevent splitting, bore pilot holes for the nails, using a drill guide—such as a Portalign tool—to maintain the proper angle. Scribe, cut to size and install the small corner dividers (A).

Cut the plywood stiffeners and stain them a red cedar color. Nail them onto the back of the rack as shown in the drawing with 4d finishing nails. Set all nailheads and fill their holes with a matching color wood filler. Sand the piece lightly with 220-grit sandpaper. Install the hinges and caster, then hang the door on a sturdy jamb.—D.A.W.

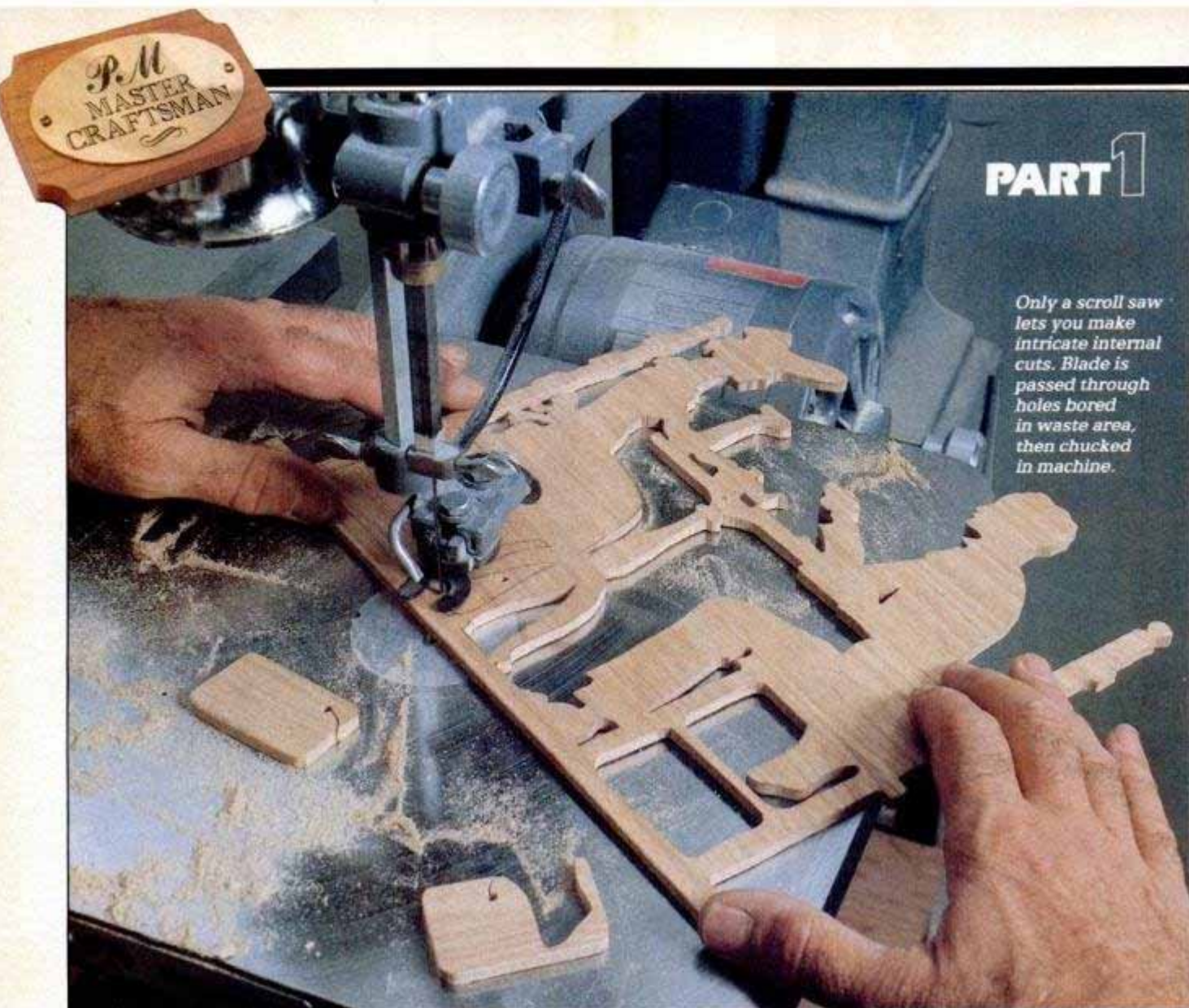


Wine rack acts as door to mechanicals room. Bottles disguise the room, while the open shelves allow free air circulation for efficient operation of the heat pump.



MATERIALS LIST—WINE RACK

Key	No.	Size and description (use)
A	4	3/4 × 8 × 10" red cedar (divider)
B	4	3/4 × 10 × 24" red cedar (divider)
C	4	3/4 × 10 × 41" red cedar (divider)
D	6	3/4 × 10 × 50" red cedar (divider)
E	2	3/4 × 10 1/4 × 70 1/2" red cedar (side)
F	2	3/4 × 10 1/4 × 36" red cedar (top, bottom)
G	3	4" brass butt hinge
H	1	3" ball, flat plate swivel caster
I	2	1/4 × 3 × 70 1/2" plywood (stiffener)
J	4	1/4 × 3 × 28 1/2" plywood (stiffener)
Misc.		Glue, 4d and 8d finishing nails, red cedar stain.



PART 1

Only a scroll saw lets you make intricate internal cuts. Blade is passed through holes bored in waste area, then chucked in machine.

Use Your **SCROLL SAW** Like A Craftsman

A stationary jigsaw does a lot more than cut curved lines. On these pages, a skilled woodworker shares his secrets for getting more out of the tool.

BY ROSARIO CAPOTOSTO

The scroll saw is generally thought of as a tool used for freehand cutting of intricate shapes in thin stock. Though it can handle those tasks with ease, a rugged, heavy-duty machine will do a great deal more. Once you have mastered basic scroll sawing and some of the simple jigs that you can make, you'll discover that this is a versatile tool with great potential.

The saw shown here is Rockwell's 24-in. model. It will cut through stock 1 3/4 in. thick and is capable of cutting to the center of a 48-in. panel. The blade

chucks can rotate 90° to permit cutting long stock by feeding from the side (and avoiding interference with the overarm). As in all quality saws, its table tilts 45° right and 15° left for routine bevel cutting. When the table is rotated 90°, you can cut bevels up to 45° on work of unlimited length.

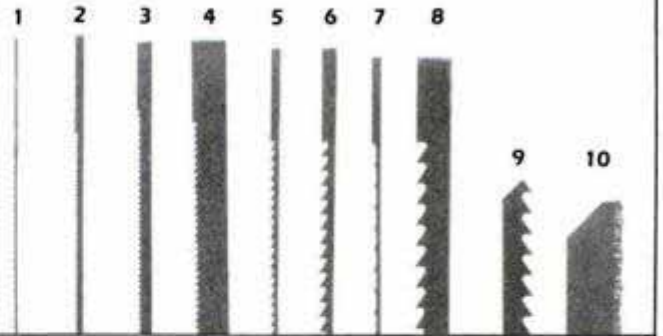
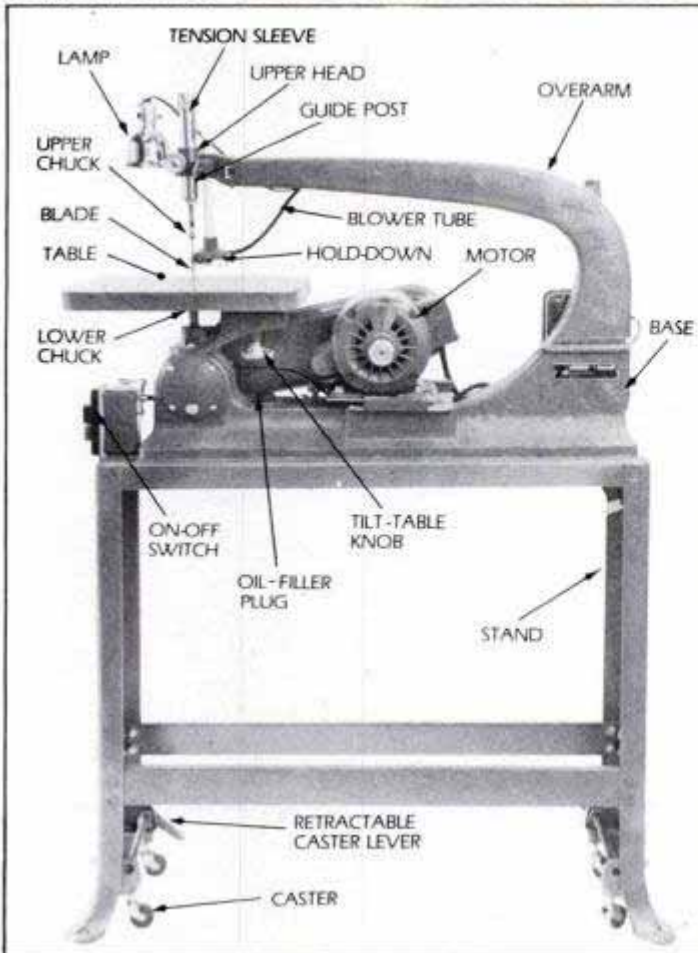
The overarm encases the upper chuck; it also supports a universal blade guide and backup roller which rigidly supports the blade in true alignment for smooth and accurate cutting. An adjustable spring hold-down provides

added accuracy and ease of operation. It holds the work firmly on the table, even on bevel cutting operations, and prevents the work from lifting with the upstroke of the blade.

The saw's lower casting houses the crankshaft, which converts circular motion into an up-and-down motion that drives the lower blade chuck. A Timken bearing crankshaft is splash-lubricated to assure smooth performance.

The saw is available with a four-speed pulley arrangement or with a variable-speed drive. With the latter

SCROLL SAW COMPONENTS AND BLADES



Profiles of commonly used scroll saw blades are shown above. Descriptions and uses of the blades are below.

COMMONLY USED SCROLL SAW BLADES

No.	Thickness (in.)	Width (in.)	Teeth per in.	Materials to be cut
1	.008	.035	20	Wood, plastics, hard rubber, ivory
2	.020	.070	32	Metals, asbestos
3	.020	.110	20	Wood, metals, asbestos
4	.028	.250	20	Metals, paper, felt, asbestos, brake lining, mica
5	.020	.070	15	Wood, metals
6	.020	.110	10	Wood
7	.020	.070	7	Plastics
8	.028	.250	7	Wood
9*	.035	.187	7	Wood
10*	Grit edge	—	—	Problem materials

*Nos. 9 and 10 are regular sabre saw blades.

Rockwell's 24-in. scroll saw, with its parts identified. Chart shows how to choose the right blade for the material being cut.

model (shown), you simply turn the variable-speed control handle to set the desired speed from 650 to 1,700 cutting strokes per minute (c.s.m.).

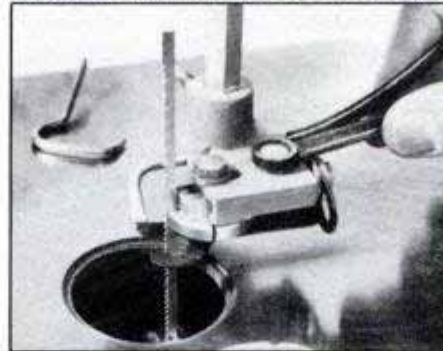
Blades and adjustments

Blades for the scroll saw come in a variety of widths, thicknesses and points, or number of teeth per inch (TPI). The speed and smoothness of cut and the minimum turning radius relate directly to these factors. The finer the blade, the smoother and slower the cut. The finer blades also permit cutting the tightest radii. The TPI range from 7 to 32. Blade thicknesses run from .008 to .028 in. and widths from 0.35 to .250 in.

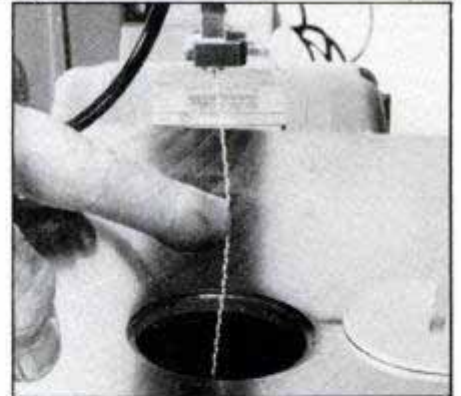
Blades with blank ends are designed to be gripped in both upper and lower chucks; they're classified, in general, as jeweler's blades. Sabre blades, also available, are blank on the lower end and designed to be held in the lower chuck only. These are frequently used with the overarm removed to facilitate sawing oversized work. Sabre blades also save time by eliminating the need for blade removal and installation when pierced (inside) cuts are being made.

Since these blades are supported only by an auxiliary guide immediately below the saw table, they are designed

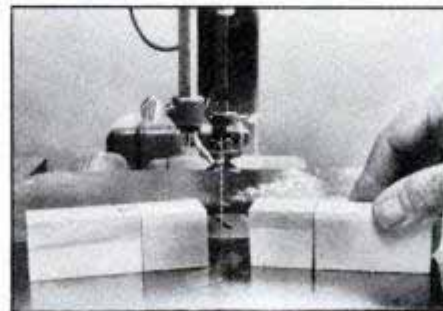
BLADE AND GUIDE OPERATION



Detail of blade guide assembly. Slots in the universal guide fit blades of varied thicknesses. Sabre blade guide and finger guard are shown in the background.



Flexed blade shows insufficient tension, causing blade drift and erratic cutting.



This test checks table adjustment for true zero. Blocks on right indicate that the table is not square to the blade. See text.

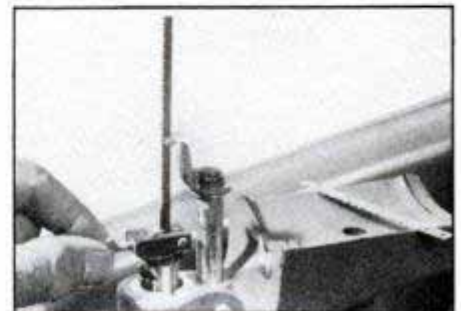


Table is removed to show the sabre blade guide in place. Chuck housing must be rotated 90° to utilize this guide.

HOW TO HANDLE HEAVY STOCK



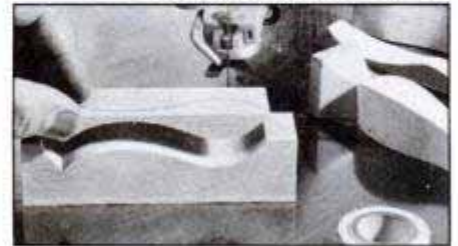
Shown above is an example of the heavy yet delicate cutting that can be done with a properly functioning scroll saw. This view is of a slice that's only about 1/2 in. thick.

SHARP CORNERS



Cloverleaf loop cut forms a sharp outside corner. To obtain a sharp inside corner, first make a bypass cut with a wide curve. Two right-angle cuts then square the corner. X-marked area is waste.

COMPOUND CUTS



For compound cuts, tape the cutoffs back into position to provide a true surface for marking the additional cuts.

CUTTING SHEET METAL



Hardboard backing with fine saw kerf provides zero clearance around blade to improve cuts in very thin sheet metal.

ANGLE SAWING



Angle cutting will produce a hollow carving blank for a model boat hull. Start cuts in holes at the rear (arrow).



Angle sawing is a novel way to build up stock. The self-jamming segments are easily glued and need not be clamped.

CUTTING HARD CERAMIC TILE



Glazed ceramic tile can be cut into any shape easily with a tungsten carbide Grit Edge sabre saw blade. The hardboard backing protects the table from scratching tile.

INTRICATE INLAY WORK

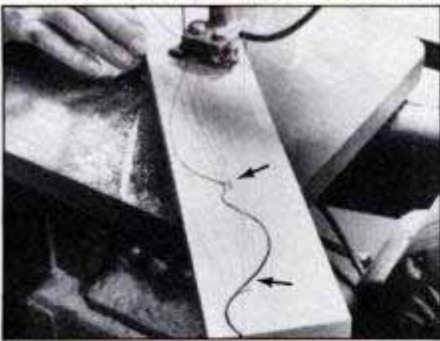


Two spaced blades are used to effectively cut inlay strings. Spacer strips used here were cut from ice cream sticks.

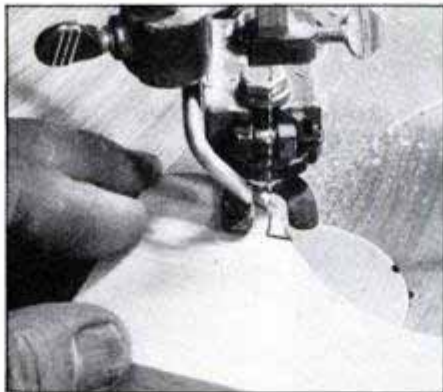


Making these intricate cuts with a single blade would prove to be very frustrating.

MASTERING TRICKY CUTS



For accuracy, cut tangent to the line. Steer work into teeth, not into the side of the blade. Bypass small details (arrows) and cut sweeping curves first.



Intricate details are tackled separately, after main curve cuts have been made.

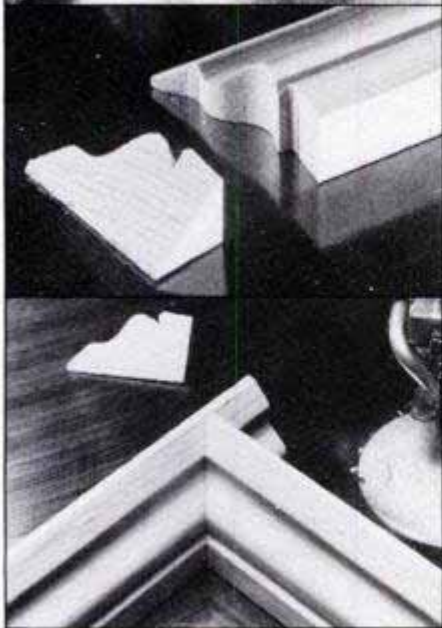
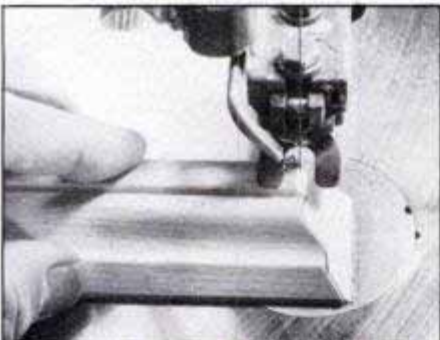


To cut an acute corner, cut to A, then backtrack to B and continue the main cut.



After removing main waste, a second cut cleans out the remaining wedge at point.

MOLDING JOINTS



For a coped molding joint, first make a 45° miter cut to reveal the outline. Then use scroll saw to follow the outline. Bottom photo above shows completed cut.

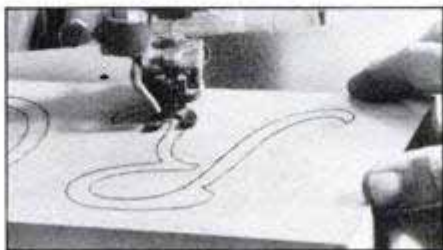
SCROLL-CUT LETTERS



Completed, raised letters produce a handsome plaque. This angled bevel cutting technique is fun and easy.



The table was set at a 3 1/4° tilt for this cut. Small-diameter blade entry holes are first made in an inconspicuous place.



To cut raised letters, set the saw to cut a slightly angled bevel. A fine-tooth blade provides maximum control and produces smooth edges that need no sanding.

with a heavy cross section. Sabre blades are usually available in two sizes: .025 in. thick, .187 in. wide, 9 TPI and .035 in. thick, .025 in. wide, 7 TPI.

In addition to these blades, conventional sabre saw blades can be used in a scroll saw. Of particular value for cutting problem materials is the Remington Grit Edge blade. Instead of conventional teeth, this blade has a cutting edge made of hundreds of superhard tungsten carbide particles.

The profiles of the most commonly used scroll saw blades are shown in the accompanying photos, and the chart indicates typical uses.

Installing blades

When mounting a blade, it is important that it be perfectly perpendicular in the front-to-back relationship (side-ways alignment is automatically set by the chuck blocks). To get it right, simply mount the blade so it abuts the back of the upper and lower chuck housings. When the blade is in position, it must be tensioned to hold sufficiently rigid and straight. To do this, pull up on the blade tensioning sleeve and lock it in place.

Though some "armchair craftsmen" may feel otherwise, there is no positive method of checking blade tension except experience. However, plucking the blade with your finger will put you on the right track. An easily deflected blade indicates too little tension and will cause the blade to drift in the cut. Too much tension on fine blades may cause them to break easily.

The universal blade guide is a disc with slots of varying widths around its rim. A slot that will fit around the blade is selected and locked into place. The slot should be neither too tight nor too loose; the blade's teeth should just clear the slot, with the roller lightly touching the back of the blade.

Before cutting an actual workpiece, check the table for squareness in relation to the blade. Using a square, sight along the blade for the initial setup; then, test-cut a scrap of wood. Flip one of the cut pieces upside down, then butt the cut edges together. If the table is in true alignment, the cut edges will match perfectly. A nonparallel joint will indicate the need for adjustment.

When you obtain perfect alignment, set the pointer on the tilt scale to zero. The pointer will now accurately register any degree of tilt up to 45°. Make this check and adjustment before every major shop project.

Cutting techniques

Irregular shapes: Cutting irregular shapes accurately is a skill acquired easily on the scroll saw, but you must

(Please turn to page 133)



PM's Guide To Refinishing Wood Floors Like A Craftsman

After sealing off room to contain dust, use a drum sander to cut old finish. Above, a maple floor is sanded. Start sanding at one end of room and work in a straight line until you reach the other end. Sand with the grain when possible. After you've covered entire room, sand the unsanded strip along starting wall. Begin by using 36-grit sandpaper, then move on to 80-grit. Sandpaper wraps around the drum and is secured by clamps (right).



Few home improvements provide satisfaction equal to the feeling you get when you rejuvenate an elegant old wood floor.

BY BILL BEYER

Make no mistake, refinishing a floor is a tedious process at best. But you derive a great deal of satisfaction doing it because the results are usually spectacular.

With some help, I refinished the two totally different types of floors shown on these pages. One is a maple floor with a handsome grain (above). The other is a typical oak floor (facing page). The same general procedure was used to finish both floors.

Rounding up the equipment

You need some special equipment to rejuvenate a wooden floor. We got the items we needed from a local rental shop. We also learned that it's advisable to phone in advance to reserve the equipment.

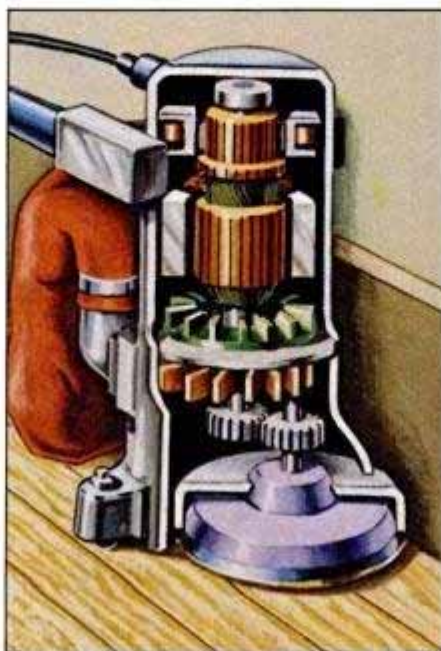
Here's what you'll need:

- Floor drum sander.
- Disc sander, called an edger.
- 36-, 80- and 100-grit abrasive for both machines.
- Floor-buffing machine.
- 16-oz. hammer.

- Nailset.
- Small wire cutter.
- Hand scraper.
- Hand sander.
- 2/0 steel wool pad for the buffer.
- Stain and sealer.
- Polyurethane varnish or other floor finish.

- Lamb's wool applicator.
- Brush and roller.
- Paste wax.

Your tool rental shop may offer two different types of drum sanders; one type sands close to the wall and obviates the need for an edger. We made use of this type, but used the edger as well, since the drum sander would have to be operated across the grain at the end walls. This, of course, would leave sanding marks that would then be removed by either hand scraping or sanding.



Along walls use a disc sander, also called an edger (above). Later, a scraper is used to scrape the corners of the maple floor. Cutaway view of edger (left) shows how the disc sands a floor up to a wall.

PM photos: Matt Doherty
 Consultant: Ray Hartwig, Hartwig Floor Sanding,
 Algonquin, Ill.
 PM art: Ed Lipinski

Preparing the floor

Before you start to sand, you may want to remove the quarter round (shoe mold) on the baseboard to better reach the floor's edges. Then carefully examine the floor. You should remove or set any nails that protrude to or above the surface and nail down loose boards. If the floor is of hardwood, bore lead holes for the nails. Also, look for and remove staples that may have held down carpet.

Next, use a wood filler in all holes and places where the wood is chipped. If you plan to use a stain, use only a wood filler that will accept the stain.

Sanding the floor

If many of the boards are warped, you should first sand diagonally across the floor/room to level the floor as much as possible. Take care to avoid sanding through the groove of the tongue-and-groove edge.

We began our sanding job with 36-grit sandpaper on the drum sander. **Caution:** When you use a drum sander, make certain you raise the drum off the floor before turning on the power. Then, gently lower the rotating drum onto the floor—as you move the sander forward. The machine will tend to pull

Step-by-step procedure for refinishing an oak floor



1 To remove an old finish, work the drum sander in direction of the grain, as here. Continue to the other end of the room, overlapping each preceding pass several inches. Then tilt the sander off its drum, roll it back to the starting point and repeat the same procedure.

away from you, so keep a firm grip on its handles.

Keep the sander moving to avoid cutting dips in the floor. When you want to end a pass, lift the drum slowly by pushing down on the handles as you move the sander. If you want to quit for a breather, turn off the motor and wait for the drum to stop moving before tipping it back onto the floor.

If the sandpaper tears for any reason, stop the sander, disconnect from power and change the paper. You'll get uneven sanding if you try to use a torn sheet of sandpaper.

