

DECEMBER 1984 \$1.50

# Popular Mechanics

**PLANS: MAKE YOUR OWN FRENCH DOORS**  
They Look Great And Help Retain Heat, Too



**AUTOMOBILES—THE FIRST 100 YEARS: Who Built The First Car?**

**PLANS**  
6 Classic Wood Toys To Make In Time For Christmas

**ROAD RACING, RUSSIAN STYLE**  
An Exclusive Inside Report

**HOME ANTENNAS**  
The Right Choices For VCR Taping, TV And Radio

**PM PROFILE**  
Dom DeLuise And His Home Workshop

## 15 NEW KIT PLANES YOU BUILD

**Fly 'Em Without A License**



The Buccaneer: A 250-Pound Amphibian Built From A Kit



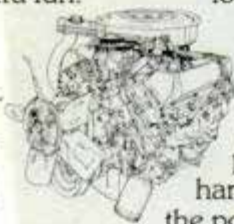


# America's best-selling pickups: Ford.

Big Ford Pickups are America's best sellers year after year.\* '85 power choices for the full-size F-Series include high-torque V-8's big as 7.5L and mighty 6.9L diesel.

For '85, Ford puts real power in the hands of America's pickup owners. Power that means quick response, easy hauling, extra work output—and extra fun.

You get a choice of five engines, including husky 6.9L diesel—the most powerful in any pickup. Ford's 5.8L High Output V-8 with 4-barrel carb



gives you 45 more horsepower than Chevy's mid-size V-8! And every Ford engine from standard 4.9L Six up leads its nearest competitor's in load-moving torque.

### Big Ford Payloads.

The trend today is to use pickups for bigger, harder hauls. Ford has the power you need. And the payload—up to 5,730 lb. worth. Plus the

ability to tow trailer loads big as 12,500 lb. when properly equipped.

Nobody else gives you so many pickups to pick from. Roomy Regular Cab models. Exclusive SuperCab with folding rear bench seat



option. Or 4-door Crew Cab, now with single or dual rear wheels.

### Built Ford tough.

These big Fords all come with 2-wheel drive. Or as 4x4's with unique

independent front suspension.

And they all come tough—Ford tough, from exclusive Twin-I-Beam up front to galvanized double-wall box in back.

### Quality is Job 1.

This isn't just a phrase. It's a commitment to total quality, which begins with the design and engineering of our trucks and continues through the life of the product. And the commitment continues for 1985. Ford is determined to build the finest trucks in the world.

### Lifetime Service Guarantee.

As part of Ford Motor Company's commitment to your total satisfaction, participating Ford Dealers stand behind their work, in writing, with a Lifetime Service Guarantee. No other car companies' dealers, foreign or domestic, offer this kind of security. Nobody. See your participating Ford Dealer for details.

\*Based on latest available registration data. †Optional, not available in California or with manual transmission. Horsepower based on SAE Standard J1349.



"My Ford Pickup & Me"



**FORD PICKUP**  
**AMERICA'S TRUCK** **BUILT FORD TOUGH**





Get it together—Buckle up!



# Built to take it. All.

Ford Club Wagons out-power, out-tow, out-room any other wagons. And for '85, they give you peak performance in your choice of high-output engines—both gas and diesel.

Here's where you find all the room and power that's missing in today's small minivan wagons.

Ford Club Wagons give you the true luxury of spacious design. No other wagons, big or small, provide so much usable space—for people and/or cargo. You can seat up to 12 in roomy comfort (15 in Super Wagon).

#### More power to you.

What a power choice you get! Five engines, from biggest standard Six to the biggest V-8 in any

wagon. Included: husky 6.9L diesel, the most powerful in its class. Plus Ford's 5.8L High Output V-8 with 4-barrel carb\*... and 27% more horsepower than Chevy can offer you.

#### Tops for towing.

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Ford's out-front design gives you extra room plus easy walk-through to the rear. Power steering is standard. Options include speed control/tilt wheel...and new power door locks/windows.

You can choose buckets or Captain's Chairs up front. Plus rear bench seats with quick-remove feature for increased cargo space and flexibility of use.

For a wagon that's great for everything from family use to recreation to van pooling—join the Club!



#### Quality is Job 1.

This isn't just a phrase. It's a commitment to total quality, which begins with the design and engineering of our trucks and continues through the life of the product. And the commitment continues for 1985. Ford is determined to build the finest trucks in the world.

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\*Optional: not available in California or with manual transmission.



"My Ford Club Wagon & Me"



**FORD CLUB WAGON**  
**AMERICA'S TRUCK** **BUILT FORD TOUGH**



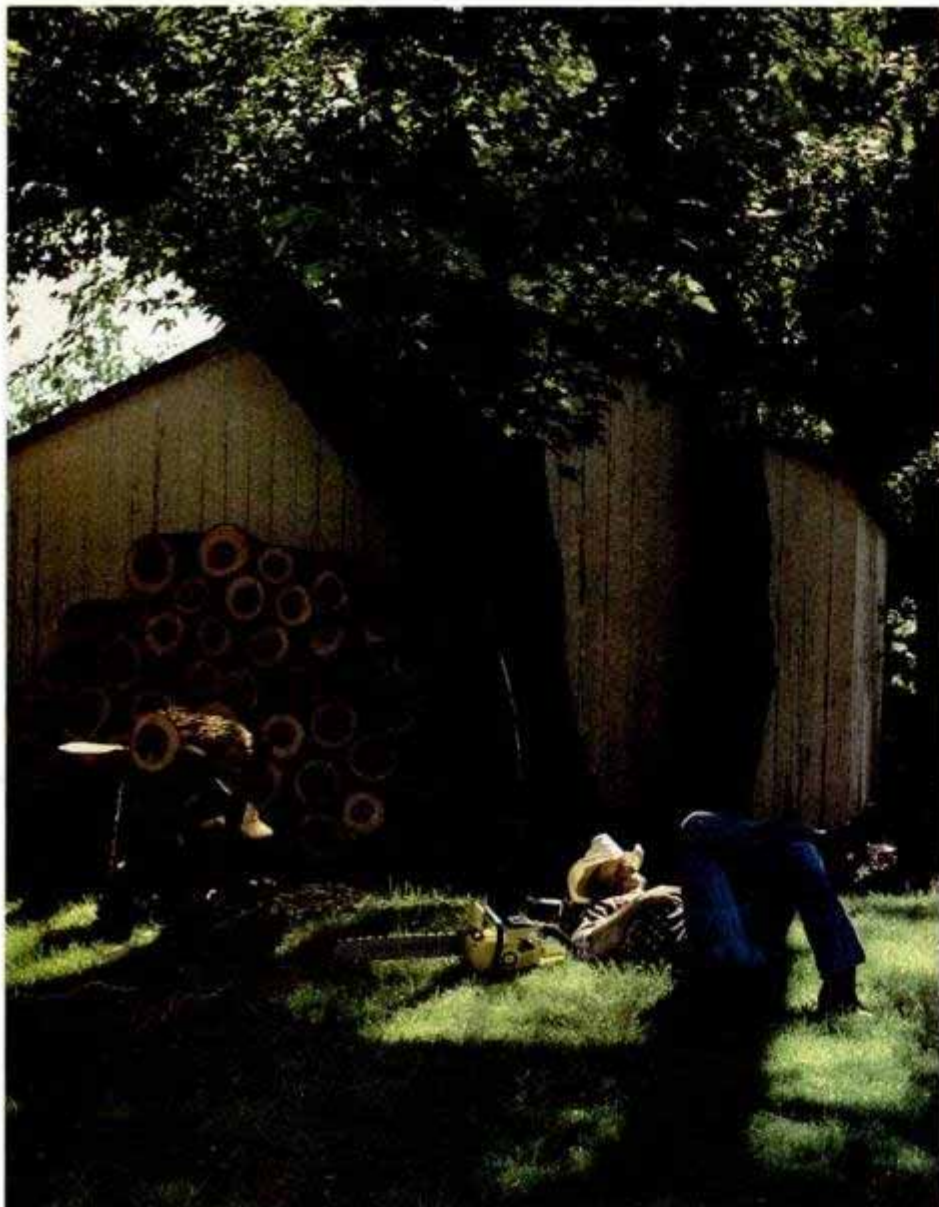


Get it together. Buckle up!

This One  
KSU9-ECH-AC31

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## John Deere Chain Saws give you time for the more important things in life.

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### ON THE COVER

Now you can fly your own amphibian—and without a license, too. The Buccaneer flying boat, which takes to either land or water, is typical of the new breed of sophisticated ultralights that are revolutionizing sport flying. See the exciting story on page 90.

—PM photo by  
Howard Levy

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# A table of

1. Full-size interior with enough room to seat six full-size adults.
2. Reclining front seats with finely woven cloth seating surfaces.
3. Luxurious, deep cut-pile carpeting.
4. AM/FM stereo radio with 4 speakers for full, rich sound reproduction (may be deleted for credit).
5. An electric clock with the precise accuracy of quartz movement.
6. Sound insulation that's so effective, it's called Super Luxury.
7. Careful attention to detail like carpeted lower door sections and conveniently located courtesy lights.
8. Carpeted, deep-well trunk, with low lift-over access. It's so roomy that no car sold in America has one larger.
9. Standard padded rear half vinyl roof with brushed aluminum wrapover molding for an elegant appearance. Optional Brougham roof treatment shown.
10. 5.0 liter V-8 engine with electronic fuel injection. Because, after all, it takes more than comfort and good looks to make a luxury car luxurious.
11. Automatic Overdrive transmission that reduces engine wear by lowering engine RPMs at highway speeds.
12. Solid body-on-frame construction for a secure, stable ride.
13. Full coil suspension system that soaks up minor imperfections in the road's surface.
14. New gas-filled shock absorbers for the smoothest riding LTD Crown Victoria to date.



**Ford LTD Crown Victoria.**



# contents.

15. Standard, steel-belted radial, white-wall tires, for sure-footed traction and low rolling resistance.
16. An optional automatic load leveling suspension that with the trailer towing package keeps LTD Crown Victoria riding smooth and level whether you're towing 5,000 pounds, or just carrying luggage.
17. The option of speed control for reduced fatigue on long trips.
18. The comfort and convenience of optional pivoting front vent windows.
19. Optional power windows with a lock-out switch for added convenience.
20. Available automatic climate control to keep your environment as you like it.
21. Optional 6-way power seat adjustments for the most comfortable seating position possible.
22. Available tilt steering wheel for great comfort and easy ingress and egress.
23. The security of your participating Ford Dealers Free Lifetime Service Guarantee. See your dealer for details.
24. The dedication to quality and craftsmanship. At Ford, "Quality is Job 1."
25. The comfort of knowing you're driving one of the most luxurious Fords ever built.

Have you driven a Ford... lately?



The luxury Ford.

Get it together—Buckle up.



# LETTERS TO THE EDITOR



## Mass-made model

I made a bunch of model racers from your excellent plans (*4 Great Playthings To Make For Youngsters*, page 118, May '81). I made one change, however. Instead of the plastic canopy, I hollowed out the cockpit so my sons could fit in their toy figures, as you can see in the photo (right).

The racers are simple to make, can be mass-produced quickly and make great Christmas presents. All the kids love playing with them. Thanks,

RODDY J. GLOVER  
CONCORD, CALIF.

*Thanks for the photo. The lifelike driver does add a nice touch. For others*



**A simple toy you can turn out fast: PM's model racer made by reader Roddy Glover.**

*who may be interested, photocopies of the racer plans are available for \$1 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.*

## Mystery solved

Thank you for clearing up the mystery of the missing Snow Cruiser (*Letters*, page 8, Aug. '84). I saw this monster in 1940 as it was being driven across Ohio from the Goodyear factory in Akron. I've often wondered what happened to it. Now I know.

EUGENE GUNSETT  
CONVOY, OHIO

## Wrong-way froe

In your article *Jimmy Carter, Craftsman* (page 73, Aug. '84), you said in a caption under a picture that "With a froe, the tree trunk is cut into sections." I'm sure Mr. Carter knows that a froe is used only to split wood, not crosscut it, but apparently your caption writer doesn't.

RICHARD D. NICHOLS  
JACKSONVILLE, FLA.

*You're right; the mistake was ours, not Jimmy Carter's.*

## Smart squirrels

I enjoyed building your squirrel-proof bird feeder (*Make This Squirrel-Proof Bird Feeder*, page 109, Mar. '83). But my squirrels must be smarter than yours because they had no trouble getting at the seed. What they couldn't reach through the hardware cloth on top, they got by simply chewing holes in the screen on the bottom.

If any other readers are having the

same problem, they might like to know how I solved it (I think). I covered the bottom screen with hardware cloth to prevent it from being chewed. I also added a second layer of hardware cloth on top, slightly offset to make the openings smaller. This keeps out the squirrels, but small-beaked birds like nuthatches, wrens and chickadees can easily reach the seed.

WALTER L. PROCKO  
COLUMBIA, S.C.

## Tipsy trailer?

Your trailer cart for a bicycle (*Build a Carry-All Bike Cart*, page 64, May '84) may seem like a clever idea, but it won't work. Since a bike must lean to make a turn, the cart will ride up on one wheel, very possibly causing both it and the bike to tip over. I'm surprised that you would publish such a dangerous idea.

KATHY SUMMERSGILL  
WARREN, N.J.

*We checked this point out carefully before publishing the design. The cart is not rigidly attached to the bike. The swivel connector used in the towbar provides sufficient play to allow the bike to lean while the cart wheels remain flat on the ground.*

## A vote of confidence

My wife and I had a nice chuckle over the reader who wondered about the stability of your "gravity" bookshelves

(*Letters*, page 8, Aug. '84). I too questioned their sturdiness, but my wife said: "Just build them the way PM says and they'll work."

Lo and behold, they did. They're not only an attractive conversation piece, but they're remarkably solid.

PERRY CRATES  
BEND, ORE.

*Thanks for letting us know. The shelves appeared in the article 4 Handy Home Accessories (page 102, Apr. '84). For others who may be interested, photocopies of the article are available for \$2.50 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.*

## Those were exciting days

I've been fascinated by aviation ever since I read your September 1909 issue (which I still have). It talked enthusiastically about such momentous events as Louis Bleriot's crossing of the English Channel and Glenn Curtiss's record-setting endurance flight of 52 minutes, 30 seconds.

Not every one was as optimistic as you in those days. A history of the United States published in 1911 had this to say about the future of aviation: "It is hardly probable that the art will ever be of much practical importance in the commercial world."

The continuing excellence of your aviation articles has certainly helped to encourage enthusiasm for one of man's greatest achievements.

CLARENCE JEFFERSON  
LINDEN, N.J.

## The price of protection

Our client, Argent Fabricating Inc., greatly appreciated your report on its chip protection kits for cars (*The PM Garage*, page 28, July '84). However, in quoting the kit price of \$19.95, you neglected to mention that there is an additional shipping/handling charge of \$3.50 and a 4 percent sales tax for Michigan residents.

CHARLES H. BROWNELL  
CHARDEN CO.  
TROY, MICH.

*We regret any inconvenience this has caused Argent and our readers. PM*





# CAMEL LIGHTS

It's a whole new world.

Today's  
Camel Lights,  
unexpectedly  
mild.



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.



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HARDWARE STORES®

**TOOL VALUE  
OF THE  
MONTH**



**7<sup>77</sup>**

Sizes  
1/4"-5/8"  
and  
8-13mm.

**11-pc. Master Mechanic®  
Combination Wrench Set**

Top quality, drop forged, chrome vanadium steel. Hurry! Offer good from Nov. 10 only, while supplies last at participating True Value Hardware Stores.

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VALUE  
OF THE MONTH**

**10<sup>88</sup>**

Carol® 20'

**Retractable Reel Light**

Has 3-wire SVT cord and side outlet, grounded metal guard, mounting hardware. Act fast! Offer good from Nov. 20 only, while supplies last at participating True Value Hardware Stores. 44610

There are more than 6,000 True Value Hardware Stores and Home Centers in 50 states. Look under "Hardware" in the Yellow Pages.



**EDITOR'S  
NOTES**

**T**he 100th anniversary of the automobile is coming up (or already past, depending on who gets credit for inventing the first car; see *Centennial On Wheels*, page 75). During our search for the origin of the species, Auto Editor Wade Hoyt visited the Daimler-Benz Museum in Stuttgart. Daimler and Benz are traditionally credited with inventing—separately—the first practical gasoline buggies in 1886. But Daimler built a crude wooden-wheeled gasoline motorcycle in 1885. Hoyt climbed aboard a replica of the rickety two-wheeler (complete with original-design training wheels) in the museum. He didn't even ask about starting the engine, having learned that the single-cylinder powerplant had set the saddle afire on the cycle's maiden voyage. While controversy continues over the first auto, this must certainly be the first motorcycle. . . . **You may be as surprised** as we were to learn the extent of car racing in the Soviet Union



Hoyt risks a hot seat.



Kuuse with a "recycled" Volga.

(*Auto Racing, Soviet Style*, page 86). It's an amateur sport, but government-sponsored sports clubs offer amazing perks to the racers—from free race cars to parts and even travel expenses. Our author, Margus H. Kuuse, is an Estonian who lives in Tallinn, the capital of his country. A racing fan since childhood, Kuuse is one of only a handful of automotive writers in the Soviet Union. His fulltime job is automotive editor of *Tehnika ja Tootmine*, a technical journal. The photo shows him outside a shop that "recycles" (rebuilds) cars. The car is a Volga, ready for mechanical transplants. . . . **Photographing the ultralights for 15 New Kit Planes** (page 90) was tricky. The photo plane had to be throttled down to near-stalling speed to stay with the slower lightweights. At that speed, a plane can be a pretty unstable camera platform. But pilot Ben Schiek applied his steady hand to his '46 Funk, and our guys Howard Levy and Shel Gallagher got the pictures.



Gallagher with Schiek in a Funk.

*John A. Sillitler*





**Now they last even longer.  
(Something to bear in mind this Christmas.)**

With all the new toys and gifts around at Christmas, it's a good idea to pick up an extra supply of DURACELL® batteries.

Our batteries are, after all, famous for their long life.

Being famous, however, doesn't stop us from trying to find ways to improve them.

As a result, today's DURACELL batteries last up to 20 percent longer than the ones we made just three years ago.

And we'll keep right on improving them.

Frankly, we couldn't bear to do it any other way.



**When it comes to making them last longer,  
we never stop.**



# IMPORTS & MOTORSPORTS



## Double take in Mitsubishi's '85 lineup



Mirage Turbo engine is 1.6-liter ohc Four.

Has it been two years since I strolled into a brand-new Mitsubishi dealership wearing my factory worker's cap with the now-familiar red diamonds emblem? My prize souvenir from visiting Mitsubishi in Japan caused a lot of

double takes. That dealer is now an established part of automobile row near me, and the Starion, Cordia and Tredia, unknown two years back, are numerous and easy to spot. For '85, those successful sellers are little changed, but they're joined by two new models, one a hot-shot subcompact and the other a loaded, luxury sedan.



Galant's got electronic o.d., suspension, steering; radio controls on steering wheel.

The Mirage at its hottest is 102 hp. The Galant's a smoothie you can drive with your fingertips. It's got electronics everywhere. You'll go to the showroom just to play with this one.

## Them's the brakes

In your '85 Mercedes, with antilock brakes and some good luck, you'll never run into anything again. But watch your rear. The trick will be to position yourself so other cars don't get you from behind. Antilock is M-B's good news for its '85 models. The bad news is we'll have to wait until sometime next year before the fusty 300D and TD wagon are sent to the Mercedes museum. Redesigned mid-range models aren't ready yet.



Mercedes-Benz mid-size sedans get a pinched-tail treatment similar to the 190.

New mid-size Mercedes is due here in '85.



## Son of a gun Vanagon

Ain't no mountain high enough to stop this Volkswagen Vanagon. It seems to be teetering at the top, but all is well. It has just crested and is in a fully controllable, careful descent. Easy when you've got four-wheel drive, which is what Vanagons in Europe will get in 1985. The one that PM caught at play is strictly a prototype. It appears no higher than 2wd Vanagons despite the drive shaft that runs forward to power



Four-wheel-drive version of the VW Vanagon will take you places you've never been.

the front wheels. The 4wd option will be available on all versions of the Vanagon, but seems especially appealing for the camper.

## Biturbo tweak

The appearance of Maserati's Biturbo sports sedan may be just too unassuming for some buyers who otherwise appreciate its merits (see *Imports & Motorsports*, page 10, June '84). For owners who want the rally sport look



Handling and appearance kit for Biturbo includes body and suspension parts, wheels.

with a little extra in the handling department, too, there's a \$3,500 kit from the Maserati Information Exchange. MIE is at Box 772, Mercer Island, Wash. 98040.

PM





**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 cranking in even the worst temperatures. And if you need service anywhere, we have over 105,000 dealers all across America to help you.

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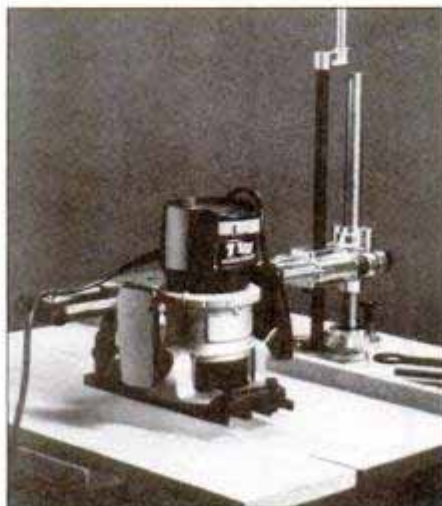
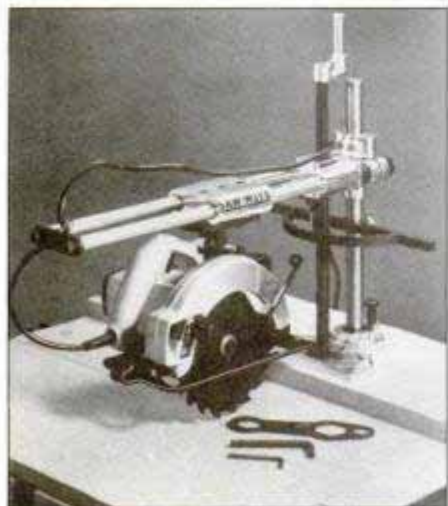
**INTERSTATE  
BATTERIES**



# THE PM WORKBENCH



## Double-duty tool conversion kit



The radial-arm saw conversion kit consists of a saw carriage clamp, two tubular-steel guide rods and an elevation crank. A similar router adapter kit is also available (right).

The Saw-Mite radial-arm saw kit converts most 7 $\frac{1}{4}$ -in. and 7 $\frac{1}{2}$ -in. circular saws into a radial-arm saw. Simply clamp the saw to the carriage to crosscut, rip, miter, bevel, dado and rabbet. The 23-pound kit is capable of a 12 $\frac{1}{4}$ -in. cross-cut and a 15 $\frac{1}{4}$ -in. rip cut. Maximum depth of cut at 45° is 2 in. and 2 $\frac{1}{4}$  in. at 90°. A router adapter kit (\$24.50) is also

available for performing pin router and shaper operations. The Saw-Mite kit is sold for \$130, not including the saw. A sturdy saw table with nonwarping top is available for \$40. For further details and information, you should contact Pippin Corp., which is located at 2696 Lavery Court No. 6, Newbury Park, Calif. 91320.—J.T.

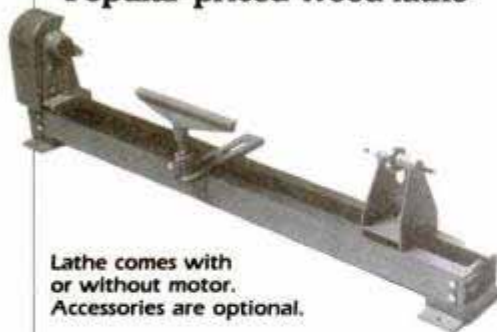
## Mini moisture meters

Woodworkers know that if wood isn't dried and seasoned properly, it will crack, bow and twist. Lignomat, Box 30145-PM, 14345 Northeast Morris Court, Portland, Ore. 97230, now offers two pocket-sized moisture meters. The Mini-Ligno (\$110) has a moisture measuring range from 6 to 20 percent, which is sufficient for most woodworkers. The Mini-Ligno E (\$120) has a range from 6 to 36 percent for people who dry their own lumber and firewood. Contact the maker for details.—J.T.



Pocket-sized meters display the moisture content of wood on an LED scale. Press the probes into wood for an automatic reading.

## Popular-priced wood lathe



Lathe comes with or without motor. Accessories are optional.

Williams and Hussey Machine Co., Elm St., Milford, N.H. 03055, has made a home workshop wood lathe more affordable. Their Model L82 12-in. lathe is offered without a motor (\$239), with a  $\frac{1}{3}$ -hp motor, belt and four-step pulley (\$295) or with a  $\frac{1}{2}$ -hp motor, belt and four-step pulley (\$309). The lathe has a 12-in. swing over the bed and measures 38 in. between centers. Features include cast-iron head and tailstock, ball-bearing construction and precision-ground-steel bed ways.—J.T.

## Brace converter



The brace is a popular tool, but it has trouble gripping round-shank bits. This converter fits in the brace and holds standard bits. It's \$20.50 from Garrett Wade, 161 Ave. of the Americas, New York, N.Y. 10013.—J.T.



Brace converter has a tapered square shank gripped securely by the brace (left). The precision-machined three-jaw chuck accepts standard drill bits up to  $\frac{1}{8}$ -in. dia.

## A quick-grip fastener

Black & Decker has developed a drywall anchoring system called Grip-It. Simply drive the twist anchor into a hollow wall using a screwdriver—no pilot hole or hammering is required. The anchor cuts its own hole entry and is removable for use elsewhere. Grip-It twist anchors and screws are at hardware stores and home centers in eight-piece (\$2.59) and 16-piece (\$4) kits.—J.T.



Drive twist anchor into drywall with screwdriver. Then, turn screw into the anchor.

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



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## Black & Decker

Introducing a revolution in power tool technology, the M47 Series™ Drill. From Black & Decker.

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\*Side handle will be included FREE with purchase of the M47 Series 3/8" Variable Speed Reversing Drill (model #7144), thru 12/31/84.

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## HINTS FROM READERS

### Making blind keyhole cuts

I improvised a tool for making keyhole-shaped slots in wooden plaques that I wanted to hang on a wall. It's a toothed cutter mounted on a 3/16-in.-dia., high-speed-steel, single-fluted router veining bit having a 1/4-in. shank. The wheel-like cutter is made from a 9/64-in. section of 3/8-in.-dia. carbon-steel drill rod.

First, drill a slightly undersized center hole in the drill rod stock with a No. 21 twist drill about .040 in. (1 mm) off center. The off-center position compensates for the fluted part of the router bit being off center with respect to its shank.

Use the router bit to ream the hole part way before driving the bit—cutting edge at the thin side of the wheel—into the hole until it projects about 3/32 in. past the wheel.

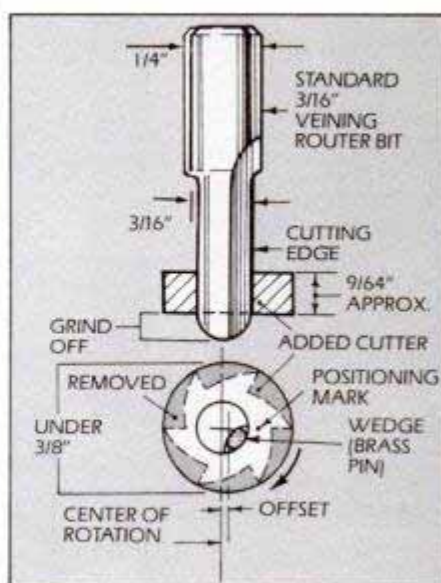
Insert the router bit into the collet chuck of a lathe and grind the drill rod



Use the cutter on a drill press after making a 3/8-in.-dia. hole at least 1/16 in. deeper than the cutter wheel thickness.

surface (and router bit tip) down slightly to make it run true. Make a punch mark on the rod stock to reposition the router bit later.

Form the cutter teeth with a jeweler's saw and slender files. Tooth notches are shallower on the thinner part of the blank. Harden and temper the cutter, then reinstall it on the bit. Make a wedge from a brass escutcheon pin, drive it into the space between the



cutter and router-bit flute, and trim it. Fill the remaining space with epoxy glue.—Walter E. Burton



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# Are you using car for you



The EPA says that you can get 49 miles out of a gallon of gasoline.

If you aren't getting that kind of mileage from your brand of gas, maybe you should think about changing your brand of car.

We recommend you try the new Honda Civic CRX HF. It was made for high mileage.

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First, the shape of the CRX is aerodynamically right for less wind drag.

It has the right kind of tires. Special steel-belted radials with low rolling resistance.

There is a 5-speed manual transmission. And there is a tachometer, and an Economy Driving Indicator light to tell you the right moment to upshift



# ng the right r gasoline?



for maximum fuel economy.

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It also has the right amount of standard features. Which is right for a Honda.

With so much right, you really can't go wrong.

EPA estimated 49 city mpg, and EPA estimated 54 highway mpg. Use both of these estimated mileage figures for your comparison only. Your actual mileage may be lower, depending on driving speed, weather and length of trip. California estimated mileage figures will be lower.

**HONDA**

The Civic CRX HF





## Addressing Chrysler's camshaft problem

*On April 27, 1984, I had the oil changed and a new oil filter installed on my 1981 Dodge Aries at an Amoco service station. The mileage was 22,265. On July 3, 1984, at 26,788 miles, the camshaft had to be replaced at a cost of \$267. I've been told that the Atlas M44 filter recommended on the filter chart by Amoco is the wrong one, because oil can't reach the camshaft area when the engine is first started. Only the short, stubby-type filter, I'm told, can be used. Can you shed any light on this? I need facts to present to Amoco if I hope to get my money back.—Rev. W.A. Chamberlain, Frostburg, Md.*

The Atlas M44 filter is equivalent to the Mopar (Chrysler) L19 filter. It is larger than the stubby-type filter you mention, which is also called a T-cup

filter. The Atlas T-cup filter is M54.

Chrysler says that either of the two filters can be used on the 2.2-liter engine, which is the engine you have in your '81 Aries. The Atlas filter chart recommends the larger M44 for the 1981 2.2-liter engine and the M54 (T-cup) for 1982-'84 2.2-liter engines.

In any case, I doubt if the filter caused the camshaft to fail. Just like the Mopar L19 and T-cup oil filters, the Atlas M44 and M54 filters have anti-drainback valves to keep oil from draining out of the filter when the engine is shut down. With oil in the filter, there's an immediate resumption of oil pressure and flow that ensures instant lubrication when the engine is started.

You could have received a defective filter—one with a malfunctioning anti-

drainback valve. Have it tested by an independent lab. Write to Holger Sommer, Mechanical Engineering Dept., Carnegie-Mellon University, Schenley Park, Pittsburgh, Pa. 15213, if you can't locate a lab in your area.

If the filter isn't defective, then it's likely that the camshaft failed because of premature wear. This has been happening to early model 2.2-liter engine camshafts because the material originally used isn't able to withstand valve spring pressure. Chrysler has developed some revised valve train parts that will not wear excessively.

If this is the cause, you may be entitled to restitution from Chrysler. Check with the Chrysler zone office for your area, which is at 5 Chrysler Rd., Box 50, Natick, Mass. 01760.

## Dismal glow

*The car is a 1978 Buick Regal equipped with a 3.8-liter V6 engine. The problem was recognized when the oil pressure warning light on the dashboard started glowing after the vehicle was driven a few miles. The mechanic who checked the engine claims he found water mixed in with the oil and indicated that more and more 1978 and 1979 3.8-liter engines are beginning to show up with this condition. His "fix" is to change the oil and filter more frequently. Do you know anything about this? If so, can you offer another solution?—Ted Mierzejewski, Bayonne, N.J.*

We have to consider a couple of things. First, what's your driving range? Is it short distance (primarily less than 10 miles per trip)? If so, condensation can build up in the crankcase, mix with oil and form sludge that will restrict oil circulation. The fact that you might not be changing oil as frequently as you should to compensate for short-distance driving would be a factor. If this is the case, your mechanic's suggestion to change oil and filter often certainly is valid. But unless you've been unusually negligent, it's hard to believe that condensation could create enough sludge to cause a noticeable loss of oil pressure.

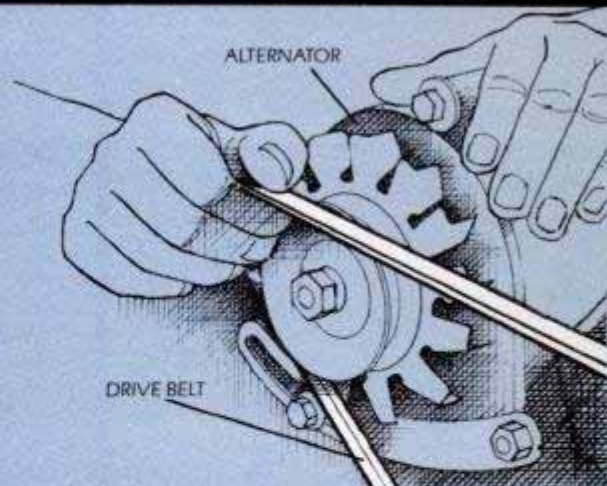
There's another possibility. The engine could have an internal coolant leak. Pressure-testing the cooling sys-

tem will usually reveal if such a leak exists, as the leaking water jackets won't hold pressure. However, some internal leaks may cause pressure loss only when the engine is hot.

On the other hand, an internal cool-

ant leak that is severe enough to cause oil pressure loss should be enough to cause the oil to look unusual. Drive the car a short distance, stop and pull the dipstick. If the oil is gray, coolant and oil

*(Please turn to page 22)*



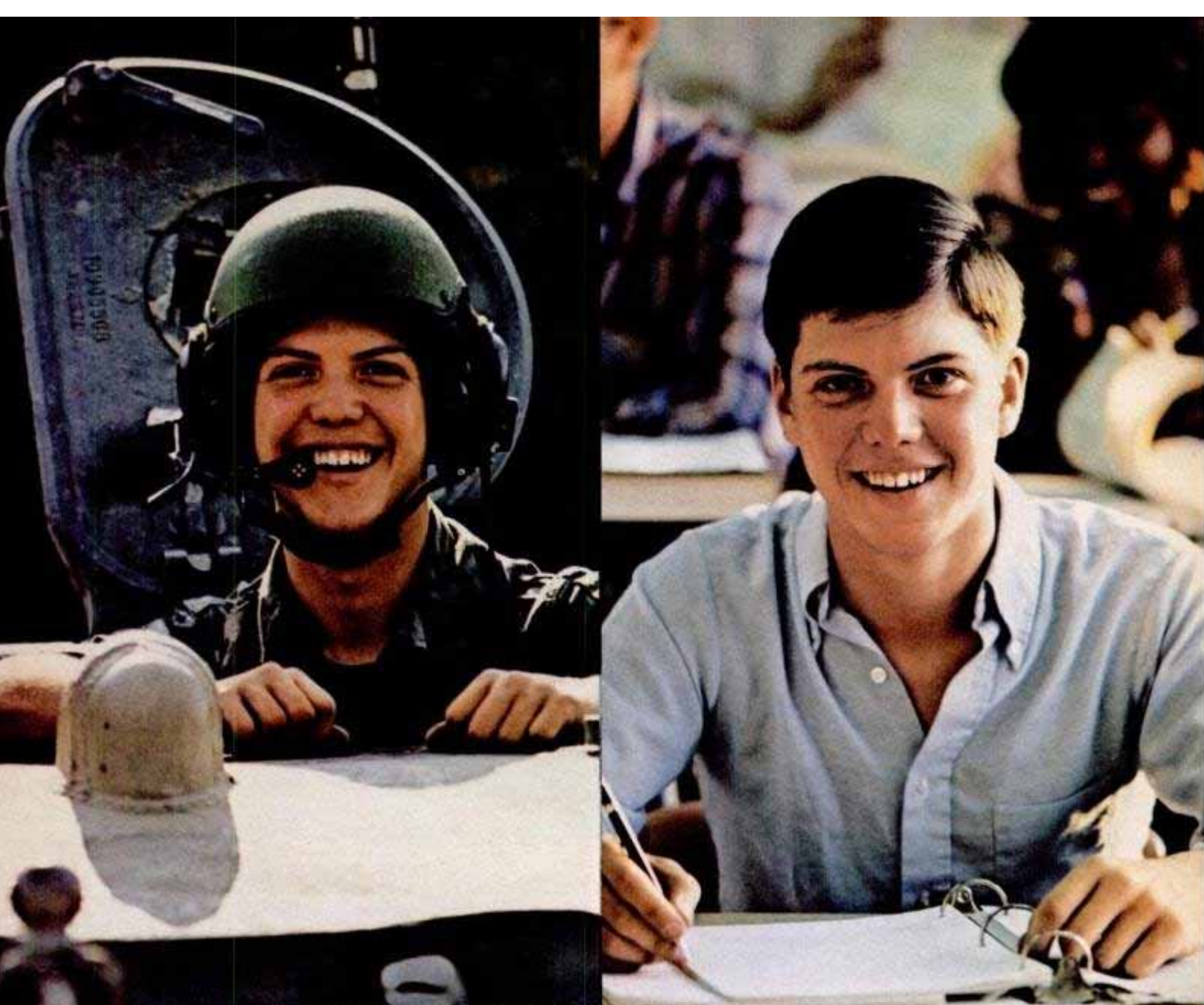
## Preemptive belt change

Drive belts are like batteries—if you wait until they fail before you replace them, you'll be stranded. Unlike a battery, you can't put a meter on a V-belt to tell when it's on its way out. Modern handless belts have no fabric cover, so it's harder to spot wear and tell when a belt is shot.

Based on its experience, Gates Rubber Co. suggests that you replace all the belts in your car every four years. This is a conservative recommendation, compared

to the guesstimates of every three years usually seen in print. Gates, which supplies a third of the OEM belts and 60 percent of the replacement market, bases its recommendation on a survey of actual belt failures. The average belt goes four years and 11 months, with the spread ranging from just over four years to just under six. So a four-year replacement cycle keeps you on the safe side without overdoing it too much.





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## CAR CLINIC

(Continued from page 20)

have mixed. The combination can also cause sludge, which will restrict oil flow and light up the oil pressure warning light. However, the loss of oil pressure may be due to other internal engine problems that were brought on by the coolant leak.

A likely spot for an internal coolant leak is the aluminum timing cover used on this engine. It may have corroded within its coolant passages, allowing an escape route for the pressurized coolant. An aluminum timing cover may fail if you've been using a coolant that doesn't contain an aluminum-protecting additive. Other possibilities include faulty head gaskets and intake manifold gaskets.

### School of hard locks

The ignition key of my 1981 Ford pickup is getting harder and harder to turn. All I've heard from mechanics is, "Replace the switch," which is expensive. Is there no other way?—William T. May, Madison, Wis.

Before I tell you what that other way is, let me go over a basic. It's natural to meet resistance when turning the key from LOCK to ACC. "High effort" is built

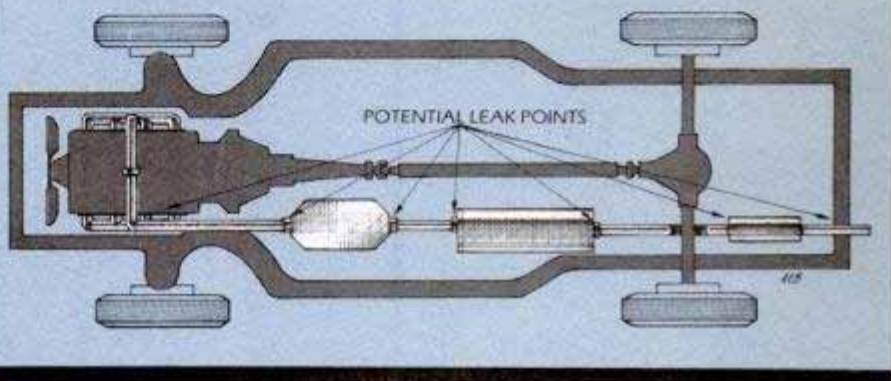
### Make CO a NO-NO

This is the time of year to wonder if breaks in the exhaust system are allowing carbon monoxide (CO) to seep inside the car. A heavy concentration of gas could prove deadly to anyone who sits in a closed-up parked car with the engine and heater running to keep warm. Furthermore, while driving, CO entering the car can make the driver and passengers woozy.

It's the small leaks that are most dangerous, because they are hard to detect. One way of finding out if they exist is to let the engine idle and stuff a rag in the tail pipe. You may need a helper to hold it there with a piece of wood. Then, check the system from stem to stern. A spot that is leaking

will "puff" exhaust you can see or hear. Pay particular attention to the areas emphasized in the drawing. They are points where damage usually occurs.

Complete the examination in 30 seconds. Leaving the exhaust system blocked for a longer time may cause damage.



## FOR SOME, CHRISTMAS IS A TIME FOR EXCHANGING GIFTS.



Check the Yellow Pages under Hardware for the Sentry store nearest you. Sentry Hardware Corporation, Cleveland, Ohio 44113. Merchandise shown in this advertisement is available from participating dealers only. Offer expires December 24th, 1984. All Sentry dealers own their own stores. They select their merchandise and set their own prices. There may be variations in products, available quantities and prices in individual stores.

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Where hardware isn't a sideline.

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<p><b>Deluxe Router Table</b> (48) (396) \$19.99</p>	<p><b>4-Way™ Screwdriver</b> (66-401) \$4.66</p>	<p><b>Unlined Split Leather Grips Gloves</b> (1010LM) \$7.99</p>	<p><b>Cordless Screwdriver</b> (2000) \$29.99</p>	<p><b>6-Gal. Wet/Dry Vac w/Free Accessories</b> (700-02-62) \$54.88</p>	<p><b>Gift Set (215G) \$10.99</b></p>



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Which should keep Dad's face lit up for quite a long time.



## DURABEAM.

IT REALLY WORKS  
WHEN YOU NEED IT.

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into the ignition switch to prevent the switch from slipping into ACC from LOCK as the key is removed. However, the key should not be hard to turn when going from LOCK to ON to IGN.

You may be able to overcome the resistance by lubricating the lock cylinder. Buy lock lubricant from a locksmith or hardware store and squirt it liberally into the keyhole. Insert the key and turn the cylinder alternately on and off about a dozen times to distribute the lubricant.

Repeat the process, if necessary. If a second dose of lock lube doesn't make things better, forget it and have a new key made. The old one may be worn or damaged.

If this still doesn't resolve the situation, remove the steering column shroud and inspect the actuator and ignition rod for free movement. If there is no obstruction, then the only thing that is left for you to do is to replace the switch.

### Chrysler TSBs

"Burn dope, Mort," wrote John Huff of Cincinnati, Ohio, concerning what I said about technical service bulletins (TSBs) being available from Chrysler (*Car Clinic*, page 18, July '84). When John ordered a set of TSBs, he was advised by Chrysler that "the manual is

no longer available and will not be reprinted."

Dave Sandifer of Hawahan, S.C., was advised that the supply of 1979 Chrysler TSBs was exhausted and it "will not be reprinted," and W.R. Peterson of Worcester, Mass., was told the same thing when he tried to obtain '81 Chrysler bulletins.

"Your information came from someone who's living in the past," Larry Lash of Chrysler told me. "We used to bind a year's worth of TSBs in book form and sell them, but that's no longer the case. But owners can still get bulletins."

According to Lash, there are two ways to get Chrysler technical service bulletins. The first is to request a specific TSB, assuming you know that one concerning your particular problem exists. The second way is to describe the problem you're having and ask if there's a TSB that deals with it. If there is, it will be sent.

You should address your requests to Chrysler Corp., Box 1718, Detroit, Mich. 48288. **PM**

### DO YOU HAVE A CAR PROBLEM?

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

### SERVICE TIPS

■ If your Chrysler Corp. car demonstrates intermittent power loss while driving at a steady speed and/or when accelerating, occurring most often in damp weather, it may be caused by the oxygen sensor wire leaking current. This affects the following engines: 1981-84 2.2-liter, 1983-84 1.6-liter and 1983 1.7-liter. A new Chrysler TSB, 08-16-84, tells how to fix the problem.

■ Don't let anyone tell you a torque converter clutch shudder that causes the car to jerk is normal. GM has issued new instructions on how to get rid of shudder if the car has a THM 125-C automatic transmission. Troubleshooting and repair are the same for all GM divisions, but each provides its own TSB. As a reference, the Pontiac TSB is 84-7-33.

■ Ford states that cold-weather hard starting or poor performance by a 1984 Escort, Tempo, Lynx or Topaz with a 2.0-liter diesel engine can be caused by snow or ice building up in the air cleaner plenum tray. A way has been found to heat the area to melt snow and ice. It involves installing a heating device that works off the car's heater. Parts are contained in a snow pack kit (part No. E43Z-9E635-A). Installation instructions are given in TSB 84-15.

■ If your five-speed 1984 Honda Prelude is demonstrating poor acceleration until it warms up, the choke unloader drag link may not be adjusted properly. TSB 84-033 tells how to adjust it.





## Refrigerated sight

Infrared sensors have given us great geological maps and photos of objects never before seen among the stars. We'd use them more, but the sensors rely on the heat of the object they are photographing and need lots of energy to run their cooling units. Thus, infrared sensors often run out of air conditioning and wander uselessly in Earth orbit. But Hughes Aircraft has developed a refrigerated sensor that powers itself. The Vuilleumier Cycle device's hot compressors contain cold gases that expand when struck by sunlight or when heat is applied through black piping exposed to the sun. The expanding gases drive the cooling compressor. Cool air is shunted through a cold cylinder to the sensor. Continuous sensor exposure to any heat source keeps the air conditioning running.



Space-based infrared sensors are kept cool for years with Hughes refrigeration system.

## Latest computer run

British mathematician Trevor Kitson predicts man will run his fastest mile in the 1990s. After that, he believes that milers will get no faster. His mathematical studies of mile runners from 1910 to the present show a straight line of improvements. In 1910, the mile was run in 4 minutes, 12 seconds. The progression was steady but curving slightly upward through last year, with top milers going just over 3:47. Kitson's calculations, published in *New Scientist*, predict an ultimate mile of 3:46.66.

## Brain tissue transplants

We reported last June (*Science Worldwide*, page 42) that University of Rochester researchers had successfully transplanted brain cells from one African green monkey to another. Now, Rochester's Don Marshall Gash has announced another step forward on the road toward human brain tissue transplants. Gash and his team have successfully transplanted abnormal human brain tissue to a green monkey. The nerve cells in the human neuroblastoma (brain tumor cells) took root in the green monkey and survived for eight months. The tumor cells were treated to render them nonmalignant before the transplant. Studies with higher primates are continuing.

## Green cheese on ice

Scientists in Japan and New Mexico believe they've recovered meteorites thrown down to Earth from the surface of the moon. The three chunks of rock were discovered in 1979 about 40 miles apart in central Antarctica's Yamato Mountains. Only recently did chemical analysis reveal that the rocks contained iron and manganese in proportions typical of moon rocks, not of meteorites. Further studies are under way to determine how the meteorites could have been blasted from the lunar surface to Earth. The date when the rocks fell to Earth is not certain.

## Closing the universe

Scientists who believe we live in a closed universe have held that there is enough matter available to keep the universe going forever. They believe that the universe began with a big bang, will cool to lifelessness over 30 billion years and then start up again as the remaining matter condenses, heats up and starts a new big bang. But University of Pennsylvania researcher Sidney Bludmen says his study of the stars indicates the universe is converting matter to energy so fast, that even if there is plenty of matter available, there won't be enough energy left for another big bang in 30 billion years.

## Ice cutting, road saving

About 8 million tons of de-icing salts are poured on the nation's highways each winter. By spring, road crews are out repairing the damage caused by the corrosive salts. But biochemical engineer Jerry L. Jones told an American Institute of Chemical Engineers gathering that new de-icing chemicals may prevent road damage by next winter.

Jones, speaking for SRI International of Menlo Park, Calif., said de-icers made of calcium magnesium acetate could replace corrosive chloride-based salts. He cited studies in 24 states that have tried calcium magnesium acetate, noting that the biggest roadblock toward using the new de-icer is the cost of manufacturing. They depend on petrochemicals to make the acetic acid in the de-icer. Jones says experimenters recently have been able to make acetic acid efficiently using specialized bacteria to ferment sugar water. If acetic acid can be produced cheaply, we're on the road to snow-free highways by next winter with no spring aftermath.

## Robot chemist

Anyone who has struggled through college chemistry will tell you frustrating tales of running a textbook experiment with dunce-cap results. The reason usually lies with the student experimenter who puts too much of this or that into the crucible. Sometimes he mixes things in the wrong order. The brightest chemistry student at Pur-



Purdue University robot is programmed to perform multistep chemistry experiments.

due University these days is a robot arm tied to a personal computer that records how much of a chemical is mixed and when. Punch in the information once and the robot gets the experiment right every time. **PM**



9 mg. "tar", 0.7 mg. nicotine av. per cigarette, FTC Report FEB. '84.



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

**VANTAGE.**  
**THE TASTE OF SUCCESS.**

*Great Taste  
with Low Tar.  
That's Success!*



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# HOMEOWNERS' CLINIC



## Multiple door chimes with one button

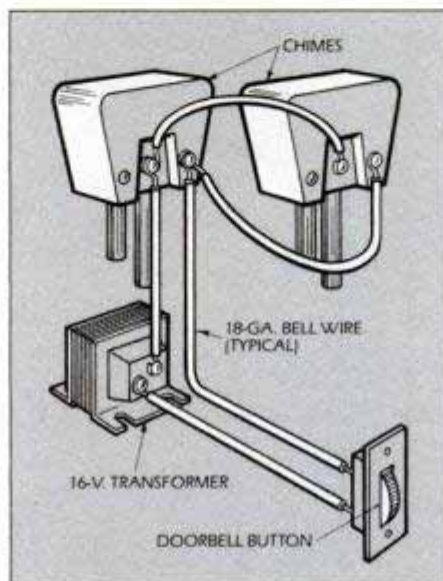
*Please describe how to install a doorbell system activated by one doorbell button that causes two door chimes to operate at the same time. The chimes are located in separate parts of the house. I understand how to install multiple door buttons for one door chime, but that's not my problem.—Donald E. Phelps, Eugene, Ore.*

If you can install a door-bell system with a single chime operated by a single button, then adding another chime is relatively simple. The chimes are connected in a parallel circuit as shown in the diagram. You can run 18-gauge bell wire from the terminals of one chime to the terminals of the second chime.

Most chimes have three terminals which enable them to be activated by two separate buttons—one at the front door and one at the rear door. The center terminal is usually for the transformer connection, and the right and left terminals are for the front and rear doorbell connections.

When wiring the chimes, make sure that you connect the wires to the same terminals on each set. It's also impor-

tant that you use a transformer of adequate size. A 10-volt transformer works with a single set of chimes, but for a two-chime system, you'll need a 16-volt transformer to do the job.



Connect two sets of door chimes in parallel circuit for operation by a single button.

## Tiling radiant-heat floor

*I have a home with radiant heating (cement slab floor with embedded circulating hot water), and I want to replace the existing vinyl tile in the kitchen. I would like to use slate, quarry tile or something similar, but I'm concerned about the disruption of heat transfer, and the chance of increased energy use. What do you recommend as the best covering for this type of floor?—John D. O'Connell, Concord, Calif.*

Any floor covering that you like will do fine. I checked with the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) and they say there would be no appreciable increase in energy use regardless of the type of floor covering.

The response time of a radiant heating system to changes in thermostat setting is normally slower than that of a hot-water system with baseboard or free-standing radiators, or a forced warm air system. This means it takes longer for a radiant system to reach the

desired comfort temperature than the other two systems. By covering the floor you will slow down this response time slightly.

## Stains in cultured marble

*My problem is stains on the surface of my cultured marble countertop. Rubber or vinyl feet from a planter left the marks after many months in position.*

*I tried Formula 409 first, to no avail. I even poured Clorox on the stain without results. Could I use rubbing compound or fine sandpaper? If this removes the sealer, how can I reseal it? Is Gel-Gloss a suitable sealer?—Margaret Williams, Puyallup, Wash.*

You can try to rub out the stains using a 600-grit (very fine) wet sandpaper and then buff the dulled area with Gel-Gloss, which is a cleaner/polish. Use extreme care, however, because the gel-coat surface finish is very thin and can easily be rubbed through. Once the surface sealer is damaged, it cannot be restored or repaired.

## Crumbling concrete

*What causes a section of concrete driveway to fail after only eight years? The apron—between the street and sidewalk—remains strong, without any pitting at all. However, the section between the sidewalk and house is crumbling to stone, sand and powder. Both sections were poured the same day, but from different truckloads. Both are exposed to the same salt from city streets, but I applied no salt to either section myself.—Paul Hirschmann, Indianapolis, Ind.*

It is possible that the concrete mix in the trucks was different, even though the mix came from the same supplier. Concrete with too much water and/or not enough cement is likely to be too weak to withstand an automobile load. You don't mention whether or not the deteriorating driveway section collects water run-off from a side yard or downspouts. Water that puddles, and then freezes and thaws, can shorten the lifespan of concrete.

If you park your car on this section, it's also possible that the de-icing salts from the city streets that accumulate on the undercarriage drip off onto the driveway, causing surface deterioration. According to the American Concrete Institute, de-icers containing ammonium salts such as sulfate, nitrate or chloride should, as much as possible, be avoided on concrete.

Since the deteriorated section is beyond rehabilitation, it will have to be replaced. This time, make sure the concrete mix contains an air-entraining admixture, which is required if the concrete is exposed to freezing and thawing.

Air-entrained concrete contains millions of microscopic air bubbles per cubic foot. These air bubbles act as relief valves because they provide tiny cavities for the expansion of water when it freezes. This type of concrete is highly resistant to chemical de-icers and the deteriorating action of the freeze-thaw cycle. **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.*



# With Canon's new home video system, your pictures look like network pictures.



Your pictures



Network pictures

Pictures that look broadcast quality.

That's what Canon's new portable home video system gives you. Because Canon Accu-Vision™ incorporates the same advanced precision optics as the Canon equipment used by the networks.

So it's not surprising you get sharp, high resolution pictures and vivid color.

Canon's new VC-30A video camera is small, streamlined and highly sophisticated. It has Canon's computer-designed f/1.4 8X power zoom lens, 2/3" high-band Saticon® tube for outstanding resolution, an exclusive infrared automatic focus system developed by Canon, 10-lux minimum illumination for shooting in very low light and a built-in character/time-lapse controller for greater flexibility.

For even more mobility, there's Canon's new, amazingly small VC-200A color video camera. It weighs only 3 lbs. 5 ozs., yet incorporates an outstanding list of features including a Canon f/1.2



6X power zoom lens and a new 1/2" high-band Saticon® pickup tube for superb picture resolution.

At a mere 7 lbs., Canon's new VR-30A portable recorder has four heads for crystal clear special effects, Dolby® stereo, high speed search capability and can tape up to eight hours.

The new Canon VT-50A tuner/timer can record as many as eight programs two weeks in advance. Plus it has 139 cable-ready channels and a built-in battery recharger. Together the VR-30A recorder and slim VT-50A tuner/timer form the new Canon DeckMate™, a unique docking system that allows convenient stacking to create a compact console VCR.

So see your Canon video dealer soon.

And ask for the system that shoots pictures that look like the networks'.

The new home video system from Canon.

DeckMate  
VHS

## Canon

Accu-Vision™

For pictures that look broadcast quality.

Canon U.S.A., Inc., One Canon Plaza, Lake Success, New York, 11042, (516) 488-6700/140 Industrial Drive, Elmhurst, Illinois 60126, (312) 833-3070/6380 Peachtree Industrial Boulevard, Norcross, Georgia 30071, (404) 448-1430/123 Paularino Ave. East, Costa Mesa, California 92626, (714) 979-6000/2035 Royal Lane, Suite 290, Dallas, Texas 75229, (214) 620-2641/Bldg. B-2, 1050 Ala Moana Boulevard, Honolulu, Hawaii 96814, (808) 521-0361. \*Dolby is a trademark of Dolby Laboratories Licensing Corp. ® Saticon is a registered trademark of NHK (Japan Broadcasting Corp.).



# THE PM GARAGE



## Hot stuff

How many times have you passed on an interesting project because it required elaborate welding equipment? This new pistol-grip oxyacetylene welding outfit gives home mechanics many of the repair and fabrication capabilities of a professional shop. The Dillon Mk III torch is claimed to be so versatile that it will weld or cut aluminum, stainless steel and cast iron.

The complete setup is \$285 and includes cutting attachments, guide wheels, heat shield, four brass tips and instruction manual. The Swiss-made tool is also fuel efficient, operating at a low 4 psi for both gases. A patented tip design concentrates the torch's heat to the area being welded, reducing the risk of heat damage, distortion and oxidation, and the need for a flux. For the name of the nearest dealer, contact Shannon Marketing, Box 378, Welches, Ore. 97067.—N.S.M.



Dillon Mk III torch allows at-home gas welding of aluminum, stainless steel and iron.

## Quickie kits



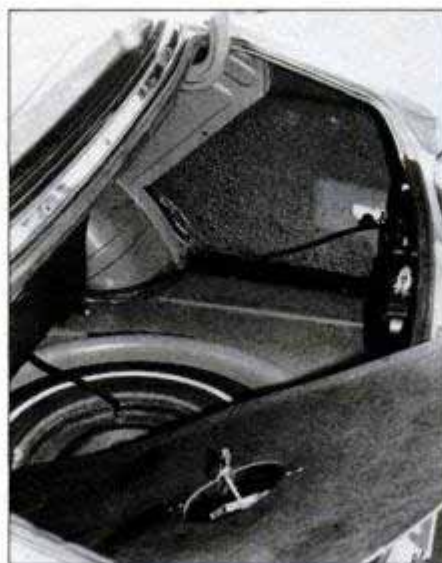
Carburetor tune-up kits contain only the most often needed repair parts and gaskets.

I've paid \$15 to \$20 for carburetor kits many times over the years, and each time I'm left with parts and gaskets I never need. Normally, all I use is an accelerator pump or a needle and seat valve, plus a couple of gaskets. The Easyway is a "short line" kit that includes only these commonly needed parts plus any other required for a particular carburetor. The kit comes with a cardboard float gauge, C-clips, plus instructions, for \$6 or less. The manufacturer is Allparts, 9511 Watson Industrial Park, St. Louis, Mo. 63126.

—Pete Warren

## Inflation checker

The last time my car had a flat my mind raced to recall when I had checked the spare. I could have avoided that anxiety with the SPARE SAFE tire valve extension. Its flexible hose extends the valve to an easy-to-reach checking point. Available in 1½- to 6-ft. lengths, it's \$7.95 to \$12.95 from RKM, Box 1137, Covina, Calif. 91722.—W.H.



SPARE SAFE tire valve extension allows pressure checks without unloading trunk.

## Magnetic attraction

I've had just about every kind of tool holder, including hooks on pegboards and strips with knobs for sockets. Still, my workbench is heaped with tools. What I need is something that just takes



Powerful magnetic strip grips tools securely and makes the workbench neater, too!

the tool and holds it. The simple answer is a powerful magnetic strip. They come in two sizes, 13 in. at about \$12, primarily for a socket set, and 24 in., about \$20, for other hand tools. They hold pretty heavy stuff, including hammers by the flat end of the head. The manufacturer is Lisle Corp., Clarinda, Iowa 51632, and they're sold in auto parts stores.—Pete Warren



# It takes a stress-tested oil to stay ahead of the little guys.

If you're driving one of today's higher revving, small engine cars, you need a motor oil that can stand the strain.

Here are facts that Pennzoil has worked with to exceed the lubrication requirements of today's small engines.

## Situation

**FACT:** Small car engines are built to tighter tolerances than V-8's. Varnish and sludge build-up become an even greater problem, robbing the engine of power and performance.

**FACT:** Like racecars, small engines need optimum oil viscosity performance at high operating temperatures. Also, small engines are harder to start or crank when cold, so they need greater fluidity for easy start-up just like racecar engines.

**FACT:** Small engines work 20% harder over sustained periods. Reduced friction is critical to minimize wear in engines which are running near the edge of their operating capability.

Knowing these vital facts, Pennzoil has been stress-tested to protect small engines that work harder to do the same job as a large engine. And since a smaller engine is under the stress of working at much higher rpm, it needs all of Pennzoil's extra protection. That's why you need Pennzoil protection in your car.

## Solution

**FACT:** Pennzoil is the leader in the development of motor oils with high tech additive properties...such as Z-7... which help prevent varnish and sludge build-up in engines.

**FACT:** Pennzoil led the way in developing high tech multi-viscosity racing oils. The same technology has been applied to Pennzoil Multi-Vis Motor Oil for your car.

**FACT:** Pennzoil was first to introduce friction reducers in all their multi-vis oils.

Pennzoil doesn't just keep up with the stress of today's small engine demands...it stays ahead. So you can depend on the latest Pennzoil state-of-the-art technology to give your car the protection it needs.

Pennzoil—quality protection worth asking for.



**HIGH TECHNOLOGY**  
**QUALITY** = **PENNZOIL**



# PM ELECTRONICS MONITOR



## Waiting for the under-\$500 car phone



We hope that by the time you read this the Federal Communications Commission will have decided the fate of General Electric's Personal Radio Communications Service (PRCS)—the under-\$500 telephone system proposed for in-car use as an inexpensive alternative to more costly cellular mobile radio telephones (see *Phones On The Go*, page 92, Aug. '84).

Though the FCC was supposed to rule on PRCS back in September, a spokesman says the commissioners were shooting for a Nov. 15 deadline.

