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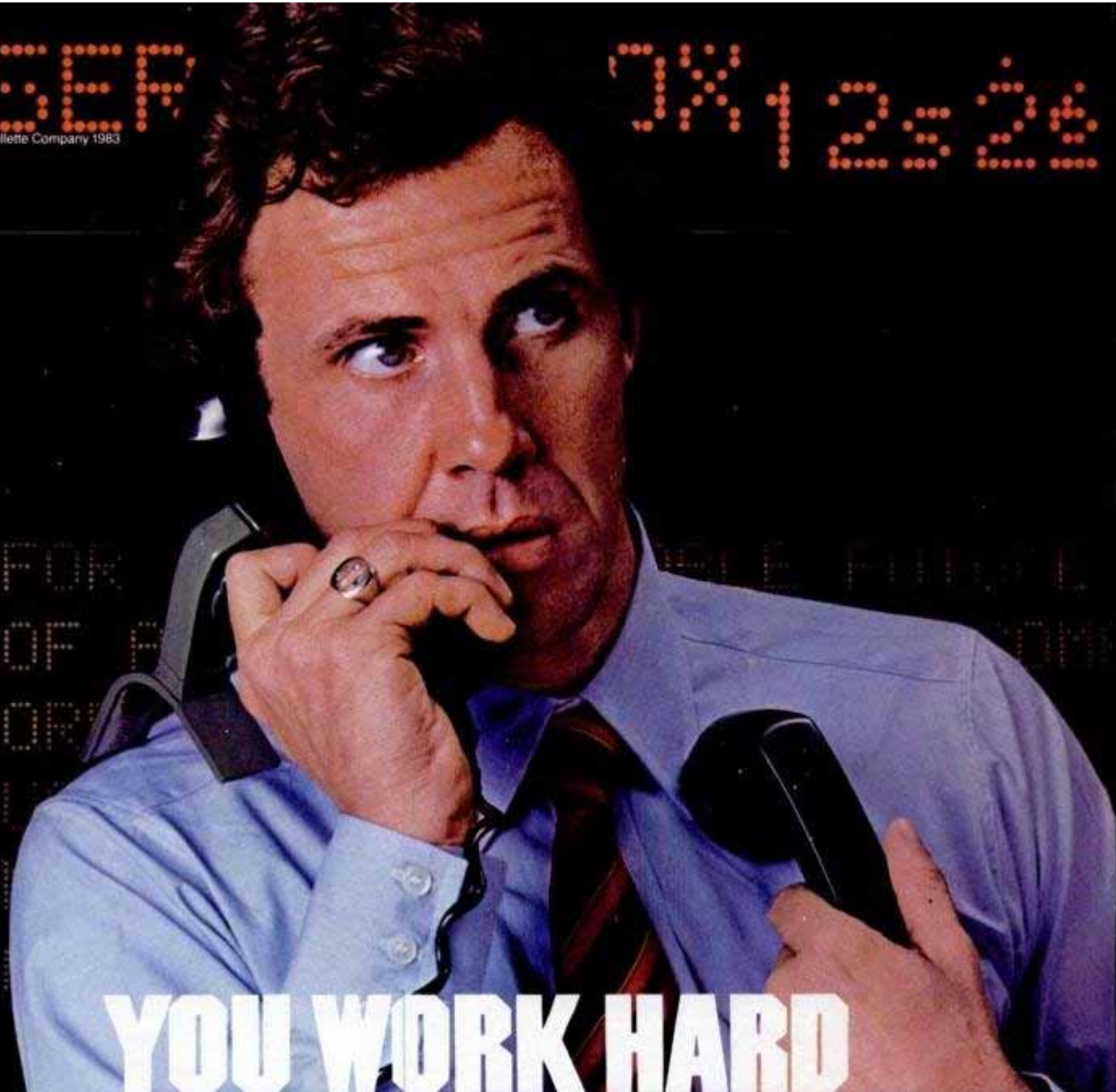
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Popular Mechanics®

VOLUME 161 NUMBER 2



ON THE COVER

Our deadly antitank TOW missile launcher goes into action, looking like a fire-breathing monster from another world. Read how it and other new battle armor will form our hard-hitting Rapid Deployment Force. Story on page 68.

—PM painting by Ed Vallgursky

FEBRUARY 1984

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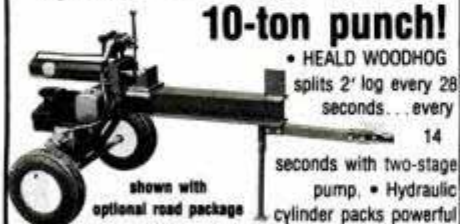
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EDITOR'S NOTES

We watch them, and they watch us. And now we have a sophisticated new watcher, as you'll read in *America's Global Lie Detector* (page 86). It seems, though, that both the United States and Russia rely mostly on an old-fashioned weekly meeting between an American and a Soviet general. They simply ask, in effect: "What are you guys up to this week?" At least, that's what PM's own watcher says he saw.

When Pan Am inaugurated daily jet airliner service across the Atlantic in 1958, there was always a chance, according to contemporary reports, that the 707s would have to refuel on the way. If winds were unfavorable, the planes landed at Gander, Newfoundland, to fill up.

In the ensuing years, we've seen those 707s give way mostly to larger and longer-range planes. Now, it appears, the question facing airlines is not how much fuel their jets carry, but how efficiently they can use it. In *Son of Jumbo!* (page 79), you'll get a look at ways the newest planes and engines have become safer as well as more miserly with fuel.

With the fuel problem being solved, we should tackle another one. I say let's go back to the good old days when we think about onboard meals. At least, the good old days as exemplified by that first Pan Am jet.

I was a guest on the 25th anniversary replay of that flight—Kennedy Airport (at that time called Idlewild) to Gander to LeBourget near Paris—this past October. The meal, too, was a duplicate of the original. Ah, the meal! For starters, there was a chef on board from Maxim's in Paris, whose very presence bode well. Main course choices were veal sweetbreads, pheasant in cream sauce and brandy, wild duckling, roast prime rib or double lamb chop.

Of course, serving meals like that would only neutralize any savings made in fuel efficiency, so I don't expect to see its like again. And just for the record: The Gander landing was a sentimental gesture. Our 1968 model 707 could have crossed non-stop; it was already more efficient than the 1958 plane. **PM**


John A. Siblett



Car buff's dream: Some three dozen vintage Citroens took us from LeBourget to Paris.



Reception at LeBourget reenacted the arrival of the first transatlantic passenger jet.




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Low-tone muffler for quiet operation.

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When John Deere builds an economy

Introducing the new R-Series Riding Mowers.

Until now, if you wanted to buy an economy rider, you had to settle for economy features. But this year, John Deere introduces the R 70 and the electric-start R 72, two solid economy riders that are built with traditional John Deere quality.

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Two-position footrests for comfortable operation.

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Deep-contoured 30-inch mower with adjustable cutting heights of 1½ to 3½ inches and a 12-inch opening for clean bagging or uniform discharge.

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rider, only the price is stripped down.

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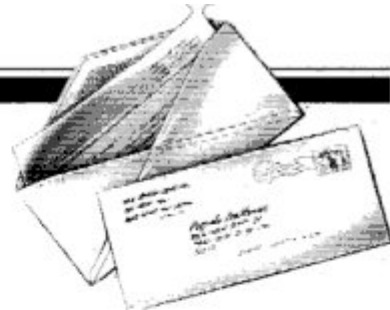
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LETTERS TO THE EDITOR

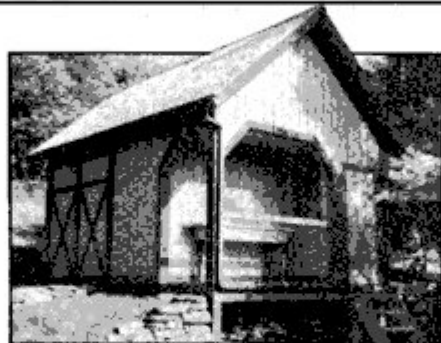


Barn brainstorm

I thought you might like to see a photograph (right) of the storage barn that we constructed from your excellent plans (*A Barn For Your Back Yard*, page 102, Mar. '83).

We had to change the design slightly to fit it to our hillside lot, a 1-in-4-foot grade.

This involved extending the foundation out over the slope on the downhill end so that we would have a level platform.



PM's back-yard barn built on a hillside by reader Norman. The elevated foundation provides additional storage underneath.

The barn turned out very well and we love it. Many thanks.

NORMAN B. NORMAN
WOODSTOCK, VT.

You did a great job of adapting the design to a problem slope, which may be of interest to other readers faced with a similar situation. For those who may wish to obtain copies of the barn plans, they're available for \$10.50 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

Last word on first GIs

John Fountain is absolutely correct about the origin of the term GI (*Letters*, page 6, Nov. '83). When I served in the Quartermaster Corps in the 1930s, the GI letters on Army supply cans *did* stand for "galvanized iron," not "government issue."

The containers were known as "GI cans" and the guys who had to scrub them out were jokingly referred to as "GIs." Later, the draftees of World War II inherited the nickname.

NICHOLAS J. CONSTANTINE
EDGEWATER, MD.

Paint stripper postscripts

Joseph Truini should be commended for his well-researched and informative article on paint strippers (*Paint Strippers: Beware The Hidden Hazard*, page 65, Oct. '83). I would like to clarify a couple of points.

The article stated that "short-term exposure to methylene chloride and methanol fumes causes light-headedness, nausea, mental confusion and irritation of the eyes and respiratory tract." These symptoms are actually the effects of *overexposure*, resulting from poor ventilation or careless application.

Also, there is no scientific evidence that exposure to methylene chloride while using good work practices and proper ventilation is harmful to persons with heart problems.

R. W. ZEMPEL
DOW CHEMICAL U.S.A.
MIDLAND, MICH.

Joseph Truini's article was outstand-

ing. As a lung specialist, I've seen many patients with toxic effects caused by paint stripper exposure.

CARL LAWYER, M.D.
PORTLAND, ORE.

As a health and safety professional, I feel obliged to add a postscript to Joseph Truini's excellent article. A respirator that does not properly fit the face of the user provides nothing more than a false sense of security. Your readers should know that all respirators, even those of the positive air pressure type, should be fit-tested before use to ensure the adequacy of the seal.

THOMAS D. HEROD
MINE SAFETY APPLIANCES CO.
MOUNTAINSIDE, N.J.

More bang for the buck

Your article *Tomorrow's Shifty Dog Fighters* (page 73, Nov. '83) provided valuable insight into modern military technology. But it makes no sense to arm an F-15 interceptor for ground-attack missions when three or four A-10s can be had for the same price.

The A-10 will remain an effective and relatively inexpensive response to vastly superior Eastern bloc ground forces for many years to come. It should not be phased out.

JOHN ROOKS
EDINBURGH, IND.

We did not suggest that highly specialized aircraft like the A-10 should be abolished. We merely pointed out that more versatile multirole fighters of the future will offer increased effectiveness

over a wider range of mission requirements, while also saving money—which should come as welcome news to taxpayers.

Since the Swedish J-37 Viggen and JAS-39 fighters were prominently mentioned in the story, it might interest your readers to know that both are built by the Saab Aerospace Div. of Saab-Scania, the same people who make the Saab 900 and Turbo automobiles.

LENNART LONNEGREN
SAAB-SCANIA OF AMERICA INC.
ORANGE, CONN.

Watch your language

You described the '84 Corvette as being "sexy" (*PM Owners Report: Chevrolet Corvette*, page 132, Nov. '83). I'm not sure what that means. Will the car replace my girlfriend? Will I get arrested for committing indecent acts in public while driving down the street? Such a car might be fun to own for a while, but I don't think I'd like it in the long run.

ED LOWE
HOLDINGFORD, MINN.

It's time for bullets

I want to congratulate you on your fine article on America's new bullet train (*Coming: The Fastest Train In The West*, page 90, Nov. '83). Obviously, we have been far behind Europe and Japan in efficient, high-speed rail service. I'm glad that we've finally learned our lesson.

JOHN L. FRETZ
SALEM, ORE.

Ford Escort Diesel: Better mileage than this leading import.



We didn't believe it at first, either.

But EPA testing figures established it. Our new Escort Diesel is rated approximately four miles per gallon higher than a Honda 750.*

Just take a look at our numbers:

46

EPA
EST.
MPG.

And because this diesel is an Escort,

68

EST.
HWY.

there's a lot more to talk

about than great economy.

Like the fact that Escort's the best-selling car in the world.**

Or that it comes with more total passenger room and more total cargo room than a Honda Accord.†

More standard features than a Toyota Tercel.††

There's even a fully independent suspension system for a smoother ride than a Nissan Sentra.

All of which means Ford Escort not only gives you a big advantage over that motorcycle pictured above.

It also beats more than its share of cars.

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When we say "Quality is Job 1," we are talking about more than a commitment. We are talking about results. A recent survey concluded Ford makes the best-built American cars. The survey measured owner-reported problems during the first three months of ownership of 1983 cars designed and built in the U.S.

And that commitment continues in 1984.

* For comparison, Honda 750 mileage is obtained from EPA emissions testing and is *not* an official rating. FS Diesel mileage applicable to sedans without power steering and A/C. Available for order. Your mileage may vary depending on speed, trip length, weather. Actual highway mileage lower. All Escort Diesel models except the FS available in California.

** Sales estimates based on worldwide production figures.

† Based on EPA Interior Volume Index.

†† Escort GL (shown) compared to Toyota Tercel 3-door deluxe liftback.

Get it together —
Buckle up.

Have You Driven A Ford...
Lately?



IMPORTS & MOTORSPORTS



New rotary racer



Formula Russell cars, with Mazda's 13B rotary engine, will compete in a new '84 racing series.

With the Jim Russell British School of Motor Racing running a car like this, I think it's time I went back for the refresher course. The rotary-engine Formula Russell will compete in a new Jim Russell/Mazda Pro Series for '84, filling the gap between amateur Formula Ford and professional Super Vee racing. Mazda's 13B Wankel is the

same engine used in RX-7s that have scored so high in IMSA, SCCA, PRO Rally and Daytona 24-hour races. Yep, count me in—and if you're interested, tell the school's president, Jacques Couture, that I sent you.

The school is located at Laguna Seca Raceway, 1023 Salinas Monterey Hwy., Salinas, Calif. 93908.

Future coupe

To some of us, a "coupe" will always be a gray-primed '40 Ford with dual, chrome-tipped pipes playing the music. Or, maybe it's a club coupe or business coupe—a '49 Plymouth perhaps—that downloads your memory bank.

Coupes aren't like that anymore, however. The clean coupe here is the latest design from Sergio Pininfarina. The four-place sports coupe uses Fiat Ritmo and Abarth mechanicals and the body achieves a .29 drag coefficient in the wind tunnel. Limited production with the Pininfarina nameplate is being considered.



Pininfarina coupe's camouflaged headlights shine through the fixed, body-colored slats.

Dueling turbos

Saab may be one of Europe's smallest automakers, but is its largest producer of gasoline-powered, turbocharged cars. Here, Saab Turbos have a visibility far beyond their numbers. It was only late last year that total Turbo production—began in 1977—hit 100,000. In contrast, this is the year that Detroit expects to sell as many as three times that number of turbos. Still, experience and success at making the best turbo car around goes to Saab.

Since the Swedish automaker started selling Turbos, I've asked: "Great performance, but would I want to own one?" The answer in '79 when I bought a nonturbo 900 was no. But a week driving an '84 Turbo recently changed that. Saab has tamed the turbo to the point where it is simply standard equipment—not an exotic and quirky add-on.

The second-generation APC (automatic performance control) Turbo was the convincer for me. Already, a third-generation turbo is in the works: It's a

twin overhead-cam, four-valves-per-cylinder powerplant that promises even greater gobs of smooth power with equal or better fuel economy. (When it's ready for production, I figure my normally aspirated '79 will be a good trade-in.)

New on Saab's '84 Turbo is one of the most perfect steering-wheel designs—in appearance, anyway. Func-



Great design of Saab Turbo steering wheel is nullified by location of horn buttons.

tionally, the horn buttons are in clumsy and dangerous positions on the spokes. Just try finding them in a curve when the wheel is turned and your safety may be at stake. I didn't face that situation, but I certainly raised the hackles of a lot of drivers who thought I was trying to honk them out of the way every time I accidentally bumped the buttons—unsafe at any position, annoying and embarrassing. There's only one place for a horn button—and it's not on a stalk, either.

Miami and Watkins Glen

The weekend of February 25 and 26 is the time to go on down to the Grand Prix of Miami for prototype sports cars.

In July, August and September, you'll find Watkins Glen back in business—not with a GP, but with IMSA and SCCA races. You can get the full schedule from Watkins Glen International, Box 500PM, Watkins Glen, N.Y. 14891. **PM**

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ALL OUTDOORS



Four-wheeler goes off-road and back

ATVs—all-terrain vehicles—have been made in all shapes and sizes. This year they get four wheels and a reverse gear in a new series from Suzuki. Quadrunners range in size and power from the diminutive LT-50 for the junior set at \$599 to the \$1,579 fire-breathing LT-185 for the aficionado who demands top performance.

ATVs with two, three and four wheels have become the workhorses of the farmer and the fun vehicles of outdoorsmen. They can become a sport and hobby in themselves (see *Riding The Mini-Baja Bashers*, page 100, Nov. '82) or the means of getting you to a remote fishing, hunting or camping site. They ford streams, climb rocks, wallow through mud and take you and your gear through just about anything a horse or mule could manage.

Suzuki motorcycle and ATV dealers have the reverse-gear machines now.



Independent front suspension and reverse gear to let you back out of anything make Suzuki LT-185 four-wheeler (above) the ultimate off-roader. LT-125 (left) also has a four-cycle, sohc, single-cylinder, air-cooled engine.

New old gun books



Outdoors enthusiasts may come across a valuable old gun and not know it. Now, two new large-format paperbacks can help turn that discovery into cash.

The third edition of *Flayderman's Guide To Antique American Firearms . . . and their values* does exactly what its title says. Just about any collectible firearm made or commonly used in this country before about 1920 is classified, described, photographed and evaluated. If there is any writing on the gun itself, you should be able to track it

down quickly through the index to a description which tells you roughly how many were made, what the measurements are, exactly what markings it should have, and its approximate values in very good and fine condition.

If you can't find the markings or read them, simply flip through the 624 pages of pictures and descriptions.

For example, the six-barrel, ring-trigger pepperbox on the cover is an Allen & Thurber .31 cal. with ivory grips, gold inlays and special engraving. The plain version with wooden grips should bring about \$550 in good condition and \$1,000 in fine condition. This ivory-gripped version is worth several times that much. This latest *Flayderman's Guide* lists for \$18.95 from DBI Books Inc., Northfield Plaza, Northfield, Ill. 60093.

Once you know what you have, Dixie Gun Works' *Black Powder Shooting And Antique Gun Supplies Catalog* is the source for original and modern-made spare parts, ammo and almost anything else imaginable related to original or replica firearms. The 1984 edition of this 560-pager is \$3 from Dixie Gun Works Inc., Gunpowder Lane, Union City, Tenn. 38261.

Nonflip trailer hitch

Towing a boat or trailer can turn a routine emergency maneuver into an upsetting experience—literally. It does not take much to set a typical trailer rocking or even to turn it over. A new trailer hitch patented by T. Richard Robe, dean of the College of Engineering and Technology, Ohio University, Athens, Ohio 45701, enables the trailer to turn over without taking the car with it.

Two additional degrees of freedom have been designed into this hitch. A pivot allows the ball to rotate a full 360° and springs and dampers allow a degree of lateral freedom to increase trailer towing stability. This is a design that should find a maker soon. **PM**



Swiveling hitch ball lets a trailer turn turtle without taking the car along with it.

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DETROIT LISTENING POST



Fiero Indy pacer

A radically modified Pontiac Fiero will pace the pack at the 1984 Indianapolis 500. The Fiero is the first four-cylinder car to pace the 500 since a Stutz did it in 1912.

For aerodynamic efficiency, the Fiero pacer has received a good dose of wind tunnel work, made easy by the car's bolt-on body panels. A new front end was fabricated to relocate the air intake lower in the air-stream, which gives the little stormer a more aggressive look. Side and rear skirts have been added, along with a fully functional rear-deck wing.

Most noticeable, though, is the neat rear air scoop jutting up from just behind the driver's head like an old Formula 1 car.

The scoop ducts air to the special 2.7-liter Four, which sports 232 hp at 6,500 rpm. Super-duty components used in the pace car engine include the block, a forged, fully counterweighted steel crankshaft and a special high-performance cylinder head. Torque is a stump-pulling 210 lb.-ft. at 5,500 rpm.

A thoroughly intelligent method for mounting the flashing safety lights was designed into the unique scoop. Using lighting units adapted from the wing-

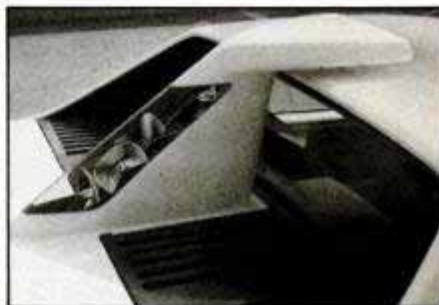


Pace car's low, aerodynamic nose was a simple swap due to bolt-on Fiero bodywork.

tips of a Boeing 747, the brilliant light built into the scoop's trailing edge marks the first time high-intensity strobes have been used on a pace car.

The Fiero chassis gets a special close-ratio manual transmission, high-torque axle shafts, wheel bearings from the Pontiac 6000STE, higher spring rates and extra reinforcement to the engine cradle. Delco/Bilstein high-pressure gas shocks help hold up the corners.

The Delco four-wheel discs with vented rotors use a truck-type electromagnetic power booster that does not



Air scoop houses strobe lights from a Boeing 747 in place of the usual rooftop light bar.

depend on engine vacuum. Goodyear 205/50VR16 Eagle GTs on 16x7-in. aluminum wheels direct the front wheels, trailed by 225/50VR16s on 16x8-in. wheels at the rear.

GM Project Saturn

General Motors has announced its intention of building yet another new small car to beat back Japanese competition.

The subcompact vehicle, dubbed only Project Saturn, is smaller than a Cavalier outside, but has almost as much interior space, GM said. "It will be called whatever Bob Stempel decides to call it," GM Chairman Roger



GM Saturn project is a front-drive subcompact that's even smaller than the J-car.

Smith says, which means that Chevrolet gets the car first.

In profile, the vehicle looks like a J-car with the Mazda 626 front end grafted on. Smith calls Project Saturn a "no-year" car, meaning GM will sell no Saturns before their time. The project has 325 high-tech types in its service, melding a triad of design-engineering-assembly concepts from the outset to produce the car as inexpensively and efficiently as possible.

The vehicle has three proposed versions: a front-drive, four-door sedan, a two-door coupe and a sports/utility vehicle. They will be powered by an aluminum, fuel-injected Four, coupled to an electronically controlled, four-speed automatic or a new five-speed/manual. Radical new manufacturing techniques—more precise casting and machining, major components sub-assembled off-line and bolted on in mod-

ules—represent a departure from usual GM processes. The new car is expected to achieve 45 mpg in the city and 60 mpg on the highway.

Another new Indian

Pontiac is going to play catch-up to Chevrolet in the sporting station wagon area. Now that Chevy has introduced its Eurosport Celebrity wagons, complete with the power and handling benefits the Eurosport sedan gets, Pontiac is seeking approval for its own A-wagon STE. It will get the 6000STE's 130-hp, HO V6, with suspension tailored for the kind of loads engineers figure folks will haul in a wagon. The A-wagon STE is sought for the 1985 model year. America can use all the better-performing grocery-getters Detroit can build.

(Please turn to page 16)

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DETROIT LISTENING POST

(Continued from page 14)

Ear to the ground

Tough tires: Motor Wheel Corp., an outfit that supplies many of the styled wheels the automotive industry uses, has been awarded a \$40 million contract to supply the Army with 220,000 "run-flat" wheels. The wheel is a Motor Wheel development, intended for service on the "Hummer" utility vehicle slated to replace the jeeps in this decade (see *The Jeep Is Dead, Long Live The HMMWV!*, page 89, Apr. '83).

According to military specification,

the wheels must be able to run 30 miles at 30 mph after a tire deflation. There is no truth to the rumor, however, that this wheel will be adapted for street use in urban environments.

Torkers: Available on production cars now as well as in parts departments is the *high-torque-capacity Dana rear end* for GM F-cars (Camaro/Firebird). The part, numbered 14044853, 14044854 or 14044855, offers final drives of 3.31, 3.92 and 4.09, respectively. It's a complete member with brake rotors and caliper brackets, but without the brake lines or calipers. Calipers from 1982, '83 or '84 F-car rear

ends are compatible with the piece, though our GM parts guru recommends the '84 units. The rear end was beefed in response to the debut of the 5.0-liter, high output, 190-hp L69 Chevy V8, with its 235 lb.-ft. of torque.

High and bright: The Department of Transportation has proposed a requirement for the 1986 model year that all new cars sport a *single, center-mounted brake light*, at or near the vehicle's rear window. This evolves from a study using New York City taxis, in which it was demonstrated that the third red eye can reduce rear end collisions. Car biz folks don't like it, but say it can still be done by '86. Depending upon which P.R. person one believes, additional cost to new car stickers will range from \$4 to as much as \$40 per vehicle. PM predicted these lights 3½ years ago (see *The Cars Of The '80s*, page 69, Jan. '80).

Rear-drive re-entry: Chrysler will begin production next month of the revived *Nowport rear-drive sedan*, planning on 9,500 for the '84 model year. Production was initially set at 13,000, and was to start in late January at Chrysler's Fenton, Mo., assembly plant. No reason is apparent for the revised timetable, and the company isn't talking.

Andy guns it: Andy Granatelli, perennial Indy entrant of the '60s, recently drove a "totally stock" '82 Camaro 184.238 mph at El Mirage dry lake in California. Andy turned another 800 rpm past the timing lights, and figures that his "commuter car" does an honest *211 mph*. Well, okay, the car did have a special twin-turbo 350 V8 built by Andy's son, V.J., of Tuneup Masters, a chain of auto tuneup centers that Granatelli now runs.

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Short drives

The '84 *Cadillac Sedan de Ville* is a very plush piece with a price tag to match. Its sexy moonroof leaked rainwater from the left side of the opening, but there are few more comfortable operating environments.

Dodge Daytona Turbo is not a Turbo Z killer, but who cares? Power from the 2.2-liter turbo Four offers a nice boost-in-the-pants feel, with good handling lacking any obvious vices. Rearseat headroom is the headache—literally: A 5-foot-9-inch woman learned it the hard way, as did her 6-foot-tall Marine date immediately following. A version tried by the New York office had many rattles, a defective passenger seatback and noticeable torque steer.

Pontiac Fiero is a good execution of the sports car theme, but needs the power that the pending HO V6 will give (the V6 turbo was shelved by the GM brass for being too fast). **PM**

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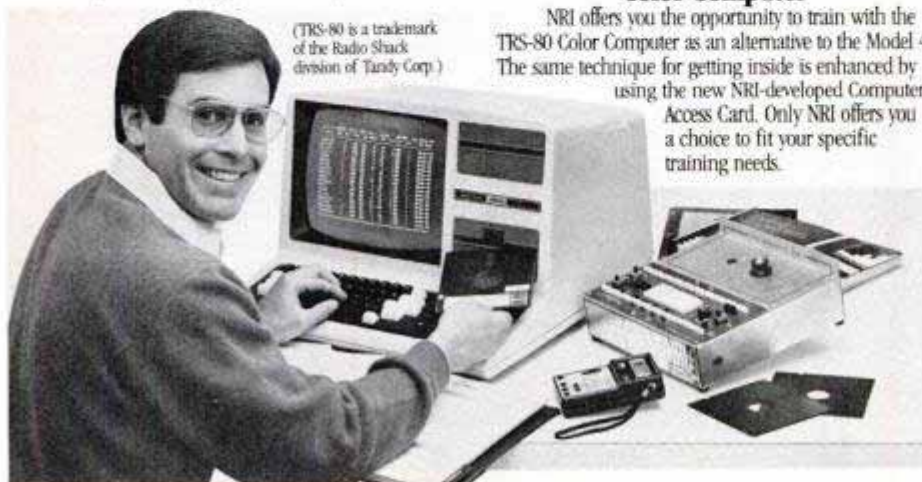
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Wishy washy windshield washer

Would you believe that the windshield washer of a 1982 Lincoln Continental, the Ford Motor Co. flagship, is causing a problem that no one can fix? The washing fluid oversprays the sides of the car by about 5 ft. on each side when I'm stopped at a light, wetting down cars or people alongside. The dealer claims nozzles aren't adjustable. He says I shouldn't use the washers unless I'm driving on the highway. That's ridiculous. When I'm in my compara-

tively inexpensive '80 Fairmont, I can wash the windshield standing still. Comments?—S. Volk, Livingston, N.J.

A source at Lincoln admits a faux pas was made when nonadjustable windshield washer nozzles were installed in the Lincoln.

An adjustable nozzle assembly that can be retrofitted may be in the works, but until it comes along—if it ever does—you'll have to put up with the inconvenience.

Don't knock it

My 1983 Chrysler New Yorker is equipped with a 2.6-liter engine which, when started cold, makes a loud knock for about three seconds. The factory representative tells me there's nothing wrong with the engine—that the knock is caused by initial oil pressure hitting the filter. Is he telling me the truth?—Ed Spencer, Panorama City, Calif.

He's probably right about not having to lose sleep over the knock, but his explanation leaves something to be desired. Chrysler thinks the knock is being caused by oil draining back as the engine sits idle. The partially dry bearings then make noise until they get a shot of oil when the engine starts. If you time it, I think you'll find that the knock stops in less than three seconds. In any event, in three years (that's how long this problem has been around) Chrysler says that no engine has failed because of it.

If the problem has been recognized, why hasn't it been fixed? The same problem in the 2.2-liter engine was rectified by installing a different oil filter adapter (part No. 4273323).

Well, the 2.2-liter is built by Chrysler—the 2.6-liter is a Mitsubishi engine, and the people in Japan don't believe the knock is caused by the

(Please turn to page 22)

Dance team

My 1982 Honda Civic has developed dancing fuel and temperature gauges, and mechanics I've consulted can't figure out why. The two needles waver in tandem. What's the reason?—Frank Lorenz, Dallas

The common denominator is a voltage stabilizer that serves both gauges. When it goes bad, voltage destabilization causes needles to waver or makes them soar to their maximum readings and stay there.

The fact that this voltage stabilizer exists is not spelled out in wiring diagrams, so it makes diagnosis difficult unless you know that it's an integral part of the fuel gauge. In order to clear up the trouble, you should replace the fuel gauge.

Braking away

At 18,000 miles, my 1982 Oldsmobile Firenza started having front-disc brake problems. The steering wheel shook uncontrollably when the brake pedal was applied, and I had to have the rotors turned—the dealer told me he couldn't find out why excessive heat had apparently caused them to warp. Pads, which were worn excessively, also had to be replaced.

The car now has 30,000 miles on it, and the problem is back. Pads are half worn and rotors are again warped. All other parts appear normal. I don't ride the brake pedal. Can you help?—Mark Daniels, Minneapolis


The brake pedal may be "ridden" for you by a brake light switch that wasn't installed properly during production. It

could be holding the pedal down a fraction of an inch—that is, just enough to keep the pads applied to the rotors. This would account for excessive heat, rotor warpage and abnormal brake-pad wear.

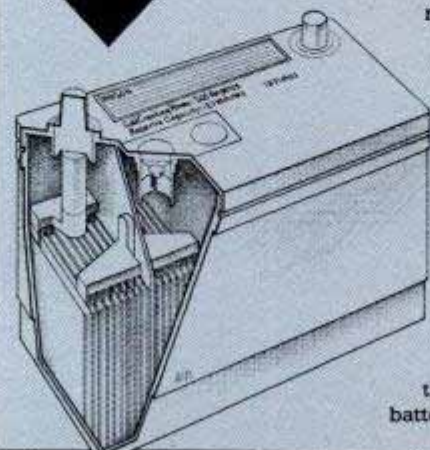
It's easy to find out if this is happening. Grab the brake pedal and pull it up. If you hear a click you just adjusted the switch to the correct setting and should be rid of this problem.

By now your rotors will probably have to be replaced. Many mechanics will not attempt to resurface badly warped rotors. They claim that, once a rotor has warped, it will do so again with little provocation, even after resurfacing.

PM CAR CARE



Hooray for CCA



Did you hear the one about the car owner who bought a new battery in the spring, had it work for him during the summer and autumn, and then fail the following winter? Why? Because he didn't realize that although the undersized battery he bought would work okay in warm weather, its power would drop as the ambient temperature fell. So, if you're replacing the car's original battery, make sure the number on the label of the replacement matches the number on the label of the old battery. If the battery you're replacing is an unknown entity, buy a new one with a cold cranking amperage (CCA) rating at least equal to engine displacement (in cu. in.). However, the CCA should never be less than 250. For instance, if your engine is 95 cu. in., buy a battery of at least 250 CCA. If the size of the engine is 350 cu. in., buy a battery rated at least 350 CCA.

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is hot, the taste is Kool.
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sensation this refreshing.



Kings, 17 mg. "tar", 1.1 mg. nicotine; Longs, 14 mg. "tar",
1.0 mg. nicotine av. per cigarette, FTC Report Mar. '83.

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

(Continued from page 20)

bearing. They think that, as oil pressure comes off the cam chain tensioner, the chain moves back into the housing. When the engine is started, the chain knocks against the housing until chain preload is returned to normal when the oil pressure builds up.

The matter is now under study in Japan. Until Chrysler and Mitsubishi resolve their differences, the knocking by 2.6-liter engines will continue. Stay tuned.

GM diesel dilemma

My husband and I bought a 1979 Oldsmobile Delta 88 diesel in May 1981 that had been driven 32,000 miles. When the odometer hit 37,500 miles, we had to replace a fuel pump. Since then, we've spent \$2,200 for repairs, and the engine is still not right.

I've written to GM three times and to the Federal Trade Commission, Consumer Protection Agency and Department of Transportation. No one can help us. I have all our receipts and several articles regarding what has become an infamously defective engine. Can you tell us where to turn?—Mrs. Robert Hegan, Winsted, Conn.

I wish I could wave a magic wand and convert this diesel back to what it should have been left as—a gasoline engine. The root of this disaster was, apparently, converting a gasoline engine to diesel use.

Many people with this problem can take GM up on an offer of an engine rebuild, but not those with 1978 or 1979 models. If you own a 1980-83 5.7-liter V8 diesel, you can replace it with a rebuilt diesel for \$1,200-\$1,600. You get a new block and the internal guts. Bolt-on items (manifolds, fuel-injection pump, fuel-injector nozzles, water pump, flywheel, and so on) that are still in good condition will be transferred from the old diesel to the new engine.

The Olds diesel can be made to run reasonably well, but not every GM dealer or independent mechanic is skilled enough to do the job correctly. Tolerances are critical in this engine, especially in the cylinder heads. It's also critical to use the correct head gaskets. On early engines like yours, the head bolts must be replaced with revised, late-model types.

The fuel pump is another matter. Early models were subject to failure.

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.

PM CAR CARE

TIP

Coping with an emergency

Here's a tip to tear out and tuck into that file marked "just in case." Just in case you accidentally break off a key in a door lock, file down a piece of old coping saw blade to about half its normal height and keep it handy. Carefully insert the blade in the keyhole until its teeth engage the key.

Draw the broken key from the lock until its end protrudes enough to be grasped with a pair of needle-nose pliers. Don't discard the two broken pieces of the key just yet—not unless you have a duplicate. You need them to give to a locksmith so he can make a new key.

But after repairs have been made, the pump should outlive the vehicle. If the fuel pump and its nozzles work correctly and the engine maintains a compression seal, it should at least work reasonably well.

On the other hand, there are some durability problems over which you have little control, like the alleged tendency for the main webbing to crack. If you feel that the entire package is failure-prone and you have exhausted other avenues of appeal, you may want to take legal action against GM. Such cases could drag on into the next decade, but if you're interested in pursuing the matter, get in touch with the Center for Automotive Safety, 1346 Connecticut Ave., Washington, D.C. 20036. Attention GM Diesel Project. A staff member will advise you on what to do.

Trouble is brewing

My 1982 Renault 18i has been driven 7,500 miles and by now has gobbled a fuse for every mile—well, almost. The fuse I'm referring to is the one for the clock, cigarette lighter and interior lights. It insists on blowing once or twice a day.

The dealer tells me he can't explain why it's happening, but he says I must replace the fuse when it blows. If I don't, the battery will go bad. Your advice would be appreciated.—Betty Abrew, McMurray, Pa.

The battery won't drain if the fuse is bad. I don't understand why the dealer told you this. In any event, there are three reasons why this fuse is blowing consistently: First, you may be installing an underrated fuse—one rated at 8 amps. is needed.

Second, if the fuse is the correct size, there may be an intermittent short in the circuit. The wiring diagram will be needed to trace the circuit and find the

spot where a bare wire is exposed. It may only contact a ground occasionally, such as when the car turns or bounces.

Finally, the manufacturer started installing a different fuse panel midway through the production run, because earlier panels were faulty. Your car may have one of the bad ones. If the first two suggestions don't help, ask your dealer to call the Repair Methods Dept. at AMC/Renault in Detroit to find out if the new panel will work in your vehicle. **PM**

SERVICE TIPS

- If your 1983 Chevrolet Chevette or Pontiac 1000 L-4 engine is hard starting when cold and shows signs of sparkplug fouling, replace the original plugs, which are R42TS, with plugs having copper-core center electrodes (R42CTS).
- A hammering sound from the 2.3-liter engine of a Ford Tempo or Mercury Topaz built after June 20, 1983, is probably a fuel-line knock caused by high fuel-flow pressure in the fuel-return line. Replace the fuel filter with part No. E43Z-9155-C.
- A 1982 GM X-body model with a 2.8-liter, V6 engine may have fuel-line knock, too. It's loudest after a cold start and may be coming from the fuel pump. If the noise disappears when the flexible fuel-return line is compressed momentarily, install a restrictor (part No. 3992372) in the return line.
- Do you have a buzz or rattle coming from underneath your Chrysler Corp. car when the engine is revving at 1,200-1,500 rpm? The problem is in cars with 2.2-liter engines built after Mar. 15, 1982. The noise may be caused by a loose catalyst air-injection distribution tube. To find out, wait for the catalyst to cool and then tap it lightly with a rubber mallet. If you hear a rattle, have it repaired as outlined in technical service bulletin 11-01-83.

Save Gas, Save Engine with 'POLY'

The following introduces one of the most fully tested and credentialed gas-saving, friction-reducing engine treatments ever to reach the market!

WHAT IS POLY? "Poly" is short for polytetrafluoroethylene (TFE). It is the slipperiest substance known to man (1981 Guinness Book of World Records, p. 188). The Petrolon Corporation, makers of Slick 50, has invented a way to permanently bind this slippery chemical to your engine with one treatment. All you do is add one quart of Slick 50 to your oil during oil and filter change. By reducing engine friction, Slick 50 increases gas mileage and horsepower and reduces engine operating temperature, thus causing your oil and engine to last longer. Just as important, it reduces metal wear, defraying costly overhauls.

HOW DO I KNOW THIS ISN'T A FRAUD? Slick 50 has some very impressive credentials. The "Consumers Digest" magazine (March/April, 1982, p. 35) states "Slick 50 does reduce engine heat and ordinary wear, and our informal tests indicate that it will improve gas mileage by about 2 or 3 miles per gallon." Researchers at the Franklin Institute Research Laboratory, after applying a powerful ultrasonic cleaning process to a Slick 50 treated engine, were surprised at its permanence. They stated, "We actually expected the Petrolon Slick-50 TFE Resin coating to also be removed, but later found it was still there."

The FAA (Federal Aviation Administration) has fully accepted Slick 50 Aircraft Piston Engine Treatment (F.A.R. #33.49). An FAA test simulating 1400 hours of engine use (equivalent to about 70,000 miles on a car) showed almost zero engine wear!

2500 miles after removing Slick 50 from the crankcase, lab tests at a leading university engineering experiment station showed that the benefits of Slick 50 were still there. They reported a horsepower increase of 16.9% and 9.9% for light and heavy loading respectively. The senior engineering researcher at the University of Southern California in San Diego stated this, "Slick 50 does increase horsepower and decreases fuel consumption in tests done at the university." The Space Shuttle Columbia uses the chemical "poly" in its gears and bearings because it is the only chemical lubricant which can withstand the heat and corrosive elements of space.

Perhaps most dramatic of all is a tor-



ture test overseen by the Automotive Services Council for Pennsylvania and shown on television station WTVE. Three cars with between 75,000 and 129,000 miles on them were treated with Slick 50. Six months later the oil was drained from each vehicle, and the cars were driven without the oil plugs for about a half hour. The water temperature never rose, and the engines sustained no apparent damage. There are many more tests available. If you are still skeptical, send \$2.00 to defray printing and postage costs, and we will send you additional, more detailed test information, etc.

HOW DO YOU TREAT AN ENGINE? Very simply. A few minutes before oil and filter change, add engine flush (sent free with each order) to clean out the engine. Let the engine idle for 10 minutes. Then drain the oil, change the filter, and add the proper amount of oil less one quart. Add one quart Slick 50, drive for 30 minutes, and leave it in the crankcase for 3,000 miles. As the engine operates, the oil carries the polytetrafluoroethylene between the parts where it is burnished into the pores of the metal. Once impregnated, it is permanent, so you do it only once, not each time you change oil. One quart of Slick 50 will treat all standard 4-, 6-, and 8-cylinder gasoline and diesel engines.

WILL IT WORK WITH MOST OILS? Yes, Slick 50 will work with all petroleum-based oils and all synthetics that are compatible with petroleum-based

oils. An exception is graphite oils. However, once an engine is treated, you can go back to a graphite type if desired.

WHAT ARE THE BENEFITS OF SLICK 50? Your actual benefits in percentages may vary, depending on the kind of driving you do, vehicle condition, weather, and geographic area. By reducing friction, Slick 50 does all of the following: It increases gas mileage. It increases horsepower—small economy cars and large RV's really need this! It reduces operating temperatures, thus increasing the lubrication and life of the oil and the engine. Last but not least, the drastic reduction in engine wear defrays or eliminates costly overhauls which could save you up to \$1,000. Slick 50 eliminates the "lubrication starvation" that all cars experience when first started before the oil has a chance to circulate. Up to 90% of the engine wear on a car can be caused by this lubrication starvation. You receive all of these benefits for \$33.95, less than the cost of two tanks of gas.

WILL SLICK 50 HARM MY ENGINE OR AFFECT MY WARRANTY? No! Slick 50 is suspended in an excellent grade of petroleum oil which meets or exceeds every manufacturer's engine warranty requirements. In addition, Slick 50 is the only product of its kind to have both an API (American Petroleum Institute) and an SAE (Society of Automotive Engineers) rating imprinted on the package. It also has a SF-CC-CD service classification.

ARE DEALERSHIPS AVAILABLE? Yes. Here's an opportunity to make handsome profits. Having such solid test results from major institutions makes Slick 50 easier to sell than many other products. Free dealership information is sent upon request.

Free engine flush sent with each order. Free shipping with orders of 2 or more.

For purchase or further information, call toll-free 1-800-525-8624 (in Colorado call 1-303-762-1385) or send to SLICK 50, 3148 S. York St., Englewood, CO 80110.

I enclose \$33.95 + \$3.00 shipping and handling.
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WORKSHOP MINICOURSE



Priming before painting

Among the numerous activities tackled by the do-it-yourselfer, painting is probably the most common of all. Modern paints excel in quality and dependability and, therefore, the occasional poor job can rarely be blamed on a faulty product. When problems do arise they are usually caused by the improper use, or complete omission, of a compatible primer.

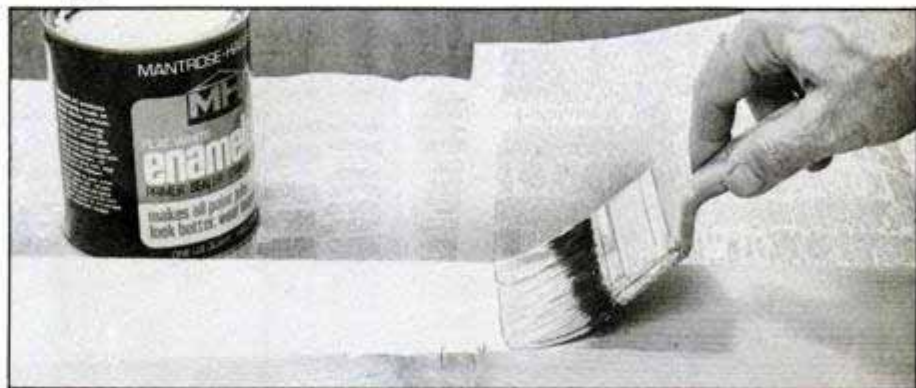
The most basic function of all primers is to promote a better bond between the paint and the surface being painted. Because primers are made in a wide variety of formulations your choice depends on both the surface being painted and the type of paint being used. Generally, the label on the paint you select will indicate the correct primer; sometimes all you'll need is a thinned-down coat of the paint. Here are some basic guidelines.

On new woodwork, the first coat should always be a primer. If knots, sap streaks, or pitch pockets are present, these should be spot-sealed with shellac *after* the prime coat. Otherwise the resins in these defects can bleed through and stain the paint. Cracks and holes should also be filled after priming. When the filler is dry and sanded smooth, it must be spot-primed before painting.

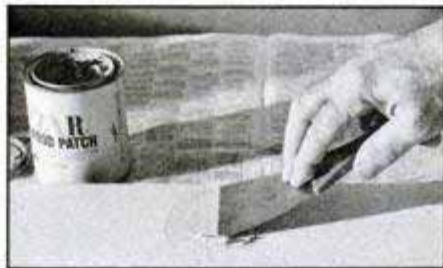
If the coating is intact on previously painted surfaces, it can serve as an effective primer as long as it's been thoroughly cleaned and lightly sanded before painting. However, peeled or blistered areas of old paint must be scraped down to the bare surface, then sanded to a feather edge to match the adjacent areas. If sanding is omitted, the scraped area will stand out.

When painting new gypsum wallboard, avoid the use of solvent-thinned primers. These will raise the surface fibers on the wallboard panels and give your finished job a "fuzzy" look. Instead, use a latex-base primer, which can be covered with latex, alkyd, or oil-base paint.

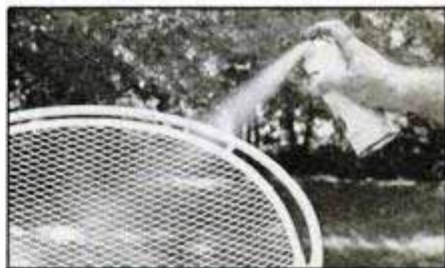
Masonry surfaces such as concrete, brick, stucco and cement block present a special problem. These contain alkali which can break down paint and cause premature failure. For these jobs, use an alkali-resistant primer. **FM**



Knots exude resins which can stain most paints. Using a shellac-based primer (as shown) or just spot-priming with plain shellac after a prime coat will prevent the problem.



Contrary to common belief, you should fill cracks, checks, holes and other depressions *after* priming to achieve the best bond.



Metal primers effectively inhibit rust formation if all rust has been removed first. A spray primer is ideal for intricate work.



On extremely rusty projects, like the hand truck above, complete rust removal is too difficult. Instead, brush off the loose rust with a wire brush, then apply rusty-metal primer. Its fish-oil base penetrates through rust and drives out all of the air and moisture.



Before painting masonry, remove all peeled paint, grime and mildew. Use a stiff brush and a solution of 1 cup bleach, 1/2 cup detergent, and 1 gal. water. Allow to dry, then spot-prime the exposed masonry with an alkali-resistant acrylic primer.



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RAMCHARGER 4x4

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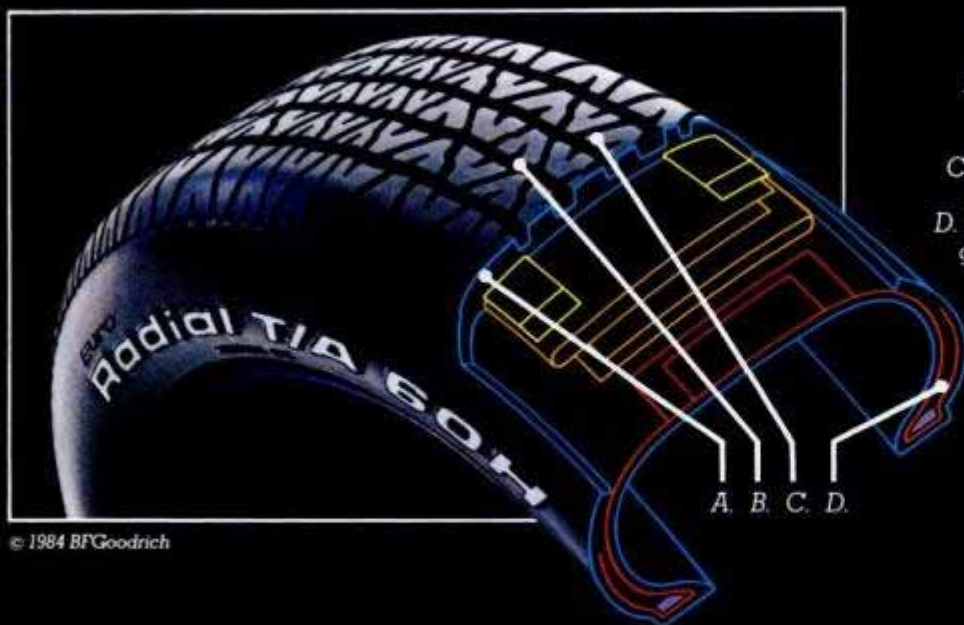


BF GOODRICH INTRODUCES AN EXCITING, SPEED-RATED TIRE FOR HIGH-PERFORMANCE SPORTS COUPES: THE NEW RADIAL T/A® 60H.

The new Radial T/A® 60H—and new Radial T/A® 70H—were designed specifically for outstanding car performance. Professional test drivers recently tested the Radial T/A 60H on unmodified foreign and domestic sports coupes. The result: impressive performance. The test vehicles generated as much as 0.812 g's during lateral acceleration under dry road conditions and as much as 0.768 g's in the wet. 60 to 0 mph dry stopping distance was as low as 158.0 feet. Most importantly, in autocross and road course evaluations, the tire provided the cars with a high level of predictability and control at the limit of adhesion.

The new speed-rated Radial T/A 60H and Radial T/A 70H are engineered with advanced materials and technology:

- A. Special tread rubber compounds promote outstanding traction.
- B. High void-to-rubber ratio reduces hydroplaning for optimal wet traction.
- C. Computer-optimized tread design offers excellent handling.
- D. High modulus bead fillers help generate quick steering response.



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The new BFGoodrich Radial T/A 60H and Radial T/A 70H—a unique combination of advanced handling characteristics derived from the world-recognized Comp T/A,[®] raised white letter styling, and the European H speed-rating. These tires are designed to make sports coupes perform.

WE MAKE CARS PERFORM

SCIENCE WORLDWIDE



From blast to gas to glass

A breakthrough in packaging nuclear waste may settle one of the biggest problems associated with operating an atomic power plant. Called In-Situ Waste Vitrification, the process employs a hot blast of electricity to turn buried nuclear wastes and the surrounding soil into a molten, gaseous soup. The soup becomes obsidian-like glass after it cools down and the gases condense. The process was awarded U.S. Patent No. 4,376,598 late last year, with a team of scientists at the Department of Energy's Pacific Northwest Labs getting the credit.

To make the glass, a power plant would bury spent fuel in a pit 4 to 7 feet deep. Then the pit would be capped with a square rig that has what



Vitrification rig (left) uses four giant sparkplugs to heat buried nuclear waste and surrounding soil to 2,500° F. Result is obsidian-like glass encasing the waste (right).

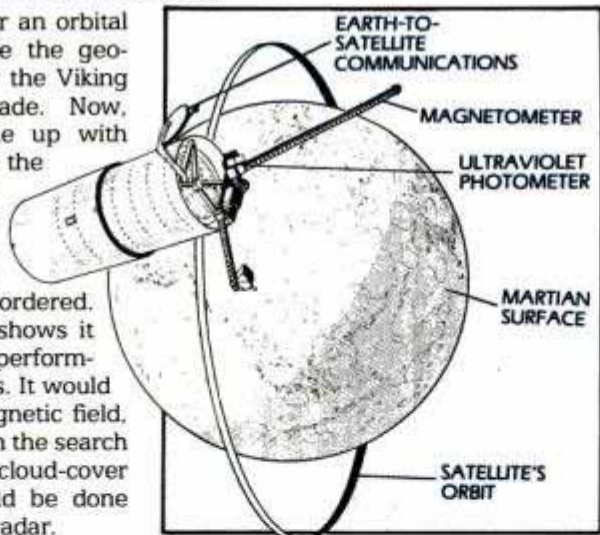


amounts to a giant sparkplug at each corner. When turned on, the four sparkplugs heat the ground to 2,500° F. Tests by Battelle Memorial Institute sci-

entists indicate the glass would contain spent nuclear fuel. Further tests are under way to establish how long the protection lasts.

The search for a new Mars orbiter

NASA has been looking for an orbital vehicle that would resume the geophysical studies started by the Viking project of the last decade. Now, Hughes Aircraft has come up with what NASA insiders say is the right rig. The Mars Geoscience Orbiter, still on the Hughes drawing boards, could be ready for orbit within two years after it's ordered. The drawing at the right shows it would make a polar orbit, performing a wealth of experiments. It would take readings of Mars' magnetic field, hydrogen content (to help in the search for surface water) and cloud-cover thickness. The latter would be done with infrared sensors and radar.



Smell the noise . . .

Will the sound of a high-powered siren clean up the air you breathe? Penn State researchers working with fly ash have found that a loud sound blast leads to "acoustic agglomeration," which means the particles collide and stick together, making them heavier and easier to collect out of the air. Will it work with other particles? Will the bad effects of noise pollution cancel out the cleanup's desirability? Stay tuned for further research.

Greenhouse effect defect?

Is the widely publicized "greenhouse effect" a real threat to the planet Earth? Some scientists say it is. With the greenhouse effect, carbon dioxide released in the atmosphere locks in infrared waves and warms the planet. This, the theory says, could lead to dangerous changes in the global weather. But a National Research Council report suggests that CO₂ may not be the culprit some say it is. In fact, the report says, science knows so little about the actual effects of CO₂ that we'd be wise to await further research before taking remedial action.

The council report does note that continued use of fossil fuels is likely to double atmospheric CO₂ concentrations within 100 years. **PM**

Ex libris Bobcat



Photo by Frank Lusk

Isaac Asimov searches NYU's 350,000-book card catalog, the first to go on computer.

Bobcat is the name of the newest computer at New York University. The "Geac 8000" computer and the first of its 100 terminals were introduced by guest speaker Isaac Asimov at a ceremony. The system uses two central processing units to catalog the 350,000 books at NYU's Bobst Library. Other universities have parts of their libraries on computer, but NYU is the first to get its entire catalog on line. Study time, officials estimate, may be cut by 45 percent thanks to the computers.

when I planned to retire before fifty

this is the business that made it possible

a true story by John B. Haikey

Starting with borrowed money Duraclean gave me the opportunity for financial security...
In eight years I sold out at a profit and retired.



"Not until I was forty did I make up my mind that I was going to retire before ten years had passed. I knew I couldn't do it on a salary, no matter how good. I knew I couldn't do it working for others. It was perfectly obvious to me that I had to start a business of my own. But that posed a problem. What kind of business? Most of my money was tied up. Temporarily I was broke. But, when I found the business I wanted I was able to start it for a small amount of borrowed money.

"To pyramid this investment into retirement in less than ten years seems like magic, but in my opinion any man in good health who has the same ambition and drive that motivated me, could achieve such a goal. Let me give you a little history.

"I finished high school at the age of 18 and got a job as a shipping clerk. My next job was butchering at a plant that processed boneless beef. Couldn't see much future there. Next, I got a job as a Greyhound Bus Driver. The money was good. The work was pleasant, but I couldn't see it as leading to retirement. Finally I took the plunge and went into business for myself.

"I managed to raise enough money with my savings to invest in a combination motel, restaurant, grocery, and service station. It didn't take long to get my eyes opened. In order to keep that business going my wife and I worked from dawn to dusk, 20 hours a day, seven days a week. Putting in all those hours didn't match my idea of independence and it gave me no time for my favorite sport—golf! Finally we both agreed that I should look for something else.

"I found it. Not right away. I investigated a lot of businesses offered as franchises. I felt that I wanted the guidance of an experienced company—wanted to have the benefit of the plans that had brought success to others, plus the benefit of running my own business under an established name that had national recognition.

"Most of the franchises offered were too costly for me. Temporarily all my capital was frozen in the motel. But I found that

the Duraclean franchise offered what I had been looking for.

"Only \$5,900 starts you in your own business. And, if you qualify, Duraclean has enough confidence in your success that they will finance the balance. The total cash investment is \$14,800.

"I could work it as a one-man business to start, and operate from my home. No office or shop or other overhead, no salaries to pay. Equipment would fit in my car trunk. (I bought the truck later, out of profits.) Best of all, there was no ceiling on my earnings. I could build a business as big as my ambition and energy dictated. I could put on as many men as I needed to cover my volume. And I could build little by little, or as fast as I wished.

"So, I started. I took the wonderful training furnished by the company. When I was ready I followed the simple plan outlined in the training. During the first period I did all the service work myself. By doing it myself, I could make much more per hour than I had ever made on a salary. Later, I would hire men, train them, pay them well, and still make an hourly profit on their time that made my idea of retirement possible—I had joined the country club and now I could play golf whenever I wished.

"What is this wonderful business? It's Duraclean. And, what is Duraclean? It's an improved, space-age process for cleaning upholstered furniture, rugs and tacked down carpets. It not only cleans but enlivens and sparkles up the colors. It does not wear down the fiber or drive part of the dirt into the base of the rug as machine scrubbing does. Instead it *lifts out* the dirt with absorbent dry foam.

"Furniture dealers and department stores refer their customers to the Duraclean Specialist. Insurance men say Duraclean can save them money on fire claims. Hotels, motels, specialty shops and big stores make annual contracts for keeping carpets and furniture clean.

"Well, that's the business I was able to

start with such a small investment. That's the business I built up over a period of eight years. And, that's the business I sold out at a substantial profit before I was fifty."

Would you like to have the freedom and independence enjoyed by Mr. Haikey? You can. Let us send you the facts. Mail the coupon, and you'll receive all the details, absolutely without obligation. No salesman will ever call on you. When you receive our illustrated booklet, you'll learn how we show you STEP BY STEP how to get customers; and how to have your customers get you more customers from their recommendations.

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APPLIANCE CLINIC



Gas clothes dryer wants to rest

We are having problems with our Montgomery Ward gas dryer, which is model No. LNC-8339A80, serial No. 97C028302. After drying two or three loads consecutively, the dryer stops and refuses all attempts to restart it until sufficient time has passed for it to cool down. It will then restart and dry normally. Any idea what the problem is?—Rick Cuevas, Houston

It sounds as if you have a vent restriction either in the exhaust vent system or in the lint collector duct in the dryer. (This also occurs in electric

dryers, and the solution is similar).

After you've unplugged the dryer, disconnect the 4-in. exhaust tubing from the unit. Vacuum the duct thoroughly and make sure the flapper in the vent hood is clean and that it moves freely. Now take the front panel off the dryer. Insert a putty knife about 4 in. from each corner between the top and front panels. Press in and pop the top open. Lift the top back.

Next, remove the four 1/4-in. screws, two on each inner side of the front panel near the top. Then remove the two

Phillips-head screws on the bottom of each corner of the front panel. Pull the front panel slightly away at the top. Disconnect the door switch leads and lift off the front panel. This will give you access to remove accumulated lint.

Vacuum in and around the motor carefully. Use caution when vacuuming around the gas valve. Be sure not to strike any part of the igniter coil with the vacuum hose. The igniter is very brittle and will break. Reassemble the dryer. If you are using flexible vinyl duct, replace it with smooth aluminum 4-in. duct or heavy-gauge flexible aluminum duct.

Microwave oven timer

I am having difficulty with the timer on my Hotpoint microwave, Model R-E930-OT2, serial No. 04904786-R. When it is set for a specific number of seconds, it sometimes doesn't activate, although the microwave is actually operating satisfactorily. Also, shortly after it was new it developed a small hole—smaller than a pinhead—in the bottom surface of the cooking compartment. Can this be harmful?—R.G. McCahan, Valdez, Ark.

I checked with Hotpoint. The people there seem to think that the electromechanical digital timer may be suffering from worn gears inside the timer mechanism. The pinhole in the oven bottom may have been caused by either the meat probe falling out of the food and touching the oven bottom, causing an arc, or the improper use of aluminum foil in the oven.

The company suggests that you place a cup of water in the oven for 20 to 30 seconds. Open the door and feel around the pinhole spot. If you feel any heat in the area, have the glass bottom replaced. To find out if the pinhole is harmful, have your authorized Hotpoint service person look at the oven.

More on vacuum pumps

I have received many letters regarding the answer I gave to James Wong in his search for an inexpensive vacuum pump for refrigeration work ("Pump From Vacuum Cleaner," *Homeowners' Clinic*, page 16, Sept. '83). Readers have suggested using piston-type automotive compressors, old refrigerator

compressors and air-conditioner compressors as vacuum pumps.

When repairing a refrigeration system, you need a vacuum pump that will evacuate contaminants such as non-condensable gas, air and water. In order for dehydration to take place in the system, you need to attain a vacuum of 29.25 in. or better. A rotary-vane vacuum pump designed for refrigerator work has the capacity to pull down to a 29.8-in. vacuum and dehydrate the system.

To accurately check a vacuum, use a mercury closed-end manometer. An ordinary refrigeration gauge is not accurate enough at such low vacuums.

The piston-type compressors on some automotive compressors or in refrigerators and air conditioners are of the reciprocating type. These pumps don't have the capacity to pull a vacuum exceeding 28.5 in. and are not recommended for use in sealed system repair.

Insensitive responder

We have a General Electric built-in cooktop, Model JP6610V2HA, serial No. RA757501-G, with an automatic surface unit. We've had numerous problems with the sensor and the responder for the automatic surface unit. I replaced the sensor unit recently. Now it seems that the responder needs repair again. A local appliance parts dealer suggested that I convert the automatic surface unit to a regular burner by installing a jumper wire on the burner connector and using a regu-

lar-type switch. What do you think?—Joseph R. Zombro, Cumberland, Md.

General Electric makes a burner conversion kit which converts the automatic surface unit switch to a regular surface burner. The kit is designed to adapt to certain models of cooktops. Unfortunately, GE does not make a kit to fit your model. The problem is that the mounting holes for the responder switch may not line up with the mounting holes of the replacement switch and the switch shaft heights are different.

If your parts dealer can supply you with an infinite heat switch that will handle the wattage of the burner as well as line up with the mounting holes at the proper height, I see no reason why it can't be done. However, contact a qualified service technician to make the change.

SERVICE TIP

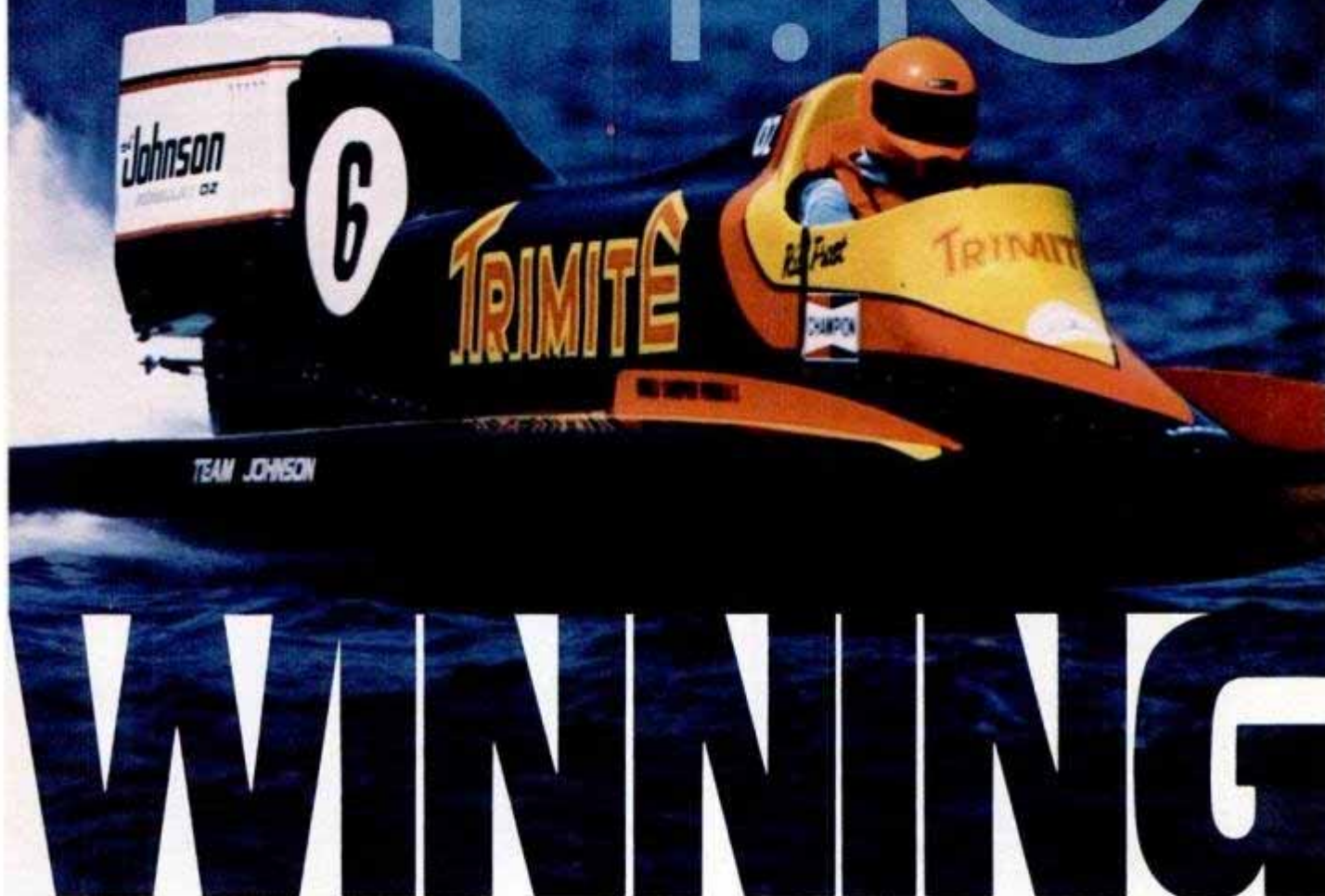
Whirlpool has put out a new booklet, *Nice Things To Know About Moving, Storing And Winterizing Home Appliances*. It gives general information on how to prepare your major appliances for moving and how to winterize or store appliances.