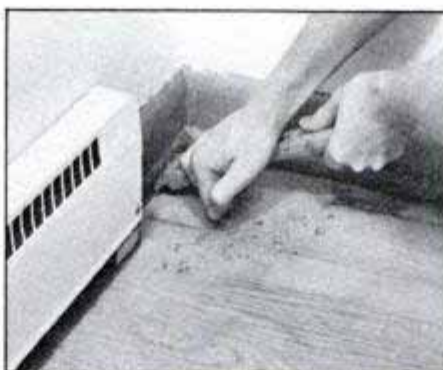
As you operate the sander, overlap strokes a few inches to assure even cutting. Start at one end of the room and work toward the other end, so that the machine is working with the wood grain.

Make a pass over the entire length of the room, then lift the sander off its drum and roll it back to the starting point. Repeat the sanding. You may pull the sander back to the starting position while sanding another strip. However, the machine takes a heavier cut when pulled against the travel direction of the drum.

If your floor is a very old one that has been sanded numerous times, don't try



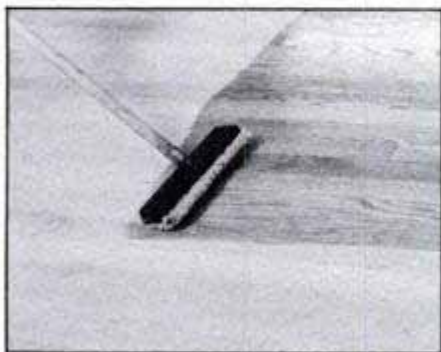
2 Use an edger at wall-floor angle to clean away old finish. Sander will leave cross-grain scratches, to be removed later by hand sanding, scraping.



3 Place the scraper tightly against the baseboard and then pull it toward you, pressing down to cut away old finish. Always try to scrape with grain.



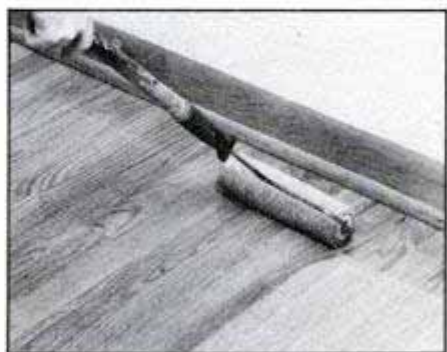
4 When all the sanding is completed, vacuum the floor to remove any dust particles. Wear crepe-soled shoes to avoid making marks on raw wood floor.



5 Next, apply a stain-sealer, using a lamb's wool applicator. Or, apply a clear sealer, as was done here. If you use the latter, let the floor absorb it all—do not wipe off. Apply sealer to approximately one-third of the floor area at a time. As you finish last third of the floor, work toward the exit.



6 When the sealer has dried completely, rub the entire surface lightly with steel wool to smooth off any grain ("whiskers") raised by the sealer applicator. Vacuum again to remove steel wool dust. You can do this job by hand with 2/0 steel wool, or use an electric floor buffer with steel wool or synthetic pad.



7 Apply polyurethane varnish with a short-nap roller; a long-nap roller can cause bubbles. Work with the rod side of the roller toward the unfinished surface, and overlap strokes. The rod side exerts most of the pressure to spread polyurethane on raw wood; light side smooths already applied finish.

to remove 100 percent of the old finish on the first sanding pass. You can complete the finish removal with finer grit papers.

On the maple floor, I lifted the cold-air return grilles to look at the ends of the boards. They indicated that the floor could be sanded several more times.

When you have finished the coarse sanding with the drum sander, use a small disc sander to clean off the narrow areas along the walls. Use 36-grit sandpaper and work along the straight grain to the corner. At the butt ends of the room (end walls), you will be pushing the sander across the grain. Keep in mind that the narrower the strip sanded across the grain, the less hand work you'll have to do later to eliminate sander marks.

Next, use a sharp hand scraper to scrape the old finish from the corners where the sanders can't reach, and to clean up other spots. Scraping also removes marks from along the butt ends of the room. Scrape with the grain whenever possible.

Your room may have old wooden grilles covering floor registers. If so, use a disc sander to clean off the grille surfaces. Work carefully to avoid splitting the wooden strip edges. If you want to clean the inside edges, use a



After the polyurethane finish has dried completely (allow two days), apply a floor wax and buff it to a sheen. A large rented floor buffer handled the oak floor quickly (left). Or you can use a buffing bonnet on a portable drill, as we did on the maple floor (above). When you press down on the handles of an electric buffer, it will move to the left. Pull up and it moves to the right. Tilt it to the left and it moves away from you. Conversely, it will move back when you tilt it to the right.

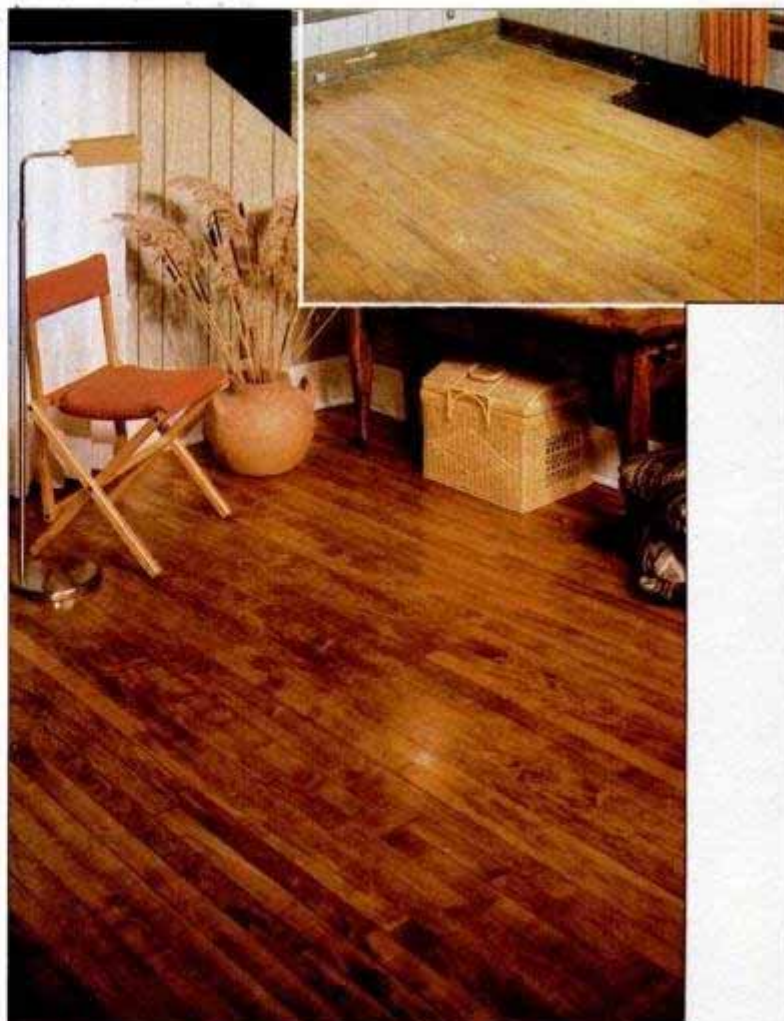
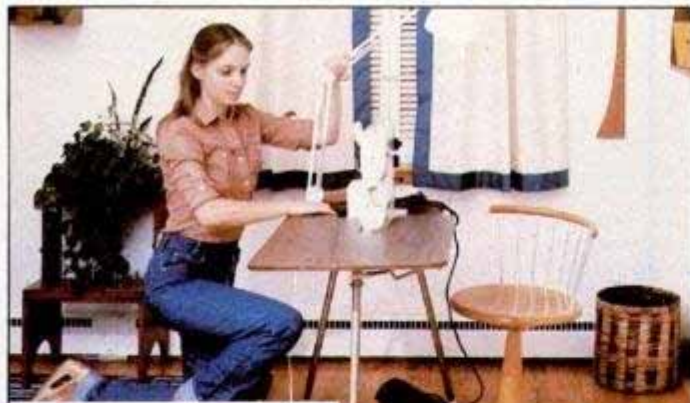
flat-bladed knife, or a stripping compound.

Intermediate sanding is done with 80-grit sandpaper on both drum sander and edger. Work as you did with the coarse paper, taking care to sand the entire floor.

Finally, use 100-grit sandpaper on both machines to eliminate all possible sanding marks. Examine the areas close to the walls, especially at the butt ends, to ensure that scratches from sanding are removed.

Use a hand sander or scraper to

Shining floor (below) is red oak finished with a clear polyurethane varnish. Black (water) stains, and marks caused by moving furniture, had marred surface (inset). Maple floor (right) has a fancy grain. Floor had become dull and unappealing (inset).



remove sanding marks, if necessary. This step is particularly important if you plan to stain the floor.

Staining and sealing

Vacuum the floor thoroughly to remove the dust before you stain the floor.

Apply stain with a lamb's wool applicator, available at most hardware stores. We used a stain and sealer combination on the maple floor. This did the job in one easy step. (The oak floor was sealed with a clear sealer.) The stain-sealer is applied, then the excess is wiped off. Work on one-third of the floor area at a time. Finish up on the final third, working your way in the direction of the exit.

A brush was used to apply the stain-sealer at the walls and a lamb's wool applicator to cover the floor's field. Excess was wiped away, using soft,

dry, lint-free cloths. If you use a clear sealer without stain, wiping is not necessary.

Allow two full days for the stain to dry thoroughly. Then, go over the entire surface with 2/0 steel wool, or a synthetic pad, in an electric floor buffer. Or, rub the floor by hand with steel wool. When stain is applied to raw wood, there is a tendency for the grain to raise whiskers. Buffing with fine steel wool will smooth out the raised grain without cutting through the stain.

If you have never operated an electric buffer, start cautiously. With practice, however, you should be able to control the buffer with ease.

Applying the final finish

Vacuum the floor again to remove traces of steel wool and wood dust. The floor is now ready to receive a polyure-

thane varnish or other finish. Use a brush to apply the polyurethane around the edges of the room and a roller to apply it to the main floor area. Be particularly careful to roll out the finish; you don't want to leave pools of liquid at the beginning and end of your roller strokes.

Allow two full days for the polyurethane to dry completely. Then, use the buffing machine to apply a paste wax with a 2/0 steel wool pad on the buffer. This will serve to spread the wax and cut the highly reflective surface of the polyurethane, leaving it with soft highlights.

Not until the wax has been applied and buffed to a polished sheen will the true beauty of the newly refinished floor be visible. At that point, you'll know the satisfaction that comes with a gleaming floor that you've refinished yourself. **PM**

Prefinished Flooring Gives New Character To An Old Floor

Many do-it-yourselfers are choosing prefinished hardwood flooring instead of unfinished flooring stock when they redo their floors—and it's not only to avoid the dusty and tedious process of floor finishing.

Tongue-and-groove, end-matched flooring with factory-applied finish is available in a wide variety of patterns that are hard to find in unfinished flooring materials. You can get prefinished flooring in strips of various widths, pegged planks, 9 × 9-in. glue-down tiles and self-stick parquet squares. Thicknesses range from 5/16 to 3/4 in., prices from about \$2.25 to \$4.50 per sq. ft. We chose a pattern of alternating-width strip flooring to go right over an old resilient tile floor.

When ordering, add in about five percent extra for waste from trimming. The flooring should be unpacked about 72 hours before installation to allow its moisture content to adjust to room environment.

To prepare for installation, remove all base trim and the covers from baseboard heaters. Cut door casings and jamb bottoms shorter by the new flooring thickness so the latter can be slipped under for a neat finish. Professionals use an angle saw for this, but you can use a hand saw.

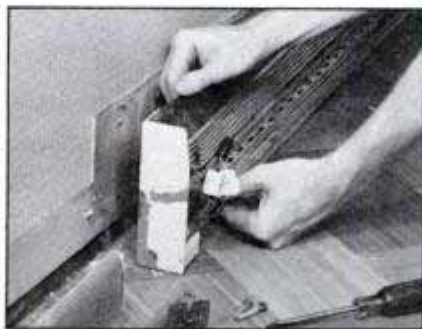
Check the existing floor for squeaks and springy spots; nail down any you find.

To start the layout for strip flooring, snap a chalkline a few inches away from, and parallel to, one wall. Strips must run perpendicular to the floor joists and you must allow a 3/4-in.

(Please turn to page 121)



We covered an old resilient tile floor with prefinished oak strips to give our family room new warmth. Installation is easy, requiring use of only a few special tools.

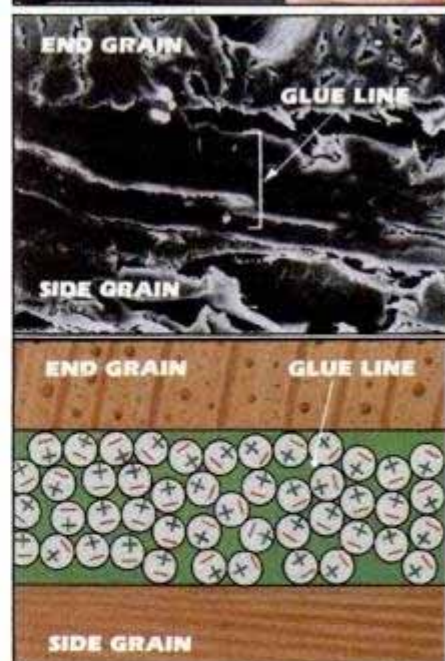


To prepare for the installation, we first removed the base shoe, baseboard molding and the covers of the baseboard heating units from the perimeter of the room (above, left). We used a circular saw, set shallow, to cut a straight line across the room, squaring off a curved seam where two floor coverings met previously (above, right). The new oak strips run across the void, bridging the slight depression.

How To Pick The Right ADHESIVE And Use It

The number of glues and adhesives available these days makes it tougher than ever to choose the right one. PM's guide will help.

CONTACT CEMENT



To show PM readers how the most common glues work, University of Florida engineers glued wood, as shown below (note wood grain in microphotos). Wood was then sliced off and photographed with an electron microscope. At right: Top row of photos shows typical use for the glues; center row is the magnified pictures (some blown up 480 times); the bottom row is an artist's rendering of how each of four glue processes works.

Contact cement is used for nonstructural bonding, such as laminating veneers. Glue molecules mix with a solvent which evaporates and causes bond shrinkage, as shown in enlarged photo. Each molecule has positive and negative electric regions. Charges within change position constantly, creating dispersion, thus adhesion.

There are few things more frustrating than carefully gluing a broken object or a wood joint, only to see the glue line fail hours or days later. Why does it happen? Perhaps the glue is too old. Or the glue may have been exposed to too much heat. Heat and adhesives are bad companions. You should take to heart that old directive, "Store glue in a cool, dry location."

Another reason for glue failure: Perhaps you used the wrong glue for the job. As the chart on a following page shows, most adhesives are designed to perform best on certain materials, although many have secondary uses. Finally, perhaps you didn't follow instructions.

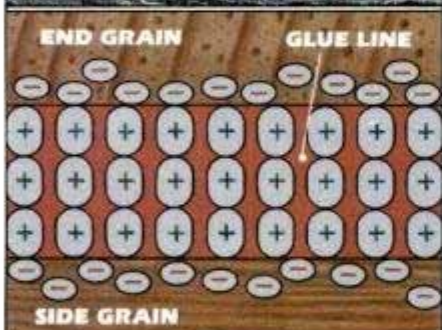
The idea of merely slapping some glue on a break, or joint, and sticking the pieces together is out of date. Adhesives today are highly sophisticated. Some, like the new family of cyanoacrylates, require no more than a tiny drop. Others, like water-base, contact-bond cements, must be applied liberally to both surfaces, as if you were putting on paint.

If you buy the right glue in small quantities for a particular job, and label it with the purchase date, you'll minimize your chances of using old glue that might fail.

"While the bad news is that every product in our industry has a shelf life," says Jim Knauss, technical manager of Roberts Consolidated Industries (makers of Weldwood adhesives), "the good news is that you can nearly always tell when the glue is too old to perform. It will be stringy or thick, dried out or lumpy. Dated plastic resin, for example, will drop in water like sand and will refuse to mix."

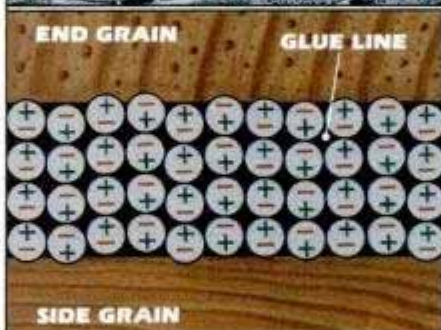
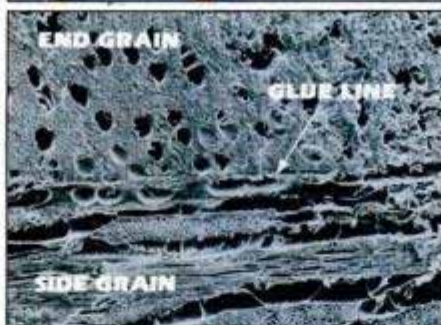
Shelf life is conservative for adhesives listed in the chart. Most makers are convinced their products will last a minimum of two years. Some have successfully used adhesives stored for as long as 15 years—in a cool, dry spot. But remember that a two-year life includes the time from capping at the factory, to distributor shelf, to you—a period estimated at three months minimum and six maximum. Unfortunately, glue

SUPER GLUE



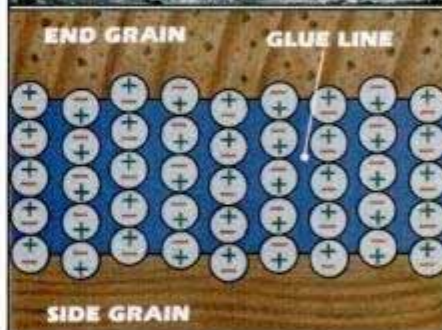
Super glues (cyanoacrylates) for porous materials like wood form a covalent chemical bond with the wood. The positively charged glue molecules and the negatively charged ionic salts at the wood surface link together to form a very strong bond. The chemical bond forms almost immediately as glue comes in contact with wood.

WHITE GLUE



White glues (polyvinyl acetates) are the most universally sold, general-purpose adhesives. Molecules in the glue don't mix as thoroughly as they do in contact cement, but adhesion is somewhat stronger. The charges stay in the same place in each molecule. Still, in products using solvent, there will be some shrinkage of the bond.

ALIPHATIC RESIN



Aliphatic resin glues, often used in furniture assembly, are diluted with water. These glues seep into the pores of the wood, adding a glue-to-wood link that gives extra strength. However, since all glues exhibit various chemical properties under differing circumstances, it's best to always follow package directions in use.

makers are not required to put the date of production on the glue container.

Types of glue

Although some adhesives are still labeled for specific jobs, such as "Glass and Ceramic Mender," the profusion of glue names is gradually subsiding. Taking their place are a dozen or so workhorse adhesives—essentially those listed in the chart.

Standing before a dealer's shelf that's loaded with adhesives, you'll have no trouble picking out the epoxies: They're clearly identified as such. The cyanoacrylates—usually tagged with such adjectives as Super or Wonder—will be identified by generic name somewhere on the label. But you'll have trouble finding a neoprene adhesive (such as Weldwood Touch-N-Glue) or a urethane acrylic resin (Loctite's Crystal Clear Sunshine Glue, for example). The descriptions below will help.

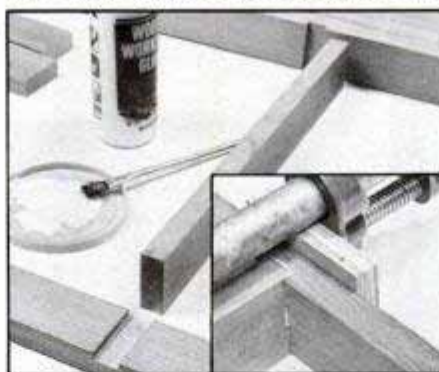
Polyvinyl acetate (PVA), familiarly known as white glue, is the most universally sold all-purpose adhesive. But not all white glues are the same. Some are watered down for youngsters' use, while others can withstand nearly 3,000 pounds per square inch (p.s.i.) when used to bond two blocks of hard maple. Since maple fails a stress test at about 2,600 p.s.i., the glue line is stronger than the wood.

Superior PVAs can be used to repair a broken china figure, a vase or costume jewelry. At least one maker claims its PVA is dishwasher safe, but warns that the glue line on a plate or cup must dry completely. Figure a week of drying when humidity is low and two to three weeks when it's high.

Aliphatic resin glues are sometimes labeled "aliphatic." Like PVAs, they're packaged in plastic squeeze bottles. They can be identified by their creamy yellow color. Aliphatic resins have virtually the same properties as PVAs. The big difference is in their "grab" or wet tack. Aliphatics are stickier, which makes your gluing job somewhat simpler, since the parts being glued will not slip or slide around quite as easily.

Liquid hide glues are as old as the hills. These adhesives, made from animal hides, are being replaced on many dealers' shelves by the newer PVAs and aliphatics. Usually labeled "hide glue," they're characterized by a tan to brown color. Packaging and properties are nearly identical to PVAs and aliphatics, except for a slower grab and set

PREPARATION: THE KEY TO GLUING A STRONG JOINT

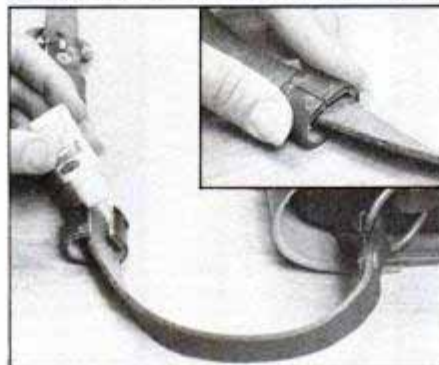


To achieve a strong, glued joint between two pieces of wood, the mating surfaces should be clean and an exact fit. Always test-fit parts before you apply glue. Use enough glue to just cover joint surface. There should be little glue squeeze-out (inset). Since end grain absorbs glue by capillary action, apply second coat.

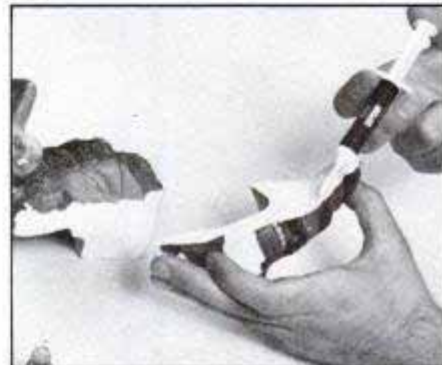


Many glue failures result from too great a dependence on the glue's holding power and not enough on preparation. For example, all the fragments of this china cup handle must be glued back in place. You can't expect glue to bridge even a tiny gap, especially on a cup handle under constant stress when in use.

NEWEST TYPES OF ADHESIVES



New cyanoacrylates repair nonporous surfaces, such as wood, and the leather bag shown. Use it as you would use the older super glues for nonporous surfaces: Apply no more than one drop for every square inch of surface you are gluing. Rub the parts together, then hold them in place until glue begins to hold (inset).



This two-part acrylic resin glue joins both porous surfaces, and nonporous surfaces such as this broken pottery. First brush the primer onto one surface. Then use the syringe to apply the adhesive onto the second surface. Setting action begins when you press the two parts together. In 60 seconds, the parts are joined.

time. Hide glues definitely need clamping. They also have more odor than the other types.

Solid hide glues are still heated in glue pots by old-time cabinetmakers. In either form, these adhesives make a strong wood joint.

Plastic resins, essentially urea formaldehyde resins, are powdery. They're sold in a can and mixed with water. This powerful wood glue is a standard in furniture factories and a favorite of cabinetmakers. Though a plastic resin joint requires clamping, it has many advantages: Once cured, it has high resistance to moisture and heat, and can withstand nearly any interior environment. Exclusively a woodworking glue, it has a comfortable four-hour pot life after mixing. That leaves plenty of time to match a couple dozen prepared joints in a large shop project.

Resorcinols are also easy to pick out. They're sold in two attached cans. One

can contains a powdered catalyst; the other, a liquid resin. Once mixed, resorcinols, too, have a four-hour pot life.

This is the adhesive of choice for outdoor work—gluing on a boat, dock, lawn furniture or water skis. Once cured, resorcinol makes a waterproof joint. Like plastic resin, this is exclusively a woodworking glue: wood, particleboard, plywood, hardboard. Moreover, resorcinol makes the strongest joint of any wood glue.