Should PRCS get the go-ahead, GE says it will begin selling the phones by mid-'85, offer repeater service in 20 cities by that time and in 40 by the end of the year. Repeater service means a PRCS call could connect two parties in cars as far apart as 30 miles. Normal

**Cellular phones are getting smarter: The new Audiotel takes up to eight messages while you're away from your car.**

home-to-car range for a PRCS is 5 miles. PRCS is like a wireless extension phone from your house: GE argues that the home-to-car range is adequate for the needs of most people.

As the drama comes to its conclusion for GE's car phone, the more expensive cellular mobile radio telephones are coming down in price and getting smarter all the time. Industry observers expect the prices to drop sharply in 1985, now that there's sufficient phone-manufacturing capacity and call-handling service.

Recently, the Audiotel mobile phone division of Audiovox introduced a cellular phone that takes up to eight messages when you're away from the car—or gives the caller a forwarding number. And Spectrum Cellular Communications has developed a modem-like device that allows cellular car phones to receive data transmissions for a portable lap computer carried in the car.

## Digital audio + laser video

The long-awaited marriage of video disc and digital sound has occurred, and it's a laser-gun wedding. PM's correspondent at the recent Dusseldorf HiFi/Video Fair in West Germany reports that Pioneer has introduced the first laser videodisc player that also can play digital audio Compact Discs. Pioneer here in the United States notes that the hybrid will be available state-side in January. Although a U.S. price has yet to be determined, the roughly \$1,200 tag for German audio/video-philies is close to the mark.

In Pioneer's CD/LD player, the ultimate in both sound and video images can be extracted from a single machine. This is because the LaserDisc player now incorporates the same semiconductor laser pickup needed to play digital audio Compact Discs (compared to older, helium-gas lasers originally used for videodisc playback). Consequently, you need connect only one machine to your stereo system to hear either CDs or movie soundtracks. The video portion is routed to your TV.

Pioneer's hybrid is a frontloading model that automatically senses disc size (4<sup>3</sup>/<sub>4</sub> in. for CD, 8 and 12 in. for LD) and sets itself accordingly. It's got an-

other neat wrinkle: The player also is capable of spinning the new laser videodiscs that have digital audio soundtracks. Until recently, the sound portion of laser videodiscs was encoded as analog FM stereo—just like radio. The Pioneer hybrid will still play the older discs, but now, if a movie soundtrack, rock video or operatic performance is recorded digitally, that's just the way you'll get it on laser video—with all the live dynamics intact.

Though the ante for the CD/LD hybrid is steep, Pioneer seems to have the only game in town. PM's inquiries to Philips and Sony—originators of the Compact Disc—find that neither plans to introduce a hybrid player in the near future. Philips, though, delighted some audiophiles at the European fair with a CD-only player that can display text and graphics on an attached TV. Slated for introduction next year, this player, for example, could show opera-lovers the lyrics as they're being sung.

## Digital TV countdown

Digital audio playback isn't the only digital news on the video front: Get ready for the new generation of digital television receivers. In fact, by the time

you read this, the new technology should be making its U.S. debut in retail stores as a 20-in. model from Toshiba.

What's digital TV? It's got nothing to do with lasers. It uses microprocessor chips to take the incoming, analog broadcast signal, break it down to its component parts and store it in digital code, then reassemble the information for display on your screen.

Digital sets should recognize and eliminate those annoying multipath (or reflected) signals that cause TV ghosts. Colors also should appear more lifelike, because the chips have memorized true color values often distorted in transmission. Thanks to that memory, too, the digital TV can freeze a TV frame—and display this as an inset picture-in-a-picture in a corner of your screen. You can get a similar sideshow if you wish to monitor something you're recording on your VCR while you watch another program.

Toshiba's remotely controlled 20-inch has built-in stereo and is expected to sell for about \$1,200. Other manufacturers have yet to reveal introduction plans, though Panasonic offers a digital set in Japan and ITT (which invented the format) has been selling one in Europe since spring. **PM**





# Match it! (if you can.)

## We made the best better. Plymouth introduces the 5/50 Reliant Super K.

For 1985, Plymouth engineers a new 5/50 Reliant K. An even better Reliant K. The Reliant Super K. The best value of any 6-passenger car\*: the highest gas mileage,\*\* the lowest base price.

The new Reliant Super K is aerodynamically redesigned. Its clean new lines reduce the drag coefficient, making it more efficient than ever. And its tough 2.2 engine has been refined for better performance.

Chrysler engineering doesn't take quality for

granted. The new Reliant Super K benefits from hundreds of engineering improvements Chrysler has made over the years. We've made the best better.

And every Reliant Super K 2-door, 4-door and station wagon is backed by Chrysler's unique 5-year/50,000-mile Protection Plan†. The name is Plymouth, the quality is Chrysler.

The new 5/50 Reliant K. The Super K. Match it! (if you can.) Buckle up for safety.

**Plymouth. Best built, best backed American cars.††**

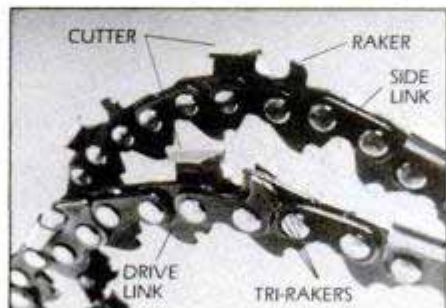


\*Based on a sticker price comparison of comparably equipped vehicles. \*\*33 hwy. est. mpg. [26] city est. mpg. Use these EPA ests. to compare. Actual mpg. will vary with options, driving conditions and habits, and vehicle condition. CA ests. lower. †Whichever comes first. Limited warranties on powertrain and outer body rust-through. Deductible applies. Excludes fleet/leases. Dealer has details. ††Lowest percent of NHTSA safety recalls for '82 and '83 models designed and built in North America. Best backed based on warranty comparison of competitively priced vehicles.



## Minimum-kickback saw chain

A saw chain that reduces the risk of kickback is available from Townsend Saw Chain Co., Box 6396, Columbia, S.C. 29260. Marketed under the name Sabre, the chain has newly designed rakers—the guide-points in front of each cutter that regulate the depth of the cutter bite. Without sacrificing cutting speed, the three-piece Tri-Rakers are claimed to substantially reduce excessive cutter penetration. Available with various cutter styles, and to fit most saws, the chains are \$14 to \$25.



Triple-thickness rakers reduce dangerous kickback caused by excessive cutter bite.

## Combination stove and dishwasher

Combining cooktop, oven and dishwasher into a single appliance provides convenient space-saving opportunities for cramped kitchens. Available with either gas or electric cooktop, the combo unit measures 30 in. wide × 76<sup>3</sup>/<sub>8</sub> in. high, including the top-mounted exhaust hood. It's dubbed Cook-'N-Clean Center by Modern Maid, and comes with stainless steel cooktop surface and black glass doors. List price for gas model is \$1,575 and \$1,450 for electric. For nearest dealer, write Modern Maid, 403 North Main St., Tipton, Pa. 19562.



## Easy-to-carry generators

Three compact generators by John Deere provide modest output, but high portability, useful for campsite, boat dock or construction site.

Model 550 (\$380) weighs 38 pounds and produces 450 watts. Model 750 (\$460), at 62 pounds, generates 600 watts. Model 1100 (\$515) weighs 66 pounds and generates 900 watts. Each

has two 12-volt outlets protected by circuit breakers, and a low-speed idle for quiet operation when not under load. For details, write to John Deere and Co., John Deere Rd., Moline, Ill. 61265.



## Chimney cleanout door

Installing this cleanout allows you to inspect or clean your chimney flue without going up on the roof or removing your fireplace insert. Called the Chimney Port, the maker says it can be mounted anywhere on the flue above the smoke shelf, either indoors or out-



doors. Measuring 7<sup>1</sup>/<sub>4</sub> in. × 12<sup>3</sup>/<sub>4</sub> in., the cast-iron cleanout has an airtight seal and is secured with stainless-steel bolts so it can't be opened accidentally between cleanings. The Chimney Port is sold for \$64.45 postpaid by Cramco Manufacturing, Box 178, Manchester Center, Vt. 05255.

PM

## Tool up for Christmas

Dremel offers its top-of-the-line Moto-Tool and kit of 40 attachments, along with a bonus router attachment, as a Christmas special for \$97.95. When used with the Model 380 variable-speed Moto-Tool, the router attachment can make decorative signs, remove old putty from windows, or rout designs into picture frames or furniture. The other 40 accessories in the kit are used for cutting, carving, sanding, polishing, buffing and grinding. For details, write Dremel Manufacturing, 4915 21st St., Racine, Wis. 53406.



## Precision drill stops

Adjustable drill stop collars that can be set to maintain a constant drill penetration depth come in a set of seven to fit drill-bit diameters from 1/8 in. to 1/2 in. The steel collars have a black oxide finish. They slip onto a conventional bit and lock into place with a hex key wrench. The package is sold at hardware stores and tool supply outlets for \$5. For further information or mail order, write to Rensen Products, 63 East 18 Mile Rd., Sterling Heights, Mich. 48078.





# Unfortunately, if the telephone you buy today isn't a Panasonic, it may be out of date tomorrow. If it lasts that long.

Choose a built-in answering machine. Speakerphone. Built-in dialer. But choose carefully, because it's built to last. After all, it's a Panasonic.

Now you can buy your own telephone. So it's important to buy the one that's right for you.

On one hand, you don't want to spend too much for a phone. Or buy one that does more than you need. On the other, you don't want to spend too little. Or the phone may become out of date in a few months. If it lasts that long.

Let Panasonic help you reach the right decision. We have the right phone for you. And the right price to go

with it. No matter what your needs or budget.

Choose from phones with answering machines built in. Speakerphones that let you talk without holding the phone. And phones with automatic dialers. And most of our phones are compatible with alternate long distance services. Such as Sprint® and MCI.

Whichever Panasonic telephone you choose, it will have one thing in common with our entire family of phones. Panasonic dependability.

And should your phone ever need service, we have a nationwide network of service centers.

Panasonic telephones. They won't be out of date today. Or tomorrow.

Speakerphone. Dialer. And answering machine. Even lets you call in for messages. Without a remote device. From any push-button tone phone.

KX-T 2425



This phone remembers 28 numbers. And will dial them for you automatically. Even redials a busy number. Up to 15 times in 10 minutes.

KX-T 2130



This slim-line phone has an automatic dialer. Call family. Friends. Emergency numbers. Up to 16 digits long. At the touch of a button.

KX-T 2203



This phone lets you connect two incoming lines. So you can put your first call on hold, while you answer a second. Also has an automatic dialer.

KX-T 3203



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**Panasonic**<sup>®</sup>  
just slightly ahead of our time.

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# WHAT BETTER GIFT FOR A DO-IT-YOURSELFER, THAN A TOOL THAT DOES IT ALL.



The remarkable device pictured below is a Dremel Moto-Tool. With its wide range of accessory bits, this compact power tool gives a do-it-yourselfer a lot of versatility in a very small package. Not only will it handle a variety of tasks, it'll handle a variety of materials. So, for example, the same tool that'll rout picture frames and polish brass, will also sharpen tools and cut conduit. And because the Moto-Tool is so compact, many times it'll do the job, where other tools won't even fit.

The Moto-Tool is available in several different models, including both constant speed (28,000 RPM) and adjustable speed (5,000-28,000 RPM) versions. Each features a reliable motor and an assortment of useful accessories.

## FREE ROUTER.

This Christmas, Dremel's top-quality Moto-Tool makes an even better gift. Because when you buy a specially marked 3801SP Moto-Tool Kit, you also get a free router attachment and bit. (A \$22.30 value.)

So if you know someone who'd like a tool that does the work of many, pick up a Moto-Tool. As thousands of people already know, there's no other single tool like it.



# DREMEL®

Gets the job done bit by bit.



Dull paint can sometimes be refurbished with a compounding treatment, either by hand or machine.



## REPAIRING MINOR BODY DAMAGE

Time-ravaged paint jobs and small nicks, scratches and dents can be fixed in your driveway with basic bodywork techniques and a little patience.

BY PAUL STENQUIST

**Y**our family wagon isn't quite the glamorous machine that it once was. The effects of use, road salt, pollution, parking lot mishaps and a variety of other hazards have taken their toll.

Where it was once bright and shiny, it is now dull and fading. The paint is chipped behind the front and rear fenderwells, and a couple of long scratches cross the door panels. A professional bodyshop repair job would be a very expensive proposition. Can you do it yourself?

Unlike mechanical work, success in body work can be measured in degrees.

With a mechanical job, you can either do it or you can't. When it comes to bodywork, however, even a feeble effort may make the car look better than it does right now, and if you can't afford a pro job, you have little to lose.

In the following sections, we'll outline some simple exterior repairs.

### Restoring faded paint

A paint surface that is extremely faded and scratched may not respond to the normal cleaning and polishing techniques described in our *Saturday Mechanic* on exterior car care (see *How To Clean Your Car Like A Pro*, page 35,



Oct. '84). In these cases, machine or hand compounding is necessary. But remember, whether you do the job with a machine or by hand, there are no guarantees. You may rub through the old paint before you have removed the oxidized surface. Rubbing through, however, is less likely if the job is done by hand.

Hand compounding is hard work. You can only do a small area at a time and a considerable amount of elbow grease is needed. Use a rubbing compound that is intended for hand rubbing and some 600-grit sandpaper.

Begin by lightly wet-sanding an area of about 2 sq. ft. with the 600-grit paper, which should be folded into quarters. After uniform sanding, polish the area with a fine grade of hand rubbing compound. Apply the compound with a soft damp rag that has been wrung out and folded into a pad. Use medium pressure and straight back-and-forth strokes. Following directions on the label, remove the compound with a dry rag. If the surface isn't glossy, you haven't removed enough of the faded paint. Do it again.

Avoid rubbing hard on edges or raised parts of a panel, since these areas will rub through first. If you do rub all the way through the paint, refinishing is the only completely satisfactory fix.

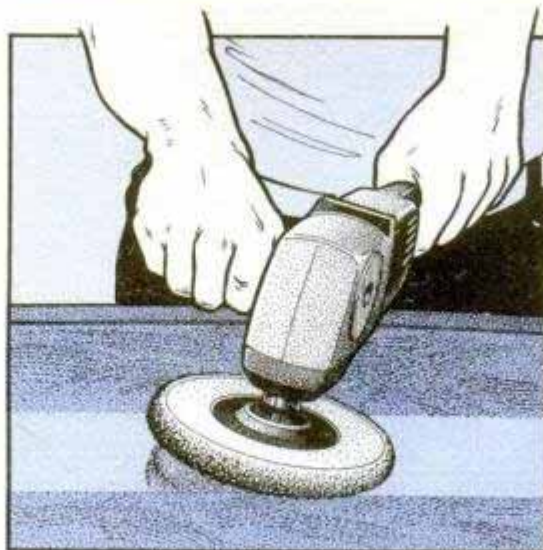
### Machine compounding

Machine compounding is faster and removes more paint, but, of course, the danger of rub-through is increased. To do the job, you'll need a power polishing machine which runs at 1,400 rpm or higher under load, and some rubbing compound designed for machine compounding.

A carpet-type pad is usually used for compounding, rather than the lamb's-wool-type pad, which is generally used for waxing. An auto parts store that specializes in body shop repairs can help you with both the pad and the compound, and a tool rental store can supply the machine.

### Rub-through precautions

Before polishing, apply a thin strip of masking tape to creases, raised edges and sharp corners of the body that will be passed over



**1** When compounding with a polishing machine, tilt the pad at a 10° angle from the surface, with the lifted side in the direction of travel.

by the polisher to minimize the chance of rub-through. Mix the compound with water if the instructions so indicate. Wear old clothes. The compound will fly all over when you turn on the machine.

When using a power polisher, wear safety goggles and a dust-type respirator. Make sure you grip the polisher firmly at all times, and keep the electric cord out of the way. (Air-powered polishers are considerably safer.)

Apply compound to a 2 by 2-ft. area of the car with a 2- to 4-in. brush. Don't apply compound to the polishing wheel. Use only as much as needed for uniform

distribution. Spread the compound over the area with the pad before turning on the machine.

Turn on the polisher and stroke the area to be compounded left to right and right to left. Don't push. Let the weight of the machine do the work.

When moving to the right, lift the right half of the pad a bit (see Fig. 1). Lift the left edge of the pad when moving to the left. Overlap the stroke directly above or below by about half its width. Once you've compounded the area moving in a horizontal direction, do the same thing moving up and down. Again, slightly lift the edge of the pad that is toward the direction of the stroke. Overlap as before.

Four passes over the area, two horizontally and two vertically, should be sufficient. If the compound is all used up before you're done, you didn't use enough. If there's a bunch left over, you used too much.

### Pad cleaning

As you're compounding, clean the pad from time to time. Lay the machine on the ground and turn it on. Hold it firmly and scrape compound buildup from the pad by applying a dull screwdriver blade to it as it spins. Move the screwdriver from the outer edge of the pad toward its center.

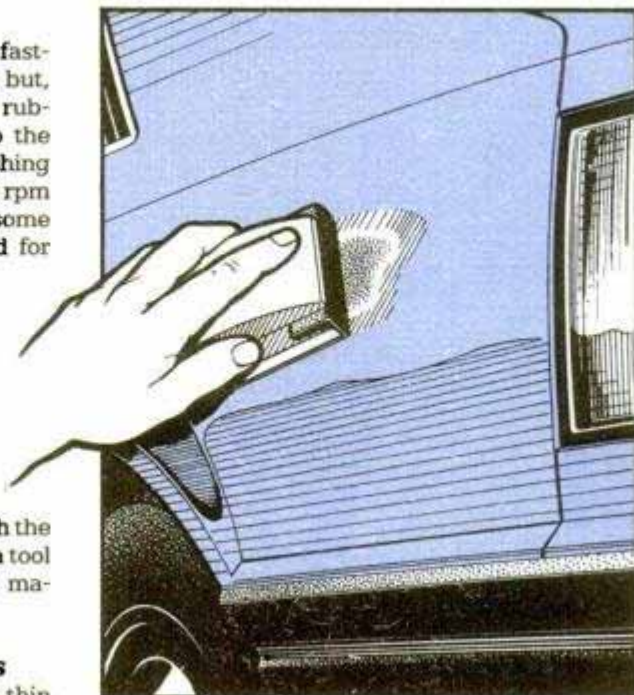
After you've done all areas that can be reached with the polisher, remove masking tape from raised edges and corners and compound these spots by hand, as well as any other areas that cannot be reached easily with the machine.

### Repairing chips and nicks

Perhaps the toughest part of repairing chips and nicks is deciding how you want to do it. Small nicks can be repaired "temporarily" in just a few minutes (more on that later). But if you want to restore the area to like-new condition, complex techniques are recommended for the various types of finishes used by carmakers today.

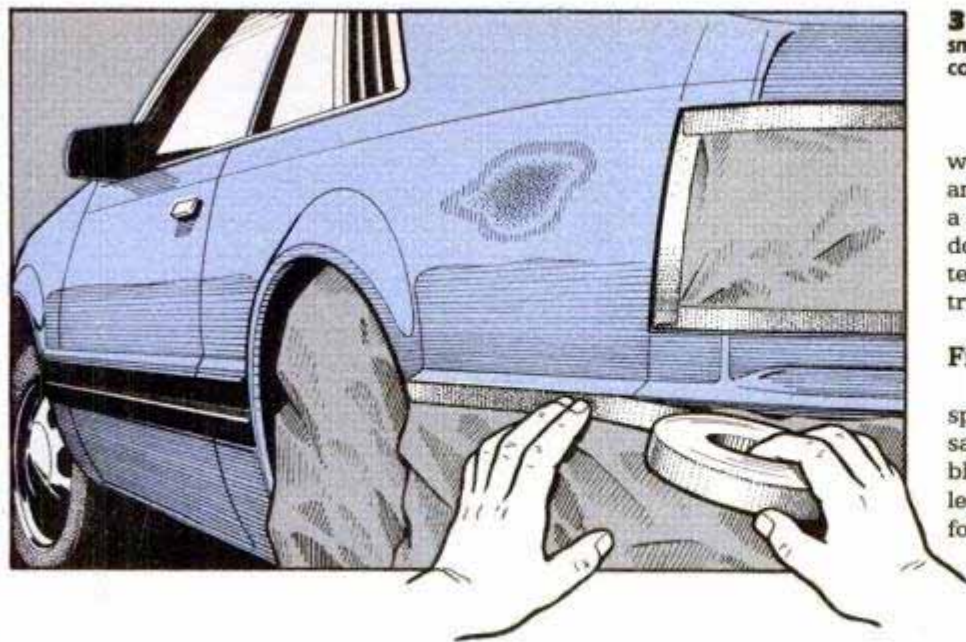
If you don't have a spray gun and compressor and don't want to rent one, you'll have to have a body shop finish up the job once you have repaired the nick. However, you can still save a lot of money by doing the body repair yourself.

Don't try to refinish part of a panel with touch-up spray cans.



**2** Use a sanding block and 80-grit paper for the first sanding of a nicked area. Follow that with the 240-grit, and then wet-sand with 400-grit.





You won't get a good match. On a small panel that is not particularly visible, such as the lower half of a rear quarter that is split by a trim line, you may decide to have a go at refinishing with touch-up spray. The results may not please you, however.

To produce a professional-looking nick repair you'll need a sanding block, 80-, 240- and 400-grit sandpaper, zinc chromate primer, finishing primer, wax-removing solvent, a tack cloth, glazing putty and a rubber contour squeegee. You should be able to purchase all of these products at any well-stocked auto parts store. If you can't find them there, you can try a parts store that specializes in body shop supplies. You'll also find a knowledgeable body work oriented counterman at most such establishments who will usually be willing to help you with problems.

Before you begin the repair of a nick, clean the entire panel with a wax-removing solvent. Wipe it dry.

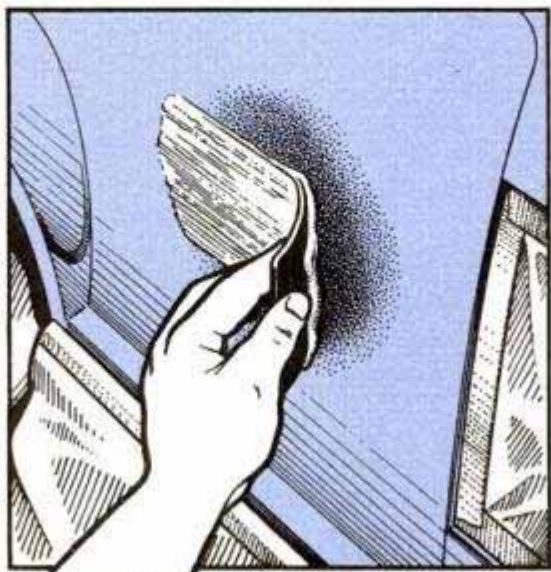
Using 80-grit sandpaper on a hand sanding block, sand the area until the edges of the nick or chip have been smoothed out and the surface is totally free of rust (Fig. 2). Hold the sanding block flat against the panel and apply moderate pressure. Work with a back-and-forth motion over an area that is sufficiently large to allow complete feathering of surrounding paint.

Continue working until you can't feel the edges of the nick. Insert a piece of 240-grit paper and sand until the surface is free

of deep sanding scratches, then wet-sand lightly with 400-grit paper until the surface is satin smooth. Wash with water, dry with a cloth rag and then wipe the entire panel with a tack cloth.

Next, mask any trim near the repair area or the edges of any adjoining panels that are close enough to be threatened by overspray (Fig. 3). Then coat the bare metal and the sanded panel with zinc chromate primer. Hold the spray can parallel to the surface and at a distance of about 10 in. Move the can back and forth, keeping it the same distance from the surface at all times.

Once the primer has dried, put a lump of glazing putty on the edge of the contour squeegee and apply it to the prime-coated repair area (Fig. 4). Apply



4 After applying a rust-inhibiting primer, coat the area with glazing putty, using a flexible squeegee. Apply the putty with a single stroke.

3 After the nick has been sanded smooth, mask adjoining areas. Then coat nick with a rust-inhibiting primer.

with moderate pressure, move quickly, and in one direction only. Don't attempt a second pass with the squeegee. If you don't like the results of your first attempt, remove all the glazing putty and try it again with a fresh lump of putty.

### Finishing putty repairs

Let the putty dry overnight, or as specified on the product label, then sand with 240-grit paper in a sanding block until the repair area is completely level with the surrounding area. Feel for any high spots and sand some more if necessary. Inspect the puttied area carefully for pits, low spots or rough areas, and apply glazing putty again if necessary, resanding as above.

Finally, insert a piece of 400-grit paper in the sanding block and wet-sand the area until it is satin smooth. Flush the area with lots of water as you sand to avoid leaving scratches.

Wash the panel with water, dry it and wipe it with the tack cloth. Then apply a final finish primer that is compatible with the color coat that will be applied.

### Temporary touch-up

If your car is nicked and chipped but you don't want to get involved in a repair that will necessitate the refinishing of a panel, you can do a temporary touch-up.

Buy a can of touch-up paint that is an exact match for the color of your car (vehicle type and year as well as the name of the color are listed on the can of paint). The best type is the brush-applied touch-up paint, but this is sometimes hard to find. You'll probably have to settle for a spray can.

Remove all rust from the nick area, but don't attempt to feather the edges. A pocket knife used as a scraper works well for this.

Once all the rust has been removed, spray some of the paint into the cover of the spray can and let it sit for about five minutes until it thickens a bit. (If you have bottled brush-type paint, use it as it comes.) Use a matchstick to apply the paint. Dip the end of the match that is not coated with sulphur in the paint and dab it onto the chipped area. Try to apply a heavy coat on the first attempt to completely fill the nick. Make sure that you have



covered all of the bare metal.

In conspicuous places, this type of repair won't produce very satisfactory results, but it is far better than simply spraying touch-up paint over an unrepaired chip. In less conspicuous places, it will serve quite well to protect the metal until a more extensive repair can be completed.

## Repairing scratches

Deep scratches can be repaired following the same procedures recommended for repair of chips and nicks. And, of course, surface scratches that have no depth to speak of can usually be removed with rubbing compound. Scratches that fall in between—not deep enough to have reached bare metal but too deep to be removed with rubbing compound—can be repaired with glazing putty.

You'll need glazing putty, finishing primer, a tack cloth, a squeegee, masking paper and tape, 240- and 400-grit sandpaper, rags and wax-remover solvent.

Clean the scratched area with the solvent, then lightly sand the scratch with the 240-grit paper. Fold the paper into quarters or smaller, and sand only enough to slightly roughen the area directly around the scratch. Sand evenly along the length of the scratch. Don't concentrate on one area.

Wash the area with a wet rag, dry it and then wipe it with the tack cloth. Apply a dab of the putty to the edge of your squeegee and smoothly wipe it across the scratch, making one pass next to the other, all along the length of the scratch. As before, don't attempt a second pass. If you're not satisfied with your first attempt, remove the putty and try again.

Allow the putty to dry overnight or as specified, then sand the area with 240-grit paper on a sanding block. Sand evenly to avoid creating low spots. Wash the area with water, dry it and wipe with the tack cloth.

Don't be alarmed if there are low spots or if parts of the scratch are not completely filled with putty. Simply reapply another coat of the putty as before. Repeat the application of putty as many times as necessary to effect a smooth repair.

Once you're satisfied that the repair is perfect, sand with 400-grit paper in a sanding block, wetting the paper and the repair



**5** When the glazing putty has dried, wet-sand with 400-grit paper. Splash water on the area as you sand to flush away sludge and keep the paper fresh.

area with water (Fig. 5). Keep splashing water on as you sand to flush away sanding residue. Use long strokes and sand until the area is perfectly smooth. Then, rinse, dry and wipe with the tack cloth.

To complete the repair, coat the area with the right type of finishing primer, depending on what type of paint will be used to color coat (Fig. 6).

As we pointed out earlier, spot repair of automotive finishes can be complicated. To find out what type of color coat or primer must be used, you'll have to visit a bodyshop supply store. Before you do, make sure you know the color code for your vehicle. You can find this code



**6** Once the surface has been sanded to a shiny smoothness, apply a finishing primer that will be compatible with the final color coat.

on the body identification plate.

Each of the various carmakers has its own name for this plate. On GM cars, other than Corvette, the body number plate is under the hood on the front or upper surface of the firewall shroud. On Corvettes, it's on the dashboard brace below the glove box or on the left door hinge pillar.

On Fords the vehicle certification label is on the lock face panel of the driver's door.

On Chrysler products, the body code plate is under the hood on or near the left front fenderwell, or on the radiator support.

On some cars, it's quite obvious which of the many numbers on the body plate is the paint code. On other cars, you'll need the assistance of a factory service manual or the counterperson in the body supply store. If you have to, make a sketch of the whole tag and let him pick out the correct paint code.

## Primer and color coat

Once the code has been determined, the man in the body supply store can check it against the color chart for your year and model car. The chart will tell him exactly what type of finishing primer and color coat should be used. For most types of automotive finish, the final color is applied in a number of coats. The first coat is sprayed so it covers an area only as large as the spot repair. Each subsequent coat covers a slightly larger area.

For some types of paint as many as six coats are necessary. Spray gun pressure usually is altered for the final coats. This technique blends the new paint into the old.

Don't attempt to do this yourself without specific instructions for your type of finish. You might be able to get instructional literature from the auto body supply store. Various books are also available.

Remember that patience is the key to successful body and paint work.

If you apply paint haphazardly, your car won't look any better than it did before the damage was repaired. If you concentrate sanding efforts in one area in an attempt to remove an imperfection quickly, you will create a low spot. And if you sand before filler, glaze or primer has had a chance to dry properly, you'll create a real mess.

FM



# 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 \$34.95, 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 \$34.95 + \$4.00 shipping and handling.  
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 Card No. \_\_\_\_\_ Exp. Date \_\_\_\_\_  
 Name \_\_\_\_\_  
 Address \_\_\_\_\_  
 (Give street address if possible for UPS delivery)



# APPLIANCE CLINIC



## Dryer overheats erratically

I have a Speed Queen gas dryer, model No. DG9031W, serial No. 5210685. At times the dryer works well on all heat ranges and other times it overheats on any heat range. Sometimes, when switching heat ranges it will change and other times it will not. What can I do to repair this?

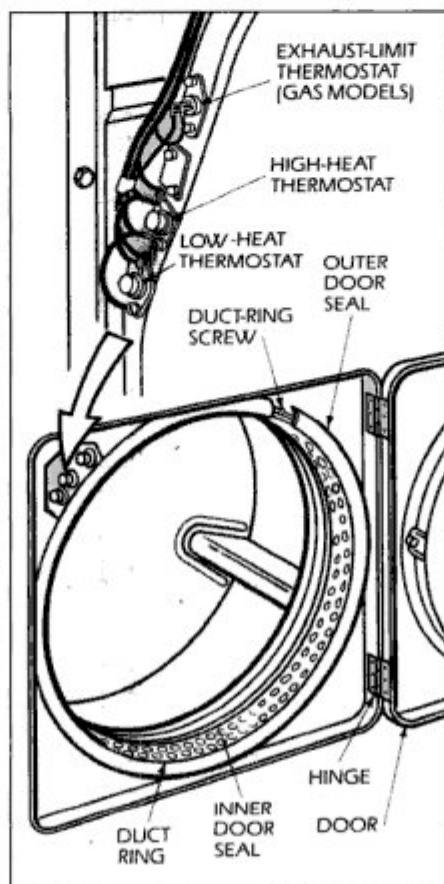
Thank you for your help.—Everett F. Adams, Rapid City, S.D.

There is a good possibility that the high-heat thermostat is causing your erratic problem. The part number for the high-heat thermostat is 54737, and it costs about \$9. The part is available in your area from Dey Appliance Parts, 300 North Phillips, Sioux Falls, S.D.

To replace the thermostat, first unplug the dryer from its electrical source and shut off the gas supply. Open the loading door and roll back the outer door seal. You will find six Phillips-head screws which hold the gasket as well as the duct ring to the dryer front.

Remove the screws and gently pull out the ring and gasket. Clean out the accumulated lint in the duct with a vacuum cleaner and a brush. Next, remove the four screws at the bottom edge of the front panel and pull this edge slightly away from the dryer. Lower the panel and remove it from the dryer. The thermostat is located on the left side of the front bulkhead assembly. The center thermostat is the high-heat thermostat.

Remove the two wires from the old thermostat and the two screws that hold it in place, and install the new part.



Center thermostat behind dryer's front panel regulates high heat. If defective, it causes erratic temperatures or overheating.

Then, reassemble the dryer, plug it back into its power source, turn the gas back on and light the pilot.

## Low-suction vacuum cleaner

Our Eureka canister vacuum cleaner, Model 3240, has very little suction. We put in a clean bag that came with the vacuum, but the suction is still poor. Can you help us?—A. Cinelli, Westport, Conn.

Several things can cause reduced suction. First, check the hose and wand for obstructions. A partially clogged hose can usually be cleaned by connecting the hose to the vacuum's exhaust port and blowing out any foreign matter. In more stubborn cases, try using a broom handle or something with a blunt end, and carefully push out the obstruction. Also check the hose for breaks or a poor fit at the intake flange.

If an obstruction is not the problem, open the vacuum and inspect the yellow paper filter and the round gray foam-rubber filter mounted on top of the fan housing. The paper filter should be changed each time you change the dust bag. The foam filter can be cleaned by shaking it out or washing it in mild soap and water. Be sure the filter is completely dry before putting it back on the fan housing or you may draw moisture into the motor and damage it.

Finally, check the filter bag. The bag is made of a porous paper. If the pores become clogged with very fine dust particles, the bag simply balloons and allows very little air to flow through it. Try changing the bag again to see if the vacuum's performance improves. If it doesn't, take it to a repair shop and have the motor checked to be sure it is performing to specifications.

## Overactive toaster

I have a Proctor-Silex toaster, Model T621W, Series G729, that sometimes pops the toast right out of the toaster. Is there any adjustment to lessen the pop-up force?—Louis Mertic, Akron, Ohio

The problem is in the chassis of the toaster. The chassis is not a serviceable item and must be replaced as one assembly. Take the toaster to an authorized repair agency and have the chassis replaced. **FM**

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.

## Sticky ice-maker tray

I have a Frigidaire refrigerator, FPC1-170T, with an IMK-5 ice maker. After a year's use, the ice-maker tray has lost its luster, and the cubes stick and won't fall out. I have city water, which causes no problems with any other appliances. I've tried coating the tray with vinegar, but that only lasts for about a week.—Wayne Marner, Valparaiso, Ind.

It sounds as if the hard water in your area is causing a mineral deposit build-up on the surface of the ice-maker tray, which is preventing the ice cubes from sliding out easily. Frigidaire says it doesn't make a coating for the ice-maker tray. But the company did say

that you can alter the flow of air blowing over the ice maker.

The ice cubes must freeze from the top down, so that when the bottom freezes it will crack the cubes loose and mineral deposits won't cause them to stick. Look at the frozen cubes in the ice bucket; they should have small cracks on the bottom. If the small cracks appear on the top of the cubes, change the air duct in the back of the freezer compartment.

The modified air duct is called a deflector kit. The part No. is 9956974, and it costs about \$6. It can be ordered from any Frigidaire parts dealer in your area.



# INTRODUCING THE TRUCK DESIGNED TO CARRY A TUNE.

## A tune you can shape with the Equalizer V.

Now the Delco Electronics Equalizer V option makes the sound of great music part of the driving enjoyment of selected '85 model Chevy and GMC trucks.

With this graphic equalizer you can separate and blend the bass, midrange and treble responses in your favorite tunes, while the system-designed speakers deliver fidelity unexpected in a truck.

That's because, unlike some other truck radios, the Delco music system wasn't an afterthought. When these trucks were on the drawing board, so was Delco Electronics, determining the precise location for the system's speakers

for optimum audio performance.

The result is a music system that's designed into the truck as carefully as the suspension. Visit



your nearest GM dealer for a test-listen of the Equalizer V.

And look for the Delco-GM name on music systems in all Chevrolet and GMC trucks. Wherever the music goes, there's Delco Electronics bringing you the art of music through the science of sound.



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BRINGING YOU *THE ART OF MUSIC* THROUGH THE SCIENCE OF SOUND.

Materiali, dimensioni e colori sono illustrativi.



# Announcing **VORTEC V6.**

**MOST POWERFUL STANDARD ENGINE YOU CAN GET IN A 1/2-TON PICKUP.**

Team a swirling, tornado-like vortex action with advanced engine technology and what do you get?

**VORTEC.** New V6 power, standard in tough full-size 1/2- and 3/4-ton 2WD Chevy Pickups, 1/2-ton 4WD Chevy Pickups and Chevy Vans and Sportvans\* for 1985.

**VORTEC's** swirl-port induction literally storms ahead of conventional engine design to mix fuel and air together more completely.

For you, this means truly impressive performance. Impressive towing power, too.

**VORTEC's** statistics? 155 SAE net horses bred for truck use and fed by four-barrel carburetion. There's even the surefire kick of electronic spark control.

**VORTEC V6.** The new standard of six-cylinder power in tough Chevy trucks.

\*Excludes G30/3500 Series.

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# NOTHING WORKS LIKE





LET'S GET IT TOGETHER. BUCKLE UP.

**A CHEVY TRUCK**



Материал защищен патентами GM



# DETROIT LISTENING POST



## Front-drive LeSabre

The 1986 Buick LeSabre looks a lot like General Motors' A- and C-car front-drivers, and we bet it's going to drive in the same traditional way the big Buick rear-drivers did—soft and easy. At Buick, the "traditional" buyers are as important as they are at Oldsmobile, and we've already seen how Olds has "up-dated" the ride of its new cars.

As the LeSabre gets smaller and goes to front-wheel drive, it loses a few pounds of weight, too. Expect the loss to trim out at around 610 pounds—all the better for fuel economy. Wheelbase will shrink from 114 inches to about 108 inches, and overall length could be reduced by as much as 20 inches.

The engines for this '86 will probably be the 3.8-liter V6 or the new 3.0-liter V6, with a diesel engine option possible. The most likely transmission candidate appears to be a four-speed automatic with overdrive.

The '86 LeSabre and a new Olds Delta 88 will be built at "Buick City," the first vehicles that will be assembled at the new manufacturing facility now going up in Flint.

It's likely that Chevy and Pontiac will leave their rear-drive B-cars (Impala,



Our spy photographer caught the downsized Buick B-car near its desert test site. The '86 LeSabre will be 610 pounds lighter and 20 in. shorter than its rear-drive namesake.



Caprice, Parisienne) untouched as long as demand exists. Buick and Olds are now part of GM's "big car" group,

while Chevy and Pontiac—the "small car" group—are supposed to be doing their own new model development.

## Korean-built Omnis?

We've previously reported the Chrysler Corp.'s interest in offshore automotive concerns. That interest has gone so far that we understand negotiations with Korea's Samsung Group are reaching a critical stage concerning a joint-venture car. Being discussed are the specifics of building a \$400 million automobile plant in South Korea to assemble as many as 300,000 units per year. The car Samsung and Chrysler would build is said to be the Omni/Horizon, but the deal could evolve into that car's replacement for the late 1980s, the so-called P-car. Chrysler wants to build such a small car for service into the 1990s. If Samsung builds it, Chrysler indicates, it would be sold in the United States and Southeast Asia in competition with Mitsubishi.

Some of the difficulty lies in Samsung having no experience in the car business—one of its strengths is building televisions. Also, it's said the Korean government could frown on additional competition for the existing

home teams; Daewoo Motor Co. Ltd. (50 percent owned by GM) and Hyundai Motor Co. (10 percent owned by Mitsubishi—which is itself 15 percent owned by Chrysler). A plus, however, is that under the current voluntary restraint agreement, Korean cars could be imported without restriction.

## Chevy revives Nova

It's definite: GM will put the Nova badge on the joint-venture car it's preparing with Toyota in Fremont, Calif. Taking into consideration the American Motors example of "Alliance" for that Franco-American joint project, GM name-givers toyed with calling the Fremont car the "Venture." Other names—a lengthy list of them—were tested for consumer acceptance, but none had the recognition value that Nova has. Small wonder. The compact Nova was one of GM's longest-running, most popular automobiles.

No automotive patriotism here, though, as once shown in the ad slogan

"baseball, hot dogs, apple pie and Chevrolet." In deference to Nova's Oriental flavor, Chevy changed its advertising slogan months ago from "USA 1 is taking charge" to simply "Chevy is taking charge."

## Belts, not bags

A survey of insurance industry executives showed that the group generally is in favor of some form of passive restraint protection for automobile passengers, but about 62 percent of those responding to the survey didn't think air bags were the way to go about it. About 64 percent of the respondents thought automatic seat belts were the best method of protection from injury during a car crash, citing the probable cost effectiveness of belts over bags.

Meanwhile, Ford is assessing the feasibility of air bags in the real world by providing the feds with 5,000 driver-only air bag-equipped cars. Some police departments are testing retrofitted

(Please turn to page 46)



"Light my Lucky."

New Lights & 100's.

Lights: 8 mg. "tar", 0.7 mg. nicotine; Lights 100's:  
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.





## DETROIT LISTENING POST

(Continued from page 44)

air bags in the field, too—one of which, we learned, inflated when the officer drove over a rough road.

### Science marches on

The Federal Highway Administration is promoting a salt-free diet for roads in the winter, proposing the use of calcium magnesium acetate (CMA) instead of the traditional calcium chloride (salt). CMA does less harm to car bodies, roads, bridges and plant life than salt, and is said to be more effective at low temperatures. Unlike salt, which occurs naturally, CMA must be manufactured.

EPA scientists claim that used motor oil is a carcinogen! Prolonged skin contact with crankcase drainings has caused cancer in lab mice. EPA advises mechanics to wear rubber gloves, wash drained oil off skin as soon as possible and refrain from sticking oily rags into their pockets.

### Ear to the ground

**In case you didn't notice, 1985 car prices are up:** General Motors new car prices have gone up an average of 2.3 percent—about \$292—over 1984

models. AMC Alliance/Encore is up by 2.3 percent and Eagle/Jeep by 4.1 percent. Ford's average new car prices have increased 1.9 percent.

**Baby limo out:** Chrysler will discontinue the smaller of two K-based limos for '85. The five-passenger Executive car sold barely 10 percent of the 900 or so sales of the seven-passenger version, which carries over. Both are built by ASC Inc.

**From Pontiac in '88:** Code-named the W-car, a sleek new front-drive coupe is under way at GM to replace the aging Bonneville and Grand Prix by 1988. Buick and Olds will get versions, powered by a 2.2-liter Four.

**Same bounce per ounce:** GM researchers have found a domestic replacement for Hevea rubber, imported from Malaysia for rubber parts. The substance, extracted from the Guayule shrub found in the American Southwest, can be developed commercially for parts such as engine mounts.

**Milestones:** Olds has built its 25-millionth car, an '85 Calais. GM Truck & Bus Group has built its 1,000,001st compact S-truck, a GMC Jimmy utility vehicle. At Ford, a single assembly plant in Oakville, Ontario, has built its 2,500,000th truck, a six-passenger crew cab.

**Building them the right way:** A shut-

down due to poor quality parts stopped assembly of Olds and Buick N-cars for 19 days earlier this year. Way to go, we say.

**Book of the month:** *The New Formula One: A Turbo Age*, by Niki Lauda, 256 pages, \$21.95; Motorbooks International, Osceola, Wis. 54020. Not only can this man drive well, but he writes well, too. In words, pictures and more than 130 illustrations, twice-World Champion Lauda takes you behind-the-wheel and behind-the-scenes in the world's most glamorous motorsport. Fascinating for the technical reader, spellbinding for the enthusiast.

**Short drives:** Now that we've spent a week in the '85 Ford LTD LX, we think we know what draws folks into police work. Ford's version of the Euro-touring sedan is the LTD in LX trim, featuring big wheels and tires, no-nonsense suspension and hot H.O. 5.0-liter V8 power. The engine and suspension are right out of the police package. A very comfortable, powerful piece of family transportation.

We also drove the '85 Continental Mark VII LSC with H.O. five-liter V8. The car was always quiet, always quick and always good-looking. It's also available with a BMW turbodiesel. The Mark can compete with Mercedes-Benz on U.S. or German turf. **PM**

# Two Great Gift Ideas

For the discriminating do-it-yourselfer.

Kar-Check's Professional Inductive Timing Light and Six Function Tune-Up Analyzer.

**NOW ON SALE AT K-MART AND OTHER FINE RETAILERS.**

Here's your chance: Tear this page out today. Write across it: "I want these."

Post it on the refrigerator door. As a subtle hint.



MODEL 4502

### Tune-Up Analyzer

- Handles electronic ignition and 4-6-8 cylinders
- Includes complete instructions
- Checks battery voltage, starting voltage, charging voltage and point resistance
- Sets engine speed (0-3000 RPM) and engine dwell (15° - 60°)



MODEL 4138

### Professional Inductive Timing Light

- Handles electronic ignition
- Includes complete instructions
- Features inductive pick-up clamp, protective rubber nosecone, color-coded battery leads, linear flash tube and spiffy chrome-plated metal case

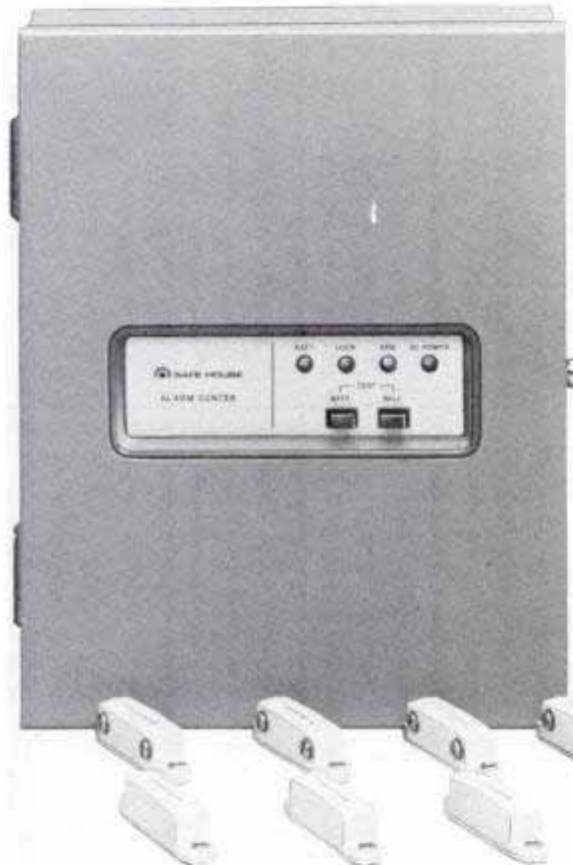


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# Security Sale!

## Save \$16.35 on Radio Shack's Home Burglar Alarm System



System Price

# 129<sup>95</sup>

Reg. Separate Items 146.30



Safeguard your loved ones and your valuable possessions with this perimeter system for professional home security. It includes all you need for easy do-it-yourself installation. You get an alarm system panel with comprehensive manual on planning, installation and operation, 100 feet of wire, high-security key lock, four magnetic switches for windows or doors, and an electronic siren. You can always expand your coverage with the addition of Radio Shack's other security devices. You can even add up to ten arm/disarm key switches for different entrances. The system has two loops. One activates the alarm instantly, the other

provides adjustable 0-45-second entry and exit delays. Alarm shuts off after five minutes, then resets automatically. An always-armed "Panic" circuit lets you trigger the alarm in emergencies. Four LEDs show system status. Power-on and arm/memory LEDs assure you that the system is armed and working. Battery and bell test buttons and battery-low indicator, too. A loop indicator lets you know if a window or door was left unprotected. U.L. listed AC operation with automatic battery backup. Come in and save! And see our entire security line while you're there. Bring your Radio Shack/CitiLine card.

# Radio Shack®

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Price applies at participating Radio Shack stores and dealers. Batteries extra.



# ALL OUTDOORS



## Water on the knee

In case you haven't noticed, hydrosledging, or kneeboarding, is one of the fastest growing water sports. The boards produced by several manufacturers use high-tech construction, such as foam bonded to a polyethylene shell. The kneeboards come in smooth bottom configurations having grooves, tunnels and rails for better directional tracking. There's even an International Kneeboard Assn.

Learning to kneeboard is only about half as hard as learning to water ski—a reason for kneeboarding's growing popularity. It should be the rage in '85.



Kneeboarding craze is the fastest growing water sport for stunting and just plain fun.

## Computerized reel

Just when the fish thought it was safe to stay in the water, along comes a high speed microcomputerized magnetic antibacklash baitcasting reel from Daiwa. The new Procaster Tournament Series Models PT10E and PT15E use a high visibility LCD digital readout, plus audible signals, that tell you how far you've cast, how fast you are retrieving and how deep your lure has sunk after the cast. This information makes it possible to duplicate precisely a retrieve rate that will provoke the fish to strike.

Information about the depth of your lure, when combined with information provided by fish-finder flashes or graph recorder images showing fish at specific depths, lets you dangle an appetizer right in front of their fishy nose. This state-of-the-art reel carries a suggested list price of under \$200.



Computerized fishing reel has digital readouts and does all but bait your hook.

## Stretch suit



Four-way stretch wetsuit is more comfortable because neoprene rubber/nylon material stretches in all directions at once.

If your wetsuit feels more like a prison than a recreational garment, then Parkway's new Thermoflex water sport exposure garments are like a pardon from the governor. An ideal material for wetsuits, Thermoflex is a combination of neoprene rubber and monofilament nylon which stretches equally in all directions, at once. The material fits exceptionally close to the skin without binding.

## Automatic treasure finder

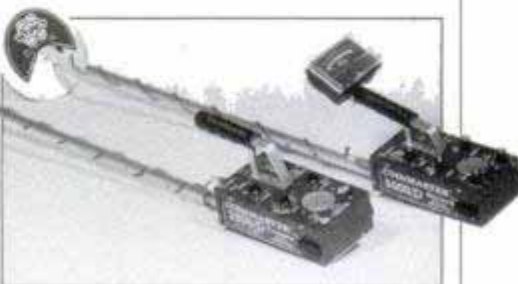
Now, even beginners can cash in on finding buried treasure in their spare time with two new metal detectors from White's Electronics. Models 2900/D and 5500/D have arrows positioned on the chassis that let you preset sensitivity and rejection signals to optimum positions for average conditions. Or, you can set the six control knobs to any setting you think is better.

The system allows the metal detector to operate with the ease of an automatic camera. Advanced treasure hunters can fine tune the unit to screen out ground and set sound threshold and discrimination levels.

The 5500/D, priced at \$399.95 comes with a depth meter that reads the depth of coin-sized objects down to 9 inches below the surface.

It discriminates between junk like bottle caps and nails and desirable targets like gold, silver and jewelry.

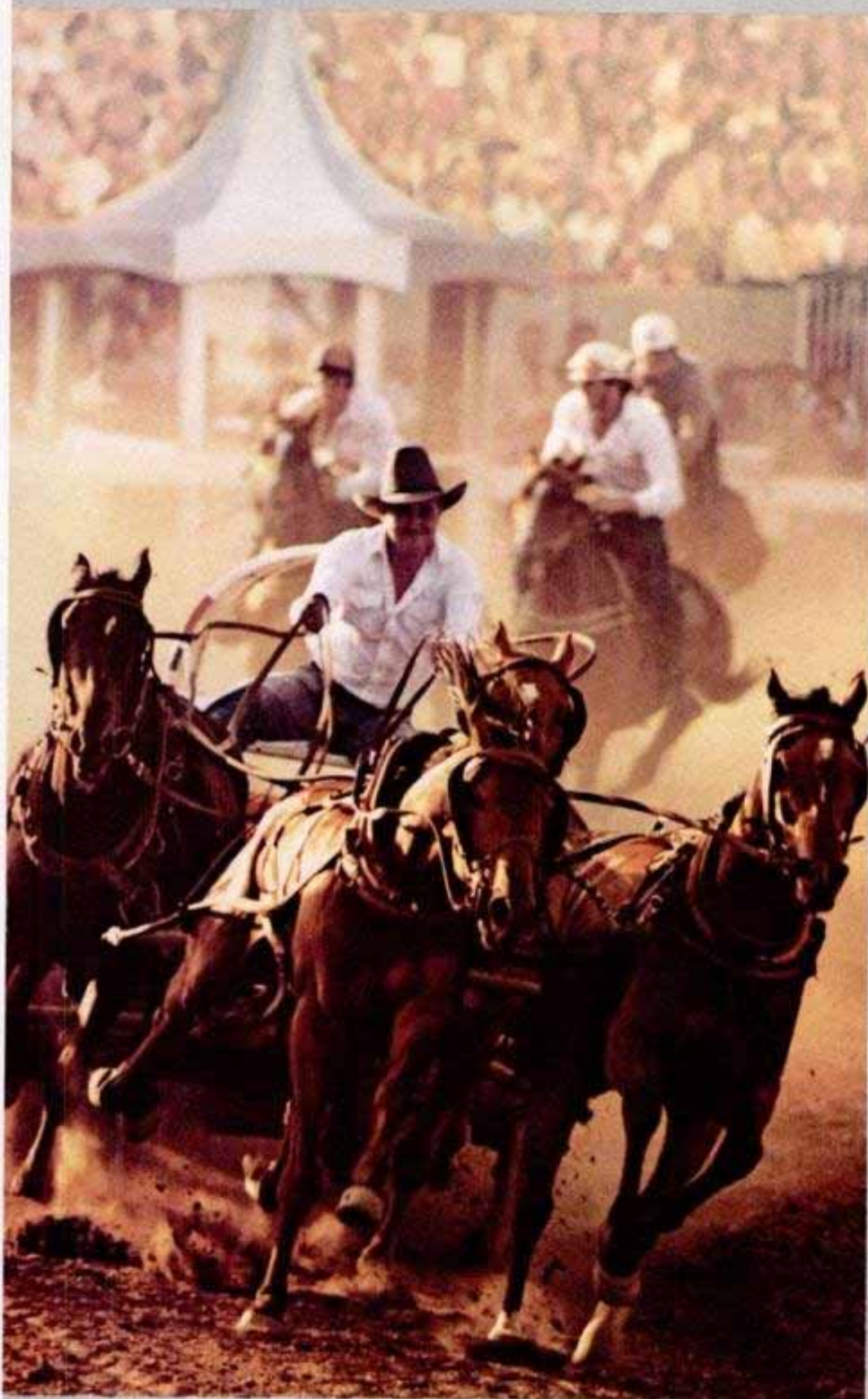
The 2900D, an excellent detector for beginners, is \$179.95. **PM**



Easy-to-use metal detectors come with pre-set controls for automatic operation.



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# Overwhelm Your Favorite Driver

## With new pocket-size PASSPORT, or the classic ESCORT

The perfect gift is more than a surprise; it hits the mark. If there's a driver on your list, you can give ESCORT or new PASSPORT with absolute confidence. Here's why.

### Credentials

*Car and Driver* magazine rated ESCORT number one in its most recent test, calling it "...clearly the leader in value, customer service and performance..."

In the six years since its introduction, ESCORT has become the classic instrument of radar detection. Our policy of continuous refinement has maintained its leading-edge performance. In fact, when it comes to finding radar, nothing can replace ESCORT. So we're not replacing it, just adding something: smallness.

### Frequent Flyers

The person on the move, switching between cars or using rentals in distant cities, needs the smallest detector possible. Ideally it would be pocketable for convenient carrying from one vehicle to another, or on a business trip. But it would have to perform—small size is no advantage if performance must be sacrificed.

Could we put ESCORT performance in a detector one fourth its size? It seemed impossible, but we turned our best technical minds loose on the subject in 1982.

### The Result

Now we're introducing PASSPORT: Radar Protection That Fits In Your Pocket. It's incredibly compact, just 3/4" high and 2 3/4" wide, about the size of an audio cassette box. PASSPORT offers ESCORT performance and features in a miniaturized package. The remarkable technology that made this possible is a story in itself. (See "Techno-Talk".)



PASSPORT offers ESCORT performance in an incredibly compact size.

### All The Right Moves

Feature for feature, PASSPORT and ESCORT are unmatched. Both incorporate our unique three element warning system. Upon radar contact, the amber alert lamp lights and the meter shows radar signal strength (ESCORT uses an analog meter, while PASSPORT has a bar graph display with eight Hewlett-Packard LEDs). At the same time, you will hear an audio warning—pulsing slowly when the radar is weak, quicker as it

strengthens, then constant as you approach the radar unit. Both units have separate warning tones for each radar band: "beep" for X band, a more urgent "brap" for K band because you have less time to act.

PASSPORT adds a Mute/Dark switch to the system. In the Dark mode, the alert lamp and the bar graph meter are defeated—only the audio warning will be activated.

The Mute function is a momentary position on the switch. When you activate the mute, it defeats the audio alert for the duration of that radar encounter. After that radar signal ceases, the system automatically resets and the audio will alert you to the next radar signal.

### Breakfast Of Champions

When it comes to performance, both ESCORT and PASSPORT are thoroughbreds. Both use our varactor-tuned Gunn oscillator, patented signal processor, and our Statistical

## TECHNO-TALK TECHNO-TALK TECHNO-TALK

### The Basics

Surface Mounted Devices are micro-size transistors, capacitors, resistors, and diodes. These remarkable components are only a fraction of the size of conventional electronic parts. PASSPORT was made even more compact by mounting the SMDs on the underside of the circuit board, leaving the top surface for custom integrated circuits, microwave diodes, and other parts too complex to be reduced to SMD proportions.

The compact size of the PASSPORT system was made possible only through the use of a remarkable technology:

### SMD: Surface Mounted Device

Originally used exclusively in the hybrid integrated circuit industry, SMD technology is just now being incorporated in high end consumer electronics. PASSPORT is the first large-scale application of this technology to a radar detector.



Figure 1





Tune in "Talkback with Jerry Galvin," America's new weekly call-in comedy talk show Sunday evenings on public radio stations. Check local listings.

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Operation Processor (ST/O/P™), which eliminates alarms caused by other radar detectors.

And either PASSPORT or ESCORT will complement any car's interior. Both are constructed of sturdy aluminum and polycarbonate. ESCORT is finished in a glare-resistant polyurethane, PASSPORT is charcoal Nextel, a rich, non-glare finish that's as durable as it is elegant.

#### Apart From The Crowd

We've always felt that users of precision electronics are entitled to deal with experts. That's why we sell direct from our factory. There are no middlemen. When it comes to customer satisfaction, we take full responsibility.



PASSPORT is only 1/4" tall and 2 1/4" wide, about the size of an audio cassette box.

And while our system of factory-direct sales was not designed specifically for gift givers, it does offer some rather special benefits. For example, you needn't worry about buying a discontinued model still in

a store's stock. Your gift will never be seen marked down in the discount chains. More importantly, giving either ESCORT or PASSPORT shows you are concerned enough about quality to track down the only source. And there's one more advantage.



ESCORT and PASSPORT come complete with accessories.

#### Easy Shopping

ESCORT and PASSPORT let you do your Christmas shopping by phone and avoid the retail hassle. No searching for parking. No standing in lines. We're only a toll-free call and a parcel delivery away.

Most important of all, ESCORT and PASSPORT are guaranteed to please. Holidays or anytime, take the first thirty days as a trial. If you're not absolutely satisfied, return your purchase and we'll promptly refund your money and your mailing costs. We also back ESCORT and PASSPORT with a full one-year limited warranty.

Now you have a choice. ESCORT, the classic instrument of radar warning, or PASSPORT, pocket-size radar protection.

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**By Phone:** Call us toll free. A member of our sales staff will be glad to answer any questions and take your order. (Please have your Visa or MasterCard at hand when you call).

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IN OHIO CALL . . . . . 800-582-2696  
(Phone M-F 8-8, Sat 9-5:30 EST)

**By Mail:** We'll need your name and street address, daytime phone number, and how many PASSPORTs and ESCORTs you want. Please enclose a check, money order, or the card number and expiration date from your Visa or MasterCard. (Personal or company checks require 18 days processing.)



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#### Seeing Is Believing

Figure 1 shows the amazing size difference between conventional components and their SMD counterparts. In fact, the SMDs are so small, prototype PASSPORTs had to be constructed with a steady hand and a tiny pair of tweezers. Hardly an efficient production technique.

#### A Serious Commitment

Although a sophisticated numerical control machine that can accurately mount SMD parts costs several hundred thousand dollars, Cincinnati Microwave is firmly committed to SMD technology. By the end of the year we will have three such machines in operation.

The machine places over one hundred SMD components on PASSPORT's epoxy circuit board, affixing them with a special adhesive. The circuit board then passes through an ultraviolet curing chamber, securing the parts for what lies ahead.

#### A 500° Bath

The circuit board is then passed through a flowing bath of molten solder. The SMDs are on the bottom as the board passes through this 500° bath of liquid tin/lead alloy. A small area of the finished board is shown in figure 2.



Figure 2

#### To Be Continued...

The revolutionary SMD components are only one part of the story that made PASSPORT possible. We'll reveal some of the other technology in future sections like this one.



# WORKSHOP MINICOURSE



## Plywood edge treatments

Hardwood veneer plywood is a great construction material with many advantages over solid hardwood. Among them are ease of fabricating large projects, great dimensional stability, resistance to splitting and warping, and near equal strength in both directions. These advantages are the result of the makeup of the panels: thin layers of wood bonded together with their grains running perpendicular to each other. However, it is just this structure that causes plywood's one major drawback: The exposed edges are unsightly and must be concealed. Here are a number of ways to hide these edges. Some are simple, others a bit more involved, but all have worked well for me.