The booklet is helpful not only for people moving to a new home, but for those who will be away for a while. To receive your free copy, write to Appliance Information Service, Administrative Center, Whirlpool Corp., 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. Problems of wide interest will be discussed in this column.

144.16

WORLD
SPEED
RECORD



Records are made to be broken, and some Johnson outboards are made to break records. Our Johnson V-8 racing machines, for example.

A Johnson V-8 powered Rick Frost to his single outboard world record speed run of 144.16 mph at Lake Windermere, England. It was the average of runs of 146.2 and 142.1 mph over the 1 km course.

And Johnson V-8 outboards have been dominating the prestigious Formula 1 boat race circuit around the world.

Recently, in Houston, a 30-ft. hull powered by four Johnson V-8s enabled driver Jimbo McConnell to compete successfully in the first APBA Unlimited race in which outboards were allowed. He took second place, averaging 99.282 mph.

At Johnson we race to win. But we race to learn, too. The heat of competition helps us develop better performing outboards for fishing, skiing and cruising.

And now Johnson offers two production, competition-class V-6 outboards. The 2.6 GT is designed for high performance hulls, and the GT 150 for tournament bass boats. Both have powerhead and lower unit features right out of the race/prep handbook.

When Johnson wins in competition, you're the one who gets the trophy.

For your local Johnson dealer's name, call 800-447-2882.

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THE PM GARAGE



Molding guide gets it straight

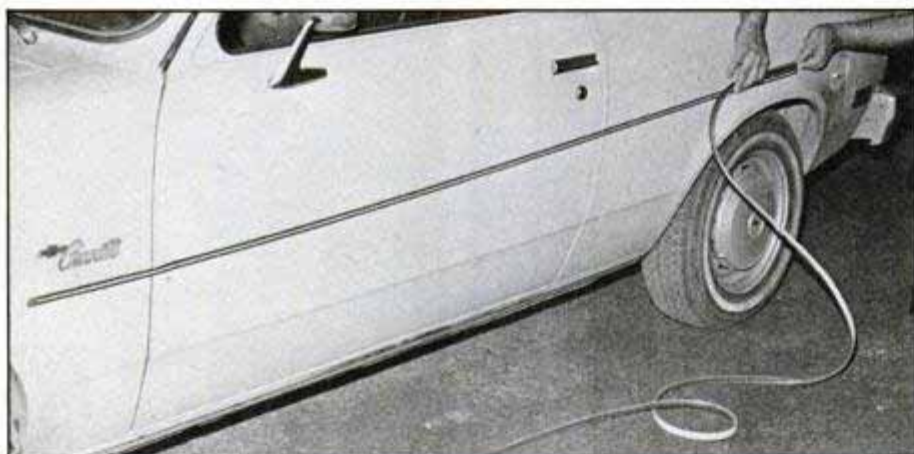
Installing self-adhesive body side moldings is a seemingly simple job that can turn out to be anything but. The hard part is keeping the molding aligned as you peel off the protective paper to expose the adhesive, then press the molding into place. Once the molding is stuck, you often can't loosen and reposition it.

A new flexible plastic magnetic guide makes the job a lot easier. Nearly 7 ft. long, the guide adheres to the body sheet metal and can be positioned any way you wish. If you want to give the molding an upward or downward

curve, you can twist the guide to see how it will look before you apply the molding. The guide is thick enough to provide an edge to lean the molding against for precision positioning, much better than you ever could do with a masking tape guide, for example.

At \$15.50 list, the guide isn't cheap, but you can use it over and over on steel-body cars. Naturally, it won't stick to plastic or aluminum bodywork. The manufacturer is K-D Tools Inc., 3575 Hempland Rd., Lancaster, Pa. 17604. The guide is sold in auto parts stores.

—Paul Weissler



Magnetic guide provides a thick, straight edge to lean on when installing molding.

Oil change aid

It used to be that you needed an automatic transmission funnel to reach the oil-filler hole in my Firebird 400 V8. This meant storing an oily funnel in the trunk.

Rockford Enterprises Inc. has come up with an alternative. Their Extendo-Tube is a 4-in. steel pipe which raises the oil filler cap well above its original position.

It requires no tools to install. You simply unscrew the oil filler cap and screw the Extendo-Tube into the filler hole. Then, screw the cap onto the top of the tube.

Extendo-Tube is currently available for all GM, Chrysler and AMC cars. Ford products are next in line.

It's available in chrome or matte

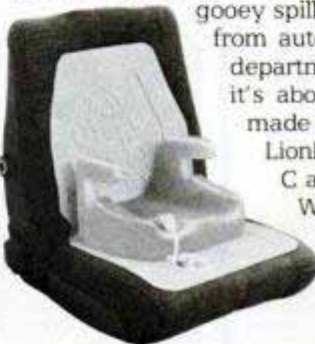
black for \$7.95 at most auto parts stores or from the manufacturer: Rockford Enterprises Inc., 10399 Northland Dr., Rockford, Mich. 49341.—Robert Lamm



Extendo-Tube lifts oil filler hole up to where you can reach it on many engines.

Guard for restraints

Child restraint devices are required in 41 states. While they do an excellent job of protecting children in a crash, they can also do a job on your upholstery. Tubular metal legs leave lasting impressions, and kids seem to eat (and leave behind) the darnedest things. Seatsaver is a rubberized mat that fits under almost any restraint seat and protects upholstery from wear, tear and



gooey spills. Available from auto parts and department stores, it's about \$12. It's made by Prince Lionheart, 2301 Cape Cod Way, Santa Ana, Calif. 92703.

—W.H.

Seatsaver protects upholstery from melted ice cream and other juvenile effluent.

A.C.-D.C. converter

It's easy to power portable TVs and other d.c. appliances from your car's cigarette lighter by using this converter. The unit has three voltage settings, 12, 9 and 6 volts, with power outputs of

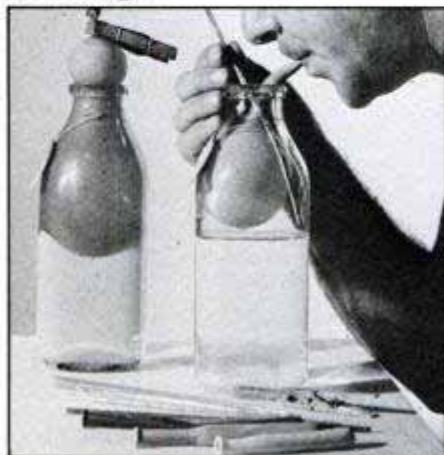


Switchable converter has 6-ft. cord and a four-pin power plug to fit most appliances.

3 amps, 900 ma. and 600 ma., respectively. You can find the converter at electronic and audio outlets such as Radio Shack. The list price is \$12.99. The unit is made by A.G. Busch & Co. Inc., 6060 Northwest Highway, Chicago, Ill. 60631.—Cliff Gromer

PM PHOTO HINTS

Blow-up!



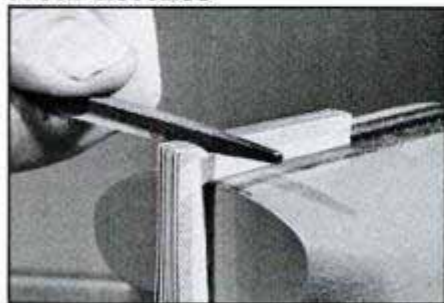
Air in a bottle can destroy a developer or other darkroom chemicals. Inflating a small balloon inside the bottle displaces air (the plastic straw lets the air escape) and allows you to seal the container.—*Louis Hochman*

The right angle



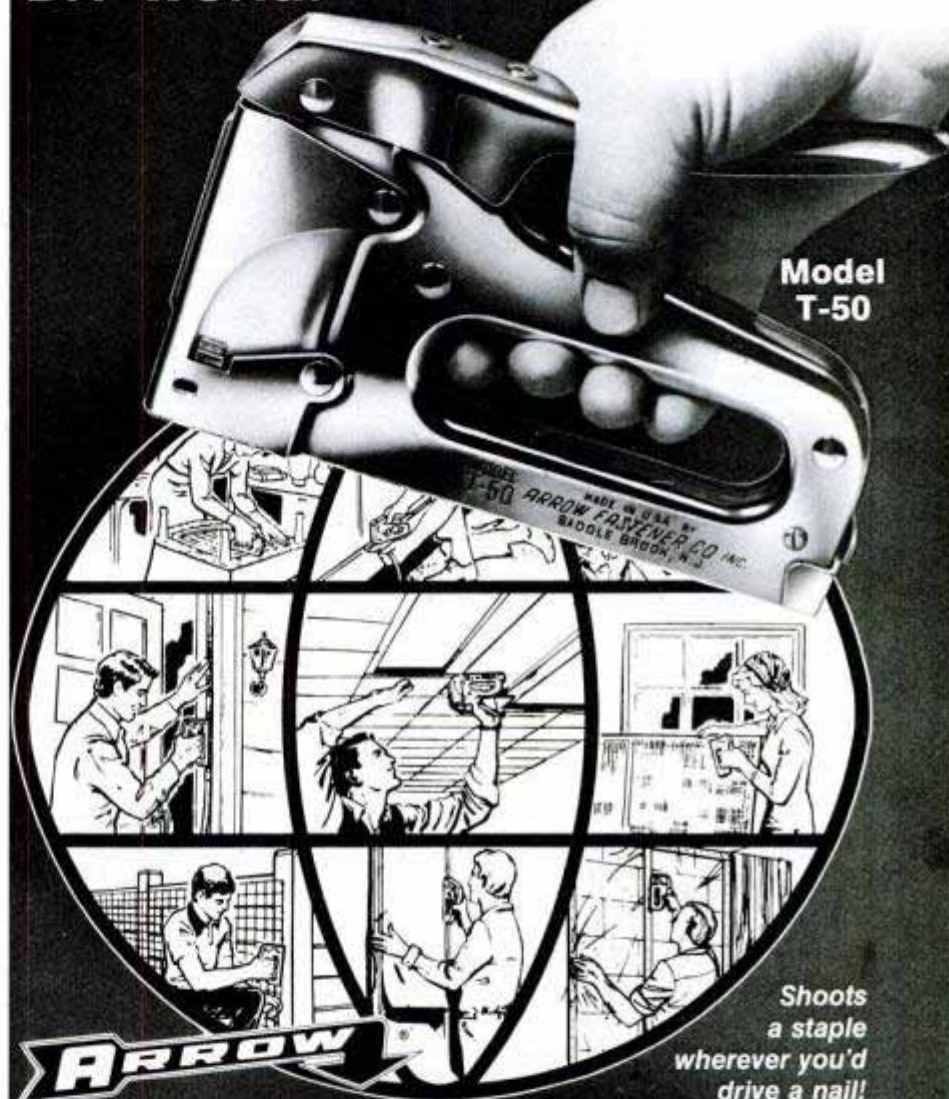
A print timer is easier to see and set if you mount it at an angle on a simple box, about six inches high, next to the enlarger post.—*Robert Hertzberg*

Neat notches



There's only one correct orientation to insert a slide. Find it easily by clamping slides and filing a notch in the upper right corners.—*Bob Brightman*

The tool that changed the nailing habits of the DIY world!



Model
T-50

ARROW

Shoots a staple wherever you'd drive a nail!
Faster...Easier...Better!

T-50 STAPLE GUN

Today, millions of do-it-yourselfers like yourself are reaching for a staple gun instead of a hammer whenever there is a fastening job to be done around the house! Why? Because one SQUEEZE shoots a strong-holding two-pronged staple in the exact spot desired in less than 1/10th the time it takes to drive a nail! And easy one-hand operation always leaves your other hand free to hold material for a faster, neater, more professional job!

In the world of staple guns, the Arrow T-50 Staple Gun is truly an American quality tradition. It's the staple gun with a proven reputation for long life, rugged durability and dependable trouble-free performance. A reputation that is recognized and respected the world over by do-it-yourselfers as well as professionals.

Use Only Genuine Arrow T-50 Staples for Jam-Proof Performance. Accept No Substitutes.
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HOMEOWNERS' CLINIC



Moisture, mold and mildew

Of all the varied problems that our readers have encountered over the years, by far the vast majority have dealt with moisture, mold, mildew, condensation and a lack of a vapor barrier. This month my column is devoted to these problems and some of their solutions.

The drawings and dew point (temperature at which dew starts to form or vapor to condense into liquid) chart help explain when and why condensation occurs and moisture problems develop. They appear in an excellent pamphlet, *Controlling Moisture In The Home To Prevent Exterior Paint Failures And Heat Loss*, written by James Sainsbury, Manager-Product Planning for Glidden Coatings and Resins. This booklet covers so much on the subject, that it should be on every homeowner's library shelf.

You can request it by writing directly to: Public Relations, Glidden Coatings and Resins, Div. of SCM Corp., 925 Euclid Ave., Cleveland, Ohio, 44115.

Molding in new home

We are having a problem with mold growing throughout our new home during the winter. The house is brick and the walls are insulated well, including the windows. We have ceiling fans in every room. We've kept the thermostat at 68° F. How can we prevent the mold from returning, especially in closets?—Lionel Laurent, Hammond, La.

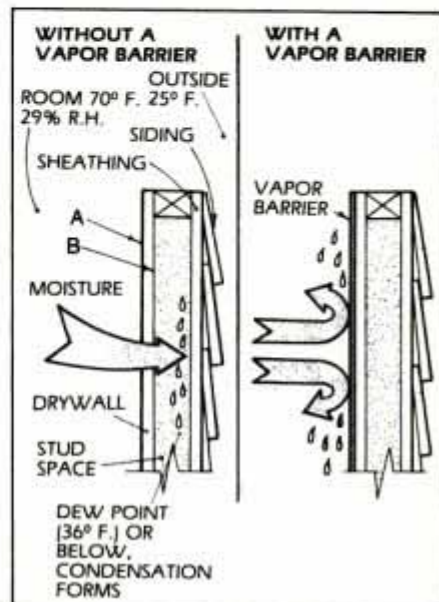
Lionel, you must introduce drier air into your house, as it's so well insulated and draft-free. "Muggy Inside" (*Homeowners' Clinic*, page 46, Oct. '81) and "House Too Vapor Tight?" (*Homeowners' Clinic*, page 32, Sept. '78) mention several methods of eliminating your problem. A "Service Tip" (*Homeowners' Clinic*, page 24, June '82) mentions a heat exchanger that deals only with adding fresh outside air that has been tempered to the same temperature of the moist air that it exhausts (depending upon heating or cooling season). It's called E-Z Vent, by Des Champs Laboratories Inc., Box 440, East Hanover, N.J. 07936.

You should first make certain that

DEW POINT CHART
(Outside Temperature At 25° F.)

Room Temperature	Room Relative Humidity (%)	Dew Point Temperature (°F.)
70° F.	79	63
	68	59
	57	54
	48	49
	38	43
	29	36
	19	26
	9	11
75° F.	79	68
	68	64
	57	60
	48	55
	38	47
	29	40
	19	30
	9	15

In winter, temperatures outside the home are below the dew point of the air inside. Unless a vapor barrier is established at point A or B (drawing above, left), the moisture will migrate through the drywall or plaster, across the insulation and through the siding. For example, if the temperature outside is 25° F., and the inside air temperature is 70° F. at 29% humidity, a surface within the wall will be at or below the dew point (36° F.). Moisture will condense—usually on the sheathing—causing it and the siding to become saturated. Moisture cannot pass through a vapor barrier (above, right).



you are doing all you can toward eliminating the moisture. Some excellent, free pamphlets, *Moisture Problem*, and *Mildew Message*, are published by Cooperative Extension Service, University of Georgia College of Agriculture, 101 Court Square, Decatur, Ga., 30030. If you can't get them from your local county extension agent, send to the University of Georgia.

Insulation prompts peeling

During the energy crunch, we had extra insulation blown in our exterior walls. It was a foam type that hardens. After about a year, the paint started to peel on the inside of our exterior walls, so we know it's from the insulation. Is there a paint I can use or a barrier to put on the wall before I paint, to prevent this from happening?—Mrs. Charles Plummer, Calena, Ohio.

Before you insulated your house, the warm, moist air from the house passed through your walls, because the space between the walls was warm due to heat loss. When you added insulation,

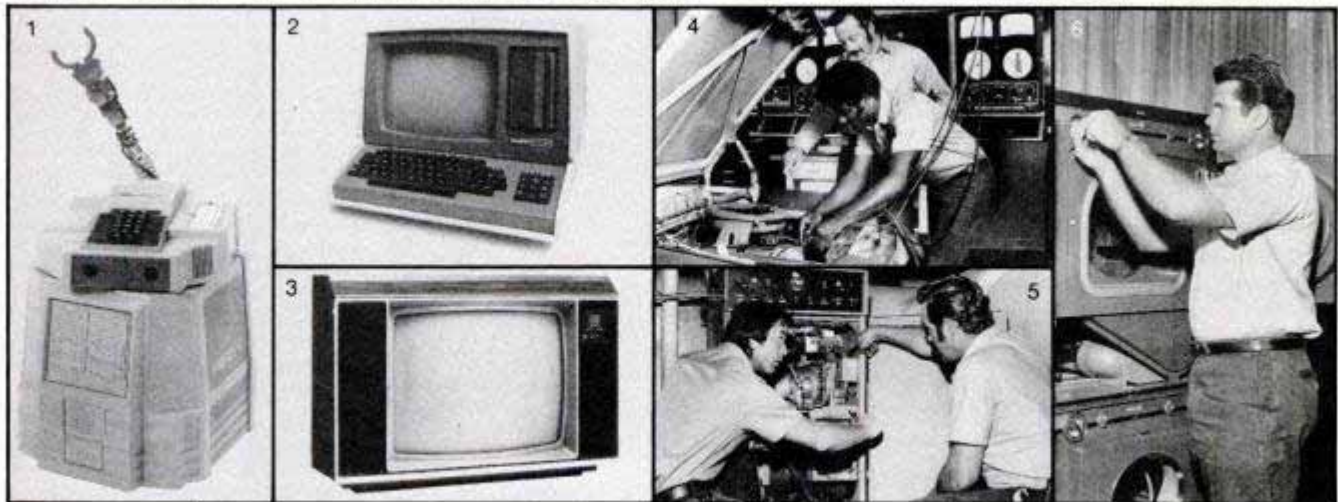
the back (or inside) of the exterior wall, the sheathing, became cold. When the warm moist air contacts the cold sheathing, the vapor condenses in the wall cavity.

You have plaster walls, which usually cannot be painted successfully when wet. Wash your walls down first with a solution of water (1 quart), household ammonia (1 cup), and a wetting detergent such as Pine-Sol (¼ cup). Follow washing with clear water and let dry.

Reduce the house humidity to help dry the walls by using exhaust fans or dehumidifiers, opening windows on dry days and reducing room temperature. When the walls are dry, feather edges of remaining paint. Then use a paint formulated as a vapor barrier, such as Glidden's Insul-Aid. **PM**

Do you have a home-maintenance or repair problem? Send it to Homeowners' Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in the column. For more home-repair and maintenance help, get PM's Home Care Guide, \$4.95 postpaid. Send your order(s) to Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.

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As you know, the Europeans make great beer. Light lagers, amber pilsners, and superb dark beer.

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Now there is a way that you can enjoy great European or American style beer for less . . . much less. In fact, for as little as \$2.50 per case.

Let me explain . . .

FISHING IN IRELAND

While I was on a fishing trip in Ireland in 1978 one of my Irish friends offered me a glass of light lager. It was fantastic beer . . . crystal clear with a thick creamy head rising half an inch above the rim of the glass.

After trying several varieties of his pilsner and ale, I was absolutely flabbergasted. I'd never tasted beer this good. It was far superior to any commercial American beer I'd ever tried.

"What kind of beer is this?" I asked.

"It's my own," he replied.

I accompanied him back to his house. There he showed me his 7½ gallon professional Mini-brewery. The brewing formula he used was the same one used by commercial breweries in Germany. Pure barley, imported hops and a special European yeast culture. It was hands down the smoothest beer I'd ever tasted.

I was so impressed that I obtained a few of his special brewing kits to give my friends back home. They enjoyed them so much that they told their friends. And within six months, we were getting calls from people all over the United States wanting to order kits.

Today we offer the same kits throughout the U.S. and Canada . . . and only with the following absolute guarantee:

If you don't agree this is the best beer you've ever tasted in your life, I'll buy the kit back.

What's more I'll pay the return postage and, I'll send you an extra \$5.00 for your time and trouble. No conditions. No excuses.

MYTHS VS. FACTS

Let me separate some myths from actual facts:

QUESTION — "I remember my Dad used to make 'home brew' years ago. It was flat and cloudy."

FACT — Old fashioned "home brew" was lousy. No argument. But we're not talking about old fashioned home brew. The Bierhaus Mini-brewery is TOTALLY different. It contains a professional brewer's fermentation tank . . . the finest hops in the world, imported from Europe . . . 100% PURE barley malt, also from Europe . . . and a superb lager yeast imported from England. The entire brewing process is anaerobic . . . just like the best commercial breweries.

QUESTION — Is it easy to make?

FACT — Absolutely. Even a klutz can brew excellent beer in just 27 minutes on a regular kitchen stove. If you want to make 6-8 cases of 12 oz. bottles, it may take 45 minutes. Let it remain in the fermenter for seven days, pour in bottles. Or keg it. You're done.



- No more late night trips to the carry out.
- No more lugging back empty beer cases in the trunk of your car.
- No more chemistry set taste.
- No more standing in line to pay \$10.00-\$15.00 for a case of beer.

QUESTION — Don't the large commercial breweries with all their expertise produce the best beer in the world?

FACT — That's like saying because cellophane wrapped pie in the supermarket is baked by a national bakery, it has to be better than a homemade apple pie fresh from the oven.

If you use our Mini-brewery and follow the instructions carefully, your beer will be better than commercial beer. We absolutely guarantee it.

One reason is that commercial breweries are allowed to use up to 52 different artificial ingredients . . . tannin, enzymes, plus a host of other chemicals to prevent gushing and to stabilize foam . . . plus three coal tar dyes for artificial color. And they don't even have to list these ingredients on the label.

Our Mini-brewery uses NO ARTIFICIAL INGREDIENTS OF ANY KIND. Absolutely none. As a result, the beer has a fantastic pure taste. You have to TRY IT TO BELIEVE IT.

QUESTION — Can I re-use the kit to make different kinds of beer?

FACT — Yes. You can use your kit over and over again for years. Here are just a few of the beers you can make . . .

LIGHT PILSNER

Very similar to most American premium beers. The light taste of pure barley together with mild hops gives this beer superb body without being filling. A great beer for parties.

BAVARIAN DARK LAGER

This nut brown lager has exceptional taste and heartiness. Excellent with sandwiches or any late night snack. Should be ordered with an extra packet of Hallertauer hops. These traditional German hops are grown in the Munich area and packaged for us in nitrogen sealed pouches.

BRITISH CLUB MILD

Originally brewed for the private clubs of Northern England, this beer contains fewer calories and carbohydrates than most commercial beers yet has a unique flavor and light amber color that make it popular in many parts of Europe. The ingredients we supply include the original Yorkshire barley malt and English hops necessary to recreate the true British flavor.

ENGLISH PALE ALE

Not to be indulged in lightly, this exquisite pub favorite was originally brewed in Newcastle, England. It has a distinctive crystal clear copper color and a potency variable from 7%-10% alcohol by volume. You should age it 6-7 weeks before drinking.

DANISH LIGHT

One of the most popular choices for brewing because of its similarity to some of the premium Canadian lagers. The alcoholic content is similar to U.S. beer but, like all of our products, contains absolutely no artificial ingredients or additives. Lightly hopped with a very clean smooth taste. Serve about 40°-44° fahrenheit.

ENGLISH/IRISH STOUT

If you've ever enjoyed a real Stout in a pub, you owe it to yourself to brew several cases for special occasions. We include true dark malt — not the artificially colored kind. These original ingredients let you brew an actual British Stout which you'll be proud to serve your most discerning guest.

DUTCH PILSNER

Very similar to Pilsner Light, but slightly stronger. Dutch Pilsner has a distinct amber color and special vibrant effervescence.

WHERE DO I GET SUPPLIES ONCE I GET THE KIT?

Just call us to reorder ingredients. We stock hundreds of different items . . . malt, hops, and yeast of all kinds. Remember, you can use your Mini-brewery over and over again for years. Federal law allows you to brew up 200 gallons a year. No Federal license is required. No taxes either.

Your new Bierhaus Mini-brewery contains an FDA foodgrade 7½ gallon fermentation tank, air lock, bottle caps, and enough ingredients to make your first test brewing of approximately 2½ cases. The ingredients will be for a standard lager beer so you can compare it to your favorite American commercial beer.

\$5.00 FREE

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Order the kit and make the beer. Serve it to your family and friends and ask them to compare it to their favorite beer. You do the same. If everyone doesn't agree it's better — far better than commercial beer — simply return the kit. I'll pay the return postage. And I'll send you a check for your full purchase price of \$39.95. And I'll send you an EXTRA \$5.00 for your time and trouble — total \$44.95. What's more, I'll send your refund within three working days from the time I receive the returned kit.

If I'm wrong, you just made \$5.00.

But, what if I'm right?

FOR EXTRA FAST SERVICE, call us at 814/833-7747 and order your Mini-brewery with MasterCard or VISA. Please call weekdays between 8:30 A.M. and 5:00 P.M. Eastern time.

Or send your check or money order for \$39.95 or MasterCard/VISA number and expiration date to: Mini-brewery, Bierhaus International, Inc. Dept. 65 3721 West 12th Street, Erie, PA 16505. Canadian residents add \$6.00. You pay UPS charges upon delivery. Pennsylvania residents please enclose 6% sales tax.

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POPULAR MECHANICS MAGAZINE, JANUARY 1982

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Robert Peppin, 1982 NAPA/NIASE MECHANIC OF THE YEAR

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OFF-ROAD MAGAZINE

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MOTOR AGE MAGAZINE, APRIL, 1982



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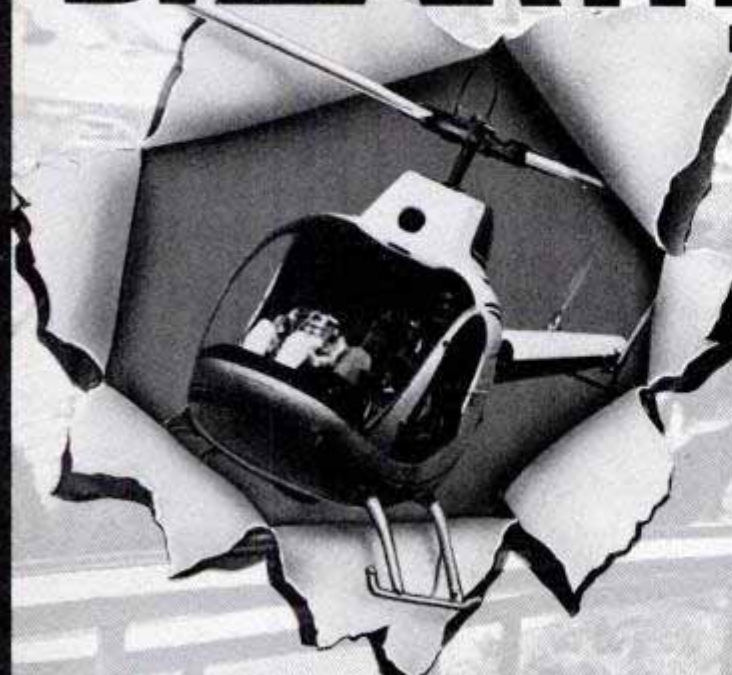
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cars. Maintaining the Exec is no more difficult, and it certainly isn't any more expensive because we teach you how to fly and maintain it yourself!

Those in the auto industry boast of aerodynamics, performance tuned wide track suspensions, electronic cross fire fuel injection, liquid crystal displays, lateral acceleration readings, front to rear weight ratios, stainless steel headers and the list goes on and on... Just one question?... What good does all this "advanced engineering" do for you when the speed limit is 55 and you're stuck on a crowded freeway anyway?

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** Helicopter Tidbits "Where Can I Land and Take Off?"

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Helicopter Tidbits

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2. You need a clear unobstructed corridor for approach and departure to and from your landing spot. No wires or tall obstructions.
3. You can't fly over densely populated areas and land in city streets or shopping center parking lots.
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PM ELECTRONICS MONITOR



Through rain, snow—and static

Like the weather, it used to be that everyone complained about the mail service, but it seemed beyond the reach of ordinary mortals to change. However, with the advent of computers equipped with modems (telephone interfaces) the concept of electronic mail seems ready to become a true mass market commodity.

MCI Mail, a new telecommunications system from MCI (a long distance alternative to AT&T), now promises to bring electronic mail within everyone's reach. On the receiving end, even people without computers will be able to derive benefit from this new service.

Like many other telecommunications services, the MCI Mail can be accessed by any office or personal computer sys-

tem which has a modem. Then the mail is sent electronically via the phone lines to the MCI main computer system. If the addressees have their own computer system, all they need do is check their electronic "mailbox."

The difference comes in when the addressee does not have a computer. The message still gets through reliably, according to MCI.

Messages are then routed to an MCI postal center in the recipient's city, or nearby. The electronic mail is laser-printed, even duplicating a company's logo and stationery. The printed version can be delivered within four hours of the electronic version being sent—at least in the "major metropolitan cities."

The new MCI Mail also offers overnight and "MCI Letter" services. The overnight service promises next-day delivery via courier in 20,000 cities in the continental United States. The MCI Letter is sent electronically to an MCI postal center in the city to which it is addressed, and then converted to ordinary, local U.S. mail.

Charges are based on the service per document rather than on the time spent connected to the system. Instant or computer-to-computer is \$1 per message. Four-hour delivery is \$25 per letter, while overnight will cost \$6 and an MCI Letter is \$2.

As this is one of the first major attempts by an existing telephone-oriented firm to get into telecommunications, we think it will be quite interesting to see if MCI Mail succeeds.

Very smart cables

If you have a computer system, you are probably ready to have a fit whenever someone refers to the RS-232C "standards."

While many computers, printers, modems and other assorted peripherals are wired so as to connect with RS-232C cables, just wait until you try using that "standard."

Often, an instruction manual will say something like, "If you have the Rev. B model then connect pins 7 and 8, if the Rev. A you will have to swap pins 5, 6 and 21." Or, often, the standard cable just won't work and good luck in finding out why.

One of the handiest devices that we've seen is the Smart Cable from IQ Technologies (Bellevue, Wash.). It is capable of connecting just about anything to anything in the RS-232C world.

At one end of the cable there is a connector which has two slide switches and five LEDs. By using the switches and LEDs, it takes less than a minute to automatically configure the cable to your equipment's often mysterious needs.

At about \$150 it is expensive. But, if you can use it for more than one peripheral, it may be a good buy. It certainly beats soldering all those little pins.

Does it all

The Anova Electronics "Master System" (pictured) is a very complete security system—and it's also a telephone center, and a light- and appliance-control center.

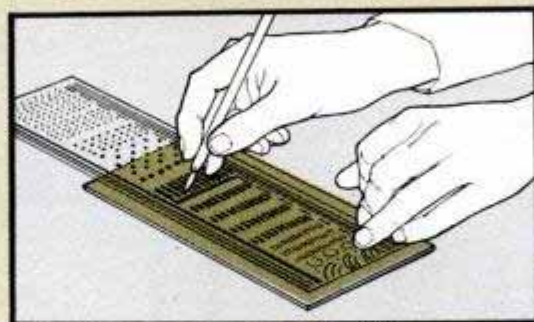
The wireless alarm system can call the police (or any other numbers) on the built-in phone/speakerphone/dialer

combo while the appliance-control center is still doing the laundry. **PM**



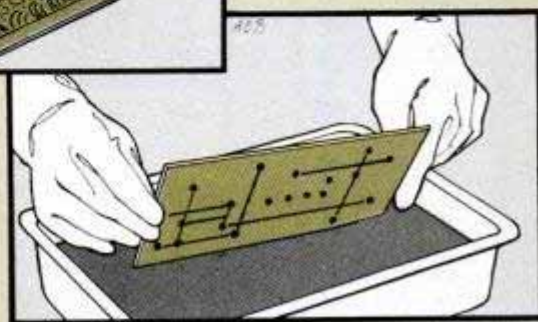
"Master System" is complete and versatile.

Easy-To-Make Printed Circuits



Dry transfers are a popular way to fabricate your own printed-circuit boards. The transfers are rubbed onto a blank copper board (left). Like press-on lettering, the circuit traces, pads and dots are easily positioned.

After the transfers are on the board (right) it is dipped in ferrocchloride for about 20 minutes. The solution eats away the copper that's not under the transfers. Clean off the board and you have a finished PC board.



All these oils would love to say they give you the best engine protection.



But only one can.

Surprised? You shouldn't be. If you're using an ordinary oil, how can you expect to get anything more than ordinary engine protection?

Ordinary oils just can't give you the extraordinary protection Mobil 1[®] synthetic oil was designed to give you.

Mobil 1 gives you better lubrication than ordinary oils, helps protect your engine better from friction and wear and also helps it stay cleaner, run smoother and last longer.

And as incredible as it may sound, Mobil 1 can even protect your engine up to 500° F above

Mobil

1

100% Synthetic Motor Oil
Saves you gas and oil changes.

and way down to 35° F below.

Besides protecting your engine a lot better, Mobil 1 also protects it a lot longer. Because it's the oil that can take you 25,000 miles or one year (whichever comes first) between oil changes.*

If protecting your engine is important to you, change to Mobil 1. You can't get better engine protection. And nobody can change that.

*Add oil as needed. New car owners follow warranty instructions. Diesel owners follow manufacturer's instructions.

Mobil 1. The official oil of the 1984 Winter Olympics.



© 1983 Mobil Oil Corporation

Buy 5 quarts of Mobil 1 in the new easy-pour resealable plastic container during February, and get a \$3.00 rebate coupon.

Моторное масло, одобренное Международным олимпийским комитетом

THE NEW LEMON LAWS— DO THEY WORK?

New laws in 19 states promise a fair shake for new car buyers. They are a last-resort alternative to lawsuits.

BY ED FALES; Illustration by Howard Lewis

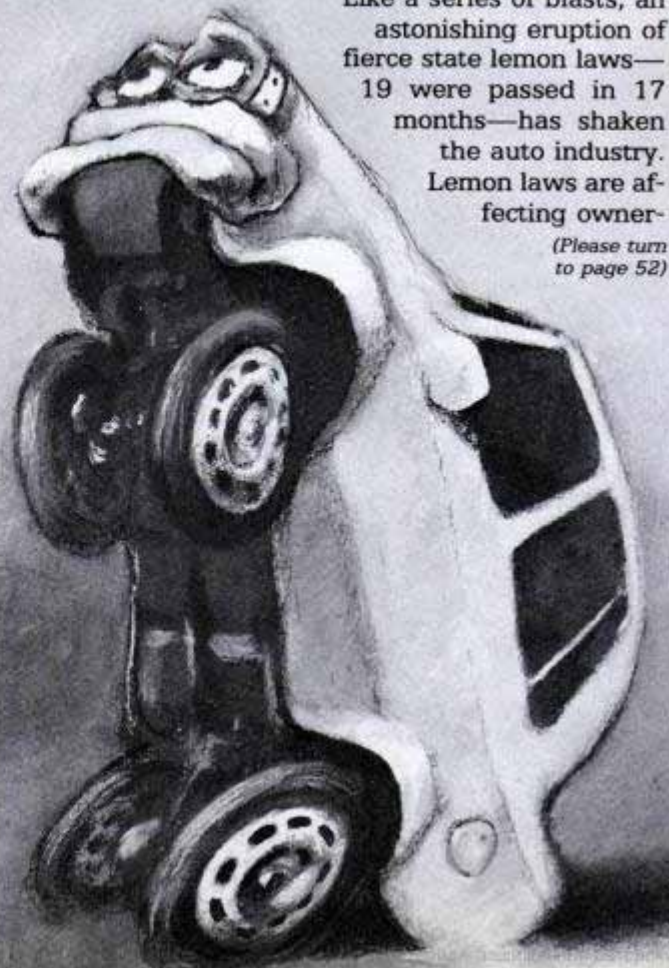
When Anthony Conti's dealer in Connecticut couldn't fix his Lincoln Continental, he sued—under old credit laws that say any "appliance" must work. Sure enough, he got his money back. But it took seven years.

When Prof. Henry Adelman's feet got wet in his new '82 VW Quantum, his dealer couldn't find the trouble (open boltholes that let the rain in). Adelman, however, didn't sue. He waved a copy of California's brand new "lemon law." He got his money back in 100 days.

When Chester Sobolewski's new Ford wouldn't back up, his dealer couldn't cure it. Chet didn't sue, either. He knew his rights under Connecticut's new lemon law: (1) a new car or (2) his money back. He got the new car—in seven days.

Like a series of blasts, an astonishing eruption of fierce state lemon laws—19 were passed in 17 months—has shaken the auto industry. Lemon laws are affecting owner-

(Please turn to page 52)



I found a way to **SELL PART-TIME...** **MAKE FULL-TIME INCOME!**



**earned \$7,700 from
my first Pace order...plus financial
security in my own business.**

1st person story by Tedd Mainwaring

"I worked on an oil drilling crew out west. We drilled 11 wells one year, every one a gusher! But did I strike it rich? Not on your life—I was paid by the hour and struggled to feed a growing family. That started me to thinking, 'Why should I do all the work while someone else gets all the gravy.'

"About that time I got injured and ended up having to move my family to a different area to take a job as a maintenance mechanic. That idea of controlling my own destiny kept gnawing at me. By now I had five children with extra expense of about \$2,400 a year sending the oldest one to a speech and hearing center.

"How could a guy like me save up enough money to start my own business? To get into most businesses you have to own a corner of Fort Knox. If I could only ease into a business without giving up the regular salary I had to count on to put food on the table. And without making any investment. As long as I was dreaming, wouldn't it be great to find something where every single spare time order could bring in *really big* extra money.

"Sound like the impossible dream? Well, I had seen a Pace Products story about a man who earned \$4,154.65 on just one Seamless Spray order. And he didn't have to invest a penny. I sent for the free information. Believe me, when I received their literature and saw how easy their field-tested sales kit made everything—I knew it could all be more than just a dream. I decided to become a Pace distributor. And it was the best decision I ever made.

YOU NEED ABSOLUTELY NO EXPERIENCE

"Now I haven't mentioned anything about Pace—I've saved the best for last. As you know, it costs a fortune these days for schools, hospitals, plants and other commercial buildings to have roof contractors repair or re-do their roofs. Pace *saves* them that fortune—by-passing the contractor. The building owner uses Pace's Seamless Spray process to apply Pace Roof Renewal Sealant right over the old roof. The cost is so low, the proven results so satisfactory for such well-known firms as General Motors, American Airlines, Holiday Inns and hundreds more, that there is little if any sales resistance.

"Pace ships the Pace Seamless Spray equipment on Free Loan. The customer pays only for the roofing products from Pace. His own men apply it. And the clincher—I would get my big commissions up front. Paid in advance. Weekly.

"With my mechanic's job, I was able to start out with Pace in my spare time. I didn't know a thing about roofs, but Pace told me everything I had to know. They showed me how easy

it is to set up a business and keep it running profitably. So all I had to do was go out and find somebody with a leaky roof, and tell him about Pace products.

"Quite frankly, my first prospect didn't buy. But I made a call for a school building with a roof the size of a football field. They called it the "Bucket Leaker," because every time it rained they had to put out buckets—in classrooms, hallways, even the cafeteria—to catch the water. I got the job and made \$7,700 on it.

"That school building is now leak-free for the first time in 25 years, so they had me do five other roofs with Pace's Seamless Spray. I was on my way. Today my family and I are enjoying a life we never thought possible before—all thanks to my accepting Pace's invitation to return that little coupon in the ad I read."

Tedd Mainwaring

MAIL COUPON TODAY FOR FREE FACTS—NO OBLIGATION

Would you like to earn big money, starting out in your spare time, like Tedd Mainwaring? Would you like the freedom and independence of your own business? It can be yours. Let us mail you the facts. Simply send in the coupon below and we'll rush you all the details. There's no obligation. No salesman will call.

Our field-tested sales kit gives you all the know-how you need to get into the Pace business. There's no waiting, no training needed. And no investment required. You can get into the Pace business that offers a way to make \$1,000 or more on one sale—even up to \$7,700 like Tedd Mainwaring—and more!

This is your once-in-a-lifetime opportunity. Get all the facts. Study them in the privacy of your own home and then decide for yourself. But don't delay. Mail the coupon now.

Pace Products Inc., Dept. PM-284
Quality Plaza 112th & College Blvd.
P.O. Box 10925, Overland Park, Ks. 66210

WITHOUT OBLIGATION send free material that tells how
I can have my own Pace business. No salesman will call.
PLEASE PRINT

Name _____

Address _____

City _____

State _____ Zip _____

LEMON LAWS

(Continued from page 50)

service manager relationships wherever they're in effect, from Oregon to Florida.

Although they vary, in general, they provide that any car under warranty that a dealer can't fix in four tries (Florida, Wyoming and Massachusetts say three) is a lemon. U.S. law says warranted repairs must be made. But the lemon laws now add that if repairs are not made, you're entitled to a new car. Or you can get your money back. But your problem must be genuine—must involve a major problem that affects your car's value or use.

In some states your claim must be made in the first 18 months, in others within 24. New York allows four years. Some give no time limit. The cure is the factory's responsibility.

Buyers get more respect

All this is a drastic attempt—some say too drastic (and needless)—to soothe the angry owner who feels shafted. As written, the new laws are supposed to protect new-car owners. In fact, legislators say, there's a trickle-down effect. Even old-car owners say they're getting more respect from car dealers.

What really shook the industry is the dismaying enthusiasm with which 19 legislatures rushed to act. In some states, the vote was overwhelming. In New York's huge legislative body it was unbelievable: 201 to 3. All this has put backbone in owners who used to feel intimidated by some service managers. "I didn't get a new car," says one owner. (Few really do.) "But I did feel stronger at the service door."

Under lemon laws, settlements are free. The factory or dealer must do as ordered by a remarkable crop of quasi-judicial auto dispute juries that have sprung up from coast to coast.

Are the laws working?

How are the lemon laws really working? Even the first—Connecticut's—is only 17 months old. Some were born only weeks ago. So in most states, actual cases are few. But in Connecticut, Rep. John Woodcock, who fathered the law, estimates that in the first 17 months alone, 40 owners were either awarded new cars or refunds. "And in most cases," says Woodcock, who has become the nation's lemon law guru, "they got new cars."

Here's a small, early sampling of 13 cases in Connecticut, Minnesota and California:

- Got a new car: 1.
- Secretly settled, possibly with a new car: 1.
- Got money back: 3.

Questions You Might Ask

What is a lemon?

The new laws in most states say a lemon is a car with a substantial defect that the dealer fails to fix in three to four tries. The defect must affect the value, use or safety of a car. Most laws also say a car must have been laid up for a total of 30 days. (Massachusetts and Florida say 15, Nebraska says 40.) Minnesota's tough law cites any car that has to be fixed just once for steering or brakes. Kentucky, although not considered strictly a lemon law state, has a law that involves any car with serious mechanical problems, even if not on warranty.

How old can a lemon be?

Most states say a car must still be on warranty, or, if warranty mileage has run out, no older than a year. New York stretches the limit to two years or 18,000 miles, and even lets the law be invoked if the owner warned the carmaker during the warranty period of troubles that might grow worse.

Are motorcycles covered?

Lawyers are still interpreting the laws in different ways. Center for Auto Safety attorneys say motorcycles appear to be covered in all lemon law states except California, Delaware, Illinois, Minnesota, New Hampshire, New Jersey and New York.

Are pickups covered?

Yes, in all states but Delaware. Most laws say pickups must be bought for personal, not commercial, use to be covered.

How much of a refund can an owner get?

Minnesota lets the carmaker deduct

10 cents a mile for past use (or a small percentage of the car's cost). New York allows a deduction for mileage over 12,000. Florida allows carmakers 20 cents a mile. Otherwise, you get what you paid for the car if you win.

Does the owner get back taxes, prep and other charges?

Several states, including Massachusetts and Florida, say refunds must include collateral items like sales tax, license fee, finance costs, and (in Florida) undercoating, towing, car-rental and dealer-prep charges.

Do lemon laws give free repairs?

They do not address this. U.S. law, however, says a manufacturer must stand behind his repair warranties. Lemon laws indirectly encourage dealers or carmakers to complete any entitled warranty repairs. And an owner who appeals to Autocap or some of the factory juries may get good-will bill adjustments if there has been mistreatment.

Can a lemon be resold by the factory or a dealer?

In Minnesota, no lemon with defective brakes or steering can ever be resold. In some states, the carmaker must give any buyer a note saying that the car had been a lemon (in some states, "an incurable lemon").

Are noncritical items like defective radios or upholstery covered?

Not by lemon laws. Autocap and some auto juries will consider such items, however.

If you lose a lemon law claim, can you still go to court?

Yes.

■ Got troublesome problems fixed at last: 1.

■ Owners lost their appeals, got no benefits, are "disappointed with the lemon law": 2.

■ Cases pending: 5.

How appeals juries work

Many of these new juries—there are now at least 300—sprang up while lawmakers were busy drafting lemon laws. The most interesting, Autocap (Automotive Consumer Action Program), suddenly has 15,000 dealer-sponsors who pay to run its 41 appeals panels. The others were created by the manufacturers, U.S. and foreign, partly in self-defense, but partly in an honest try at winning back your loyalty.

Most lemon laws require that, before you can claim a refund or new car, you must go before an appeals jury that meets dispute-settlement standards established by the Federal Trade Commission. According to John Woodcock's staff, Ford and Chrysler juries do. Some

Autocaps do, others are working toward it. The Better Business Bureau (BBB) is trying to find out whether it qualifies.

Here's what to do if you appeal:

1. Make one last try to settle the problem with the dealer, zone office, or factory. Local dealers have phone numbers of the zone office and factory.

2. If this won't get results, phone or write your appropriate jury (see list at the end of the story). Gather every scrap of evidence—bills, invoices, work orders, memos, dates. In Texas, you're required to appeal any dispute first to the State Motor Vehicle Commission.

Usually, the jury's staff will call the dealer or factory and try to coax a settlement. If this fails, most invite you to sit around their table, informally, with you and your dealer both telling your story. Some investigate very thoroughly. You may have to bring your car and they may test it.

You may get a decision in days, or

(Please turn to page 54)

CAMEL LIGHTS



9 mg tar.

9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

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

Camel Lights.
Low tar.
Camel taste.

LEMON LAWS

(Continued from page 52)

even hours, and it binds the manufacturer and/or dealer. By contract, he must do what the jury says—unless, of course, you lose.

You don't usually need a lawyer. In fact, as this is written, BBB juries won't admit them. You can appeal to such juries in any state, whether it has lemon laws or not. Some juries have awarded new cars or refunds in states that have no such laws.

Who are the jurors? Mainly, they're unpaid volunteers, often leading citizens who give time as a public service. Often, they're merchants, independent mechanics, editors, housewives, teachers, ministers, lawyers. Some boards, like Autocap, have dealer members. But for every dealer, there's a consumer rep sitting opposite.

Most juries are fair

Are their decisions fair? There are gripes, but many juries seem surprisingly fair. Says Gerald Murphy, head of Autocap's Washington, D.C., jury office: "Funny thing, our dealer members are usually tougher on dealers, and our consumer reps are usually tougher on car owners!"

For U.S. and foreign-car owners in general, there are now 41 dealer-estab-

lished Autocap panels coast to coast. Many have 10-member juries and they'll consider reasonable disputes about anything from a 1984 AMC to a Rolls-Royce that's gone 150,000 miles. Half the jurors are consumer reps, half are dealers.

For Ford-Lincoln-Mercury owners, a new network of over 30 Consumer Appeals Boards (CABs) will hear any honest product or service dispute, no matter how old your car. In fact, Ford's Mike Davis says: "We find most complaints are on out-of-warranty cars." CABs have five voting members (three consumer reps, one Ford, one Lincoln-Mercury dealer).

In its first five years, CABs have had 42,000 inquiries and accepted 10,000 cases for investigation. Ford says more than two in five get a better break on appeal. A few new cars have been given, there have been some refunds, and some major parts like transmissions or engines have been replaced. Only 43 owners went to court.

Reviewing warranty repairs

For Chrysler-Dodge-Plymouth owners, at least 52 Chrysler Customer Satisfaction Boards (CSBs) review only service-related disputes over warranty repairs. They won't handle disputes over alleged design defects or out-of-warranty cars.

CSBs have five members: a consumer rep, a public rep (who could be a public official), a technician certified by the National Institute for Automotive Service Excellence (NIASE), a Chrysler rep and a Dodge or Chrysler-Plymouth dealer.

Chrysler's routine is more stringent than some. Your appeal is all handled in writing. You do not appear. If your car must be tested, you get a free loaner. CSB decisions bind Chrysler or the dealer.

Keeping customers happy

Believe it or not, GM is getting tips from IBM, AT&T and even McDonald's on good ways to keep customers happy. GM began testing a Customer Assistance Program in 1978 and now pays the Council of Better Business Bureaus to administer the mediation of disputes in its 140 Bureaus. GM doesn't discuss details, but according to one report, each Bureau gets \$15 to mediate a dispute or, if that fails, \$35 for binding arbitration. GM calls mediation "an informal process of re-establishing communication between both parties." Arbitration binds GM but not the owner, if he doesn't like the decision. BBB will look at GM cars up to five years old, with no mileage limitation.

First, as noted, an owner must try to settle with (1) his dealer, or (2) GM's zone office or (3) by contacting GM

Customer Service (see *Where To Call If You Have A Dispute* on this page).

If all this fails, BBB sends you a list of five names of possible jurors, with a biography on each. You score your preferences 1 to 5. So does the factory. The highest scorer becomes your jury. Some states require a panel of three.

According to CBBB, of 26,300 appeals in eight months last year, 17,000 were settled by mediation and 1,800 by arbitration. Some 7,500 are still pending.

Auto age limit

For VW, Datsun-Nissan and Porsche-Audi owners, BBB arbitrates as it does for GM, except that cars can be no more than three years old.

For Jaguar, Rover and Triumph owners, the procedure is the same as above, but cars must still be on warranty.

Disputes in some states are resolved by the attorney general, secretary of state or the motor vehicle commission. These have clout because they enforce commercial laws and license dealers and manufacturers.

Even if you lose a jury decision, you can still hire lawyers and sue, and whatever any auto-dispute jury has ruled now becomes legal evidence for or against you. But suing is expensive, can take months or years, and may cost more than your car is worth. Some suits fall under the Magnuson-Moss federal warranty act of 1975, which says manufacturers must stand behind their warranties.

Lemon law results

In Washington, D.C., an industry-advisory group cites a survey which shows that owners who get good treatment tell eight friends. Those who get bad treatment tell 16. With manufacturers and dealers more responsive than ever to consumer complaints, perhaps we'll see the day when lemon laws are no longer needed. **PM**

Where To Call If You Have A Dispute

Owners' manuals, especially the recent ones, often give phone numbers and/or addresses of owner-assistance boards. But first talk with your dealer, then the carmaker's zone office, then the carmaker's headquarters. Some zone offices will relay your inquiry to the head office.

Autocap is listed in many big-city Yellow Pages. For phone numbers and addresses in all states, contact NADA Autocap Office, 8400 Westpark Dr., McLean, Va. 22102 (or call 703-821-7144).

For GM cars, write GM Customer Service, GM Building, 3044 West Grand Blvd., Detroit, Mich. 48202, or phone 313-556-2294.

Better Business Bureaus appear in city Yellow Pages. For a full list, with phones, write to Council of Better Business Bureaus, Wilson Blvd., Arlington, Va. 22209, or call 800-228-6505.

Ford Consumer Appeals Boards: From most places, dial 800-241-8450.

Chrysler Customer Satisfaction Boards won't take calls. Contact them by mail. Address for your area is in owners' manuals (look under "Service Assistance"). Or ask dealer or zone office for a list of boards. Detroit Customer Relations address is Box 1718, Detroit, Mich., 48288. Phone 313-956-5970.

Lemon Law Tally

■ There were 19 states with lemon laws as this report was drafted. The Center for Auto Safety in Washington, D.C., lists: California, Connecticut, Delaware, Florida, Illinois, Maine, Massachusetts, Minnesota, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New York, Oregon, Texas, Washington, Wyoming and Wisconsin.

■ A federal lemon law has been proposed in Congress.

■ These 18 states have considered, or are considering, lemon laws: Alaska, Arizona, Colorado, Georgia, Hawaii, Indiana, Kansas, Louisiana, Maryland, Missouri, New Mexico, North Carolina, North Dakota, Oklahoma, Pennsylvania, Rhode Island, South Carolina and Vermont.



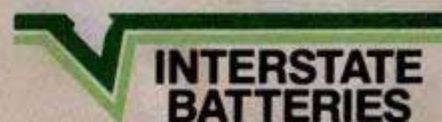
**If our battery can
make this Bulldog bark,
we can make your Bronco buck.**



Interstate Battery. No matter what you want to start we've got a dependable, hot-firin', heavy-duty battery that'll get you crankin' in even the worst temperatures. And if you need service anywhere, we have over 94,000 dealers all across America to help you.

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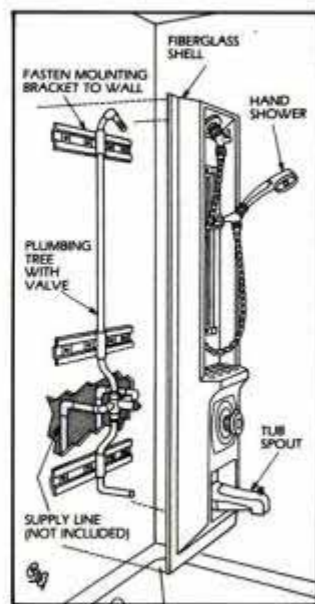
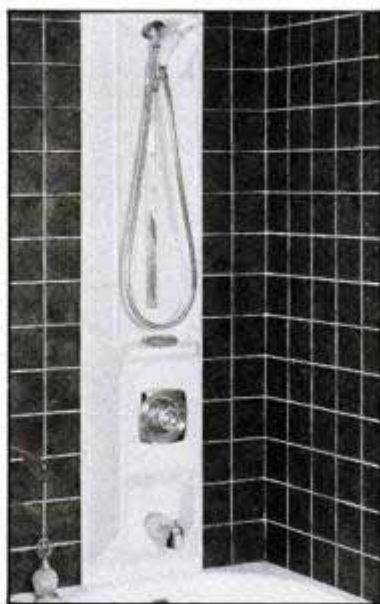
On-the-wall shower tower

The Swan Corp. has a simple way to remodel a showerless bath into a modern shower/bath combination. The Shower Tower mounts directly to the shower wall, eliminating costly in-wall plumbing and wall repairs.

The preplumbed fiberglass unit comes complete with a single lever blender valve, connection points for water hookup, control knob, tub faucet and either a standard or handheld shower head. Easy-to-install mounting brackets are included so that you can attach the plumbing tree to the wall.

The Shower Tower costs \$150 for the standard showerhead and \$175 for the handheld model, which is shown here.

For more information, you should contact the Swan Corp., Dept. PM, 408 Olive St., St. Louis, Mo. 63102.



Catalytic converter for wood stove



Catalytic combustion, the latest technology in wood-burning, is now available to anyone with an airtight stove, thanks to the Nu-Tec Catalytic Retrofit converter (\$129.95).

According to the manufacturer, the Nu-Tec converter can turn your airtight wood stove into a cleaner burning unit with a higher heating efficiency. Smoke that would normally pass out the chimney to form creosote and pollutants is catalytically transformed into heat that you can use in your home.

The Nu-Tec converter mounts inconspicuously on the flue and can be installed in less than 30 minutes using standard hand tools, according to the maker. The entire cast-iron unit, including the catalytic converter, is covered by a limited five-year warranty. For further details, contact Nu-Tec Inc., Box 908, East Greenwich, R.I. 02818.

Portable drill goes everywhere



The hand-cranked ScrewBall drill (\$16.99) features a keyless metal chuck and four self-contained bits: $\frac{3}{32}$ -, $\frac{1}{8}$ -, $\frac{9}{32}$ - and $\frac{3}{16}$ -in. dia. For details, contact ScrewBall, Div. of Fiskars Corp., 1450 Spencer Rd., Newton, Kan. 67114.

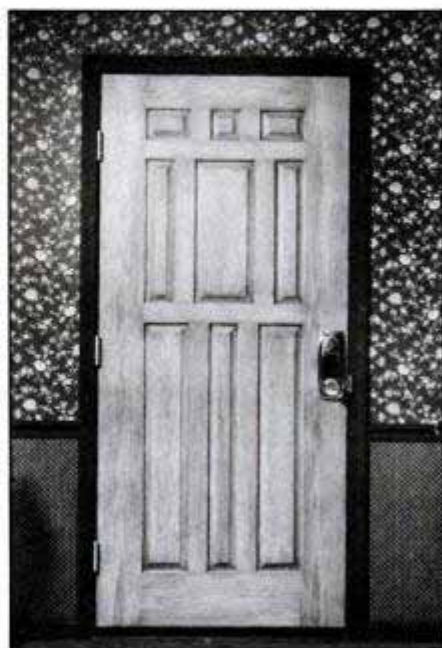
Knock on fiberglass?

The Fiber-Classic exterior door shown here has realistic wood-like panels made of fiberglass. Panel faces are laminated to hardwood stiles and rails, so you can plane and sand to fit existing jambs. An insulating core of polyurethane foam results in a R-value of 10. Most wood doors have an R-value of 2.7.

The Fiber-Classic is guaranteed for five years against warping and splitting. Doors are available in 32- and 36-in. widths (\$200 and \$250) or as a pre-hung unit (\$250 and \$325). For details, contact Thermo-Tru, 2806 North Reynolds Rd., Toledo, Ohio 43615. **PM**

Emergency switch

The 911 Locator (\$24.95) is an electronic switch that causes a light to blink rapidly. This enables police to find your house quickly after you phone in an emergency. It's made by Slater Electric Inc., 45 Sea Cliff Ave., Glen Cove, N.Y. 11542.



Wealthy Man Wants to Give You His Wealth Secret Before It's Too Late!

Dear Friend,

My name is John Wright. Not too long ago I was flat broke. I was \$30,000 in debt. The bank repossessed my car because I couldn't keep up with the payments. And one day the landlord gave me an eviction notice because I hadn't paid the rent for three months. So we had to move out. My family and I stayed at my cousin's place for the rest of that month before I could manage to get another apartment. That was very embarrassing.

Things have changed now. I own four homes in southern California. The one I'm living in now is worth more than half a million dollars. I own several cars, among them a brand new Mercedes and a brand new Cadillac. And as of now, I have \$178,000 cash in certificate of deposits in just one of my bank accounts in Beverly Hills.

I'm not really trying to impress you with my wealth. All I'm trying to do here is to prove to you that if it wasn't because of that money secret I was lucky enough to find that day, I still would have been poor or may be even bankrupt. It was only through this amazing money secret that I could pull myself out of debt and become wealthy. Who knows what would have happened to my family and me.

Knowing about this secret changed my life completely. It brought me wealth, happiness, and most important of all peace of mind. This secret will change your life, too! It will give you everything you need and will solve all your money problems. Of course you don't have to take my word for it. You can try it for yourself. To see that you try this secret, I'm willing to give you \$20.00 in cash. (I'm giving my address at the bottom of this page.) I figure, if I spend \$20.00, I get your attention. And you will prove it to yourself that this amazing money secret will work for you, too!

You probably are asking yourself, why is he sharing his secret with me? My response is, "why not". First, I've already made enough money to retire for the rest of my life. Second, my secret is so unique that we won't be competing with each other. Third, nothing is more satisfying to me than sharing my secret only with those who realize a golden opportunity and get on it quickly.

This secret is incredibly simple. Anyone can use it. You can get started with practically no money at all and the risk is almost zero. You don't need special training or even a high school education. It doesn't matter how young or old you are and it will work for you at home or even while you are on vacation.

Let me tell you more about this fascinating money making secret:

FAST MONEY

With this secret the money can roll in fast. In some cases you may be able to cash in literally overnight. If you can follow simple instructions you can get started in a single afternoon and it is possible to have spendable money in your hands the very next morning. In fact, this just might be the fastest legal way to make money that has ever been invented!

ALMOST NO-RISK

This is a very safe way to get extra cash. It is practically risk free. It is not a dangerous gamble. Everything you do has already been tested and you can get started for less money than most people spend for a night on the town.

"WORK" AT HOME

One of the nicest things about this whole idea is that you can do it at home in your spare time. You don't need equipment or an office. It doesn't matter where you live either. You can use this secret to make money if you live in a big city or on a farm or anywhere in between. A husband and wife team from New York used my secret, worked at home in their spare time, and made \$45,000 in one year.

SIMPLE

This secret is simple. It would be hard to make a

mistake if you tried. You don't need a college degree or even a high school education. All you need is a little common sense and the ability to follow simple, easy, step-by-step instructions. I personally know a man from New England who used this secret and made \$2 million in just 3 years.

AGE DOESN'T MATTER

You can use this secret to make money no matter how old or how young you may be. There is no physical labor involved and everything is so easy it can be done whether you're a teenager or 90 years old. I know one woman who is over 65 and is making all the money she needs with this secret.

NO PERSONAL SELLING

When you use this secret to make money you never have to try to convince anybody of anything. This has nothing to do with door-to-door selling, telephone solicitation, real estate or anything else that involves personal contact.

LEGAL AND HONEST

Everything about this idea is perfectly legal and honest. You will be proud of what you are doing and you will be providing a very valuable service.

NO LONG HOURS

It will only take you two hours to learn how to use this secret. After that everything is almost automatic. After you get started you can probably do everything that is necessary in three hours per week.

I know you are skeptical. That simply shows your good business sense. Well, here is proof from people who have put this amazing secret into use and have gotten all the money they ever desired. Their names are not mentioned here in order to protect their privacy but I have full information and the actual proof of their success in my office.

PROOF

- A woman from Oregon started out by using my secret method in its simplest form. She later reported that it had brought her \$14,000 in cash.
- A man from Rhode Island applied my secret and with the help of his family, made over \$40,000 in a year in his spare time.
- A man from California, who was broke at the time, tried my secret and made \$147,000.
- On the basis of my secret, a husband and wife team from Virginia grossed over \$100,000 cash in eleven months.
- A man from California made over \$265,000 in one year, with this incredible secret.
- I talked to a man from Ohio, who now lives in Santa Monica, CA. He said: "Thank you for sharing your secret... with this amazing, yet simple secret, I received \$220,000 in just two months."

As you can tell by now I have come across something pretty good. I believe I have discovered the sweetest little money-making secret you could ever imagine. Remember — I guarantee it.

Most of the time, it takes big money to make money. This is an exception. With this secret you can start in your spare time with almost nothing. But of course, you don't have to start small or stay small. You can go as fast and as far as you wish. The size of your profits is totally up to you. I can't guarantee how much you will make with this secret but I can tell you this — so far this amazing money producing secret makes the profits from most other ideas look like peanuts!

Now at last, I've completely explained this remarkable secret in a special money making plan. I call it "The Royal Road to Riches". Some call it a miracle. You'll probably call it "The Secret of Riches". You will learn everything you need to know step-by-step. So you too can put this amazing money

making secret to work for you and make all the money you need.

To prove that this secret will solve all your money problems, I'm not even asking you to send me money. Instead, postdate your check for a month and half from today. Obviously it is not actually money because it is not negotiable for 45 days. You can easily stop payment on it any time you want. I can't cash your check for 45 days before I know for sure that you are completely satisfied with my material.

IMAGINE HOW YOUR WHOLE LIFE WILL CHANGE IF YOU USE THIS SECRET TO GET ALL THE MONEY YOU NEED!

- You won't have to worry about bills.
- You will be master of your own time and fate and nobody can boss you around.
- You will have more time to spend with your loved ones and you will be able to take care of them in emergencies.
- You can have the house you want, the car you want, the vacations you want.
- And most of all, you will finally have PEACE OF MIND!

If you need (or just want) more money, there are a lot of reasons why you should take advantage of this amazing secret. (And I can't think of a single reason why you shouldn't). It will probably solve all your money problems forever. In fact, I am so completely convinced that my powerful secret works money miracles, that I'm willing to give you the most unusual guarantee ever offered. That is, if it doesn't solve all your money problems, I'll return your original uncashed check, plus an extra twenty dollar cash bonus just for doing me (and yourself) the favor of giving the secret an honest try according to my simple instructions.

\$20.00 FREE!

There is no way you can lose. You either solve all your money problems with this secret (in just 30 days) or you get your money back plus \$20.00 in cash FREE!

Do you realize what this means? You can put my simple secret into use. Be able to solve all your money problems. And if for any reason whatsoever you are not 100% satisfied after using the secret for 30 days, you may return my material. And then I will not only return your original UNCASHED CHECK, but I will also send you an extra \$20.00 cashiers check just for giving the secret an honest try according to the simple instructions.

I GUARANTEE IT! I have given references, therefore, there is absolutely NO RISK ON YOUR PART.

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PM SOFTWARE MONITOR



Fantasy warfare challenges the imagination

The game of *Parthian Kings* from Avalon Hill is a unique, new style of computer game which should appeal to anyone with a love for strategic design and tactical maneuvering on the screen of their favorite personal computer. For one to four players, *Parthian Kings* is not only an excellent game, but shows how a designer can use a computer to enhance a game beyond what a non-computerized board game can offer.

When you boot the disk, rather than getting right into the game, you must first design your own army units and even a battlefield map. Design of army units is guided by a screenful of choices: The computer helps you to calculate all the interlocking variables of choosing a unit's strength, movement range and armor rating. The temptation is to design unbeatably powerful units, but the game gets around that nicely by assigning a monetary cost to the formation of units: the better the unit, the more money it will cost to produce later in the game.



A *Parthian Kings* battlefield features various terrain features along with the silhouetted images of the opposing armies.

Then you can design a map. You can place cities where you want them, and arrange the terrain features (which govern movement and certain combat factors). Or, you can just use the included map of Parthia from the disk.

