

APRIL 1976 75 CENTS

Popular Mechanics

**17 PAGES OF HOME
IMPROVEMENT
SPECIAL!**

**51 ways
to add
comfort
and
value**

**Be a big-rig expert with the
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**20 inside tips that
take the gamble
out of buying
a used car**

**PM rates 11
low-cost HI-FI
TURNTABLES**

**Now telltale
prints can trap
oil spillers**

**How we'll tap
STARPOWER
to beat the
energy
fadeout**

**3 easy cures
for problem
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FOR SUMMER
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† In California see your local Subaru dealer for price and gas mileage figures.



**THE SUBARU 4 WHEEL DRIVE WAGON.
CLIMBS LIKE A GOAT, WORKS LIKE
A HORSE AND EATS LIKE A BIRD.**

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Plan your garden around this versatile garden house made of redwood and photographed by Fred Lyons

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Popular Mechanics®

APRIL 1976 • Vol. 145 No. 4

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SPECIAL FEATURES:

Truckwatcher's guide to the big rigs. Our passion for big trucks is just beginning, as is our interest in identifying them. Page 76.

Boats to catch more bass lists the many extras and built-in refinements that are now considered essential by the bass-fishing experts. Page 94.

Science taps star power for unlimited energy. By using an artificial sub, researchers hope to tame the fusion power of the H-bomb. Page 71.

Home Ideas Guide is a special-section roundup of ideas and projects to help you spruce up your home and property this spring. Starts on page 119.

Now 'fingerprints' are trapping oil polluters. Amazing new techniques can lead the Coast Guard to solving mysterious offshore oil spills. Page 80.

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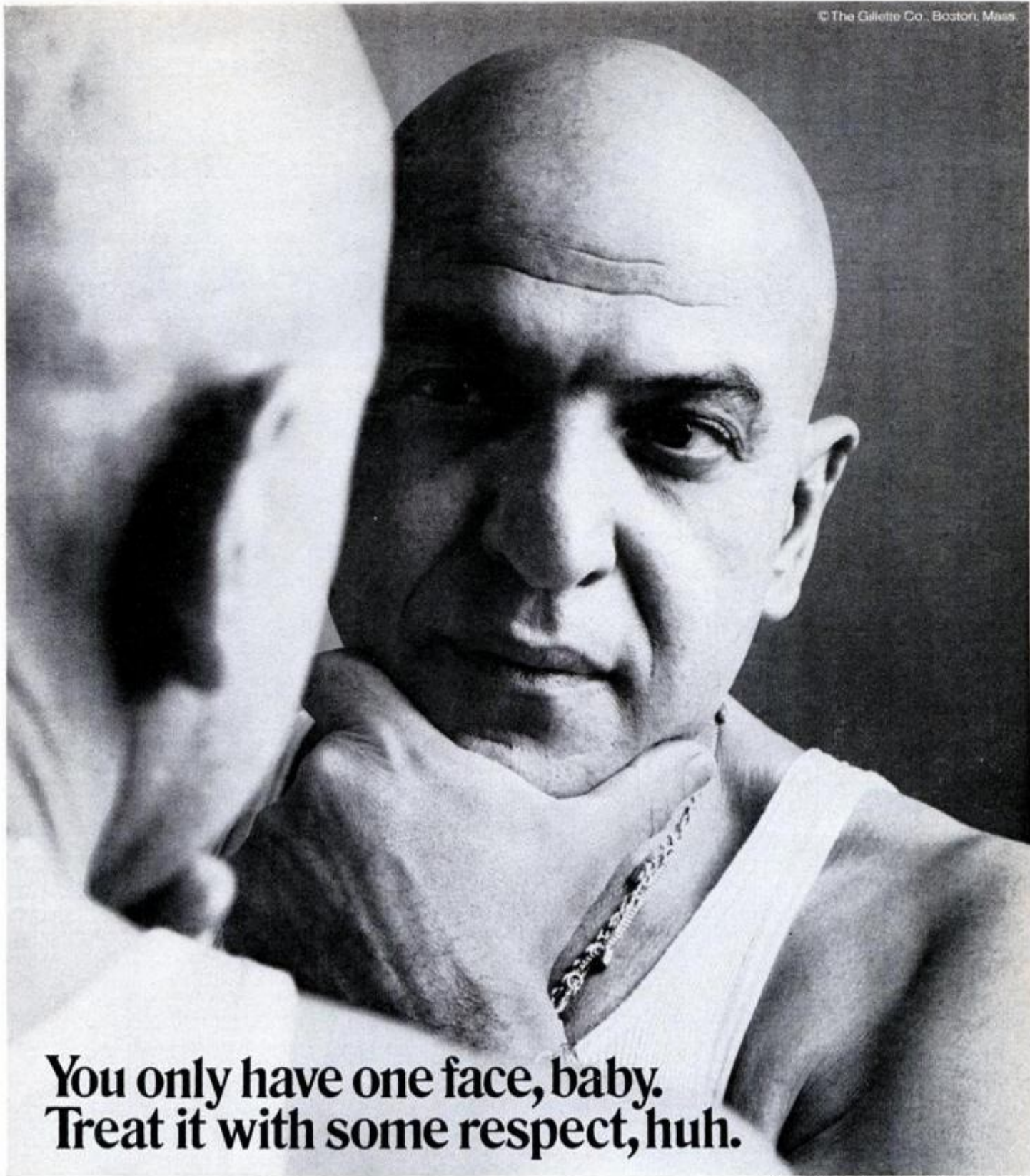
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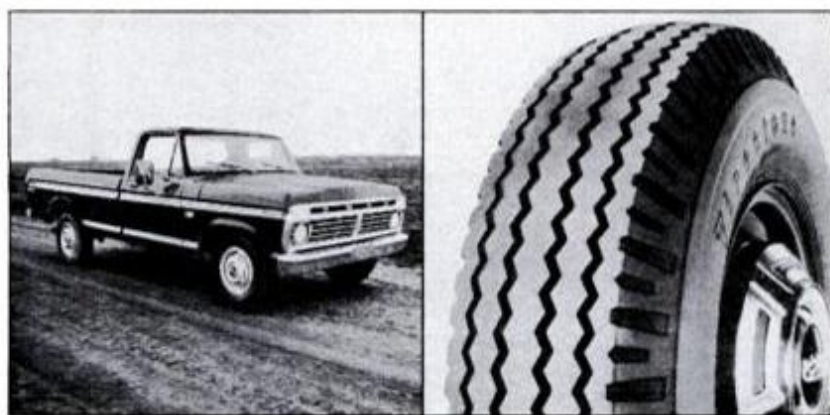
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LETTERS

TO THE EDITOR

No smiles for 'Ma Bell'

Your article, *Invisible Revolution Inside Your Phone* (page 92, Jan. '76), brought no smile to my face. While the phone companies spend billions of dollars on new research for far-out ideas, millions of consumers pay exorbitant prices for inferior service. Business and professional people have vast arrays of devices and circuits available to facilitate their work, but John Doe spends many hours trying to call across town on his party line.

I can only conclude that "Ma Bell's invisible revolution" is to increase profits for "Ma Bell" rather than improve service to people on the other end of the line.

FRANK G. MCNEELY
CASPER, WYO.

An ill wind

Just a few observations on *Weather Demons in the Sky* (page 49, Jan. '76) from an old "prop" pilot.

All airport personnel should be aware of reversing winds that occur in the "scud-roll" that often precedes thunderstorms. When a heavy, stabilized plane loses its head wind in seconds during landing, it is caused by a sudden loss of lift and not a "gust from the rear," or a "violent downdraft," as stated. Modern jets do not respond instantly to applied power like prop jets do.

Your artist illustrated the culprit perfectly on page 49. The head wind that brought the storm to the airport has quickly changed to a tail wind for the landing plane, and is being sucked in under the "scud-roll" (dark, angry clouds) and up into the storm center.

The only dangerous wind shear I've encountered near ground is the vortex mentioned behind powerful planes in takeoff. Even under violent thunderstorms over level land or out at sea, there is always a stable and less turbulent strata of air 50 to 100 feet "above the deck."

I suggest two solutions: First, all controllers should raise landing speeds 20 mph during local turbulence, as did Capt. Nickerson of Eastern Airlines. Second, install a 10-mile ring of six wind monitors that will accurately display the actual wind direction and speed for approach to the runway in use. Thus

landings could be temporarily held while the quick passage of a "scud roll" is monitored across the airport.

WILLIAM C. OTWELL
TRAVERSE CITY, MICH.

A number of witnesses stated there was a large lightning strike in the flight path of EAL 66. It is a known fact that a bolt of lightning creates a vacuum which is what makes the thunderclap after the flash.

I have been with TWA for 31 years as a mechanic and have flown over a million miles in all kinds of weather so it is of great interest to me.

I think that EAL 66 could have flown into a vacuum created by the lightning bolt and lost lift in the vacuum for a few seconds, getting into trouble before they could recover. Nobody has brought up the fact of nature yet, and I think it should be checked out by the FAA.

ROBERT B. RYAN
TORRANCE, CALIF.

\$35 hockey game

I am 15 years old and I have just completed your air-hockey project (*Build This Tabletop Hockey Game for Family Fun*, page 94, Nov. '75). The total cost of the project was \$35, including two four-inch squirrel cage fans. It was a lot of fun to build and it really works great!

STEVE PALERMI
QUEENS VILLAGE, N.Y.

Here come the diesels

May I compliment you on that fantastic diesel section (*Here Come the Diesels*, page 60, Jan. '76)? It is a view of a triple diesel overview present, future and private. Beautiful!

MICHAEL J. ROMANIUK
MATTAPAN, MASS.

The article was very interesting and informative. I also enjoyed the owners report on the Mercedes 240 (*The Pleasure and Pain of Owning Diesel*, page 62, Jan. '76). Since I own a '74 Peugeot 504 diesel station wagon, I thought you might be interested in my experience.

I bought the car with air conditioning in October 1974. After 57,000 miles, my average mileage is 30

ppg. Average cost per gallon is 47 cents. So far this is the most economical car I've owned in 20 years. The "proof of the pudding" in auto economy is not the purchase price—it's the cost per mile. Depreciating the purchase price over three years and allowing only \$1500 salvage value, my total cost including insurance, operation, etc., comes out to 5 cents per mile.

This is my first Peugeot and first diesel. My biggest complaints are low torque, diesel vibration and some slackness in the steering. I hope to drive it for at least 200,000 miles. Thanks for a good magazine. Keep up the good work.

D. LOWELL NISSLEY
SARASOTA, FLA.

The 'safe' accident era?

Safety and Style: You'll Be Getting Both! (page 76, Jan. '76) may forecast the 21st century car. However, some it looks more like preparation for a public demolition derby. The pedestrian "trap" and trampoline hood" would make Henry Ford Sr. turn over in his grave.

Are we about to enter the era of the "safe and sane" accident?

ROBERT B. ROSS
CAMBRIDGE, MD.

Repairing broken cassettes

Your article, *Snarled and Broken Cassette Tapes Can Be Fixed* (page 5, Jan. '76), is better than most "expert" methods I've seen.

However, I suggest that you unseal the welded cassette with the cassette lying flat, instead of standing it on edge. This way, there's no chance for the tape to fall out.

Unsealed cassettes can be repaired with white glue, applied carefully, then allowed to dry overnight.

F. GIFFORD
MESQUITE, TEX.

Backward bezel

As a novice collector of old clocks and a maker of new, I happened to notice that the school clock on your December 1975 cover has the upper door (bezel) opening to the left. Standard school clock doors always open to the right except on some

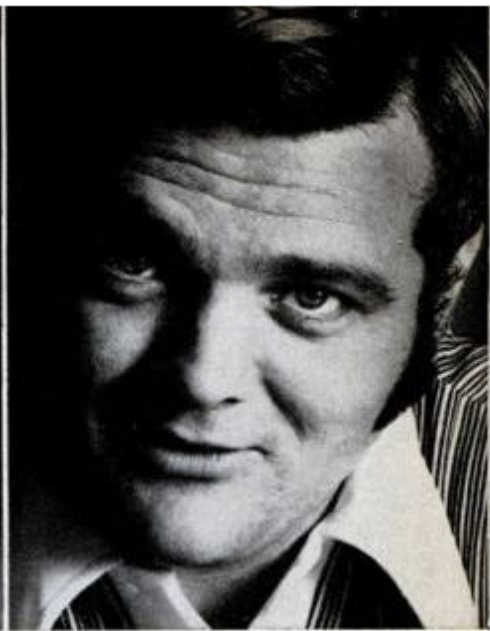
(Please turn to page 187)



One beautiful experience deserves another. Like an A&C Grenadier. Long. Slender. Elegant. A superb blend of imported and domestic tobaccos that rewards you with the rich, smooth taste you're looking for. In light or dark natural wrapper.

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GET A FREE RIDE
THROUGH COLLEGE
TELL HOW THEY
BECAME ENGINEERS.**



RON JAKUBAS

"Something happened to me on my way to an engineering degree. I fell in love, got married, and had to take a factory job. But I wasn't going to settle for that. So I enrolled with ICS. Their training not only helped me get a couple of promotions but also pass the Michigan exam for Registered Professional Engineer. Today, I own my own manufacturing company. That's more than most college men can say. Do I recommend ICS? You bet I do."

GARY BURNASH

"Too bad, but the college I went to didn't hand out degrees in hot rodding. So after my first year my Dad and I had one of those long talks. The upshot was, it was time to get serious. So I got a job and signed on with ICS. They taught me everything. Print reading. Materials. Hydraulics. Even how to use a slide rule. I'm making triple my starting salary now, but here's the best part—I'm a half owner in the business. If I want another raise, the man I ask is me."

JACK TERRY

"I grew up near the Okefenokee Swamp and what that means is, you don't expect life to be a gravy train with biscuit wheels. I went to work real early with the Florida Department of Transportation as a beginner draftsman. I heard the fellows tell of ICS so I sent for the information. Before long, I got to be a First-Level Highway Engineer at twice the pay. It took five promotions but the ICS training was a real help to pass each promotion exam."

Ron, Gary, and Jack are three of our outstanding graduates. Like them, you too can become an engineer without going to college. Of course, ICS can't guarantee you'll get a job or be as successful as these three men. But if you're serious and willing to work, ICS can train you from scratch, at home, for one of the many engineering jobs opening up each year. For a *free* Career Booklet and *free* Demonstration Lesson, mail the card or coupon today.

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SCIENCE WORLDWIDE



Californians commute by water

A smooth combination of powerplant and propulsion system will move commuters to and from work when the first of three waterjet ferries goes into service this spring between San Francisco and its Marin County suburbs. Three 2800-hp marine gas turbines provide power for three Jacuzzi pumps. The vessel is steered by moving stern-mounted water nozzles (photo, below) through an arc of 90°.

Gas turbines were chosen over diesels to save space, and the hull is made of aluminum to save weight. The 250-ton ferry is capable of 25 knots even when filled to its 750-passenger



capacity. The three ferries, it is hoped, will provide an attractive alternative to San Francisco-bound commuters, whose cars are creating increasing congestion on the Golden Gate Bridge.

Here's another crummy diet

If you want to lose weight, eat bread—lots of it, says Dr. Olaf Mickelsen, professor of food science and human nutrition at Michigan State University. He reports that two groups of MSU men lost an average of 19.4 and 13.7 pounds after eight weeks on a bread diet. The groups differed only in the kind of bread they

ate. One group grew lean on a commercially prepared bread and the other ate a low-fat, high-cellulose loaf especially prepared for the experiment.

"The diet is simplicity itself," says Dr. Mickelsen. "The volunteers ate 12 slices of bread daily and whatever else they desired—even snacks. The diet works because the bread provides filling bulk that limits the amount of other foods and calories that can be comfortably eaten." Starch in the bread prevents the development of "ketosis," a blood condition associated with weight loss that can cause headache and nausea. The diet also caused a reduction in the volunteers' serum cholesterol levels—a dividend that could be important for overweight people with heart problems.

Chemicals losing battle with bugs

Controlling pests with chemicals is becoming increasingly difficult, and if alternative technologies are not perfected, serious problems will be posed for agriculture and for public health. This warning is contained in a recent report from the National Research Council, which is made up of scientists who conduct studies in the public interest.

The effectiveness of chemical pest control is challenged by the appearance of genetic resistance in many pest species and by the breakdown of "natural" control mechanisms.

The report recommends a "substantial expansion of present efforts" to develop such alternative technologies as: "third generation" chemicals that interfere specifically with the

biochemical systems of pests but are relatively nontoxic to vertebrates; bacterial and viral agents, some of which offer "great promise" as control agents; breeding of pest-resistant plants and the introduction of genetically modified bugs—such as sterile males—into natural pest populations.

Scientists master yellow peril

The researcher behind the beaker is "getting the yellow out" of a piece of the Yellow Pages—not as simple as it might seem. Western Electric buys about 240,000 tons of paper a year for Bell System directories, and about half of that paper is used for the Yellow Pages. In the past, the yellow dyes could be bleached only with strong chemicals that degraded the paper fibers, making them unsuitable for recycling into paper usable for printing.

Western Electric researchers in Springfield, N.J., now have a yellow dye that can be bleached quickly with a mild chemical agent leaving fibers robust enough for recycling into



printing-grade paper. They figure that if the paper for a year's supply of Yellow Pages can be recycled, it will save over 950,000 trees. Pass that along to all your friends in the woods. ★★★

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Introducing Delco Big D Shock Absorbers. The biggest and toughest Delco's ever built.

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to smooth out the road and give you a Red Carpet Ride. And they come in a complete line, so you can choose the right size and type to fit your needs.

They're built tough for everything from subcompacts to big

wagons and pickups. Delco Big D Standards and Heavy Duty Big D's have the famous shock design advances

Big D's are extra wide for a Red Carpet Ride.

pioneered by Delco, plus the big 32-mm (1¼") piston. The Big D Extra Heavy Duty,

with a 35-mm (1⅜") piston, can take on the really tough jobs. And for special help with heavy loads and towing, you can choose from Big D Spring Lifts and adjustable Air Shock Systems.

Big, tough, precision-built with Delco quality control, Big D Shock Absorbers have it all, and in a size and

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THE BICYCLE SHOP

GENE ANSWERS READERS THIS MONTH

How to 'unclunk' a chain

My 10-speed chain "clunks" in the small sprocket position. No tooth bent on sprocket, no chain hang up, chain well lubricated. Suggestions?
—John Tulle, Sacramento, Calif.

I'm afraid "clunk" isn't descriptive enough for accurate diagnosis. Closest symptom this word suggests is chain rub on chainstay. You may not have replaced a spacing washer when taking the rear hub apart for cleaning and relube, in which case the gear cluster would be moved that much closer to the chainstay. There's very little clearance between the stay and the chain as it is. Hold the rear wheel off the ground, twirl cranks with chain on big front and small rear gears, checking to be sure chain does not rub on chainstay. If it does, add a thin spacing washer between cone and locknut (on axle) on free-wheel side. Or chain may have worn and stretched, in which case it should be replaced.

Keeping up the pressure

I cannot keep my tubular tires above 60 p.s.i. with the pump I have. Is there a good Presta valve pump for tubular tires that will let me hand-pump them up to 90 p.s.i.?—Dave Olson, Woodbury, Minn.

Best pump for Presta valves is the Campagnolo "Silca" that, with a little elbow grease, will let you hand inflate to at least 100 p.s.i. (I suggest you buy tubular tires with butyl tubes so you don't have to pump them every day.)

Bike for a heavyweight

I am six four inches tall, weigh 250 pounds, put a lot of stress on a bike frame and wheels. I am told that a bike frame which fits me, from 27 to 29-inch frame size, is weaker than smaller frames and could break. Is this true? What type of hubs and spoking do you recommend to reduce spoke breakage problems?—Alf Helmer, Brooklyn, N.Y.

A well-made, custom-built frame that gives you about one-inch clearance between you and the top tube when straddling the bike with both feet on the floor (with shoes off) is just as strong as a smaller frame-set. Big-frame bikes are seldom off-

the-shelf items, so I suggest a good custom frame builder. For wheels I would use 40-hole rim and hub with crossed three tandem spokes or Robergel "Sports Etoile" spokes. The "crossed three" lacing pattern should also be used with high flange hubs. You'll have a set of wheels that may not win any prize for beauty but will be highly resistant to spoke breakage even on rough roads.

Small parts . . . big problems

Where can I buy a new rear tension spring for my Sun Tour derailleur? Bike shops around here have this part; they advise me to buy a new derailleur.—Donald J. Novicki, Erie, Pa.

For a dealer near you who stocks the part, write the importer: West Coast Cycle Supply Co., 1241 East Watsoncenter Rd., Carson, Calif. 90744.

A silk purse . . . ?

Can a multiple-sprocket freewheel and hub assembly be adapted to the rim and frame of a standard middle-weight balloon-tired bicycle?—Tod Nicholson, Marion, Ind.

Sure, but you would still have a standard, middle-weight balloon-tired bike, and the wider gear ratio would add very little toward upgrading this machine. You can buy hubs with 36 or 40 spoke holes to match your rim. You will have to spread the rear stays to force the wider hub into the dropouts, and you'll probably find the chain will rub on the chainstay in the small, outer gear.

Loose fingertip solution

My Campagnolo bar end-shifter tension screw comes loose every three miles or so. Also, I would like to use the new Michelin 27 x 1 1/8-in. light-weight wired-on tires, but the tubes have Presta valves. Would these valves wiggle and be damaged in the larger Schraeder valve hole?—Tom Sobol, Gary, Ind.

Tighten both sides of the tension adjustment so it will stay put. Also, did you lose a washer when assembling? The thinner-diameter Presta valve stem is outside-threaded for a locknut, which should keep the valve in place. I use Presta valve-stem tubes in my Schraeder-valve hole

ribs and never have problems. The Presta valve lets you use the good Campagnolo Silca pump, although you can now buy the thinner 27 x 1 1/8-in. tubes with Schraeder valves.

Motorized bikes

While in Canada recently I saw a lot of people scooting around on little motorized bicycles. Where can I buy one here? Are they legal?—Raymond A. Roberts, Louisville, Ky.

Nine states now call these motorized bikes bicycles; thus they are exempt from motor vehicle registration and anybody can ride one. Other states are planning such a move.

I use such a machine almost daily to shop and get around town. I can keep up with city traffic, and park where I could never squeeze my Detroit iron into or would never leave my good bike, even locked up. My little Velo-Solex gets about 170 mpg, goes 35 mph, holds a week's groceries for five in two saddlebags, costs around \$450. Its motor can be disconnected so it can be pedaled for exercise or if you run out of gas. Importer is Motobecane America, Ltd. 86 Orchard St., Hackensack, N.J. 07601. Before buying, check classification of mopeds with your state motor vehicle bureau.

Workshop bike stand

Is there a good, but inexpensive work stand for the occasional home bike mechanic? I hate to spend \$75 or more for a tool I seldom use.—Frank Casitas, Pueblo, Colo.

My home bike "work stand" costs about 50 cents. I use two padded hooks attached to two pieces of rope and suspend the bike from the ceiling. The hooks go around the top tube. For something more stable, though, \$19.95 plus postage brings you a collapsible bike stand from Willmarths, 1245 South Beverly Glen Blvd., Los Angeles, Calif. 90024. It collapses to about two inches thick when stored. ★ ★ ★

If you have any questions about bicycling send them to The Bicycle Shop, 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.

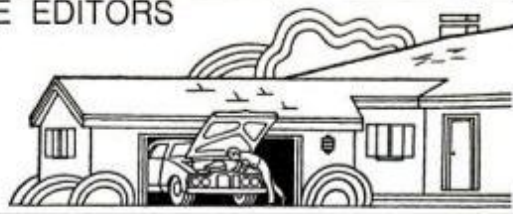
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THE PM GARAGE



Per-Lux fog lights

If you live in foggy country, as I do, you'll appreciate a headlamp replacement called Per-Lux. It works only in cars with round quad headlight systems.

Installation takes about 15 minutes per side and requires only a Phillips screwdriver for most cars. The Per-Lux units replace a quad



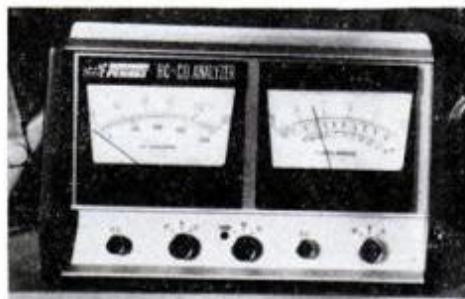
system's low beams. Instructions call for wiring Per-Luxes so the high and low beams come on separately, but alternate footnotes and two pieces of extra wiring light up all four units on "high" (same as normal).

Per-Luxes give a bright, flat beam that doesn't bounce back into your eyes when you drive in fog or falling snow. I've tried several types of fog lights, and these equal the best of them. Also, you don't have an extra set of lamps cluttering up the front of your car.

Per-Lux fog lamps cost \$55.30 at many auto stores, or write directly to the distributor: Per-Lux, Inc., 804 East Edna Pl., Covina, Calif. 91723.—M.L.

Exhaust analyzer

Sears, which has been offering a CO meter for some time, recently introduced a more sophisticated exhaust-gas analyzer that measures both CO and HC. It's a fairly costly machine (about \$300), but it does a lot of different things. For the serious hobbyist, the filling-station mechanic,



plus many tune-up and repair shops, it fills that huge gap between the big Buck Rogers analyzers and the timing light/compression gauge.

Sears' HC-CO Emission Analyzer triples as 1. a tune-up machine, 2. a diagnostic tool, and 3. a tester to check pollutant levels. You can quickly tune late-model cars to factory emission specs, which also happen to give optimum gas mileage. You can pinpoint carburetion, ignition and mechanical problems. And you can see whether a given engine complies with smog regulations.

This analyzer is quick, accurate, rugged, and simple in the way it works. Like any test equipment, it does take a bit of getting used to, but once you've mastered the two meters (and that's simpler than mastering a vacuum gauge), you'll never want to go back to cruder, slower test equipment.—M.L.

Windshield cleaner



A soapless windshield cleaner that really works is Clear Smear by Turtle Wax. It doesn't foam up or spot or discolor paint. You can squirt it directly onto a prewetted windshield or add it to your washer reservoir. One 8-ounce, 99-cent squeeze bottle contains enough cleaner for three average washer refills. Clear Smear is sold in most automobile accessory stores.—M.L.

Do-it-yourself wipers

With windshield wiper replacements now costing \$6 to \$11 a pair, it's refreshing to find a cut-and-fit kit that retails for \$2.49.

Storm Chasers, manufactured by Tridon Ltd., Burlington, Ont., Canada, fit all American cars and most of the imports that use blades up to 19 inches long. Adapters are provided for both steel and plastic-backed blades.

You simply snap the backing at the appropriate score line (the various lengths are ruled beside the scores), slide the backing onto your old blade



arm, insert the rubber wiper, cut it off with scissors, force in a plug and that's it.

Storm Chasers are sold at most auto stores and filling stations in the United States and Canada.—M.L.

Inexpensive wheel puller

Three sets of 3¾-inch puller bolts come in this handy steering-wheel-puller kit. These are threaded for most U.S. Standard and SAE applications (all steering wheels have threaded holes for pulling). You'll have to buy special bolts for some imported cars. The \$4.95 puller is sold through most auto chain stores by Hollywood Accessories, Compton, Calif. 90220.—M.L.





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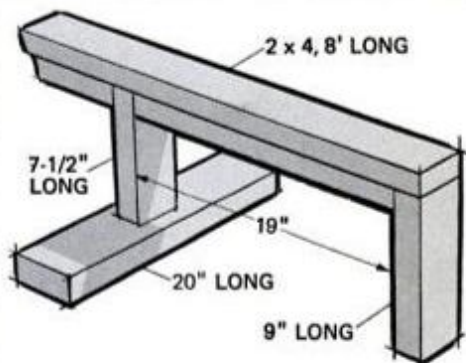


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QUICK SHOP PROJECT

Balance beam from 2x4s



Budding gymnasts can perform cartwheels, turns, jumps and Olympic-style poses on this easy-to-make mini-balance beam. Built from 2x4s, it takes less than one hour to put together and is light enough for your children to carry.

You'll need a pair of 8-ft. lengths for the beam itself. Cut two 7½-in., two 9-in. and two 20-in. lengths from a 6-footer for the legs. Form cross supports by joining the 7½ and 20-in. pieces as shown; attach them 19 in. in from each end. Then nail the 9-in. ones to the ends of the beam. Finally double-up the top member with tight-fitting horizontal supports between the legs.

Use a good grade of lumber, since most young gymnasts like to practice barefooted. Sand carefully to keep top edges smooth, but not overly round. Varnish or wax as desired.

—Elyse M. Rogers.

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		CL-594

CAR CLINIC

BY MORT SCHULTZ



Some like it hot

I've been a professional mechanic for six years, but never have I come across a problem like we're having in this shop with a 1970 Buick LeSabre. The car overheats when we start it up. Here is what has been done: new water pump; thermostat; heavy-duty radiator; hoses; timing chain; distributor and fan; serviced heat-riser valve; replaced head gasket; cleaned block and found absolutely no blockage in the water jackets; reconditioned cylinder heads, and verified that the sending unit and gauge work. This car really overheats, running no less than 245° on a cool day. It's now sitting in a corner, gathering dust. What have I missed?—Michael J. Stavola, Brooklyn, N.Y.

Maybe a part called a thermovacuum switch, Mike. It sits in the coolant passage at the left front corner of the intake manifold of a V8 engine. The purpose of this part is to advance the ignition timing at idle when coolant temperature is high, allowing the engine to run cooler. To test whether the switch is working:

1. Disconnect the distributor vacuum hose at port D (for "distributor") of the switch.

2. Connect a vacuum gauge and check for vacuum with the engine idling. The engine must be at normal operating temperature, so if it's hot let it cool down.

3. If more than five inches of vacuum are recorded, and hoses are connected properly to the switch's two other ports (C for "carburetor" and MT for "intake manifold"), replace the thermovacuum switch. When the new switch is being installed, be sure to use a soft-setting sealant on the threads.

The nose knows

What can I do with my 1975 Chevrolet Vega station wagon (140-cu.-in. engine), which emits such a noxious smell from the engine it makes me nauseous? The smell prevails with the windows open. I've taken the car back to the dealer, but the mechanic just laughs and tells me I must get used to it.—Joseph P. Krawulski, Holiday, Fla.

Maybe the guy has a distorted sense of humor, because I don't see anything funny. However, you didn't give me much information to go on. What kind of smell is it—exhaust, rotting odor, or what?

If you're getting an exhaust smell, floor panels should be checked for open seams and the exhaust system examined for leaks. Seams can be sealed with a body putty called dumdum.

If the smell is a foul, rotting type, check the airconditioner ductwork under the firewall for open seams. Seal them.

I've got a hunch, though, that you may be a person who is particularly sensitive to odors, and you should be aware of the fact that the airconditioner-heater blower motor in your car turns on as soon as the ignition is turned on and doesn't turn off

until the engine is shut down. This is to permit constant circulation. This may be the reason for the odor which to you is objectionable. The constant circulation may be circulating a condensation-type odor from moisture which has accumulated in the ductwork into the vehicle through duct doors.

If this is the case, I think you would be more comfortable having the blower disconnected. You can do this by breaking the circuit at the hot lead going to the blower and installing a toggle switch which can be mounted beneath the dash. This switch will allow you to turn the blower on when it's needed and off when it isn't.

Marking time

It's a 1975 Lincoln Mark IV that's causing my trouble. Every time I accelerate, there is a bad hesitation. At times, the engine dies. The service manager hasn't been able to solve the problem. Why?—Hubert Abney, Dayton, Ohio

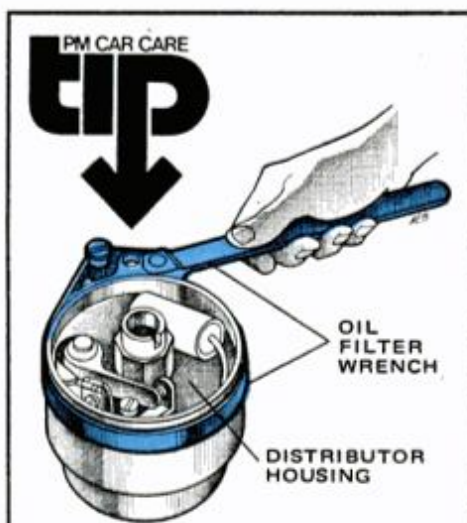
Because he hasn't found the service bulletin that tells him how. I'm speaking about service bulletin No. 86 (3/21/75), article 1055, *Stumble, Hesitation and/or Stall on Light to Moderate Acceleration*. The information describes how to correct a deficiency in the accelerator-pump circuit.

Dippy dipstick

The lower end of the oil dipstick in my 1973 Plymouth Scamp slant-6 engine broke off after I owned the car two years. The piece apparently wedged between a rod and the crankshaft, breaking the rod and sending it through the block. I had to install another engine. The Plymouth dealers in this area can't explain what happened. Can you give us a clue?—Richard J. Maxwell, Colonial Beach, Va.

Try this one for the dipstick breaking: Someone or something caused the dipstick tube to bend, which made it necessary to insert the dipstick at an angle. The crankshaft caught the tip of the angled dipstick and broke it off. I imagine this is what happened if the tip of the dipstick did

(Please turn to page 26)



Freeing frozen distributor

One of these days, you're going to unbolt the distributor and try turning the housing so you can set ignition timing, only to find that the housing won't turn. It will be frozen. Don't rush to get a hammer. That can lead to damage. Instead, wrap your oil filter wrench around the distributor housing as shown above. It should provide ample leverage to allow you to free the component. If the distributor is really stuck, squirt some manifold heat-control-valve solvent around its base. This will loosen the part without damaging it.

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CAR CLINIC

(Continued from page 22)

break off, because I've not been able to detect any defect in design which would cause this, and the dipstick tube is "bendable."

However, I'm kind of suspicious of the explanation that a tip of a dipstick could cause the extensive damage you describe. Since you don't give me any other symptoms leading up to the incident, and since you yourself seem to believe that the dipstick caused the damage, then I won't doubt it. But I'm entitled to my dubiousness.

From now on, I think it would be a good idea to keep your eye on the dipstick and tube, just in case someone or something somehow puts some pressure on the tube. If the tube bends, straighten it carefully. The dipstick should go into the engine vertically—not angled!

Enough to boil my oil

I've been driving 62 years and have never had an accident, but I swear I'm going to have my record broken if you can't help me. My car is a 1968 Ambassador eight-cylinder that runs like a dream, but at unexpected times all four wheels lock when I apply the brakes. I've had brakes re-lined although old linings were good and have consulted two different garages that said they aren't able to help. Can you help?—Mrs. Ruby Railsback, Spokane, Wash.

Heaven help us when two supposedly professional shops don't have the knowledge to diagnose a serious problem like this one. The cause of your trouble, Mrs. Railsback, is one of the following (in order of most probable occurrence):

1. Pedal linkage bellcrank is binding.
2. Binding in the power-assist unit (the unit should be replaced).
3. Master cylinder damage, such as a worn primary cup or blocked compensator port. In any event, the master cylinder probably has to be overhauled or replaced.

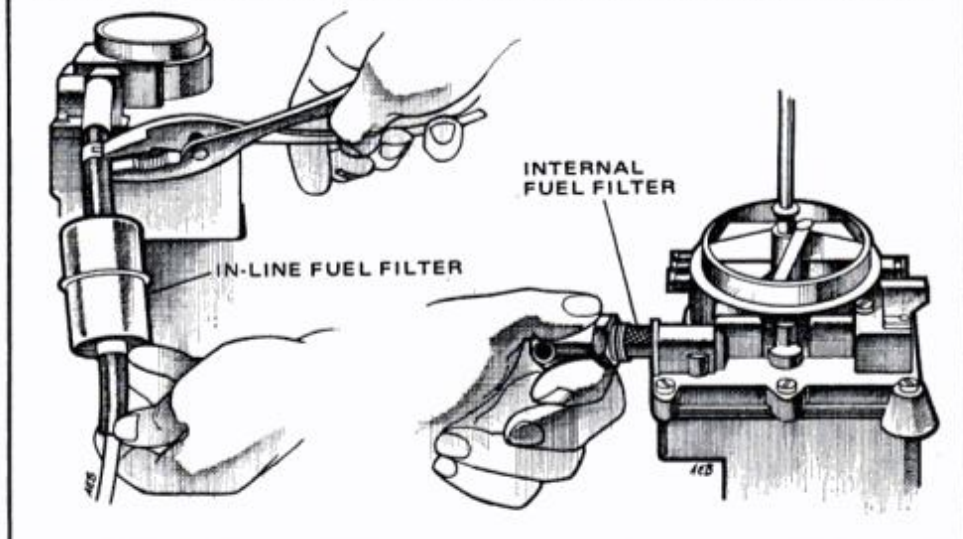
All four wheels are locking—not one—so the trouble has to lie with a component affecting all four wheels. Only the pedal linkage, power-assist unit and master cylinder fall into that category. New brake linings, indeed!

Persistence pays

Early in the game, in several *Car Clinic* columns, I reported that engine damage to 1971-74 Chevrolet Vegas resulting from overheating would be covered by company warranty for up to 50,000 miles. Some

Keep out-of-sight in mind

Most AMC and Chrysler models, and some Ford models, possess a fuel filter out in the open where you can see it. The filter is cut into the fuel pump-to-carburetor fuel line and is easily replaced, which is a job you should do every 12,000 to 15,000 miles (first illustration). Changing filters averts the possibility of a clogged filter halting the flow of fuel. Fuel filters in GM and other Ford models aren't as obvious. They are located in the carburetor inlet (Illustration 2), and because they are out of sight may make some think there is no fuel filter. These filters are no less important than the others and should be removed for cleaning and/or replacing as often as others. Bronze internal filters may be cleaned in kerosene and returned to service. Paper filters should be replaced.



of our readers benefited from the advice. Others were dismissed by dealers and company representatives with comments to the effect, to paraphrase, that the guy who writes *Car Clinic* is nuts. I would like to quote from a recent UPI story datelined Washington, D.C.:

"Millions of motorists in the United States and Canada are needlessly paying to have their cars fixed because Ford and General Motors refuse to admit they will pay for certain repairs, the Center for Auto Safety said Tuesday.

"The problems range from rusting in certain Fords, especially the 1972 Pinto, to engine overheating in the 1971 through 1974 Chevrolet Vega, the group said. It urged the government to require the automakers to disclose their programs for making such repairs.

"As it now stands, the center said, only the 'most persistent and if you will, obnoxious,' car owners who go beyond the dealer and complain loudly to the district manager get the companies to pick up the bill."

Enough said.

Left, right. Left, right

I have a problem with the directional signal lights of my 1966 Plymouth. They burn out frequently—that is, every couple of days to every couple of weeks. No one has been able to identify the cause of the trouble. Can

you tell me what it might be?—Charles L. Miller, Seaford, Del.

Try moisture that gets into or forms in the housings. See whether lens gaskets are damaged. If gaskets are in good condition, grind off a smidgin from the bottom of each lens. This separation will allow ventilation, permitting moisture to dissipate.

Late model ping-pong

My 1976 Mercury Monarch with 250-cu-in., six-cylinder engine is only a month old and pings like the devil. At first, it only happened when the car was straining uphill, but now it pings all the time. The dealer can't eliminate the trouble. A service station attendant said I should use a premium unleaded gasoline, and ping-pong is decreased when I do, but I don't see why I should pay the high price for this gas when the car is supposed to run on regular unleaded. Can you help?—Audrey J. Ryan, Natick, Mass.

Not really. Pinging became a headache with the 1975 models, which were the first to require the use of unleaded gas, and it continues to be a pain in 1976. The condition will exist as long as practically all unleaded gasolines remain at their present relatively low octane rating. Only one unleaded gas—Amoco, a premium sold at premium prices—is

(Please turn to page 28)

"In 1973, I insured my house for \$40,000. When it was destroyed in 1975, State Farm paid me \$52,200."

— Jack Horn, State Farm policyholder, Ralston, Nebraska.

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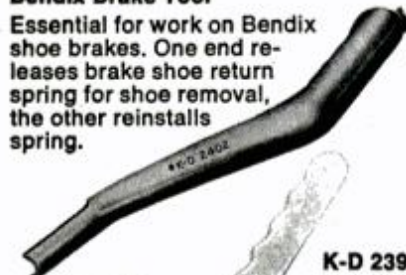
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CAR CLINIC

(Continued from page 26)

sufficiently high in octane to eliminate pinging or reduce it to an acceptable level.

One other thing you can try is to retard ignition timing about 6° from the specified setting. However, don't be surprised if you have to ease speed-up as you accelerate from a standing stop, since rapid acceleration may cause stalling.

Sorry I can't be more encouraging, but this is the way matters stand at the moment.

In search of plug sellers

In the October, 1975, *Car Clinic*, I told you that Champion has a new, free service booklet entitled *Troubleshooting the AMC, Chrysler, Ford, GM and IHC Electronic Ignition Systems*, and available from Champion marketers. I've been flooded with mail asking for the address of Champion marketers.

Sorry I failed to make clear that "Champion marketers" refers to a dealer who sells Champion spark-plugs. The address, in other words, is in your own home town—at almost any service station or automobile parts store.

Charged Camaro

Recently, my son purchased a new battery for his 1971 Chevrolet Camaro. Last week he parked the car in our yard, turned off all electrical accessories and took the key from the ignition. He didn't operate the vehicle for several days. Then one afternoon he noticed the right front headlight was hanging out and was held by one wire. He raised the hood and almost fainted. The top two inches of the new battery were completely melted off, fender and hood were heated white, and wires from the battery were melted off at the battery. Have you ever heard of anything like this? The battery hadn't exploded, but just seemed to melt internally.—Art Race, White Oak, Calif.

There are two likely explanations. The battery's positive cable, which runs down alongside the frame, through a metal eye loop and on to the starter, may have shorted out against the frame at any spot—a place that bears close examination is the eye loop. Vibration and/or excessive tension on the cable could have rubbed off insulation at this or any point, leading to a short. This would have sent a surge through the battery causing the tremendous heat which created the damage.

The second possibility is that the

battery was defective to begin with and it shorted internally through the plates. If your investigation of cables fails to reveal a short, I would ask your battery dealer to get in touch with the company service personnel who will want to conduct their own investigation.

Number game

The part number (1051343) you gave in the August '75 *Car Clinic* to clear up rocker-arm squeal in the Chevrolet L-6 engine doesn't make it. Our Local Chevy dealer claims the number is for windshield glue. Please check.—Ron Schneider, Brighton, Ill.

I did, and the dealer's "boss" in Detroit says the number, which is GM's designation for Loctite 75, is correct. However, a new procedure to stop squeal was issued after our August report. Have your Chevy dealer consult service bulletin 75-T-5 (9/11/75).

SERVICE TIPS

■ **Chrysler Corp.** has issued a service bulletin (02-02-75 [11/24/75]) that stresses the need for correct tie-rod height adjustment in curing a vehicle with a wandering problem. The information explains the correct procedure for measuring tie-rod socket housing-to-torsion-bar clearance and making the adjustment, including modification of the idler-arm bracket. Refer your service manager to it should you have the problem.

■ **Stick this in your hat** and remember it if you own or are planning to own a Chevrolet Chevette. The optional wheel covers consist of two pieces—a cover and trim ring—that appear as one. If you attempt to pry off the cover to get at wheel lugs by prying against the outer edge of the trim ring, you'll damage the trim ring. You have to pry against the outer edge of the wheel cover. Since the cover holds the trim ring, the ring will fall loose when the cover comes off.

■ **Ford Motor Co.** has some sound advice for owners of all cars, now that we're moving into warmer weather. In order to provide maximum engine cooling efficiency during high-temperature driving, use equal parts (50:50) of water and permanent-type (ethylene glycol) coolant when it becomes necessary to add or completely refill the cooling system. Use only high-quality ethylene glycol. Do not use alcohol or methanol antifreeze. If you get into a bind, you may substitute plain water, but replace it with permanent-type coolant as soon as possible to prevent damage to the cooling system caused by rust or overheating. ★★★

GOT A PROBLEM WITH YOUR CAR?

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



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A Sheetrock patch you won't see

Most problems that can develop with Sheetrock are literally skin deep. As your house goes through seasonal changes in temperature, wood framing members may shrink and shift. This can cause nailheads to pop and seams to ridge or separate. These situations can be solved by surface repair and spackling.

But what about larger holes? Like the time you were hanging a picture, missed the stud, and sank the nail and the hammer into the wall. Or you may have a nice round hole in a room where the doorknob has been driven through the Sheetrock by a child crashing open the door on his way to dinner. You can't spackle these holes unless you intend to fill up the entire space between the studs—don't try it.

Some people follow this approach by cramming newspapers into the wall to fill the hole before spackling. Although this system does turn your wall into a sealed time capsule for future generations, it doesn't provide much support for the spackle since the paper is not firm and will eventually fall. There is one good way to make a patch that is not only durable but unnoticeable.

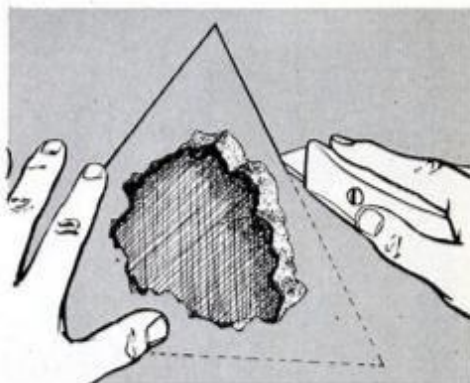
■ **First:** Cut an equal-sided triangle around the hole. Make four or five passes with the knife; don't try to cut through with one stroke. As you cut, angle the blade edge 45° to the outside of the cut with the blade tip pointing toward the center of the triangle.

■ **Second:** Cut a duplicate triangle (also called a dutchman) holding the knife at the same angle. This will let the edges of the hole and the plug seat against each other and keep the plug flush with the wall surface.