—Rosario Capotosto



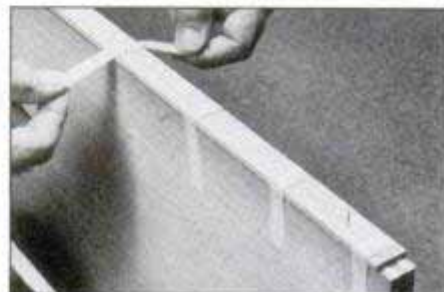
Adhesive-backed hardwood veneer tape is applied directly to edge with a few passes of hot clothing iron.



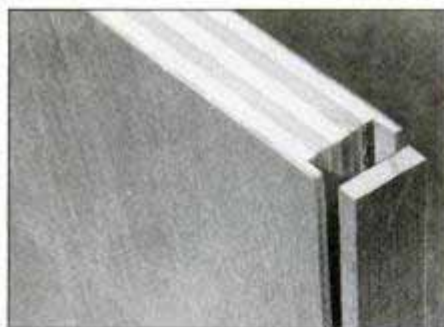
For curved edges, where using an iron to apply adhesive backed veneer tape is impractical, use plain hardwood veneer tape instead. It is attached with contact cement.



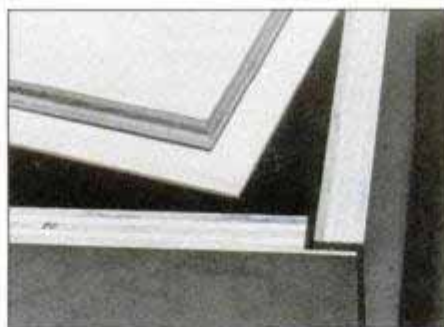
If you want to cover the edge of a plywood piece that must be rabbeted, be sure to apply veneer tape before rabbeting. Otherwise, overall length dimension will be off.



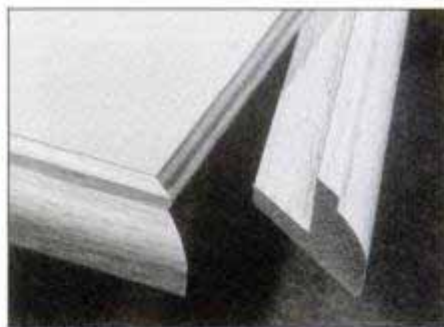
Solid-wood edging is stronger than veneer tape, so it's better for edges that get heavy use. Glue and tack-nail in place with two brads, then "clamp" with masking tape.



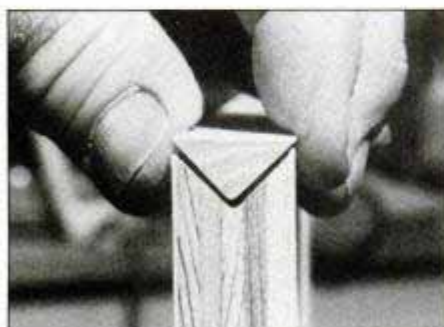
Solid-wood bands can also be let into edge by first cutting a groove with dado blades. You can leave only the face veneer on both sides or double accent line as shown above.



Panels can be joined with deep rabbets and glue so face veneer covers matching edges. If only two pieces are joined, joint is weak; if third is added as shown, joint is okay.



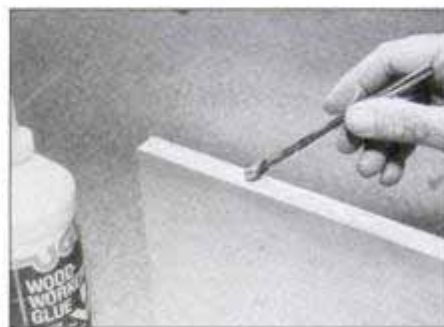
For tabletops, cover edges with thick moldered boards that have mitered corners and a deep rabbet cut in the top edge. The rabbet increases gluing surface for more strength.



A V-shaped solid-wood strip glued into a V-groove cut in the panel yields a well-concealed edge. Cut groove in two passes using table or radial-arm saw with blade at 45°.



To conceal edges without adding anything to them, use a splined miter joint and glue. A good spline for 3/4-in.-thick stock is a 1/2-in.-wide piece of 1/8-in.-thick plywood.



If edges will be painted, two coats of diluted yellow glue can conceal them. Ratio is 1 part water to 4 parts glue. Sand edges smooth beforehand and after glue dries.



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You sense the power right away.  
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- 1,460-pound payload, standard. Almost  $\frac{3}{4}$  ton! More than Toyota, Chevy S-10, Ford Ranger standard models.
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Nissan King Cab has nine cubic feet  
of lockable, inside storage (with  
jump seats) that make it first and still  
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## PM drives the Volvo 740 GLE and 760 Turbo

Two new models fill in the market chinks.

BY WADE HOYT, Auto Editor

When Volvo asked me to fly to Europe and drive their new 740 GLE model from Bologna to Geneva, I couldn't say no. I was curious to see how such a car would behave on its home ground. It seemed like an odd combination, putting the company's small engine—a 2.3-liter Four—into its big, 7-series car, especially now that gas-crisis worries seemed to be over.

Their public relations man patiently explained to me that the 740 GLE with the four-cylinder engine weighed about the same as the smaller, boxier, older DL and GL models, but it was roomier, more aerodynamic and more luxurious, forming a sort of a bridge between the entry-level L-series Volvos and the wedge-shaped 7-series cars with their base V6 engines. As for performance, all he said was: "Wait and see. It's on the same level as the DL and GL."

We didn't do much waiting in Italy and Switzerland, charging along the *autostrada*, blasting halfway up the Alps and through the St. Bernardo tunnel, then along the *autoroute* to Geneva, all the while trying to keep up with Bo-Gilbert Persson, Volvo's in-house rally driver and madman.

Its 114 hp propelled the 740 GLE along at speeds up to 110 mph, with mid-range acceleration and performance that was more than adequate. In fact, it was hard to tell you weren't

driving the smaller Volvo, except for the fact that the 7-series car is roomier and quieter. Although they look bigger, the 7-series cars are actually  $\frac{1}{2}$  in. shorter than the L-cars, but their longer wheel-base gives them a bigger look, more interior room and a smoother ride.

The 740 is equipped with Volvo's multiadjustable seats that have a combination of settings that would make Quasimodo comfy. In addition to the expected forward and back travel, the seats can be adjusted for height, lumbar support, seat-cushion angle and seat-back angle. All adjustments are manual, however, not powered. "Bun warmers" in the driver's seat turn on automatically to take the chill out of cold winter mornings.

Two transmissions are available: a four-speed manual with an electrically engaged overdrive, or a German-built ZF four-speed automatic with a lockup torque converter.

The automatic has a lockout switch for the overdrive fourth gear on the shift knob. Leave it alone and it shifts in and out of O.D. on its own, just like any four-speed automatic. Flick the switch and O.D. is locked out, keeping you in the lower three gears when you want a bit more engine braking on twisty, hilly roads or when you want a manual "kickdown" for passing. The handy gearshift switch does the job without



The Turbo engine compartment is packed with an intercooler and turbo plumbing.



European 740 GLE compartment has plenty of room to work—like the good old days.

the need to take your eyes off the road and study the shift quadrant.

This should not be confused with the identical O.D. switch on manual transmission Volvos—it engages a fifth overdrive gear.

The four-wheel disc brakes were put to the test during a couple of panic turnoffs from the poorly marked *autostrada*, when it became necessary to hastily change course as one exit after another loomed up unexpectedly.

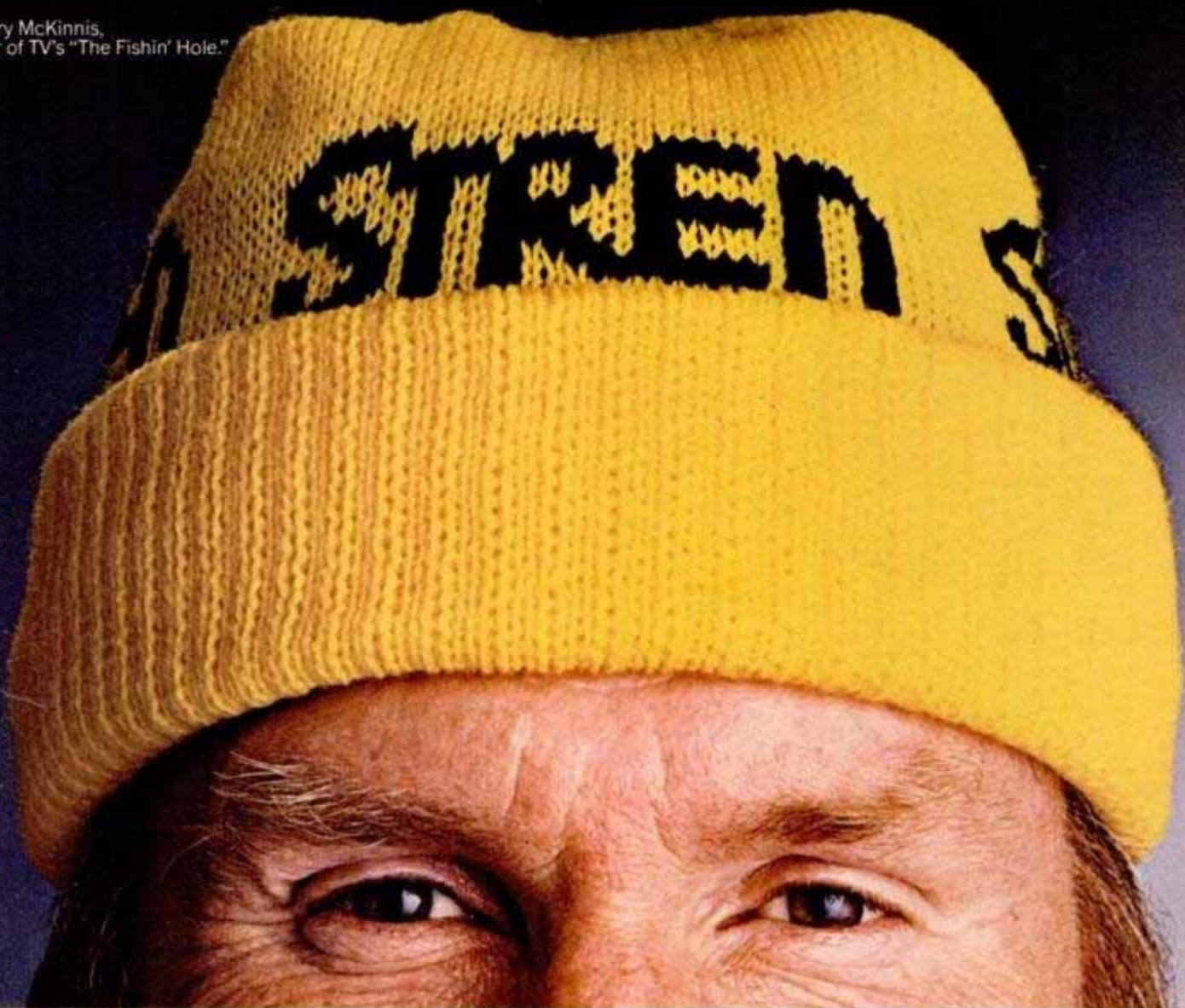
The power steering is just about perfect, with plenty of road feel, but the oddly bent turn signal and wiper control levers are a bit awkward to use.

Back in America, I borrowed the new 760 Turbo, which had just gone on sale. Here, Volvo's model numbering system begins to get a bit murky. The 4s and 6s have nothing to do with the number of

*(Please turn to page 56)*



Jerry McKinnis,  
star of TV's "The Fishin' Hole."



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Limit one Winter Fishing Hat per customer.

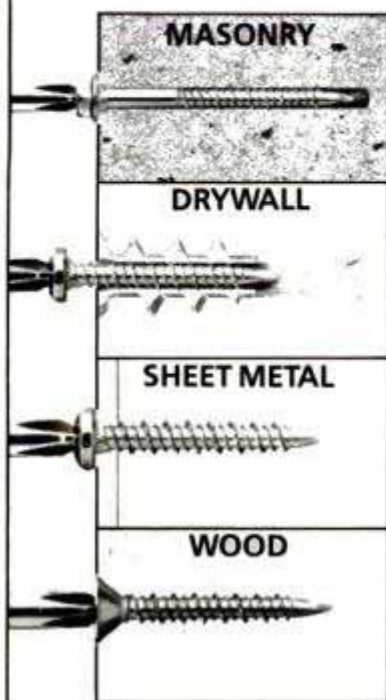
Offer good only on Stren purchased November 22 through December 24, 1984 in the U.S.A. Allow six to eight weeks for delivery. Subject to state and local regulations. Void where taxed, restricted or forbidden by law. Request must be postmarked by December 24, 1984.

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So get new Grip-It anchors. And get a hold of what they can do.



**Grip-It™**  
Anchor System

**B-D Black & Decker®**

## FIRSTHAND REPORT: 740 GLE and 760 TURBO

(Continued from page 54)

cylinders in a given model's engine. The 760 cars are the full luxury models. The 740s have less equipment and lower price tags, but to call them "low line" is a disservice.

Volvo's four-cylinder turbo uses a modest 10.5 psi of boost and an inter-cooler the size of a radiator to raise output from 114 to 162 hp. This gives the stately looking car 0 to 60 performance in the 8-second bracket, which is definitely sports car country.

The 760 Turbo is a real rocket ship, with enough power to get you into real trouble if you go hog wild with it. Naturally, we couldn't get anywhere near the Volvo's top speed of 125 mph with the Turbo in America, but it would zoom up to well above the national speed limit with little turbo lag.

The four-wheel disc brakes were sure, smooth and confidence-inspiring, thank goodness. Although its handling is superior to many four-door luxury cars, slightly tauter control would be appreciated by the hard driver, even if there was a slight penalty in ride harshness. Although the majority of Volvo drivers probably do not push their cars as hard as we did, those who buy the racy model should get racy handling. (There is a boy racer model in the works, and it will arrive in 1985 as the 740 Turbo. Basically it's the same car with less power equipment, sportier blackout trim and a lower price tag.)

What Volvo has done with these two new permutations is to extend its upscale 7-series in two different directions—economy and performance. At about \$17,500, the 740 GLE is a logical step up from the older \$12,000 to \$17,000 DL and GL cars. Although it's equipped with power steering, brakes and windows, an AM/FM stereo and velour upholstery, it is not so well-

### THE PM REPORT CARD

VOLVO	740 GLE GRADE	760 TURBO GRADE	COMMENTS
Acceleration	B+	A-	Some lag on Turbo.
Handling	B+	B+	Turbo could stand tauter control.
Braking	A	A	Straight and fade-resistant.
Steering	A	A	Nice road feel for power steering.
Transmission	B+	B+	Both units have unusual "extras."
Ride	A	A	Very smooth, little road shock.
Fuel economy	B	C	24 mpg on GLE; 18 mpg on Turbo.
Seating	A	A	Firm, multiadjustable, no power.
Vision	A-	A-	Excellent; some blockage from headrests.
Gauges/controls	A	A	Simple, easy to read.
Ventilation	B	B	Some whistle when dash vents are closed.
Noise @ 55 mph	B+	B+	Minor gear whine on manual.
Cargo capacity	A	A	Big, deep trunk.
Engine serviceability	A	B-	Turbo plumbing causes clutter.
Fit & finish	A	A	Just excellent.

equipped as the 760 models. The 740 has radial tires on alloy wheels, but they're 14-in. wheels instead of 15-inchers. Its sunroof is manual, not powered, and the air-conditioning does not feature climate control.

Next step up is the coming 740 Turbo. With 162 hp and a \$19,000 price tag, it's a comparative bargain. That's followed by the \$20,000 760 GLE, with its smooth 134 hp V6 engine (see *PM Owners Report: Volvo 760 GLE*, page 180, Mar. '84).

Then comes the \$21,000, 162-hp 760 Turbo four-cylinder. And, finally, out in left field, is the \$22,000 760 GLE turbo diesel with its 130-hp inline Six. The 760 models all feature the larger wheels and tires, power sunroof, climate control, central door locking plus all the other goodies and gizmos you'd expect on a 20-grand luxury sedan. Volvo's marketing men now have filled in just about every chink in the \$12,000 to \$22,000 range.

PM



Interiors of both cars feature full instrumentation and plush, multiadjustable seats—leather in the 760, velour in the 740.



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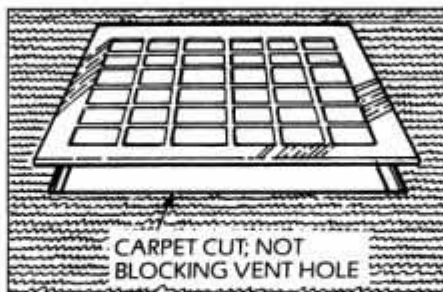


# 4 Energy-Saving Tips From PM Readers

## 1 Trimming carpet

I couldn't understand why one room of our home was much colder than the others. I removed the floor register and discovered that carpet had been cut on three sides and forced down the hole, blocking warm air. I trimmed and removed the carpet in only 10 minutes, and made the room much warmer.

—John Oliger, Columbus, Ohio

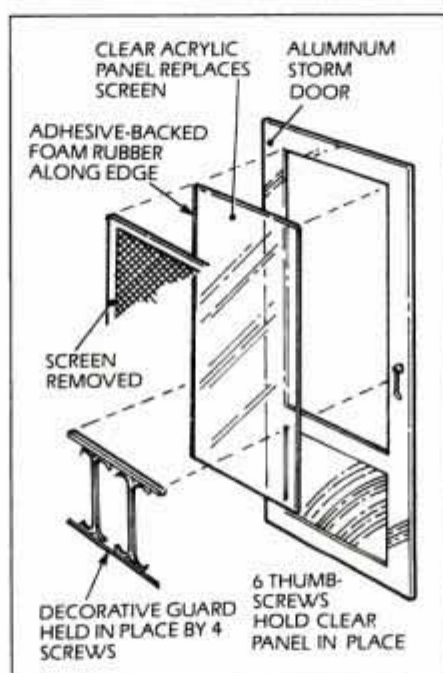


## 2 Screen door fix

Last winter when I opened my back door and found snow between the inside door and my aluminum screen door, I decided it was time to combat the elements. Replacing the screen with solid glazing seemed the easiest and cheapest solution. First, I removed the decorative guard held to the door by four screws. Then, I removed the screen by loosening the six thumbscrews that hold the screen clamps. I measured the size of the opening and decreased both dimensions by 1/4 in.

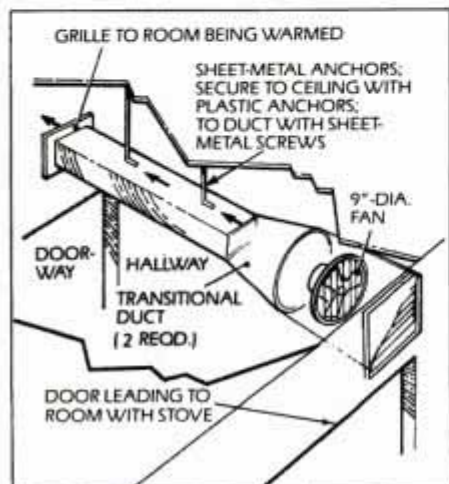
Next, I purchased a piece of clear acrylic cut to size, and a roll of 1/4-in.-thick foam rubber with tape on one side which I applied to the edges of the glazing. Finally, I inserted this into the door opening, tightened the thumbscrews and reinstalled the decorative guard.

—Anthony J. Kreiter, Milwaukee



## 3 Sharing warmth

Circulating air warmed by a wood stove into adjoining rooms can be a problem. Warm air rises easily, but won't move



laterally unless pushed or pulled mechanically. We've solved the problem using ductwork and a fan installed at ceiling level.

Above the doorway in the warm room, insert a 3 1/4 x 10 1/4-in. grille, 1 1/2 in. below the ceiling. On the cold side, use a transitional duct (3 1/4 x 10 1/4 in. expanding to 9 in. round) to connect the grille with a 9-in. circular fan drawing 75 cfm. Beyond the fan, use another transitional duct to connect the fan with rectangular ductwork. (Materials available at heating equipment suppliers.) Wire the motor with metal-sheathed cable to a nearby light switch. Suspend the ductwork from right-angle strips of metal screwed into the ceiling joists and ductwork.

Finish by painting it the same color as the ceiling.

—E. Barrett and G. Burns, Harrisburg, Pa.

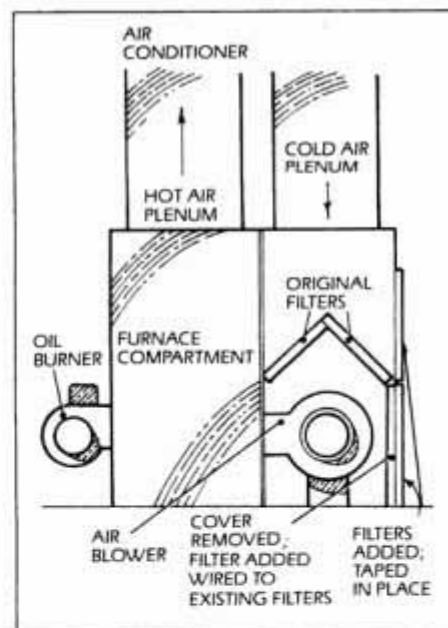
## 4 Redirecting air

Our two-story house is heated by an oil-fired, forced-air furnace. The furnace is located in a small workshop in one corner of the basement. I was disturbed to find that the hottest room in the house was this basement workshop area.

One way of recovering this heat would have been to put an intake vent in the cold air return plenum near the ceiling. However, this would have caused workshop dust to circulate all over the house.

I compromised by removing the cover panel across the fan and filter compartment so that the warmed air could pass upward.

To combat dust circulation, I closed off the space below the in-furnace filters with a 16 x 20-in. washable filter. It is held in place by 22-ga. copper wire secured to one of the existing filters, to form a tight seal inside the door frame. Washable filters are stiff enough to



stand when supported in this way, but flexible enough to be worked behind the door frame.

Then, I taped two disposable fiberglass filters over the entire cover opening with masking tape. Now, air coming from the upstairs cold air return ducts still passes through the original set of filters, but air from the workshop must pass through two sets of filters to recirculate through the house.

—B. Viney, Nepean, Ontario, Canada



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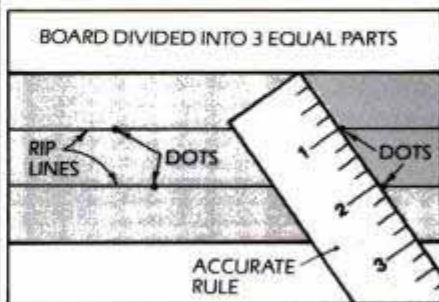


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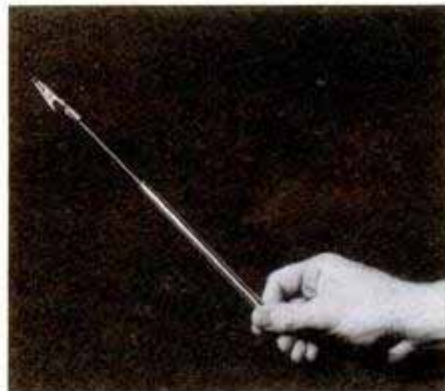
## HINTS FROM READERS

### Dividing space on a board



Here's a novel way to divide a board in equal parts for ripping, or to measure equal divisions between parallel lines. Place a rule diagonally across parallel lines so the desired number of divisions is seen on the rule. Make several sets of dots at division points along the parallel lines. Then use a straightedge to connect the dots.—*Oscar Brown*

### Adjustable match holder

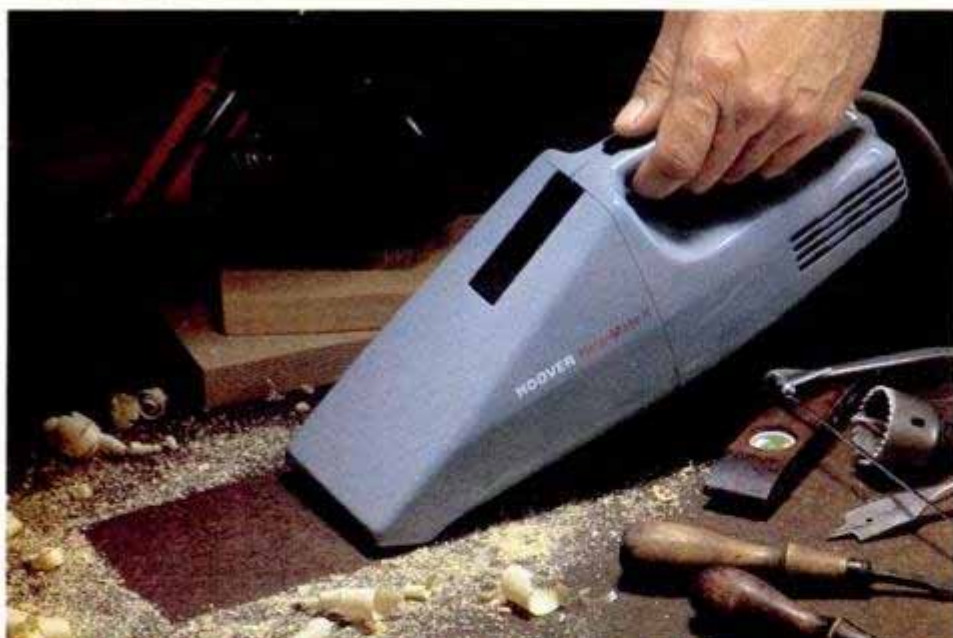


An adjustable match holder, convenient for lighting the pilot light on your hot water heater or furnace, can be made from an alligator clip and a telescopic antenna removed from a portable TV. Cut off the tip of the antenna. Solder the alligator clip to this end. Insert the match in the clip claws, light it and extend the antenna as needed.

—*John Uzzolino*

### Oil-can drip catcher

Push a thick, snug-fitting felt washer down over the spout of an oil can to minimize oil drips. The felt catches oil running back down the spout so it won't drip off the can.—*Lane Olinghouse*



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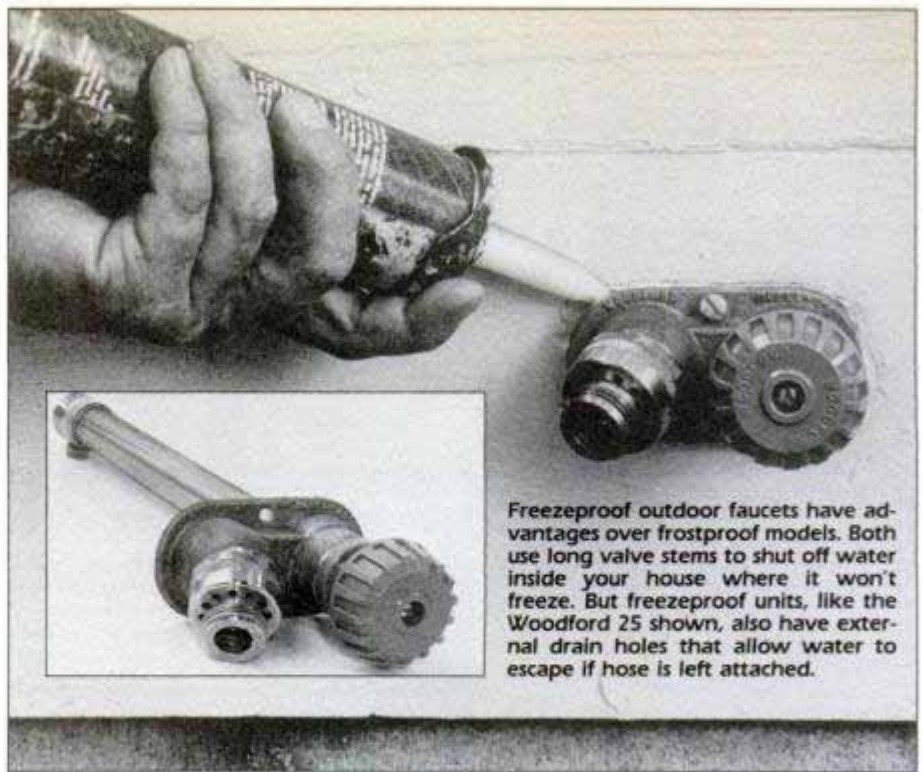
An unplanned basement swimming pool ranks right up there with peeling wallpaper and squirrels in the attic as least favorite occurrences for homeowners. Forgetting to remove the hose from your outdoor faucet and not turning off the interior shutoff valve before freezing temperatures hit can produce just such a disaster.

Many homeowners have tried to avoid this problem by installing—or having installed—frostproof outdoor faucets, also called hose bibs or sillcocks by plumbers. These units have extra long valve stems, aligned horizontally, that are turned from the outside faucet handle but seat well within the house where the temperature is warmer. This means that the water is stopped at a point where the temperatures should never fall below freezing. Thus, no broken pipes, no matter how cold it gets outside. Their greatest advantage is that you don't have to remember to close your interior inline shutoff valve when the colder weather comes.

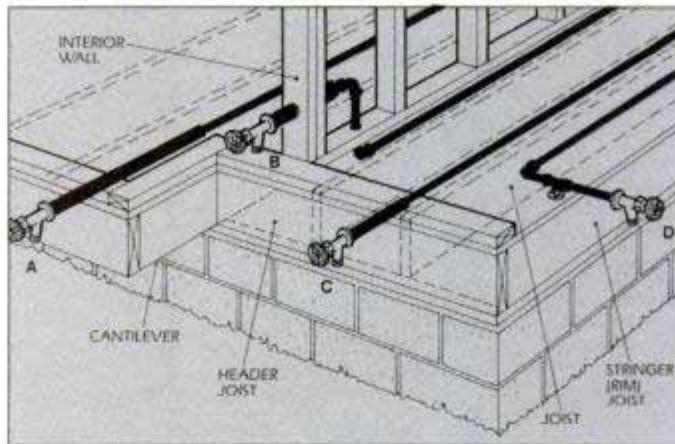
However, there is a way that a frostproof faucet can freeze. If you leave the hose attached and coiled at the faucet, the water in the fixture between the valve seat and the hose connection will not drain. Then, when the extreme cold comes, the fixture can freeze and split. Chances are that you won't notice anything wrong until you turn on the hose in the spring. Then, you'll wind up with a flooded basement floor months after the real damage was done.

To be certain that you won't get caught up in this, there is a new type of freezeproof outdoor faucet that you can install. The Woodford models 20 and 25 are examples. Model 20 retails for about \$20 and has small drain holes around the hose connection so that water cannot collect in the unit even if the hose is attached all winter.

There is another benefit to some freezeproof models like the Woodford 25: an antisiphon backflow preventer. This option allows you to immerse your hose in impure or toxic substances, like some pesticides, without running the risk that some of this material might siphon back into the household water supply. Some local ordinances require



Freezeproof outdoor faucets have advantages over frostproof models. Both use long valve stems to shut off water inside your house where it won't freeze. But freezeproof units, like the Woodford 25 shown, also have external drain holes that allow water to escape if hose is left attached.



The four most common ways sillcocks are plumbed are: (A) through a cantilevered floor, which requires extra long replacement unit; (B) through an interior wall, often in concrete slab foundation houses; (C) between open joists in the basement, the most common type; (D) across or through joists with a right-angle bend—with or without interior shutoff valve.

the use of this type of unit. The Model 25 with a backflow preventer sells for about \$25. Both models are available at hardware stores, plumbing supply houses or from Woodford Manufacturing Co., 1626 Delaware Ave., Des Moines, Iowa 50306.

For ease of installation, these units have a clever dual-purpose connecting fitting. Inside, the fitting has a standard  $\frac{1}{2}$ -in.-dia. seat that slides over  $\frac{1}{2}$ -in.-dia. copper tubing. It can be sweat-soldered right in place. Outside, the same fitting has male pipe threads that can screw into a standard iron pipe or copper female adapter. Which one you use depends on the specific requirements of your plumbing system.

If the supply line to the existing faucet is a straight run and is accessible from the basement below, the job is a snap. First, shut off the water to the line either by closing an inline shutoff valve or by closing the house service line valve at your water meter. Open up the outside faucet and let all the water drain out. If you have copper tubing

supply lines, just cut the line with tubing cutters beyond the point of the old connection. Then, go outside and remove the screws holding the faucet mounting flange to the house. Pull out the entire unit.

If, on the other hand, the faucet is connected to iron pipe plumbing lines, the unit will be screwed into a pipe-thread adapter. To remove this setup, first remove the faucet flange mounting screws outside. Go back inside and unthread the fixture. Use two pipe wrenches—one to back hold the existing plumbing and the other to turn out the faucet unit. Then, go back outside and pull out the assembly.

Install the new freezeproof unit by sweat-soldering it to the end of the existing copper supply line or by threading it into the iron pipe adapter. Depending on the length of the new faucet unit, you may not be able to attach it directly to the place where the old one was removed.

Often, you will have to make up some (Please turn to page 70)



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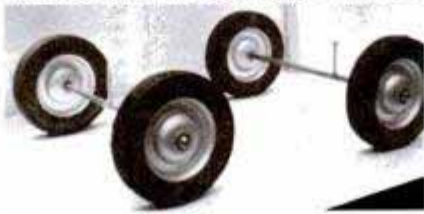
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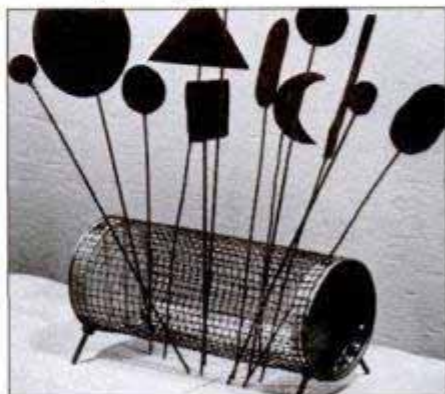


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## PM PHOTO HINTS

### Handy dodger holder



Dodging wands are kept right at your fingertips in this handy holder made from hardware cloth and a couple of metal jar caps. Cut the mesh about 8 inches wide and long enough to wrap around the lids. Fasten it to the lids with sheet-metal screws and use small bolts for legs.—*David W. Roberts*

### Telltale washer test



It's important to know how efficient your print washer is. You can test it by adding a little milk if the tray is black or ink if it is white. The water should run clear in about five minutes if the washer is working properly.—*Robert Hertzberg*

### Focusing aid

You can save time focusing your enlarger if you first record the height of the negative carrier for each size of enlargement that you are likely to make. Final focusing then requires only a quick touchup.—*Ron Jegerings*



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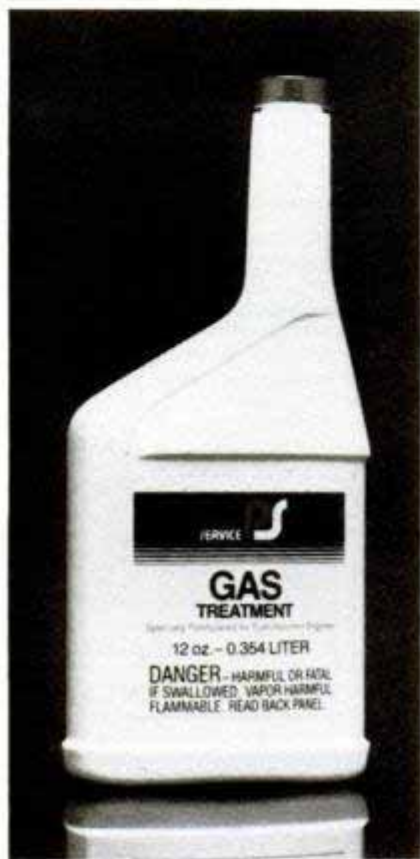
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## FREEZEPROOF FAUCET

(Continued from page 64)

difference in length. For copper lines, this requires adding a 1/2-in.-dia. sweat coupling to the end of the cut supply line. Then, cut a nipple of the proper size and sweat it between the faucet unit and the coupling.

For iron pipe, you should make a transition into copper by installing a male or female adapter to the end of the iron pipe supply line, then sweat a copper nipple to it. Finish up by sweating the faucet unit to the nipple. Keep in mind that when you are sweating the faucet unit in place, you must first completely open the valve by turning the faucet handle. Otherwise, the heat will melt the valve seat washer and the faucet will leak.

Once the proper connections are made, reattach the faucet mounting flange to the outside of the house and caulk around its perimeter to prevent any heat loss. Check for leaks and you're done.

When the connection is not accessible from below, but is hidden above a finished ceiling or behind a finished partition wall, some changes must be made in the installation procedure. First, you must determine the location of the connection within the enclosed

space so you won't spoil a good deal of drywall or plaster looking for it.

The accompanying photos illustrate two options depending on the faucet you are replacing. If it's a frostproof unit, just remove the valve stem and measure its length. Add 1 in. for the depth of the valve seat. Then, add the thickness of the foundation wall, floor deck or house wall, depending on your situation. Next, measure from one corner of the house or from another convenient reference point such as a basement window and subtract the thickness of the foundation or house wall from this figure. Then, go downstairs and mark the ceiling where these two points meet.

If you are replacing a standard sillcock, again remove the valve stem, but this time slide a stiff wire into the faucet. When it hits an obstruction—either an interior shutoff valve or a right angle bend in the supply line—this is the point at which you should make the new connection.

Cut a small access hole in the drywall or plaster at this point and look for the connection with a flash light. When you locate it, enlarge the hole so it is centered around the joint. Then, replace the faucet as explained earlier. Repair the drywall or plaster and you're done.—Merle Henkenius

## Replacing faucet on straight piping run



When installing a new freezeproof faucet on a straight run—here we are replacing an old frostproof model—first cut the supply line indoors, beyond the faucet-supply line connection. Then, pull out assembly and unscrew or cut off old faucet.

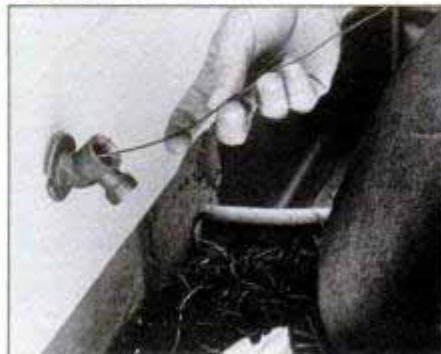


New faucets have two-way end fitting. Male pipe threads can be screwed into female adaptor, or unit can be sweat soldered onto standard 1/2-in. copper tubing.

## Locating connection when piping is hidden



When replacing old frostproof faucet, you can locate position of interior plumbing connection by removing valve stem and measuring its length. Add to this number the thickness of the foundation wall, then mark interior ceiling accordingly.



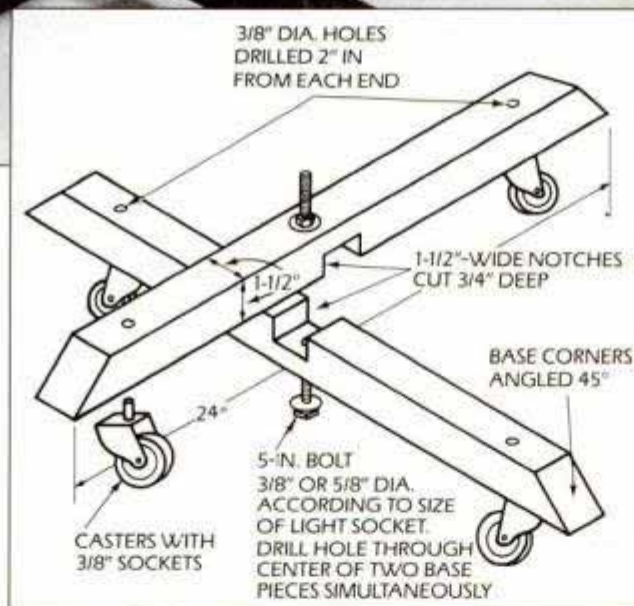
To locate the interior plumbing connection for a standard sillcock, first remove the valve stem. Then, slide a stiff wire into faucet until it butts either the interior shutoff valve or a right angle bend.



# BUILD A LOW/BOY LIGHT STAND



PM's lowboy light stand, above, is a knee-high helper for creating special effects or taming difficult shadows. It requires few materials and it's easy to build. Diagram shows critical dimensions.



Attack tough lighting situations from the ground up.

BY KENN OBERRECHT

A photographer often needs to illuminate subjects from a low angle, either to fill harsh shadows or reach hard-to-light areas near the floor. A low-angle light also can be used to create special effects, backlight translucent backdrops to eliminate shadows or to fill light subjects or backgrounds from beneath.

Jury-rigging a conventional light stand seldom produces the professional results you can achieve with a lowboy light stand—a device easily built in an hour with simple tools and readily available materials.

The schematic diagram shown here provides all the dimensions and assem-

bly instructions you'll need. The only optional element in the design is the use of a  $\frac{3}{8}$ -in. or  $\frac{5}{8}$ -in. bolt to join the cross members. The bolt size depends on the light-head socket size you decide you want to use.

For materials, you'll need two 24-in. pieces of nominal  $2 \times 2$  ( $1\frac{1}{2} \times 1\frac{1}{2}$  in. actual) stock. Four light-duty casters, a 5-in. bolt with matching nut and two washers are all the hardware required. For finishing, you'll want medium- and fine-grit sandpaper and paint. For tools, use a  $1\frac{1}{2}$ -in. or narrower wood chisel, center punch, hammer, drill with  $\frac{3}{8}$ - and  $\frac{5}{8}$ -in. bits, wrench, miter box and backsaw.

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## PM People

# Dom DeLuise, Mr. Fixit



Dom DeLuise shows off some of the things he has restored. His mother, wife Carol and dog Midnight stand behind DeLuise.

'Remember, my father was a garbage man. So when I see a pile of wood . . .'

"I'm no master craftsman, but if you call me Mr. Fixit, you'll be flirting with the truth," Dom DeLuise says as we are setting up an interview at his Pacific Palisades home. It's a 30-year-old three-bedroom ranch that has been expanded in every direction but down. The coastal soil is not hospitable to basements.

We had been greeted at the door by Dom's wife, Carol, who had taken us on a tour of DeLuise's fixit projects through the step-down living room out to the breakfast nook in the dining area. There, the comedian was helping his mother, a good-natured octogenarian, build a bird feeder with a punctured coffee can for seeds and a foil pie plate on which the birds could stand.

DeLuise, a compulsive junk retriever, has fixed several grandmother clocks, including refinishing and antiquing the wood. He's done cement work inside and outside his home, and reclaimed half a dozen chairs and tables other people had decided to throw away.

BY J.T. JOHNSON



The framing hammer left by his father is his favorite. The workshop is in a far corner of the garage behind two wooden doors.

The comic, who has endeared himself to moviegoers in box-office hits like "Fatso" and "The End," keeps some of the zaniness of his characters with him

as he works in the warm chaos of his home. His repair of wooden tools is done with scraps at hand with no thought of whether the woods or stains match. He finishes cement work with a garden trowel rather than a float. His building plans are sketched on the backs of envelopes. He calls it "functional amateurism."

As we walk out toward his garage workshop, DeLuise points to various reclaimed objects. "See those two sets of bellows?" he asks, motioning to a pair of exquisite wooden objects hanging on the wall. "I refinished them, replaced the leather, added the brass tacks and put on this coat of arms." The coat of arms isn't his.

"My father was a garbage man," DeLuise says proudly and emphatically. He shows us an old framing hammer his father had left him. "A watch and this hammer was all that he gave me. Oh, yeah, and my father's legacy also included a 4-foot, solid-steel pry bar. I

(Please turn to page 152)







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For the guy who wants to tune into the aircraft and tower transmissions, we've got the Z 45. It's got the same coverage as the Z 30 with the addition of the aircraft band with forty-five total channels.

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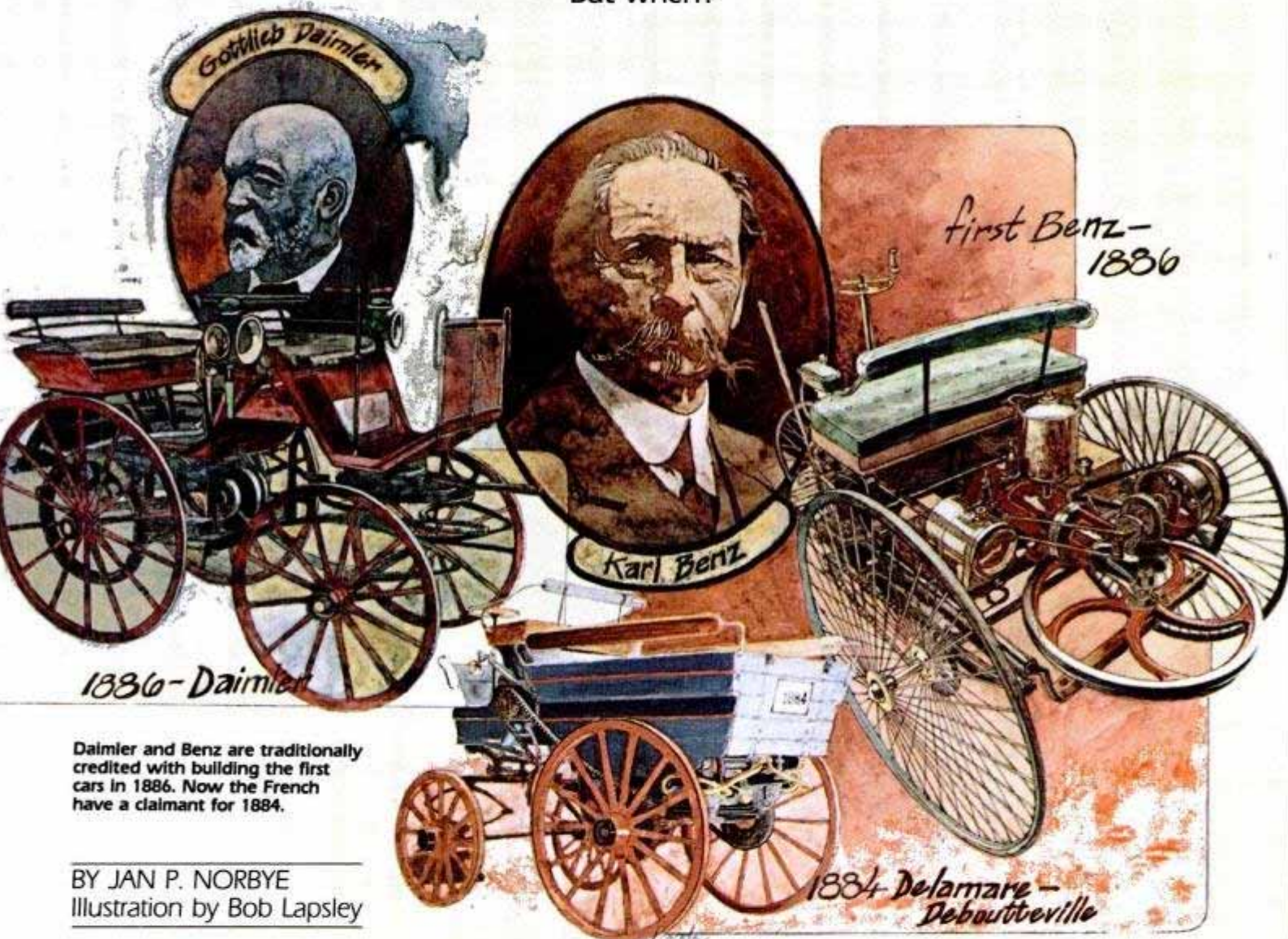
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# 100 YEARS

## CENTENNIAL ON WHEELS

The automobile passes an important milestone.  
But when?



Daimler and Benz are traditionally credited with building the first cars in 1886. Now the French have a claimant for 1884.

BY JAN P. NORBYE  
Illustration by Bob Lapsley

**T**his year marks the 100th birthday of the automobile. Or is it 1886? Or maybe we missed it in 1960. It all depends on your definition of a car.

Contrary to popular belief, Henry Ford did not invent the automobile. He wasn't even close. What Ford did was perfect the assembly line technique, well after the turn of the century. This allowed him to lower the cost of the automobile drastically, bringing a rich man's plaything within reach of the masses, thereby changing Western so-

ciety. Reason enough to be famous.

This year, France is celebrating the centenary of French automobiles, making a big deal of the experiments and patents of Edouard Delamare-Deboutteville. The implication is that France built the world's first car in 1884. This may be a new one on you. Most Frenchmen had never heard of the guy either. And automobiles of a sort existed long before 1884.

Steam-powered stage coaches were in regular service between many towns

in Britain from 1820 to 1840. They were built by such men as Goldsworthy Gurney, Walter Hancock, Ogle & Summers, Squire & Macerone, John Scott Russell and others.

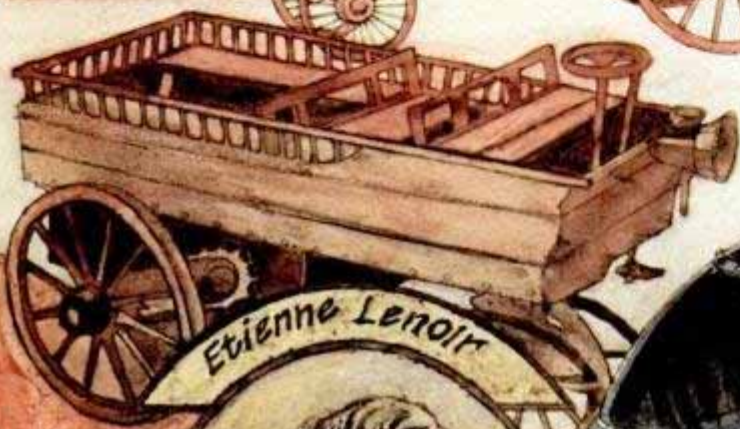
Charles Dietz and his sons ran steam-driven road tractors hauling passenger carriages on routes around Paris and Bordeaux prior to 1850. And in America, steam coaches were built in the 1860 to '80 period by Harrison Dyer of Boston, Joseph Dixon of Lynn, Mass., Rufus Porter of Hartford, Conn., and



# THE FORERUNNERS

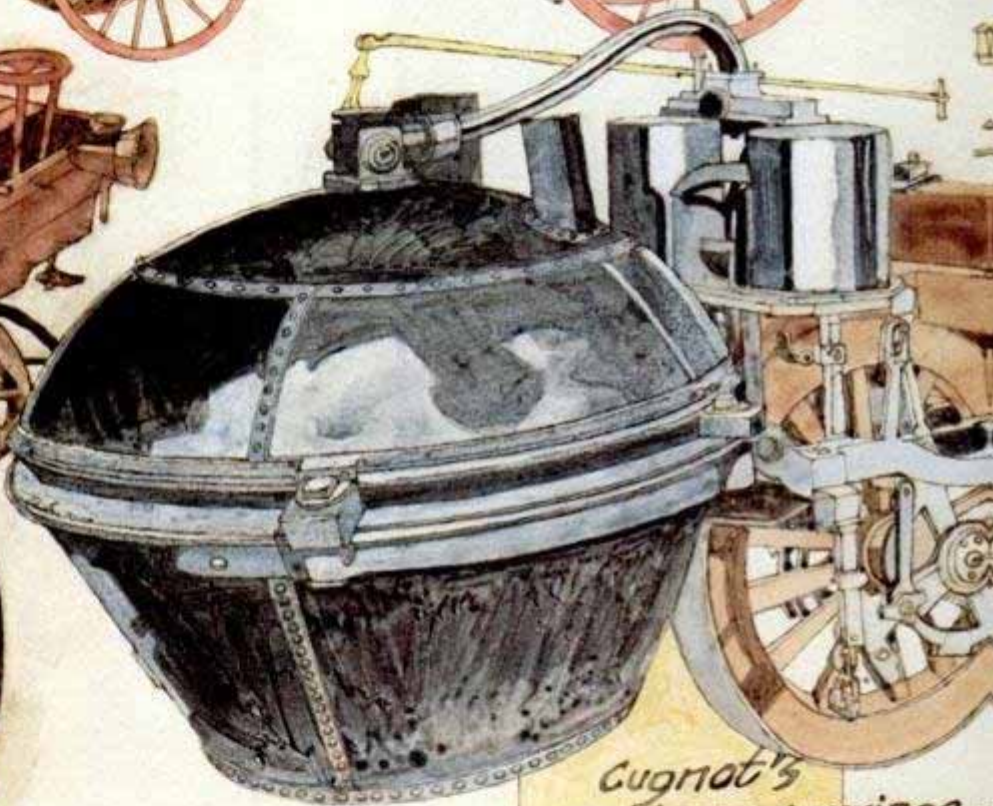
Many of the self-propelled vehicles that preceded the first cars had steam engines. Others used stove gas or various petroleum distillates. The Marcus and Lenoir gasoline-powered carts both pre-date Daimler and Benz, but both men were dabblers who did not develop their inventions into practical automobiles.

Gurney's 1820  
Steam carriage



Etienne Lenoir

Lenoir  
Cart -  
1860



Cugnot's  
Steam carriage -  
1769

William T. James of New York City.

Amedee Bollee Sr. was the most remarkable of the steam-car pioneers. Heir to a bell foundry at Le Mans, he added mechanical workshops and built a series of advanced-design vehicles from 1873 to 1883. There was nothing particularly new or refined in his steam power systems, but his sense of vehicle architecture was superb. *La Mancelle*, built in 1878, had a front-mounted engine, shaft drive to the differential, chain drive to the rear wheels, steering wheel on a vertical shaft and driver's seat behind the engine. The boiler was

carried behind the passenger compartment. Bollee built a series of steam carriages with romantic names like *Rapide* and *L'Obeissante* (the Obedient One). His sons, Amedee Jr. and Leon, both became makers of gasoline-powered cars. Amedee Sr. also invented an independent front-wheel suspension system with upper and lower transverse leaf springs in 1878.

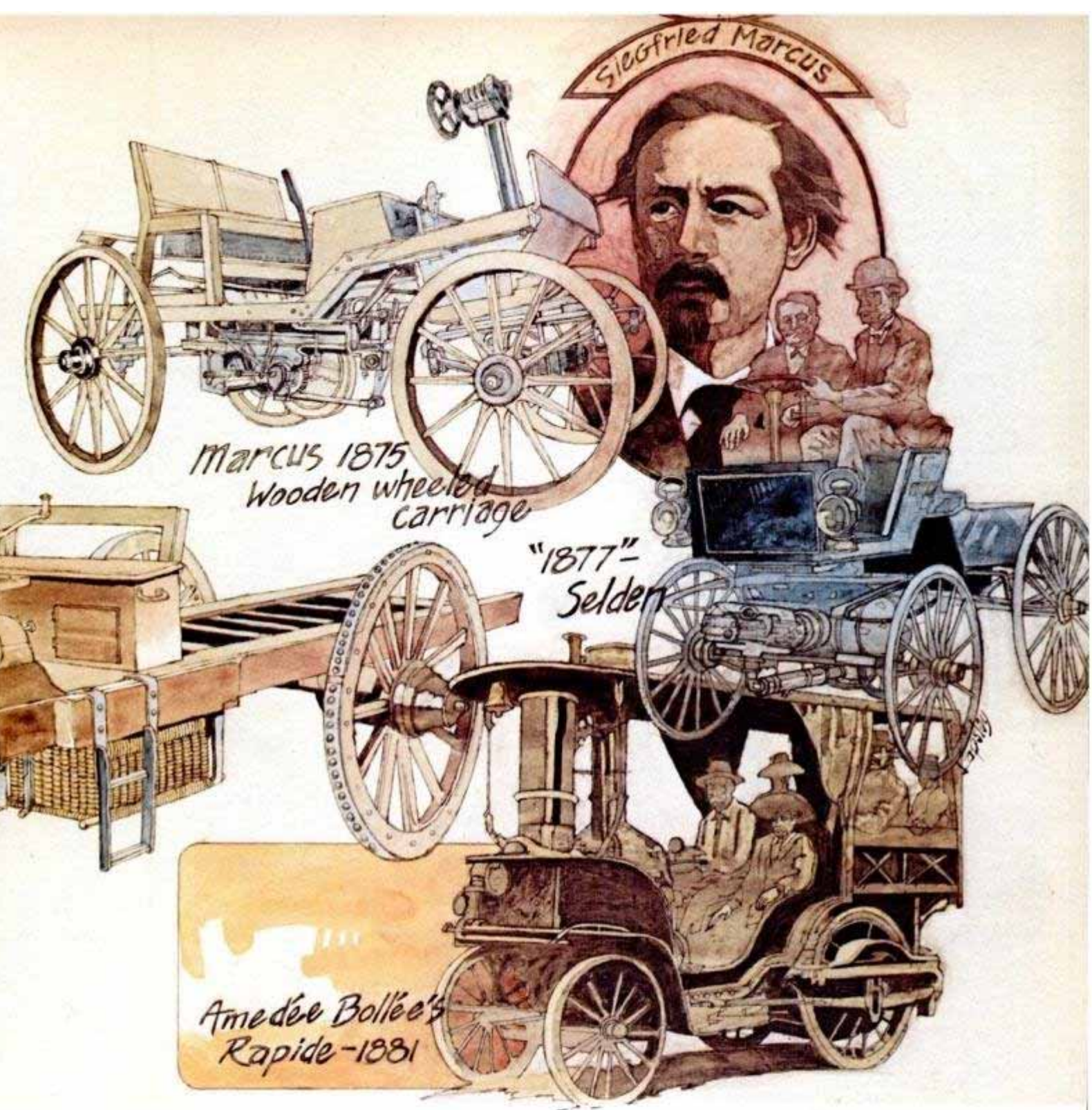
Use of steam power for road vehicles can be traced back to 1769, when a French artillery engineer, Nicolas Joseph Cugnot, constructed a three-wheeled military tractor at the Paris

Arsenal. It ran at a speed of 2½ mph, but it was nearly uncontrollable and crashed into a stone wall during a demonstration.

Was this the birth of the car? It depends. The Cugnot vehicle can be regarded as the first automobile in the world, if the definition is broad enough. How should it be defined? By fuel, type of engine, drive system, seating capacity, speed or what?

When Daimler-Benz (makers of Mercedes-Benz cars) says that the automobile was invented in 1886 by Karl Benz and Gottlieb Daimler, it's basing its





*Marcus 1875  
Wooden wheeled  
carriage*

*"1877"  
Selden*

*Amedée Bollée's  
Rapide-1881*

claim on its own definition: a light carriage for personal transport with three or four wheels, powered by a liquid-fueled internal combustion engine. In doing so, the company ignores Daimler's gas-powered motorcycle of 1885 (see *Editor's Notes* on page 8).

But even by that definition, the French have a prior claim: Belgian-born Jean Joseph Etienne Lenoir, who settled in Paris and became a naturalized French citizen, invented his gas engine in 1858 and patented it in 1860. He used electric spark ignition, but the engine ran on stove gas and had no

compression. It was shown to the press in a three-wheeled cart in 1860. A liquid-fuel version, with a primitive carburetor, was built in 1862 and installed in a three-wheeled wagon early in 1863. It is on record that it successfully covered the 18 kilometers from Paris to Joinville-le-Pont and back, securing its place in history as the first spark-ignition petroleum-fuel car to demonstrate its roadworthiness.

But Lenoir did not continue his work on cars. So we (and Daimler-Benz) can make the Lenoir claim void by narrowing the definition further: It doesn't

count as a car if you gave up. You must persevere, and your experiments must lead to actual car production. That's what Karl Benz and Gottlieb Daimler did. Or did they?