The computer will play up to three opponent kings, although we found the speed of the program to be such that having the computer play more than



Included map of Parthia can be used as a battleground, or else the players can design their own worlds to conquer.

two was very time-consuming. Each king runs his own kingdom, setting tax rates and forming armies and convoys out of the type of units he has previously designed. Movement, firing and combat are all animated onscreen. If you're tired of reflex arcade action, a game like this could be just what you're looking for (now on the Apple II and on other machines soon).—N.S.

Homework on Homeword

Who says a word processor has to be difficult to use and learn?

Not the people at Sierra OnLine with their new *Homeword* package. While it would not be a good choice for writing a novel, it's excellent for students and home users.

Pictorial commands (called "icons") are shown at the bottom of each



Homeword program makes use of pictorial "icons" at the bottom of the screen which are chosen by the user to set commands.

screen. These icons, which may be chosen via the keyboard using the return and arrow keys, substitute for memorizing complex keyboard entries.

You can edit text, format a printout, even load and save documents to and from disk by choosing an icon (although there are optional keyboard commands, too, for those who like using them).

Text may be previewed on screen as it will appear on paper. Even as you type, a schematic-style look at the printed version is always available. Also, while editing, a constant readout of available computer and disk memory is displayed.

Homeword is currently available for the Apple, Atari and IBM PCjr machines.—N.S.

A keystroke saver

If you're like me, you often edit on a word processor a document which has a number of recurring phrases or words.

If you've typed something like "XYZ Corporation" a hundred times, just think how great it would be if a single swipe at a key could type the whole title. Now, with *Smartkey*, you can do just that.

But *Smartkey* isn't limited to just turning multiple keystroke textual phrases into one-keystroke entries; it can also be used as a sort of automatic program customizer.

If you are using a program with complex command sequences, you can teach *Smartkey* that pressing D for Delete really means to send the program a control-k followed by an escape-2 sequence, for example.

Once you run *Smartkey* at the beginning of a computing session, it remains in the computer memory and can be called from just about any other program. This means that you can define keys while you are doing other tasks.

Smartkey is from Heritage Software and is available for just about all computers using the CP/M operating system.—N.S.



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NISSAN	2389	103/4800	134/2800	1460	5 spd./w overdrive	\$5999*	34.1	7.9	STD.	STD.
TOYOTA	2366	100/4800	130/2800	1400	4 speed	\$5998*	34.1	6.5	STD.	N/A
FORD RANGER	1995	73/4000	107/2400	1235	4 speed	\$5993*	36.7	6.6	STD.	STD.
CHEVY S-10	1940	82/4600	101/3000	1000	4 speed	\$6408*	36.8	6.4	STD.	STD.

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PM Reproductions

Build LINCOLN'S Rocking Chair

Here are step-by-step instructions
for making a fine antique reproduction.

TEXT AND PHOTOS BY DAVE WARREN

In the early 1860s President Abraham Lincoln purchased a cane rocking chair for his home. According to local historians, the small walnut rocker was used by Mrs. Lincoln while sewing and to rock the Lincoln babies to sleep. Today, over 120 years later, the beloved Lincoln rocker still graces the sitting room of their Springfield, Ill., home. Now, by special permission of the U.S. Department of the Interior, you can build a reproduction of this lovely rocking chair for your home.

Begin by selecting clear, warp-free walnut boards that equal or surpass the rough dimensions given in the materials list. Since walnut is an expensive wood, it's wise to shop around. After checking with local lumberyards and hardwood retailers, stop by a wholesale hardwood distributor. Although these firms don't sell retail, they do occasionally sell "shorts"—the cut-

off ends and rips from larger timbers. Shorts are perfectly good, but too small for the wholesaler to trade. If his selection of walnut shorts meets your needs, it could be a real savings.

First, surface-plane the boards to their respective thicknesses. Make cardboard templates for the various chair parts (A-D, F and I) according to the drawing. Pencil the template shapes onto the boards and cut out the chair parts. Band saw all curved parts including the compound curved top rail. Note that the back posts taper from 1 1/8 in. thick at the seat to 3/4 in. at the top.

The chair is assembled with mortise and tenon joints. Cut the mortises by first boring a series of holes and then chiseling the mortise square. Or, use a drill press fitted with a mortising chisel. Cut the tenons by hand, with a tenon saw, or on a table saw using a tenoning attachment. Also, bore holes into the front (I) and back (C) posts to accept the three dowels located under the seat. Turn the walnut dowels on a lathe, or check with woodworker supply houses for ready-turned hardwood dowels. Note that two dowels are 3/8 in. dia. and the third dowel, which spans the back posts, is 1/2 in. dia.

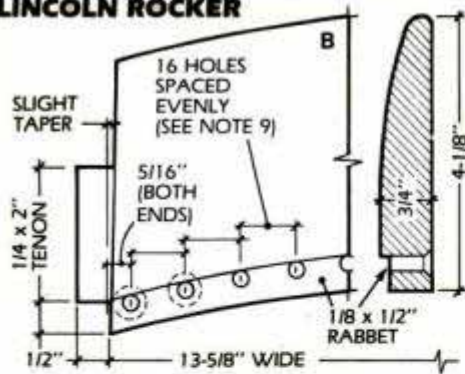
Next, rabbet the front and back posts to accept the rockers. Carefully chisel a 1/8-in.-deep x 1/2-in.-wide rabbet in the top rail to provide a recess for the cane. This

(Please turn to page 62)

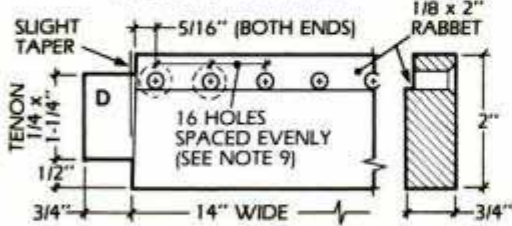
Follow our plans—including step-by-step hand caning instructions—so that you can make Mary Lincoln's solid walnut rocking chair.



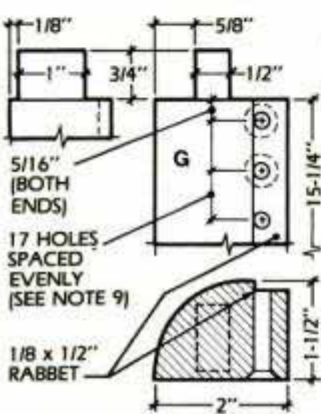
LINCOLN ROCKER



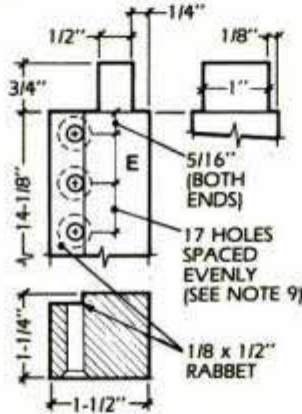
DETAIL 1—TOP RAIL



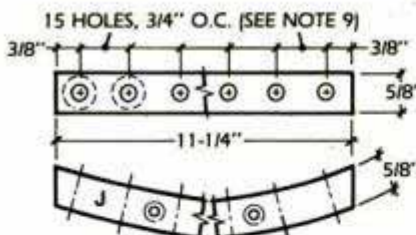
DETAIL 2—BOTTOM RAIL



DETAIL 4—FRONT RAIL

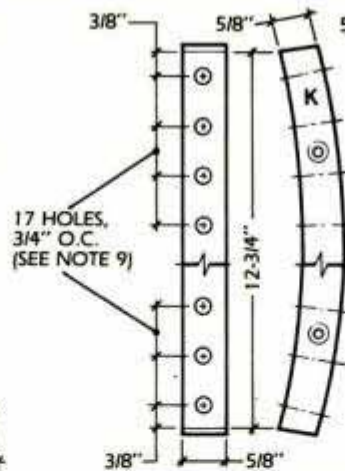


DETAIL 5—BACK RAIL

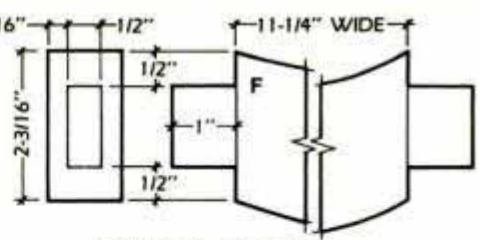


DETAIL 6—SEAT CLEAT

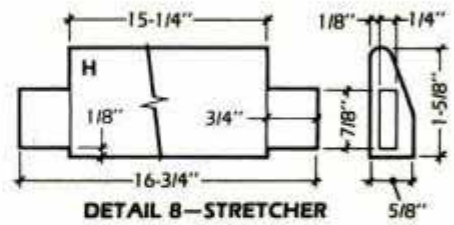
NOTE 9
BORE 1/4"-DIA. CANE HOLES; USE 1/2" COUNTERSINK TO FINISH BACKSIDE OF EACH HOLE



DETAIL 3—POST CLEAT

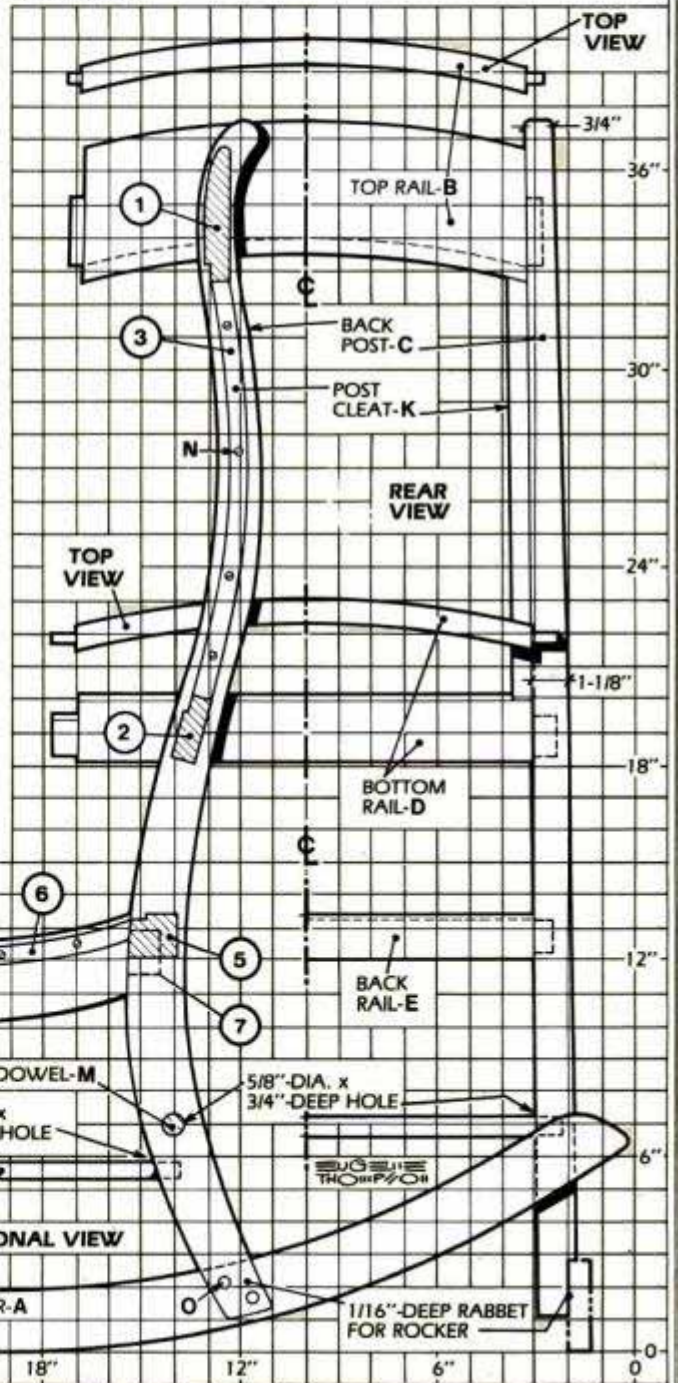


DETAIL 7—SIDE RAIL

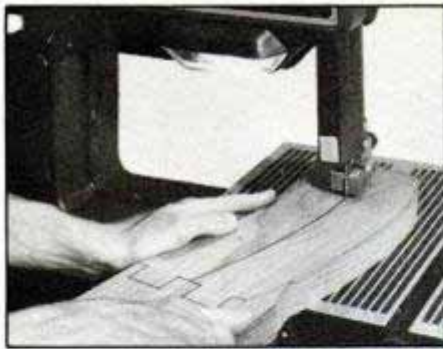


DETAIL 8—STRETCHER

EACH SQ. = 1"



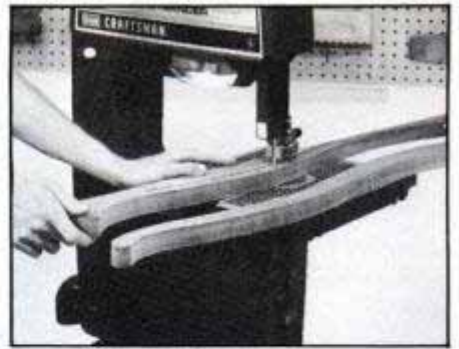
CHAIR CUTTING AND ASSEMBLY



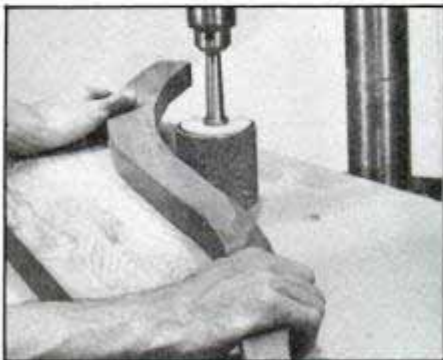
To save material, lay out the two side rails so that they share a common line-of-cut. Then cut out the pieces on a band saw.



Clamp the two side rails together. Use a spokeshave to smooth the edges simultaneously. Remove all blade marks.



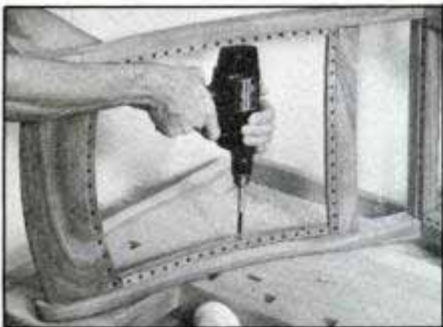
Cut out the curved back posts on the band saw following the pattern shown on page 61. Use the cutoff waste for post cleats.



Use a drum sander chucked in a drill press to sand back posts smooth. If you are careful, you can use a belt sander instead.



Use a band saw to cut curved top rail from a 1 1/4-in.-thick walnut board. Feed workpiece slowly to avoid breaking the blade.



Attach the cleats to the inside of the back posts with 1 1/4-in. No. 10 fh screws after boring the 1/4-in.-dia. caning holes.



Screw the rocker to the front post with two 1-in. No. 12 fh screws. Counterbore screw holes to accept 1/2-in.-dia. wood plugs.

ROCKING CHAIR

(Continued from page 60)

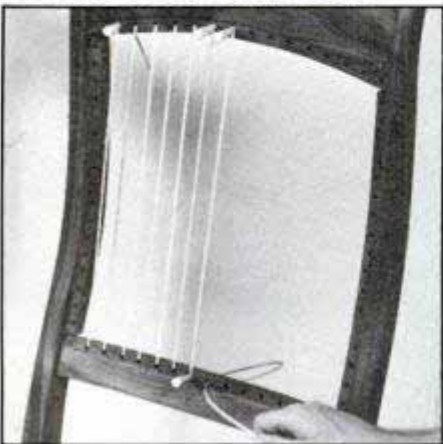
must be cut by hand because of the compound curve of the piece. Cut the same size rabbet in the front, back and bottom rails, but this time use a router with a rabbeting cutter. Here, the rails have only single curves.

Next, bore 1/4-in.-dia. cane holes through the rabbets in the four rail pieces. Countersink the backside of each hole. The cane is secured to the back posts and side rails through cleats, not rabbets. Band-saw the cleats to match the shape of their respective chair part. Then, bore 1/4-in.-dia. holes for the cane before attaching the cleats with 1 1/4-in. No. 10 fh screws. Space the caning holes as shown in the drawing.

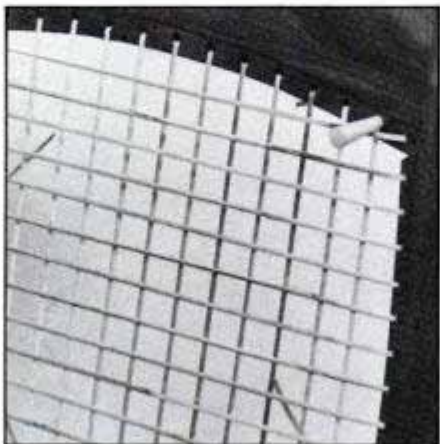
Next, sand each chair part with 120-grit abrasive paper. Dry-assemble the chair, making sure that all joints fit properly. Now, glue and clamp the chair's side assemblies. After the glue dries, join the two side assemblies with the horizontal chair parts. Check carefully to be certain that the chair is true and square, not twisted. Finish-sand with 220-grit abrasive paper. Finish the chair with a French polish: 70-percent orange shellac and 30-percent boiled linseed oil. Rub on four coats of polish using 4/0 steel wool.

(Please turn to page 64)

CANING PROCEDURE



Soak the cane in water for 10 minutes, then weave it vertically starting at top left. Caning pegs hold the cane taut. Soak a second strand while working the first.



Starting at the top left, string the second strand horizontally, crossing over the vertical cane. You should pull each run tight and hold it temporarily with a peg.

MATERIALS LIST—LINCOLN ROCKER

Key	No.	Size and description (use)
A	2	5/8 x 5 x 30* walnut (rocker)
B	1	1 1/2 x 5 1/2 x 14 3/4" walnut (top rail)
C	2	1 1/4 x 5 x 38** walnut (back post)
D	1	1 1/2 x 2 x 15 1/2" walnut (bottom rail)
E	1	1 1/4 x 1 1/2 x 15 3/4" walnut (back rail)
F	2	1 1/4 x 3 1/2 x 13 1/4" walnut (side rail)
G	1	1 1/2 x 2 x 16 3/4" walnut (front rail)
H	1	3/8 x 1 1/2 x 16 3/4" walnut (stretcher)
I	2	1 1/8 x 3 x 13** walnut (front post)
J	2	3/8 x 2 x 12** walnut (seat cleat)
K	2	3/8 x 2 x 13** walnut (post cleat)
L	2	3/16"-dia. x 12** walnut dowel
M	1	3/8"-dia. x 16** walnut dowel
N	16	1 1/4" No. 10 fh screws
O	8	1" No. 12 fh screws, 1/2"-dia. x 1/2" wood plug

*Rough dimensions; trim pieces as per drawing.
Misc.: 1 hank medium cane, carpenter's glue, 120- and 220-grit abrasive paper, orange shellac, linseed oil, 4/0 steel wool.

NEWSCIENCE/UPDATE

Barbara McClintock: The world has finally caught up to her ideas.



When 81-year-old Barbara McClintock learned from a radio broadcast that she had won the Nobel Prize for Physiology or Medicine, she was at a loss. "I knew I was going to be in for something," she says. "I had to psych myself up. I had to think of the significance of it all; to react. I had to know what approach I would take."

There were many approaches McClintock could have taken. For one, she might have been bitter. After all, she was being honored for a discovery she had made 30 years before, which most mainstream geneticists had promptly rejected—that genes are not always locked into permanent positions on a chromosome, that they can move, causing variations and mutations in an organism's offspring. Or she might have been elated at being vindicated at last. Or she might have taken the opportunity to berate scientists for their closed minds.

Instead, as she had all her life, McClintock met the world graciously but with reserve. She held a single press conference and told journalists, "The prize is such an extraordinary honor. It might seem unfair, however, to reward a person for having so much pleasure over the years, asking the maize plant to solve specific problems, then watching its responses." Afterward, she turned on the heels of her oxfords and retreated to the solitude of her laboratory.

McClintock is only the third woman ever to win an unshared Nobel. She made her prizewinning discovery of gene transposition while studying Indian corn, a plant she began investigating as an undergraduate at Cornell and continued probing for five decades. "When you get to know the maize plant well," she explains, "you begin to know what it can do for you and what questions you can ask."

The more she studied, the more fascinated she became. "Plants to most people are just plastic organisms that don't move or do anything," she says. "Yet they are so smart. They have to combat their environment in the most clever ways."

McClintock says that when she first realized in the late 1940s and early 1950s that variations in new plants were being caused by the movement of genes now known as "jumping genes," other geneticists thought she was crazy. But she never doubted her findings. "Anybody who had that evidence thrown at them with such abandon couldn't help but come to the conclu-

sions I did. I just knew sooner or later that it would all come out in the wash."

Colleagues believe McClintock was secretly wounded by the cool reception her theories received, but she understands the response: "It took long for my concepts to be accepted, I think, because nobody had the extraordinary experience I had of attempting to do one kind of experiment with the maize plant and carrying it through." She also acknowledges, "We had no understanding of DNA to work with at the time." Nor did scientists have electron microscopes or the concepts of microbiology. Says McClintock, "We weren't ready."

According to her biography, *A Feeling for the Organism*, by Evelyn Fox Keller, even as a child, McClintock "had a striking capacity for autonomy, self-determination and total absorption." Since college, she has devoted her life single-mindedly to scientific study, feeling little need for distractions or interpersonal relationships. Even her closest colleagues report that she's difficult to get to know. McClintock told her biographer, "I could never understand marriage. I never went through the experience of requiring it."

During the 1920s and '30s, McClintock preferred to work alone and rarely published her findings. Even so, she gained a reputation. At the age of 40, she was offered a job at the Carnegie Institute's Cold Spring Harbor Laboratory on Long Island, and she has worked there ever since. "An oasis," she calls it. "If I had been at some other place, I'm sure I would have been fired for what I was doing." She stopped publishing altogether in the 1950s, she explains, because "I thought nobody was reading it, and what's the use of publishing? I was having too good a time doing the work."

Finally, in the 1970s, geneticists realized McClintock had been right all along, and in 1981 the big awards began arriving—eight of them, including a John D. and Catherine MacArthur Foundation stipend of \$60,000 annually for five years. And now the Nobel prize.

In her ninth decade, Barbara McClintock still spends her days working in her laboratory. Recently, she has joined investigators in other areas of science, primarily microbiology, helping them to understand the maize plant. "We have to find out a lot more about the nature of the gene," she says, "what controls its action, what's behind it. I think we have a long way to go." ■

NEWSCIENCE

Surgery stifles sonorous snores

When the comical "ZZZZ" of cartoons becomes buzz-saw loud in real life, snoring ceases to be a joke: It can be downright disruptive. But silent nights are now being made possible by a surgical technique developed in Japan and recently introduced into this country.

Snoring is the noise made by air turbulence wherever there is an obstruction in a person's breathing passage-way. According to F. Blair Simmons, professor of surgery at Stanford University School of Medicine, loud snorers are people whose soft palate (the back roof of the mouth) relaxes too much during sleep. The limp tissue, he says, "acts like a ball valve in a police whistle—it just flaps back and forth as a person breathes."

In the new procedure, excess palate tissue is removed surgically and the rest is stretched to bridge the gap. The operation has been successful 95 percent of the time—either banishing snoring entirely or dramatically decreasing its volume.

A snorer is a candidate for the operation, says Simmons, if the snoring occurs in every sleeping position, if it can be heard at least one room away and if the snorer's bed partner has moved to another room. ■

Crop yields cut by car exhaust

Each time you hop in the car to go to work or to the supermarket, you put a small dent in the nation's wheat harvest.

Tests under controlled conditions at Cornell show that ozone—created largely by automobile exhaust—reduced the yield of certain strains of wheat by up to 25 percent.

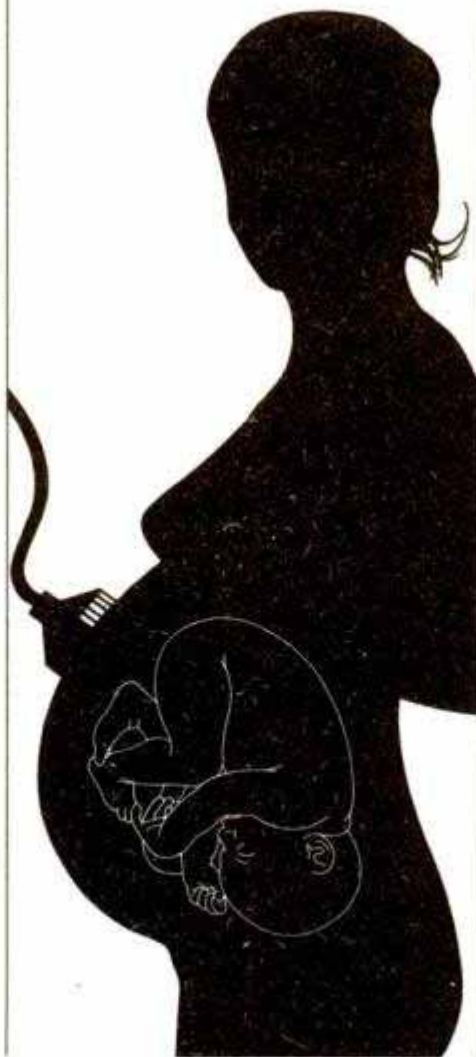
According to plant physiologist Robert Amundson, ozone shortens the functional lifetime of the plants' leaves. "It's a case of premature senescence," he says. "The plants are aging faster than normal." ■

The average human inhales over a gallon of air a minute when resting. During exercise that rate can be 30 times higher.



Surgery can keep the soft palate (red) from fluttering, reducing ZZZ's to zzz's.

A baby's personality and musical tastes may be detectable before it's born.



Microbe extract offs mosquitoes

Israeli and American scientists have come up with a more effective mosquito killer—a newly discovered toxin produced by bacteria.

Known as BTI, the toxin acts quickly. Entomologist Richard Garcia, of the University of California, Berkeley, says that the chemical killed half of the test population of one species of mosquito within minutes and the rest in about an hour.

Control in the field, says Garcia, is excellent, even when vegetation covering the water protects developing insects. And BTI shouldn't affect the mosquitoes' natural enemies—a degree of selectivity unattainable with broad-spectrum pesticides. ■

Musical taste in the womb

Clifford Olds placed headphones on a pregnant mother's belly, and her unborn baby listened to a waltz from Gounod's *Faust*. The baby responded immediately, says Olds, "as if it wanted to get up and dance."

Since then, British research psychologist Olds has introduced dozens of fetuses to music's charms while monitoring their heartbeats. In each instance, the music altered the fetal heart rate. The mother's experience, meanwhile, was irrelevant: Fetal hearts showed little response when the headphones were placed on the mother's ears rather than on her belly.

Olds notes that different kinds of music evoke different patterns of heartbeat. And the same music quickens the heart in some fetuses, slows it in others.

Olds has even predicted a baby's personality based on its fetal response. Each of a set of twins reacted differently to the same song: One's heart beat faster, the other's slowed. Olds announced that they'd be fraternal—and one would be an extrovert, the other an introvert. Two years later, the twins' mother said he'd been right. Other mothers cite similar accuracy.

Since music also makes fetal hearts beat more regularly, says Olds, "perhaps at some point, music will be used as a treatment for fetal distress" whenever the heartbeat becomes dangerously irregular. ■

A parrot speaks its mind

Parrots, rather than chimps or dolphins, may be the first animals to hold meaningful conversations with humans—if the remarkable performance of Alex, a red-tailed African gray at Purdue University, is any indication.

Ethologist Irene Pepperberg has, over the past six years, taught Alex what she calls "basic communication skills." At last count, Alex could proficiently identify, request or refuse more than 50 objects using vocal labels. And he can correctly identify new objects by stringing together separate symbols already in his repertoire.

Pepperberg has achieved these results with what she refers to as a model-rival presentation. Two humans demonstrate the type of interaction required by performing in front of the parrot. One person, acting as the "trainer," asks the second person to identify the object, then hands it over if the answer is correct.

Similar experiments carried out at Harvard in the 1950s by psychologist O. W. Mowrer failed. Why are Pepperberg's a success? Because, she says, she uses objects or toys of intrinsic interest to the bird, and unlike Mowrer, she doesn't offer to reward Alex with food for responding to nonfood objects. ■



A high-performance parrot at Purdue is baffling scientists with its verbal feats.

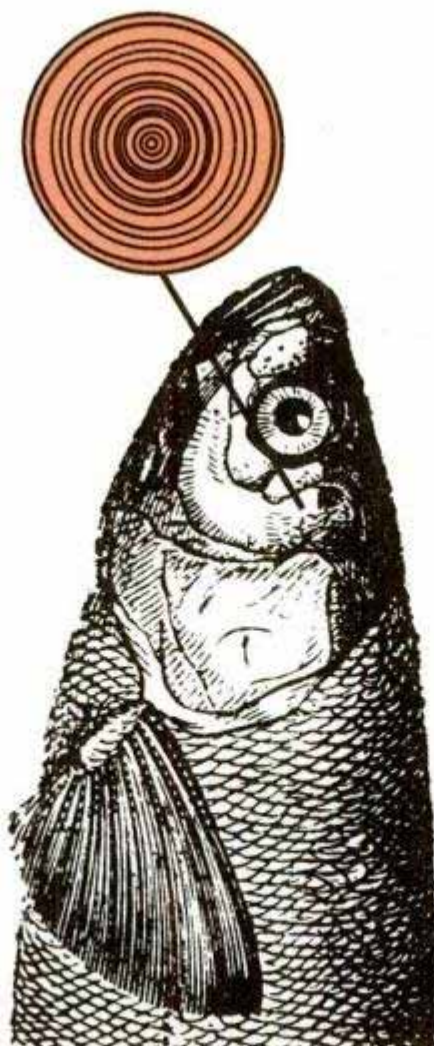
The rings in a fish's ear bone are a daily diary of environmental conditions.

How fish ears warn of pollution

A fish's life story is etched into tiny bones in its ears. The bones are called otoliths, and they grow like tree trunks, in concentric rings.

At least one of these microscopic layers is added each day the fish grows—up to six years in some species. By matching records of weather conditions with changes in the rings, scientists can learn when the fish was hatched, when it migrated, how it grew, how the water temperature varied from day to day, and when and how the fish changed its behavior.

"By examining the daily rings for differences in thickness, density and chemical composition," says Edward Brothers, a marine biologist at Cornell University, "we can trace the origins of fish stocks and determine, for example, whether a group of salmon caught in a particular area are from the same



stream. If so, we can decide whether harvesting should be limited to prevent serious depletion."

Recently, ichthyologist F. Doug Martin and graduate student Timothy Mulligan of the University of Maryland's Chesapeake Biological Laboratory also discovered that otoliths contain evidence of pollution. The rings absorb heavy metals, and their growth is affected by temperature changes in the surrounding waters—sometimes a sign of pollution. Martin and Mulligan have observed a direct relationship between copper, cadmium and zinc in the otoliths of white perch and the amount of time the fish were exposed to water containing these metals.

All in all, says Brothers, "otoliths provide us with a powerful new tool for understanding fish ecology." ■

Tracking thieves with microbes

A bundle of traveler's checks disappears from a bank, probably stolen by an insider. To catch such a thief, police in Charlotte, North Carolina, may soon employ telltale microbes.

How? A second set of traveler's checks is sprayed with a harmless solution containing bacteria, then planted in the bank. After these checks disappear, papers handled by each employee are swabbed with Q-Tips, which are then rubbed on culture dishes. Soon, a black streak appears in one employee's dish. Nabbed!

Microbiologist James Oliver, of the University of North Carolina, Charlotte, helped develop the microbe tag for Charlotte's police crime lab. "We found some rare, harmless microbes from Germany. To make sure they were harmless, we injected them into mice, which were unaffected," he says.

"We chose bacterial spores because they are among the hardiest biological forms in nature—they thrive regardless of conditions." Adds William Best, assistant director of the crime lab, "With microbes, the suspect doesn't suspect he's a suspect." The technique is now being evaluated in the field. ■

Abe Lincoln's lankiness may have come from Marfan syndrome, a hereditary connective-tissue disease.

RESEARCH ROUNDUP

"Sleeping" sloth plays possum

You can't tell whether a three-toed sloth is awake or asleep by watching it. Three scientists, observing sloths in the wild, thought the animals slept 70 percent of the day. But when they checked the animals' brain waves, the researchers found that sometimes when the sloths seem to be dozing, they're actually wide awake—and sometimes when they're up and moving, they are, in fact, asleep.

Physiologist Sara Huggins, of the University of Houston, and several Brazilian colleagues report in *Comparative Biochemistry and Physiology* that sloths are truly asleep only 66 percent of the day. The cause of the odd brain activity is still unclear. ■

Tooth trouble

Hard-playing athletes with impacted wisdom teeth could be in for a mouthful of trouble.

According to oral surgeon Alan Schwimmer and co-workers at Beth Israel Medical Center in New York City, reporting in the *American Journal of Sports Medicine*, a contact-sport player with an impacted wisdom tooth runs more risk of having his lower jaw fractured by a blow than one who has had the extra tooth removed. Says Schwimmer, "The fact that the third molar is there decreases the mass of bone." As a result, he explains, the area around the embedded tooth is actually weaker than the rest of the jawbone. However, by removing the tooth, the area it occupied will fill in with bone. ■

A strand in the web of a golden spider is as strong as a steel wire of the same thickness.

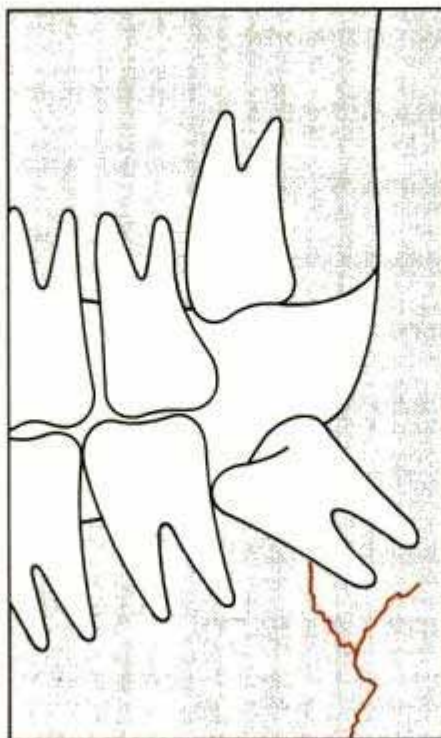
Sweden tracks canine cancers

Sweden has the world's most complete registry of human cancer statistics. Now they're starting a cancer registry for dogs. According to the Stockholm daily *Svenska Dagbladet*, Sten-Erik Olsson, at the Swedish Radiation Safety Institute, has started the data bank on a small scale but hopes to expand it soon.



The sluggish sloth has strange sleeping habits—you never know when it's awake.

The lower jaw is more likely to break if impacted wisdom teeth aren't removed.



Dogs, he says, are of special interest in cancer research because the different breeds have unique biological characteristics: "We have found that different dogs tend to develop different kinds of tumors. Large dogs, for example, are much more likely to get malignant bone tumors; skin cancers seem to strike boxers more than other breeds; and shorthaired retrievers suffer from various soft-tissue tumors." ■

Fever fighter

Scientists have found a substance that is thousands of times more effective at reducing fever than the same amount of aspirin or Tylenol. And this substance, called alpha-MSH, is produced naturally in the brain, so it should have few side effects—unlike the man-made medications.

Its fever-fighting potential, described in *Science*, was discovered by researchers at the University of Texas Health Sciences Center. James Lipton, a member of the team, says that during fever, alpha-MSH builds up in an area of the brain that controls body temperature. There, it apparently sets a ceiling for the fever. Adding more alpha-MSH, he says, should make it possible to lower that ceiling. ■

Jupiter's magnetic field is huge; it would appear much larger than the full moon if it were visible.

Ugliness linked to delinquency

Some delinquents may act ugly because they are ugly. A study of adolescent boys has found that those whose appearance was judged "fair" or "poor" behaved more antisocially than those whose looks were rated by interviewers as "excellent."

Boys who have poor complexions, little physical maturity or a weight problem, reports Emory University sociologist Robert Agnew, "are seen as more aggressive and less intelligent. They are liked less, and their work is more likely to be judged as inferior. They are cut off from society to a certain extent, so they have less to lose by indulging in delinquency." Agnew cautions that the findings are preliminary. More research—including a study of girls—is needed. ■

NEWS/SCIENCE/INNOVATIONS

The computerized creations of Raymond Kurzweil can talk, listen and sing.

Within two years, you'll be able to buy a typewriter that takes dictation. Never mind that IBM and Bell Labs say it can't be done in less than five. Raymond Kurzweil promises it in two.

A Kurzweil promise is worth listening to. He's the man who, in 1976, introduced an optical scanner that can read—aloud—any printed text, no matter what the typeface. It's been called the greatest boon to the blind since Braille. It can also reprint what it reads. Kurzweil says IBM and Control Data have been trying to duplicate his technology, but so far they haven't caught up.

An accomplished pianist and the son of a Bell Symphony Orchestra conductor, Kurzweil also invented a unique music synthesizer that duplicates with disturbing accuracy the sound not only of a piano but of nearly every other acoustical instrument. With it, a single musician can "play" several instruments at once—and the synthesizer can simultaneously notate every sound played on it, of whatever speed or rhythm.

Now Kurzweil is working on a speech-recognition system that attaches to a word processor and "understands" 10,000 words at the rate of 150 per minute. He believes he's far ahead of the competition. His team, he explains, includes "experts in artificial intelligence, pattern recognition, speech science, linguistics, psychoacoustics, information theory, advanced computer architecture, VLSI [very large scale integrated] circuitry, signal processing and human factors. IBM is big in information theory, computer architecture and VLSI, but not in psychoacoustics or linguistics. As an interdisciplinary team, ours is unequalled."

There are already speech-recognition systems on the market that understand a few simple commands. Airport baggage handlers use them to route luggage; factory inspectors use them to keep track of product defects. But these systems can generally recognize only one word at a time. And their vocabulary is at most several hundred words.

Kurzweil's project is far more complex. It will incorporate two systems: One will analyze sound; the other will analyze grammar and syntax to distinguish between similar sounding words, such as "ware" and "wear."

Kurzweil's biggest challenge is that no person pronounces a word exactly the same way twice. But he has solved problems like this before. For example,

to create his optical scanner, his team had to identify shapes that were constant in each letter through every typeface. Now, Kurzweil explains, "we're trying to identify the characteristics of pronunciation that don't change with the speaker or between utterances." Such invariables are found more easily, of course, in 26 letters than in 10,000 English syllables, even if the principle is the same. The system will be "speaker dependent"—trained to understand only one voice, at least at first—and the speaker will have to tell the machine how to punctuate. He will also have to pause very briefly between each word when dictating. But Kurzweil is confident he'll have his typewriter to market long before his competitors will. He predicts that his speech-recognition unit will be contained in an 18-inch cube and cost \$5,000.

Raymond Kurzweil turns 36 this month. He has been working with computers for 24 years. At 13, he designed software for statistical analysis that was distributed by IBM. At 16, he won seven national awards—including a first out of 60,000 entries at the International Science Fair—for a computer program that could compose music in the style of Mozart. As a sophomore at MIT, he developed a program that matched students with appropriate colleges; he sold it a year later for \$100,000 plus royalties.

In 1974, he founded Kurzweil Computer Products, which developed the reading machine. In 1980, he sold the company to Xerox after an initial payment of \$3.6 million. He continues with the company as its part-time chairman, reportedly at a six-figure salary. In 1982, he founded Kurzweil Music Systems (to make the synthesizer) and Kurzweil Speech Systems (to confront the challenges presented by the typewriter). He is president of both.

Though proud of his accomplishments, Kurzweil believes his future will eclipse his past. "I consider myself *a*) an inventor and *b*) an entrepreneur," he says. "Each of these tends to develop skills and get better with experience. It's a matter of combining your knowledge of the world with learning how to put people together and systems together. Inventions don't come to you, bang, in the shower. They come from analyzing needs, followed by years of painstaking research." The only difference is, Raymond Kurzweil seems to need fewer years per invention than everybody else. ■



NEWS SCIENCE

Two boats for the price of one

You can slap a powerful motor onto a sailboat, but that doesn't make it a speedboat; the shape of the hull prevents efficient use of horsepower.

At least, that used to be true. Now, a British designer named Ian Anderson has invented a boat that does both jobs well. His Multi-Role Cruising Boat, described in the British journal *New Scientist*, would seem at home in a James Bond thriller: At the push of a button, the sailboat's keel retracts into the hull, streamlining it. Simultaneously, twin wedge-shaped protrusions emerge at the rear of the boat's underside.

The sailboat is now a hydroplane. As it accelerates, the bow lifts out of the water. Riding just on the wedges and a small section of hull, the boat is partially freed from the dragging effect of contact with the water.

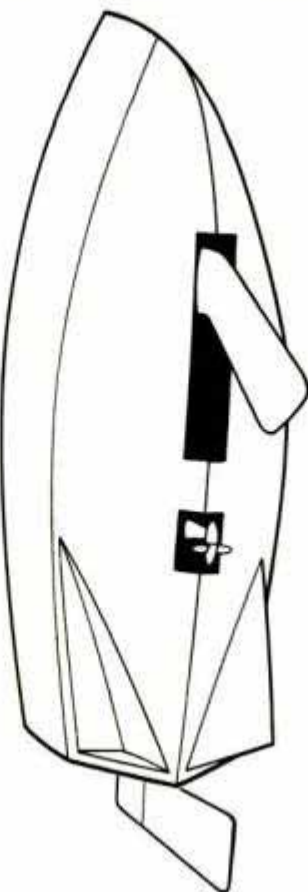
Anderson has proved the worth of his design in test tanks and is now trying to sell franchises to boat-building companies. ■

X-ray gun works on the spot

A football player who crumples in agony must now be taken away for X-rays. But a portable X-ray gun that instantly spots broken bones will soon allow fallen athletes to be examined right on the field.

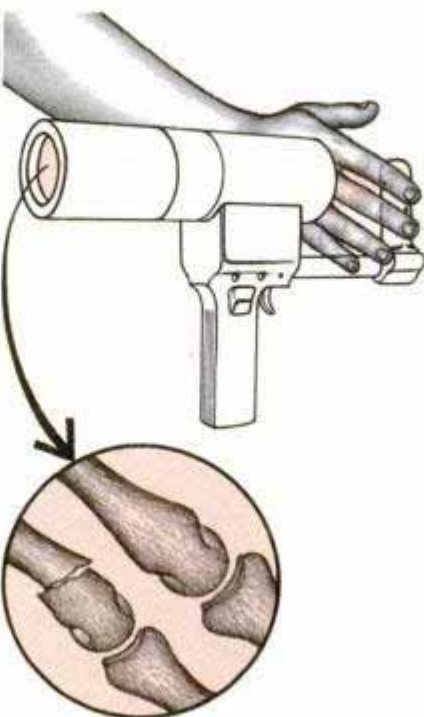
Called a lixiscopes (for low-intensity X-ray imaging), the battery-powered gun derives its sensitivity from a NASA tool for photographing celestial bodies that have low levels of radiation. A bead of radioactive iodine in an attached arm emits X-rays that, when the trigger is pressed, pass through an object—wrist, hand or knee, for example—held in the gap between the iodine bead and the gun's barrel. The rays are converted to visible light, intensified thousands of times and viewed on a small circular screen. In current models, the image is upside down and reversed. The radiation dose is so slight that it would take three min-

The Glen Canyon Dam on the Colorado River holds back silt as well as water—9.5 million tons a day.



Movable sections on a boat's bottom make the best shape for sail and power.

A hand-held X-ray gun allows doctors to detect broken bones at an accident.



utes of exposure for it to equal the radiation in a standard chest X-ray.

The lixiscopes's use is by no means limited to broken bones. Pediatric surgeon Sterling Blocker, of St. Louis Children's Hospital, has used it experimentally to check catheter position in monkeys. In premature human babies, these tubes are pushed into the lungs to aid breathing; if wrongly placed, they can be fatal. These infants may undergo 100 such checks in a month and a half; but Blocker expects the lixiscopes exam, which is much faster than an X-ray, to minimize their exposure to hazardous radiation.

The lixiscopes is also a useful security device. Bristol Myers has used it to monitor Excedrin capsules for contamination, and several embassies use it to detect mail bombs. ■

Plastic mirrors: solar solution?

Solar power systems have been born and have died in droves over the past decade. The cause of death is usually cost. Now, a team of engineers at Denver's Solar Energy Research Institute is working on a scheme to cut the price in half.

The plan begins with the heliostats—the mirrors that reflect and concentrate the sun's rays onto steam-generating boilers. Instead of glass, says group manager Lawrence Murphy, they propose using heliostats, 10 meters in diameter, made from a sheet of high-strength plastic only a quarter of a millimeter thick. The plastic is coated with a reflective, metallic film and stretched over a frame resembling a trampoline turned on its side. Large arrays of these reflectors could supply power to thousands of consumers.

Unlike glass, plastic heliostats won't crack in harsh climates. And since they will weigh less, they'll be cheaper to make, ship and erect.

There are problems: Winds of only 20 miles per hour, for instance, push the polymer out of shape, scattering its focus. But when the problems are solved, Murphy estimates this solar Saran Wrap will produce as much heat per square meter as glass. ■

Aluminum is so strong the type used in airplane wings can support 90,000 pounds per square inch.

Melting waste with electricity

The Department of Energy (DOE) has a new way to process radioactive and toxic waste that has been buried in the ground: Melt it and turn both the waste and the surrounding soil into a huge, glasslike block.

Four carbon electrodes are driven into the ground, and each one is connected to a power source. Then a strong electric current is passed between the electrodes through the soil. Almost immediately the temperature of the soil reaches a blistering 1,300 to 1,500 degrees Fahrenheit, and waste rock and earth all begin to melt. Natural convection slowly distributes the waste evenly through the soup, and a cover traps escaping gases and draws them into purifying equipment.

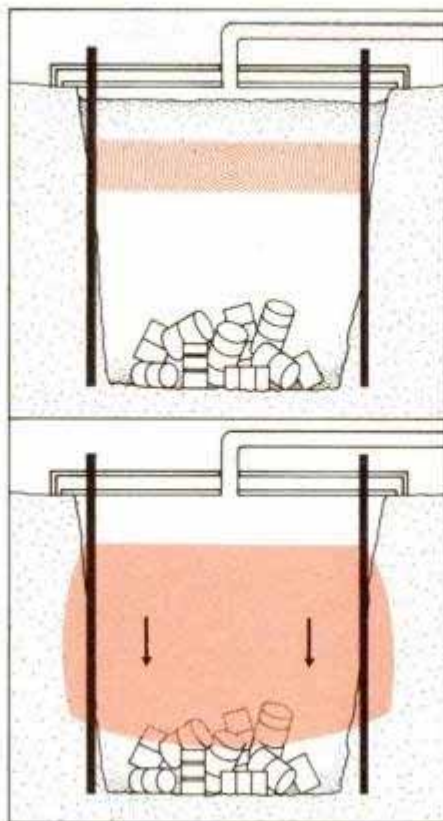
When the soup cools, it forms an inert block resembling obsidian. Tests have found the block to be more durable than granite or marble and as impervious to leaching as laboratory glass. The mass also shrinks as it melts, and after it cools, it can be covered with topsoil.

Experiments with pilot-scale equipment produced blocks up to 20 tons. This indicates that large-scale equipment using 3,000 kilowatts of power for 17 days (similar to the electrical capacity of a typical office building) would produce cubes 20 feet per side, weighing 400 tons. Says research engineer Craig Timmerman of the DOE's Pacific Northwest Laboratory, which is operated by Battelle, "It appears that all organic matter is destroyed, and radioactivity is chemically and physically encapsulated." He adds that the process is "at least ten times" more economical than excavation, transportation, processing and reburial. ■

Sonic alarms lead to safety

When a fire breaks out on a ship and clogs corridors with smoke, sailors can't always find their way to safety, even with exit lights flashing. So the Navy is testing a system of audible pings designed to point the way out.

In the new system, speakers are evenly spaced along a ship's corridors. Each succeeding speaker pings at a higher pitch than the one before, and when there's a fire, they sound off in



Toxic waste is buried and electrically melted into manageable glasslike blocks.

A series of alarms that sound at ascending pitches will help sailors escape fires.



sequence—like flashing runway lights at an airport. The system also uses voice recordings that say, "Don't use this ladder," or "Turn left here," to keep sailors heading away from the fire, not toward it.

Currently, the system is orchestrated by crewmen flipping switches at a ship's damage-control station. But the Navy is also trying out automatic controls so that humans won't have to scout smoking infernos before exit routes can be mapped out. Says Charles Hall, a physicist at the Naval Ship Research and Development Center in Annapolis, who is testing the system, "It has good potential for use in office buildings and hotels as well." Sailors who have helped test the system unanimously approve. ■

New buildings stand up to earthquakes

Most skyscrapers would topple during earthquakes. So several universities are studying new proposals for dampening an earthquake's wrenching effects.

Among the proposals: cables along the side of a building that could be pulled taut in response to stress; or bursts of air, as from a jet engine, that would exert a force along the side of a building opposite the destructive forces. Says Larry Soong, professor of civil engineering at the State University of New York, Buffalo, "Ideas such as these will hopefully alleviate stresses in the structure and mitigate damage."

One mechanism is already in use against high winds: New York's Citicorp Building has a 400-ton block of concrete floating in oil on its sixty-third floor. When winds blow strongly, machines push the block toward the wind in an effort to offset any sway.

But Citicorp's mechanism probably wouldn't counteract the effects of an earthquake. Says James Yao, professor of civil engineering at Purdue University, "Our studies look toward the time when we'll build taller buildings, much more flexible than those of today." ■

When iron rusts, energy is released as heat. If thousands of iron filings were packed into a box, the heat produced would be enough to set the container on fire.

EVERYDAY SCIENCE

What's the sense of humor?

Even chimpanzees have a sense of humor—sort of. According to psychologist Harvey Mindess of Antioch West College in Venice, California, chimps that know sign language "do a kind of slapstick, like urinating on the trainer and then making the sign for 'funny.'" As for humans, humor seems to have been part of civilization from its roots. "Sequences painted five thousand years ago in Egyptian tombs portray a kind of slapstick humor," says Stanford University psychiatrist William Fry, Jr.

But why did humor evolve? Paul McGhee, associate professor of human development at Texas Tech University and author of *Humor: Its Origins and Development*, says, "Humor is really a predictable and inevitable manifestation of human development." McGhee feels that a sense of humor is an expression of our ability to think. In order for something to strike us as funny, it must be intellectually stimulating. "Kids love riddles," he says, "because they're just tackling the challenge of words with more than one meaning. Of course, for adults, they are no longer funny. By the same token, most adults know that a pun isn't really very funny. But for the person who came up with the pun, who went through the cognitive process, it's much more humorous."

Mindess, on the other hand, sees humor as a "disinhibiting" agent. "It frees us from controls and taboos imposed by society," he points out. Because different taboos trouble different people, no single joke produces liberating laughter in everyone. Mindess has classified all jokes into 10 categories—nonsense, philosophical, social satire, ethnic, sexual, scatological, hostile, degrading to women, degrading to men and sick.

One of Mindess's philosophical jokes: A man falling off a cliff catches hold of a root and, hanging in midair, cries to heaven, "Is anyone out there?" A disembodied voice answers, "Yes, my son. Let go and I will bear thee up." The man hesitates, then cries out, "Anyone else?"

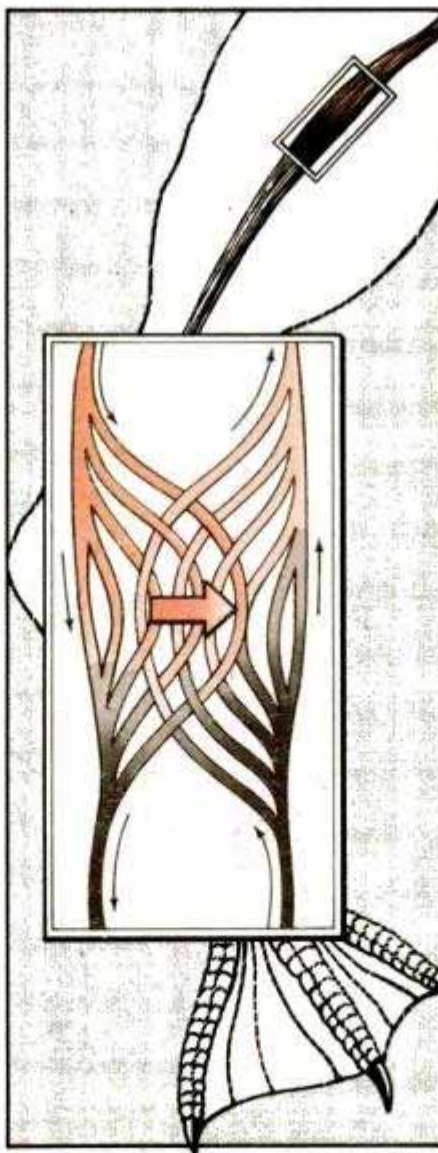
An example of a hostile joke: It's better to keep your mouth shut and be thought a fool than to open it and remove all doubt.

"When we ask people to rate jokes in each category," he says, "certain pat-



Humor may help us cope with society's strictures—or it may be a mental game.

The bundle of vessels in a duck's thigh transfers outgoing heat to frigid blood.



terns emerge. For example, someone who likes nonsense humor and philosophical jokes tends to be more of an intellectual, whereas a preference for hostile, sick and ethnic humor is usually linked to a person who is uninhibited and easygoing."

Mindess, though, can't explain how jokes are liberating. "Is a humorous view of life an escape from reality," he muses, "or is it actually a superior way of perceiving reality? We just don't know." ■

Sand grouse, birds that live in arid areas, carry water to their young in spongelike belly feathers.

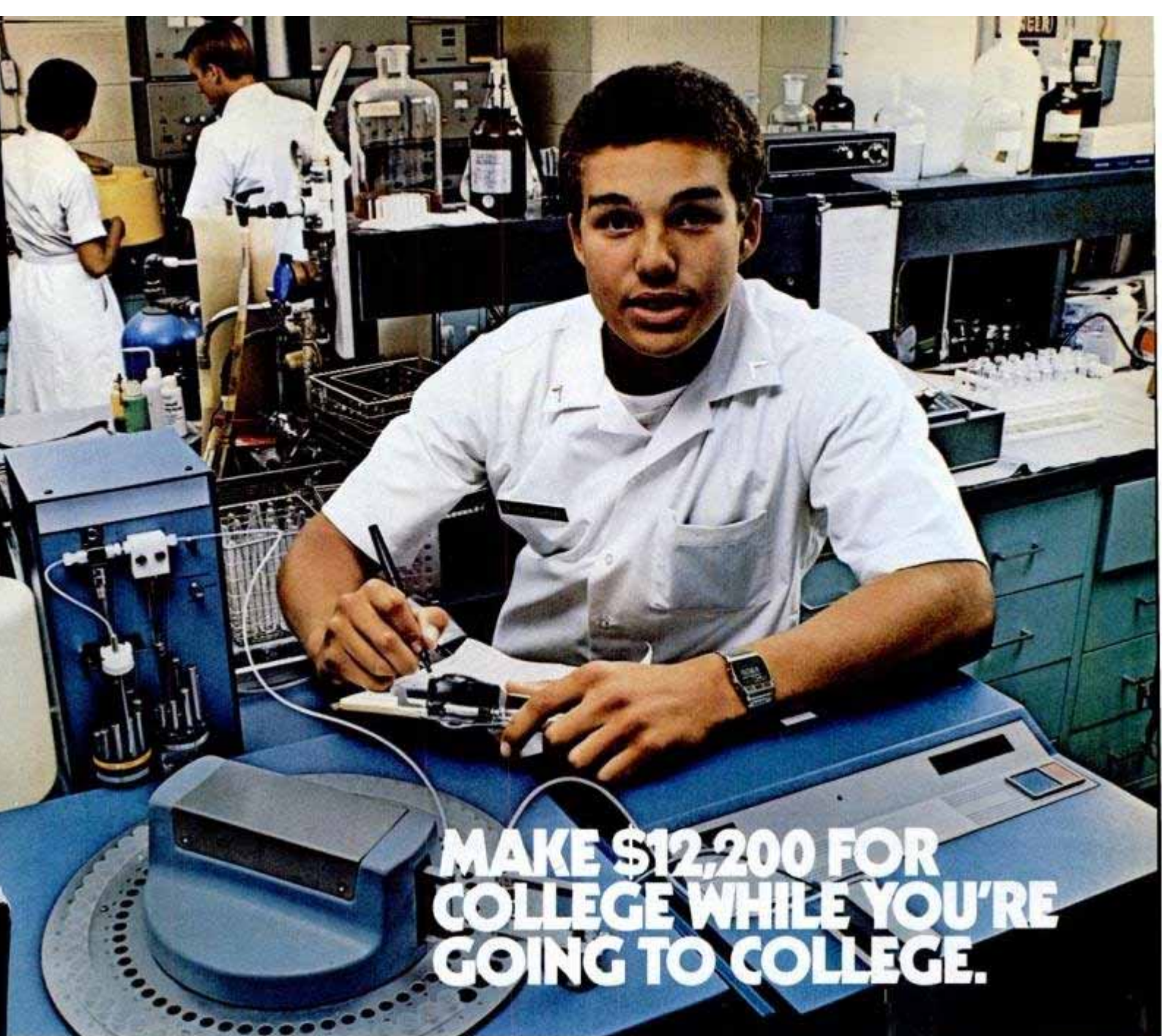
Why don't ducks' feet freeze?

A duck's feet nearly freeze in icy water. But they don't—and its upper-body temperature stays constant—because all birds are protected by a network of arteries and veins in their legs called the rete mirabile, or "miraculous net."

In all warm-blooded animals, arteries carry warm, oxygen-rich blood to the extremities. Veins return the cooler, "used" blood to the heart and lungs. In a bird, however, the flow of warm blood to the feet is carefully regulated; if it were not, the bird would quickly lose heat through these featherless appendages. That is where the rete comes in. Blood entering the legs transits this tight bundle of vessels. The arteries lie next to veins filled with cooler, inbound blood. Heat is exchanged, "pre-heating" the blood in the veins. As a result, a bird loses very little body heat, expending just enough to keep the feet from freezing.

Thus, even when the temperature is a bone-chilling zero degrees Fahrenheit, a pheasant, for example, has its toes at 37 degrees and its body at a comfortable 106. ■

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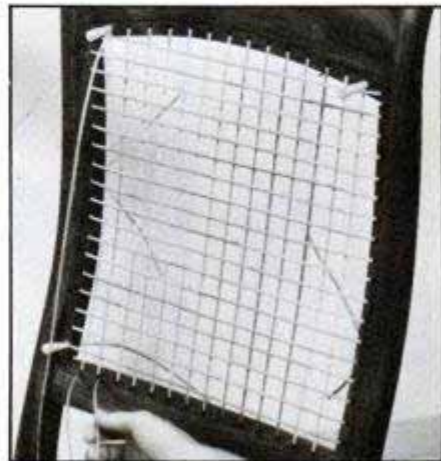
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ROCKING CHAIR

(Continued from page 62)

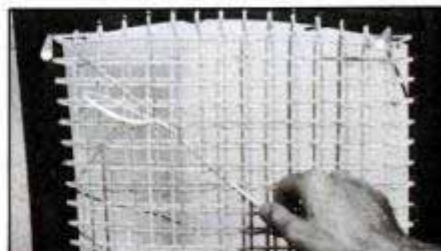
Finally, weave medium cane across the back and seat as shown. (As an alternative, use prewoven cane installed in routed grooves.) With a little patience, you'll soon be rocking in your own antique reproduction. **PM**



Repeat the first step, weaving the cane vertically in front of the horizontal cane. When stringing the cane, keep it to one side of the hole, next to the first cane.



Now, repeat the horizontal run. Weave the cane under the first-run vertical cane and over the second vertical strand. This action creates the basket weave look.



Weave diagonally from the top left to the third from bottom hole on the right side—under strands one and three, over strands two and four. Then repeat the diagonal weave from top right—over strands one and three, under strands two and four.



Work two strands of binding cane simultaneously to cover holes. Work one strand through the holes, around first strand, then back through the same hole. Tie the ends.

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Sensational! That's the **MONEYMAKING POWER** of VIP Professional Vinyl Repair . . . the business of your own that can be part or full time for **QUICK AND GROWING PROFITS!** You need no study — no training — just a few hours' practice and you're ready to do repairs for pay, — **BIG PAY!** You can be in business practically overnight.

**Start for less than you make
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With just a small down payment, you get the complete VIP going-into-business kit . . . all equipment, materials, complete step-by-step instructions, business-building helps . . . everything you need!

\$513⁰⁰
in first 10 days!
"The first 10 days I made \$513. Now getting business from 15 car dealers, 6 furniture stores, 4 restaurants and bars, and clothing stores."
H. Whaley, Wash.



**HERE'S THE VIP
VINYL REPAIR KIT
that puts you
in your own
HIGH-
PROFIT
BUSINESS**

**ALL FACTS FREE
BY MAIL — NO
SALESMAN WILL
CALL. MAIL
COUPON NOW**

"Wherever I see vinyl, I can do business"
"I've made as much as \$60 in 3 hours."
C. Herrera, Jr., Ariz.



**9 HOLIDAY INNS FOR
HUSBAND/WIFE TEAM**
"These Inns have put us on a monthly allotment. We are busy every day. Wonderful to be one's own boss. We are putting on one repairman to handle business other than Holiday Inns. With our setup, we have weekly checks coming from just the Inns."
Mr. & Mrs. Bechtel, Ohio

**STEADY WORK FOR
20 CAR DEALERS**
"20 car dealers give me all their repair work. I call on two or three every day, take care of what's needed. No matter what the repair is, it's easy to do with VIP."
R. Lanning, Ky.



**\$440 IN
9 HOURS!**
"I repaired 55 chairs at the NCO Club at \$8 each — \$440 for 9 hours' work. Materials and transportation cost only \$35!"
D. Gagnon, S.C.



**They all
started by
mailing a
coupon like
this. YOU
CAN TOO!**



**MAKE \$20 TO \$30
FOR AN HOUR'S JOB
LIKE THIS**

**UNLIMITED CUSTOMERS
FOR YOUR SERVICE**

Auto dealers, car shops, restaurants, motels, bars, clubs, hospitals, bus companies . . . these are just a few of the places that need vinyl repairs, repeatedly. The business is there, waiting for you. And a repair job that takes 1/2 an hour to an hour can mean a quick \$15 to \$30 for you . . . most of it **PURE PROFIT!**

**MEN, WOMEN, HUSBAND/WIFE
TEAMS FIND VIP QUICK,
CLEAN, EASY, PROFITABLE!**

Both women and men enjoy this easy, profitable way to make good money fast and steady. The VIP exclusive process is so easy, the directions so simple, that anyone who can read plain English can do it. And what a money-maker! A sure way to have an independent income, or build to a business as big as you want to make it. There's no end to the demand!

**GET ALL INFORMATION FREE BY MAIL.
NO SALESMAN WILL EVER CALL.
MAIL THE COUPON BELOW OR PHONE
TOLL FREE ▶ 1-800-621-6633
In Illinois: 1-800-572-0444**



VINYL INDUSTRIAL PRODUCTS
2021 Montrose Ave., Dept. 184
Chicago, Ill. 60618

Vinyl Industrial Products, Dept. 184
2021 Montrose, Chicago, Ill. 60618

PLEASE RUSH BY MAIL FREE FACTS about VIP Vinyl Repair and how I can start making money within a few days! No salesman is to call. I am under no obligation.

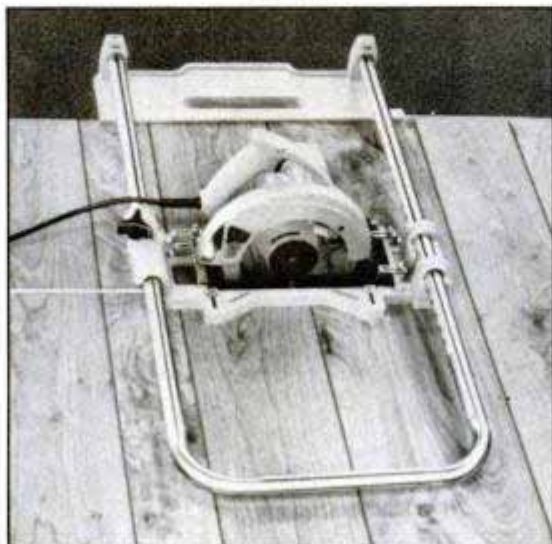
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Print Address _____
Print City/State/Zip _____

THE PM WORKBENCH



Versatile three-tool cutting guide

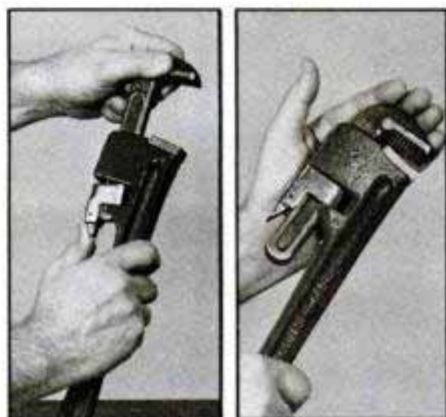
For the do-it-yourselfer who wants to add accuracy and safety to paneling and remodeling jobs, the Panel Crafter portable guide will come in handy. You can use it with a circular saw, sabre saw or router to cut sheet material such as plywood, paneling, particleboard and hardboard. The guide permits cuts from 1/2 to 24 in. wide and bevel cuts of up to 45°. Normal depth-of-cut capacity is reduced by about 1/16 in. when using the guide. The Panel Crafter sells for about \$40 at hardware stores. For details, contact Vermont American, Hardware Tool Div., Lincoln, N.C. 28092.—J.T.



Panel cutting guide locks the saw on track for quick, accurate cuts that can be up to 24 in. wide. The guide will also accept a sabre saw or router.

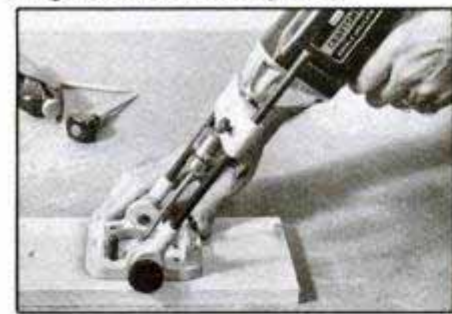
Revolutionary wrench

Your old pipe wrench has become obsolete, thanks to the Kwik-Grip no-slip pipe wrench. The 14-in. wrench has a quick-release button for instant adjustments. The aluminum wrench weighs about two pounds, half the weight of the same size standard wrench. The Kwik-Grip is \$18 postpaid from the Romano Tool Co., 6941 Jackson Dr., San Diego, Calif. 92119.—J.T.