Epoxies were in great demand a decade ago. Now more mature, they continue to be popular. Makers have developed three variations on the standard two-tube, resin-and-hardener combination. One type uses the same 50:50 blend from the two tubes, but setting time has been reduced from hours to minutes. This reduces or eliminates the need for a tie or tape clamp. Curing time for both the regular slow-set epoxy and the fast-set epoxy, how-

Text and information: John H. Ingersoll
PM color photos: Steve Fay and Harry Wicks
PM illustrations: Walken Graphics Inc.
PM black and white photos: Rosario Capotosto
Electron microscope photos and research: Chris Batich, University of Florida

ADHESIVE FACTS

Adhesive	Best use	Initial grab	Setting time	Curing time	Strength	Clamping needed?	Moisture resistance	Heat resistance	Color when dry	Package size/price	Shelf life	
Polyvinyl acetate (white glue)	Wood and wood products	½-2 min.	10-30 min.	24 hr.	High	Possible light taping	Poor	Poor	Clear	8 oz./\$1.40-\$1.75; 1 gal./\$9-\$12	1½ yr.	
Aliphatic resin	See above	10-60 sec.	5-20 min.	24 hr.	High	See above	Fair	Good	Clear to pale amber	8 oz./\$1.80-\$2.25; 1 gal./\$10-\$14	1½ yr.	
Liquid hide	See above	Slow	2-3 hr.	8-12 hr.	High	Yes	Poor	Excellent	Amber	8 oz./\$3.25-\$4; 1 gal./\$18-\$28	1 yr.	
Urea formaldehyde (Plastic resin—two parts)	See above	Very slow; 4 hr. pot life	4 hr.	12-16 hr.	High	Yes	Excellent	Good	Light tan	8 oz./\$2-\$2.75	1 yr.	
Resorcinol (two parts)	Wood, wood products, exterior	See above	10-12 hr.	24 hr.	Very high	Yes	Waterproof	Good	Brown	2 parts: 10 oz. powder; 32 fl. oz. resin/\$10-\$16	2 yr.	
EPOXIES	Fast set	Metal, glass, ceramics, china, hard plastics, marble, etc.	Slow	4-8 min.	12-24 hr.	Tie or tape during set	Good	Good	Clear, white or gray	½-oz. tube/\$1-\$2; 2½-oz. bar/\$1.80-\$2.50; 1-oz. liquid/\$1-\$2	2 yr.	
	Slow set		4-6 hr.									
Cyanoacrylates (Super glue)	Type for non-porous surfaces (see above); type for porous surfaces (wood, leather, etc.)	Very fast	10-30 sec.	24 hr.	Very high	No	Fair to good	Fair	Clear	.07 fl. oz./\$1.50-\$2	9 mo.-1 yr.	
Acrylic resins (two parts)	See epoxies; also bonds any two dissimilar materials	Fast	3-8 min.	5-20 min.	Very high	No	Good	Good	Amber to tan or clear	2 parts: 16-fl.-oz. adhesive; 12-fl.-oz. activator/\$2-\$3	1 yr.	
Urethane acrylic resin (anaerobic)	See epoxies; requires tight fit	1-2 min.	2-5 min.	20 min.-2 hr.	High	No	Good	Good	Pale amber to clear	.25 oz./\$3.50-\$6.50	2 yr. +	
Neoprene	Metal and tile repair; metal to other surfaces	Fast	Set; pull away for 8 min.; press	24 hr.	Medium-high	No	Excellent	Good	Light tan	1 fl. oz./\$1.80-\$2.25	1 yr.	
Silicone	Glass, metal, ceramic, tile	Slow	Fast	16-24 hr.	Fair	Light taping	Excellent	Excellent	Clear or color	2.8 fl. oz./\$2.80-\$3.75	1 yr.	
CONTACT-BOND GLUES	Flammable solvent	Laminates to plywood, particleboard, etc.	Tack-free; 15-30 min.	Bonds on contact; 3 hr. open time	24 hr.	Medium	Only to laminate bends	Good	Good	Amber	1 gal./\$10-\$18	1 yr.
	Nonflammable solvent	See above	See above	See above	24 hr.	Medium	See above	Good	Good	Amber	1 gal./\$18-\$23	1 yr.
	Water-based acrylic	See above	Tack-free; 30-60 min.	As above, but 5 hr. open time	24 hr.	Medium	See above	Fair to good	Good to excellent	Clear	1 gal./\$15-\$20	1 yr.
CONSTRUCTION GLUES	Solvent-based	Paneling, tile-board, subfloor, gypsum board	8-12 min.	10-15 min.	24 hr.	Medium-high	Possible light bracing	Good to excellent	Fair to good	Light tan, black, others	11-oz. cartridge/\$1.50-\$3.50	1 yr.
	Water-based	Paneling, sub-floor, ceiling tile, etc.	Slow to medium	20-30 min.	24 hr.	Medium-high	Finishing nails on paneling	Fair to good	Good	White to off-white	11-oz. cartridge/\$2.25-\$3.75	1 yr.

Most adhesives in this chart should be applied at room temperature. Aliphatics are an exception; they can be coated successfully on a surface at 40° F. Initial grab is also called wet tack. Setting time refers to the time an adhesive needs to solidify enough so clamps or other pressure can be removed. Curing time is a relative figure, indicating how soon the object can be put back safely into

use. However, adhesives generally don't attain full strength during this period. Most achieve about 75 percent of full strength and continue curing for days, reaching 100 percent in roughly one week. Shelf life is a conservative approximation. Glues may well last longer, especially if they are capped tightly immediately after use and then stored in a cool, dry spot.

ever, is still at least 12 hours—and 24 hours is better.

A second variation delivers the two clear liquids in a two-tube syringe. When you press the dispenser, the resin and hardener combine as they're forced through a single spout.

Finally, there are epoxy sticks of putty consistency. You slice equal portions of the two sticks, and knead them together

to form a pliable mass. This type acts as much like a filler as an adhesive. It's ideal for patching metal pipe, gutters, metal toys, wrought-iron railings and cast-iron lawn furniture or for sealing broken masonry.

While its cost might deter you from using it over a large area, it's still the glue of choice in many instances because of its versatility. It can attach almost any two

surfaces to one another. After curing, clear epoxies will even permanently repair dinnerware that will be sent repeatedly through a dishwasher.

Cyanoacrylates are the new guys in town, though not so new that they haven't had some bad press notices. Applied correctly, these so-called "super glues" will fasten any nonporous surface

(Please turn to page 122)



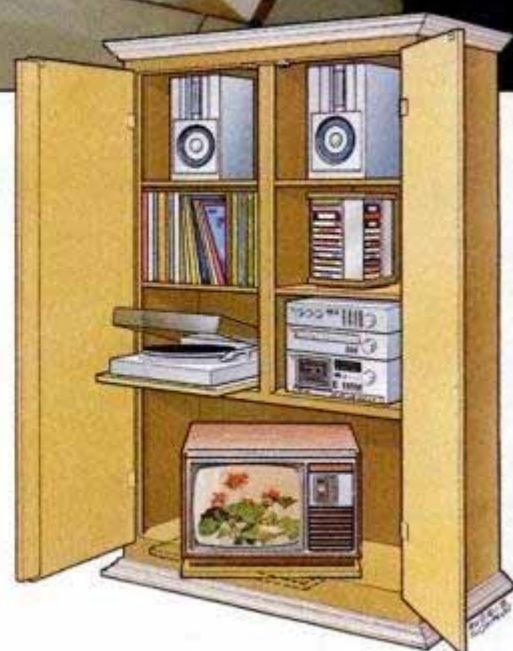
3 Simple Built-Ins That Improve Any Room

If you're planning to make a change, here's a roomful of attractive ideas, including a distinctive painted-floor treatment, easy-to-build shutters and a super-functional entertainment center.

A sure way to upgrade your living style—and the value of your home—is with a well thought-out modernization program. To create a living room do-over that could easily be duplicated by an ambitious do-it-yourselfer, Popular Mechanics recently joined

forces with PPG Industries: The result is the handsome room shown above.

All of the improvements can be done by you—there is no need to call in high-priced professionals. The most ambitious part of the job is building the [\(Please turn to page 110\)](#)



Entertainment center features slide-outs for turntable and TV (latter also swivels), ample room for records and tapes.

*How does
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3 SIMPLE BUILT-INS

(Continued from page 108)

entertainment center for housing stereo and television equipment. For most of the balance of the job, you must don your painter's cap.

Designer Shirley Regendahl selected a complementary color scheme using semitransparent latex stains. To protect

Designer: Shirley Regendahl
 Technical art: Eugene Thompson
 Color photo: Hans Van Nes Studio
 Sofa: Stratford Co.; chairs: Stratolounger-LoBacks

the stained surfaces, they were coated with satin-finish polyurethane varnish. See the color guide at the end of the story for the list of materials used.

Entertainment center

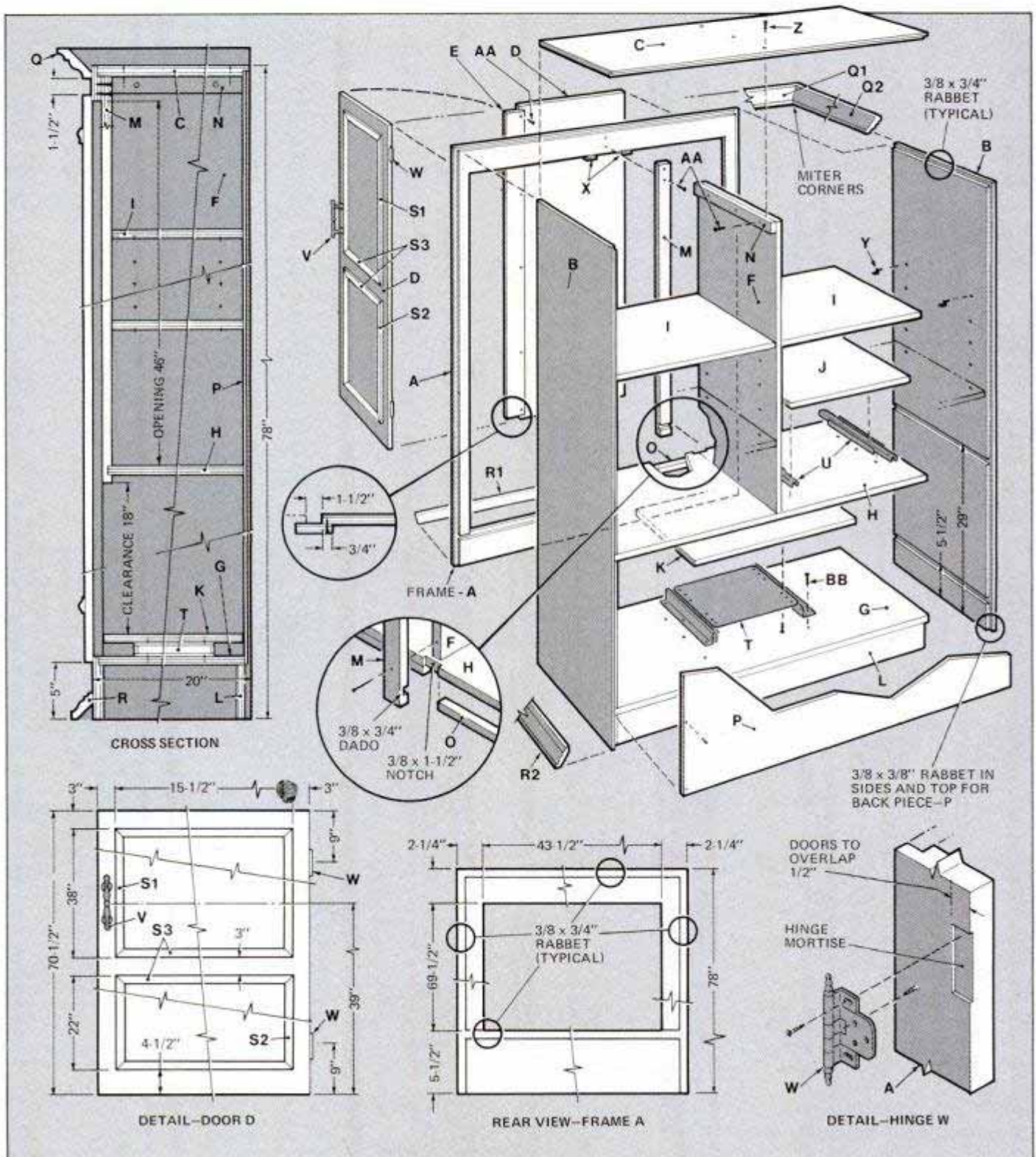
Most of this cabinet was made from $\frac{3}{4}$ -in., lumber-core plywood, pine veneer. This material is expensive, so take care to avoid wasting any. If you plan to paint your cabinet instead of staining it, you can use less expensive fir plywood. If you do, first prime it with a pigmented shellac, such as Bin. For

smooth edges, use a hollow ground planer blade for all cutting.

Begin cabinet construction by cutting the sides and top to size. Then cut the appropriate rabbets as shown. Lay out the dadoses in both sides—for the fixed shelf and bottom—at the same time. Cut the dadoses with either router and mortise bit, or a table saw fitted with a dado head.

Next, cut the cabinet divider. Lay out the adjustable shelf support holes in the divider and sides at the same time

(Please turn to page 112)



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 1/2 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 miniaturization, 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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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.

Because SUPER-EAR is the ultimate listening device, you can use it to pinpoint hidden squeaks in your car or the source of mysterious engine noises.

Construction experts use it to check for flaws or cracks in buildings.

It Works Anywhere!

Ever put your ear to a railroad track to try to hear the train? Try it with SUPER-EAR. You'll hear that train many miles away. Use it as a powerful stethoscope on yourself, a friend, or a pet. You can even hear a bird's breathing.

The only source for SUPER-EAR is New Horizons. Choose from two models — Model SB-5, with ultrasensitive microphone, \$139.95 (two for only \$129.95 each); or Model SB-1, with suction-type microphone, \$99.95 (two for only \$89.95 each).

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- 2 for \$119.95 each
- Dyna-Mike Model X-18, \$149.95
- 2 for \$139.95 each
- Dyna-Mike Model X-3, \$99.95
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3 SIMPLE BUILT-INS *(Continued from page 110)*

to reduce the chance of shelf misalignment. Bore the holes.

Cut the bottom, base support (L) and fixed shelf to size. Then cut the $\frac{3}{8} \times 1\frac{1}{2}$ -in. notch in the front edge of the fixed shelf to receive the center stile.

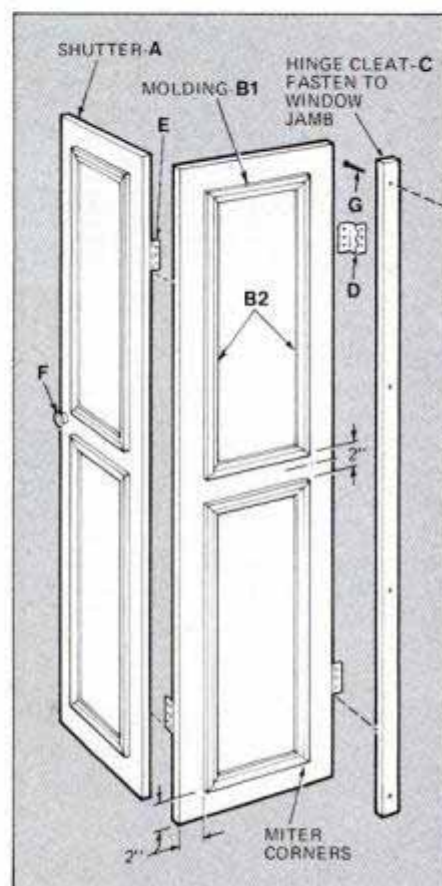
Cut the cabinet fascia from a single sheet of plywood, using a circular saw with guides (for the saw shoe to ride against) utilized for every cut. Take extra care with plunge cuts so all interior edges are straight and smooth. Clean the inside corners of the frame with a handsaw and a sharp chisel. Sand lightly to remove any "whiskers" from the edges.

Cut the rabbets on the back side of the frame and test-fit the sides in them to ensure a good fit before proceeding. Then cut the back, taking care to make the cuts absolutely square. This piece serves to keep the entire cabinet square

and if it is cut and installed poorly, the doors won't line up later.

Cabinet assembly

Tack-nail the cabinet together to check for fit, apply match marks lightly where needed and disassemble. Begin final assembly by joining the top, bottom and fixed shelf to the sides with 6d finishing nails and glue. Set nailheads and fill with wood filler. Install the base



Shutters are mounted on a hinge cleat.

MATERIALS LIST ENTERTAINMENT CENTER

Key	No.	Size and description (use)
A	1	$\frac{3}{4} \times 48 \times 78$ " pine plywood (frame)
B	2	$\frac{3}{4} \times 19\frac{1}{2} \times 78$ " pine plywood (side)
C	1	$\frac{3}{4} \times 19\frac{1}{2} \times 47\frac{1}{4}$ " pine plywood (top)
D	2	$\frac{3}{4} \times 21\frac{1}{2} \times 70\frac{1}{2}$ " pine plywood (door)
E	1	$\frac{3}{4} \times 3 \times 69\frac{3}{4}$ " pine plywood (door lip)
F	1	$\frac{3}{4} \times 18\frac{1}{2} \times 48\frac{1}{4}$ " pine plywood (divider)
G	1	$\frac{3}{4} \times 19\frac{1}{4} \times 47\frac{1}{4}$ " pine plywood (bottom)
H	1	$\frac{3}{4} \times 18\frac{1}{2} \times 47\frac{1}{4}$ " pine plywood (fixed shelf)
I	4	$\frac{3}{4} \times 18 \times 22\frac{3}{8}$ " pine plywood (adjustable shelf)
J	1	$\frac{3}{4} \times 18 \times 20\frac{1}{2}$ " pine plywood (stereo platform)
K	1	$\frac{3}{4} \times 18 \times 24$ " pine plywood (TV platform)
L	1	$\frac{3}{4} \times 4\frac{3}{4} \times 46\frac{1}{2}$ " pine plywood (base support)
M	1	$\frac{3}{4} \times 1\frac{1}{2} \times 49\frac{3}{4}$ " pine plywood (stile)
N	1	$\frac{3}{4} \times 1\frac{1}{2} \times 18\frac{1}{2}$ " pine plywood (cleat)
O	2	$\frac{3}{4} \times \frac{3}{4} \times 22\frac{1}{2}$ " pine plywood (apron)
P	1	$\frac{1}{4} \times 47\frac{1}{4} \times 73$ " pine plywood (back)
Q1	1	$1\frac{1}{2} \times 3\frac{3}{8} \times 60$ " crown molding
Q2	2	$1\frac{1}{2} \times 3\frac{3}{8} \times 26$ " crown molding
R1	1	$1\frac{1}{2} \times 2\frac{3}{8} \times 60$ " crown molding
R2	2	$1\frac{1}{2} \times 2\frac{3}{8} \times 26$ " crown molding
S1	4	$7\frac{1}{2} \times 1\frac{1}{4} \times 38$ " panel molding
S2	4	$7\frac{1}{2} \times 1\frac{1}{4} \times 22$ " panel molding
S3	8	$7\frac{1}{2} \times 1\frac{1}{4} \times 15\frac{1}{2}$ " panel molding
T*	1	TV extension chassis No. TV 1005
U*	1 pr.	14" platform slides No. 168 x 137
V**	2	9" brass pull with $1\frac{3}{4}$ " backplate No. 1325
W***	4	4" semiconcealed brass cabinet hinge with ornamental tips No. 5990-693
X	2	Magnetic catch
Y	16	Shelf support clip
Z	6	2" No. 10 fh screw
AA	10	$1\frac{1}{4}$ " No. 10 fh screws
BB	10	$\frac{3}{8}$ " No. 10 fh screws

Misc.: $\frac{3}{4}$ " brads, 4d common nails, 4d and 6d finishing nails, veneer tape, wood filler, glue, stain, satin finish polyurethane.

*from Albert Constantine and Son Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461

**from Wm. Hurnath Co. Inc., 153 East 57th St., New York, N.Y. 10022

***from Dave Sanders Co., 115 Bowery St., New York, N.Y. 10002

MATERIALS LIST—SHUTTERS

Key	No.	Size and description (use)
A	2	$\frac{3}{4} \times 12 \times 54$ " pine plywood (shutter)
B1	8	$\frac{3}{8} \times \frac{7}{8} \times 8$ " panel molding
B2	8	$\frac{3}{8} \times \frac{7}{8} \times 24$ " panel molding
C	1	$\frac{3}{4} \times 1\frac{1}{2} \times 54$ " pine plywood (hinge cleat)
D	2	$\frac{3}{4} \times 4$ " wraparound brass cabinet hinge
E	2	$\frac{3}{4} \times 2$ " brass cabinet hinge
F	1	1"-dia. brass knob
G	4	3" No. 10 fh screws with finishing collars

Misc.: $\frac{3}{4}$ " brads, veneer tape, carpenter's glue.

Note: Alter measurements and materials requirements to suit your window, if necessary.

support and attach the back, using glue and 4d common nails.

Let the glued-up cabinet dry overnight. The next day, cut the center stile to size and screw its top end to the back of the frame, as shown in the drawing. Let the other end remain free for the time being.

Cut the top cleat and screw-fasten it

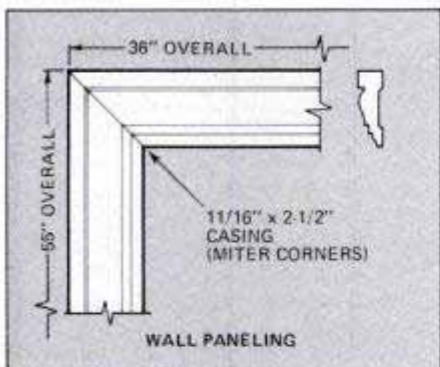
to the divider. Slide this assembly into place and install with three screws down through the cabinet top and three up through the fixed shelf. Attach the center stile to the divider and shelf using 4d finishing nails.

Glue the aprons to the underside of the shelf and clamp until dry. Install the hardware for the television and stereo sliding platforms according to the manufacturer's instructions. Cut the adjustable shelves.

Measure the opening for the doors to see if it matches the dimensions shown on the drawing. Make any necessary adjustments to the size of your doors, then cut them. Keep in mind that each door overlaps the frame 1/2 in. on the top, bottom and sides. Sand all door edges smooth and apply veneer tape. Attach the door lip to the back of one door with glue and screws. Miter the panel molding to size; test-fit the pieces and set them aside. Follow the same procedure with the upper and lower crown moldings.

Add veneer tape to the side edges of the cabinet fascia to hide the laminations, and apply tape to all exposed plywood edges. Cut the mortises in the frame face for the door hinges and mount the doors. Finish by installing the magnetic catches and brass door pulls.

Sand the cabinet with 180-grit sandpaper, dust off and apply stain inside and out. Stain the panel and crown moldings a contrasting color. Allow stains to dry overnight, then attach the panel molding with 3/4-in. brads, and the crown molding with 4d finishing



Detail is created with stock moldings.

nails. Set all nailheads, fill depressions with wood filler and touch up with the appropriate-colored stain.

Let the cabinet dry overnight. Apply a satin-finish polyurethane varnish, following manufacturer's directions on the label. Use two coats, sanding lightly in between with 220-grit abrasive.

The wall paneling is stained and finished to match the entertainment center. Use 1/4-in.-thick pine veneer plywood for the paneling and standard colonial window and door casing for the

(Please turn to page 114)

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3 SIMPLE BUILT-INS

(Continued from page 113)

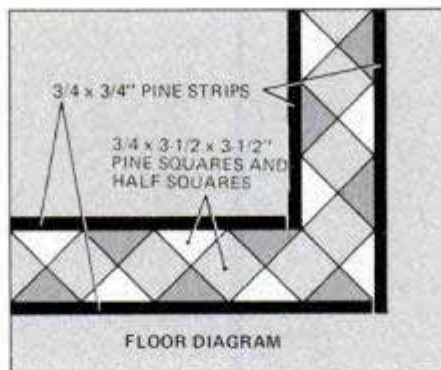
molding, as shown in the drawing. Install the plywood with panel adhesive and 1/4-in. paneling nails. Miter the moldings to size, test-fit the joints and stain. When they're dry, nail the moldings in place and apply one coat of satin-finish polyurethane to both the paneling and molding.

Making the shutters

The shutters are constructed much the same as the entertainment center doors. The plywood panels are cut to the desired size and the edges are covered with veneer tape. Miter-cut molding pieces to length and check fit.

Stain the plywood and moldings to match the colors used elsewhere, then nail the molding in place as before. Apply two coats of polyurethane. If a gloss is desired, rub the finish with 4/0 steel wool when it's dry.

Next, cut the hinge cleats to length (you'll need two per window) and attach them to the jamb as shown. Use finishing collars under the screw heads. Make certain the cleat is plumb in both planes before securing it. If it isn't, the shutters will either swing open or closed by themselves, depending upon the misalignment. First, mount the hinges that join the shutter pairs, then



Colorful "carpet" is, in reality, made of painted wood triangles, border strips.

install the hinges that attach to the cleats. As each assembly is completed, it can be attached to the cleat.

Painted "carpet"

The distinctive floor treatment in this room was achieved with tongue-and-groove pine planking and a geometric "carpet" border (see drawing above). While both are relatively easy to install, craftsmanlike cutting is required. For this reason, use a hollow ground planer blade in your table saw or radial-arm saw to cut the border pieces.

Begin with the carpet border. Select enough flat pine stock for each of the different-colored squares and triangles and then stain each board the appropriate color. When they're dry, cut the

squares and triangles to size, using accurately placed stops on either table-saw miter gauge or radial-arm-saw rip fence.

When all parts are cut, touch up their edges with stain. Let them dry. Snap chalklines on the floor to mark the carpet border layout, then cover the area with mastic that will allow the chalklines to be visible underneath. Install the blocks and the prestained pine border pieces. Carefully toenail the strips (through predrilled holes) in place to achieve the tightest possible fit. Use 4d finishing nails. Set the heads and fill the holes.

Complete the floor by laying the wide pine planking surround; begin along one wall of the room and work your way across. Toenail these boards in place, using 6d finishing nails through the tongues. When all of the planks are down, mask the "carpet" border to protect it and apply stain to the boards. When the floor is dry, apply two coats of polyurethane varnish. **FM**

COLOR GUIDE

Walls and ceiling paneling: Sequoia Redwood.
Shutter and cabinet plywood: Sequoia Redwood.
Panel and crown molding: Winter White.
Floor boards: Weathered Shakes.
Floor inlay: Sequoia Redwood, Winter White, Weathered Shakes.
Inlay border: Blackthorn.
Note: All stains are Rez Interior Latex Stain by Pittsburgh Paints.

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NEW RVs

(Continued from page 85)

els for '83. Almost every builder of smaller pleasure craft already has a runabout in the line. What they're adding are more bass boats, more broad-beamed deckboats and more open-cockpit fishing utilities, often with convertible tops for sun and rain protection and occasional camping.

Biggest boating boom is in the



New Winnebago Centauri van looks like the Itasca Phasar, can get 24 mpg.

growth of the sailboards, with a variety of brands and colorful sails arriving on the market. Higher performance models may have a selection of mast-step positions, daggerboard slots and foot bindings.

Perhaps the slow economy and slackening of new boat sales have helped make more kit boats available again. Two recent additions are 29-foot houseboats from Fisher Craft (Box 304, Byron, Calif.) and Quest 19, 33 and 36 sailboats by Hunter Marine (Box 1030, Alachua, Fla.). Both makers supply



Aquasport 24-foot offshore fishing utility boat can top 41 mph with big outboards.

basic hulls plus cabins and fittings that can be added by the owner. Savings come as the home craftsman finishes off and customizes the interior, installs the engine and selects only the hardware and options he will need. Kit building also offers a chance to spread out construction costs over a much longer period of time, and can help a bigger boat fit a smaller budget.