From the experimental cars of Daimler and Benz it was indeed a short step to industrial production—but not in Germany. Daimler-Benz concedes that the first car manufacturers in the world were French—Panhard & Levassor in 1889, followed by Peugeot in 1891. Since both were buying their engines from Daimler when production began,

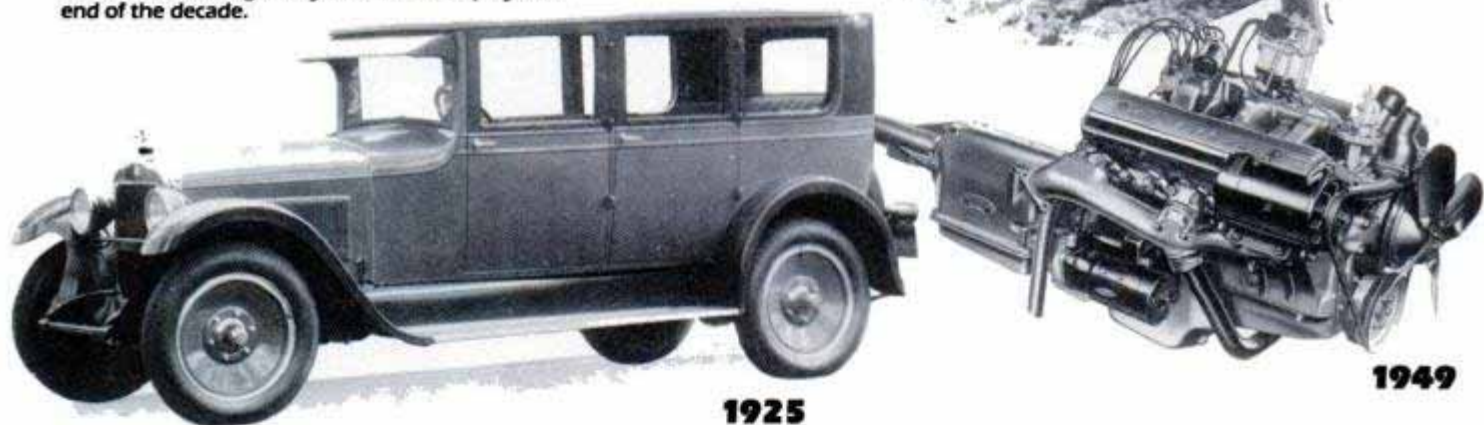
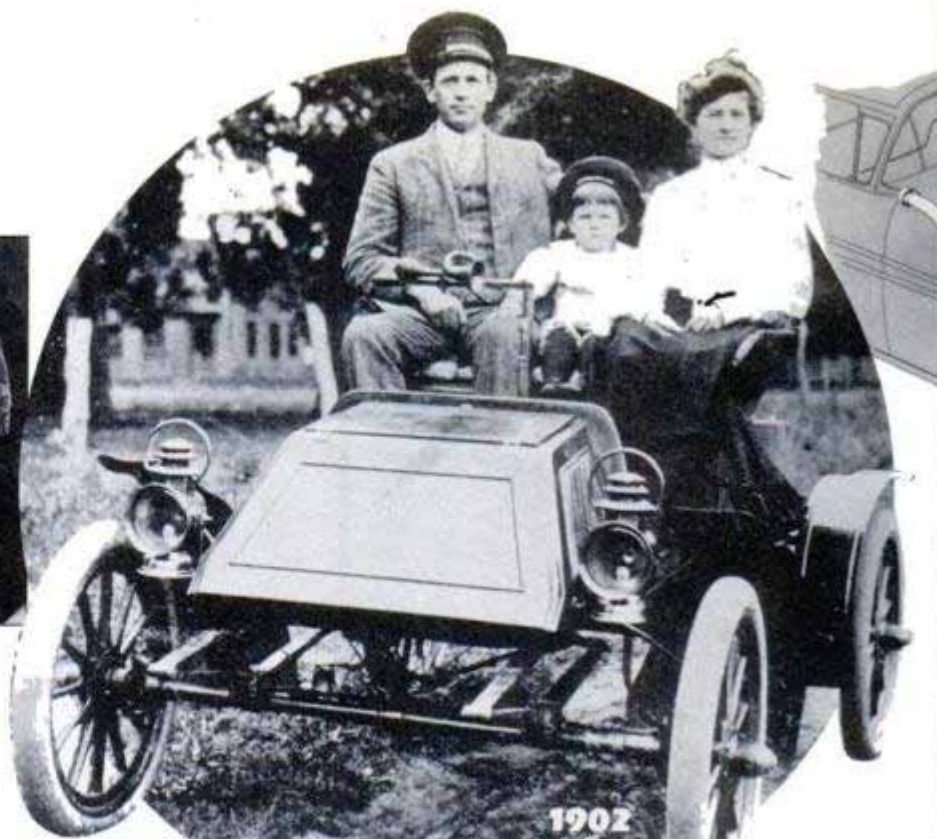
*(Please turn to page 121)*



# 100 YEARS



The early cars were little more than motorized horse carriages with chain drive and tiller steering, like this 1902 Rambler. By the time the 1910 Pope Hartford was built, single- and twin-cylinder engines had given way to huge Fours and Sixes that delivered 50 to 60 hp and 5 to 6 mpg. Family cars had enclosed bodies by the '20s—the 1925 Wills Sainte Claire Six even offered a heater! The first short-stroke overhead-valve V8s of Cadillac (shown) and Oldsmobile sparked the horsepower race of the '50s. Big family cars had 300 hp by the end of the decade.



## AMERICAN CARS THE FIRST CENTURY

Although Europeans invented the car, American ingenuity put the world on wheels.

BY ROGER HUNTINGTON

The first "car" built in America was a horse buggy with a 4-hp, single-cylinder engine, assembled by Charles and Frank Duryea in 1892-'93. Their second car won America's first auto race, a 50-mile, nine-hour marathon from Chicago to Evanston, Ill., on Thanksgiving Day, 1895.

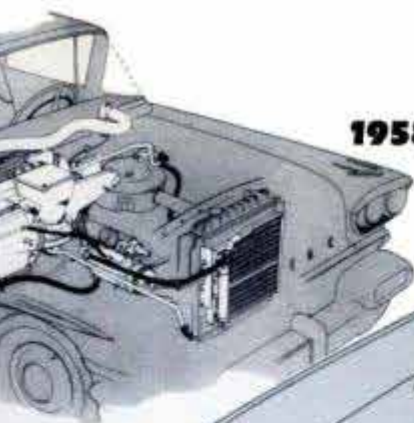
Ransom Eli Olds built a three-wheeled steam car in 1891 and a gasoline buggy in 1897. By the turn of the century he was mass producing his Curved Dash Oldsmobile, selling 2,100 of them in 1902 and 5,000 a year by 1904, when he left Oldsmobile to found the REO Motor Car Co. Henry Ford

perfected the assembly line, but Olds had introduced mass production and popular-priced cars to America.

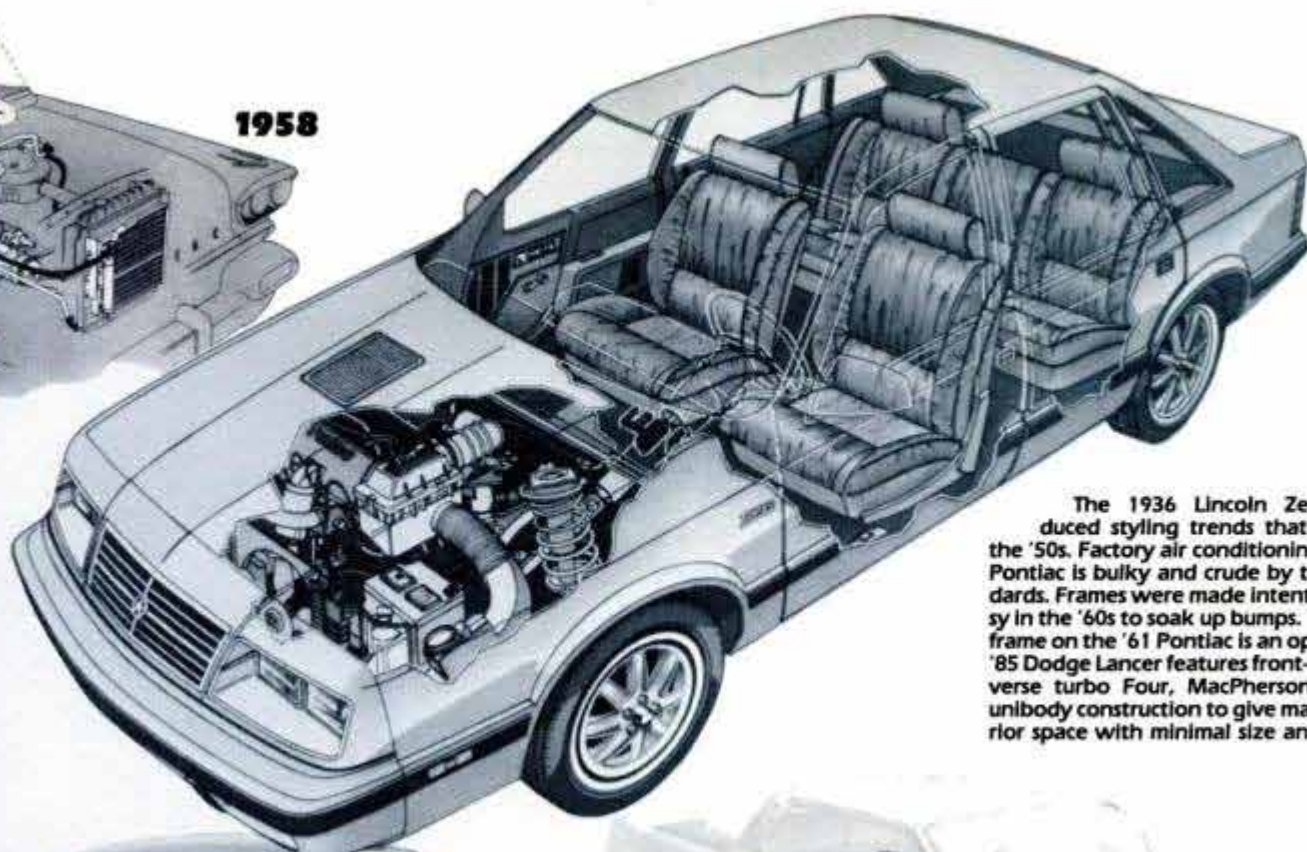
The first practical, factory-produced automobiles were little more than motorized horse carriages. A tiny one-cylinder motor under the seat drove through a chain, and you steered with a "tiller," like a coaster wagon. Nothing to it. It was enough to be getting around a little faster than a horse could take you. And the car didn't get tired after a few hours.

Within a few years, automobiles had taken on the general configuration we know today. That is, a multicylinder engine in front, clutch and transmission under the front floor, shaft drive to a live rear axle, leaf springs on all wheels, foot-operated brakes, steering by wheel and gear linkage, and pneumatic tires. Advanced developments that came in this early period before World War I





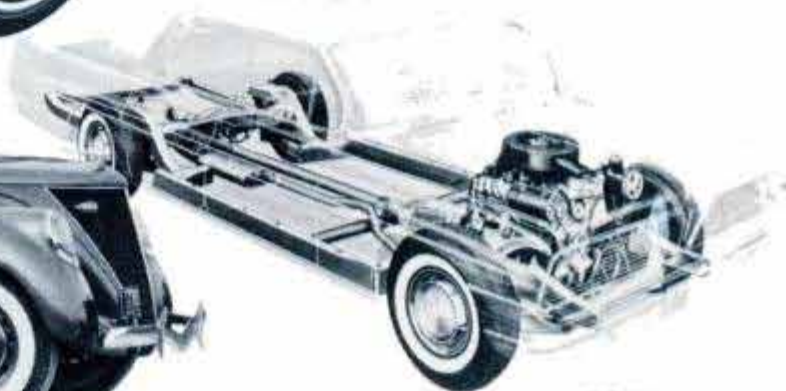
1958



The 1936 Lincoln Zephyr introduced styling trends that lasted into the '50s. Factory air conditioning on the '58 Pontiac is bulky and crude by today's standards. Frames were made intentionally flimsy in the '60s to soak up bumps. "Perimeter" frame on the '61 Pontiac is an open box. The '85 Dodge Lancer features front-drive, transverse turbo Four, MacPherson struts and unibody construction to give maximum interior space with minimal size and weight.



1936



1961

included electric starters, shock absorbers, four-wheel brakes, all-steel bodies, helical gears, pressure lubrication in engines, automatic spark advance, demountable rims and fabric cord tires.

Despite these early advances, there were some tough unsolved problems that made "automobiling" a definite challenge. Tires wore out fast and blew out at every opportunity. Gasoline was more like kerosene, and oil was like molasses. Cold-weather driving was hardly practical. Alloy steels weren't very strong, so axles and springs frequently broke in deep ruts. The electric starter made it possible for women to drive—but they still had to cope with the balky transmission and heavy clutch. Electric cars were recommended for ladies.

Engine maintenance required constant attention. Valves needed grinding and rings and bearings needed replace-

ment every few months. Sparkplugs and ignition points were iffy, even when new. Cylinder heads had to be removed to dig carbon out of the chambers, and oil sludge could be scooped out of crankcases by the handful. Actually, automobiles were rich men's playthings in those early years.

Henry Ford's famous Model T changed all this in the period around WWI and the early 1920s. Here was a car that combined most of the worst mechanical faults of its contemporaries—and yet it was a milestone development of automotive history. The secret: The first successful use of assembly line mass production. Ford popped out millions of the things over a 20-year period, with only minor changes in design. This not only brought the price down to where anybody could afford one, but it filled the junkyards with an endless supply of

dirt-cheap interchangeable parts that you could bolt together to keep your T on the road indefinitely. Crude as it was, the Ford Model T literally put America on wheels.

The decade of the 1920s was a time of refining basic principles. Or, honing the crude ingredients into something resembling easy, comfortable dignified transportation. For instance, the introduction of the "ethyl" lead additive for gasoline in 1923: This allowed a two-point jump in compression ratios overnight, which helped both performance and fuel economy. The '20s also saw the switch to closed sedan bodies for family cars, sometimes even with the luxury of a heater. A 6- or 8-cylinder engine rested on rubber mounts to reduce vibration, with hydraulic shock absorbers and low-pressure "balloon" tires to cushion the road. Other re-

*(Please turn to page 118)*



# SKIS

## ON THE LEADING EDGE

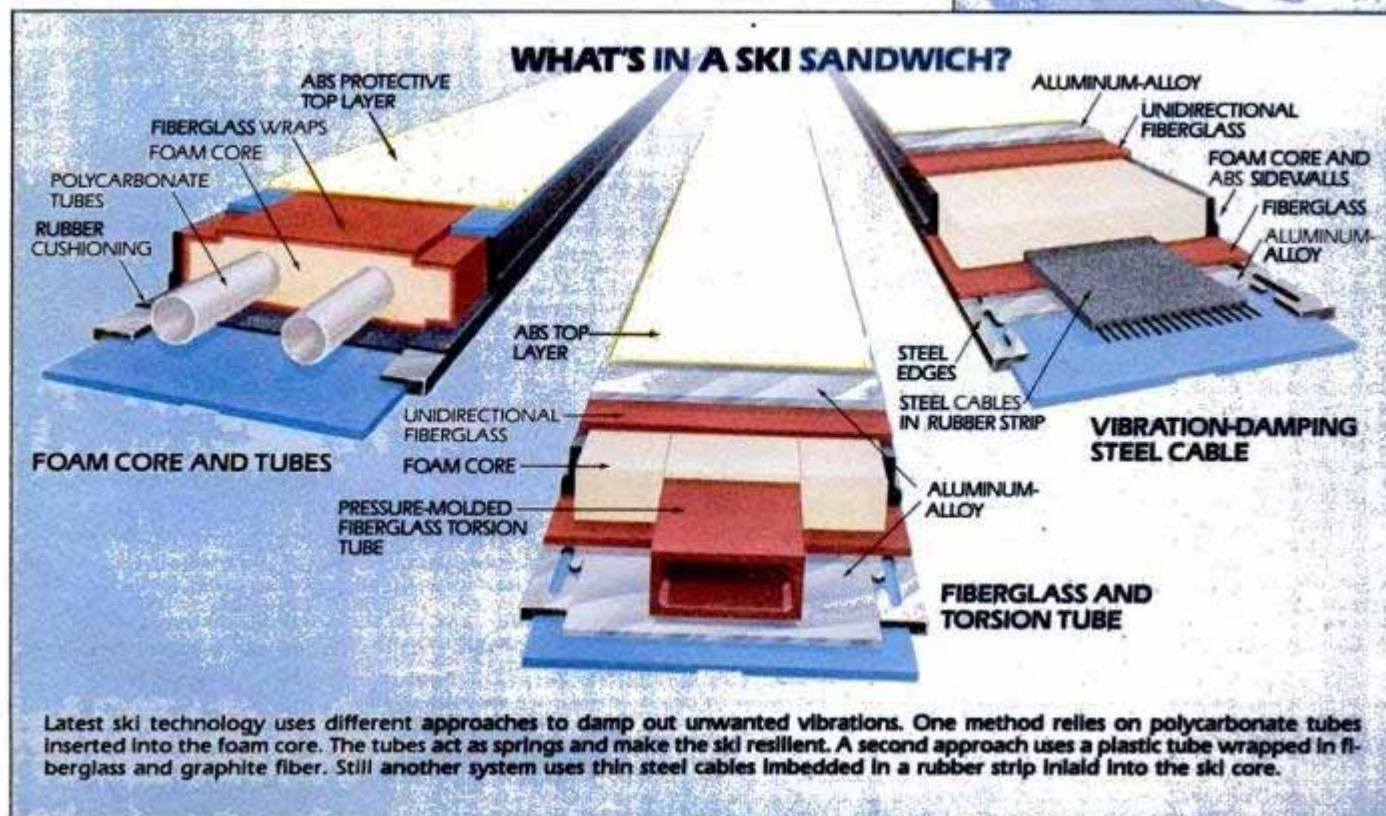
Schussing down the slopes these days means Kevlar, frequency harmonics, sandwich-foam laminated construction and computer-aided design.

BY SETH MASIA

**W**hen, in 1947, Howard Head left his job with Curtiss-Wright to bring aircraft engineering methods to ski manufacturing, he started a trend. Snow-ski designers have watched the aerospace industry ever since. For the past 40 years, they've been quick to adopt new technology from companies like Boeing and Lockheed, and today more than ever the watchword on the slopes is high-tech.

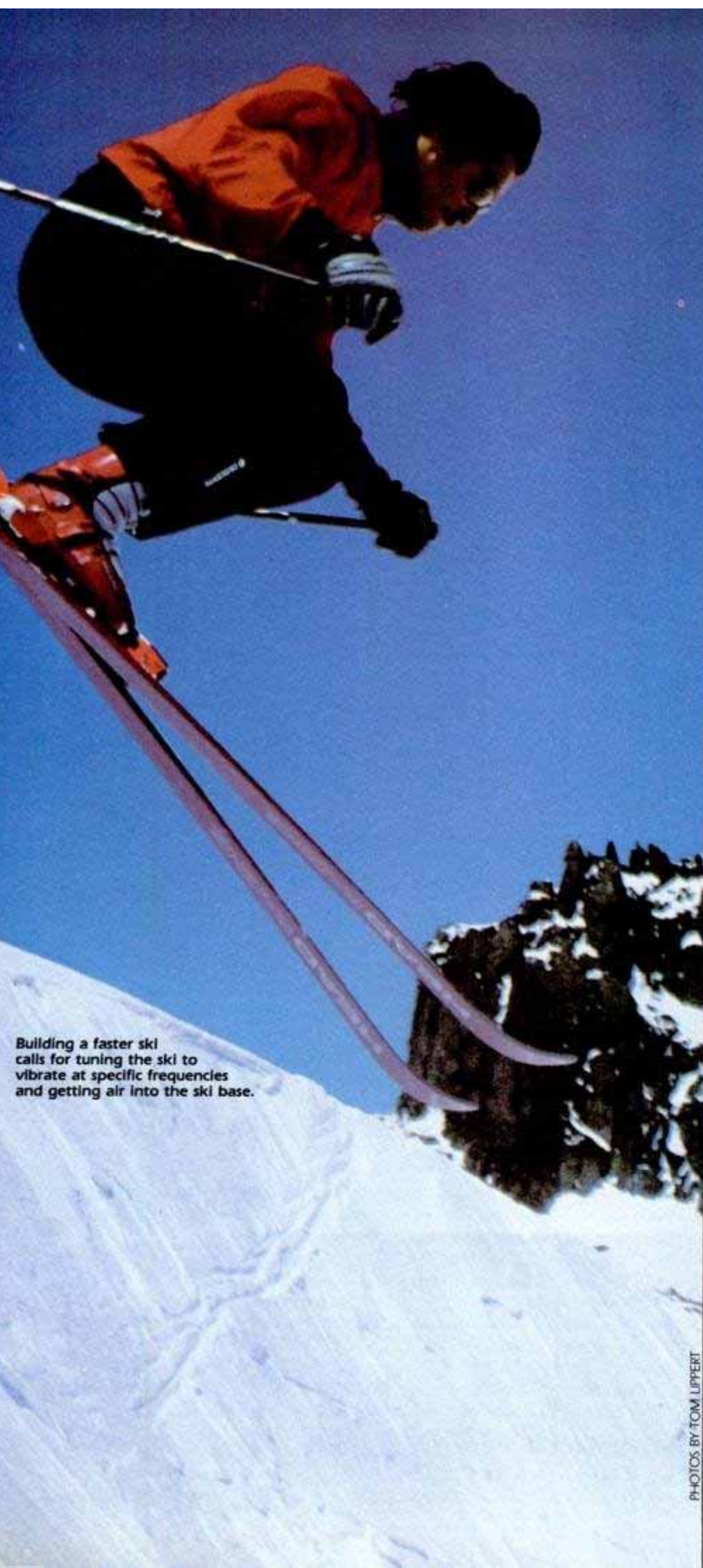
Skis are commonly stressed far be-

yond typical loadings for aircraft structures, as Head discovered early. His first skis, built of aircraft-aluminum sheets sandwiched around a paper honeycomb core, broke easily when tested by expert skiers. That was in the early 1950s. It wasn't until the late 1960s that aircraft materials technology could provide a lightweight structure that would stand up to the flexing a ski gets. During that era, Hub Zemka, a California-based engineer, used aluminum



DRAWINGS BY GEORGE RETSECK





Building a faster ski calls for tuning the ski to vibrate at specific frequencies and getting air into the ski base.

PHOTOS BY TOM LIPPETT

honeycomb and specially developed adhesives from the Hexcel Corp., a leading supplier of aerospace materials, to build a lightweight ski that would hold together.

Today, ski manufacturers around the world, competing to build faster, more maneuverable and more durable skis, continue to borrow technology from leading-edge industries.

Andrew Marshall, a former engineer and ski divisions coordinator at Hexcel, points out that American companies usually have earliest access to newly declassified materials.

"Typically, materials developed for use in rockets and military aircraft are picked up for use in commercial jets once the military lifts restrictions on them," Marshall says. "Then, as production rises and prices fall, the guys who make high-performance sporting goods find uses for the new materials." Marshall points out several types of fiberglass, graphite, Kevlar and boron fibers as examples.

Today, most skis are made of epoxy resin reinforced with E-glass, a material originally developed for the Air Force to make airplane radar housings and antenna armatures. The E designation refers to its use in electronics—the material is transparent to electromagnetic radiation. Ski makers are only now beginning to experiment with much stronger and more expensive S-glass, engineered specifically for structural members in high-performance aircraft. A third kind of fiberglass, C-glass, is not likely to find its way into skis. It's

*(Please turn to page 130)*





# LIGHT WORKS



The laser is quickly becoming the favorite tool of science, engineering, medicine and industry.

PHOTOS: USDA



BY DENNIS ESKOW, *Science Editor*

It travels at 186,000 miles per second, moving across space so swiftly that no one can tell us exactly what it is made of. It seems to have a mind of its own, always taking the shortest possible journey between two points. It also seems fluid and formless, and yet it can be made to travel around corners and down the sub-microscopic fibers of tiny tubes. We call it light, and in the past 20 years we've learned to bend it, shape it and use it in a new, highly controllable device called the laser (Light Amplification by Stimulated Emission of Radiation).

In just five short years, we've brought the laser out of the research center and into the home and office. From a California lettuce field where lasers accurately

level the ground to within 30 mm, to an operating room where lasers are saving previously written-off limbs, to a telephone system that carries millions of conversations on a beam of photons, light works in magnificent ways.

"The laser will give us superfast computers, bloodless heart surgery and incredibly accurate engineering devices before the 1980s are over," says Herbert Coffee, a futurist who spoke at a Smithsonian Institution gathering last summer. "Even as I speak, lasers are revolutionizing automotive design, civil engineering and communications."

In less time than it takes light to travel from some visible stars to Earth, the laser has evolved from a theoretical proposition made by Albert Einstein to a

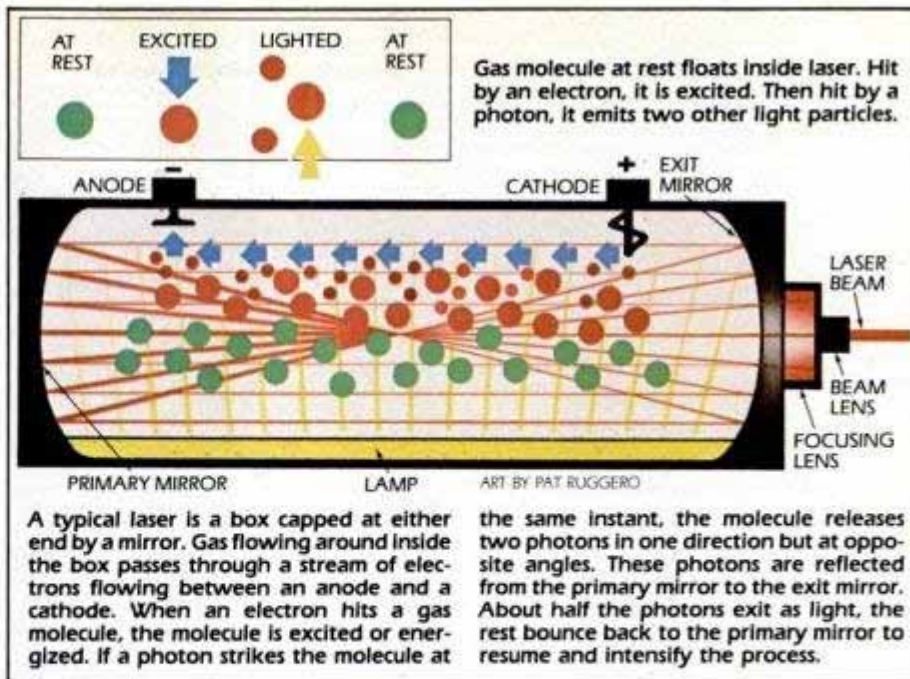




A computerized tractor pulls a leveling blade across a California lettuce field as laser hits its directional antenna (far right). Process makes field leveling accurate to within 30 mm, ensuring against wasted irrigation. Farmer runs laser from a remote console (insert, far left). Finished field is almost perfectly flat (inset left).



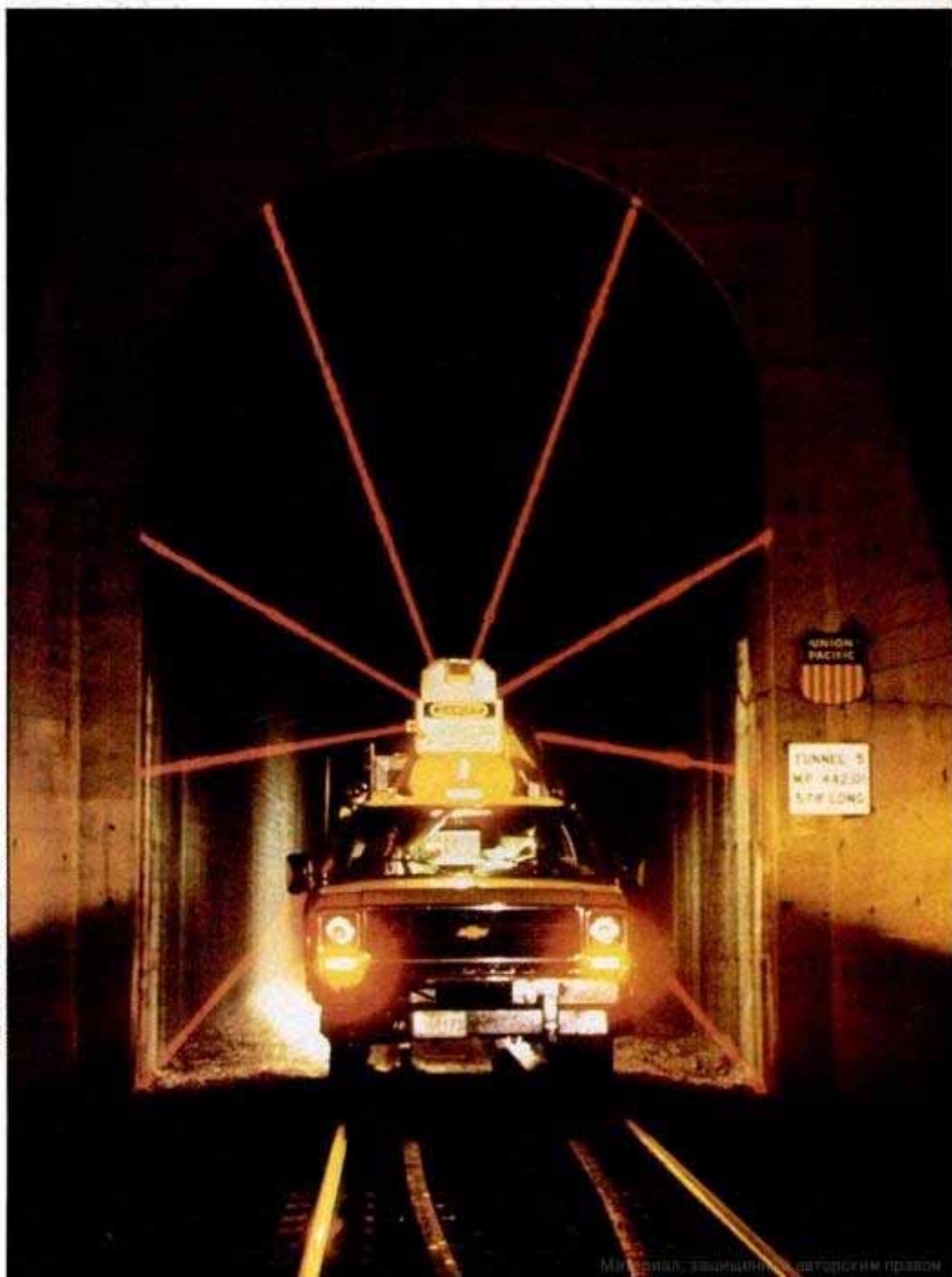
Daimler-Benz engineer uses laser beams to measure the contour of a model car body (above). A laser-equipped truck (right) passes through a train tunnel, its pencil-thin lights bouncing off the wall to measure the tunnel before completion.



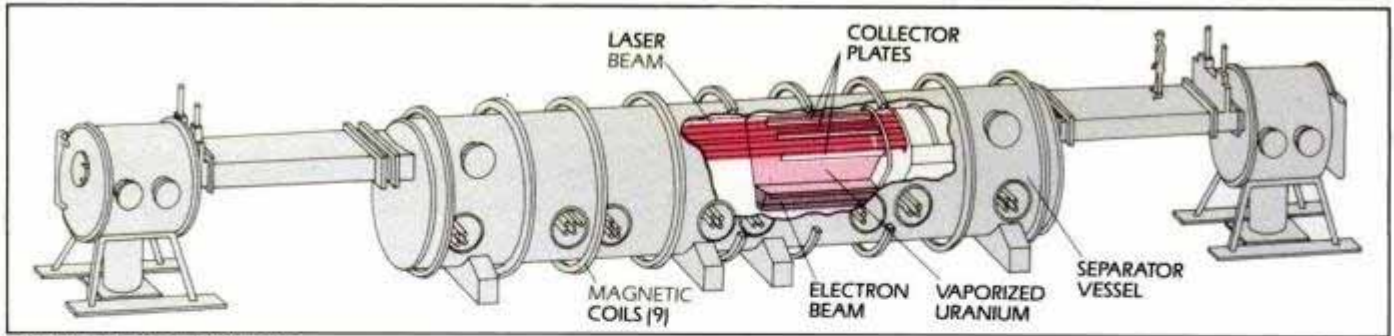
A typical laser is a box capped at either end by a mirror. Gas flowing around inside the box passes through a stream of electrons flowing between an anode and a cathode. When an electron hits a gas molecule, the molecule is excited or energized. If a photon strikes the molecule at

the same instant, the molecule releases two photons in one direction but at opposite angles. These photons are reflected from the primary mirror to the exit mirror. About half the photons exit as light, the rest bounce back to the primary mirror to resume and intensify the process.

PHOTOS BY CHUCK O'REARWEST LIGHT







COURTESY LAWRENCE LIVERMORE LAB

Lawrence Livermore Lab laser separation process exposes metallic uranium to an electron beam that vaporizes metal. Lasers ionize a specific atom of uranium, which is magnetically pulled onto a collector plate. Laser refining will be quicker and cheaper.

working tool. Einstein, in 1916, suggested that a molecule given a jolt of energy and then exposed to light would produce a very intense beam of photons, or light particles.

Physicists found other questions much more enchanting, so the laser went largely forgotten until the late 1950s. Then, Berkeley physicist Charles Townes and Stanford researcher Arthur Schawlow published work on the design of the first operating laser. Inventor/physicist Gordon Gould also claimed authorship of the first laser design.

None of the original researchers, however, actually built a working laser at that point. The first working model was built by Hughes Aircraft, quickly followed by one at Bell Labs in the early 1960s. These relatively weak rigs amplified light through a ruby crystal. Later in the decade, researchers by the dozens began to develop high-powered, versatile lasers that amplified light through various gases. The gas laser opened the door to the technological frontier on which we stand today.

The basic laser is a gas-filled box capped with mirrors on opposite ends. The gas flows freely in the box, passing now and then into a stream of electrons that flow between an anode and a cathode. When an electron strikes a gas molecule, the gas particle goes from the low energy rest state to an excited energized state. Strike an energized gas molecule with a photon and the gas emits two photons that fly off in the same direction but at opposite angles. The process takes place in millionths of

a second, so if you were watching it in progress, you'd see gas flowing around a lighted tube with streams of light pointing away from the gas center.

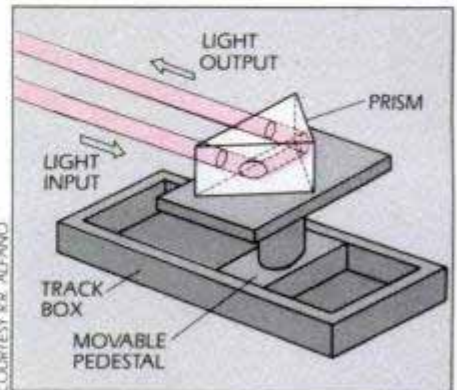
The photons strike the highly reflective primary mirror, which zaps light rays to a less reflective exit mirror at the opposite end of the box. About half the light exits the box as a weak beam. The rest bounces back to the primary mirror and gets reflected again, along with a new supply of photons from the ongoing gas reaction. The result is a highly energetic beam of light. Depending upon what kind of gas you use and how intense the light or electron source is, the laser can be adjusted to do anything from forming a 3-D image on a screen to making razor-sharp cuts in human skin.

In the past year, the leading edge of laser research has produced an unexpected medical miracle and a long-predicted communications phenomenon.

At Stanford University, Robert Ginsburg's research team used a laser to save the leg of a 62-year-old patient whose arteries had become clogged with cholesterol. Cholesterol blockages generally are treated by inserting a balloon device in the offending blood vessel and expanding the balloon until the cholesterol is pressed against the vessel's sides, thereby restoring smooth blood flow. In the case of the first laser-treated patient, the blockage was too advanced for the balloon treatment and he was told his leg would have to be amputated. The patient gave informed consent to become the first to receive laser treatment.

With the laser technique, a thin optical fiber is inserted into the vessel and the laser is turned on. In seconds, the powerful light beam vaporizes the cholesterol deposits. The first test case was a success.

**Largest laser in the world is Livermore's trillion-kilowatt rig used in fusion power experiments.**



Light that is bounced off a movable prism is helping scientists keep time to trillionths of a second with accuracy.



A laser device reads fingerprints, then it sends the prints to a computer, where they are matched against records.

In communications, the first fiber-optic long-distance service was established last year between New York and Boston. The service increases the potential number of calls per line by a factor of 20, replacing wires with fiber-optic cables.

In other developments:

- Daimler-Benz used lasers to make 3-D holographic images of auto bodies, eliminating the need for scale models on which to conduct tests. It's all done by computer. The West German company also uses lasers to measure precisely the dimensions around a clay model for design purposes.
- The Defense Department constructed a laser that can pierce tank armor.
- Brown University researcher Ted Morse developed a laser treatment for fiber-optic cables that cleans impurities out of the cables to permit passage of







Lasers are being used in a variety of measuring jobs. At lumber mill (above), lasers guide saws to cut boards to size and along a straight line, ending waste from bad cuts.



A laser fires during Defense Department tests to develop an armor-piercing ray.

more electrons, and therefore, more telephone calls.

- Lawrence Livermore Labs designed a laser that excites a specific atom of uranium so that raw uranium ore can be refined quickly and cheaply. Livermore is also completing work on the world's largest laser, a trillion-kilowatt machine that focuses a beam on a fuel pellet to power a nuclear fusion machine. The fusion process is still experimental.

- R.R. Alfano and colleagues at the Institute for Ultra-Fast Spectroscopy and Lasers at City College of New York developed a laser clock that times chemical and biological reactions to femtoseconds (trillionths of a second). A laser beam is fired at a prism sitting atop a sliding rail in a box. The distance from the prism to a target measures a known number of femtoseconds. When the beam is reflected to the target, the distance from the prism is measured and time measurements can be made.

- A new device developed for law enforcement agencies reflects laser light from a fingertip down a fiber-optic tube and then to a computer, which reads the fingerprint and matches it against other fingerprints already held in a computer's memory.

A report last year by International Resource Development, a market research firm, puts the world laser market at \$3 billion a year and growing. By 1994, the report says, the market will have grown to \$10 billion. That's about the time Herbert Coffee predicts we'll see a supercomputer with no chips. Using laser light, the computer will be able to switch information circuits on and off literally at the speed of light. That phenomenon itself should take us to dazzling new heights in what is just the beginning of a climb into one of science and technology's most promising new realms. **PM**



Bell Labs scientist analyzes colors, or wavelengths, of laser light. Photos at left show fiber-optic cables. Top is a standard cable. Bottom has been cleaned by laser for passage of more electrons and information. Brown University developed cleaning technique.



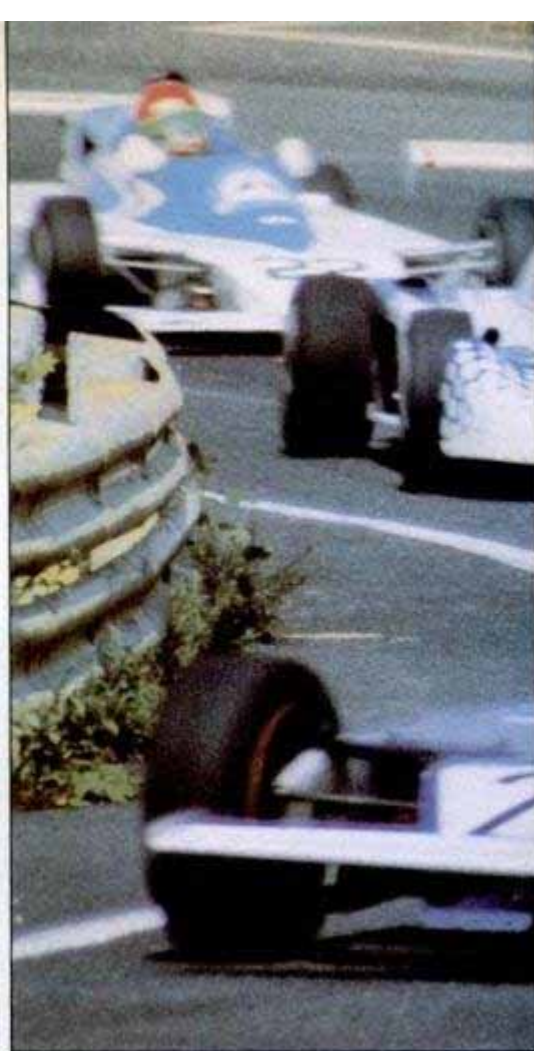
# AUTO RACING



# SOVIET STYLE

The urge to race is universal. Only the cars and the rules are different in the U.S.S.R., where the government offers racers some amazing perks.

BY MARGUS HANS KUUSE



Formula East cars [above] combine modern downforce bodywork with a tube frame and 85-hp four-cylinder sedan engine. Powerplants are from Fiat-based Ladas [right]. Car No. 64 belongs to '83 sedan champ Aleksey Grigoryev. Formula Juniors [upper right] are entry-level racers. Friendship Cup race [center] features 150-hp Formula 3 cars from Czechoslovakia [No. 24], U.S.S.R. [72] and East Germany [81].



**D**uring World War II, several of the great pre-war German Formula One cars—Auto Unions and Mercedes—were captured by the Red Army and sent back to the Ministry of Transport in Moscow. These thunderous racers had provided Nazi Germany with a powerful propaganda tool, and there was a serious Soviet government program to duplicate that success for the U.S.S.R. An immensely complicated 2-liter, 12-cylinder mid-engine racer called the Sokol was built, heavily patterned after Dr. Porsche's Auto Union. However, there were no drivers

of international caliber available to control the beast, and the project was shelved. Since then, stock-block amateur classes have been the norm.

Open-wheel single-seaters with four-cylinder engines are the fastest racers in the U.S.S.R. today. Most entries in any given event are built by TARK, a racing car constructor in Tallinn, the capital of Estonia. By supplying the vast Soviet Union, TARK has become one of the largest race car builders in Europe. With a capacity to build up to 70 Formula cars a year, TARK's racing shop is sizeable by any standards. Since

1958, it has built nearly 1,000 racers, a number that puts it in the same league as England's prolific Lola and March factories.

TARK's current customer car—its 20th design and seventh "production" model—is called the Estonia 20. Its down-to-earth design is straightforward rather than sophisticated—a perfect design for the amateur racer to prepare, maintain or repair. Priced at about \$9,000, roughly the same as the cheapest Soviet Lada sedan, it is one of the most affordable 2-liter racing cars in the world.





PHOTOS BY THE AUTHOR



Estonian champion Toomas Napa checks his Formula 3 car in Riga's rustic Gasoline Alley (top). A transmission swap, Soviet style (middle). If you don't have a lift, just roll the car onto some tires. *Sovtransavto*, the state transport organization, carries the Soviet team to international races (above). Most product decals on Eastern bloc race cars are only decorations, but East German Orwo-Film logo (left) is a real ad.

Although the Estonia 20 is satisfactory for regional and national racing, it comes up against stiff competition from racers like the Czechoslovakian Avia and East German SRG in international races among Eastern bloc countries. For these events, TARK developed a modern downforce design (see *How Indy Cars Stick To The Track*, page 188, May '84). Called the Estonia 21, it's raced by the U.S.S.R.'s No. 1 drivers, Toomas Napa, Raul Sarap and Avo Soots.

There are three racing car classes, or formulas, in the U.S.S.R. Formula Molodjoshnaya (Formula Junior) uses 350-

cc air-cooled motorcycle engines, and is on its way out. It may be replaced by a class for stock 1-liter water-cooled engines from a Soviet minicar with a maxiname—the Zaporozhets.

The Formula East class allows stockblock engines up to 1,300 cc. These are powered by 1.3-liter Lada engines in a fairly mild state of tune, producing about 85 hp, compared to the stock sedan's rating of 69 hp.

Formula 3 is the hot setup in Soviet racing. Although the rules allow a 2-liter engine with compression ratio of 10:1, in reality there are no Soviet

stock-blocks that can be bored and stroked beyond 1.85 liters. Most successful Formula 3 teams start with the 1.6-liter Lada engine, some bore it out and most add Western Weber or Dell'Orto carburetors. German Kugelfischer fuel injection is a rarity. Competitive engines produce 140 to 150 hp. One experiment ended in mechanical disaster when it attempted to weld larger

*(Please turn to page 134)*

*The author is an auto writer who lives in Tallinn, the capital of the Soviet Republic of Estonia (see Editor's Notes, page 8).*



# THE RIGHT ANTENNA: MORE IMPORTANT THAN EVER!

Broadcast sources are improving—FM is playing digital records, TV is getting stereo sound, even AM radio is going stereo. The right antenna is a must to get the most from the airwaves.

BY MARC STERN

**B**efore you go storming back to the retailer who sold you an apparently defective TV set next time you get a lousy picture on it, consider this. Mother Nature and modern man have conspired to place a variety of obstacles in the path of the broadcast pictures and sound waves searching for your home receiver. No matter how expensive or sensitive your TV or radio receiver is, it can't perform any better than the electrical signal it's receiving. The old computer maxim applies: Garbage in, garbage out.

You can help those signals find their way home by selecting the right antenna, installing it properly and maintaining it in top condition. Installation and maintenance are important. If you're on the fringe area of radio or TV stations, expect bad reception if your antenna is rusty, has poor mechanical connections or is pointed in the wrong direction.

Because of recent or pending changes in the quality of broadcast programming, now is as good a time as any to take a close look at your antenna with an eye to upgrading reception.

Soundwise, many FM stereo stations are adding the new laser-read, digital compact discs to their on-air repertoire. A good antenna will help you pick up these noise-free, full dynamic range recordings with no transmission-related fuzziness or fading. Broadcast TV's ready to go stereo too, as is AM radio. If you're planning to buy an up-to-date receiver to pick up the new sound dimension, it will pay to invest in a good antenna at the same time.

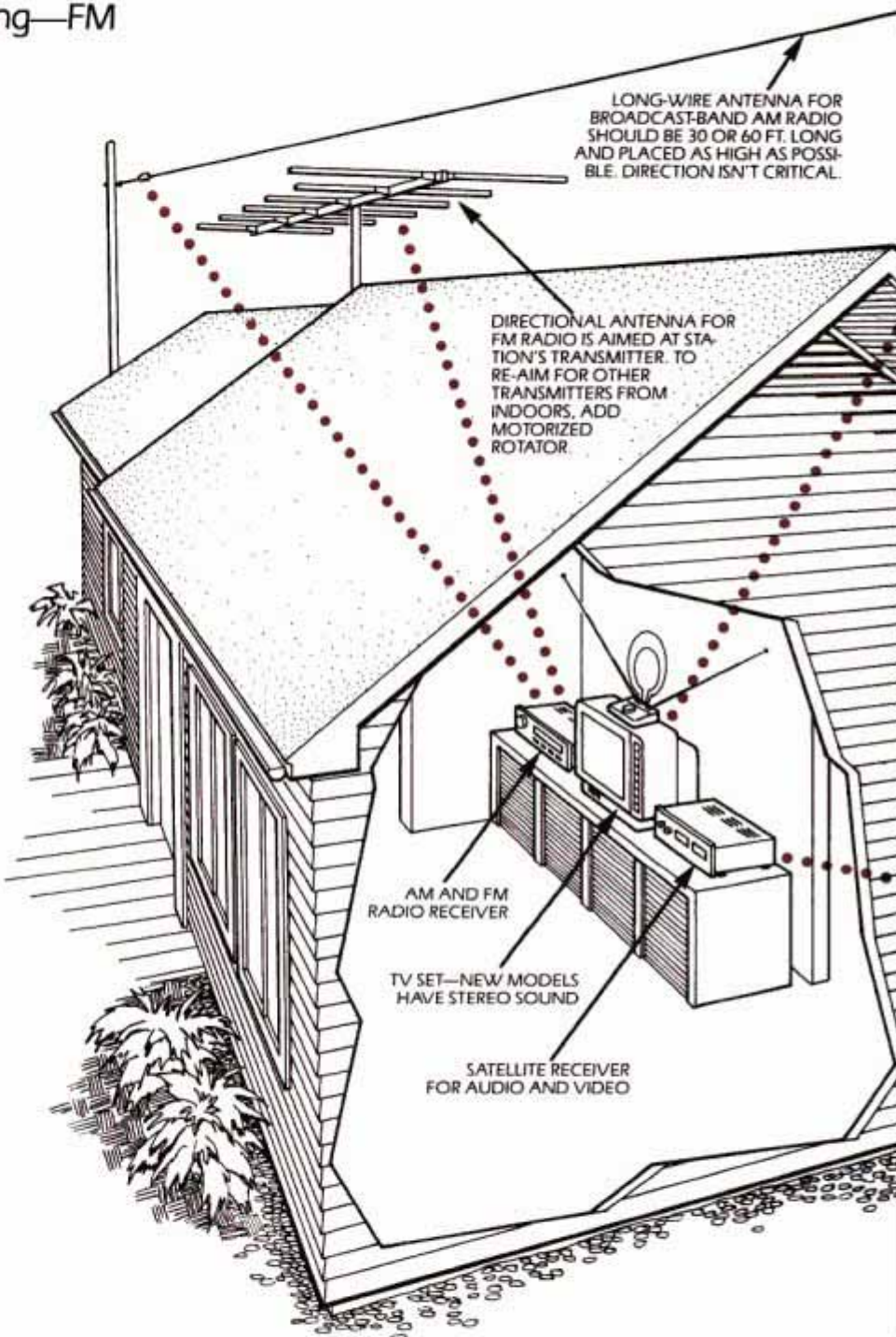
On the video side of the picture, a new generation of TVs is aborning that uses digital circuitry *within* the receiver to process and improve the received analog broadcast signal. Moreover, at least one manufacturer, RCA, is now building TV sets that process the full color signal transmitted by the broadcaster. Most TVs, for cost reasons,

don't. Other manufacturers probably will add this feature before long, and begin to incorporate it into videocassette recorder tuner sections, too. With these innovations in mind, it only makes sense to feed your TV all the signal you can.

In choosing and installing an antenna, it pays to follow these tips:

First, antennas are cut for specific frequency ranges—FM, VHF, UHF.

Make sure the one you buy covers the stations you want to receive. Second, the feed line that connects the antenna to your receiver must match the receiver's impedance rating. This figure should be listed in your owner's manual, or on the back of the set. Finally, for optimal reception, all connections and connectors should be kept free of rust and corrosion. Also, make sure the feed line has no cracks or breaks.







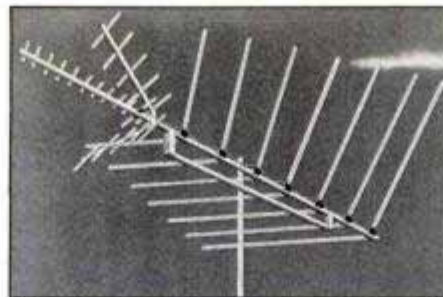
COMBINATION VHF/UHF ROOFTOP TV ANTENNA CAN PROVIDE BETTER RECEPTION THAN INDOOR TV-TOP MODELS. IT SHOULD BE AIMED DIRECTLY TOWARD TRANSMITTER SOURCE TO AVOID MULTIPATH "GHOSTS." MOST PICK UP FM RADIO, TOO.

DIRECTION OF SATELLITE TV ANTENNA IS ALTERED MECHANICALLY TO PICK UP SIGNALS FROM DIFFERENT "BIRDS." DISH SIZE CURRENTLY RUNS FROM 10 TO 12 FT. IN DIAMETER. AN ATTACHED AMPLIFIER BOOSTS SIGNAL BEFORE RELAYING IT TO INDOOR RECEIVER.

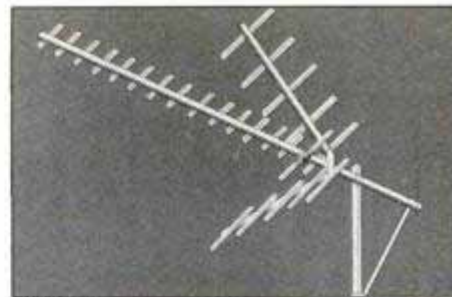
With this said, it's time to look at the antenna options you have.

### Outdoor television antennas

An outdoor TV antenna must deal with signals in two different frequency ranges—VHF and UHF. These signals act somewhat alike, but differ in their received power levels. VHF signals tend to carry farther from a transmitting tower than UHF. Accordingly, a



Most rooftop TV antennas combine VHF (long elements) and UHF (short elements).



UHF-only antennas also can be roof-mounted for improving difficult reception.

television set that receives VHF frequencies well (stations 2 through 13) might have trouble with UHF (stations 14 through 83).

To solve this problem, a UHF antenna has to be more sensitive than the VHF. It also must have an additional component—a reflector or collector element. Acting somewhat like a mirror, this component collects signals and assembles them at a central point on the antenna before relaying them to the TV.

For the television owner who wants the best possible reception on all bands, the way to go is with a directional beam antenna that includes a reflector or collector element. Many outdoor antennas on the market combine elements for both VHF and UHF reception. Moreover, most of these also can be used to improve reception on your FM radio or stereo receiver since the entire FM radio band is situated between VHF stations 6 and 7.

Keep in mind that a single antenna can feed more than one receiver, including your videocassette recorder's tuner section. All you need do is connect the antenna lead (wire) to the required number of band separators and signal splitters, which then route the signals to the proper receivers.

### Indoor television antennas

Although an outdoor antenna placed as high as possible is the best way to go,

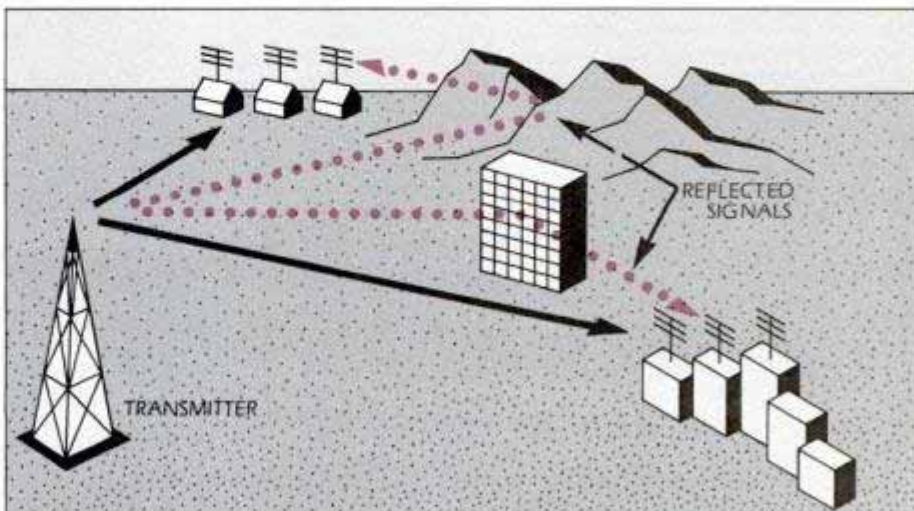
many apartment dwellers must use indoor antennas to pick up broadcast TV. Television signals act much like FM radio signals and are subject to difficulties caused by terrain, buildings and the way they interact with the Earth. In this situation, the indoor television antenna user needs all the help he can get.

An indoor antenna capable of directivity is the ticket. That is, you should be able to rotate the elements and fine-tune the antenna for the strongest signal. A curtain-type of antenna for UHF is also very effective. Both of these alternatives offer marked improvements over the traditional rabbit ears found on the backs of television sets.

Television signals pose another problem because they operate in two slices of the radio spectrum—VHF and UHF. Both are affected by the same types of problems. However, UHF poses still a further problem. Because the wavelength of the signal is relatively short, something as seemingly harmless as a tree branch or nearby telephone pole may cause problems with a station's signal. Thus, a directional type antenna is the answer here, too.

This type of antenna is probably familiar to most television users. It combines a movable center loop with the traditional rabbit ears into a single television-top unit. When all else fails, try adding a signal amplifier. This de-

*(Please turn to page 126)*



TV ghosts and fuzzy FM sound (multipath distortions) occur when signals arrive at the receiver after the direct signal. A well-aimed antenna alleviates this problem.





A big, fully enclosed cabin offers all-weather comfort in this high-wing Pony monoplane. The craft does 60 mph on only 25 hp, burns less than 2 gallons an hour, will sell for under \$10,000.

# 15 NEW YOU CAN FLY

BY SHELDON M. GALLAGER  
Photos by Howard Levy



Speed-reducing flaps on this 40-hp Clipper are an indication of just how far ultralights have come. Kit offers choice of either tri-gear or taildragger [above] configuration, sells for \$6,595.



New centerline float provides amphibious operation with less drag and better control than twin floats. Shown on a Quicksilver GT. It fits most center-spar ultralights, costs about \$2,200.



About the only thing that makes them ultralights is that they happen to weigh less than 254 pounds—the maximum weight allowed by the FAA for unlicensed aircraft. In all other respects, these remarkably realistic little flying machines are as close as you can get to the looks and performance of a true airplane without having to have a pilot's license and a bottomless bank account. For as little as \$3,000 to \$8,000—less than the price of most cars—you can enjoy the fun and thrills of flying your own plane—until now, for most people only a wistful Walter Mitty dream.

Gone are the frail-looking stick-and-fabric contraptions that dominated the ultralight scene a few years ago. Today's models all have standard aircraft-type three-axis controls with separate rudder, elevator and ailerons. Some even offer such advanced features as speed-reducing flaps, wheel brakes, steerable landing gear and airplane-like instrument panels. Many have fully enclosed cockpits or cabins for added comfort in cold weather and cross-country cruising. All are single-seaters—an FAA requirement for unlicensed ultralights—and all are powered by small,



# KIT PLANES

## WITHOUT A LICENSE

Believe it or not, they're ultralights, but you have to look close to tell them from real airplanes.

From nostalgic replicas of old-time fighters to exotic new shapes of the future, here are the latest in license-free fun planes you can build for less than the price of a car.



Low price, simple construction, three-axis controls, folding wings and a steerable tail wheel are features of this Fisher FP-303. Kit with 28-hp engine is only \$2,798.

One of the most intriguing new ultralight shapes is the Buccaneer amphibian (left), winner of the EAA's Best New Design award. Retractable wheels permit operation on land or water. Kit price with 28-hp engine is \$7,995.



You can fly your own dawn patrol in these nostalgic replicas of famous World War I fighters. At top left is a German Eindecker, first warplane to mount a deadly prop-synchronized machine gun. Ironically, the original's top speed of 80 mph was not much more than that of today's ultralights. A kit is about \$6,000. At lower left is a French Nieuport 11, plans for which will be about \$75. In echelon formation at right are a German Fokker D-VII (top), a French Spad XIII (center) and a British SE-5a (bottom). All three planes are kit-priced at \$6,995.



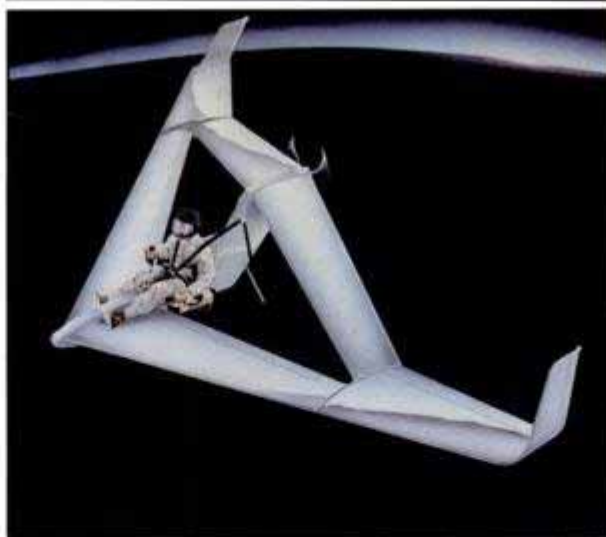
fuel-stingy engines of 25 to 40 hp that burn less than 2 gallons an hour. Top speeds range from 50 to 60 mph—not particularly fast, but still exciting when you're skimming over treetops only a few feet above the ground. Stall speed on all models is less than 25 mph—another FAA requirement—ensuring slow, safe, gentle landings.

Until recently, ultralights were strictly land-bound machines. Now you can operate on water, too, hopping leisurely from lake to lake and then back to land again.

One of the newest and most ingenious of these dual-mode amphibians is the Buccaneer, whose sleek, hull-like fuselage gives it the look of a miniature flying boat, complete with outboard sponsons under the wings. Winner of the Experimental Aircraft Association's Best New Design award for ultralights, it has retractable wheels that swing up for use on water and down for use on land. Able to take off and land in less than 200 feet, the Buccaneer is kit-priced at \$7,995. (For source information on this and other aircraft, see the listing of makers at the end of this article.)

### Add your own amphibious float

Another way to lead your ultralight to water is to fit it with add-on floats offered as optional equipment by a number of manufacturers. One slick new development is a single, centerline float that attaches directly under the main fuselage boom to convert a land-gear ultralight into an amphibian, giving the craft the appearance of a flying boat



World's most exotic ultralight? The futuristic shape shown in the artist's concept above and photo at bottom right is an ultralight today, but it could be the basis for tomorrow's airliner (see text). Called the Trident T3, it incorporates a principle known as a joined wing—two sets of wings joined at their tips to increase lift, reduce drag, resist stall.

similar to that of the Buccaneer.

Advantages of the single float over twin seaplane-type floats are said to be less drag, greater maneuverability and shorter takeoffs because of reduced friction in the water. For operation on land, the float has built-in wheels that can be raised and lowered by a single handle easily reached from the pilot's seat. Made by Spaulding Craft Inc., it fits most center-spar ultralights, comes with sponsons that attach to the wings and sells for about \$2,200.

### Fly a WWI fighter

For warplane buffs, there's a whole new crop of ultralights

made in the image of famous World War I fighters. Except for the fact that they all weigh less than 250 pounds, they look and fly almost exactly like the historic planes they're patterned after. These colorful reproductions include a French Nieuport 11, a German Fokker D-VII, a French Spad XIII and a British SE-5a—all in the classic biplane configuration. There's also a German single-wing Fokker Eindecker, the dreaded "Fokker Scourge," as it was known to Allied pilots, and the first warplane to mount a forward-firing machine gun synchronized to shoot through the propeller.

The Eindecker is a full-scale copy of the original and sells in kit form for about \$6,000. The Nieuport is a 7/8-scale replica you can build from plans costing about \$75. The Fokker D-VII, Spad XIII and SE-5a are all 96 percent scale

*(Please turn to page 138)*



A rare low-wing design, the Bobcat has the high cockpit and good visibility of a crop duster. Features include removable wings and a 25-hp mill with electric start. Plans are \$100; construction cost, about \$3,000.



A 12-cubic-foot baggage compartment makes the Panther ideal for cross-country cruising and camping. Kit-priced at \$5,800, it has full-span ailerons, removable wings, steerable tail wheel and a 28-hp engine.



You can't get much closer to a real-plane look than this 27-hp, enclosed-cabin Solo, said to be the first all-composite ultralight. Priced at \$15,000, it comes with instruments, wheel brakes, steerable nose wheel.



Survivability is a key design feature of this 28-hp Wren. Pilot is surrounded by an energy-absorbing "crash tub" for impact protection. Craft can be built from a kit for about \$6,000 or from plans for \$100.



For those who prefer wind-in-the-face flying, this new J-4 Sportster is an open-cockpit version of the J-3 Kitten. Winner of the EAA's Grand Champion award for ultralights, it's \$5,900 with 28-hp engine.



Trident T3 has a 32-foot wingspan and power-off glide ratio of 15 to 1, giving it near-sailplane performance. Its high-lift, twin-wing design is said to be inherently stable, easy to fly and difficult to stall.