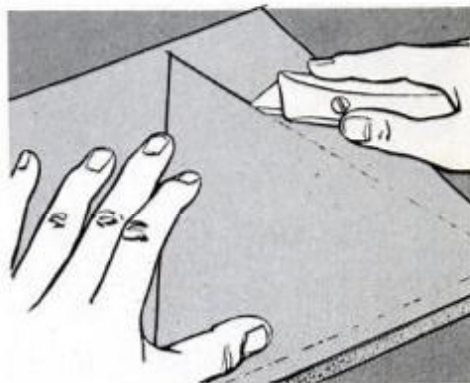
■ **Third:** Check the plug in the hole for size. If the angles are a little off (they probably will be since you're cutting by eye) you can use a wood rasp to equal them off so the patch sits flush. When you have a good fit, butter the edges of the plug with joint compound and set it in place.

■ **Fourth:** Finally, proceed with conventional butt joint taping and feather out the last two coats for a smooth finish. If you have trouble cutting the angles, you can glue and clamp strips of Sheetrock to the inside edges of the hole to make a good backstop for the plug. After they've set, install the plug and tape to finish.—*Mike McClintock, Associate Home and Shop Editor*

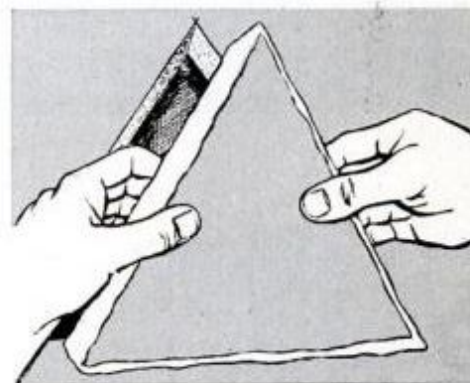
1. Cut the triangle



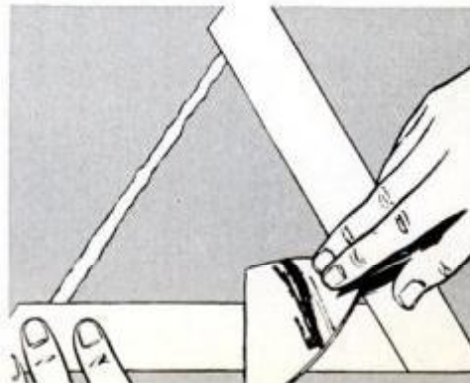
2. Cut the plug



3. Butter the edges



4. Tape to finish



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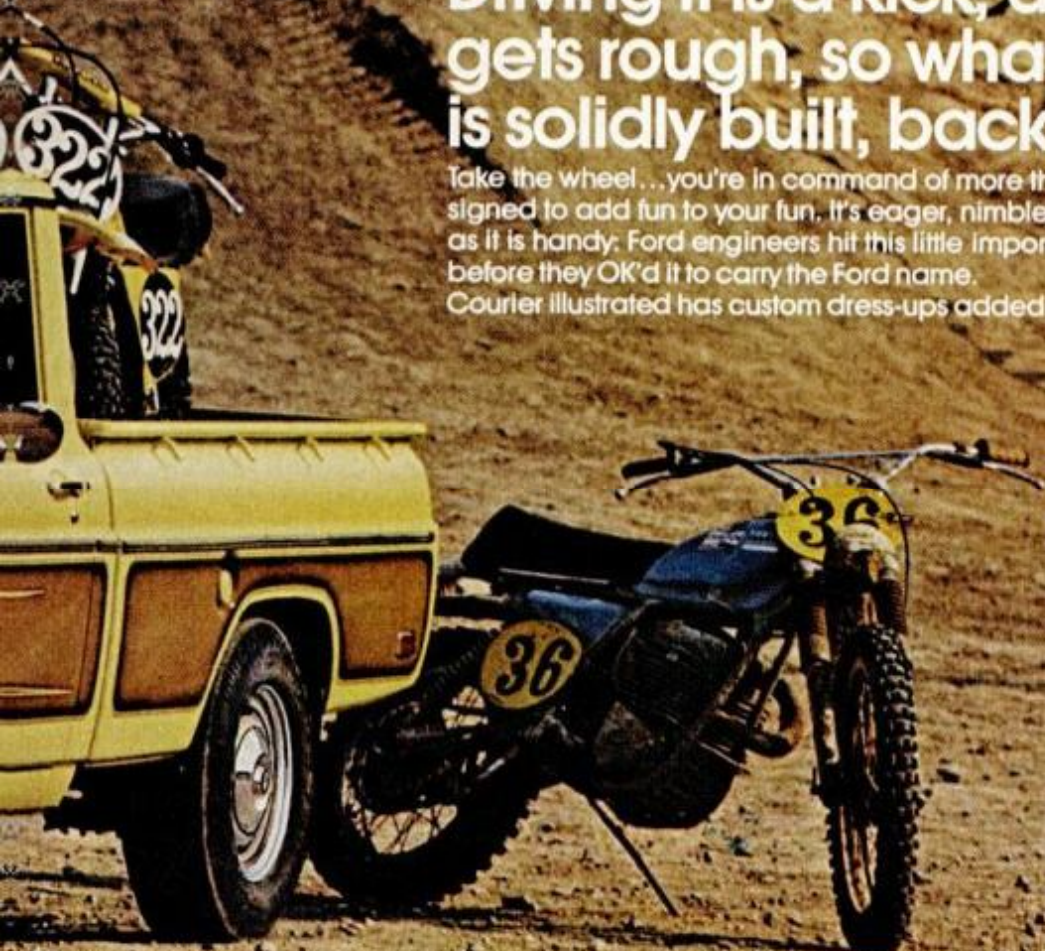
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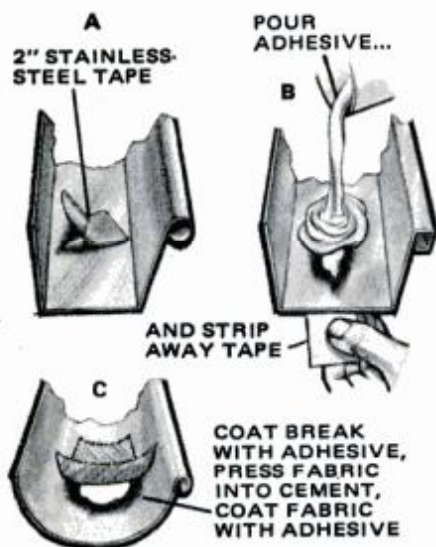


HOMEOWNERS' CLINIC

Rusted gutter repair

One of my gutters is rusted through in two places, one small opening and one fairly large. What's the best method of repair?—Jim Schultz, Kansas City, Kans.

The details indicate three common methods of repair, but you have to use your own judgment as to which to use. Small openings can usually be repaired with stainless-steel tape as indicated in detail A. Larger



openings are usually quite effectively closed by methods B or C, depending on the type of gutter. Of course, with all three methods, care must be taken to clean the surface thoroughly with a wire brush and a careful dusting to remove all loose material which would prevent the adhesive from bonding properly.

Wet sills in crawl space

The sills in the crawl space under our house seem continuously wet and are covered with a dark-colored, mold-like substance. We close vents in the foundation walls in cold weather to prevent water pipes under the floor from freezing. Is there a cure for this mold and dampness condition?—Mrs. M.C. Hepler, High Point, N.C.

You should insulate the water pipes against freezing (an insulating material is made for the purpose) and leave the foundation vents open throughout the year. If this doesn't cure the trouble entirely, then cover the area within the crawl space with

a plastic membrane, carrying it up the walls at least a foot and overlapping the joints about the same distance. This will prevent the rise of moisture, which is a basic cause of the trouble.

Varnish with the shakes

I was told never to shake varnish before use, but I have not been told why. What happens when you do?—H.P., Miss.

Replacing the lid on an opened can may trap air inside, producing bubbles in the varnish if you shake the can. Your brush will pick up these bubbles and lay them on the surface being finished. When the varnish is drying, the bubbles will form tiny flecks that you can feel on the surface. Always stir—never shake—varnish.

Faucet washers wear out

I have to replace washers in bath and kitchen faucets every six months or so. The seats seem to be in good condition, yet the old washers have rather deep grooves when examined closely. What's wrong, or what am I doing wrong?—Frank J. Hall, Bergenfield, N.J.

You may be using washers of the wrong size or type, or you may need to resurface the washer seats with a resurfacing tool made for the purpose. Usually this special tool is available from a local rental service at a nominal charge. Be sure that the washers you're using are of the correct size.

'Blooming' finish

I've just removed a chest of drawers and a vanity from the basement where they had been stored, covered with newspapers to protect against dust. Now the finish seems to have turned a milky white that doesn't come off readily. Is there any way to correct this damage, or must I refinish?—Nancy Holston, Louisville, Ky.

The "milky white" you see is referred to as "blooming" of the finish and removal is no easy task. First try rubbing with a half-and-half mixture of boiled linseed oil and turpentine kept warm in a pan of warm water. Use a clean, lintless cloth in a rub-on

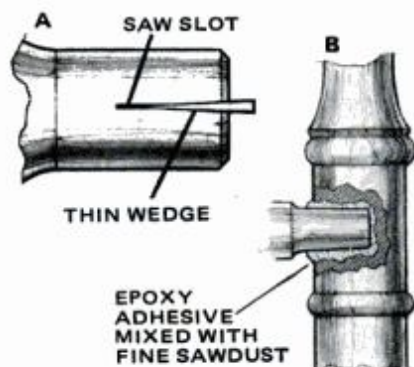
and rub-off motion. There's a chance that this will clean up the milky color and restore the finish. If not, then complete refinishing of the furniture is the only sure cure.

Wobbly chair

One of several old chairs I recently bought is wobbly, the rungs loose in the joints. Can you show me how to tighten up its loose parts?—Edward Ely, Greensboro, N. C.

There are several methods, but the two I've found most successful are those detailed. The first, detail A, works very well where the hole taking the tenon is not greatly enlarged. Use a wedge that will expand the rung enough to lock it and still permit it to enter the hole as far as it should. Apply glue in the hole or socket, press the parts together and clamp until the glue is dry.

A second procedure, which is shown in detail B, is generally successful when the socket is unduly enlarged. Mix the epoxy adhesive as directed, then add a pinch or two of fine sawdust. Apply immediately and clamp the stretcher, or rung, in place. Al-



low ample drying time. You might try a product known as Chair-Loc which swells the wood, making an effective joint when the socket is not greatly enlarged. ★★★

Do you have a home maintenance or repair problem? Send it to Homeowners Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of wide interest will be discussed in this column. For more home repair and maintenance help, get PM's Home Care Guide, \$4.49 postpaid. Send orders to PM, Dept. HCG, Box 1014, New York, N.Y. 10019.

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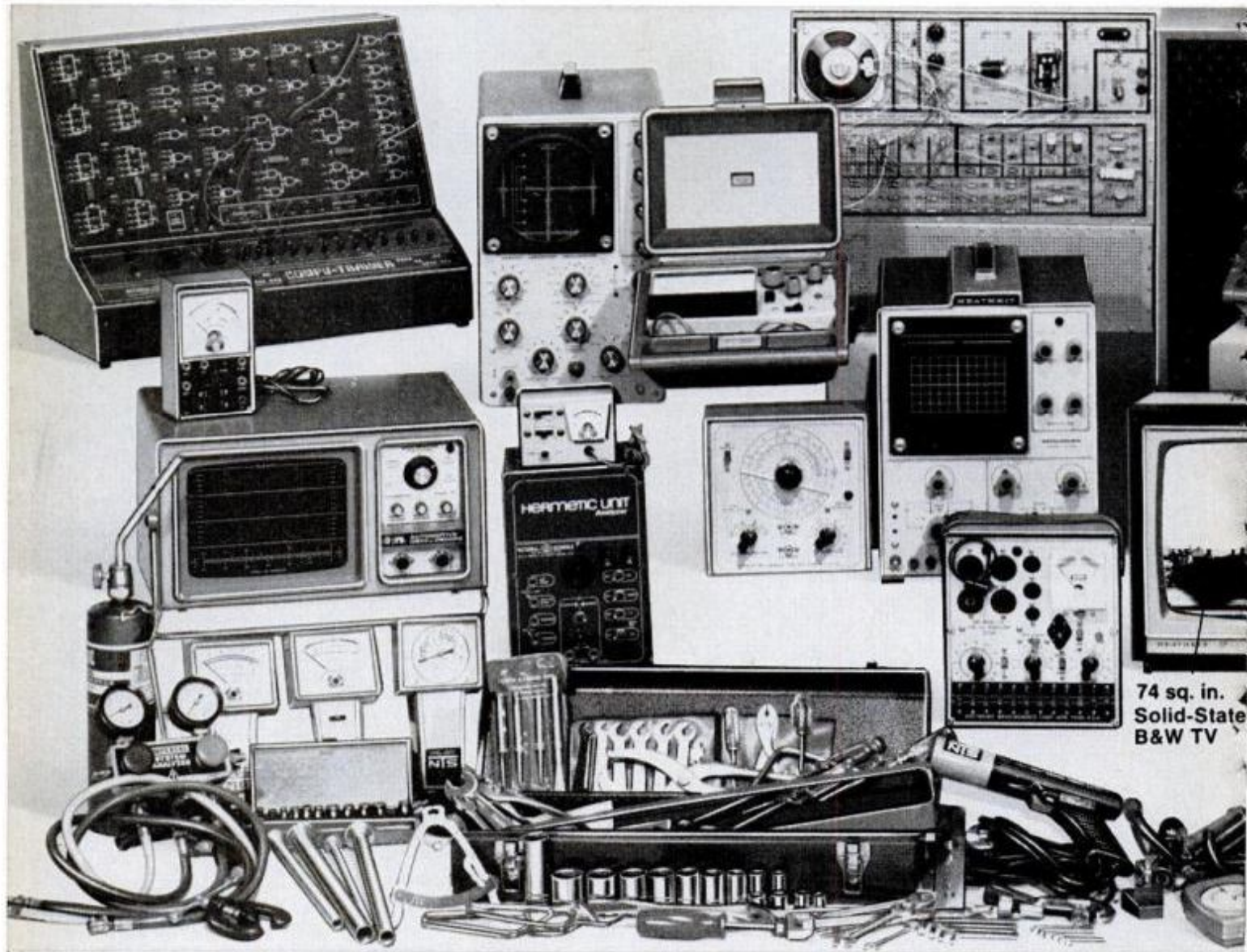


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Goin' through the roof

The Pontiac Trans Am is drafting the Corvette as America's red-hot



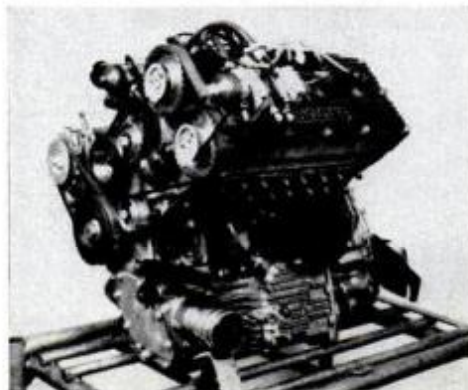
sports car and it's getting ready for the slingshot. This gold-trimmed version, which was seen at the auto shows earlier this year, is now in production and is available as you see it, complete with hatch roof. Pontiac is dishing up a variety of golden anniversary models for this, its 50th year in automobile production, and this is one hunk of birthday cake we'd stand in line for.

Rally round the 99

If you follow European rallying you know that Saab has ruled the roost with its tough old 96 model. They're not scrapping that V4 wonderwagon, but they'll be running another car this year. The Saab 99 Rally EMS is a competition version



of the basic 99 EMS available here. Not surprising to those familiar with the 99, no reinforcing of the body has been necessary to adapt the car for the grueling sport of rallying, but big changes were made under the hood. The new competition powerplant is still two liters, but with double overhead cams and four valves per cylinder, and power is up to 220 hp from 115. A little more tweaking and Saab hopes to peak it out at 230 or 240 hp.



Coup de grace

Going by first impressions from this photo, the BMW 630 CS, just shown at the International Auto Show in Geneva, is certainly the most dazzling design BMW has come up with in some time. The coupe is powered by a three-liter, six-cylinder engine that is rated at 185 hp. A 633 CSi version—3.3 liters and fuel-injected—is rated at 200 hp. BMW's plans are to have the car



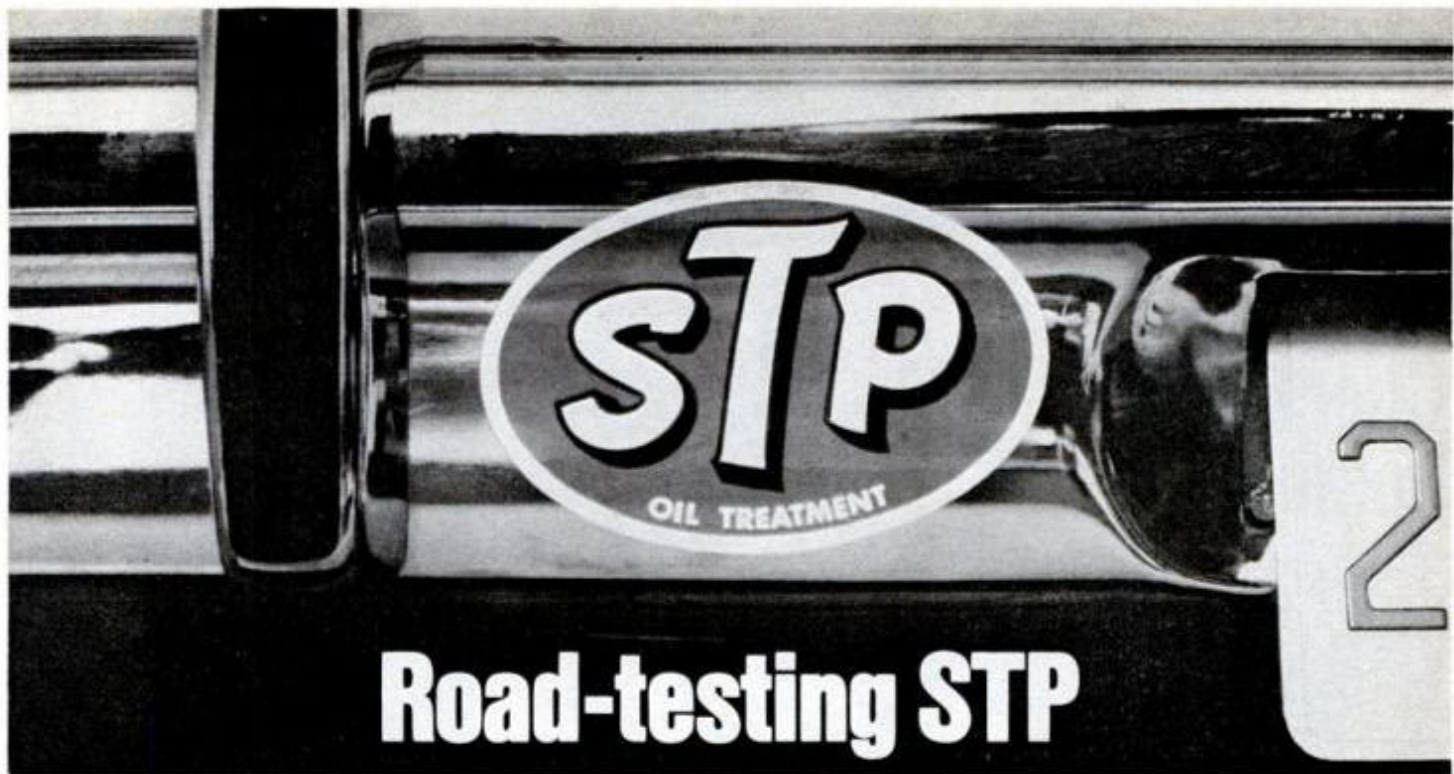
available here before the end of the year.

Over on the two-wheel side, the BMW Motorcycle Owners Assn. (BMWMOA) has joined forces with the American Motorcycle Assn. (AMA) to speak out with a single voice concerning legislation that affects motorcyclists. BMWMOA has almost 5000 members. P.S.: AMA's 1976 Competition Yearbook is out: It's \$3 from the AMA Sales Dept., Box 141, Westerville, Ohio 43081.

Toyota hatches another



The Toyota Celica Liftback is finally here, and, remember, you saw one of the first photos of the car in *Imports and Motorsports* way back in May 1975 (page 15). The next hatchback model from Toyota will be in the Corolla series. The all-new Liftback Corolla, shown in the photo above, was recently unveiled in Tokyo. It'll be a while before it's available in the United States, since the demand for hatchbacks is strong in Japan, too. ★★★



Road-testing STP

Just about everyone has heard of it and 18 million people use it. But not many people can tell you what STP Oil Treatment is and what it can do to help reduce engine wear and oil consumption. That's one reason why the STP Corporation hired Automotive Research Associates (ARA) to test STP Oil Treatment under typical pleasure car driving conditions.

27 cars road-tested 600,000 miles

ARA tested 27 cars ranging from one with only 1,867 miles on it to one with 266,900 miles on it. A single and a multi-grade premium motor oil were used. Each was tested for two 6,000-mile oil change intervals. Then the test was repeated with STP added to each oil. Professional drivers ran the cars through a range of speeds from stop-and-go driving to long stretches at 55 mph.

Lubrication experts analyze the results

After completion of the tests two of the country's prominent lubrication authorities (Ward O. Winer, PhD and author of over 50 publications on lubrication and related subjects, and Charles F. Schwarz, former Chairman of the U.S. Army Engine Oil Reviewing Committee), reviewed the data and concluded:

"The analysis of the fleet test data from Automotive Research Associates, Inc. (ARA) on STP Oil Treatment, conducted during 1974, clearly shows that use of STP Oil Treatment results in a reduction of oil consumption and wear rate."

Taking care of your engine

These scientific tests run a total of more than 600,000 miles show that adding STP Oil Treatment, even to a premium grade 10W-40 oil, reduced wear of cylinders and sliding iron and steel parts; reduced wear of bearings and other parts contain-

ing copper and aluminum; and reduced oil consumption, too. All of which means that anyone who wants to be sure they are doing everything they can to take care of an engine should probably consider using STP Oil Treatment.

What's in a can of STP Oil Treatment?

STP Oil Treatment is a concentrate of important ingredients for reducing wear in your car's engine. One ingredient is a long chain polymer which reduces the rate at which oil thins out as temperature rises. Another ingredient is ZDDP which reduces metal-to-metal wear, metal corrosion, and oil oxidation. That's why STP Oil Treatment can improve the ability of virtually any motor oil to reduce wear.

The real value of STP is added protection

Lubrication experts hasten to point out that STP Oil Treatment is not a fixer, or a mechanic in a can. It can't repair worn or damaged engines. But STP can help your oil do a better job even under tough operating conditions . . . high speeds and stop-and-go driving. Beyond that, it also helps reduce metal-to-metal wear, corrosion and oil oxidation.

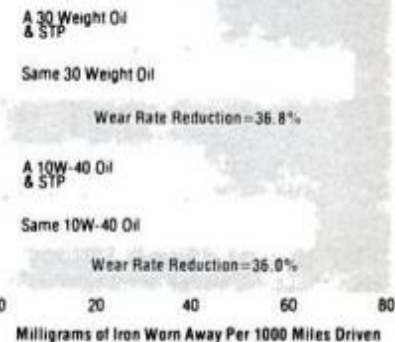
Smart money

If you consider the fact that a car wash can cost more than a can of STP Oil Treatment, it's a matter of simple arithmetic that you can give your engine the added protection of STP Oil Treatment for a full year for less than the price of a couple of car washes.

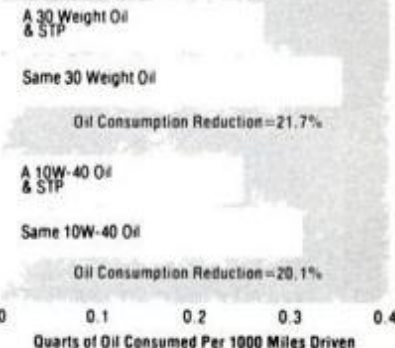
Helps reduce engine wear and oil consumption.



Scientific Tests on Cylinder and Sliding Iron and Steel Part Wear Rate for Oils With and Without STP*



Scientific Tests on Oil Consumption for Oils With and Without STP*



*Here's what the graphs mean: On the wear graph, for example, for every 1,000 miles driven, 64.8 milligrams of iron were worn away without STP in a 10W-40 oil, and 41.5 milligrams of iron were worn away with STP in the same 10W-40 oil. This is an average reduction in wear rate (calculated from parts per million of iron measured in the crankcase oil) of 36%. Of course, use of STP will not always result in a 36% reduction in wear rate. The results shown are averages for the test cars. Results for individual test cars varied. The actual wear and oil consumption results that you obtain may also vary depending upon the way you drive, driving conditions, the motor oil you use, your car's condition, model year and optional equipment. What these scientific tests show is that the use of STP Oil Treatment will help reduce wear and oil consumption.

RICHARD PETTY says:

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Richard Petty, America's Winston Stock Car Driver and NRI Automotive Consultant.



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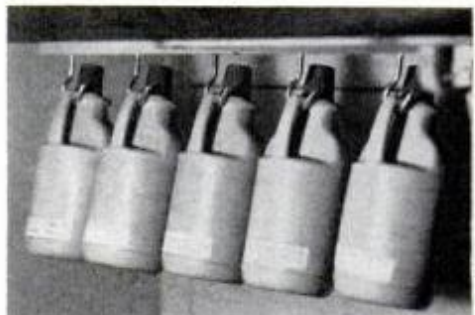
FROM READERS

Splints for crippled cables



When my expensive, plastic-clad, 21-inch cable release accidentally bent, I splinted it like a broken leg before the fracture could become complete. My splints were used wooden match halves, each cellophane-taped to the cable till the break was surrounded. Then plastic electrical tape was *tightly* wrapped around the splinted area. Press the release plunger as you do each step to make sure the release still works smoothly, straightening the cable if necessary. And be careful not to splint over the swivel end that fits into the shutter.—*Grace Weinstein, Los Angeles*

Hanging bottles save darkroom space



Chemical jugs and bottles with handles can be stored out of the way beneath your darkroom table. Use ordinary clothesline hooks.—*J.P. Greeves, Alexandria, Va.*

Learn For The
First Time:

Just Released!

HOW TO LEGALLY STEAL YOURSELF RICH

AND PAY NO INCOME TAXES

Have you ever wondered how people become and stay wealthy?

People become wealthy because they have learned how to benefit from the legal system we live under. They have also mastered the secrets of offsetting their salaried or business incomes--legally! They have discovered the techniques of converting taxable income into non-taxable income the 100% legal way. If you would also like to beat the system and have it work for you instead of being a slave to it, then keep reading because you will be shown HOW TO LEGALLY STEAL YOURSELF RICH AND PAY NO INCOME TAXES WITHOUT GOING TO JAIL by CASHING IN ON YOUR LEGAL RIGHTS.

You may not realize it but you have an untapped source of wealth right under your nose.

Did you know that you work 4 months out of the year for the government, just to pay local, state, and federal taxes?

Have you ever asked yourself WHY the very wealthy and big-salaried executives "get away" with paying little or no income taxes while you have to pay a much larger portion of your income?

Did you know that it's impossible for anyone to become wealthy without having a clear-cut understanding of how the legal system we live under works or how to tip the scales of justice in your favor while financially benefiting from it?

It is a fact that many millionaires do not pay a cent in Federal taxes because they have mastered the tax loopholes that are unknown to most wage earners and small businessmen.

Letting the system work for them, instead of working for the system, is how people become and stay rich, while the tax burden stays on you. And believe it or not, the tax laws allow it. Now it's possible for you to tap into this large annual reservoir of taxed earnings that you were previously forced to give up. Now you can benefit from the mighty forces known as the legal system. Now, hundreds, even thousands of tax dollars can flow to you instead of Uncle Sam.

You will learn the loopholes that are in the tax laws and regular laws and you'll learn to take advantage of them. Now for the first time the secrets that the rich have been using so successfully for years to evade income taxes, are revealed also HOW THEY LEGALLY STEAL THEMSELVES RICH by CASHING IN ON THEIR LEGAL RIGHTS. That's how they preserve their capital for further investments! Now so can you, by imitating them.



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By an Attorney at Law
and a Tax Accountant

- You will learn among other things:
- How to completely avoid paying income taxes at all on your business income.
- How to protect your business as well as yourself from malicious and unlawful tactics.
- How to transfer earnings from one family pocket into another and save many hundreds of dollars in taxes each and every year.
- How to arrange working with a lawyer and pay him only after he is successful in winning your case.
- How to turn your savings account into a tax shelter. Almost 200 names and addresses of U.S. Foundations listed state by state and alphabetically.
- A code on each Foundation listing to help you identify the ideal Foundations able to grant cash to you.
- How to control up to one million dollars per year for life.
- Pay off your loans without money.
- Receive 100% return on your investments.
- Earn 21% guaranteed dividends.
- How to get a guaranteed income for life.
- How to convert higher yielding taxed bonds into tax-free bonds.
- How to profit when large corporations make mistakes.
- How to avoid paying taxes on earnings from your stock investment.
- How to protect yourself from libel and slander.
- How to avoid paying taxes on the interest earned on your regular or timed savings account.
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- How to get a 10% tax-free return on your investment with virtually no risk on your invested capital.
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- How to collect from invasion of privacy.
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- You will learn exactly how the I.R.S. discovers unreported income.
- You will learn how to save your drivers license should the need arise.
- You will learn the 35 questions used by the I.R.S. to trip you up.
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ALL OUTDOORS

Centennial

If you will be traveling this summer through my home state of Colorado—and you should—write ahead for information on additional activities. Special rodeos, glacier hikes, regattas, pack burro races, river raft runs and hill climbs have been scheduled to celebrate 100 years of statehood. Outdoor event schedules for Colorado's centennial are available free from Colorado Vacation, 956 S. State Capitol, Denver, Colo. 80203. Just ask about your favorite form of outdoor action.

Passport to the parks

Are you planning this year to visit a national park, seashore, historic site or monument in Arizona, Arkansas, California, Colorado, Florida, Georgia, Idaho, Massachusetts, Montana, Nebraska, New Hampshire, New Jersey, New Mexico, New York, North Dakota, Oregon, Tennessee, Texas, Utah, Virginia, Washington or Wyoming? Good news. The Golden Eagle and Lifetime Golden Age Passports will once again be available at the same price of \$10 for the Golden Eagle and no charge for the Golden Age for U.S. citizens and permanent residents of 62 or older.

Both provide free admission for the purchaser and his carload or family to cover 60 national parks and attractions that charge entrance fees. The Golden Eagle Passport is good for the rest of the year and the Golden Age, if you're 62 or up, for the rest of your life. For oldsters, it also offers a 50-percent discount for certain recreation facility charges

and camping fees at national parks.

The passports are available at all federal entrance fee areas and other locations listed in a brochure on the park passport program available from the Bureau of Outdoor Recreation, 18th and C Sts. N.W., Washington, D.C. 20240. With entrance fees running 50 cents to \$3 per person at popular parks, the Golden Eagle is a good way to support the National Park Service and save money, too.

CB status

Is a Citizens Band walkie-talkie going to join the Sierra cup, compass, and Swiss Army knife as one of the staple items of equipment for outdoorsmen? Until recently we would have said no, and added a certainly not for pleasure boats. But last time I talked with the Federal Communications Commission, they told me they had 2,658,860 CB licenses on the books with hundreds of additional applications flooding in. These usually cover several transmitters each, are for full power operation, and don't include the hundreds of thousands of little milliwatt units that require no license at all.

What this means is that even with a CB's limited range, there is a fair chance that in an emergency you might be able to get through to someone who could give advice or send help. And for wilderness camping, several CBs provide a good way for party members to keep in touch and check in periodically.

Emergency channel 9 is not monitored by the Coast Guard and is not substitute offshore for a VHF radio



Small enough to trail behind a motorcycle or any compact car, large enough for standing headroom and sleeping space for two, the tent camper from Time Out Corp., Elkhart, Ind., weighs 230 lbs., has 5x7-ft. floor space when open, has a 20-lb. hitch weight.

WITH BILL McKEOWN



telephone. But some means of communicating is better than none. Excellent new portable shoulder-strap five-watt 23-channel self-contained sets are now coming on the market, and can be easily carried on even the smallest craft. As a boatman-at-large, I've scorned the use of CBs on coastal waters, but I'd be wrong to do so any more. You can frequently raise base camp, a marina, other boats or even listeners ashore who can relay messages if necessary.

Treasury tips

There are a lot more chores for the Department of the Treasury than the pleasant task of playing with money. Secret Service, Customs, and the Bureau of Alcohol, Tobacco and Firearms are also Treasury divisions, and the National Firearms Tracing Center in Washington must often track down the original ownership of a stolen gun as the only way to solve a crime. Their figures show that of 158,000 handguns stolen annually, 107,000 are taken from private homes, and at least 10 percent of handguns seized in street crimes were stolen.

With more than 700,000 stolen guns on the loose right now, it's obvious that private owners should be more careful. The Alcohol, Tobacco and Firearms Bureau recommends these simple precautions:

■ **Lock your guns** into place with a steel strap or chain running through the trigger guard of rifles and shotguns. Lock up handguns out of sight in a secure place, and don't store guns and ammunition together.

■ **Write down a description** and the serial numbers of your guns and keep this with other important papers in a safe place. If a gun is stolen, ask your police to notify the National Crime Information Center in Washington. While improving the chances of getting your gun back you may also help prevent further crime.

Noted and needed

The annual National Sporting Goods Assn. trade show is usually an accurate indication of outdoor sport trends, and recent statistics show tennis and skiing are growing fastest. Boating, camping and recreational vehicle travel all are gaining in popularity, along with the hunting and fishing that go with them. The NSGA preview displayed refinements in backpacks and tents, with no major changes but a much larger assortment available. LP gas camping appliances are also continuing their popularity; tanks are now offered in a wider assortment of sizes. The Bicentennial seems to have inspired many new replica and commemorative rifles and pistols, with many that are designed for black powder muzzle-loading use. Daniel Boone would have been delighted.

Not every outdoor accessory is available yet, however. There may be one around, but I have yet to spot a hybrid screen house that can switch from shelter canopy to tent and back again. Newly popular, the screened-in shade shelters are blossoming out on campgrounds across the country. An ideal extra for RVs, they pack compactly, yet erect quickly for outdoor cooking, dining, parties and relaxing in the shade.

When the sun slants low or a gusty breeze chases dust devils, however, there are no models (at least none I've seen) with curtains that can be unrolled and zipped down inside or outside the screen walls for protection. Even an arrangement to raise the screen sides might be worthwhile on hot days when there are no bugs and also little breeze. The two-room tents with inner bedroom and outer screened patio that were first popularized in Europe offer some of this

(Please turn to page 46)



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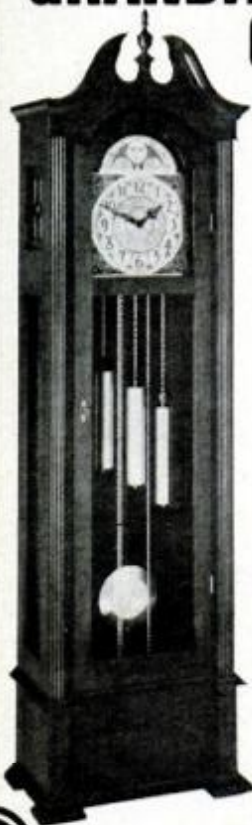
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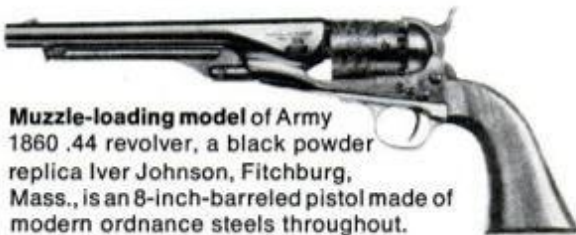
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ALL OUTDOORS (Continued from page 45)

advantage. But what seems to be needed now is a screen house that doesn't need drop cloths clothespinned to the inside.

Tune-up trails

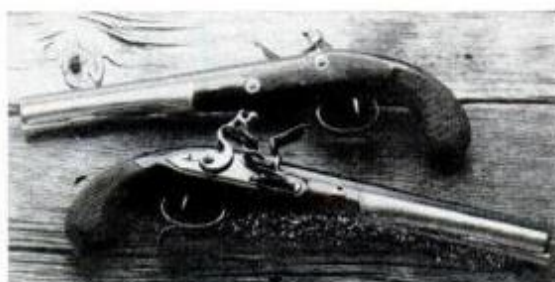
Thanks to an assist from the Zebco fishing equipment division of Brunswick Corp., the popular Vita Parcours physical fitness trails of Europe are now being established in this country in cooperation with the Interior Department's Bureau of Outdoor Recreation. Twenty exercise stations along a 1½ to 2-mile route instruct a participant in a series of calisthenics along the way. Present plans call for trails in 10 communities. ★★★



Muzzle-loading model of Army 1860 .44 revolver, a black powder replica Iver Johnson, Fitchburg, Mass., is an 8-inch-barreled pistol made of modern ordnance steels throughout.



Roundabout Cooler, jug from Coleman that can double as a cooler, has a locking lid and lift-out inner tray for holding food plus tall bottle hatch. Faucet dispenses drinks.



Historic replicas of flintlocks used in Hamilton-Burr duel (originals had hair triggers). This \$2500 pair is from Bicentennial Society.



Three new special-edition, limited-production International Scout models have Bicentennial theme. Patriot comes in three lengths and Travler, Sno Star in two; Spirit is styled Scout II.

Runabout action stretched out to 30 feet, Scarab from Wellcraft Marine combines high speeds with cruising capability and forward cabin with bunks for two. Speeds reach 60 mph.



Bait bucket top becomes ready-to-use bait scoop in this new model from Expand-Foam, Inc., Antioch, Ill. Designed for minnow scooping.

Test drive an incredible '76 Scout and take home a \$23 Coleman® Sleeping bag for only \$8.



We outrated every vehicle tested, even our top competition, in hill climbing, maneuverability, stability, acceleration, gearing, and braking.

An incredible performance. Add to that a surprisingly comfortable ride, the tremendous convenience of our unique "selective" 4-wheel drive and all the options you'd ever need or want. From power steering to skid plates.

Stop by and see for yourself at any participating dealer. Take a Scout II, Scout Traveler™ or a Scout Terra™ for a spin on or off road, and pick up a great sleeping bag, for the fun of it.

It's simple. No hassle, no strings.

Just stop in at your local International Scout dealer, test drive any one of our 3 new '76 Scout models, then take home one of Coleman's finest cold-weather bags. For a fraction of its value.*

Just \$8 for a rugged 4 lb. backwoodsman bag of scroll stitched Acryfill® with heavy-duty double zipper. A fantastic offer. Good through May 31, 1976.

What's in it for us?

We're betting once you test drive the incredible Scout you'll be back to buy it.

For good reason. Scout® II is the best 4-wheel drive vehicle in its class.

Last year Scout II outmaneuvered and outperformed Jeep CJ-5, Blazer, Bronco, Cherokee, and Trail Duster in Petersen Publications' big on and off road test program.

The only one to rate "excellent" in 15 out of their 17 engineering and performance tests.



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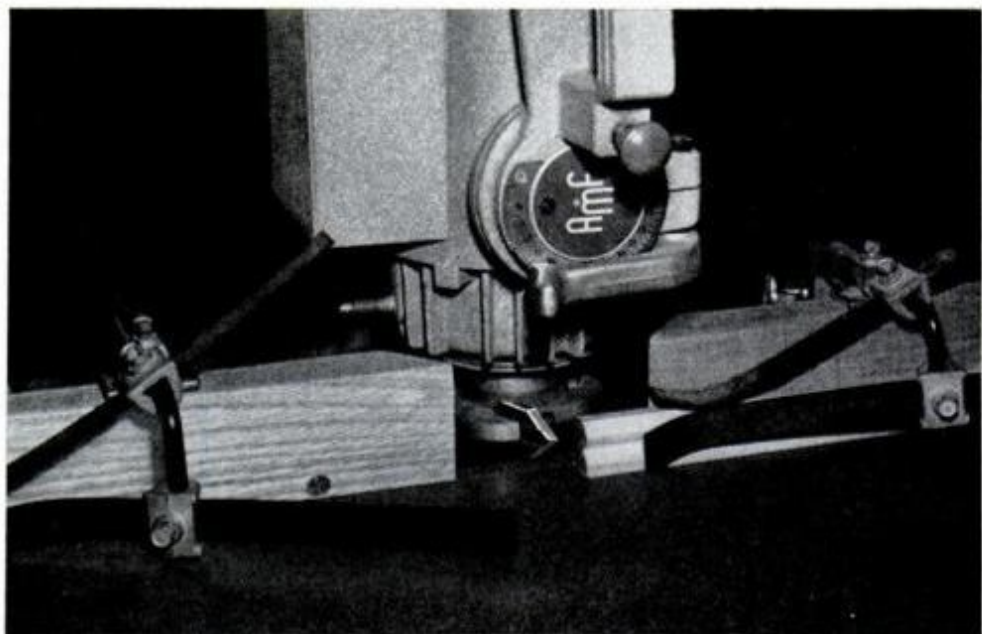
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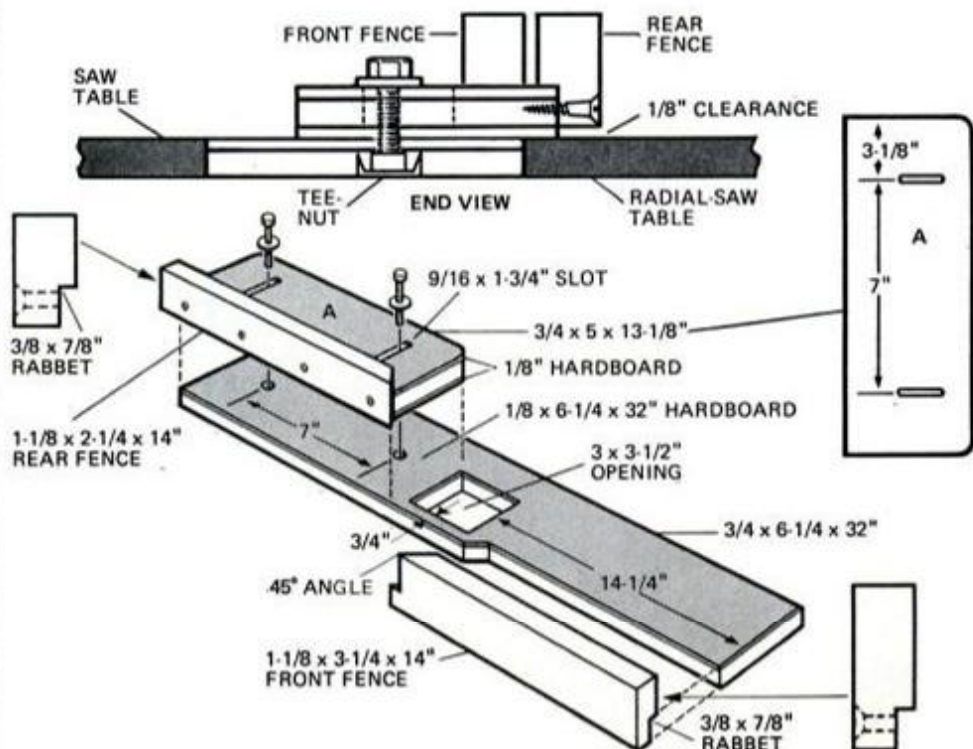
Molding-head fence for a radial-arm saw



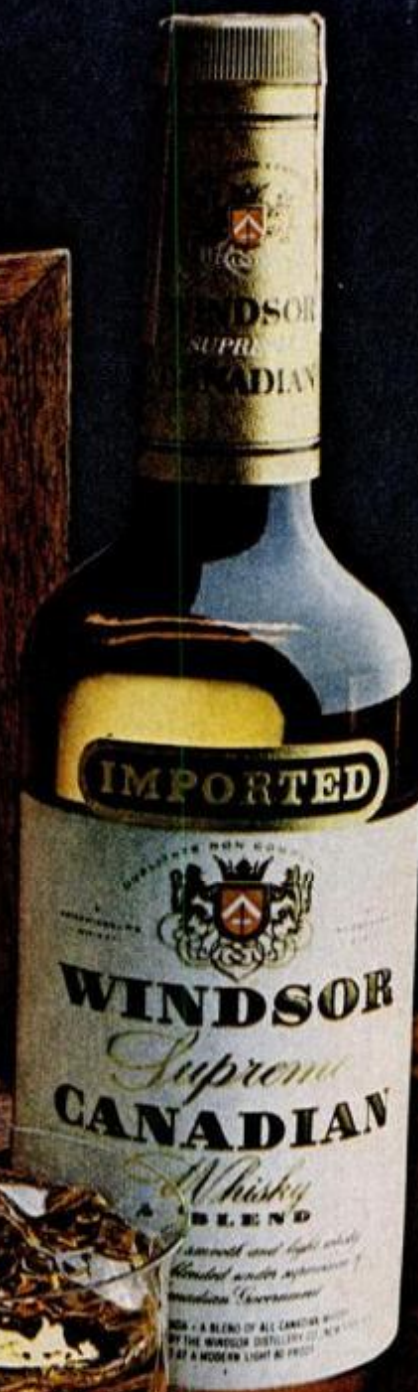
Fence fits flush in table in place of saw's own fence and rear table board which you remove. Hold-down fixtures shown, Sears Model No. 9GT3230, sell for \$8.50 per pair.

Used with a molding head, this adjustable fence assembly makes your radial-arm saw perform like a real wood shaper. It drops in place flush with the table surface and occupies the area behind the saw's fence. You remove both fence and rear table board when you want to use it. Total thickness of the base must equal thickness of the saw's wood table. The 1/8-in. hardboard covering on the bottom of the fence provides for free movement over the table.

The square opening in the base provides clearance for the motor arbor and vertical cutter adjustment. Two 3/8 x 1 1/2-in. capscrews, washers and Tee-nuts are used to lock the movable fence in place. I used oak for the two fences and rabbeted the edges. The rest I made of fir plywood. I glued and clamped the tempered hardboard to the surfaces indicated. By changing the width of the base, the fence can be made to fit any radial-arm saw.—C. E. Banister



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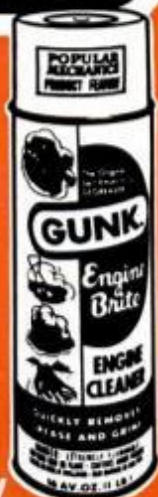
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How to use shims

Not many building materials come perfectly straight or perfectly even. Not many houses are perfectly level or plumb. This situation is referred to as "conditions in the field."