Making hulls lighter and more fuel efficient has not reduced the cost of manufactured boats. In order to main-



Light Kevlar construction is an option for 55-mph, Hydra-Sport 2500 Fisherman.

tain or add strength while shaving off pounds, new and often more expensive products are often used. Hydro-Sports, in Nashville, Tenn., has been a leader in the use of Du Pont's Kevlar in fishing boats as a light substitute for fiberglass. Fishermen find equal speed is possible with a smaller motor that uses less gas. Fisher Marine of West Point, Miss., uses light marine aluminum to improve performance, and now has a 16-foot, J-Boat model with lines like the



Designed for mini-pickup conversions, Eagle Mirage has an aerodynamic body



Clean runabout lines are a feature of the economical aluminum Fisher J-Boat.

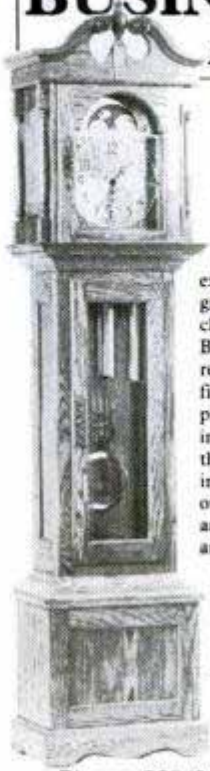
sleek appearance of heavier fiberglass.

For divers, Answer Marine (Hialeah, Fla.) has created a 21-foot Divemaster model. And for airboaters who favor skimming over water as thin as dew, Panther Airboats (Cocoa, Fla.) has new aluminum and fiberglass craft with easier-to-service automotive powerplants as well as aircraft engines. **PM**

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7 NEW SPEAKERS

(Continued from page 91)

though still adventurous, designs. Built to go against the wall, the 7 uses the large radiating area of any reasonably uncluttered wall surface to propagate a deep, seamless bass and unusually uncolored midrange. Since the wall is actually a part of the speaker design, it's no surprise that voices played over even one speaker have an astonishing feel of placement and dimension. The stereo effect is similar—but even better. The 7s nearly attain that unreachable goal: live sound.

Boston Acoustics A-200

Challenge: Find a floor-standing loudspeaker that is broad enough to give mids and highs a hard, uninterrupted baffle against which they can produce precise, clean sound. Give the box enough volume to back up a hefty woofer and adjust it to use a hard floor surface to reinforce the bass. Now, make the speaker only 6¾ inches deep!

So far, the only solution to this problem is the Boston Acoustics A-200. The question is: How can so shallow an enclosure pump out so much healthy, vibrant bass sound? If the A-200 sits out from its rear wall and isn't overly close to side walls (especially very reflective ones) it matches depth with fine imaging. Even when the unavoidable compromises of home placement, dictate positioning near surfaces other than the wall, this is an uncolored, astonishingly open-sounding speaker. If you think you cannot live with sizable speakers, hear *these* before you decide for good.

B&W LM-1

Back in the early days of hi-fi, many Americans looked at the small but productive British audio industry with awe. Everyone who has heard the new B&W LM-1, the company's first mini, has felt that awe once more. The little "Leisure Monitor" is a considerable innovation for any company, because it's the first loudspeaker intended primarily for the car and then for home use. It comes either as a die-cast, sealed enclosure (home or car rear-window deck) or as a panel-mounted unit with several possible bracket configurations. The photo on page 90 shows the most versatile of the bracket combinations. The LM-1 is always sold in mirror-matched pairs.

This is an unusual loudspeaker both from a cosmetic and an engineering point of view. The front panel is fairly conventional looking, except for the independent wire-mesh grille over each driver (there are two). A switch between the grilles sets the speaker for

FLAT performance—uncolored, accurate, normal for the home—or for a LOUDNESS contour that helps neutralize the worst anomalies in car acoustics.

The unusual shape of the cast, sealed enclosure presents as few parallel sides as possible and so damps unwanted standing waves inside.

Deep, smooth bass and an unflappably smooth treble complement a warm and clearly focused midrange. Even very deep bass comes through, despite the lack of bulk the LM-1 presents to the eye.

Koss Dyna-Mite M-80

Like a cherry bomb or M-80 firecracker the Dyna-Mite makes a big noise from a small package. Koss paired 4½-inch bass/mid drivers at each end of the small column and popped in a standard dome tweeter in the center. The result is more bass radiating area than a 6-inch woofer, without the bulk of the box a bigger driver demands.

We found that the Dyna-Mite fits handily on a normal record shelf. With your record albums standing like bookends against the speaker's side, there is a pleasant reinforcement of the modest but adequate low-frequency output. As long as the volume doesn't get up into the glass-shattering range, these are very listenable little mites indeed.

Magnat Plasma

The Plasma is the loudspeaker design that, in a manner of speaking, sparked the idea for this article. It called to mind a science fiction story which described portable sound systems that used no speakers; instead, they worked directly on the air and caused it to vibrate with the music. Now, the West German firm of Magnat has gone a long way toward making this post-Jules Verne dream a reality.

Surround an insulated needle electrode—just the tip showing—with a grounded spherical wire mesh to act as its opposite electrode (see the illustration on page 91). Establish a substantial charge between the two, pulsating at a rate of around 27 megahertz. A startling magenta and sodium discharge corona with the temperature at the discharge tip around 1,500°C. is the result. At so high a temperature, minor fluctuations in the heat bring on extremely rapid changes in the amount of airspace the corona occupies. Cool the air slightly and it contracts; heating expands it. If the corona temperature is controlled by an audio amplifier, via the Plasma electronic black box, these rapid warmings and chillings can generate extremely precise high-frequency sound. The unit's top-notch frequency response is enhanced by incredible transient response, as the speed of

reaction is called; it's almost instantaneous.

The Plasma supertweeter is perhaps the first diaphragmless audio sound source. The result is that the sound doesn't radiate from an area, large or small, but from a dimensionless point. Therefore, it is omnidirectional and extremely even.

Safety? The hot corona is contained within the wire-mesh sphere, which is also a Faraday shield against the ionization extremes of the discharge. A larger outer shield, also of sound-transparent mesh, completes the protection. The hot discharge is small and localized.

Seeing and hearing the Plasma tweeter in a darkened room is an eerie experience. Most audiophiles can't lay out \$3,500 for a pair of tweeters—yes, the lower frequency components that go with it are available from Magnat—but there is no visual or musical experience quite like it.


Ohm Walsh 2

So much research has gone into getting sound out of loudspeakers that a first look at the Walsh 2 can be puzzling. This speaker appears to be exerting all the force of the main driver on the air within the attractive enclosure. Actually, while most drivers work like pistons, shoving the air in and out, this design shivers like an autumn leaf to make its waves in the musical world.

Most loudspeaker cones are rigid. Their designers strive for speakers that are light, but hard enough to accelerate and decelerate instantaneously, and as a unit. Ohm took a different path altogether. The late Lincoln Walsh developed a cone that had just the right pliability to ripple down and just the right damping at the big end not to ripple back up the surface. An electromagnetic impulse, much the same as in standard cones, starts a small, quick wave down the cone. The sound wave generated at the top arrives over the bottom of the cone exactly as the ripple reaches the same point. The resulting sound wave is a coherent pulsation of sound that starts as a wall and gently curves outward. From above if one could see sound, it would look like a rapidly enlarging doughnut or the ripple formed by a pebble tossed into a pond. The small tweeter that provides high treble is time aligned to add its own contribution exactly as the main sound wave passes it. Slight damping of the rear part of the main cone's waves assures that reflections off the rear wall won't interfere with the main sound.

The innovative Walsh 2 is a revelation: smooth bass, precise imaging, a sense of space, yet a firm placement of instruments. Frankly, the longer we listened, the more modest the price tag of \$598 a pair seemed!

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TOMORROW'S CARS (Continued from page 79)

produce cars with headlight covers. They claim the inside of the cover will get dirty and cut down headlight penetration. Yet, when the same DOT people decide to build their "safety" car, it's equipped with headlight covers for improved aerodynamics.

The same situation exists for the RSV's "friendly" windshield and high-mounted rear lights. The Europeans currently have a windshield (Securiflex) that reduces lacerations if a passenger flies into it. This is the type installed on the RSV. Yet there is a regulation issued by the DOT which forbids this windshield from being fitted to cars sold in America.

The reason for this has to do with a road abrasion standard which states that the inside and the outside of the windshield must withstand the same amount of road-induced sandblasting. The softer inner side of the Securiflex can't meet the standard.

The final item is the high-level taillights. The RSV's taillights are mounted at eye level on the rear pillar. Tests conducted by DOT and others have proven that high-mounted taillights are more visible and reduce the chances of rear-end collisions. Yet a regulation exists which limits the height of taillights to a point well below eye level. The government seems to be telling the automakers, "This is what you should be doing, but we won't let you do it."

In this sense, the car of the future will probably be as much a response to legislation as it is an engineering exercise in solving some tough problems.

Volkswagen Auto 2000

Like the RSV, the Auto 2000 was cosponsored by the government. This time, it was the German government collaborating with VW.

It's interesting to note the philosophical differences in approach between the WV car and the DOT car. The mandates are the same in either case: build a car that will be safe, economical and affordable, and have a social conscience, too.

The crushable box sections of the Auto 2000 are similar to those of the RSV, as are the passive safety belts. But the Auto 2000 doesn't use air bags. Instead, VW concentrated on "active" safety systems like the antilockup braking system and an aggressive suspension system that would aid a driver in avoiding an accident rather than trying to protect him after a collision.

After driving both vehicles, the difference in philosophy is quite apparent. The RSV's steering is heavy, unresponsive and generally not pleasant at all to drive. While it does give you a sense of invulnerability, I don't think it's the sort

of car anyone would really buy. The Auto 2000, on the other hand, is a fully integrated car. It handles well, responds quickly and surrounds you with a pleasant environment. Ergonomically, it's thought out much better. In a sense, it's a more realistic approach and a more accurate guess at what an advance car will be like.

The engine and transmission were given the same amount of attention as the safety aspects and the suspension. The car can be equipped with either a 1.1-liter, three-cylinder, turbocharged diesel or a 1.2-liter, four-cylinder, fuel-injected gasoline engine fitted with a mechanically driven supercharger. The one we drove had the gasoline motor.

The diesel engine is a direct port-injection type rather than the prechamber types that are currently being produced. The problem of excessive noise from the direct-injection motor was solved by enclosing the engine in a soundproof box. Direct injection is about 15 percent more fuel efficient than the prechamber variety.

The transmission system has a stop/start device which automatically kills the engine when you stop for a traffic light and restarts when you touch the gas pedal. The flywheel has a clutch on either side and continues to spin at around 850 rpm while the motor is stopped. This lessens the demand on the starter motor in the stop/start driving mode.

In an urban cycle the diesel engine yields 65 mpg and 71.3 mpg at a steady 56 mph. At 75 mph, fuel economy goes down to 48 mpg. Figures for the gasoline motor aren't completed yet, but they should be slightly less than that.

GM's coal burner

As much as we moan about the price of gasoline, it's still the cheapest and most readily available fuel. Compared to milk at \$3 per gallon or even Gatorade at \$6.67 per gallon, gasoline at \$1.40 per gallon is frivolously cheap and will continue to be the fuel of choice for a good many years to come. But that doesn't mean that other fuels couldn't be utilized for "specialized" cars in the future.

General Motors, for instance, has built a coal-burning turbine car. It uses a modified Automotive Gas Turbine (AGT) motor which uses a finely ground and specially formulated powdered coal as the fuel. The coal is stored in a plastic box equipped with a vibrating device and an air blower which feeds the coal to the engine.

There are a few problems that must still be solved before this engine sees production. First is the problem of ash content in the coal and second is the

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problem of efficiency. Ash, the noncombustible material in coal, basically clogs up the works in the finely machined tolerances of the gas turbines. Right now, the best available coal has a two percent ash content. To make the engine as durable as a conventional gas motor, the ash content has to be reduced to 1/2 of one percent.

Efficiency at the present state of the art can't be increased due to the amount of heat generated by an AGT. Essentially, the hotter a turbine works, the more efficient it is. This is not a problem with aviation turbines because of the low ambient temperature. But land-locked turbines have to live in a hotter environment.

According to Albert Bell, GM's director of AGT research, the use of ceramic components would allow much hotter operation and a great increase in efficiency. Low-ash coal and ceramics technology capable of making the AGT a real contender are not too far away.

As installed in an Eldorado test vehicle, the turbine motor will run for 6,500 miles on a ton of coal—which GM buys for \$86 per ton. But before you grab your checkbook, the asking price of the motor is about the same as a condo on Pebble Beach.

Bell predicts—with all things being equal, such as volume production of the turbine and a distribution system for the powdered coal—that it would cost about half the price per BTU compared to gasoline.

When the tap finally goes stone dry, it's at least comforting to know GM will have *something* for us to drive.

Alternate fuels

Other energy sources, such as hydrogen, biomass and electricity, are currently too expensive or inefficient for large-scale use. The manufacturing of hydrogen at present results in a net energy loss. That field needs a major breakthrough, which probably won't come for decades.

Biomass—alcohol products made from surplus agricultural products and garbage—is too expensive and couldn't support large-scale use. Even if every available acre of usable land were devoted to biomass fuel, it could only supply a fraction of world use.

And with electric power, a big breakthrough is needed in battery technology. Lead-acid batteries are inefficient, don't have enough energy density and are too heavy; there isn't even enough lead in the world to go around. Electric cars are, at best, limited to specialized vehicles, not family cars.

Ford's compressed gas

Ford also has an alternate for the gasoline engine. It's a car that runs on
(Please turn to page 120)

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TOMORROW'S CARS

(Continued from page 119)

compressed natural gas (CNG). With a few modifications to its existing 1.6-liter transverse Escort motor and the addition of compressed-gas tanks, Ford can free you from your gas station.

The distribution system is already in place and as close as your gas range. Plans are already underway to manufacture and sell gas compressors which can be installed in your house. Hook the compressor up to your gas line, plug your car into the compressor and you're just about self-sufficient.

The problem, due to tank size, is that your range on wheels is limited to about 210 miles round trip. When installed in an EXP you'll get the gasoline equivalent of 32 mpg in city driving, but for 25 percent less cost. Currently a compressor costs close to \$3,000.

A car running on CNG performs and handles just as well as a gasoline-powered car and the whole system is a genuine near-future possibility.

Electronic controls

With the advent of computerized engine controls, the car became a very

sophisticated piece of equipment. The most powerful car computer extant is GM's 3C unit, which controls virtually every engine function. And yet, only a third of its capability is being utilized. The rest of it is essentially asleep. And it may stay asleep because Ford seems to be leading the way in electronic gadgetry.

On a recent visit to Ford we got a look at a dash-mounted CRT with a touch-screen control. Touch the menu and you come up with all the radio controls displayed. Touch it again and the climate controls are displayed. And if you want to see where you are, touch the screen and you get a map of your area, with the location of the car indicated by a marker. The map locator is in contact with a navigational satellite to keep you from going astray.

Ford also has a hand-held transmitter which will open the trunk, pop open the door locks, sound the horn, turn on your headlights and raise the antenna—all of this from 200 feet away. The coded pulse necessary for this operation has several hundred thousand combinations so the chances of someone else's transmitter opening your car are remote.

As if that weren't enough, Ford's electronics people have developed voice-activated controls. Just speak into the steering wheel hub and you can turn on your lights, raise the antenna or open the trunk. The possibilities of the system are limitless. The next step, of course, is having the car talk back and maybe give you an argument if you try to drive with low tire pressure or a low oil level.

The first major step in that direction will have to be in multiplex wiring. All this wizardry requires miles of wiring if conventional circuitry is used. But multiplexing, where one single wire carries all the messages by means of encoders and decoders, will reduce the size of a wiring harness to more manageable levels.

The only stumbling block to multiplexing right now is the cost of the coders compared to conventional on/off switches. But that's a problem that volume production can easily solve.

Beyond the horizon

The car of the future, then, will be a lot like the car of the present—only more economical and run on a variety of economically feasible fuels. It may evolve into a fleet of specialized vehicles for specific tasks. It will also have a higher concentration of advanced technologies, some borrowed from other fields and some developed specifically for the automobile. If anything, the car of the future will handle better, be safer and be endlessly entertaining. Personally, I can't wait.

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PREFINISHED FLOORING (Continued from page 103)

space between new flooring and walls to permit expansion. This space will later be concealed when the baseboard and base shoe are replaced.

For parquet, square or rectangular units, snap perpendicular layout lines at the center of the room or at the principal viewing point.

To lay strips, face-nail the first row on the guideline with steel cut nails or 8d threaded flooring nails set 12 to 16 in. apart. Then, drive nails through the tongue at a 45° angle with the same spacing and set the heads. This technique is called *blind nailing*. Nailing closer than 3 in. from the end of strips may cause splitting.

Slip the groove of a second-row strip over the tongue of the flooring already in place. Tap the edge of the new piece to get the seam tight, using a wood block to protect the tongue. Blind-nail the second and successive rows.

Lay out several rows at a time. Strips are cut to random lengths and

the seams (joints) formed by end-butts should not be closer than 6 in. in adjacent rows. The last strip in a row will have to be cut for fit.

Continue nailing the strips row by row, checking occasionally to make sure rows are running parallel to the wall opposite the starting point. Any midcourse corrections should be gradual.

A flooring nailer, which is generally available through rental outlets, will speed up the work on interior rows.

As you get close to the opposite wall, you may have room only to nail into the end tongues of strips. You can rip off the tongue from the next-to-last row to gain maneuvering space for slipping the last row into position. Strips for the last row may have to be ripped to fit. They will be face-nailed.

To complete the installation, replace all base moldings. Set and fill all face nails.—*B.B.*



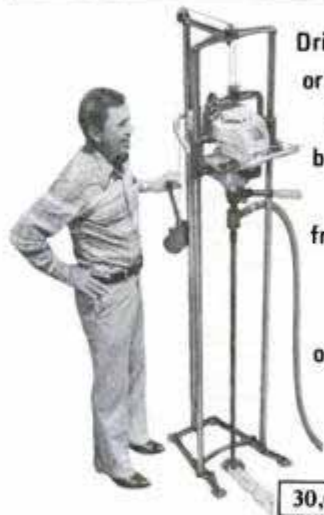
After nailing down the first couple of rows by hand, you can switch to a nailing machine that drives and sets barbed staples with one blow of a mallet (above, left). Minor layout adjustments can be made by planing flooring edges or by spacing adjacent rows with a putty knife blade to spread them slightly. As you approach the opposite wall, you run out of room for using the nailer and have to set the last few rows by hand (above, right).



The first and last rows of flooring are face-nailed. Use wax filler to conceal the nailheads (above, left). If room has an exterior door or if floor surface changes from one room to the next, install a saddle in the doorway (above, right). We found an oak saddle with grooves for seating vinyl weatherstripping. After cutting the saddle to the correct size, it was face-nailed in place. The weatherstripping, which was tapped in place with a mallet, conceals the nailheads. To accommodate the thickness of the saddle plus the new flooring, the door bottom was trimmed with a bevel edge to suit the angle of the new saddle.



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PICK THE RIGHT ADHESIVE

(Continued from page 107)

to a similar surface. Recently, a new version (see *Newest Types of Adhesives*, page 106) was developed for porous surfaces.

Cyanoacrylates set by reacting with vapor in the air: They don't need oxygen. That's why they can seal your fingers together very quickly. Your skin is constantly producing moisture. This reaction with vapor also explains why a tiny container of cyanoacrylate, left open, is soon useless.

You need only one drop of cyanoacry-

late per square inch. When the patch covers less than a square inch—say, a diamond remounted in a platinum setting, or two halves of a decorative button—one drop is too much. A joint filled with too much of the stuff will fail faster than one touched with too little. So look for a package with a pin-like applicator that eases application of amounts less than one drop.

Coming soon is a blister pack that includes cyanoacrylate and acetone thinner. Use the acetone (or nail polish remover) to rebreak a bad bond or to unfasten fingers glued fast.

Acrylic resins are also newcomers to

the field (see page 106). They're sold in two-vial blister packs which house a primer and an adhesive. You apply the primer to one surface and the adhesive to the other. When you press the surfaces together, setting action begins instantly. After 60 seconds you may be able to let go.

Urethane acrylic resins cure without oxygen, which is why they're called anaerobics. They're best used to glue nonporous surfaces in very tight gapless fits. Glass to glass, metal to metal, or metal to glass are typical applications. Anaerobics don't hold as well for

(Please turn to page 124)

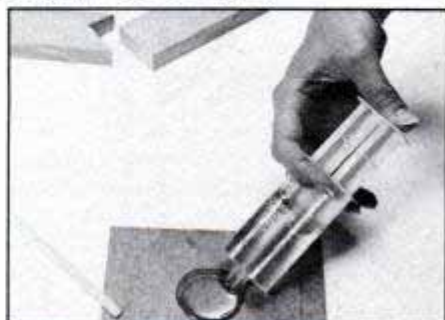
USING THE RIGHT APPLICATOR TO APPLY THE RIGHT AMOUNT OF GLUE



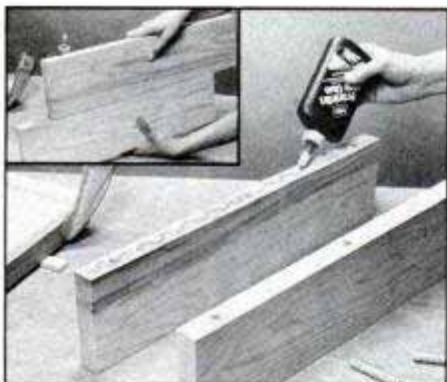
A brush is an ideal tool for coating large surfaces, such as wallpaper, with a thin, even coat of adhesive. Brushes are also handy for large woodworking jobs.



Use a roller to apply contact-bond adhesive to plastic laminate. Apply a thin, even glue coat by rolling it on in overlapping passes, then evening out the glue.



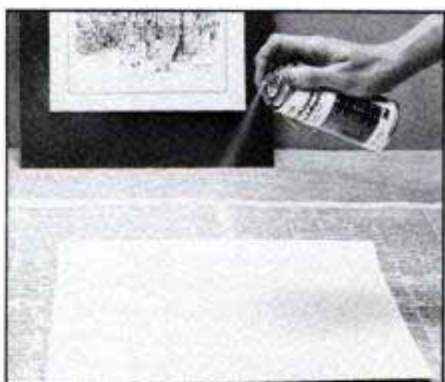
The plunger on this epoxy-cement applicator forces out proper amounts of hardener and resin. Use this type of glue to join parts that can't be clamped.



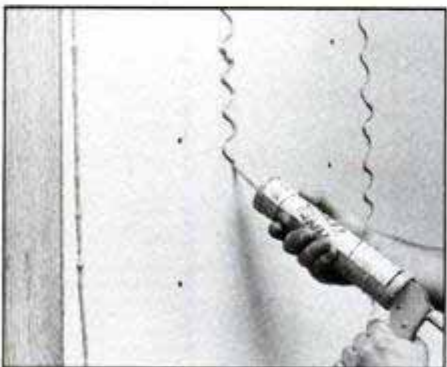
This hide glue and many other woodworking glues come in plastic bottles with spouts. Apply zigzag glue bead and rub parts together to spread glue.



A notched trowel spreads adhesive for fastening ceramic tile and other material. Use a trowel with properly sized notches, as specified on the adhesive container.



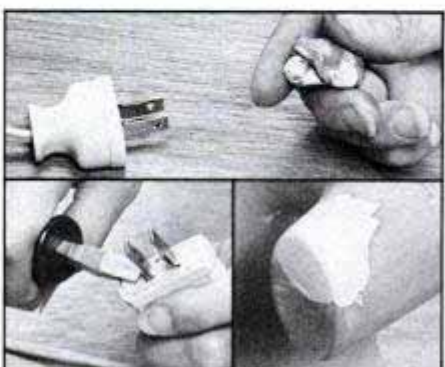
Spray adhesive bonds paper, such as a print, to a backing without penetrating the front. To bond, spray both surfaces, dry 5 minutes and join them.



This panel adhesive and other construction glues are often packaged in cartridges. Apply them with a caulking gun, laying out beads in vertical zigzags.



A needle-nose glue injector puts glue in tight places. It can glue a chair rail, as here, or a veneer blister, for example. It's from Constantine, Bronx, N.Y.



Knead the two-part epoxy sticks together and mold them, like clay, into shape. Adhesive provides electrical insulation (left), repairs cracked handle (right).

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HOW TO PICK THE RIGHT ADHESIVE (Continued from page 122)

broken pieces from which tiny particles may be missing.

Neoprenes are rarely labeled as such. However, you'll be able to identify them from their instructions for use. Apply the adhesive to one of the mating

surfaces, and press on the part you want to glue. Then pull the surfaces apart as you would open a hinge. Wait the number of minutes noted in the instructions (usually about eight), and press the parts together again, this

time for keeps. Use neoprenes for metal or tile repairs.

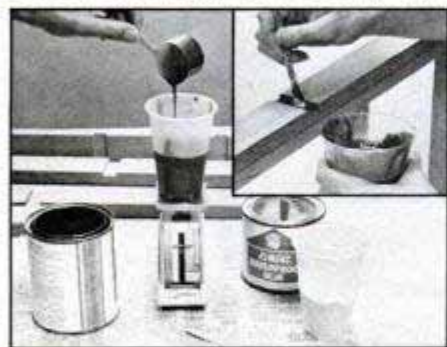
Silicones are sealants. They have some adhesive properties, but high strength is not one of them, since silicones tend to remain rubbery. When cured, however, they do form a dishwasher-safe bond on china. They're less effective on glass stemware.