**H**ow much over the speed limit do state police allow you to drive?

If you're making a right turn through a red light and a car coming from your left through the green light plows into you, who's liable?

Can you sue if your car is damaged by a pothole?

If you lend your car to someone who doesn't have a valid driver's license and he or she has an accident, can you be held responsible?

Can you hold licenses in more than one state?

PM asked these and seven other questions involv-

ing cars and the law to authorities in all 50 states. Many of the answers differed from state to state—proof that, as a car owner and driver, you shouldn't take anything for granted.

Most states responded to all our questions—others only to some. Before you read the answers, this caveat must be stressed: Use these answers only as general guides. Situations are seldom cut-and-dry, and court deliberation often is required to determine who is at fault in a particular case. If you find yourself in a gray area, seek professional legal advice.

# THE LAW AND YOUR CAR

BY MORT SCHULTZ; Illustrations by Dick Anderson



*No definitive answer*—Ark., Calif., Idaho, Kan., La., Mass., Mich., Mont., N.J., N.C., Okla., Ore., R.I., S.C., Tex., Vt.

only ones indicating exceptions, if you believe you're in a special category (military, out-of-state student and so

*(Please turn to page 136)*

**Where a right turn is permitted on a red light, who is responsible if a car having a green light strikes a car making a turn on red?**

*Car making the turn*—All except the following: Ala. (for a jury to determine), Kan. (the court makes the decision), Mich. (requires a legal opinion), Minn. (depending on circumstances, both may be found civilly liable), N.H. (generally, the vehicle farthest along in the intersection would have the right of way), R.I. (depends on comparative negligence of the drivers), Vt. (depends on specific circumstances), Wis. (could be dual responsibility).

*No definitive answer*—Ark., Mass., Mont., Ohio, S.C.

**Can you hold more than one driver's license—one from a state in which you do not have legal residency?**

*No*—All states except Mass., N.Y., Tenn., Vt., Va.

*Comment*—In Fla., you may hold a dual license if you provide a statement indicating need. In Ill., you can hold another license for the first 90 days of residency only. In N.C., nonresident military personnel and members of their households may have dual licenses. Although these states are the



**Do state police allow you leeway over the legal speed limit? If so, how much?**

*No*—Ariz., Conn., Del., Fla., Hawaii, Ill., Ind., Minn., Miss., Mo., Neb., Nev., N.Y., N.D., Ohio, Utah, Wash., W. Va., Wis.

*Yes*—Ala. (depending on traffic and weather conditions), Alaska (4 mph), Colo. (less than 5 mph), Ga. (at the discretion of the trooper), Iowa (tolerance is not made public), Ky. (4 or 5 mph), Me. (no exact amount), Md. (depending on traffic, weather and road conditions), N.H. (depending on circumstances), N.M. (up to 5 mph), Pa. (by law in Pa., no person may be convicted through the use of radar for excessive speed, unless the speed recorded is 6 or more mph over the posted speed limit. The decision to arrest in other cases is left to the discretion of the individual officer), S.D. (up to 5 mph), Tenn. ("a little over the limit"), Va. (up to 5 mph), Wyo. (not a policy, but some officers allow 5 mph over).



# 7 CLASSIC TOYS

## To Make For Your Kids

With their removable parts and movable features, these wooden toys will fascinate youngsters.

**W**ith a small amount of time and basic woodworking skills, you can put together these sturdy wooden toys—and have as much fun as your kids or grandchildren will have. The movable parts are engaging and help stimulate a child's development.

The designer, Cherry Tree Toys Inc., Belmont, Ohio 43718, offers the following packages: full-size plans only, plans and turned parts, complete uncut kits in cherry, complete precut kits in poplar. Prices are postpaid on orders of \$20 or more; add \$2 postage for smaller orders. Phone in orders (614-484-1746) with Visa or MasterCard. Color catalog is \$1.



Classic toys are (front to back) Rolls-Royce, log truck and earth dump truck. Toys on the facing page are (front to back) biplane, front-end loader and small train.

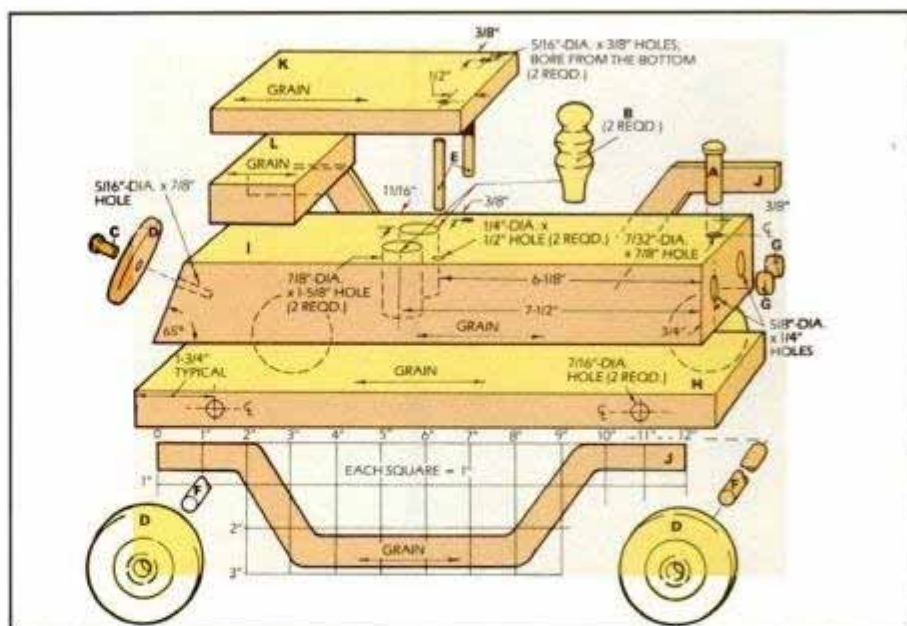


**ROLLS-ROYCE**

**T**he top of this Rolls-Royce lifts off to reveal two removable people. Parts A through D (see materials list) are turned on a lathe or purchased.

To shape the running board (J), make a grid of 1-in. squares on paper and draw in the shape. Then transfer the pattern onto wood. Cut out the remaining parts. Bore holes in the car roof (K) for the roof supports (E). Glue the roof to the rear roof (L). Bore holes required in the body (I). Center the body onto the fender section (H), and glue in place.

Sand all surfaces with 80-grit abrasive, rounding over exposed edges. Sand with 120- and 180-grit abrasive, dusting and wiping with a tack cloth. Glue running boards to protrude 1/4 in. above body. Glue in the lights, attach the wheels and apply a finish. Package prices are: plans, \$2; plans and turned parts, \$7; uncut kits, \$16.50; precut kits, \$22.50. From Cherry Tree Toys.



### MATERIALS LIST—ROLLS-ROYCE

Key	No.	Size and description of hardwood (use)	
A	1	7/32"-dia. x 1 1/16" shaft, 3/16 x 3/8"-dia. button (radiator cap)	G 2 3/8"-dia. x 3/8" dowels (lights)
B	2	3/16"-dia. x 2 5/16" turning (people)	H 1 3/4 x 2 3/4 x 12 7/8" (fender)
C	1	5/16"-dia. x 1 3/16" shaft, 3/16 x 1/2" button (spare tire fastener)	I 1 1 3/4 x 2 3/4 x 12 1/8" (body)
D	5	3/4" x 2 1/2"-dia. 3/8"-dia. center hole (tires)	J 2 3/4 x 2 3/4 x 12 1/8" (running board)
E	2	1/4"-dia. x 1 5/8" dowels (roof supports)	K 1 1/2 x 2 3/4 x 5 1/2" (roof)
F	2	3/8"-dia. x 4 1/8" dowels (axles)	L 1 3/4 x 1 3/4 x 2 3/4" (rear roof)

Misc.: Carpenter's glue; 80-, 120-, 150-grit abrasive; mineral oil or wood bowl seal from Constantine's, 2050 Eastchester Rd., Bronx, N.Y. 10461 (or other child-safe finish).





PHOTOS BY LAYMAN NEWMAN; DRAWINGS BY ED LIPINSKI

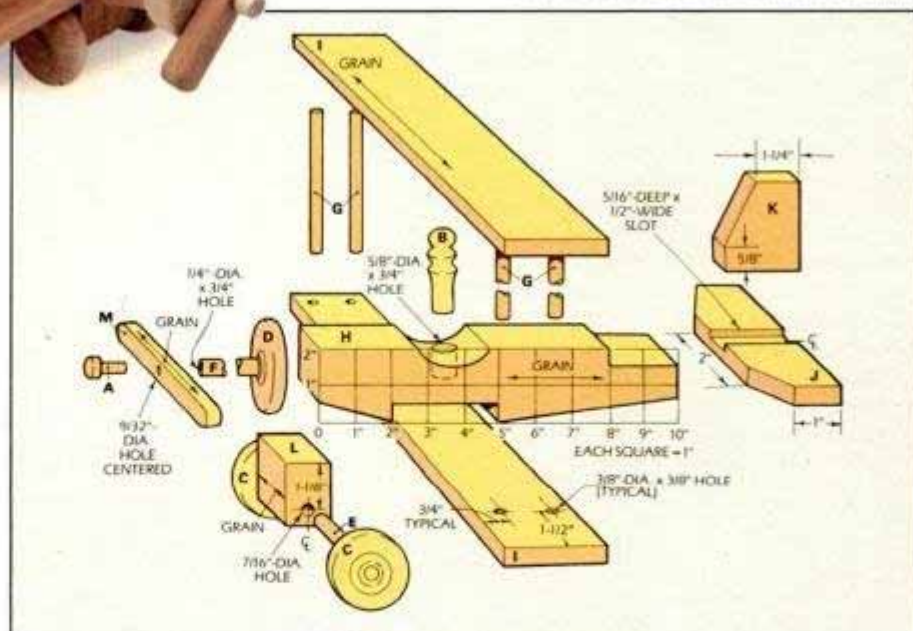


## BIPLANE

The biplane has a revolving blade and a removable pilot. Parts A through D are turned on a lathe or purchased.

To shape the fuselage (H), draw a grid of 1-in. squares on paper and draw in the shape. Then transfer the pattern onto the wood. Cut out all parts. Cut the slot in the tailpiece (J) to depth and chisel out waste. Glue the propeller fastener (F) into disc (D). Then, bore all holes. Sand all surfaces with a progression of 80-, 120- and 180-grit abrasive, dusting and wiping with a tack cloth between grits.

Join the wings (I) with supports (G). Glue the tailpieces (J,K) together and to the body. Glue the wing assembly and disc (D) to the plane body, then glue the axle block in place. Attach the propeller and wheels, then apply finish. Package prices are: plans, \$2; plans and turned parts, \$4.50; uncut kits, \$13.50; precut kits, \$21.50; Cherry Tree Toys.



### MATERIALS LIST—BIPLANE

Key No.	Size and description of hardwood (use)		
A	1/4"-dia. x 1 1/4" shaft; 3/8 x 1/2"-dia. button (fastener)	H	1 1 3/4 x 2 x 10" (fuselage)
B	3/16"-dia. x 2 5/16" (pilot)	I	2 1/2 x 3 x 9" (wings)
C	3/4 x 2"-dia; 3/8"-dia. center hole (wheels)	J	1 1/2 x 2 x 4 1/4" (tail)
D	3/4 x 2 1/2"-dia; 3/8"-dia. center hole (disc)	K	1 1/2 x 2 x 2 3/8" (vertical tailpiece)
E	3/8"-dia. x 3 3/8" dowel (axle)	L	1 1 x 1 3/8 x 1 3/4" (axle block)
F	3/8"-dia. x 3/4" dowel (propeller fastener)	M	1 1/2 x 3/4 x 4 1/4" (propeller)
G	4 3/8"-dia. x 4" dowels (wing props)	Misc.:	Carpenter's glue; 80-, 120-, 180-grit abrasive; child-safe finish (see project No. 1).





## LOG TRUCK

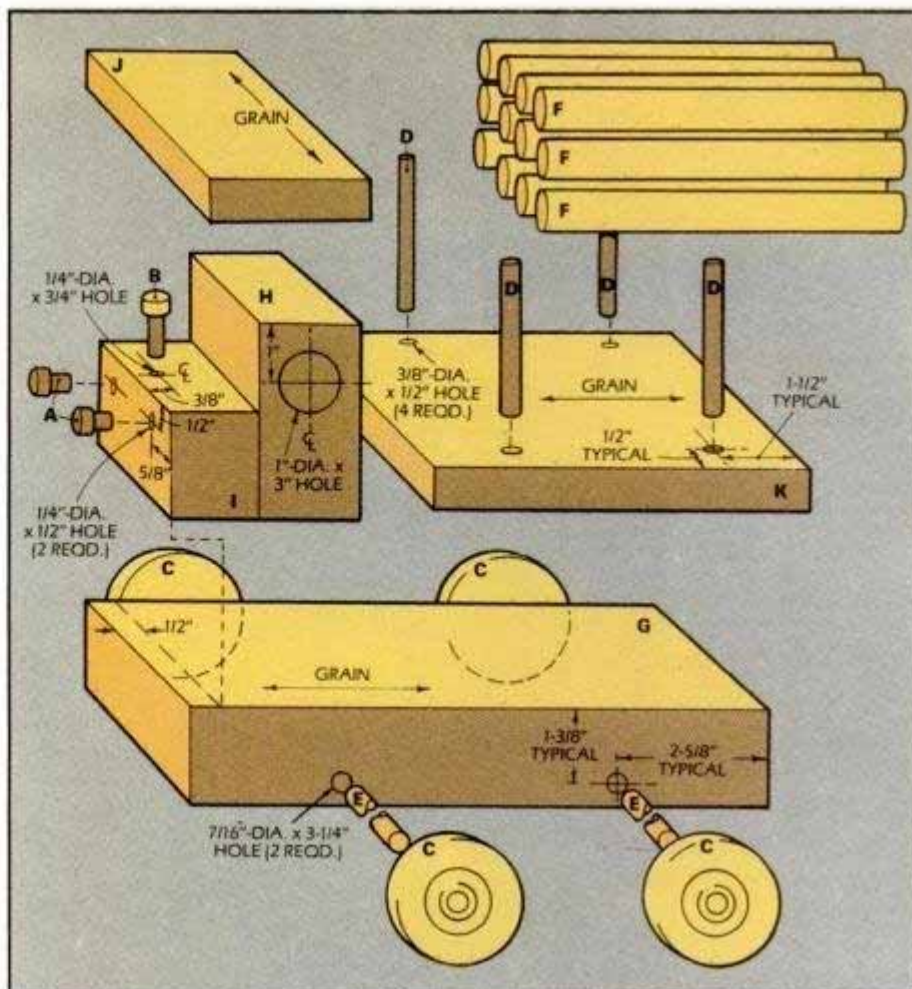
The log truck has 12 removable logs. Parts A through C are turned on a lathe or purchased.

Cut parts to size and bore holes as indicated on the drawing. Sand all surfaces with 80-grit abrasive, rounding over exposed edges. Then sand with 120- and 180-grit abrasive, dusting and wiping with a tack cloth. Glue hood (I) to the body (G) and cab (H). Glue on the roof (J). Glue the bed (K) to the body. Join the accessories and fasten the wheels. Apply finish. Log truck prices are: plans, \$2; plans and turned parts, \$8.50; uncut kit, \$17.50; precut kit, \$19.50, from Cherry Tree Toys.

### MATERIALS LIST— LOG TRUCK

Key No.	Size and description of hardwood (use)
A	2 1/4"-dia. x 1/2" shaft; 3/8 x 1/2"-dia. button (lights)
B	1 1/4"-dia. x 1 1/4" shaft; 3/8 x 1/2"-dia. button (air filters)
C	4 3/4 x 2 1/4"-dia.; 3/8"-dia. center hole (wheels)
D	4 3/8 x 2 3/4" dowels (truck bed posts)
E	2 3/8 x 4 1 3/16" dowels (axles)
F	12 3/4 x 6 1/4" dowels (logs)
G	1 1 3/4 x 3 1/4 x 10" (truck body)
H	1 1 3/4 x 3 x 3 3/8" (cab)
I	1 1 1/2 x 1 3/4 x 2 1/4" (hood)
J	1 3/4 x 2 3/4 x 4 1/4" (roof)
K	1 3/4 x 4 1/2 x 6 1/2" (truck bed)

Misc.: Carpenter's glue; 80-, 120-, 180-grit abrasive; child-safe finish (see project No. 1).



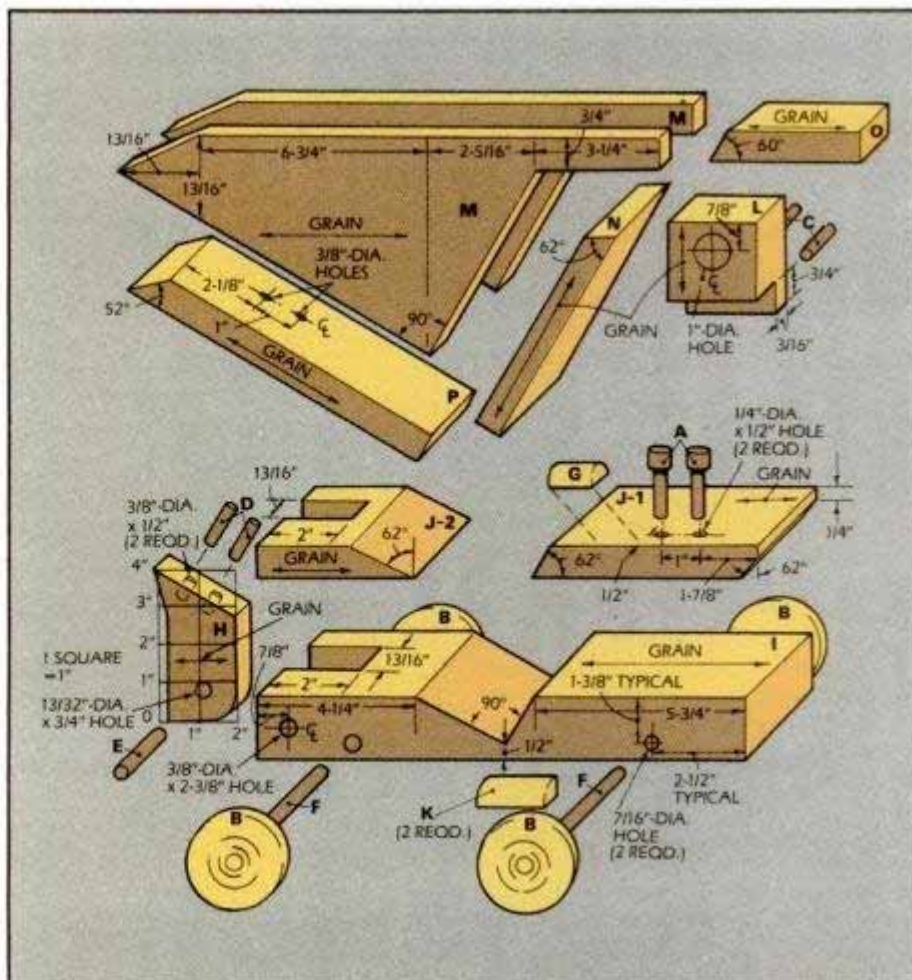
## EARTH DUMP TRUCK

The earth dump truck has a tilting bed. Parts A and B are lathe-turned or purchased. Draw dump pivot (H) and cut out all parts. Assemble the truck bed (J-1, J-2, I). Assemble the dump parts (M-P). Sand all surfaces following instructions for log truck (above). Glue on dump pivot (H). Bore holes. Glue L and G (sanded flat on one side) in place. Assemble the toy and attach the wheels before adding parts K. Apply finish. Plans, \$2; plans and turned parts, \$6; uncut kits, \$27.50; Cherry Tree Toys.

### MATERIALS LIST— EARTH DUMP TRUCK

Key No.	Size and description of hardwood (use)
A	2 1/4"-dia. x 1 1/4" shaft; 3/8 x 1/2"-dia. button (air filters)
B	4 3/4 x 2 1/2"-dia.; 3/8"-dia. center hole (wheels)
C	2 1/4"-dia. x 7/8" dowels (cab fasteners)
D	2 3/8"-dia. x 1 1/4" dowels (dump fasteners)
E	1 3/8"-dia. x 2 3/8" dowel (pivot pin)
F	2 3/8"-dia. x 4 5/8" dowels (axles)
G	1 1 x 1 1/8" dowel (fuel tank)
H	1 3/4 x 2 3/8 x 4 1/8" (dump pivot)
I	1 1 3/4 x 3 x 13" (lower truck bed)
J-1	1 3/4 x 3 x 6" (upper truck bed front)
J-2	1 3/4 x 3 x 4 1/4" (upper truck bed rear)
K	2 3/4 x 3/4 x 1 3/4" quarter round (step)
L	1 1 3/4 x 2 1/4 x 2 7/8" (bed)
M	2 3/4 x 5 1/8 x 14 1/8" (dump sides)
N	1 3/4 x 4 x 5" (dump front)
O	1 3/4 x 4 x 4" (dump top)
P	1 3/4 x 4 x 9" (dump bottom)

Misc.: Same as for log truck (above).







## SMALL TRAIN

**R**emovable parts on the small train are the cargo, cabin top and people. Parts A to D are lathe-turned or purchased.

First, cut all pieces as indicated, then bore all holes needed. Sand surfaces with 80-grit abrasive, rounding over exposed edges. Then sand with 120- and 180-grit abrasive, dusting and wiping with a tack cloth. Glue the cargo platform (I) and car bases (J) overhang-

ing their underbodies (K). Glue on the engine cabin (M) and top (N), centered on the cabin. Glue the engine front (L) in place.

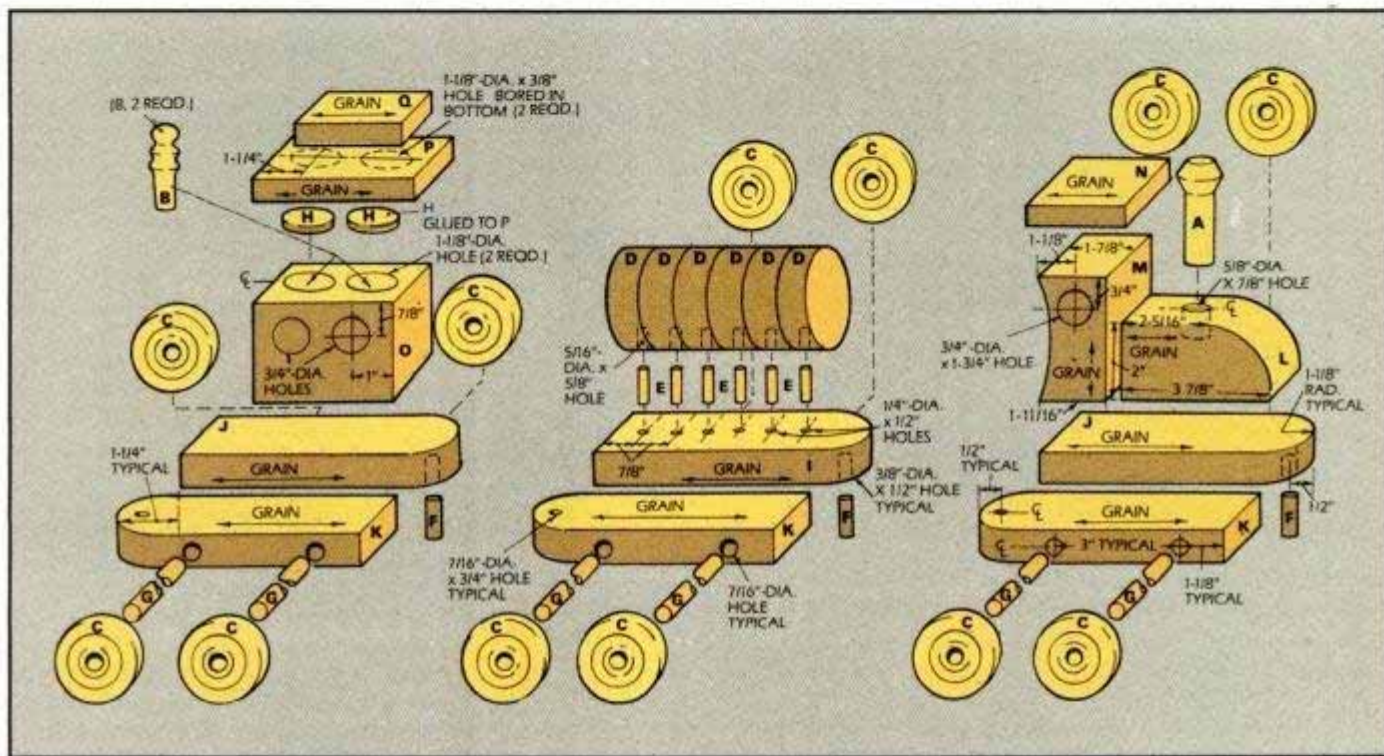
Glue the passenger cabin (O) in place, centered on base (J). Glue plugs (H) and roof (Q) to cabin top (P). Glue the cargo fasteners (E) to their platform (I). Cargo (D) isn't glued. Assemble the remaining accessories and attach the wheels. Finally, you should apply a child-safe finish.

The small train packages are: plans, \$3; plans and turned parts, \$14.50, from Cherry Tree Toys. Kits are not available.

### MATERIALS LIST—SMALL TRAIN

Key No.	Size and description of hardwood (use)
A	1 $\frac{3}{8}$ "-dia. x 2" shaft; $\frac{3}{4}$ x $1\frac{1}{4}$ "-dia. button (smokestack)
B	2 $\frac{9}{16}$ "-dia. x $2\frac{1}{2}$ " (people)
C	12 $\frac{3}{4}$ x 2"-dia.; $\frac{3}{8}$ "-dia. center hole (wheels)
D	6 $\frac{3}{4}$ x $2\frac{1}{2}$ "-dia.; $\frac{3}{8}$ "-dia. center hole (cargo)
E	6 $\frac{1}{4}$ "-dia. x 1" dowels (cargo fasteners)
F	3 $\frac{3}{8}$ "-dia. x $1\frac{1}{4}$ " dowels (car couplers)
G	6 $\frac{3}{8}$ "-dia. x $3\frac{7}{8}$ " dowels (axles)
H	2 $\frac{1}{2}$ " x 1"-dia. rounds (plugs)
I	1 $\frac{3}{4}$ x $2\frac{1}{4}$ x $6\frac{1}{2}$ " (cargo platform)
J	2 $\frac{3}{4}$ x $2\frac{1}{4}$ x $6\frac{1}{2}$ " (car base)
K	3 $\frac{3}{4}$ x $2\frac{1}{4}$ x $6\frac{1}{2}$ " (underbody)
L	1 $1\frac{1}{4}$ x 2 x $3\frac{7}{8}$ " (engine front)
M	1 $1\frac{3}{4}$ x $1\frac{7}{8}$ x 3" (engine cabin)
N	1 $\frac{1}{2}$ x $2\frac{3}{8}$ x $2\frac{1}{2}$ " (engine top)
O	1 $1\frac{3}{4}$ x $2\frac{1}{2}$ x $3\frac{1}{2}$ " (passenger cabin)
P	1 $\frac{1}{2}$ x $2\frac{1}{4}$ x 4" (passenger cabin top)
Q	1 $\frac{1}{2}$ x $1\frac{1}{4}$ x $2\frac{3}{4}$ " (cabin roof)

Misc.: Carpenter's glue, 80-, 120-, 180-grit abrasive; child-safe finish (see project No. 1).



## FRONT-END LOADER

**T**he front-end loader has a pivoting scoop and a removable person. Parts A through C are lathe-turned or bought.

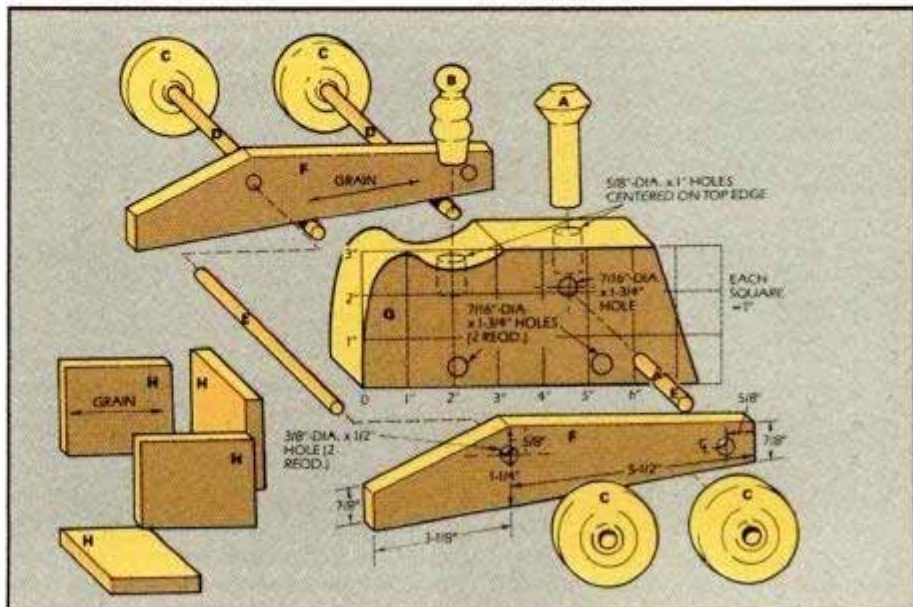
To shape the body (G), draw a grid of 1-in. squares on paper, draw in the shape and transfer it to wood. Then cut all parts. Bore all holes as shown. Glue the two interior scoop parts (H) together, then glue the scoop sides. All surfaces with 80-grit abrasive, rounding over exposed edges. Then, sand with 120- and 180-grit abrasive, dusting and wiping with a tack cloth.

Glue the scoop fasteners (E) to the lifts (F), and glue the scoop between the lifts. Assemble the accessories and attach the wheels before applying finish. Plans, \$2; plans and turned parts, \$6; uncut kits, \$12; precut kits, \$17.50, from Cherry Tree Toys. **FM**

### MATERIALS LIST—FRONT-END LOADER

Key No.	Size and description of hardwood (use)
A	1 $\frac{3}{8}$ "-dia. x 2" shaft; $\frac{3}{8}$ x $1\frac{1}{4}$ "-dia. button (air filter)
B	1 $\frac{9}{16}$ "-dia. x $2\frac{1}{2}$ " (driver)
C	4 $\frac{3}{4}$ x $2\frac{1}{2}$ "-dia.; $\frac{3}{8}$ "-dia. center hole (wheels)
D	2 $\frac{3}{8}$ x $3\frac{3}{8}$ " dowels (axles)
E	2 $\frac{3}{8}$ x $4\frac{1}{2}$ " dowels (scoop fastener)
F	2 $\frac{1}{2}$ x $1\frac{7}{8}$ x $8\frac{5}{8}$ " (scoop lift)
G	1 $1\frac{3}{4}$ x $3\frac{1}{8}$ x $7\frac{1}{2}$ " (loader body)
H	4 $\frac{1}{2}$ x 2 x $2\frac{1}{2}$ " (scoop)

Misc.: Carpenter's glue; 80-, 120-, 180-grit abrasive; child-safe finish (see project No. 1).





# HOW TO THREAD METAL

Here's a complete course on using taps and dies to thread metal. Included are three valuable, keep-'em-handy reference charts.

BY ROSARIO CAPOTOSTO



Two-handed tap and die wrenches provide leverage for cutting large diameter threads. The one-handed T-handle wrench (center) uses small taps.

Inside and outside spirals and interlocking grips of great force may conjure up images of Sunday afternoon football. But for the do-it-yourselfer, these phrases refer to cutting threads in metal.

The inside and outside spirals are the matching threads on a nut and bolt and, if the fit is perfect, the result is an interlocking grip of great force. While nuts and bolts of virtually any size can be purchased, there are times when you must renew stripped threads, cut threads to match existing nuts, bolts or screws, or make screw-type fasteners from new metal stock. All you need to do these jobs is a set of relatively inexpensive hand taps and dies, precision tools that cut threads in metal.

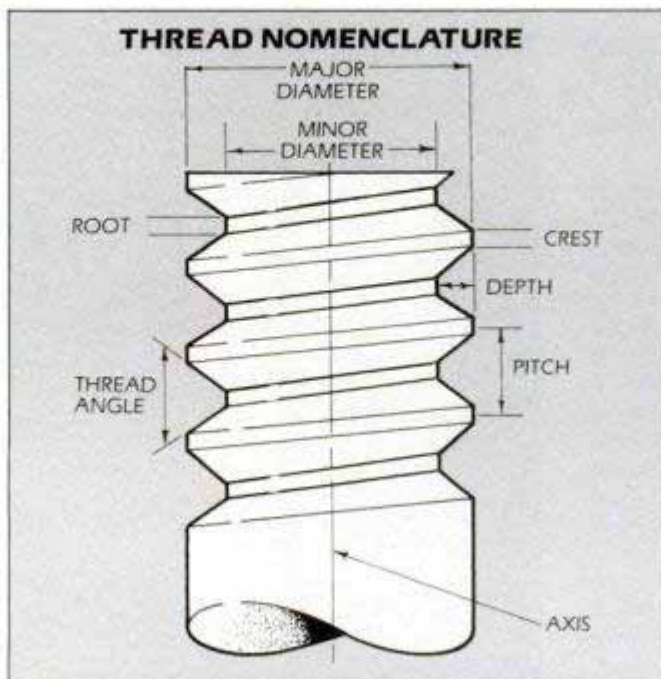
A tap cuts internal threads on the wall of a drilled hole, such as in a nut. Just as a drill removes material when making a hole, a tap cuts material away to form threads. A die is a tool that cuts external threads on round stock, such as on a bolt.

Before getting into the specifics of the tools and techniques used in threading

metal, some explanation of the various sizes and thread configurations is in order.

The current, standardized system of thread configurations and sizes is the American National Thread. It includes two series of thread sizes: NC—National Coarse, sometimes referred to as United States Standard (U.S.S.); and NF—National Fine, frequently referred to as Society of Automotive Engineering (SAE). NC thread is for general-purpose use. NF threads are used to meet stricter requirements and where fine adjusting is required. Taps and dies meeting these standards are the ones most widely used in the home shop, although metric threads also are common.

American National taps and dies are designated by a fraction or whole number representing the outside diameter of the thread, the number of threads per inch and the symbol identifying the thread type. Thus, a tap marked  $\frac{1}{4}$ -20 NC means it will cut threads for a  $\frac{1}{4}$ -in.-dia. screw or bolt with 20 coarse threads per inch. Taps and dies with a diameter less than  $\frac{1}{4}$  in. are



Common external thread parts are identified above. Cut external threads using dies. Internal threads are made with taps.



marked according to the wire gauge sizes of machine screws. For example, a die marked 10-32 NF will cut threads for a No. 10 machine screw with 32 fine threads. In the metric system, the measurements are in millimeters and include a class number—I, II or III—indicating tightness of fit. A Class I fit is loose, II is medium and III is tight.

### Threading tools

Taps come in three basic types: taper, plug and bottoming. These differ in the length of the taper on the starting end. The taper tap is tapered for the first 5 to 8 threads. These are used



Taper, plug and bottoming taps are shown to the left. Note the decreasing taper. Pipes carrying liquids or gases must have tapered, leakproof threads (above).

threads to find the number of threads per inch.

To cut satisfactory internal threads with a tap, it's important to drill the correct size hole. The drilled hole (which should be countersunk before tapping) must be small enough to leave sufficient stock in which to cut threads.

Correct tap drill size can be determined by the following formula:

$$\text{Tap drill size} = \text{Major diameter of thread} - (.75 \times 1.299) \div \text{No. of threads per inch}$$

mostly for threading through holes. The tapered end prevents threading to the bottom of a hole. The plug tap has 3 or 4 threads tapered at the end and is used after the taper tap if additional threads are required in a blind hole. The bottoming tap has only a 1½- to 2-thread taper and is used to tap full threads very close to the bottom of a blind hole. Start the hole first with a taper or plug tap. For the average job, the plug tap strikes a happy medium. It starts easily and has a suitable number of full threads for most home applications.

The tap has a square end which accepts either a bar-type or T-handle tap wrench. The former, turned with two hands, is used with larger taps; the latter is used for smaller taps and can be turned with one hand.

As for dies, two types are commonly used—the solid hex and the round adjustable. Hex dies are designed to cut threads of standard size on bolts, studs and rods. Round adjustable dies also cut standard-size threads, but are slotted to allow minute adjustments for cutting slightly oversize or undersize threads when a tighter or looser fit is wanted. The adjustment is made by turning a setscrew.

The die is held in a die stock, available with or without an adjustable guide. The type with a guide is recommended because it ensures cutting straight threads.

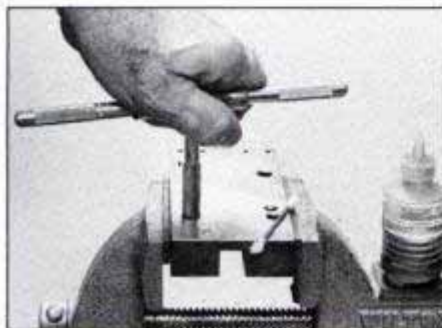
### Cutting threads

To cut new threads to match those on an existing piece, first measure the number of threads per inch on the piece so you can select the correct tap or die. One way to do this is to place the edge of a rule on the threads and count the number of grooves in one inch. An easier way is with a screw pitch gauge. The gauge has a series of toothed blades, each marked with a number corresponding to the threads per inch, or pitch. Just match the blade to the

So, for a ¾-in.-dia. hole at 10 threads per inch, the formula to find the correct tap drill size reads:

$$\begin{aligned} \text{Tap drill size} &= .750 - (.75 \times 1.299) \div 10 \\ &= .750 - .097 \\ &= .653 \text{ (decimal equivalent of tap drill)} \\ &= \#2\frac{1}{32} \text{ (nearest correct tap drill size)} \end{aligned}$$

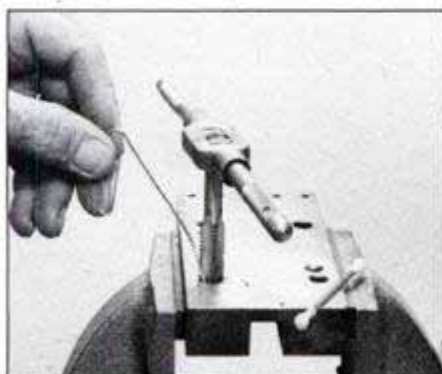
Obtaining clean, true threads is easy if you follow a few simple rules. Secure the work firmly and apply the correct lubricating fluid (see the chart on page 101). Aim the tap carefully at the start so it's perpendicular to the hole. Check



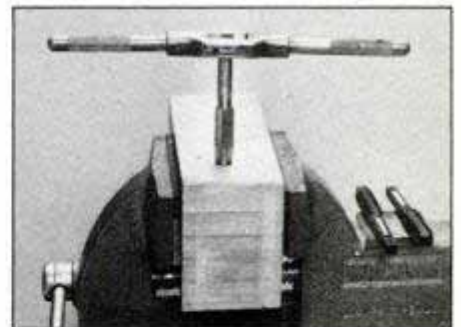
To start a tap by hand, grasp the wrench in the center with one hand and press down firmly while slowly turning the wrench.



When the tap starts biting, use both hands and hold the handle at the ends. Back off a quarter-turn after each forward half-turn.



Use a straightened paper clip to poke chips from between the tap flutes. Clogged chips may cause the tap to jam and break off.



Use a taper tap to start the threads in a blind or closed hole. Then continue tapping, using a plug and bottoming tap.



A blind hole doesn't let chips fall through, so they must be forced out. Remove tap, blow air into hole. Be sure to wear goggles.





Before inserting the die, position die stock with adjustable guide facing up. Align guide to ensure straight threading, then tighten the guide's holding screws.



With the guide adjusted, insert the die with the tapered side down. To start die squarely, hold stock with both hands near the center, bear down and rotate clockwise.



After the first few threads are started, move hands to handle end. Downward pressure can be relieved, since die self-feeds as it's rotated due to screwing action.

this constantly with a square. Back off the tap a quarter-turn after each forward half-turn to break off the metal chips. Use a wire to prod the chips free from the tap flutes and out of the bottom of the hole.

In a blind hole, chips pile up at the bottom and can cause problems. One solution is to bore the hole deeper than is needed, if possible. The extra depth provides space for the chips to collect, out of the way of the cutting tip.

In the case of bottom-tapping, chip removal is handled differently. As the tap nears the bottom of the hole, it must be withdrawn constantly. A few bursts of air from an ear syringe will clear out the chips nicely, but make sure to wear safety goggles when doing this. Another



Adjustable round die cuts standard-size threads on bolts and rods, but slot allows minute adjustments for cutting oversized or undersized threads. The adjustment is made by turning setscrew on edge of die.

er way is to insert a magnetic rod into the hole to pick up the chips.

To cut external threads on a rod, start by filing or grinding a chamfer of approximately 30° on the end, so the die sits squarely on the rod. Before inserting the die into the die stock, adjust the guide fingers. Place the die stock over the rod with the guide's chuck plate facing up. Then, rotate the chuck plate until the fingers lightly touch the rod. Tighten the guide-holding screws.

Insert the die into the stock (tapered side facing the guide), then hold the tool squarely on the rod as you turn it to start the cut. The guide keeps the die on a true plane, but you must apply even pressure on both handles of the stock as the die begins to cut.

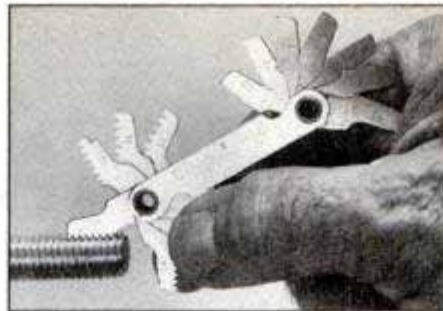
## Letter, Fraction And Number Size Drills

Drill Size	Decimal (in.)	Drill Size	Decimal (in.)	Drill Size	Decimal (in.)	Drill Size	Decimal (in.)	Drill Size	Decimal (in.)
80	.0135	50	.0700	22	.1570	17/64	.2656	1/2	.5000
79	.0145	49	.0730	21	.1590	H	.2660	33/64	.5156
1/64	.0156	48	.0760	20	.1610	I	.2720	17/32	.5313
78	.0160	3/64	.0781	19	.1660	J	.2770	35/64	.5469
77	.0180	47	.0785	18	.1695	K	.2810	9/16	.5625
76	.0200	46	.0810	17/64	.1719	9/32	.2812	37/64	.5781
75	.0210	45	.0820	17	.1730	L	.2900	19/32	.5938
74	.0225	44	.0860	16	.1770	M	.2950	39/64	.6094
73	.0240	43	.0890	15	.1800	19/64	.2969	5/8	.6250
72	.0250	42	.0935	14	.1820	N	.3020	41/64	.6406
71	.0260	3/32	.0938	13	.1850	5/16	.3125	21/32	.6562
70	.0280	41	.0960	3/16	.1875	O	.3160	43/64	.6719
69	.0292	40	.0980	12	.1890	P	.3230	11/16	.6875
68	.0310	39	.0995	11	.1910	21/64	.3281	45/64	.7031
67	.0320	38	.1015	10	.1935	Q	.3320	23/32	.7188
66	.0330	37	.1040	9	.1960	R	.3390	47/64	.7344
65	.0350	36	.1065	8	.1990	11/32	.3438	3/4	.7500
64	.0360	7/64	.1094	7	.2010	S	.3480	49/64	.7656
63	.0370	35	.1100	13/64	.2031	T	.3580	25/32	.7812
62	.0380	34	.1110	6	.2040	23/64	.3594	51/64	.7969
61	.0390	33	.1130	5	.2055	U	.3680	13/16	.8125
60	.0400	32	.1160	4	.2090	3/8	.3750	53/64	.8281
59	.0410	31	.1200	3	.2130	V	.3770	27/32	.8438
58	.0420	1/8	.1250	2	.2210	W	.3860	55/64	.8594
57	.0430	30	.1285	1	.2280	25/64	.3906	7/8	.8750
56	.0465	29	.1360	A	.2340	X	.3970	57/64	.8906
3/64	.0469	28	.1405	15/64	.2344	Y	.4040	29/32	.9062
55	.0520	27	.1440	B	.2380	13/32	.4062	59/64	.9219
54	.0550	26	.1470	C	.2420	Z	.4130	15/16	.9375
53	.0595	25	.1495	D	.2460	27/64	.4219	61/64	.9531
1/16	.0625	24	.1520	E, 1/4	.2500	7/16	.4375	31/32	.9688
52	.0635	23	.1540	F	.2570	29/64	.4531	63/64	.9844
51	.0670	9/32	.1562	G	.2610	15/32	.4688	1	1.000
						31/64	.4844		

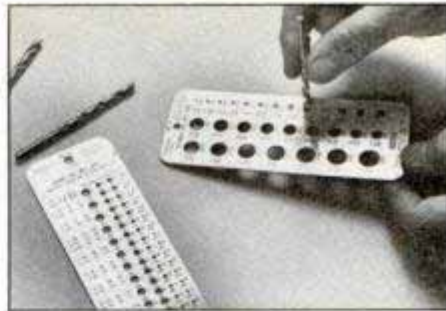




Sears' 41-piece tap and die set is ideal for home workshop. Accessories include adjustable guide die stock, screw pitch gauge and assorted tap wrenches.



Screw pitch gauge is a useful accessory for determining screw size. First, match the blade to the screw thread. Then, check the number located on the gauge blade.



A drill plate is used to check the size of drills. Each hole is marked for a specific drill size. The plates are available for fractional, number and letter-size drills.

### Threading wood and acrylic

Threads can be cut in acrylic plastics and hardwoods such as cherry, maple, ash and oak using NC threading forms. Both internal and external threads can be cut in acrylic, but in wood only internal threads can be successfully made using metal-cutting dies. Special wood-cutting taps and dies are available for wooden threaded rods.

Consider the thickness of the material into which you want to cut threads in relation to the screw or bolt to be used. If the screw is to enter the edge of the material, screw diameter should not be greater than half the thickness of the material. For example, the maximum diameter of a screw to be inserted into the edge of 1/2-in. stock would be 1/4 in.

Generally, the same tap drill sizes and procedures described for threading metal apply for other materials, with the following exceptions: Acrylic should be lubricated with soapy water. Lubricate wood with candle wax. With acrylic, the tap or die is backed off after each full turn to break off the chips. When tapping wood, backing off the tap is not necessary.

For an extra tough internal screw thread in wood, consider using a threaded insert rather than threading the wood itself. The insert is a steel fitting which has 1/2-13 NC threads on the outside and 1/4-20 NC threads on the inside for accepting a bolt. Drive the insert into a 27/64-in.-dia. threaded hole using a screwdriver.

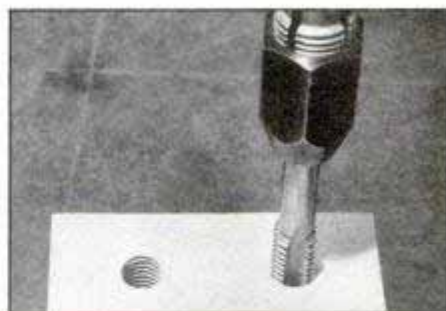
PM

### Recommended Lubricants For Threading Various Materials

Material	Lubricant
Aluminum	Kerosene or kerosene mixed lightly with lard oil
Bakelite	Dry
Brass	Dry
Bronze	Kerosene
Cast Iron	Dry or air blast
Copper	Lard oil
Hard Rubber	Dry
Magnesium	Kerosene
Stainless Steel	Kerosene mixed with lard oil
Steel	Lard oil, cutting oil, or vegetable shortening
Wrought Iron	Lard oil
Zinc	Kerosene



Acrylic plastic accepts threading well. Use the same tap drill sizes as for metal and lubricate the tap with soapy water.



Tap threads into hardwood using coarse thread taps. For smooth and easy cutting, lubricate the tap with candle wax.



Threaded inserts in wood allow metal-to-metal fastening. Although not required, tapping hole first makes threading easier.

### Tap Drill Sizes

Thread	Drill	Thread	Drill	Thread	Drill
#0-80	3/64	9/16-12	21/64	1/2-14	23/32
#1-64	No. 53	9/16-18	33/64	3/4-14	59/64
#1-72	No. 53	5/8-11	17/32	1-11 1/2	1 1/2
#2-56	No. 51	5/8-18	27/64	1 1/4-11 1/2	1 1/2
#2-64	No. 50	3/4-10	21/32	1 1/2-11 1/2	1 7/8
#3-48	5/64	3/4-16	11/16	2-11 1/2	2 1/2
#3-56	No. 46	7/8-9	49/64	2 1/2-8	2 5/8
#4-40	No. 43	7/8-14	13/16	3-8	3 1/4
#4-48	No. 42	1-8	7/8	3 1/2-8	3 3/4
#5-40	No. 39	1-12	59/64	4-8	4 1/4
#5-44	No. 37	1-14	15/16	5-8	5 9/32
#6-32	No. 36	1 1/8-7	63/64	6-8	6 11/32
#6-40	No. 33	1 1/8-12	1 1/8	<b>Straight Pipe</b>	
#8-32	No. 29	1 1/4-7	1 1/4	Thread	Drill
#8-36	No. 29	1 1/2-6	1 1/2	1/8-27	S
#10-24	No. 25	1 1/2-12	1 1/2	1/4-18	29/64
#10-32	No. 21	1 3/4-5	1 3/4	3/8-18	19/32
#12-24	No. 17	1 3/4-12	1 3/4	1/2-14	47/64
#12-28	No. 15	2-4 1/2	1 25/32	3/4-14	15/16
1/4-20	No. 8	2-12	1 59/64	1-11 1/2	13/16
1/4-28	No. 3	2 1/4-4 1/2	2 1/4	1 1/4-11 1/2	1 33/64
5/16-18	F	2 1/2-4	2 1/2	1 1/2-11 1/2	1 3/4
5/16-24	I	2 3/4-4	2 1/2	2-11 1/2	2 7/32
3/8-16	5/16	3-4	2 3/4	2 1/2-8	2 21/32
3/8-24	O	<b>Taper Pipe</b>		3-8	3 9/32
7/16-14	U	Thread	Drill	3 1/2-8	3 25/32
7/16-20	W	1/8-27	R	4-8	4 9/32
1/2-12	27/64	1/4-18	7/16	5-8	5 11/32
1/2-13	27/64	3/8-18	27/64	6-8	6 13/32
1/2-20	29/64				

### Metric Tap Drill Sizes

Tap Size (mm)	Drill Size	Dec. Equiv.	Nearest Fraction	Tap Size (mm)	Drill Size	Dec. Equiv.	Nearest Fraction
3 x .50	No. 39	.0995	3/32	8 x 1.25	17/64	.265	17/64
3 x .60		.0937	3/32	9 x 1.00	9/16	.3125	5/16
4 x .70	No. 30	.1285	1/2	9 x 1.25	9/16	.3125	5/16
4 x .75	1/8	.125	1/8	10 x 1.25	11/32	.3437	11/32
5 x .80	No. 19	.166	13/64	10 x 1.50	R	.339	11/32
5 x .90	No. 20	.161	5/32	11 x 1.50	3/8	.375	3/8
6 x 1.00	No. 9	.196	13/64	12 x 1.50	13/32	.406	13/32
7 x 1.00	15/64	.234	15/64	12 x 1.75	13/32	.406	13/32
8 x 1.00	J	.277	9/32	1/8-28BSP	21/64	.3281	21/64



# Build An Old-Time Icebox For Your Home Bar

This handsome oak icebox stores glassware and beverages in style with room to spare.

BY JOHN CAPOTOSTO

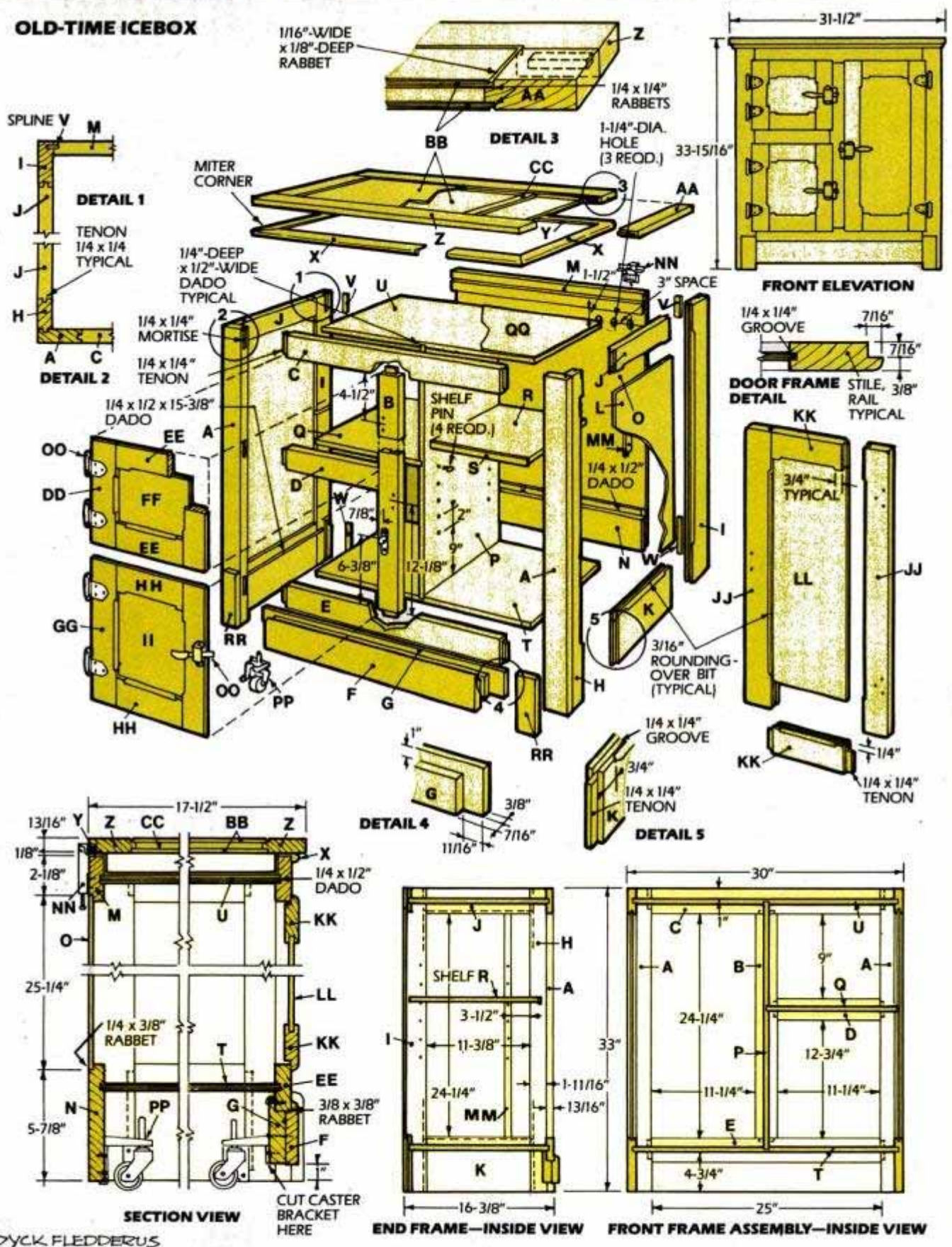


Lid of icebox opens to reveal plastic-lined mixing compartment. Adjustable, recessed shelf (lower left) allows flexible storage.

**O**ld-time iceboxes, which were once a necessity, are now expensive collector's items. We've incorporated many of the details used in turn-of-the-century ice chests in our handsome bar and storage cabinet. Like all 11 models that were shown in Sears' 1902 catalog, our icebox features frame-and-panel



# OLD-TIME ICEBOX



DYCK FLEDDERUS

construction, brass hardware and casters. Our slightly scaled-down version has a hinged lid that opens to reveal a mixing compartment lined with plastic laminate. The solid oak came dressed to 13/16 in. If you choose stock of different thickness or assemble it with  
*(Please turn to page 141)*

### HOW TO ORDER PLANS AND HARDWARE

For full-size plans of the icebox bar, send check or money order for \$10.50 to: Icebox Bar, No. PL-1284, Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101. To order hardware for old-time icebox, send check or money order in the following amounts to Armor Products, Box 260, Deer Park, N.Y. 11729: complete set of hinges and latches, \$44 postpaid; adjustable tension hinges for top, \$6/pair ppd.; set of four concealed casters, \$15 ppd.; golden oak paste filler, \$11.50 ppd./3-lb. can.





## TWO SETS OF FRENCH DOORS YOU CAN BUILD

French doors can add a touch of class to anyone's home, while at the same time effectively zone rooms for more comfortable heating.

BY NEAL BARRETT

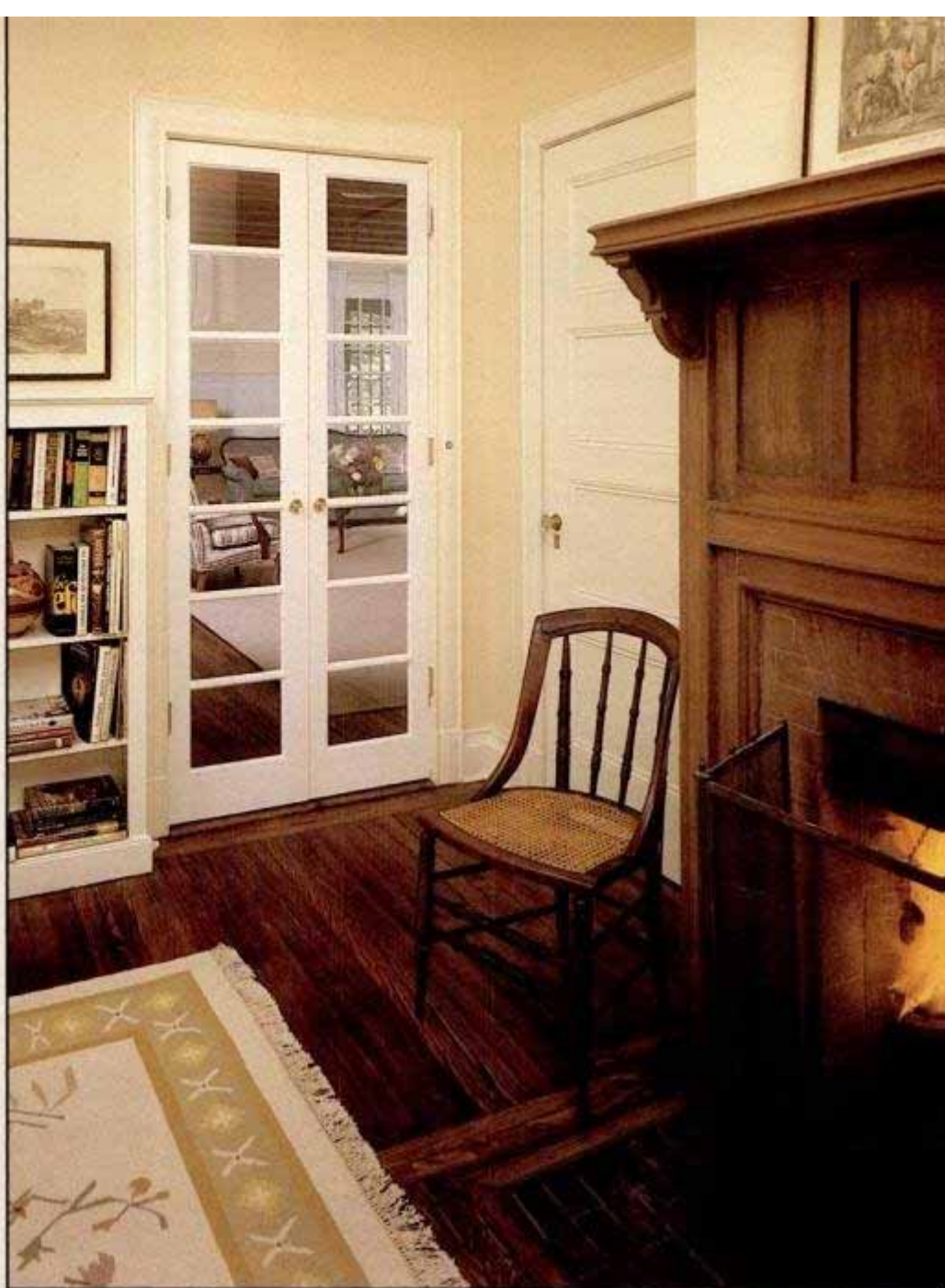
**W**ith the cold winter months upon us, can larger heating fuel bills be far behind? Of course not. And so we look for ways to economize. One straightforward way is to lower your thermostats, putting more heat in the rooms you use the most, and less in the other rooms.

The problem with room zoning for heating comfort is that often the best solution—a door—is visually unappealing. Or, it so reduces the penetration of natural light into interior house rooms that you begin to feel like you're living

in a cave. That's why we designed these French doors. They allow plenty of light to pass through, at the same time that they close off a room. And we think they will make a stunning visual addition to the interior design of anyone's home.

Because individual requirements will vary, we chose two door types that would cover most situations. If you prefer a high-style approach, the leaded glass doors are a good choice. For a more traditional feel, look to the wood muntin doors. However, both can be





These two sets of French doors can work in a variety of different openings. If you have a wide archway like the one on the facing page, the bifold option is the best bet. Because the doors are narrow and fold back on themselves, their swing into the room is significantly reduced. If, on the other hand, you have a standard archway like that shown above, a single pair of doors will work fine. For either, you can choose the leaded glass or wood muntin design.

made to work in a larger opening where a bifold action reduces the door swing into adjoining rooms. And both types can hang in a smaller opening where only two doors are required.