To free upper jaw, press the quick-release button (left). Push down to close wrench.

Adjustable drill guide



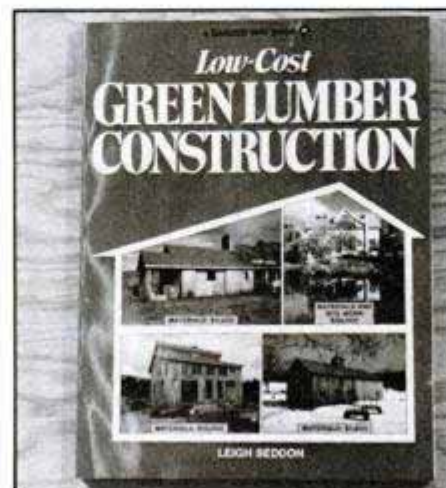
Guide adjusts for boring angled holes (above) or for drilling right angle holes (below). Note anchor pin (arrow) that centers guide for boring the workpiece edge.

Obtain drill press accuracy with your portable drill by using the Precision Drill Guide (No. 36). It allows accurate boring of right-angle holes or adjusts for angled boring up to 45°. The guide is \$20 at hardware stores. Contact the General Hardware Co., 80 White St., New York, N.Y. 10013.
—Rosario Capotosto



A builders' book

One of the most distressing results of inflation is the incredible cost of housing. Author Leigh Seddon offers a solution for owner-builders in his new book, *Green Lumber Construction*. Seddon explains how cost-conscious builders are using native green lumber to cut costs. It's available in bookstores for \$8.95, or from Garden Way Publishing, R.D. 1, Box 105, Pownal, Vt. 05261. Add \$2 for handling.—J.T.



This book shows cost-effective ways of building with native green lumber.

Ceiling fan hanger bracket



Hanger bracket, once it's expanded, bites into joists to hold ceiling fan securely.

This cross-brace hanger bracket makes it easy to install a ceiling fan when access isn't possible from above the ceiling. Simply insert the hanger through an opening as small as 3-in. dia. and tighten the ratchet-type bolts. Sizes are available for 16-in. o.c. joists (\$25) and for joists spaced 24 in. o.c. (\$30). For details, contact Hunter Fans, Marketing Services Dept., Box 14775, Memphis, Tenn. 38114.—J.T.

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.



S-10 Maxi-Cab shown with available rear jump seats and required front bucket seats.

CHEVY S-10 MAXI-CAB. IT LIVES UP TO ITS NAME.

Ford and Dodge offer nothing like Chevy S-10 Maxi-Cab. And Datsun's King Cab doesn't begin to compare in: **Maxi-room.** Up to 50% more in-cab storage space behind the seat than Datsun.

Maxi-towing. 3,000 lbs. more than Datsun on 2WD models with available V6 and Trailering Special Package.

Maxi-power. A V6 is available, Datsun doesn't offer one. **Maxi-4x4.** Revolutionary Insta-Trac, standard on S-10 Maxi-Cab 4x4, lets you shift from freewheeling 2-wheel drive to 4-wheel-drive High and back again at any speed. You can't do that with Datsun. Maximize your truck value with a tough Chevy S-10 Maxi-Cab.



OFFICIAL U.S.
CARS AND TRUCKS
OF THE XIV
OLYMPIC WINTER
GAMES



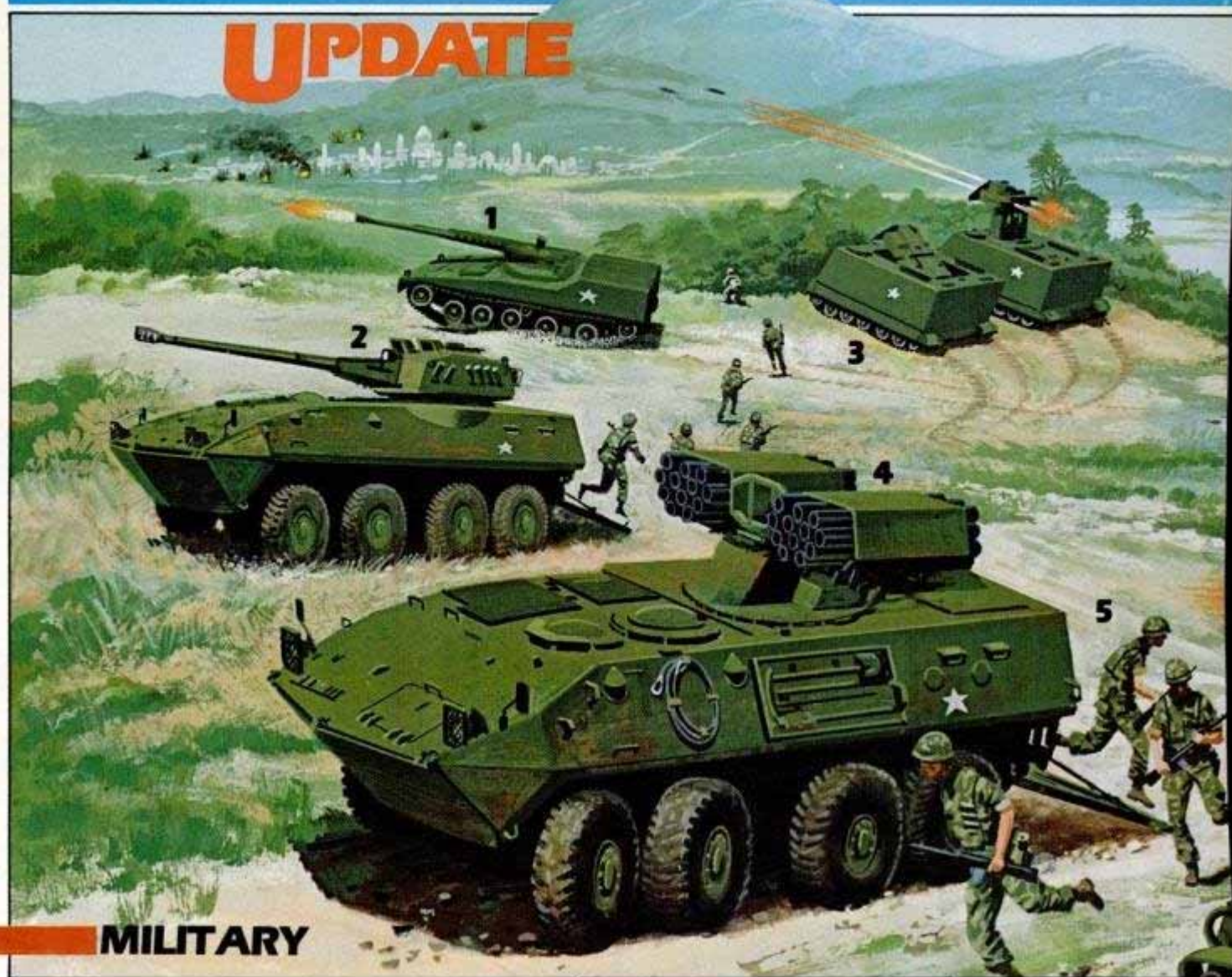
Sarajevo '84
1984 OLYMPIC GAMES

Some Chevrolet trucks are equipped with engines produced by other GM divisions, subsidiaries, or affiliated companies worldwide. See your dealer for details. Let's get it together...buckle up.

CHEVY TOUGH IS TAKING CHARGE



TECHNOLOGY UPDATE



MILITARY

Coming: Our fast new battle armor

When the U.S. Rapid Deployment Force was first proposed in 1980, nearly everyone agreed it was a good idea, but few seriously believed it would be needed so soon. That was before our troubles in Lebanon, Grenada and Central America. Now all doubts have vanished and the RDF, recently renamed Central Command, is shifting into high gear. Its objective: to develop a lean, tough, hard-hitting strike force that can go anywhere in the world at a moment's notice.

The result is a whole new breed of fast, agile fighting machines that are light enough to be readily transportable, yet heavy enough to deliver decisive firepower. Three of the latest and most lethal are the RDF Light Tank (RDF/LT), the Improved TOW Vehicle (ITV) and the Light Armored Vehicle (LAV). All three can be quickly airlifted into combat by helicopters or small car-

go planes like the C-130, eliminating the need for huge C-5A transports that require long, heavily reinforced runways. They can also be delivered directly to an embattled beachhead aboard the Navy's new air-cushion landing craft (see *Our Fast New Armada*, page 83, Jan. '84).

At less than 15 tons, the new RDF Light Tank weighs only one-quarter as much as traditional tank designs like the mammoth 58-ton M-1. Yet it has virtually the same power-to-weight ratio (24 hp/ton) and can scoot over forbidding terrain at a brisk 40 mph.

Its 75-mm automatic cannon fires 70 rounds per minute, making it, in effect, a large-bore machine gun capable of penetrating all but the heaviest frontal armor on Warsaw Pact tanks. Unlike the flat-firing cannon on other tanks, it can be pointed upward to knock down enemy aircraft. Thus, the RDF/LT is

actually two potent fighting machines in one—a ground-attack tank killer and a highly mobile anti-aircraft battery.

The Improved TOW Vehicle, looking like something from another world, fires the deadly TOW antitank missile from an unusual pop-up launcher that can be raised to shoot over an embankment or other screen, while the hull and crew remain safely hidden. The launcher also retracts into the hull so its twin firing tubes can be reloaded from inside without exposing the crew. The ITV weighs 13 tons and can fire two missiles every 40 seconds while traveling at 42 mph.

Of the three, the lightest, fastest, and most versatile is the Light Armored Vehicle, also called the Piranha. A multipurpose, eight-wheel-drive, amphibious assault vehicle, it serves as both a high-speed gun platform and an armored troop transport. Interchangeable



The ITV: strange new look in tank killers.



Versatile LAV can fire rockets or cannon.

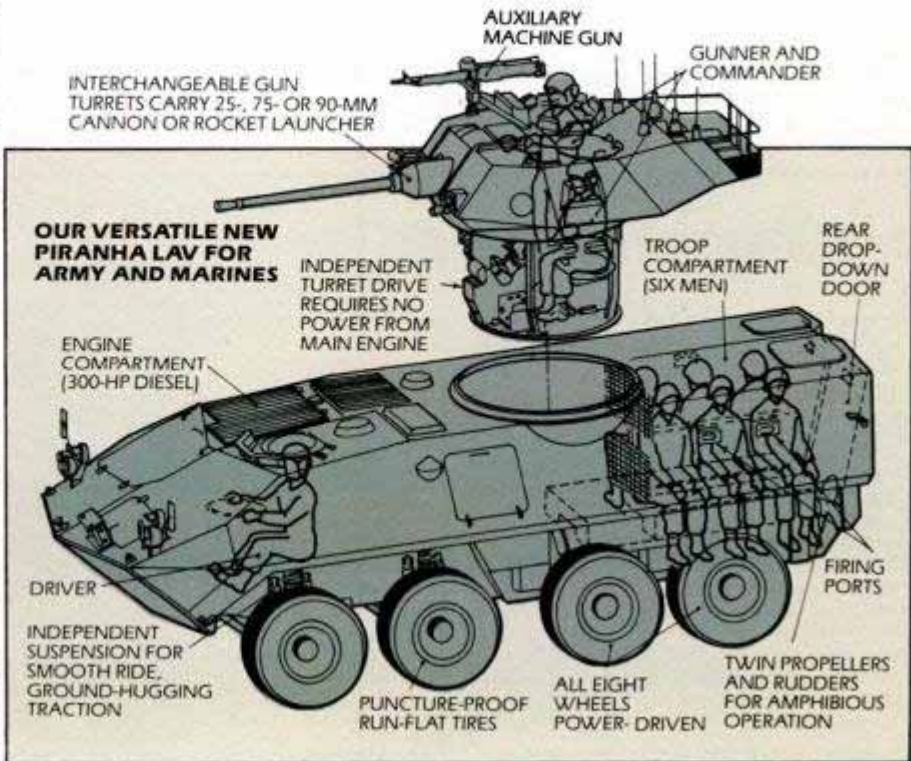


RDF/LT hits 40 mph, has antiaircraft gun.

New combat vehicles shown above and on facing page are: 1. RDF/LT with 75-mm cannon; 2. LAV Piranha with 90-mm cannon; 3. ITV with missile launcher retracted for reloading; 4. LAV Piranha with 80-mm multiple rocket launcher; 5. LAV troops disembark by rear exit ramp; 6. LAVs in amphibious mode crossing water; 7. RDF/LTs with cannon elevated for antiaircraft use; 8. ITV with TOW missile launcher raised for firing.

turrets allow it to mount cannon from 25 to 90 mm or a vicious 80-mm multiple rocket launcher. Six soldiers, firing through side ports, can be carried in back. To speed their deployment in battle, the entire rear end drops down to form an exit ramp. The LAV weighs 12.5 tons, can exceed 60 mph on land and has twin propellers and rudders for operation on water.

But the real significance of the Central Command's new rapid-response force may lie in what it won't do—it won't employ atomic weapons. By providing us and our NATO allies with a strong deterrent based on conventional arms, it could prevent a confrontation from escalating into nuclear war—and that's the best news.



TRANSPORTATION

Harley built for speed

Harley-Davidson bikes established the first land-speed motorcycle record of 265 mph in 1970. Now, a Harley-Davidson streamliner, the Tenacious, has been assembled to challenge bigger numbers.

The Tenacious, which is powered by a 175-plus hp engine, was built to shatter the 318 mph mark. Dennis Manning, who set the original record, is the designer of the latest speedbike. A single V-Twin engine powers Tenacious.



The Tenacious (above) is a "streamliner" bike built to travel over 300 mph on a Harley-Davidson V-Twin (at left).



Honda's prototype of the turbo-supercharger uses a system that pipes exhaust gas over a turbine shaft that runs a compressor for increased power. Recycled exhaust gas makes engine more efficient.

Patented heat

Honda has just been issued U.S. Patent No. 4,396,085 for a bike that should be flying down American roads by next year. The new turbo-supercharger is designed to overcome one of the greatest drawbacks of a supercharged engine—wasting energy in the form of heat running off the compressor. Honda's machine takes exhaust air from the engine inlet into a pipe that carries the hot exhaust over a turbine shaft, turning a compressor wheel and translating most of the energy into power.



IT'S ALL MINE

British researchers have taken a hint from France's high-speed trains for the design of a coal mine shaft train. The lead car acts as a power transformer, distributing charge to motors that efficiently power each axle on the cars.



CHRISTINE BLOWS UP

The star of John Carpenter's Columbia Pictures thriller *Christine* is a devil-possessed 1958 Plymouth Fury that can reconstruct itself after an accident. An inflatable Kevlar model was used to film close-ups of the vehicle repairing itself.

ALTERNATIVES

TAKES CANS, PAYS COINS

Those old-fashioned vending machines take coins and give cans of soda. But Envipco's "Can Redeemer" works in reverse. Insert a can and the machine compacts it. Then you get change. By the end of the decade, most states are expected to have deposit laws.



THIS SUIT HAS NO BUGS

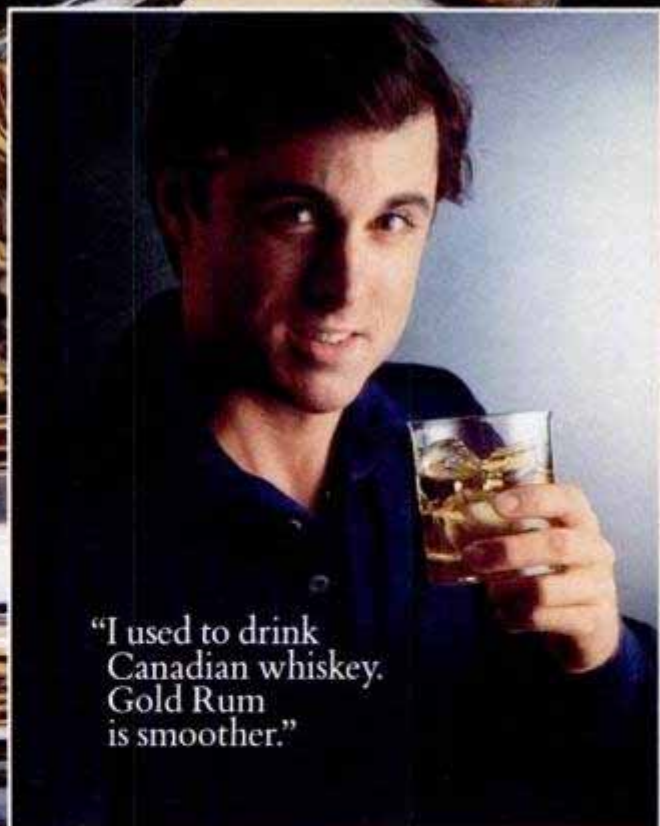
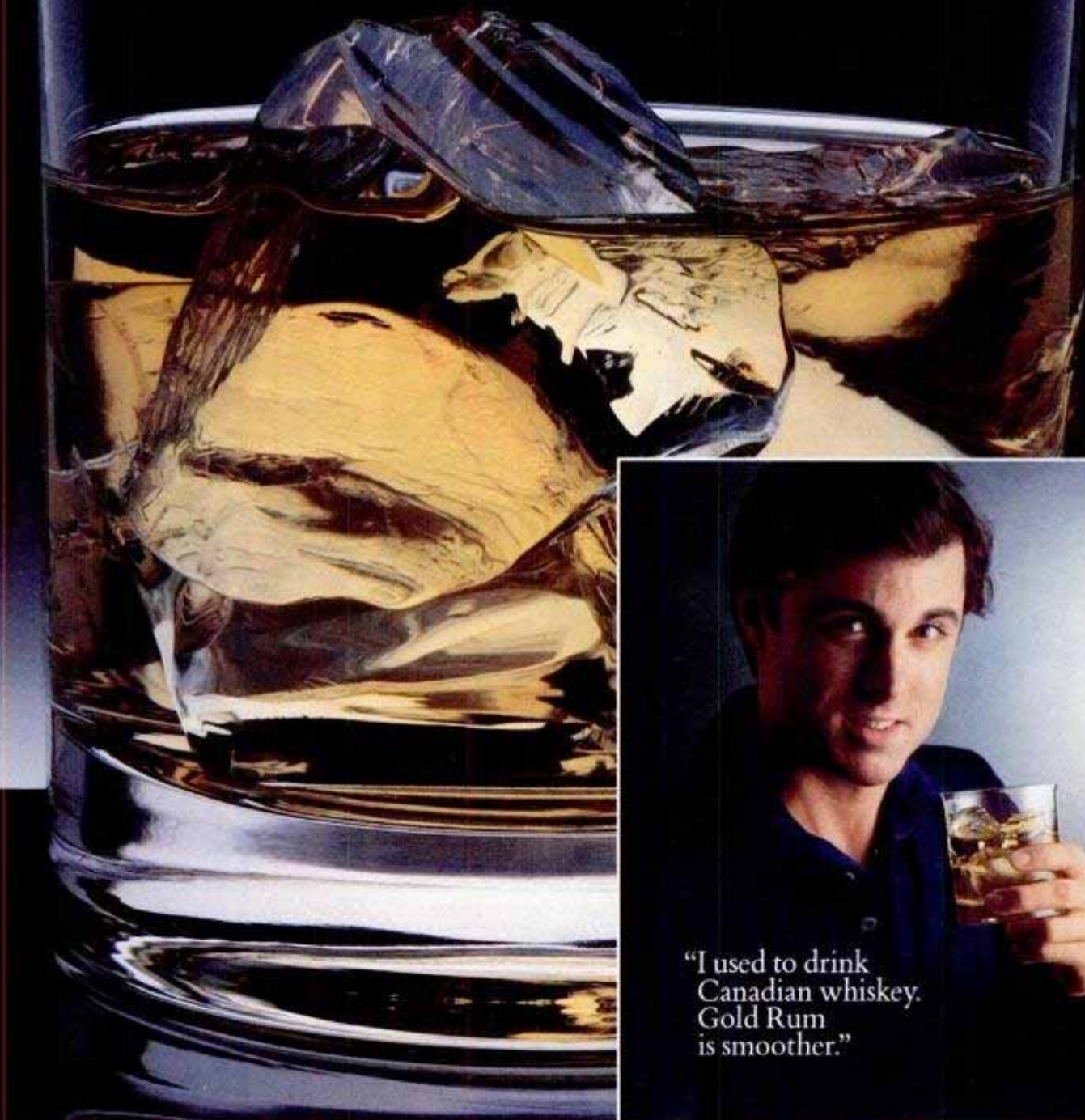
The Insect Protection Suit by Meyers Corp. is made of nylon netting. It is available as a jump suit or as a two-piece suit with gloves. The suits come in camouflage colors for hunters. What you wear underneath is up to you. It sells for \$23 postpaid.



BLOCKS OF CONCRETE

London's newest housing project is a 520-unit concrete apartment building that stretches across five city blocks. Prestressed concrete and honeycombed steel girders combine to make the continuous design possible.

**Gold Rum. The first sip will amaze you.
The second will convert you.**



**"I used to drink
Canadian whiskey.
Gold Rum
is smoother."**

People everywhere are switching to Puerto Rican gold rum. The reason? Puerto Rican gold rum has the lightness that people prefer today.

You'll find that gold rum makes an exceptionally smooth drink—on the rocks, with soda or ginger ale, or with your favorite mixer.

If you're still drinking Canadian, bourbon or blended whiskey, it's because you haven't tasted Puerto Rican gold rum.

THE GOLD RUMS OF PUERTO RICO



Get Your Trailer Ready For Spring



Rock wheel from top and bottom to check for play in bearing with trailer jacked up.



Rollers in their cage pop out in your hand after removing hub cap, cotter pin and nut.

Most trailers require just an hour or two of service to be in shape.

BY MORT SCHULTZ

Without maintenance, a trailer can develop problems that could lead to expensive repairs or even cause an accident. A winter weekend, when you can't find anything else you really want to do, is a good time to shape up your light trailer for summer service. If your trailer is a winter worker, it probably needs the attention even more. Here's what to check.

Tires and wheels

If the trailer is in storage, support it on jacks. The tires, deflated to 20 psi, should be off the ground. Don't forget to pump them up before using the trailer. If the trailer is in use, check pressures and keep the tires at recommended levels. Trailer tires run hard—never less than 35 psi. Most run at 55 to 60 psi.

Inspect tires for cuts, bulges and worn tread. The old Lincoln penny test is valid for checking tread depth. Insert Lincoln, head down, between ribs at several points around the tire. If you can see the top of Lincoln's head, the



To remove outer race or cup to replace bearing assembly, drive it out with a brass drift.

tire is worn at that spot. More than a couple of worn spots call for replacing a tire, as does a cut or bulge.

When was the last time you had your trailer's wheels balanced? If it's been a while, or you're replacing tires, take off the wheel/tire assemblies and take them to a shop that has a dynamic balancer. Unbalanced wheels vibrate vertically and cause the trailer to hop.

With boat trailers, service wheel bearings once a month during the boating season. With other small trailers, once a year is sufficient. To service a wheel bearing, remove the hub cap, straighten and take out the cotter pin,



Special hub cap with grease fitting, called Bearing Buddy, speeds lubrication service.

and unscrew the adjusting nut. Pull the wheel toward you. The outer bearing will separate. Take it off the spindle and lay it aside on a clean surface.

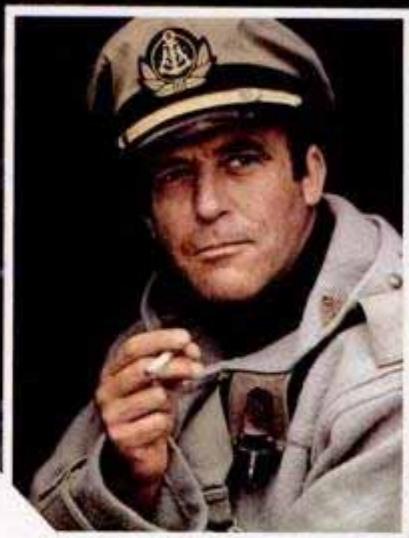
Take off the wheel and lay it down, hub up. Use a brass drift and hammer to tap out the inner wheel bearing.

If a bearing is pitted, corroded or feels rough as you spin the rollers, replace it. If not, slip on clean rubber gloves, scoop a glob of wheel bearing grease into the palm of your hand and pack it into the bearings until grease oozes from between rollers.

Use the brass drift and hammer to
[\(Please turn to page 76\)](#)

Reach for a world of flavor.

MERIT



The low-tar cigarette
that changed smoking.



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

© Philip Morris Inc. 1983

8 mg "tar," 0.6 mg nicotine av. per cigarette, FTC Report Mar.'83

GET YOUR TRAILER READY

(Continued from page 74)

reinstall the inner bearing. Put the wheel back on the spindle and install the outer bearing and adjusting nut. Tighten the nut until the wheel binds slightly as you spin it. Then, loosen the nut about 1/4 turn and insert the cotter pin. The wheel should spin freely, but should have no play as you hold the tire on top and bottom and attempt to rock the wheel back and forth.

For a few bucks, you can avoid the chore of removing bearings for greasing. Buy a Bearing Buddy for each wheel. It has a grease fitting. You can attach a grease gun to the fitting and pump grease inside the hub. Bearing Buddys come in different sizes. Remove a wheel hub cap and take it with you to a trailer and RV supply store so you can get the right size.

Suspension

Get under the trailer and inspect springs for cracks and misaligned leaves. Replace springs that are broken or otherwise damaged beyond a simple leaf alignment.

Examine the bushings. Make sure the rubber isn't cracked or dried out. Replace any damaged bushings.

If you don't want to get under the trailer, you can still check the springs. With the trailer on the ground and tires properly inflated, push the trailer from side to side. An unusual amount of side sway indicates a bad spring, but a visual inspection is more accurate.

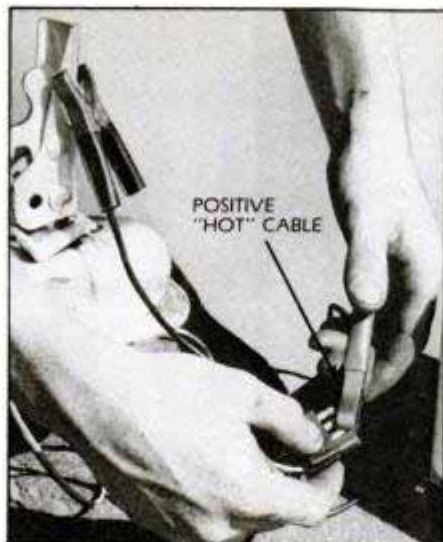
Lights

Use a 12-v. battery charger or 12-v. battery and jumper cables to get juice for checking lights and turn signals. Or, you can hitch the trailer to the car. Connect the ground cable to the frame and the positive cable to each terminal, in turn, of the trailer's electric connector to see if the lights and signals work.

If one or both running lights or signals don't work, the trouble is usually a burned out bulb or a damaged wire. Sometimes, the bulb socket may rust out. For each circuit—the left running light, the right running light, the left turn signal and the right turn signal—there are two wires to inspect. One is the hot wire. The other is the ground.

The color of insulation covering the wires is generally standard from trailer to trailer. White is the common color for a ground wire. Brown is usually the color for running light wires. Yellow is for the left turn signal wire and green for the right-turn signal wire.

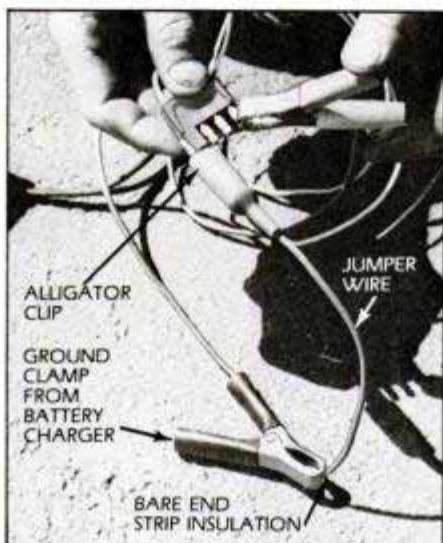
You may not be able to attach the large clamp that's on the end of the battery charger ground cable directly to the ground terminal of the trailer's electrical connector, because the terminal is



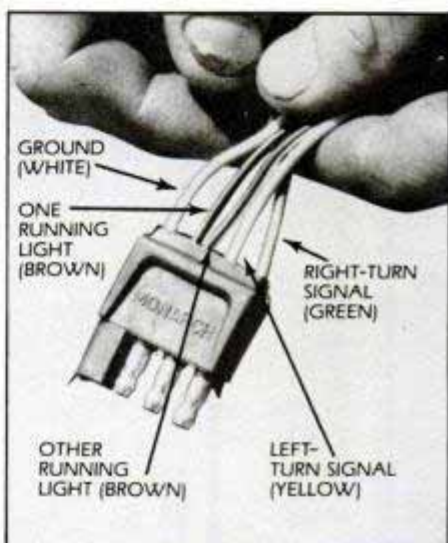
Test trailer lights by connecting ground and hot leads from battery or charger to plug.



Professional electric circuit tester has a sharp probe to piece insulation on wires.



If charger clamp won't fit into connector, rig a jumper wire with smaller alligators.



Wire colors make ground white, taillights brown, left signal yellow and right green.

covered by a shield. Get a length of jumper wire, 18 to 24 in. long. Strip insulation from one end and attach a small alligator clip to the other end. Now, connect the clip to the ground terminal of the trailer electrical connector and the ground clamp to the jumper wire. The hot cable clamp goes on the terminal of the light you want to test.

Cosmetics

Use steel wool to clean the metal parts of the hitch system of both the trailer and car. See that the links of the safety chains aren't spread and that the chains are securely attached to the coupler.

Are the trailer bed and body clean? Body dents can usually be banged out with your fist and painted with spray paint. You can use spray paint to touch up scratches as well. Unfortunately, damage caused to front panels by jack-knifing the trailer into the tow car while backing usually can't be repaired. You have to replace the crumpled panel.

Mechanical and cosmetic problems can all be dealt with by any reasonably competent home mechanic. The one problem you cannot fix yourself, unless you are a well-equipped welder, is that great vehicle killer, demon rust. While you can't handle a case of terminal rust without replacing the frame—in which case you might as well replace the whole trailer—you can keep rust from eating your trailer.

If you launch boats in salt water, you already know what to do. Wash off the salt as soon and as thoroughly as possible. This is your first line of defense. Then, keep after it every couple of months. Your best weapons are a small sanding disc in your electric drill and antirust primer and paint. Thorough and careful inspection followed by cleanup and touch-up can keep rust at bay. If you don't make the effort, soon it'll be goodbye trailer.

Taking care of your trailer during the off-season means you'll have more time in good weather to enjoy using it. **PM**

JEEP® INTRODUCES LEANER AND MEANER 4-WHEEL DRIVE CHEROKEE.



From the engineering experts at Jeep, this is the newest advance in Jeep 4-wheel drive technology.

*The all-new Cherokee is leaner ... to give you the highest gas mileage ever in a Jeep. Mileage that beats Bronco II and S-10 Blazer.**

And Cherokee is meaner ... You get more ground clearance than S-10 Blazer and Bronco II. And more horsepower-per-pound than S-10 Blazer, too. This is Jeep ruggedness. Jeep power. Jeep agility.

Cherokee is built in a different way than its competitors. Jeep's Uni-frame Construction is a welding of the frame to the body shell

to create one solid rugged unit.

And our Quadra-Link Front Suspension combines a solid front axle with four locating arms and coil springs to give you a remarkable combination of ruggedness off-road and smoothness on-road.

There's more inside, too. Like shift-on-the-fly between 2- and 4-wheel drive. And seating for 5, not 4 like the competition. You get more cargo room. Plus, only Jeep gives you a choice of 2-door and 4-door availability.

CHEROKEE

24 EPA EST. / **33** EST.
MPG* / HWY

S-10 BLAZER 4X4

23 EPA EST. / **33** EST.
MPG* / HWY

BRONCO II

20 EPA EST. / **30** EST.
MPG* / HWY

Jeep is a registered trademark of Jeep Corporation.

*Use EPA EST. MPG for comparison. Your mileage may vary with speed, weather, trip length. Actual highway and CA figures lower.

The all-new leaner, meaner Cherokee is at your Jeep dealer's now. Helping to make up what is the world's largest selection in 4-wheel drive.

	ALL-NEW CHEROKEE	S-10 BLAZER 4X4	BRONCO II
Wheelbase Length (In.)	101.4	100.5	94.0
Ground Clearance (In.)	7.7	6.6	6.5
2-Dr and 4-Dr Availability	YES	NO	NO
Cargo Room (Ft')	71.2	67.2	64.9
Seating Capacity	5	4	4
Uni-frame Construction	YES	NO	NO
Quadra-Link Front Suspension	YES	NO	NO
Payload (pounds)	1150	1000	726
Select-Trac 2WD/4WD Available	YES	NO	NO



WHEN IT COMES TO 4-WHEEL DRIVE... ONE WORD SAYS IT ALL.



The Velvet Canadian



No other Canadian feels
as smooth as Black Velvet.
Premium. Imported.



Cockpit of new two-jet airliner seats two crew members. It uses video displays to replace distracting dials and meters.

SON OF JUMBO!

The new twin-engine jets use amazing technologies to squeeze all they can out of a drop of fuel. They also demand a little something extra from the flight crew.

BY DENNIS ESKOW, Science Editor

The raw and salty wind blowing across Paine Field kept the dignitaries huddled near the rail of the observation deck. And the sense of expectancy, as when one knows he is watching mankind take a giant step forward, kept their eyes riveted to the huge craft sitting on the Seattle airfield that cold February morning 15 years ago.

Just seeing the the first production-model Boeing 747 standing still was exciting. She was an awesome symphony of metallic shape and potential power. Her 195-foot, 8-inch wingspan could nearly cover a pro football field. The flight deck rode above the passenger section, giving the viewers the image of a multistory building with wings. Even today, there is no commercial aircraft larger than the 747.

Once her engines started warming, the crowd grew animated. Then it hushed as the four powerhouses roared, pushing the jumbo jet down the runway and off to its surprisingly graceful maiden flight. Less than one year later,

Pan American World Airways put the first 747 into operation on a flight from New York to London. The millionth jumbo jet passenger boarded a 747 just six months later.

The 747 was aviation's answer to the oceanliner, and the orders started pouring in. Soon Lockheed would enter the market with its wide-body L-1011 TriStar jet, and McDonnell Douglas would make it a horse race with the jumbo DC-10 series. Men of vision were planning bigger and more powerful versions of the new superjets capable of carrying many more than the 400 or so passengers lofted by the new jumbos. Their visions seemed limitless. But then the unexpected Arab oil embargoes sent the price of fuel skyrocketing. Within five years after the first jumbo jet took off, America's airline industry was feeling the pinch of what would turn out to be a long-term struggle to keep big jets in the air while keeping fuel bills down to earth.

But while the oil-price news seemed ominous, the news of developing technologies to make the perfect jumbo jet



McDonnell Douglas' Super-80 (left) is a stretch version of the DC-9. The Boeing 757 and 767 (right) both sip fuel and have identical cockpits.

was much better. New engines, computerized flight decks and increased experience with the high-speed big birds gave birth to an aviation revolution that's still going on.

Lockheed has pulled out of the airline manufacturing business, opting for specialization as a military supplier. But the remaining competitors are on a full-steam alert to produce jets that create the best of all possible worlds. The craft they have produced have been pleasing to the airlines, judging from comments from officials at the various companies. But the question of how the flying public will adapt to the new jets is far from settled. The latest wide-body and stretch jets have two rather than three or four engines. They seat two men on the flight deck instead of three.

Whoever said "familiarity breeds contempt" never flew in a Boeing 747. In a Popular Mechanics survey of 100 travel agents in six major air-traffic cities (Atlanta, Chicago, Dallas, Los Angeles, New York and Washington, D.C.), 26 percent said their airline customers specifically request a 747 more than any other plane. That makes the 747 twice as popular as its nearest rival, the L-1011. And the agents themselves prefer the 747, with 46 percent naming it their favorite.

The DC-10, which suffered several mishaps in its first years of flying, has passed the safety inspections of American and international agencies in recent years. Yet it remains the jet that 25 percent of the agents said they would least prefer to fly. Where do the new jets, which try to get hundreds of passengers aloft with a minimum cost of

fuel, stand among the people who use them the most?

"It's too early to say," said Marvin Kempler, who books flights for corporate customers in New York. "At this early stage, you may hear a few complaints, but honestly, no one has said they'd refuse to fly in a twin-engine jet."

In the PM survey, only 12 percent of the agents said they had tried a Boeing 757, 26 percent had had a flight on the 767, 60 percent had flown in a Super-80 and just 9 percent had tried the new European entry into the "downsized" wide-body competition, the Airbus A310.

Airline pilots initially balked at the two-man crews, calling them potentially unsafe, especially on long-range flights. But the two-man cockpit is widely used today, and few pilots consider the trimming of a crew from three to two to be truly dangerous. Some have even found a bonus in the necessary uniformity of the arrangements of dashboard indicators from one craft to another. For instance, a pilot who qualifies on the instruments for a Boeing 757 on the Federal Aviation Administration exam automatically qualifies for the 767. (Some airline officials are looking forward to the 1990s when a flight deck's indicators will likely be contained on a bank of video screens regardless of the aircraft. At that point, a pilot qualifying on the instruments of any one jet will be able to handle all models.)

The Boeing flight decks place all systems controls within reach of either flight officer. Even the forward windshields of the 757 and 767 have identical forward views. While the flight decks of the Super-80s and Airbus jets differ in sev-

A Look Inside The Super-Engines

With a wide-body jet, the powerplant design comes first. This fact has made merchant princes out of the big three jet engine builders—Pratt & Whitney, General Electric and Rolls-Royce. But the fuel cost increases of recent years also make the prince slaves to efficiency.

A joint General Electric/NASA energy-efficient engine project (nicknamed "E-cubed") has produced a turbofan model projected to consume .528 pounds of fuel per hour for each pound of thrust produced while cruising at 35,000 feet. This is about a tenth of a pound less than current jets are using—a savings that could add up to tens of millions of dollars over the operating life of, say, a Boeing 747.

Most of the wide-body jets yet to be built are expected to be twin-jet models, such as the Boeing 767. When such a jet, fueled for a 1,000-nautical-mile trip, loses an engine, the operational ceiling immediately drops

from 40,000 to 23,000 feet. And, although any twin-engine design must be able to climb and maintain safe altitude on one engine, the loss of an engine on takeoff or landing leads to anything but a routine piloting maneuver.

In the latest generation, high-bypass tur-

bofan jets are being offered as a possible solution to the problems posed by twins. These engines convert more than 30 percent of the total energy stored in fuel into available power. At takeoff, a turbofan develops the equivalent of more than 2.5 hp for each pound of engine weight. On the automotive level, that means we would have 500-hp Honda Civics blasting along our roads.

How has all of this performance been achieved? By designing components that work in unthinkable extremes—where air pressures can be 30 times ambient; where a gaseous mix heated thousands of degrees means parts machined to close tolerances



General Electric engines manufactured for twin-jet wide-bodies have more fuel efficiency.



Production has been cut back on Airbus A310 (left), and Lockheed has pulled L-1011 (right) from "downsized jumbo jet" competition.

eral respects, they are similar in the use of video screens to post various flight indicators that used to be shown on the faces of dozens of dials. This reduces the pilot's eyestrain and lets him relax a bit. Of course, the multiple electronics that run a twin-engine aircraft are far more complex than avionics of past years, and they demand a little extra out of the flight crew. "Pilot responsibility during a flight also gets bigger as the engines get fewer," said one airline pilot at a recent Washington, D.C., dinner for pilots.

After about 18 months of service, the Boeing 767 is the leading seller among the "downsized" jets. More than 180 of them have been sold or are on order from airlines. Much of the reason is in a combination of its advanced avionics and 96 percent fleet dispatch reliability record—a measure of how much this plane keeps the airline free of delays. The 767 carries more passengers than its competitors—211 in an average seating configuration—yet it needs only 5,300 feet of runway to take off at maximum gross weight, fueled-up for a nonstop trip of 4,100 miles.

The Super-80, a stretched version of the DC-9, carries 172 passengers 2,000 nautical miles nonstop. It has a reliability record close to the 767 and it sips fuel about as well. But it can't carry as many passengers, and some say the cabin is a little cramped.

The Boeing 757 is designed to replace the versatile 727, the last model of which was made in 1983. The 757 carries an average 185 passengers about 2,200 miles nonstop. On a 500-mile flight, it burns up 80 percent less fuel per seat

than the 727. In 1985, Boeing officials say, a 10-airplane 757 fleet replacing a fleet of 727s will cut fuel costs by \$25 million per year.

Ask an aircraft manufacturer what's in store for us by 1990 or 2000 and he'll say very little. The industry is going through a period of steep and tough competition that is expected to wipe out several of the smaller commuter lines and perhaps some of the older established companies. Still, the airlines that stay in business will be ordering new aircraft partly to keep from going under. Thus, although Lockheed has taken itself out of the new jet race, a recent company publication discussed plans for designing improved cabin and flight deck instrument systems. McDonnell Douglas, taking advantage of the emerging Pratt & Whitney and General Electric engine technologies, is expected to decide by the middle of this year on a fuel-efficient jet called the MD-100. According to a McDonnell Douglas official, this downsized wide-body craft would have had trouble getting started because the plane requires lots of power or a very long runway to take off. Since the PW4000 offers up to 60,000 pounds of thrust in an efficient engine, the company's engineers are now confident that they can bring their brand into direct competition with the new Boeing wide-bodies.

Oddly enough, in an era when economics are threatening many of the airlines, technology is promising more business than ever to the manufacturers committed to staying in the race. **PM**

must mesh perfectly; where the tips of an 8-foot-diameter fan move faster than the speed of sound and the force exerted on the blade roots is expressed in *tens of tons*.

Like any kind of fluid pump, a jet engine works best when leakage around active parts is kept to a minimum. But a certain amount of clearance has to be provided because of differential expansion. At take-off, hot turbine blades expand faster than the outer casing—without built-in clearance, the blades would hit the casing. At cruise power, however, temperatures become more evenly distributed, and built-in clearance permits leakage. By bleeding cool air from forward engine stages and circulating it around the turbine section, the casing can be "shrunk" back into optimal configuration. In Pratt & Whitney's forthcoming PW4000 engine, the process now built into the PW2037 will be enhanced by bleeding hot air from an aft compressor stage and injecting it into the rotor cavity farther forward, thus expanding the blades out toward the shell.

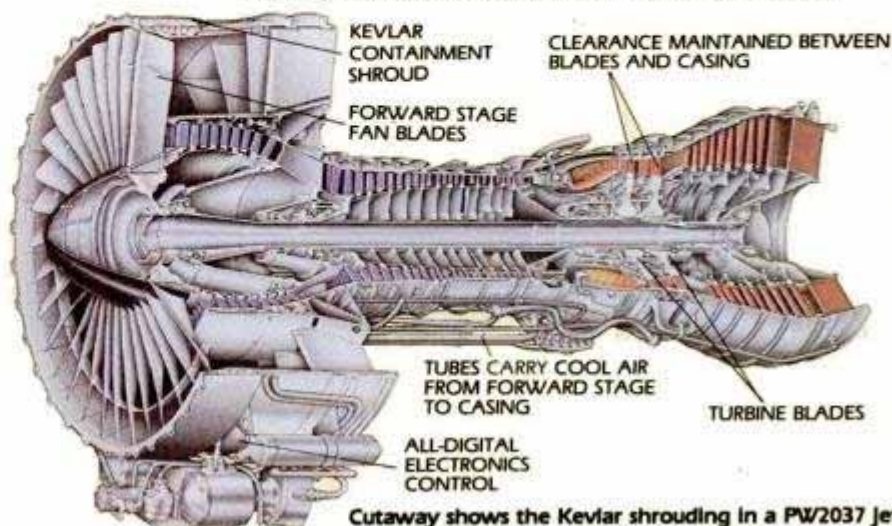
The PW4000 will have 27,000 fewer parts than current jets. It also will have better constructed components that may greatly reduce the potential for a disaster from uncontained engine failure. Rotor burst or

uncontained fan-section failures can release a burst of shrapnel. Newer turbofan engines have a Kevlar shroud over the fan-section casing to contain a failed blade, a precaution against a serious accident and an indication that the potential is still there.

Perhaps no single industrial mission chal-

lenges as wide a range of high technologies as does the creation of engines for today's air transportation. The purpose of airline deregulation is to ensure the availability of affordable air travel to a majority of Americans—but powerplant technology is the enabling miracle.—Robin Nelson

ACTIVE CLEARANCE CONTROL-PW 2037 TURBOFAN



Cutaway shows the Kevlar shrouding in a PW2037 jet.

Automotive Oddballs

Remember hydraulic windshield wipers, flexible driveshafts, pop-up turn signals and amphibious automobiles? Their manufacturers are trying to forget!

BY PETE WARREN; Illustration by Craig Tennant



Do you remember the
camshaft driven by
connecting rods?

How about a suspension
system that was filled
with antifreeze?

Or the Wrist-Twist Steering
system, which used two tiny
wheels instead of a big one?

Styling extremes like tailfins, portholes
and Continental kits are gone now,
but today's high-tech aero look may
well become tomorrow's design cliché.

Drive a car off the road and into the water, where it operates as a powerboat. Does that sound like fun? It was. Called the Amphicar, such a vehicle enjoyed modest sales success in the 1960s.

The combination of car and boat was just one example of many novel approaches to automotive design following World War II. Some ideas were accepted, now represent the norm, and no longer seem unusual. Others were doomed by safety standards and changing technology. And some ideas were ahead of their time, and the materials available were inadequate. Or, perhaps the bright idea had a fatal flaw no one thought of until it was too late and owners were swearing from coast to coast.

Here are PM's favorites from the postwar period. With two exceptions, they all actually went into production.

Amphicar—This German car really was ingenious—a boat hull on a car chassis. A rear-mounted engine powered a rear-facing transaxle. Attached to the transaxle was a transfer case called the "water transmission." It had two shafts aimed to the rear and these were splined into shafts that held the propellers.

Volkswagen recently showed a modern adaptation, an amphibious Rabbit, using the transaxle's new four-wheel-drive power takeoff to drive a propeller instead of the rear wheels. VW's only intent with the experimental vehicle is to promote its marine engine program. The Sea Golf, as it is called, is not for sale. It's just the latest in a wacky line of waterborne VWs.

Citroen Sahara—There aren't many service stations in the desert, and it could be a long walk to an oasis if the engine failed. Citroen's front-wheel-drive 2CV Sahara model, offered in the mid-1960s, had a unique solution: a spare engine in the rear. The second engine was coupled to a second transaxle. In poor traction conditions (like sand dunes), you could run both engines and transaxles to get four-wheel drive.

Of course, to many people, this hardly compares in weirdness with the "normal" Citroen DS-19 sedan, sold here in the 1950s and '60s. It had a central hydraulic system that not only lubricated the engine and provided power steering, but also had self-leveling hydropneumatic suspension, power brakes, power-assisted gearshift and even power jacking if you had a flat tire. Oil leaks were a common problem and replacement pumps were expensive.

Ford Skyliner—The open-air feeling of a true convertible and the security of a steel top seemed like a great combination, and in 1957 Ford put the two features together in its famous Skyliner, which had a retractable hardtop that disappeared into the trunk. It wasn't an original idea (Peugeot had such designs in the 1930s), but it was something new here. However, Ford sold only 50,000 of them in three years. Most people wanted a trunk they could use.

Those who opted for the retractable hardtop soon found that it had seven reversible motors, 10 power relays and 14 switches, plus more circuit breakers than anyone could count. A Ford mechanic who could fix a Skyliner was treated like royalty by owners with problems—of which there were many.

'Better ideas' that weren't

Some of Ford's other "better ideas" were no more successful:

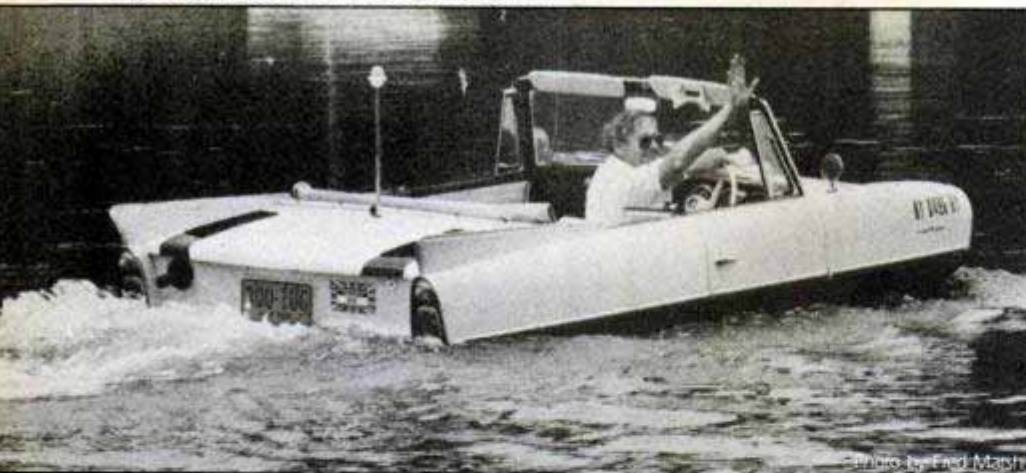
Wrist-Twist Steering—This one never actually got into production, but a small number were built in the mid-60s and distributed to members of the press for on-the-road evaluation. The system consisted of two very small steering wheels, mounted to the left and right of the steering column and connected to it by a concealed chain drive.

The tiny wheels had little thumb holes in them! These were combined with a very fast steering ratio, and a flick of the wrist was enough to whip the car around a sharp turn. The fast ratio and small wheels meant that power steering was a must, and there was even an electric power-steering pump that came to the rescue if the engine stalled. Press reaction was favorable, but the feature was never released to the public because of safety concerns.



What about retractable hardtops? There were at least two of them.

And don't forget amphibious automobiles, which were the only true dual-purpose cars.



German Amphicar of the 1960s was a true amphibian. Note boat registration on the fender.

Automatic door locks—In the mid-1950s Ford introduced "rolling door locks," a safety feature that automatically locked the doors when the car was moving. The system used a vacuum device triggered by movement of the speedometer cable. Unfortunately, Ford found that many people left their keys in the ignition when the car went through a car wash, and the vehicle came out the other end with its doors locked. Many modifications were made over the next several years, including a vent that unlocked the doors when the car stopped. However, this also raised objections, and the system eventually was dropped.

The golden windshield—One of Ford's more expensive but golden ideas was a Lincoln of the mid-1970s: It actually had gold particles in the windshield and backlight. The gold formed an invisible heating circuit to remove frost (it had no wire lines). The circuit was 110 v., so Ford had to install a second alternator just to produce the higher-voltage current.

Hydraulic windshield wipers—Windshield wipers operated by power-steering fluid under pressure from the PS pump were used on some Ford luxury cars from the early 1960s to the early '70s. Leaks were not a major problem, but dirt could be. Dirt was trapped in a filter screen in the motor, where it restricted fluid flow. Many power-steering pumps were erroneously replaced as a result, and even if a mechanic suspected the wiper motor, the screen was hard to reach and clean. Multispeed electric motors were an even better idea that the entire industry adopted.

Mechanical valve lash adjuster—Sticking hydraulic lifters were a major service problem of the 1950s and '60s. To get around them and still eliminate the need for valve adjustment, Ford installed "Silent Lash" mechanical compensators in its 1961 six-cylinder engines. The compensators consisted

of a bulb-shaped eccentric between the valve stem and rocker arm, and a spring-loaded plunger in the side of the rocker, bearing against one end of the eccentric. As the valve closed, the plunger pushed the eccentric out to take up free play. The setup worked, but improvements in hydraulic lifters and motor oils made hydraulics a simpler approach.

GM's gems

General Motors also had some interesting designs, and one of its failures is used in a modern form on the '84 Continentals:

Air-spring suspension—The '57-'59 Cadillac had rubber air springs at each wheel and three body-leveling valves (two at the rear, one in front), an air compressor lubed by engine oil and a cable-activated lift valve (to raise the car when the driver wished).

Photo courtesy of Michael Lamm



Mercury's experimental Wrist-Twist Steering employed two palm-sized wheels with thumb grips. The press loved it.

The system was prone to air leaks. The compressor suffered from a short operating life. And the air springs' rubber bladders cracked in very cold weather. Owners who paid hundreds of dollars extra for the system paid hundreds more for a changeover kit to get rid of it. In the years since, air springs have proved themselves on trucks and buses, and the new Continental system has a permanently lubed compressor, solid-state height sensors and a digital computer. The air springs' rubber will survive nicely even at 40° below zero, according to Goodyear.

Dynaflow transmission—One of the

most popular "automatic" transmissions of the 1950s was the Buick Dynaflow. Owners raved that it was so smooth you couldn't feel it shift. Actually, it didn't shift—because it really was a hydraulically controlled manual transmission. DRIVE was just high gear, and if you wanted LOW, you had to shift into it.

The car accelerated well because it had a powerful eight-cylinder engine and a torque converter that provided the equivalent of 3-to-1 gear reduction. A torque converter isn't an efficient way to get gear reduction, and as self-shifting automatics became smoother, they displaced the Dynaflow.

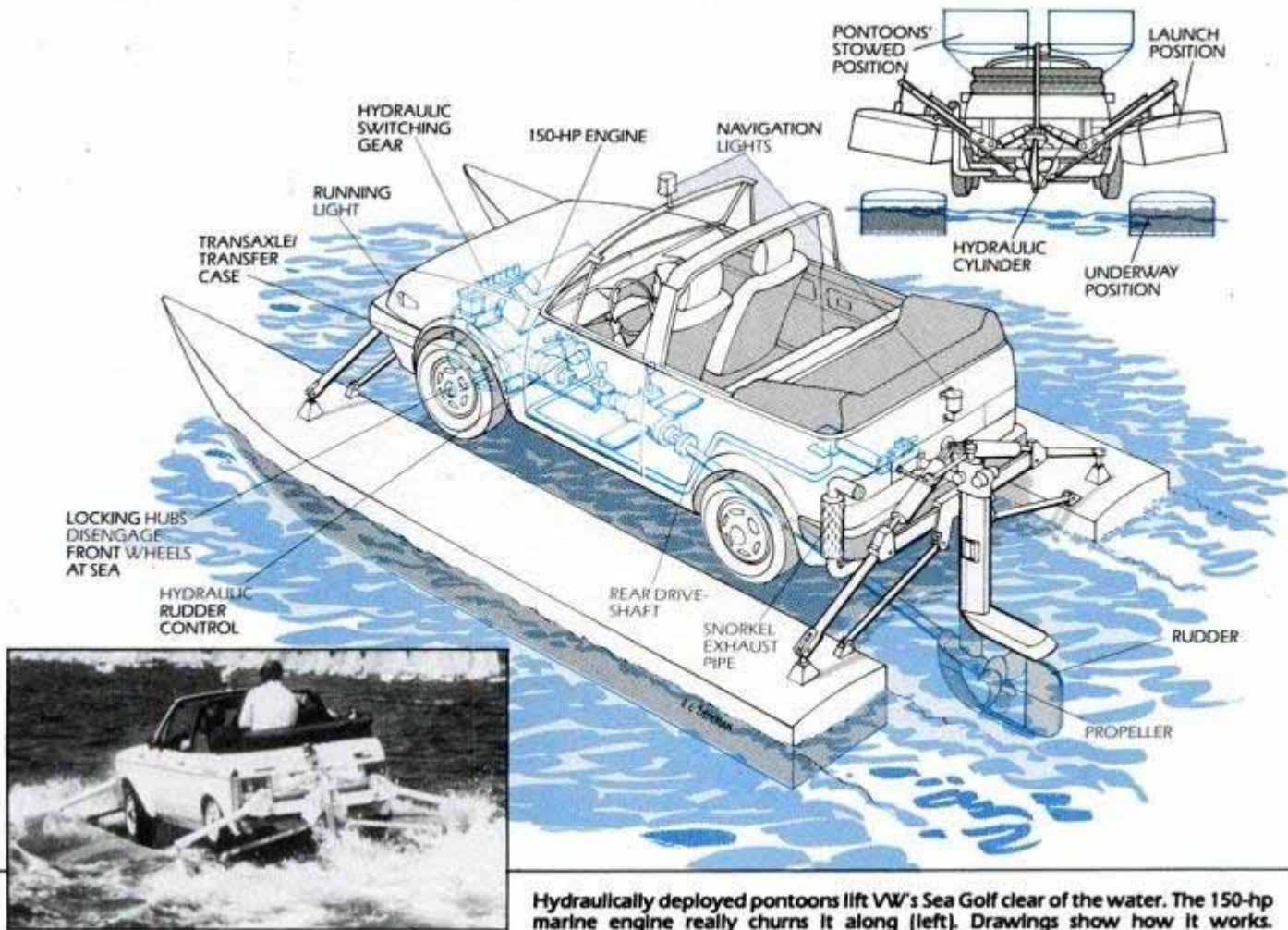
The Corvair air-cooled engine—When GM introduced the Corvair in 1959, air-cooled engines were old hat. However, the Corvair's fan belt drive was something else. It was run at 90° angles, which meant that it had to be twisted. GM said it had tested the belt every possible way, but the motoring public apparently found ways GM hadn't thought of, and many failures occurred. Belt tightness was critical. If the belt was too loose, it popped off; too tight, it overstressed the bearing for the air-cooling blower. More durable belts helped with these problems, but safety concerns fanned by Ralph Nader's book *Unsafe At Any Speed* doomed the car.

Flexible driveshaft—The '61-'63 Pontiac Tempest had a flexible driveshaft, something like a big speedometer cable. The relatively thin shaft startled many people, but it was on a car with a front engine and rear transaxle, so all the shaft had to do was transmit the relatively low engine torque, not the multiplied torque that goes from the transmission to the rear axle in a conventional car. It did this job properly. However, the flexible shaft was in a long tubular housing, called a torque tube, that was rigidly bolted to both the engine and transaxle. The entire power train, mounted in relatively soft rubber, set up a rocking motion that was transmitted to the passenger compartment.

Aluminum-block Vega—There have been many engines with aluminum blocks, but they all used cast-iron cylinder liners—until the 1971 Chevy Vega 140-cube four-banger. It had aluminum cylinder walls, too. The engine was very sensitive to low coolant level, which would result not merely in overheating but in catastrophic engine failure. By the time Chevy had the bugs out, the engine's reputation was shot.

Small carmakers' brainstorm

Smaller U.S. carmakers and parts manufacturers have also contributed



Hydraulically deployed pontoons lift VW's Sea Golf clear of the water. The 150-hp marine engine really churns it along (left). Drawings show how it works.

some interesting design features, such as:

The torque converter clutch—The 1951 Packard Ultra-Matic was the first car with a torque converter clutch, and it worked reasonably well. In fact, it was the secret of some amazing highway gasoline mileage numbers—around 18 mpg—that the powerful, heavyweight car achieved in the old Mobil Economy Run. This compared well with the usual Packard numbers of 6 mpg or even less in city driving.

Vacuum clutch—This was a 1950s attempt by Hudson at semiautomatic shifting. The accelerator linkage operated a switch that opened a solenoid vacuum valve on a slave cylinder. When the driver hit the accelerator, the solenoid valve opened to admit vacuum to the cylinder, causing it to engage the clutch. Some very brisk acceleration was possible with this design, because there was no need to feather the clutch and throttle; you could just floor the gas pedal and go.

Tire inside a tire—Although puncture-sealing materials for tubeless tires are in wide use today, nothing did the job in 1956. So Goodyear introduced a treadless tire that fit within the existing tubeless tire. The inner tire worked very well, although it was somewhat costly. If you got a blowout, you could run on the inner tire for 100 miles or so.

The inner tire was inflated by the usual Schraeder valve. The outer tire was inflated by inserting a needle valve through the sidewall, just like a basketball! The idea was sound and is still used in many racing stock cars.

Other European designs

Although the Amphicar and Citroen head the list of novel European designs, there are many others, such as:

"Trafficator" turn signals—The English "trafficators" were finger-shaped pointers, one on each side of the car. When the driver operated the turn-signal lever, he completed a circuit to a

solenoid that would flip up the appropriate pointer to indicate the direction of the turn. The solenoid was a more complex approach than a simple flashing lightbulb. And it wasn't as visible. They were discarded in the 1960's.

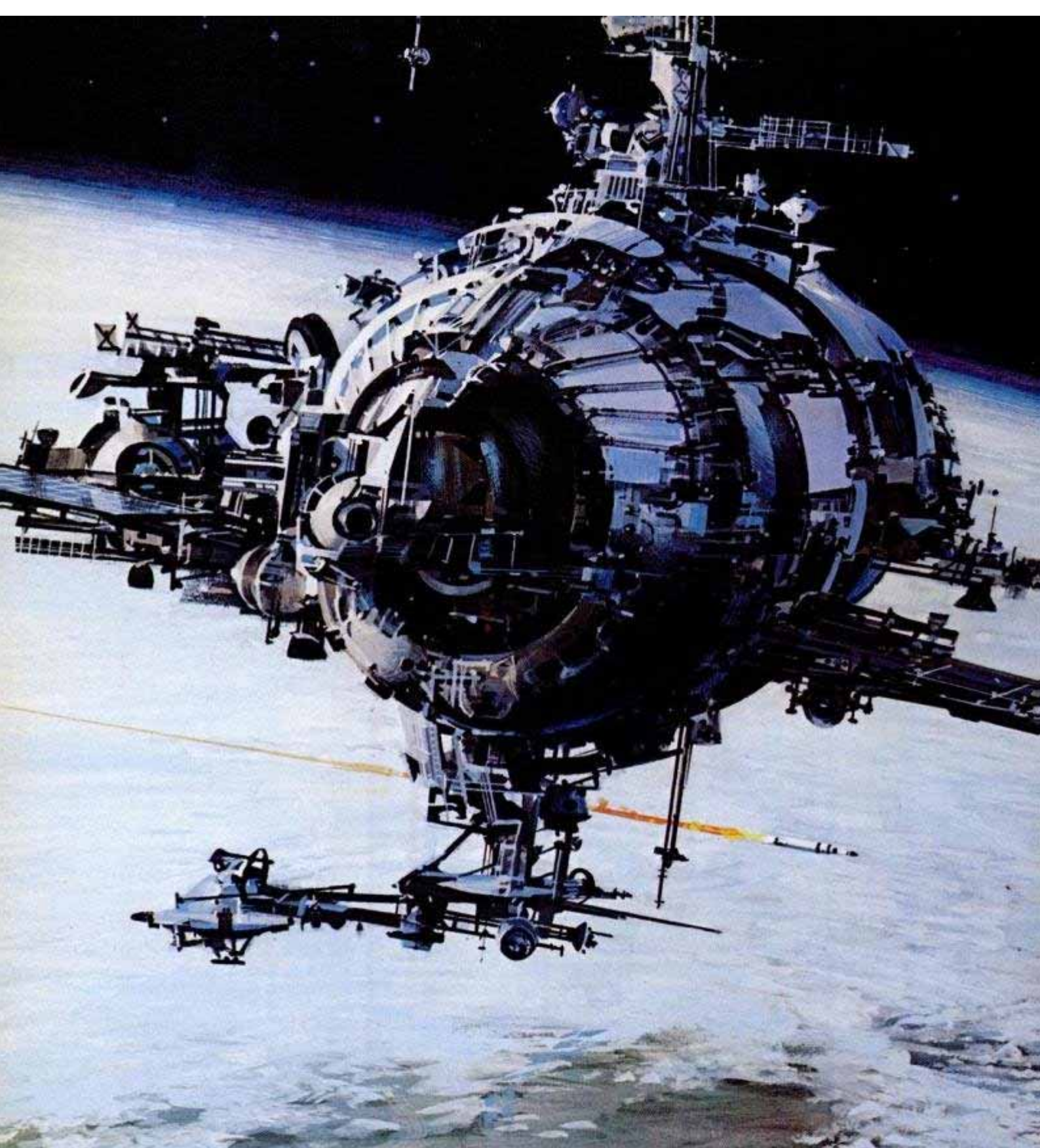
Connecting rod camshaft drive—Instead of chains, gears or toothed belts, some European cars have used a form of connecting rod between the crankshaft and overhead camshaft. The crank drove an intermediate shaft at half speed. The rod's ends wrapped around eccentrics on each shaft, so the movement of the intermediate shaft

(Please turn to page 118)

Ford's folding metal hardtop could squeeze your oranges before you got them home. Poor reliability was another drawback.



Photo by Michael Lamm



Artist's conception shows Big Bird satellite over the Soviet Union. Satellite takes photos and listens in on Soviet communications. Also shown are TR-1 spy plane and Hawkeye plane with radar dome. A 10-story radar station follows Soviet activities from an Alaskan island. Similar radar is carried aboard a Navy cruiser.

AMERICA'S GLOBAL LIE DETECTOR

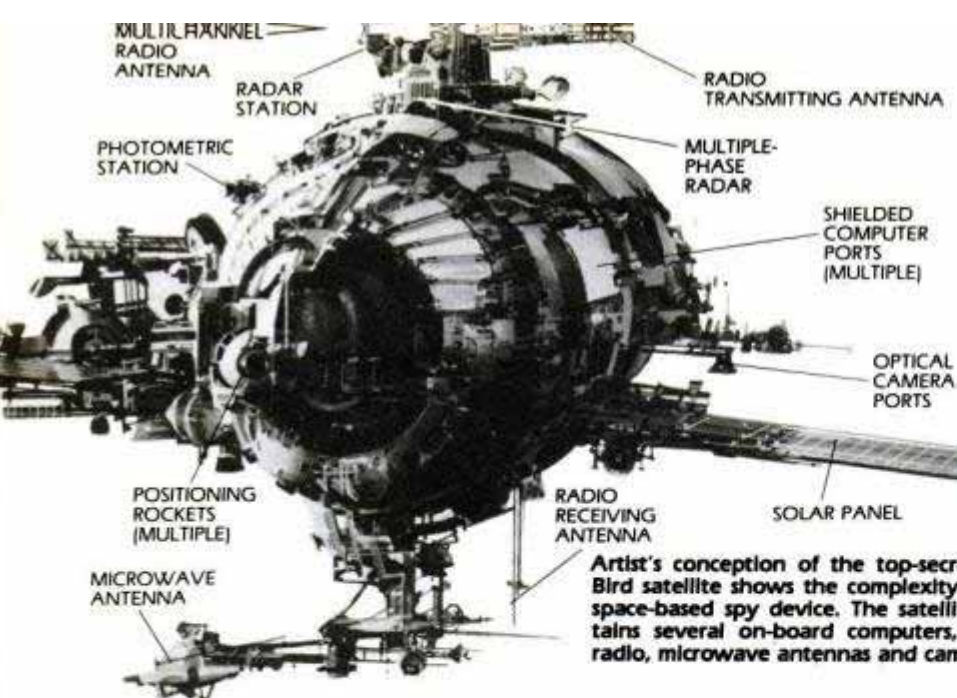
As the Russians move troops and equipment and test new weapons, we're watching from space, sky, sea and land.