Contact-bond cements, which are used almost exclusively for laminating and veneering, are available in three types: flammable, nonflammable and water-based acrylic. Before the Consumer Product Safety Commission required a change in 1978, the flammable types had a low flash, making them dangerous to use in a poorly ventilated room. While you should never light a match or smoke in the presence of flammable cements, and should ventilate the room in which you're working, the flash point is now within levels considered safe by the CPSC. Both the flammable and nonflammable types are clearly labeled.

Despite its flammability, this first type of contact-bond cement is, by volume, the most popular for two reasons: It dries to a tack-free surface fast (the

(Please turn to page 128)

SIX GLUE TRICKS THAT PROS USE



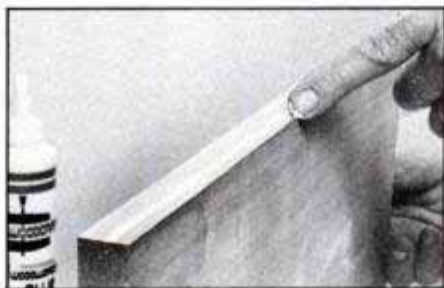
1 When working with resorcinol, weigh the parts on any small scale to ensure mixing the proper amounts of liquid resin and powdered catalyst. If you're using a small amount of glue, mix it in a disposable cup for easy cleanup. Don't use resorcinol in direct sunlight, as the glue will absorb the sun's heat and set too quickly. Use a brush to apply an even coat on large surfaces (inset).



2 These clamp cushions, used to protect a workpiece when clamping parts, are handy because they don't fall out of place when the clamp is loosened slightly. The cushions have holes bored a bit larger than the clamp jaws' diameter. The jaws slip into the cushion holes. In use, the cushions stay in place until the clamp is loosened to a greater degree than the depth of the cushion hole.



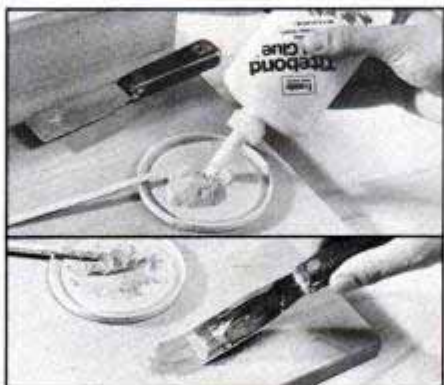
3 Cabinetmakers often use pinch dogs to pull joints together without clamping. Drive a dog in place straddling the joint. These are from Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461.



4 To avoid excess glue squeeze-out on hard-to-clean inside joints, run your finger along the inside edge after spreading the glue. This will wipe off potential squeeze-out before you join the parts.



5 To remove glue squeeze-out from a piece you plan to paint, wipe off excess glue with a rag. Don't do this on wood that will be given a stain finish. The wiping pressure will force some of the wet glue into the wood pores, preventing the stain from penetrating. Instead, let the glue set until it is dry. Then shave it off with a sharp chisel. This leaves a clean wood surface.



6 Sander dust from a wood project mixed with glue makes a matching wood filler for gouges in that piece. After mixing (top), work the mix into the gouge with a putty knife (bottom). Don't make the mix too wet with dark woods; this tends to make the patch too dark. Dust from a belt sander works quite well.

MANUFACTURERS LIST

Below is a partial list of companies producing adhesives. "Household" refers to workshop and home-repair glues—white glue, epoxies and so on. "Construction" describes cartridge adhesives applied with a caulking gun on such surfaces as wall paneling and subflooring. "Surfaces" is the title given to cements for floor tile, wall tile, wall covering, plastic laminates and so on.

Full line: Household, construction, surfaces

Borden Inc., Box 16700, Columbus, Ohio 43215.
Devcon Corp., Endicott St., Danvers, Mass. 01923.
Dow Corning Corp., Midland, Mich. 48640.
Franklin Chemical Industries, 2020 Bruck, Columbus, Ohio 43207.
H.B. Fuller Co., 315 South Hicks Rd., Palatine, Ill. 60067.
Leech Products, Box 2147, Hutchinson, Kan. 67501.
Lucas Group (Tiger Grip adhesives), 1370 Ontario St., Cleveland, Ohio 44113.
Macco Adhesives, SCM Corp., 900 Union Commerce Building, Cleveland, Ohio 44115.
Miracle Adhesives Corp., 250 Pettit Ave., Bellmore, N.Y. 11710.
Roberts Consolidated Industries (Weldwood adhesives), 600 North Baldwin Park Blvd., City of Industry, Calif. 91749.
Wilhold Glues, 8707 Millergrove Dr., Santa Fe Springs, Calif. 90670.

Household construction

3M Co., Household and Hardware Div., 3M Center, St. Paul, Minn. 55101.
Household
Krazy Glue Inc., 53 West 23rd St., New York, N.Y. 10010.
Loctite Corp. (Duro adhesives), 4450 Cranwood Ct., Cleveland, Ohio 44128.
Magic American Chemical Corp., 23700 Mercantile Ave., Detroit, Mich. 48209.
Permabond International, 480 South Dean St., Englewood, N.J. 07631.
Ross Chemical Co., 8485 Melville St., Detroit, Mich. 48209.
Woodhill Permatex, Box 7183, Cleveland, Ohio 44128.

Construction

Dap Inc., Box 277, Dayton, Ohio 45401.
Gold Bond Building Products, 2001 Rexford Rd., Charlotte, N.C. 28211

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Evans Adhesive Corp., 925 West Henderson, Columbus, Ohio 43214.

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

PICK THE RIGHT ADHESIVE

(Continued from page 124)

point at which panels can be laminated) and it's cheapest of the three types.

The second variety is made nonflammable with additives. It also becomes tack-free quickly and requires ventilation during use. Its biggest drawback is its cost: This type is the most costly of the three. The last type, a water-based acrylic, takes longer to reach a tack-free state and is medium priced. The water-based variety is also the safest to use.

Construction adhesives are usually packed in cartridges designed for use in caulking guns. They fall into two general groups: solvent-based and water-based. The solvent-based category includes neoprenes and styrene butadienes. Neoprenes are more expensive, but many professional builders consider them to be the cream of the crop.

Water-based adhesives also include two major types: acrylics and PVAs. Like other water-based glues, they set slowly, but their performance is high. It's unlikely you'll find any of these labeled by chemical category, but price is a guide. Construction adhesives secure wall paneling and subflooring.

Other varieties

Missing from the chart is an entire group of household adhesives, usually sold in quantities of a gallon or more. These glues are used for putting down carpet, resilient floor tile, ceramic tile, wall tile, acoustical ceiling tile and wood parquet flooring, among other things. While properties differ from brand to brand, performance of established brands (including those packaged by floorcovering and tile makers) is uniformly high. None, except the ceramic wall-tile adhesives, are unusually strong, since great strength isn't a particular requirement. In fact, a certain resiliency in these adhesives, often labeled "cements," is beneficial.

Also not included in the chart are older materials, such as the caseins, rarely found today, and "hot glues," chalk-shaped sticks that are heated in glue guns. Improved PVAs and aliphatics—easier to use on wood projects—have stolen much of hot glue's thunder. But the hot glues often prove invaluable in special gluing situations when clamping is impossible.

For anyone with a working knowledge of chemistry, glues aren't difficult to mix and package. Because of this, a good many "back-yard" companies have sprung up in the United States. Their locally made and distributed products may be top rate, or they may give you nothing but problems. Sticking with known brand-name materials—and following directions—will help you avoid no-stick situations. **PM**

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The FAA recently passed laws making it legal for anyone to fly inexpensive, personal ultralight airplanes. Here's where to get all the facts before you buy or fly. The rest is up to you!

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The "Vector 610" offers thrilling, open-air flying.

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See everything from economical go-kart engined "air-tourers," to more powerful, snowmobile-engined, high performance machines. The pages of *Ultralight Aircraft* are jam-packed with the details of all the new planes. All sell for a mere fraction of the cost of a "conventional" airplane. None need to be registered nor does the pilot need a license to fly them! Most require no special tools or mechanical ability to assemble. All can be folded and stored at home!

Ultralights enable you to get into and out of remote areas - where all the good hunting and fishing areas, everyone talks about, are located. Many are adaptable to pontoons for "off-water" operation. You can even stow gear and fish from your seat! This comprehensive manual reveals models you didn't know existed, or won't find anywhere else.

Get your ultralight FREE and make money while you're having fun. There's a great need for sales reps - people who fly around and show their friends and others how great ultralight flying really is. You could actually "write-off" your ultralight on your tax return!

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This is not a theory book! *Ultralight Aircraft* contains only practical "how-to" information that you can easily use. Just picture yourself in the seat of your own ultralight as you shove-in the throttle and takeoff! This authoritative, up-to-date book gives you all the information you need to make intelligent decisions. It's designed to inspire and guide you every step of the way. Let it help you make your flying dreams come true.

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NEW LITTLE KIT PLANES (Continued from page 88)



First amphibious ultralight, Diehl's XTC (pronounced "ecstasy" if you say it fast) has wheels for land use that retract into hull-like fuselage for quick conversion to water operation. The unusual twin-tailed, canard-winged craft has three-axis control, takes engines from 30 to 40 hp, requires no license. Kit will sell for about \$6,000.



At 250 pounds, sporty Mohawk was classed as true airplane, now is license-free. Twin-engine, twin-tailed, enclosed-cabin craft can be built from \$100 plans for only \$3,500.

not constitute a weight penalty. One curious effect of the new FAA ruling is that some ultralights too heavy to be foot-launchable—the old criterion for license-free operation—will now find themselves exempt from licensing under the more liberal weight provision.

Some makers, in an attempt to cover all bases, are going after both licensed and unlicensed buyers. The new Swallow, for example, is offered in a 220-pound, 60-mph version for untrained neophytes and in a more potent 290-pound, 70-mph model for the licensed set. Two-place ultralights, though requiring at least one licensed occupant, are also gaining in popularity. These include Rotec's Rally 3, Eipper's MX II, Gemini's Hummingbird and Eastern Ultralights' Snooper.

Slicker looks, controls

Now that ultralights don't have to pretend they aren't airplanes, they're rapidly shedding the primitive, stick-and-fabric image inherited from hang gliders. Sleek new cockpit pods—some affording full pilot enclosure—are replacing the precarious-looking open-air perches of earlier days.

Tailless Ultavia uses nose-mounted canard for pitch control, spoilerons for roll, wingtip rudders for yaw. Spoilerons can also be deployed collectively for precise glide control—a very sophisticated arrangement. Fuselage fairing has steerable nose wheel, instrument panel. Kit is \$4,495.



In some models, the old wire-braced, bird-cage look is giving way to rigid, strut-braced wings. And diehard wind surfers who once vowed they'd never give up weight shift for control are now happily forgoing body English for the more civilized joystick and rudder pedals of conventional aircraft.

Today, almost all makers offer some form of full three-axis control (independent control of pitch, roll and yaw). Some employ the traditional rudder, elevator and aileron arrangement, while others favor such exotic alternatives as tail-first canards (nose-mounted elevators), ruddervators (combination rudders and elevators) and spoilerons (spoilers acting as ailerons). Some even give you wing flaps for added lift on landings and takeoffs, and speed brakes for precise glide-path control. (For a more detailed discussion of ultralight control systems, see *14 New Ultralights You Can Build From Kits*, page 94, May '82.)

As an example of the growing sophistication in ultralights, the new Vector 610, an updated version of the earlier 600 model, has an ingenious dual-mode joystick that gives the pilot a

choice of two different control systems. In one mode, the rudder, elevator and spoileron functions are all linked to the stick. This gives a smooth, automatically coordinated response (rudders and spoilerons acting together)—a one-control system that's easy for the novice to master.

In the second mode, the rudder function is transferred to foot pedals. This allows the more advanced pilot to cross-control (rudders and spoilerons opposed) for negotiating tricky cross-wind landings and takeoffs. The basic Vector 610 kit, with 22-hp engine, is \$4,890. The dual-mode control will be sold as an optional extra.

First aerobatic ultralight

Until recently, if you talked about doing loops and rolls in an ultralight, you'd have your sanity questioned. Not anymore. Now along comes Eipper with its new MX Super, the first ultralight specifically designed—and publicly promoted—for aerobatics.

The MX Super (MX stands for multi-axis) is essentially a souped-up version of Eipper's popular Quicksilver MX, with a stouter airframe, heftier powerplant (42 hp instead of 30) and shorter wings for more nimble maneuvering. Though not exactly a Pitts Special, it can dazzle you with daring corkscrew rolls, graceful wingovers, hammerhead stalls, heart-stopping tail slides, spins and most other aerial gymnastics generally associated with highly specialized stunt planes.

Aware that all this wild stuff may be a bit beyond the novice pilot, Eipper will initially market the MX Super as a licensed aircraft only. The kit is expected to be about \$6,500. Later, an unlicensed version may be made available to pilots who can demonstrate sufficient skill to cope with such violent antics.

Parachutes for ultralights

Bailing out of a disabled ultralight poses a special problem. Because most mishaps occur at very low altitudes, the pilot has little time to get safely clear of his craft in the usual manner. One clever answer is a ballistically deployed parachute developed by Pioneer International, the company that makes recovery chutes for the space shuttle's booster rockets.

In the Pioneer system, the chute attaches to the airframe, rather than the occupant, and recovers both the plane and pilot together. This lessens the danger of a botched-up bailout and also provides a surrounding structure for added impact protection.

Mounted in a mortar-like canister on top of the wing, the chute is ejected by an explosive charge, opens fully within

(Please turn to page 132)



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NEW LITTLE KIT PLANES

(Continued from page 131)

1.5 seconds, and is effective at altitudes as low as 150 feet. The system was designed for use on Pioneer's new FlightStar, but can be adapted to fit other ultralight makes. It will sell for \$995 as an optional add-on. The FlightStar, a 30-hp, three-axis-control, license-free craft, will be kit-priced at about \$7,333.

For land or water

You can add pontoons to most ultralights these days, but you have to bolt them on in place of the wheels, a time-consuming job. Now Sealord has come up with amphibious floats that eliminate the changeover. They contain built-in wheels that can be hydraulically lowered for use on land or retracted for use on water. They're expected to sell for \$1,600 to \$2,000 and will fit most ultralights. Now you can take off from a dirt strip and land on a pond, or vice versa, by flicking a switch! **FM**

ULTRALIGHT SOURCES

- **Aeroplane XP:** Ultralight Flying Machines of Kentucky, 2700 Freys Hill Rd., Louisville, Ky. 40222.
- **Falcon:** American Aerolights Inc., 700 Comanche N.E., Albuquerque, N.M. 87107.
- **FlightStar:** Flight Designs Div., Pioneer International Corp., Box 631, Pioneer Industrial Park, Manchester, Conn. 06040.
- **Hawk:** CGS Aviation, 4252 Pearl Rd., Cleveland, Ohio 44109; also Twin Star Aviation, 1039 Center Rd., Conneaut, Ohio 44030.
- **Hummer:** Maxair Sports, 32 Water St., Glen Rock, Pa. 17327 (info pack \$6).
- **Hummingbird:** Gemini International Inc., 75 Bank St., No. 13, Sparks, Nev. 89431.
- **Invader:** Ultra Efficient Products, 1637 Seventh St., Sarasota, Fla. 33577.
- **Kasperwing:** Cascade Ultralites Inc., 1490 19th Ave. N.W., Issaquah, Wash. 98027 (info pack \$5).
- **Koib UltraStar:** Koib Co. Inc., R.D. 3, Box 38, Phoenixville, Pa. 19460 (info pack \$2).
- **Mitchell B-10:** Mitchell Aircraft Corp., 1900 South Newcomb, Porterville, Calif. 93257 (info pack \$7).
- **Mohawk:** Warpath Aviation Corp., Box 225, Piggott, Ark. 72454.
- **MX Super and MX II:** Eipper Aircraft Inc., 1080 Linda Vista Dr., San Marcos, Calif. 92069 (info pack \$4).
- **Pterodactyl Ptiger:** Pterodactyl Ltd., Box 191, Watsonville, Calif. 95076 (info pack \$5).
- **Rotec Rally 3:** Rotec Engineering Inc., Box 124, Duncanville, Tex. 75116 (info pack \$5).
- **Scout:** Topa Aircraft Co., 1401 Offshore, Oxnard, Calif. 93033.
- **Sealord floats:** Composite Industries Inc., Flight Systems Div., Box 8452, 1600 South Division Ave., Grand Rapids, Mich. 49507.
- **Snoop:** Eastern Ultralights, Box 424, Chatsworth, N.J. 08019.
- **Swallow:** Swallow AeroPlane Co., Box 833, Sparta, N.J. 07871 (info pack \$3).
- **Ultavia:** Ultavia Aircraft Inc., Las Vegas Municipal Airport, Las Vegas, N.M. 87701.
- **Vampire:** American Microflight Inc., 8225 East Montebello, Scottsdale, Ariz. 85253.
- **Vector 610:** Vector Aircraft Corp., Turners Falls Airport, Industrial Park, Box 304, Turners Falls, Mass. 01376 (info pack \$5).
- **Witch:** Greenwood Aircraft Inc., Box 401, Alexandria, Minn. 56308.
- **XTC:** Diehl Aero-Nautical, 1855 North Elm, Jenks, Okla. 74037.

SCROLL SAW

(Continued from page 99)

start with a few practice sessions on scrap. Remember to feed slowly while guiding the work so the blade's side is always tangent to the cutting line. The feed pressure should always be directed forward, into the blade's teeth, never into the side of the blade. When a curved cutting line includes intricate detours, such as tight turns, it is generally achieved by making a continuous pass to cut large curves first, bypassing the tight spots. When the large waste pieces have been cut off, the smaller cuts can be tackled separately.

When you must execute a very tight curve, keep the work advancing just fast enough so the blade is cutting into the material continuously. Don't stop advancing the work while turning; this will usually cause the blade to twist and possibly break.

Acute inside corners are rarely cut in a continuous pass; instead, these are accomplished in two passes, as illustrated. This procedure is quite simple: The initial pass is made directly into the corner. The blade is then backtracked to permit rerouting it to the second line and the cut is continued. When the waste has been removed, return to the corner to make the final cut and clean out the waste.

Straight cuts: Straight freehand cutting is done best with a wide blade. However, if right-angle inside or outside corners are involved, such a blade will not permit you to make the turn in a small radius. To obtain a sharp outside corner, you need only make a reverse loop into the waste area, then lead directly into the right-angle line, as illustrated. For an inside corner, make a wide turn, then make two cuts to clean out the corner.

Internal cuts: A main feature of the scroll saw is its ability to make internal cuts—cuts that start and end within the material—without a lead-in cut from the outside edge. The blade is inserted through a prebored hole in the waste area and then tightened in the chuck. Sometimes a hole or holes can be dimensioned and positioned so they form part of the pattern, thus eliminating some curve cutting. However, when the bored hole serves only to provide blade entry, it should be bored away from the cutting line. This will enable you to see the path the blade takes and permits steering (tracking) the work close to the cutting line.

Coped joints: A coped molding joint is one in which the second piece in an inside corner is cut with a matching profile to abut the first tightly. The first step is to cut a straight 45° miter on the end of the second piece. This reveals the cross sectional contour on the face

of the molding. The scroll saw is then used to make a straight 90° cut, following the shape along the top edge.

Compound cuts: Compound-angle cuts can be made on the scroll saw, provided the thickness of the stock is not greater than the saw's capacity. First, you must be careful to preserve the waste piece from the preceding cut and tape it back into its original position. Next, draw the outline on the second plane and make the cut. Repeat again if necessary. **Caution:** Apply tape securely and make certain it is perfectly flat. Masking tape has a tendency to catch on the saw's table.

Angle sawing: This is a novel method for making raised letters, or for building up stock for lathe turning blanks or carved projects, such as model boat hulls and the like. To make a raised letter, an internal bevel cut is made with the table set at a slight tilt. The space left by the saw kerf will allow the inside piece to jam tight when it is pushed up through the stock from which it was cut.

The amount that the piece will telescope depends upon the width of the saw-blade kerf and the degree of bevel, as well as the thickness of the stock. These are variables, but a good starting point for a test would be to set the table for a 3° bevel. In the example shown, the bevel worked out to 3½°. The blade used was .020 in. thick, .070 in. wide, 32 TPI. The stock was ¾ in. thick. The resultant letter projection was ¼ in.

Note: It is essential that the work always be kept on the same side of the blade. If it is swung to the other side, the bevel angle will change, thus ruining the piece.

A slight departure was employed in angle-sawing the boat hull illustrated. Instead of boring one blade entry hole for each section to be cut, two holes were bored in the back corners. The table was tilted 4° left to make the series of cuts on the right side, from the back to the point. The table was then tilted 4° right to make the left side cuts. Finally, cuts across the back from hole to hole severed the piece.

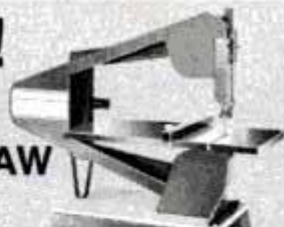
The advantage of this approach, in lieu of using only a single blade entry hole for each section, was that it permitted use of a coarse 10-TPI blade (.020 in. thick, .110 in. wide) for easy cutting of the ¾-in.-thick hardwood stock. The fact that the sharp turn at the point was avoided made this feasible.

This article covers the basics of working with a scroll saw—with some advanced techniques thrown in, as well. No matter what others may tell you, the only way to become a craftsman is through practice. In Part 2 next month, we'll share some secrets that will make this tool even more valuable to you as a craftsman. **PM**

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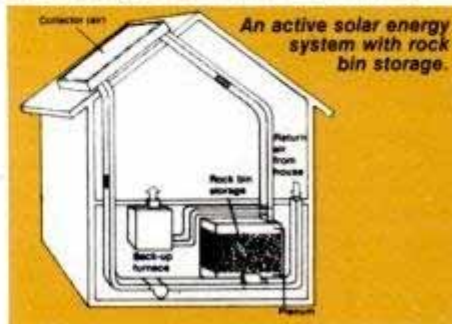
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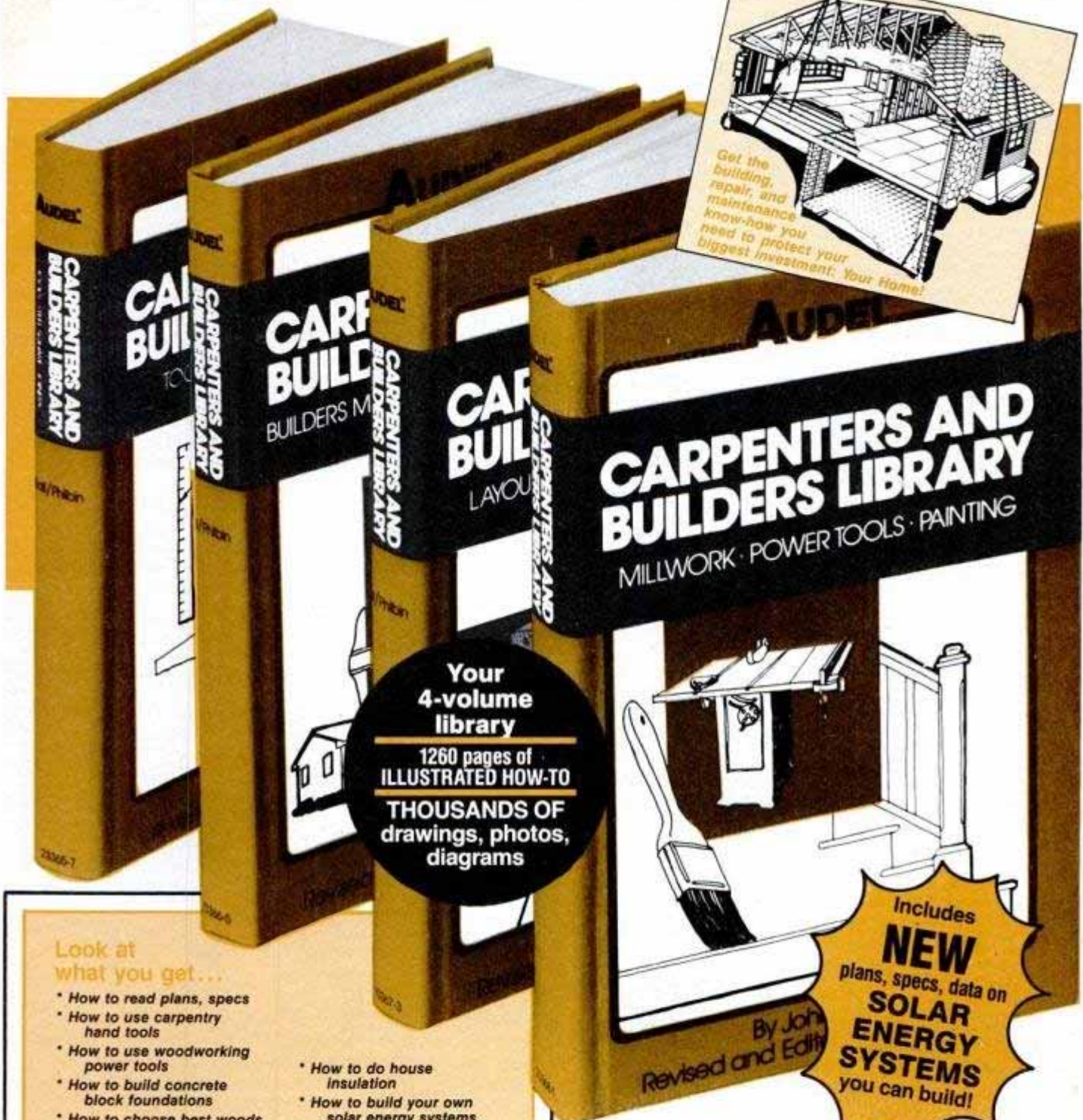
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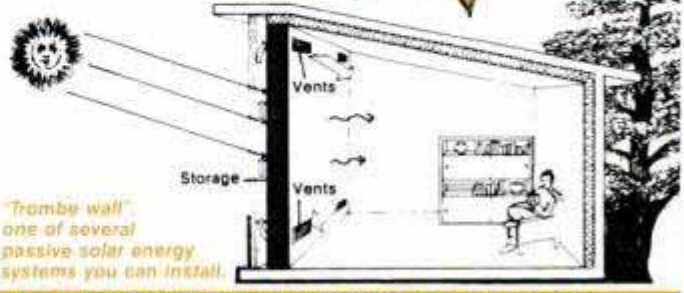
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SOLAR SYSTEMS

(Continued from page 95)

from the surrounding air. As such, it acts like an air conditioner. For this reason, the device must be installed in a well-ventilated area. If it is placed in a confined room, the surrounding air will quickly become cooled to the point where the heat pump no longer operates efficiently.