#### Door construction basics

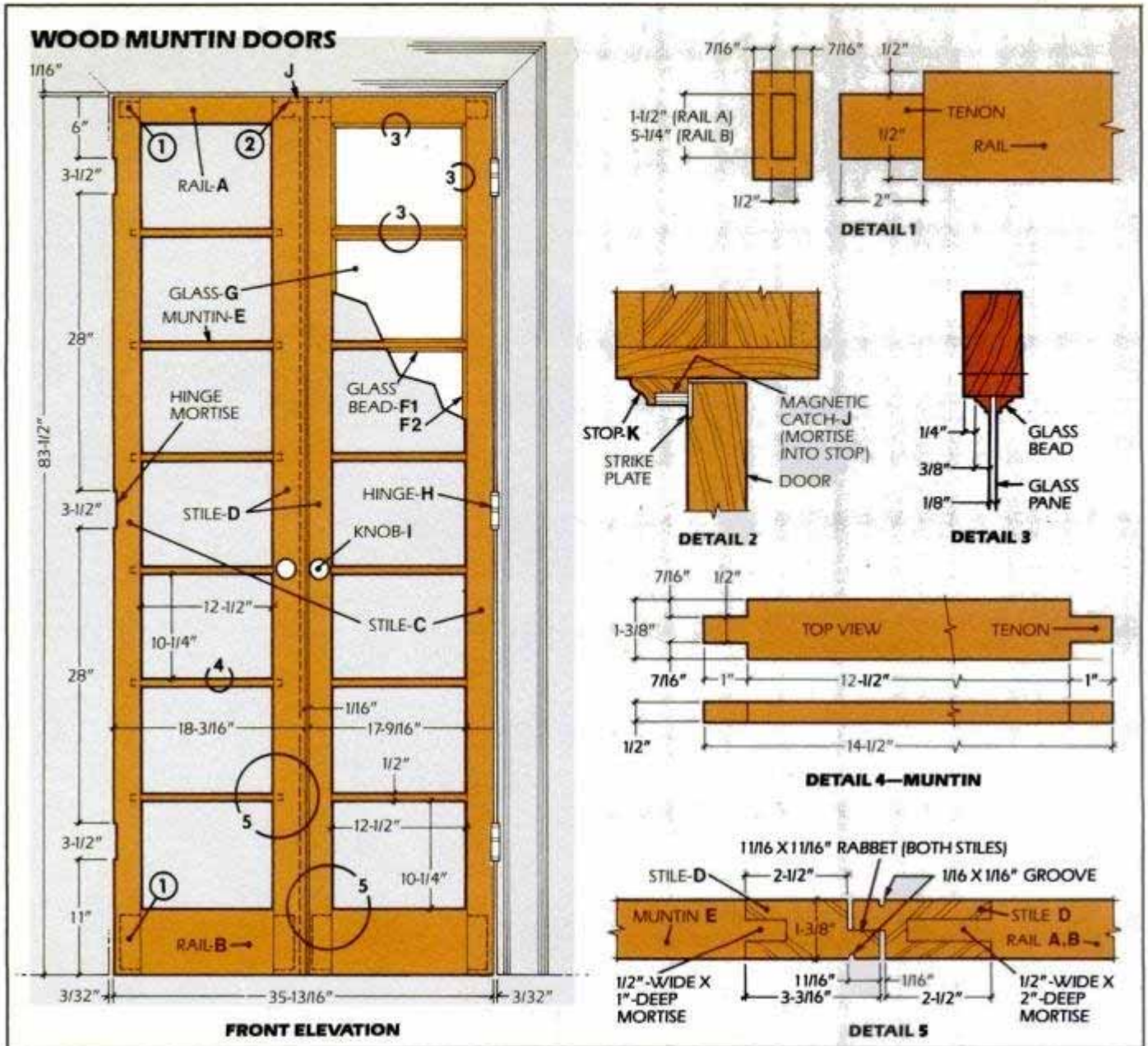
French door construction certainly is not beyond the scope of the home workshop. It is important, however, that critical aspects of the work be approached with care. As in all fine work, measurement and cutting to close tolerance are important. But in door

construction, this must be reemphasized, since the product of your labor is subjected to great stress in use and failed joints will not only be unsightly, they could render the doors inoperable. Also, your stock must be properly prepared before any joints are cut. Surfaces must be flat and edges straight. If you begin with stock that is twisted or

**Color photos:** George Ancona, leaded glass doors  
 Jim D'Addio, wood muntin doors  
**Room stylist:** Gabe Hemick  
**Black and white photos:** Neal Barrett  
**Technical art:** Eugene Thompson







warped, the errors will compound as the project advances. If you do not have a reliable jointer and thickness planer, be sure to specify at your lumber supplier that each piece of stock be delivered flat and jointed on one edge.

### Opening measurements

Before beginning, determine the proper door size for your opening. Generally, it's desirable to have a  $\frac{3}{32}$ -in. margin on the hinge side of each door,  $\frac{1}{16}$  in. between the top of the doors and the head jamb, and  $\frac{1}{16}$  to  $\frac{3}{32}$  in. between the doors when closed. The space underneath can vary from  $\frac{1}{4}$  to  $\frac{3}{4}$  in., depending on the type of floor covering.

Carefully measure the opening at several points, both for width and height, and check for plumb side jambs and a level head jamb and floor. If the measurements vary, be sure to use the largest dimension in calculating door size. You can plane, or cut, the doors to

fit later during the installation phase.

Our two-panel French doors were made to fit a  $36 \times 84$ -in. opening. We chose a traditional overlapping rabbet joint where the doors meet. Therefore, each door was made  $18\frac{3}{16}$  in. wide and  $83\frac{1}{2}$  in. high (see drawing). Our four panel doors fit a  $66\frac{1}{2} \times 80$ -in. opening. Since they all have square edges, each was made  $16\frac{1}{2}$  in. wide  $\times$   $79\frac{1}{2}$  in. high.

Because the basic joinery of rails and stiles is the same for both doors, our building instructions start with the wood muntin doors. The methods explained for these also apply to the leaded glass doors discussed later.

### Wood muntin doors

Begin by ripping  $\frac{5}{8}$  poplar or pine to rough width and crosscutting to rough length for all door parts. Joint each piece on one face and one edge, then surface to  $1\frac{3}{8}$  in. with a thickness planer. Rip and crosscut all pieces to

**MATERIALS LIST—**  
**WOOD MUNTIN DOORS**

Key	No.	Size and description (use)
A	2	$1\frac{3}{8} \times 2\frac{1}{2} \times 16\frac{1}{2}$ " poplar (upper rail)
B	2	$1\frac{3}{8} \times 6\frac{1}{4} \times 16\frac{1}{2}$ " poplar (lower rail)
C	2	$1\frac{3}{8} \times 2\frac{1}{2} \times 83\frac{1}{2}$ " poplar (hinge stile)
D	2	$1\frac{3}{8} \times 3\frac{3}{16} \times 83\frac{1}{2}$ " poplar (inner stile)
E	12	$\frac{1}{2} \times 1\frac{3}{8} \times 14\frac{1}{2}$ " poplar (muntin)
F1	56	$\frac{3}{8} \times \frac{3}{8} \times 12\frac{1}{2}$ " glass bead molding
F2	56	$\frac{3}{8} \times \frac{3}{8} \times 10\frac{1}{4}$ " glass bead molding
G	14	$\frac{1}{8} \times 10\frac{1}{8} \times 12\frac{3}{8}$ " glass pane
H	6	$3\frac{1}{2} \times 3\frac{1}{2}$ " Stanley No. RD 741 butt hinge
I	4	Surface-mounted door knobs
J	1	Magnetic catch with strike plates
K	18 ft.	$\frac{7}{16} \times 1\frac{3}{8}$ " pine doorstop

Misc.:  $\frac{5}{8}$ " brads, wood filler, 120- and 220-grit abrasive paper, primer and paint.

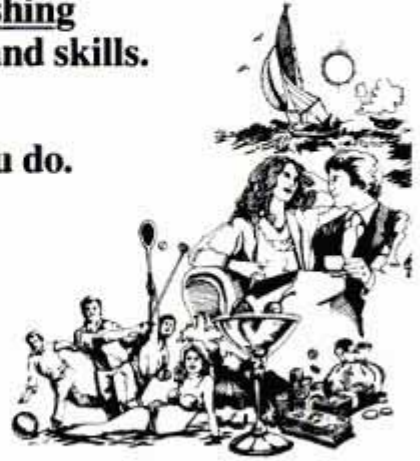
finished size. Following the dimensions given on the drawing, mark the location of the rail and muntin mortises on all stiles at the same time to ensure perfect alignment. Clamp a fence to the drill press table to help position the stiles, (Please turn to page 108)



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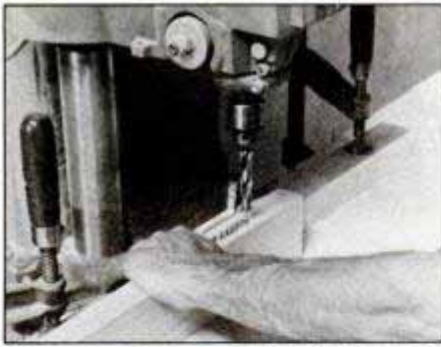
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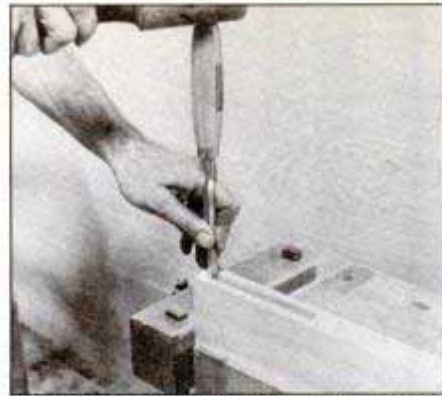
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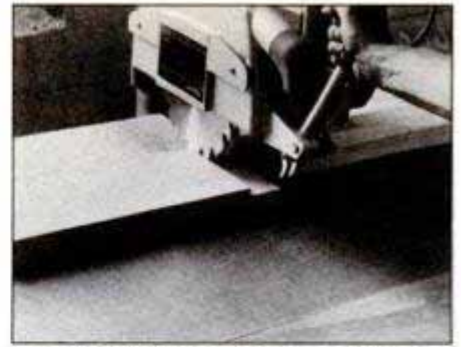




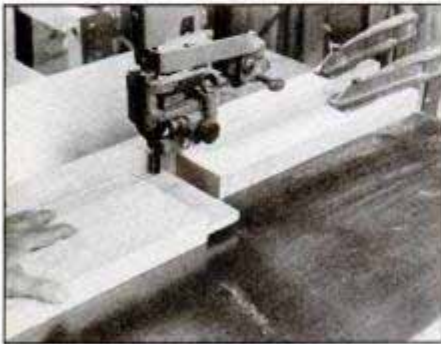
Clamp a temporary extension table and an alignment fence to the drill press table, then bore overlapping  $\frac{1}{2}$ -in.-dia. holes in door stiles to accept the rail and muntin tenons.



Use a sharp chisel to square corners and remove any ridges left by mortising.



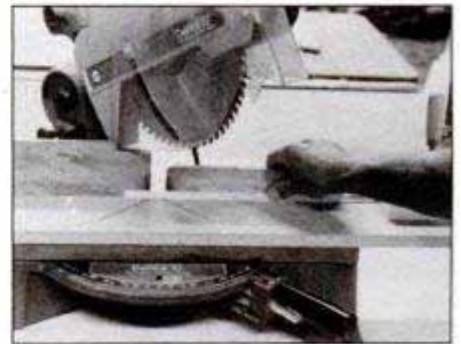
Use dado blades in radial-arm or table saw to cut rail and muntin tenons. Clamp stop block to table to ensure identical lengths. (Saw guard removed for photo.)



Cut  $\frac{1}{2}$ -in.-deep shoulders on top and bottom of rail tenons. Use either a band saw with stop block clamped in place, or hold rail in vise and cut by hand with backsaw.



Rout matching rabbets on opposite sides of door stiles using  $\frac{3}{4}$ -in.-dia. straight cutter.



Miter one end of each bead, then miter other end to proper length. If door assembly was accurate, all horizontal pieces should match perfectly, as should all vertical pieces.

## FRENCH DOORS

(Continued from page 106)

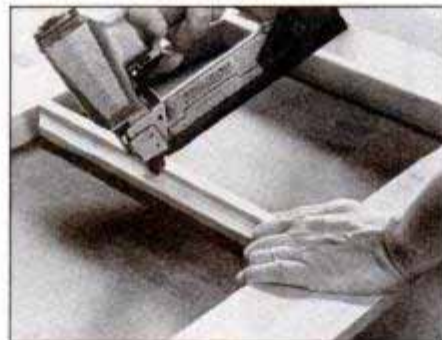
then carefully bore overlapping  $\frac{1}{2}$ -in. holes 2 in. deep to remove most of the waste from the top and bottom rail mortises. Bore  $\frac{1}{2}$ -in. holes 1 in. deep for each muntin mortise.

When all holes are bored, use a sharp chisel to square the hole corners and remove the rest of the waste. These surfaces must be very smooth because the strength of these critical joints is wholly dependent on a tight fit.

Use dado blades in either the radial-arm or table saw to cut the tenons on the door rails and muntins. Note that the rail tenons are 2 in. long and the muntin tenons are 1 in. long. Use a stop block clamped to table to make sure all like tenons are exactly the same length. Since the dado blades leave small ridges on the tenon cheeks, cut the tenons slightly oversized, then shave them to smooth finished thickness with a sharp chisel. Cut the  $\frac{1}{2}$ -in. shoulder at top and bottom edge of each rail tenon using a band saw or backsaw.

### Door assembly

Before assembly test each joint for proper fit. When satisfied, spread glue on the inside surfaces of each mortise and on each tenon cheek, then join the pieces. Because of the number of joints in each door, it's important to work



Attach bead molding to rails and muntins using  $\frac{3}{8}$ -in.-long brads. Air-driven brad nailer works great for this job, but pieces can be hand nailed, too. Set heads and fill holes.

quickly so the glue doesn't set before all parts are in place. Use a bar or pipe clamp at each joint to draw them tight. Check the doors for squareness by comparing opposite corner diagonal measurements. If the measurements are the same, the door is square; if they differ, readjust the clamps to bring the parts into square. When the glue has set for about 30 minutes, scrape off any squeeze-out with a sharp chisel, then leave the doors clamped for at least eight hours.

Next, clamp each door to the bench and rout the center stile rabbet on each using a  $\frac{3}{4}$ -in., two-flute straight cutter. Make the cut in two or three passes to avoid straining the router or splintering the stock. Then, turn over each door and



Door butt hinges must be mortised into stile edges. Router template above gives quick, professional results, but hand mortising with a sharp chisel will work as well.

rout the decorative  $\frac{1}{16} \times \frac{1}{16}$ -in. groove on the face of each stile using a  $\frac{1}{16}$ -in. straight bit.

### Glass installation

At this point, measure and cut the  $\frac{3}{8}$ -in. glass bead molding that secures each pane of glass. These wood strips should be cut carefully to meet in a tight mitered joint at each corner. Use a miter box to make the cuts. If your joinery and assembly have been accurate, all the horizontal and vertical pieces should be the same size, respectively. Cut the moldings for both sides of each door, eight pieces for each pane of glass. Set aside one batch, then begin attaching the remaining molding pieces to one

(Please turn to page 110)



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\*Use these figures for comparison. Your mileage may vary with speed, weather, trip length. Actual highway and California figures lower. '85 figures not available at printing.

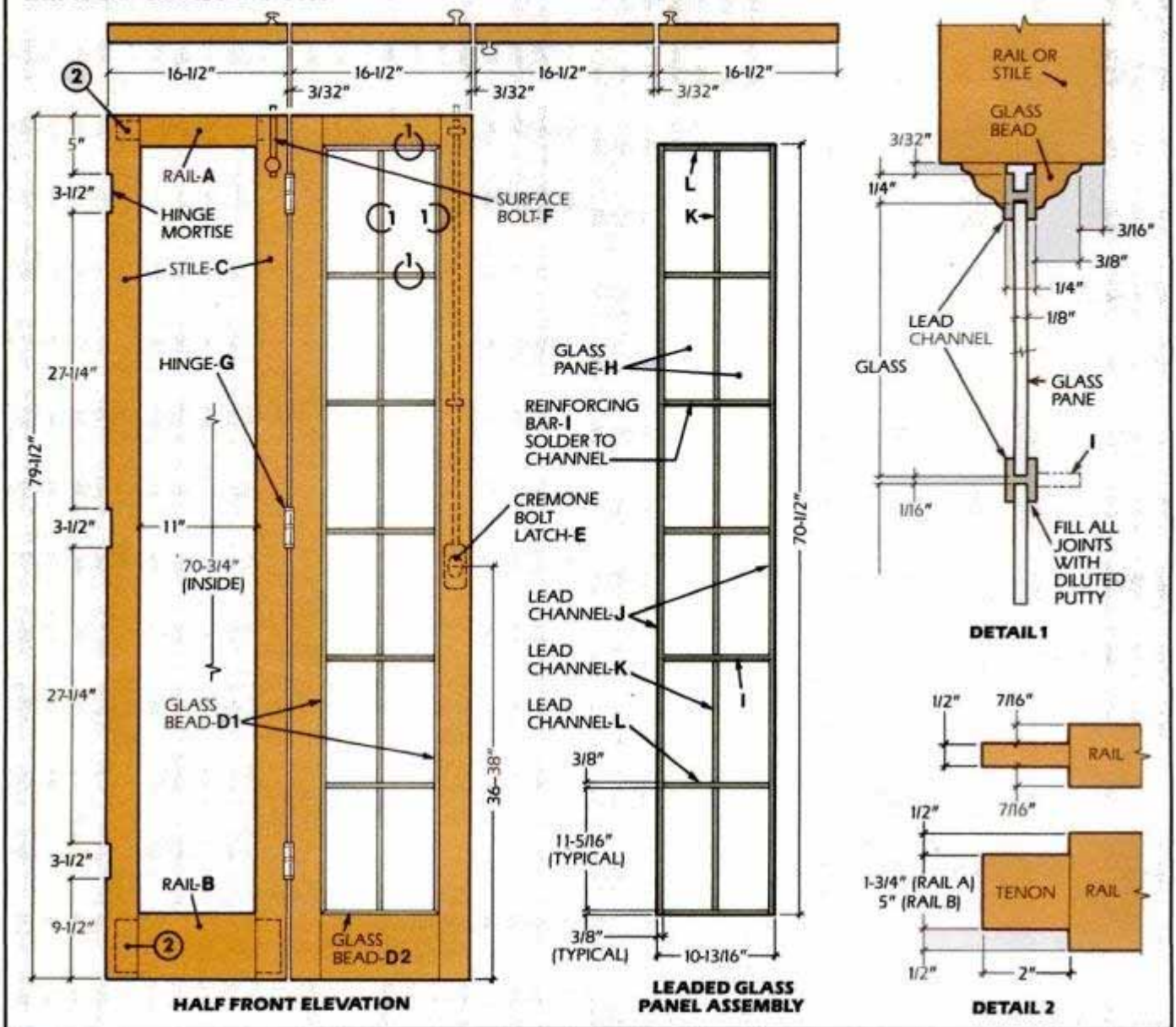
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## LEADED GLASS DOORS



## FRENCH DOORS

(Continued from page 108)

side of the rails and muntins. Because of the fragile nature of these strips we used an air driven brad shooter with  $5/16$ -in. brads to attach the beads. But these can be driven by hand as well. Use three or four brads per piece and position the strips so the glass pane falls precisely in the middle of the muntin. The mitered corners should be tight and the molding should lay flat and straight.

After the bead molding has been applied to one side of each door, but before the glass is installed, fit the doors to the opening and cut the hinge-mounting mortises. We used a Rockwell Hinge Butt Template No. 59380 to rout the mortises for the three  $3\frac{1}{2} \times 3\frac{1}{2}$  in. hinges in each door. This tool greatly reduces the time required for hinge mortising, and does a clean, professional job. However, careful hand mortising with a sharp chisel works well, too.

Once the doors are fitted to the opening, remove the hinges and sand the doors with 120- and 220-grit sandpaper. Then lay the doors on a flat, padded surface with the molded side down and set each pane of glass in its opening. Apply the second set of bead moldings over the glass, set the brad heads and fill with wood filler. Prime and paint the doors, making sure to cover all surfaces, including the top and bottom edge to prevent warping due to moisture penetration. Reattach the hinges and hang the doors. Mortise a magnetic catch into the head jamb stop, then add four pull handles of your choice and you're done.

### Leaded glass doors

Construction of the frames for these doors is basically the same as for the wood muntin doors, with the horizontal muntins omitted. Also, the door edges are square, not rabbeted, where they meet.

## MATERIALS LIST— LEADED GLASS DOORS

Key	No.	Size and description (use)
A	4	$1\frac{3}{8} \times 2\frac{3}{4} \times 15'$ poplar (upper rail)
B	4	$1\frac{3}{8} \times 6 \times 15'$ poplar (lower rail)
C	8	$1\frac{3}{8} \times 2\frac{3}{4} \times 79\frac{1}{2}'$ poplar (stile)
D1	16	$\frac{3}{8} \times \frac{3}{8} \times 70\frac{3}{4}$ glass bead molding
D2	16	$\frac{3}{8} \times \frac{3}{8} \times 11'$ glass bead molding
E	2	Surface-mounted cremone bolt
F	2	6" surface mounted door bolt, Stanley No. CD 379
G	12	$3\frac{1}{2} \times 3\frac{1}{2}$ " Stanley No. RD 741 butt hinge
H	48	$\frac{1}{8} \times 5\frac{1}{8} \times 11\frac{5}{8}$ " glass pane
I	8	$\frac{1}{8} \times \frac{3}{8} \times 10\frac{5}{16}$ " steel reinforcing bar
J	8	$\frac{3}{8} \times 70\frac{1}{2}$ " lead H-channel
K	24	$\frac{3}{8} \times 11\frac{5}{16}$ " lead H-channel
L	28	$\frac{3}{8} \times 10\frac{1}{16}$ " lead H-channel
Misc.		Oleic acid flux, 60-40 solder, gray glazing putty (DAP No. 1012), horseshoe nails, $\frac{5}{16}$ " brads, 120- and 220- grit abrasive paper, wood filler, primer, paint.

\* Part No. 45015, available from Renovator's Supply Inc., Millers Falls, Mass. 01349. Write for catalog and price.

After the frames are assembled and bead molding applied to one side of each door, measure the frame opening for the leaded glass panels. For ease of

(Please turn to page 112)



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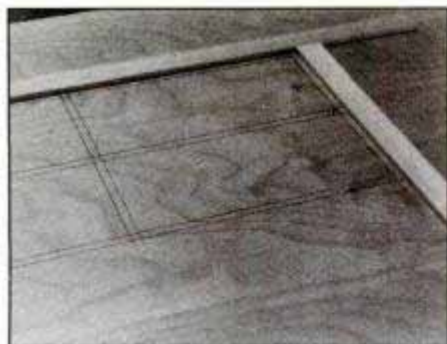
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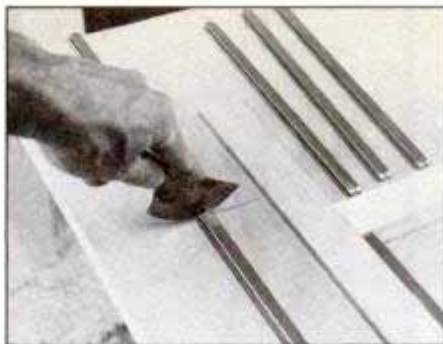
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Draw full-scale diagram of panel onto flat layout board. Then nail lath strips—perpendicular to each other—on two edges. Strips serve as alignment guides.



Stretch lead channel to straighten, then make all length cuts prior to assembly. Wiggle blade through channel to avoid crushing ends. Make sure all cuts are square.



Once all the lead and glass have been fitted, drive tapered, square-edged horseshoe nails into layout board to keep assembly aligned during soldering process.

## FRENCH DOORS

(Continued from page 110)

installation, the overall size of the finished panel should be  $\frac{3}{16}$  in. to  $\frac{1}{4}$  in. less than the frame opening in both height and width.

You will need the following items to fabricate the leaded glass panels:

- A layout board of  $\frac{3}{4}$ -in.-thick plywood at least 12 in. larger in both dimensions than your panel size. Nail a piece of lath along one long edge and another, perpendicular to the first, along one short edge. This lath will serve as an alignment guide during assembly.
- $\frac{3}{8}$ -in. lead channel. This is sold by the pound.
- Oleic acid flux with a small applicator brush.
- 60-40 solder.
- Lead knife for cutting the channel.
- $\frac{1}{8} \times \frac{3}{8}$ -in. steel reinforcing bar.
- Gray glazing putty (DAP No. 1012).
- Lead vise or locking pliers.
- Horseshoe nails for holding panel in place on the layout board.
- Heavy-duty soldering iron.

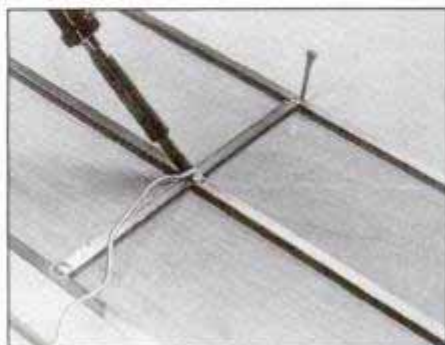
### Panel layout

Begin construction by making a full-sized drawing of your panel on the layout board. Align the top and one edge against the lath. Then, determine the size and number of glass panes based on this drawing. Be sure to allow  $\frac{1}{16}$  in. for the lead between the panes and  $\frac{1}{4}$  in. for the channel on the panel perimeter.

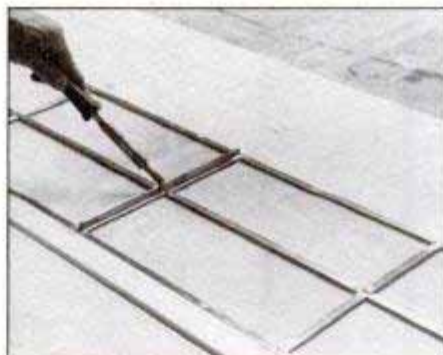
Before cutting the lead to size, it must be stretched straight and to proper tension. Hold the end of each piece in a lead vise or in locking pliers clamped to the end of the workbench. Grasp the free end with another pair of pliers and pull the channel until you feel it stretch and straighten. Using the lead knife, cut all the pieces required for each panel. (The proper arrangement of joints is shown in the drawing detail that is titled *Leaded Glass Panel Assembly* on page 110.) Make the cuts by gently wiggling the knife as it passes through



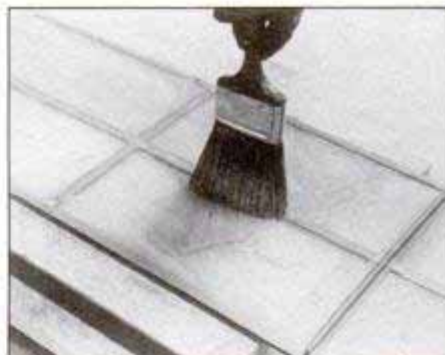
When finished, panel is ready for soldering; edges fit snugly between lath alignment strips and nails. Outboard panel corner should have one nail on each edge.



Hold iron just above joint and touch tip with solder. Solder will melt and fall over joint. Hot iron can be used to smooth joint but should not rest on lead channel.



Center reinforcing bar on its edge across horizontal channel joint, then rest hot iron on top edge of bar. Heat will melt solder on joint below and bind bar to lead.



Thin gray glazing compound with mineral spirits then work into lead channel with paint brush. Wipe off excess with burlap rags and let panel dry for 24 hours.

the lead. Do not crush the channel by pressing too hard, and make certain that you maintain a square cut.

### Panel assembly

Start assembly by placing the lead for one edge and top against the lath on the layout board. Butt the lead together and carefully slide a pane of glass into the top corner, seating it tightly in the channel. Fit the vertical lead piece on this pane and slide the other top pane into place. Fit the horizontal channel along the bottom of both, then proceed downward in this manner until you reach the bottom of the panel.

Check while working that your panel corresponds to the drawing on the layout board below. When all panes are in

place, slide the long channel on the far edge into place and hold it there by driving horseshoe nails into the layout board as shown in the photo.

Brush a small amount of flux onto each joint, then hold the hot soldering iron just above each. Touch the solder to the iron until a drop falls on the joint. You can use the iron to smooth the joint slightly, but do not let it rest on the channel for more than a second or two because it will melt the channel.

Practice this technique on some scrap material until you feel comfortable with the process. A good solder joint will barely protrude above the surface of the lead.

When all the joints on one side of the  
(Please turn to page 148)



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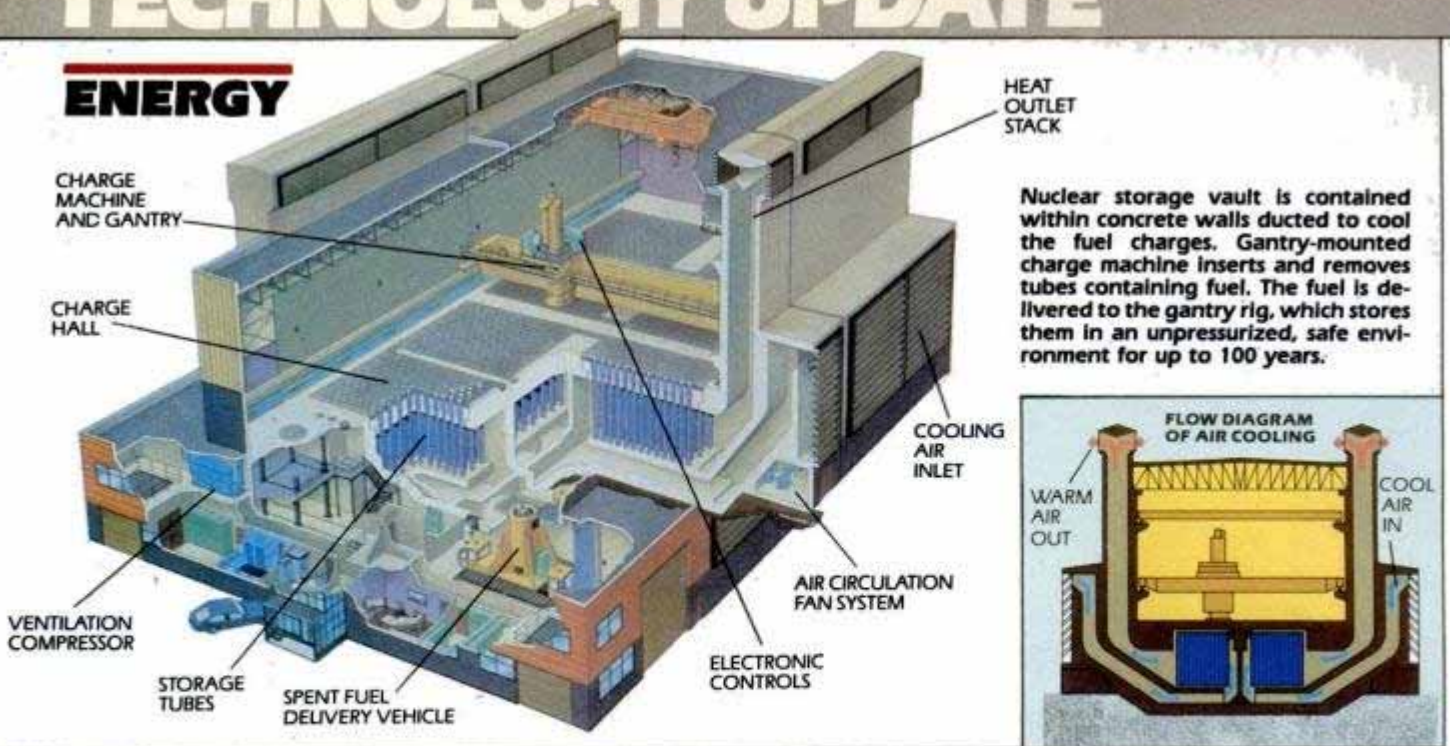


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## Vault holds nuclear treasures

America's nuclear power industry is quickly moving from go to on hold amid rising concerns about possible reactor accidents and environmental problems created by spent nuclear fuel. Now, British engineers have developed a Modular Dry Storage Vault (MDSV) that may eliminate many of the major anxieties of critics and pave the way for developing fuels for high-powered breeder reactors. The MDSV, a prototype of which has been built by GEC Energy Systems Ltd., provides for safe storage of uranium fuel from standard reactors. It also preserves the waste so it can be used in a superpowerful fast-breeder reactor.

Currently, American nuclear waste is stored in pools at the

reactor storage site. Even the loudest defenders of nuclear energy allow that wet storage poses environmental threats from evaporation of waste into the air and from leakage into ground water. The best solution on the horizon is vitrification, a process by which the spent uranium is melted into a mass of silica and clay, sealing it away from the environment. The trouble with this method is that the uranium is inaccessible to future reprocessors for fast-breeders.

The MDSV is a sheet-metal warehouse enclosed in a concrete vault lined with materials impervious to nuclear radiation. The spent fuel is placed in unpressurized tubes within a charge hall. Each tube is called a charge. The MDSV allows for 100 years of safe storage.

PHOTO BY CHARLES C. POWELL

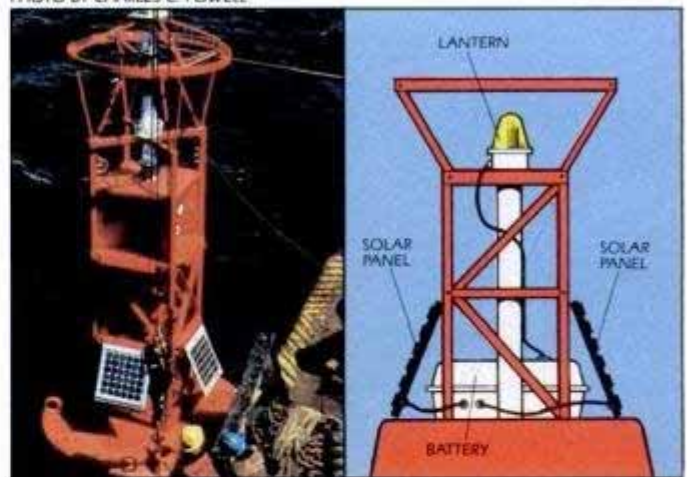
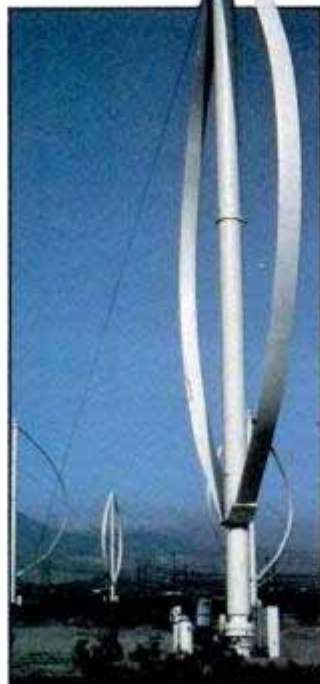
## ALTERNATIVES

### Electric eggbeaters

A new 80 ft. aluminum wind turbine is undergoing tests on a wind farm near Palm Springs, Calif. The Vawtpower-185 employs two huge rotating eggbeater blades that sweep a total area of 3,000 sq. ft.

Each of the 160 vertical axis units at the farm produces power for more than 20 households. The turbines' motor generators each produce 460-volt, three-phase electricity. The Vawtpower-185 will be marketed beginning early next year.

**New wind turbines each produce power for 20 households.**

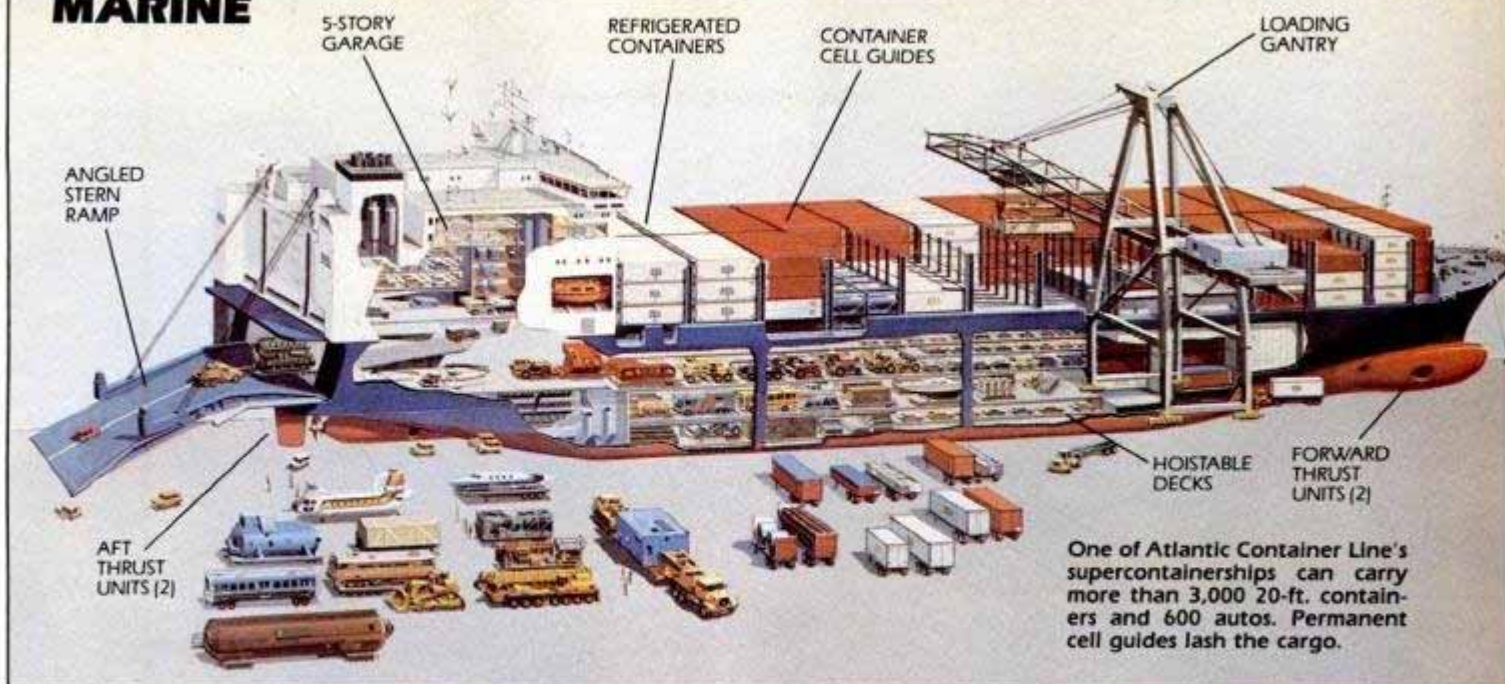


### Solar power for good buoys

The Coast Guard is placing 10,000 solar-powered buoys in waterways around the United States. Each buoy's fog light is powered by four collectors angled near its base. The power is collected in a storage battery. With the new buoys, the Coast Guard expects to cut boating accidents in darkness by almost 10 percent, since the solar models will never run out of electricity and black out.



## MARINE



One of Atlantic Container Line's supercontainerships can carry more than 3,000 20-ft. containers and 600 autos. Permanent cell guides lash the cargo.

## Giants of the sea

Atlantic Container Line is launching a five-vessel fleet of supercontainerships, the container equivalent of supertankers. The 820-ft., 37,000 deadweight-ton vessels can house the equivalent of 2,000, 20-ft. containers and 600 automobiles in the stern structure. Permanent cell guides on the weather decks can accommodate the equivalent of almost 1,500, 20-ft. containers that fit snugly within the guides. Thus, lashing of

cargo will become an extra precaution procedure rather than the only way to hold down cargo.

An angled stern ramp will allow crews to load and unload containers and cars at the same time. In transit, the cars are stored in a five-story garage, where they will be protected from the salty air. Forward and aft thrust units will allow for easy steering to dock.

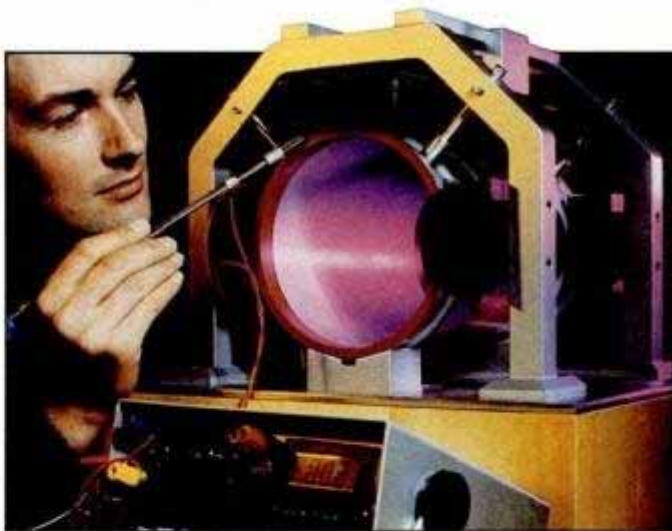
The supercontainerships will make all current container vessels obsolete by the 1990s.

## INVENTIONS

### Computerized device has a sense of smell

Below decks, any good-sized ship collects potentially poisonous or volatile chemicals in the ambient air. Argonne National Laboratory researcher Joseph Stetter and his team have developed a computer that can sniff out chemicals, alerting the crew to any impending danger. The 15-pound Argonne sniffer is a tube connected to a microprocessor. As air passes into the processor's test chambers, sensors analyze its chemical and combustion characteristics. With the new system, thousands of lives will be saved by preventing explosions at sea.

Crewman waves Argonne sensor tube below decks (top). The air is evaluated in computer chambers (bottom).



### New rotor is very attractive

The Mag-Lev concept propels a train suspended above a magnetized track so it's pulled along on a cushion of air, eliminating friction and producing high speeds and efficiency. British researchers are now applying the concept to a new high-tech rotor for generators and other machines. The rotor cylinder rides inside a magnetized housing. By computer-switching the charge of the magnets around the cylinder, it turns at breakneck speeds with almost no friction. When the rotors are available in five years, they'll improve by 40 percent the efficiency of all machines that use them.



## MILITARY



**1** SHIP TRACKS ENEMY SUB ON SONAR, LAUNCHES AIRBORNE TORPEDO OVER IT

ROCKET-POWERED DRONE CARRIES TORPEDO INSIDE IT

**2** TORPEDO IS RELEASED OVER TARGET AND DEPLOYS PARACHUTE

**3** ONCE IN WATER, TORPEDO JETTISONS CHUTE AND HOMES IN ON ENEMY SUB

SONAR

## Flying torpedoes fool subs

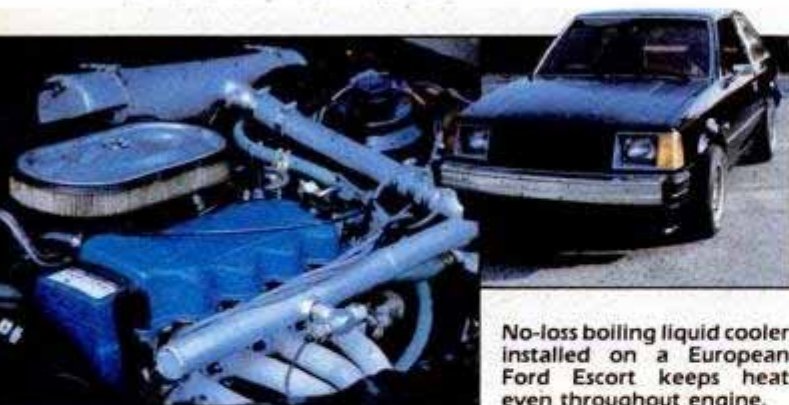
Trying to hit an enemy submarine with a conventional underwater torpedo is tricky because the sub often has time to detect the oncoming torpedo with its sonar and get out of the way before it strikes. Alerted to the threat, the sub can then turn its own torpedoes on the attacker.

With a new airborne torpedo delivery system now available, the enemy sub has no knowledge of the torpedo's presence until it's too late to avoid it. The attacking ship launches the torpedo inside a rocket-powered drone that carries it out over

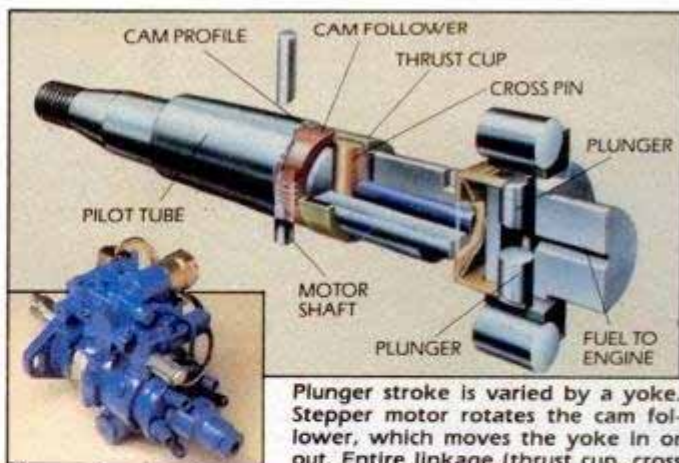
the target, then releases it on a preprogrammed signal. The torpedo floats down attached to a parachute until it enters the water. Then, it jettisons the chute and homes in on the sub so fast that the enemy has no chance to get away.

Another advantage of the airborne delivery is that it allows a ship to stand off at a distance and attack a hostile sub far beyond the effective range of the sub's torpedoes, thus making it impossible for the enemy to strike first. Called the Ikara, the system is made in Australia and distributed by British Aerospace. It's designed to handle a wide variety of torpedo types, including the U.S. MK46.

## AUTOMOTIVE



No-loss boiling liquid cooler installed on a European Ford Escort keeps heat even throughout engine.



Plunger stroke is varied by a yoke. Stepper motor rotates the cam follower, which moves the yoke in or out. Entire linkage (thrust cup, cross pin, pushrod, yoke and spring) rotates with the plungers.

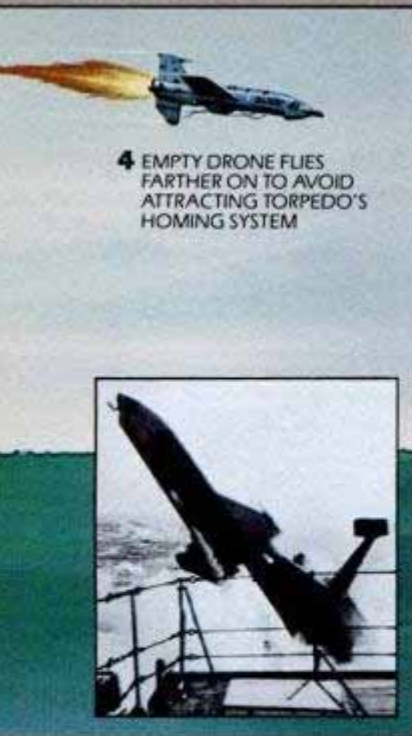
## Technology for cooler heads

Conventional pressurized circulating liquid automotive cooling systems cause front cylinders to run cooler than rear ones. Bubbling of the coolant sets up localized hot spots that induce knock and cause emission levels to rise. Now, National Technologies has patented a no-loss boiling liquid system that shunts boiling coolant to a condenser, where it returns to the liquid state and flows back into the water jacket. The Evans Process cooling system thus transfers heat quickly, keeping the temperature uniform throughout the engine.

## Diesels go electronic

Electronic control of fuel delivery has so far been utilized on gasoline auto engines only. But Stanadyne's new electronically controlled fuel delivery unit is built for diesels. Sensors read engine rpm, piston position and other operational factors to tell the computer when to activate a pump stepper motor, which injects fuel into the cylinder. The system allows more precise fuel metering than conventional pumps. GM will introduce the system in 1986.





4 EMPTY DRONE FLIES FARTHER ON TO AVOID ATTRACTING TORPEDO'S HOMING SYSTEM



Rocket drone (inset) is launched to begin parachute homing sequence that leaves submarine helpless on attack.

Editor: Dennis Eskow  
Contributors: Sheldon M. Gallager, Jack Hammond, Wade Hoyt, Paul Stenquist, Ida Beck, Paul A. Powers



## AVIATION

Artist's conception of new dual-role F-15E fighter/bomber shows how close-fitting bomb racks hug fuselage to reduce drag. Conformal fuel tanks blend smoothly into air intakes and are barely visible.

### New fangs for the F-15

One way to save money on expensive jet fighter planes is to keep improving what you already have. The famed USAF/McDonnell Douglas F-15 Eagle, originally designed as a defensive air-to-air interceptor, will soon be modified to serve as a potent ground-attack fighter/bomber.

To minimize the speed penalty of added armament, the new dual-role F-15E will be fitted with so-called conformal bomb racks and auxiliary long-range fuel tanks that hug the fuselage to reduce drag. Sophisticated low-altitude, terrain-following avionics will guide the refitted plane to its

target automatically during treetop-level bombing and strafing runs.

The modifications are expected to cost about \$4 million per plane—a fraction of the \$20 million to \$30 million that a completely new ground-attack fighter/bomber would cost.

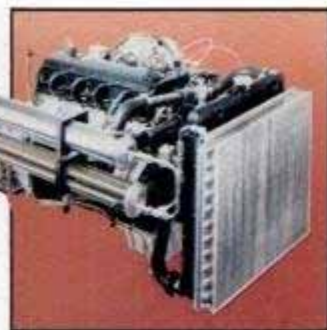
### All-composite helicopter

The sleek, tandem-rotor troop transport shown in the artist's conception at right will be the first helicopter made almost entirely of weight-saving plastic composites, including even its driveshafts and rotors. Most of these parts are bonded with high-strength adhesives. As a result, the new helicopter will be 25 percent lighter than a comparable metal airframe. Its slippery streamlining and retractable landing gear—another helicopter first—will also reduce drag by almost 50 percent, permitting speeds up to 250 mph.

Under construction by Boeing Vertol, the new Model 360 is said to be so tough that its fuselage will withstand the impact of a 23-mm high-explosive shell.



Artist's conception of a new all-composite tandem-rotor helicopter now under construction. Most fuselage parts are bonded with high-strength adhesives, eliminating even metal fasteners.



### Starting hot

Daimler-Benz is experimenting with a hydride preheater that will eliminate automotive cold starts. The rig uses a powdered metal that mixes on electronic command with a hydride fluid creating an exothermic chemical reaction and heat. As gasoline flows through the unit, the gas is warmed before it is sprayed into the carburetor. When marketed in the 1990s, the system is expected to up fuel mileage by 10 percent.



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**AMERICAN CARS—THE FIRST CENTURY**

(Continued from page 79)

finements that occurred in the '20s included such things as automatic chokes, easy-shifting synchromesh transmissions, automatic chassis lubrication, power-operated windshield wipers, vacuum-assisted clutches and even the first crude experiments with power steering.

**Ride improvements**

Engineers remember the 1930s mainly for tremendous improvements in the *ride* quality of American cars. Two major breakthroughs brought it about: Engines were moved forward between the front wheels. This not only gave more passenger space, but the engine mass far forward smoothed out the pitch frequency. The car floated instead of bouncing. Another trick was independent front suspension on coil springs. Remember GM's "Knee Action"? Getting rid of the heavy beam front axle not only reduced the oscillating mass of the front wheels for better ride, but eliminated shimmy and feedback in the steering. Cars had an entirely different feel overnight.

These changes also brought a revolution in body styling. Shortening the hood and moving the passengers forward allowed modern "fastback" lines, with grilled radiators and skirted fenders. Chrysler had a disastrous experience with aerodynamics in 1934—its Airflow model just didn't sell—but cars like the 1936 Lincoln Zephyr set styling patterns for years to come.

The modern-car image got another

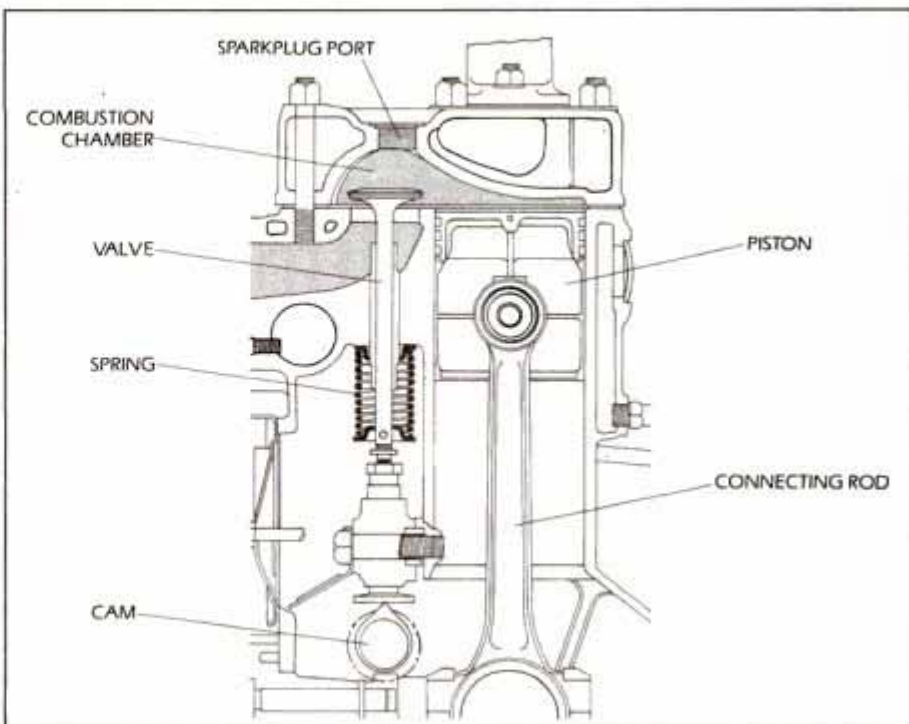
boost in 1939, when Oldsmobile introduced the first fully automatic transmission—a fluid coupling tied to a self-shifting, four-speed planetary gearbox. All you had to do was put the shift lever in *DRIVE*, step on the gas and go. The American family car was never the same after that. After WWII, automatic transmission development mushroomed in all directions—torque converters, two-speed gearboxes, geared turbines. By the mid-1950s, automatics were ordered on the majority of all family cars.

**Horsepower race**

The '50s also will be remembered for the horsepower race. After Olds and Cadillac introduced the modern short-stroke overhead-valve V8 engine in the late '40s, the whole industry seemed to go crazy for performance, power and luxury. Family cars were considered social prestige symbols in those days, so you needed a muscular engine to heft around all that chrome and sheet metal. Within 10 years, the typical car weighed over 2 tons and packed 300 hp in a big-inch V8 that gave only 10 or 12 mpg. The package also included an automatic transmission, power steering and power brakes. Not bad cars—but big and gaudy.

Auto enthusiasts like to remember the 1960s for 400-hp factory "muscle cars" and unrestrained industry wooing of a lucrative new youth/performance market. And there were some wild

(Please turn to page 120)



Low-compression, inefficient "side-value" designs dominated engines of the '20s and '30s.



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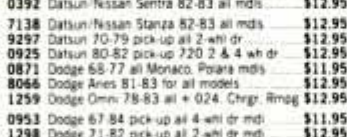
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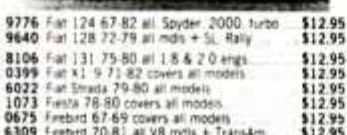
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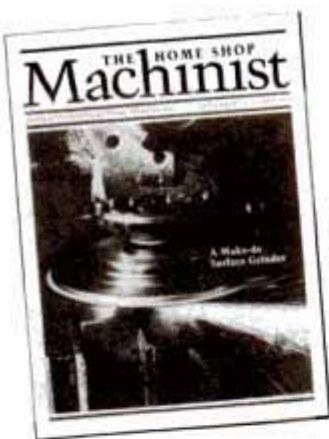


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## AMERICAN CARS—THE FIRST CENTURY

(Continued from page 118)

developments here. But it was also the decade when family automobiles were upgraded with such luxuries as air conditioning, power seats, power windows, individual bucket seats, automatic headlight dimmers and fold-down seats in station wagons.

Ride smoothness and silence were helped by the general adoption of coil spring suspension on all wheels, ultra-low tire pressures and isolating the body on a flexible perimeter frame that actually acted as a crude spring to soak up road harshness.

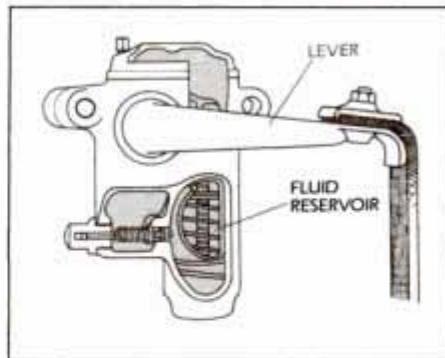
### Federal regulations

The whole scenario changed in the 1970s. Suddenly, it was the federal government telling the companies how to design cars—in the form of tight laws to control exhaust emissions, and new safety standards to improve highway crash survival. New regulations came almost faster than the engineers could keep track of them.

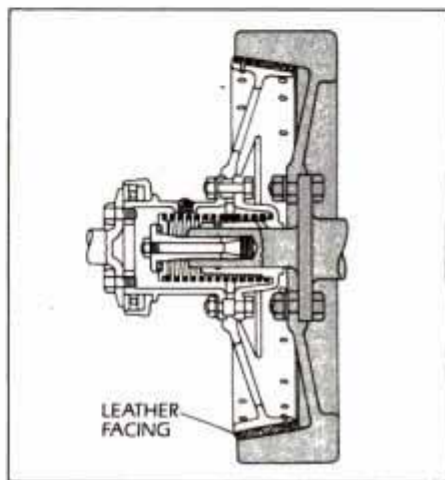
When this trend was combined with the unexpected Arab oil embargo in 1973, the whole direction of auto design changed overnight. Long-range planning was impossible. Gasoline prices were doubling every few months. At the same time, federal emission standards often required engine modifications that hurt fuel mileage, while the new safety standards added economy-killing weight. For several years in the mid-'70s, U.S. automotive design was in a state of chaos.

However, Detroit has integrated traditional American luxury and gadgetry into smaller, lighter cars that can meet government and market requirements for fuel economy.

Take the recent trend to front-wheel drive with transverse engine placement. This gives maximum passenger and trunk space with minimum external



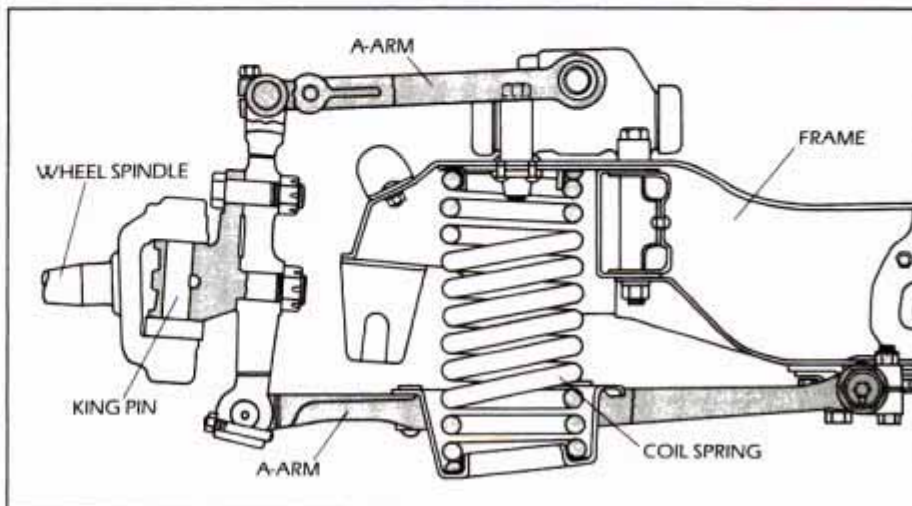
Hydraulic shocks of the '20s worked only on rebound, via a strap connected to the axle.



Early clutches had a conical cross section and leather facing. They had neck-snapping engagement and needed brutal pedal effort.

size and weight. The strong trend to electronics is a natural result of exhaust emission regulations that have required sophisticated computerized feedback control of fuel metering. Federal emission and mpg standards have forced us to electronics—and tomorrow's car will make the best of it. We haven't seen anything yet!

PM



GM's independent front suspension improved handling and eliminated steering shimmy.



## CENTENNIAL ON WHEELS

(Continued from page 77)

vital participation by the motor makers of Germany is implicit. At that time, Daimler was more interested in royalties and licensing fees for his engines than he was in actually building cars.

The French companies made each new car a little bit different from its predecessor for years. The first true production model was the Benz Velo of 1894. Benz built 134 cars to the exact same specification during 1895.

In the meantime, the French had invented motor racing: The Parisian daily newspaper *Le Petit Journal* sponsored a run from Paris to Rouen in 1894. The following year, a group of wealthy enthusiasts founded the *Automobile Club de France*, the first of its kind.

Daimler and Benz did not work in a vacuum; they were aware of many experiments going on at the time:

- Alphonse Beau de Rochas was a self-taught civil engineer working in a laboratory in Paris. In 1861, he was the first to spell out the sequence of the four-stroke cycle and provide a theoretical pressure diagram—but he never built an engine. He received French patent No. 52,593, dated Jan. 16, 1862.
- Nikolaus August Otto was a merchant who dropped out of business to

experiment with gas engines at the age of 22. He had an atmospheric gas engine running in Cologne in 1862 and began production, selling about 50 units a year. Realizing the value of compression, he also invented charge-stratification. His first experimental four-stroke engine ran in 1876, and his patent (No. 532) is dated Aug. 4, 1877. His small shop grew into Gasmotorenfabrik Deutz, where Gottlieb Daimler later worked as chief engineer.