The total effect is that when you install a window, the sill may be out of level, or when you hang a door, the jamb may not be plumb. You may also run into the same trouble when you frame a new addition. To solve these and other field condition problems, use shims.

A shim is a small piece of material, usually wood, that will make up a small discrepancy in measurements. If you could strip the walls of your house down to the frame, you would undoubtedly find shims under some sills, studs, rafters, or joists. This is common building practice and is often the final touch needed for a good job. They are usually made out of the same material that they are supporting. Where great compression

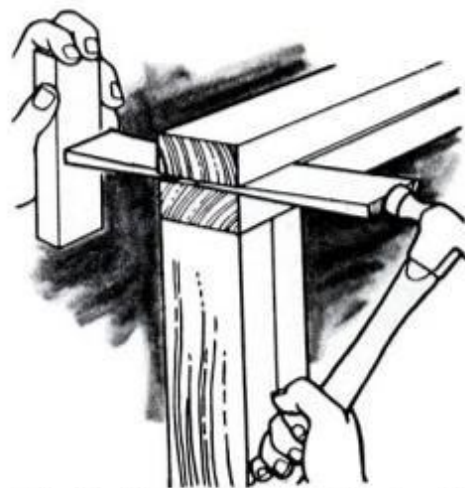


Shim from both sides. This will help to keep the board level and stable.

can be expected (like a girder resting on a masonry footing) a static material like slate is used. The most common shimming material is wooden shingle points. Most builders carry some extras for this purpose and split them with the grain.

The most common mistake in shimming is to drive a single shingle point in from one side. This frequently results in an uneven and unstable condition. The beauty of shingle shims is that use of a pair together produces automatic leveling. Here's how it's done:

First, split up a shingle to make 2 or 3-inch-wide pieces. Then start the thin edges toward each other from opposite sides of the board. Drive them in so they meet in the center under the board. Here, you might find that backing one up with a block and sharply tapping the other will help the thin points overlap. Now you can put your level on the board and check the bubble as you tap the shingles—first one, then the other.



Drive the shims across each other in order to raise the board as much as you want.

With gentle taps you can raise a board in very fine degrees until you get exactly the right amount of rise to a level condition. Don't worry about the excess shingle—it's easily trimmed. Firmly score the edge of the shingle flush to the board with a razor knife. A sharp blow from the opposite side will break it off cleanly. If most of the shingle has been driven through, and only a few inches of the thickest part remain, you should trim it with a handsaw.

It's really a simple process worth doing carefully. Remember, you don't need shims to rectify a mistake, although they are great for that purpose if you really build yourself into a problem. You do need them as another tool in the carpenter's bag of tricks that can make irregular



Trim off the excess so that the edge will remain flush for Sheetrock or siding.

materials look good on the finished job. Careful shimming on the frame will save you a lot of time and a lot of headaches when you start to put up Sheetrock and trim. You won't see the shingle points when you're done and you will see the results of an accurate and professional job.—Mike McClintock, Associate Home and Shop Editor



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Матеріал, що містить інформацію про здоров'я

APPLIANCE CLINIC

BY PAUL MANN



Waste not, want not

We own a Waste King dishwasher that the repairman can't fix. It is a built-in model that's sitting next to the sink until we remodel. After use there is always moisture on the inside door. This has caused my silverware to start rusting. The repairman says our water is hot enough and the heating coils are working. What's the answer?—Mrs. Morris Parks, Glenwood, Iowa.

Your dishwasher will perform as it should once you remodel and get the unit built-in—if it is properly installed. Dishwashers, like automatic clothes washers, should be vented so moisture can escape. Furthermore, most dishwashers have blowers that aid in dissipating moisture, and I assume the repairman checked its operation.

Until you remodel, let me suggest that after a cycle you immediately crack open the dishwasher door and leave it ajar for five minutes before removing dishes. A towel or potholder, placed behind the door, will keep it cracked open.

Why a washer leaks

We have a Whirlpool automatic clothes washer. Somehow water leaks all over the floor. What can I do to stop it?—Irving Morton, Detroit, Mich.

I can't tell from your letter whether the machine is leaking or if the water won't shut off after a cycle is completed. These are separate problems, with different causes.

The main reasons water won't shut off after a cycle has been completed are: a bad water-inlet valve (test

and replace if found faulty); a plugged or leaking pressure-switch control hose (repair, if possible; replace, if not); or a defective water-level control switch (test and replace if found faulty).

Reasons a washing machine can leak water include: Inlet hoses aren't secured to the inlet valves (tighten, making sure hose clamps are in good shape); the drain hose isn't secured to the pump (tighten, making sure the clamp is in good shape); the pump gasket is shot (replace); a leak in the tub; or a bad water-carrying hose somewhere on the line.

Manuals are available

Your readers might be interested in knowing that we are able to provide repair manuals for many popular ap-

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liances.—Daniel Sperry, manager, Parts Distributors Corp., 341 West Glenside Ave., Glenside, Pa. 19038.

Mr. Sperry sent me his company's list of repair manuals for most makes of automatic clothes washers, clothes dryers, dishwashers, refrigerators, freezers and window airconditioners. Other manuals are concerned with refrigerator ice-makers, wiring diagrams for laundry equipment and gas-burner controls. Prices range from \$3.95 to \$10.

Constant hassle

The Constant Pilot in the oven of our Welbilt Jewel Model 5A-30 gas range has a tendency to go out. The only adjustment we can make is to set the Constant Pilot selector cartridge on either natural gas or LP gas. (See inset on diagram.)

Since we have natural gas, our selector is set to N. What now?—W. Brown, Staten Island, N.Y.

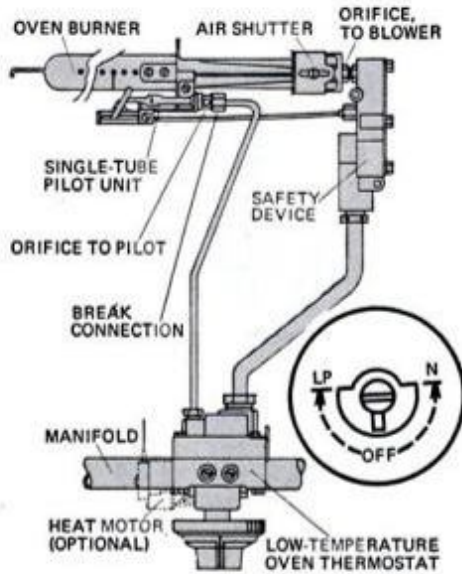
Now clean the pilot orifice. It has a tiny hole; even a small amount of carbon will block it. When it's blocked, the pilot doesn't get sufficient gas—and poof.

The diagram below should help you in servicing. You don't have to shut off the gas supply, but if it makes you feel safer, go ahead. How-

ever, if you don't, don't smoke or have any flame near the oven.

Break the tube connection going to the orifice. Some gas will escape from the tube; plug it with a wad of putty. Remove all putty before reconnecting the tube.

With the orifice removed, use a small soft-bristle brush to clean it.



Then blow out the hole. You can do this by mouth or with an ear syringe you can purchase in a pharmacy.

Do not use any object to ream out the orifice. You may enlarge the hole and make matters worse.

Straight talk

We are considering installing a dishwasher in our home. Friends have told us that water temperature must be set at 180° for the appliance to work properly, and also that we should not drain into our 1000-gallon septic system. There seems to be no one who can advise us on this matter, except you.—Mrs. William Shrader, Jermyn, Pa.

A dishwasher will operate perfectly well on 145° water, which is sufficient to kill bacteria and get dishes clean.

Not drain into a septic system? Nonsense. I speak not only from technical knowledge, but from first-hand experience; my home is septic system-equipped and we've had no problems whatever in coping with the system. ★★★

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

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HIGH QUALITY! LOW PRICE!

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- Solid, heavy-gauge brass West German dial face

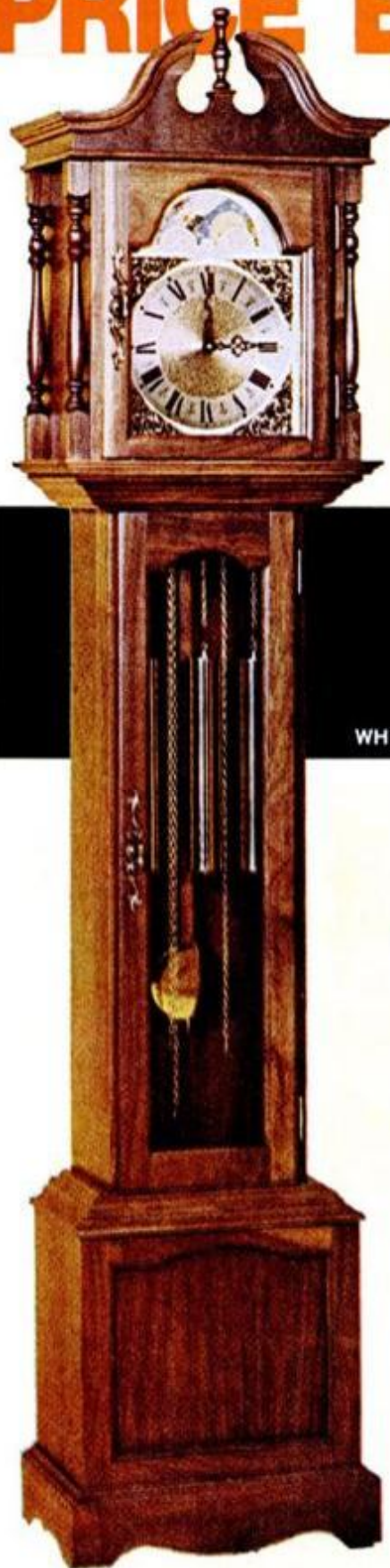
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Putting waste fuel back in your tank

Gasoline vapors cause staggering losses. Now new fume-recovery techniques are reducing pollution and saving precious fuel to boot.

by Conrad Miller

Those wispy little fumes you see rising from your gas tank as the attendant fills it up look innocent enough. But the fact is, they represent an incredible amount of wasted gasoline as well as a serious source of air pollution. According to government statistics, for every 247 cars that fill up at a service station, a tankful of gasoline disappears into the air. That works out to a loss of more than 11,000 gallons a day in a city the size of Washington, D.C.—4 million gallons a year. Multiply that by all the towns and cities across the nation and the total becomes staggering.

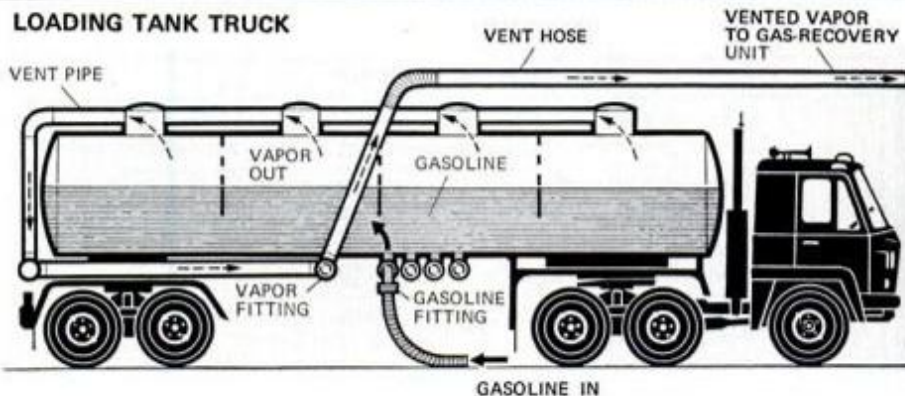
Gasoline loss through vaporization occurs whenever fuel is transferred and exposed to air. This happens at three main points—at central loading depots where big tank trucks are filled, at filling stations

(Please turn to page 58)

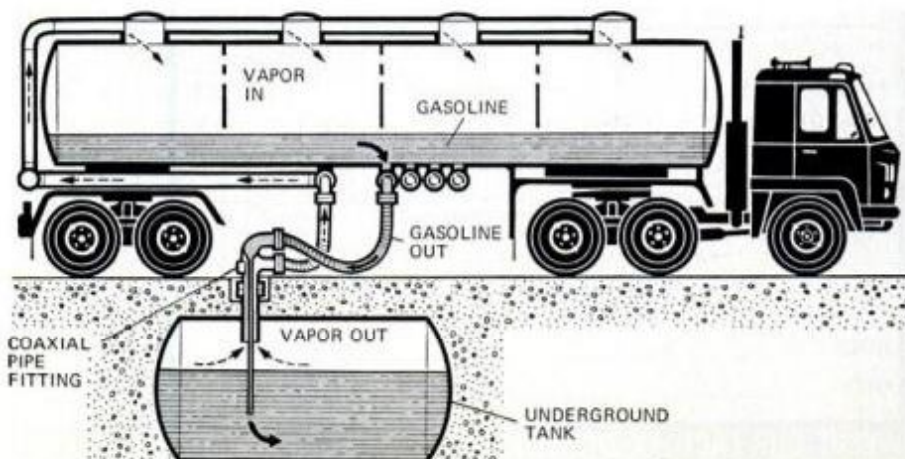
Diagrams at right show two ways waste fuel vapor is captured for reuse. As tanker truck is loaded, fumes are drawn off at top and piped to recovery unit where they're condensed back into liquid gasoline. At unloading point, fumes are channeled back into truck through twin-hose arrangement as fuel is pumped into filling station's tank. Fumes are then drawn off again at loading depot for repeat of cycle. Photo at top shows dual-hose vapor trap developed by Goodyear.



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UNLOADING TANK TRUCK



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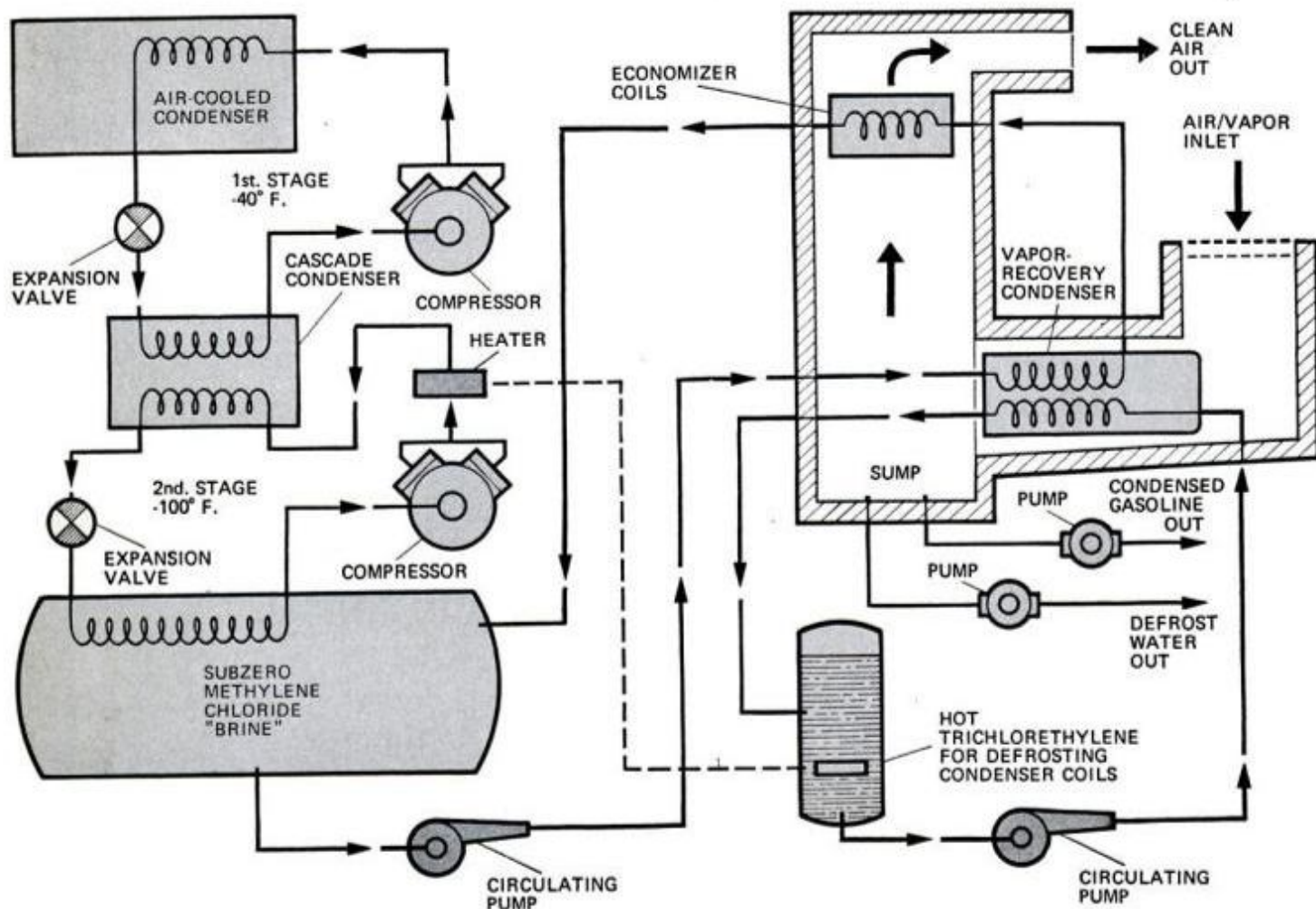
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HOW GAS-RECOVERY SYSTEM WORKS



It doesn't look like much outside, but gas-recovery unit (right) is maze of complex refrigeration equipment inside. Diagram shows how two-stage cooling brings temperature down to -100°F ., required to liquefy captured gas fumes.

WASTE FUEL

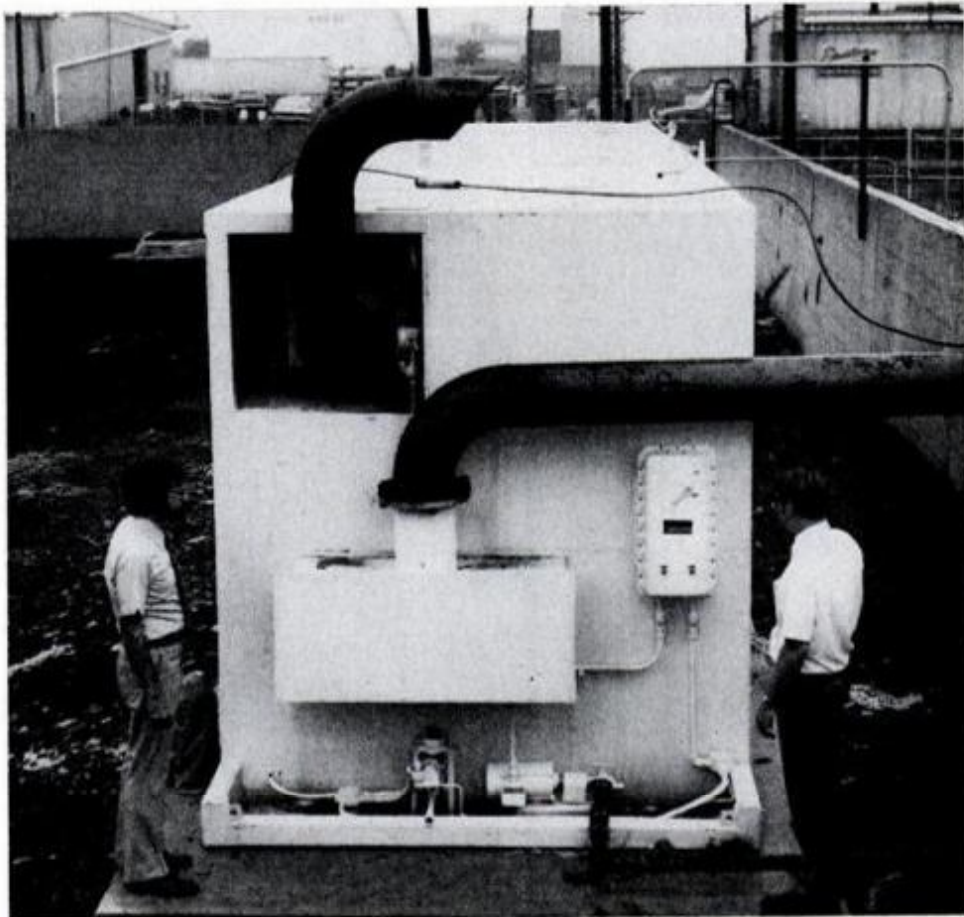
(Continued from page 56)

where fuel is pumped into underground storage tanks, and finally at the pump as the gas goes into your car. Of the three, the greatest single losses occur during the loading process because of the large quantities of fuel being handled. At a typical tank farm pumping 10,000 gallons a minute, the volume that escapes as vapor amounts to 800 gallons a minute!

Solution not easy

The EPA (Environmental Protection Agency) has ruled that such massive vaporization of gasoline into the atmosphere must be stopped. How to do it, however, proved to be tricky. Piping off the fumes to be burned would be both wasteful and dangerous. Absorbing them in an activated charcoal "sponge" was

(Please turn to page 60)



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WASTE FUEL

(Continued from page 58)

considered, but calculations indicated the amount of charcoal needed would be so monstrous that not even a mass the size of the Washington Monument would be sufficient to soak up the volume.

The ideal solution would be to catch the errant fumes and return them to usable fuel, but unfortunately gasoline vapor does not condense back into liquid form at normal temperatures the way many other liquids do. It must be chilled down to 100° F. below zero before it will liquefy. No conventional refrigeration equipment would be up to such a job.

Two-stage refrigeration

The challenge was taken on by Tenney Engineering, Inc., of Union, N.J., long experienced in designing supercooling cryogenic systems. Tenney solved the problem using a clever technique called "cascade" refrigeration. Temperature is brought down to the desired point in two stages instead of all at once, dividing the job and making it easier. Two huge 75-hp compressors are used (by comparison, a home refrigerator compressor is about 1/5 hp).

In the first stage, Freon 502 is cooled down to -40° F. The second stage, chilled by the first, pulls Freon 13 on down to -100° F., the temperature needed to liquefy vaporized gasoline. But that's not all—now the process becomes even more complex. The second-stage refrigerant is fed through coils into a 2000-gallon tank of methylene chloride "brine," chilling the brine down to the same -100° F. temperature. This provides an enormous reservoir of stored cold—an important feature of the system.

The reason for the brine tank is twofold: At peak truck-loading periods, the capacity of the two compressors alone might not be able to handle the tremendous volume of gasoline fumes fast enough. But the huge supply of stored cold in the brine provides ample capacity without straining the compressors. It also allows the compressors to operate during off-hours, keeping the brine at the proper temperature for the next loading operation.

Supercooling condenses fumes

The supercooled brine is circulated through finned coils in a gasoline-recovery condenser. Vapor-laden air is blown across the coils, chilled, and vapor condenses out as liquid gasoline. The gasoline flows down into a sump where it collects and is

pumped out to a storage tank for reuse as fuel. The air, now cleaned of its fumes, continues on out into the atmosphere, a pollutant no more.

Another ingenious touch is the use of an "economizer"—a series of heat exchanger coils located in the air outlet passage. Brine from the condenser flows through these coils on its way back to its storage tank. Outgoing air, still icy cold from the condenser, now helps to recool the warmed-up brine—a sort of reverse operation. Thus "waste cold" is used to ease the load on the refrigeration system.

Periodically, the gasoline-recovery condenser must be "defrosted" as water vapor in the air condenses on the coils, icing them up—just as in a home refrigerator. To do this, hot liquid, heated by compressor discharge, is circulated through a second set of coils around the condenser. This melts the ice, and the water drains down into the sump where it's drawn off.

Trapping gas fumes

How do you catch gasoline vapor? This is clever, too. Tanker trucks are loaded from the bottom. As fumes rise inside, they're drawn off at the top through a vent pipe. From the vent they travel through a hose to the gasoline-recovery unit. At each delivery point, two hoses are connected to a filling station's tank. As fuel is pumped in through one hose, gas fumes are forced out the other hose and back into the truck.

A special double-walled coaxial pipe fitting, developed by Emco Wheaton, Inc., of Conneaut, Ohio, makes possible a single connection to a station's tank, saving time and simplifying the job. Gasoline pours in through the inner pipe, and fumes escape through the outer one. When the tanker truck is empty, it returns to the loading depot and the process is repeated, with the fumes drawn off as fresh fuel is loaded.

While the gasoline-recovery system is still in limited use at a few tank farms, it will eventually be installed nationwide under EPA regulations. The EPA is, of course, concerned mainly with its effect in reducing air pollution, but it also offers an important bonus—the potential saving of millions of gallons of gasoline every year.

Next comes the pump

Catching fumes at the pump is a bit more difficult. Several types of gas-scavenging pump nozzles have been developed, but there have been some problems. The most common type consists of a flexible rubberlike

(Please turn to page 62)

Volaré



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You and your packages. Handled with care.

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The Volaré is very easy on gas. According to E.P.A. estimated mileage results, of all Volarés, the



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WASTE FUEL

(Continued from page 60)

boot that surrounds the nozzle and presses up against the filler-cap hole in your car as the nozzle is inserted in the tank. Fumes rising from the tank are captured by the boot, and a second hose carries them back down to an underground tank. Some such nozzles use an electrically operated vacuum assist to help draw the fumes from the tank; others rely on the natural displacement of the gasoline to force the vapor out.

Fuming over fumes

Some garagemen grumble that new twin-hose booted nozzles are expensive to install, awkward to handle, frequently don't make a snug, airtight fit against the car and tend to pop out of the tank if left unattended, spilling gasoline on the ground and creating a fire hazard. This last problem, if as serious as some report, means a garage attendant must hold the nozzle in place the entire time your car is being filled instead of putting the pump on automatic and doing other chores like washing your windshield, checking your oil or attending to other cars—a time-wasting nuisance.

There's also a special problem with cars designed to run only on unleaded fuel that have a restrictive flutter-valve trap in the neck of the filler pipe to let in only the smaller nozzles used on unleaded pumps. Attendants claim the bigger gas-scavenging nozzles won't fit into such cars unless a screwdriver or wire hook is inserted to pull the trap out of the way—another nuisance.

Despite these objections, however, it seems certain that some form of fume-trapping filler device will become a national requirement, at least at bigger filling stations (under present EPA regulations, smaller stations pumping less than 10,000 gallons a month are exempt from the requirement). The twin-hose nozzles are already in partial use in at least nine major test areas, including San Diego—the first to introduce the system—Los Angeles, San Francisco, Boston, Denver, Newark, Washington, Sacramento and the San Joaquin Valley in California.

According to the EPA, an estimated 9 million gallons of fuel a year are being salvaged in just these test areas alone, with the promise of many millions more to come as the program spreads. Apart from environmental benefits gained, in a gas-hungry world every drop of fuel saved—even a fume—counts. ★★

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Motorcraft traps twice as much dirt as AC, Purolator or Fram



Here's why

The difference between this Motorcraft Oil Filter and the others is what's inside. Instead of just a paper filter, Motorcraft gives you both nylon and cotton. In lab tests supervised by an independent testing company, Motorcraft trapped more than twice as much dirt during the filter life cycle as the others did. Don't let just a few pennies* keep you from getting the filter that tested best. Ask for Motorcraft wherever you buy parts, or service your car.

Motorcraft 



TESTED TOUGH

*Based on manufacturers' suggested retail prices.

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Start fresh with Belair.

Light menthol to make your smoking fresh and free again.



The light touch of menthol.

Windproof Ronson Butane lighter with adjustable flame. Yours for free B&W coupons, the valuable extra on every pack of Belair.

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Kings, 15 mg. "tar," 1.1 mg. nicotine; Longs, 17 mg. "tar," 1.2 mg. nicotine, av. per cigarette, FTC Report Nov. '75

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DETROIT LISTENING POST



Full-size wagon on way out

The full-size station wagon is apparently doomed. Detroit will continue to produce wagons, but they will be scaled down. More mid-size than full-size. The standard-size wagon will still be around a few years, until 1978 or '79. After that wagons will shrink in size and cargo capacity.

Detroit isn't overlooking the guy who likes the roominess of a wagon. In place of the big wagon, they will try to sell him a van. It will be a new type of van, a cross between a van and a big wagon. The crossbreed will be higher and have more vertical space than a big wagon, but less horizontal space (length) than current wagons.

Imports aren't down yet

Manufacturers of foreign cars are entitled to snicker when they hear Detroit say they've got the imports on the run. Detroit's been saying that for 20 years. The importers go right on selling a million to a million and a half cars in this country year after year. The battle is getting interesting again and it could become another case of the tail (the imports) wagging the dog (the domestics). It's happened before.

Detroit now says it has the products or is developing the products to send the imports packing. Small, light cars that give good mileage. No argument about that. Drive a Chevette. But also drive Datsun's new (to this country) F-10. Datsun has just started importing the F-10 into the United States, so it may not be available in all parts of the country.

The F-10 is even smaller than Chevette. Datsun hadn't put a price

on the car at the time this was written, but you can bet it will butt Chevette head-on. Datsun isn't the only importer with a smaller-than-Chevette car. Toyota, VW, Subaru and Leyland have sub-minis they could sell in this country.

That's not a prediction that the mini imports will outsell Chevette. Chevette is a good car for the money and is backed by a sales organization that is the envy of every car manufacturer in the world. But if the more-mini-than-Chevette cars sell in sufficient numbers, they could put the spur to Detroit to go back to the boards to design even smaller cars.

New warning light on '77s

All '77 model cars will carry a warning light on the dash to tell you if you're running low on brake fluid. Government order. Some of the higher price jobs may go beyond the order and incorporate a warning device to flag you when brakes require checking or relining.

Will Big 4 become Big 8?

The number of car manufacturers in the United States could increase by 100 percent in the next few years. There are four major companies now, excluding the "minors" such as Checker and Avanti, so it would take only four new entries to increase the number by 100 percent.

Volvo will begin making cars in Chesapeake, Va., next year. Volkswagen has wanted to produce automobiles in the United States for 20 years and may have decided on a production site by the time this issue of PM comes off the press. Volvo and VW would increase the number of

manufacturers by 50 percent. How about the other 50?

Datsun has been mulling the idea of a U.S. plant for several years. The VW decision could be the push Datsun needs to get off the fence. If Datsun, the top-selling import in the United States, and VW begin assembling cars in this country, could Toyota stay out of the game? The number of U.S. car manufacturers could increase from four firms to eight during this decade.

Cadillac: light and lean

GM's edict to its divisions to "get the weight out and the mileage up" applies even to king Cadillac. Caddy is testing a mini-sized version of its 500-cu.-in. engine and expects to show impressive gains in fuel economy on its '77 cars. Nothing like Chevette's 40 mpg, but economical by Cadillac standards. Cadillac has yet to put the down-sized engine in a production car. Testing is being done on stripped '76s to simulate savings in weight the company expects to make on the '77s. The '77s will be 500 to 700 pounds lighter than the '76s.

Prices up, weight down

If the toss-up is between fat prices or fat cars, the auto companies think fat prices are easier to live with. So say suppliers who sell parts to car firms. Suppliers say carmakers have been really brutal the past two years in demanding lower prices. "Get the price down or lose the business," the purchasing agents threaten.

A supplier doing business with GM and Ford notes a change. "They haven't exactly told us we can increase prices," he reports, "but they

(Please turn to page 68)



The spare tire is getting smaller as it inches toward oblivion. It's sure to disappear as puncture proofing becomes more advanced. For now, though, there's Firestone's new Tempa-Spare, shown tucked away at left. It takes 50 percent less space than the full-size tire at far left. It's stored fully inflated, and even though it's smaller than regular tires, it doesn't cause car to tilt when put on. It can be run at 50 mph and used over and over until wear indicators show up.



VEGA ESTATE



CHEVELLE MALIBU CLASSIC ESTATE



CHEVROLET CAPRICE ESTATE



SILVERADO SUBURBAN



BEAUVILLE SPORTVAN

1976 Vega wagon. Big economy. Small price.

Here's a wagon with the cargo space you occasionally need, plus the gasoline economy you always need.

**35 mpg highway.
24 mpg city. EPA ratings.**

These ratings are for Vega wagons equipped with the standard Dura-Built 4-cylinder, 140-cubic-inch engine, 3-speed manual transmission and 2.92 rear axle. Test cars were not equipped with air conditioning.

Remember: These mileage figures are *estimates*. The actual mileage you get will vary depending on the type

of driving you do, your driving habits, your wagon's condition and available equipment.

In California see your Chevy dealer for EPA mileage figures and engine/transmission combinations available on California emission-equipped cars.

Lowest priced '76 wagon built in America.

Based on a comparison of Manufacturers' Suggested Retail Prices, our lowest priced Vega wagon (shown at right), at \$3,227, is the lowest priced wagon built in America. Tax, license, desti-

nation charge and available equipment are additional.

And talk about practicality.

The Vega wagon and Vega Estate (a neat "woody" version) seat four adults with storage room behind the second seat.

Flip down the second seat though, and you can take up to 50 cubic feet of cargo through the rear liftgate.



Part of Chevy's full line of 1976 wagons.

Being *America's Family Station Wagon Builder* means offering wagons for all kinds of American families.

And we do.

Chevelle. Mid-size, that's the right size.

For many families, Chevelle is just the wagon.

It's available as a 2-seat or 3-seat wagon. The tailgate lifts up and out of the way.

Standard equipment includes Turbo Hydra-matic transmission, power steering, power brakes, steel-belted radial tires and the Chevrolet Efficiency System.

Choices: Malibu, Malibu Classic or Malibu Classic Estate.

Chevrolet. Full-size, comfortable, practical.

For families with larger needs, we offer two choices:

Impala and Caprice Estate, 2- or 3-seat.

Standard features on both include Glide-Away tailgate, power steering and power brakes, Turbo Hydra-matic transmission, steel-belted radials, a 400-cu.-in. V8, the Chevrolet Efficiency System.

Suburban. Some call it superwagon.

It's built on a tough truck frame, yet has a comfortable interior.

It seats up to nine with available seats, carries about half again as much as many

wagons, and can move about seven tons including trailer, passengers, luggage and Suburban.

Sportvan. The family space vehicle.

It can seat up to 12 with available seats.

There are wide-opening double doors in the rear, and a sliding side door that needs only 4½ inches clearance.

And rounding out Chevy's wagon lineup . . . Blazer, a go-almost-anywhere fun vehicle.



DETROIT LISTENING POST

(Continued from page 65)

indicate if we can get the weight down on the piece and make it as durable as before, they won't give us the gate if we up the price." Translation: Car prices will continue to go up, but you will get better mileage. Henry Ford II has already said there is "no way" of avoiding a price hike on the '77 models this fall.

Overloaded cars overstocked

If you like a lot of extras and will settle for an off-the-floor job instead of a special order, this is a good time to dicker with the dealer. The auto companies always ship a batch of everything-on-'em cars at the start of a model run to catch customers who want to be first with the newest. They made too many this year. The longer a car sits in the showrooms, the more it costs the dealer in floor planning—interest the dealer pays the bank. Some overdressed pieces have been sitting around five to six months and dealers would like to unload them.

Mini-bus no easy ride

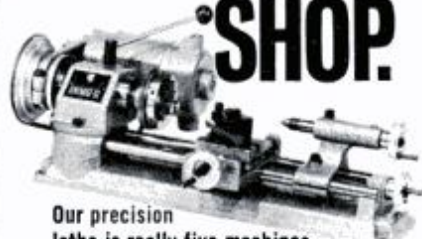
I borrowed a mini school bus for a weekend and it gave me new respect for people who drive those rigs regularly. I covered about 250 miles over three days. The wind was fairly strong, but it wasn't a gale like we frequently have in Michigan during the winter. I had to wrestle with the steering wheel to hold the bus on the road. On the last leg, just over 100 miles, I tried different speeds, dropping to 40 and pushing as high as 65. It was a fight to stay in lane at any speed. I was really whacked when I got home. Many mini bus drivers in my part of the country are women. If my experience is typical of what they have to put up with on a windy day, I give them a lot of credit. And I didn't have a load of fussing kids to distract me.

More nutty numbers from EPA

Thanks to mathematicians at the Environmental Protection Agency, GM's 1980 cars will give even better mileage than anticipated. For a year GM has been saying it is working for a 52 percent improvement in mileage of its 1980 cars compared against counterpart '74s. EPA recently recalculated the '74 base period and GM's self-imposed target of 52 percent gain in mileage now figures out to 56 percent.

GM recognizes the hanky-panky for what it is, so it isn't doing much shouting about the "gain." You can prove or disprove just about anything with EPA numbers. ★★

YOUR OWN MACHINE SHOP



Our precision lathe is really five machines in one: lathe, drill press, grinder, miller and polisher. It works in metal, plastics and wood to exacting tolerances; lets you perform dozens of operations with only a little practice. (We even offer exciting project kits, some of which are ideal for the beginner.)

Get all the details. Find out why 200,000 craftsmen have bought this unique machine. Send for our free brochure. For more detailed information, send for our 44-page handbook, only \$2.00.

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EXTRA UTILITY
EXTRA COMFORT



Big Wheel Turf-Rider

Save money on rugged, all-gear lawn and garden tractors. Buy Kit factory direct. Assemble yourself (on a weekend). Enjoy more leg room, year 'round work-power. Both offer 12 or 16 hp., over 30 attachments incl. mower, garden tools, snow-blower, blade, loader, etc. Send now, to:

NEW!
Mini-Beep



STRUCK KIT, Dept. PM46B, Cedarburg, Wis. 53012
 Catalog showing Struck Tractor Kit construction & uses (specify Turf-Rider or Mini-Beep) — 50¢. Both catalogs — 75¢.
 Plans for fabricating both Turf-Rider and Mini-Beep Tractors from local materials — \$6.00 (refunded on any purchase).

Name _____
Address _____
City, State, Zip _____

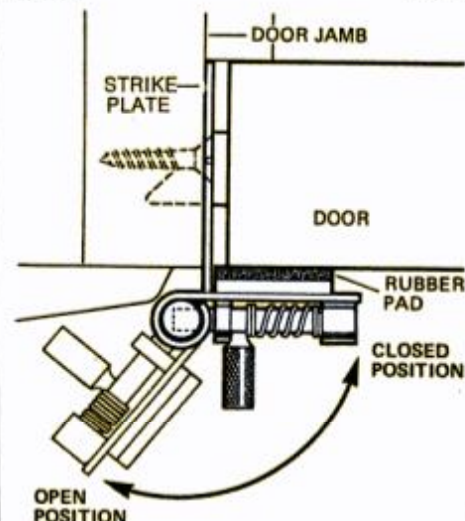
Internal security



When a new internal security device called Ded-Lok is attached to the inside of your front and back door in a locked position, you have no fear of someone forcing the door open to gain entry when you're at home alone or asleep. It can't be done even with a key. Only you can open the door and only from inside. Ded-Lok's locking pin will withstand over 1200 lbs. shearing pressure.

The lock, which works like a hinge, is designed for use on any standard 1 3/4-in.-thick exterior door. To install it, you simply remove the door's striker plate and replace it with the Ded-Lok. To lock the door, you swing the bumper plate against the door, and a locking pin automatically snaps in place.

To unlock, you pull a small knurled handle to disengage the pin and swing the bumper plate back out of the way to clear the door. The lock is childproof, makes it impossible to lock yourself out and can be installed at any point along the door's edge should the lock's striker plate be of a different size than the existing one. Ded-Lok is made by Designed Hinge Co., 7243 Atol Ave., North Hollywood, Calif. 91605 and sells for \$3.95. ★★



They don't crown number two.



If there were a better tasting whiskey,
we wouldn't be number one.

Say Seagram's and Be Sure.

SEAGRAM DISTILLERS COMPANY, N.Y.C.
AMERICAN WHISKEY—A BLEND, 80 PROOF.

The proud smoke

Product of a proud land.

Tobacco. It's as proud a part of the American tradition as Niagara Falls. At Liggett & Myers, we've made tobacco into a cigarette worthy of that tradition. The rich, mellow, distinctively smooth L&M. Smoke it proudly.

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



Filter King: 18 mg. "tar", 1.2 mg. nicotine, av. per cigarette, FTC Report Nov. '75.

Even if the Arabs remain friendly enough to keep selling us their oil at fancy prices, we're inevitably heading for the ultimate energy crisis. In about 30 years, geologists predict, most of the wells will run dry. What then?

One answer to this vital question is taking shape in what used to be a cow pasture some five miles north of Princeton, N.J. There, at the Princeton Plasma Physics Laboratory, I got my first glimpse of a gigantic machine that may affect our civilization even more profoundly than did the invention of the steam engine. Called

reactor like the Tokamak over other future power sources is its economy. Its basic fuel is deuterium, a hydrogen isotope found naturally in water—the cheapest and most plentiful stuff on Earth. From a single gallon of water, fusion reaction produces energy equivalent to 350 gallons of gasoline. And the cost of processing—once the machine is paid off—runs about 4 cents for that one gallon of water. What's more, the fuel supply is virtually limitless. It will last as long as the Earth.

There are still other advantages. The whole problem of radioactive

Science taps star power for unlimited energy

By using an artificial sun, researchers hope to tame the fusion power of the H-bomb.

by Hans Fantel

X-rays streaming from hot sun plasmas were "captured" on special film to make this photo of sun. Picture was taken from rocket.

the Tokamak, a name given to it by its Russian inventors, the device holds the promise of fulfilling man's ancient dream of generating cheap and plentiful power.

In principle, the Tokamak is an artificial sun, generating power by fusion of atomic particles, exactly the way live stars generate their heat and light. Or, you may consider the Tokamak an H-bomb in civilian dress. But unlike the bomb, which releases its vast energy in one bang, the Tokamak aims at "controlled fusion reaction," metering out its energy in a gradual, orderly way so that it can be converted into ordinary electric current.

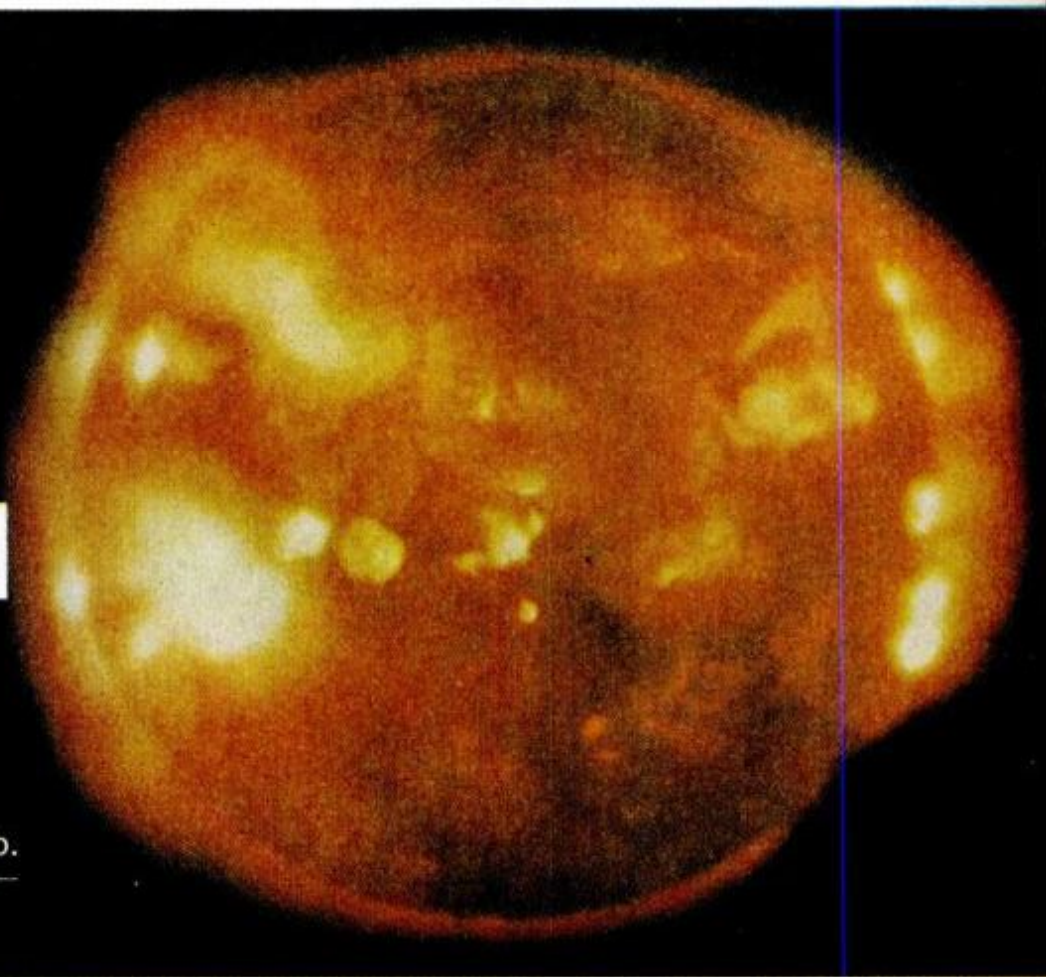
The main advantage of a fusion

garbage is sidestepped. Unlike present-day atomic powerplants, which work by splitting atoms, the fusion reactor, in which atoms are combined, produces no radioactive waste and doesn't pollute the environment. Only the reactor itself gradually becomes radioactive in prolonged use and must be buried after it has outlived its usefulness. But this is no major problem. Also, there is no danger of runaway reactions causing a blowup due to accident or sabotage.

A fourth state of matter

As one physicist put it, "Instead of blowing up, it just fizzes out if something goes wrong."