If, at any point, the surrounding air temperature drops below 40° F., the heat pump will shut off and the electric resistance heating element in the water tank will take over. This element functions only as a last resort.

Unlike the tempering tanks, the solar collectors do not have to be manually drained when the cold weather arrives. This is handled automatically by means of a drain-down valve (X) that spans both the inflow and outflow lines (S and W, respectively) to the collector. The drain-down valve is regulated by another sensor (T) located at the bottom on the bottom side of the roof collectors. When the water temperature inside the panels drops to 45° F., the drain-down valve immediately blocks water from going up to the collectors and drains what is up there down into the sump pump through plastic tubing (Y).

The final component of the system is

a tempering valve (GG), installed for safety. This device automatically mixes colder water with the hot water before it goes out of the system for home use. The valve operates only when the water heated by the solar collectors, on the hottest days, is too hot to use.

A solar-assisted heat-pump system like this one is an expensive installation. The combination solar water tank and three collectors costs about \$3,100. The heat pump adds another \$1,000 and the pipes, fittings, valves and pipe insulation another \$700.

The tempering tanks, while certainly not as efficient as the collectors, go for about \$350—including the \$100 condensation tray we had made at a local sheet-metal shop. These can be installed with any hot-water tank system. Because the system is manually operated, it also eliminates the need for costly sensors and complex valves.

Both the solar-collector system and the tempering system will save money when it comes to heating water, but don't expect a quick return on your investment, especially with the collector panels and solar tank. However, the current Federal Renewable Energy Source tax credit does change the investment picture substantially. It allows a tax credit of 40 percent of the first \$10,000 spent on materials and

labor for a solar energy installation. Instead of costing \$3,100, the solar collectors and water tank would effectively cost \$1,860.

Unfortunately, the heat pump does not qualify for the tax credit and neither do the tempering tanks because they are not mounted in the direct path of the sun's rays. One way to ease the financial burden is to stretch out your solar investment by installing the system in stages: first the heat pump, then the tempering tanks or solar collectors and solar tank, and ultimately the pipe insulation on the hot-water lines.

Finally, no matter what you plan to do, keep in mind that there is no guarantee that these federal tax credits will be renewed in December 1985. By far, your best money-saving technique is to do the whole installation yourself. By following the installation instructions for the products you buy and the basics of good plumbing (below) you can cut costs drastically.

Plumbing basics

All the copper tubing throughout this system is 3/4-in. diameter, joined by the sweat method. To make the joints you'll need a propane torch, a tubing cutter, solder, flux and either emery paper or coarse steel wool.

Begin by planning your tubing runs

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so they require the minimum amount of tubing and fittings, both of which are expensive. Keep in mind that the system should be designed so all lines pitch slightly down, about 1/4 in. per 4 ft. of run. This allows you to drain the system at a single point for making repairs.

Cut each tubing section to length, using the cutter. Then sand the end where the fitting will go with emery paper or steel wool. Sand the inside of the fitting, as well. This procedure eliminates any foreign matter that could weaken the sweat joint.

Once the mating pieces are clean, apply a generous amount of flux to both and push them together. Then start heating the joint with the torch. The torch flame should be adjusted so that the deep blue part of the flame is about 1 in. long. The torch should be held so the tip of this inner blue flame is just touching the copper.

Leave the flame on the joint for a few seconds, then stretch out a pigtail of solder from the solder roll and touch the joint with it while the flame is still in place. If the copper is hot enough, the solder will melt and be drawn directly into the joint by capillary action. If the solder does not melt instantly, remove it and continue heating the joint; then try again. Once the solder wells out of the joint, remove the flame and let the joint cool for at least one minute.

Keep in mind that you do not have to work from the top of the joint if another position is more convenient. Solder applied to the bottom or side of the joint will be drawn in just as well.

Be extremely careful after soldering to avoid being burned by the copper. The solder may cool and harden enough for the joint to be sound, but copper acts as a heat sink and retains the heat for a long time. If you want to move onto another joint quickly, you can cool the previous one by wrapping it briefly in a wet rag. **PM**

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- American Appliance Mfg. Corp., subsidiary of MorFlo Industries Inc., 18450 South Miles Rd., Cleveland, Ohio 44128 (heat pump, hot-water tank, solar controls, drain-down valve, tempering valve).
- American Olean Tile, Lansdale, Pa. 19446 (ceramic floor tile, Primitive Encore 806).
- George C. Brown & Co., 1730 West Lee, Drawer B, Greensboro, N.C. 27402 (red cedar lumber).
- Everpure Inc., 660 North Blackhawk Dr., Westmont, Ill. 60559 (water filter, kitchen tap).
- Halo Lighting Div., McGraw-Edison Co., 400 Busse Rd., Elk Grove Village, Ill. 60007 (recessed down lighting).
- Masonite Corp., 29 North Wacker Dr., Chicago, Ill. 60606 (redwood paneling, Stuccato ceiling).
- Nomaco Inc., Hershey Dr., Ansonia, Conn. 06401 (water-pipe insulation).
- Solar Components Corp., Box 237, Manchester, N.H. 03105 (30-gal., porcelain-lined tempering tank).
- Springsoft International Inc., 1701 Glenlake Ave., Itasca, Ill. 60143 (water softener).
- Taras Corp., 16591 Milliken Ave., Irvine, Calif. 92714 (brass bypass valve).

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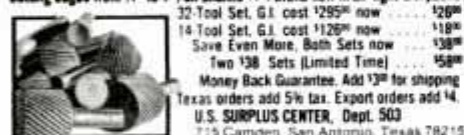
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MOST AMAZING RESCUE

(Continued from page 82)

Florida 737, having been de-iced 45 minutes earlier with a mixture of 40-percent ethylene glycol and 60-percent water, finally received clearance for takeoff. Lifting off far down the 6,870-foot runway, the blue, green and white jetliner barely seemed to climb through the opaque sky. As it started to head due north, following the prescribed departure pattern over the Potomac River, the airliner shuddered as it struggled to gain altitude. Now, with its nose up and tail down at an exaggerated angle, it narrowly cleared two of the bridges spanning the Potomac, 4,000 feet north of the runway.

Air Florida 90 was bearing down directly on the crowded northbound span of the bridge. The plane was literally falling from the sky, a looming figment of a nightmare come true. It struck the bridge directly, shearing the tops off several cars and a truck, ripping through a 180-foot section of railing, then plunging into the freezing water as it broke apart—its tail section separating from the main fuselage by some 200 feet. The fuselage broke through the ice packs to sink into 26 feet of frigid water; the tail section remained afloat.

One witness on the bridge was reported as saying, "It was so loud I couldn't hear myself scream." Another described the crash of the plane as a "swishing noise," followed by deep silence broken only by the idling of the traffic and the rustle of snow.

First report

At 4:04 p.m., Evelyne White of Arlington, Va., heard the news on her citizens band radio, dialed 911 on the telephone and reported to police: "A plane crash, on the 14th St. bridge." The call triggered an immediate response from neighboring fire and police departments, emergency medical units, the city's only icebreaker boat, and even a Coast Guard cutter. The entire Washington area was put on a virtual emergency alert, a condition that was exacerbated some minutes later when D.C.'s usually smooth-running Metro underground system was jolted by a derailment. Arlington communications technician Richard Singer relayed White's report to the National Airport fire department which was told by air traffic controllers that they had no confirmation of a crash. However, they did report that Flight 90 had disappeared from their radar screens.

It was 11 more minutes before Ron Galey of the Interior Department's U.S. Park Police received a call from an air traffic controller that "a 737 had gone down near the 14th St. bridge."

Immediately, Usher and Windsor sprang into action. They loaded their turbine-powered utility helicopter with all the flotation devices they could find and unroped the copter from its moorings. As Galey plowed the launching pad free of snow, the two pushed the Bell 206L-1 LongRanger II out onto the pad. Minutes later, a confirming call from National launched the copter off the pad. Officer Usher, a Vietnam veteran who had been shot down once in the Central Highlands, lifted the helicopter—radio coded "Eagle One"—into what his partner described as "almost whiteout" conditions.

"My initial concern was that the icing on the windshield would give us real problems, but somehow it dissipated," said paramedic Windsor. Visibility was one-half mile, the ceiling was at 300 feet and the slashing snow was so bad that the crew initially had trouble even finding the crash site.

Pilot Usher, calmly coordinating the dual controls of a cyclic control stick and a collective control stick with a twist-grip throttle and with tail rotor control pedals, followed a course along the river to the bridge, some six minutes flying time.

Nothing to see

"When I heard 'airplane crash,' I kept expecting to see mayhem and slaughter," recalls Usher. "I was absolutely shocked to see almost nothing. In fact, our first reaction was: 'Where the hell did that airplane go?'"

"I noticed a large crowd on the D.C. side of the river. But when I hovered low over the water between the two spans [the northbound and southbound crossings], I could see only broken ice where apparently the fuselage had gone through. What I did see, however, at the base of the northbound crossing, was the tail section, sticking up above the water. And there were six people clinging to it."

Also visible was scattered debris from the wreckage—shreds of clothing, luggage, tennis rackets, shoes and torn insulation from the fuselage.

Usher radioed to the National tower that the space between the two spans of the bridge was too narrow for any more than a single helicopter to maneuver. "I was also concerned," says Usher, "that the jet fuel in the water might somehow be ignited, then spread by the rotor wash from our copter."

Only a small helicopter could have maneuvered as adeptly in that confined area. Eagle One was to put Bell's patented "Noda-Matic" rotor suspension to its fullest test. The helicopter's transmission and rotor are mounted on parallel nodal beams which flex in a wave form around points that produce virtually no vibration.

With Windsor harnessed to a seat belt and perched outside the right door on the skid of the copter, Usher hovered low as Windsor threw down life jackets and ring buoys. Then he dropped a rope with a life ring tied at the end. A middle-aged man clinging to the tail remains passed it to Kelly Duncan, a 23-year-old Air Florida stewardess, one of five crew members aboard the flight. Duncan managed to cling to the ring while the helicopter lifted her over the broken ice. Moving between the many trees lining the shore, she was deposited into the waiting arms of people who had set up an emergency treatment station on the sharply sloped banks of the river. From there, she was put on another helicopter and taken to a hospital; her body temperature was so low it did not initially register on the thermometer. Eagle One's race with time was, in part, a race against the devastating effects of hypothermia. In the 32nd waters of the Potomac, crash survivors could not be counted on for more than 30 minutes of consciousness.

Eagle One wheeled back to the sinking tail section once again. This time, Windsor threw two lifelines down to the five remaining survivors. Joseph Stiley, Patricia Felch and Priscilla Tirado grabbed one ring; the other was passed by a man to Bert Hamilton, the late arriving passenger who had trouble finding a parking space earlier.

Slow going

As the helicopter revved its turbine engine to haul its clutching load, it had to slowly and tentatively edge its way across the jagged pieces of ice, towing its crippled and fast-weakening victims. It became all too clear they couldn't sustain their grips.

"It was an incredibly helpless situation," recalls Windsor. "Most of them were too weak or injured to hold on." The only one who did was Joseph Stiley, a 42-year-old professional pilot, who was literally dragged to shore with two fractured legs.

With the remaining survivors barely floating in life vests and rings, and on the edge of losing consciousness, Usher had to resort to skimming the Long-Ranger II over the icy surface, almost scooping them into the waiting clutches of Windsor who could then lift them onto the skid. Several times, Usher dipped so low the rear of one skid broke the surface of the river.

Had the skids iced up, they might have unbalanced the craft, endangering the tail rotor. "We would have been in big trouble if that tail rotor went into the river," says Usher.

In this way, Windsor held Bert Hamilton, and then Patricia Felch, on the skid of the copter as Usher gingerly

(Please turn to page 142)

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MOST AMAZING RESCUE

(Continued from page 141)

maneuvered it to shore and ever so carefully lowered the dazed survivors to the rescuers on the shore. Examination would later show that the primitive rescue devices were woefully inadequate for survivors like Felch and Hamilton. He had a broken arm and a body he described as being so sore "it felt like someone held a track meet across it." As for Pat Felch, a 27-year-old secretary for General Telephone and Electronics in McLean, Va., her strength was sapped by what was diagnosed later as a broken right leg, broken right wrist and a lung contusion.

Still left in the river were the man who had selflessly passed the ring to the other victims on the tail section and Priscilla Tirado, floating motionless on her back among the ice floes. Usher deftly positioned the helicopter so that the lifeline with its attached ring swung in the direction of her upstretched arm. The young woman hooked the ring feebly and pilot Usher slowly coaxed the hovering helicopter toward shore, trying to avoid jagged pieces of ice which could dislodge her tentative hold. Finally, too weakened, she lost her grip and slid helplessly into the water.

Skutnick takes the plunge

Like thousands of others, Lenny Skutnick, after he left his car pool in stalled traffic, was drawn to the accident site. He paced the riverbank while rescue workers stood by helplessly, unable to cast lines far enough out in the river to reach the sinking woman. Suddenly Skutnick, seeing Tirado slip from the ring into the water, yanked off his coat and boots, plunged into the icy black water and reached the young woman as she appeared to be going under. He gripped her around the waist and brought her close to shore where a fireman, also now in the water, pulled her into a knot of rescue workers. Interviewed later, the modest government worker explained, "I just did it. When I got out of the water, I was satisfied. I did what I set out to do."

Skutnick, through his televised exploits, became an instant hero and was praised that night by President Reagan who said: "Nothing had picked him out to be a hero, but without hesitation there he was and he saved her life."

Priscilla Tirado had been taken from death's grip. Her body temperature on arrival at the hospital was only 81° F. She was minutes away from cardiac arrest and she had a broken leg. She experienced her greatest pain, however, when she regained consciousness: She was told she had lost her seatmates—her husband and infant son.

Usher and Windsor headed out once

more for the tail section to pick up the man who had voluntarily put all the others ahead of him. But now, he was nowhere to be seen. Eagle One circled repeatedly . . . but its two crew members never again saw the man they remembered so vividly. "In a mass casualty situation, you'll find people like him, but I've never seen one man with that much commitment. I couldn't see any sign of him. We couldn't have been gone that long. I was ready to go in after him." Windsor said later.

At 5:30 p.m., as freezing rain continued to fall, Usher released the standby fleet of military helicopters which had the combined capability of airlifting as many as 100 victims to medical attention. Eagle One and its two-man crew headed back to an emotional reunion with colleagues at the Park Police aviation headquarters.

The helicopter had operated under marginal conditions and rescued all but one survivor in circumstances which only such a machine, superbly flown, could withstand. Rescue boats were immobilized by the ice, firemen on shore had no equipment capable of reaching far enough into the river, and there was only enough space for one helicopter to operate.

"I was happy we got five of them," said Usher. "I was despondent about

not getting the sixth. But I feel strongly that we went out and did what we had to do. When I saw the rescue on TV, I thought to myself, 'That's what we're supposed to do.'"

As the grim recovery of bodies from the Potomac began, questions were raised about the rescue capability of the entire region, and the 206L-1 helicopter in particular. Park Service Aviation Commander Lt. John J. McLeod was reported as saying there had never been an attempt to obtain a more expensive twin-engine helicopter which might have been able to pick up all six survivors simultaneously. Indeed, both Officers Usher and Windsor noted that there had never been a need for a larger type helicopter, considering the kind of rescue and reconnaissance work usually done by the U.S. Park

Police. For instance, a winch might have aided in the rescue operation, but weight limitations precluded its addition on board the copter.

Eagle One will long be remembered in the annals of helicopter rescue—so vivid was its versatility as displayed before a nationwide television audience. It was clear demonstration that the helicopter is indispensable in rescue operations. Months later, the need to upgrade the rescue facilities immediately at all airports, like National, which have over-water approaches and departures was given serious emphasis in the National Transportation Safety Board's review of the accident.

Air Florida 90 was a grim disaster. Against that stark recollection will always be etched the heroic performance of Eagle One. **PM**

Why Flight 90 went down

Official National Transportation Safety Board (NTSB) findings, released eight months after the Air Florida crash, confirmed that icing played a major role in the accident. It did cause an engine instrument to misregister actual thrust levels; it did add a pitch-up tendency to the Boeing 737's flight characteristics after takeoff.

The NTSB, noting that the latter is a well-known phenomenon, held that the

accident could have been avoided with proper crew response. The finding was contested by the Air Line Pilots Assn.

Nonetheless, more consistent de-icing procedures are now in effect everywhere. For the first time, airports must assume responsibility for emergency rescue of crash victims when the accident occurs near the airport. This responsibility even extends to water rescues.—R.N.

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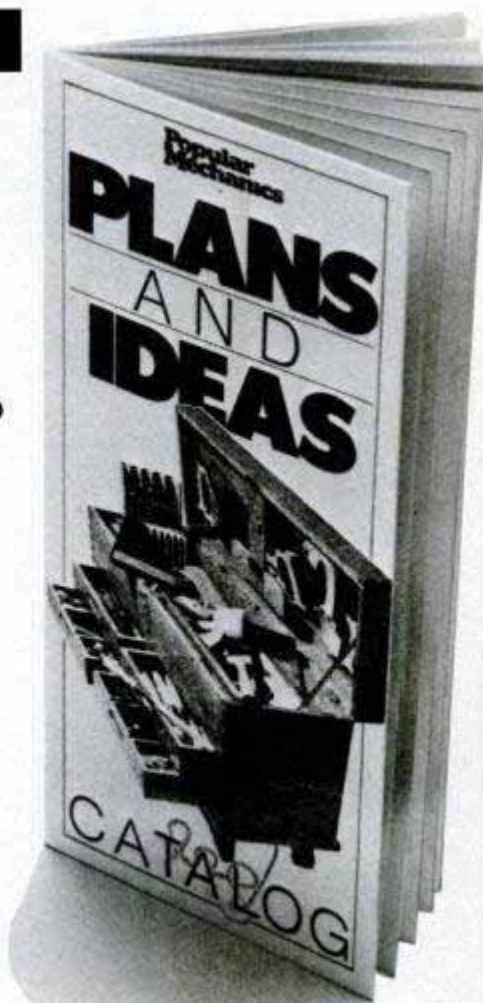
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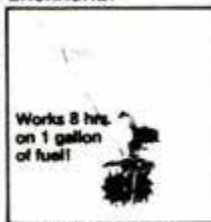
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BOAT ELECTRONICS

(Continued from page 75)

have been adopting the new electronic navigation aids, as well.

On a boat big enough to mount larger antennas, and shelter the instruments hooked up to them, a skipper can pinpoint his position almost anywhere in the world. The latest Loran C units present chart or longitude and latitude coordinates plus speed over the bottom, headings, and estimated time of arrival at numerous checkpoints along a course. Latest models can be preprogrammed to dodge obstacles along the way, change course at predetermined checkpoints and then plot the reciprocals, while calculating wind and current drift to steer you safely back home. A few Loran C units even interface to steer an autopilot automatically.

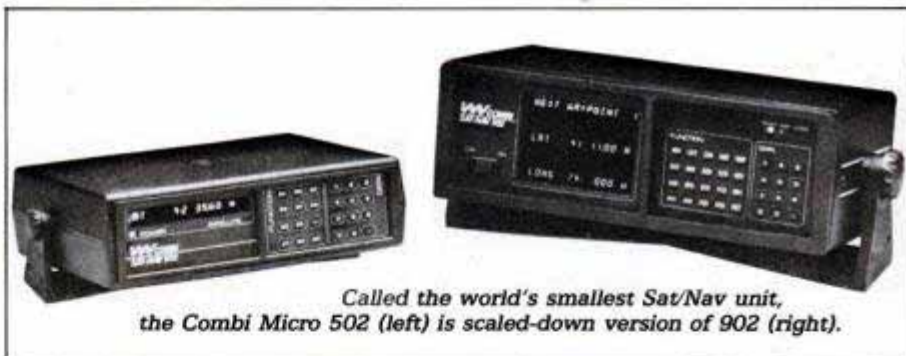
Satellite navigation (Sat/Nav) units, perhaps the most sophisticated of position-finding devices, have come down to compact size, and down somewhat in cost (to under \$3,000). And Texas Instruments now has Lorasat, an integrated system using Loran and Sat/Nav signals simultaneously. TI has also introduced a seagoing equivalent of a home or office computer that monitors engine, fuel, speed and distance factors



Seagoing equivalent of home computer, Texas Instruments 8000 Marine System stores fuel, navigation, engine data.



Hand-held communication with 78 international channels is possible with latest VHF radios. Model 678 by Ray Jefferson has high/low power.



Called the world's smallest Sat/Nav unit, the Combi Micro 502 (left) is scaled-down version of 902 (right).



For anglers looking for fish's favorite temperature, Ray Jeff has meter above. Lowrance's X-15 Grayline graph recorder (left) can spot fish and then zoom in for a close-up chart of sonar signals.

while continuously recording and updating the results. It's called the TI 8000 Integrated Marine System.

Raytheon and others are making more compact radar sets while adding tracking and close-up features, and radar is no longer a collision-avoidance and navigating tool for big boats only. Weather chart recorders are also be-

coming an aid for smaller cruising craft. These provide printouts of weather systems as seen by weather satellites.

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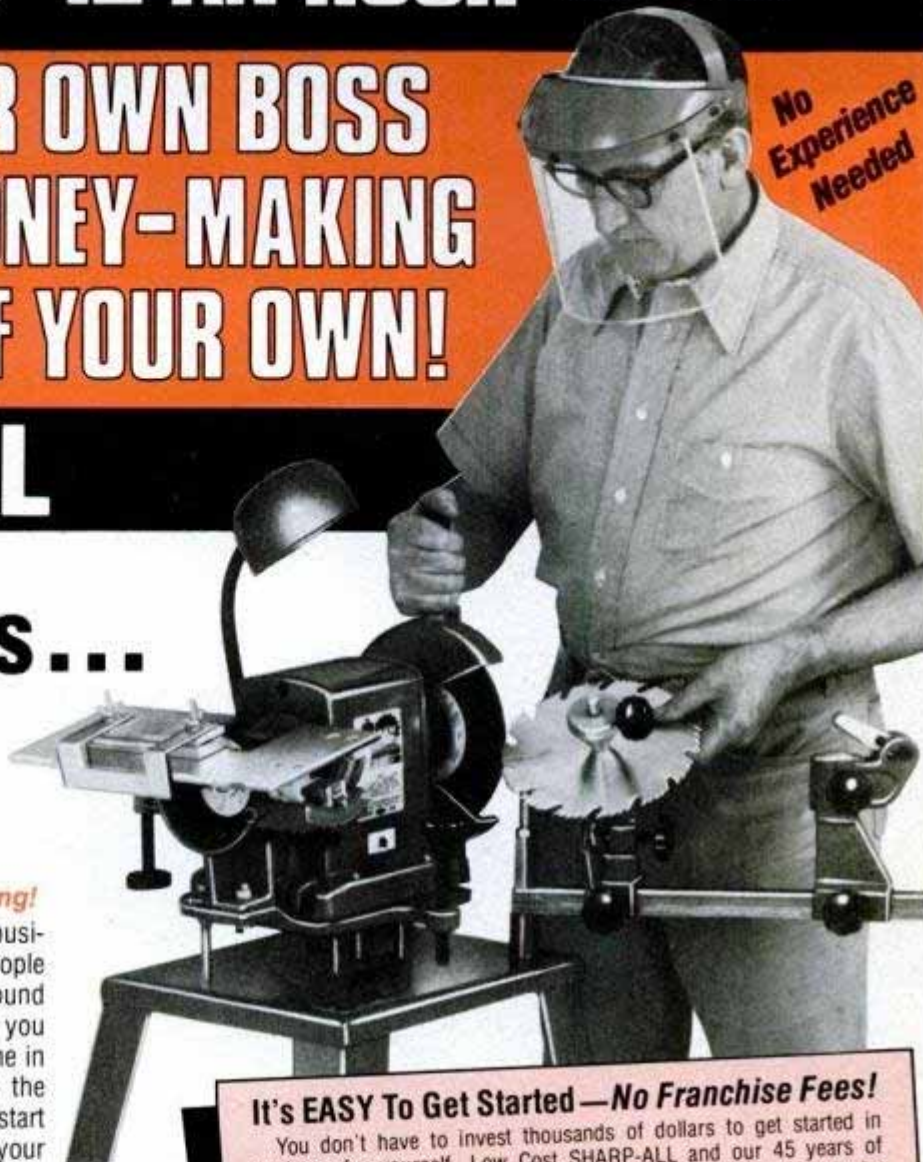
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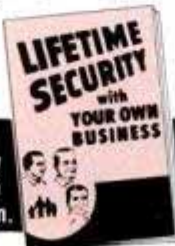
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Fitting Out To Face The Cold

Good new gear can help stretch outdoor action throughout the winter season.

BY BILL McKEOWN
OUTDOORS EDITOR



1

More down-to-earth lessons from outer space are being built into outdoor equipment, and new materials are making cold-season clothing feel warmer, fit better, last longer. After thousands of years of studying ways to keep comfortable in winter weather, we're still finding improvements that keep in body heat.

The dangers of exposure that can occur any time of year—hypothermia—are being investigated and new methods to keep up the temperature of the body core are being devised.

Two systems—the layering and barrier methods—seem to work best. Though quite different, each is

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2 Snowmobile suits are the best for ice fishing, spectator sports and other not-too-vigorous winter activities.

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3



4

worth testing with some of the new materials to find the one that is most successful for you. Any outdoor activity is likely to cause you to sweat when you wear warm clothing, no matter how cold the temperature. Once you stop to rest, soggy clothing next to your skin will chill you rapidly and make it difficult to warm up again. The obvious answer is to be able to control the release of your body heat to the air by layering.