BY MICHAEL KREPON AND BARRY BLECHMAN; Illustrated by John Berkey



Last September, when the Soviet Union shot down a Korean Air Lines jumbo jet, Japanese and American officials quickly reported the incident in great detail. This information came from intelligence-gathering methods that reconstructed the movements of Russian aircraft and even tapped into the Soviet air-to-ground communications system. By vividly presenting this evidence, an immediate indictment against Russia followed. The Far Eastern network used to reconstruct the fate of the airliner was just part of the worldwide system now in place to protect American security and monitor existing treaty compliance by the Russians. The following article, written by two experts in the field, provides us with non-classified details on how the system works.

Reconnaissance photos taken over a few weeks reveal unusual truck movement into the Soviet missile test



Artist's conception of the top-secret Big Bird satellite shows the complexity of the space-based spy device. The satellite contains several on-board computers, radar, radio, microwave antennas and cameras.

tion will be helpful in determining the missile's weight and that of the payload it carries.

An odd-looking oceangoing ship nicknamed "Cobra Judy," stuffed with sophisticated sensors, cruises international waters off the Pacific coast of the U.S.S.R. to monitor the missile's re-entry.

And on an island off the coast of Alaska, just 450 miles from the impact point, a massive radar nicknamed "Cobra Dane" follows the dummy

warheads dispensed from the strategic rocket. This may seem like a difficult task, but Cobra Dane is no ordinary radar. It's 10 stories high and represents the state of the art in radar technology—a "phased array" which can detect an object the size of a basketball 2,000 miles away. Cobra Dane scans the skies electronically with over 34,000 radar "eyes" able to track 300 missiles as they churn through the Earth's atmosphere and another 200 objects in outer space. Cobra Dane can sweep the skies by constantly switching electronic impulses in every magnitude and direction.

The information collected by Cobra Dane and other sensors is fed back to intelligence analysts in Washington. In time, they compile a profile of the Kremlin's newest rocket.

Keeping track of what the Soviet military is up to is made easier by modern technology, but it's by no means a routine matter. One problem is the Kremlin's secretive practices, which include sending back radio messages from rocket tests in code—a process known as encryption. Nevertheless, the United States manages to keep extraordinarily

range north of Moscow. The United States has its eyes and ears trained on the busy scene.

From 100 miles above the Earth, a multifaceted "Big Bird" satellite keeps watch over dozens of Soviet military installations, crossing over Russia every 90 minutes. Its cameras can be programmed from Earth stations to zoom in and out, photographing wide fields of view or moving in so close that a trained photographic interpreter will be able to identify individual vehicles on the ground. As a former Central Intelligence Agency director said, the satellites can distinguish between Guernseys and Herefords grazing on the range.

This time, however, the subject is the test of a new Soviet intercontinental ballistic missile (ICBM). The missile is unmistakable: It weighs 90 tons and requires special fueling and firing equipment. Perhaps as many as 30 test firings will take place before the new ICBM enters the Russian inventory of strategic rockets.

Like a global lie detector, America's system of various sensing devices in air and space, and on land and sea, picks up and relays data to skilled analysts. This allows the United States to determine whether the Russians are living up to a peace treaty.

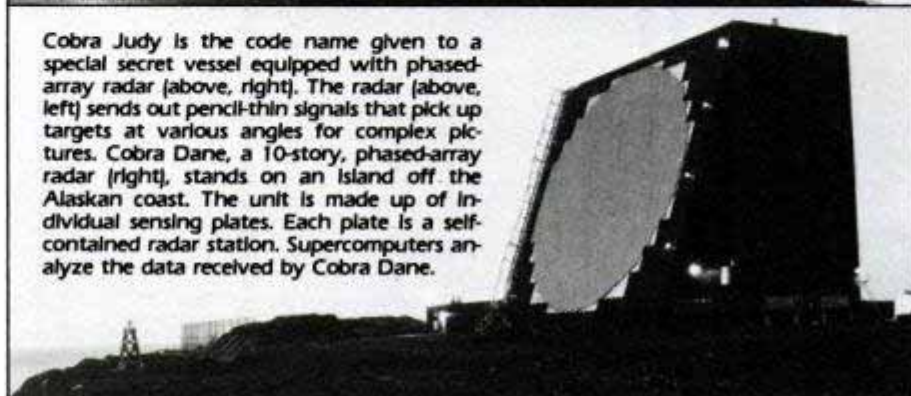
Big Bird works with reconnaissance aircraft and a vast network of satellites. Their primary job is to keep an eye on the Russians, although they can also be trained on other global hot spots. "Ferret" satellites home in on Soviet radar and microwave transmissions to help build up a more accurate picture of what the Russians are saying to one another. Infrared detection satellites key on sudden bursts of heat from a rocket launch or a secret nuclear weapon test.

Feeding the information network is a combination of land-based radar sta-

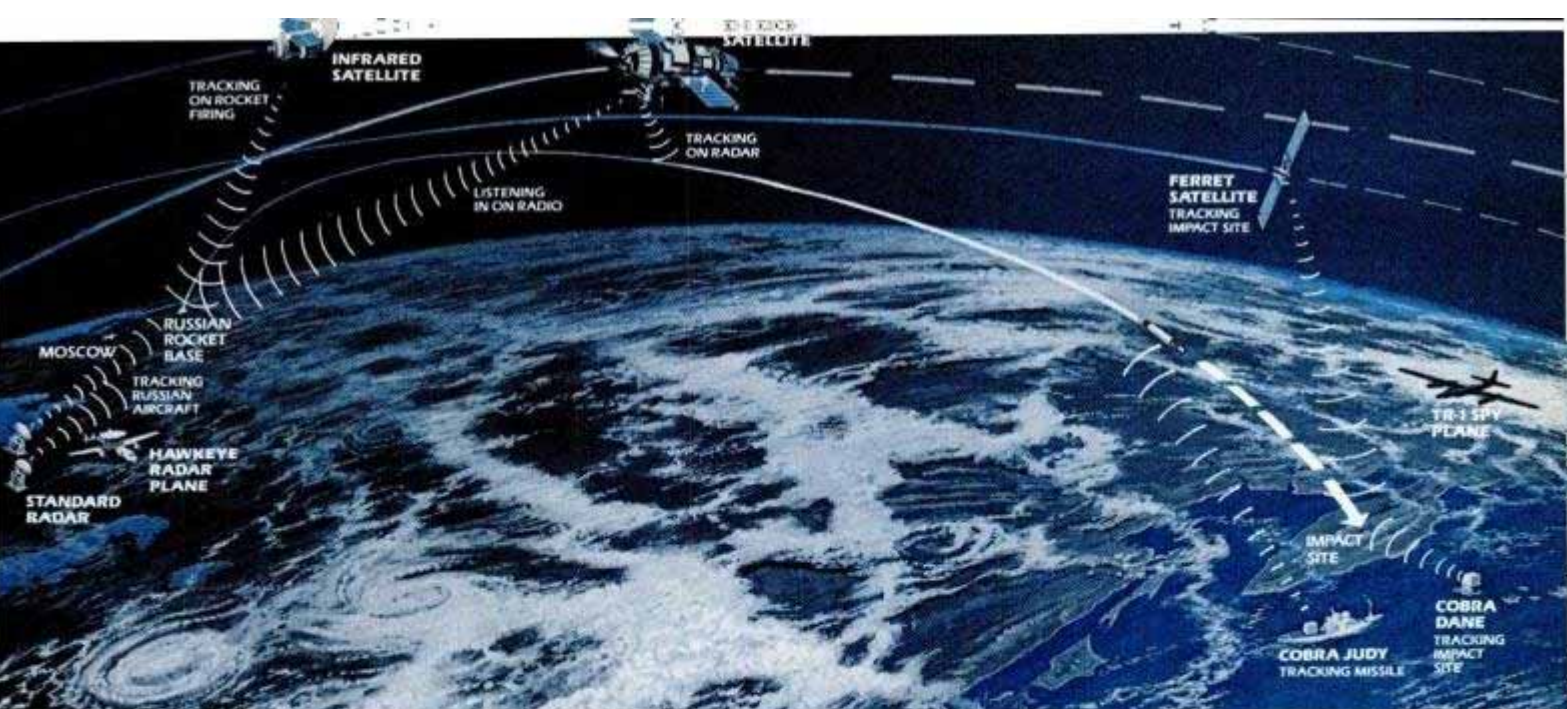
tions, ocean-listening devices and patrol aircraft. In Washington, photo interpreters working at computerized consoles enlarge satellite photos pixel by pixel. Or they compare a series of photos taken of the same point at different intervals, or taken at different bands along the electromagnetic spectrum.

When a missile is fired from the Soviet launch pad, an infrared satellite in Earth-stationary orbit 22,000 miles up picks up the exhaust trail. Thus, we learn how many missiles have been fired and in what direction each is headed.

We know from past experience approximately where the new missile is headed. U.S. ground installations on the periphery of the U.S.S.R. track the missile and pick up radio messages, or "telemetry," sent to its designers and engineers on the ground. This informa-



Cobra Judy is the code name given to a special secret vessel equipped with phased-array radar (above, right). The radar (above, left) sends out pencil-thin signals that pick up targets at various angles for complex pictures. Cobra Dane, a 10-story, phased-array radar (right), stands on an island off the Alaskan coast. The unit is made up of individual sensing plates. Each plate is a self-contained radar station. Supercomputers analyze the data received by Cobra Dane.



Big Bird satellite performs many functions as it watches a Soviet missile test launch. The infrared unit detects heat from a missile and can change both its altitude and attitude. Ferret can photo-

graph the impact site, while Cobra Dane and Cobra Judy follow the launch with their phased-array radar systems. Spy planes and conventional radar watch from outside Russia.

good track of Soviet military activities.

Intelligence gathering has come a long way since the American Civil War, when Gen. George McClellan used a tethered balloon to survey the defense of Richmond with a crude new device known as the camera.

A century later, a specially designed reconnaissance aircraft, the U-2, was flying high over Soviet territory. In 1960, overflights came to a halt when the Russians shot down a U-2 piloted by Francis Gary Powers. That same year, the United States began using a photo-reconnaissance satellite, the Discoverer. Every so often, the space vehicle would drop a film capsule toward Earth, and an Air Force plane would retrieve it in midair like Willie Mays basket-catching a fly ball. In the 20 years since Discoverer, U.S. intelligence capabilities have improved considerably.

Only rarely does the public gain a glimpse of how effective U.S. monitoring capabilities are. Last year, President Reagan televised pictures of new military facilities in Nicaragua. The scene was reminiscent of the Cuban missile crisis from the Kennedy years. The global lie detection system often works superbly, but the results depend on the quality of interpretation, much as they do with a police department lie detector.

Every American president has said adequate and effective verification is essential for any future treaty with Russia. And every administration wants to be able to assure the public that U.S. intelligence can detect Soviet cheating in time to respond effectively.

Just how sensitive is our verification system? Let's return to the Soviet rocket headed for splashdown in the Pacific.

Is it 5 percent heavier than the model it's supposed to replace? Our intelligence eyes and ears may have difficulty determining such a small change at the outset. But we would know if the Kremlin's new model were 50 percent heavier. This level of disparity is important because it could be translated into military capability: Heavier rockets can lift a larger number of nuclear weapons. Fortunately, the greater the disparity, the easier it is to detect it.

Would Soviet officials cheat on nuclear arms control agreements? Probably, if they thought they could get away with it. But the record of Soviet compliance with nuclear arms control agreements has been good. Through 1980, there were no cases in which the U.S.



This photograph by Big Bird was used to show Soviet military presence in Nicaragua.

government concluded the Soviets violated specific provisions of an agreement to limit nuclear weapons.

Still, disputes have arisen. President Nixon, Ford, Carter and Reagan all found the Soviets difficult to deal with, habitually exploiting ambiguities in negotiated agreements and pressing our tolerance for such behavior.

The 1972 SALT I agreements established a private U.S.-Soviet forum to discuss compliance questions—the Standing Consultative Commission, or SCC. The present U.S. representative to the SCC is Gen. Richard Ellis, the retired commander-in-chief of the Strategic Air Command. The Soviet representative is also a military man. Soviet representatives are said to have been willing to discuss military systems in unprecedented detail at SCC meetings.

In the past, every issue raised behind these closed doors—and there have been many—has been settled. Either the Soviets stopped the practices that were causing us problems, or they were explained in a way that eased our concerns.

Combined, the United States and the Soviet Union are believed to have almost 50,000 nuclear weapons. So far, we have avoided using them against each other, but there's no guarantee that this situation will last forever. That's why we're negotiating with the Soviet Union—to prevent nuclear war and to reduce these stockpiles. We know from experience that success won't come easily. But we also know there is no chance of success without the U.S. worldwide intelligence network to keep track of Soviet military activities.

Michael Krepon is a former director of Defense Policy and Program Review of the U.S. Arms Control and Disarmament Agency. Barry Blechman is a former assistant director for Weapons Evaluation and Control in the same agency. Both currently work on the Treaty Verification Project of the Ploughshares Fund, a West Coast foundation interested in arms control.

BOATING '84

This is the year you should come closer than ever to finding that "perfect boat." New ideas in propulsion, hull design and creature comforts in the '84s are making boating faster, safer and more fun than ever.

In outboards, the big news is oil injection. Just about every major builder offers it this year, bringing an end to messy oil and gas mixing. Advantages include smoother running, better economy and longer motor life. Also new is a whole line of outboards from Yamaha, expressly designed for the U.S. recreational market. The firm offers 17 motors from 2 hp to more than 220.

The fuel shortage of a few years back seems to have been left behind, at least in the minds of many boat builders. There are more big boats this year than there have been in some time. Even in bass boats, hulls to 20 feet

are appearing. Boatmen who can handle the initial cost will reap the benefits of greater safety and comfort in rough water, plus lots of extra storage space for all the odds and ends that drift around inside most boats.

On the other hand, there are lots of small, light hulls available this year. Smaller family cars of the '80s make it tough to tow big, heavy boats, but even the smaller imports can make it up the ramp with a 400-pound aluminum boat on a lightweight



Ranger's 392 at 20 ft. is the largest production bass boat in the country. Twin consoles give protection to mates as well as the captain.



Built-in Shakespeare trolling motor gives Electric Feather almost 14-knot top speed. At only 78 pounds, this 12-foot pirogue runs silently on 12-v. marine battery you recharge at home.



Hypalon coating on Achilles inflatable makes it tough enough to pull up on any shore without worrying about abrasion and tender enough to take three or four out to any craft.

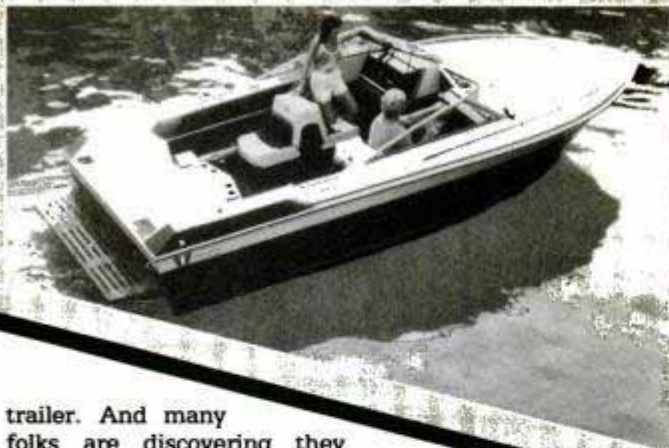
Now you can leave the dock on board a boat of the perfect shape and size, designed to do exactly what you want it to do.



Sponson-hulled Starcraft CPS 200 features a small, flat pad just ahead of the stern to reduce wetted area and drag while planing at top speed. Designed for all-out performance by Art Carlson, the sponsons stabilize the hull at any speed.



Walk-through windshield and bow-rider seats help make Aquasport 222WT into a fun family run-about for fishing or skiing on salt or fresh water.



trailer. And many folks are discovering they don't even need a trailer if they go to ultralight ABS plastic or aluminum canoes and john boats which can be cartopped, or to an inflatable that fits in the trunk when deflated.

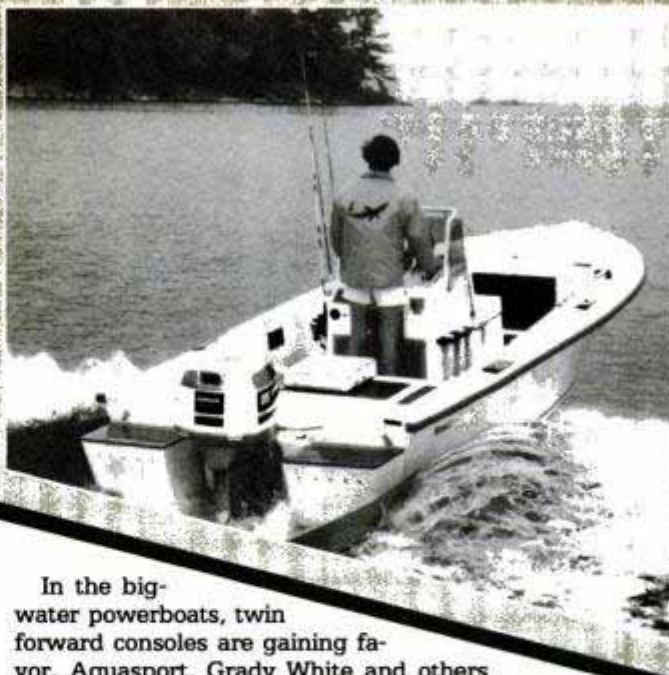
Canoes from firms such as Mad River can be purchased with hulls of Royalex plastic, Kevlar, Kevlar/Airex foam, or fiberglass. Each material has special advantages for special applications. With more families getting into canoeing, bigger hulls, such as the new 18-foot Columbia from Old Town, are providing the needed carrying capacity.

Inflatables are becoming a viable alternative to "hard" boats—they're available in sizes large enough to carry over 1,000 pounds and can handle motors to 60 hp. They're remarkably light for their size, fast and fuel efficient, and new materials such as the Hypalon coating on the Achilles line make them tough enough to land anywhere. Sevylor even offers a sail kit for its "balloon boats."

Shallow-dock sailboats

In fact, the nationwide popularity of sailing is still growing rapidly, despite the ready availability of fuel for powerboats. Trailerable "minicruisers" small enough to launch anywhere but big enough to sleep two to four are sure to be good sellers this year. The O'Day 222 is a case in point—it can be launched in only 20 inches of water. Sailboards and small cats such as those from Hobie are still hot items with the younger set.

In aluminum boats, V-hulls are showing up on many john boat designs. The Vs are a bit tougher to build and consequently a bit more expensive. But there also are some larger center-console models, including the good-looking 19-foot Striper from Sea Nymph. And Starcraft is building a comfortable 19-foot cruiser with plenty of freeboard for running offshore.



In the big-water powerboats, twin forward consoles are gaining favor. Aquasport, Grady White and others build them. Advantages over center-console designs include much more cockpit space aft for fishing and a drier ride at the helm, especially when a canvas top is snapped to the windshield.

Walk-around cabin models also remain popular with blue-water cruisers and fishermen. The walk-around design provides easy access to the bow for fishing and handling anchor or dock lines, while the cabin gives extra-dry storage plus space to sleep.

You'll probably see more offshore boats with Sea Drive systems from OMC this year. Many manufacturers are offering the system factory-installed. An alternative is an outboard rigged on Gil brackets aft of the transom. The big advantage of the Gil brackets is that there's no transom cutout, so following seas stay out of the cockpit.

Flat-out performance

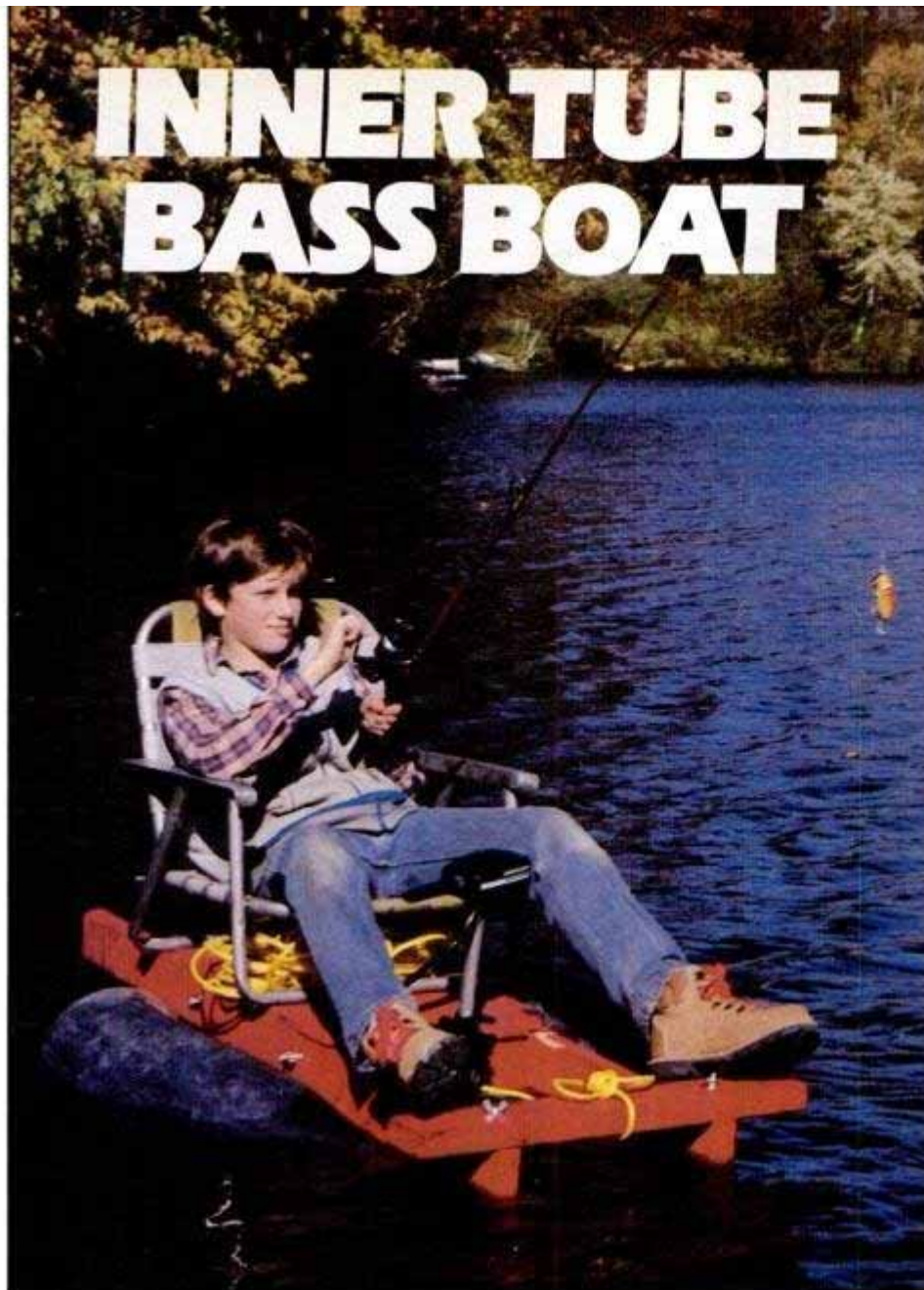
High-performance boats continue to hold a strong following. A popular hull design this year is the "pad" boat, with a deep V forward to provide a smooth ride in rough water and a small, flat pad aft to provide minimum wetted surface and maximum speed when the boat is trimmed up in smooth water. MonArk's McFast series, in fishing and skiing models, uses this design. Also good for eye-watering speeds is the Art Carlson-designed CPS 200 from Starcraft—sponsons provide stability at top speed.

Whether you're interested in flat-out speeds or in silent, leisurely sailing, chances are good you'll find something that's just right in the 1984 boating lineup. **PM**



Wellcraft 210 Elite (top left) is a slick ski boat with seating for five and a cuddy that sleeps two; portable head is standard. The 210 handles sterndrives to 260 hp. Mako 17 (top right) for fishing or use as a runabout will fly with 85 horses on the transom. Sea Ray's new Monaco (left) uses a recessed hull design for quicker planing, less bow rise and improved overall performance.

INNER TUBE BASS BOAT



Build our basic float boat, add a trolling motor and get to the best fishing without spending a lot.

BY ANGUS LAIDLAW

If you're hooked on fishing quiet waters, as little boat as possible should come between you and your sport. PM's inner tube bass boat is just about the least boat you can use. Its quiet competence takes you to your favorite fishing holes unobtrusively. With it, you can laze across the pond or hang along the river bank under the trees and become almost as much a part of the scene as the fish.

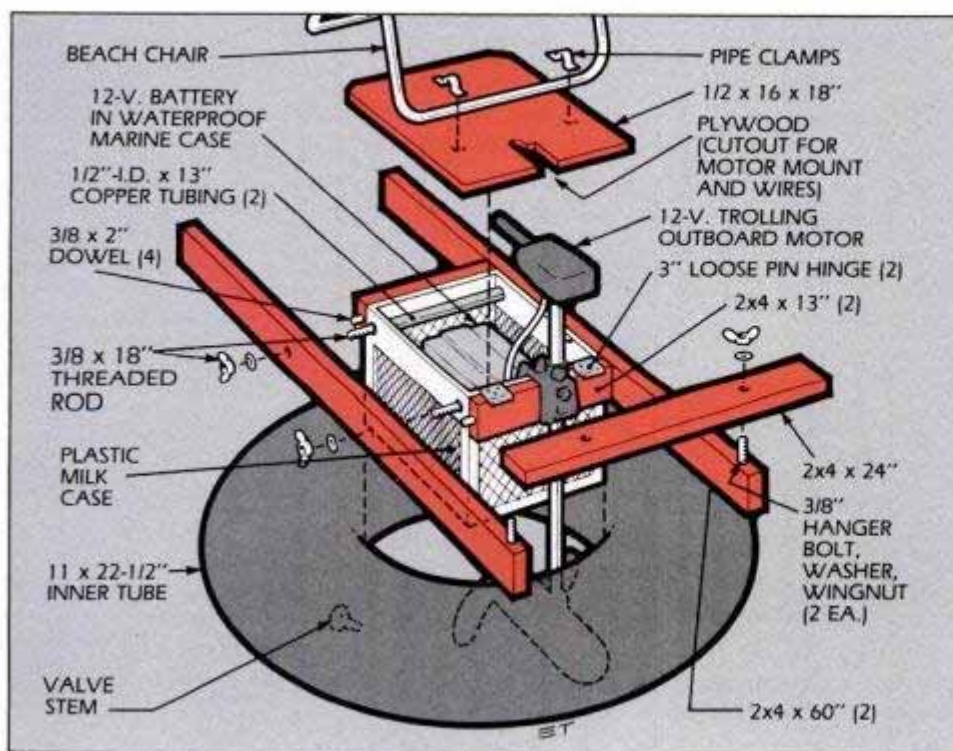
Called the Water Bug by its teenage designers, Andy Rose and Barry DeGroot, the boat consists of a truck tire inner tube, plastic milk crate, five short 2x4s and a seat—plus a minimal electric trolling motor and a battery. You can build it the expensive way with all new equipment, in which case you can run the tab up to about \$300 if you work at it. Or, you can do it on the cheap, with stuff you scrounge, and keep the cost down to half that or less—depending on how clever you are and how much you have to lay out for the battery and electric trolling motor.

Milk crate is a key

Construction is so simple and obvious that you'll end up making most of it up as you go along. The first determining factor is the size of your plastic milk crate. The plastic lattice-work box we used was 13 inches wide by 18 3/4 inches long. It just fit inside the 11.00x22.5 truck tire inner tube before it was overinflated to increase its size and the stability of the boat.

Given the box and the tube, you need five lengths of 2x4 lumber. It doesn't have to be pretty, but you want it smooth where it bears on the tube. The two side rails, with cross members, fit around the milk crate. Dowels trapped in drilled holes in the side rails and the ends of the spacers locate them positively. A 36-inch length of 3/8-inch threaded rod, cut in half, goes through the topmost fore and aft openings in the case and clamps with wingnuts and washers to hold the frame together. Two 13-inch lengths of 1/2-inch copper tubing keep the threads from chewing up the box. The fifth 2x4 becomes the footrest when mounted flat

(Please turn to page 120)



PM's Tire Test:



PM used two Pontiac Trans Ams to test a complete range of Goodyear tires, from the lowliest bias-play to the giant 245 Eagle GT—eight sets in all (six sets stacked at left and one set on each car). Tests of braking and adhesion were made on wet surfaces (inset), and tests on dry pavement were for braking, adhesion, acceleration and rolling resistance. The test data, presented in the chart that follows, will help you choose the best type and size tire for your car.

Bigger Is Better

... But only to a point. We test eight sets of Goodyear tires—and get some surprising results.

Nobody is an expert when it comes to buying tires. Oh sure, most people realize that radial tires are better than bias-plys, and that expensive tires are better than cheap tires. But beyond that, who knows? All those black rubber doughnuts look the same when they're sitting in the racks at the tire store, and the salesmen might as well be speaking in Swahili.

Take heart. When we called the Goodyear people, they didn't know either. "Well," they waffled, "every tire

is a compromise between price, performance and tread life. It depends on what you want." So we decided to do a tire test and, once and for all, find out exactly what differences exist between various types and sizes of tires. We used Goodyears, but you can expect similar results from equivalent tires made by other companies.

According to Goodyear's engineers, the most popular tire size in America is 205/70-14, which fits on a 14x7-inch rim. Goodyear makes four different tires in this size. But as they pointed out, many people fit wider, low-profile models when they buy new tires. To keep the same outside diameter, so that you don't change the car's ground clearance or speedometer readings, you'd have to use a 215/65-15 tire on a 15x7-inch rim or a 245/60-15 on a

15x8-inch rim. To get the same diameter in a taller, narrower, less expensive tire, you'd use a 195/75-14 or E78-14 on a narrower 14x6-inch rim.

We mounted our eight sets of tires on Cragar wheels. Pontiac supplied two identical Firebird Trans Ams fitted with five-liter V8s, automatic transmissions and Koni shock absorbers. We then decamped to Newburgh, N.Y., and spent two days testing at Stewart Airport under both wet and dry conditions. We ran eight separate tests, calculated to measure everything you'd want to know about a tire:

Coast-down is a measure of rolling resistance; the longer the car rolls, the better your fuel economy. We coasted in NEUTRAL from 60 to 30 mph, and measured the time in seconds.

Quarter-mile acceleration measures



PM crew checks the readout on computerized road-test equipment, which is fed by a "fifth wheel" clamped to car.



The hard part of the test was changing all those tires! Thirty-two tires and wheels were used on two test cars.



Huge Stewart Airport water truck dumped 10,000 gallons of water at a time onto test site for wet weather tests. Note "fifth wheel" on Trans Am.

PM TIRE TEST—SPECIFICATIONS AND RESULTS

TIRE MODEL	SIZE	LIST PRICE*	TREAD WIDTH (in.)	DIAMETER (in.)	LOAD RATING AT 26 PSI (lbs.)	COAST-DOWN (sec.)	1/4-MILE (sec. @ mph)
Powerstreak II	E78-14	\$41.30	5.20	26.18	1,190	15.34	18.34 @ 79.8
Custom Polysteel	P195/75R14	\$66.05	5.32	25.50	1,213	43.16	18.14 @ 78.5
Custom Polysteel	P205/70R14	\$73.45	5.73	25.34	1,235	40.49	18.30 @ 78.5
Arriva	P205/70R14	\$80.40	5.64	25.27	1,235	25.99	18.70 @ 78.8
Eagle GT	P205/70R14	\$114.50	6.20	25.35	1,235	23.25	17.89 @ 79.5
Eagle GT	P205/70HR14	\$121.15	6.20	25.35	1,235	35.70	18.08 @ 78.9
Eagle GT	P215/65R15	\$118.85	7.10	26.02	1,312	44.67	17.88 @ 80.1
Eagle Steel GT	P245/60R15	\$133.35	7.91	26.58	1,521	33.33	18.27 @ 77.3

*Prices are for lowest-priced version; whitewalls and raised letters add to the price. White figures are bests; bold figures are worsts.

TIRE VERSUS SUSPENSION

The relationship between the tire and the suspension is an intimate one.

For example, the tread width on our test-winning 205/70R14 Eagle GT is 6.2 inches; on the 245/60R15 version of this same tire, it's 7.91 inches.

Larger contact patch

All other things being equal, the wider tire has a larger contact patch—it puts more rubber on the road—and thus should generate higher cornering, braking and acceleration forces.

But that's true only if the suspension can keep the full width of the tread in contact with the pavement.

On a racing car, you can use very wide tires because the suspension is designed for use only on very smooth surfaces. Typically, it has very limited travel, no camber change and negligible body roll.

A racing suspension is a very narrow-focus mechanism, designed to perform a limited task.

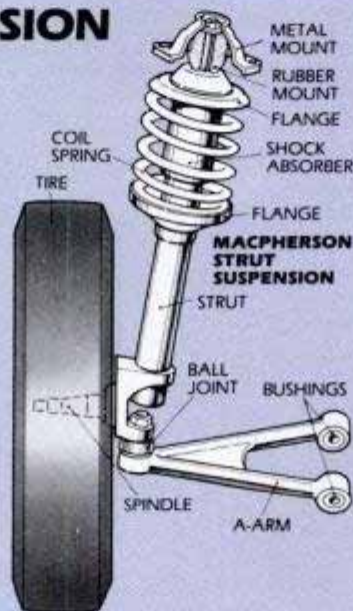
Rolling to the outside

A passenger car must be much more versatile than a racer, and so must its tires.

In hard cornering, even on a perfectly smooth skidpad, the comparatively soft passenger car suspension will allow the body to roll to the outside.

This is true even on sporty cars like our Trans Ams. In addition, modern MacPherson strut front suspensions allow a surprising amount of camber change.

Eventually, this lifts the inside edge of the tread off the pavement as you corner harder.



A low-aspect ratio tire—like the 245/60R15—has a stiffer sidewall and a sharper shoulder between sidewall and tread, which compounds the problem.

The 205/70R14, by comparison, has a more flexible sidewall and a very rounded shoulder. Indeed, the tread actually extends partway up the sidewall on this tire.

Outcornering the big ones

Under extreme conditions, the 205/70R14 is actually cornering on its shoulder/sidewall, while the 245/60R15 tries unsuccessfully to balance on the sharp corner of its shoulder. The result? The narrower tire actually has more rubber in contact with the pavement.

And that's how a 6.2-inch-wide tire can outcorner a 7.91-inch-wide tire, all other things being equal.

both traction and rolling resistance. We recorded both time in seconds and speed in miles per hour at the end of the quarter-mile, from a standing start.

The **slalom** is our normal test of transient handling—cones spaced 100 feet apart over a 700-foot course. We measure the time in seconds, and convert to average speed in mph. It's done from a 60-mph flying start.

Braking is our usual 60-to-0-mph test, except that this time we did it twice, on dry pavement and on a flooded track. We measure the distance in feet from brake application to a full stop.

The **skidpad** is our normal 200-foot-diameter test of steady-state traction. This time we ran it on flooded pavement as well. It's measured in G-force.

Finally, we set up a half-mile **road course** that tested acceleration, braking and cornering. We measured lap times in seconds.

When you read our results, you may be surprised at the seemingly small differences in times. For example, on the skidpad, our worst figure is .630 g; our best figure is .808 g. To put this in perspective, you pull .3 g rounding a 90° corner in typical city traffic and .6 g when you drive too fast into a freeway off-ramp in your family sedan and squeal the tires. At .8, you're plastered up against the door, sliding sideways, at the very limits of adhesion for any street-legal car. At 1.0 g, you're driving a racing car.

The same thing is true of our other figures. The difference between 37.27 seconds—our slowest road course time—and 35.53 seconds—our fastest road course time—doesn't seem like

Produced by the PM Auto Dept.
Text: Rich Taylor
Photos: Frank Lusk

SLALOM (mph)	BRAKING (ft.) (Wet/Dry)	WET SKIDPAD (cw/ccw)**	DRY SKIDPAD (cw/ccw)**	ROAD COURSE (sec.)	BESTS	WORSTS
53.18	297/245	.656/.630	.682/.679	36.38	0	6
54.04	341/250	.663/.637	.723/.693	36.63	0	0
55.84	239/233	.671/.675	.717/.702	37.27	1	1
55.32	266/225	.718/.667	.742/.750	36.86	0	1
58.37	327/ 221	.759/.752	.789/.791	35.53	3	0
58.08	373/ 315	.744/.734	.785/.765	35.61	0	1
56.70	385/312	.795/.782	.768/.808	35.80	6	1
59.48	290/264	.746/.715	.752/.771	35.81	1	1

**Skidpad figures measured in G-force; cw = clockwise; ccw = counterclockwise.

much. But it would translate to a difference of 8.7 seconds at the Indianapolis Motor Speedway, or nearly 35 mph in lap speeds. At that rate, you'd lose the Indy 500 by a hundred miles.

In other words, there are *significant*

differences in the performance of these tires, differences that can change your car from an indifferently handling slug to a joyful driver's machine, differences that will save you time, money and, perhaps, save your life in an emergency

situation. If we learned anything from this tire test, it's that *tires* are the single most important factor in your car's over-the-road behavior—and no place to skimp.

E78-14 Powerstreak II

While coast-down times for most of the radials clustered around 40 seconds, the bias-ply Powerstreak II generated so much rolling resistance that times were cut to 15 seconds. Translated into everyday driving, that's a loss of 2 to 3 miles per gallon—and the clearest possible explanation of why nearly all car manufacturers have switched from bias-ply to radial tires as standard equipment, even on their cheapest cars.

The inexpensive Powerstreaks performed about as well as Goodyear's low-priced Custom Polysteel radials in our handling and braking tests, and actually beat them around the road course. Bias-ply tires lose traction very gradually as they near their limits, which makes them quite predictable. But their limits are so low that, on a test

(Please turn to page 119)

HOW TO READ A TIRE

There are over 20 separate bits of information cast into the sidewalls of your tires. Some of them are more important than others. The manufacturer and the brand name are your assurance of *The Right Label* . . . many private-label tires

are thinly disguised rip-offs of name brands.

Next most important marking is size. A typical size label might read P205/70HR14. The "P" stands for passenger car. The 205 is the width from sidewall to

sidewall of an inflated tire, measured in millimeters. All tires sized 205 will be roughly 8.2 inches wide. This doesn't mean the tread will be this wide. Tread width depends on the design of the tire.

The 70 is the aspect ratio, or the ratio between the width and the height of the sidewall. A 205/70 tire should have sidewalls approximately 143.5 mm. Aspect ratios of 45 to 50 percent seem to be the practical lower limit for street tires.

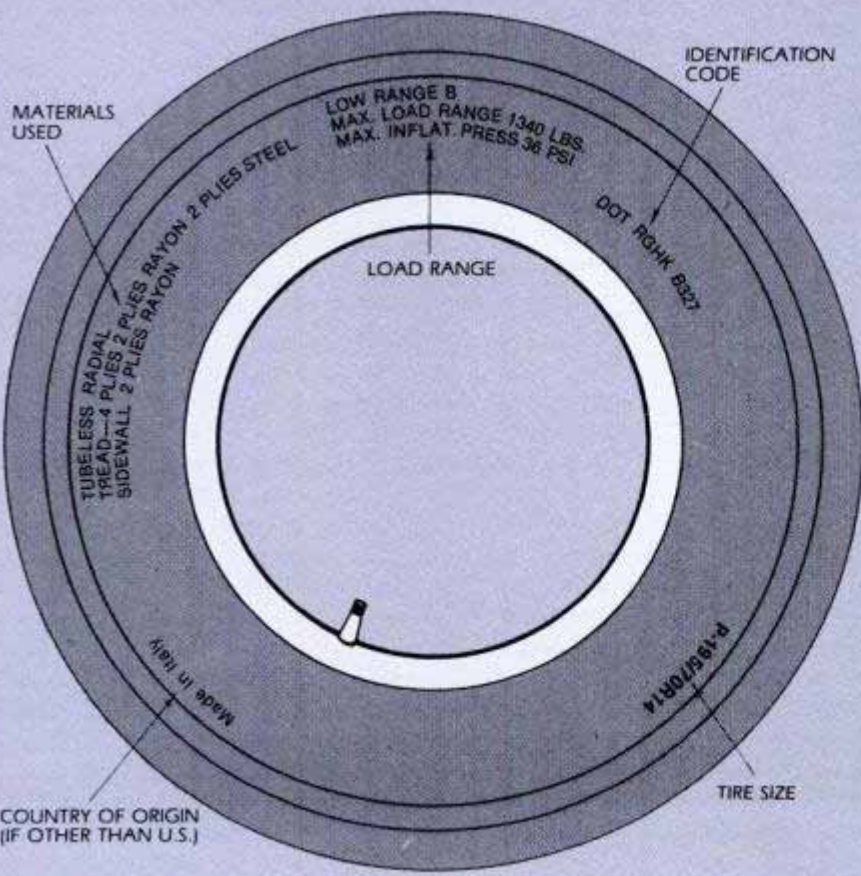
S, H or V are European sustained speed ratings. Not all American tires carry them. These ratings have nothing to do with tread wear. An "R" means it's a radial tire.

The last numeral is the diameter of the wheel in inches.

Every tire has a maximum air pressure rating stamped in the sidewall. Usually this is 35 psi. You should treat this as your recommended air pressure. Using 35 psi rather than 25 psi is worth 3-5 percent in fuel economy, according to tire engineers, and it will also bolster your handling and tire wear. After 35 psi, there's a negligible effect on mileage, but a definite effect on ride. The best compromise for street use is 32 to 35 psi.

In our testing, we often mention "break-away." Every tire has a point during lateral acceleration (cornering) at which it will lose traction and begin to slide. "Friendly" tires will lose traction gradually.

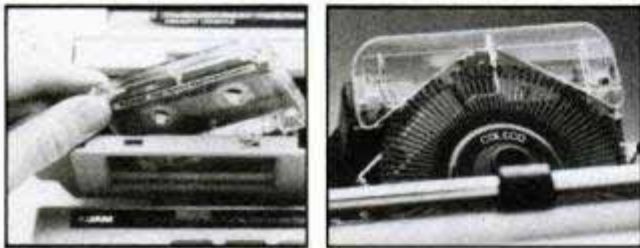
Other tires exhibit sudden breakaway: One instant everything is fine, the next, you're sliding backwards off the road. Tires with sudden breakaway are a handful even for an expert driver. Breakaway is difficult to measure with instrumentation, which is why we talk subjectively about it in this test. But it's very important.



BIG BYTES FOR LITTLE BUCKS

These four new computers are powerful, but power shouldn't be your only consideration. We tested them and here's how they rate.

BY NEIL SHAPIRO, Electronics Editor



Adam from Coleco is a fully integrated system with its keyboard, digital tape drive and daisy-wheel printer, all for about \$700. The digital tape (above, left) offers faster program loading and data searching than conventional tape, but it's still slower than a floppy disk. Daisy-wheel-type element (above, right) allows the printer to deliver letter-quality documents. Tape-loaded BASIC doesn't support sound or advanced graphic potential, but Coleco says that will change soon.



In many ways, the Coleco Adam is just about the most revolutionary concept in how to design and sell a home computer that we have seen. A keyboard, digital tape drive and even a daisy-wheel printer are all included and packaged together.

The printer is a completely integrated part of the system. And it delivers documents which look as if they've been produced on an expensive typewriter (instead of the "dotty" look of other, dot-matrix style printers). The printer contains the power supply which runs the rest of the system.

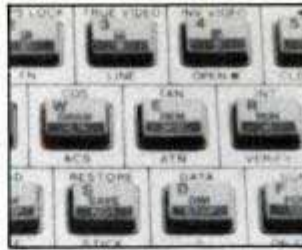
When you turn on the computer, you're in for another surprise. Instead of coming up in a dialect of the BASIC programming language, Adam starts a computing session by greeting the user with its built-in word-processing program. "We wanted *everyone* to be able to do something with Adam right away," one of Coleco's officers told us. So, instead of designing a computer that can be a programmer's buddy right away, Coleco wants Adam to hit it off with everyone who wants to write a letter or a report.

The keyboard further bears this out with a set of special function keys labeled with some of the word processor's built-in commands. One keystroke on a labeled keytop allows the user to print, clear the screen, delete and move text, and more.

The keyboard is very responsive and full-featured, similar to those on computers costing perhaps double Adam's \$700 price tag. While the plastic case is light—and on first heft, it seems on the flimsy side—typing on it is an absolute joy. We had no problem adjusting to it.

The built-in word-processing program compares very favorably with many programs which sell for \$100 to \$200. The easy-to-use commands all make use of the Adam's specialized keyboard, so learning the program takes less than an hour. You may not want to write a novel with this word processor, but it should serve most home users and students well.

Of course, Coleco has not turned its back on the programmer. The Adam comes with Coleco "Smart-



Timex-Sinclair 2068 offers user-definable graphics as well as sound for about \$200. Keyboard is packed with multifunction keys (see the detail). The "E" key not only has the label for the letter, but when typed in different modes, will produce the command words "REM," "TAN," "ATN" and ">=" The keyboard does seem confusing at first.



Spectravideo SV-318 has easy-to-program sprite graphics and sound for about \$300. What at first seems to be a normal, if unusually placed, joystick is really a tiltable disc. As the detail shows, shallow depressions on disc also allow you to tilt the disc with a fingertip instead of the stick. Disc controls movement of the cursor.



PCjr by IBM features an infrared keyboard which allows you to operate cordless from as far away as 20 feet from the main unit. While its insides feature a powerful IBM PC-style micro-processor, its "chiclet"-style keyboard seems inappropriate in a machine at its current price level. By the time you add a disk drive and extended memory, the price of about \$1,200 is too close to the cost of machines that would probably prove to be better all-around buys.

won't run, and neither will nearly all graphic programs, particularly high-resolution programs.

And speaking of graphics, this and sound were the only areas of the Adam we found not quite developed enough.

At the top of the tape drive is a cartridge slot. Plug in any of the many Colecovision Home Video game cartridges and away you go with breathtaking video action and thrilling sound effects. Yes, the Adam is also a complete Colecovision game as well as a full-featured computer!

But, because of the "Apple-compatible" BASIC, you cannot as yet access any of the stunning Coleco-style graphics or sound in your own programs. We spoke to Coleco about this and were told that, around the time this article comes out, they plan to have special graphics packages available. Those packages will have software which will allow Coleco computerists to program Coleco graphics in a Coleco manner. There should even be an assembler program available to let

(Please turn to page 139)

BASIC" on digital tape. It's not nearly as fast as a floppy disk machine, but it sure does leave a normal cassette deck standing still. Our best estimate was that using the digital tapes (which look like thin audio tapes) was about 8 to 10 times faster than a normal cassette.

The SmartBASIC program loads in less than a minute. Once it is in the machine, you have what Coleco calls an "Applesoft-compatible BASIC. In other words, it is very similar to the BASIC which comes built into the Apple IIe computer system. But this is not quite exact. While SmartBASIC does use the same structure as Applesoft BASIC, the Coleco Adam has a totally different monitor program (the program in its main ROM which tells it how to accept commands). This means that many text-only Apple programs

Build PM's Computer Hideaway

When you're ready for work or play, just roll back the top and glide the cabinet to wherever you want it.

BY NEIL SHAPIRO, Electronics Editor, AND ROSARIO CAPOTOSTO

You've got your computer console, a monitor and printer, a few disk cases, maybe a sheaf of printouts and some manuals—and suddenly you notice that you can't find your keyboard under the clutter.

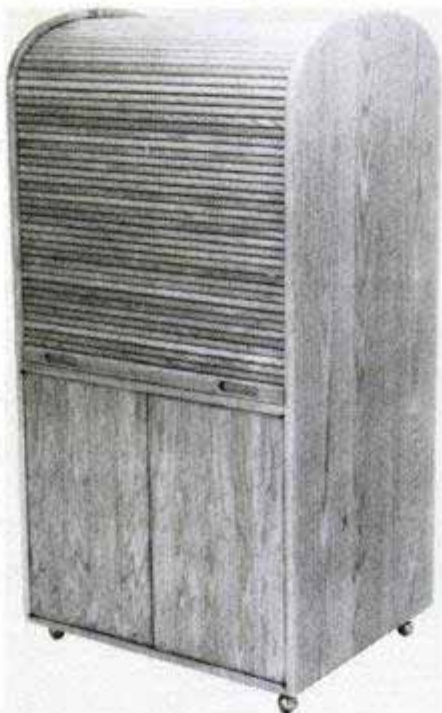
If the computer revolution is taking over—and even overflowing—whatever home space you've assigned to your setup, take heart, because here's a beautiful and utilitarian design to help solve that problem.

Our roll-top unit can be used with any of the popular computers, whether the computer features a detached keyboard, such as the IBM PC (which we show here), or a built-in keyboard, such as the Apple IIe. Besides keeping the keyboard handy on its sliding shelf, this unit will also allow easy access to your floppy disks, keep your printer ready to operate, and even provide storage space for manuals, printouts and library cases of disks.

Set on casters, the roll-top unit can be moved quickly to your favorite working spot in any room. So, if you like working at your desk in the evening and the family room in the afternoon, this unit will follow your every working—or playing—whim.

The hideaway will blend in with just about any decor. The smooth-sliding tambour roll-top hides the glassy CRT tube, disk-drive faces and crowded keyboard surfaces that so many computerists love—but that so many computerist spouses would rather not see as a room's focal point.

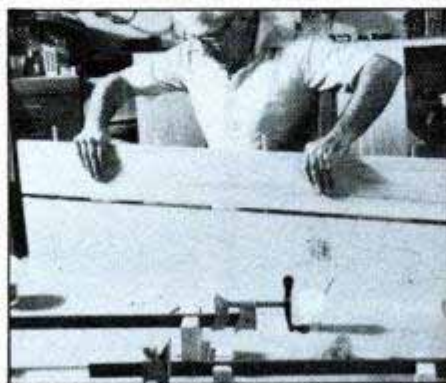
And, just as you don't have to be a computer engineer to operate one of today's home computers, you also won't need to be a mechanical engineer to begin building your own roll-top computer tamer.



With its roll-top tambour and clean, smooth lines, this computer cabinet complements both traditional and modern furnishings.

Construction procedure

The cabinet sides and tambour are made of solid red oak and the back, shelves and doors are red oak veneer



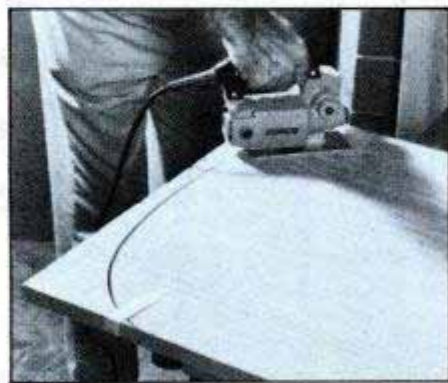
Edge-join red oak stock to make cabinet sides, using glue and 1/8-in.-dia. hardwood dowels. Space dowels evenly along joint.

plywood. Select your lumber carefully because warped stock will not do for this project.

Begin by edge-joining several boards to make the side panels. Use dowels to reinforce the joint and to obtain flush alignment. Then lay out the curve on the top of each side using the drawing on page 103 as a guide. Cut the curve with a sabre saw and sand the edge smooth.

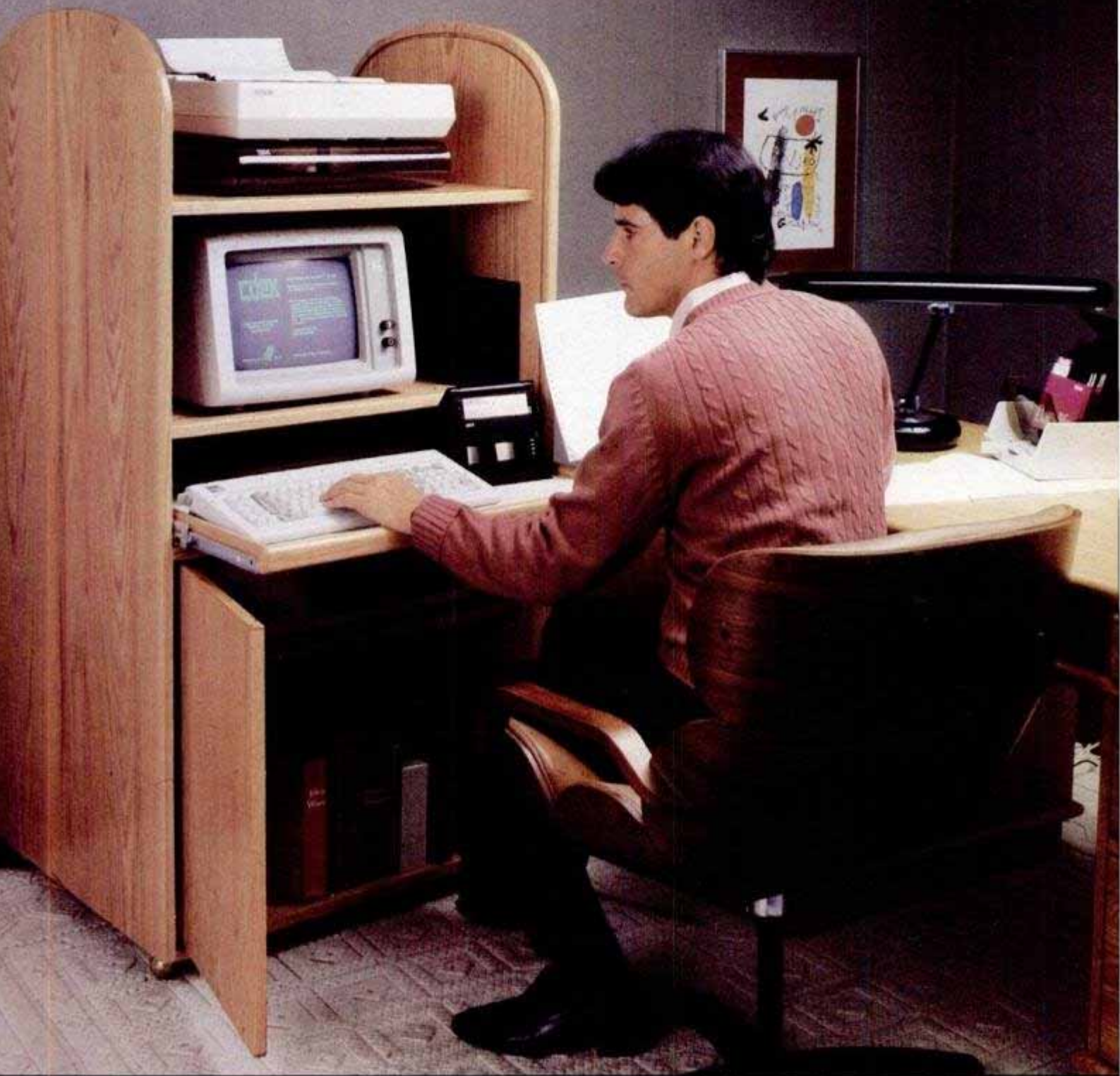
Lay out the blind dadoes as shown in the drawing and use a router with a 1/2-in.-dia. straight bit to make the cuts. The simple jig shown on page 102 will assure accuracy. (Most light-duty routers do not have the power to drive a 3/4-in.-dia. bit through hardwoods like oak. But if you have a heavy-duty router, use the larger cutter and omit the jig.) Start your cuts at the back edge and stop short of the front as shown in the drawing. Square off the end of each dado with a sharp chisel, then glue small blocks into the back end of each dado to close the gap.

Routing the tambour groove in the sides requires a template made of 1/4-in. plywood or hardboard. To make one, rip the plywood exactly 2 in. narrower than the width of the side, then rough-cut the top edge so it conforms basically to the shape of the curve. Center the

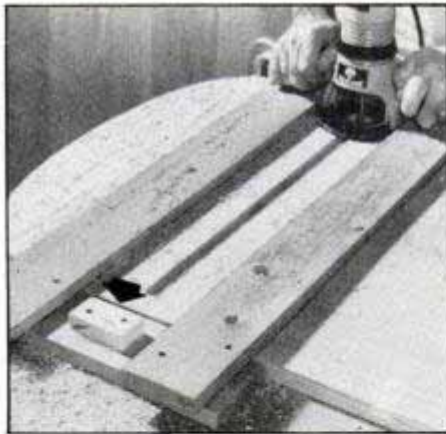


Lay out arc on top of cabinet sides, then cut with sabre saw. Use masking tape to support waste stock until cut is complete.

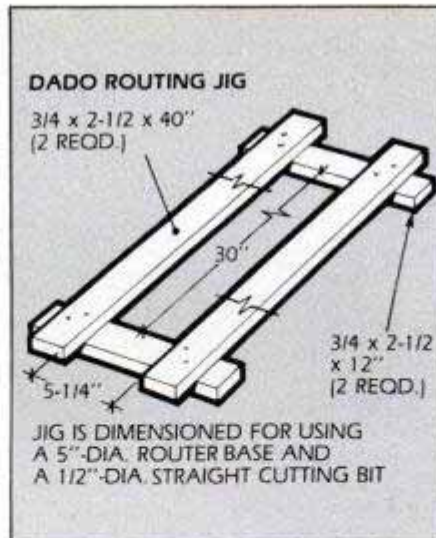
Design, construction and black and white photos:
Rosario Capotosto
Color photos: Harry Hartman
Technical art: Eugene Thompson



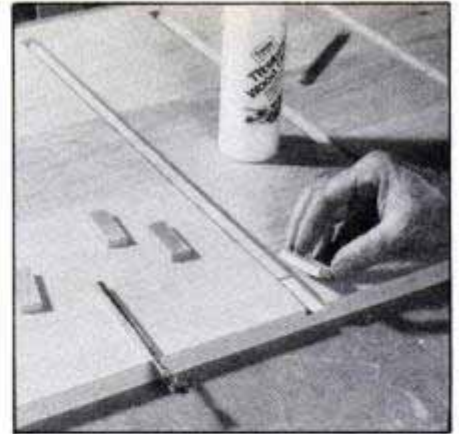
Made of solid red oak and 3/4-in.-thick red oak plywood, this substantial cabinet is caster-mounted to provide maximum versatility. The unit can be easily rolled out from the wall and used in conjunction with a home office desk or even a dining room table. The sliding tambour door hides and protects valuable computer components. When raised (far left), it provides immediate access to a slide-out keyboard shelf (left). There's also plenty of room for storing reference material below.



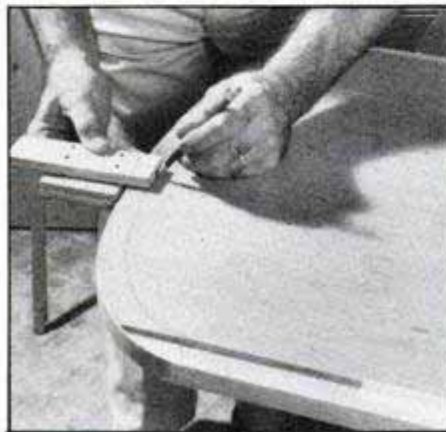
Cut blind shelf dados with router and jig (see drawing at right). Move stop block (arrow) in or out depending on how far shelf must be set back from cabinet front.



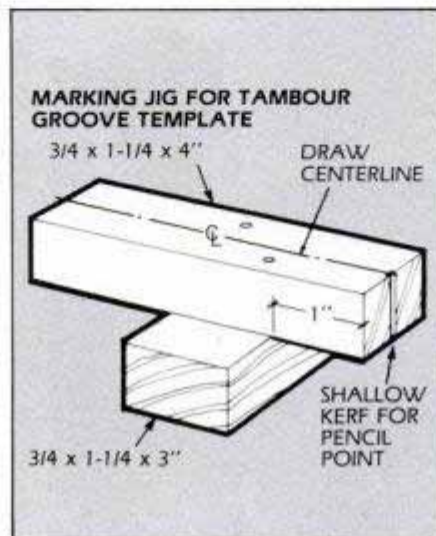
JIG IS DIMENSIONED FOR USING A 5/8"-DIA. ROUTER BASE AND A 1/2"-DIA. STRAIGHT CUTTING BIT



Glue 1/4-in.-thick blocks into shelf dados to fill back end. Cut blocks from solid stock so that the grain runs in the same direction as side. Clamp until dry, then sand flush.



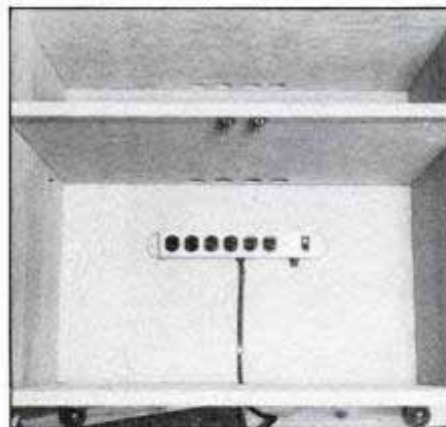
Use marking jig (see drawing at right) to transfer arc from the cabinet side onto routing template of 1/4-in. plywood. Keep the jig centerline perpendicular to edge.



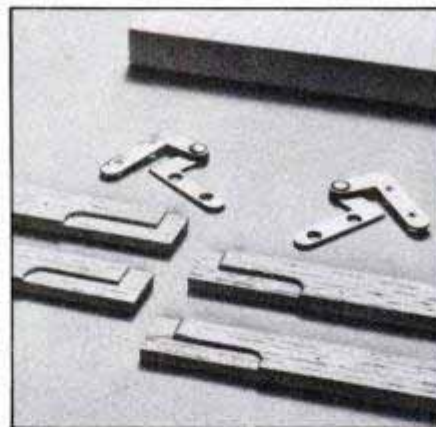
3/4 x 1-1/4 x 3"



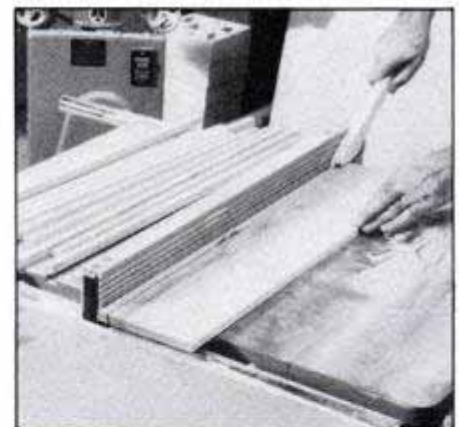
Cut template arc with jigsaw, sand smooth and tack-nail to case side. Install template guide in router base, then cut groove in several light passes, not all at once.



Attach a multi-outlet strip to the case back just below the main unit shelf. Feed power cord through a 1 1/2-in.-dia. hole in the case bottom and secure it with a wire clamp.



Cut hinge mortises in door edging before edging is glued to plywood panels. Hinges are paired, right and left, and should be installed with smooth pivot side facing up.



Rip tambour slats at 10° bevel from 3/8-in.-thick stock. To minimize waste, flip board end for end after each pass to obtain the second bevel. Be sure to use a push stick.

template on the cabinet side and tack-nail it in place.

Make the marking jig shown above and use it to transfer the shape of the side curve onto the template. Be sure to keep the centerline of the jig perpendicular to the curve. When the transfer is complete, remove the nails, and cut and sand the template smooth. Reattach it to the side using the same nail holes to assure alignment.

Use a template guide, inserted in your router base, and a 3/16-in.-dia. straight bit to cut the tambour groove. Do not try to cut the entire depth in one pass. Instead, make three or four passes, progressively increasing the cutting depth. Start at the bottom of the back and guide the router against the template until the groove is complete. Hand-sand the groove edges to ease any sharp corners.

Next, cut the back panel to size. Then cut the dados for the shelves in the back and cut the grooves for the back in the cabinet sides. Cut the shelf panels to size and add the solid wood edging, as shown in the drawing.

After boring the vent and cord holes in the shelves, dry-assemble all parts to make sure they fit properly. Round over the cabinet side edges with a router

(Please turn to page 136)



The chord harp with its colorful, hand-painted soundboard accompanies our singer (above). Other kit instruments are: hammered dulcimer (foreground) and teardrop dulcimer. Building the five-string banjo (inset) requires minimal woodworking skill.