■ Siegfried Marcus was a prolific inventor living in Vienna. He had a four-stroke engine running in 1870, using some sort of petroleum fuel and a 2-foot-high carburetor. Between 1870 and 1875, he is reported to have installed such an engine in a small wagon converted into a cart by removing the rear axle. The flywheel was its rear wheel. A four-wheeled Marcus vehicle is thought to date from 1875. The Marcus vehicle in the Vienna Technical Museum is dated 1888, but conforms to descriptions of the 1875 vehicle.

■ George Brayton of Boston, Mass., developed an engine with precompression, running on light petroleum fuel, in 1874 and it is considered the first safe and practical oil engine made. But for compression of the charge, it needed two outside pumping cylinders.

■ George B. Selden, a shrewd patent

attorney from Rochester, N.Y., filed a patent for a "road engine" in 1879. Under the liberal patent laws of the time, he was allowed to back date his patent to 1877 and to amend and expand it frequently. When it was finally issued in 1895 it covered a front-drive, three-cylinder carriage with a transverse engine. Although he had never built a car, Selden used his patents to extract royalties from early American manufacturers on every auto they built.

When Henry Ford refused to pay royalties, a famous court suit followed. During the long trial, the owners of Selden's patent were finally forced to build a vehicle in 1904. Essential details in Selden's patents had been left deliberately vague, and the car built in 1904 had much benefit from then-current technology. Despite all these loopholes, the "1877" Selden barely ran. The patent was finally shot down in 1911.

Those are uncontested facts. The trouble is that now the French want the world to believe it was Edouard Delamare-Deboutteville who invented the automobile, in 1884.

Deboutteville was 22 years old when he went to work in his brother's textile plant just outside Rouen. A year later, in 1879, he invented a universal machine capable of cutting, milling, drilling and

(Please turn to page 122)

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## CENTENNIAL ON WHEELS

*(Continued from page 121)*

turning. He became interested in the internal combustion engine primarily as a source of power to run the machinery in factories, and secondarily for propelling road vehicles. He was aware of the patents of Beau de Rochas and Lenoir, and also knew of Otto's patent.

His first engine was a single-cylinder four-stroke unit, built early in 1883. It ran on stove gas, but Deboutteville had also created a carburetor for running on liquid (petroleum) fuels. The outstanding things about his engine were:

- Coil-and-battery ignition, with a sparkplug.
- Mechanically operated overhead intake and exhaust valves.
- High compression ratio.

This engine was put in a three-wheeled vehicle that was destroyed in an accident. Undaunted, Deboutteville built a four-wheeled car with a two-cylinder engine. This design figures in the 1884 patent. The vehicle was a modified horse-drawn wagon, but the new engine was noteworthy for its:

- Pistons with rings.
- Provision for air- or water-heating of the carburetor.
- Air- or water-cooling of the cylinders.
- Speed control on the intake manifold.

- Exhaust muffler.
- Progressive clutch.

It is certain that the car was built, but the evidence that it ever ran is weak. You'll look in vain for any mention of a test drive in local newspapers. Deboutteville's patent went unnoticed. It was never exploited at all.

A great pity, for Deboutteville's proposed car was extremely well thought out. He had solutions to all the basic problems, but he had to give up his experiments to concentrate on making a living. Instead of developing the car, he removed its engine and put it to use in the factory. He became a manufacturer of industrial engines, but had nothing more to do with automobiles.

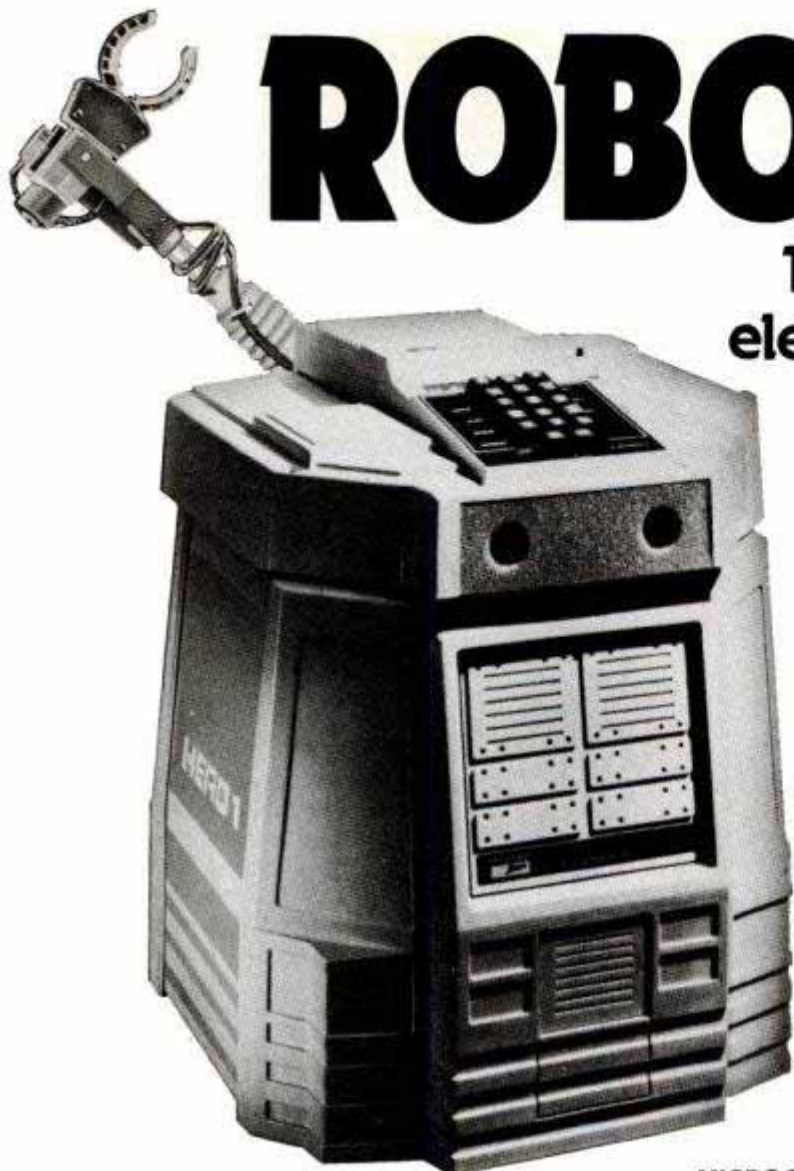
Both Daimler and Benz could have gained by reading the 1884 patent, for their first vehicles were very primitive in several regards. Daimler's engine from 1885 was a vertical single-cylinder of 462-cc displacement, delivering 1.1 hp at 650 rpm. It had a suction-operated intake valve and hot-tube ignition. It had an evaporative "surface" carburetor, and the speed control was a butterfly valve mounted on the exhaust pipe. He did not design a car for it, but installed it in a horse carriage with a centrally pivoted front axle. And it did not run in 1886. The first test drive took place on Mar. 4, 1887.

Karl Benz spent many years developing the two-stroke engine before turning his attention to the four-stroke cycle in 1885. He put a slide valve on the intake port and fired its sparkplug from a high-tension coil. The mixture was produced in a surface carburetor, and he put a speed governor on the intake side. The single-cylinder Benz engine had 954-cc displacement and delivered 0.67 hp at 250 rpm.

The "car" Benz designed around the engine was a light three-wheeler with belt drive, which first ran on the streets of Mannheim in June 1886. Benz did not build a four-wheeled car until 1891. It was only after seeing the success of Peugeot and Panhard & Levassor that Daimler and his assistant, Wilhelm Maybach, began to think in terms of complete cars rather than just engines.

Was the automobile invented in France or Germany? The argument may never be resolved to the satisfaction of both sides. One thing to bear in mind is that the car is not one invention but a mechanical creation composed of hundreds, if not thousands, of inventions. In truth, we are still inventing the car, for the car is an ever-changing assembly of ideas, systems and parts. In the past 100 years, the French contribution to its advance has been as significant as that of the Germans. **PM**





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(Continued from page 89)

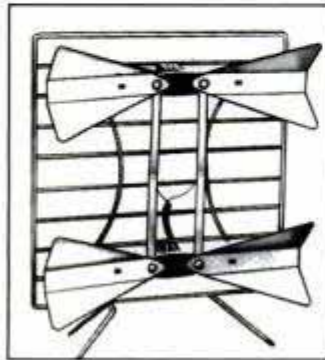
vice takes a weak signal and boosts it electronically. The amplifier may be installed either at the front end of the antenna lead or at the end of the cable where it connects to the TV set.

### Satellite reception

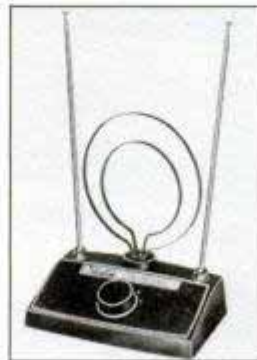
There's an interesting phenomenon going on in this country—satellite television. Nearly a million satellite dishes

are now in place in back yards all around the United States. By aiming an antenna at a geostationary Earth satellite, you can receive a great deal of programming not otherwise available from your local TV broadcaster. Besides the various pay TV channels, many of the major television services transmit signals to those satellites from a central site for retransmission to other areas of the country.

The optimum antenna for this type of reception is the 3-meter (about 10 feet)



Indoor TV antennas come in a variety of shapes and types. Although most combine VHF and UHF functions, UHF-only antennas (such as the curtain model, left) also are available. The most effective rabbit ears antennas (model at right) let you fine-tune to get the best VHF signal. UHF reception also is enhanced by directional models that let you rotate the center loops to receive the strongest signal possible.



## How To Talk Antenna

**Amplifier**—A solid-state device attached to the antenna which takes weak signals and boosts their strength so they are usable by a receiver.

**Anodizing**—Also called gold-anodizing. Little more than coating an antenna with a corrosion-resistant substance so an antenna will last long.

**Coaxial cable**—The wire leading from the antenna to your set. Enclosed in plastic, it has a center of copper wire, an insulation layer and an outer layer of copper braid for ground. It is weatherproof and efficient. Impedance rating usually is 75 ohms.

**Gain**—The ability of an antenna system to increase the strength of an incoming signal. It is measured in decibels. Every 3 dB increase in gain translates to a doubling of received signal strength. The higher the gain of an antenna, the better. Gain figures, by the way, are sometimes inflated in manufacturer's specifications. Look to see that gain figures all are compared to the same standard, usually a vertical antenna. Failing that, see what mileage from the transmitter is estimated.

**Impedance**—Measured in ohms, this is a measure of system efficiency. All system impedances must be matched to work correctly. A 300-ohm twin-wire antenna lead won't work well with a receiver that requires a 75-ohm antenna output.

**Matching**—Also called impedance matching, this ensures that all parts of the system are balanced and work

with the same efficiency. A match box or matching transformer converts one level of impedance to another via circuitry. For instance, when mating a 300-ohm outdoor lead to a 75-ohm indoor cable.

**Multipath**—Mother nature can split radio signals into two or more parts, which can arrive at your antenna at different times. Each signal takes a different route to your antenna. The weaker, reflected multipath signals can result in TV ghosts or fuzzy FM stereo sound. At worst, one signal can cancel out another and blank out the station entirely.

**Reflection**—Radio signals which bounce off objects such as buildings or mountains are said to be reflected. Reflection can either weaken or strengthen a station's signal or can cause signal strength to vary.

**UHF**—Ultra-high frequency TV signals. They don't travel very far—about 15 miles at sea level. You receive them on channels 14-83 on your set. Improve UHF reception by using a steerable, high-gain antenna, mounted as high as possible.

**VHF**—Very-high frequency TV signals. They travel farther than UHF—about 30 to 50 miles at sea level. You receive them on your set via channels 2-13.

**VSWR**—This is the Voltage Standing Wave Ratio, another measure of system efficiency. The lower the VSWR the better. Most antennas should be below 1.5 to 1.

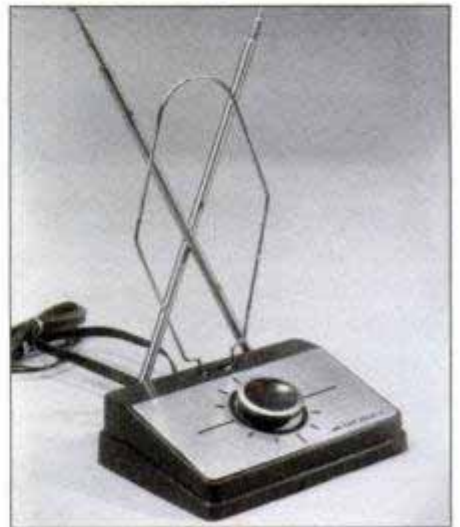


The satellite dish picks up many channels.

dish. It looks much like the traditional radar antenna, and is, in fact, much like it. At the center of the dish, located at the prime focal point, is what is known as an LNA or low-noise amplifier. This picks up the minuscule amount of satellite signal actually reaching Earth, and boosts it before sending it on to the satellite TV receiver and TV set located indoors. A satellite receiver looks much like a regular stereo receiver. It lets you tune in on a satellite transmission, then relays the audio and video information to your TV.

The reason the LNA is called "low noise" is because it relays the signal with little distortion, so that the receiver and television set get all the signal possible. A satellite antenna also requires a very specialized, low-loss type of connector cable and precise placement to perform well. Although install-it-yourself kits are available, many people hire a professional surveyor to site the dish properly in relation to the satellite positions.

(Please turn to page 128)



Indoor FM antenna looks like the TV type.



# Eastwood's Home Autobody Repair Shop



## Body Solder: The Permanent Panel Repair

Body solder makes a permanent professional-quality repair that won't crack, lift, or shrink. Easy to apply with a household propane torch and can be shaped to any contour. Great on patch panels, seams, and edge work. Accepts paint just like sheetmetal. Far more durable than synthetic fillers. The craftsman's method still used today by the best body shops, restorers — even by auto manufacturers. The complete kit includes four ½ lb. sticks body solder, 2 paddles, 1 lb. tallow, ½ lb. tinning butter, 14" body file with holder, and FREE instruction book "Auto Body Solder" containing 50 pages, with over 50 illustrations (the most complete source of body solder techniques available!).

- #6730 Home Craftsman Body Solder Kit ..... \$58.00  
 #6400 Extra Sticks 30-70 Body Solder ½ lb. .... \$ 3.50 ea.



Featured in Oct. '83 Hot Rod

## The Sure Way to Kill Rust. Eastwood's Sandblaster.

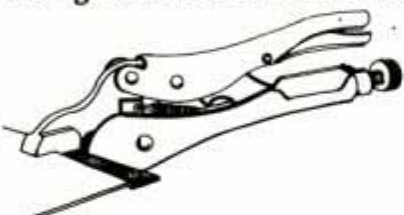
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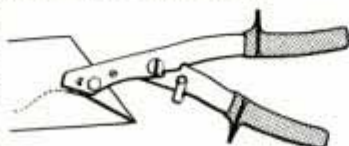


Just adjust tool to metal thickness, flange repair area and lay in patch panel. Your weld will be flush with body metal, which minimizes grinding and uses less filler. Works in tight areas to make sharp curves. Requires little effort for perfect flanges.

- #6286 Panel Flanger ..... \$29.95

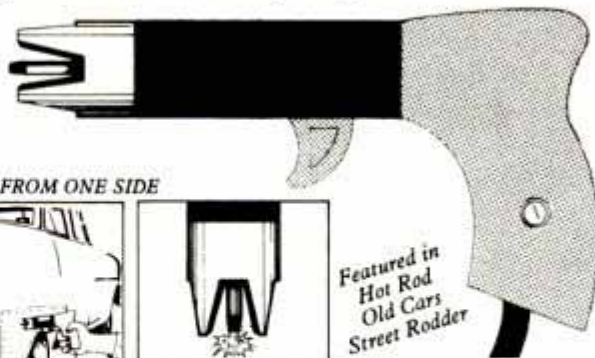
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ARC FUSES METAL

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## THE RIGHT ANTENNA

(Continued from page 126)

### Indoor FM reception

Because of the transmission characteristics in the VHF portion of the spectrum where FM radio stations are located (between channels 6 and 7), specialized antennas are needed. These antennas must help overcome multipath losses, reflections and polarization changes.

Multipath losses occur because VHF signals tend to bounce around. They are affected by such things as trees and buildings, and two or more signals may arrive at an antenna at the same time and confuse the FM receiver. The result is fuzzy sound. The antenna you want is one that will latch onto and hold the strongest signal, while rejecting multipath signals.

Another reason why weak FM broadcast signals have a fading in-and-out quality is that the antenna also must handle signals which are coming to it at many angles. This is called a polarization problem. For the indoor listener, perhaps the best antenna would be the directional type. It offers you the chance to fine-tune for strongest reception. Another alternative is the simple two-element dipole antenna. Available from any electronics shop and included with many FM receivers, this is the basic directional antenna. Turning it should clean up reception.

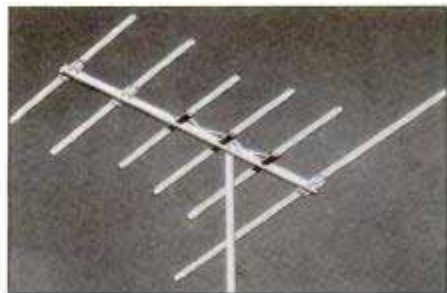
Another good alternative is a version of an old radio favorite, the minicurtain antenna. This type of antenna offers more receiving area than other types of indoor FM receiving antennas. It has two bow ties which serve to focalize received signals, and looks much like a cake rack with bow ties attached.

### Outdoor FM reception

FM receivers and antennas must deal with tricky signal characteristics, and it's wise to use a beam-type of antenna. These offer great sensitivity and the ability to pull in a strong signal from a mishmash of radio waves.

Because the FM frequency is VHF,

it's quite possible to have as many as seven or more elements on an outdoor FM antenna. This means it will be successful at pulling in distant signals. But, as more elements are added to the



FM reception is best with an outdoor beam.

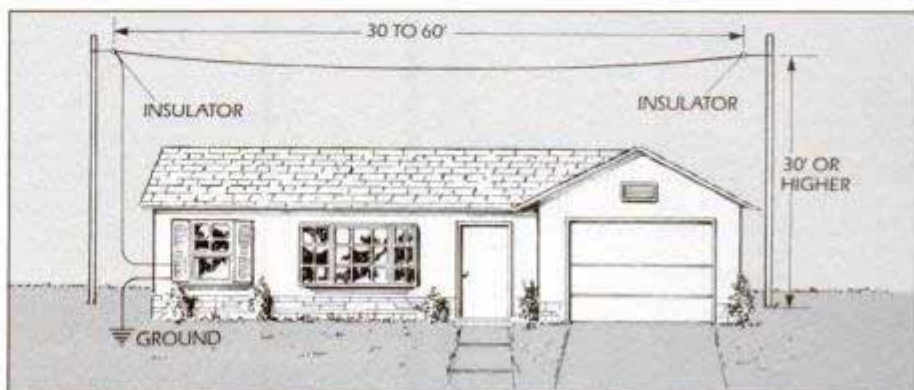
beam, the narrower its aim becomes. Thus, you will find that with only a little misaiming, the signal you had hoped to find has disappeared to be replaced by another. It will require re-aiming this antenna to get the signal back.

You will need some sort of rotator mechanism to change antenna direction from indoors. This is especially true if your favorite stations are located on all points of the compass. Rotators, mechanical or electrical, can be expensive. Instead, supplement your permanently oriented outdoor antenna with an indoor model you can fine-tune.

### AM broadcast band

In the winter, because of certain atmospheric conditions, it's sometimes possible to hear AM stations thousands of miles away. The best way to do this is with a long wire antenna 30 or 60 feet long and placed as high and as clear of obstructions as possible. For the apartment-bound, the ferrite-bar antenna located on the back of most hi-fi receivers should improve reception when rotated.

Although AM signals carry over long distances, sonic fidelity has never been considered important because voices and music are transmitted monoaurally. Now that more AM stations are switching over to stereo broadcasts, a good antenna coupled to an AM stereo receiver will enhance your music listening pleasure. **FM**



Mount AM long wire antenna as high as possible, using insulators to couple the line to uprights. Run line to the receiver, and attach receiver to an appropriate ground.



# Popular Mechanics PLANS

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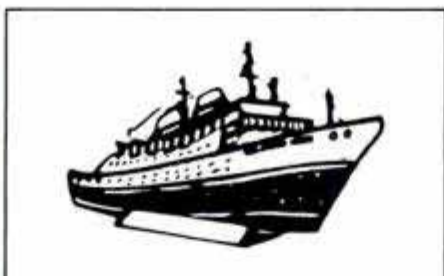
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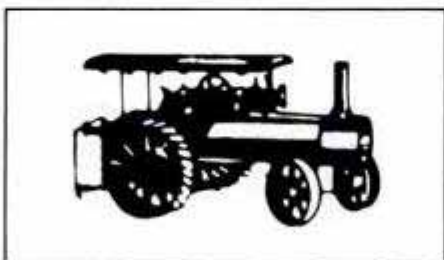
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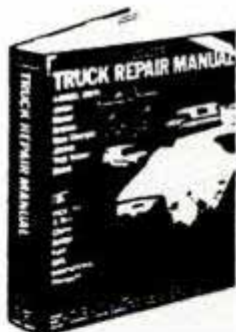


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## HIGH-TECH SKIS

(Continued from page 81)

designed to stand up to corrosive chemicals.

The first fiberglass skis were laid up wet, the way you'd build a glass boat hull, and most are still built that way. At the K2 factory on Vashon Island, Wash., strips of fiberglass cloth are wrapped around a core of polyurethane foam. The epoxy resin is squeegeed into the cloth and the assembly is then placed in a mold and cured for 20 minutes at about 300° F. in an oil-heated press. Phillip and Steven Mahre, the twins from nearby Yakima, Wash., won their gold and silver medals at the Sarajevo Olympics on skis made this way.

In Reno, Nev., Hub Zemke still builds Hexcel skis using a more sophisticated material: pre-impregnated fiberglass. "Because the manufacturer of the fiberglass puts the epoxy adhesive into the cloth, you have a lot more control over the final product," Zemke says. "We know exactly the proportion of resin to glass fiber in every sheet we use."

Prepreg glass is more difficult to work with because it must be cut with a knife instead of sawn to shape, and the heat generated by a saw blade flash-cures the edge of the sheet. Also, it is molded at a higher temperature than

wet-process glass. That's why Hexcel uses an aluminum honeycomb core. Until recently, no structural foams were available that would stand up to the molding temperatures that are required by prepreg glass. Zemke also makes aircraft parts in his factory, using the same materials.

At the other end of the country, in Middletown, Conn., a division of the Olin Corp. makes fiberglass skis of prepreg and pre-cured glass. Pre-cured fiberglass comes in flat, hard sheets, and it's simply cut to shape and laminated to a foam or wood core. A new model, the Olin Ultra, is further reinforced with Kevlar and graphite fibers.

### Damping vibration

"It takes very little graphite fiber to make a ski much too stiff for the average skier to handle," says Olin product development engineer Ed Pilpel. "We use just two slim rods of graphite inlaid into the wooden core, and we use it not so much for strength as for its vibrational characteristics. If you select several different structural materials, each with its own harmonics, then each layer of the structure will vibrate at a different frequency, and they tend to damp each other. You won't find the ski chattering and vibrating uncontrollably at some given speed."

French ski makers have recently done some interesting work in vibration control. Rossignol, the world's largest ski maker, began researching vibration patterns six years ago. "We felt that damping vibration throughout the ski made it feel lifeless and slow," says chief engineer Maurice Woehle. "We wanted to reduce only certain, very specific vibration frequencies, and it was very difficult to do." Rossignol looked to the aerospace business for help, and found that French helicopter manufacturers had solved similar problems in rotor blade design.

Today, Rossignol's high-performance and racing skis contain a vibration absorbing system which looks like a strip of tire cord. Thin steel cables are embedded in a 10-inch rubber strip, inlaid into the ski's core. As the ski vibrates, some of its mechanical energy is lost in heat buildup in the rubber strip.

Woehle's lab found that placing the VAS strip in the forebody of a slalom ski, designed to carve short, slow turns on ice, helped reduce high frequency vibration and improved racing times. Placing two strips in the tip and midsection of a giant slalom ski, designed for carving long, fast turns, reduced lower frequency vibration and improved stability at higher speeds.

One of Rossignol's subsidiaries, the



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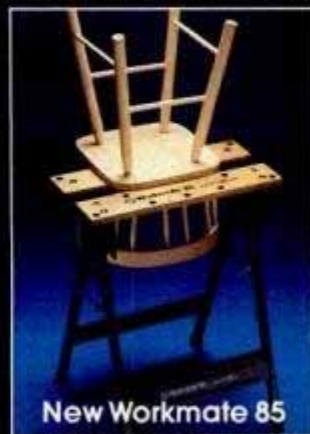
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Dynastar factory, found another way to control similar vibration. A vibration-damping cartridge is inserted through the tip of each of the company's racing skis. Inside the cartridge is a lead weight coated with a low-friction nylon material and sandwiched between a pair of foam donuts. As the ski vibrates, the inertia of the weight tends to hold it steady, and vibrational energy is absorbed in the cushioning donuts.

At Dynamic, another French factory, the slalom ski is damped with graphite fiber, similar to Olin's uses. For a new fast recreational ski, Dynamic engineers wanted to eliminate the expensive wood core, but needed to preserve the springy action that wood provides. They designed a foam core containing two hollow polycarbonate tubes. The tubes act as springs, making the ski highly resilient.

Another company building hollow-core skis is the Swiss Authier factory, another Rossignol subsidiary. In the United States, Authier skis are sold under the Lange brand. The factory uses a molding system devised by engineer Willy Haldemann. A plastic tube is wrapped with a blend of fiberglass and graphite fiber, and dipped in resin. After it's placed in the mold, the tube is inflated, and then cured. The result is a light, hollow structure.

In Austria, downhill racing is the national sport, and major factories like Atomic, Fisher and Kastle have invested millions of dollars learning how to make skis glide faster. During the 1960s, experiments showed that forcing air under the base of the ski could improve glide speed, because air is 100 times less viscous than the microscopic sheet of meltwater that forms under a ski base. Until they were outlawed as unsafe, ski factories even tried building air scoops on the tops of their skis to force air through pores in the base.

### **Ski structure**

Today, glide is regarded as a function of ski vibration and ski base texture, which engineers refer to as structure. Very fast skis, such as the Atomic speed skis on which Franz Weber holds the world speed record at 129 mph, are engineered to vibrate at a constant high frequency, but at low amplitude. This vibration serves to break up surface tension in the water layer under the base.

Sanding the base to create microscopic longitudinal striations has also been found to improve the air mix under the base. Since snow is a very abrasive material, it tends to smooth out the striations after a number of high speed runs. Ski designers counter this

by using very dense, tough polyethylene plastics as a base material. Molecular weights for these plastics go as high as 8 million, and high melting temperatures mean they can't be extruded into sheets. Instead, pellets of high-density polyethylene are compressed or sintered into blocks, and sheets are literally carved off the edge of the block.

The Austrian ski factories grew from woodworking shops rather than from the imaginations of aerospace engineers. But, even in Austria, there's been a lively exchange of technology with other industries. Fischer, Austria's largest ski maker, builds laminated fiberglass structural posts for the Airbus commercial jet, using technology it developed for skis. And, recently, it has adopted a vacuum-laminating system from the electronics industry. Instead of coating ski parts with adhesives, and then assembling them in a mold, Fischer now builds some skis by putting the parts in a mold dry, then evacuating the airtight mold. Resin introduced at one end of the mold is drawn by the hard vacuum through the ski's structure, providing a strong, consistent bond.

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**SOVIET RACING**

(Continued from page 87)

cylinder sleeves into a Lada block and use four pistons from a 500-cc Jawa speedway motorcycle.

Competitors commonly season their racing engines in stock-looking Lada sedans, resulting in a socialist version of "Smokey And The Bandit." Only a few of these hot rods have ever been stopped by the militia during banzai runs from the Dnepr River to racetracks in the Georgian Republic or on the Baltic Sea. Racing drivers have similar inclinations the world over!

There are also racing classes for 1.3- and 1.6-liter stock cars, plus the Falcon-like 2.5-liter Volga sedans.

**Soviet circuits**

Until recently, most race tracks have been closed-off public highways or park roads in places like the Byelorussian capital of Minsk, the Lithuanian city of Kaunas and the Estonian capital of Tallinn. In Leningrad, a true street circuit ran around Kirov Stadium.

The first permanent circuit was built in 1965 in a park in the Latvian capital of Riga. Two more have since been erected in Kiev and Tbilisi. Tracks are under construction in Minsk, Kaunas and within walking distance of my home in Tallinn. With this new con-



Big Volga is the Soviet equivalent of a NASCAR stocker. Engine is a 2.5-liter Four.

struction, automobile road racing is coming to an end in the U.S.S.R., but motorcycle races will continue on the roads.

The Soviet racing season lasts for six months, from April to September, and includes three rounds in the U.S.S.R. Championship, five races in the socialist countries' Friendship Cup and some regional racing in the spring and fall.

**Getting equipment**

Although the racers are amateurs who spend some of their own money on their cars and equipment, the Soviet government lends support that Western racers would envy. Travel expenses, hotel bills and meals are paid for by state-sponsored sports clubs. Teams are supplied with racing cars, transporters, spares, tools, gas and oil.

Racing tires are distributed by the Central Auto Club of the U.S.S.R. (Goodyears, Dunlops or Michelins to Formula 3 teams and Russian Prostor or Czechoslovakian Barum tires to Formu-

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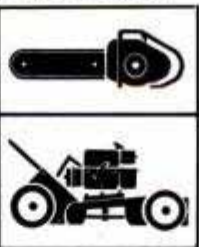
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## THE LAW AND YOUR CAR

(Continued from page 93)

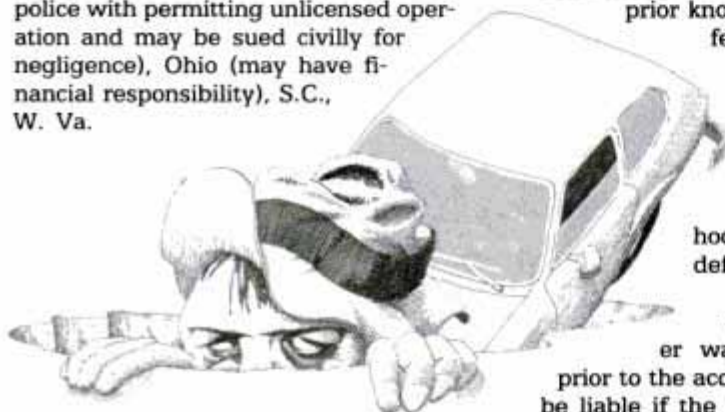
on), check with the state motor vehicle bureau.

**If you lend your car to someone who doesn't have a valid driver's license and he or she has an accident, can you be held responsible?**

**Yes**—Ala., Ariz., Calif., Colo., Conn., Del., Fla., Ga., Hawaii, Idaho, Ill., Ind., Iowa, Kan., Ky., La., Me., Md., Mass., Minn., Miss., Mo., Neb., Nev., N.H., N.J., N.M., N.C., N.D., Okla., Ore., Pa., R.I., Tenn., Tex., Utah, Vt., Wash., Wis.

**No**—S.D., Va. (if the person lending the car has no knowledge, he or she is not at fault), Wyo. (not criminally liable unless owner has knowledge of lack of a license).

**No definitive answer**—Alaska (up to court), Ark., Mich., Mont., N.Y. (no provision of vehicle and traffic law holds the car owner responsible; however, the owner can be charged by police with permitting unlicensed operation and may be sued civilly for negligence), Ohio (may have financial responsibility), S.C., W. Va.



**Can you sue if your car is damaged by a pothole?**

**Yes**—Alaska, Ariz., Calif., Colo., Conn., Fla., Ga., Hawaii, Ill., Iowa, La., Me., Md., Mass., Mich., Minn., Neb., Nev., N.H., N.J., N.M., N.Y., N.C., N.D., Okla., Ore., Pa., Tex., Utah, Vt., Va., Wash., Wyo.

**No**—Del., Ind., S.D., Tenn.

**No definitive answer**—Ala. (may appeal), Ark., Idaho, Kan., Ky. (may appeal), Miss., Mo., Mont., Ohio, R.I. (may appeal), S.C., W. Va., Wis.

**Comment**—In most states, suit may be brought against the agency that is responsible for maintaining the roadway. The procedure in Ala., Calif., Ky. and R.I. is to file a claim with the responsible agency. In Calif., if the claim is denied, you may sue. There may be a time limit in your state for bringing suit or filing a claim. In R.I., for example, claims must be brought against the director of the department of transportation within seven days of the date of damage.

**Can police search your car if they stop you for a traffic violation?**

**No**—Hawaii, Mass.

**Comment**—The U.S. Supreme Court has upheld the right of police to search a vehicle stopped for traffic violations only if the officer sees contraband lying in open view or has reasonable cause to believe contraband is in the vehicle. Some states contend that police can also search for evidence if the search is incidental to the arrest. For example, they can search for alcohol if the operator of the vehicle is stopped for driving while intoxicated.

**Can you be held liable if the hood or wheel of your car suddenly flew loose and caused an accident?**

**Yes**—Alaska, Calif., Colo. (unless it's a manufacturing defect), Del., Fla., Idaho, Ill., Ind., Iowa, Ky., La., Me., Md., Mass. (unless it's a manufacturing defect), Miss., Mo., Neb. (if it could be determined that the owner had prior knowledge of the defect), Nev., N.D., Okla., S.D., Tenn., Vt., Wash. (liability would depend on such factors as whether the hood or wheel was defective or in need of repair and whether the owner was aware of this prior to the accident), Wyo. (may be liable if the owner was negligent in maintaining the vehicle).

**No**—N.H. (if, in fact, it was truly an accident, it is doubtful that the driver would be cited), Va. (nothing in statutes to cover this, but ordinarily if there was nothing wrong with the vehicle prior to it being driven, the officer would not issue a violation; however, it's possible that the insurance company could decide otherwise).

**Maybe yes, maybe no**—N.C. (depending on the degree of negligence by the owner and any contributory negligence by the other driver), R.I. (the laws of comparative negligence apply; therefore, one or both parties could be deemed responsible for the accident and, therefore, liable).

**No definitive answer**—Ala., Ark., Ariz., Conn., Ga., Hawaii, Kan., Mich., Minn., Mont., N.J., N.M., N.Y., Ohio, Ore., Pa., S.C., Tex., Utah, W. Va., Wis.

**Can your car be registered in a state other than the one in which you are a resident?**

**No**—Ala., Alaska, Ariz., Calif., Colo., Conn., Del., Ga., Hawaii, Idaho, Ill., Ind., Iowa, Kan., Ky., La., Me., Md., Mich., Minn., Miss., Neb., N.H., N.J.,

N.Y., N.C., N.D., Okla., Ore., Pa., R.I., S.D., Tenn., Utah, Vt., Wash., W. Va., Wis., Wyo.

**Yes**—Ark., Mass., Mont., Nev., N.M., Ohio, Va.

**No definitive answer**—Mo., S.C.

**Comment**—Many states cite exceptions for military personnel and out-of-state students. Calif., Hawaii, Kan., Ky., Mich. and N.C. permit out-of-state registration for a limited period varying from 10 days to one year, or until the out-of-state registration expires. Fla., N.D. and Tex. indicate that registration is required only by those people who are employed in the state or those who have children attending school in the state.

**Suppose you let your car's registration expire. You park the car legally on the street in front of your home, and another vehicle runs into it. Who's responsible?**

**The other vehicle**—All states except those noted below.

**Variation**—Kan. (the owner of the parked car must carry liability insurance; if not, his driver's license would be suspended until he shows proof of insurability and an agreement to pay for damages or a release from the driver who hit the parked car for the damages sustained to that car), Mo. (depending on local parking regulations, which may or may not permit parking of unregistered vehicles).

**No definitive answer**—Ark., Mass., Mich., Mont., N.H., Ohio, S.C.



**If you're found guilty of a traffic violation and believe you're innocent, can you request a jury trial?**

**Yes**—Ala., Alaska (only for a criminal offense such as driving while intoxicated, hit-and-run, reckless driving), Ariz., Colo. (only for a criminal offense), Conn. (if fined \$100 or more), Del., Ga., Hawaii (must request a jury trial at time



of arraignment), Ill., Ind., (must request a jury before the trial date), Iowa, Kan., Me. (only for a major violation), Md. (can appeal to next higher court; depending on the offense, it could be trial by jury), Mass., Mich. (if violation is a misdemeanor), Minn. (when a jail term may result), Miss., Neb. (only if it's a moving violation and if jail time is part of the sentence), N.M., N.C., N.D., Okla., Ore. (only if the offense is a major traffic violation), R.I. (only if the violation is criminal in nature), S.D., Tenn., Tex., Utah, Vt., W. Va., Wis. (must request within 10 days of pleading not guilty), Wyo.

**No**—Idaho, Ky. (may appeal), La., Nev., N.H. (may appeal), N.J. (may appeal), N.Y., Ore., Pa. (may appeal), Wash.

**No definitive answer**—Ark., Calif. (the solution would be to attempt an appeal of the decision), Mo., Mont., Ohio, S.C., Va.

**Comment**—If you are cited for a major traffic violation that could result in a jail sentence or high fine, it would be in your best interest to seek advice before the initial trial from an attorney familiar with trial and appeal procedures in the state in question.

**Can a member of a volunteer fire department or rescue squad be held re-**

**sponsible if he or she causes a traffic accident while rushing to an emergency in his or her own car?**

**Yes**—Ala., Alaska, Ariz., Calif., Conn., Del., Fla., Ga., Idaho, Ill., Ind., Iowa, Kan., La., Me., Md., Mass., Miss., Nev., N.H., N.J., N.D., Okla., Ore., S.D., Tenn., Utah, Vt., Va., Wash., Wyo.

**No**—Hawaii (law provides exceptions when an emergency vehicle uses authorized audible and visual signals), Neb. (as long as the vehicle responding to the emergency has authorized lights and sirens operating, it has the right of way), N.M. (not if the vehicle has an emergency equipment permit, is outfitted with authorized signals and follows the rules and regulations required of an emergency vehicle), N.Y. (not if the driver was not willfully negligent), R.I. (such a driver has the right of way in an emergency; however, he or she may be held liable in a civil action if there is negligence).

**No definitive answer**—Ark., Colo., Ky., Mich., Minn., Mo., Mont., N.C., Ohio, Pa., S.C., Tex., W. Va., Wis.

**If your car is stolen and involved in a hit-and-run accident, can you be held responsible?**

**No**—All states except those noted below. Most states claim you would not have responsibility as long as you re-

ported the car stolen and/or made a reasonable effort to prevent the theft. A question of negligence on your part could arise if you left the keys in the ignition.

**No definitive answer**—Ark., Conn.,



Fla., Kan., Mich., Minn., Miss., Mont., Ohio, Ore., Pa., S.C., W. Va.

**Comment**—Many cases seem to rest on whether the car was left unattended with the key in the ignition. Calif., N.C. and Utah say that the owner of the car cannot be held criminally responsible, but could have civil or financial responsibility. **PM**



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## 15 NEW KIT PLANES

(Continued from page 92)

reproductions and will sell as kits for \$6,995 each.

With the 3/4-scale JN-4 Jenny introduced earlier (page 96, Jan. '84), you now have a total of half a dozen World War I replicas to choose from. And these are just the beginning. Other authentic reproductions of vintage warplanes in ultralight form are already being planned by several makers. According to some rumors, these may even include ultralight versions of legendary World War II fighters.

### From economy to luxury

For economy flying, it's hard to beat the Fisher FP-303, a little low-wing monoplane that sells as a kit, with engine, for just \$2,798—one of the lowest cost ultralights you can buy.

For those looking for a bit more luxury, there's the Solo, one of the most sophisticated of the new models. A high-wing, enclosed-cabin monoplane, it offers an all-composite airframe, said to be the first in the ultralight field. Among its many advanced design features are dynamically balanced control surfaces to reduce stick forces and wings that fold flush against the fuselage for easy storing and trailering. It also has a fully instrumented cockpit with a true aircraft-style control yoke, a steerable nose wheel, brakes and a built-in ballistic parachute. Its price is expected to be around \$15,000.

### Most exotic ultralight?

What may be the ultimate ultralight is the Trident T3, a wildly futuristic design based on a serious concept currently under study by the Navy, NASA and Rockwell International for possible application to huge commercial jetliners (see *Funny Wings For Future Airliners*, page 142, June '84). Its exotic shape, known as a joined-wing configuration, consists of two sets of wings, one sweeping backward from the nose and the other at the tail where a horizontal stabilizer would normally be.

Joined together at their tips, the twin, tandem wings form a rigid, self-bracing structure that lightens weight and permits the use of thinner airfoils, reducing drag. The rear wing, unlike a conventional tail, becomes a lifting surface as well, increasing overall lift and reducing drag still further.

The arrangement is so efficient, in fact, that the biggest problem the Trident's designers faced was in keeping speed down to the 63-mph maximum allowed under FAA rules. The craft has a 32-foot wingspan, a 25-hp engine with pusher prop, an electric starter for easy inflight restarts and a power-off

(Please turn to page 140)



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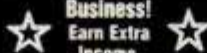
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## 15 NEW KIT PLANES

(Continued from page 138)

glide ratio of 15 to 1, approaching the performance of a high-lift sailplane. Its three-axis control surfaces consist of inboard elevators that also double as flaps, outboard ailerons and wingtip rudders. It will sell as a kit of premolded parts for a price not yet determined.

### Tighter FAA regulations?

The growing sophistication of ultralights is the good news. The bad news is that their accident record is causing concern among the FAA and other safety-minded organizations. In a recent study of 61 fatal crashes by the National Transportation Safety Board, it was found that a far greater percentage were caused by loss of control than by structural failure, suggesting that pilot error due to inexperience is a significant factor in ultralight safety—or lack of.

The result is that ultralight fanciers may soon have their cherished unlicensed freedom sharply curtailed. The FAA currently is reviewing its regulations governing ultralights and there's talk it may eventually require that prospective ultralight pilots go through a flight training course and pass a proficiency test before being allowed to fly.

And if stricter control doesn't come from the federal government, it is almost certain to be imposed at the state level. Already, four states—Louisiana, Michigan, Pennsylvania and Wisconsin—make flight training mandatory and four more states—Idaho, Montana, Virginia and Washington—actually require that ultralight pilots be licensed.

So, enjoy the fun while it lasts—but enjoy it safely. **PM**

### ULTRALIGHT SOURCES

- **Bobcat:** Robert Baker, 865 South Houston, Piggott, Ark. 72454.
- **Buccaneer:** High Craft Aero-Marine Inc., 110 Mingo Trail, Longwood, Fla. 32750.
- **Clipper:** Worldwide Ultralite Industries, 27711 Interstate 10, Katy, Tex. 77450.
- **Fokker Eindecker:** The Airplane Factory Inc., 711 Brandt Vista Ave., Dayton, Ohio 45424 (info pack \$2).
- **FP-303:** Fisher Flying Products Inc., Rte. 2, Box 282, South Webster, Ohio 45682 (info pack \$5).
- **J-4 Sportster:** Anglin Special Aero Planes Inc., Box 2496, 824 Locust St., Hendersonville, N.C. 28739.
- **Nieuport XI:** Graham R. Lee, 8027 Argyll Rd., Edmonton, Alberta T6C 4A9.
- **Panther:** Rotec Engineering Inc., Box 220, Duncanville, Tex. 75116 (info pack \$5).
- **Pony:** Tesori Aircraft Factory, 7219-104 St., Edmonton, Alberta T6C 4A9.
- **Quicksilver GT:** Eipper Aircraft Inc., 26531 Ynez Rd., Temecula, Calif. 92390 (info pack \$4).
- **Spad XIII, SE-5a and Fokker D-VIII:** Squadron Aviation Inc., Box 23276, Columbus, Ohio 43223 (info pack \$5).
- **Solo:** American Air Technology, 1290 Bodega Ave., Petaluma, Calif. 94952 (brochure free with SASE).
- **Spaulding Craft floats:** Spaulding Craft Inc., 935 Harbor Lake Dr., Box 357, Safety Harbor, Fla. 33572.
- **Trident T3:** Summit Aircraft Corp., Box 884, Denton, Tex. 76201.
- **Wren:** Wren Aviation Inc., 1901 East 51st St. S., Wichita, Kan. 67216.

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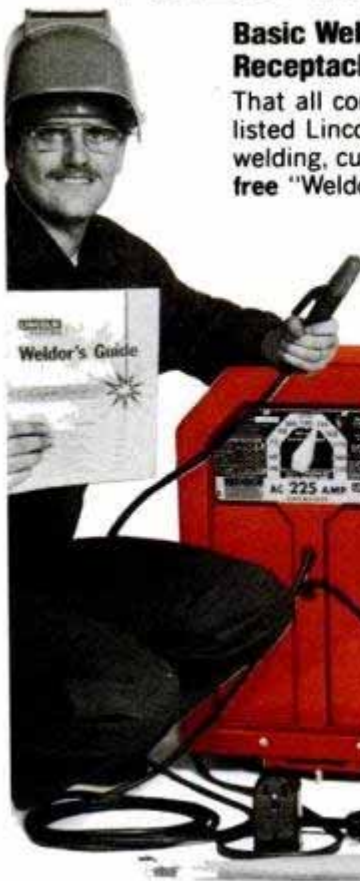


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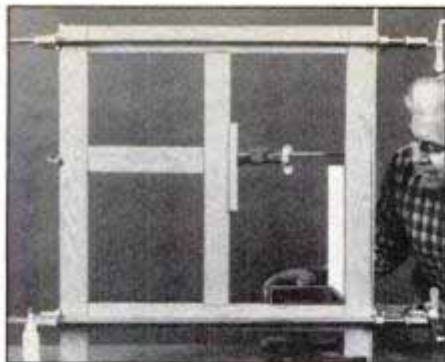
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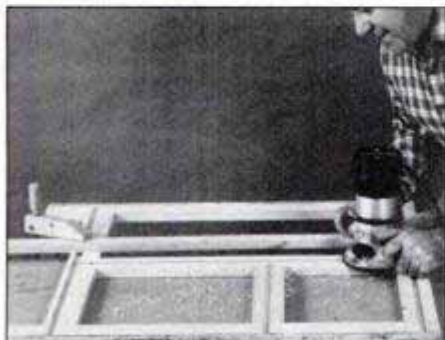
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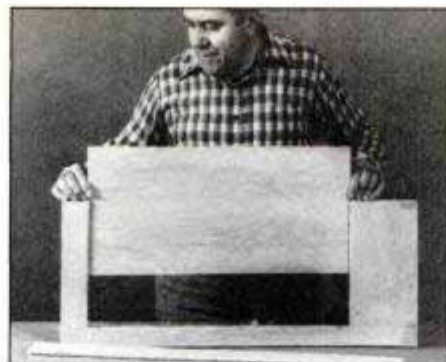




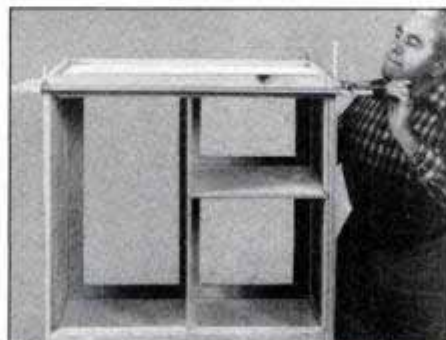
Gluing the outer stiles completes assembly of the front frame. Use protective glue blocks to cushion stile edges from clamp jaws. Check the frame for squareness.



Groove the inside faces of the cabinet's front frame to accept the inner compartment parts. Use a router with a straight cutter. Guide it on edge of straight board.



Panels for cabinet ends fit into grooves cut in inner edges of rails and stiles. Check to make sure that panels slide in easily before joining the end frames with glue.



After the inner parts are assembled and glued into front frame and ends, add the back rails. Clamp them as shown above. Splines will be driven into the mortises.

## OLD-TIME ICEBOX

(Continued from page 103)

different joints, alter the dimensions to compensate for the changes.

Rip front frame rails and stiles (A, B, C, D and E) to the specified width. Then cut each part to length. Cut the mortises and tenons with a table saw, shaper, router or by hand. To ensure the frame fits together with tight glue lines, cut or sand  $1/32$  in. off the end of each tenon. Seal the end grain on the three rails (C, D and E) and the center stile (B) with a 1:1 mixture of water and white glue. Apply the runny mixture to the tenon ends and shoulders. Allow it to dry about 15 minutes. Then apply full-strength glue to the tenon at one end of the center rail (D) and join it with the mortise of the center stile (B). Fit a scrap block with a mortise cut into it over the unjoined end of D to protect it, then clamp the parts. Check for squareness and allow the glue to set. Join the upper and lower rails (C and E) to the center stile. Then add the outer stiles (A).

Cut stiles (H and I) and rails (J and K) for the end frames. The front stiles (H) must have a  $1/4 \times 1/4$ -in. tongue milled into the front edge. Cut tenons in the ends of the rails and cut grooves  $1/4$  in. wide and  $1/4$  in. deep into the inner edges of all end frame parts. The rear stiles are rabbetted to receive the back. Also cut mortises for the splines in these pieces. Cut end panels (L) from

$1/4$ -in. plywood with veneer that matches the solid stock. Dry-assemble the end frames without the panels and round over the inside edges with a  $3/16$ -in.-radius rounding-over bit. Stop the cuts at a uniform distance, say  $3/4$  in., from each corner. Finish-sand all end parts before glue assembly.

Follow the same gluing procedure as described for the front frame.

Parts for the inner compartments of the icebox (P, Q, R, T and U) are cut from  $1/2$ -in. fir plywood. Face the front of the adjustable shelf (R) with solid edging (S). Bore  $1/4$ -in.-dia. holes  $5/16$ -in. deep for adjustable shelf pins in the divider. Prepare a solid oak strip (MM) and fasten it to the inside of the large compartment end since the  $1/4$ -in. panel is too thin to accommodate a shelf pin.

The divider (H), bottom (T) and top (U) must all have dadoes  $1/2$  in. wide by  $1/4$  in. deep. Cut a panel for the back (O) from  $1/2$ -in. plywood and the upper and lower back rails (M and N) from solid stock. Rabbet the back rails to accept the back panel. Cut grooves in the ends of the rails so they can be joined to the end frames with splines (V and W). Also cut the dummy drip pan door (F and G) and leg blocks (RR). Groove the inner faces of all frame parts and cut dadoes.

Join the assembled cabinet ends to the front frame, clamp and allow the glue to set. Slide the bottom, top, divider and fixed shelf into what, at this

(Please turn to page 142)

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## OLD-TIME ICEBOX

(Continued from page 141)

point, is a three-sided box. Then, join the upper and lower back rails to the cabinet. Mount the back panel with 1/2-in. No. 4 flathead screws driven into the rabbets and divider. Mount the drip door assembly by screwing the ends of the backer to the back of the face frame

stiles. Install the casters (PP). Caster bracket on the front pair must be cut.

To line the mixing compartment, first cut the large bottom piece of laminate (QQ) to size and mount it with contact cement. Then, cut narrow strips for the sides and mount them. The J-molding (X) is mounted around the top edges of the mixing compartment. Join the front

(Please turn to page 147)

## CARING FOR BRASS



To check whether brass objects are solid or plated, test them with a magnet. Ferrous metal that has been plated will be drawn to the magnet as shown.



After removing protective coating, shine brass with a mildly abrasive commercial polish. Wear rubber gloves to protect surface from fingerprints.



To set up for spraying on a fresh protective coating of lacquer, mount locks, latches, rosettes and other common hardware to a block of scrap as shown above.



Driving brass screws into a block of scrap makes it easy to strip, polish and recoat the heads. Allow finish to dry before removing screws from the block.

**B**rass objects like the hardware on our old-time ice chest retain their brilliance for many years because of a lacquer coating, usually applied at the foundry, which prevents tarnishing and oxidation. After about 10 years of wear, the finish usually requires restoration.

When restoring a brass piece, first check whether it is solid brass or brass plate. Use a magnet. If the object is drawn to the magnet, then it has a ferrous metal base that is only brass plated. You can also scratch the object in an inconspicuous spot. If the scratch is silver, the object is brass plated. Plated brass can be restored a few times with care, but eventually the plating will wear off.

The first step in restoring brass is to remove the old protective coating. Soak the object in lacquer thinner or acetone. Try liquid paint stripper for stubborn coatings, and rub with 4/0 steel wool. Or, try a strong liquid detergent, vinegar or a solu-

tion of one part ammonia and two parts hot water. You might also try boiling objects in a solution made from four teaspoonfuls of baking soda dissolved in a quart of water.

Work in a well-ventilated room and wear rubber gloves during stripping. Use a toothbrush to scrub hard-to-reach areas.

Rinse off solvent with mild soap and warm water, then polish with a commercial metal polish using chamois or any soft cloth. Rub in one direction, not in circles, and keep turning the cloth. Remove all residue. Rinse the object and dry it immediately.

If you wish, apply a fresh protective coat of lacquer or tung oil. Lacquer can be sprayed on, or the object can be suspended on a wire and dipped into a solution of equal parts lacquer and thinner. To finish with tung oil, heat the object in an oven at 150° F. for about 30 minutes, then remove it and rub oil in with a cloth using straight and figure-eight strokes.—John Capotosto

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# TOOL SPECS

## Key to Smart Tool Buying

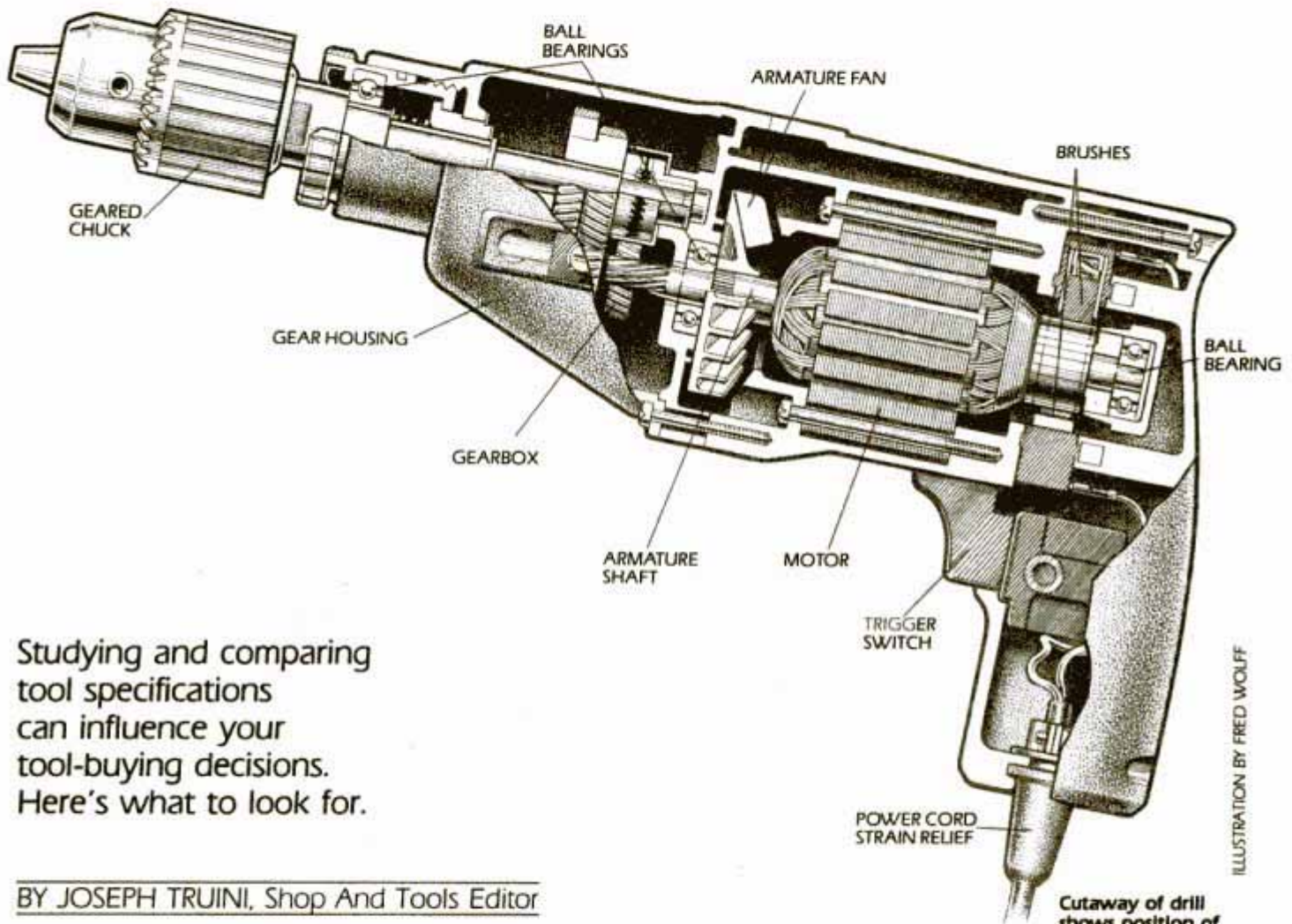


ILLUSTRATION BY FRED WOLFF

Studying and comparing tool specifications can influence your tool-buying decisions. Here's what to look for.

BY JOSEPH TRUINI, Shop And Tools Editor

Cutaway of drill shows position of bearings and other vital components.

**A**t one time, buying a portable power tool was fairly simple. You'd go to the local lumberyard or hardware store and buy a tool with a brand name you trusted. It was often the same tool that your father used. Purchases were based mostly on personal preference and past experiences. Although these are two valid reasons for purchasing a tool, they alone are not enough.

Today, manufacturers are offering more tools than ever before and it's important to study the details, the specifications, before buying. The introduction of foreign tools has created a competitive market similar to the situation found in the automobile industry—quality products available in a wide range of prices.

Today's toolmakers recognize the need for a wide range of products to satisfy all skill levels. However, it

wasn't long ago that the homeowner had only two choices: Pay top dollar for a high-quality, professional grade tool or buy a light-duty, low-quality tool. There were no middle-range tools for the average do-it-yourselfer. Now, manufacturers commonly produce a consumer, tradesman and professional line of tools.

Tools are also available at more places than ever before. Besides the lumberyard and hardware store, power tools are sold at home centers, discount department stores, mass merchandisers, manufacturer's service centers and through mail-order tool companies. So, it's easier to buy the tool that is just right for your budget and skill level. But, deciding on a specific model is more difficult because of the many choices available. For example, Skil makes 14 different circular saws and Black & Decker offers more than 50 drill





PHOTOS BY JOSEPH TRUINI

Tool nameplates will reveal the model number, UL label and other specifications.

models. The first step in making an intelligent buying decision is to research the tool market so you can compare and evaluate the tool specifications of different brand tools. By doing this, you'll learn which ones are best suited to your purposes.

### Do your homework

All major toolmakers offer a catalog that describes each tool in detail (see end of story for a source list). Studying the catalogs is a great way to compare the specifications—amps, horsepower, weight, capacities, bearings, rpm—of one tool to another. Tool specifications can be clues to the expected performance of a tool and can justify the price difference between two seemingly identical tools. Tool catalogs also provide valuable information concerning warranties, accessories, service center locations and tool operator safety. When ordering a catalog, be sure that you ask for a current retail price schedule, too.

After studying the catalogs, bring them to the stores for use as reference guides. You'll find that most stores carry only a few models of each tool from two or three manufacturers. Contact the manufacturer if you're having trouble locating a specific tool and ask them for a list of tool dealers in your area.

Another important factor to consider before purchasing a power tool is the location of the nearest authorized service center. If the tool breaks down, you shouldn't have to send it back to the manufacturer for repairs. Check the tool catalog for the nearest service center. Call them and ask a technician about the speed of repairs and the availability of replacement parts. Porter-Cable, for example, pledges to have a disabled tool operating within 72 hours or they'll provide a loaner tool.

### Locating tool specifications

There are four places to discover tool specifications: in the tool catalogs, on the tool's packaging, in the owner's manual and on the nameplate affixed to the tools. I've discovered that the catalogs contain the most helpful informa-

tion regarding tool specifications.

The specifications that will influence your buying decisions the most include the ampere rating (amps), horsepower, what type of bearings are used and if the tool carries an Underwriters Laboratories (UL) label.

**Amp rating**—Amps are the standard unit for measuring the strength of an electric current. The amp rating of a tool is usually found on its nameplate.

It's commonly thought that higher amp ratings mean more power, and in most cases this is true. But, don't use amp ratings as the single deciding factor when comparing tools. A low-grade tool often requires more current to perform the same job as a high-quality, highly efficient tool. Thus, the lower-grade tool may have a higher amp rating.

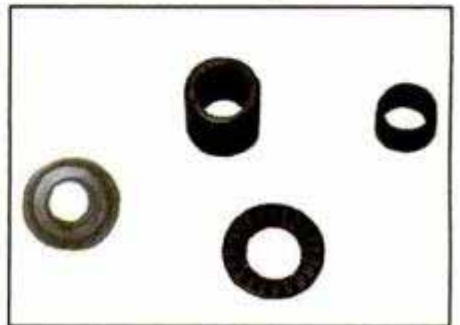
**Horsepower**—The horsepower rating of a tool motor represents the maximum horsepower which the motor can develop, rather than the actual horsepower output when operating at the specified amp rating. In actuality, motors can run for only a very short time at maximum horsepower without burning out. But the horsepower rating does give you an idea of the motor output when comparing tools.