Layering might start with long underwear and a wool shirt and pants, followed by a down or fiberfill jacket and light, wind-shell parka. Instead of a



For slogging through slush and snow, Red Ball has new, no-seam, injection-molded Master hipers with insulation.

heavy, old-fashioned overcoat that must be either fully on or off, today's outdoorsman can unzip or remove a layer or so of clothing before he starts sweating heavily. Some modern designs include underarm and crotch zippers so a garment can be partially opened to increase ventilation. Clothing that is loose allows easy movement and also provides dead-air spaces that add insulation.

Recent underwear improvements have been particularly interesting. Cotton tends to remain damp and is usually not preferred for winter wear. Wool retains its heat-keeping ability even when wet, but its scratchy feeling next to the skin can irritate some wearers. Dual-layer mixes with synthetics and natural fibers have been more successful. Silk is sometimes worn as a warm underlayer. And now a polypropylene knit is being used for long johns that are quick-drying and lightweight.

Tried initially as a wicking lining in diapers to keep babies dry, the material next proved successful in knit underwear for Norwegian commercial fishermen.

Recently several American companies have been importing it or weaving it here. Patagonia Software, 235 West Santa Clara St., Ventura, Calif. 93002, a division of famous mountain climber Yvon Chouinard's Great Pacific Iron Works, offers standard and expedition-weight polypropylene underwear, as well as jackets, pants, socks, gloves and face masks. Breath moisture passing through the mask is reported to be removed by wicking action before it has a chance to freeze.

Also new from Patagonia and others is the use of polyester pile fiber for jackets, vests and pants. About half as heavy as wool for equal warmth, the material can be woven to resemble fleece, washed by machine, wrung out after a shower or dunking, and will dry from body heat.

The barrier method

Perspiration wicked away from the skin can cause problems if it dampens a down garment along the way. Down loses its insulation properties when wet and is difficult to dry. Whenever inner or outer moisture may be encountered, one of the synthetic fiberfills is likely to be a better choice (see *Fine New Fibers Fight The Cold*, page 108, Oct. '82).

The barrier system also takes care of the cooling perspiration that your body gives off as it heats up from exercise. Instead of wicking away the moisture, a vapor barrier retains the sweat and the heat, and convinces the skin's heat sensors that there is no longer any need to sweat.

A waterproof covering against the skin or almost on it prevents evaporation and, as with a diver's wet suit, keeps your hands, feet, torso or whatever is wrapped up, at a warm, wet, stable temperature without further sweating. This is the theory behind wearing plastic bags on your feet or over thin socks and covered with heavier socks and boots to retain warmth. Some people find the method uncomfortable; others report it highly satisfactory.

Space blankets and metalized radiant liners, something like the material of space suits, can reflect back body heat, as well. Radiant barrier liners are now available in some sleeping bags, jackets and gloves. Stephenson, with its Warm-lite Equipment (RFD 4, Box 45, Gilford, N.H. 03246) was one pioneer in this form of insulation for camping gear. The company's catalog is \$3.

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*"The Trans Am is plainly
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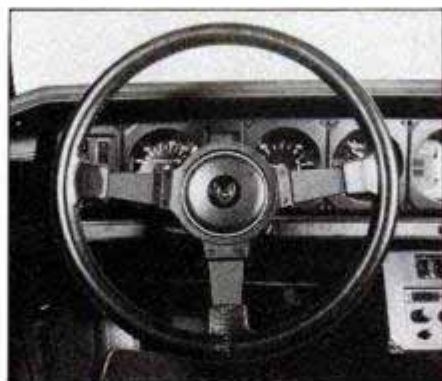
PM photos: Bill Ashe

Styling sold them and
handling keeps 'em happy.

Trans Am owners tell us that John Schinella really did his job. They might not know Schinella by name, but 86.1 percent of the T/A buyers we surveyed agree that the lanky, boyish Pontiac designer and his staff have sculpted one heckuva automobile. Firebird owners emphatically and enthusiastically applaud the Trans Am's styling. The T/A's design accounted for more kudos and favorable comment than any other aspect.

"I consider the '82 Firebird Detroit's greatest styling achievement to date," declared a New York construction vice president—one of the Trans Am owners we surveyed by mail. "My new T/A has turned more heads than any Ferrari or Porsche could."

A Michigan salesman agreed. "I saw pictures of the car a year ago and just had



Interior scores a styling success. Some owners referred to it as very Ferrari-like.

to have one. It's by far the best looking car on the road today."

A Georgia high-school teacher: "My students love the car as much as I do! I get at least 15 comments a day. 'Must be nice to drive a car like that,' they say, and, 'May I borrow your car?' and, 'I'll wash it for you.'"

An Illinois printer: "I believe this new Trans Am is the slickest looking car to come out of General Motors since the Corvette."

An Illinois engineering tech: "It's a beautiful, sporty car that will stay in style for a long time."

And a Pennsylvania purchasing agent: "Great looks caught my eye, and after driving the Trans Am and sampling its

**A NATIONWIDE SURVEY
BASED ON 861,363
OWNER-DRIVEN MILES**

performance and handling, I couldn't resist it."

While the vast majority of owners glowed about the T/A's styling, a few pointed out minor problems inherent in the design itself. A Missouri bartender,

for example, mentioned: "The new car is aerodynamically superior [a Cd of 0.39], but our roads are rough around here, and the front spoiler sits too near the ground. It keeps getting knocked off." We noted reports of spoilers falling victim to speed bumps and parking-lot tire stops, as well.

A Michigan retiree added that, "... the [optional] 15-inch wheels with the WS6 handling package are too big for their openings, resulting in tires rubbing fenders during hard cornering."

A Louisiana wire-line operator: "The pop-up headlights still need work. They stick now and then, and you have to go out and open them by hand. Also, the



Fit and finish were praised by owners as being higher quality than previous GMs.

engine compartment is terribly tight. It's nearly impossible to change the spark-plugs."

An Ohio industrialist spoke for several when he said, "Why cover up the aluminum wheels with plastic wheelcovers? They're ugly, ugly, ugly!" A Tennessee truck driver added, "I don't see why they design such a nice-looking car and then stick on those cheap plastic wheel discs." Several owners said they'd taken them off, and a few mentioned that they rattle.

But right behind looks, which captured the hearts and minds of virtually all Trans Am owners, performance and handling ranked second and third, respectively. "I've never driven a car that handles curves like this baby," said a Louisiana stereo-shop owner. A Massachusetts veterinarian echoed, "The car handles like it looks: superb!" A Georgia textile manager: "I like the firm ride and excellent handling."

And a California electronics technician, who told us he'd driven his car into Mexico on vacation, glowed, "The four-wheel disc brakes are fantastic. As for the suspension system, all over Mexico no car could keep up with me on those curvy roads."

Handling, though, drew more praise than did straight-line performance, because 9.2 percent of our respondents told us they wanted a huskier engine. A Michigan manager wasn't alone when he observed, "The Trans Am is plainly underpowered. I think GM ought to use

the 350 V8, instead of the 305, and then they ought to add a five-speed transmission." [As it happens, General Motors likely will release the 350 and the Doug Nash overdrive four-speed stick in the near future.]

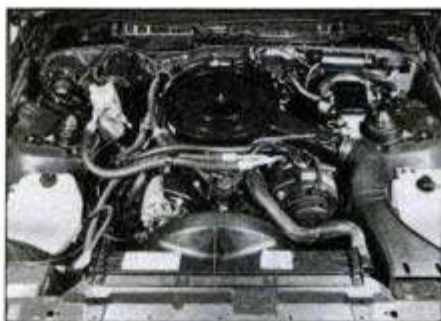
Turning now to the Firebird's interior, most owners considered it outstanding in all ways but one. A California secretary confided, "The fold-down rear seat is great for added luggage capacity. I don't need a ski rack anymore."

The flaw, of course, was rear-seat legroom. A Georgia sales consultant commented, "I always give my rear passengers the name of a good chiropractor." Perhaps, then, an Ohio shop supervisor was right when he suggested, "The Trans Am should be a two-seater."

As for front seating, Pontiac offers Recaros in the black/gold Trans Am Special Edition and contoured buckets otherwise. A Kentucky scientist told us, "There's more legroom in the front of my Trans Am than in most sports cars, and I consider the front seats extremely comfortable."

A Texas project engineer: "Good front legroom on the driver's side, but I wish they'd eliminate the hump on the passenger's floor over the catalytic converter."

We sent out our questionnaires very early in the Firebird's production run, so some of our respondents (owners of 1982 models) were less than happy with their cars' assembly. Nearly 68 percent report-



Even with the V8 motor, most owners felt the Trans Am was way underpowered.

ed mechanical problems of some sort—a fairly high figure. Most troubles tended to be minor, but some were serious. Fuel induction with the twin throttle-body injectors accounted for 20.1 percent of all T/A ills. Some of this was due to the fuel system itself; some to the microprocessor that controls it. Nor were items like porous rear-axle castings and burned-out headlight motors uncommon.

When we asked for comments on quality and workmanship, 70.1 percent in our sampling rendered a *good to excellent* verdict. That's a healthy figure for an American car. A Michigan computer engineer commented, "Quality is excellent, with a lot better workmanship than a few years ago. It's a really tight car. I have

(Please turn to page 152)

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OWNERS REPORT: TRANS AM

(Continued from page 151)

to open a side window to slam the hatch—it's that tight."

Little quality lapses annoyed some owners, though. A self-employed Coloradoan said, "Get rid of those tape stripes along the rocker panels. I'm careful to wash my car by hand, but even then, the tape comes off." And an Indiana insur-

ance salesman sighed, "Typical Pontiac: Good here, questionable there. The hatch roofs never have fit right."

When we asked owners to outline ways to improve the Trans Am, we got these responses. A Washington, D.C., attorney: "Change nothing, but pay closer attention to detail." A South Carolina pharmacist: "I'd like better fuel mileage. I'd hoped to get 17 mpg, but am getting only 13."

A retired Californian: "I'd like to see

the button on the console moved from the driver's side of the lid, because whenever I rest my elbow there the compartment pops open." And a Georgia broker: "Give the Trans Am a bigger gas tank."

A Georgia pilot summed it up by saying, "The Trans Am is the most exciting fun car I've ever owned. Excellent handling, ride, power and gas economy, considering engine size. I'm definitely a confirmed Trans Am nut!" **FM**

SUMMARY OF FIREBIRD TRANS AM OWNERS REPORTS*

Total miles driven 861,363	Specific dislikes:	Comfort opinion (rear seats):	Number of vehicles owned:
Average miles per gallon:	No complaints 15.4%	Excellent 9.5%	This car only 37.2%
Manual transmission	Gas mileage lower than expected 10.4	Good 14.8	Two cars 42.3
In town 15.8	Noise, rattles 8.8	Average 34.4	Three cars 12.2
Long trips 20.5	Poor quality materials 8.2	Poor 41.3	
Automatic transmission	Not enough horsepower 7.1		
In town 15.8		Had any mechanical trouble?	Makes of other cars owned:
Long trips 20.0		Yes 67.5%	Chevrolet 32.5%
		No 32.5	Pontiac 30.9
Transmission choices:	What changes would you like?		Ford 11.4
Manual four-speed 90.5%	No changes 13.1%		Oldsmobile 11.4
Automatic three-speed 9.5	More engine power 9.2	What type of trouble?	Cadillac 10.6
	Better quality materials 8.7	Induction system 20.1%	
Why did you choose the Trans Am?	No plastic wheelcovers 8.7	Cruise control 18.7	
Styling 86.1%	Better gas mileage 5.5	Transmission 15.7	Age distribution of owners:
Performance 18.0		Electrical system 13.4	15-29 years 46.8%
Handling 16.0	Workmanship opinion:		30-49 years 46.9
Past experience 11.3	Excellent 29.1%	Dealer repairs satisfactory?	50-plus 6.4
	Good 41.2	Yes 61.2%	
Specific likes:	Average 20.6	No 38.8	Would you buy this car again?
Styling 82.7%	Poor 9.0		Yes 85.6%
Handling 64.8	Comfort opinion (front seats):	Dealer service opinion:	No 14.4
Performance 21.4	Excellent 58.2%	Excellent 24.0%	Would you buy another Pontiac?
Comfort 17.3	Good 33.7	Good 30.7	Yes 86.7%
Economy 14.3	Average 6.6	Average 29.6	No 13.3
	Poor 1.5	Poor 15.6	

*Percentages might not equal 100% due to rounding or insufficient data.

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"Not enough power, engine gives up at 4,000 rpm."

—MICHIGAN BUILDER

"It's comfortable and fun to drive. Engine bay layout is easy to service."

—MINNESOTA MACHINIST

"There's grace and beauty in each part—true engineering regardless of cost."

—ILLINOIS COMPUTER PROGRAMMER

They love styling, handling, but want more power.

An Illinois salesman beamed as he told us, "I can't count the number of times that people on the street and in other cars have asked me, 'What is it?' 'Who makes it?' 'How much does it cost?' 'Do you like it?' Or they'll say, 'What a nice-looking car!'"

While most Americans recognize Camaros, Supras and 280-ZXs, not many recognize the Fuego—at least not yet. Fuegos still tend to look exotic, and they attract lots of attention.

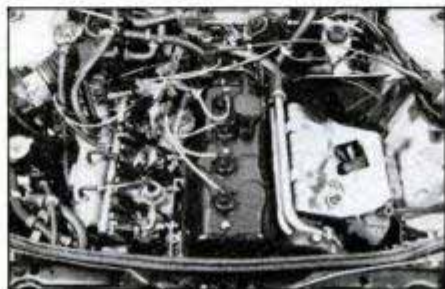
Most owners will tell you that the main reason they bought their cars—and the main reason Fuegos turn so many heads—is because they're handsomely styled. Styling persuaded 78.7 percent of Fuego owners to choose this car over its rivals.

Price came in second as a major purchasing influence. The prices Fuego

PM photos: Bill Ashe



Interior comfort and quality of assembly earned much praise from Fuego drivers.



Nonturbo, 1.6-liter Four was too anemic. Turbo owners rated performance higher.

buyers paid, according to our survey, ranged from about \$8,300 for the base coupe to just over \$13,000 for the turbocharged and fully loaded automobile. The unturbocharged Fuego stickers for \$8,695, while the turbocharged version lists for \$11,095.

It's pretty hard these days to find auto owners who aren't sticker-frazzled and downright outraged at what they had to pay for their cars, but the Fuego proves a notable exception. "Can you name another turbocharged car,"

A NATIONWIDE SURVEY BASED ON 1,712,217 OWNER-DRIVEN MILES

asked a Nebraska recording technician, "that lists for right at \$11,000?"

The Fuego's engineering and its generous list of standard equipment also
(Please turn to page 154)

PM OWNERS REPORT: FUEGO

(Continued from page 153)

had a lot to do with convincing owners that they were getting a good deal.

A Montana ballplayer commented, "I bought my Fuego for its value. I paid \$10,500 for the turbo, and that got me good performance, good fuel economy, comfort for four and visual appeal in a package for which I would have expected to pay \$13,000 to \$15,000. I've had no mechanical problems whatsoever."

A retired Navy pilot from New



Well-bolstered front seats received high marks for comfort, even on long trips.

Hampshire added, "It's an exciting design—aerodynamic yet practical, with excellent visibility. I still find myself admiring the car as I walk away

from it. I also consider the Fuego a very comfortable car: quality seating and a soft, smooth ride. Front-wheel drive gives good cornering and traction on ice and snow."

Owners of manual-transmissioned Fuegos reported fuel mileage at around 26.5 mph city and 33.0 highway. The turbocharger didn't make much difference one way or the other.

The turbo package includes air conditioning, and that proved the source of some annoying mechanical failures in early Fuegos. Seems a combination of too small a compressor pulley and too weak a fan belt caused a lot of owners to get hot under the collar. While an impressive 51.7 percent of Fuego owners reported no mechanical problems of any sort, 29.7 mentioned broken fan belts, and this Florida broker wasn't alone in his anguish. "The fan belt broke five times on my car," he said. "This was two months before the recall. My dealer didn't get the new pulley and stronger belts until after the recall."

American Motors issued the recall last July, asking its dealers to install a larger compressor pulley and stronger fan belt. For many owners, though, the recall came awfully late. A few apparently didn't even know about it because they were still breaking belts.

Another nagging but less serious problem affected about seven percent of the owners we queried. "My car has always had an extremely irritating brake squeal," frowned an Ohio sales rep. "The dealer insists that it's typical of all Renaults and says nothing can be done about it." Actually, AMC put out a service bulletin on this and most dealers should be trying to correct it.

Dealer service was generally regarded as good to excellent, with 68.7



The only complaint owners had about the hatch was the absence of security cover.

percent of our respondents placing it in that range. "The dealer's mechanics are efficient," opined a Utah retiree, "but I don't trust one of the service managers."

An Ohio engineer, though, had the biggest smile on his face as he announced, "This dealer is more than exceptional. When I broke down on the road, he came out 50 miles round trip at 10 p.m. to try to fix my car. When he couldn't, he towed it and left me with a loaner. That's unheard of nowadays."

Unfortunately, there's sometimes a lag in parts availability—or such was the case early in the model run.

On the topic of comfort, we noted both pros and cons. An Illinois sales

(Please turn to page 162)

SUMMARY OF THE 1982 RENAULT FUEGO OWNERS REPORTS*

Total miles driven 1,712,217	Styling 68.9%	Excellent 49.5%	Dealer service opinion:
Average miles per gallon:	Handling 54.1	Good 41.4	Excellent 29.5%
Turbocharged, manual	Comfort 45.6	Average 7.7	Good 39.2
In town 26.3	Economy 45.6	Poor 1.5	Average 19.0
Long trips 33.0	Performance 21.5		Poor 12.3
Nonturbo, manual	Ride 21.5	Comfort opinion (front seats):	Number of vehicles owned:
In town 25.6	Specific dislikes:	Excellent 80.1%	This car only 34.8%
Long trips 33.1	No complaints 18.2%	Good 18.4	Two cars 46.4
Nonturbo, automatic	Squeaky brakes 15.9	Average 1.5	Three cars 13.9
In town 25.3	Not enough horsepower 12.8	Poor 0.0	Four or more cars 4.8
Long trips 30.6	Not enough headroom 11.6	Comfort opinion (rear seats):	Makes of other cars owned:
Engine choices:	Parts and service 10.5	Excellent 35.0%	Ford 15.5%
Turbocharged 27.4%	What changes would you like?	Good 46.7	Chevrolet 13.2
Nonturbocharged 72.6	More headroom 16.5%	Average 15.6	Oldsmobile 10.9
Transmission choices:	More horsepower 16.2	Poor 2.7	Volkswagen 7.5
Manual five-speed 82.1%	No changes 10.0	Had any mechanical trouble?	Datsun, Buick, AMC
Automatic three-speed 17.9	Squeak-free brakes 5.8	No 51.7%	(each) 6.9
Why did you choose this car?	How much did you pay?	Yes 48.3	Age distribution of owners:
Styling 78.7%	Under \$8,500 3.9%	What type of trouble?	15-29 years 29.5%
Price 31.5	\$8,501-\$9,500 18.2	Engine drive belts 61.5%	30-49 years 49.0
Economy 19.5	\$9,501-\$10,500 42.5	Brakes 14.6	50-plus 21.4
Handling 16.5	\$10,501-\$11,500 20.5	Electrical 9.2	Would you buy this car again?
Comfort 12.7	\$11,501-\$12,500 8.4	Dealer repairs satisfactory?	Yes 84.8%
Specific likes:	Over \$12,500 6.5	Yes 65.0%	No 15.2
Workmanship opinion:		No 35.0	

*Percentages might not equal 100% due to rounding or insufficient data.

TECHNOLOGY UPDATE

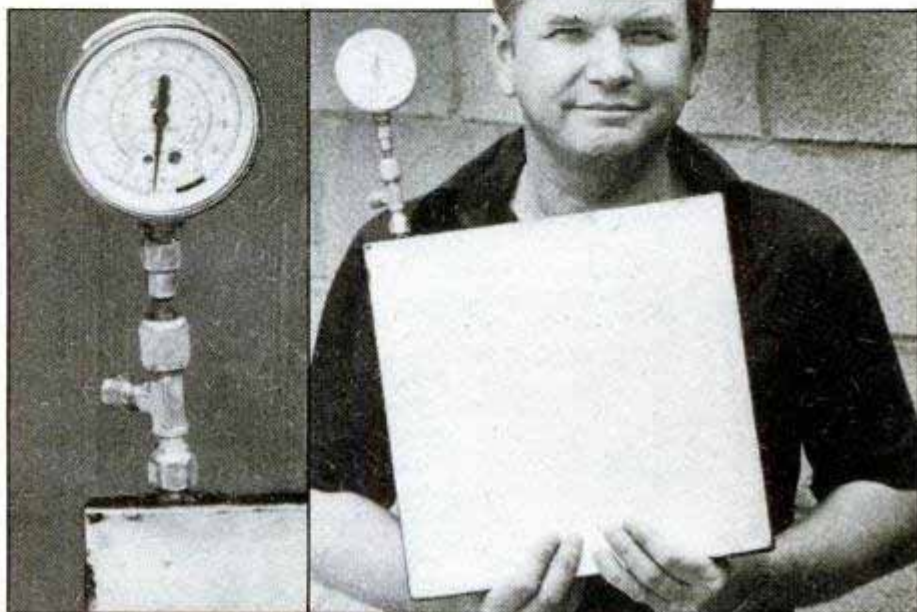
He's got plenty of nothing

Inventions

John Ruseckas has never forgotten how impressed he was, as a kid, by his thermos bottle's ability to keep liquids hot or cold all day, regardless of the ambient temperature. Today, the Air Force officer, a navigator with many flying hours in bomber and transport aircraft, is spending his spare time trying to make the same principle work in other types of "containers."

Ruseckas believes that a vacuum induced within conventional building materials—bricks, cinderblocks and various paneling media—could provide a new level of insulation properties. He's applied for patents on several modes of vacuum insulation. Right now, he's interested in selling licenses on techniques he's already tested; he says he'll deal with corporations or individuals, pricing licenses commensurately.

To make a vacuum brick, Ruseckas uses molds that yield two separate parts with an interior space. The space surface is sealed with a resinous compound, and the air is evacu-



Ruseckas with fiberglass panel; the dial at left shows near vacuum induced inside.

ated to a near-vacuum condition.

Paneling and even glazing materials can also be designed to have a vacuum "pulled on them," says the inventor. It's a matter of placing spacers in the material to keep the two sides from collapsing inward. Glass isn't permeable and would retain the vacuum indefinitely;

Ruseckas has also been working with materials, however, which are permeable. For these, it's possible that sections of vacuum would have to be reestablished over time.

The construction costs, Ruseckas claims, are not prohibitive. He sees vacuum potential for everything from recreation vehicles to fire doors.

Media

Cable talks back

While major cable TV interests are entering what experts believe is a shakeout period, small-scale experiments in "interactive" cable are demonstrating what the future may bring.

In Peabody, Mass., a collaboration between the local cable distributor and J. Walter Thompson, the large advertising agency, has produced something called Cablesnoop. From a "menu channel," subscribers select from a number of short subjects of special interest. Almost all of them are supplied or underwritten by companies with related products. For instance, food companies might sup-

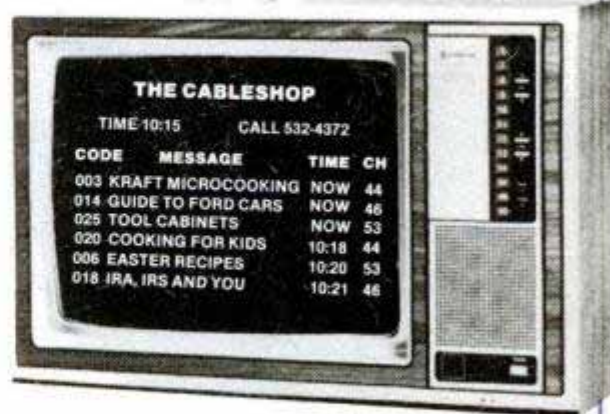
port recipe shows or Kodak might sponsor a picture-taking clinic.

The subscriber dials an access number, identifies himself to the Cablesnoop computer with his individual code, and dials the number of the presentation he wants to see. Then, a message guide channel indicates the time his message is scheduled and the channel on which it can be seen. If a program is already scheduled due to another request, that information is relayed as well.

According to Peabody lore, a man waiting for his wife to finish dressing for dinner dialed up a Ford Escort film recently and was so impressed

that he went out and bought one.

Meanwhile, in the high-income community of Ridgewood, N.J., an interactive test will supply 500 families with free computer keyboards.



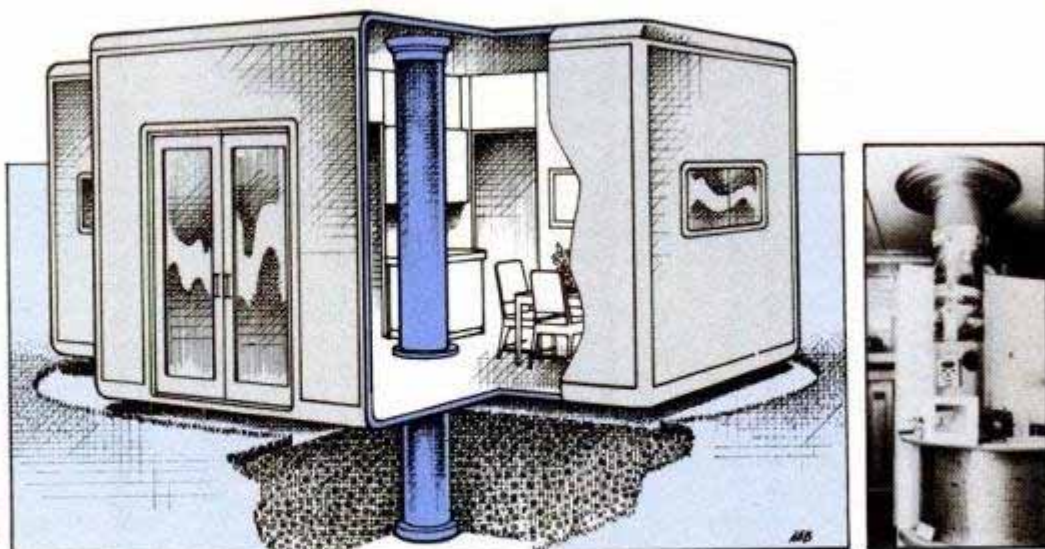
Guide channel shows a schedule of requested films.