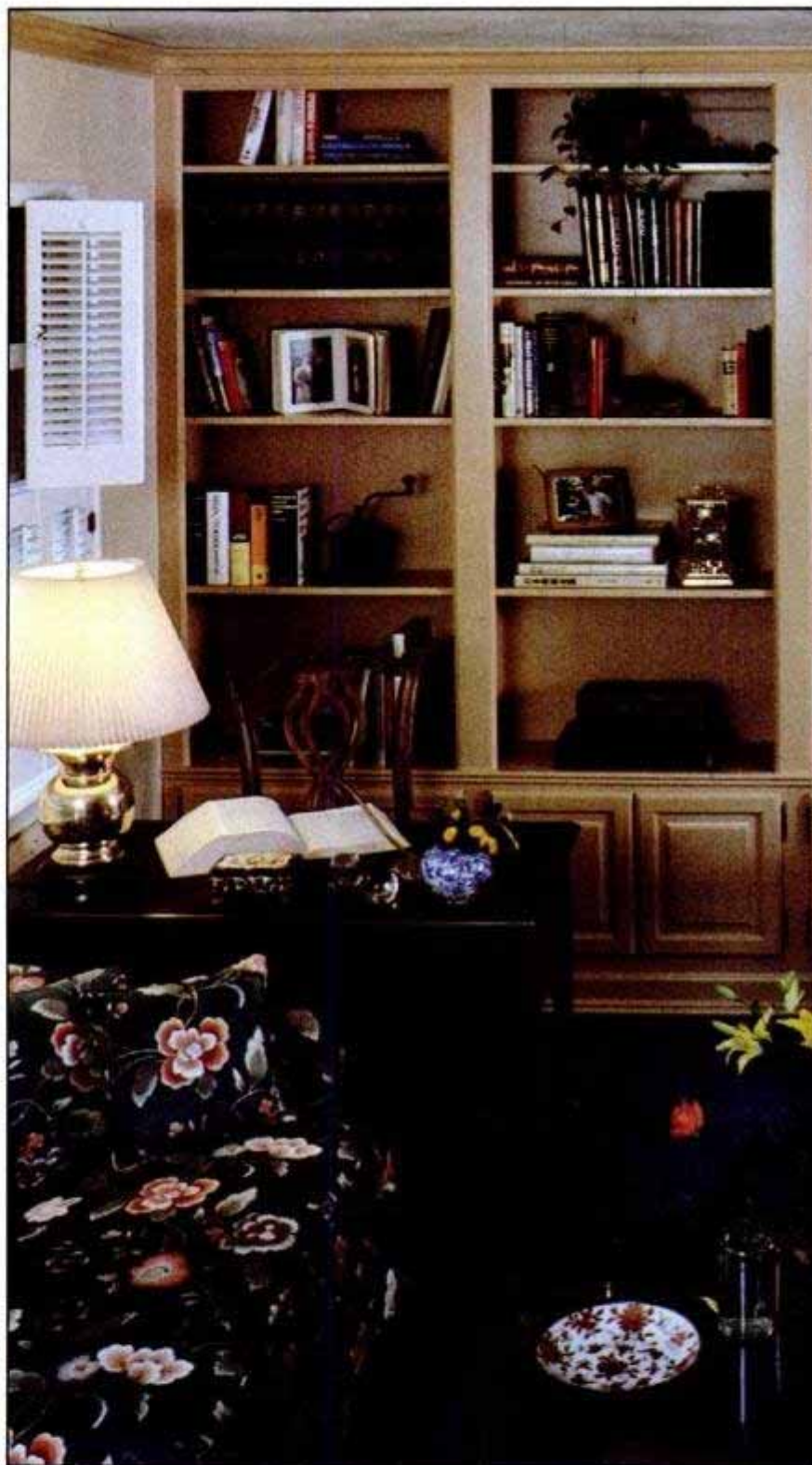


Redecorate with a **BOOKCASE WALL**

Build PM's floor-to-ceiling unit for books and favorite things, and you'll transform your living room.

BY BILL HARTFORD
Managing Editor

Five individually constructed boxes fit together to fill the living room wall at right. The 3-in.-wide stiles and 3½-in. crown molding that's continued around the room give the bookcase wall a designed-in look. The appearance and the storage space of the 12-in.-deep unit is enhanced by the row of base cabinets with raised-panel doors. The top two bookshelves are designed to be adjustable (below). A hatch (bottom) that is built into the bottom of one or more cabinets then covered gives you a great place for hiding cameras or other valuables.



Turning a whole wall into a bookcase is one of those "dream" projects. You plan to do it for a long time—while books keep piling up in a corner. Or, if it's not books that you accumulate, it's probably something else: Just about any collection can be displayed nicely on all the shelf space you get with a floor-to-ceiling bookcase. And, as you can see above, by designing in a base row of cabinets, you get out-of-sight storage space.

Usually, the wall in your living room, or whichever room you're considering for the bookcase, selects itself. It's the one—most likely the *only* one—without



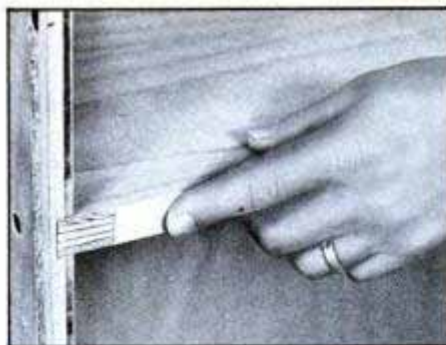
doors, windows, a stairway or other interruptions. In the living room shown, the wall measures 13 ft., 5 in. and the ceiling is a standard 8 ft. With these dimensions, a division of the space into five equal compartments provides the best proportions for the unit.

Since our living room is a modest 13 ft., 5 in. by 18 ft., we didn't want to cut into it with too deep a wall unit or use deep cabinets as a base for the shelves. Our design takes only 1 ft. off the length of the room, and (as we were delighted to find out) actually makes it appear larger.

After deciding on a 2-ft.-high row of cabinets for

the base, we laid out shelf spacing with an eye to proportion and the ability to accommodate oversize books and other tall objects we might wish to display. We made the bottom two compartments of each unit a fixed height. The top three compartments are adjustable in height because we made the top two shelves movable.

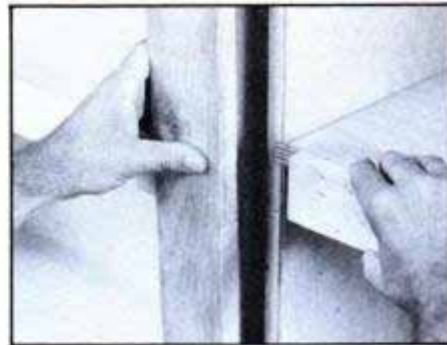
To make our construction as integral as possible with the living room, we extended the 3½-in. crown molding that tops off the bookcase completely around the room, then added it to the adjacent dining room.



Veneer tape covers exposed edges of the birch plywood that is used to build boxes.



First box of five is placed in position in left-hand corner of room; others follow in line.



After cutting and attaching 3-in.-wide stiles to bridge box edges, cut the rails to fit.



Space between bottom shelf (B on drawing) and floor is usable if a hatch is built in.



Two equal-length baseboards are used at floor. Electrical outlet plate mounts on back.



Use finishing nails to attach moldings to the interior edges of the stiles and headboards.



Cabinet door scrap shows assembly of raised panel, rail and stile (see drawing).



Attach the cabinet doors with self-closing hinges mounted on the cabinet stile edges.



Extending the wide crown molding around the room completes the built-in look.

Once you have divided your wall length by the number of individual units that will go together, you can start constructing the "boxes" of $\frac{3}{4}$ -in. birch plywood. Our five boxes are each 32 in. wide and $94\frac{1}{2}$ in. high. Note that the height is $1\frac{1}{2}$ in. short of 8 ft. Since you'll be building the boxes in your shop then tipping them to an upright position in the living room, do not build them to ceiling height or they won't clear. With our design, the molding covers the $1\frac{1}{2}$ -in. gap at the ceiling.

Start by cutting box sides, tops and bottoms and five shelves. The tops, bottoms and fixed shelves are dadoed into the box sides, so they are $\frac{3}{4}$ in. longer than the adjustable shelves. Cut five backs for the boxes from $\frac{1}{4}$ -in. lauan plywood. The dimensions are 32 in. \times

$89\frac{1}{4}$ in. Note that the height need be only $89\frac{1}{4}$ in. ($94\frac{1}{2}$ minus $5\frac{1}{4}$ in.), since the backs need not cover all the way to the floor, but only far enough down to provide backs for the base cabinets.

Assemble the boxes using glue and 6d finishing nails driven through the sides and into the fixed shelves, tops and bottoms. For the adjustable shelves, bore two holes $\frac{1}{2}$ in. deep in each side of the boxes to accept standard shelf-support pins at the preferred shelf spacing. You can bore additional holes for different spacing at this time or wait until you may want to move the shelves. Installing the lauan backing on the boxes now will assure that they are assembled square with no racking. Use glue and 4d finishing nails.

All the stiles (H and I in the materials list) can be attached to the boxes now rather than after they are installed in the room. Glue the 2-in.-wide end stiles (H) to the left and right side boxes as shown in the drawing. Attach with 6d

finishing nails. Set the nailheads and fill the holes with wood filler. These extend to within 6 in. of the floor (which is the width of the footboards) and to $2\frac{3}{4}$ in. of the top of the boxes (the width of the headboards).

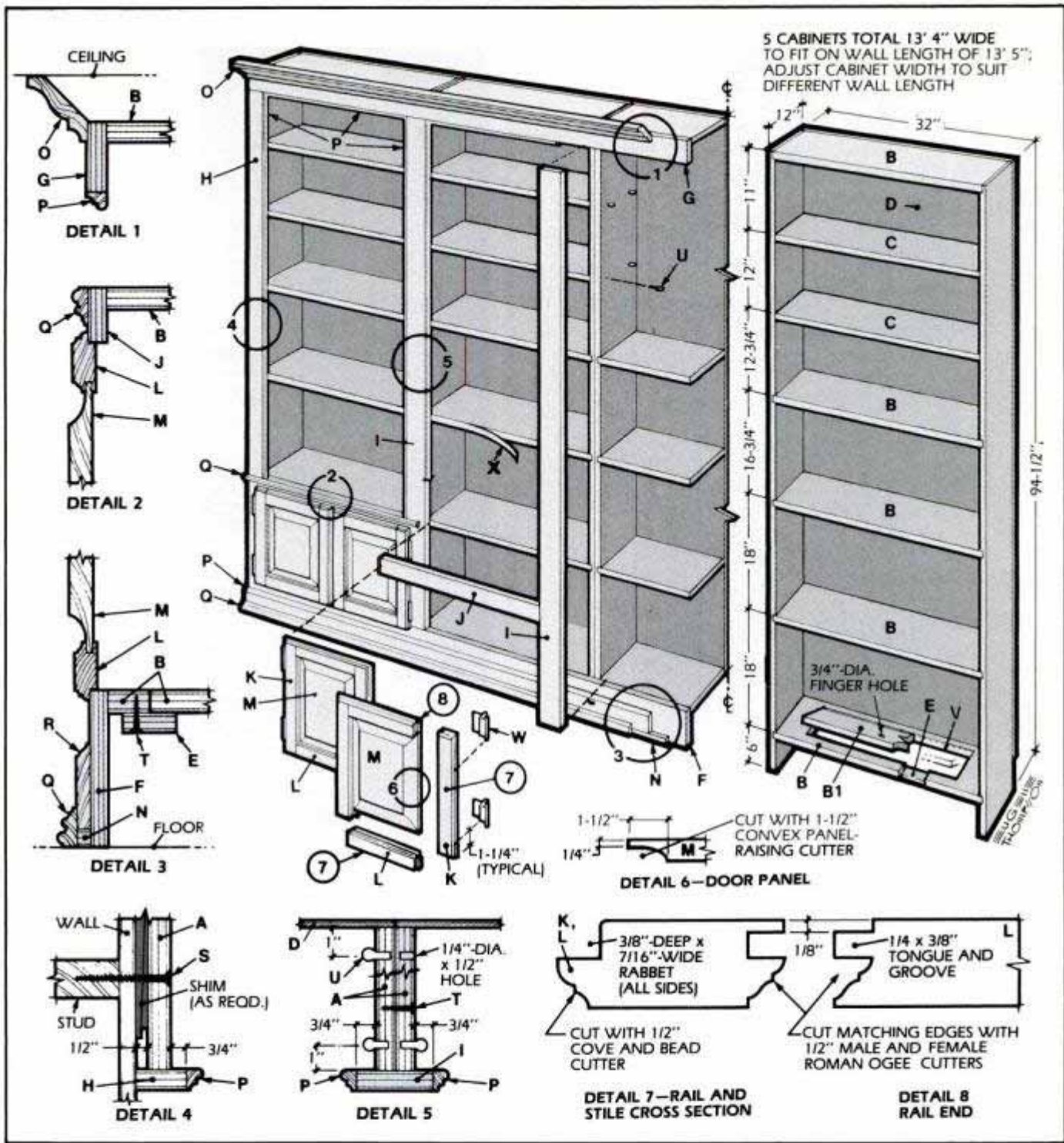
Attach the center stiles in the same manner to all the right sides or all the left sides, depending on the direction you'll be installing the units. This lets each box be slipped behind the stile of its neighbor as you install them.

Making the cabinet doors

The most handsome cabinet door for a wall bookcase of this design is the raised-panel type. Making the 10 raised-panel doors is clearly the most difficult and time-consuming part of the job. Door frame rails and stiles and door panels are of poplar, which is easy to work and takes a paint finish very well. The door panels are cut on a shaper or a radial-arm saw with a convex panel-raising cutter. The rail and stile

PM color photos: Michael Merle
Black and white photos: Iv Doin
Technical art: Eugene Thompson
Design consultants: Bob Sarapede and Frank Fiero
Room stylist: Gabe Herrick

5 CABINETS TOTAL 13' 4" WIDE TO FIT ON WALL LENGTH OF 13' 5"; ADJUST CABINET WIDTH TO SUIT DIFFERENT WALL LENGTH



glue joints were cut with Rockwell's cabinet and cove kit No. 43-922. Or, use a router with the bits specified in details 7 and 8 on the drawing.

Assemble the doors by gluing together the rails and stiles. Do not glue the door panel in place—it should "float" in the frame grooves to allow for expansion and contraction. Put the completed cabinet doors aside. They'll be hung after the boxes are installed.

Before moving the boxes to your living room, you may want to cut "hatches" in the bottoms of one or more of the cabinets for use as hiding places. We put one in the right-hand cabinet and use it for storing cameras.

Move the boxes to your living room
(Please turn to page 135)

MATERIALS LIST—BOOKCASE

Key	No.	Size and description (use)	L	QTY	Material
A	10	3/4 x 11 3/4 x 94 1/2" plywood (side)	L	20	1 3/8 x 2 1/4 x 11 5/8" poplar (door rail)
B	25	3/4 x 11 3/4 x 31 3/4" plywood (top, bottom, fixed shelf)	M	10	1 3/8 x 11 1/4 x 13" poplar (door panel)
B1	1	3/4 x 9 1/2 x 21 1/2" cutout (hatch)	N	2	1/2 x 3/4 x 80 1/2" plywood (filler strip)
C	10	3/4 x 11 3/4 x 30 1/2" plywood (adjustable shelf)	O	14 ft.	1 1/8 x 3 3/8" crown molding
D	5	1/4 x 32 x 89 1/4" plywood (back)	P	80 ft.	5/8 x 3/4" base cap molding
E	1	3/4 x 2 x 30 1/4" plywood (hatch stop)	Q	28 ft.	5/8 x 1 3/8" base cap molding
F	2	3/4 x 6 x 80 1/2" plywood (baseboard)	R	14 ft.	1/2 x 3/4" colonial base molding
G	2	3/4 x 2 3/4 x 80 1/2" plywood (headboard)	S	As reqd.	3" No. 10 fh screws
H	2	3/4 x 2 x 85 3/4" plywood (end stile)	T	As reqd.	1 1/4" No. 10 fh screws
I	4	3/4 x 3 x 85 3/4" plywood (center stile)	U	40	Shelf support pins
J	5	3/4 x 2 x 29" plywood (rail)	V	1	1 1/2 x 21" continuous hinge
K	20	1 3/8 x 2 1/4 x 16 3/4" poplar (door stile)	W	20	3/4" offset hinge
			X	As reqd.	Birch plywood veneer tape

Misc.: Carpenter's glue; shim shingles; 4d and 6d finishing nails; 1" finishing brads; 220-grit sandpaper; wood filler; enamel primer; semigloss enamel paint (Benjamin Moore Satin Impervo Enamel CB-64).

BOOKSHELVES TO BUY AND BUILD



Craftsman's Corner solid oak bookcase comes as kit.

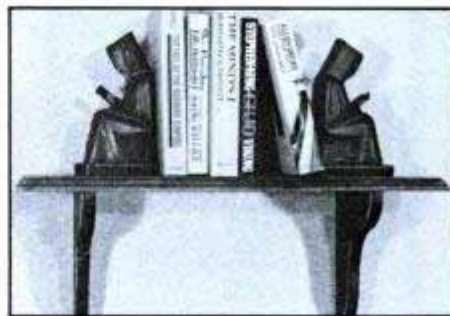
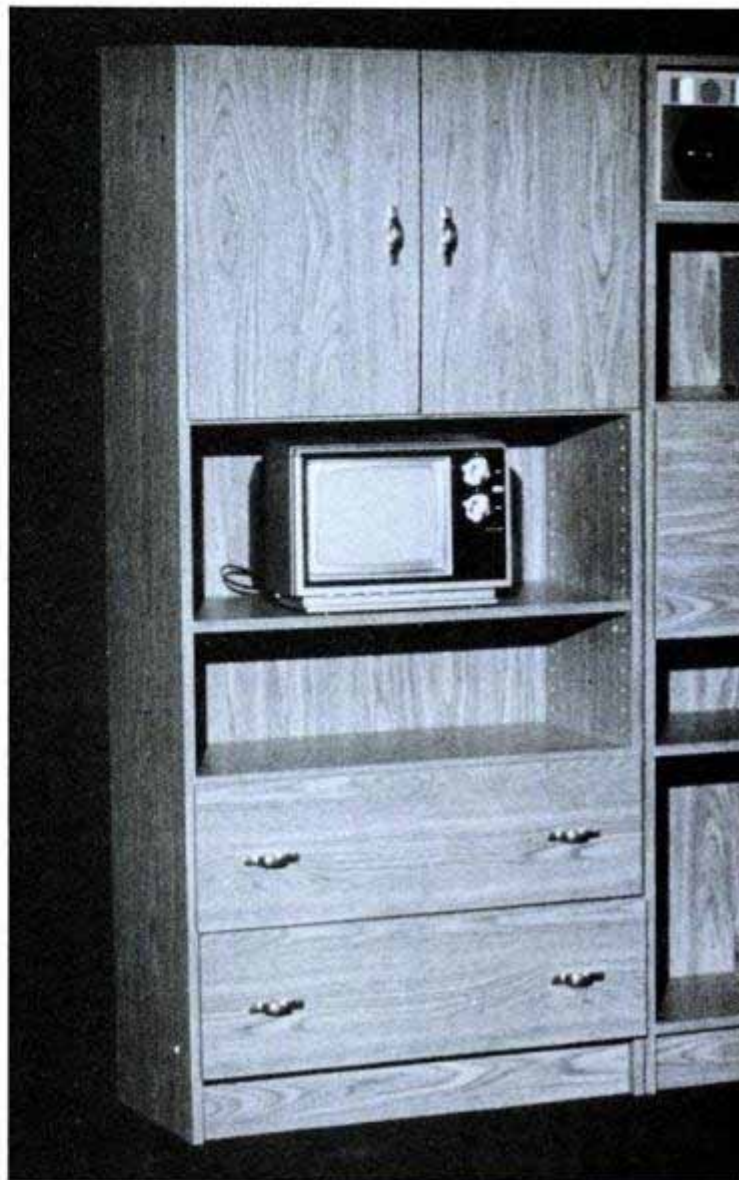
Here's a look at what's available in the world of manufactured bookshelves—plus a bookcase to build in a weekend.

TEXT AND PHOTOGRAPHS BY WILLIAM BEYER

When you're looking for book shelves to buy you have a wide choice of options. On the one hand, there are elaborate factory-built cases which provide everything from book storage to a place for the TV, stereo and your record collection. These tend to be fine pieces of freestanding furniture and are expensive. On the other hand, there are very simple, and relatively inexpensive, wall-mounted shelving systems that nearly everyone can install. In between are all kinds of kits that come in various stages of assembly.

To begin with, you don't have to go the costly route of the factory-built bookcase to get a similar look. In its 1983 fall and winter catalog, Sears offers a system (shown above, right) that appears factory-built, but you assemble it with only a screwdriver. A 72-in.-high bookcase with five 30-in.-wide shelves in a wood grain finish costs about \$125. An 18-in.-wide unit, the same height, runs about \$100.

For a radically different look, you can get a steel utility shelf system, either in standard gray or a wide variety of decorator colors. The Hirsh Co. is one manufacturer of these attractive and economical bookcase/storage systems. They work equally well in a shop or a child's bedroom, as shown in the photo at right. These units measure 30 × 30 in.—either 12 in. or 16 in. deep—and can be stacked to create wall units 60 in. high. A single unit sells for about \$15 to \$20 depending on depth. These systems do come

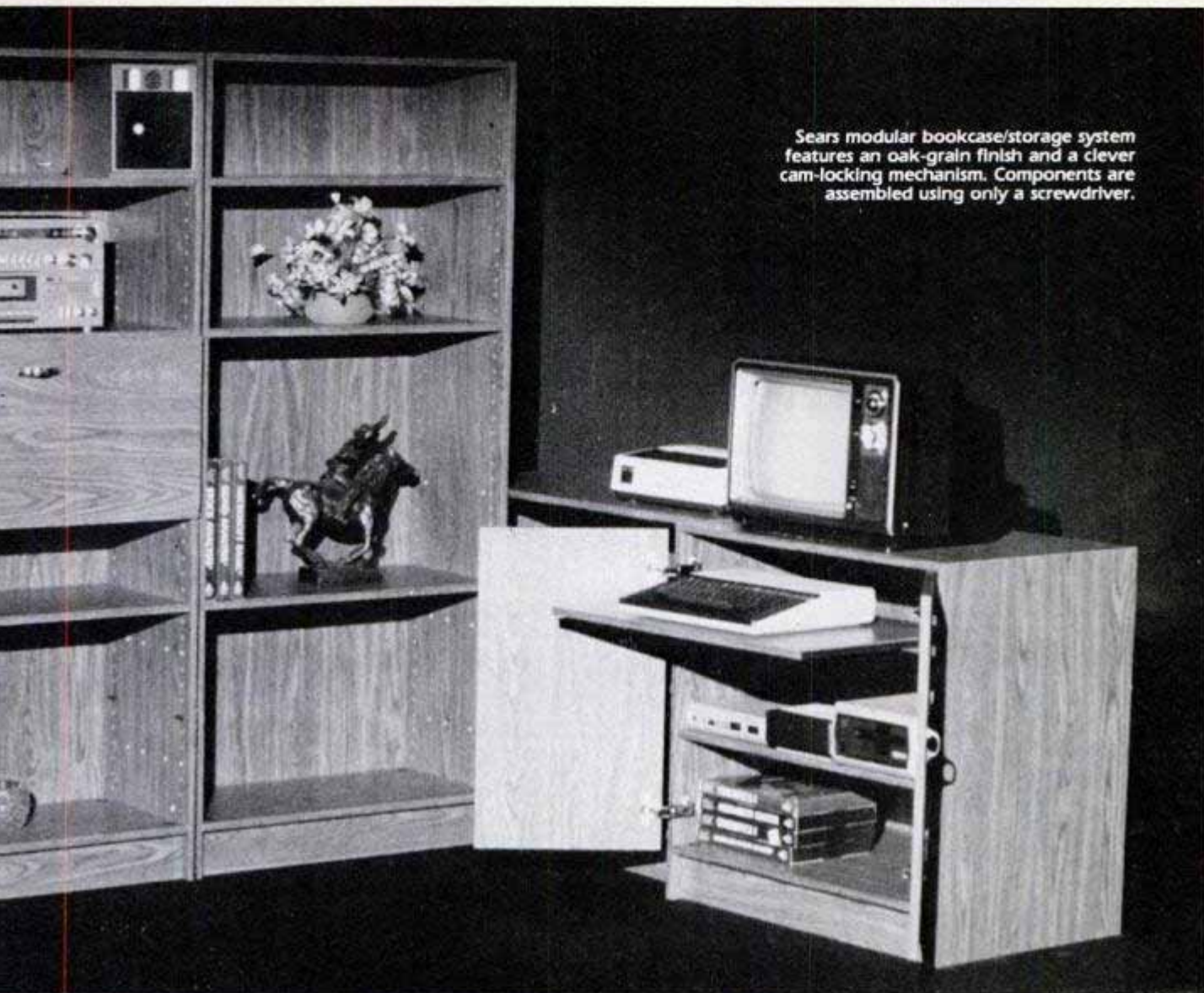


Flair Fold wood shelf and brackets (left) attach directly to the wall. A metal fitting, set into the back of each bracket (right), can slide easily over the two wall-mounted screws.

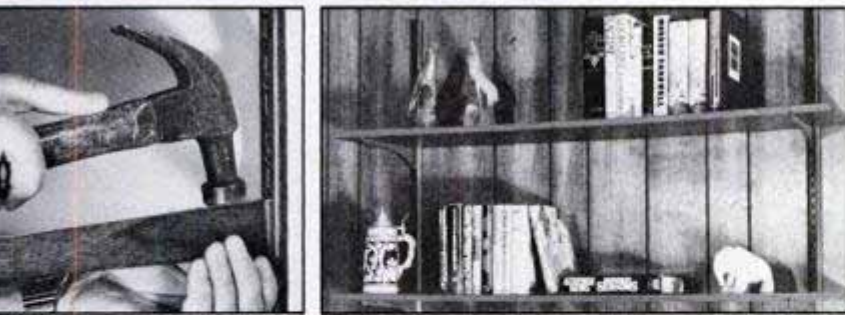
unassembled, but they are easy to put together with the nuts and bolts provided.

Another easy-to-assemble bookcase is shown on page 130. This system, made by Knappe and Vogt, uses special brass clips to join the case sides, top, bottom and shelves. These clips come in right angles to form corners, tees which join the shelves to the case sides and crosses to support shelves alongside interior vertical dividers.

The clips are sold separately at hardware stores and home centers that carry the manufacturer's Melatex shelf boards. The clips fit either 5/8-in.- or 3/4-in.-thick boards, so you can make your own shelving from hardwood or plywood stock and just buy the clips to join them. The unit



Sears modular bookcase/storage system features an oak-grain finish and a clever cam-locking mechanism. Components are assembled using only a screwdriver.



Steel standards with brackets (right) feature fully adjustable shelves. In order to install the brackets, you first insert the end keys into the standard's slots and then tap them in place with a hammer (left).

shown uses $\frac{5}{8}$ -in.-thick by 10-in.-wide Melatex boards which range in price from about \$5 for a 24-in.-long shelf to \$15 for a 72-in.-long shelf. The clips let you customize your bookcase to suit your own needs.

All you need for assembly is a tack hammer and the $\frac{7}{8}$ -in. brads that are sold with the clips. This system is so easy to construct that you can do it right in the middle of your living room floor. Just make sure the boards are tight to each other before installing the clips. When you have completed the assembly of one side, carefully turn the whole unit over, attach the clips on the other side, and you're done.

Bookcase kits are another shelving option and they are [\(Please turn to page 130\)](#)



Hirsch's easy-to-assemble steel shelving is available in a variety of attractive contemporary colors.



Finishing touches go on Sky-line's double-wide manufactured house before it heads to its site.

PM's Complete Guide To Prefabricated Housing

We offer some insight into the types of factory-built houses and their differences, and we add a surprise or two.

BY JOHN H. INGERSOLL

Savings can really add up when you build a house on your own. But if you build from scratch, the work can be overwhelming. However, there is another way: a prefabricated house. With a prefab unit, instead of cutting every board on the job, that part of the work is done for you in a factory.

When you build your own prefabricated house, you can reduce your total investment by up to 50 percent. You'll surely save between 30 and 40 percent over a built-for-sale, stick-built house. However, house construction is arduous and time-consuming. Once it is completed, though, building your own house is probably one of the greatest thrills you'll have.

If you complete only those construction steps about which you feel confident and subcontract the rest, you can save 10 to 30 percent. Act as the general contractor and savings will fall in the 5 to 10 percent category.

There are other advantages in opting for prefabrication:

■ **Speed**—Contract with a builder for a panelized or pre-cut house and you'll probably move in sooner than the three months normally needed to build a conventional house. Order a modular or

manufactured house (a double-wide, for example) and once site work and foundation are completed, you'll get as close to an "instant house" as any system offered today.

■ **Professional help**—Opt for contracting your own house, and you'll get help. Suppose you hire framers to erect the shell of a pre-cut house. Before you ask



Several men following the stacking plan of a pre-cut log house can assemble the unit in a few days.

for bids, the manufacturer arms you with facts on how many men can erect the shell in how many days.

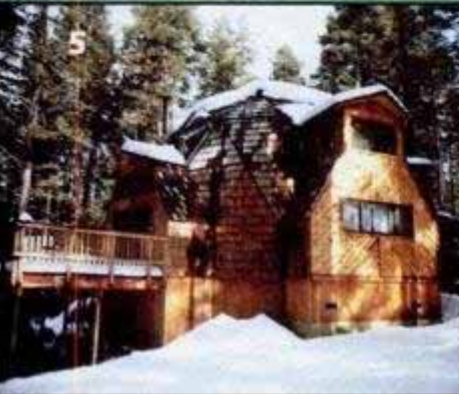
■ **Wide selection**—Almost any style you've seen or imagined is yours for the asking. Compared to builder model houses, which could number 100 in an

average metropolitan area (plus 200 to 300 variations on paper), there are well over 4,000 styles and sizes of prefabricated houses to be seen in catalogs from the 250 or so major makers of pre-cut, panelized, modular and manufactured residences in the United States. And there may be another 100 designs in Canada.

■ **Customizing**—Design fees for a custom house are less than those a residential architect would charge. Architects, on the average, receive \$50 to \$75 per hour, or they charge on the basis of a percentage of the construction cost. Nearly every maker of panelized or pre-cut housing is willing to design and fabricate whatever house you want. If all you demand is a slight change, there's no charge. A substantial alteration of a model may require plan changes and a small fee.

Buyers take advantage of this option. A 1982 profile of Pre-Cut International Homes buyers revealed that only 3 percent chose a stock plan, while 48 percent worked with the company to produce a custom plan and 49 percent ordered a modified stock model house.

There are three basic variations of prefabricated houses:



- 1 House from Real Log Homes affords spacious living. Guest room and bath are over the garage.
- 2 Panelized house called the Cottage by Acorn includes solar roof collectors and a solarium.
- 3 Manufactured house by Champion has wood siding, shingled roof and a concrete foundation.
- 4 Modular house made by Cardinal contains three bedrooms, two baths, family room and garage.
- 5 This dome house made by Monterey Domes features customized push-outs and a wooden deck.
- 6 Precut house by Lindal had its origins in a stock model, but then struck far off on its own.

Panelized housing is the granddaddy of prefabrication. Today, panelization refers essentially to finished or partly finished wall sections. The sections usually are 4x8 ft. and include plates, studs and sheathing. Windows, doors and roof trusses are also usually in the package. Some firms ship panels finished inside with insulation and dry wall.

Two men can assemble house walls in a few hours over a finished foundation and subfloor. Once all the prebuilt portions are in place, plumbing, heating, wiring, baths, kitchen, lighting and applying finish materials proceed as they do in a stick-built house.

Precut housing begins as wrapped bundles of cut-to-fit studs, plates, joists, headers, beams and so on. Each wood member is numbered or lettered. The same code designation appears on the working drawings. Referring to the drawings, the builder or owner/builder determines where every piece goes. Once the framing is finished, the precut home is completed in the same way as a stick-built house.

Modular and manufactured housing is 90 percent factory built. A foundation is prepared on the site. When the house or house sections arrive, there are utility connections to make and, for more

than one section, sealing the housewide butt joint. Otherwise, everything is assembled, installed and finished in the factory. House sections are lifted from the road or truck bed and placed over foundations by a heavy crane.

Common questions

Do prefabricated housing companies have national building code approval of their products? Yes. Few prefabricated housemakers would stay in business without approval. That doesn't mean

Prefabricated houses can be easier to build than stick-built houses.

every local building department accepts factory construction without a personal review.

Don't building plans require a local architect's seal for approval? In rare cases, yes. The fee may run between \$200 and \$400. But the vast majority of building departments accepts the seal of the engineer or architect employed by the prefabricated house producer.

Don't many communities bar manufactured (mobile) homes? Yes. Although the number is declining, some

communities in every state refuse to grant zoning variances for what many still call a "trailer park." Many times there are pragmatic reasons, such as the loss of tax income (most mobile homes are taxed as personal, rather than real, property). But in some cases prejudice is also involved.

Isn't it more difficult getting mortgage money to buy or build a prefabricated house? Buying a completed prefabricated house brings you no more hassle than buying any new house. However, general contracting or building on your own will turn up some lender resistance toward handing out a construction loan (see *Financing A Prefabricated Home* on page 115).

How much do shipping costs add to the price of a prefabricated house? You can calculate between \$75 and \$250 per truck for the first 50 miles, and \$1.25 to \$1.50 per mile per truck after that.

At what distance do shipping costs grow uneconomical? Not many homebuilders buy packages from a factory more than 300 miles away. For individual buyers, the story is different. Acorn Structures plant manager Henry Millette says the company has been shipping houses to the Boulder, Colo., area for some time. For a two-truck load,

that's \$3,600 away from the Acton, Mass., plant. Milette says, "Buyers figure they get a custom-designed house without a \$6,000 to \$8,000 architect's fee, so the shipping cost is worth it."

Do prefabricated houses save more energy, less energy or about the same as stick-built houses? Except at sites outside the jurisdiction of building departments, all houses today must meet an energy conservation standard. All prefabricated housing is built to meet or exceed these standards, no matter where they are shipped. A number of companies push beyond prescribed levels. Standard walls for a Lindal Cedar house are rated at R-21.14; ceilings at R-33.3. In addition, Lindal and Acorn have developed passive solar options. Acorn also has an active solar package.

Nine factory-built types

Here is an alphabetical list of the types of house packages and complete homes sold today. Most are variations on precur houses, the type most easily adapted to do-it-yourself construction.

1. A-frame—This design spread quickly in vacation areas and is occasionally found in suburban locations. Some were built on site. Many were prefabricated.

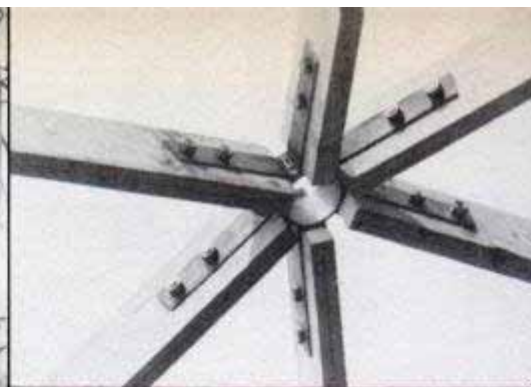
Today, perhaps a half-dozen companies produce precur and panelized parts for A-frames and modified A-frames. Modified versions will use the "A" as a core from which additions extend.

2. Do-it-yourself—A lot of precur housing. Do-it-yourself companies sell to owner/builders. A smaller number market exclusively to build-it-yourself people. Two of these companies, Curtis Homes and Miles Homes, make construction loans at below-market interest rates to buyers. In some cases, Miles will finance the foundation.

To get construction money from Curtis, you sign for a "complete-it-yourself" program. After the foundation is in, a Curtis crew erects a weathertight shell. You take over at that point and complete the house. Miles delivers the house package for you to build from the foundation up.

All companies contacted in the do-it-yourself group provide a detailed construction manual and full working drawings, and offer help if you get stuck, either through a local company rep or dealer or via a toll-free phone number.

Styles include ranch, split-level, split-entry and two-story in traditional or contemporary designs. Everything to finish the house is available from the companies, either standard or as an option. Owners finish their homes in an average of six months to two years. Company officials claim that less than 2



The basis of this dome's framework is the triangle, which is repeated six times around each hexagon (left). An example of dome hardware (above) is Timberline's steel straps. They are welded to a center ring and sandwich each wooden member.



With a swing of the crane arm, Cardinal's house module moves from truck bed to foundation. Patented system allows the module to be lifted by its ridge pole.



A package from Pre-Cut International contains lumber marked by hand or machine-stamped on the production line. Marking designates location in house frame.

Quick Key To Prefab Housing Terms

A-frame: Any house with a front elevation that resembles the legs of an "A." Its sidewalls and roof are the same.

Conventional construction: Any house built on site, using lumber cut on the job.

Dome home: Modeled after R. Buckminster Fuller's geodesic dome, this house uses precur wood framing, steel connectors and bolts in a web of triangles.

Double-wide: A mobile/manufactured house, factory-finished in two sections over a chassis. It is towed to the site and connected, side by side, to form a ranch style house up to 32 ft. deep.

Expando: A single-wide mobile/manufactured house with an addition transported inside the main house body. At the site, the addition is pulled out.

Factory-built: See prefabricated.

Kit house: At minimum, a package of precur, house-framing members with detailed assembly instructions. At maximum, every part to build a complete house.

Log house: A house having outer walls assembled with debarked, precur, notched logs, usually included as part of a kit.

Manufactured house: Modern term for a mobile home, a factory-completed house on a chassis, hauled to its site.

Mobile home: A term widely used for a manufactured house. "Mobile" belies its use, since 96 percent remain permanently on the site to which they are first towed.

Modular house: A factory-built house, completed in several large sections (roof in place), following conventional construction standards and shipped on truck-hauled

flatbeds to a site where the sections are connected over a prebuilt foundation.

Panelized house: A house assembled with prebuilt wall sections on a 4x8-ft. module. It often has floor and roof sections and roof trusses. It is shipped flat in panels.

Pole house: A house supported on pressure-treated wood poles driven into the ground below frost level. This technique is used often for difficult sites (slopes, shorelines).

Precur house: A house for which all framing lumber has been factory-cut to size and numbered.

Prefabricated: A broad term defining any house construction step completed in a factory environment. The word applies equally to prehung doors and entire houses completed under a factory roof.

Sectional house: A definition predating "modular house" but still used by some. To confuse the issue, some sales people apply the term to double-wides.

Single-wide: A manufactured house not less than 8 ft. by 40 ft., or 320 sq. ft.

Stick-built: Conventional construction.

Trailer: A camper. Also, a term applied to manufactured houses before 1945.

Triple-wide: A manufactured house assembled from three prebuilt sections usually, but not necessarily, parallel to one another. House depth is up to 42 ft.

Truss: A fundamental part of many prefabricated houses, a truss is made up of framing connected to make the whole substantially stronger than any individual member, called a chord. Trusses are most often used to support a roof.



The interior parts of this house, such as the stringers, treads and banister of the staircase, are delivered cut and ready for assembly. Later, stairs will be carpeted. This precut house was made by Lindal Cedar Homes, which is in Seattle.



Careful eave and rake detailing, which includes precut dentils, is designed into this panelized house to give it a custom look. The house is by National Homes.

percent of the buyers fail to finish.

3. Dome houses—Domes are another form of precut housing and are built as much by owners as by builders. Most dome packages include steel connectors, steel straps, precut wood framing, hardware and precut plywood sheathing. At least one firm, Timberline, sells only the connectors, straps and hardware, since it's cheaper to buy the lumber locally.

For hardware, framing and close-in materials, package prices range from \$4,000 to \$50,000. House sizes are from 600 to 3,000 sq. ft. A second dome can be added to make a cluster. One maker, Cathedralite, says that two unskilled couples can erect and close in dome framing in six to 14 hours. Of course, the time-sapping work on any house is finishing, not framing.

4. Log houses—Another offshoot of the precut system are log structures. These houses have spread from the backwoods to suburban communities. About half of the log packages sold are assembled wholly or in part by owners. Logs are debarked, trimmed, pressure-treated, cut to size for the house plan and notched.

A package usually includes logs for exterior walls, hardware, prehung windows and doors, framing lumber for

roof, detailed plans, a construction manual and a half-day to a day of on-site technical assistance.

Log walls are not conventionally insulated. However, a recent National Bureau of Standards (NBS) study confirmed the argument log housemakers have used consistently: Log walls do more than insulate naturally, they retain heat and release it during nights and cloudy days. Officially, the average log wall rates between R-12 and R-13.

One- and two-story log house models are sized from 600 sq. ft. to nearly 3,000 sq. ft. and are priced as packages from \$10,000 to \$40,000. Interior log walls are cut flat. Exteriors show the natural log shape, except a new style from Lincoln Logs Ltd. in Chestertown, N.Y., which is indistinguishable from lap siding.

5. Manufactured houses—Still trying to shake the pejorative use of "trailer," the manufactured, or mobile, house industry has made a great deal of progress. In many cases, no one can tell a manufactured house from its stick-built neighbor. Called double-wides and triple-wides, houses take shapes as varied as conventional housing.

Today's single-wide—the familiar ci-
(Please turn to page 158)

Financing A Prefabricated Home

When you buy a conventional stick-built home, your financing worries begin and end with qualifying for a mortgage. However, financing is a bit more complicated with a prefabricated home that you are building. Besides finding mortgage money, you must also line up a construction loan to pay for materials, labor and other expenses.

Getting a construction loan can be relatively easy if a professional contractor is building your home. But if you plan on doing most or all the construction on your own, prepare for some stiff resistance. "In general, banks don't like to lend to owner-builders," says Peter Hart, senior vice president of New England Log Homes Inc. Lenders fear the do-it-yourselfer will get in over his head, leaving the bank stuck with a loan on a hopelessly botched, unfinished shell. To combat this, prepare yourself before you visit a lender:

First, obtain a site plan showing where your home will stand. Your land should already be approved for building by local authorities. If you own the land, it can serve as equity for the construction loan.

Second, have detailed specifications for the home. Most makers provide blueprints and spec sheets so the lender can determine the quality and value of the home.

Third, have cost estimates for every phase of construction. Show labor and materials costs for everything from the foundation and subfloor system to plumbing and electrical work. And include interior finishings and fixtures. Usually, the

home manufacturer will provide you with all or most of these estimates.

If the banker knows a dealer will be providing technical assistance and consulting during construction, he's more apt to make the loan. Sometimes, the banker may insist you hire the dealer or another professional as a general contractor to oversee the job.

Once you've convinced the lender you're a good risk, he'll usually make a construction loan equal to 80 percent of the total cost of your home and land. The interest rate on the loan generally is pegged a few points above the prime rate. The term usually runs from six months to a year, but you only pay interest during that time. The entire principal is due at the end of the term.

It simplifies matters if you get the construction and mortgage loans from the same lender. This way the construction loan simply converts to a mortgage. However, some lenders won't make both loans.

Some home manufacturers offer construction financing themselves, and at better rates and terms than banks. Curtis Homes, for instance, currently gives customers two-year construction loans at the bargain rate of 10½ percent. Curtis also postpones interest payments during the first four months of the loan, although interest does accrue during those months.

To find out what financing assistance, if any, various manufacturers offer, contact the Home Manufacturers Council of the National Assn. of Home Builders (1-800-

368-5242, extension 576) and ask for a list of members serving your area.

Manufactured homes, also known as mobile homes, are a slightly different case. Here, the problem isn't finding a construction loan (mobile homes are only sold completely built), but finding a conventional mortgage.

Until recently, virtually all mobile homes were financed with relatively short-term installment loans of 10 to 15 years. But in a major breakthrough in March 1983, the Housing and Urban Development Dept. made mobile homes eligible for the FHA Title II program. This gave mobile home buyers access to the same 30-year, FHA-insured mortgages used for stick-built homes. There are two conditions: The mobile home must be on an approved permanent foundation and it must be financed along with the land on which it sits. If it is, you can get a loan of up to \$67,500 with a downpayment of just under 5 percent. Lenders also have begun to make long-term mortgages under a Federal National Mortgage Assn. program.

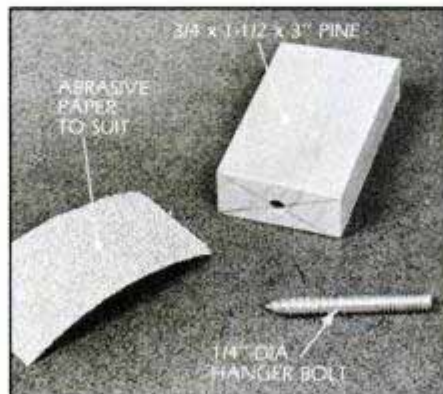
Several Veterans Administration and FHA Title I programs provide attractive loans with low downpayments even for mobile homes not placed on permanent foundations. For information about VA and FHA rates, downpayment requirements and maximum loan amounts, write to the manufactured Housing Institute, (see the source list on page 159) and ask for *Quick Facts About The Manufactured Housing Industry*.—Walter L. Updegrave

10 Carpentry Tricks From A Master Craftsman

1 JIGSAW SANDING



Mount the sanding block in saw's lower chuck. Remove blade guide for easy access.



The sanding block is ready for assembly. Note the block's centerbored pilot hole.

You may be aware of the jigsaw's versatility as a cutting tool, but with this easy-to-make attachment, it can perform sanding operations as well.

Insert the wood-screw threads of a 1/4-in.-dia. x 2-in. hanger bolt into the end of a 3/4 x 1 1/2 x 3-in. wood block. Then, use rubber cement to glue abrasive paper to both faces of the block. Glue coarse grit on one side, medium on the other. Or use adhesive-backed paper such as 3M's Press'n Sand.

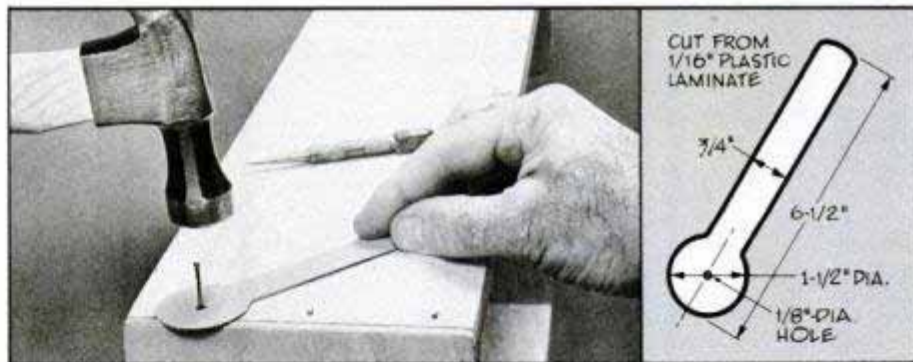
For sanding, place the protruding machine-screw threads in the saw's lower chuck. Use different-shaped blocks for specific sanding operations.

2 DIMPLE-FREE NAILING

Prevent accidental hammer dimples on wood surfaces with this handy protective shield. Cut the shield from 1/16-in.-thick plastic laminate and bore a 1/8-in.-dia. centered hole as shown.

To use, start the nail, then place the shield over the nail. Hold the shield flat against the workpiece face and drive the nail until it's flush with the laminate.

Remove the shield and use a nailset to drive the projecting nailhead flush with or below the workpiece surface, as desired.



3 TRUING BOARD EDGES



Steer the saw along a straightedge guide. Arrows indicate unevenness in board edges.

To successfully edge-glue two boards, their mating edges must be perfectly true. Dressed lumber is rarely purchased with edges that are suitable for joining. However, here is a quick and foolproof method that you can use to true the edges of any two boards—simultaneously.

Clamp the boards with their mating edges butted together tightly. Then, using a straightedge guide and a portable circular saw, cut straight through the center of the joint, removing stock from both boards.

If the gap between the boards is wider than the saw kerf, repeat the procedure as many times as necessary to close the gap. The result will be two straight and true mating edges that will produce an "invisible" joint.

About The Author

This is the eighth installment in a series of shop technique articles by master craftsmen. Each article reveals time-tested shop secrets and techniques used by craftsmen to achieve professional-looking results in their workshop projects.

This installment's craftsman is Rosario Capotosto. No stranger to PM readers, Rosario has been contributing his wealth of knowledge to our pages for more than 10 years. His vast experience encompasses more than 30 years of writing how-to woodworking articles and books.



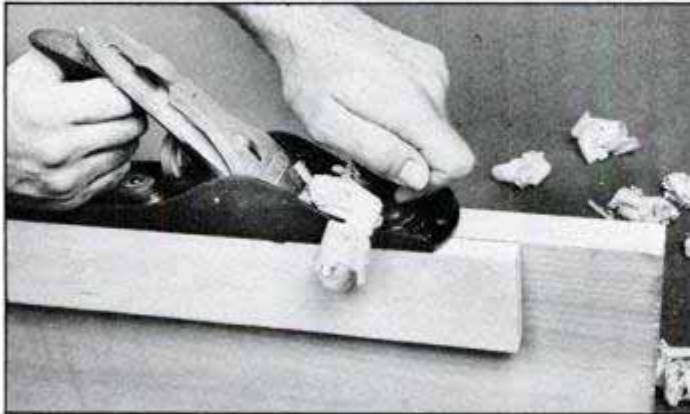
4 PLANE GUIDE

This simple bench plane guide can aid you in planing perfectly square edges. Choose a square-edged piece of $\frac{3}{4}$ -in. stock for the guide and cut it 3 in. longer than the plane. The guide's width often is determined by the job, but a $2\frac{1}{2}$ -in. width will be sufficient for

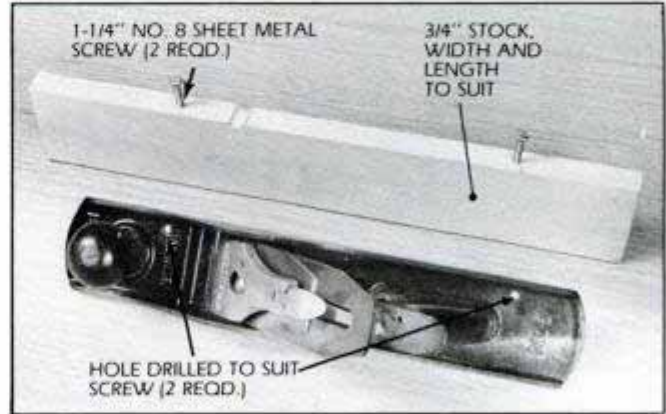
most work. Cut a $\frac{1}{8}$ -in.-deep \times $\frac{1}{2}$ -in. notch in the guide's top edge. The notch will allow the guide to clear the protruding plane iron (blade) and sit flat against the plane's bottom. Next, bore two $\frac{3}{16}$ -in.-dia. mounting holes through the plane's base. Attach the

guide to the plane with two $1\frac{1}{4}$ -in. No. 8 sheet-metal screws.

To use, simply keep the guide flat against the workpiece's face while planing. The plane will cut perpendicular to the guide thus forming a square edge.

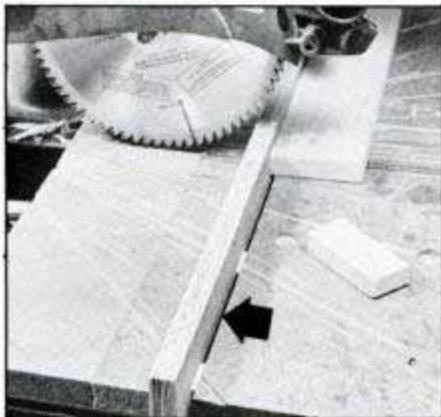


During planing, keep the guide flat against the workpiece's face.

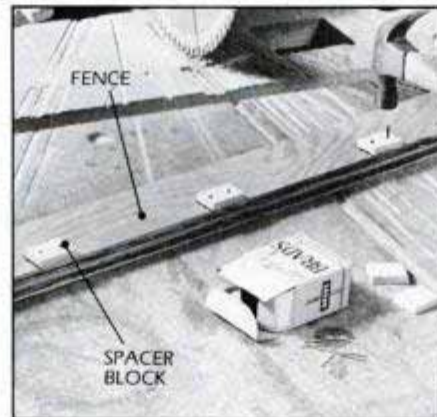


Here's the guide prior to mounting. Note the iron-clearing notch.

5 RADIAL SAWDUST SLOT



Spacer blocks between the fence and the worktable create a sawdust slot (arrow).



Nail spacer block to the fence every 6 in., but not directly under the saw-blade path.

Sawdust that collects along a radial-arm saw fence can cause inaccurate cutting. The sawdust forms small mounds that prevent the workpiece from abutting the fence tightly. To eliminate this problem, provide a sawdust escape slot between the fence and the worktable.

Make the sawdust slot by nailing $\frac{1}{8}$ \times $\frac{3}{4}$ \times 1-in. softwood spacer blocks along the fence. Place the blocks 6 in. apart, but don't put one directly under the saw-blade path. Position the fence on the saw with the spacer blocks facing forward. Tighten the fence lock knobs and be sure the spacer blocks are below the worktable's surface.

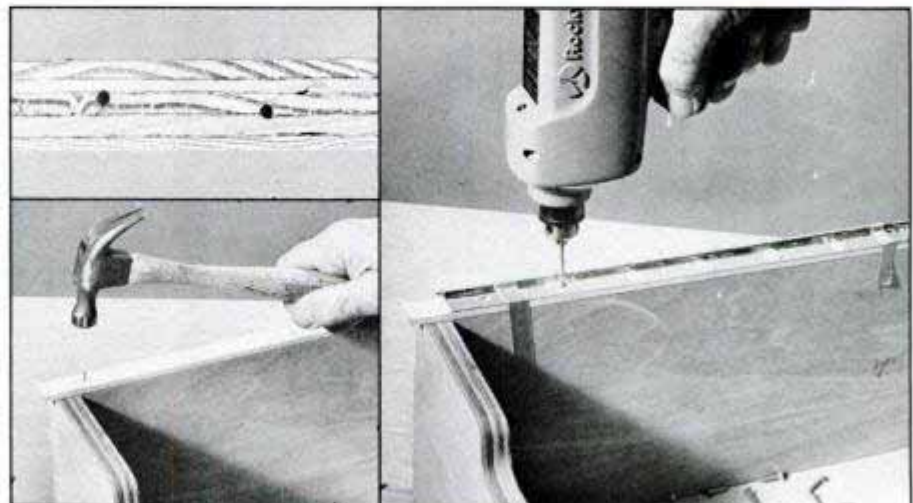
6 HINGING A PLYWOOD EDGE

Boring straight pilot holes into the edge of fir plywood for a continuous hinge can be tricky. The drill bit often is deflected off course when it hits a glued joint, a dense knot or a void in the plywood's edge.

To solve this problem, nail a $\frac{1}{8}$ -in.-thick pine reinforcement strip to the plywood's edge. Then tape the hinge in place over the pine strip. Punch screw-hole center marks and bore pilot holes through the strip and into the plywood edge. The pine strip will serve to support the drill bit and keep it straight. Remove the strip before installing the hinge.

This technique is also useful for installing other styles of hinges and hardware on delicate surfaces.

(Please turn to page 134)



Prevent deflected drill bits (upper left) by nailing a pine strip to the plywood's edge (lower left). Tape the hinge in position and then bore the pilot holes (right).

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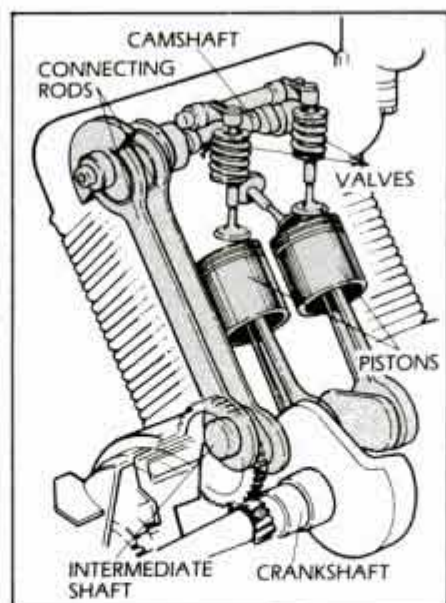
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AUTOMOTIVE ODDBALLS (Continued from page 85)

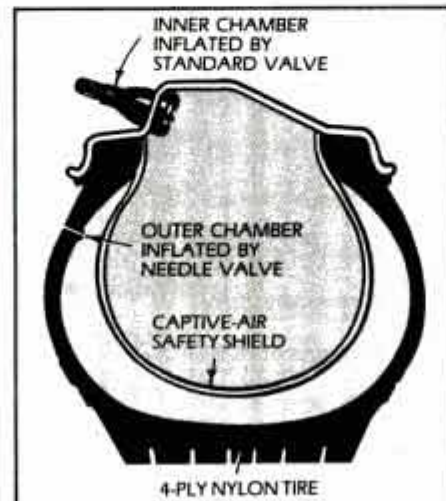


NSU Prinz was the last car sold in the U.S. to use connecting rods to turn the camshaft.

pulled the camshaft around, too. The NSU Prinz of the 1950s was one of the last cars sold in the United States with that design.

Dyna-starter—The NSU Prinz also had a combination generator (dynamo) and starter, a carryover from the 1930s. If you apply battery current to a generator, it will run as an electric motor. The NSU used a relay to apply the current, running the unit as a starter motor. When the engine started, the Dyna-starter was driven as a conventional generator.

Antifreeze suspension—Over 20 years ago, British Motor Corp. (now British Leyland) introduced a combination spring and shock absorber called Hydro-Lastic. The spring was a rubber cone on top of a cylindrical metal housing divided into two chambers. The bottom chamber had a rubber diaphragm that rested against a tapered piston.



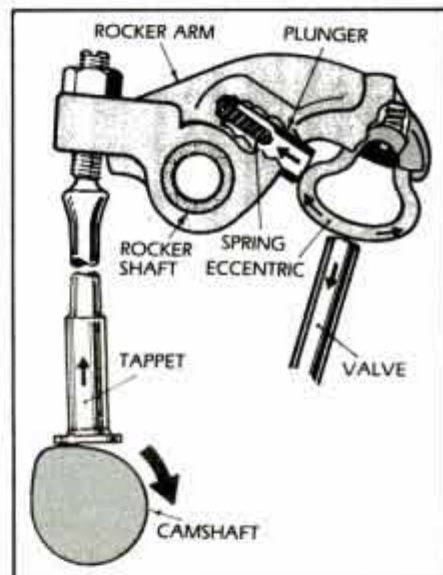
Goodyear's Captive-Air safety tire sported a treadless tire inside of a normal tire.

Both chambers contained an antifreeze solution.

When the car hit a bump, the piston pushed on the diaphragm, forcing the antifreeze up, opening a rubber valve and admitting antifreeze into the upper chamber at a controlled rate. A tube from the top chamber of each front unit was connected to the top of a rear unit, so when the front hit a bump and the antifreeze flowed into the top chamber, some continued through the tubing to the rear unit, where it caused the body to rise in anticipation of the bump.

This was supposed to stabilize the ride on some cars, but it affected the handling on others, so some models did not have the interconnecting tubing. In recent years the rubber spring was discarded in favor of a sealed assembly filled with nitrogen, but the system is still in use.

"Rubber band" automatic transmission—Back in 1959, a Dutch car called



Spring-loaded plunger in Ford's Silent-Lash rocker arm took up any valve-train play.

the Daf appeared with a strange automatic. Instead of clutches, gearsets and fluid, it had front and rear pulleys with rubber belts wrapped around them. The pulleys were a split design that could spread apart or come together, forcing the belts up or down in the pulley grooves. This changed their working diameter—the equivalent of changing gear ratios.

This type of transmission design is called a CVT (for continuously variable transmission) and it's now made by Volvo of Holland, successor to Daf. Early belts could transfer only a small amount of power, and still had a short life. They're much improved today and CVTs made by GM, VW and others are expected in the next few years, some of them using metal link "belts."

The Japanese approach

Now that the Japanese are major car producers, they have their own unique approaches, such as:

The shaking radiator—The radiator on the new Mazda 626 is mounted in rubber, and the top mounts have enough clearance so the radiator can shake a bit to absorb the idle roughness characteristic of small, transverse engines. The manufacturer says: Fear not, the radiator won't shake apart and you'll appreciate the smoother idle. Is he right? We'll have to wait and see.

Technology sometimes comes too fast. GM's early automobile diesels were so troublesome, few want a GM diesel today.

The turbos introduced in the late 1970s suffered from acceleration lag, engine knock and oil coking, and nearly went down the drain. Now the problems appear to be solved and they're back.

Engine computers continue to have problems, but they're the only realistic way to meet today's emission and economy standards, so they stay.

Perhaps the least popular new technology is the talking car. We take orders at work and at home and really don't want to get them from the car. Even with a new politeness, the talking car hasn't been winning over the public and hopefully won't last much longer. Some models now have "mute" switches so you can make them shut up without vandalism.

Has some piece of modern automotive engineering that's not on our list really turned you on...or given you fits? Write to us about it in a letter addressed to Auto Oddities, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. **PM**

PM'S TIRE TEST

(Continued from page 97)

track, you spend most of your time sliding around.

After two days of testing, the Powerstreaks were literally ready for the scrap yard, while the radials were just nicely broken in. Even though Goodyear's least expensive radial costs 75 percent more, you'll more than get your money back in superior tread life and improved fuel economy. The Powerstreak II is probably the best bias-ply tire ever built—but that's like introducing a new, improved Model T Ford. Admirable, but who needs it?

P195/75R14 Custom Polysteel

The Custom Polysteel must have been designed as the ultimate standard equipment tire for Detroit sedans. It's (Please turn to page 122)

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More Than Expected: "This machine pays for itself by making money out of scrap boards. It is a very well built machine and I confess it is more than I expected for the price. It does everything you say it will!"

Stephen Schultz, Orangeville, Penna.

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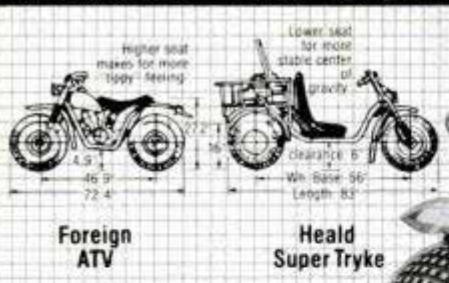
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INNER TUBE BOAT

(Continued from page 93)

across the front of the frame. Two machine-threaded lag studs with wing-nuts and washers secure it. Let the ends stick out beyond the frame to support your feet comfortably.

A plywood lid covers the milk crate/battery box. The seat mounts on the lid or, if you use a low-to-the-ground folding beach chair as we did, its frame may be wide enough to rest directly on the side rails. We hinged the cover to the center 2x4 cross member and cut out a rectangle on the hinge side so the motor could be clamped over the cross member and the front end of the box. Put the hinges at the front so you can lean back in the chair without tipping back into the water.

The smallest electric trolling outboard you can find powers the float boat more than adequately. We used a Mercury Thruster II which does the job very well indeed. The battery—we put it in a marine battery case to keep it dry—fits in the milk crate under the lid, so you need a slot for the power cord and the cutout for the mounting clamp.

Since the whole purpose of the inner tube bass boat is convenience, we assembled ours with wingnuts for easy takedown. With the tube deflated, everything but the motor, side rails, lid and footrest fits in the milk crate and all of it goes in most car trunks easily.

Seat will need adjusting

Make a trial assembly at home, but do not attach the seat permanently until the boat is in the water. You will almost certainly want to move it fore or aft to trim the somewhat top-heavy craft. Besides a rope to secure it, don't forget to bring an air pump to expand the tube once the frame and motor are in place. Blow the tube up to a good size before locating the seat. We used nails clinched over the aluminum frame of the beach chair before installing permanent clamps with screws.

Accessory equipment built into your tube boat should include a couple of eyebolts fore and aft on each rail plus a cleat for an anchor rope. A short length of plastic pipe is a good rod holder.

The boys' original design called for tying the frame to the tube, a good idea. But we found that adding a bit of air to increase stability and carrying capacity expanded the tube to the point where it locked the milk case firmly in place. In fact, you had to assemble the boat and install the motor before adding extra air or you couldn't put it together.

Even though you'll be plying calm waters and probably shallow ones most of the time, a life vest or flotation jacket is always a good idea.

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PM'S TIRE TEST

(Continued from page 119)

inexpensive, long-wearing, has adequate performance in almost every area and—a big factor when you're trying to achieve a 27.5 mpg/Corporate Average Fuel Economy (CAFE) average—spectacularly low rolling resistance.

But the 195/75R14 Custom Polysteel was slower around the road course than the bias-ply Powerstreak II, and the 205/70R14 Custom Polysteel was okay at low speeds, but virtually uncontrollable in the slalom test. It wanted to break away viciously at the slightest provocation, and was downright dangerous when driven near the limit. Our drivers' notes on both tires contain comments like "difficult to control," "scary" and "severe understeer."

Indeed, the only incident we had during two days of testing was when the Custom Polysteels suddenly lost traction at 60 mph during the slalom. The resulting slide was enough to snap the lugnuts right off the studs on one wheel. Our test driver was treated to a scary series of 360° spins as the brake drum dug into the pavement and the left rear wheel went rolling past him.

The difference between these tires, which we think are difficult to control, and others in this group is much greater than our test figures might indicate. On a race track, with lots of run-off room in case he makes a mistake, an expert driver can force a tire into going fairly quickly. If you try the same thing on the street, you'll end up on your neighbor's front lawn . . . or worse.

P205/70R14 Custom Polysteel

The 205/70 is the same tire as the 195/75R14 Custom Polysteel, just 10 centimeters wider and slightly lower in profile. And that was borne out in our test results. The wider tire has greater rolling resistance, but the extra rubber on the road made it faster through the slalom, faster around the skidpad and better in braking.

On the other hand, these 205/70s were the slowest of all around our road course, and a handful at all times. They work fine until you reach their limits of adhesion, then they suddenly lose traction and slide without warning. Our testers found them very difficult to control . . . to the point of being dangerous. As one tester wrote, "I wouldn't have these tires on my car!"

P205/70R14 Arriva

The Arriva is Goodyear's "all-season" radial, meant to go in rain and snow as well as on dry pavement. As you might expect, this dual-purpose design entails some compromises. For example, its blocky tread gives the Arriva very poor rolling resistance and

poor traction in dry testing. But surprisingly, the Arriva was also fifth on the wet skidpad. A second in wet braking was its highest score. And the tread wore out almost as quickly as that on the Powerstreak II.

While we couldn't test it, even Goodyear admits the Arriva doesn't give as much traction in deep snow as a real snow tire. All in all, the Arriva comes across as a typical committee design—not outstanding at anything.

P205/70R14 Eagle GT

The Eagle GT wasn't the widest or most expensive tire in our test. But while it was poor in rolling resistance and wet braking, it was second in acceleration, the slalom and wet skidpad, and first in the dry skidpad, road course and dry braking. Judged simply by the numbers, this is the best all-round tire in the group.

But it's even better than that. As one of our testers wrote in his log, "This is the best all-round tire I've ever encountered for street driving . . . easy to control, nice smooth ride, phenomenal cornering limits. It's the best tire for this car in this test."

The Eagle GT even has a supernatural ability to mask deficiencies in the car itself. Our nose-heavy Trans Ams understeered severely when equipped with lesser tires; the Eagle GTs made them corner like well-balanced European GT cars. Switching from mediocre tires to Eagle GTs is like switching from a Sears .410 to a custom-made Purdys 12-gauge shotgun. You can feel the difference.

Of course, there are trade-offs. Each Eagle GT lists for \$114.50—nearly twice as much as a Custom Polysteel. But the child in the road you might brake to avoid on Eagle GTs, you might hit on Custom Polysteels. The drunk you might swerve and miss on Eagle GTs, could put you off the road on Custom Polysteels.

Granted, a set of Eagle GTs lists for \$164 more, but you can buy them through discount mail-order tire dealers for only \$100 a set more than Polysteels. We think that's a small price to pay for the additional safety, performance and feel. As another tester wrote, "This is a great tire—the one I'd buy for my own car."