The Tokamak converts the deuter-

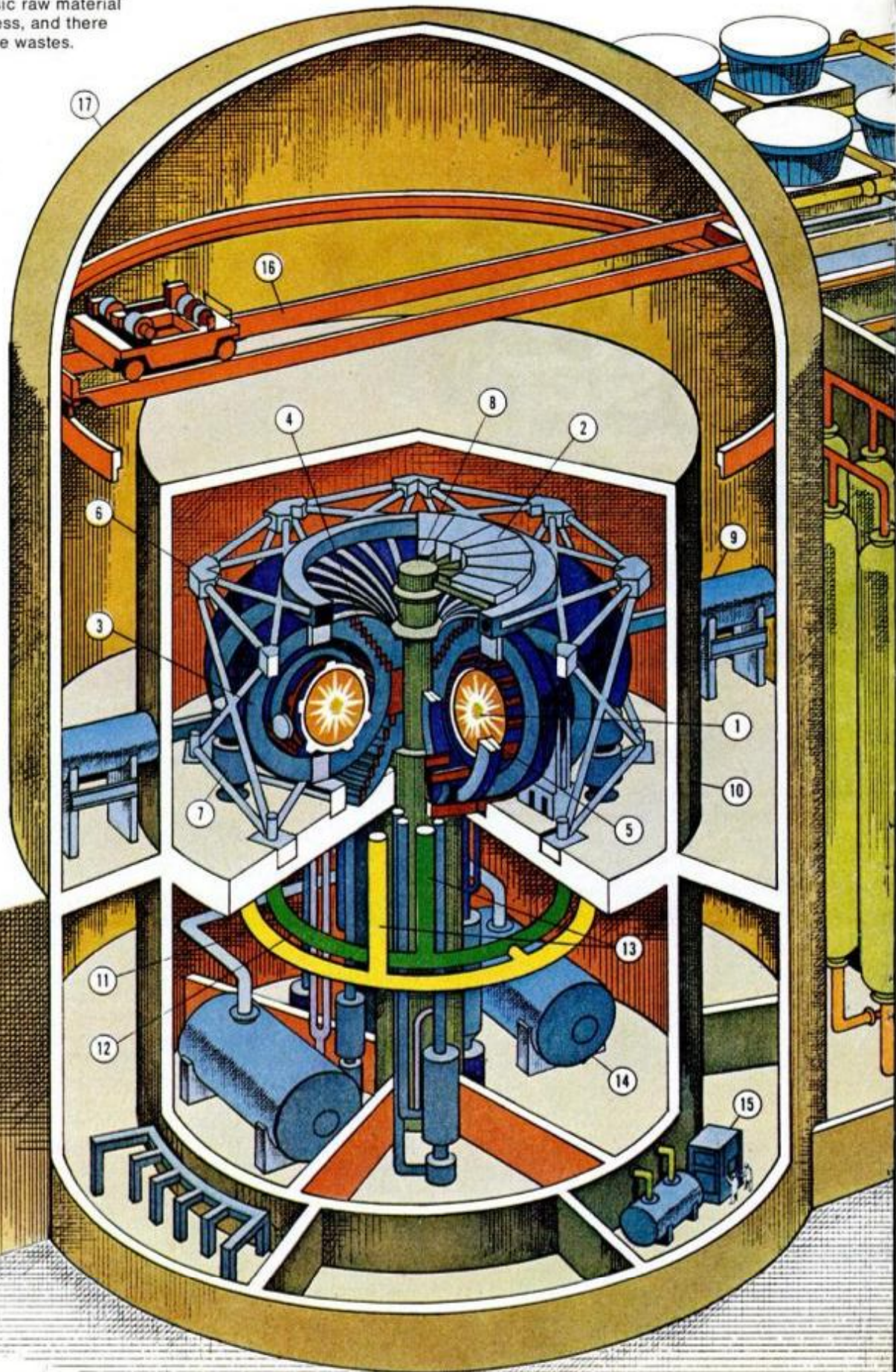


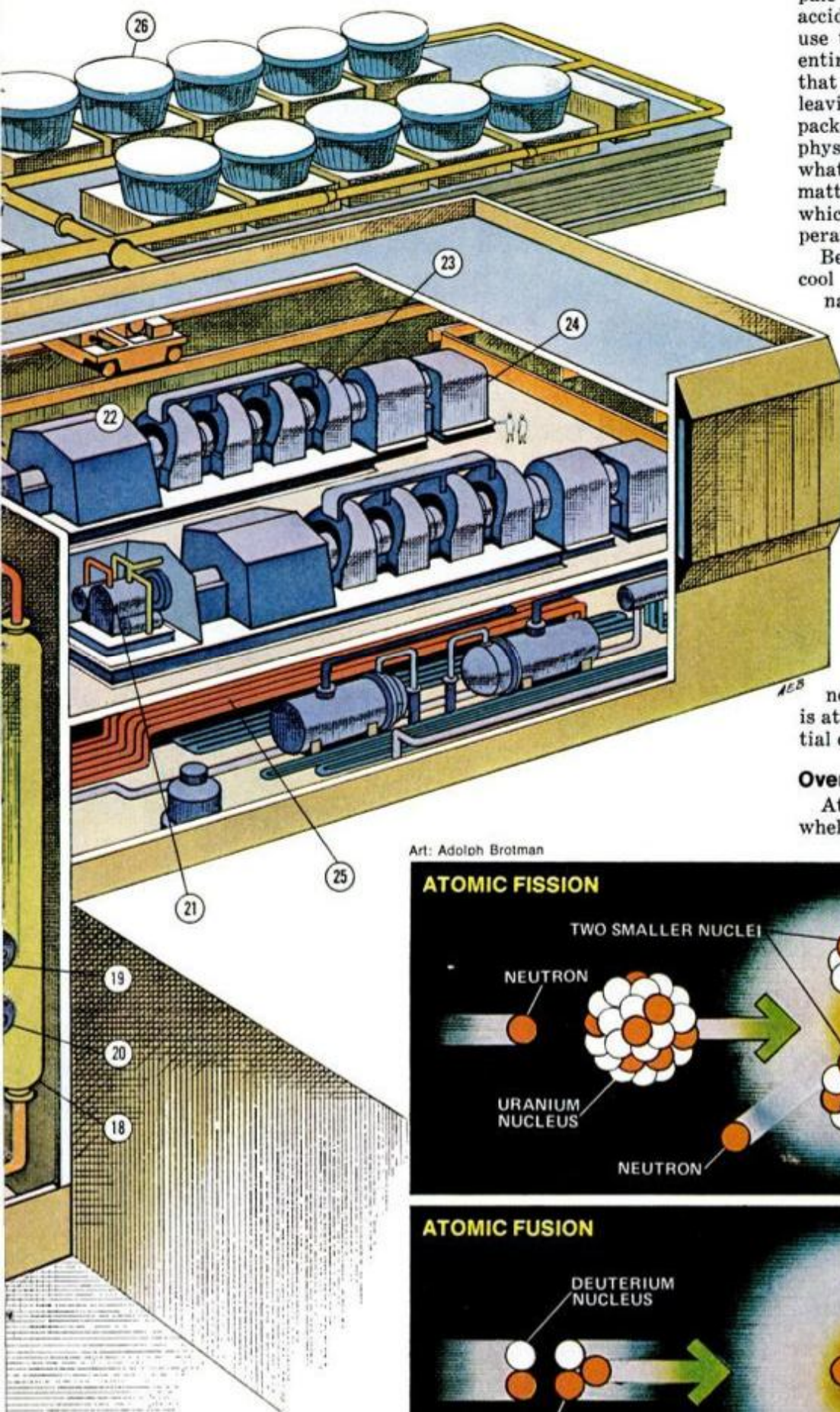
A single gram of matter yields a huge wallop

The Princeton Large Tokamak is designed to heat and squeeze plasmas in its doughnut-shaped torus until fusion occurs, releasing torrents of energy. The basic raw material—water—is virtually limitless, and there is no problem of radioactive wastes.

Tokamak elements

1. Torus vacuum chamber
2. Shielding
3. Toroidal field coil
4. Ohmic-heating field coil
5. Equilibrium field coil
6. Torque frame
7. Vacuum pump
8. Central column support
9. Fuel injector
10. Shield
11. Helium outlet header
12. Helium inlet header
13. Gas lines
14. Storage tank
15. Cryogenic system
16. Crane
17. Containment shell
18. Steam generators
19. Hot helium supply header
20. Cold helium return header
21. Very-high-pressure turbine
22. Intermediate-pressure turbines
23. Low-pressure turbines
24. Generator
25. Steam lines
26. Cooling towers





ium into a so-called plasma. To most people, the term plasma means the pale liquid sluiced into the veins of accident victims. But when physicists use the word, they mean something entirely different: a substance so hot that it literally tears itself apart, leaving a frantic swirl of energy-packed particles. Only recently have physicists recognized plasma for what it really is: a fourth state of matter (like solid, liquid and gas) which occurs only at ultrahigh temperatures.

Because the Earth is a relatively cool place, plasma doesn't occur naturally on our planet—except in the immediate vicinity of a lightning bolt or other strong electric flash, where the temperature is very high. But it's plentiful elsewhere in the universe. Some estimates claim that 99 percent of all matter in existence is plasma. The stars are made of it.

Like our own sun, they are huge plasma balls, superhot gas hopped up with energy, radiating light, heat and radiowaves into the far reaches of the cosmos. Plasma is therefore the prime energy source in the universe. And

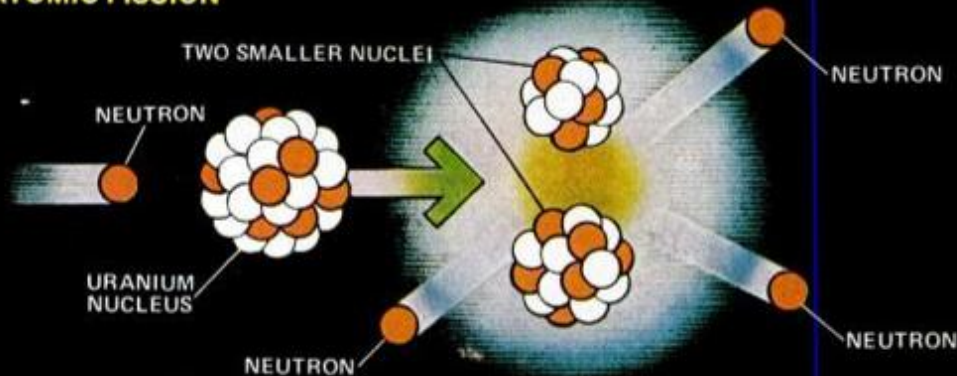
now, for the first time, mankind is attempting to tap its energy potential directly.

Overwhelming size

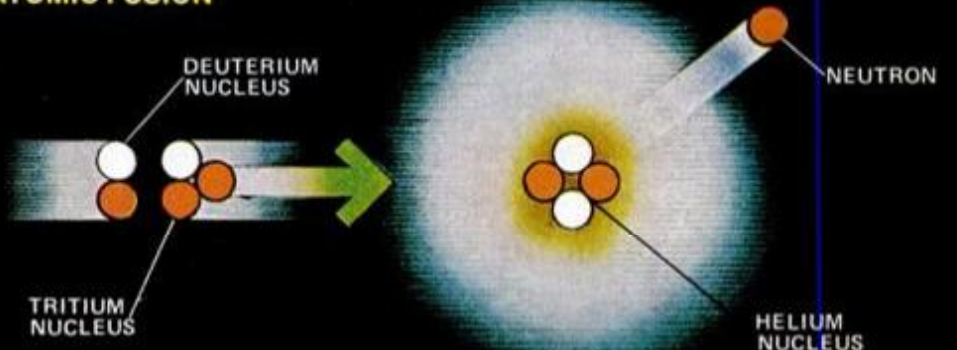
At first glance, the Tokamak overwhelms you by its sheer size. With

Art: Adolph Brotman

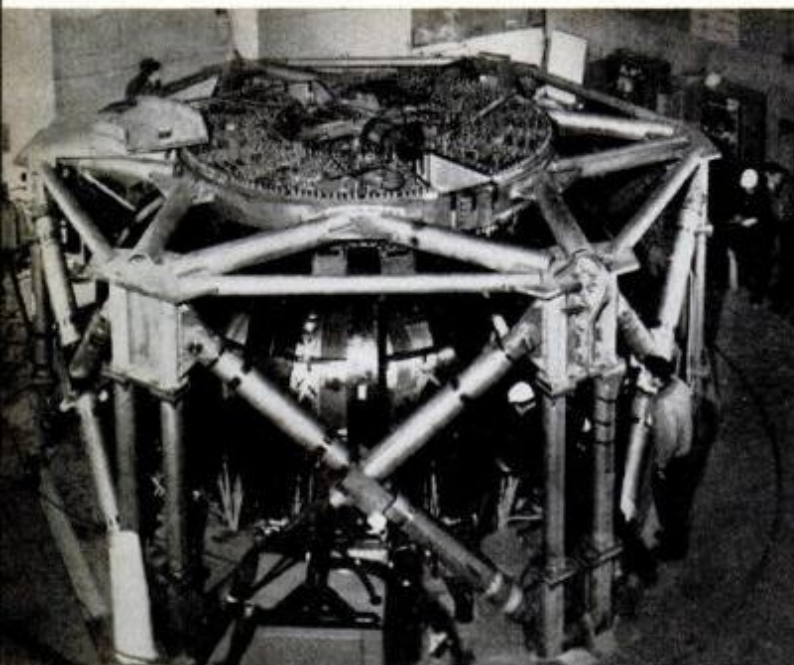
ATOMIC FISSION



ATOMIC FUSION



In a fission reaction, the uranium nucleus is split. In fusion, tritium and deuterium fuse to form helium. Both release big amounts of energy.



Massive steel frame is needed to support the magnetic coils of the Princeton reactor (left). Powerful forces inside the metal doughnut tend to knock over the coils.

its accessory equipment, it fills a hangar space as big as a sports arena. The engineers and technicians clambering on scaffolds to complete the machine's assembly seem like small monkeys in a metal jungle. Water-cooled cables that connect the enormous components are as thick as a man's thigh.

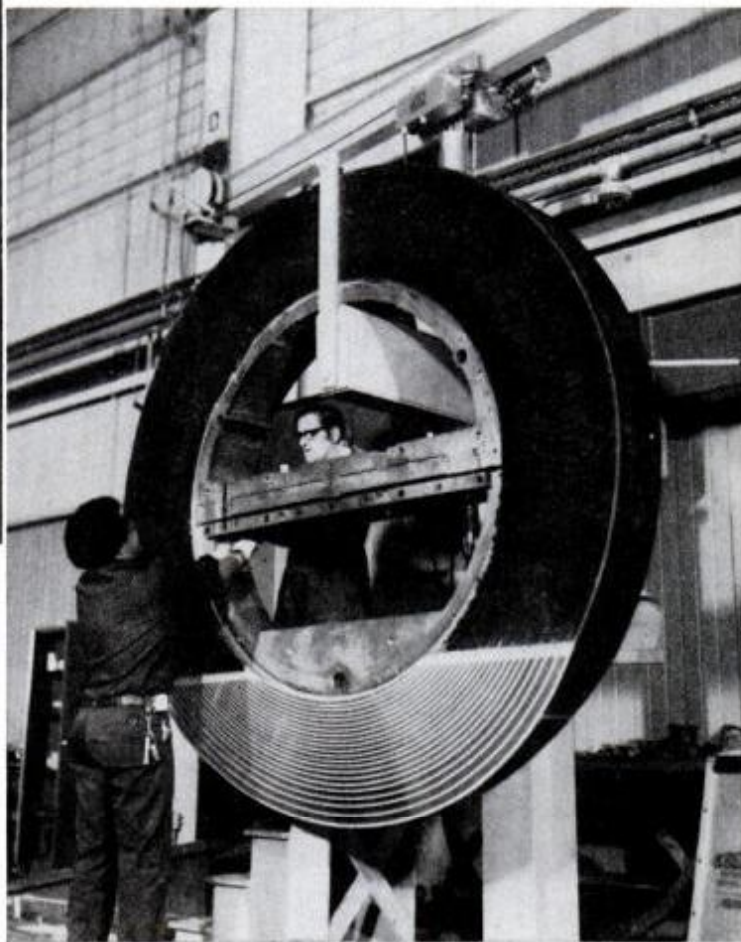
Guiding me through the towering maze of machinery was Dr. Melvin B. Gottlieb, director of the Plasma Physics Laboratory. A tall, cordial man whose professorial calm fails to conceal his enthusiasm and dedicated sense of purpose, Dr. Gottlieb explained the basic structure of the Tokamak. At its center is the torus, a massive circular tube resembling an outside doughnut. Inside this metal tube, the plasma whips around like a dog chasing its tail, lashed on by powerful electric pulses. When this sizzling tornado reaches the proper conditions of density and temperature, the fusion reaction takes place: Ions of deuterium and tritium, both isotopes of hydrogen, fuse together and become helium. In so doing, some of their mass is converted into energy.

The key to this reaction is Einstein's famous formula $E = mc^2$, where E stands for energy, m for mass, and c for the speed of light. The speed of light is 900,000,000,000,000,000 centimeters per second. Multiply by this figure and you'll see why a single gram of matter yields an enormous wallop of energy. This accounts for the incredible efficiency of atomic fusion as an energy source.

Fusion takes great force

Trouble is that fusion does not take place unless the particles are thrown together with great force. In an H-

One of several toroidal field coils is worked on prior to installation around doughnut. Such coils produce powerful magnetic field that's used to contain raging plasma. If plasma touches wall of metal doughnut, the reaction stops.



bomb, fusion is triggered by the power of a fission A-bomb. In the Tokamak this is done by heating the plasma to the staggering temperature of about 100 million° C.

Such temperatures are hard to reach and even harder to maintain under stable conditions. In fact, one purpose of the Tokamak is to explore various heating methods. Three types of heating are used in the Tokamak:

- Since plasma conducts electricity, a strong electric current sent through the plasma heats it the way electricity heats the wires in your toaster. Yet this alone cannot bring the plasma all the way up to reaction temperature. Unlike normal substances, plasma decreases in electrical resistance with increasing temperature. Consequently, the hotter it gets, the less additional heat can be produced in this way. That's why auxiliary heating methods are needed.

- To make the hot plasma hotter, it is squeezed by a strong magnetic field. This magnetic compression, like any other form of pressure, raises the temperature still further.

- Even more heating energy is pumped into the raging plasma stream by hitting it with high-frequency radiowaves (similar to the way you roast meat in a microwave

oven). An 800-megacycle radio beam slams into the plasma with a power of hundreds of kilowatts.

Can't explode

By combining these three heating methods, the Tokamak can reach Goal No. 1: It brings the plasma up to temperatures where fusion takes place and energy is released. But when that happens, you run smack into Big Problem No. 2: The hurricane of plasma racing inside the torus is extremely difficult to control. The frantic merry-go-round must be kept floating inside the metal doughnut without touching the walls. If it did, even the briefest contact with the metal walls would cool the plasma and quench the reaction. This happens to be a great safety factor: If the plasma goes out of control, the Tokamak literally stops cold (unlike conventional atomic fission reactors, which may blow up when their controls fail).

But this makes it necessary to "contain" the plasma in a floating state. To do this, the torus is surrounded by huge magnetic coils. Since the plasma responds to magnetic forces, these electromagnets can keep the plasma suspended with-

(Please turn to page 166)

Ocean flight by jetfoil

A PM reporter rides Boeing's fast, new 'flying' liner.

by Bjorn Kulkopf

She starts out like any boat, maneuvering slowly out into open water. Then suddenly there's a surge of power, her bow comes up, she leaps ahead and the huge craft seems to take off like an airplane. Her hull climbs completely out of the water, riding on three hydrofoils, one forward and two at the stern. Acceleration jumps dramatically to speeds of 45 knots or better—more than 50 mph!

I was riding Boeing's big, new Jetfoil, a 92-foot-long, 190-passenger, jet-powered, ocean-going hydrofoil liner, one of the first of its kind. It and a sister ship are currently operating in the Hawaiian Islands, making high-speed passenger runs between such places as Honolulu and Maui. A third will soon join the island fleet, and others will provide fast ferry service across the English Channel.

Like a luxury airliner

Not only does the Jetfoil "fly" like an airliner, but she has all the luxury appointments of a wide-bodied jumbo jet. Roomy passenger compartments in the double-decker have 10 seats across with two aisles. As in jetliners, pretty stewardesses wheel refreshment carts up and down the corridors. Two things are significantly unlike an airliner, though: There are no seatbelts—you don't need any—and large picture windows provide a magnificent view of the passing scenery.

Watching from the control room—more like a jet's cockpit than a conventional ship's bridge—I marveled at the smoothness of the ride. Once the craft is foil-borne, there is none of the pitch and roll of regular boats. Hydrofoils as such aren't new. Thou-

(Please turn to page 186)



Riding high, Boeing's big new 190-passenger Jetfoil slices along on her "stilts" at speeds up to 50 knots—more than 57 mph. At center left is dual-control, airliner-type cockpit with author looking over pilots' shoulders. At center right, craft banks into a turn like a plane, permitting high-speed maneuvers without discomfort to passengers. At left, bow foil is retracted for docking. The ocean-going hydrofoil makes runs in the Hawaiian Islands, will soon also cross English Channel.

Truckwatcher's

You know the Mack 'bulldog',
but can you tell
a Peterbilt from a Kenworth?



Kenworth rig bears down with callouts in low: Study the cabs of the big rigs and note what they're sporting. Big rigs are trucks in Classes 7 and 8, that is, with gross vehicle weight over 26,001 pounds. Look for air-smoothing, fuel-saving devices on the newer trucks, like that on the GMC cab roof on the facing page.



guide to the big rigs

by Michael Lamm

America's love affair with the automobile might be on the wane today, but our passion for big trucks is just beginning. There's presently a growing enthusiasm for trucks—something akin to the interest in hot rods, sports cars and classics that swept the nation 25 years ago. People outside trucking are beginning to notice trucks—the wild paint jobs, the chrome, the "class" and the power. Youngsters and teen-agers, instead of playing name-that-car as the new models flash past on the highway, now





pride themselves on being able to identify Marmons, Brockways, Peterbilts, Internationals, Autocars, GMCs, Macks, Chevys, Whites, Fords, Kenworths, Western Stars, Dodges and so forth.

If you've been eyeing the big rigs yourself lately, you're by no means alone. Television producers and novelists have discovered the appeal of big trucks in such TV series as "Movin' On" and books like *Haulin'* by Phillip Finch and *Truck* by Katherine Dunn. Monty Tak, a lady trucker who used to pilot big rigs coast to coast, recently wrote a dictionary of trucking called *Truck Talk*.

More and more women, in fact, are crawling up into those tall cabs and settling into inflatable air seats behind oversized steering wheels. Bekins, for example, now purposely hires husband-and-wife owner-operator teams to jockey their moving vans.

It's a fascinating world—trucking—one we're aware of constantly. Yet few motoring enthusiasts know much about the inner workings of trucks. This guide will acquaint you with some of the basic hardware—the rigs you see coming down the roads.

Two-basic configurations

We're talking now about Class 7 and Class 8 trucks—on-highway tractors with GVW (gross vehicle weights) of 26,001 to 33,000 pounds for Class 7 and 33,001-plus pounds in Class 8.

Highway tractors come in two basic configurations: cab-over-engine (c.o.e.) and conventional. Conventionals have their engines under a hood out front, with the radiator prominent. Conventionals are generally considered more comfortable to drive and ride in; the driver doesn't sit atop or ahead of the front axle. C.o.e.s are foreshortened to save space, because some states legislate maximum overall lengths, particularly with double trailers.

C.o.e. cabs come in various lengths from 48 to 105 inches. Cabs with sleepers are generally about 30 inches longer than nonsleepers.

Wheelbases of both c.o.e.s and conventionals commonly range from 150 to 300 inches. Wheelbase figures, though, can be confusing, because some tractors have single drive axles and others have double rear axles. Those with double drivers are designated 6x4s (six wheels total, four being drivers); while other tractors might be 4x2s or 6x2s. A few on-highway trucks use 4x4 and 6x6 all-wheel drive—notably FWD, Walter, Oshkosh and Fabco—as do many off-highway rigs built for the handling

of special construction, mining and logging jobs.

Truck manufacturers

As in the auto industry, a great shakeout of independent truck manufacturers took place during the 1950s. In 1951, the White Motor Co. bought out Sterling, then Autocar in 1953, and Diamond T plus Reo in '56. White now markets White, Autocar, Freightliner, and, until recently, Western Star.

Western Stars, built in British Columbia and Utah as conventional's only (no c.o.e.'s), are all-steel trucks, with steel used even for the cabs. Autocars, on the other hand, are mostly aluminum, including frames, cabs and tractors. Whites and many other trucks use fiberglass in cab construction. Light weight adds payload potential and saves fuel and highway taxes.

Freightliners, long marketed through the White organization, are actually engineered and built by Consolidated Freightways, headquartered in Portland, Ore. Freightliner is now setting up its own dealerships.

Reo and Diamond T merged in 1967 to form Diamond-Reo, which declared bankruptcy in 1975. You still see quite a few Diamond-Reos on the road.

Peterbilt, formerly Faegeol, and Kenworth merged and are presently owned by the Pacific Car and Foundry Co. of Renton, Wash. Peterbilt is widely regarded as the "Cadillac of trucks," although Freightliner also fancies that distinction.

Brockways and Macks are marketed by Mack Trucks of Allentown, Pa., but the two companies maintain separate managements and engineering departments.

International builds a great number of Class 7 and 8 trucks and claims to be No. 1 in big-rig sales. Mack makes the same claim.

You also see a fair number of Ford, Chevrolet, GMC and Dodge trucks on the road, although Dodge stopped manufacturing Class 7 and 8 trucks in 1975. Seen much less often are such rare nameplates as FWD, Oshkosh, Marmon, Walter, Fabco and CCC, all built primarily for special uses.

East and West Coast trucks

If you split the United States at the Rockies on a topographical map, you'll note that western terrain is a lot more rugged than in the East. The mountains of New England are foothills in the West. That means that trucks used out West have to be different from those driven only in the East. West Coast trucks—Peterbilts, Freightliners and Western Stars—

(Please turn to page 160)

IT'S NEW **NOW**



Compact scroll saw is kind to neighbors

Designed for minimum work space, Dremel's new mini Moto-Saw (17½ inches long, 8 inches wide, 8¾ inches high) has rubber feet for use on a table or counter. A 12-inch throat takes softwood 1½ inches thick. The 3450-rpm, 1.5-amp. motor handles light metal. It won't generate radio or TV noise. \$39.95. Emerson Electric, 4915-21 St., Racine, Wis. 53406.



Practical, portable crystal-less scanner

The optical reader in Linear Systems' Optiscan makes the crystal-less scanner unique. A credit-card-size memory, programmed by the user, is inserted in the 7¾ x 10 x 2½-inch portable unit, which takes 10 channels at a time. Device comes with antennas for all bands, costs \$369.95. Linear Systems, 220 Airport Blvd., Watsonville, Calif. 95076.

Shape of pilotless planes to come

Next on the aerospace agenda is the high-altitude, long-endurance Remotely Piloted Vehicle (RPV)—a pilotless plane capable of carrying large, heavy payloads, controlled from remote stations. Artist's conception shows proposed configuration of Teledyne Ryan Aeronautical's "Compass Cope RPV," a craft with sophisticated remote avionics and landing systems.



Wide-angle reflectors for biking safety

Come June, all new bikes must be equipped with wide-angle reflectors—front, rear and sides—to protect night riders. Kits to bring present bikes up-to-date offer wide-angle reflectors, plus spoke reflectors that circle with the wheels, to alert car drivers. Stimsonite, Amerace Corp., Ace Rd., Butler, N.J.



Military 'hovership' on the drawing board

Latest in proposed seagoing military vehicles is the world's first "hover warship." It's a 2200-ton antisub, helicopter and missile carrier with a potential speed of 100 mph. Plans call for a hull as wide as the English Channel Hovercraft are long. Designs under way are by former Hovercraft design experts now working with Bell Aerospace Corp. of America.



Elegant classic, back on the road

The rusted hulk of a 1937 Aston Martin, found in a Buckinghamshire garage by a British newspaper executive, turned out to be one-of-a-kind made for a director of the car company. Two Rolls-Royce body specialists went to work on it, with results shown, after 15 months of restoration. Original cost was about \$3500. Today's Ve Aston is pegged around \$30,000.

Now 'fingerprints' are trapping ocean polluters

by James H. Winchester



HELICOPTER SIGHTING
SUN., JULY 20th



STRAITS OF FLORIDA



2nd REPORT
SAT., JULY 19
8:30 AM



At 10:10 a.m. on Friday, July 18 last year the fishing boat *Danny III*, pushing against an eight-knot wind and two-foot seas in a moderate rain 10 miles south of Key West, Fla., radioed the Coast Guard: "Dark oil slick in main ship channel. Relatively small. Moving away from land."



The Key West Coast Guard station wasn't too concerned, even when other boats next day reported oil slicks, all of them still several miles offshore, and some of them located miles back up the chain of islands toward Miami. They were marked as "minor spills," and no connection made between them.

On Sunday, July 20, the picture became more focused. Calls flooded the Key West Coast Guard station. Fishermen reported heavy globs of oil washing ashore on several shoals on the edge of the main ship channel 8 to 10 miles offshore. Several boats returned to Key West marinas with their hulls coated with heavy oil. Most

disturbing, a private plane landed to report oil only two miles offshore, drifting toward the Key West beaches.

Shortly afterward, another private pilot radioed sighting heavy oil off Big Pine Key, nearly 40 miles up the Keys. Lieutenant Henry Prezomski, acting head of the Key West Coast station, deeply worried by now, requested a Coast Guard flight from Miami for an overall aerial survey, telling his superiors: "I think we have something big!"

Lieutenant Prezomski was right. By 5:00 p.m. the helicopter crew from Miami confirmed heavy oil in a patchwork pattern from the Dry Tortugas, well to the southwest of Key West, to five miles beyond Marathon. At 9:00 o'clock that night, well aware now that there was one overall problem rather than two or more scattered slicks, the Coast Guard issued a bulletin: "Major oil spill heading into Key West beach area on south side."

Anything involving over 40,000 gallons of oil is regarded by the Coast Guard as a major emergency, and there have been many bigger spills than the Florida Keys nightmare, where an estimated 50,000 gallons of heavy crude eventually was recovered from the beaches, plus another 40,000 to 50,000 gallons of polluted debris, which included sand, grass and water.

With rare exceptions, though, the cause and source of most major oil spills are readily apparent: a tanker gone aground, broken pipeline, ruptured storage tanks or a collision between oil-laden barges. In the Key West mishap the cause of the spill and the source of the oil were a complete mystery.

One of the world's worst

In most oil spills, too, pollution is generally confined to a relatively small area in the immediate vicinity of the accident. The Key West oil washed ashore along a 40 mile-long distance. This was serious enough in itself, but the area is filled with thou-



3rd REPORT
SAT., JULY 19

Amazing new techniques
can lead the Coast Guard
to solving the mysteries
of oil spills along our shores.

1st COAST GUARD
SIGHTING



2nd COAST GUARD
SIGHTING
8:15 PM, SAT., JULY 19

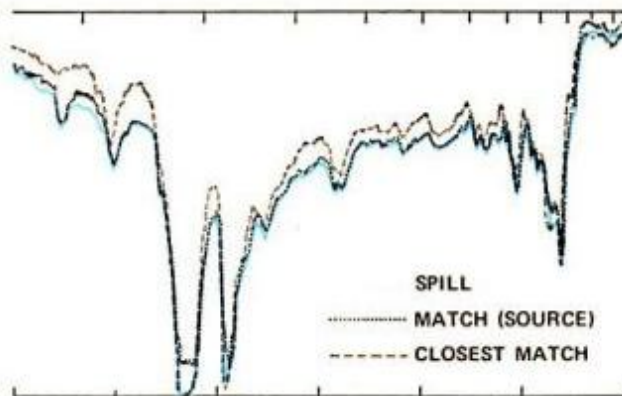


sands of small grass and mangrove-covered shoals and islands, blanketing the water like polka dots, so that the total shoreline covered with oil was more than 1000 miles. Rarely in the world has an oil spill been known to have contaminated so much of the water's edge. Only the *Torrey Canyon* spill off Cornwall, England, in 1967 and the supertanker spill in the Straits of Magellan in 1974 rank higher in the total amount of shoreline polluted.

Shallow water slowed cleanup

Complicating everything was the shallow water, only a few inches deep in many places. When tides went out the heavy oil was left behind to stick to the mangrove roots and turtle grass on the tiny keys. Cleanup boats couldn't get in close enough to work effectively. When suction trucks, operating like giant vacuum cleaners, could get close enough by land, the grass mixed with oil clogged their pickup hoses.

Says the Coast Guard: "Because the oil was so scattered, so hard to



The tanker *Garbis* (above) is alleged by the Coast Guard to be the ship from which oil spilled into the Florida Straits. At left is an example of results from one of four tests used to match oil fingerprints. It shows infrared analysis of three oil samples—from the original sample; from a sample that is a match; from the closest-match sample. Oil fingerprinting is done in Coast Guard's New London, Conn., lab (lower left). Oil floats ashore in Florida Keys (below).





From 40,000 to 50,000 gallons of oil-polluted debris was removed from beaches and mangroves in Florida Keys (above). Another 50,000 gallons of heavy crude oil was recovered from the water. Pumps sucked up oil trapped by oil booms (below) used by Coast Guard strike team.

Wide World photos.



reach and so difficult to handle, what we had was a problem spill rather than a catastrophic spill."

Arresting a suspect

It took over three weeks for the Coast Guard, local Florida teams and civilian contractors with special equipment to get the oil under control in the Florida Keys, but three and a half months were needed to track down the most likely source of the spill. When Capt. Vassilios Kyranos Psarroulis, the Greek-born master of the 825-foot-long Liberian tanker, *Garbis*, was arrested by federal marshals early last November at Gloucester City, N. J., a Delaware River port near Philadelphia, and charged with failure to report the spill off Key West, the Coast Guard officially hailed the case as "the most complicated detective work in maritime pollution history." (Charges dismissed March 3, 1976. EDITORS.)

Tracing the oil from the Florida Keys to the *Garbis*, whose owners will have to pay the estimated \$400,000

spent to clean up the mess if the charges against them are upheld in federal courts, is the first really large-scale application of a new and sophisticated method of oil-sleuthing. Collectively, the painstaking process is the chemical analysis of samples taken from a spill, which are then matched against other samples col-

lected from suspicious sources, such as fingerprints from the scene of a crime are checked against the prints of a suspect.

In busy shipping lanes

It was obvious from the start that the Florida Keys oil was deliberately

(Please turn to page 188)

Oil-spill strike force goes into action

A few minutes before the Coast Guard issued its first bulletin at 9:00 p.m. on Sunday, July 20, last year, that a major oil spill was headed for the Key West beaches, Coast Guard Lt. Frank Collier answered the phone in his home at Slidell, La., near the Mississippi border a few miles inland from the Gulf of Mexico. Lt. Cmdr. George Davis, the marine environmental protection officer at the Seventh District Headquarters of the Coast Guard in Miami was calling. "Looks like we have a big one," he said anxiously. "Can you get here in a hurry?"

Lieutenant Collier is the executive officer of one of three new and still almost unknown special Coast Guard teams that now respond, like firemen rolling with the bell, to major oil spills anywhere in the United States and its possessions, and even to pollution disasters in foreign waters when requests are made by other nations.

Ready to roll in two hours

Trained to contain and clear up large oil spills, members of this National Pollution Strike Force are ready to be on the road or in the air with their tons of special equipment within two hours of being alerted. The three teams, formed in 1973, have 18 to 20 officers and men in each group stationed permanently at Bay St. Louis, Miss.; San Francisco, Calif., and Elizabeth City, N.C. Arriving at the scene of a spill they take charge until the emergency is over, evaluating the problem first, then determining how to fight it and, finally acting as overall coordinator until the cleanup is completed.

Lieutenant Collier, who was the night's duty officer, began phoning others in the Gulf Strike Team, which covers the Gulf Coast, Florida, the region from New Mexico to Sioux City, Iowa, to South Carolina, and beyond to Puerto Rico, the Virgin Islands and the Panama Canal Zone. Within an hour the team was assembled. Its first job was to locate several thousand feet of boom which could be deployed close to shore to keep the oil from spreading.

Booms and other special gear

This plastic boom, only one item among a vast array of special gear needed to combat a major oil spill, looks like overgrown links of giant sausage. Each of its eight-foot sections, jointed together in 200-foot lengths, is 10 inches in diameter. Filled with a foam-like material, similar to that used in life preservers, to keep it afloat, it supports an 18-inch plastic curtain hanging below it, which acts as a shield to contain or deflect the oil on the surface of the water. The boom is bulky and awkward to handle; a 200-foot stretch weighs 1480 pounds, and a huge C-130 four-engine cargo plane can accommodate only 1000 feet of it folded up in the fuselage.

Boom sections flown in or trucked

Having located available booms in half a dozen scattered locations around the country

and arranged for it to be trucked or flown immediately to Key West along with other gear, some of which weighed a couple of tons or more, Lt. Cmdr. William Monson, commanding officer of the Gulf Strike Team, Lt. Collier, and Boatswain's Mate William Lockwood left New Orleans at 3:00 a.m. on a commercial airline flight. After a brief stop at Atlanta, they arrived in Miami at 7:45 a.m. on Monday, July 21.

Helicopter survey

The two officers took a taxi to the Coast Guard air base to board a helicopter for a flight over the Keys to survey the spill from the air and get an idea of what they faced. Lockwood went on to Key West by local airline to get ready for the supplies already on their way. All three had their canvas response bags with them, packed with boots, coveralls, survival knife, snake-bite kit, first-aid supplies, canteen, compass, water-purification tablets, water dye, shark repellent, and walkie-talkie radios. Says Lockwood: "Oil is seldom spilled on open beaches where you can reach it by car."

Continuous service

All day Monday, the cleanup equipment from the Gulf team's own supply depot and elsewhere poured into Key West, along with additional team members. The final C-130 from Elizabeth City, N.C., landed at the Key West Naval Air Station just before dawn on Tuesday. Lt. Cmdr. Monson was on hand to greet it. By this time he and the other members of his team had been on their feet almost continuously since being alerted early Sunday evening.

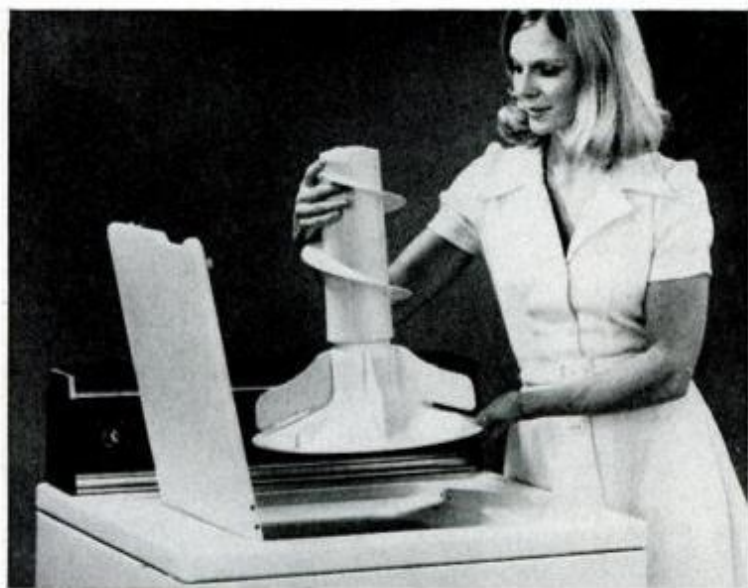
Prison inmates helped

On Wednesday, July 23, the team's own mobile command post in a huge self-contained van arrived from Bay St. Louis after a nonstop 1250-mile trip. Tons of cleanup equipment were on the scene. Civilian contractors, to be paid from a central pollution fund created by Congress, were being hired. Florida State prison inmates were mobilized to help. The Strike Team experts, working alongside the labor gangs as well as supervising and planning, were everywhere.

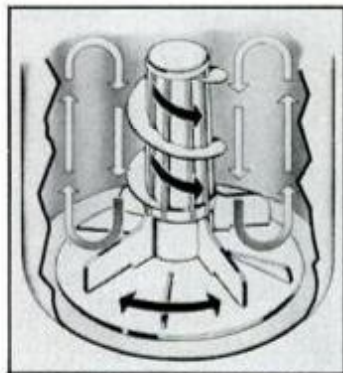
Big job done in three weeks

On Aug. 8—just over three weeks after the spill was first reported—Lt. Cmdr. Monson announced the cleanup operation completed. Over 50,000 gallons of oil and 40,000 to 50,000 gallons of oily debris had been removed from the beaches. The weary team members headed back to Bay St. Louis. Since 1973, the team has worked on more than two dozen major oil spills in such widely separated spots as the Straits of Magellan at the southern tip of South America, the Houston ship channel, Puerto Rico, the Mississippi River and waters outside Singapore. Based on past experience, they wouldn't have long to wait for the next alarm. ★ ★ ★

IT'S NEW NOW



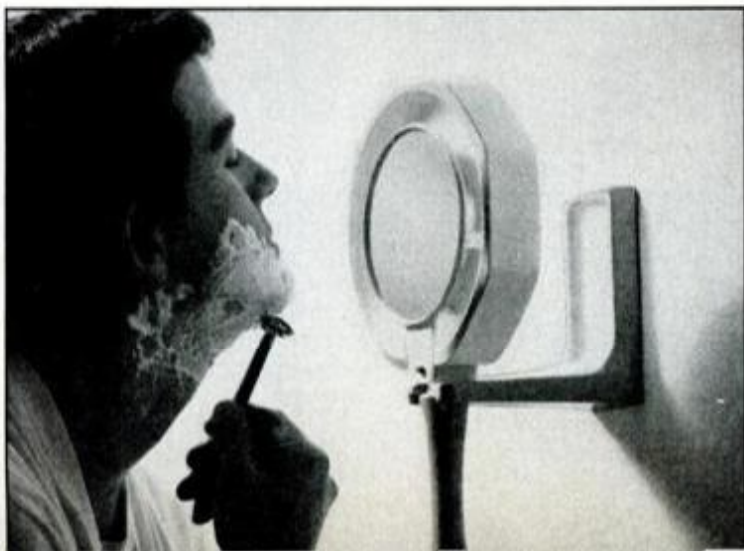
Dual action cleans large washes better



Wash is said to come out 58 percent cleaner with a new "dual action" agitator from Sears, Roebuck. Bottom plate paddles back and forth, while center post rotates and augers laundry downward. Each load is "rolled over" seven times per cycle. Agitator comes in new Sears Kenmore models, can also be bought for older models for \$30.

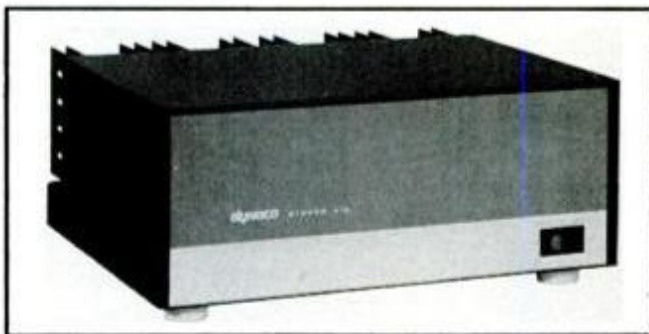
Lighted looking glass for hand or stand

Regular and magnifying mirrors surrounded by glowing light are features of a versatile new looking glass that hangs on a wall, stands on a vanity, swivels to any position, can be removed from its bracket for hand-held use. The two-sided mirror is compact enough to carry on trips. Made by GE, it's about \$17.98 at department and housewares stores.



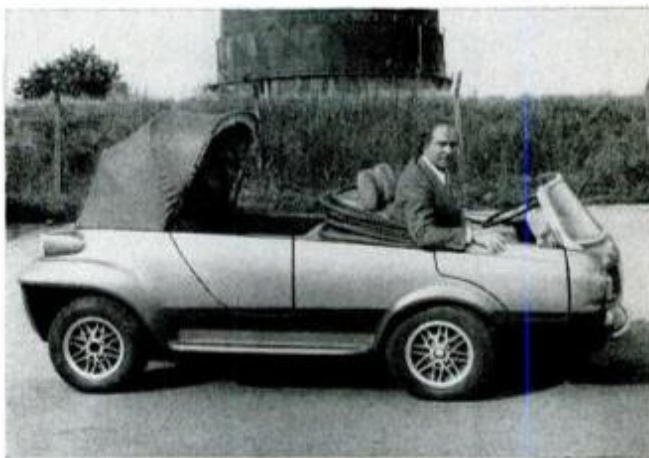
'Caddy' for an iron

Tippy irons left upright on the board need not be a hazard. "Ironsaver," a new safety device, features a metal clamp that anchors the iron to the board. Cost is about \$4.95. Triad Engineering, 18621 Parthenia St., Northridge, Calif. 91324.



Low-cost super stereo kit

Brand-new two-channel amplifier from Dynaco boasts all-silicon semiconductors and the same driver stages, thermal tracking and other top-quality components of their "400"—without nonessential frills. Result: Stereo 410 Dynakit, featuring the 400's audio excellence at less cost (\$399). Dynaco, Box 88, Blackwood, N.J. 08012.



'Electric rickshaw' is easier on the legs

British designer Roy Haynes calls his odd-looking creation an "electric rickshaw." Designed for short-run use as a taxi or shopping car, the mini electric can do 30 mph for 50 miles per charge. Haynes hopes to put it into production, but the price won't be mini—about \$8000.

Phone amplifier you build from a kit



Talk and listen up to 10 feet away. A slide control adjusts volume. The "listen" button lets everyone in the room hear a caller without being heard. It's Heathkit's phone amplifier kit. \$69.96 with dial; \$49.95 without. Heath Co., Benton Harbor, Mich. 49022.

Shooting tips that win

What would it take to put an average shooter—like most of us—in the parade of champions marching to the new Olympic Stadium at Montreal on July 17? And how do you leave 16 days later with a gold medal in your gun case?

Bill Blankenship has been called America's top handgunner—six national and four world championships among other honors—and we asked him the secrets behind successful olympic competition. Here are his exclusive tips, the techniques that made him best for over 15 years until he retired from active competition in 1970. Like other sports, tournament competition can require a special life style, but Blankenship notes that even basic match shooting



Sight alignment, rather than "sight picture," results in proper focus on gun.



Safe handling, essential to all shooting, is demonstrated as Blankenship holds the hammer in cocked position while releasing slide so hammer can't fall forward.



World-traveled gun case mounts "accurized" .45s that won Blankenship national and world championships. He now travels as Colt Arms sales director for Southeast.

has a unique ability to develop character traits as well along the way.

To become a winning marksman, do you practically need to be born with a rifle in your hands? Judging from Bill Blankenship's example, perhaps a French horn would be best. In Richlands in the southwest corner of Virginia, Bill learned gun handling and went rabbit and squirrel hunting with his father and grandfather, using a single-barrel shotgun when he was 10. But he was more interested in music and played trumpet in the high school band and then in the Army when he enlisted in 1948. Bill likes a challenge, he points out, so he taught himself trombone and the difficult French horn. Assigned with an Army band to Honolulu two years later, Blankenship began to spend time at the rifle and pistol range. "I guess I liked the noise," he remembers, "and the concentration and the challenge. It was like music."