Design

This place really swings

What's short on looks but long on vistas? A Dutch idea for a vacation cottage that is supported entirely by a central pillar. And while the prefab unit's exterior is strictly Late Fotomat, its ability to revolve to face any direction, or even follow the sun, is a big plus.

Stationary units can be erected on the pillar as well; or the owner can specify manual or motor-driven units. The top-of-the-line version comes with a sun-tracking photocell to keep the appropriate side of the house aimed at the sun all day.



Revolving prefab vacation house has all utilities connected through its central support column.

The design, by Dutch architect D. Voorhaar, also features advanced insulation and heat retention. All plumbing, electrical and ventilating out/inlets are located in the central pillar, which is filled with concrete during installation. The basic building

material used is aluminum sheet over Klege-cell insulation.

A small cubic unit (not shown) and a larger cruciform version (above) are being made available, assembled or in kit form, by the architect. The larger version, with almost 300

sq. ft. of floor space, is about \$22,000 assembled. Kit prices, based on individual specifications and orders, will be quoted by the architect. Contact the Architectenbureau Bouwhuis Voorhaar, Vermeerstraat 131, 3817 Amersfoort, Holland.

Alternatives

Energy from tired tires

Kutrieb Corp., a Wisconsin firm specializing in pollution control systems, is marketing a process that converts old tires into energy. The company stresses that this not just a way of getting rid of the tires: The derived energy can be sold at a profit.

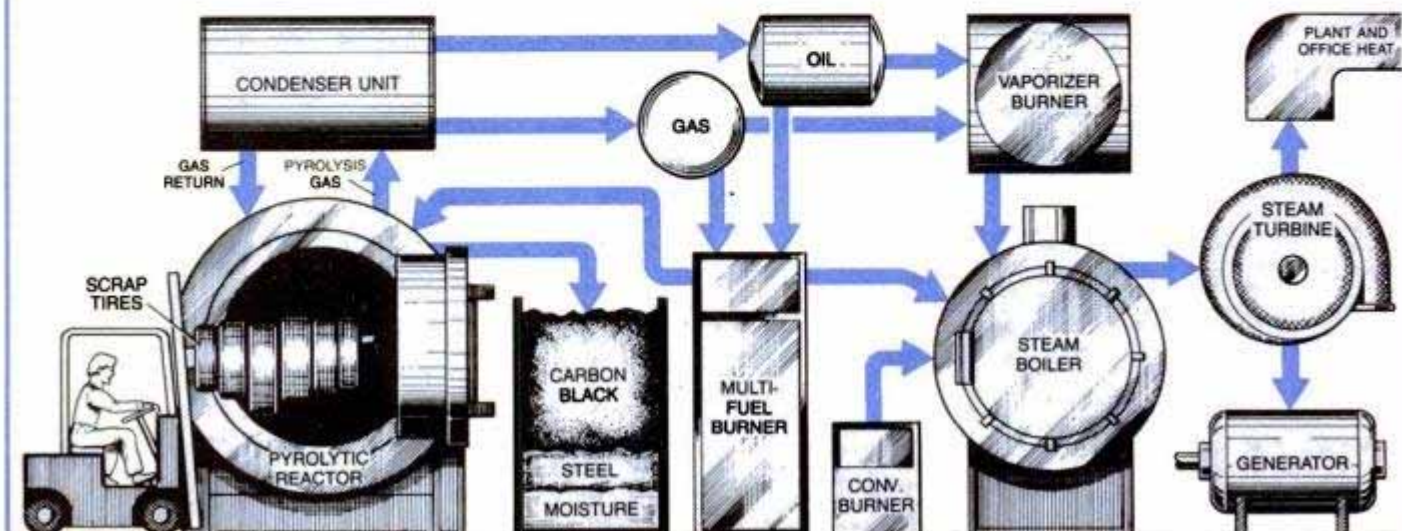
According to Kutrieb, the energy equivalent of a gallon of fuel oil can be recovered from each passenger car tire of average size.

The key to the process is a stainless-steel reactor chamber, called a pyrolator. Inside the unit, tires are broken down without cutting, shredding or open flame, since the atmosphere is oxygen-free.

The scrap rubber from this process is degasified and circulated, via a closed-loop system, through a tube

condenser that's cooled by ordinary air. Oil is then distilled from the gas and transferred to a holding tank while the gas is compressed for process fuel.

The company has impressive projections of energy recovery. It plans to sell packaged pyrolators for about \$225,000 and claims that the buyer's payback period may be as short as two years. The Kutrieb Corp. is located at 430 Phillip St., Chetek, Wis. 54728.



Energy

Big push for oil

The U.S. is awash in oil. A U.S. geological survey estimates that 70 percent or more of all the petroleum in U.S. oil deposits is still locked in rock.

"If only we could push 4 or 5 percent of this oil out of the wells, we could generate more petroleum than is expected from Alaska's North Slope oil fields and the wells in the Gulf of Mexico," says J. David Wolf, general manager of the Goodyear Tire chemical div. Until now, that's been a tall order, but the situation may soon improve.

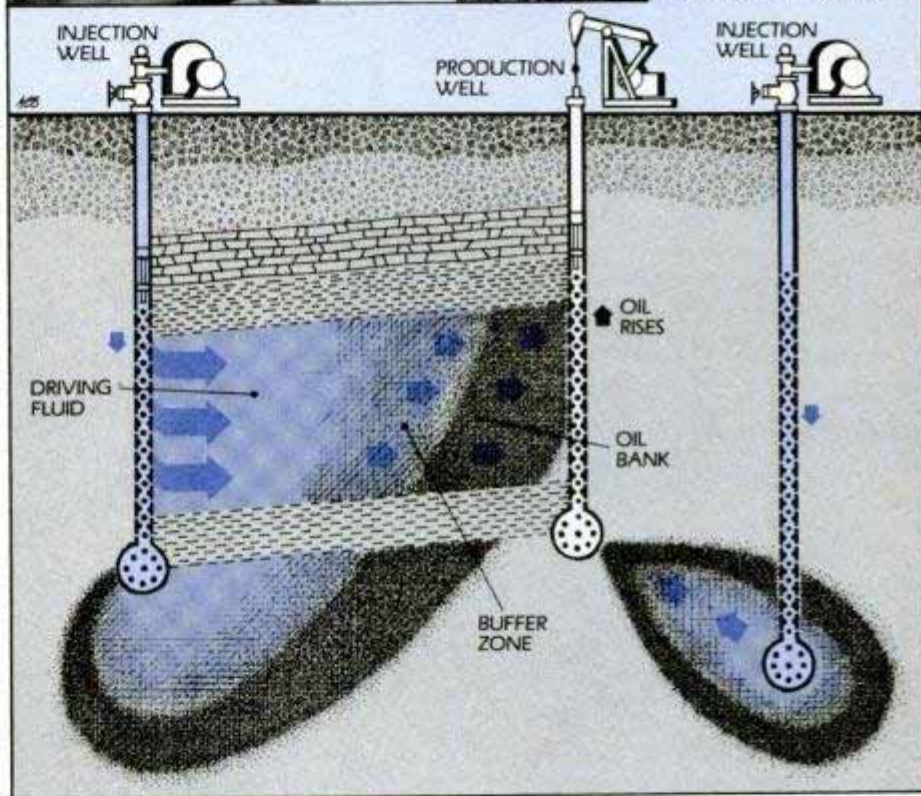
Goodyear has developed a new gooey substance which is supposed to be the best trapped-oil pusher developed to date. It's a water-soluble, high-molecular-weight latex polymer called Wingflood.

What supposedly makes Wingflood better than other chemicals that are used for extracting trapped oil is its ability to maintain high viscosity after extended periods under the high-temperature, high-salt atmosphere inside many oil wells.

Viscosity retention is the key. The thicker the stuff stays, the more pressure it can exert against the trapped oil. Not only that—the length of time an enhanced oil recovery (EOR) agent maintains viscosity is important. It takes months from the time the substance is injected for it to get the oil to the well.



Goodyear Chemicals' Richard Bauer (left) examines a sample of a new "oil-pusher" fluid—Wingflood. Diagram below shows how polymeric liquid is injected at high pressures into known oil reservoir. When it permeates the oil-bearing rock, oil is forced to the surface via the main wells.



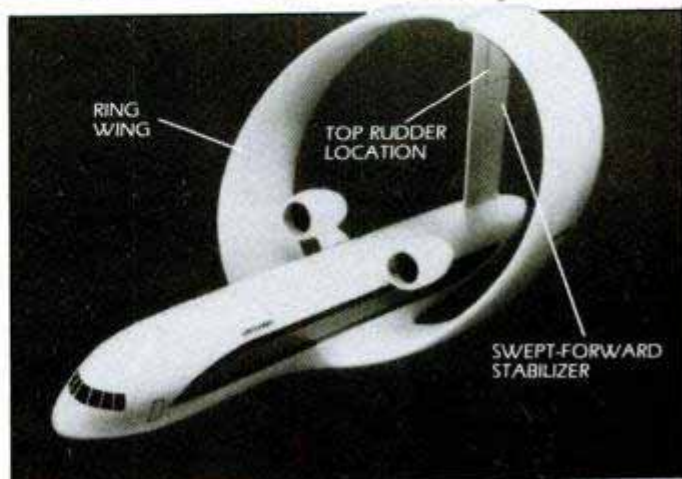
Aviation

A ringer

The ring-wing format has been tantalizing designers of aircraft for years. One—a small-scale, remotely piloted version—has even flown. A new design from Lockheed-Georgia Co., however, sweeps the ring-wing aft to where the vertical stabilizer, which is swept forward, can serve as a structural support for the craft.

A "top rudder" would be incorporated in the vertical element to initiate and provide roll control. A full aerodynamic evaluation of other control inputs and the design's ultimate potential awaits the end of a current (model) wind-tunnel test program. A full-scale aircraft wing would weigh about one-half that of a conventional wing capable of supporting the same load.

Editor: Robin Nelson
Contributors: Denise McCluggage, Mort Schultz



New design has support from swept-forward vertical stabilizer.

Housing

A wall of water

Wood frame construction lacks the thermal mass of masonry, which can retain and radiate the heat of the sun. Therefore, going solar in a frame building has often required an active solar system.

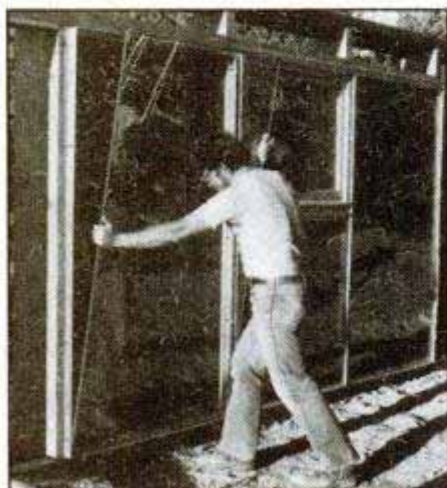
Now there's something called Heatwall. It is a modular, water-loaded, unvented trombe wall that brings the advantage of passive solar heat to the south-facing walls of "stick builds." It is also usable in retrofits. And it does something few passive elements do—it qualifies for tax credits, since it isn't structural.

The Heatwall is essentially an aluminum tank with five compartments to hold plastic water bags. Two people can fit it into a 2 x 12-in. stud wall, and secure it with eight screws. The water chambers are then filled from a garden hose and sealed.

Glazing is done on-site, using standard PPG patio door replacement panels or Exolite double-skinned acrylic plastic. Both are relatively inexpensive double-glazing systems. Heatwall units serve as their own mullion system for the glazing, so no additional frames need be built.

On the in-facing side of Heatwall, standard sheets of wallboard can be affixed with mastic then taped and painted to match the room.

For heat collection, a black sur-



Standard patio glass or Plexiglas fits Heatwall opening. Units can be retrofitted, with adjustments, to frame homes.



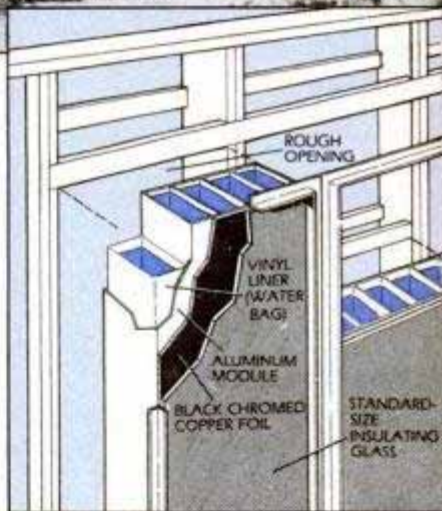
New Mexico home has a Heatwall on south side. Strings on left are for climbing vines that give summer shade.

face, in this case black chrome plated to copper foil, is used. This "selective surface" acts as a one-way mirror to heat. Rated for .93 absorption and .11 reflectance, it allows the sun's energy to pass easily to the water storage, but retards the heat's reradiation to the cool night air.

Water stores about 62 B.T.U./per cu. ft./per degrees F. of temperature rise. The water capacity of the compartments in Heatwall is calculated to get no hotter than the 90° to 100° F. This seemingly low temperature range (for a heating system) is effective because people surrounded by surfaces close to their own body temperature don't lose significant body heat to those surfaces. Thus, they retain their sense of comfort. The effective radiation from Heatwall extends up to 20 feet from the wall.

Tests indicate that one Heatwall is adequate to heat an average room. Three to six units can provide a 1000-sq.-ft. structure with 54 to 80 percent of its heat, depending on the climate. The solar-saving fraction of 54 percent is taken from a test structure with six Heatwalls in the Chicago area. The 80-percent figure is from a four-Heatwall structure near Albuquerque, N.M.

Heatwall was observed at the Los Alamos (N.M.) Scientific Laboratory for seven weeks starting in January 1981. With average weekly outside



temperatures ranging from 28° to 41° F., the unit achieved a solar savings fraction of 76.8 percent.

Besides the full-sized 4 x 8-ft. Heatwall, there's a half-wall partner designed to team up with a Marvin awning-opening window. And there's a matching frame for a full-sized window that also uses the PPG glass patio replacement glazing. Heatwall modules can be mixed and matched to provide a southern exposure with a variety of direct and indirect solar gain, ventilation, daylight, doors and views.

Full-sized Heatwalls cost \$785; the half-wall is \$630 and the frame for a direct-gain window is \$97 (plus on-site glazing).

For information, contact the Heatwall Co., 5001 East 59th St., Kansas City, Mo. 64130, or Wayne Nichols, Communico, No. 2 La Vereda, Santa Fe, N.M. 87501.

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PM OWNERS REPORT: FUEGO

(Continued from page 154)

manager observed that, "A neighbor complimented my Fuego's ride quality compared to his 1980 Eldorado. And there's plenty of rear-seat room, too."

Lack of headroom is a complaint we heard fairly often, mostly from owners of Fuegos with sunroofs. The sunroof ceiling rests lower than the conventional roof, prompting a Georgia deli clerk to note, "The seats are comfortable, but they stand relatively high, causing taller persons to slouch. Even so, I feel the Fuego is the first car of this type that's really comfortable."

When we asked for comments on quality and workmanship, the praise fairly flew. Over 90 percent of our owners rated workmanship *good to excellent*. "Solid all the way," is how a Wisconsin high school principal put it.

In the overall area of handling and performance, a California naval officer wasn't alone when he suggested, "I wish Renault would junk those TRX wheels and tires. Why do they have to lock us into mediocre-handling tires? I'd rather have Pirelli P7s."

But a Minnesota graphic designer also wasn't alone in stating, "Maneuverability is fantastic. The car corners great. Unfortunately, there's not much pickup in first and second gear."

This last comment concerned a car without turbocharging. In all, 16.2 percent of the Fuego drivers we surveyed agreed that without the turbo, this engine needs some other sort of boost. Several suggested going to larger displacements and even adding a couple of cylinders.

More horses, headroom

Whatever other improvements owners would like, though, more headroom and more horsepower topped the list. These suggested changes, in fact, ran neck-and-neck in our survey at about 16 percent. Other urgings included adding a security shade to the rear hatch and moving the horn from the steering column to the hub.

The Fuego isn't a controversial car, and the great majority of owners agreed that it's a very pleasant one to drive and live with. A sheet-metal layout man from Illinois struck the proper chord when he wrote on the back of his questionnaire: "I really can't say enough good things about the Fuego. My wife always says I'm too fussy and pick up on little things, like the loose stitch in our Lincoln's glove-leather upholstery. But I find only quality in our Fuego. It's designed and put together better than any car we've ever owned, and that includes the Lincoln, a Toronto, a Cougar and more. Plus, with the turbocharger, it's fun to drive." **PM**

PM LOOKS AT...

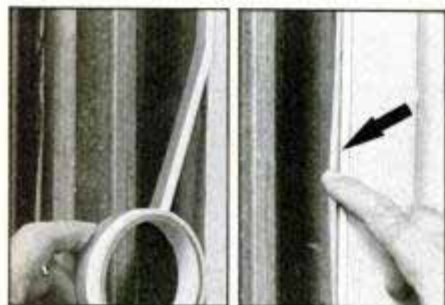
Easy-to-install weatherstripping

Wonderstrip is a Mylar tape that offers a simple, effective way to prevent energy loss at windows and doors.

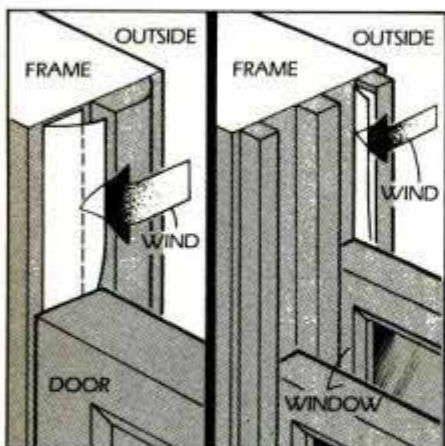
Install Wonderstrip around openings by pressing the adhesive-backed half of tape behind the stop molding. (Window and door applications differ slightly; see drawing.) Then, fold tape over into a springy, lengthwise V shape.

When the wind blows into the seal, it presses the free half of the tape tightly against the opposing surface to seal even the smallest cracks. Its flexibility allows the Mylar to conform to irregular surfaces.

The only tool needed for installation



Mylar tape is pressed onto stop molding and then folded over to form a "V-seal."



is a pair of scissors. The maker guarantees flexibility, adhesion and resistance to both abrasion and temperature changes for five years. The 1/4-in.-wide tape comes in white and brown. It's about \$6 for a 34-ft. roll, \$13 for a 30-yd. roll. From Manco Inc., 2040 West 110th St., Cleveland, Ohio 44102.—H.W.

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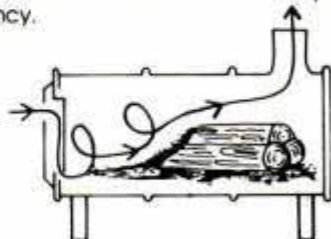
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BULLISH ON SOTZ!

I... purchased direct from your factory your two barrel stove kit. I raise English Bulldogs professionally, and I have a kennel made in an old farm barn. It is only partly insulated, having crumbling cement walls and a nine foot ceiling. It

cost me over \$500 to heat a 40x40 ft. room in it last year using LP gas. We just went through a cold snap the first week in Dec. and I am very pleased to tell you that thanks to your stove kit, the two LP gas heaters never got off the pilot. The day I got the stove running, I threw in a couple of good size chunks of oak, set the damper at about half open, and making sure the fire was going good, I went into the house for dinner. Returning to the barn about one hour later, I found all my dogs panting from the heat, which was about 90 degrees. I can't imagine how much heat the stove would give off if it was full of wood! I have found that now I can give my dogs adequate ventilation without worrying about \$\$\$ going out the LP gas flue. Your barrel stove also out performs our combination Heart of the Home combination wood LP gas furnace in the basement of our house.

A.R. Peterson, Plainview, Mn.

SPORTSMAN'S CHALLENGE

I have easily split several cords of firewood consisting of white oak, cherry, poplar, and maple, all with amazing speed and with minimal physical exertion. I've even participated in a "Sportsman's Challenge" against a hydraulic splitter, against which my...maul proved much faster. My only regret is I have now sold the maul to the owner of the gas powered hydraulic splitter, who was completely amazed by its performance. During these times of phony advertising and cheap workmanship, I am truly thankful to find a firm who is honest and sincere and provides quality products.

David A. Hojnacki, Monroe, Mi.

WIFE'S DELIGHT!

... Your publication moved me to try the "Barrel" stove. Even though I'm new at this woodstove business, I've built a barrel stove, put up a good chimney and have been burning since early Sept. ... My wife was delighted to tell the oil man that our tanks are still filled to the top since our last delivery. We have already saved about \$300 some odd dollars with this new installation.

H.J. Ramirez, Parksville, N.Y.

SOMETHING'S FISHY

I will start off by saying your barrel heater kit is the best investment I have ever made...My brother has a Fisher Stove, but he says he's getting rid of it and going to order a two-barrel kit from your company. It's very seldom this day and time you truly get a bargain, and as I have told everyone around my community, your barrel kit cannot be matched. My brother, he has bragged about my stove every time he comes around...now that he has your kit, he's advertising his new Fisher Stove for sale. So that shows you how good your product really is...we are spreading the news about our satisfaction from your products. P.S. Every cold night I give thanks to your company.

Canie Alexander, Bristol, Va.

NO GAS PAINS

Your 55HDD kit works great. The gas furnace hasn't come on since the wood burner has been installed, and it heats the whole house. Keep up the good work. P.S. Thanks for your fast service.

Don Buckner, Mineral Ridge, Oh.

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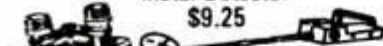
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We at Sotz have been making the same quiet offer for years: Try a Monster Maul at our risk! Within one year, if you don't think it's the fastest, least tiring method of splitting firewood, let us know, and we will give you your money back, including shipping . . . Plus, it's guaranteed against failure for 10 years.

OUR 26TH YEAR

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24" OAK

DYNAMITE!

I have used your Monster Maul for two years with outstanding results. I know of nothing that can compete with this device in curly or difficult wood—except possibly dynamite! Wood cutting would be much more burdensome if I weren't able to split the big stuff in the woods so I can get it out much easier. This is a real wood splitting machine. I think I could out-split a mechanical splitter especially if the wood was curly or knotty. I see you now have a lady maul for splitting clear wood and small stuff. . . So we are going to order one. I feel if I can't split it, I'll bash it into kindling!

Jackie E. Allen, Warsaw, Oh.

WATCH OUT FOR FLYING WEDGES!

I'm ordering my second Monster maul. I use to use wedges but after being hit by them I gave up. . . A wooden handled maul...for \$20.00 broke on the second shot so I got my first Monster Maul. You can't get it stuck and I know it'll last forever. It does work easier. I use one at home to split fresh cut wood and the second will be at my. . . camper out in the woods.

John H. Hanson, Lafayette, Ind.

SPLITS OVER 150 CORDS IN ONE SEASON!

Over a year ago, I purchased your Sotz Monster Maul and have never been happier. My husband and I have in just one winter season split over 150 cords of oak and assorted hard woods with your maul. We recently received your latest

edition of the Sotz News and I really was impressed with your Lift N Saw...There have been too many occasions where our saw has been jammed or we take our chances and hope we don't hit a rock, but we're never that lucky. Again, thank you for a really fantastic product. I can see why you guarantee your products for so long. They're really worth it.

Dawna Beckmann, Lenox, Mass.

WHO NEEDS IT?

I am heating a 25' by 25', 3 story farm house with one of your double barrel stoves in the basement. I put it in in Jan. last year and left the oil furnace running (the woodstove was put in to help only). After two weeks I decided the oil furnace only ran to maintain boiler heat so I shut it down. Fantastic. I couldn't believe it. +6°, 30-35 mile per hr. winds., 75° in dining room, living room and kitchen. I am well satisfied with this.

L.D. Hubbard, Upper Marlboro, Md.

THE OTHER HALF

I am pleased to order one of your famous Monster Mauls. I have used one in the past and found it to be unequalled in strength, durability and ease of use. Your ad says there is no need to be a strong man; that's for sure, because I'm a woman! Cynthia Smith, Bristol, Vt.

82 YEARS YOUNG!

If I could not replace it, I'd not sell the maul for \$50.00. I've used nothing in its class and I was born in 1900. I'm enclosing \$24.95, for another so I'll have a "loaner" and one to use myself. My friends, family and neighbors. . . have all been

astonished and delighted with it. You don't know how good it is to use your splitter instead of my Kelly double bit axe. With the axe I used (lost) half my working time freeing the blade when it sunk in but the wood didn't split. Your maul usually splits the block with one blow, if not, it bounces free and I swing again. Herbert C. Root, Vidor, Tex.

MONSTER DISAPPEARS!

Your Monster Maul is the best log splitter I've seen yet. Although I haven't seen mine for some time because when one friend gets done with it there is another waiting in line for its use. Thank you for such an honest product at an honest price, rarely seen in this day and age.

Ed L. Lucas, Hemingford, Neb.

TWO SATISFIED LOGGERS

Standing next to the 30 inch red oak on that cold February afternoon, my friend chuckled as I approached with my equipment. He, equipped with chain saw, splitting maul, sledge, and assorted wedges, gave me the "are you for real" appraisal seeing only me, my saw, and my new Monster Maul. "What's that thing?" he queried, hefting the unblemished orange tool. "They call it the Monster," was my brief reply. Within the next hour the Monster demonstrated its ability to live up to its name and claims. It was truly awesome. The results: one pick-up truck load of coarse-split oak, two satisfied loggers, unused sledge and wedges and definitely an order for another Monster Maul. The Monster Maul is for real. IT WORKS.

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