P205/70HR14 Eagle GT

We had great expectations for the HR Eagle, a European-style, high-performance tire which Goodyear considers the *creme de la creme* of its tire line—with a \$121 price tag to prove it. But as one tester wrote, "A disappointment. . . . Mediocre performance at a premium price." The HR Eagle finished behind the less expensive Eagle GT in

(Please turn to page 124)

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RADAR REPORTER

If you're the sort who notices legends in the making, you've seen what car magazines have been saying about ESCORT. "All things considered, the ESCORT is the best piece of electronic protection on the market," concluded *Car and Driver*.

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ESCORT even uses a separate warning tone for each radar band. "Beep" for X band, a more urgent "brap" for K band because you have less time to act. And always, there is the meter for quick visual verification.

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Another problem with most detectors is false alarms. They sound off so often you're never sure if it's radar or something else. And recently the problem got even worse.

Some short-sighted marketers began importing cheap detectors from overseas. But these units had a slight problem. They *transmitted* radar signals on both radar bands, setting off all detectors for up to a mile away.

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PM'S TIRE TEST

(Continued from page 122)

every test except rolling resistance. It did poorly in both wet and dry braking, and no better than second in the high-performance tests on the dry skidpad and road course. Based on our testing, we'd say the HR Eagle is overrated—more expensive, but not as good as the Eagle GT.

P215/65R15 Eagle GT

This is the standard tire on the Firebird Trans Am, so, quite naturally, we expected it to perform well in our test-

ing. And it did, winning four tests, compared to only three wins for the narrower 205/70R14 Eagle GT. It was surprisingly slow through the slalom, however, poor in braking and slower on the road course.

The 205/70R14 turned in a more consistent performance, and has to be ranked as the better tire overall.

On the other hand, the wider 215/65R15 felt just as good... neutral handling, smooth ride, easy to control. It also fills up the wheelwells nicely—an important consideration for Detroit stylists.

As one driver noted, "You can see

why Pontiac picked it as their OEM tire." This cuts both ways. Presumably, Pontiac's suspension engineers spent long hours fine-tuning the Trans Am to take full benefit of this tire.

P245/60R15 Eagle steel GT

These huge doughnuts certainly look impressive, but their 7.91-inch tread was just too wide to work on the Trans Am's street suspension. Under hard cornering, you could feel the car get up on the shoulder of the tire, slide, fall back on the tread, get up on the shoulder again, slide, ad infinitum. In the final analysis, they were significantly slower than the 205/70R14s in almost every test except the slalom, where our rapid transient maneuvers left no time for weight transfer and suspension movement to lift the tread.

If you could tune your car's suspension to keep this wider tread in contact with the pavement at all times, these tires would be faster around a corner. Realistically, you wouldn't want to drive the hard-riding, hard-steering result unless you were a confirmed masochist. A racing suspension—and a wide, racing-type tire—is just too specialized to function successfully on the street.

What we learned

Goodyear was right. Every tire is a compromise. But so is a passenger car. In both cases, what you want is the best possible performance over a wide variety of conditions, not exceptional performance in one area at the expense of everything else.

When it comes to cars, this means that a Firebird is more useful for everyday driving than either a Model T or a Formula One Ferrari.

When it comes to tires, this means that Goodyear's P205/70R14 Eagle GT is the finest passenger car tire of those we tested. It's an excellent value for the money, will outperform tires that are both cheaper and more expensive, is easy and forgiving to drive and has tread that will breeze through 50,000 miles.

Equivalent tires available from other manufacturers include Firestone's HPR, Goodrich's Comp T/A and Pirelli's P6.

All too many people say, "I don't need expensive tires on my old station wagon. My wife just uses it to drive the kids to school." That's just our point. There really is a difference between cheap rim protectors and a high-performance tire like the Eagle GT—a difference that could save your life, or the lives of your wife and kids. An extra \$100 or \$200 spread over four or five years is a small price to pay for that safety. Your driving pleasure and peace of mind will come for free. **PM**



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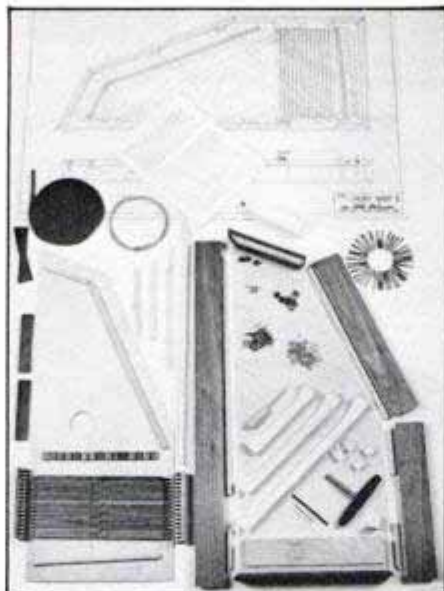
2 Chord harp

Carl Dudash's chord harp was, for me, the most satisfying of the kits to complete. Thanks in part to the traditional hand-painted soundboard (an extra cost option at \$70), it probably is also the most pleasing to look at.

A special glue mix supplied with the kit (cherry or walnut frame, spruce soundboard) proved easy to work with and reasonably quick-setting. There is great stress on the chord harp's frame, so the clenching nails must be carefully set and the glue joints must be nearly perfect. *Caution:* Glue the soundboard during a period of average humidity. More than 100 various-sized holes must be bored to make this harp.

Dudash's instructions are not only detailed, but even supportive. I did, however, position the lettering on the opposite side suggested so it wouldn't be obscured when reaching the chord bars. The inexperienced should work slowly—it will take them every bit of 30 hours to complete.

The chord harp is primarily an instrument for accompaniment. It has a



Dudash Chord Harp II kit includes comprehensive instructions, a precision drawing, special glue and all parts needed to produce this multistringed instrument.

unique, nostalgic sound that takes to a variety of playing styles. Even a beginner can strum along with folk ballads in a few minutes' time.



Shim the principal soundboard brace from underneath before you glue on the chord harp soundboard. This will prevent the brace from deflecting and making poor contact.



Precise positioning and depth (note flag on drill bit) are critical when boring the over 100 holes needed to complete the kit.

3 Teardrop dulcimer

Folkcraft Instruments' mountain dulcimer in the traditional teardrop style is almost an exercise in instant gratification. (Hourglass-shaped models are also available.) The instrument is made entirely out of walnut, which gives it a rich look even though the sides, back and top are uniformly thin sections.

The dulcimer's prenotched end blocks serve as a jig that determines its basic shape, although you can vary it to your taste somewhat with a little pressure. A shaping tool like the Stanley Surform will help you put this instrument together in no time. Be sure to clean up glue beads, or an oil finish, which looks great on this instrument, will carry streaks.

You set your own frets in presawn slots. Be sure to take the sharp edges



End-piece jigs force the teardrop dulcimer into its standard shape. You can make small adjustments by hand to help the symmetry when you glue the sides to the bottom.

off with a file and emery paper. The peg head extension is traditionally carved into a scroll. To do a good job requires care and patience.

The dulcimer's sound is not big, but it has a great folksy quality derived from "drone" strings which make it sound like a plucked bagpipe. With some experimenting, you can pick up melodies almost by instinct. It is easier to play than other fretted instruments.

(Please turn to page 126)

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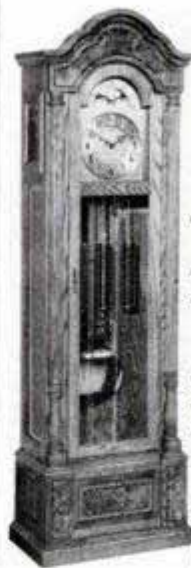
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INSTRUMENTS FROM KITS

(Continued from page 125)

4 Hammered dulcimer

The trapezoidal frame of the hammered dulcimer, also from Folkcraft Instruments, is even more heavily braced in its interior than the chord harp.

The instructions are somewhat sketchy, though, so take the time to refer carefully to the drawings and follow the specified order in fastening and gluing joints.

The tuning peg holes are prebored, which saves a good deal of work. But be careful that you don't let finishes or wax get into them. Otherwise, the pegs will slip.

The spruce soundboard is more than twice as thick as those you'll find on most instruments. The reason for this is so that the hammered notes will not be overly sustained and run together disagreeably.

According to the supplier, you can use any decoratively shaped sound hole without affecting the tone or volume of the instrument.

If you should choose a circular hole, as I did, the thicker soundboard will permit you to use a half-round file to give it a nice bevel. Make sure you use a properly sharpened chisel when slicing screwhead covers from the plugs of cherry supplied.

The hammered dulcimer was the real tonal surprise in this quartet of instruments.

This particular instrument has a haunting sound reminiscent of gypsy music. You can play it either with the wooden hammers supplied, or with padded ones. The simplest melodies seem quite profound. **PM**

SUPPLIERS— INSTRUMENT KITS

■ **Diamond Eagle five-string banjo:** \$479 from Stewart-MacDonald Mfg. Co., Box 900, Athens, Ohio 45701; (800) 848-2273. Add \$70 for pre-fretted and pre-inlaid neck; \$75 for optional hand-engraved armrest and \$25 for engraved tailpiece. Shipping additional; free catalog.

■ **Chord harp:** \$210 cherry frame or \$220 black walnut from Carl Dudash Harpsichords, 11 Jewel St., Enfield, Conn. 06082; (203) 749-8800. Add \$95 for hand-painted soundboard. Partial kit for experienced woodworker includes only hard-to-find wood parts, all hardware, \$97.50. Postpaid prices; free brochure.

■ **Teardrop dulcimer:** \$59.95 walnut or \$49.95 cherry from Folkcraft Instruments, Box 807, Winsted, Conn. 06098; (203) 379-9857. Shipping additional; free catalog.

■ **Hammered dulcimer:** \$220 with cherry outer case or \$240 with walnut outer case from Folkcraft Instruments (address above). Playing stands available at \$60. Shipping additional.

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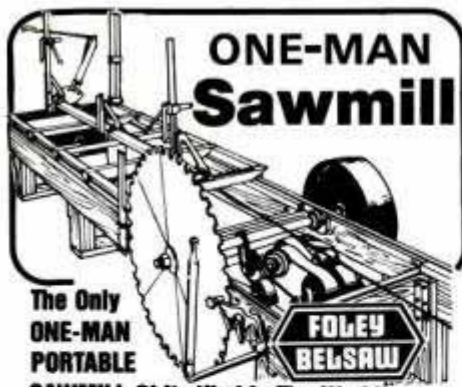
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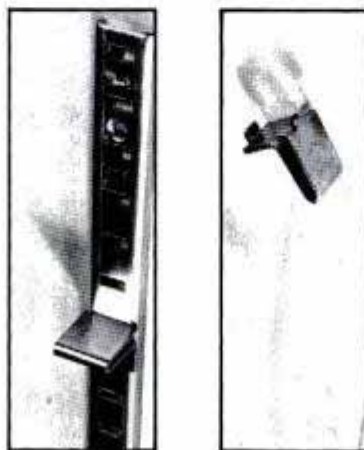
BOOKSHELVES

(Continued from page 111)

available in a variety of furniture styles. One that I especially like is shown on page 110. It's called the Barrister bookcase kit and is made by Craftsman's Corner. This case is a stacking unit system that features glass panel doors which swing up and slide back into the case for complete access to the books. All the screws, nails, brads and sandpaper you need are in the kit. You supply glue, a few clamps and some hand tools.

Wall-mounted shelving

There are basically two types of wall-hung shelving—those that use wall-



Steel standards and clips like these are used to make shelves adjustable inside cabinets and bookcases. Two standards and two support clips are required at both shelf ends.

mounted standards to support the shelf brackets and those that use the brackets attached directly to the wall. Probably the most common and versatile system features standards made of U-shaped metal channels which are slotted over their entire length. Metal support brackets fit into these slots and lock into place perpendicular to the standards. An example is shown on page 111. These brackets, in turn, support shelf boards of your own making or the prefinished shelf boards from the same manufacturers. Keep in mind that it is best to use standards and brackets from the same maker because not all these systems are interchangeable.

Standard and bracket sizes

Standards are generally available in 12-, 24-, 36-, 48-, 60-, and 72-in. lengths; brackets come in 6-, 8-, 10-, 12-, and 14-in. widths. The prefinished shelf boards match these bracket sizes and are in lengths from 2 ft. to 6 ft.

The second type of wall-mounted system features brackets that are attached directly to the wall, with the standards eliminated. Probably the most common shelf of this type is Flair Fold's prefinished wood brackets and shelf board shown on page 110. These



Knape and Vogt's bookcase kit features prefinished shelf boards that are joined by brass clips. Matching brass brads for installing the clips are included in the package.

are available in different styles—from colonial to modern—and prices vary from about \$15 for a 9 × 24-in. shelf to \$30 for a 9 × 60-in. shelf.

Wall-mounted brackets are also available in steel with black, brass or chrome finishes. Stanley Works, Knape and Vogt, and National Manufacturing all make these types. They also manufacture the prefinished shelving to match the brackets.

Not as flexible

Keep in mind, however, that the wall-mounted bracket system is not as flexible as the standard and bracket system. With the latter you can relocate the shelves anywhere along the standards simply by moving the brackets. But with the wall-mounted brackets, the entire assembly has to move if your needs change. This means screw holes to patch and paint retouching to match the rest of your room.

The screws that accompany either system are long enough to penetrate drywall or plaster and reach into the studs behind; they are usually 1½-in. No. 10 screws. When driven completely into pine, these screws can hold more than 300 pounds. But because only about ¼ in. of the screw actually holds in the stud, the capacity is reduced to about 100 pounds. Therefore, it's important to fill every mounting screw

(Please turn to page 132)

SOURCES—BOOKSHELVES

- Craftsman's Corner Inc., 4012 Northeast 14th St., Des Moines, Iowa 50302 (oak furniture kits).
Flair Fold Inc., 75 Carman Rd., East Farmingdale, N.Y. 11735 (prefinished pine brackets and shelf boards).
The Hirsh Co., 8051 North Central Park Ave., Skokie, Ill. 60078 (steel utility shelf systems).
Knape and Vogt, 2700 Oak Industrial Dr., Grand Rapids, Mich. 49505 (standards, brackets and laminated-finish shelf boards).
National Manufacturing Co., Sterling, Ill. 61081 (standards, brackets and laminated-finish shelf boards).
Pluswood Inc., 1145 Oshkosh Ave., Oshkosh, Wis. 54903 (laminated-finish shelf boards).
Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60694 (screwdriver-assembly wall bookcase systems).
The Stanley Works, 195 Lake St., New Britain, Conn. 06050 (standards, brackets and laminated-finish shelf boards).
Weyerhaeuser Co., 2525 South 338th, Federal Way, Wash. 98002 (printed particleboard screw-together bookcases).



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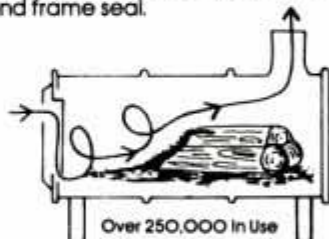
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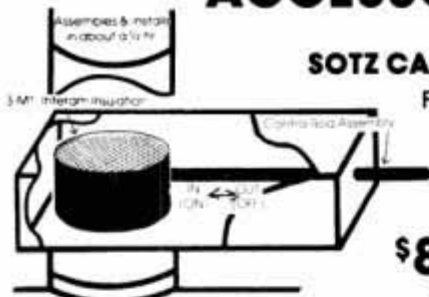
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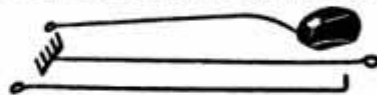


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WOODSTOVE TOOLS	FACTORY PICK-UP	DEL. TO YOUR DOOR
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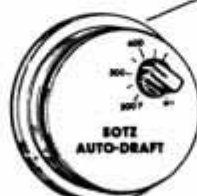
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BOOKSHELVES

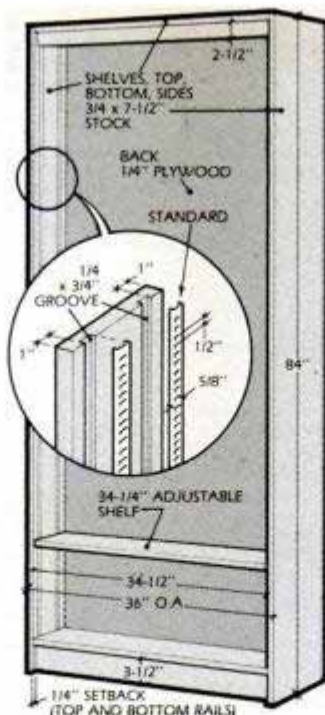
(Continued from page 130)

hole on the brackets or standards, no matter what weight you are planning to put on the shelves.

Of course, care should always be taken with regard to the weight stored on a wall-mounted system. For instance, one foot of record albums stored in their jackets weighs about 45 to 50 pounds, while a similar length of hardbound books weighs only about 10 pounds. So, if you are planning on storing very heavy items on your shelving, make sure to hit at least one stud on short shelves and two or more studs on shelves that are 32 in. or longer.

Bookcase to build

One kind of easy-to-make bookcase that requires no special skills is shown at right. These shelves are 7½ in. deep to accommodate most hardbound and paperback books. All that's required is cutting the boards to the sizes, then assembling the parts with glue and finishing nails. The grooves for the shelf standards can be cut with either a router or a dado head in a table saw prior to assembly. If you don't have these tools, mount the standards on the inside surface of the case sides and reduce the overall shelf length by ½ in. **PM**



This easy-to-make unit features construction methods that can be applied successfully to almost any bookcase. The fully adjustable shelves are supported by recessed standards and clips, while the plywood back keeps the unit square and helps attach the case to the wall.



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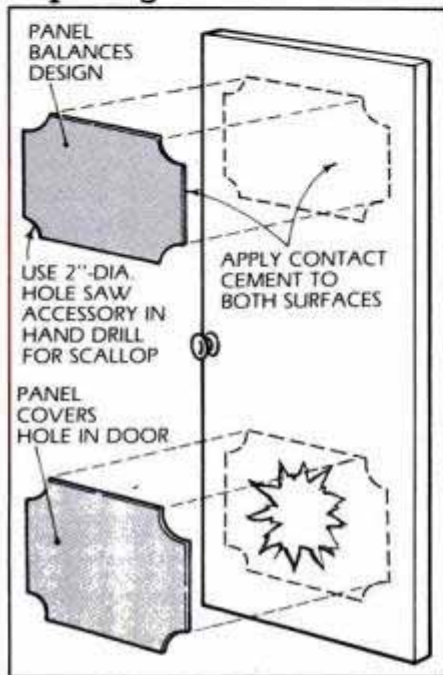
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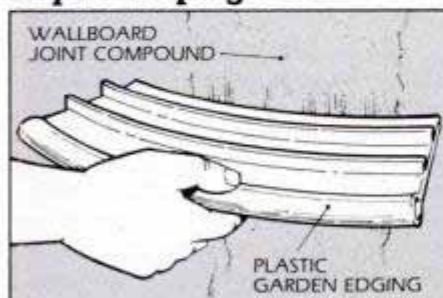
HINTS FROM READERS

Repairing hollow-core doors



On a table saw, cut out panels from old doors that are too damaged to repair. Shape decorative patches from this salvaged material for use over holes in repairable doors. Shape similar panels as needed to balance the effect of the repair patch. You can make a decorative scallop in the corner of each panel with a 2-in.-dia. hole saw accessory. Secure the patches with contact cement.—*Joseph Miller*

Drywall taping tool



A flexible piece of plastic garden edging helps spread joint compound on gypsum wallboard after the tape is in position. The flexible lip gives enough lift to level the second coat and feather its edges.—*Howard Hornik*

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The materials in our kit may be better than those used in the original *Swift*. The keel section and frames are pre-cut plywood, ready for quick assembly. The *Swift's* hull is planked twice; once with thick, flexible limewood for strength, then overlaid with planks of African walnut for lasting beauty.

You won't have to make the fittings—we've done that for you. Our kit contains ready-to-use blocks and deadeyes of rare, yellow boxwood. We include eyelets, bracers and belaying pins—over 70 parts of solid brass! Even the cabin door hinges are brass, as are the 250 miniature nails you'll use to fasten the plank-



ing to the hull and deck. And, since the original wooden *Swift* had no plastic parts, our kit doesn't either—*anywhere!*

Creative? And how! Overwhelming? Not a bit! But be prepared for hours of the most challenging, engrossing, relaxing fun you've ever had.

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We want to introduce you to this great hobby, now! So we've made it easy for you to get started.



Our special offer includes the *Swift* kit plus all the tools you'll need to build her: miniature pliers, hammer, knife, file, tweezers, sandpaper, glue, wood oil, and more. You'll also receive a free copy of Richard Mansir's "How to Build Ship Models," a 64-page beginner's guide. You don't have to buy anything else. The tools normally cost \$15; the book retails for \$7.95. But they're yours, FREE when you buy the *Swift* kit at its regular price of \$39.95 (plus \$4 handling and insured delivery).

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10 TRICKS

(Continued from page 117)

7 CUTTING RINGS

Cutting solid rings using a sabre saw or jigsaw is time-consuming. But with a multiple-blade hole saw and a drill, you can cut perfectly round rings quickly and easily.

Mount two blades in the hole saw's toolhead at the same time. Select two saw blades that will produce a ring of the desired thickness and diameter. This technique works with both a portable electric drill and a drill press.



Cut rings by using two saw blades at once.

8 TURNING SMALL DIAMETERS



Place dowel in drill and contour with file.

Here's a way to turn small-diameter, decorative finials and spindles on a drill press.

First, select the desired diameter wood dowel and chuck it in the drill press. Then, using a variety of files, rasps and abrasive tapes and cords, contour the dowel to the desired shape. Use very fine grit abrasive paper for the finishing touches.

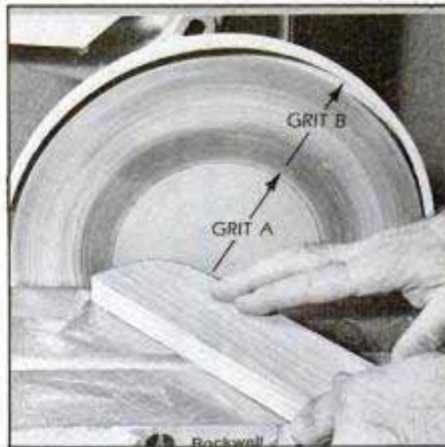
For best results, run the drill at its highest speed.

9 DOUBLE-DUTY DISC

Unless you happen to have two disc sanders in your shop (an expensive luxury), switching from rough to smooth sanding requires changing the discs. But this trick provides you with two different sanding surfaces on one disc sander.

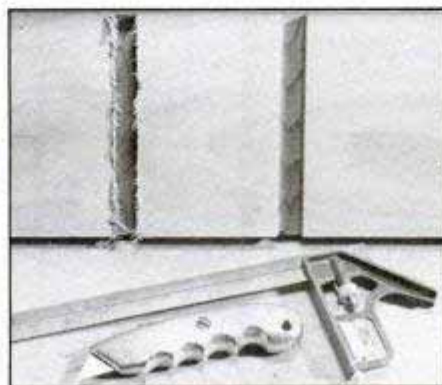
Using a circular template and a razor knife, simultaneously cut out the centers of two sanding discs—one coarse grit, one medium.

Glue the outer ring from one disc and the center portion of the other to the disc sander. Now you can sand both rough and smooth finishes on the same machine. Use the cutoff pieces in reverse order when it's time to replace the sanding surface.



Glue sections from two different abrasive grits for both smooth and rough sanding.

10 'SPLINTERLESS' DADOES



Change splintered dados (left) to smooth dados (right) by scoring the lines-of-cut.

Cutting dados will often tear and splinter the crossgrain on a piece of wood. This is especially true in the case of plywood veneer.

To prevent this, score two lines just outside the lines-of-cut with a sharp razor knife. The scored lines will allow the wood's grain to "break off" cleanly as the cutting tool passes by. The result is "splinterless" dados and a more professional-looking joint.

This technique is effective with all varieties of dado-cutting tools, including routers, shapers and either radial-arm or table saws fitted with dado heads.

FM

REDECORATE WITH A BOOKCASE WALL

(Continued from page 109)

in the order they'll go up against the wall. Before standing up the left or right box (depending on which way you've decided to do the installation), remove any room moldings that might interfere with a flush fit, and transfer the measurements for locations of wall outlets to the backs of the boxes. Cut openings through the backs so the receptacles and wall plates can be remounted on the backs after installation.

Move boxes into position

As you move each box into position, fasten it to its neighbor using 1 1/4-in., No. 6 fh wood screws driven through the box sides. Countersink the screw heads and fill the holes with wood filler. When all boxes are fastened together, secure the boxes to the walls using 3-in. No. 10 fh wood screws driven through the case sides and backs and into the wall studs. Two or three screws per unit should be plenty if you hit the studs soundly.

Next, cut and attach the cabinet rails (J) between the stiles. Use glue and 6d finishing nails driven into the shelf behind. Set the nailheads and fill the holes with wood filler. Glue veneer tape to all the plywood edges that will be exposed.

You can now attach moldings around the stiles using 1-in. finishing brads. Headboards and footboards can be installed at this time. Use 6d finishing nails and glue. Set the nailheads and fill the holes.

Baseboard molding can go on now, too (unless you are planning to lay wall-to-wall carpeting against the unit, in which case you should wait until the carpeting is installed).

Priming and painting

Now, before installing the cabinet doors and the crown molding, is the time to paint the unit, the doors and the molding. Begin by sanding the entire case with 220-grit sandpaper. Remove the dust with a vacuum and tack cloth. Before applying two coats of Benjamin Moore Satin Impervo Enamel CB-64, we primed the unit, doors and molding with Moore's enamel undercoat with one-half CB-64 tint. (The walls were done with Moore's Regal Wall Satin CB-59, a color slightly lighter than CB-64.)

The cost of materials for a bookcase wall of our dimensions can be kept between \$600 and \$700, including the cabinet door hardware we chose. The hinges are the Ajax 5990AB self-closing type. Moldings are pricey—\$1 a ft. for the ceiling crown, for example—so if you're redoing the room while build-

ing your bookcase wall, it would be a good idea to budget about \$800 for the project.

Install the cabinet doors using a 1/16-in.-thick piece of wood—or a scrap piece of plastic laminate—between the left and right doors of each box. This leaves just enough room for smooth opening and closing. If your doors are a little too tight for the opening, sand the edges where they meet for the proper clearance. If they are a little loose, use shim scrap behind hinges on the left

and right sides to achieve the dimensions.

You'll find that packing books wall to wall in your new addition will give the room too much of a library or lawyer's office look. Needed relief can be provided with small lamps in one or more compartments and the use of framed prints and other favorite objects.

Now, just enjoy the fun of arranging your things, organizing your books and using the phenomenal space that a bookcase wall gives you. **PM**

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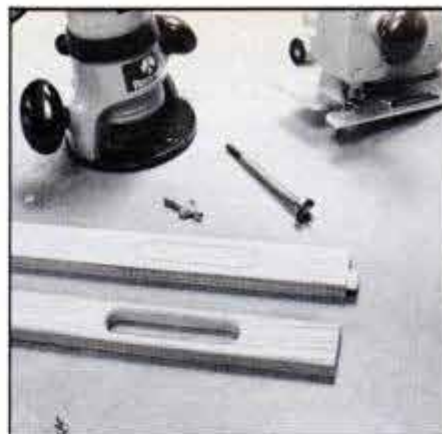
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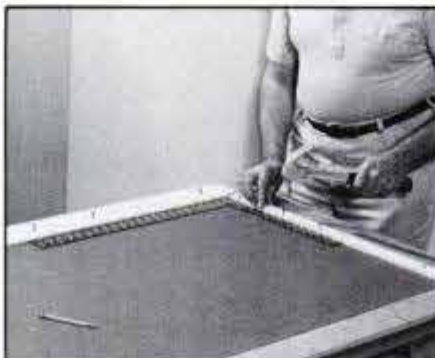
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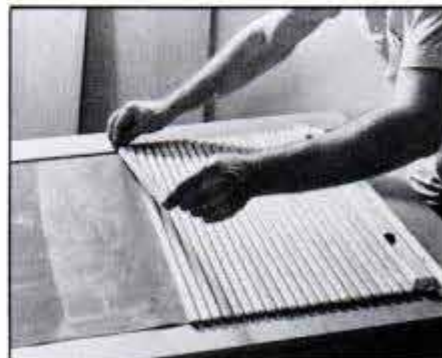
Round over slats using molding cutter in table saw. Tape scrap board—with 10° edge bevel—to fence to prevent slat from tipping. Featherboard applies side pressure.



End slat is made from two boards. Bore two holes in outer piece for each finger grip, cut out waste between and round outside edges with router. Glue and clamp together.



Lay canvas on flat surface and nail wood strip along one edge. Nail second strip over canvas end at a right angle. Pull canvas tight. Nail third strip over far end.



Apply contact cement to canvas and tambour slat, then hold slat with one end up and butt shoulder of slat rabbet against guide strip. Lower slat onto the canvas.

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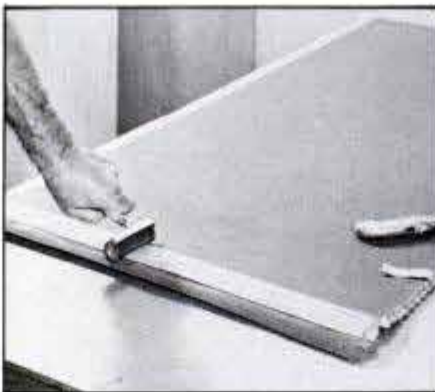
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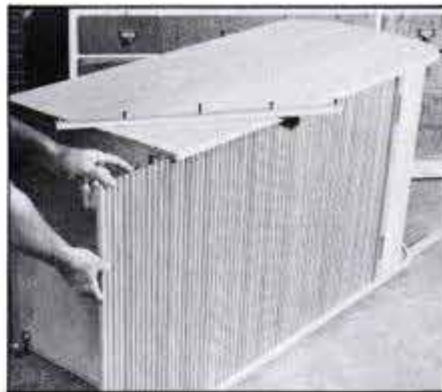
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When tambour is complete, glue a strip of oak veneer onto back side of end slat to conceal canvas. Use contact cement and roll smooth. When dry, cut off waste canvas.



Wax tambour edges and cabinet grooves, then slide assembly into grooves working from the back of cabinet. Screw—do not glue—tambour stop onto bottom of cabinet.

and finish-sand all parts. Use slow-setting hide glue to assemble the cabinet because you'll need at least 1/2 hour to get all the parts positioned. Check for square and clamp overnight.

Cut the keyboard shelf panel and apply the plastic laminate. Glue on the side trim boards and install the drawer slides as shown in the drawing. Next, measure the cabinet opening for the lower doors and make any necessary adjustments to the door measurements to conform precisely to your cabinet.

Keep in mind that the doors are attached with knife hinges and are held

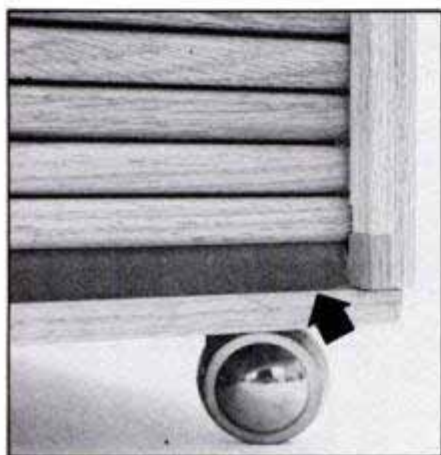
closed with magnetic touch latches, so door pulls are not required. Also the hinges are mortised only into the door edges, not into the cabinet. It's easier to cut these mortises before the edging is glued to the plywood panels. Cut the strips to size and use a straight router bit, chucked in a drill press, to make the 1/16-in.-deep cuts.

The tambour for this cabinet is big, consisting of 66 slats plus the finger-pull slat at the end, and it's heavy. In order for it to function properly, all pieces must be made and assembled with great accuracy. Because of its

length and weight, the tambour should always be opened with care. *Never let it slide freely down the back.*

Begin by measuring the distance between the two tambour grooves throughout the entire groove lengths. If any discrepancy exists, base your slat measurement on the tightest spot. Then deduct $\frac{3}{16}$ in. from this length to determine the finished slat dimension.

Both sides of each slat are beveled 10° . To do this, use a planer blade in a table saw and begin by making a bevel cut on one edge of your stock. (Be sure to joint the stock first so you have a straight edge to start with.) Next, set the rip fence for a $\frac{3}{4}$ -in.-wide cut and feed the board into the blade with the previously beveled edge running against the fence. Continue ripping the slats, alternately turning the board end



Glue rubber bumper (arrow) along top surface of tambour stop using contact cement. Bumper prevents damage to the slats if tambour is opened too quickly or dropped.

over end so that each pass will result in the double bevel on each slat.

When all slats are ripped, tape a scrap board with a 10° bevel to the rip fence as shown, then use a table saw molding cutter to round over the outside face of the slats. (The scrap board will keep the slats from tipping over.) Also, be sure to clamp a featherboard in place as shown. You should always use a push stick.

Finish-sand the slats on all sides. Then apply a finish to the individual slats before assembly. Apply one coat only to the rabbet surface and none to the bottom of the slat.

Medium weight (10-oz.) acrylic canvas was used to join the slats. It's available at most dry goods stores. Hold the material up to the light. If light passes through, the cloth is too porous for a good bond: It will allow the contact cement to bleed through.

Cut the canvas to width, $\frac{1}{8}$ in. narrower than the slat length from rabbet shoulder to shoulder. Lay it on a flat work surface, then tack a $\frac{1}{4}$ -in.-thick guide strip along the length of the cloth.

(Please turn to page 138)

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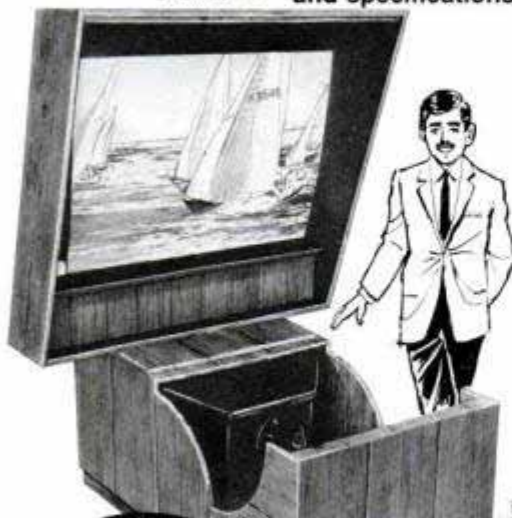
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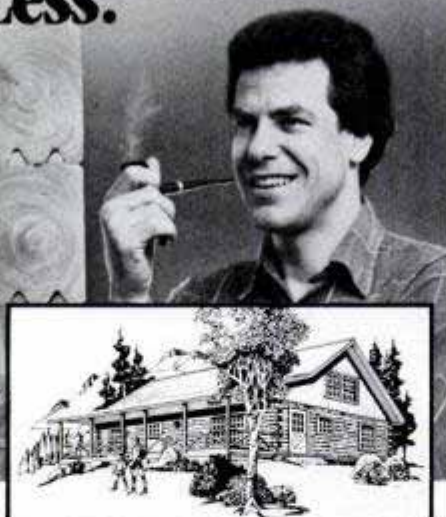
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COMPUTER HIDEAWAY

(Continued from page 137)

1/16 in. away from the factory edge. Using a square, tack a second strip over the canvas end at a right angle to the guide strip. Stretch the canvas tight and nail a third strip over the far end.

Begin assembly by applying the contact cement to the canvas and slats, working in sections about 20 in. long at one time. Apply two coats to the cloth and one to the wood.

Permanent bond is made on contact so you must work carefully. Butt the shoulder of the slat rabbet against the guide strip while holding the other end up. Then slowly lower the slat into position. Apply final pressure using a small rubber-faced roller.

When the assembly has been completed, turn the tambour over and apply a strip of red oak veneer on the back of the end slat to conceal the canvas from view. Apply a finish to the cabinet and when it's dry, rub a candle tip in the tambour grooves and on the slat ends. Lay the cabinet on its side and insert the tambour as shown. Then attach the tambour stop and rubber bumper. And, finally, install the multi-outlet strip and the casters. **FM**

MATERIALS LIST— COMPUTER CABINET

Key	No.	Size and description (use)
A	2	1 3/16 x 2 3/4 x 56" oak (side)
B	1	3/4 x 28 1/16 x 49 1/2" plywood (back)
C	2	3/4 x 28 1/16 x 20 1/2" plywood (printer, monitor shelf)
D	2	3/4 x 28 1/16 x 21 1/2" plywood (center shelf)
E	1	3/4 x 28 1/16 x 21 1/4" plywood (main unit shelf)
F	2	3/4 x 13 7/16 x 22 3/4" plywood (door)
G	1	3/4 x 3/4 x 28 1/16" oak (edging)
H	3	3/4 x 3/4 x 28 1/16" oak (edging)
I	2	3/4 x 1 1/4 x 28 1/16" oak (edging)
J	4	1/4 x 3/4 x 13 1/16" oak (edging)
K	4	1/4 x 3/4 x 22 3/4" oak (edging)
L	1	1 3/16 x 2 x 29 1/16" oak (stop)
M	10	1/4 x 3/4 x 1 1/2" oak (filler block)
N	1	3/4 x 1 1/2 x 27 1/16" oak (sliding shelf front)
O	2	1/2 x 1 1/2 x 16 3/4" oak (sliding shelf side)
P	1	1/2 x 1 1/2 x 27 1/16" oak (sliding shelf back)
Q	1	3/4 x 16 3/4 x 26 1/16" plywood (sliding shelf bottom)
R1	1	1/2 x 1 1/2 x 28 1/16" oak (end tambour slat)
R2	1	3/8 x 1 1/2 x 27 3/4" oak (end tambour slat)
S	66	3/8 x 3/4 x 28 1/16" oak (tambour slat)
T	1	1/16 x 1 1/2 x 27 3/4" oak veneer
U	1	27 3/4 x 54" 10-oz. canvas
V*	1	3/4 x 3/4 x 28" rubber bumper
W	4	2" Shepard Satellite plate caster No. 9007
X	20	3/8 x 2" hardwood dowel
Y*	2 pr.	Knife hinge Armor No. DOH 163
Z*	2	Magnetic touch latch
AA	5	1 1/4" No. 10 fh screw
BB	2	18" Grant full extension drawer slide No. 328
CC	1	1/16 x 16 3/4 x 26 1/16" Wilsonart Natural Almond plastic laminate No. D30-6
DD	1	Perfect-Line multiple outlet strip No. WBG6-1 with 8-ft. cord
EE	1	Wire clamp

*Knife hinges, touch latches, and rubber bumper are available in one package from Armor Products, Box 290, Deer Park, N.Y. 11740 for \$12.50 postpaid.

BIG BYTES

(Continued from page 99)

advanced programmers achieve true arcade quality.

There are some rough edges to this system—such as no way to tell programs from text files in a catalog of the tape, a screen scroll in the word-processing program that's too slow, a slow and very noisy printer, and an occasional burp from the printer during an arcade game. But there's nothing that detracts from the overall, surprising value of the complete system.

At its current price range, the Coleco Adam competes with and overpowers everything else in its class. Only higher-priced units such as the IBM PC or the Apple IIe offer more.

But if even \$700 is too big a price tag, there are now computer systems priced at under \$300 which are quite exciting. Both the Timex-Sinclair 2068 and the Spectravideo SV-318 are better-than-average entry-level machines.

Time for computing?

The Timex unit is easy to program, thanks to both its built-in graphic commands and, to a lesser extent, its keyboard. The keyboard is a mixed blessing. Rather than full-size typewriter keys, Timex uses small rectangular keys, so the keyboard is referred to in the industry as "chiclet" style.

At the best of times it's difficult to type on a chiclet keyboard. And Timex has made things even more confusing by assigning up to five meanings to each key. The keys are labeled above, below and three times on their tops—quite a feat of miniaturization in itself.

But, the good news is that this Timex machine, like its venerable ZX-81 ancestor, is programmed to deliver many often-used entire words or commands with only one keystroke. There is no need, for example, to type "PRINT." Just hit the "P" key (in the right mode) and the computer does the rest.

Drawing lines and circles and plotting points in eight colors are easy using the built-in BASIC commands. And, there are also some built-in graphic symbols which may be used building-block style. The user can also design his own graphic symbols.

This little computer can sound off, too. Easy commands allow for anyone to program musical notes. And slightly more complex commands can allow for three-part harmony.

For \$200, the 2068 is a nice package. About the only not-quite-right detail we can point to is the quality of the 2068's display. The unit we used would not deliver a picture free of waviness or

(Please turn to page 140)

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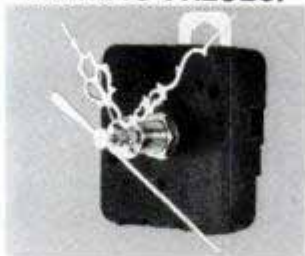
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BIG BYTES

(Continued from page 139)

interference on three televisions or a direct-input monitor. Other units we saw functioned similarly. Take a look before you buy and be sure that the display is acceptable to you (we got used to it, but we know many perfectionists who would never be happy).

Built-in joy

The Spectravideo SV-318, at \$299, may be a little hard to find everywhere, but it is worth searching out. Like the Timex, it has a chiclet keyboard, but one of rubber-topped keys. Each key is labeled with up to three functions, usually including two graphic symbols per key. Typing is done in the usual key-at-a-time manner. One very nice touch, however, is a built-in joystick and cursor controller on the right-hand side of the keyboard.

The red plastic stick can be tilted to control games or—better—to move the cursor around on screen. (The cursor is a small box that shows where the next typed character will appear.) This allows you to edit programs and other data quickly.

The graphic capabilities of this machine are stunning. It uses some of the easiest to program sprite graphics that we have seen. First, you define a shape that will be seen on screen as a moving "sprite." Then you simply program the movement (or animation) in BASIC. Up to 35 sprites can be on screen at one time. The quality of the video signal was almost monitor quality on two TVs and, of course, excellent on a direct-input monitor.

With sound controlled by its own microprocessor—so you can easily use background music—the SV-318 is a very nice little machine. The only thing the potential buyer might think twice about is the availability and choice of software. We have not, in our travels, seen very much SV-318 compatible software on the shelves. Of course, since the SV-318 uses a Z-80 CPU, it can run the CP/M operating system—but only if you add a disk drive and expander. However, we don't think this is the best way to go about forming a CP/M system.

Goliath or David?

Thousands of reporters, editors, potential buyers and just the curious swarmed through the New York City IBM showroom in search of "Peanut," a computer that was rumored to be IBM's secret and powerful weapon. Somewhere, the name of Peanut got changed to PCjr, and somehow the mighty colossus looked a lot smaller that day.

The PCjr, which we saw only at the
(Please turn to page 142)

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BIG BYTES

(Continued from page 140)

show and in what might be described as a prerelease stage, was a terrible disappointment.

Let's start off with the good news. It features a 16-bit CPU just like its big brother, the IBM PC. It has a full 64K of RAM (program memory). It has a built-in serial port as well as a special keyboard that operates via an infrared beam so that a physical connection between the keyboard and main cabinet is not needed (up to 20 feet away).

Other specifications do look impressive on first examination. The 64K of RAM program space complements the 64K of ROM which contains the same version of powerful Microsoft BASIC as does the IBM PC. And the PCjr does have a built-in RS-232 interface for such serial devices as a printer.

The bad news is the type of keyboard and the extent to which PCjr accepts IBM PC compatible software. The keyboard is a chiclet style—with blank, unlabeled white keys. The labels for the keys are on the case rather than key-tops. The chiclet keys mean a touch typist will not like this machine. The odd labels mean a hunt-and-peck typist will have difficulty. Worse, the keyboard has a distinctly toylike feel to it.

Software-wise, the unexpanded (no disk drive) PCjr will run only normal, slow tapes and cartridges. Even if you do get a disk drive, many of the most popular programs for the IBM PC (such as Peachtree's accounting packages, *Typing Tutor* and others) will not run (although some, such as *Visicalc 1.2*, will).

Entry-level computing

But, on balance, this will make the majority of people who were hoping to complement their office IBM PC with an at-home PCjr less than happy. This is not a computer system which any businessman or professional would feel comfortable with. Neither would it be competitive with other computers favored by high school and college students. The one place it might have found a niche would be in the elementary school educational market and for entry-level home use.

But it has been priced out of those markets. At \$669 for the basic unit and \$1,269 for a unit with a disk drive, almost any other computer in those price ranges is a better buy. Indeed, the Coleco Adam at its price of \$700 is directly competitive and would be of more use in most instances.

The time is right to enter into computing. And, armed with your new knowledge, you should be able to find your way.

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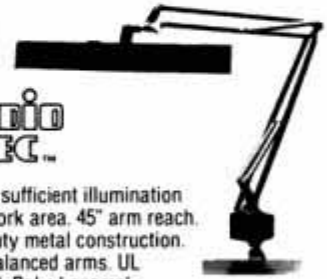
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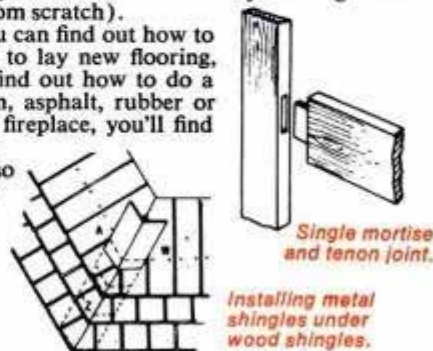
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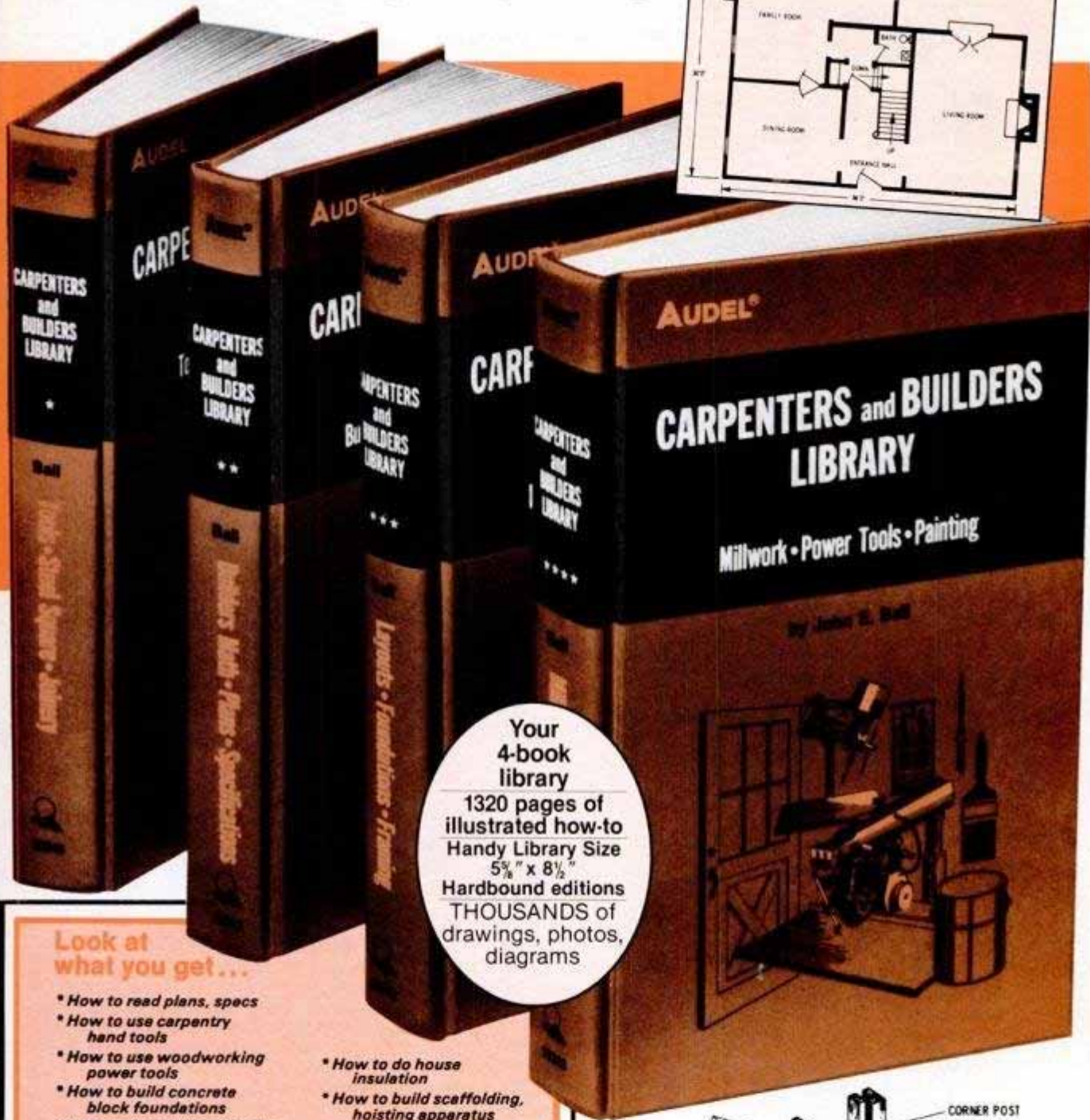
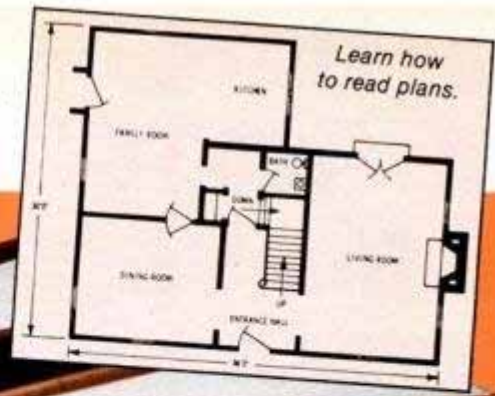
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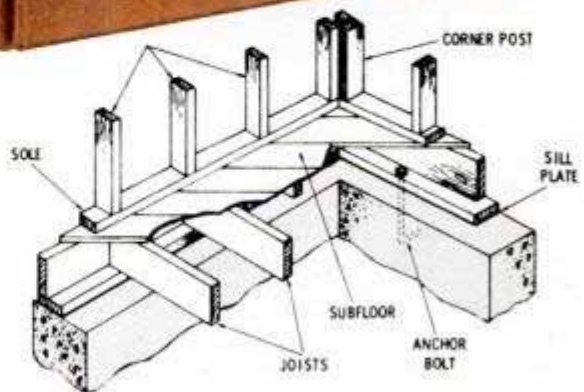
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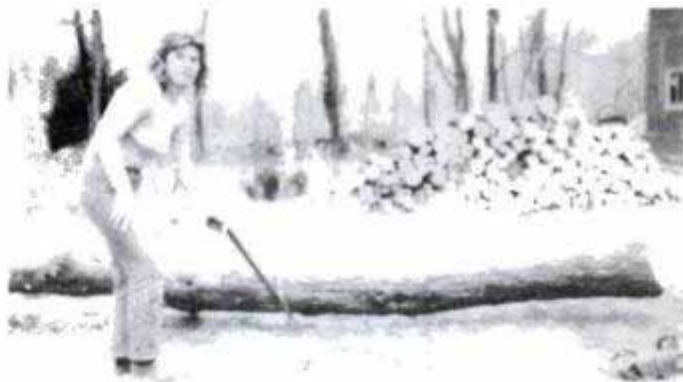
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HOW TO DRY OUT A WET BASEMENT

Sometimes a relatively minor effort can solve the problem of a chronically damp basement.

BY WILLIAM BEYER

Dampness, rust, mildew, mold and allergic reactions are only a few of the problems produced by water, or even excessive dampness, in the basement of your home. At the very least, you can't use the basement for storage or other purposes. At the worst, a wet basement makes the whole house almost unlivable.

The water filling your basement can be condensation. Or it can be from a more drastic problem, like an underground river trying to flow through

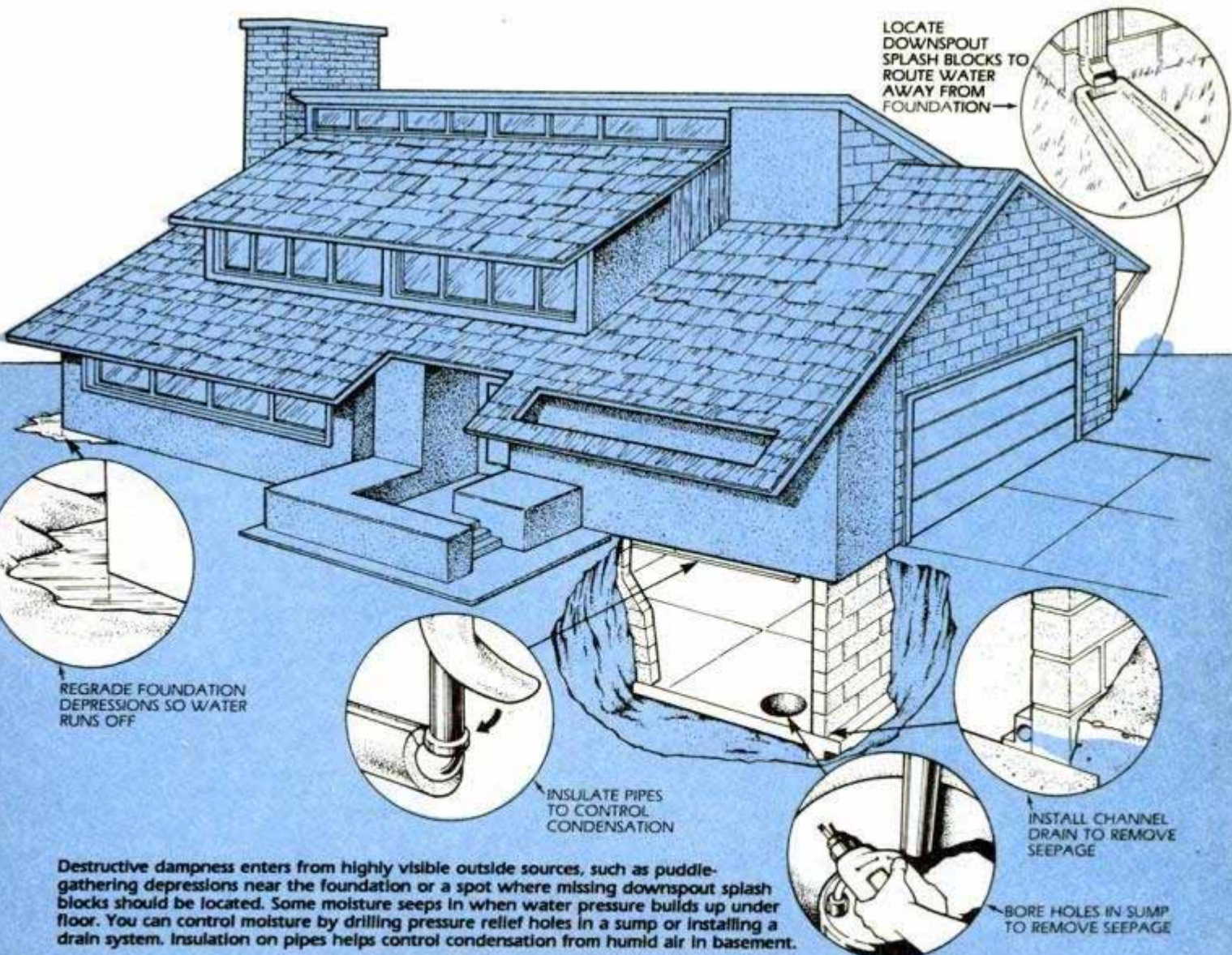
your home. The cures range from the simple and inexpensive to major reconstruction projects. Fortunately, in most cases there is no need to sell the house or engage in drastic procedures. Often, simple solutions work effectively.

Summer dampness is caused by excessive humidity in cool basement air during hot weather. Sometimes, you can correct the problem with ventilation. A dehumidifier will almost always do the trick.

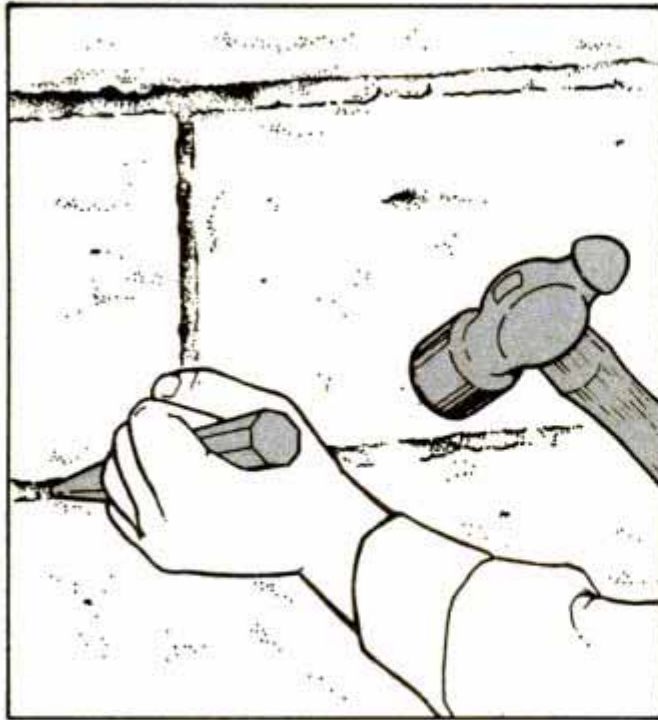
Most appliance dealers stock dehu-

midifiers and advertise them heavily just before the hot weather begins. Sears, for example, offers dehumidifiers in capacities ranging from 12 to 40 pints per day. The figures tell how much water each size can squeeze out of the air in a 24-hour period.

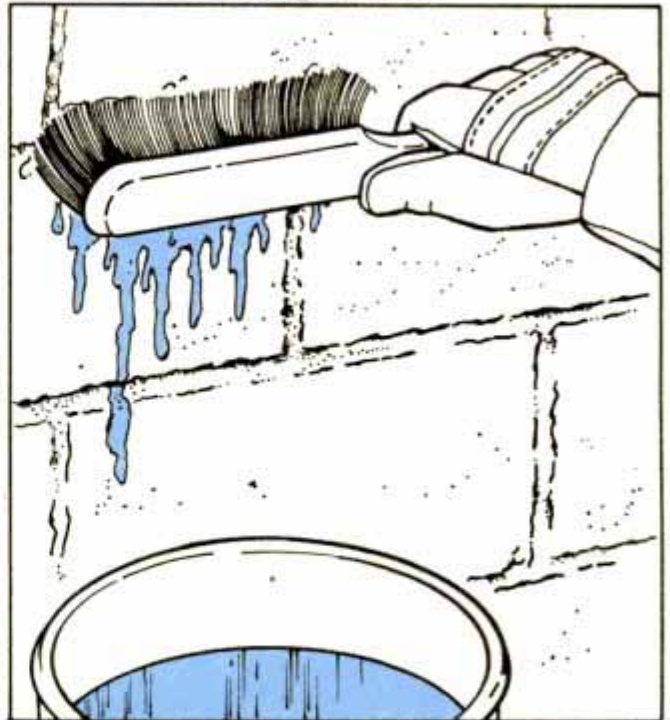
There's no set formula to tell you what size to buy, but about 22 pints should handle normal summertime dampness in an average-size basement. In one older house with a 25×30-foot basement, a 22-pint dehu-



Sealing A Crack Or Joint In An Inside Masonry Wall



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Step 2—Wash down the area with an acid etching agent so that the sealant adheres. Wear rubber gloves and eye protection.

midifier does the job effectively, running less than half the time. It usually requires emptying twice a week in really hot weather and once a week when outside temperatures stay under 80° F. If outside temperatures are usually below 80°, a smaller, 12-pint machine could probably handle the job.

For extra-damp conditions or a larger area, you might want greater capacity. In making the size choice, you're better off getting one that's too big rather than not big enough. The higher price of the larger model will soon be offset by its lower power consumption, since it operates in cycles rather than running continuously.

Typical costs for operating a dehumidifier run about \$10 per month in an area of high utility rates. This cost only applies during hot weather. This small amount of money makes your basement usable as a workshop, darkroom, storage area, or just about anything.

Another way to dehumidify your basement in hot weather is to use a heat pump/hot water heater combination. Sears claims its water heating heat pump saves as much as \$388 per year, depending on electric rates, compared with an electric water heater.

The heat pump takes heat from the air in your basement and transfers it to cold water drawn from the bottom of the water heater tank. While the pump absorbs heat from the air, water vapor condenses on the evaporator coils, making it a dehumidifier as well as a water

heater. One unit worked so well as a dehumidifier that it replaced two previously required in a very damp basement. It cost less to run than the pair and produced hot water as a bonus.

Dehumidifiers and heat pumps, like air conditioners, must have a drain to remove the water they condense from the air. Small dehumidifiers have a catch pan which must be emptied by hand. They, or larger models, can be connected to a drain line to the floor sump, floor drain or, with the aid of a small electric pump, to the outside. However, you must carry this line far enough from the house to avoid seepage problems.

Pipe condensation

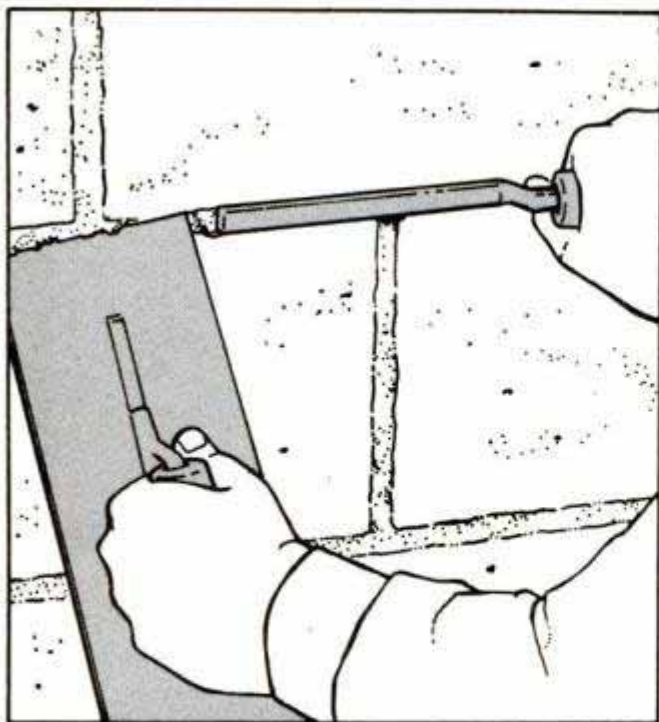
Even after removing the excess humidity that makes your basement dank, cold water pipes may still collect condensation. Running cold water through a long pipe for an extended period aggravates the problem. So, if you have a lawn-sprinkler system, wash clothes in cold water or fill a swimming pool, you can create a wet-pipe problem. Insulating the cold water pipes stops this condensation.

Some insulation wraps around the pipe like a bandage. Spongy foamed plastic insulation formed into 3-ft. split cylinders is easier to install. It comes in sizes to fit over standard cold-water pipes. The split tubes slip on easily and can be miter-cut to form square corners around pipe elbows.

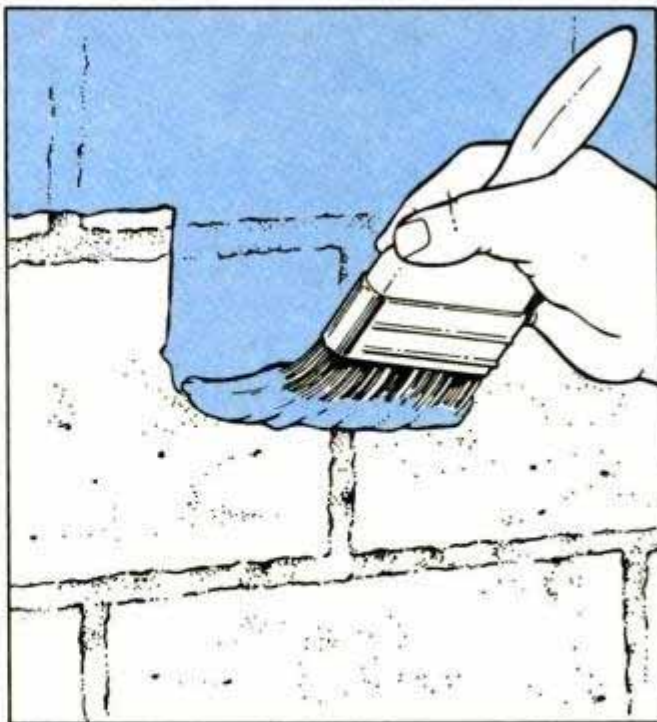
Just as general dampness in hot weather indicates a condensation problem, sudden wetness when it rains or chronic wetness during fall or spring rainy seasons tell you something else. Is this wetness something new? Or has it always been that way in this house? The answer tells you where to attack the problem. In either situation, though, you know the water is coming in from the outside. In most cases, the cure is simple—direct the water away from the house.

Basement window wells eventually become clogged with leaves and other garden debris. Cleaning them out could stop leaks under these windows. Each window well should have a drain or gravel at the bottom which should be several inches lower than the bottom of the basement window sill. If there is a drain pipe at the bottom, it should have a grid or cover to keep the pipe from becoming plugged. A screen or insulating plastic bubble cover over the opening keeps out the worst of the wet and most debris. While you're cleaning out the well and checking its drain, take a look at the window and frame. Caulking could solve the problem.

If an above-the-ground window leaks, check the grade around the foundations under it. If the ground slopes toward the basement wall, rainwater could flow toward the window and collect in a puddle, then it could leak through the window or seep through the wall at that point.



Step 3—Fill picked-out joints with a vinyl cement mix to make a tight seal against seepage and to improve the wall appearance.



Step 4—Apply waterproofing paint to the cleaned and sealed wall. This further inhibits dampness and brightens the basement.

Clogged gutters and missing, damaged or misaimed downspouts can pipe rainwater directly from the roof to the basement. Clean out and repair gutters, and extend downspouts or add splash blocks to lead water away.

Seeping ground water

Standing water or persistent dampness that comes right through the basement floor or through the joints between the foundation wall and the floor calls for more than minor corrective efforts. Still, a do-it-yourselfer can deal with most of the situations.

Older homes may not have had drain tiles installed around the foundations when they were built. If tiles were installed around the footings of a newer home, they may have been crushed or broken during construction. Perforated drain tiles laid around the outside perimeter of the basement walls on the level of the footings carry ground water past and around the house. If there is a lot of water, the tiles may have been installed to allow ground water to enter the basement, where it can be carried to a French drain well, basement sump or city storm sewer.