Then for Christmas 1952, Bill's wife Helen bought him a fine Colt .45 automatic and Bill took up the challenge to excel. For the first couple years he competed in Army rifle matches as well, but finally settled for handgun tournaments. Eight years later he won his first world championship. To reach that level, he recalls, it was a matter of practice, concentration, dedication, and the need to decide how badly he wanted to be best and what he was willing to sacrifice—it was a lot, in fact, like being the virtuoso musician he had become.

You need an added edge

Once Bill Blankenship had made these decisions, he went to his Army base doctor, pharmacist, dietitian and physical conditioning and range officers for advice. Muscular coordination and steel nerves are essential for a marksman, but when you're shooting against other experts with these qualities, you need



Hand-engraved Walther PPK was presented to Bill Blankenship after he won two gold medals in Germany competing against 52 countries.

an added edge. As a result, Blankenship gave up tobacco, liquor, coffee, tea, plus any food before a match that could be hard to digest. Though a cheery evening party might be going on, Bill would leave for bed at the same time every night, rise at the same hour, follow a precise, disciplined routine and try to keep all personal concerns out of his mind before firing time. Medicines might help a cold or headache but could also have after-effects as a depressant or stimulant or induce a nervous stomach. Instead of big meals, in fact, Bill found he could eat snacks before and during a championship match so his stomach was never full or empty.

Then he made a study of the most difficult calibers and conditions—big weapons with their blast and kick; rapid fire and the need for instant reflexes; bad weather with

Olympic medals

Blankenship, a pistol expert, shares handgunner secrets that are right on target.

by Bill McKeown
OUTDOORS EDITOR

rain cutting visibility, crosswinds affecting shooters and bullet flight, sun-glare on sights. By concentrating on the hardest features of the sport, Bill got so that he looked forward to adverse conditions. He wasn't afraid of them, could handle them, and they gave him another edge.

A decision to make

The time came, however, when Blankenship had to make a decision between his band music at posts around the country or a transfer to Fort Benning, Ga., where he could spend hours every day on the range as a member of the Army pistol team. Shooting and international competition for the United States both won.

A beginner, Blankenship advises, should do the same thing an expert does when he hits a slump—practice the basics. This means proper stance, grip, breathing control, trigger squeeze and sight alignment. "Sight picture" is all right as a term for wing shooting where you focus on the target," Blankenship explains, "but with the pistol you must concentrate on your front and rear sights.

Working with a good coach is a great advantage. Unfortunately, except for our service teams, we don't have the national system of clinics and qualification of coaches that other countries do."

How should a beginner get started? Talk with an experienced, well-trained shooter and find where you can get instruction, Blankenship advises. Your first handgun might be good .22-cal. target revolver.

And what should you buy to keep around the house? No gun, he states firmly. You shouldn't own a firearm unless you are willing to learn how to use it safely and store it securely. A cheap "throw-away gun" is useless and dangerous. Advice and instruction are available, and it is the responsibility of the owner to learn proficient handling.

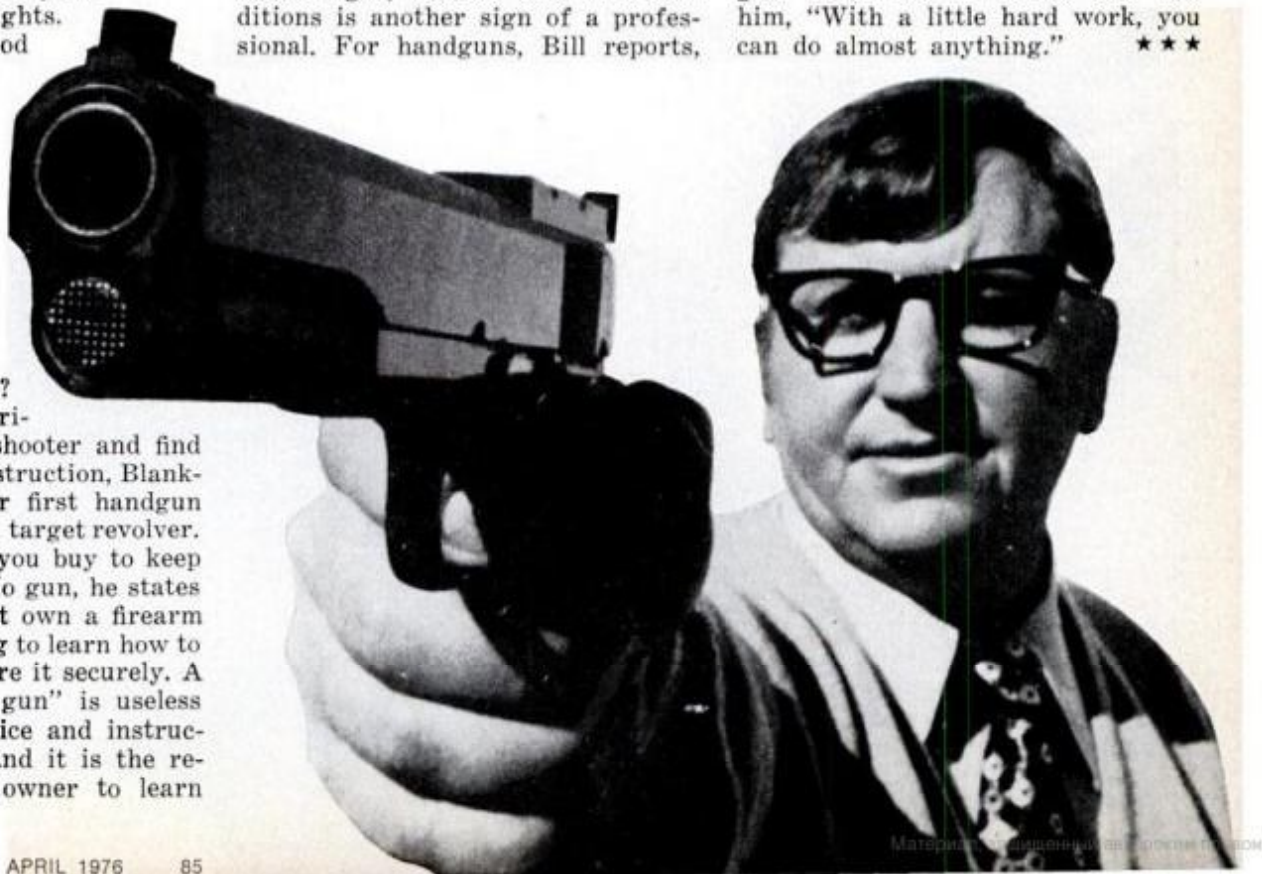
Range training and discipline are especially vital for young shooters, Blankenship points out. This is the one sport where any clowning or carelessness can cause instant injury, or worse. Learning safe firearm handling is the first step in the careful practice that can make an expert, but it is also a good test experience for the young shooter. A youngster who cannot or will not follow firing-range rules must not be allowed to handle firearms, Blankenship feels, and can also be spotted as one who needs help in conforming to society's other necessary rules before he gets in trouble. The competition experiences become a good evaluation of physical and emotional maturing.

What it takes to move up

The experienced shooter, as he tries to leave the plateau of average scores and move up to consistent excellence, should use the professional approach, Blankenship believes. Ear protectors or plugs are probably desirable to help prevent hearing damage or flinching. A notebook to record light, weather and wind conditions is another sign of a professional. For handguns, Bill reports,

quality factory loads are satisfactory. Reloading can save money, considering the quantity of shells an experienced shooter will go through, but it is not necessary for added accuracy today. Added refinements like telescopic pistol sights may help a shooter with weaker eyesight, but may be harder to hold on target. Two-hand grip on a handgun can be useful for hunting in the field.

But making the fewest mistakes, planning every match beforehand, shooting with full concentration and only your own score in mind are the basic techniques of the experts. Blankenship remembers a U.S. Pistol Team trip to the World Championships in Cairo in 1962 where he won his third world title. Preparations had included months of training. The team had arrived in Egypt weeks early so they would be recovered from any food upsets by match time. Instead, their fine physical condition held off dysentery until just before shooting, while the Russians flew in their team the night before—too late to catch it before they shot. Bill, nevertheless, won his gold medal. As his father had told him, "With a little hard work, you can do almost anything." ★★★



Pontiac's new Sunbird shares everything but trim and its optional V6 engine with the Chevrolet Monza Towne Coupe. The Sunbird costs \$72 more than the Monza, and for an additional \$176 you can have the 231-c.i.d. V6. Two-thirds of the Sunbird owners we queried did opt for the V6.

According to our survey, the V6 averages 2 to 3 mpg less in normal driving than the ohc Four. The Four, by the way, comes in two ratings, one with the single-barrel carburetor and the other with a twin-barrel. We didn't differentiate between the two in our questionnaires, but the average gas mileage posted by our owners was slightly below EPA figures for city driving and **considerably below** on the highway (see chart). This led to some disappointments, especially from owners of the V6 with automatic.

"Gas mileage," says a West Virginia school

◀ The EPA figures get buyers' hopes up. The EPA seems about seven mpg optimistic on the highway cycle.

▶ Styling was top feature in nearly 60 percent of all Sunbird buying decisions.

principle, "is too far from advertised figures. I'll buy a larger car next time, because the gas mileage doesn't compensate for the lack of space and comfort. I traded in a 1970 Catalina V8, and my mpg in the V6 Sunbird, which weighs 1000 pounds less, is very little better."

An Indiana hospital administrator: "I'm getting very poor gas mileage so far—14 to 20 mpg—but I am told it will improve as I put on more miles. I hope so."

By and large, however, Sunbird owners love their little cars. Here are a few typical praises:

"Only high marks for our new Sunbird as yet. We looked for months and almost decided to buy a Toyota when the Sunbird came out. We felt that was it. **Styling changed our minds.**"—North Carolina receptionist.

"It's a smooth-flying bird!"—New York housewife.

"Good mileage, handles well, and I've driven

PM OWNERS REPORT: PONTIAC SUNBIRD

Sunbird styling soars but bombs in trunk



Sunbird's styling sold most owners, and front-seat comfort rates extremely high. Pontiac shares this body and the four-cylinder engine with Chevrolet's Monza Towne Coupe; also offers Buick's V6.

several small cars, none of which felt so solid as the Sunbird. Also I like the V6—it's not underpowered."—Indiana maintenance foreman.

"It's nice to drive, handles well in traffic and on the highway, gets good gas mileage, is beautiful in appearance, and is compact but still sporty."—New York court office assistant.

"I'm in your country only seven weeks," writes a former New Zealander who now lives and works in Michigan. "In comparing my new Sunbird with New Zealand autos, it's apparent that the finish of American cars is much superior. Performance rates about equal, but American engines seem to outlast New Zealand's by almost double. Courtesy and fair dealing by the dealer overwhelmed me. I have yet to see or hear of such service in New Zealand. The American motoring public should be very happy with the attention they receive from their auto manufacturers."

On the whole, owners rate dealer service quite high, with 71.4 percent giving marks of good to excellent. Dealer sales courtesy also fared well: 77.2 percent rate this aspect good to excellent. Both figures are higher than average. Here are comments.

"My dealer was willing to cut his price to make a sale. I found him very polite."—Michigan teacher.

"Pontiac dealer's service department has been very good to me. They put an extension on my seat tracks so the seat can be moved farther forward. They also pinstriped the sides and offered me a vinyl top. I'm very impressed with the salesman and dealership."—Montana lumberwoman.

The biggest aggravation to Sunbird owners is the smallish luggage compartment. "Trunk

is useless except for carrying one suitcase."—California engineer. "It's not deep enough for groceries," complains a Minnesota brake operator. "The well for the Space-Savr spare tire could easily have been made a little larger so a regular tire would fit, thus giving more trunk room."—New York optometrist.

But a Rochester, N.Y., teacher points out, "It's true that trunk space is limited and groceries won't fit without tipping the bags sideways, but the optional fold-down back seat allows for lots of luggage room!"

Owners of cars with automatic transmissions report an above-average number of repairs. A Manhattan senior engineer says he had his transmission replaced at 1000 miles, and the new one still doesn't work right. A Texas airlines marketing planner had his transmission lock up and had to have the car towed in for service. There's apparently some slippage and hesitation with certain V6/automatic combinations. Owners with the three-speed and five-speed manual gearboxes also report needing repairs and replacements, a number complaining that reverse and second gears on the five-speed are too close together on the gate. They say they keep mixing them up.

Comfort received extremely high praise from front-seat riders—94.8 percent rated it good to excellent. It's another matter in the rear, though, where 59.7 percent judged comfort fair to poor due to cramped legroom. But as one Indiana retiree put it, "In my opinion, this is a fine two-passenger car. To increase

Next time you're cursing Detroit, consider the plights of car owners in many other countries.

One thing front passengers would like is an optional reclining seatback.

Here's something for short drivers to remember. This little lady is 5-foot-2.

A nationwide survey based on 388,828 owner-driven miles

by Michael Lamm
WEST COAST EDITOR

Photos by the author



rear-seat capacity would lessen the styling impact."

Minor complaints about the interior involve the dimmer switch (hard to find), ashtray location (clumsy), and emergency brake (on the console, making a storage bin there impossible). Since the unlockable glovebox is small, a number of owners grumbled about poor interior space planning.

On-the-road handling impressed a great number of owners. "The way it handles in snow is great," states a Detroit shipper, "because going up North, the car had no problem hugging the road at 80 mph and felt like it would do another 10 to 20 mph easily."

However, "... my biggest dissatisfaction is that I had to buy radial tires to get the RTS (radial-tuned suspension) package. Ride is great and handling adequate with the Uniroyals I was forced to take. I would have preferred a decent set of radials, like Michelins or Pirellis."—Michigan electrical contractor.

"Handling and maneuverability are excellent," asserts a North Carolina serviceman, "and V6 performance is good despite a rough idle." One Pontiac service technician commented that the lumpy V6 idle is "just one of those things you have to live with."

"The V6 engine is very peppy, and it's a very roadable car. With slight suspension changes, the Sunbird would compare with anything going. It still drives better than my previous Cadillac and is more fun."—Kansas businessman.

In the "I-wish-they'd-change" department, we received these suggestions (among others): "Reposition ashtray." "The seatbelt on the driver's side sticks out in such a way that when I shut the door, the buckle bores a hole into the door fabric." "I'd like to see the Sunbird in a hatchback version." "Add a reclining seat option."

"Revise the inside door locks so they're easier to open and close." "Stronger bumpers—mine collapsed when I tapped another car at 2 mph." "Give me gauges instead of trouble lights." "Lower the price." "I'd like to see the ventilation outlets moved from the foot area up to face level." "A day/night rear-view mirror ought to be standard. A buyer doesn't realize he's not getting one until after he's bought the car." "Change sun visor on driver's side so it doesn't hit mirror when pulled down."

Pleased owners predominated in our survey. An Illinois agricultural pilot reports, "Our 17-year-old son drives our Sunbird and loves it, especially the interior and five-speed overdrive transmission. He had radial tires put on, and it's a grand car."

A Detroitter says, "I wish my wife would agree to trade her 1974 Camaro for another Sunbird just like mine." ★★★

The Sunbird's speedometer tops out at 80 mph, as do those on many other 1976 cars.



Not many owners mentioned rough idle—this is one of the few.



For a hatchback, this owner might try the Pontiac Astre or Ventura.



Sunbird's least-liked feature is shallow trunk which barely has room for one suitcase and can't carry grocery bags upright. Nor is Space-Savr spare loved by all. Yet fold-down rear-seat option, though available, is seldom ordered. Sunbirds with V6s and automatics deliver disappointing mileage, but perform briskly and handle well.

Summary of 1976 Pontiac Sunbird Owners Reports*

Total miles driven 388,828

Average miles per gallon

140-c.i.d. Four
In town (EPA, 21.0 manual) 20.3
Long trips (EPA, 33 manual) 25.7
231-c.i.d. V6
In town (EPA, 18 manual) 17.8
Long trips (EPA, 30 manual) 23.1

Engines:

231-c.i.d. V6 66.4%
140 c.i.d. Four 33.6

Transmissions:

Automatic 69.4%
Five-speed manual 17.9
Four-speed manual 7.5
Three-speed manual 5.2

Why did you choose the Sunbird?

Styling 59.0%
Economy 52.2
Size 36.6
Handling 9.7

Specific likes:

Styling 60.2%
Handling 47.7
Economy 37.5
Comfort 25.8
Ride 13.3
Size 10.9

Specific dislikes:

Trunk too small 22.0%
Economy below expectations 13.0
Not enough legroom 8.9
Rough ride 4.9

What changes would you like?

More trunk room 24.2%
More legroom 14.5
Relocate ashtray 7.3
Change seat shape 7.3

Dealer service opinion:

Good to excellent 71.4%
Average to poor 28.6

Workmanship opinion:

Good to excellent 76.8%
Average to poor 23.2

Comfort opinion (front seats):

Good to excellent 94.8%
Fair to poor 5.2

Comfort opinion (rear seat):

Good to excellent 40.2%
Fair to poor 59.7

Number of vehicles owned:

Sunbird only 37.8%
Two cars 45.2
Three cars 11.1
Four cars 5.2
Five or more cars 0.7

Makes of other cars owned:

Pontiac 37.6%
Chevrolet 21.2
Ford 7.1
Buick 7.1
Volkswagen 5.9
Oldsmobile 5.9

Had any mechanical trouble?

Yes 52.9%
No 47.1

What type of trouble?

Transmission 25.4%
Carburetor 12.7
Electrical 8.5
Shift linkage 7.0

D'd you repair it yourself?

No 93.1%
Yes 6.9

Dealer repairs satisfactory?

Yes 67.1%
No 34.9

Age distribution of owners:

15-29 years 43.9%
30-49 years 33.3
50-plus 22.7

Would you buy another Sunbird?

Yes 77.7%
No 37.3

*Percentages might not equal 100% due to rounding or insufficient data.

No need to dress up for a space walk to go hiking this year, but many far-out new developments in compact electronics have outdoor applications that add convenience, comfort and safety. Look through a backpack or around a campground today and you're likely to find refinements that would have been science fiction 10 years ago.

Pocket radios are not new, but now some multichannel models will tune in the VHF 24-hour-a-day weather stations that can be heard in many parts of the country. Others receive marine and aircraft frequencies that also give advance warning of threatening weather. Though the VHF weather transmissions have about the same limited line-of-sight range as TV stations, new stations being added will give wider coverage.

Citizens Band can go along with backpackers

Thousands of sportsmen are already taking Citizens Band transceivers afield, and the gradual trend toward single-side-band (SSB) and the possibility of increasing the present 23 channels promise some relief for busy bands. Though CB is also of limited range, owners can frequently contact listeners who will relay calls for help or instructions. Among recent developments are portable 23-channel walkie-talkies with self-contained batteries, made by Midland, Lafayette and others, that offer full legal power. For motorcycle, 4WD and snowmobile use, the five-channel Enduro from Beltek claims shock resistance and has an earphone with boom mike that clips into a helmet.

Miniature circuitry shows up in the built-in light meters that activate automatic exposure cameras and in new digital stop watches that time rallies, free falls and various sporting events. Rechargeable batteries are proving useful in everything from simple flashlights and camping lanterns to space-suit reflective fabric heated gloves and boots. Tiny strobe-light flashers can signal for help, serve as a warning blinker or mark base camp during low visibility. And a number of camping stoves, lanterns and heaters now have piezoelectric lighters so that no matches are required.

Fishing extras that help you zero in on lunkers

Electronic gadgets have gained such a reputation for helping anglers that legislators in one state, with apparently nothing better to do, have even been trying to outlaw recording depthfinders instead of putting limits on species caught. It still takes more to catch a fish than turning a switch, but the sonar-type devices do show likely bottom structure and schools that may be hanging around them. Electronic sensors also will measure temperature, color and oxygen content of the water. Vexilar has a new finder indicating bottom depth in red, mud layers in yellow and fish in green. Wesmar and Stembridge Products have scanning sonars that practically show radar-screen pictures of what's below.

Sailors can navigate with small computers

Pleasure skippers, particularly those who cruise out of sight of land, have a host of space-age benefits. While commercial craft can get a navigational fix from satellites, smaller boats may choose manual or automatic radio direction finders, radar, loran, aircraft aids such as Omega, and even compasses aided by electricity. Wesmar has a new automatic pilot linked to a "saturable core" solid-state compass said to sense the earth's electromagnetic field and need no moving parts. Small computers also come programmed for celestial navigation.

Remote-control explosiveproof switches, flammable-gas sniffers, electronic speed limiters, trim activators and alarms are more bonuses from modern technology. Electronics is making going outdoors easier. ★ ★ ★

Space-age gear for sportsmen

New electronic gadgets help you navigate, find fish—and keep in touch.

by Bill McKeown
OUTDOORS EDITOR

Portable radio/telephones you can now sling over a shoulder, like the Pearce-Simpson VHF marine Catalina at right, can move from cruiser to dinghy. New Vexilar DE-12 (lower right) shows bottom in red, sand or mud in yellow, fish flash in green, and unit's straight-line display has stop-action feature so readout can be studied. Westwind Products' Electronic Engine Monitor (inset below) prevents accidental engine overspeed and damage if boat jumps prop out of water. Automatic rpm limiter stops over-revving while additional sensors monitor oil pressure, water-jacket temperature, signal trouble with light and buzzer at helm. Newest CB walkie-talkies, like Lafayette units below, now handle up to all 23 channels.



Photo: Karen Beecher



Good news and bad news about low-cost component turntables

PM tests 11 under-\$130 single-play turntables and finds some great values—some not so great.

by Hans Fantel

Turntable prices have been climbing faster than a scared squirrel, but you can still get good—and not-so-good—component turntables for less than \$130 each, including arm, base and dust cover. Of 11 I've just tested for PM, several are unqualifiedly excellent—only two did not measure up to acceptable standards.

None of the 11 models tested was a changer. All were single-play designs, a type that's fast gaining popularity.

Few albums now require stacking on a changer—with most you play one side, then flip the record over (even a changer can't do this for you). Besides, in the low and moderate price ranges, single-play turntables offer higher quality per dollar.

But though they aren't changers, most of our single-play turntables do offer some automation. All but two lift the tone arm when the record ends, and return the arm to its rest position; two models tested will also set the arm down for you in the record's starting groove.

What affects turntable quality?

Auto-return is the bigger boon. Without it, you have to jump up at the end of the record. To help you set the arm down safely, all the tested models except the Acoustic Re-

search AR-XA have cue controls that let you place the arm over any part of the disc without touching the needle to the grooves, then lower the arm gently.

All that turntables have to do is turn a record in a circle while an arm swings freely over the disc surface. But in a glance, you can often see craftsmanship that's a clue to the precision inside and the overall quality of the machine.

For example, the turntable platter not only has to rotate, but to rotate with almost no vibration; otherwise, the phono cartridge picks up this vibration along with the music, causing "rumble." Especially if your speakers have good bass response, rumble will sound like thunder in the distance, fogging over the soft passages of music. A turntable with lots of rumble can so overload the amplifier with these low-frequency noises that it constantly distorts the music. Rumble filters on some amplifiers help, but they also cut out some low notes with the rumble.

Keeping vibration at a minimum means machining parts to fine tolerances and carefully fitting them in strong supporting frames and precision bearings—all of which adds to the cost.

Belt drive damps vibration

All the turntables in this report also link their motors and platters

TOSHIBA

SANSUI

PHILIPS

KENWOOD

ROTEL

PIONEER

GARRARD

AR





SANYO

CONCORD

BSR

with elastic drive belts, which filter residual vibration still more.

Constant speed is another requirement. Fast speed variations (known as "flutter") and slow ones (known as "wow") are annoying, especially on long-held organ or piano notes. Speed constancy depends partly on the quality of the drive motor, but also on the drive system and on the mass and balance of the turntable platter, which acts as a flywheel to smooth the motion.

Finally, the turntable must be isolated from outside vibrations, which could make the tone arm jump or skip. Footsteps on a shaky floor are one source of such vibration, but even trickier are airborne or floor-borne vibrations from the speaker. If these vibrations shake the record, arm or table, you have "acoustic feedback"—a rumbling sound or, in extreme cases, a moaning howl when the volume is turned up.

As for the tone arm, it may seem to be just a stick on a swivel. But to let the phono cartridge it holds track across the record properly, it must hold the cartridge at a precise angle, move with exceptionally low

bearing friction and have just the proper resonance and balance. The single best measure of a tone arm's quality is the minimum tracking force it needs to let a high-compliance cartridge track a loud recorded passage cleanly.

How turntables were tested

Numerical specifications are useful ways to compare turntable performance, but what matters to most users are two basic questions: "Can I hear it?" and "Will it bother me?"

That's why I set up strictly user-oriented tests for these turntables. To check rumble, I played silent grooves on the Stereo Review SR-12 test record, through Yamaha's excellent CA-800 amplifier and two Dynaco 40XL speakers which have plenty of bass response. What I heard shows up in the table on page 182.

This test record also has an ingenious flutter test: The same piano recording is repeated several times, with differing, measured amounts of flutter. When you can no longer hear a difference between one band and the next, you've reached the point

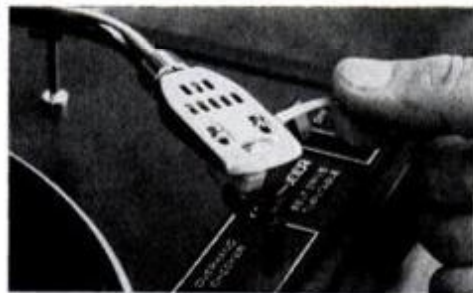
(Please turn to page 182)



Cartridge heads on most of our turntables were mutually interchangeable type shown. AR, BSR, Garrard and Philips had different, but still detachable cartridge mounts.



Stylus force gauge of Philips was a scale whose platform was the tone-arm rest.



Stylus position gauge on Pioneer was this pop-up post; others used detachable gauges where gauges were supplied.



Antiskating adjustments were mostly either string-and-weight type (near side of tone arm above) or weight-and-lever type (rods visible behind tone arm below). I found no difference in performance—even with AR, which had no antiskating.



Plugs you produce at home

You can pop out poppers for a bargain 50 cents each.

by George Linnane

When my son cast the surface popper into his first school of bluefish, the strike was so vicious that it caught him unprepared. He fumbled with the antireverse lever just long enough to allow the fish slack, and the blue lunged to the surface and broke off the line. It was hard to lose a king-size fish and even worse to see a \$3 popping plug go with him. Junior realized this could get expensive and homemade poppers might be the answer.

For basic material, we considered broom handles and $\frac{3}{4}$ -inch birch dowels, settling on the dowels because of uniformity and unpainted finish. An electric drill, mounted in an inexpensive drill press stand, and sanding discs are the only power-tool necessities, but since my



These poppers produce, as proved by big striped bass landed by the author's son.

shop has a table saw and belt sander, we used them as well. After studying a number of successful plugs, we decided one $4\frac{5}{8}$ inches long with a $\frac{3}{4}$ -inch diameter would match a seven or eight-foot spinning rod with 10 to 15-pound test monofilament line. Heavier lures for bigger tackle were later made of $\frac{7}{8}$ -inch stock in five-inch lengths. Designed for bluefish and striped bass, they are suitable for pike, muskellunge, pickerel and fresh-water bass too. Dimensions and weight can be changed for other species.

First step is to cut a $5\frac{1}{2}$ -inch length of dowel. Next, drill one end with a $\frac{1}{2}$ -inch bit $\frac{1}{2}$ -inch deep. Then route this hole with a spherical

rotary file bit, rounding it into the concave shape which causes the splashing and popping. We found this a critical operation that had to be done while the blank is held vertically with pliers in the drill stand for careful, accurate shaping. The blank can also be clamped in a vise and drilled freehand.

Before sanding, the hollowed end is cut at a 45° angle and then re-routed again with the rotary file bit to deepen the hole. The shaft can then be hand or disc-sanded. Weighting consists of drilling a $\frac{3}{8}$ -inch hole, $\frac{3}{8}$ -inch deep in the underside one inch from the tail end and filling it with molten lead. Weighting down the tail end makes it sink and improves popping and casting. Total weight: about $1\frac{1}{4}$ ounces.

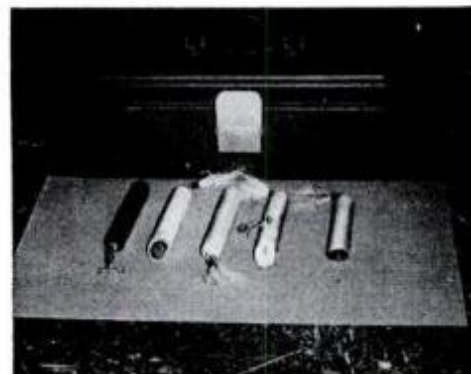
For painting, two coats of a flat oil-base primer proved necessary, plus three coats of acrylic spray or airplane dope. Metallic Christmas glitter from a hobby shop was rolled into a final clear plastic coat. Three No. 214 $\frac{3}{4}$ -inch zinc-plated steel screw eyes, one at each end and one $1\frac{1}{4}$ inches from the front lower lip are screwed into predrilled holes, with size 1 galvanized treble hooks secured to the back two. A white bucktail was tied to the tail hooks. Cost of materials is a thrifty 50 cents per plug if you make 25. ★★



First cut divides $\frac{3}{4}$ -in. birch dowel into $5\frac{1}{2}$ -in. length for the popper plug bodies.



Head and tail ends are rounded on a belt sander, shaft smoothed with hand sanding.

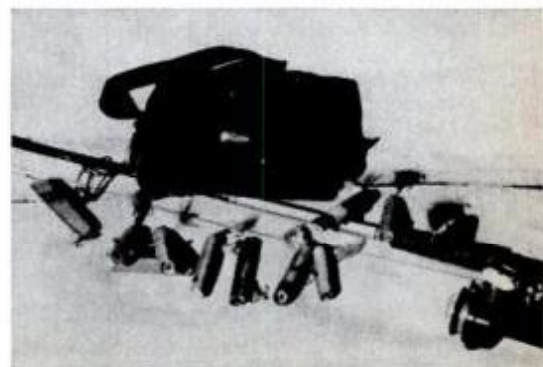


Bottom hooks were omitted on some plugs for easier casting, improved balance.

Hollow head making plug pop is routed into concave cup with spherical file bit.



Plugs are painted with a number of coats. One or two treble hooks are then added.



Finished plugs are dressed with bucktail streamers of deer-tail hair tied on hooks.

Boats to catch more bass

Many extras and built-in refinements are now considered essentials by the experts.

by Bill McKeown OUTDOORS EDITOR

Photos by the author

So far this year, no bass boat comes with a framed guarantee that it will find more fish—though many seem to mount almost every other accessory. A number of new models now have refinements that expert fishermen consider essential or particularly helpful for ease of operation, extended range of action, maneuverability, comfort, safety—all the factors that add to the enjoyment of hooking more fish.

Last fall I spent a full day on the water with Tommy Martin, taking notes and photographing his boat equipment and rod-handling techniques that earned him the Miller BASS Masters Classic championship of 1974. Tommy has been a year-round guide for 10 years on Toledo Bend at Hemphill, Tex., and competes in tournaments all summer to become eligible for the BASS Classic, the world series of fishing.

Our boat was a 17-foot Ranger Model 175AC with this year's Johnson 115-hp outboard with Trim'N Tilt, a Silvertrol Executive Pro 12/24 electric troller, Lowrance 0-60/0-120 foot locator/sounder, Silvertrol Total Electric System for simple plug-in battery changing, retractable Boat-Rein tie-up rope, LectrAnchor with 50 feet of line, power pedestal seats, and assorted built-in compartments for locked storage of gear, aerated wet wells for the live-fish weigh-ins required at BASS tournaments. The console instrument panel mounted a speedometer, tach, fuel gauge, trim indicator, outside water temp gauge and ignition-kill switch. Total price for the rig: about \$7800.

Martin wore a life vest while driving, and most of the time during practice sessions as well as when he moved forward rapidly to swing down the electric and average more than one fast cast per minute.

Though most bass boats have had tri-hulls for a stable platform in the past, some new high-performance models are 18 feet or more, take 150 hp and up, and use semi-deep-V bottoms for handling chop at 40+ mph. Not every boatman will want tournament action necessarily. But the new bass boat refinements will make inland fishing this year a lot more pleasant and productive. ★★

Basic gear starts with stable hull like this Glastron, pedestal seats, a large outboard for speeding to likely spots, electric for maneuvering.



For pattern casting around stumps, pilings, underwater structures where bass like to live, pro fisherman Tommy Martin tests variety of lures, retrieves.



Fully equipped model may have spring-loaded retractable dock lines, bow anchor with an electric winch, trolling motors at both bow and stern.



Rigging up before sunrise for a tournament test, bass master Bill Dance prepares several rods that can stow in long lockable side compartments. Wells with aeration will keep fish alive for weigh-in and later release.

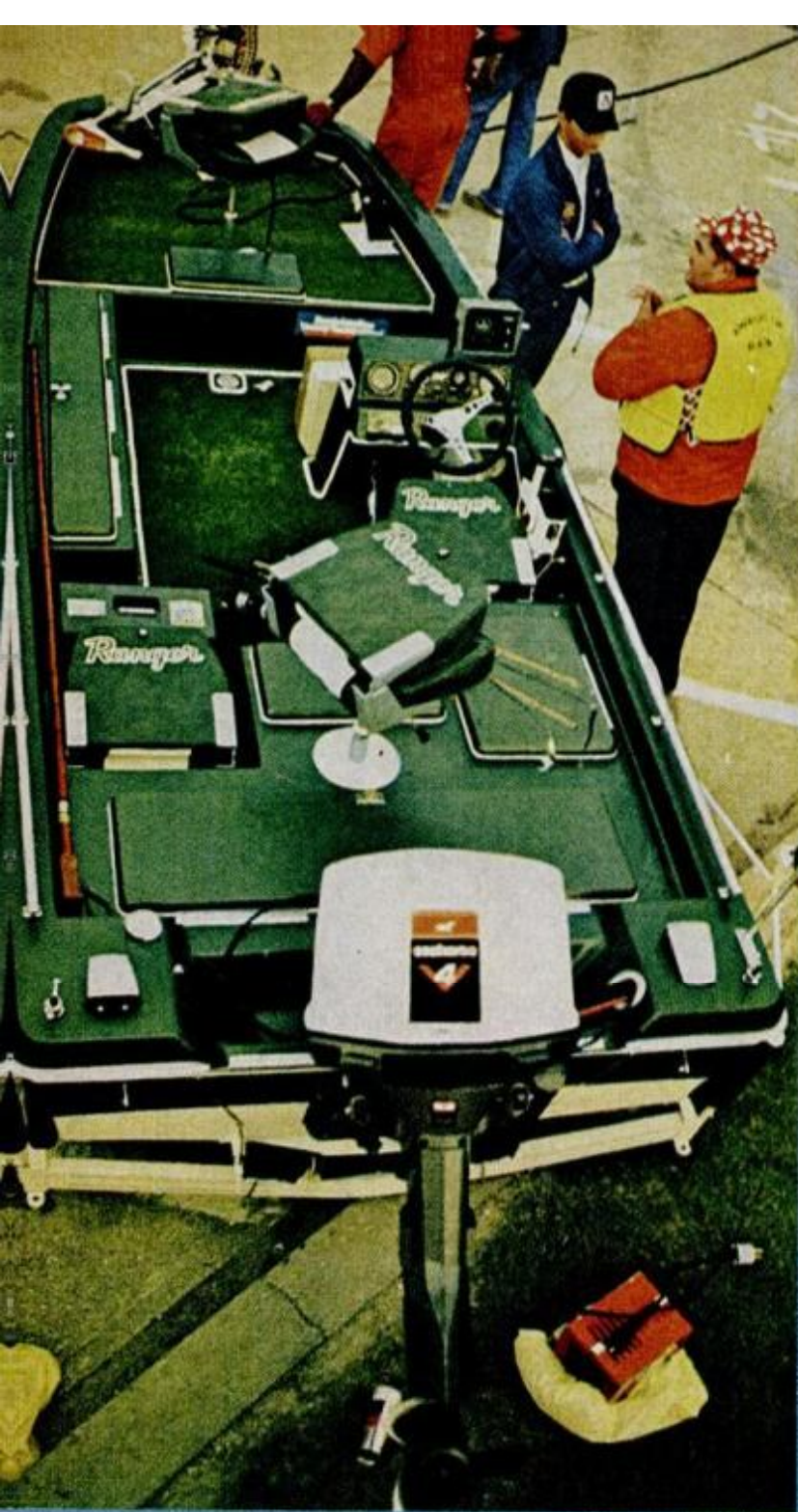


Console electric system white panel has switches for charging, trolling, use of 12 or 24 volts, easy fuse changing. Large tackle box will stow under helm.

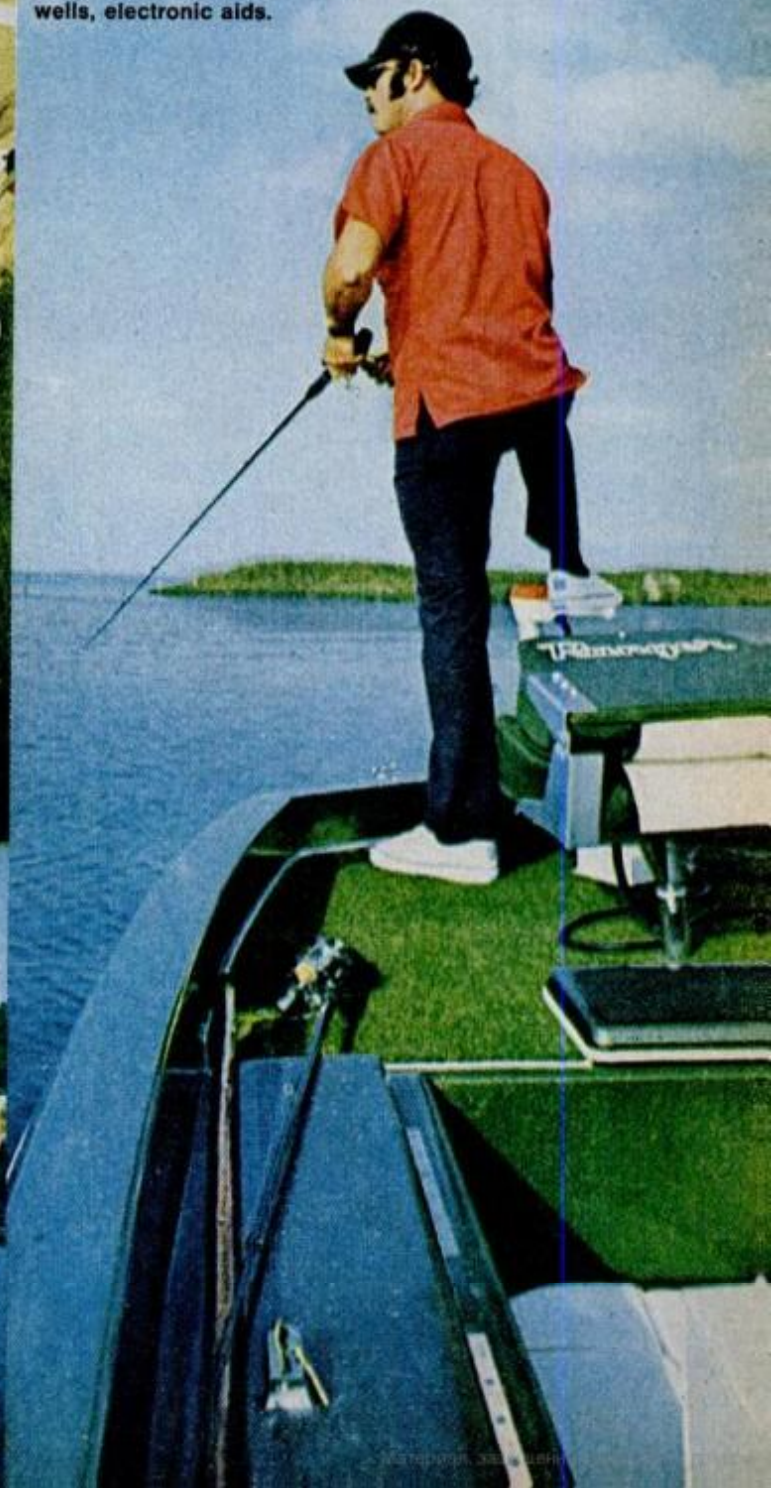


Martin studies locator/sounder readings while craft speeds out to hot spots. New depth-finder transducers install inside hull.





For the latest in bassin' action, you need platform and walk-around space for stand-up casting as Bass Masters Classic winner Tommy Martin demonstrates while steering electric outboard with one foot. Large outboards use power tilt, below, in shallow channels. Interiors feature compartments, wells, electronic aids.



STOL aircraft: slowly on the rise

Nimble short-takeoff-and-landing planes are proving themselves as city-to-city shuttles and as workhorses in the boondocks.

by John F. Pearson SCIENCE EDITOR



More than likely, you've never heard of Airtransit Canada. It's an air service north of the border that's been in operation less than two years, has but a single route (of about 110 miles) and has been a consistent money-loser since its first day.

Yet Airtransit's officials are happy with its performance and are looking to expand the operation. A further indication that Airtransit—a subsidiary of Air Canada—is no fly-by-night phenomenon is the parade of aviation-industry visitors from the U.S.S.R., Japan, Italy, Norway and other countries.

Faster intercity travel

Airtransit is an experiment to test the feasibility of using a STOL system to speed intercity air travel of short and medium distances.

Short takeoff and landing (STOL) aircraft aren't the latest things on wings, with beginnings that go back beyond World War II. Dornier, a leading West German aircraft manufacturer, even claims to have STOL-related patents dating back to the '20s.

Through the years, STOL and VTOL (vertical takeoff and landing) concepts have given rise to many a

What's the quickest way to go from downtown Montreal to downtown Ottawa? By Airtransit Canada—an air service set up to demonstrate advantages of a STOL (short takeoff and landing) system for intercity travel. Sophisticated avionics permit Airtransit's 12-passenger Twin Otters to operate even in heavy weather. Victoria, the Montreal STOLport, can be seen at bottom of photo (right). It's only a five-minute drive from the downtown area of the Canadian metropolis.





strange-looking bird with tilting props, tilting wings, or both. But the need for planes that can operate from small, primitive airfields has also produced rugged aircraft used for cargo transport, pipeline surveillance, rescue missions, aerial surveys and military communications.

Extra lift from bigger flaps

Basically, STOL planes use oversized flaps to gain the extra lift needed to operate from runways of 2000 feet or less. Steep approaches and low landing speeds combine to make for a short roll on landing. (In contrast, a standard commercial jet requires a runway about two miles long.)

Though there are signs that the situation may change, the United

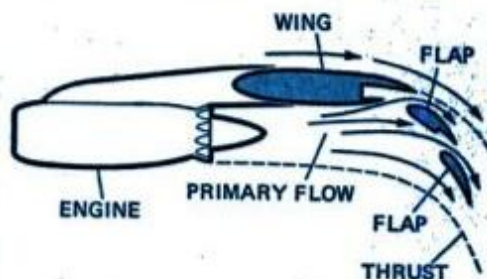
Prior to takeoff, the Airtransit pilot inserts card to program onboard computer for the selected route. Airborne, the computer takes over navigation function.

The two entries in the Air Force jet STOL competition



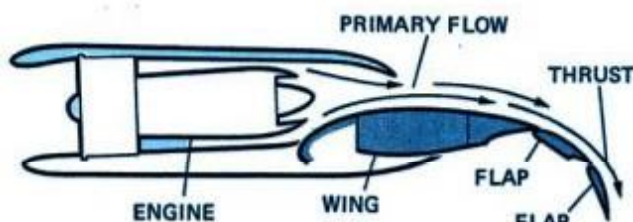
Produced by McDonnell Douglas, the YC-15 is now being tested. It has a system that lowers large wing flaps directly into the exhaust airflow from four engines, greatly increasing aerodynamic lift.

MCDONNELL DOUGLAS PROTOTYPE



The Boeing entry, the YC-14, uses "upper surface blowing" (USB) to generate the extra lift needed to operate from runways of 2000 feet. The USB effect is similar to the way water from a faucet follows the contours of the back of a spoon. Air from the engines, attached to the leading edge of the wing, blows across the wing's surface and follows the contours of curved flaps attached to the trailing edge. Airflow can be made to turn almost 90° so that it blows downward, thus creating a strong lifting force.

BOEING PROTOTYPE



States has not been a big producer of STOL planes. In Germany, the Dornier company started turning out STOLs in the early '50s and now claims about 1000 planes are operating in 52 countries. Another important maker—De Havilland Aircraft of Canada—reports more than 350 of its Twin Otters in service in 46 countries.

Airtransit's fleet is made up of six Twin Otters, painted a gaudy red-orange that makes the planes highly visible (even to this somewhat color-blind reporter). Last winter, after Airtransit had been operating more than a year, I flew to Canada to see what the air service was like.



Almost a decade ago, this De Havilland Buffalo (above) demonstrated how well the STOL plane could operate from small airfields by landing in New York's East River Park. The steep approach is typical of the STOL landing. The four-engine plane (left) is the 50-passenger Dash 7, also made by De Havilland, that is slated to fly STOL routes in Canada. Dornier, a leading aircraft manufacturer in West Germany, has produced a number of STOL aircraft since the 1950s. The DO-29 VTOL (vertical takeoff and landing) plane is noted for having pusher props capable of being rotated 90° downward to create a powerful upward push.



Airtransit links two of Canada's major cities—Montreal and Ottawa. In Montreal, the Victoria parking lot, built on reclaimed land for Canada's Expo '67, was converted to a STOLport with a single 2000-foot runway. Victoria is about a five-minute drive from the center of town.

Its counterpart in Ottawa is Rockcliffe Airport, an old military air facility that's less than 15 minutes from the downtown area.

In each city, Airtransit has STOLmobile (limousine) service. In Montreal, for example, the small bus leaves the Hotel Bonaventure, the only pickup point, 15 minutes before flight time.