Horsepower ratings are most important when buying a router or circular saw. Choose the horsepower rating

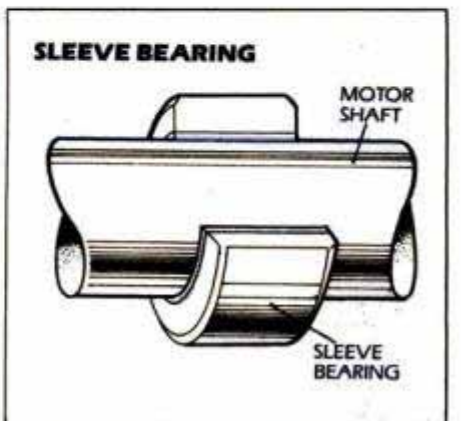
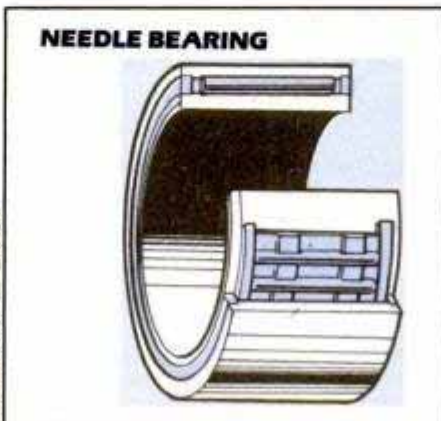
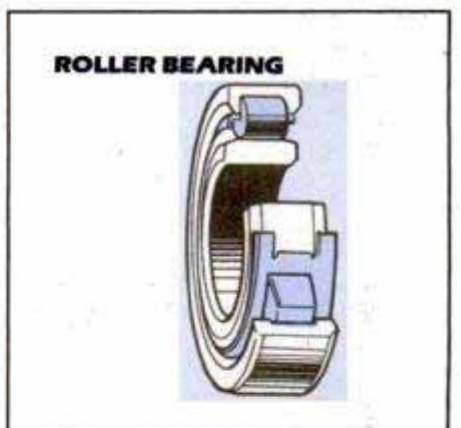
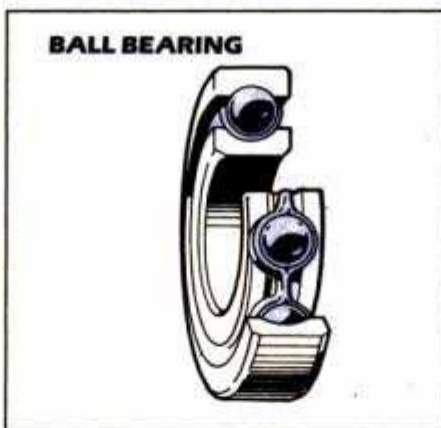
depending on the job you're doing. Don't expect a 5/8-hp router to perform the heavy-duty operations of a 2- or 3-hp router. When you're looking for power, look for more horsepower.

**Bearings**—Discovering what kinds of bearings are used in a tool is probably your most important quality consideration. It's a simple fact that high-quality bearings improve the performance and life of a tool. The types of bearings used are usually listed in the manufacturers catalog or in the owner's manual.

There are basically four types of bearings used in tool construction (see drawings on this page): ball, roller, needle and sleeve. Occasionally, you'll see ball-thrust bearings, a special type of ball bearing that is designed to resist loads acting in an axial direction to the armature shaft. They're commonly



Types of bearings in power tools are (left to right): ball, roller, needle and sleeve.



Drawings show cutaway views of four bearings. The rolling elements, balls, rollers and needles, are held in position by the cage. Sleeve bearings have no rolling elements.



used in hammer drills. Sometimes, a combination of bearings are used, such as ball and roller or ball and sleeve. All ball-bearing construction is considered the most desirable, with ball and roller construction a close second.

Ball bearings consist of steel balls that move within an enclosed circular channel called a cage. Roller bearings, on the other hand, are made of cylindrical rolling elements. Needle bearings are similar to roller bearings except that the rolling elements are longer and generally have smaller diameters. Their one advantage over roller bearings is that they require less space. In every other respect, though, needle bearings perform with far less efficiency than either ball or roller bearings.

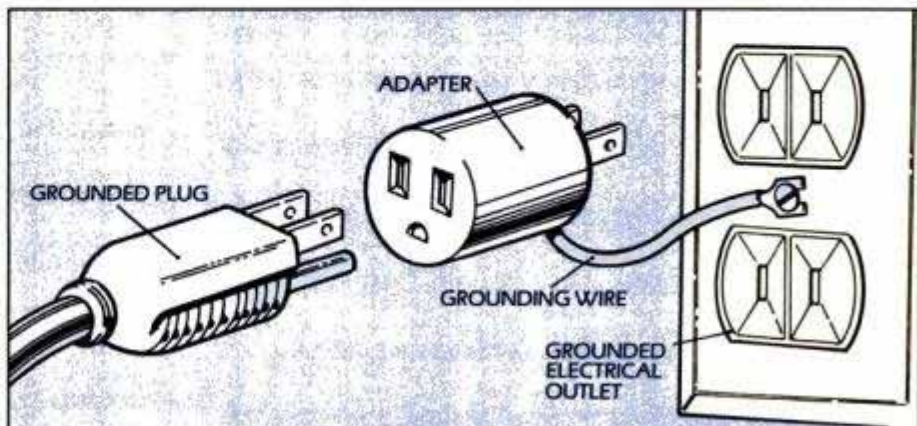
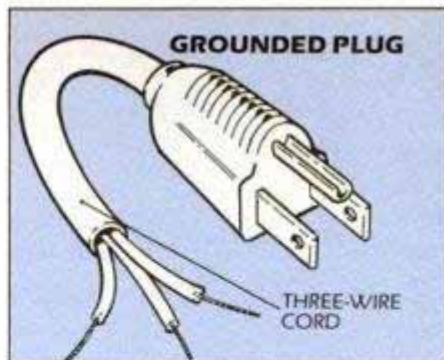
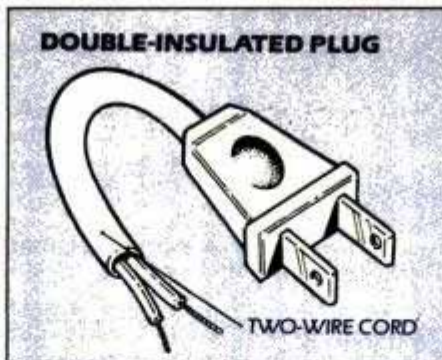
A sleeve bearing has no true rolling element and is the least efficient bearing. Sleeve bearings are commonly used, though, in combination with ball and/or roller bearings in quality tools. They're used in areas where the least amount of load will be exerted on the bearing.

Single-sleeve bearings (see photo) are made from powdered bronze or iron that has been impregnated with lubricant at extremely high temperatures. As the sleeve heats up during tool use, the lubricant is released from the metal. Single-sleeve bearings are commonly used in drills.

As you compare tool specifications, you'll find that the bearings are often the difference between the regular-duty tool and a heavy-duty model.

**Underwriters Laboratories**—While most tool specifications affect a tool's price, performance and durability, the most important specification, the UL label, assures tool operator safety. The UL label means that the tool has been tested and met stringent electrical and mechanical safety standards. Look for the UL label on the tool nameplate, packaging and owner's manual. All major toolmakers carry the UL listing and we strongly recommend buying only UL-listed tools.

Also, make certain that the tool is



Tools have a double-insulated, two-wire cord (top, left) or a three-prong grounded plug (top, right). Use an adapter (above) to match a grounded plug with a two-wire outlet.

either double-insulated or has a three-prong grounded plug (see drawing). Both provide protection from the danger of electrical shock.

All power tools have a basic or functional insulation system to separate the current-carrying parts from each other and from the metallic motor components. Without this functional insulation, the tool would not operate. In double-insulated tools, an extra insulating system is provided for additional protection against electrical shock in case the functional insulation fails. Double-insulated tools have a two-wire cord with a two-prong plug.

Grounded tools have three-wire cords and a plug with three prongs, one of which is the ground. A wire connects the ground prong to the tool's metal housing.

**Caution:** Use a grounded plug only in

a matching outlet. Never break off the grounding prong for use in a two-wire outlet. An adapter, as shown, can be used with a two-wire outlet, but *only* if the outlet itself is grounded *and* the adapter pigtail is attached to the facing plate mounting screw as shown in the drawing above. If necessary, you should have an electrician check the electrical outlet for ground.

Double-insulated and grounded tools are equally safe when they are used properly. The average homeowner will find that double-insulated tools are more versatile since many homes have two-wire outlets.

The following is a detailed look at five popular power tools—drill, circular saw, sabre saw, belt sander and router—and what specific information is important to know before purchasing any of these tools.



## Drills

The portable electric drill is by far the most popular consumer power tool. They're available in a variety of styles, capacities, power ratings and prices.

Drills are sized according to the maximum diameter bit accepted by the chuck. The most common sizes are 1/4, 3/8 and 1/2 in. Active homeowners will find that a 3/8-in. drill provides a nice combination of power and versatility in

a medium price range. Drills are rated by amps and by the no-load speed (rpm). Amps generally range from 2 to 6. The higher the amp rating, the more powerful the drill. The rpm, on the other hand, drop as the power increases. So, if you're looking for power in a drill, buy lower rpm and higher amps.

Two popular drill features are variable-speed trigger control and a reversible motor. Variable-speed allows you

to control the bit speed with finger pressure and the reversing mode is necessary for removing screws and jammed drill bits.

Next, handle the drill. It should feel balanced and comfortable in your hand. Some models have center-mounted handles which distribute the weight evenly, making the tool less nose-heavy. Also, check to be sure that the drill manufacturer offers a full line of accessories.





## Circular saws

When fitted with the appropriate blade, the portable, powerful circular saw will cut wood, metal, plastics and masonry materials. Circular saws are classified by the diameter saw blade they use. Common sizes range from 4 1/2 to 10 1/4 in. The 4 1/2-in. saw is a specialty tool used for cutting plywoods, paneling and trim stock. The 10 1/4-in. saw is an industrial heavyweight that has no practical use for the homeowner. The middle-range models, 7 1/4- and 8 1/4-in., better suit the consumer. The principal

difference between these two is the larger saw has a greater depth of cut.

When comparing saws, the tool specifications which influence your buying decision the most include the horsepower, amp rating, bearings and maximum depth of cut at 90° and 45°.

The safety features to look for when buying a circular saw are an electric brake that stops the blade within seconds of releasing the trigger, and a slip-clutch that prevents dangerous kick-back and motor burnout. Should the blade become bound in a cut, the clutch will override the connection between the blade and the motor. This allows the

motor armature to rotate even though the blade is stopped.

Also, check the saw's retractable blade guard. See that it slides up smoothly, closes quickly when released and operates without excessive play that could cause the guard to hang up. Choose a saw that has a front handle or knob for additional control and a heavy gauge, sturdy wrap-around shoe.

Most circular saws are rated standard-, heavy- or super-duty based upon the amps, horsepower and bearings. The best buy would be a standard-duty, 7 1/4-in., 1 1/2- to 2-hp, 10-amp, ball-bearing circular saw.



## Sabre saws

The lightweight, portable sabre saw, or jigsaw, is unsurpassed for cutting curves in a variety of materials including softwood and hardwood, plywood, metal, plastic, leather and rubber.

Sabre saws are rated according to horsepower, blade speed and blade stroke length. Consumer saws range from 1/8 to 5/8 hp. As with other tools, more horsepower means greater cutting power. A 1/2-hp sabre saw is adequate for the average do-it-yourselfer.

Saw blade speed is measured in strokes per minute (spm). Saws are

available in single-speed, two-speed and variable-speed models. The variable-speed model offers greater versatility and control.

The blade stroke length is the distance that the blade travels in one stroke. A 1-in. stroke length is the most common. Some sabre saws have a scrolling mechanism which allows the blade to pivot 360°. Scrolling sabre saws are worth the additional cost if you need to perform intricate, highly detailed scrollwork.

Other points to look for when comparing sabre saws include the cutting capacities in wood and metal and if the

shoe is adjustable for cutting angles. Also, examine the saw blade clamp, the fixture that holds the blade in the saw. This is a common weak link in sabre saws. Be sure that the blade clamp fits on the saw shaft without excessive play. Any wobbling in this clamp will be transferred to the blade. Be certain that the clamp accepts universal, straight shank saw blades. Avoid a saw that uses only specially shaped blades. And finally, choose a saw in which adjustments and blade changes are made with a screwdriver, not a hex-key wrench. It seems that you can always find a screwdriver.



## Belt sanders

A portable belt sander is a quick, easy way to smooth rough boards and remove old finishes. Sanders are identified according to their belt size and belt speed.

The most popular size sanders are 3 × 21 in., 3 × 24 in. and 4 × 24 in. The 3 × 21-in. sander is a good, all-purpose tool for the home workshop. For light-duty sanding, Skil and Black & Decker each make a small, easy-to-handle 2 1/2 × 16-in. sander. The power of a belt sander is determined by the amp rating

and horsepower. But generally, the larger the belt size, the more powerful the sander.

The belt speed is rated as surface feet per minute (sfpm). Look for this information in the tool catalogs. The best performing 3 × 21-in. belt sanders operate with a belt speed between 1,000 and 1,300 sfpm. Be certain that the sander has an adjustment knob for keeping the belt on track. Some Skil sanders have an automatic tracking system that eliminates the adjustment knob.

Next, check the belt changing procedure. The simple practice of changing

sanding belts shouldn't be a troublesome task. Choose a sander equipped with a belt release lever for quick, easy belt changes. Other desirable features in belt sanders include a dust-collection system and a flat-top design that allows you to secure the sander upside-down for use as a stationary sander.



## Routers

Routers are rated by rpm, horsepower and amps. They're sized according to the maximum diameter bit accepted by the collet (chuck). A 1/4-in.-capacity collet is the best choice for do-it-yourselfers. Rpm range from about 15,000 to 30,000. As with a drill, the lower the rpm, the more powerful the tool. Horsepower ranges from a 5/8-hp light-duty

laminated trimmer up to a 3 1/2-hp professional router. The mid-range 1- and 1 1/2-hp routers will provide enough power to handle most woodworking operations.

Next, check the router handles for comfort and the on-off switch for convenient location. The trigger switch is the safest because you can squeeze it while keeping both hands on the tool. Toggle and slide switches can seldom be reached from the handles. **PM**

### CATALOG SOURCE LIST

The following major toolmakers and suppliers offer catalogs free of charge, unless otherwise noted.

Black & Decker, 701 East Joppa Rd., Towson, Md. 21204. (Request literature on specific tools.)

Bosch Tool Corp., MAS Dept., 3701 Neuse Blvd., New Bern, N.C. 28560-9399.

Hitachi U.S.A., 4487-F, Park Dr., Norcross, Ga. 30093.

J.C. Penney Co., Box 2028, Milwaukee, Wis. 53201. (General catalog, \$3.)

Jepson Inc., 23140 Kashiwa Court, Torrance, Calif. 90505.

Makita, 12950 East Alondra Blvd., Cerritos, Calif. 90701. Attention: Catalog request.

Milwaukee Electric Tool Corp., Advertising Dept., 13135 West Lisbon Rd., Brookfield, Wis. 53005.

Montgomery Ward, Box 4695, Dept. PM, Chicago, Ill. 60680. (General catalog, \$4.)

Porter-Cable, Advertising Dept., Youngs Crossing at Highway 45, Box 2468, Jackson, Tenn. 38302-2468.

Ryobi America, Power Tools Div., 1158 Tower Lane, Bensenville, Ill. 60106.

Sears, Roebuck and Co., Dept. 139H-PM, 925 So. Homan Ave., Chicago, Ill. 60607. (Send \$1.)

Skil Corp., Advertising Dept., 4801 West Peterson Ave., Chicago, Ill. 60646.

Wen Products, Literature Dept., 5810 Northwest Highway, Chicago, Ill. 60631.





J-molding, made up from solid stock that's rabbetted and rounded over, is applied to the mixing compartment's edges after lamination. Miter front corners, butt rear joints.



Since the top frame is rabbetted with a router after being glued, round corners must be squared with a chisel before the plywood insert can be installed.



The lid is mounted with spring-loaded hinges that can be adjusted to compensate for its weight. Turning the screw clockwise increases tension that holds the lid open.



Concealed swivel casters have mounting brackets that attach to corners of the base. See the order box for the supplier of this and other special hardware.

## OLD-TIME ICEBOX

(Continued from page 142)

corners of the J-molding with 45° miters; butt the rear joints.

The top lid is of frame construction with a hollow center section. Cut solid stock for the rails and stiles (Z and AA) and prepare the mortises and tenons. Rabbet the inner edges of the frame after the pieces are joined, squaring round corners left by the router bit using a chisel. Glue the ends of the two stiffeners (CC) and fit them into frame.

### MATERIALS LIST—OLD-TIME ICEBOX

Key	No.	Size and description (use)	Y	1	1/8 x 7/8 x 29" oak (trim)
A	2	1 3/16 x 2 1/2 x 33" oak (front stile)	Z	2	1 3/16 x 2 1/2 x 31 1/2" oak (lid frame front)
B	1	1 3/16 x 2 1/2 x 24 3/4" oak (center stile)	AA	2	1 3/16 x 2 1/2 x 13" oak (lid frame end)
C	1	1 3/16 x 2 1/2 x 25 1/2" oak (front top rail)	BB	2	1/4 x 13 x 27" oak veneer plywood (lid insert)
D	1	1 3/16 x 2 1/2 x 11 3/4" oak (center rail)	CC	2	5/16 x 1/2 x 12 1/2" oak (lid stiffener)
E	1	1 3/16 x 2 1/2 x 25 1/2" oak (front bottom rail)	DD	2	1 3/16 x 2 1/2 x 9 3/4" oak (top door stile)
F	1	1 3/16 x 3 1/2 x 25" oak (drip pan door)	EE	2	1 3/16 x 2 1/2 x 7 1/2" oak (top door rail)
G	1	3/4 x 3 1/2 x 28 3/8" scrap (drip pan door backer)	FF	1	1/4 x 7 1/16 x 5 3/16" oak veneer plywood (top door panel)
H	2	1 3/16 x 1 15/16 x 33" oak (front end stile)	GG	2	1 3/16 x 2 1/2 x 13 1/2" oak (bottom door stile)
I	2	1 3/16 x 2 1/2 x 33" oak (rear end stile)	HH	2	1 3/16 x 2 1/2 x 7 1/2" oak (bottom door rail)
J	2	1 3/16 x 2 1/2 x 11 7/8" oak (end top rail)	II	1	1/4 x 7 1/16 x 8 15/16" oak veneer plywood (bottom door panel)
K	2	1 3/16 x 6 1/4 x 11 7/8" oak (end bottom rail)	JJ	2	1 3/16 x 2 1/2 x 25" oak (large door stile)
L	2	1/4 x 11 3/16 x 24 1 1/16" oak veneer plywood (end panel)	KK	2	1 3/16 x 2 1/2 x 7 1/2" oak (large door rail)
M	1	1 3/16 x 2 1/2 x 28 3/8" oak (rear top rail)	LL	1	1/4 x 7 1/16 x 20 7/16" oak veneer plywood (large door panel)
N	1	1 3/16 x 6 1/4 x 28 3/8" oak (rear bottom rail)	MM	1	5/16 x 3/4 x 24 1/4" oak (adjustable shelf strip)
O	1	1/4 x 25 x 29 1/8" fir plywood (back)	NN	2	Brass adjustable tension hinge*
P	1	1/2 x 15 3/8 x 27 3/8" fir plywood (divider)	OO	set	Brass hardware including door hinges and latches*
Q	1	1/2 x 14 7/16 x 15 3/8" fir plywood (fixed shelf)	PP	4	Concealed swivel casters*
R	1	1/2 x 12 1/2 x 13 3/8" fir plywood (adjustable shelf)	QQ	6	sq. ft. Plastic laminate
S	1	1/4 x 3/4 x 12 1/2" oak (shelf edging)	RR	2	1 3/16 x 2 1/4 x 5" oak (foot)
T	1	1/2 x 15 3/8 x 28 7/8" fir plywood (bottom)	Misc:		5/8-in. No. 4 FH screws, 3/4-in. No. 8 RH screws, white carpenter's glue; contact cement; pigmented paste filler; sanding sealer or thinned shellac; semigloss lacquer; furniture rubbing compound.
U	1	1/2 x 15 3/8 x 28 7/8" fir plywood (top)			*See order box for source.
V	2	1/4 x 1/2 x 2 1/2" plywood scrap (spline)			
W	2	1/4 x 1/2 x 6 1/4" plywood scrap (spline)			
X	1	3/8 x 1 5/16 x 72" oak (J-molding, rabbetted and shaped)			

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## FRENCH DOORS

(Continued from page 112)

panel are complete, remove the nails and carefully turn over the panel. Solder all joints on the second side. Next, cut the reinforcing bar—two pieces for each panel— $\frac{1}{2}$  in. shorter than the width of the panel. Clean the bar with 120-grit sandpaper and spread flux on the bar at points where it will intersect the soldered joints on the panel. Center the bar across the panel width, standing on edge, then working on one joint at a time, heat the bar with the iron held directly on its top edge. Keep it there until the solder on the joint below melts and bonds the bar to the panel. Follow the same procedure for the remaining intersecting joints.

### Filling lead channel

After all the joints are soldered, the panes will still be slightly loose. To correct this, the lead channel must be filled with putty. Use gray glazing putty (DAP No. 1012) thinned with mineral spirits to the consistency of flour paste. With a paint brush, work the putty over the glass and into the channel as shown. Use short, circular strokes, then let the putty set for a few minutes and wipe off the excess with burlap rags. Again, use circular motions, forcing the putty farther into the channel as you remove the waste. When one side is complete, turn the panel over and fill the other side, then let the putty dry for 24 hours.

### Panel installation

Before sliding the glass panels into the door frames, fit the doors to their opening and cut the hinge mortises. Hang the doors, make any required adjustments, then take down the doors. Remove all 12 hinges and sand all four panels with 120- then 220-grit sandpaper. Then, lay each door, molded side down, on the workbench. Carefully center the glass panel in the frame opening with the reinforcing bars pointing up. Insert small shims of lead channel between the panel and wood frame to keep the panel from shifting. Then cut the wood glass bead to length and notch it with a sharp knife or chisel to fit around the reinforcing bars. Carefully nail the bead in place with  $\frac{3}{8}$ -in. brads. Set and fill the brad holes, then prime and paint the doors.

Join each pair of doors first by installing their hinges, then hang each pair as if they were one door on the door jambs. Mount the cremone bolt door latches on opposite sides of each interior door and mount the surface bolts on the other doors as shown in the drawing. Align the doors, then bore the four holes in the head jamb to receive all the strike plates. **FM**



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EA4



## DOM DELUISE

(Continued from page 72)

hide them from workmen, who by the way, have cleaned me out."

Among the more complicated projects DeLuise has taken on are the two natural stone facades around fireplaces in the living room and family room. Rock is tough to shape, DeLuise admits.



Working on a junked table, our Mr. Fixit adjusts a plane he retrieved and restored.

And we all know that vertical cement work is tricky. How did he do it?

"Whaaaaat? Cement is cement," DeLuise shrugs. "Italians are born with cement. You look at the rocks. You have a sense just where they should go."

"I used a mop handle on this one," he

says pointing to shoulder-level near the fireplace. "I put the cement on, then stuck the rock in. But, I needed to brace it while the cement dried overnight. The mop was wedged against the rock, but the handle was too short so I stuck a footstool under the mop. But the footstool would scoot out, so I pushed the couch against it. Worked great."

As you enter DeLuise's workshop, you get the sense that more goes on here than meets the eye. He has power tools like a circular saw, hand sander and drill. But most of his shop, tucked against the far wall, is hand tools and pieces of this and that. The room also is graced with a sand-filled punching bag and small gym with free weights where his sons work out.

"I don't take responsibility for this mess," DeLuise says. "My children come in and use it and I'll find my tools everywhere. Once, I was digging a hole for a tree just outside and I found two pliers and a hammer—in the ground!"

His workbench, which he designed but had built by a pro, is hidden behind two 4 x 8 plywood doors. Close the doors and the mess is gone. The only tool that ever leaves the workbench area on purpose is the folding saw. "I carry it in my car," DeLuise explains. "You never know when you're going to have to saw something."

One afternoon, DeLuise tells us, he was driving along the scenic Coast Highway when he spied an armload of wood tied up with a string. "Hey, I said to myself, firewood!" He recalls coming out of the car toward the bundle. "I pick up the wood and look at it and I say, 'No, not firewood, chair.'" He threw it into his Mercedes, raced home and that evening sat comfortably in his newly restored rocking chair.

"Now remember," he cautions. "My father was a garbage man. So when I see a pile of wood . . ."

DeLuise discourses on the restoration of grandmother clocks. One was given to his mother as a wedding present. "I grew up with that chiming every hour of my life," he says.

Each of the three clocks we see has, at some point, been taken apart, its works cleaned, oiled and straightened and its cabinetry restored.

Sometimes, Mr. Fixit starts a project, gets himself into a jam and has to call on the nearest family member for help.

"Once, I was fixing a washer in the bathtub faucet and I couldn't get it out. I tried gum, a magnet, everything," he recalls. "So, I'm working on the washer and the nut springs out and drops down into the pipe. I call my son, Michael, and he says, 'Turn on the water. It'll flow up and push the nut out.'"

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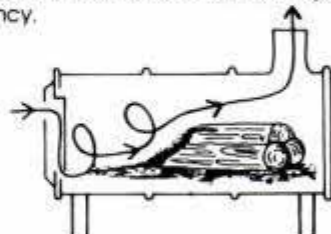
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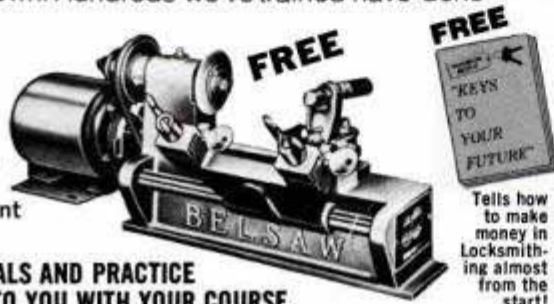
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That made sense. "I got the nut sure enough. But we were standing in 2 feet of water all over the bathroom."

When other Hollywood celebrities don't know what to do with their odd pieces of personal property, it often gets deeded to Dom DeLuise. Leading us out to his yard area, DeLuise points to a child's playhouse. "Merv Griffin said he was going to throw it out. I said no, I'll come and get it. Now we use the



DeLuise romps with Midnight, who doesn't like the doghouse as much as Dom.

playhouse to store bicycles and an old punching bag."

And there was Gene Wilder's doghouse, which is shoulder-length to a grown man. "Big dog," DeLuise explained. "I raised the roof a little. It makes a great toolshed."

For his own dog, a miniature poodle named Midnight, DeLuise designed what he calls the seven-minute doghouse. For style, he admits, it will never win an award. "So far, nobody has copied it," DeLuise laughs. It is made of four wood boards and a pair of fiberglass sections taped together. Inside, there's a lining composed of a robe DeLuise once wore in a comedy scene. "Midnight doesn't just run into the house. But, you can get him to go in."

The comedian says he gets his fixit inspiration "from the muse." But building projects, even those involving cement work, are often inspired by his readings in *Popular Mechanics*. On the Johnny Carson show, he once said his greatest unfulfilled ambition was to appear on the cover of PM.

"A lot of people in this community work with their hands," DeLuise tells us. Among his friends, George Montgomery is the best woodworker. And what of his best friend, Burt Reynolds? "Burt? He doesn't even cut meat."

As we are leaving the DeLuise home,



Dom and his mother build a bird feeder from a coffee can and a foil pie plate.

we look at the yard area just outside the breakfast nook. Three bird feeders stand suspended from a bush. One is a \$25 model of elegant finish built from a professional kit. There are no birds feeding from it. The second is a green plastic flower pot glued to a pie plate. The birds ignore that one, too. The third is a tin foil plate with coffee can silo. A red plastic lid that originally sealed in the coffee flavor now serves as a roof to keep rain out of the bird feed. Here, the birds flock and fight one another for a shot at the seeds. It's the feeder he fashioned from scrap with his mother's help. Both Dom DeLuise and the birds prefer it.



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Kwik-Chek gauges. Extension bar for the 24-in.-capacity gauge (right) is not shown.

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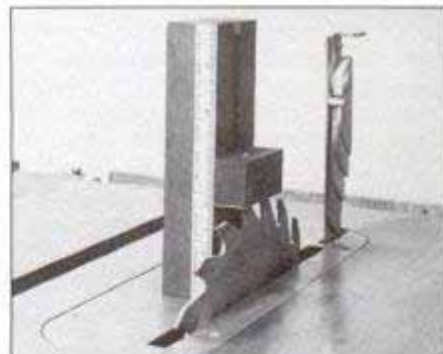
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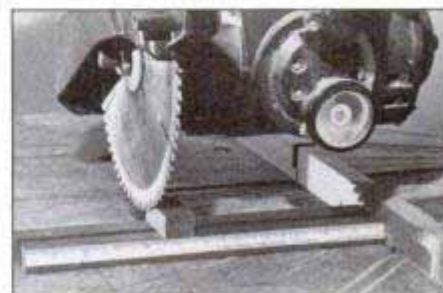
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This is how the gauge is used to accurately set blade projection height. The sliding block is held in position by a magnet.



Kwik-Chek gauge is used in this manner to accurately position the blade of a radial-arm saw preparatory to making a rip cut.



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## FIRSTHAND REPORT



# DRIVING VW's 1985 Golf and Jetta



Golf two-door (top) and four-door (above) are both hatchbacks with distinctive, high-level taillights. Otherwise, restyling is subtle; improvements, however, are many.

The Rabbit's now called Golf. You can call the Jetta the best sporty German sedan for the money.

BY GARY WITZENBURG

**Y**ou'll be hard-pressed to tell the new Golf from the old Rabbit. VW is going to have to sell it on virtue alone, a rather unique concept in American marketing. But, come to think of it, that worked pretty doggone well for the original Beetle in its early days.

The new Golf fairly oozes virtue from its every pore. Just for starters, it has an inch more rear legroom, 30 percent more luggage capacity behind its fold-down rear seats and 40 percent more fuel capacity in a

lighter, stronger, safer 14.5-gallon tank made of high-impact plastic. These improvements effectively take care of the only three major complaints the old Golf's European buyers had.

This was accomplished primarily by stretching the old Rabbit's body 4.7 in. (to 158 in.) and the wheelbase 2.6 in. (to 97.3). But VW's designers didn't stop there. They also made the new Golf 2 in. wider (at 65.5 in.) and

stuffed 3.5 in. more elbow room in front and 4.4 more in back, which qualifies it as a full five-passenger EPA "compact," instead of a four-passenger "subcompact" as before.

Then, they smoothed its familiar-looking contours to an impressive 0.35 coefficient of drag (Cd), a 17 percent improvement; better, in fact, than a lot of so-called sports cars. (The slippery new Corvette parts the wind with a 0.34 Cd.) Contributing to this considerable accomplishment, which really does make a difference in both economy and performance, are a long list of wind-cheating tricks developed over the course of many hours in the wind tunnel. These include rounded corners, tightened gaps, smooth seams between body panels, a tapered front end, a flexible front spoiler, a smaller radiator opening, underbody deflectors to minimize turbulence around the rear axle, flush fixed "vent" windows, nearly flush side windows, aero-contoured outside mirrors and new "soft" water drain strips replacing metal channels

*(Please turn to page 158)*



Jetta four-door sedan execution is excellent: The rear windows even roll all the way down.



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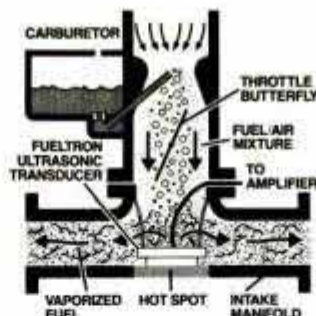
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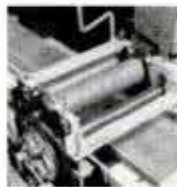
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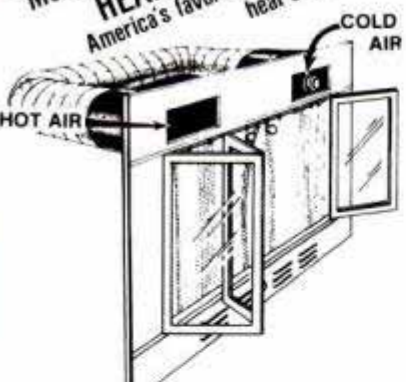


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## VW'S 1985 GOLF AND JETTA

(Continued from page 156)

along the front pillars and roof.

Under this new body is a suspension designed to provide both a quieter and more comfortable ride and more agile and precise handling. This it does through wider tracks (1.6 in. wider front, 2.8 in. rear), increased suspension travel (16 percent more in front, 6 percent in back) and some trick new asymmetrical bushings that absorb road shocks in the fore-aft direction while limiting lateral deflection. Less deflection means less front toe-in or toe-out during acceleration and braking and less rear-axle steering effect during

cornering. The front MacPherson struts have larger mounts for better isolation, while the rear system (similar to that on VW's larger, more expensive Quantum sedans) uses a V-section torsion beam axle with integral trailing arms.

The price-leader Sparmeister model is powered by a 52-hp, 1.6-liter, diesel four cylinder good for 38 mpg city and 46 highway and about 17 seconds 0 to 60 with its five-speed manual transaxle. The other choice is an updated overhead-cam 1.8-liter Four from last year's high-performance Rabbit GTI. This energetic little beauty has a new Bosch KE-Jetronic electronic injection system and quieter, lower-maintenance hy-

(Please turn to page 160)

## The Jetta That Money Can't Buy

The Integrated Research Volkswagen (IRVW 3) continues a series of idea cars that started with the ESVW 1 experimental vehicle. This third project is intended to see just how much high-tech equipment can be sensibly stuffed into a compact. The IRVW 3 has a computer-controlled air suspension, antiskid brakes, an antiwheelspin system, an electronic navigation device and a 180-hp version of the GTI engine.

The four-cylinder, fuel-injected engine is equipped with a belt-driven supercharger that is neither a Roots (lobe) nor a turbine (vane) design. Secretive VW calls it a spiral-type compressor, which must be some form of Archimedes' screw. The blower has an intercooler and a unique bypass circuit that allows some of the pressurized charge to recirculate through the compressor at part throttle.

At full throttle, a bank of butterfly valves routes all of the charge to the intake manifold. This gives instant response whenever you tap (or mash!) the gas pedal.

The transmission is a manual with four speeds and an automatically engaged overdrive FIFTH. It provides an immediate kickdown into FOURTH for passing.

Other wonders include a pneumatic suspension that lowers the car as speed increases (for better handling and aerodynamics), radio controls on the steering wheel hub (to limit distractions), and a liquid-crystal instrument display that cannot be read by the passengers (which cuts down on nagging navigators). Speed sensors at the wheels are used in the antiskid brakes, but also cut back engine power if a wheel begins to spin on ice or sand.—W.H.



Soft air suspension allows some body roll in the corners (above) and rocking on the straights, but the spring rate stays the same no matter what the payload, unlike steel springs, where rate changes with load. The powerful engine (right) uses a unique spiral supercharger and intercooler to produce 180-hp.





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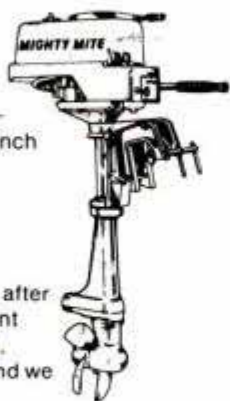
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## VW'S 1985 GOLF AND JETTA

(Continued from page 158)

draulic valve lifters, pumps out a strong 85 hp and delivers 10.3-second 0-to-60s and 27/34-mpg '85 EPA ratings.

Also in the interest of noise reduction, the engine/transaxle mounting system is re-engineered. The transaxle mount itself is a neat little device that combines steel, rubber and a shock-absorbing chamber filled with silicone dampening fluid. Standard transaxle is a close-ratio five-speed, while a three-speed automatic is optional with the gas engine. VW also wants you to know its engineers have concentrated on something they call "elasticity," meaning 40-to-60 mph acceleration for passing and merging. The diesel Golf performs this trick in a respectable 12.1 seconds, and the five-speed gas version does it in an excellent 8.4 seconds.

The inside styling is as underwhelming as the outside, but the new interior is more user-friendly, more comfortable and quieter than the Rabbit's. VW's



Golf/Jetta dashboard switches are placed high for an almost "heads-up" type display.

easy-to-reach column stalks for turn signals and dimmer switch (left) and wiper/washer (right) are retained, while rocker switches for headlamps and other key controls are high and easy to see and reach on either side of the steering wheel. They flank a simple rectangular cluster housing, inside which are a round, highly legible 120-mph speedometer, a matching 7,000-rpm tachometer, fuel and temperature gauges, twin rows of jewel-like LED idiot lights, a digital clock, and (on five-speed models) VW's famous upshift light that keeps nagging you to shift to the next higher gear to save fuel.

The radio and climate controls are nicely redesigned and also mounted high for easy reach and visibility, and the heater/ventilation system is much improved to give better flow and faster response to inputs. The glovebox is disappointingly tiny, but there's good small-item storage room in door panel bins, underdash cubby boxes and a couple of shallow trays on the console.

Standard equipment does include power front-disc brakes, rack-and-pin-



ion steering, manual right-hand and remote left-hand outside mirrors, tinted glass, intermittent wipers, console and trip odometer—but the el-cheapo Sparmeister doesn't get the console or the right-hand mirror. Among the major options are VW's passive safety belt system, a steel sliding sunroof, power steering, air conditioning, cruise control, rear wiper/washer, metallic paint, AM/FM four-speaker auto-reverse cassette stereo and a split (one-third/two-thirds) folding rear seat.

### Jetta: the sport sedan

As before, there's a Golf-derived, full-trunk sedan called Jetta, available in two-door and four-door variations. (Also as before, Jettas will be imported from the Fatherland, while Golfs will be U.S.-built in VWoA's Westmoreland County, Pa., plant.) Essentially identical under the skin, the new '85 Jetta somehow manages to look far better and more contemporary than its plain-looking hatchback Golf cousins. Its wider, Euro-style aerodynamic halogen headlamps, sloping notchback rear roofline, Mercedes-type high rear deck and a more visually pleasing (to us) rear panel and taillamp arrangement are the major reasons why. Optional engine is a turbocharged 1.6-liter diesel with 68 hp and 37/42 mpg '85 EPA ratings.

An up-level GL version of the four-door gets into sports sedan territory with a four-spoke sport steering wheel, aerodynamic wheel covers, black fender flares and rocker covers and more—but we'll have to await the '85½ high-performance GLI (and Golf GTI) to have our sporting senses more thoroughly gratified.

We were able to try an assortment of five-speed and automatic-shift gasoline-engined '85 Golfs and Jettas on the Mid-Ohio road racing course near Mansfield. The combination of track and highway experience gave us good feelings about both cars. Whether you appreciate their styling, it's hard to find fault with the way these little German-designed jewels drive.

There's no question they're better than their predecessors in every functional way. Their performance is good with the automatic, excellent with the five-speed, and their handling is impeccable despite the rather small (175/70SR-13) tires and (5½ × 13 in.) wheels. As drivers' cars, they're so good, in fact, that we can't wait for the hot GTI and GLI versions.

Braking and steering are equally impressive, though we'd like to see the Jetta's load-sensitive brake proportioning valve on the Golf as well. Ride is much like that of a larger German car—supple, well-controlled, neither too stiff nor too soft and wimpy. The five-

(Please turn to page 162)

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## VW'S 1985 GOLF AND JETTA

(Continued from page 161)

speed's ratios are beautifully matched and response from the fuel-injected engine is instant.

For some reason, the shift pattern stamped into the Golf's gear handle says E (economy) for the top ratio, instead of 5. Also, the shift pattern in our test cars seemed a little too close and tight, too prone to finding the wrong slot.

Finally, if there may be any promise unkept about these cars, it's the one about noise. Granted these were early, even preproduction, examples, and they are certainly quieter than the old Rabbit and Jetta. But we noticed a surprising amount of wind noise around the pillars, some road noise from the tires transmitted through the body and a lot of engine buzziness at high rpm.

All things considered, the Golf should be competitive in its price range (a little higher than the Rabbit's) for those wanting understated function, mechanical competence and German engineering. The Jetta, though, may be the sleeper of the year—sort of a front-drive BMW 3-type for a whole lot less money.

There are no near-term plans for a Golf convertible, so VWoA says the popular Rabbit ragtop will continue to be imported as long as there's demand for it. Also, like all VWs, the new Golf and Jetta carry VW's new Two-Year Unlimited Mileage Protection Plan. **PM**

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VW	GOLF GRADE	JETTA GRADE	COMMENTS
Acceleration	A	A	Perceived performance very good.
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Steering	A	A	Precise, accurate.
Transmission	B	B	Ratios excellent; H pattern too tight.
Ride	A	A	Much improved over the Rabbit.
Fuel Economy	A	A	With diesel, it's 46-mpg highway.
Seating	B	B	Firm support, infinite reclining.
Vision	B	A	C-pillar's the culprit in the Golf.
Gauges/controls	B	B	Plain looking but functional cluster.
Ventilation	B	B	Better than Rabbit.
Noise @ 55 mph	C	C	Considerable wind and road noise.
Cargo capacity	A	A	Hatch so-so; Jetta trunk huge.
Engine serviceability	A	A	The 1.8 Four is an energetic beauty.
Fit and finish	B	B	Hard to find any glitches.



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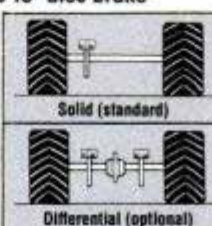
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Ring Master tool (above) is used to cut concentric wood rings to make objects like a vase (left), which normally are done by turning on a lathe.

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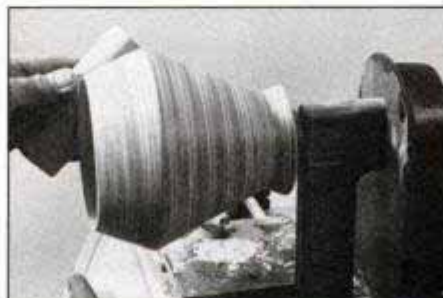
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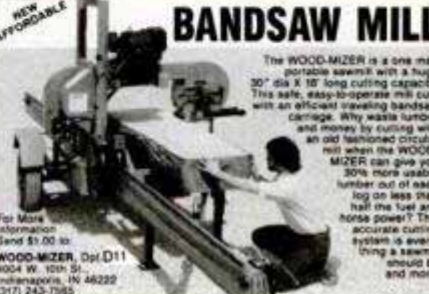
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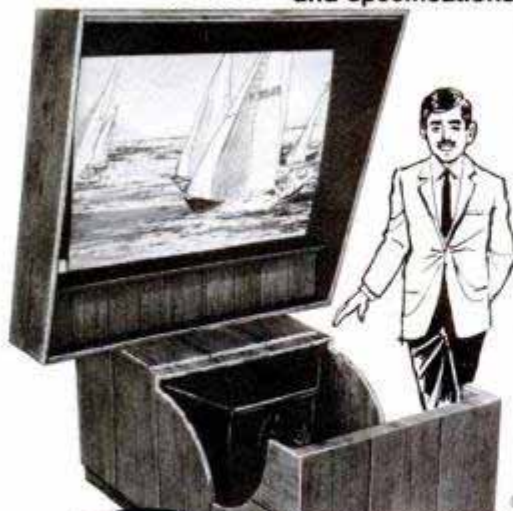
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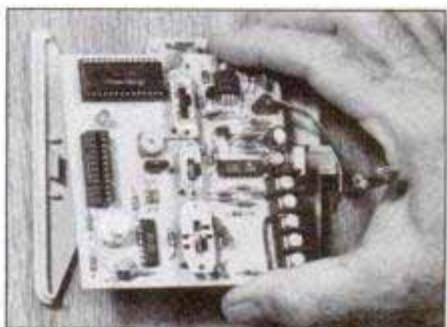
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Magic-Stat, an electronic thermostat, is programmable for six different daily temperature settings and seven different daily programs. It also has a cold-weather compensator which calculates when the furnace should turn on. Thus, on cold days it will begin heating earlier than it will on warmer days. These features result in maximum energy savings.

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Installation requires only a screwdriver. It's \$79.95 postpaid from Quad Six Inc., 3753 Plaza Dr., Ann Arbor, Mich. 48104, or at hardware stores.

—Rosario Capotosto



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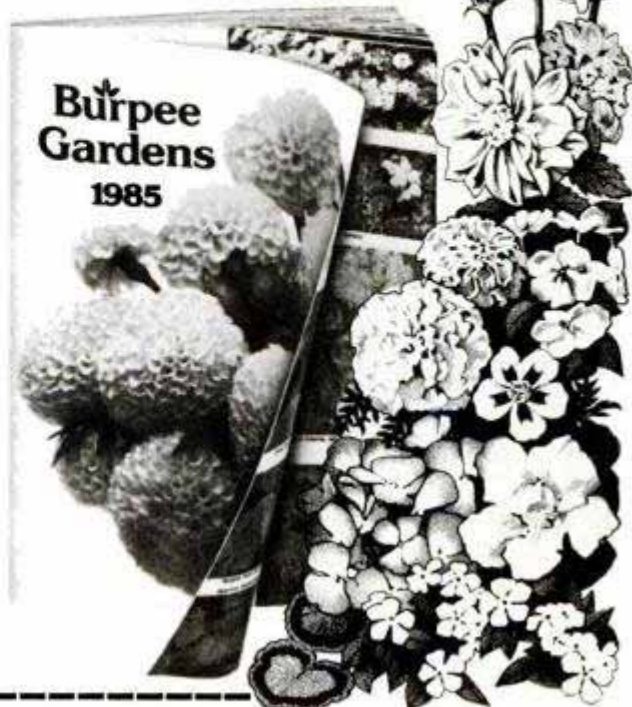
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Sanblade combines a two-faced sanding disc with a circular saw blade. High rpm enables the 40-grit aluminum oxide abrasive bonded to both sides of the blade to sand cut edges as smooth as 120-grit used normally. Diamond-honed carbide teeth cut up to 50,000 board-feet before dulling, according to the manufacturer.

Kerosene and an old toothbrush remove gum from the abrasive on the blade. It's supposed to last almost indefinitely, but can be recoated and the teeth resharpened by a dealer.

Clemson Group, 22 Cottage St., Middletown, N.Y. 10940, offers both sizes at above prices, plus \$3.50 shipping. Write or call toll-free: 800-431-5741.

—Rosario Capotosto

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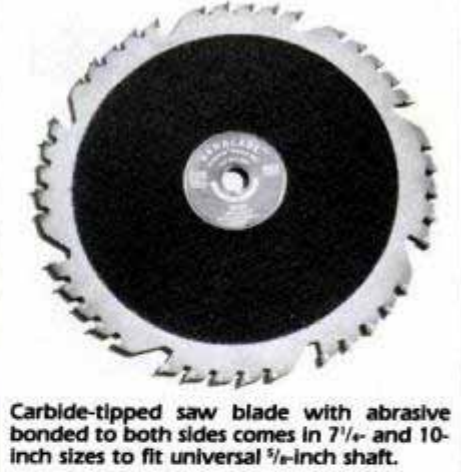
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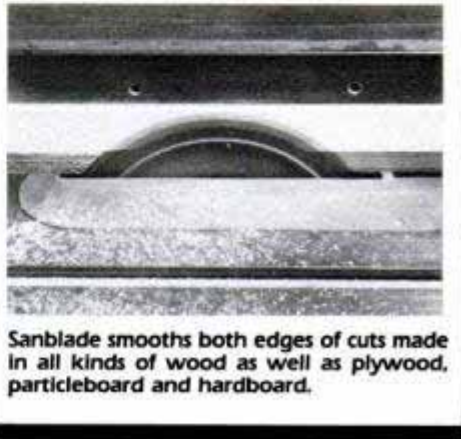
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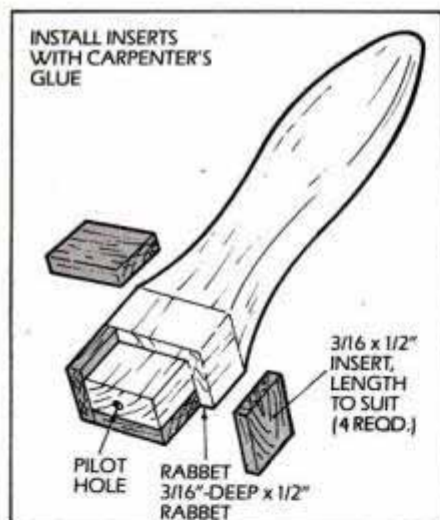


# HINTS FROM READERS

## File handle



Make a flat file handle from an old paintbrush by cutting off the bristles. Then glue reinforcing inserts into rabbets cut in the perimeter of the handle end.



Often, it's worthwhile to recycle old paintbrushes by fitting files or other hand tools into their wooden handles. After cutting off the unwanted brush parts, bore a pilot hole in the handle's end to receive the file tang. Then fit round handles with tubular ferrules or wire to discourage splitting.

If the handle is square or rectangular, it can be strengthened by cutting rabbets across the end of all four sides and gluing pieces of maple or other wood in them. Grain direction of these inserts should run across the handle grain. All four sides of a rectangular handle end can be reinforced in this way. The inlays can extend a little above the handle surface, for greater strength. Use a good grade of wood glue.

—Walter E. Burton.

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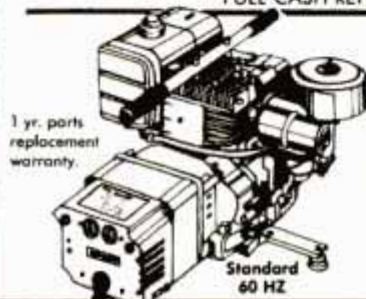
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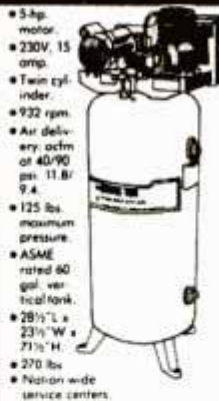
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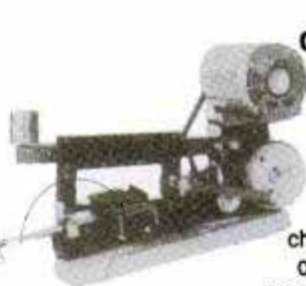
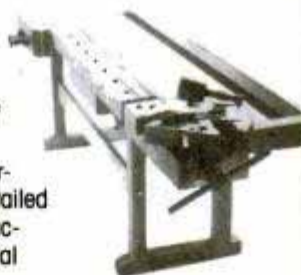
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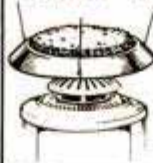
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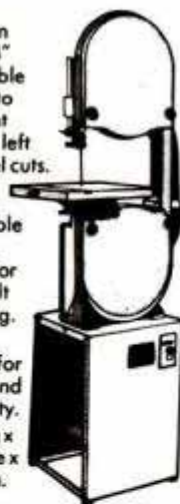
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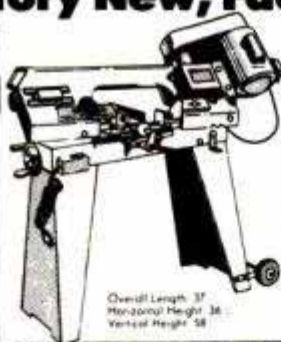


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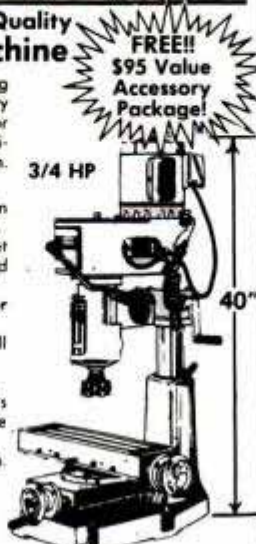
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(Continued on next page)

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(Continued from preceding page)

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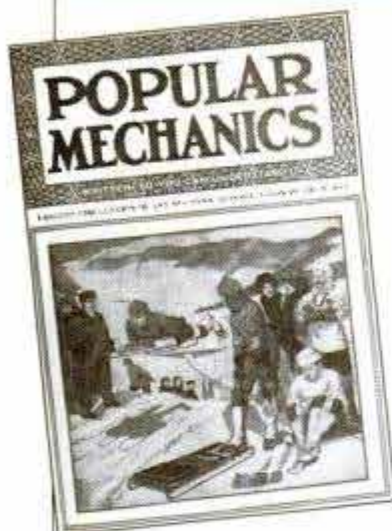
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# PM'S TIME MACHINE

75 YEARS AGO: December 1909



Toboggans race at St. Moritz.

## Sawtooth for feet

The hottest sports craze of 1909 was tobogganing and we visited St. Moritz, Switzerland, for an update on the event.

The run, we noted, "is scientifically constructed." To engage banked heights and grip ice, tobogganers wore "sawtoothed protuberances" on their shoes. No match for today's graphite cleats.

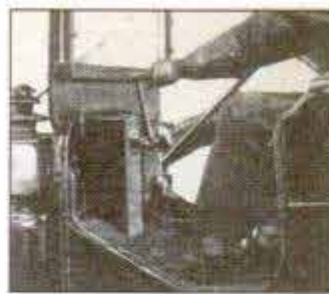
## England takes flight

Britain rolled out its first biplane. A generation later, British Aerospace competed with U.S. aircraft makers.

## Halley's comet

In December 1909, scientists were predicting good visibility of Halley's comet, due to appear the following spring.

"The period of its greatest brilliance will occur early in May," PM correctly predicted. Astronomer Cecil Dolmage couldn't speculate on the exact contents of a comet, but he noted hydrocarbons, sodium and iron were likely constituents. Our knowledge of comets, Halley's in particular, should be updated in 1986 when Soviet and European satellites encounter Halley.



## Crank behind wheel

Detroit had come out with a new engine crank running through the dashboard to a countershaft. Thus, the driver didn't have to get out of the car. The idea was popular for 10 years.

50 YEARS AGO: December 1934



Some speedboats fly.

## Waterbugs take off

A new class of speedboat called "the waterbug" had taken boat racing enthusiasts to a heady 50 mph in rough water in 1934. Nontip chines built on the hulls kept the boats from capsizing in each other's wake. A new speedboat cost \$150.

## Diamond in the shop

American tool manufacturers started using real diamonds on some tools. Jewelry, marred with faults or chips, was ground to produce the first diamond cutting edge.



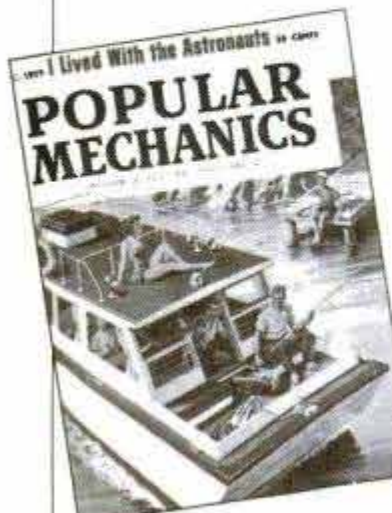
## Cool fuel for trucks

Detroit's newest trucks were air conditioned by running fuel through a cab compressor. It cooled the cab, then flowed on as dry gas to the intake manifold. Unfortunately, the coolers broke down often.

## Fillerup, and move

The Ohio Oil Company began building highway filling stations that could be moved from place to place. The 5-ton stations fell out of favor in the 1940s, when it seemed gas stations would be forever profitable.

25 YEARS AGO: December 1959



PM builds a new houseboat.

## Housing on water

In 1959, houseboats were so popular that a Doris Day film, "Houseboat," became that year's hit. We gave plans in two parts for this 24-ft. beauty that slept four comfortably. Fuel crunches made houseboats unstylish by the '70s.

## Ford's Comet

Our *Detroit Listening Post* announced the coming of the Mercury Comet, an upsized version of the compact Ford Falcon. Both cars were off the market early into the next decade.

## Super bridge starts

Construction began on the Verrazano-Narrows bridge linking New York's Brooklyn with Staten Island. The \$320 million bridge was completed on schedule in 1965. The bridge remains an impressive civil engineering feat. The 4,260-ft. span over the Hudson River was itself impressive. But the bridge was built double-decked with six lanes on each level and it stretched out 6,690 ft. It was so successful British engineers are copying its design in a Thames bridge now under construction.



## Our first spacemen

Author Joseph Bell posed with Walter Schirra (left) and Scott Carpenter (right) while researching our first biographies of American astronauts. **PM**



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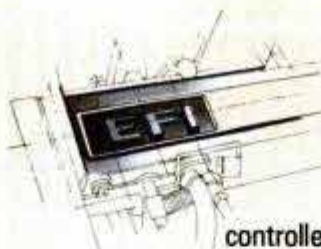
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Don't worry about the 185R14 tires, either. Eight plies help keep them on

OH WHAT A FEELING!

the job even when the whole load hits 8,500 pounds.\*\*

Finally, a heavy duty truck that's

**5000 LBS.  
TOWING**

built for the kinds of equipment you

haul. And the kind of ambitions you have.

\* Including occupants, equipment and cargo.  
\*\* Max. GVWR not to exceed 8,500 lbs for vehicle and trailer combined.  
\*\*\* 22 City MPG, 27 Highway MPG. Remember: Compare these estimates to the "EPA Estimated MPG" of other trucks. You may get different mileage, depending on how fast you drive, weather conditions and trip length.

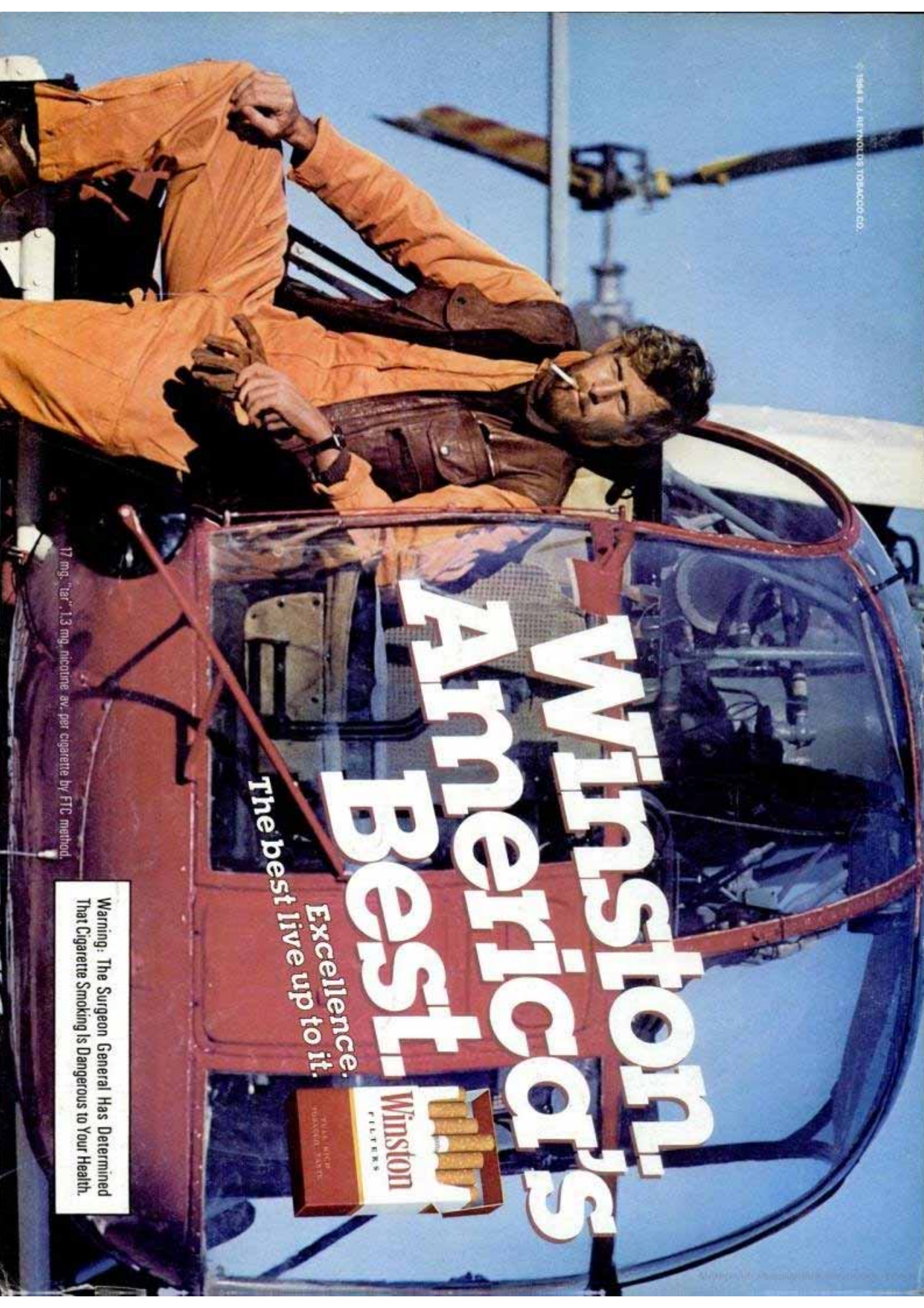
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Excellence.



17 mg. "tar", 1.3 mg. nicotine av. per cigarette by FTC method.

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