If there are no drain tiles, or if some have been crushed, hydrostatic pressure can force ground water through any cracks over the footings or in the floor. This seepage is most common when snows melt. Local building departments may have construction records showing drain tile locations and

How To Spot A Wet Basement When Buying A House

A permanently wet basement can be a good reason for not buying a house. Unless you get the seller to make repairs before you agree to buy, it could become an expensive problem for years to come.

When you house hunt, look for water staining on the basement walls and floor. Most basements have slight recesses which collect water. After these areas dry up, these spots appear darker than the surrounding area.

Staining along a crack can indicate hydrostatic pressure. Some hairline cracks are normal, so disregard those which show no signs of staining.

Outside problems

Staining on a wall under a window could point to a grade problem outside that window or to a window well clogged with dead leaves. Make sure you check the outside area.

Newly painted walls and floor may show discoloration or flaking paint under the new coat if there are leaks.

Hidden danger

Separate stacks of storage boxes may have been placed to hide indications of seepage. Move some of the boxes and check their undersides for dampness. Also check the legs of wooden tables or workbenches for water marks more than 1/4 in. above the floor. A stain lower than that

could come from mopping up the floor.

Any tools or other steel equipment stored in the basement may show signs of rust if dampness is a problem. A working dehumidifier and rust points to a serious problem.

Check stored cloth items for mold, mildew and dampness.

Basement paneling

Paneling on exterior basement walls usually points to a dry basement. Check to be sure by moving furniture away from the wall to look for warping or bubbling of the panels. Staining or ply separations near the floor probably mean a moisture problem.

Window wells should be clear of leaves and debris.

The ground around the house should slope away, not toward, the foundation walls. Use a level or come back on a rainy day to check.

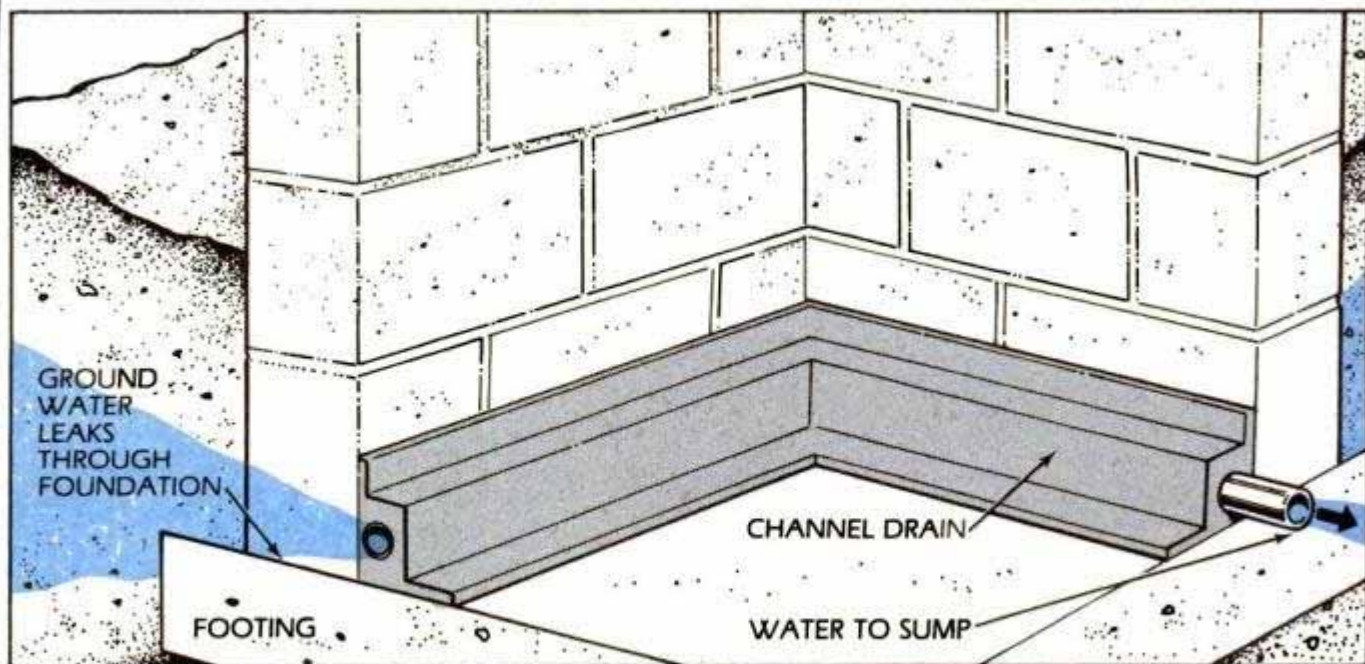
Gutters and leaders

A house without gutters and leaders can be a wet basement candidate unless there are drain tiles to carry the water away from the footings. Downspouts should have elbows and splash blocks.

Talk to the neighbors. Ask about spring flooding and big rains.

But the best advice is to visit the house on a rainy day to see for yourself.—W.B.

Controlling Seepage Where The Wall Joins The Floor



You can control chronic leakage between the walls and the floor of your basement by letting the water through, and then catching it in an enclosed gutter. Called Channel Drain, the gutter system collects seepage and carries it away in a plastic channel to a sump or floor drain, or to the outside with the help of a small pump.

Channel Drain comes in 4-ft. sections with special inside and outside corners, end caps, drain caps, fasteners, joint tape and caulk. The system won't reduce hydrostatic pressure under the

floor unless you drill holes through the slab along the edges where it can catch the water and remove it. However, Channel Drain does offer a do-it-yourself solution to an expensive problem.

Basic tools are all you need to install the system. You'll need an electric drill with $\frac{1}{4}$ - and $\frac{1}{2}$ -in. masonry bits, hammer, hacksaw, caulking gun, tape measure and safety goggles. Channel Drain is available, with complete instructions, from home supply centers. Or write to Channel Drain, RBI Industries, Box 1016, Cumming, Ga. 30130.

where they drain. For an older house, there may be no records.

If directing as much water as possible away from the foundation and basement walls does not dry up your cellar, you'll have to seal the joints. This can be done from the inside with commercial materials like Waterplug (Thoro System Products, 7800 Northwest 38th St., Miami, Fla. 33166) or Burke Plug (The Burke Co., 2655-T Campus Dr., San Mateo, Calif. 94403). After chipping and scraping out any loose material around the crack or joint, etch the wall with acid to improve adhesion. Caulk the crack, then paint the surface with a waterproofing paint. Special acrylic latex caulks set quickly and bond well with old concrete. The surface should be wet when caulked.

A sump at the low point in your basement with an electric sump pump can relieve hydrostatic pressure as well as remove water. The sump should be of a size and depth recommended for the pump you plan to install. It can have a sealed bottom to collect water or a bed of gravel or stone to make it somewhat self-draining. If it's sealed, drilling a series of $\frac{1}{4}$ -in. holes just below the bottom of the floor slab can relieve hydrostatic pressure that might otherwise force moisture through cracks in the

floor. Any water that collects can be pumped either outside or to a drain.

If your basement has no sump, you can make one. Cut a round hole in the floor big enough to fit the upper lip of a heavy-duty 5-gal. plastic pail. A steel pail or drum rusts out in a few years. As with a masonry sump, bore $\frac{1}{4}$ -in. pressure relief holes just below the level of the floor slab. Follow the directions that come with your sump pump about power, grounding and drainage.

Another solution to seepage between the walls and the floor is a gutter system such as the Channel Drain (see *Controlling Seepage Where The Wall Joins The Floor* on this page).

Wall cracks

Patching a wall crack and sealing it from the inside can be a do-it-yourself job. But if settling or expansion and contraction with drastic temperature changes opens the crack again, you'll have to patch it from the outside. This is usually a professional job.

Locally known and respected waterproofing contractors can do the job, but beware of heavily promoted systems claimed to stop wet basement problems without digging. These usually force a clay-like substance, called Bentonite, down along the foundation through

hoses and pipes. It swells when wet but is not always successful in permanently sealing porous walls. For serious hydrostatic pressure problems, drain tiles around the foundation—a major construction project—are the only long-term solution.

Sealing an external wall crack calls for digging down to expose it, cleaning and chipping out loose bits of concrete and mortar, and scrubbing the surface clean to prepare it. Pack a layer of aluminum foil into the crack to form a base for the acrylic latex caulk, which should remain flexible enough to seal despite slight movement after it has set.

Even after you've worked to keep water out of your cellar, a basement water alarm can help (see *Build The Basement Water Alarm*, page 56, July '80). Copies are available for \$1.50 from PM Readers' Service, 224 West 57th St., New York, N.Y. 10019. **PM**

MORE INFORMATION

ASHI, the American Society of Home Inspectors, publishes *Wet Basements*, a three-page booklet. This lists and illustrates numerous faults leading to wet or leaking basements and crawl spaces. It also suggests cures. Valuable for homeowners and would-be-homeowners, it shows pitfalls to avoid if you want to keep your basement or crawl space dry. For a copy, send \$1 with a stamped, self-addressed, business-size envelope to: ASHI, 1629 K St. N.W., Suite 520, Washington, D.C. 20006.

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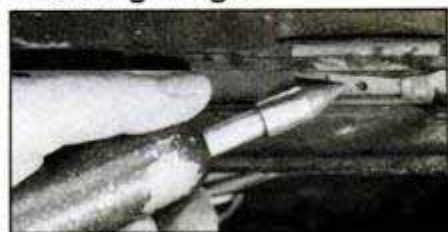
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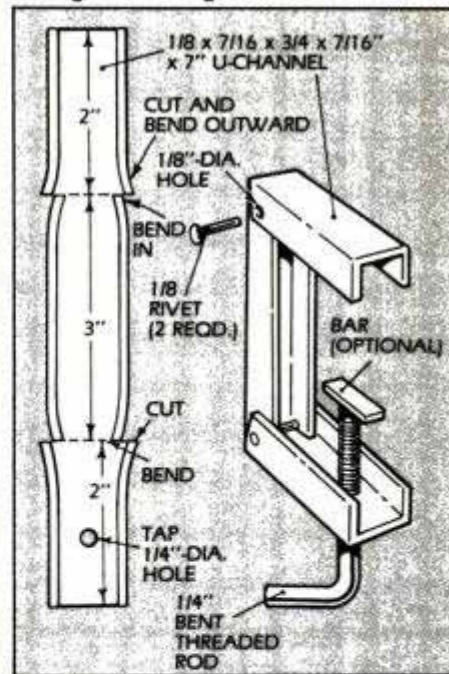
HINTS FROM READERS

Greasing hinges



To keep badly rusted and stiff auto hinges lubricated for the long term, drill a 1/8- or 3/16-in.-dia. hole through the hinge and oil the hinge pin until it is loose. A shot of grease with a chainsaw sprocket-tip grease gun will keep the hinge free for years. Here, we lubricate a hinge on the engine compartment of a Volkswagen bus.—E.J. McIntyre

Simple clamp



A scrap of channel iron makes a good light-duty clamp. Make two cuts across the open side of the channel as shown. Bend the ends perpendicular to the middle. Drill holes through both bends and insert 1/8-in. rivets. Tap a hole for a threaded L-shaped rod or a stovebolt turnscrew. If the thread strips the channel, insert a nut and bend the sides inward.—Charles Hardy

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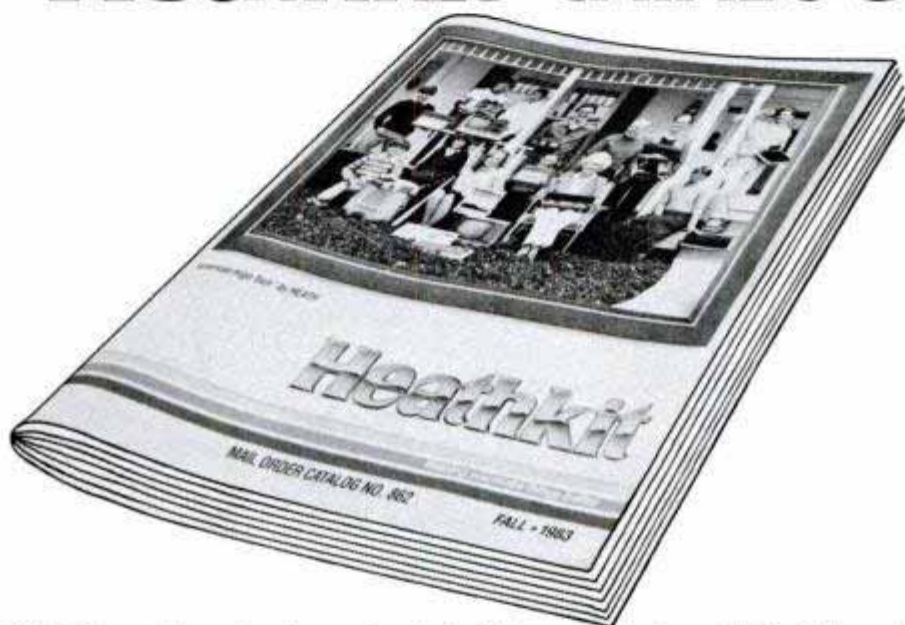


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PREFAB HOUSING

(Continued from page 115)

gar-shaped mobile home—is much larger, more elegant and better equipped than its predecessor. Community bans against manufactured housing are receding as more of these houses are permanently located on foundations and treated as real property (and also taxed as real property). Resale prices for manufactured units of all styles and sizes are also holding up well.

Prices for furnished single-wides start below \$14,000. Multiple-section houses at the top of the range can break \$50,000. Generally, multiples are sold without furniture.

6. Modular houses—These are really stick-built houses almost entirely produced under a factory roof. They are shipped in several large sections by truck to a site and positioned by crane over a foundation, then zipped up by a company crew. Modulares have mostly been one-level structures. Now, All-American Homes is offering a 1½-story Cape Cod Model.

Sizes start around 800 sq. ft. for a two-bedroom model and expand among models to about 1,800 sq. ft. Delivered prices (not including foundation and zip-up) start under \$30,000 and rise to over \$50,000. Cardinal Industries has also developed add-on modules—a master bedroom/bath and a family room.

7. Panelized houses—When the word "prefabrication" is used, many people picture the panelized house. As described above, prebuilt wall panels form the base of the package. They are joined on site. This branch of the business deals almost exclusively with home builders or buyers working with custom builders.

Dealing with a company that makes panelized residences—or a builder who erects them—gives you a design advantage. Just about any house design imaginable can be produced through panelization. Models shown in company manuals span a design range that's wider than any other single group.

Wide ranges of prices and sizes are also available. Through custom designs, the possibilities are limitless. And stock models priced over \$100,000 are not uncommon.

8. Pole house—At present, there is only one major company producing pole house kits—Pole House Kits of California. This, too, is a variation on precast housing. While treated poles drastically reduce the need for foundation work, move-in prices for these houses would have to be classified among custom homes.

Sales are divided about equally

between professional builders and owner/builders. Economy, standard and deluxe packages of components are offered, and shipped anywhere, f.o.b. by the California plant. A deluxe package covers framing, flooring, railings, walls, ceilings, roof, windows and doors, stairs and steps, hardware and cabinets. Plumbing, heating, electrical and finish items are purchased locally by the home buyer.

A manual describing the house styles and the pole-building system is offered by Pole House Kits for \$7. Send a check to the manufacturer at Dept. E, 2201 Martin St., Irvine, Calif. 92715.

9. Precut houses—Aside from panelized, modular and manufactured houses, all of the previously named styles are certain types of precut houses. One more version is identified specifically as precut. Firms that manufacture this type of home have been in the prefabricated housing business for many years and were originally called "precut" companies. The two companies surveyed, Lindal Cedar Homes and Pre-Cut International Homes, are both located in Seattle. Both companies produce houses with a shell that's essentially cedar.

As with other precut styles, over 50 percent of the buyers for Lindal and Pre-Cut have a hand in the construction of the house.

Package prices run from about \$18,000 for a compact 750 sq. ft. house to more than \$100,000 for a solar-energy-fortified residence with more than 3,500 sq. ft. A package includes all materials to close in a house and ready it for the finishing steps.

Although stick-built houses are not going to disappear from the construction scene, their number will decline as time passes. The age of the factory-built house is upon us, and it will grow in size and importance for an excellent reason: economy. **PM**

SOURCES— PREFABRICATED HOUSING

Names and addresses of the foremost makers of prefabricated housing are listed in a 50-cent pamphlet, *150 Top Manufacturers Of Factory Houses You Can Build Yourself*. A book, *Complete Guide To Factory-Made Houses*, is \$9.95 postpaid. For either, write to The Building Institute, Dept. PM, 855 Piermont Ave., Piermont, N.Y. 10968.

For more information and a list of members, write to the National Assn. of Home Builders, 15th and M Streets NW, Washington, D.C. 20005. Address mail to the association council you're interested in: HUD-Code Mobile/Manufactured Housing Committee

Log Homes Council
Modular Housing Council
National Dome Council
Pre-cut, Panelized and Components Council

To obtain a pamphlet on the merits of manufactured (mobile) housing, send a self-addressed, stamped envelope to: Manufactured Housing Institute, Suite 511, 1745 Jefferson Davis Highway, Arlington, Va. 22202.

A member list is available from a new log house group: North American Log Builders Assn., Box 369, Lake Placid, N.Y. 12946 (includes U.S. and Canadian log house makers).

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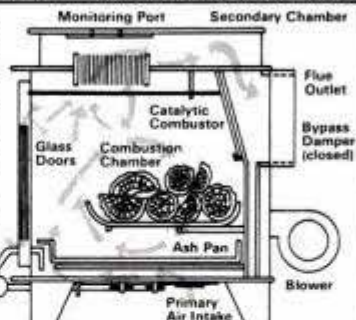
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Fire box size ... 17"D x 25 1/4"W
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Safety approvals: Tested to UL standards by the Gas and Mechanical Laboratories. ICBO listed on report No. 3558.

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- 4-Jaw Lathe Chuck \$46.80
- Face Plate \$4.50
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- Master Set of Turning Chisels \$44.95
- Spindle Shaper Kit \$44.00
- General Electric Motor \$49.50 (with other item) \$54.55 (purchased separately)
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DIRECT FACTORY OFFER AND REVOLUTIONARY PATENTS decrease costs, increase efficiency. Full scale power tools of heavy duty 100% cast iron and steel. Streamlined design reduces weight, cuts material and production costs. Special patents provide added efficiency, accuracy, savings. Parts made, assembled, tested, packed in our own factories, shipped direct.

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***10-YEAR LIMITED WARRANTY.** Any part or parts of any AMT power tool which become inoperative for any reason within 10 years of the purchase date will be repaired or replaced by the factory. Your only cost, for return postage.

**Except motors to which the same terms for one year warranty will apply.



8" TILT ARBOR POWER SAW DOES WORK OF \$150.00 BENCH SAW as is. Converts easily to equal any \$300.00 floor model cabinet unit!

Crosscuts, rips, mitres, cuts compound angles, dados, makes grooves and moldings.

\$52.50

f.o.b. factory. Wt. 22 lbs. Including completely assembled cast iron and steel 8" saw with ground cast iron table, blade guard, miter gauge, Less blade. RIP FENCE, if desired, for easier work alignment, \$6.50 add'l.

PRECISION BALL BEARING SPINDLE for commercial service, \$12.50 add'l.

SAW BLADE TILTS . . . TABLE STAYS LEVEL. Lock securely at any angle up to 50°. Raises, lowers, 0° to 2-1/4". Takes standard blade, saw insert removes to take dado heads, if desired for easier work alignment; Standard size (for bench saw) \$6.50; long rip fence for cabinet base (as shown), \$7.50.

FREE CABINET BASE PLANS Use bench saw as received (inset photo) . . . or transform easily and inexpensively into floor model (as shown) guaranteed to do work of floor models costing \$300. FREE plans . . . all you'll need are a sheet of 3/4" plywood and 3-4 hours. Use your AMT saw for cutting. Plans provide 27" x 24" work surface, 33" height.

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DOES WORK OF \$200 UNITS.

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Comparable in speed, precision and durability to units selling for \$200 and more, .36" between centers. For wood and plastics. Tubular steel bed rails with dual point suspension increase accuracy, ease of operation. Precision ball thrust cup center, heavy spur center, graduated 1-rest, 3-Speed pulley for different work diameters. Heavy-duty ball-bearing model \$79.50.

f.o.b. factory. Shipping Wt. 30 lbs. Faceplate (optional) for turning bowls, lamp bases, etc. \$4.50. Set of 3 high speed turning chisels, \$11.00 add'l; Set of 8, \$29.00.

PRECISION 4" x 36" BELT SANDER

f.o.b. factory Wt. 18 lbs.



Mitre gauge: \$3.50 add'l.

\$52.00

Disc Sander attachment including disc, bracket, ground cast table (fits 0-45°); \$17.00 add'l.

The world's most talented belt sander. Heavy cast iron sander has belt track and tension control; includes 4" x 36" standard sanding belt. Changes from horizontal to vertical sanding in seconds. Uses 1-3 HP or larger motor.

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Larger and heavier than our popular 4 1/4" model to handle bigger stock. Three blade cutter head has micrometric adjustment so that individual blades can be set easily. Fence fully adjustable 45° to 0° to 45°.

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SPINDLE SHAPER KIT with holddown

\$44.40

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Makes beads, coves, moldings, tongue-and-groove joints, etc. Easy assembly plans. Has sealed greased-for-life ball bearings, adjustable height control, fence assembly. Takes 1-4 HP or larger motor. Standard 1 1/2" bore cutters available.

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MASTER SET WOOD TURNING CHISELS

High quality turning chisels handcrafted to exacting metallurgical standards. Set of 10 includes two skewes, three gouges, parting tool, round nose, spear point, plus two inside turning tools—all in a wooden storage case.

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Holds workpiece firmly without screws. Cast iron and steel chuck with 4 independent, reversible, stepped, black steel jaws. Outside diameter chucking 7/16" to 5"; inside diameter chucking 7/8" to 6". Fits all AMT wood lathes and others with headstock spindle threaded 3/4" x 16". Chuck key included.

\$46.80

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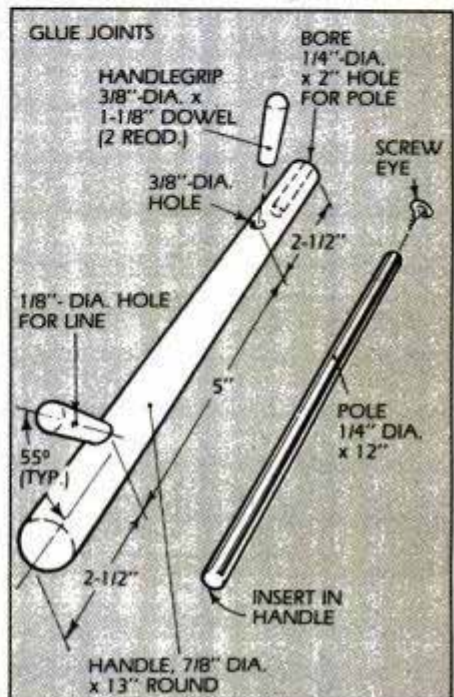
BRAND NEW MOTOR

Develops a full 1 HP. New General Electric Motor for use with any power tool in this ad. Features 1 1/2" shaft, 1725 RPM. \$49.50 if purchased with any AMT tool (\$54.55 if purchased separately). 17 lbs. f.o.b. factory. Covered by a one year limited warranty.



HINTS FROM READERS

Pole for ice fishing



With a dollar's worth of materials, a drill, a saw and some wood glue, you can make this very practical pole for ice fishing. Cut the handle, handle grips and pole to size. You can use an old broomstick for the fishing pole handle, and dowels for the grips and the pole. Round the upper ends of the grips with 80-grit abrasive. Bore holes in the pole handle at approximately 55° angles, 2 1/2 in. from both ends for the grips. Bore a hole for the pole.

Next, bore a 1/8-in.-dia. hole in the back grip for the fishing line. Then glue parts in place and install the screw eye. Run one end of the fishing line through the screw eye and the hole in the back grip and tie the line. You can control the line depth by wrapping and unwrapping it around both handle grips.—David Butler

Vise advice

You can make simple vise jaw pads with two-face tape and plywood or hardboard. I attach the two-face tape to the pads and stick them to the inside of the vise jaws. Now my hands are free to work.—Howard E. Moody

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OUR LIQUIDATION PRICE

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SUCTION CAPACITY 190 g/min
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MAX. PRESSURE 150 BAR

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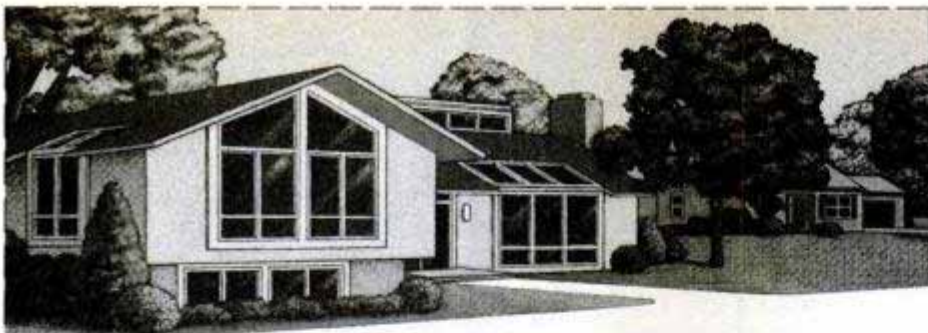
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Add \$15.00 ea. for shipping and handling.
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PEUGEOT 505 (Continued from page 72)

manual transmission is available on the gasoline model. Fifth gear has a 0.82:1 overdrive ratio, and the rugged Peugeot-built unit has synchro rings that are bigger than the gears themselves.

The front suspension uses fairly ordinary MacPherson struts. But the rack-and-pinion steering has variable power assist that increases as you apply more muscle to the wheel, thanks to a small torsion bar inside the steering box that responds to driver effort.

The live rear axle contains a limited-slip differential (inside an aluminum housing) and conical coil springs that provide progressively stiffer support for increasing loads. Side-to-side movement of the suspension is limited by a sturdy, transverse Watts link. But its most unusual feature is the torque tube that encloses the driveshaft from the transmission to the differential. This device transmits the thrust of the rear wheels directly to the car's engine/transmission mounts, rather than pressing the suspension components into double duty, as most cars do.

A lot of finesse

But enough nuts and bolts. How does it all work? With such finesse that you'll wonder why you've been putting up with awkward, ill-handling station wagons for all these years. The Peugeot has that rare combination of stable, confidence-inspiring handling with a limousine ride. Performance is pretty snappy with the five-speed, and more than adequate with the automatic. Even the turbodiesel is no slouch, although it is the slowest version of the three. Besides a 1,125-lb. payload (which Peugeot calculates as five people plus 244 lbs. of luggage), the gasoline version can tow a 3,300-lb. trailer. The diesel will pull 2,200 lbs.

The deeply sculpted front bucket seats are very comfortable, especially the big-buck leather option. But even the standard vinyl or velour seats are outstanding, and they are not so deeply contoured that getting in and out is difficult.

The basic GL model has a sticker price of \$11,990 and a page-long list of standard features including roof rails, power steering, heated and electrically adjusted outside mirrors, digital clock and an illuminated vanity mirror. The \$15,800 S version throws in a/c, cruise control, rear wiper/washer, heated front seats, power windows and door locks plus a killer six-speaker AM/FM stereo sound system.

Both models are elegant, comfortable and practical wagons, but the GL—with a few options from the S package—is the better bargain. **PM**

In just a few hours you can build a collector's miniature masterpiece.

Few crafts are as satisfying to a man as working with wood. The beauty of the hardwood grain...the perfect smoothness from hand sanding...the gleam of the varnish finish—these are the pleasures you experience when you build our extraordinary museum quality miniature furniture kits.

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Begin your crafting adventure with our miniature reproduction of the William and Mary clock for only \$1, when you become a trial member of The House of Miniatures Collectors Society.

As a trial member, you will have the opportunity to purchase, *if you wish*, other museum quality miniature kits. However, you are not obligated to buy any additional kits—ever!

Remember, this William and Mary clock is available for \$1 by mail only. *With no further obligation on your part.* Mail coupon today.

An \$8.95 retail value

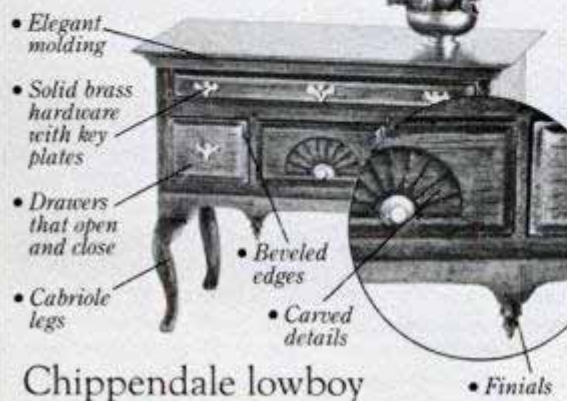


Start with this museum quality William and Mary Clock Kit for \$1* with no further obligation

*Clock measures 7 1/4 inches tall. Door opens to reveal the solid brass clock weights and pendulum! Kit has everything needed to assemble clock.

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Each kit has fine details



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BP12

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Please enroll me as a trial member of the Society and send me the William & Mary clock kit. Bill me only \$1* If I am not completely satisfied, I may refuse delivery of the second shipment by writing "cancel me" on the shipping label. If I keep the second shipment, I will be a regular member and receive additional shipments every four weeks. The price for each shipment, which will contain one or two kits, is \$9.95* I may return any shipment and I am not obligated to accept any minimum number.

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Include tinted glue, oil base stain (for authentic color), glaze stain for antiquing and highlighting and other materials to professionally finish your kit to museum quality.

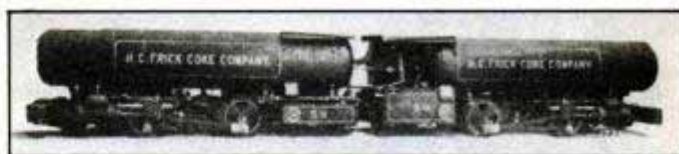
PM'S TIME MACHINE

75 YEARS AGO: February 1909



Airship "bombs" LA.

Los Angeles 'bombed'
Roy Knabenshue sailed over Los Angeles and dropped confetti bombs onto the heads of thousands of people who thronged the business district to try and sight him. Only once was Knabenshue's presence above the city discovered, and that was when he turned a miniature searchlight on the crowd of people surrounding the city hall, just before dropping "bombs" among them. Airships can play a great part in engagements on the battlefield.



Compressed air locomotive

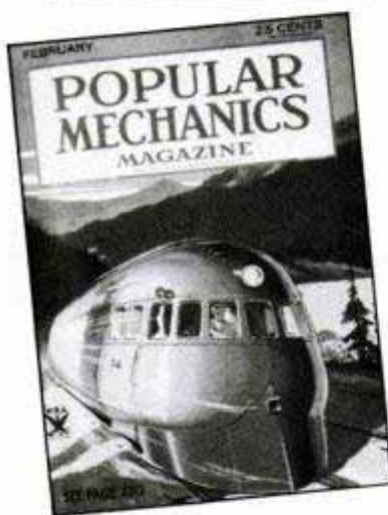
Eight compressed air locomotives have just been completed by the H.C. Frick Coke Co., for use in one of the company mines. The locomotives are arranged to be operated in tandem. The same air pressure is maintained at all times at 150 lb. per square inch by reducing valves. Initial pressure of the storage tank is 800 lb. per square inch.

Fire trucks

Three up-to-date fire-fighting machines have been installed by the fire department in Joplin, Mo. The gas engine not only drives

the fire truck, but furnishes power to drive the pump as well. The gas engine with which the truck is equipped is of the four-cylinder type and can develop 75 hp.

50 YEARS AGO: February 1934



Trains will go 110 mph.

Flying trains

Wingless airplanes on tracks, carrying passengers, mail and express across country every hour at 90 to 110 miles per hour, followed by similar self-powered units transporting freight at the same high speeds, all at one-third the present cost—this is the immediate future of American railways. These new trains will be shaped like the fuselage of an airplane, streamlined at front, rear, both sides and the bottom, driven by oil, diesel or distillate. Even now, a new

kind of engine is being developed which may reduce operating costs still lower without sacrificing other desirable features.

Sidecar boat

Use of the motorcycle sidecar as a boat has been found practical in Germany. Pontoons are fitted on each side of the car, which is propelled by double-ended paddles. Changing the sidecar into a boat may be accomplished quickly. Manufacturers are considering sidecars equipped with rudders.

Gas-sipping racers



Not only are racing cars covering more miles at top speed on a tankful of gasoline than they formerly did, but orders are out that they must still be more economical. The conservation campaign has started.

25 YEARS AGO: February 1959



Riding the "pocket" ski lift.

Car-driven ski lift

A "pocket" ski lift fits into the trunk of an automobile. It weighs only 145 pounds and is capable of lifting 150 persons an hour on any grade up to 30 percent. The inventor uses his car as a motor to drive a drum, around which a steel cable is wound. The car is jacked up on wedges, lifting the rear wheels off the ground and transferring their rotation to an axle, which in turn transfers it to the cable drum. The inventor then takes one end of the cable to the top of the hill and anchors it.

Jupiter's shelter



Vertical missile shelters that open like petals of a flower will be blossoming soon at Jupiter launching sites. Purpose of the portable, stand-by shelters is to protect the Jupiter missiles from inclement weather

during the "waiting" stages. There's room inside for missile workers.

Repeating bow

Archers can get off two arrows in short order with an "automatic loader" attached to the bow. The loader is clamped to the handgrip and the spare arrow is slipped into a holder which pivots to a vertical position. The archer then holds another arrow in the normal hunting position. The "kick" of the first arrow trips the loader, which instantly swings the second arrow into the bowstring.

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You can even listen to weather, business and marine radio calls. Plus radio telephone conversations that offer more real life intrigue than most soap operas. And with our new model MX5000, there's even more.

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Introducing the all new Regency MX5000, a 20 channel, no-crystal scanner that receives

continuously from 25 MHz to 550 MHz. That's right! Continuous coverage that includes CB, VHF and UHF television audio, FM Broadcast, and civil and military aircraft bands. Plus a host of other features like keyboard entry, a multifunction liquid crystal display that's sidelit for night use, selectable search frequency increments, and a digital clock.

PRACTICAL PERFORMANCE

Another new addition to the Regency line is the 30 channel MX3000. It's digitally synthesized so no crystals are necessary, and the pressure sensitive keyboard makes programming simple. What's more, it has a full function digital readout, priority, search and scan delay, dual scan speed,

and a brightness switch for day or night operation.

AT HOME OR ON THE ROAD

With the compact design, slanted front panel, and mounting bracket the MX3000 and MX5000 are ideal for mobile* use. But we also supply each radio with a plug-in transformer and a telescoping antenna so you can stay in touch at home.

See your Regency Scanner Authorized Dealer for a free demonstration on these and other new Regency Scanners. Or, write Regency Electronics, 7707 Records Street, Indianapolis, IN 46226.



MX5000

MX3000

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11 GPM @650 PSI until more pressure is needed. Kicks
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RPM. 12 Lbs.

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Built-in relief valve. 1/2" in-out ports. 1/2" cylinder ports.
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Has pressure sensitive detent, hands free on return
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Cylinders



TYPE	STROKE	ROD	WT	ITEM #	PRICE
Tie Rod*	3"x24	1"	50	909324	\$108
Tie Rod *	4x24	1"	70	909424	\$133
Tie Rod	4x24	2"	78	908424	\$137
Tie Rod	5x24	2"	100	909524	\$210
Welded Tee*	4x24	1"	49	90424	\$132

*These can be shipped U.P.S.

Quality
Gas Engines



HORIZ	HP	SHAFT SPECS	ITEM #	WT	PRICE
Tecumseh	5	1/2" Recoil	6051	40	\$132
Briggs	5	1/2" Recoil	6052	40	\$137
Briggs	8	1" Recoil, model 190432	6080	50	\$204
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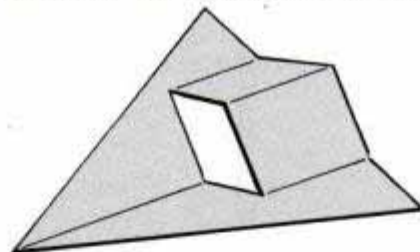
PATENTLY UNUSUAL Plane, yes...simple, never

BY DENNIS ESKOW
Science Editor

William Harlan Pryor is widely considered the Charles Lindbergh of paper airplanes. Pryor holds the record for the longest paper plane flight—a 15-second glide performed by his single-sheet model which had broad, sweeping wings like an F-111 jet. His aircraft was loudly acclaimed, but never patented. After all, who would patent a paper airplane?

Surprise! Since 1968, the U.S. Patent Office has assigned patent numbers to 188 paper airplanes. Some are single sheets with folds and cuts to make them fly better. Some need several sheets of paper or small strips of thinly cut balsa or plastic to get airborne. None fly anywhere near 15 seconds.

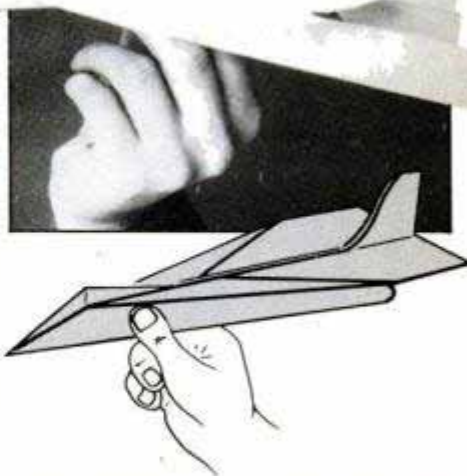
"I wanted to create something that could be folded simply, with advertising on its fuselage or wings," says James M. BonDurant, an Ohio evangelist who was inspired by the design of jets flying out of Wright-Patterson AFB. He was granted U.S. Patent 4,377,052 last March. "I hope to sell the plane to a



English plane folds like a Japanese origami.

fast-food chain or toy company that would use it as a promotion," he says.

We struggled for two hours before coming up with the correct BonDurant plane shown in the photo on this page. We drew lines on the paper, following the patent instructions. But it wasn't until we folded a plane without the aid



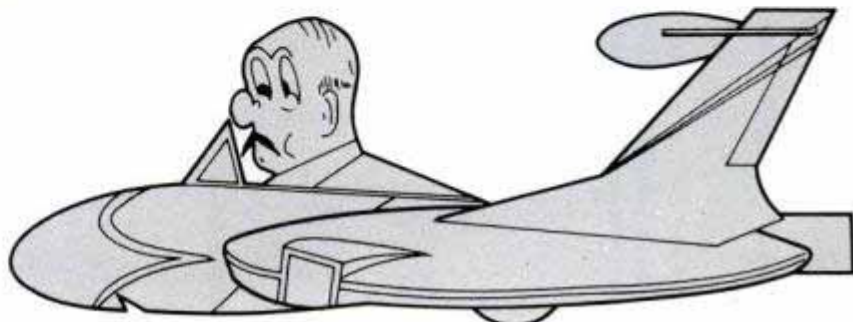
BonDurant plane took two hours to fold from plan. It stayed aloft for four seconds.

of lines that we got a flying model. It stayed airborne four seconds.

Other unusual paper airplane designs include a glider with the folded geometry of a piece of Japanese origami. Through an intricate set of paper cuts, you get a flying delta wing with a cube-shaped fuselage. (U.S. Patent 4,172,337). The delta wing vehicle stays airborne a couple of seconds if it doesn't get off to a gusty start. Roy English of Portland, Ore., holds the patent on that one.

An obviously promotional craft has been patented (4,106,232) by Daniel Higgins of Naperville, Ill. His plane made from at least one sheet of planar material, according to the patent, comes with a built-in cartoon-like pilot. I didn't try to make a model.

If you'd like a copy of any of these patents, send a \$3 check for each one, payable to the Commissioner of Patents and Trademarks, to: Commissioner of Patents and Trademarks, Washington, D.C. 20231. Be sure to provide the patent number. To avoid mistakes, write the name of the inventor beneath the number. **PM**



The Higgins plane uses at least one sheet of planar material, according to the patent.

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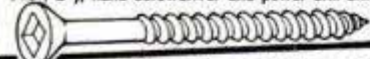
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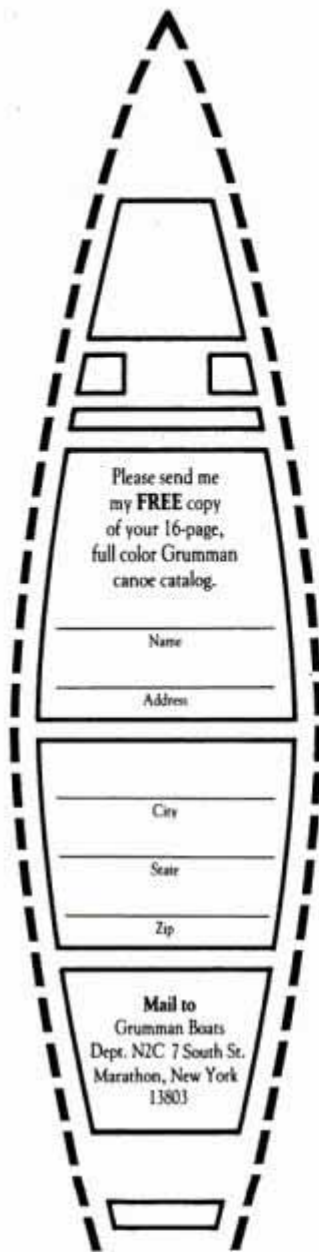
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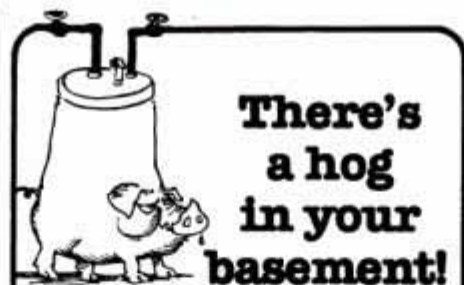
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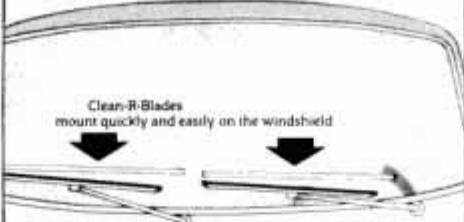
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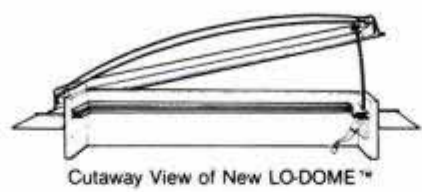
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2 Good Shop Tricks

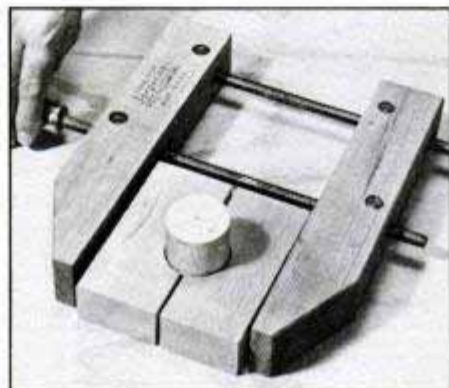
Center-boring round stock

I stumbled upon this method for center-boring round stock on my drill press while making napkin holders. The problem was trying to hold the round stock steady while boring through the center.

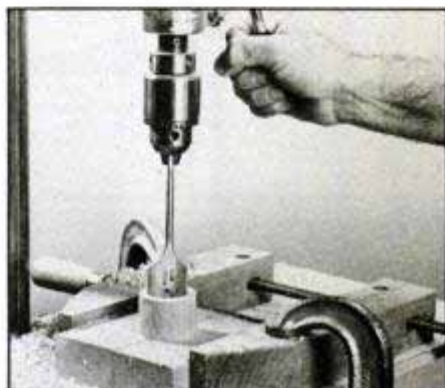
The solution employs an adjustable hand screw, two 2x6 clamping blocks and two C-clamps. First, with a band saw, make semicircular cutouts in each block. The cutout is the same diameter

as the round stock, but is cut slightly shallower than half a circle. This prevents the clamping blocks from coming together and allows the pressure to tighten just on the stock.

Clamp the stock between the blocks, using the hand screw as shown. Use C-clamps to secure the hand-screw assembly to the drill press table directly under the drill bit. Now you can bore out the center easily.—Jon Gullett



Tighten the hand screw to hold the round stock securely between clamping blocks.



Center-bore the round stock with the hand screw clamped to the drill press worktable.

An Improved steel wool pad

Steel wool is an invaluable aid in my refinishing and woodworking projects. But the steel wool comes in preformed pads that are difficult to work with, especially on flat surfaces.

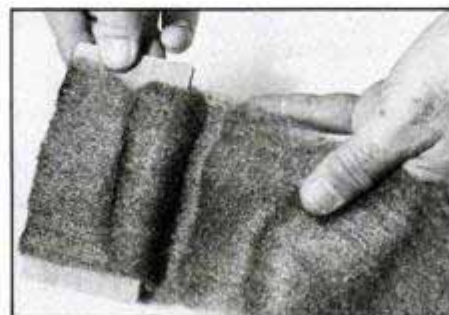
The improved steel wool pad shown here offers more control while providing a larger cutting surface. First, unroll the preformed pad. Then, wrap the steel wool around a 1/4 x 3 x 6-in. hardboard or plywood backup block. A loose wrap is better than a tight one. Now, use the steel wool in the same manner

as you would use a sanding block.

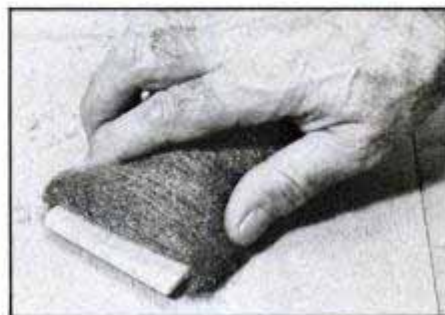
The backup block reinforces the steel wool for faster cutting action while extending its useful life. The block prevents the steel wool from balling up and wearing out as quickly as when it's used as a preformed pad.

After using one section of the steel wool, remove it and rewrap it back onto the block with a new surface showing. Repeat this procedure until the steel wool's entire surface has been used.

—Thomas A. Gardner



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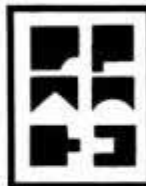
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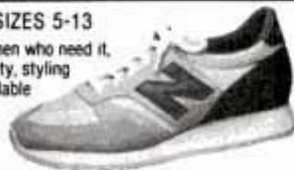
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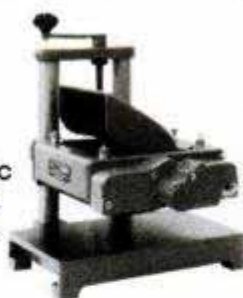
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HOW TO COUNT WORDS: Name and address must be included in counting the number of Words in your ad. Each initial or number used counts as 1 word: J.J. Smith, 224 West 57th Street, New York, New York 10019: 9 WORDS. Zip codes are not counted. Phone #: 2 Words. Symbols used as keys are charged for. City or State count as 1 word each: New Brunswick, New Jersey: 2 words. Abbreviations such as C.O.D., F.O.B., R.P.M., U.S.A., P.O., 5x7, 16mm are counted as 1 word. (P.O.Box 392 counted as 3 words) Webster's International Unabridged Dictionary will be used as our authority for spelling, compound words, Hyphenations, abbreviations, etc. Please make checks payable to **POPULAR MECHANICS**.

Only \$57.00 for 10 word minimum

\$5.70 each additional word

**BOLD FACE CAPS add
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(First Word: No Charge For Bold Face)

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No Charge for CAPS	2	3	4	5	6	7
8	9	10-\$57.00	11-\$62.70	12-\$68.40	13-\$74.10	14-\$79.80
15-\$85.50	16-\$91.20	17-\$96.90	18-\$102.66	19-\$108.30	20-\$114.00	21-\$119.70
22-\$125.40	23-\$131.10	24-\$136.80	25-\$142.50	26-\$148.20	27-\$153.90	28-\$159.60
29-\$165.30	30-\$171.00	31-\$176.70	32-\$182.40	33-\$188.10	34-\$193.80	35-\$199.50
36-\$205.20	37-\$210.90	38-\$216.60	39-\$222.30	40-\$228.00	41-\$233.70	42-\$239.40
43-\$245.10	44-\$250.80	45-\$256.50	46-\$262.20	47-\$267.90	48-\$273.60	49-\$279.30
50-\$285.00	51-\$290.70	52-\$296.40	53-\$302.10	54-\$307.80	55-\$313.50	56-\$319.20

YOUR NAME _____ PHONE: _____

(PLEASE PRINT)

FIRM (NAME IN AD) _____

YOUR ADDRESS _____

CITY _____ STATE _____ ZIP _____

DATE: _____ YOUR SIGNATURE _____

(PLEASE PRINT OR TYPE COPY • FOR ADDITIONAL WORDS ATTACH SEPARATE SHEET)

GENEALOGY

FIND YOUR FAMILY HISTORY in the National Archive records searching at home. Free information. Archive Films, Dept. C21, Box 415, Hollis, NH 03049

TRAVEL AND RESORTS

FREIGHTER Cruises, First Class - Less than \$50 Daily! TravLips Association, Box 188N8, Flushing, NY 11358

FREE TRAVEL ANYWHERE IN USA. Three Guaranteed Methods. Free Details. National, Box 10053P, Largo, FL 33543

SPECIAL SERVICES

INFORMATION On anything. Ferguson Research Specialists, 60-15 Woodside, Woodside, New York 11377.

HEALTH, VITAMINS

ARTHRITIS - Bursitis Sufferers, New Arthritis Temporary Pain Relief. Arthrocare Aloe Vera Lotion is FDA Approved. Money Back Guarantee. \$13.95, 8 oz., Visa, Mastercard, Check. Add \$1.00 Shipping. Alabama Electrolysis, 229 Noble Avenue, Montgomery, AL 36104

GARDENING & LAWN CARE

MOLES - Rid Your Yard of Moles Easily. Send \$3.00. Darrell Moore, R8 Box 157, Edwardsville, Illinois 62025

GROW MORE VEGETABLES. Avoid mistakes. Expert's garden. Customized computer generated garden plan. Free Brochure. FGPPM, P.O. Box 159, Enfield, Connecticut 06082

THE ULTIMATE EDGER. Today's Edging with Tomorrow's Technology. For Free Information: 4941 Hialeah, Abilene, Texas 79606

FLOWERS, PLANTS & NURSERY SUPPLIES

GROW GINSENG. Very Profitable. Have seeds, roots. Golden Seal. Complete information. K. Collins, Viola, Iowa 52350

RECIPES, COOKING, ETC.

DELICIOUS POLYNESIAN APPETIZERS!! 27 recipes. Great for parties or snacks! \$3.25. HoChoy Enterprises, Box 2589PM, Cambridge, Mass. 02238

HEARTY WINTER CHILI. 20 Mouth-Watering Recipes To Warm You! Variety. Send Only \$2.00! Precious Service, 7000102 Carriage, Brecksville, Ohio 44141

NEW ZEALAND Famous Pavlova Dessert \$3 Airmailed. Muller, Box 5, Waipu, New Zealand

VEGETARIAN COOKBOOK. Over 777 Recipes. \$4.50. Rhoberly Enterprises, 5670 Ash Street, Suite #1, Dept. PMB, Los Angeles, CA 90042.

BEST Chinese Chow Mein. Delicious Recipes. \$2.00. Box 23525, Minneapolis, MN 55423

1000 MEALS UNDER 50¢. SEND \$2.00. Penny Gourmet, Box 916Y, Sanibel Island, FL 33957

WINEMAKING, BEERMAKING, ETC.

WINEMAKING-BEERMAKING-GASOHOL. Free Supply Catalog. Yeast Equipment. Continental, Box 188PM, Casselberry, FL 32707

WINEMAKERS-BEERMAKERS— Free Catalog—Fast Service—Large Selection: Kraus, Box 7850-L, Independence, Missouri 64053.

WINEMAKERS-BEERMAKERS Fresh Stocks, Fast Service, Free Catalog. O'Brien's, Box 284D, Wayne, IL 60184

BEER LOVERS — Brew your own. Delicious! Inexpensive! Free Catalog. Beer Gear, Box 25093M, Lansing, Michigan 48909

BEERMAKERS ONLY! Free Catalog/Newsletter. William's, Box 461M, Oakland, California 94604.

BEERMAKING-WINEMAKING We're #1. Free Catalog. Vineyard & Brew, P.O. Box 401-B, Sault Ste Marie, MI 49783

CIDER CHAMPAGNE - Make Sparkling Alcoholic Drink. \$2 to: Phil Reed, 1107 E. 3rd #8, Long Beach, CA 90802.

WINE/BEER MAKING Catalog: B&J Enterprises, 1845 South 19th, Springfield, Illinois 62703

DISCOUNT BEVERAGE SUPPLY CO. now selling direct! P.O. Box 248, Villas, NC 28692

FREE ENCYCLOPEDIA Winemaking, Beermaking Supplies, Equipment, Ingredients. Vynox, P.O. Box PM15498, Rochester, NY 14615

FREE BEERMAKING BOOK Plus Catalog. Finest Equipment, Ingredients. Fully Guaranteed. SPI, Box 784-M, Chapel Hill, NC 27514

MAKE QUALITY BEER. Wine. Free catalog. Village Store, Box C-51PM, Westport, MA 02790

FREE BEERMAKING CATALOG. Quality. Selection. Lowest prices anywhere. **HOME BREW**, Box 158M, Haslett, Michigan 48840

KAHLUA and IRISH CREAM Homemade at 1/2 Retail Price! \$3.00. Kair Recipes, 107 Bracebridge Cres. S. W., Calgary, Alberta, Canada T2W 0Y6.

BURGLAR ALARMS & HOME PROTECTION

OUTDOOR SECURITY PROTECTION- Homes, Farms, Cabins, Driveways. Easily Install Yourself. Information. Detect Alarm, Rt. 1, Erhard, MN, 56534

WARNING Cards. Proven home Warehouse. 20 for \$5.00 Check. HGCO, 2150 Cross, Eugene, Ore. 97402

PREVENT FROZEN PIPES! MONITOR TEMPERATURE BY TELEPHONE. Information. H&M Manufacturing, Box 143, Haddon Heights, NJ 08035

HI-TECH SECURITY PRODUCTS. Everything from top quality hardware and plug in burglar & fire alarms to sophisticated glass break sensors and infrared motion detectors. Name brand equipment at discount prices to protect your family and business. Free brochure. 45 page catalog, \$1.00 (Refundable). **ADVANCED SECURITY**, Box 156, Dept. 88, Dekalb, IL. 60115

To Celebrate Our 10 Millionth Sale!
FAMOUS "MULTI-WRENCH"

(Fits every size nut and bolt)

**ONLY \$2
WITH THIS AD**

This is *NOT* a Misprint.

This special offer is being made to celebrate the 10 millionth sale of the famous New York importing firm of Abernathy & Closther. It is open to every person who mails this original printed ad to the company address (below) before Midnight, April 25, 1984.

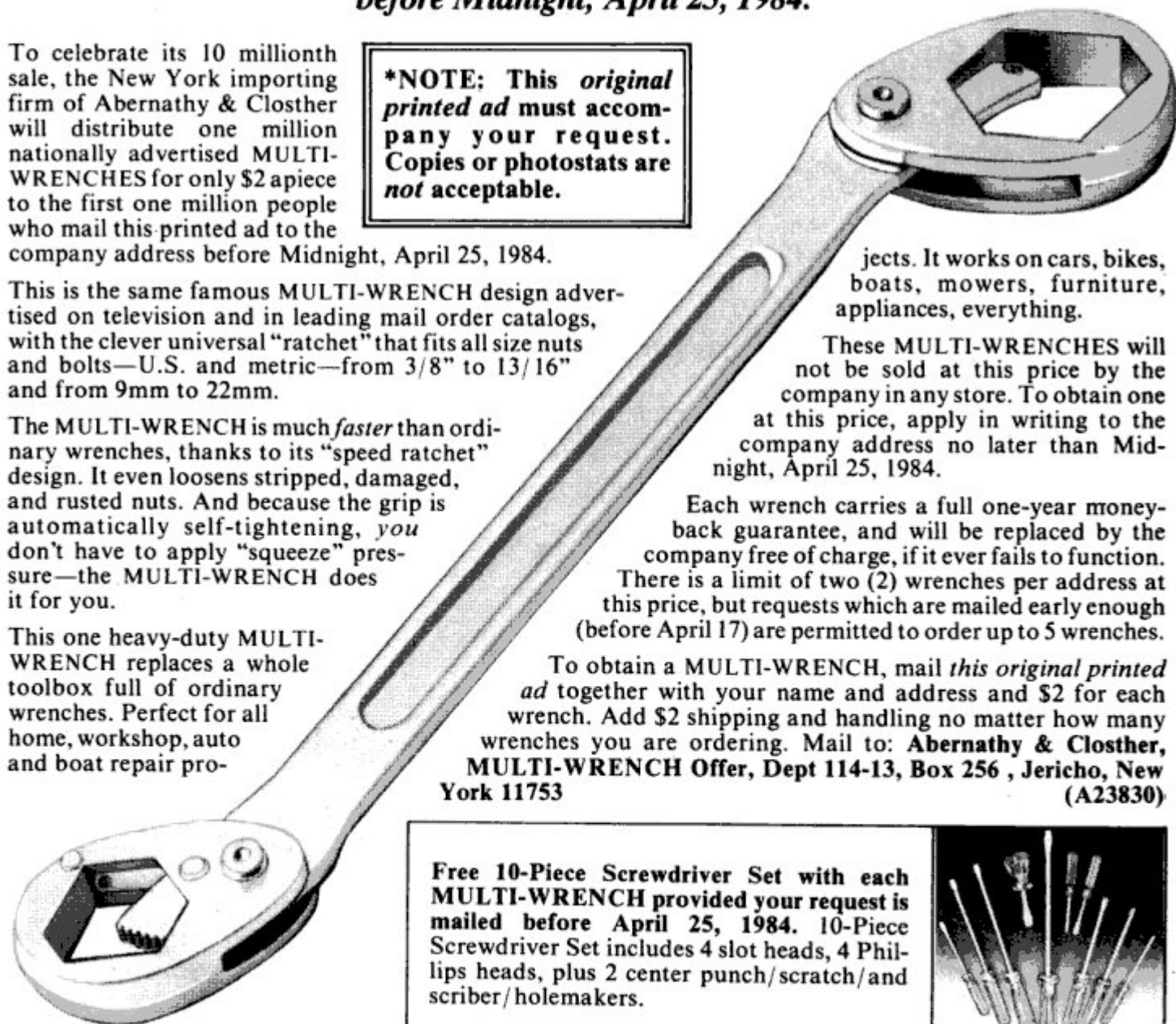
To celebrate its 10 millionth sale, the New York importing firm of Abernathy & Closther will distribute one million nationally advertised MULTI-WRENCHES for only \$2 apiece to the first one million people who mail this printed ad to the company address before Midnight, April 25, 1984.

This is the same famous MULTI-WRENCH design advertised on television and in leading mail order catalogs, with the clever universal "ratchet" that fits all size nuts and bolts—U.S. and metric—from 3/8" to 13/16" and from 9mm to 22mm.

The MULTI-WRENCH is much *faster* than ordinary wrenches, thanks to its "speed ratchet" design. It even loosens stripped, damaged, and rusted nuts. And because the grip is automatically self-tightening, *you* don't have to apply "squeeze" pressure—the MULTI-WRENCH does it for you.

This one heavy-duty MULTI-WRENCH replaces a whole toolbox full of ordinary wrenches. Perfect for all home, workshop, auto and boat repair pro-

***NOTE: This original printed ad must accompany your request. Copies or photostats are not acceptable.**



jects. It works on cars, bikes, boats, mowers, furniture, appliances, everything.

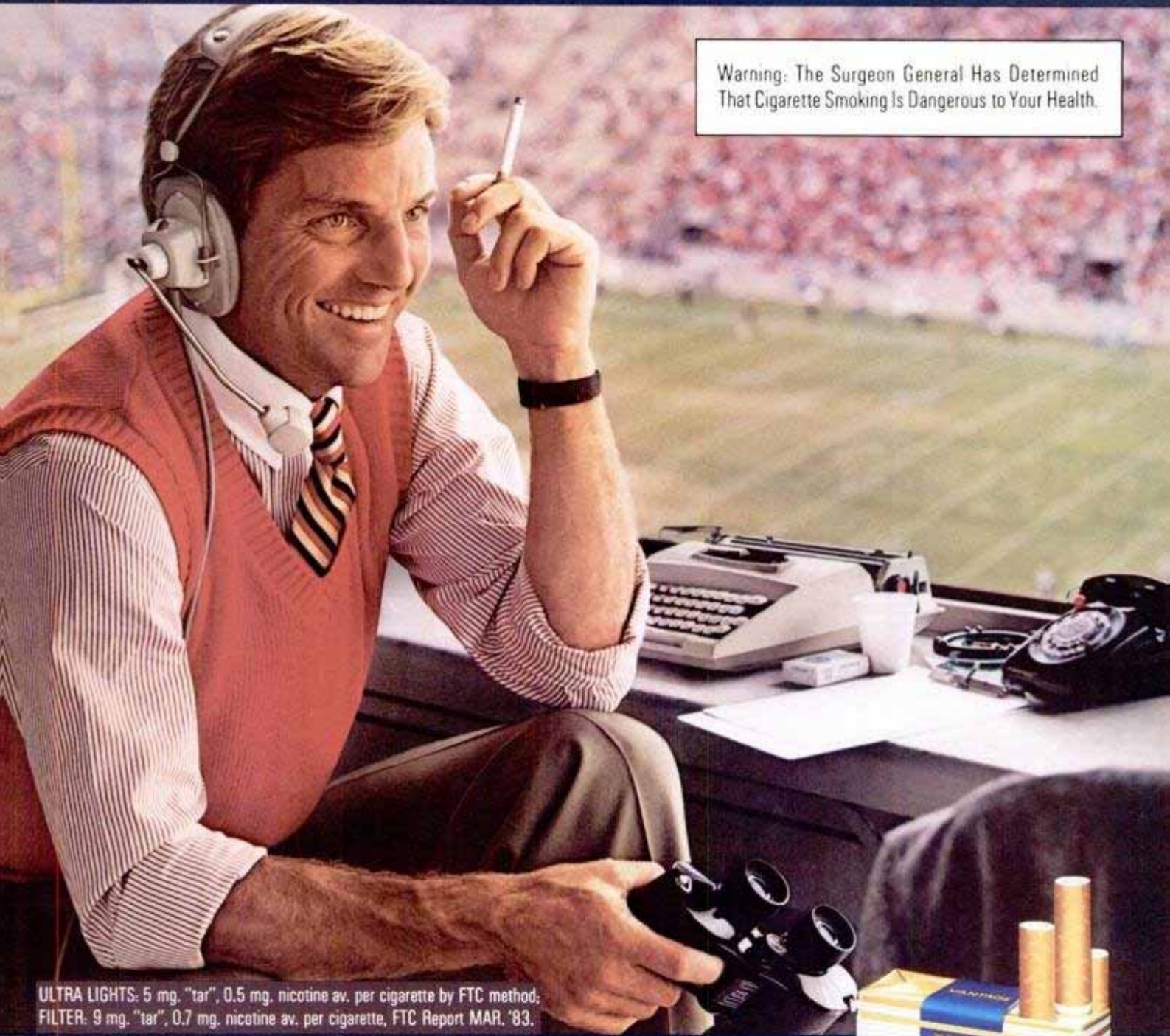
These MULTI-WRENCHES will not be sold at this price by the company in any store. To obtain one at this price, apply in writing to the company address no later than Midnight, April 25, 1984.

Each wrench carries a full one-year money-back guarantee, and will be replaced by the company free of charge, if it ever fails to function. There is a limit of two (2) wrenches per address at this price, but requests which are mailed early enough (before April 17) are permitted to order up to 5 wrenches.

To obtain a MULTI-WRENCH, mail *this original printed ad* together with your name and address and \$2 for each wrench. Add \$2 shipping and handling no matter how many wrenches you are ordering. Mail to: **Abernathy & Closther, MULTI-WRENCH Offer, Dept 114-13, Box 256, Jericho, New York 11753 (A23830)**

Free 10-Piece Screwdriver Set with each MULTI-WRENCH provided your request is mailed before April 25, 1984. 10-Piece Screwdriver Set includes 4 slot heads, 4 Phillips heads, plus 2 center punch/scratch/and scribe/holemakers.





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

ULTRA LIGHTS: 5 mg. "tar", 0.5 mg. nicotine av. per cigarette by FTC method; FILTER: 9 mg. "tar", 0.7 mg. nicotine av. per cigarette, FTC Report MAR. '83.

VANTAGE. THE TASTE OF SUCCESS.



Great Taste
with Low Tar.
That's Success!

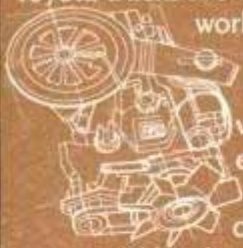


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The new generation 1984 Toyota trucks are turning the truck world upside down, because they're the most advanced trucks ever built. But if one truck had to do it all by itself, this would be the one.

It's the all-new Standard Bed with a big, powerful 24 liter SOHC engine, powering a 1400-pound payload* with ease. However, the biggest news is the price — \$5,998** — making it Toyota's lowest-priced truck. Low price doesn't mean compromise, either. Besides the 24 liter SOHC engine, 4-speed synchromesh transmission, and fully transistorized



ignition, the Standard Bed comes with all this equipment: power-assisted brakes with ventilated front discs and rear drums, steering-column controls designed for ease of operation, mist cycle wipers with twin stream washer, and the comfort of full three-across seating.

This truck is designed to be easy on the eyes. But the exciting new wedge-shaped front is not just for good looks. It's part of overall improved aerodynamics. Add-



ing to the lowered drag coefficient are the new flush surfaces on the

OH WHAT A FEELING!
TOYOTA

front and side windows with the bonus of reduced wind noise. The Toyota Standard Bed.



It'll measure up to your tough demands for an all-around machine. And you'll see why it's one of the new generation 1984 Toyotas turning the truck world upside down.

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

MOST ADVANCED TRUCKS EVER BUILT!

THE NEW GENERATION
TOYOTA STANDARD BED.
IT MAKES HARD WORK LOOK EASY.



NO SWEAT!