At 8:35 a.m., when I came down from my room at the Bonaventure, Airtransit's small bus was parked near the entrance, unmistakable in its red-orange glow. Promptly at 8:45, as scheduled, the bus left with its eight passengers. I timed the run to the airport: exactly five minutes. I watched as other passengers bought tickets before going through a brisk but thorough security check. The 9:00 a.m. flight to Ottawa took off right on the dot.

Capt. Art Tonkin, a stocky, friendly man who is director of flight operations, took me in tow. We'd barely finished shaking hands when an attractive blonde, an Airtransit colleague, stepped up and gave him



a peck on the cheek. "It's his birthday," she told me, "and it's the custom here." A homey touch, I thought, and not out of place in the small but comfortable passenger lounge we were passing through on our way to a conference room.

Two-year test project

In my briefing, Capt. Tonkin emphasized that the air service was set up as a two-year demonstration project to explore commercial possibilities. Including preliminary re-

search, the system cost \$25 million—for two terminal buildings, hangars and other structures, the six Twin Otters, STOLmobile vans and various operational expenses.

The Twin Otter carries only 12 passengers (elimination of a coat rack provided room for the twelfth seat). If the plane had 20-passenger capacity, Capt. Tonkin said, the service would be making money.

Airtransit has performed as expected, carrying about 95,000 passen-

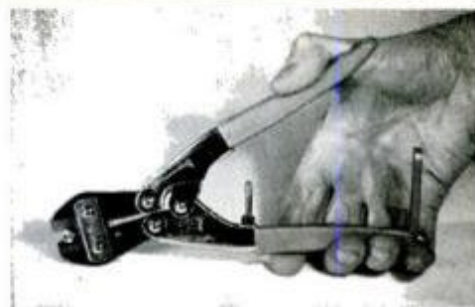
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IT'S NEW NOW



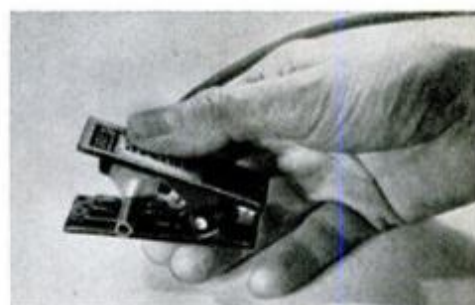
Bike barn in a kit

With bikes, garden tractors and snowmobiles in the garage, where do cars go? A new back-yard barn kit may solve the problem. Standard 8x8x8-foot frame comes with numbered pieces and instructions (you buy siding, roofing, flooring, nails). Total cost: \$200. Time: a weekend, says Jer Manufacturing, Coppersville, Mich. 49404.



One-hand bolt cutter

Home workshop bolt snipping seldom calls for cumbersome two-foot leverage. Now there's an 8-inch-long bolt cutter you can squeeze like pliers to snip through nails, rods, wire and hard steel bolts up to 3/16-inch diameter. About \$3 at most stores. Steelcraft Tools, 885 Centennial, Piscataway, N.J. 08854.



Shirt pocket tubing shear

Plastic tubing up to 1/2-inch o.d. can be sheared in a clean, quick, right-angle cut with a handy 2 3/4-inch-long, one-ounce hinged tool called a "Snimp." It fits a shirt pocket, can be bench or wall-mounted. Made of plastic with replaceable blade, it's \$2.11. Imperial Eastman, 6300 W. Howard, Chicago, Ill. 60648.



Variable-power staple gun fits the 'zap' to the job

Staple anything from clippings on a cork bulletin board to ceiling tile on furring strips with this all-purpose gun featuring a power control knob. By adjusting the knob, energy fed to the driving mechanism is varied to accommodate the work. Called "Powermatic," the new gun has a hand guard and safety lock. It drives five staple sizes from 1/4 to 9/16 inch (including Lock-tile staples). About \$24.95 at hardware stores. Made by Swingline Consumer Products, 32-00 Skillman Ave., Long Island City, N.Y. 11101.

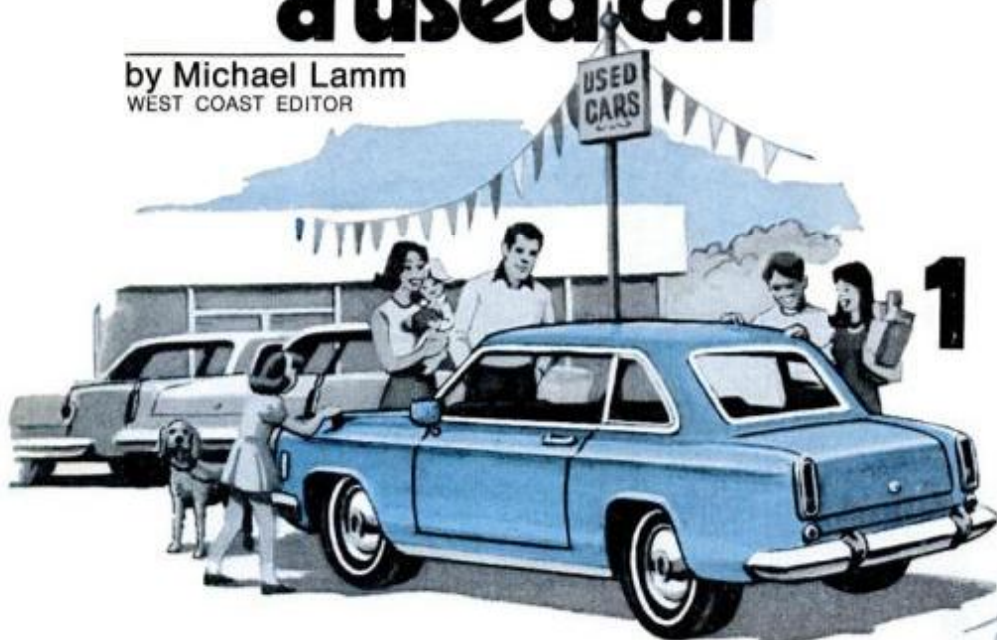


Weatherproof plastic picnicking

Plastic picnic table and benches for the terrace or yard won't peel, warp, splinter, and never need paint. Clean with a damp cloth. Table (27 x 70 x 28 inches high) and benches (9 1/2 x 70 x 16 1/2 inches high) come in readily assembled units and cost about \$59.95. Dapol Plastics, 53 Northboro St., Worcester, Mass. 01604.

20 tips to take the gamble out of buying a used car

by Michael Lamm
WEST COAST EDITOR



Make and year of car aren't so important as condition and the candidate's ability to fill your needs. Say you've settled on a 1972 Dart as your ideal year, size and type of car. Don't look just at 1972 Darts, though. Look too at 1971-73 Novas, Mavericks, Valiants, Hornets, Comets, Apollos, Omegas, Venturas, Volvos and Peugeots. That way you open up a lot more prospects for finding a good, clean, low-mileage used compact.

2. Eyeball the car. Check for exterior ripples and defects by sighting down all sheet-metal surfaces: fenders, hood, decklid, doors, roof. Ripples mean bodywork, possibly because of an accident or rust holes. Fresh paint and/or paint overspray might mean the same thing. Remember that light colors tend to hide ripples and blemishes. Always inspect a used car in sunlight, never at dusk (after working hours) or

Minimize the risk in used-car shopping by following these common-sense tips.

New cars cost too much, and so do used lemons. So the trick is to find a used car that's as good as new and a few thousand dollars less expensive. Impossible? Not if you can remove the gamble. And you can.

When you begin those treks down to used-car row, your best friend is patience. So often people rush into a used-car deal as if there's no tomorrow. Salesmen capitalize on buyer impatience. "Better hurry and decide now," the salesman might tell you, "because there's another customer itching to buy this car." Never let that sort of talk stampede

you. If it takes you two weeks to find just the right car—even two months—don't rush yourself.

1. While you're settling down, think long and hard about what sort of car you really need. Everyone's talking small cars these days. But if you've got five kids, two dogs, a 15-foot house trailer, and you're a rockhound, it's not likely you'll be totally happy with a used 240-Z as your family car.

Consider a number of makes

Common sense tells you to balance such factors as passenger and carrying capacity, fuel economy, number of doors and so forth against the size of your family (present and future), how long you plan to keep the car, plus cost and availability of repairs.



under artificial lamps of any type.

3. Also look for interior abuse. The odometer reading should match pedal and carpet wear and seat sag. Be on the lookout for a punctured headliner, ripped seats, scorched fabric, a scuffed package tray, re-dyed carpets or vinyl, new rugs and new pedal pads.

Most used cars have been "detailed," which means the dealer, or a shop that works for him, has tried to cover signs of wear and tear with

dye jobs, a new package tray, new trunk mat, respraying the dashboard padding, spraying carpets or replacing worn ones, installing new armrests, even reglazing bull's-eyes in windshields. Be alert for "detail" jobs and try to look beyond them.

4. Detailing extends to the used car's mechanicals. Detailers usually steam-clean and then spray-paint the engine, radiator, air-cleaner and the like, and sometimes they replace



underhood decals. The purpose again is to make the car look as new as possible, and that's fine, but it masks evidence of the car's previous use and maintenance. A gummy, grease-encrusted engine at least tells you something about the car's history. A detailed engine tells you nothing. Again, you have to look beyond the fresh paint and new decals. Search for areas that have eluded the detailer. Check, for example, the condition of the battery box, fan belts, air-cleaner element, cracked ignition wires, rusty spark-plugs and so forth.

Telltale signs

Smoke from the oil filler or breather, especially if it's heavy, can tell you that the running engine is burning or pumping oil. Rusty



water spots on the firewall give clues to previous radiator boil-overs.

5. Make sure everything works. Prospective buyers always try a car's radio (and dealers therefore make sure it's playing), but also note whether gauges are functioning. Roll all windows up and down. Test lights, locks, air-conditioner, heater, all accessories, seat adjustment.

6. The biggest gamble remover, the best warranty, the greatest lemon protection you can



give yourself when you're shopping for a used car is this step: Take every car you're seriously considering buying to a professional mechanic or an auto diagnostic clinic for a thorough check. Such an inspection usually costs \$10 to 12. Make an appointment with the shop or person who'll do the inspecting, and then drive the candidate car to that place of business. Tell the used-car dealer that you'll be doing this, and if he won't let you (he'll say his insurance doesn't cover such events, but that's not so), forget that car.

Professional inspections usually

take about 40 minutes and should always include an engine compression check—all cylinders should show amply high and fairly equal readings.

7. Brakes and front-end alignment. The mechanic should pull one front wheel or drum to inspect the disc or lining. At the same time he should test the front end for play in the ball joints, steering, links, and suspension components. Front-end maladies can be particularly expensive, and most used-car buyers never test for them before they make their purchase.

8. While the car is still on the lift, have the mechanic look for



frame damage or bent underpinings that might indicate past collisions. Also poke around for rust holes, not just in the rockers and floor pan but also in the exhaust system—muffler, pipes, catalytic converter, and so forth. Note condi-



tion of all four tires plus springs and especially shocks. And look for telltale leaks from brake cylinders and lines, engine, transmission, rear axle, radiator and gas tank. Any abnormal leaks (a little lube

(Please turn to page 180)

Nostalgia meets today's
energy needs in one
attractive package

by Conrad Miller

A fan for all seasons



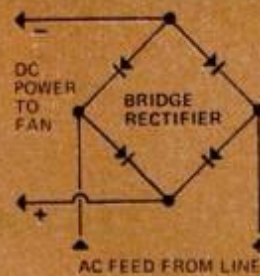
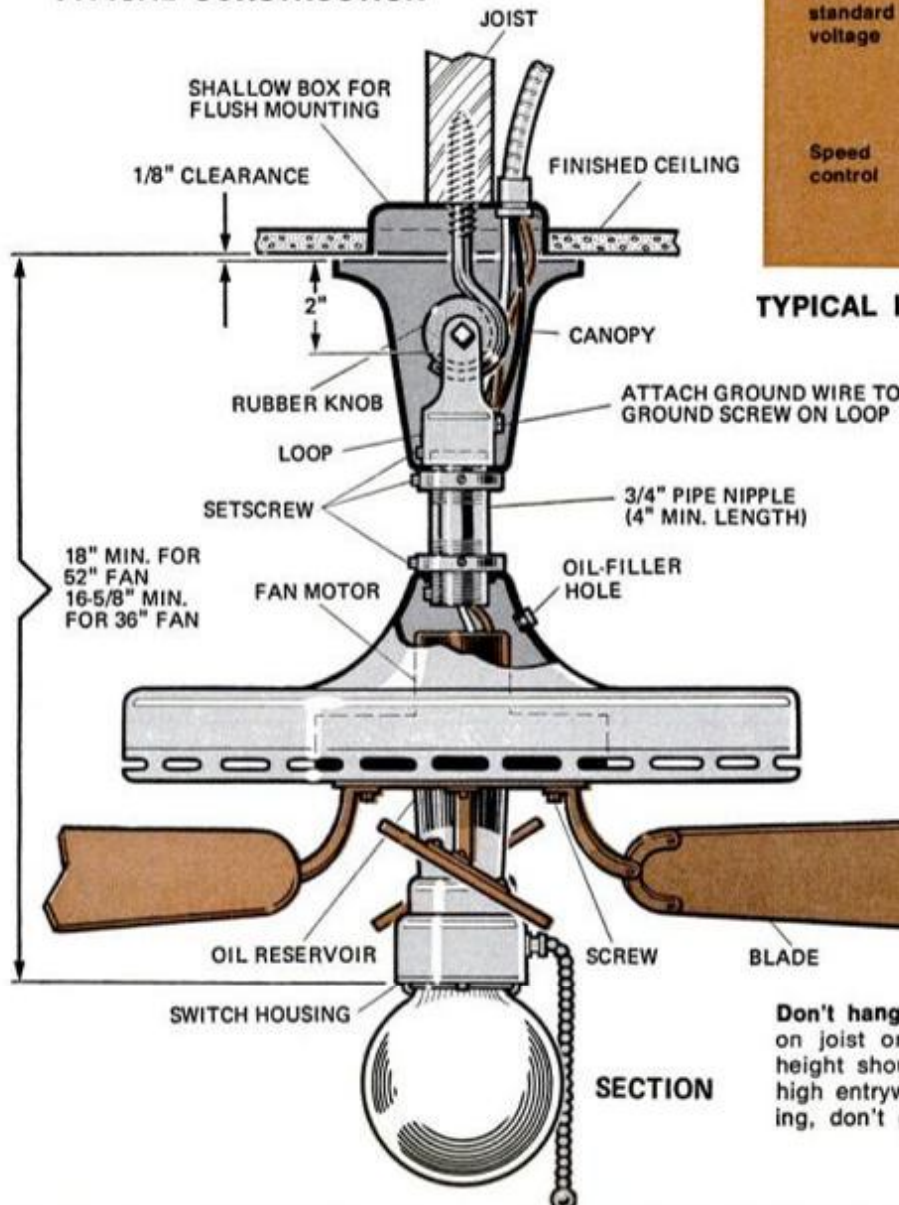
Remember the old ceiling fans with the huge blades that turned lazily over dimly lit bars in old Humphrey Bogart movies? You might also have seen one slowly cooling the air above your favorite table at an old ice-cream parlor. Well, you're likely to see more and more of them—in restaurants, bars and maybe even your own home. These fans are generating a lot of interest lately, partly because they conjure up a nostalgic period in American life, but also because they provide an efficient and practical addition to modern heating and cooling systems.

A cool breeze

In some areas, where summer room temperatures are moderate, a fan can move enough air to make you feel comfortable. In this case an 80-watt ceiling paddlewheel, substituting for a 1000-watt airconditioner, represents a dramatic 92-percent energy saving. Fans are also a natural for commercial applications where heating and cooling can get wasted in the high ceilings common in factories and large production shops. Winter fuel costs can be cut 25 percent by fans that propel the warm air down toward the floor where it's needed.

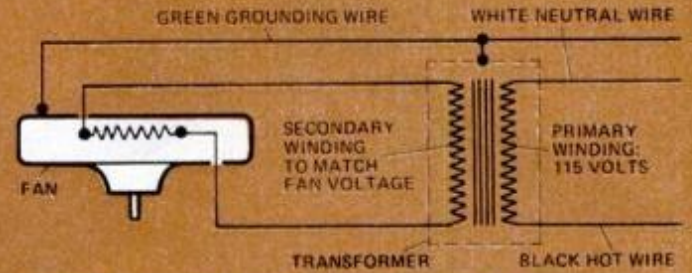
In summer, it's the combination of heat, humidity, and dead air that can really get to you. If you're doing light work in a room at 78° and 80-percent relative humidity, your body can be generating 600 B.T.U. of heat. You feel hot, sweaty and uncomfortable because there's not enough evaporation from your skin surface, which is the body's version of airconditioning. You'll

TYPICAL CONSTRUCTION



To install bridge rectifier on d.c. fans, follow wiring diagram at left. Check conversion guide for rating you'll need. Available from Allied Electronics, 401 East 8th St., Fort Worth, Tex. 76102.

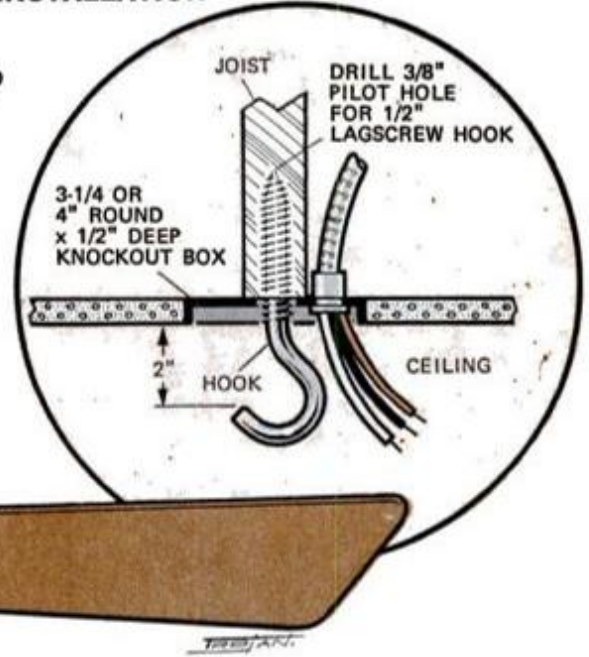
For conversions needing a transformer, follow the wiring diagram shown below. Use of a three-wire cable (with green grounding wire) will protect the circuit against internal ground-fault hazards.



60-Hz conversion guide by nameplate designation

- 133 cycles** At 60 Hz, fan will rotate only half of its rated revolutions; needs twice the nameplate voltage so 110 rating should be powered by 220-v. transformer.
- 50 cycles** Normal current will run fan 20 percent too fast; it can be slowed down with a stepdown transformer.
- Direct current** 110-v. motor needs a bridge rectifier. We mounted a 2-amp. epoxy bridge on motor frame of 110-v.d.c. model. If current is greater, get a bridge equaling the rating. If current is not given, estimate it by measuring motor's resistance at terminals with ohmmeter and dividing voltage by resistance. Example: 110-v. motor measuring 147 ohms will draw 0.75 amps., calling for 1 or 2-amp. rated bridge. If d.c. voltage and wattage are given, divide watts by volts to get current ampere rating.
- Non-standard voltage** A transformer solves this problem (see diagram above). To determine size needed, multiply current times voltage and add 25 percent for safety. Example: 32-v. rating at 3.5 amps. needs 150-v. transformer. Low-voltage d.c. fan needs step-down transformer with bridge rectifier. Be sure it can handle load; demand is higher on low voltages.
- Speed control** Many fans have built-in speed control via switch or pull-chain. To add this feature to an old d.c. fan, install dimmer switch rated at 7 to 10 amps. in place of toggle at box for off-on control.

TYPICAL INSTALLATION



Don't hang a fan on bridging or furring. Locate dead center on joist or rafter before you drill the pilot hole. Fan-blade height should be well above head level. A vaulted ceiling or high entryway are good locations. If you're unsure about wiring, don't guess. Consult local codes or hire an electrician.



Modern two-speed fan by Emerson moves 4000 cu. ft. of air on 100 w.

New model by Hunter has solid-state speed control and switch to reverse airflow.



The oldest fans we've found were belt-driven by remote power and in some cases were driven by water motors which would be a real find for an antique collector. The *Hunter Ventilating Fan Catalogue*, dated 1903, describes its unit as "a combination of the Syracuse Water Motor and fan that is thoroughly practical where city water can be used to good advantage." The earliest electric fans operated on direct current and used 4 or 8-volt wet batteries for power. When d.c. lighting systems came into use, commutator-type motors were built for 115, 165, 220 and 250 volts. When the induction motor was developed for single-phase a.c., ceiling fans were designed around it. The first motors were split-phase and had to be started by hand.

Although there are new fans being manufactured, you might have fun restoring an antique. The trick is to convert the old motor to run on 60-Hz American household current. You can check the cycle number listed on the nameplate of an old fan against our conversion guide listings for instructions. As general policy, follow safe-wiring procedures when installing an outlet box for the fan and use at least 14-gauge conductors. Make sure that you run the switch leg through the hot (black) wire and never the neutral (white). Ground each junction or switch box as well as the fan motor to the third wire (green) to avoid any shock hazard that might develop from an internal ground fault.

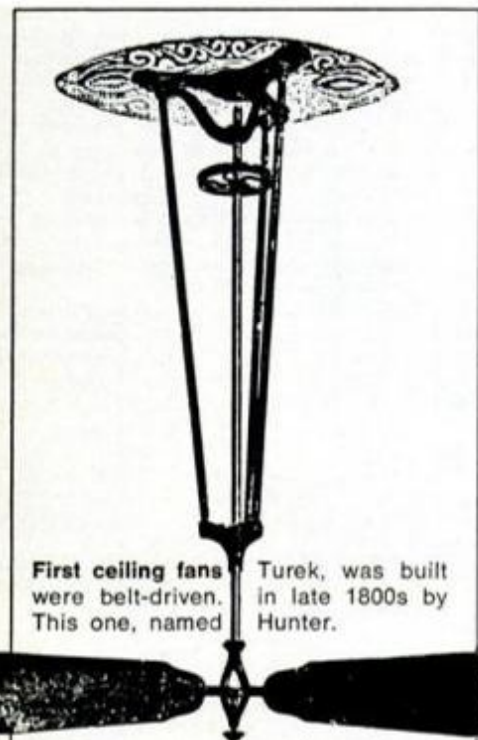
Select a safe location for the fan you install. The blades must be well above head level. The ridge pole of a valuted ceiling is an ideal location because it's high enough to be out of the way, and the fan will move the air that is normally trapped there.

Doing a safe, complete job will contribute to your peace of mind on those hot summer evenings when you'll be relaxing in a room full of atmosphere, nostalgia, and a soothing, gentle breeze. ★★★

complain that the room is stuffy. But as the fan moves the air, it increases the rate of evaporation from your skin, which lowers the skin surface temperature and makes you feel cooler.

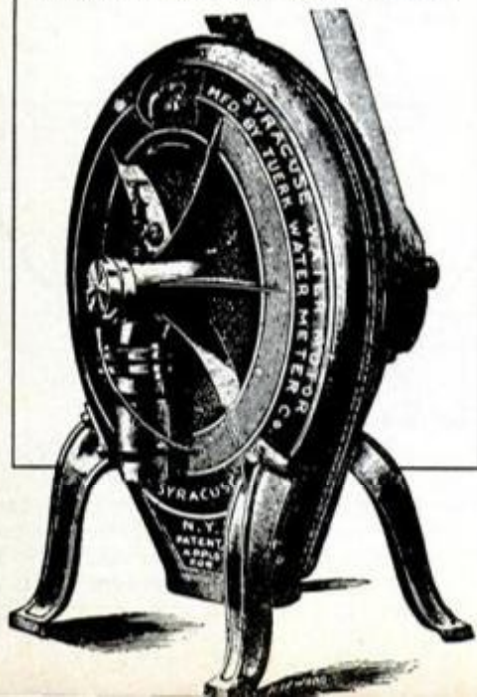
Slow is good

Big, slow-rotating fans and propellers are efficient. Boat and airplane props (except small sizes) are geared to turn more slowly than the engine. Moderate revolutions are engineered into them to maintain high efficiency. It's built into ceiling fans for the same reason—to let the big blades move a lot of air on a little electricity. They're usually driven by slow-speed electric motors having many poles. A two-pole motor on 60-Hz household power has a synchronous speed of 3600 rpm, and a six-pole machine turns only 1200 rpm. Most ceiling fans have 18-pole motors (400 rpm) and some have been built with as many as 24 poles which drive the blades at less than 300 rpm—that's really geared for a lazy summer afternoon.



First ceiling fans were belt-driven. This one, named Turek, was built in late 1800s by Hunter.

At the turn of the century, ceiling fans were driven by water motors getting power from city water systems.



OLD FANS FROM EMERSON ELECTRIC

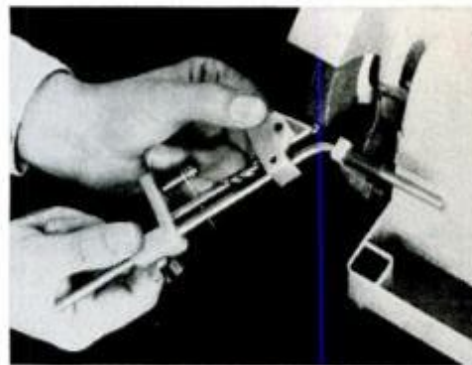
Type	Blade diameter	Cycles	Production	Motor
CF 1	60 in.	60	1895-1896	Brush and commutator
CF 28	56 "	60	1897-1901	Induction, 2 speed
CF 30	30 "	133	1897-1911	" 1 speed
3114	52 "	25	1909-1910	" 1 speed
8114	52 "	40	1909-1910	" 2 speed
35241	52 "	25	1915	" 3 speed
35661	32 "	60	1925	" 3 speed

IT'S NEW
NOW



Combo microwave-electric range for fussy chefs

If you're gung-ho for charred steak hot-rare in the middle, a new combination range may be your dish. The family chef can cook full-size meals with microwave energy, conventional heat, or a combination—using metal utensils. Prepare meals right from the freezer, cut cooking time in half with combo, or do high-speed cooking with micro. \$829. Litton, 400 Shelard Plaza S., Minneapolis, Minn. 55426.



New bite for dull bits

Now you can put a new edge on old drill bits. A drill point sharpener fits any bench grinder to re-edge standard 180° drills up to 7 inches long and from 1/8 to 1/2 inch in diameter. It adjusts for bit length. Sharpeners for 90° and 135° points also available. \$7.45 postpaid. One Minute Co., Box 154, East Freetown, Mass. 02717.



Drywall joint kit

All you need to finish drywall paneling like an expert, says the maker, is this new kit containing ready-mix compound (enough for 5 panels), 60 feet of reinforcing tape, wide-blade applicator and illustrated instructions which also cover texturing and patching. U.S. Gypsum, 101 South Wacker Dr., Chicago, Ill. 60606.



Pin-on button badge maker

Make button badges with a hand-operated press plus color dies. Kit includes 25 badge blanks and 25 discs for slogan badges. Cut your own 2 3/4-inch disc design. Instructions come for pressing designs between transparent cover and pin back. \$31.70 ppd. R.P.M. Associates, Box 618, LaSalle, Ill. 61301.



Trim guard to help paint smearers

Professional painters "cut in" window muntins. Do-it-yourselfers often paint the glass. Now a "Dual Trim Guard" keeps paint off walls and windows. A long edge protects walls when painting baseboards; short edge is for tight window corners. \$1.19. Red Devil, 2400 Vauxhall Rd., Union, N.J. 07083.

Car safety standards: Too

Detroit says that safety equipment required by federal standards

If you own a 1975 or 1976 American-made automobile, you probably have little if any idea of how much federally imposed antipollution and pro-safety standards added to the price you had to pay. But you know for certain that car prices are climbing out of sight. Not only do they cost more to buy initially, but they cost more to operate. Somewhere along the line, you keep telling yourself, the camel's back has to crack.

On a cumulative basis, standards on the '75 models added about \$400 per car. On the '76s, this figure was upped by another \$75 to \$80. By the time the '77s bow, federal standards will have added about \$750 to the price of a new car.

Auto industry executives see the imposition of evermore rigid federal standards as possibly being the catalyst that will send vital auto



Louis C. Lundstrom, Executive Director, Environmental Activities Staff, General Motors Corp.

"If we're going to build and sell a successful car, we have to provide what's useful for the customer."—GM

sales plummeting. It's not that automakers are against the standards per se. Rather, they'd like them eased somewhat, the imposition of their scheduling put back.

What the automakers question is the entire gray area of costs of the standards in relation to consumer benefits produced. It ain't, they say, necessarily worth it.

Last year U.S. car manufacturers ran big ads in major newspapers designed to alert car owners to pending federal legislation on emission controls. The ads urged readers to write their congressmen saying whether they favored stricter controls, or a five-year extension of existing standards.

A study validated by the National Opinion Research Center indicated that 32 million people read the ads, ten million recalled what the ads

preached, and that of these, two out of three favored extension of existing standards rather than the imposition of stricter ones. Speaking, obviously, were a lot of battered pocketbooks.

Thus armed, the industry cried, "Foul!" It thought—and still thinks—it had a legitimate point: that the people forced to pay for what auto men tend to think of as federal meddling are overwhelmingly opposed to the idea. The industry claimed that some federal standards penalized fuel economy far out of proportion to their benefits, and that others were only marginally effective.

On the other hand, those critical of the industry were quick to point out that all the standards were doing, really, was forcing automakers to step up research and development of cars that wouldn't foul the air unduly and that would be comparatively safe. Some critics claimed the industry did not propose alternatives (or a time schedule for their implementation), nor did it spell out whether or not it in fact made a profit on the installation of existing federally imposed equipment.

PM asked four questions of the four major U.S. car manufacturers to determine not only what they had to say about federal standards but also to get their idea on what you—the guy who now pays and will continue to pay—can do to express your opinion.

Our questions were directed to Gerald C. Meyers, executive vice president, American Motors; Sydney L. Terry, vice president, Public Responsibility and Consumer Affairs, Chrysler Corp.; Herbert L. Misch, vice president, Environmental and Safety Engineering Staff, Ford Motor Co., and Louis C. Lundstrom, executive director, Environmental Activities Staff, General Motors Corp.

■ Which of the current motor vehicle standards have proved to be of real value?

American Motors: In the case of emission standards, despite the speed at which we must work, the objective is right. The air *should* be cleaned up. The government *should* step in to provide for the orderly transition from what is not right to what is right. The industry is not against emission controls themselves,

but the *speed* of transition, which is close to impossible and is costing the consumer a great deal of money.

Chrysler: The need for some regulations is obvious. No one would voluntarily buy a car with emission controls and pay an extra \$100 unless he was assured that everybody else had to pay \$100 for a cleaner car, too. There were many areas where regulation was needed—bumper height, for example. Standards were agreed upon by the industry, but companies kept departing from them because of styling or

"Regulation robs the buyer of freedom of choice because someone else decides what he ought to have, what he ought to pay."—Chrysler

the need for more radiator area. When the government wrote the original 20-odd standards in 1966, it took the best safety features of the automobile and set those as interim standards for all cars. We found no fault with those. Among them was the laminated windshield, an excellent cost-effective safety standard. And the energy-absorbing steering

column—there's ample evidence it saves lives—and lap and shoulder belts.

Ford: At the time the first bumper standard was being proposed, Ford made the obvious observation that the most important thing you can do with



Sydney L. Terry, Vice President-Public Responsibility and Consumer Affairs, Chrysler Corp.

bumpers is make them so they meet other bumpers. Automakers couldn't agree on height, so it was a good idea to have this standard. We also thought we should go to a heavier bumper. But the government ended up overdoing it and we had to do so much buttressing we added too much weight. Now that they've backed off a bit we think the bumper standard will be effective—and cost-effective, too. We now have a good bumper standard; it's unfortunate it cost mil-

costly for too little benefit?

pushes car costs ever higher—with questionable benefit to owners.

lions of dollars to go too far and then back up.

General Motors: Windshield wipers and washers which must follow specific standards; a defroster system that is tightly regulated as to how it must perform; another that has to do with the vision provided by the rear-view mirror—are all these of real value? No one knows. There's so little difference between what we'd put on a car because we believe it's the right thing for the customer that in many cases the federal standard is meaningless. If we're going to build and sell a successful car, we have to provide what's useful for the customer. What would be the use of providing a mirror that was too small? Any mirror we'd use would be very close

"It would be well if consumer groups were more responsive to the cost-benefit implications prior to the completion of rule-making."—Ford

to the present standard. Yet we must continuously measure, monitor, certify and go through many stages of control that are really unnecessary.

■ **Which standards have not proven to be of benefit, or are only marginally effective?**

American Motors: Let's take 5-mph bumpers. There hasn't been a single life saved or injury reduced because of these.

Yet it is the one thing that has added more weight to cars than any other. It's the greatest penalizer of fuel economy since the advent of airconditioning. We needed better bumpers, but it's one thing to do a good job of protecting the sheet metal, and quite another to say: "Hit that wall at 5 mph." The consumer doesn't understand this; he thinks a heavier bumper does a better job—and never a good enough job, according to his insurance company.



Herbert L. Misch,
Vice President, Environmental and Safety Engineering Staff, Ford Motor Co.

How much protection should you give a person? I'd say that whenever a person exercising due diligence can get hurt, then we automakers should design to protect him. But what about neglect? Should we protect the operator who doesn't care how he approaches a wall or a post? The air bag issue is one of protecting people despite their neglect. Air bags are "passive restraints." *Passive.* Even if you do nothing to help yourself, you are to be protected. Count me out. As intelligent people we should in part take steps to protect ourselves. To make every car buyer pay to protect the guy who isn't interested in protecting himself—the drunk driver, for example—is social injustice.

Chrysler: The cost-effectiveness of padded sun visors and padded dashboards is questionable. And headrests are ineffective because they're adjustable. I don't think a permanent headrest that is high enough to protect the tallest person is the answer because it would limit visibility for others. Adjustability isn't the answer because people wouldn't adjust them properly. I'd favor having it permanent but of a height to protect the majority of people from whiplash without being higher than it need be to do the job.

Ford: Marginally effective? That takes us back to the specific provisions of given standards that make them effective—or make them costly without any benefit. Most of us are concerned about cost effectiveness: what the cost will buy in safety benefits. There are some standards—like headrests—of which we question the total value. There are others about which we're dubious—for example, those pertaining to flammable materials inside the car that would prevent the spread of a cigaret fire or something similar. We've always agreed that there should be such a standard. But statistics show that very few deaths are caused by the burn rate of materials in the car. Passengers die of suffocation caused by *fuel-fed* fires. Yet burn-resistance requirements have been made more stringent. It will add to the cost to the consumer and it's questionable whether it will add anything to his safety.

General Motors: There's a controversial new braking standard that

went into effect in '75. We get very few complaints about brakes; they give excellent mileage—60,000 miles and more without servicing is not uncommon. This year the federal standard says those brakes aren't adequate. We must build more heat capacity. We've



Gerald C. Meyers,
Executive Vice President,
American Motors Corp.

done that with heavier lining, larger drums that cost more and put more weight into the car—for the sole purpose of being able to give the car more abuse. The new lining that meets the standard wears out faster and the brakes will squeal. We believe the noise and the loss of mileage aren't worth the extra heat capacity that will be of use to very few customers. We not only gave National

Highway Traffic Safety Administration reports on this, we gave them demonstrations to prove what the new standards would do to brakes. But the standard was adopted.

"The industry is not against emission controls themselves, but the speed of the transition, which is close to impossible and is costing the consumer a great deal of money."—AMC

Highway Traffic Safety Administration reports on this, we gave them demonstrations to prove what the new standards would do to brakes. But the standard was adopted.

■ **Why is the industry opposed to the standards that call for added roof strength and side door beams?**

American Motors: We question the cost-effectiveness of these standards. What some proposed modification is eventually going to mean in

(Please turn to page 197)

WHAT DO YOU THINK?

Want to sound off about motor vehicle standards—or take issue with any of the points discussed in this article? Your congressman and the National Highway Traffic Safety Administration will listen—if enough people feel the same way. Write us and we'll see that your letter gets to the NHTSA.—The Editor

How to replace your

I proved it to myself: If you want to save money you should replace rotted exhaust system parts or, if necessary, the entire system *yourself*.

Using a 1973 Dodge Dart six-cylinder as an example, I surveyed a mail-order house (J.C. Whitney and Co. of Chicago), a new-car dealer and a local supplier to find out how much each would charge for parts alone. I then asked two nationally known companies (Midas and Scotti) what they would charge for installing an exhaust system.

Here's the breakdown for parts only (do-it-yourself replacement):

	Mail order	Parts dealer	New-car dealer
Exhaust (front pipe)	\$7.98	\$12.72	\$16.58
Tailpipe	4.98	7.82	10.70
Muffler	9.98*	14.80	23.95*
Clamps and gasket	1.60	1.60	2.40
Total	\$24.54	\$36.95	\$53.63

*Guaranteed for as long as you own the car.

Midas and Scotti asked \$60 and \$65, respectively, to install an exhaust system in the Dodge. Mufflers supplied by both are guaranteed for as long as you own your car. The tailpipe furnished by Scotti is also guaranteed.

Dirty work but worth it

I can't deny that replacing an exhaust system can be a dirty, sweaty job, but I figure it's worth a little perspiration to save \$35 or \$40. The toughest part is usually loosening



Clamps are used to secure the components of the exhaust system. Various types are used and all are likely to rust tight. Use penetrating oil or hacksaw to remove.



Exhaust system inspection should be done periodically because of the danger of carbon monoxide leaks. Flake off rust to see how deeply it has eaten into metal.



Condition of muffler is checked by ear: Dull thud when rapped indicates pending failure; sharp ringing, a sound muffler. If wrench goes through, replace muffler!

nuts and bolts that have frozen stiff over the miles.

However, you have an ally in penetrating oil. Drown stubborn fasteners with oil and let set 10 to 15 minutes. The fasteners may need another shot before they loosen.

If a nut and bolt prove particularly stubborn, cut them away with a sharp chisel and hammer.

If the entire exhaust system has to be replaced, and you're not trying to salvage parts for reuse, the only fasteners you normally have to remove are at the exhaust pipe-to-ex-

haust manifold connection. Other parts can be cut away in a manner easiest for you. You can use a hacksaw or an exhaust and tailpipe cutter that will cost about \$15.

Do not use a torch. Someone inexperienced working with flame beneath a car is playing with danger. There is always a chance of accidentally having flame get in the way of a gas line or fuel tank.

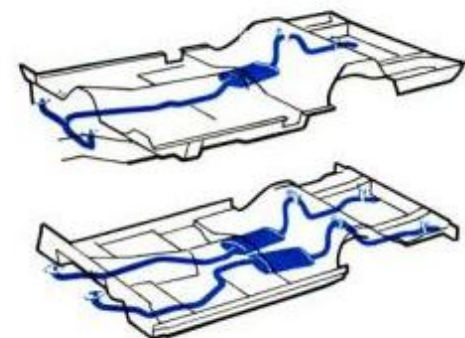
Round out your tool needs with socket and open-end wrenches, and a tube of exhaust-system joint sealer.

A rack simplifies job

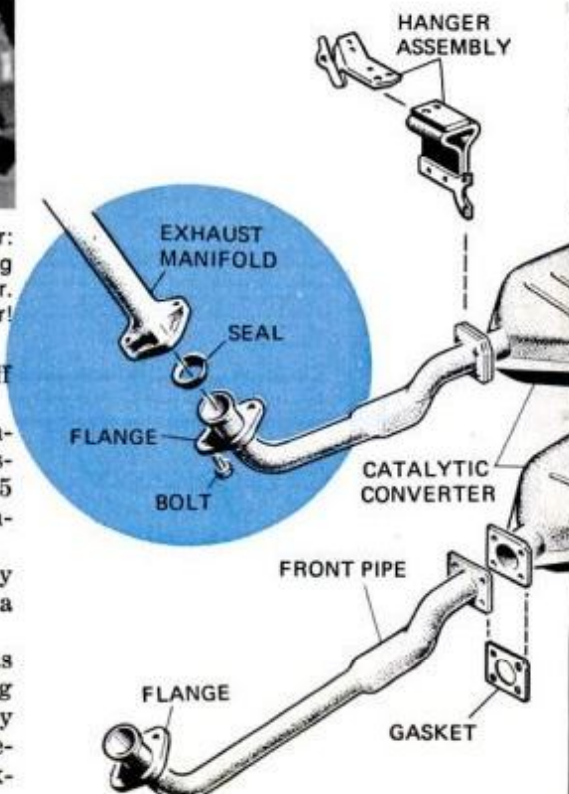
You can tackle exhaust-system replacement lying flat on your back, if you must, but the job is made much easier by getting the car in the air. If you're friendly with a guy at a local gas station or garage, maybe he'll let you use his lift during off-hours. If not, you can place the car's four corners on jack stands. Just make sure the stands are strong enough to take the weight and are properly set.

The exhaust system should be cold when you work to avoid burns.

Every exhaust system has three common parts: exhaust (front) pipe, muffler and tailpipe. Parts are suspended from hangers which are bolted to the undercarriage, and



Two exhaust-system variations are shown here. At top is a single system with crossover pipe: one branch for each side of the engine. A dual exhaust system is shown above: The two practically identical exhaust lines are separate.



exhaust system

SATURDAY MECHANIC

by Mort Schultz

joints where parts meet are usually secured with clamps.

Most cars have one exhaust system, but some with V8 engines have two. A dual exhaust system is nothing more than two identical (or almost identical), but separate single-exhaust systems, one serving the engine's right bank of cylinders and the other serving the left bank.

The front pipe of cars having V8 engines and single exhaust systems is a so-called crossover pipe—a single pipe having two branches.

One branch attaches to the exhaust manifold on the right side of the engine, and the other attaches to the exhaust manifold on the left side. Exhaust feeds from both branches into the common pipe and out through one system.

Many cars also have resonators, which are merely second mufflers, smaller than the main muffler, that help further reduce engine noise.

Don't damage valuable parts

Many 1975 and practically all 1976 models are equipped with catalytic converters. A catalytic converter is part of the exhaust system, but most times other exhaust parts fail much faster than a converter which is designed to last 50,000 miles.

This means that in replacing an exhaust system having a catalytic converter you have to exercise care not to damage the converter when taking it from the car and when re-installing it.

Also watch how you handle long exhaust pipes and tailpipes that are still in usable condition when disconnecting them to replace a shot muffler. When releasing one end of the pipe and shifting to the other end to make a disconnection, support the pipe by wrapping a length of soft wire around it and tying it to a rail or cross-member. This keeps the pipe straight and stops it from bending.

After new and/or reusable parts are put back together, spread a liberal quantity of exhaust-system joint sealer around the joints before you tighten the clamps. The sealer, not the clamp, prevents the joint from leaking.

Up front where you may have to remove the exhaust pipe from the exhaust manifold, there may be a gasket. If there is, throw it

away and replace with a new gasket.

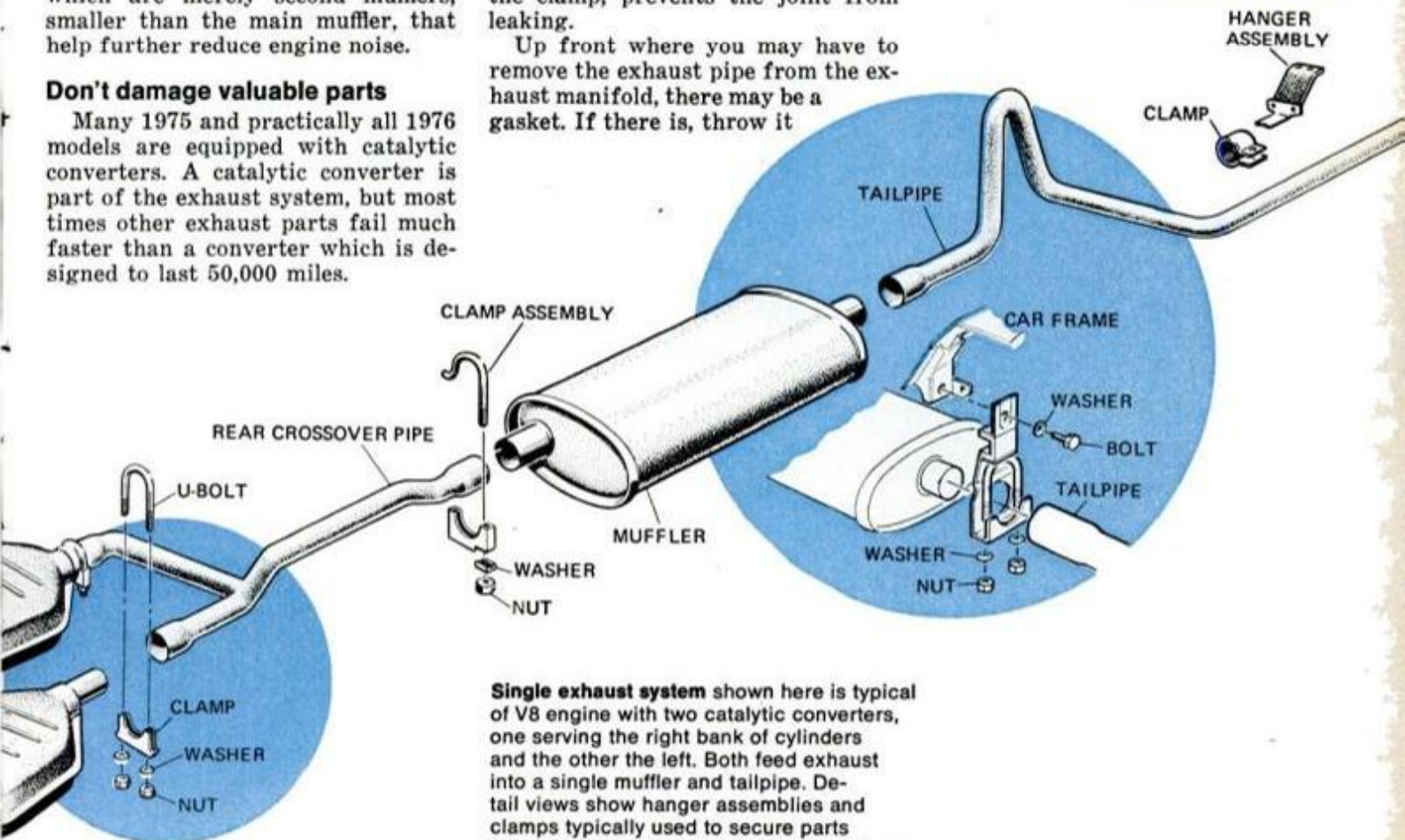
If you have a torque wrench and are able to get your hands on manufacturer's tightening torques for fasteners (specs are given in service manuals), use it. However, a torque wrench isn't really necessary. But caution is.

Use care in tightening

Tighten fasteners securely—that is, enough to keep parts from moving and banging against the undercarriage. But don't tighten them to a point where you'll crush pipes.

To give you guidance in replacing an exhaust system, here are directions to follow when doing the job on Valiants and Darts with six-cylinder engines and without catalytic converters; and on Granadas, Monarchs,

(Please turn to page 198)



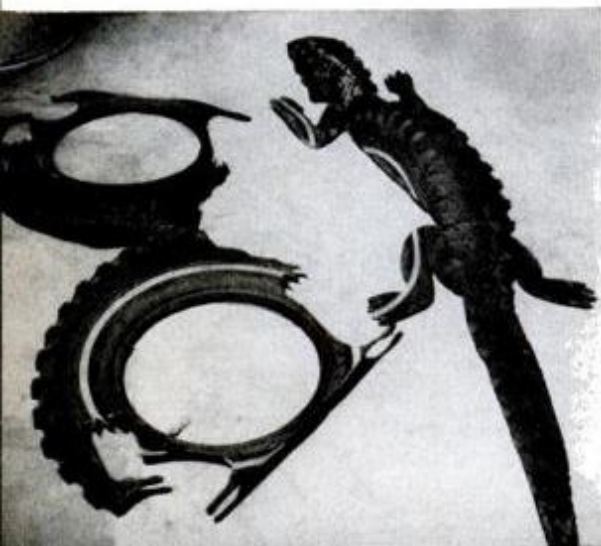
Single exhaust system shown here is typical of V8 engine with two catalytic converters, one serving the right bank of cylinders and the other the left. Both feed exhaust into a single muffler and tailpipe. Detail views show hanger assemblies and clamps typically used to secure parts together and to hang system from car frame. Make sure you have all the parts you need before starting the job and remember that you won't be able to get close enough to these red-hot parts to start work if you've just used the car!

IT'S NEW
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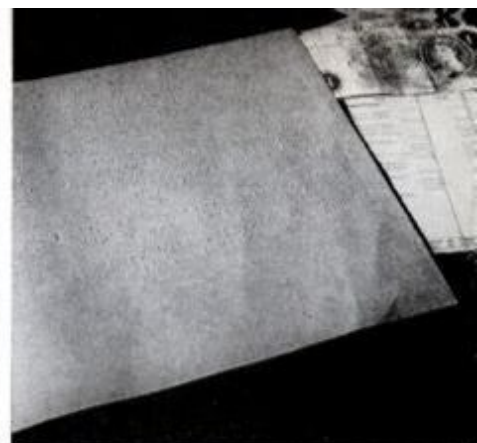
Soleful world of sneakers

Remember sneakers? One pair served for everything until toes came through uppers and the canvas evaporated. Now you're not with it unless you have half a dozen pairs for specific activities. Today, Goodyear's plant in Windsor, Vt., makes special tread for (L to R) clay court tennis, hiking, natural turf football, jogging, soccer, plastic grass football, sailing, grass court tennis, basketball and, believe it or not, auto rallying. For basket weaving you still can go barefoot.



Alligators from tire casings

Animals carved from old tire casings are a new playground attraction for young kids. The idea, conceived by a creative Israeli immigrant, William Weisz, requires special tires for special animals. The alligator, above, was carved from the snowtire at left. Nubby tread makes perfect alligator skin. Cost is about \$23 for a frog to \$29 for an elephant. Tirecraft, Dolin Metal Products, 475 President St., Brooklyn, N.Y. 11215.



Braille telegrams and bank accounts

"Braillegrams" and braille bank statements are the latest in new services for the blind. The telegrams were initiated recently by Western Union. Just tell the operator you want to send a Braillegram; no extra charge. Embossed statements are a service of Marine Midland Bank in England which was developed by Warwick University Research Unit for the Blind. Embosser, linked to a computer, maintains confidentiality.



Easy does it!

Canal locks between Puget Sound and Lake Union, Ore., are 80 feet wide, but a floating drydock the Navy wanted to take through was 81 feet in width. Navy engineers solved the problem by loading the port side with concrete, heisting starboard with pontoons and tugging it through at a 38° list. It will be used to build a fleet of ecology ships.

Skateboard safety sliders

Plastic pads that strap to skateboarders' hands provide sliding surfaces that are applied to pavement to control skids, prevent tumbles and help stop without loss of skin. They also aid balancing by offering wind resistance. D & L Products, 11892 Cardinal Circle, Garden Grove, Calif. 92643.



Make this swing toolholder for your lathe

by Martin Cleve

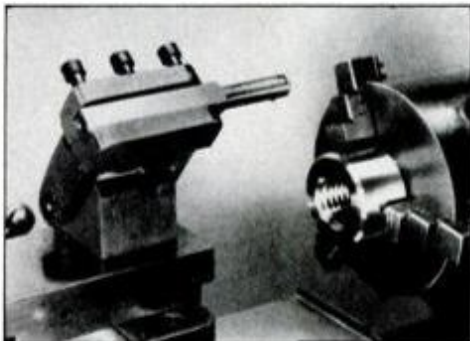
One of the most bothersome tasks in lathe work is adjusting the tool bit to the correct height—usually by packing thin metal strips below the tool and checking against the lathe's center point. With this universal swing-away-type toolholder, I not only can check the progress of thread cutting by simply swinging the tool upward, but I can return it to exactly the same position without retracting cross slide or carriage, as normally required.

I made the holder to fit my 7-in. lathe and milled the jaw to accept $\frac{3}{8}$ -in.-square-shank bits. To make frictional adjustments so the holder swings without play or binding, you simply tighten the $\frac{1}{4}$ -in. capscrews

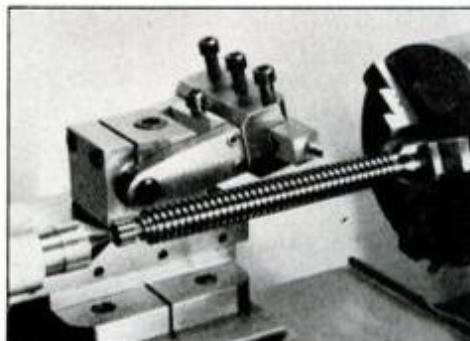
in the pivot pin. Use a single bolt to attach the holder to the cross slide. Placing a fiber washer between the holder and cross slide improves friction and eliminates the need for excessive tightening.

For ordinary turning or external threading, mount the holder with the jaw at right angles to the axis of the lathe. You can adjust tool height with a thin metal strip, such as a razor blade, sandwiched between the tool tip and the work.

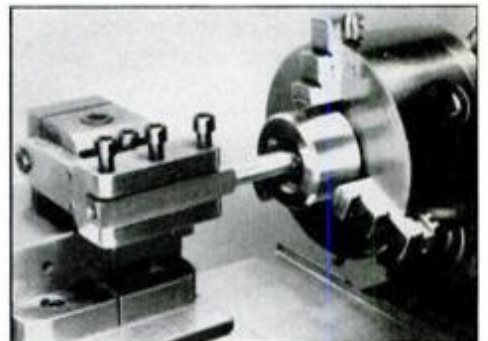
For internal boring or threading, set the jaw parallel to the lathe axis. In this position, the tool cannot clear the work for noncutting return passes except by advancing the cross slide. ★★★



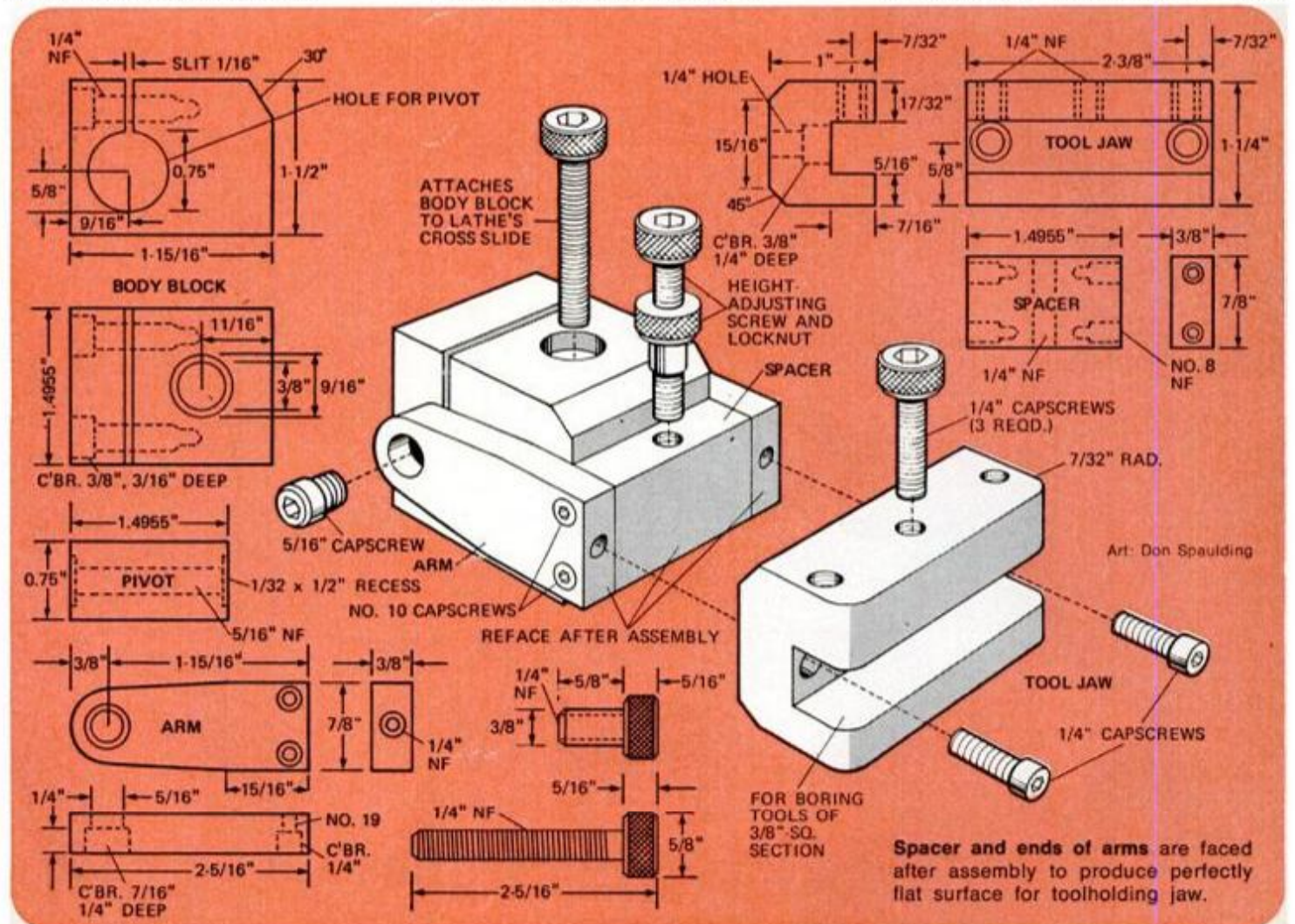
Pivoted to body block bolted to cross slide, cutting tool is swung upward and clear of work to check progress.



For ordinary turning or thread cutting, holder is swung around so tool-holding jaw is at right angle to lathe axis.



For internal boring or thread cutting of workpiece, toolholding jaw is positioned so it is parallel to lathe axis.



Spacer and ends of arms are faced after assembly to produce perfectly flat surface for toolholding jaw.

Three ways to handle problem ceilings

One way is with texture paint, another with plasterboard, a third with acoustical tile. Your pocketbook must decide.

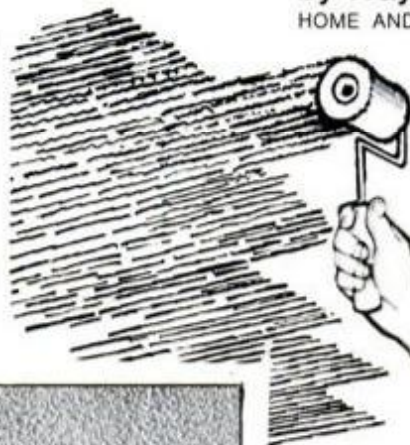
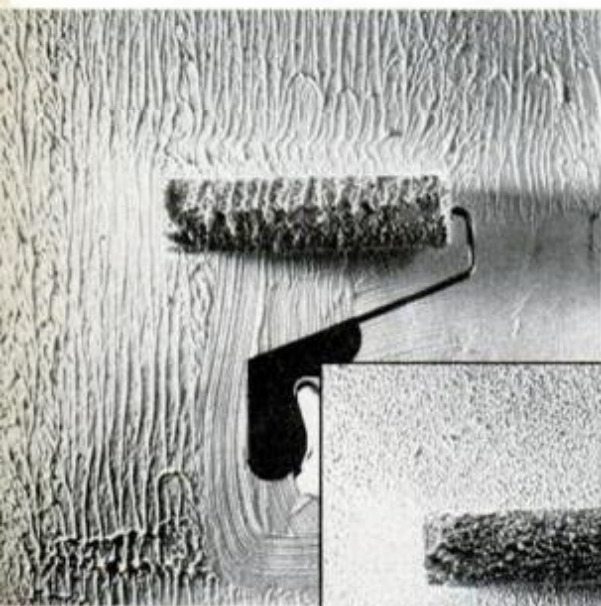
by Wayne C. Leckey
HOME AND SHOP EDITOR

If your home is old (40 years or more) and has plastered walls and ceilings, consider yourself lucky if the plaster hasn't cracked during the years due to structural settling. Most homes don't fare so well. Cracked ceilings are common in older homes and cause homeowners a continual headache.

Of the three ways to tackle a cracked ceiling, painting with texture paint requires the least work and is the least expensive. You put it on directly from the can with brush or roller, then while it's still wet you give it a stucco-like texture by pouncing, stippling or swirling with a stiff-bristle brush, sponge or crumpled paper to achieve the pattern you prefer. The resulting sculptured finish makes an attractive ceiling as you see below, and it does cover cracks. Its one drawback is that you're stuck with it—its not easy to remove should you want to go back to a smooth untextured surface. Some brands I hear can be steamed off like wallpaper although I haven't tried it.

Basically, all texture paints are thick, heavy-bodied coatings which come in a choice of finishes: smooth texture, stucco texture and sand finish. If it's a sand finish you like, you'd pick sand-finish paint, apply it with

1 'Replaster' with texture paint



Photos: Arvon Products



Art: Adolph Brotman

brush or roller and leave the effect without touching it further. If you want a more sculptured look, you'd use stucco finish, apply it thick and give it an additional texture by twirling the brush or by sweeping the roller in overlapping semicircles. The paint is applied a few square feet at a time, then worked over to gain the effect you want.

As with any paint job, there's surface preparation to be done. All scaling paint must be scraped off. Holes where the plaster is missing must be filled level with spackling compound. It's best to pull off wallpaper if it has been used in an attempt to hide cracks.

I've always opened windows as recommended for proper ventilation and drying. Coverage per gallon varies from 60 to 120 sq. ft. depending on the thickness of the texture pattern. Texture paint from Arvon Products (which I've used) runs about \$7.95 a gallon. It can be tinted if you don't want flat white. You can buy special deep-contour rollers 4 in. wide which are made to dip into a gallon can, also brushes with a pistol-grip handle which I've found easy on the wrist in working overhead. Sometimes a small trowel is used for smoothing the high spots in the textured surface as the wetness disappears.



Special 4-in.-wide roller lets you work out of gallon can, applies texture in one easy operation. Texture brush with contour handle makes painting less tiring.

2 Cover with plasterboard

When a plastered ceiling is too far gone and so badly cracked you could not hope to take care of it with texture paint, you have two options—cover it with sheets of plasterboard or hide the cracks with ceiling tile. If you prefer plasterboard over tile and the smooth paintable surface it provides, okay but it takes muscles.

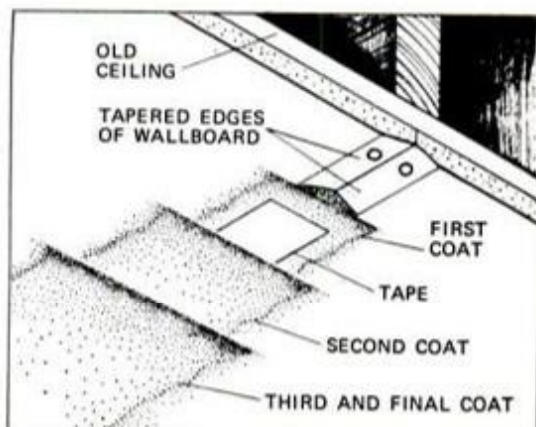
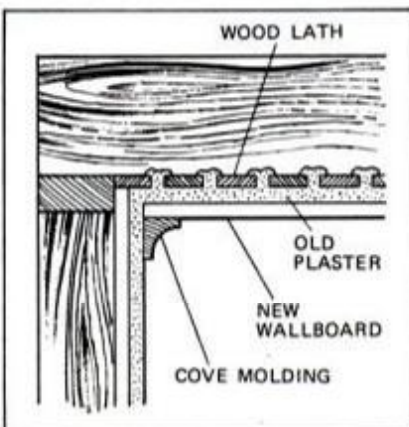
You'll need some help

Find someone to assist with the heavy 4x8 sheets of gypsum board and hike them up against the ceiling. Support tees make this part of the job less difficult than you might think, and fortunately you'll only have to struggle with a minimum of full sheets since cross joints must be staggered. You'll be working with less than full sheets once the big ones are up.

Pick a starting corner where the ceiling joists run crosswise to the sheet, and position the sheet so its end falls midway on a joist to provide nailing for the abutting sheet. Your support tees should be about 1 in. longer than the floor-to-ceiling height so they will force the plasterboard tight against the ceiling when wedged under it. Drive nails in rows 7 in. apart, then strike each nail one more time to "dimple" (set) the head, taking care not to break the face paper. Continue filling in and nailing the smaller pieces until the whole ceiling is covered wall to wall.

The hard part is done although taping and filling the joints and dimpled nailheads with joint compound can be a tedious job. Use premixed joint compound and, with a 4-in.-wide joint-finishing knife, apply compound in the valley created by

Support tees are used to raise and wedge plasterboard against ceiling for nailing. Plank across saw-horses lets you reach it.



NAILS—TYPE, SIZE AND NUMBER

Wallboard thickness	Nail type	Per 1000 sq. ft. of wallboard
3/8", 1/2"	1 1/4" wallboard nail annular threaded	6 lbs.
3/4"	1 3/8" wallboard nail annular threaded	6 lbs.

PREMIXED JOINT COMPOUND AND TAPE

Plasterboard (sq. ft.)	Ready-mix joint compound (gal.)	Wallboard tape (rolls)
100-200	1	2/60'
300-400	2	3/60'
500-600	3	1/250'
700-800	4	1/250', 1/60'
900-1000	5	1/250', 2/60'

the two adjoining tapered edges. Next take your joint tape, center it firmly in the wet bedding compound with a knife at a 45° angle. The pressure should squeeze out some of the compound, but enough must remain for a good firm bond.

When it's thoroughly dry (at least 24 hours), apply a fill coat extending a few inches beyond the edge of the tape and feather the edges of the compound. When the first finishing coat is thoroughly dry, use a 10-in. joint-finishing knife and apply a second coat and feather the edges about 1 1/2 in. beyond the first coat. When this coat is dry, sand lightly, wipe off the dust and apply the third and final

coat. The feathered width of the joint should now be 12 to 14 in.

Use basically the same steps with the butted end joints. But since there is no valley to fill, feather the compound well out on each side so there is no ridge buildup to cast a shadow. No tape is used in covering nailheads—just the same three-coat treatment. The thing to avoid with nailheads is bowing the knife with excess pressure as this tends to scoop compound from the dimpled area.

Stock ceiling cove molding is used to conceal the joint around the perimeter. The ceiling is now ready for paint.



Joint-finishing kit includes premixed compound, 20 yards of tape and plastic applicator. From U. S. Gypsum.

3 Tile it with a second ceiling

Ceiling tile is a dependable problem solver—even if the problem is more than a cracked ceiling. It can be a ceiling that's simply too high or has exposed pipes, ductwork or other low-hanging obstructions.

There are four ways to treat a cracked ceiling with tile: 1. You can cement it directly to the old ceiling. 2. You can staple it to wood furring strips nailed to the ceiling. 3. You can support it by a metal channel system screwed to the ceiling. 4. You can suspend it below the old ceiling by a hanging concealed grid.

Tile can go directly onto plaster

When the existing ceiling is sound and level but has many hairline cracks, tile can be cemented directly to the old plaster after removing any flaking paint or loose wallpaper.

When a ceiling is not level or has humps, you must use furring, wood or metal, to make it so. There are self-leveling metal furring channels that you attach directly to the existing ceiling and into which cross tees lock to hold 12x12 or 12x48-in. tile. Being rigid, the channels can't bend to assume the unevenness of a ceiling. Wood furring will bend, so the strips must be shimmed where needed with shingle points to make them level in both directions.



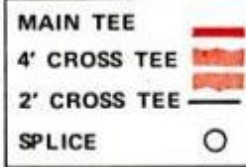
Use of furring, metal or wood, as illustrated above, is one of three ways to hide a cracked ceiling with tile. When ceiling has hairline cracks but is sound, tile can be glued directly to it with dabs of brush-on cement. When ceiling is in bad repair, a suspended ceiling in which the tile is supported by a grid system may be the answer.

When your problem ceiling involves more than cracks, a suspended-ceiling system such as Armstrong Cork's Integrid is best. Here you hang metal supporting runners by wires which you attach to the ceiling with screw eyes. Then you install tile and cross tees to the main runners. A unique tongue-into-flange edge has a slotted kerf that receives the cross tee and conceals it.

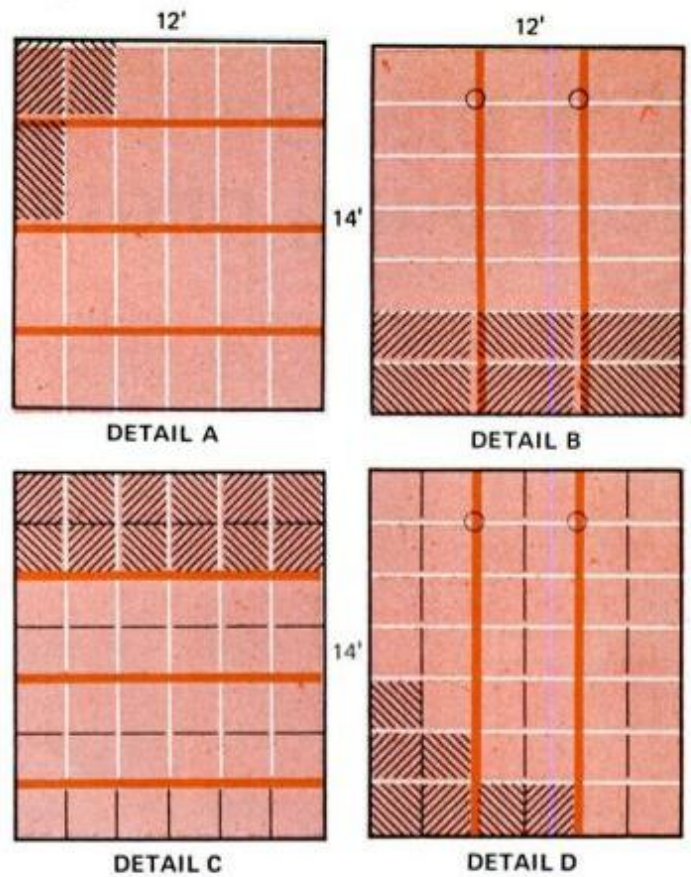
When cementing tile directly to the ceiling, you have to work outward in four directions from centerlines that divide the area in four quarters and place the tile edges along the lines. To find the center of the ceiling, stretch lines diagonally from the four corners and make a mark where they cross. By starting from centerlines, border tiles at the ends and sides of the ceiling will be the same width, not narrow ones along one side.

Another thing to remember when applying wood or metal furring to a ceiling: The furring must be placed crosswise to the ceiling joists so you can nail or screw it to solid structural members. ★ ★ ★

In detail A, where room is not a multiple of four and 2x4-ft. tiles are used, measure from center of ceiling in 4-ft. increments to locate main tees. When you want tees parallel to long room dimension, measure from edge of ceiling as in detail B.



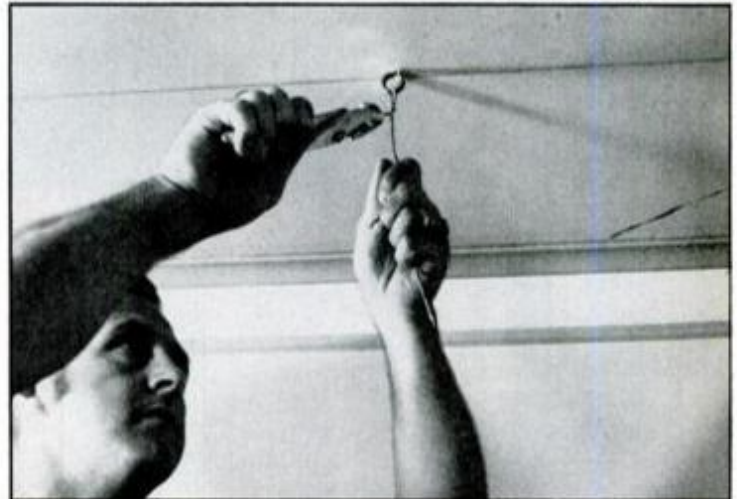
For 2x2-ft. tile in same-size room, measure from edge of ceiling in 4-ft. increments to locate main tees (detail C). When main tees are to run parallel to long dimension, space 4 ft. apart, install 4-ft. cross tees at 2-ft. intervals (D).



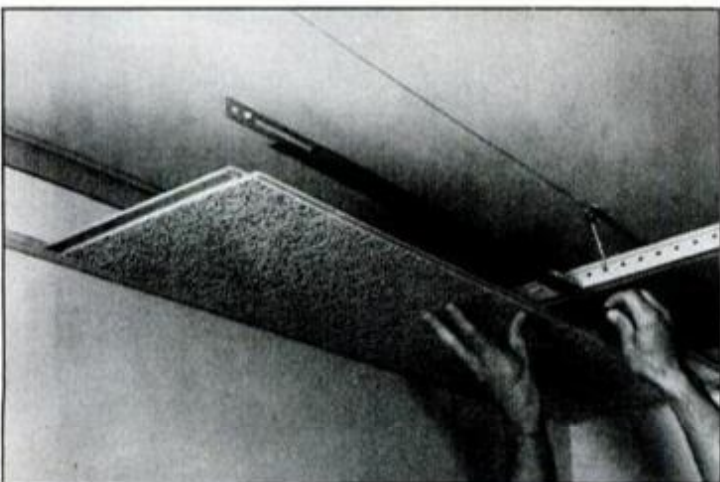
Photos: Armstrong Cork Co.



1. When you install suspended ceiling, chalk new ceiling height around perimeter of room. Nail metal molding to studs along line.



2. Turn screw eyes in rows into your ceiling joists. Then insert hanger wires through the eyes and attach firmly by twisting.



3. Main runner sections are supported by wires threaded through holes and twisted. Suspend runners perpendicular to joists.

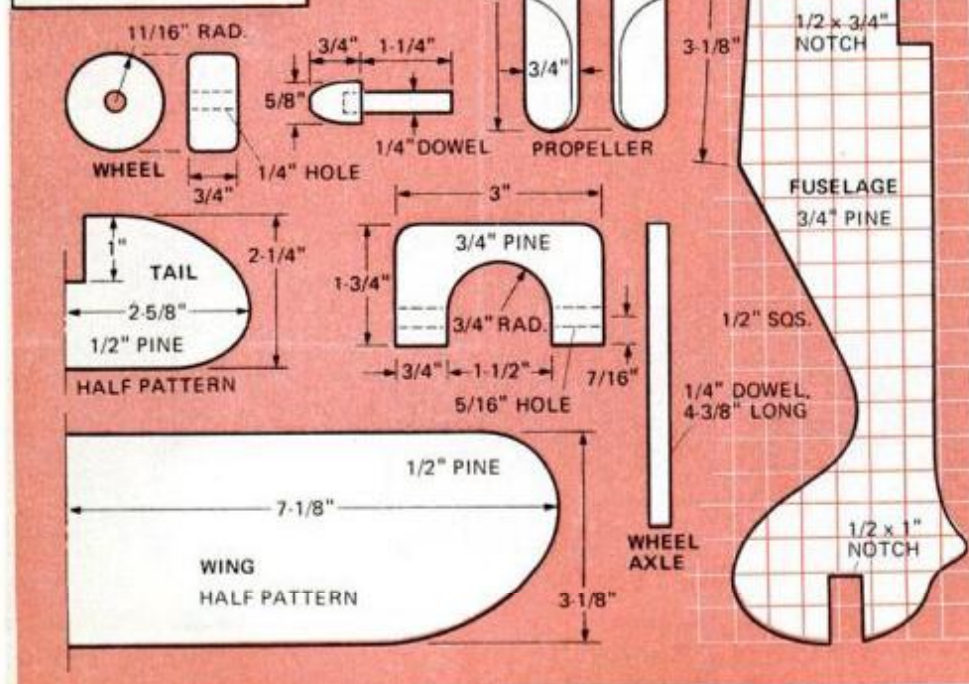
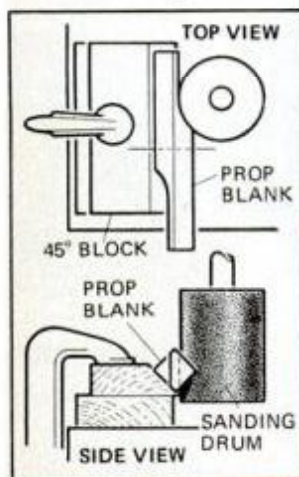


4. First 1x4-ft. tile (or four 12x12-in. tiles) rests on wall molding. Cross tee snaps on runner, slides into slotted tile edge.

Toy plane for young pilots

This chunky little block airplane for a chunky little aeronaut is a simple, nearly indestructible toy with just enough realism to excite his interest—including a prop that spins. It can be built in a couple of evenings. Wing and tail sections call for 2 feet of $\frac{1}{2}$ x 6-in. clear pine; about 14 inches of 1 x 6 are needed for the fuselage. Propeller pin and wheel axle call for 8 inches of $\frac{1}{4}$ -in. dowel. All remaining parts can be made from scraps of $\frac{3}{4}$ -in. stock. Follow the plans below for dimensioning and cutting each piece. Sand all edges until round to avoid splinters.

The propeller is easily made on a drill press. A plain block jig, beveled to 45° , is clamped to the table as shown. The $\frac{3}{4}$ -in.-sq. blank is then held against the bevel and run past a sanding drum on the drill-press spindle. Leave enough hub for a $\frac{5}{16}$ -in. hole for prop pin and hub cowl. Assemble parts with brads and epoxy.—*H. R. Haggerty*



Art: Fred L. Wolff

Home Improvements At Your Fingertips!

Thumb through the fourth annual Popular Mechanics Home Ideas Guide—beginning on the following page—to find a wealth of plans, projects, and interesting ideas for your home.

These pages are packed with great features for better living indoors and out. There are stunning skylights to brighten a room and add drama . . . garden houses for elegant outdoors dining . . . kitchen and laundry slide-out, built-ins for ease and convenience . . . the latest tools and products . . . smart deck accessories . . . even sound advice on designing room additions that really meet your needs. There's an idea for every room in your house.

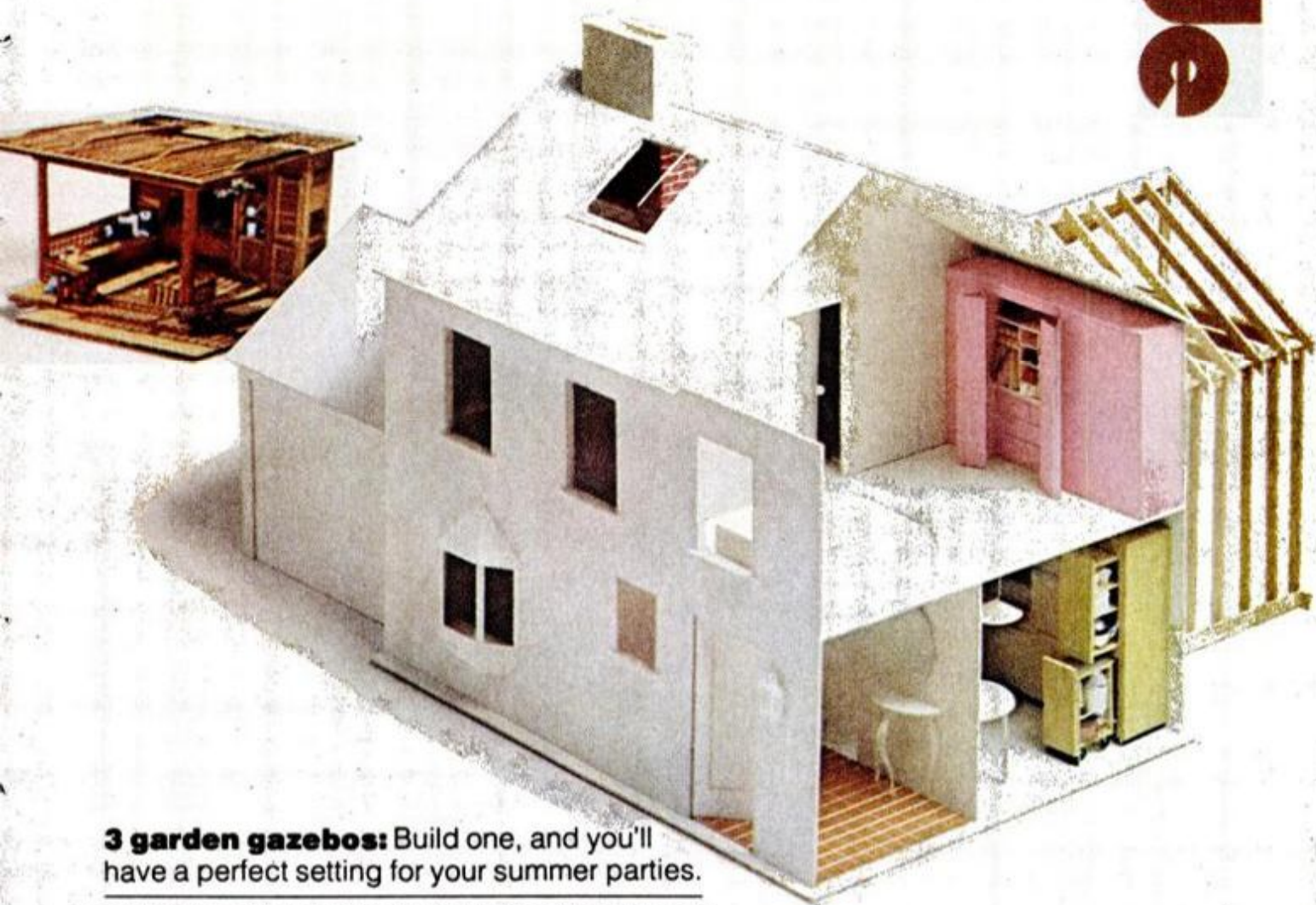
This special magazine-within-a-magazine puts a world of home improvement information in your hands. To make it easy for you to save this guide, we've made it a completely self-contained unit. Here's how to remove it from the rest of the magazine for easy reference.



- 1 Bend the magazine's pages away from the Guide's front cover.
- 2 Bend the magazine's back pages away from the Guide's last page. (Fig. 1)
- 3 Pull the Guide out. (Fig. 2)
- 4 Staple or hole-punch the Guide.
- 5 Keep it for handy reference.

POPULAR MECHANICS 1976

home ideas guide



3 garden gazebos: Build one, and you'll have a perfect setting for your summer parties.

Built-ins: Here's how to bring the dead space in your home back to life.

Planters and benches: 5 projects to make your deck more comfortable and better looking.

Skylights: Install one to brighten a gloomy room; it'll also keep you cooler in summer.

Quarry tile: Lay this floor in your entry and forget about muddy shoes and wet raincoats.

Plan an addition: With PM's advice, plan your dream room and get exactly what you want.

Best of the new products: Here's a roundup of the top new products for your house in '76.

Photo: Irv Bahrt
Construction: Blake Hampton

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Ornamental plastic shutters Bird Asphalt Roofing
Popular Mechanics—April 1976





Screen house: Pilings are used for support in this unique setting. The design beats mosquitoes in back yards, too.



Garden gazebo: This back-yard house is so versatile it can be elegant, informal, or strictly business for gardening.



Canopy gazebo: Elegant and simple are the words here. The construction blends in beautifully on a wooded site.

3 gracious garden houses for delightful summer parties

These versatile buildings will make summer more fun around your house.

by Mike McClintock
ASSOCIATE HOME AND SHOP EDITOR

Many houses used to be built with a huge porch in front or off the side. On warm summer evenings you'd be likely to find a family sitting out there rather than inside a hot, stuffy house. Unfortunately, this is a thing of the past. There's another feature of the American homestead that's disappearing and that's the barn. As the car replaced the horse, garages and carports were built to shelter the new vehicles. Without a large porch or a barn, the modern American home has lost its outdoor living and working space. One of these garden houses, or a combination of some of their features, could be the answer.

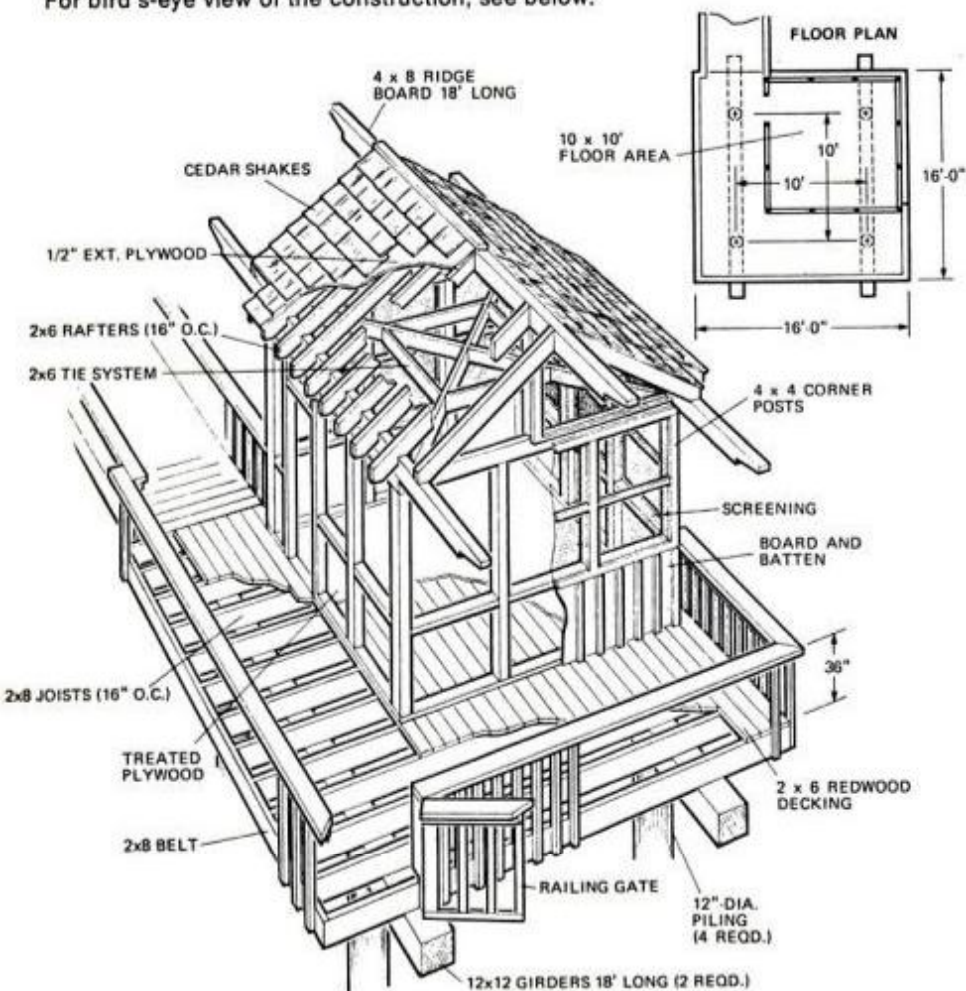
Keep off the grass

All three have one thing in common—a wood floor. This gets you up off the ground, provides a dance floor, and means that you don't have to balance a drink between two dandelions. But in each case, the floor has been taken a crucial step farther. The most common pitfall of outdoor structures is that they frequently look as if they were dropped out of a plane onto your back yard. They just don't look as though they belong there. All these gazebos have extended flooring, as deck platforms, a balcony, or a ramp, past the structural lines of the building. This softens the look of the structure and makes it more a part of the ground it's on. Aside from



Screen house

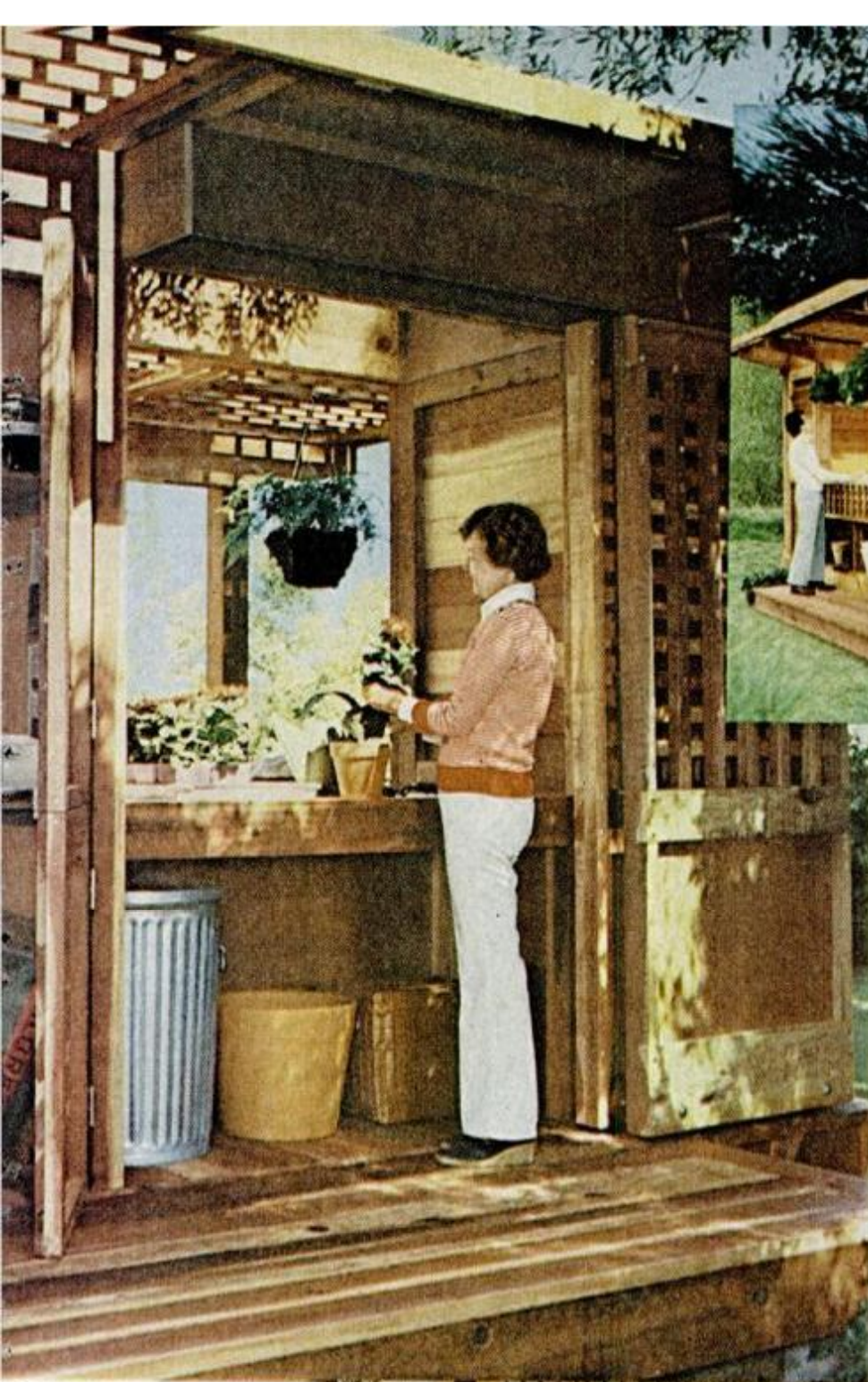
The 10x10-ft. screen house is offset on the 16x16-ft. piling frame, thus creating pleasant deck space. For bird's-eye view of the construction, see below.



Garden gazebo

the design considerations, another tool that will make a good-looking site is landscaping. This is most obvious in the location of the canopy gazebo. The roof line, which might have looked quite severe if it were out in an open area, is successfully nestled in a stand of trees. The simplicity of the construction, using treated poles, is totally harmonious with the surroundings. On a smaller scale, the lines of the deck on the garden gazebo can be muted with shrubs or planter boxes.

All the deck platforms outside the 4x4 posts on the garden gazebo are made up from 2x8 structural-grade redwood. The interior of each box is framed 16 inches on center with short lengths, and 2x4s are face-nailed to form the deck. The



Working garden center is at the rear of the garden gazebo. Lattice doors on rubber wheels slide away to reveal a solid potting counter and plenty of storage space.

One section of the deck was not completed so that the lawnmower could be wheeled easily into the "closet." More storage area for pots is located under the bench.



Plant your garden around the gazebo. You can build 3x10-ft. deck units for use as ramps leading through the garden.



The trellis roof is made up of 2x2s in frames. Use them for filtered light or use plywood for shade.



Pile up some pillows and settle back for a sunbath. This corner deck is great for flowering plants too.

dimensions are all modular (4x8, 3x12 and so forth) so there is absolutely no material waste. These platforms are so dimensionally stable that they don't need footings. They can rest securely on level ground and you can arrange them in any way you prefer. A few well-placed toenails will hold one in place as a bridge that rests on two other decks to create different levels.

The roof of the garden gazebo is designed for a dry climate; 2x4-ft. panels are made up using 2x2s to form a lattice. This will cut the direct sun but still keep the light, airy feeling you want outside. Depending on the climate where you live, part of the roof could be solid. The lattice panels fit into the roof framing system and can be removed for a piece of plywood if you want more protection. Although the plans don't include wiring diagrams, I urge you to run a code-approved line from your house out to the shelter. A few simple boxes with floodlights will make it look like a dream house at night and let the party keep going well after dark. I'd

also install at least one duplex receptacle (grounded) for a radio, TV, warming tray or coffeemaker. Complete and detailed construction plans for the garden gazebo are available for \$5.95 from California Redwood Assn., Dept. PM, 617 Montgomery St., San Francisco, Calif. 94111.

Select your location

To get the most use from your garden house, it has to be located close enough to the main house so you can easily bring out food and drink. It can't be far away from the garden or you'll spend too much time going back and forth with a wheelbarrow. It makes sense to try for a site in between. Check these guidelines.

Sighting-in on a site

- **Don't sink a pole** or pier over any underground piping or septic tank.
- **Don't build in a natural grade depression** that collects ground water.
- **Don't build too close** to your property line. Check local codes.
- **Do look for a natural rise.** To get good drainage and minimum settling.

■ **Do plan ahead for access,** walkways, ramps and any electric lines.

■ **Do consult local building codes.** Make sure your site is legal.

Good sense and good cents

If possible, try to keep construction time to a minimum. A smart move is to cover the surrounding lawn area with polyethylene for the few days needed, or build yourself a simple gangway into the construction area. On most jobs, the surrounding area takes such a beating that it needs major "renovating" after the building is done. The more foliage you can preserve during the job, the more natural the garden house will look on its site. Keeping the area reasonably clean can avoid reseeding or buying new sod.

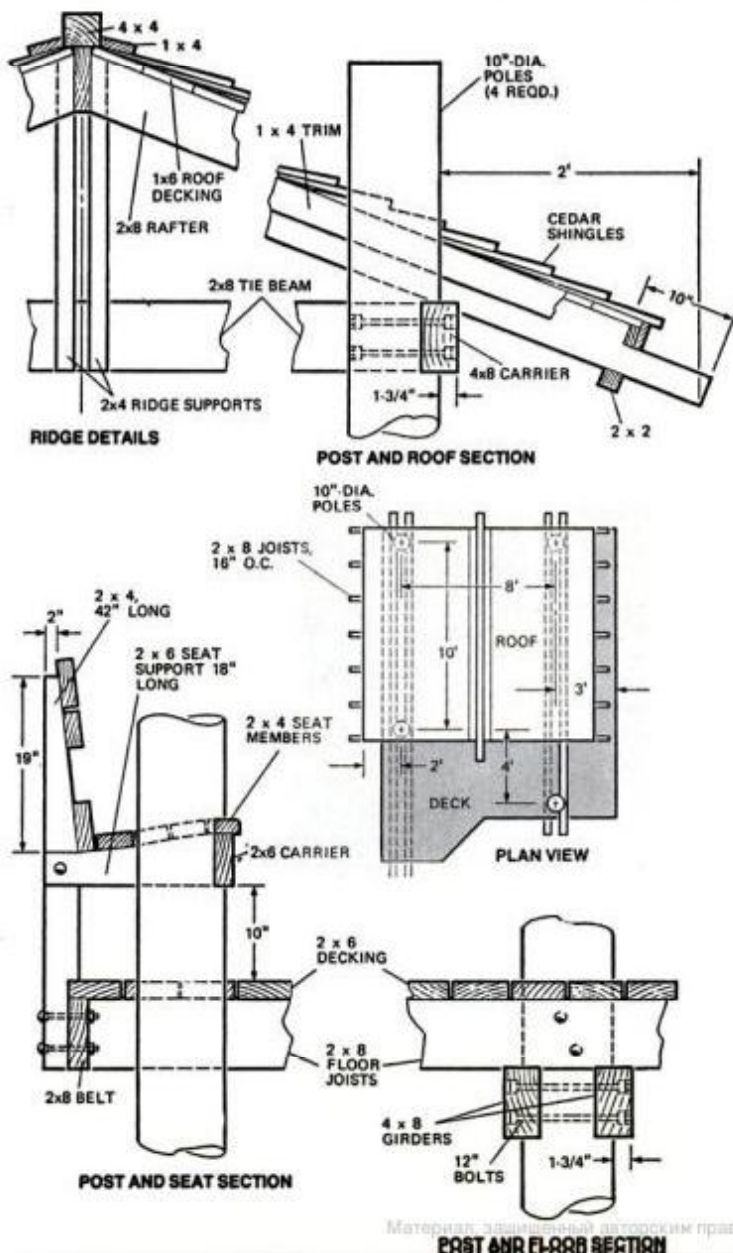
Keep a long-range point of view

- **Don't leave materials stacked** on the lawn or you won't have one when you're done.
- **Don't cut through major roots** of adjacent trees. Try a few test holes.
- **Don't underbuild the frame** or *(Please turn to page 162)*



Canopy gazebo

Once you've sunk the four poles in the ground, construction moves quickly. Double girders, bolted through the poles, support conventional 2x8 joists. Single upper carriers support roof. Construction techniques are simple, strong.



Your wife will love its underfoot comfort.

Tredway™ from Armstrong. The flexible, seamless floor you install with staples.

Now you can give your wife a dream of a kitchen floor—that's not a nightmare to install. It's so flexible, you can fold up enough for a whole room and carry it home.

Because it's 12 feet wide, it will be seamless in most rooms. And when you install it, this same flexibility makes your job even easier.

Tredway is cushioned vinyl, to make it quieter and more comfortable to walk on. And it comes in five richly embossed designs, each in a selection of up-to-date colors, all with the look of expensive glazed ceramic tile.



Tredway is really easy to install. Here's how:

First, take up the molding around the perimeter of your room. Second, unroll Tredway and position it against the walls. Fitting and rough cutting couldn't be easier. An ordinary utility knife will do it.

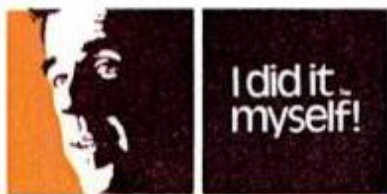
Then you just staple it every three inches around the edges. (In spots where a staple gun won't reach, or over concrete, use a thin band of adhesive under the edge.)

Replace the molding to cover the staples, and that's it. Since Tredway has the unique ability to adjust itself to the dimensions of your room, it will contract and stay taut to hide typical irregularities in the floor below.

Ask your Armstrong retailer to demonstrate this remarkable new floor for you. Or, send the coupon below for complete information.



Floor design copyrighted by Armstrong



Armstrong

Armstrong, 7604 Church Street, Lancaster, Pa. 17604

Please send me brochures showing all the Tredway designs and colors, plus complete installation information.

Name _____

Street _____

City _____

State _____ Zip _____

Slide-out built-ins for kitchen and laundry



Wire clothes-sorting baskets ride in grooved runners. Wash baskets resting on built-in shelves will work, too.



Roll-out appliance cart poses as cabinet door when parked. Slide-out dish shelves are accessible from sides.

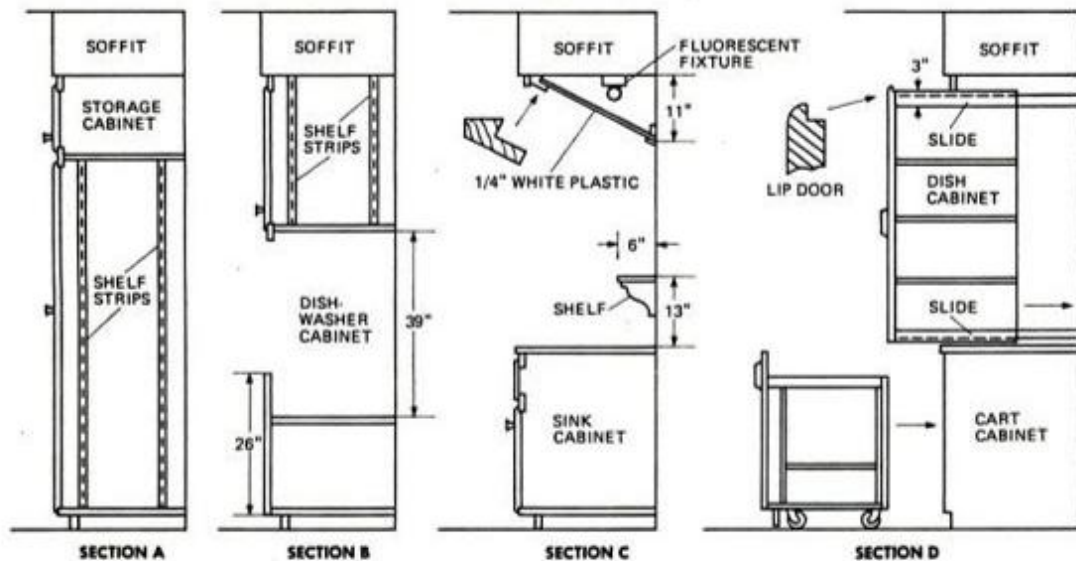


Installed at counter level, dishwasher requires no stooping to load and unload it, no squatting to service it.

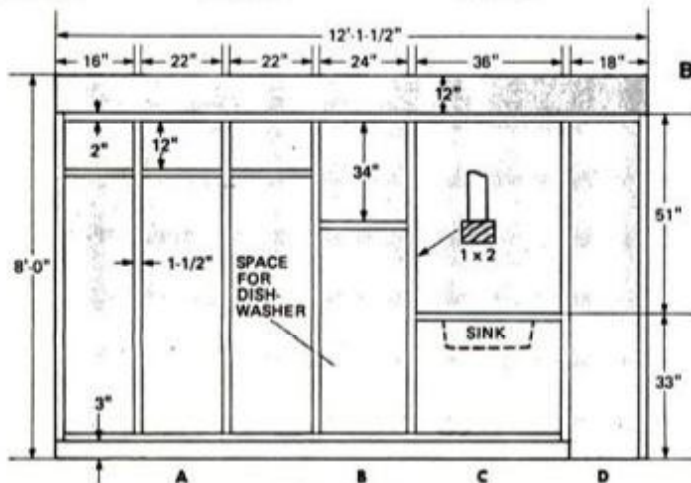
Storage is nearly as important as good equipment in creating an efficient laundry area. In Maytag's laundry center above, cabinets to the left of the washer are fitted with pull-out wire-basket drawers to store soiled clothes according to wash loads. With four such drawers, it's easy to sort whites, colored, wash-and-wears and delicates. The cabinets to the right of the dryer provide cedar-lined storage for off-season clothes. Upper cabinets are used to safely store laundry aids out of reach of children.

Unusual aspects of the custom-designed kitchen, above left, include a no-stoop dishwasher that's 18 in. off the floor, and a roll-around appliance cart that pulls out of the cabinet convenient to a dinette table. It has a warming tray on top and adjustable

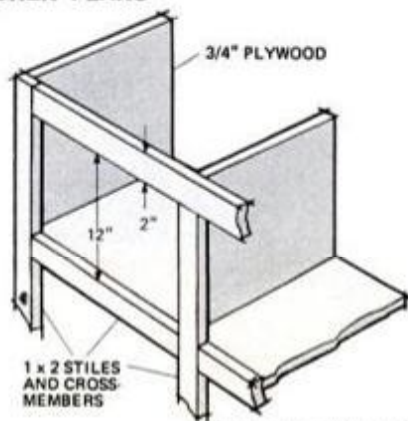
(Please turn to page 130)



Elevation and section drawings at left show how one-wall kitchen is built. Plywood forms basic compartments; edges are faced with 1x2s.



BUILT-IN KITCHEN PLANS



Your wife will love its cozy, textured look.

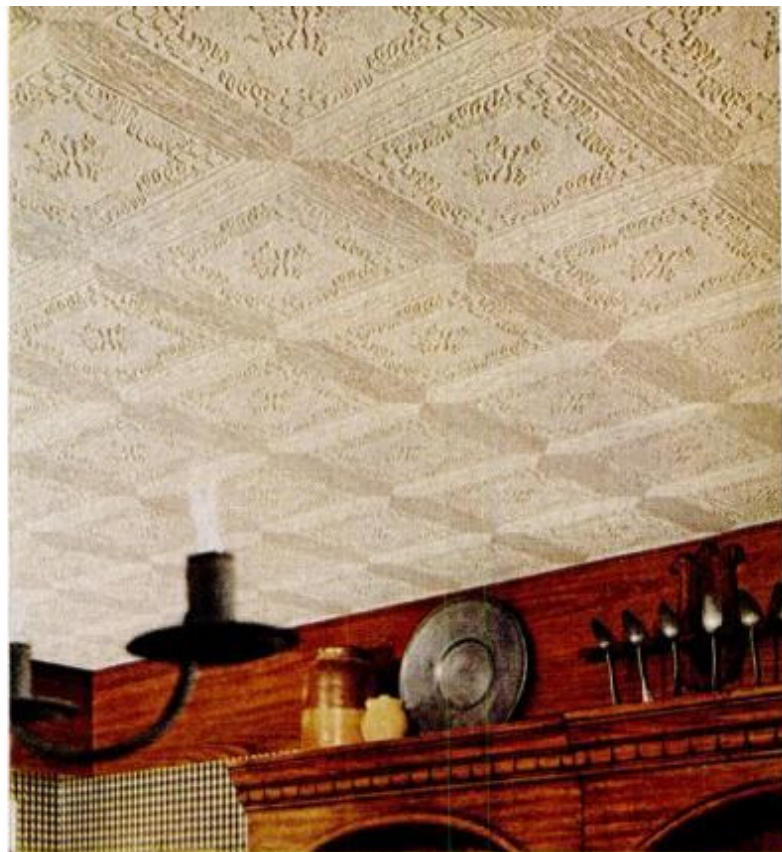
The Armstrong Integrid® System. As easy as

3-2-1

3 steps. 2 days. 1 man.

If you've put up a tile ceiling, you know what a hassle it can be. Nailing up all those furring strips—two nails every 16 inches. Stapling up every tile—four staples each tile. A long, hard job. But no more. Not with the Armstrong Integrid Installation System. It's a lightweight interlocking metal system that goes up quickly and easily with a minimum of nailing and no stapling. Best of all, the metal never shows!

You can buy Integrid in convenient premeasured packages. They include everything but the nails. There's practically no waste, and no special tools are required.



Here's how the Integrid Installation System works.

Step 1.

Install the metal furring channels directly to your old ceiling. (Or you can suspend Integrid on hanger wires to lower the ceiling.) The metal won't warp and rack like wood furring strips, so you won't have to worry about joints pulling apart. Only 12 nails for a 12' x 12' room, not 260.



Step 2.

Slide the tiles into place. Choose from a wide assortment of designs, from formal Victorian to casual rough-plaster effects, including the Early American sampler design shown above. With this system, each tile interlocks with the others for a tight fit that minimizes joints. The old beveled edges and block look are gone. Now the design flows uninterrupted wall to wall.



Step 3.

Snap each metal cross tee onto the metal channel, and slide it into the groove on the side of each tile. Each tee supports four 12" x 12" tiles, and the metal "disappears." The interlocking ends of each tee are slotted to help compensate for common installation errors, like leveling. Integrid—fast, reliable, and as easy as 3-2-1!

For more information, see your Armstrong retailer—listed under "Ceilings" in the Yellow Pages—or mail in this coupon.



I did it
myself!

Armstrong

Please send me color brochures on the Integrid Installation System and the names of my nearest Armstrong Ceiling Center™ retailers.

Armstrong, 7604 Watch Avenue, Lancaster, PA 17604

Name _____

Street _____

City _____

State _____ Zip _____

If you're all thumbs when it here's a helping hand

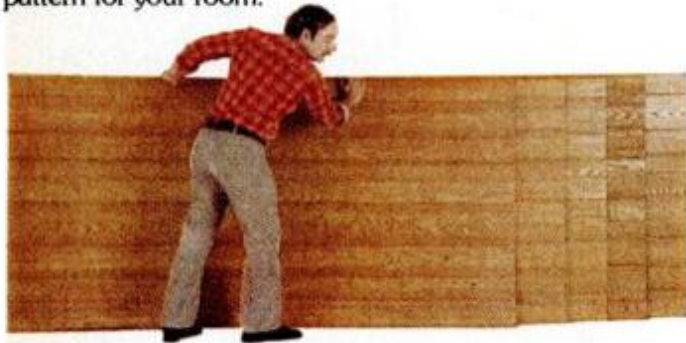
Don't let the idea of putting up paneling scare you. If you can hit a nail with a hammer, measure with a ruler, and use a saw, you can put up Masonite brand paneling yourself.

1. First, you'll need a plan. Measure the room you want to panel. Then draw a floor plan indicating doors, windows, stairways, pipes or beams. Then take this to your Masonite dealer. He'll help you select the amount of Masonite brand paneling you'll need.

One thing to remember when you pick your paneling—the lighting at your Masonite dealer will differ from your lighting at home. So, as a general rule, a wall of dark Masonite brand panels in your home may look darker than the one sample panel in your dealer's showroom.



2. Once you get your panels home, let them stand unwrapped on the long edge for 48 hours, so they'll adjust to the room temperature and humidity. Then stand them up, and arrange the panels along the wall until you find the most pleasing pattern for your room.



If your walls are flat and smooth, you can put the paneling directly on your walls. If you have concrete or masonry walls, you'll need a simple framework of furring strips (inexpensive lengths of 1" x 3" lumber). Your Masonite dealer can help you here, too.

3. Now you're ready to put up your panels and cut those that will need to be trimmed. If you're going to use a power saw, cut with the finished side down. If you're using a handsaw, mark and cut with the finished side up. The old carpenter's adage is good advice here: measure twice and cut once.

4. Start paneling at the corner of the room. Use a simple carpenter's level to make sure you have the first panel straight up and down. (That's what carpenters call "plumb.") If you use panel adhesive follow the directions on the cartridge. If you use nails, make sure they go into the wall studs. Studs are the 2"x4" boards that form the supporting inner framework for your wall. By tapping gently along the wall until you hear a solid sound, you can find exactly where they are.



5. When your first panel is "plumb" and secure, you're ready to put the next one up. The edge of this new panel should touch the edge of the previous panel very lightly. When you come to a door or window frame, you'll have no trouble as long as you measure carefully before cutting. A pattern drawn on newspaper first will be your safest bet.

6. For electrical outlets, measure from the floor up and from the edge of the previously installed panel. Then draw a pattern on your panel, drill holes in the inside corners of the pattern, and cut out the pattern with a key-hole saw.



7. When all your panels are in place, you're ready for Masonite brand mouldings for the floor, ceiling and around the windows and doors. The mouldings will cover up any minor measuring or cutting errors along the edge and give your paneling a finished, professional look. And since they are prefinished and color-coordinated, there's no painting or stain matching required. There's even a moulding for inside and outside corners.

Stand back and take a look. You've added richness and beauty to what was just an ordinary room.

Best of all, you've done it with Masonite brand hardboard paneling. That means your new walls can take wear and tear. Because Masonite brand paneling is tough. It resists splitting, cracking, knocks and dents. Yet Masonite hardboard paneling is easy to maintain. It's made from real wood and has all of

comes to things like paneling, from Masonite.[®]

real wood's advantages, without the disadvantages. And a special process imparts an astonishing realness to every Masonite design.

Putting up Masonite brand hardboard paneling can be easy. If you have any questions just ask for our free "Masonite guide to paneling." You'll find it and more than 60 intriguing Masonite designs at your Masonite dealer.

Look for him in the Yellow Pages under "Paneling."

**When you ask for
Masonite paneling,
make sure you get
the Masonite brand.**



Man-made finish on real Masonite brand hardboard.

Forester series™ Butternut.



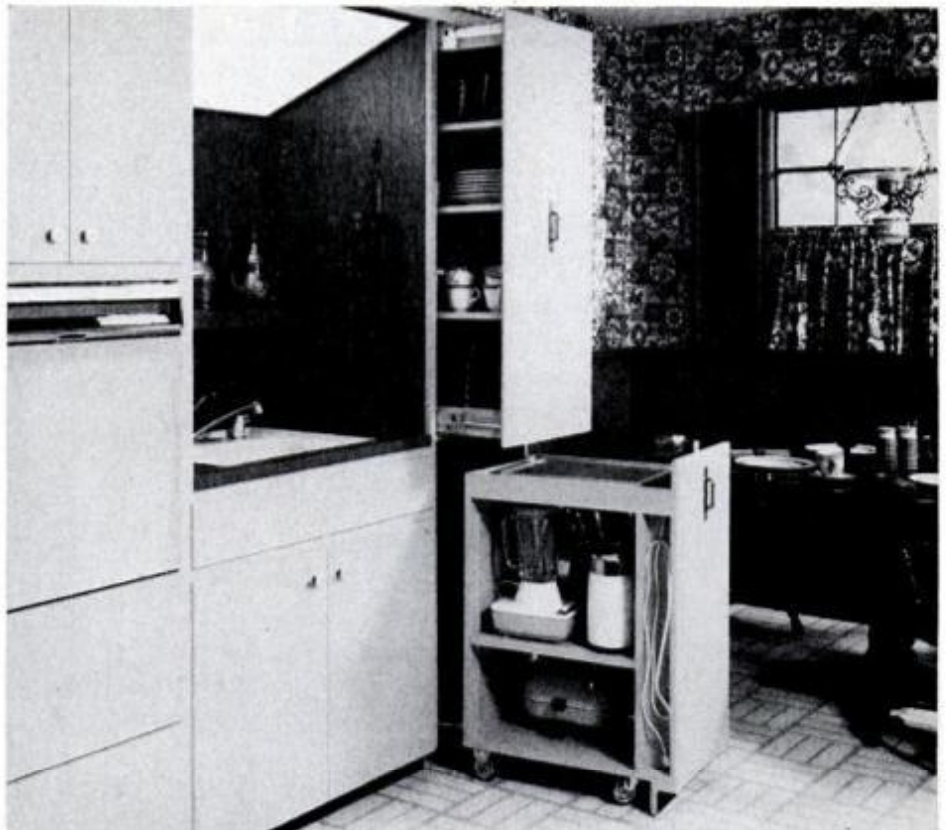
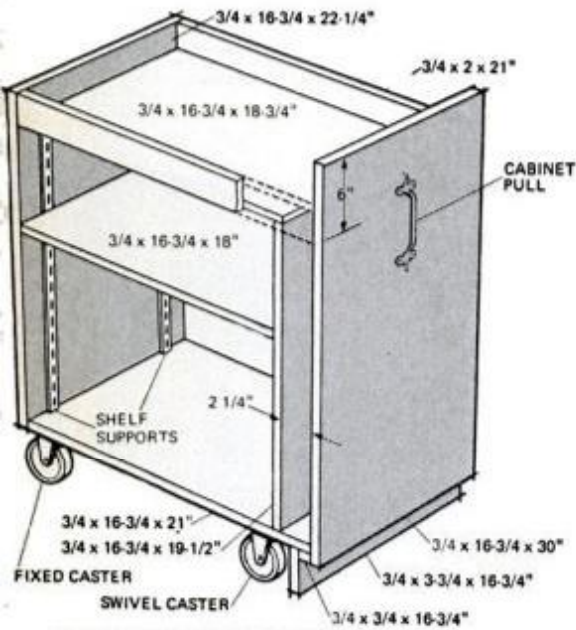
home ideas guide

SLIDE-OUT BUILT-INS

(Continued from page 126)

shelves to keep small appliances extra handy.

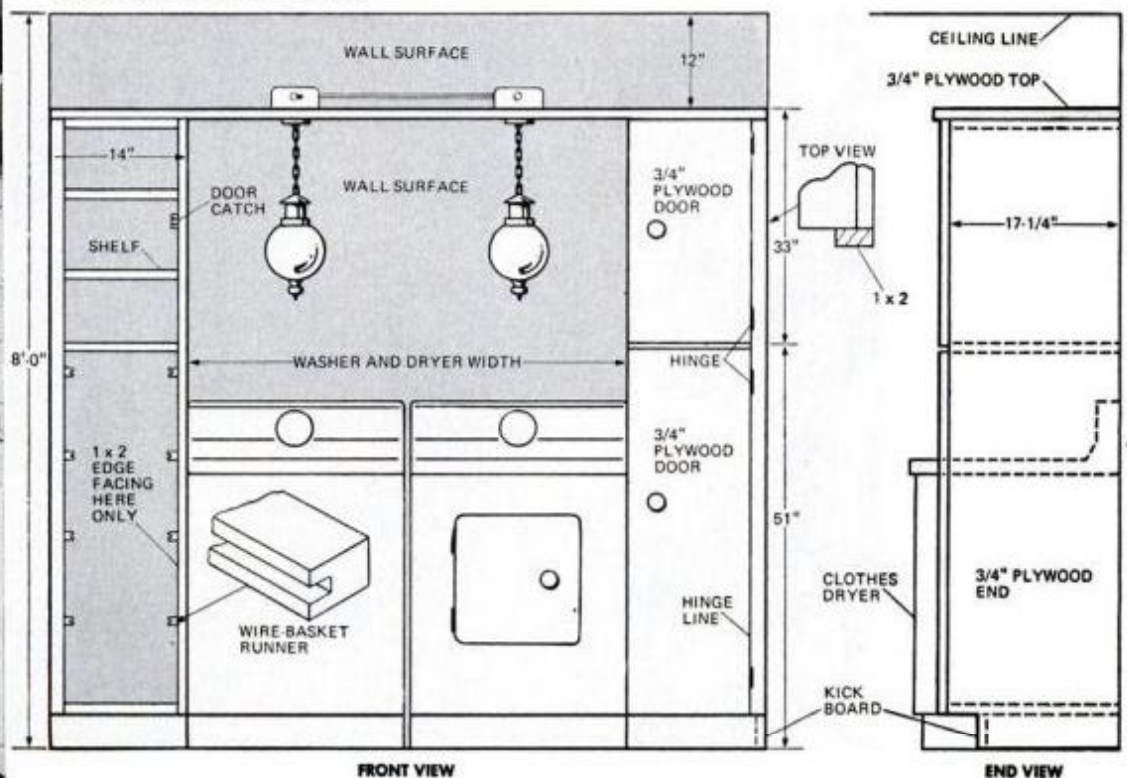
Dish storage is made convenient in a pull-out cabinet above the appliance cart, and the sink located between washer and storage is made bright as day by an overhead fluorescent "skylight." ★★ ★



Sink is convenient to dishwasher and open-sided pull-out dish cabinet. Shelf over sink is for accessories; white plastic "skylight" conceals fluorescent fixture. Sink alcove is lined with matching room paneling. Appliance cart parks in compartment below dish storage, looks like matching cabinet door.

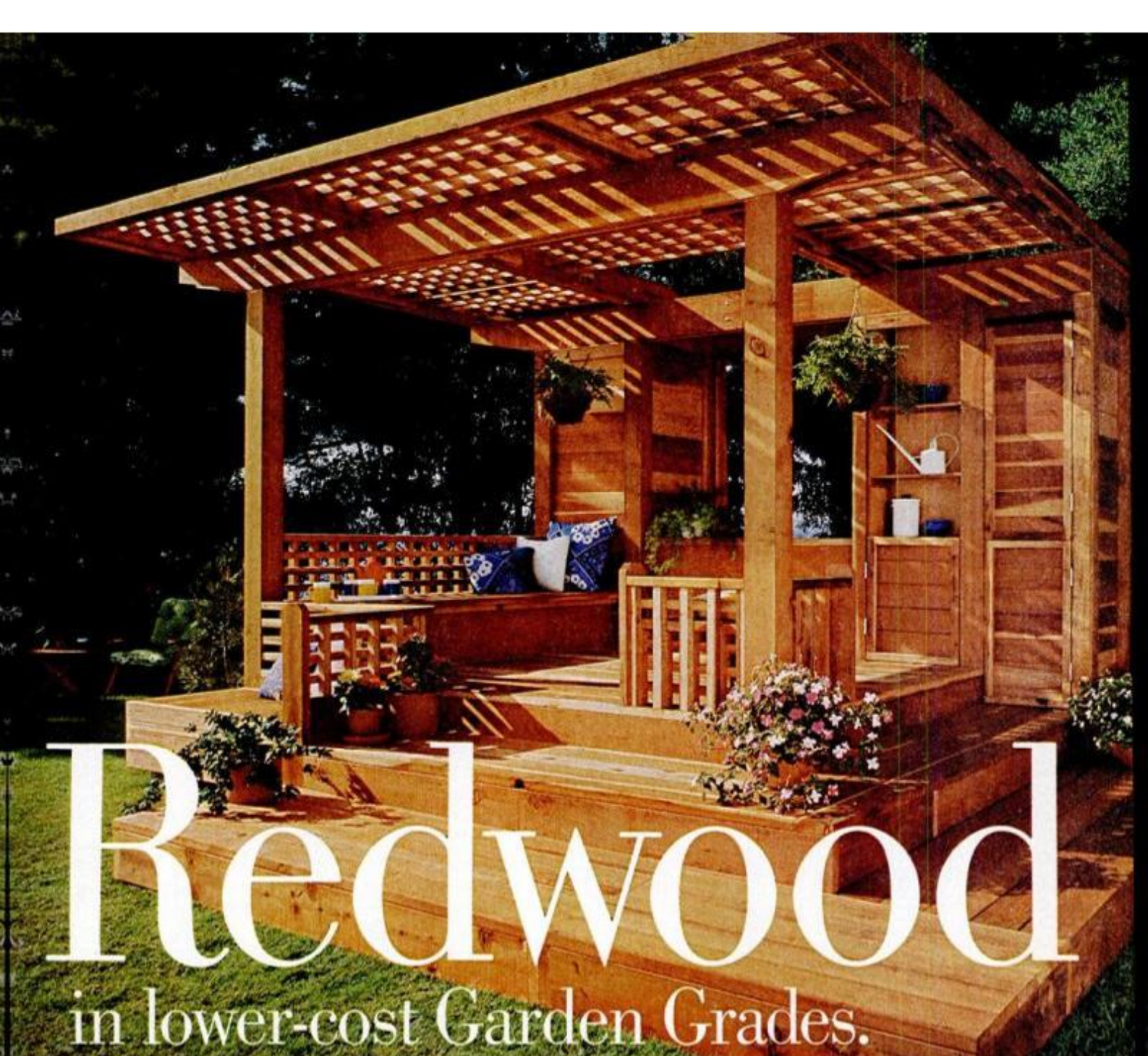


LAUNDRY-CENTER PLANS



Overhead shelf 12 in. from ceiling simplifies wiring of hanging lights and offers useful storage space.

Art: Hank Iken



Redwood

in lower-cost Garden Grades.

The rustic texture, random knots and color streaks of redwood garden grades make them the natural choice for outdoor use. And these same features make them by far the least expensive way to enjoy the beauty and practicality of California's luxury lumber.

A happy example is the multi-purpose family garden center shown here—designed for entertaining, for family leisure, for storage, for potting and puttering.

This center is featured in our new 12-page color booklet, "Redwood Garden Shelters," along with many other versatile garden structures and "how to" tips on construction and finishing of redwood garden grades. Use the coupon to order your copy now.

CALIFORNIA REDWOOD ASSOCIATION
617 Montgomery Street
San Francisco, CA 94111

I enclose 35¢ for your new booklet
REDWOOD GARDEN SHELTERS.

NAME


ADDRESS

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Build it better—see your Redwood Dealer first.

 CALIFORNIA REDWOOD ASSOCIATION
Redwood—a renewable resource.

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the powerful
Skil Cordless
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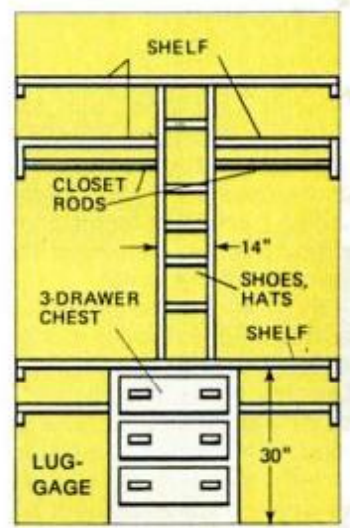
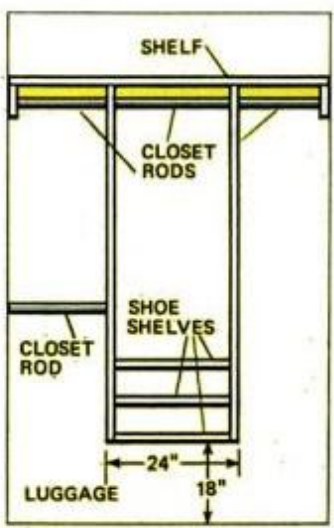
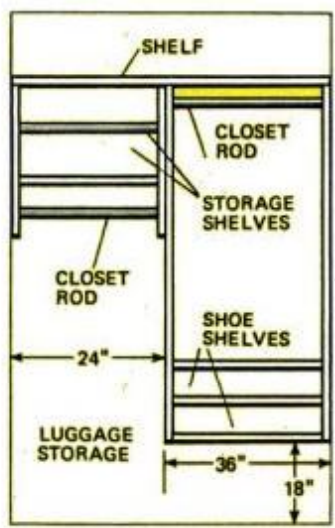
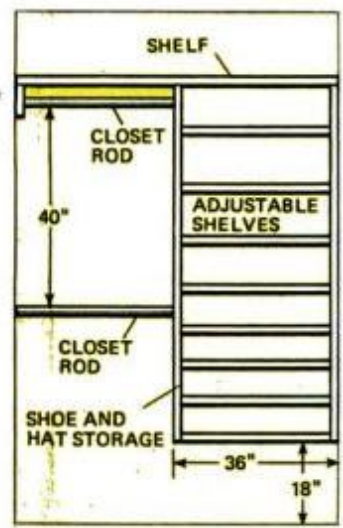
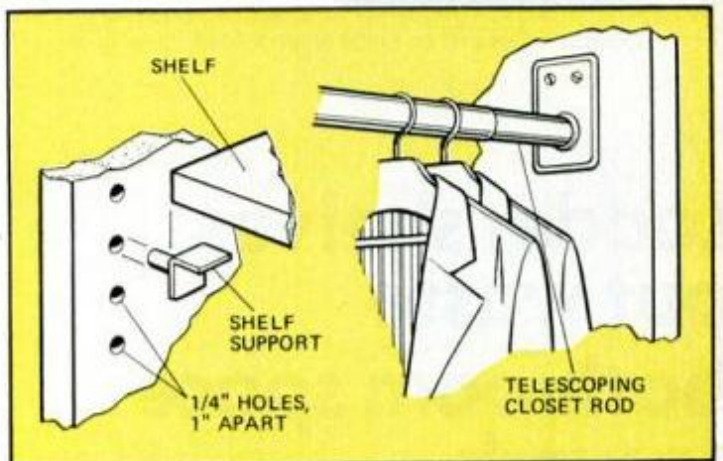
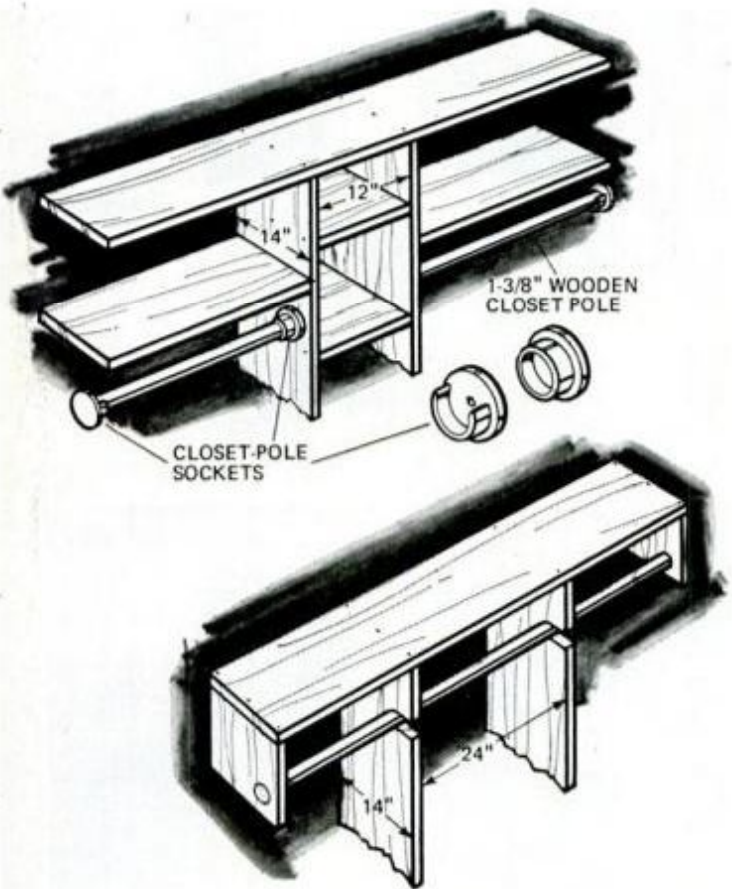
DRIVES SCREWS. Gear ratio
of the Skil Cordless gives
you high torque plus
precise control to drive
screws. Reversing switch
means you can also
remove screws.

3/8" CHUCK. Accepts full
range of drill and
screwdriver bits up to 3/8".
With Skil Cordless,
you can tackle more
jobs and tougher jobs.

SKIL 3/8" CORDLESS DRILL & SCREWDRIVER

Put an end to closet clutter

It takes more than the usual single shelf and clothes pole to keep a closet organized, efficient and uncluttered. Only by compartmentalizing a closet with high and low hanger rods and off-the-floor shelves for shoes can you hope to segregate your Sunday best from your everyday clothes and footwear. Putting order in your closets isn't difficult. All it takes are a few pine boards, wood or metal clothes rods, and a saw, hammer and screwdriver. In fact, if you don't want to do the work yourself, Lee Industries, Inc., 105 Irving St., Framingham, Mass. 01701, makes and sells ready-made closet space savers in aluminum and polystyrene that you simply hang. ★★★



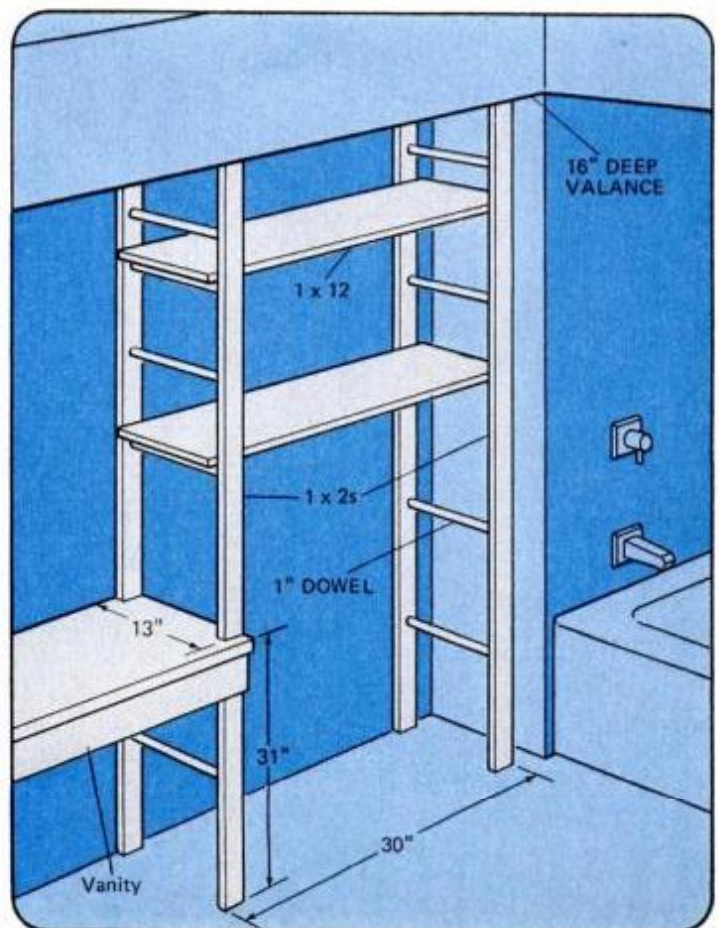


Board shelves rest on rungs of ladder-like uprights and bridge toilet (above) to gain extra storage space in crowded bathroom.

Ladder shelves put waste bathroom space to work

If you have need for more storage and shelf space in your bathroom but can't see how to manage it, American-Standard shows how it can be done in most bathrooms, large or small, if you make use of the wall space over the toilet. Supported by ladder-like, floor-to-ceiling uprights placed on each side of the toilet several roomy shelves can be installed without interfering with the use of the toilet.

Even if you can't duplicate the arrangement above, in which one ladder upright supports one end of the lavatory counter and an overhead valance, a pair of uprights alone, plus two or three shelves, will provide a lot of handy shelf space a small bathroom may sorely need. The ladder uprights are 1x2s, the rungs 1-in. dowels glued in equally spaced holes. The shelves are no deeper than the toilet tank. ★★★





**LAST NIGHT BODEN'S YARD
WENT DOWN THE DRAIN.
SO DID \$550.**

Don't you want for septic tank or cesspool trouble to start. Use Rid-X® now. 50¢ worth once a month can save you hundreds of dollars.

The Bodens are real people. Their cesspool really needed work. This picture was taken as it was being done. The job really cost \$550.

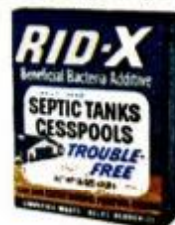
It could happen to you! For years the Bodens were like most home owners. Their sewage system worked fine, so they ignored it. Meanwhile, trouble built up underneath their feet until one day, it surfaced. They learned the hard way—when you see septic tank or cesspool trouble, it may be too late.

That's why you should start using Rid-X now, before trouble starts. Today's modern detergents, bleaches and lyes can destroy the active bacteria your sewage system needs to work efficiently. Rid-X is a beneficial bacteria additive made to help reactivate that essential bacteria action; to help liquefy waste matter, oils and fats. Rid-X works to keep septic tanks and cesspools trouble-free.

Don't confuse Rid-X with liquid and caustic products made to simply unclog drains. Rid-X is specially made to work inside septic tanks and cesspools. Just 50¢ worth, flushed down the toilet bowl once a month, can save you hundreds of dollars! Buy Rid-X today, at your hardware or food store.

SPECIAL COUPON OFFER.

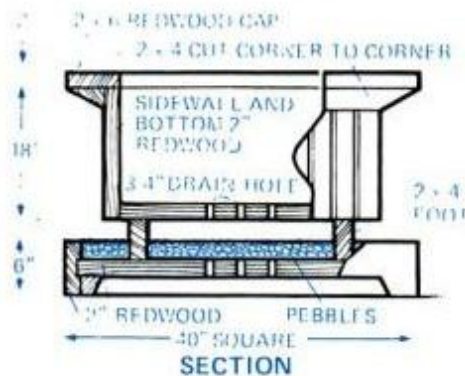
Get a discount coupon worth 50¢ towards your purchase of Rid-X (it's like getting the first month's supply free)—plus a free 16-page booklet on septic tank-cesspool maintenance. Send name and address to Rid-X, P.O. Box 225, White Plains, N.Y. 10606.



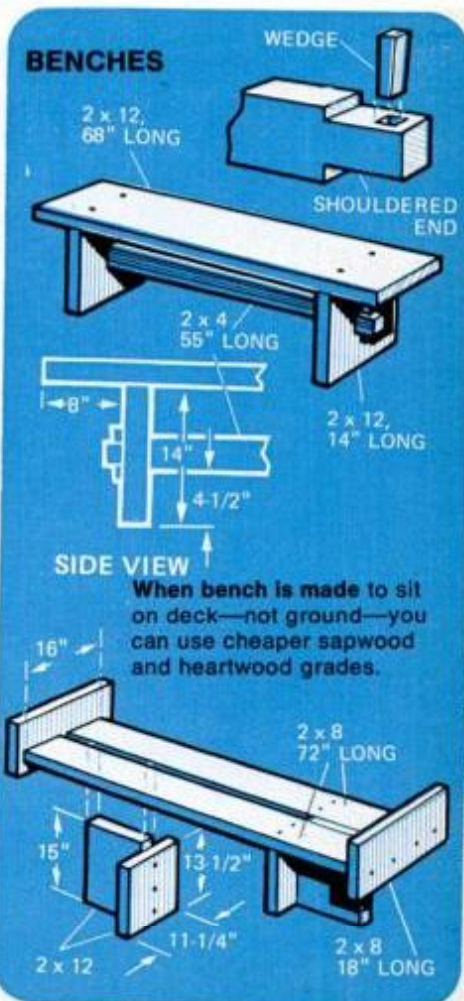
home ideas guide

No other wood is better behaved outdoors than redwood: It's strong for its weight, good-looking and able to withstand the weather with minimum shrinking, swelling, checking or cupping. Most important,

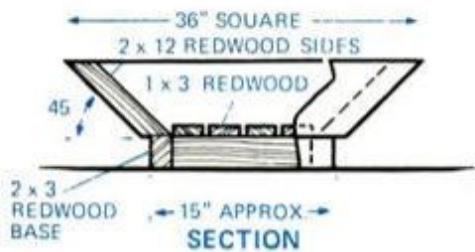
5 Easy planters and benches for your deck



All-heartwood grades of redwood are recommended for planters filled with soil. This attractive tub planter rests in a bed of smooth pebbles.



Designs: California Redwood Assn.



Abruptly angled sides of hopper-style planter require compound mitered cuts at corners. Mitering the 2x12 stock is done best with radial-arm or tilting-arbor saw. Use stainless steel, aluminum alloy or hot-dipped galvanized nails.

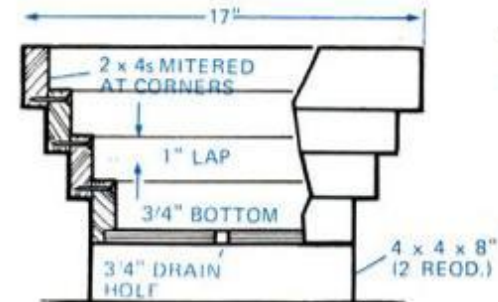
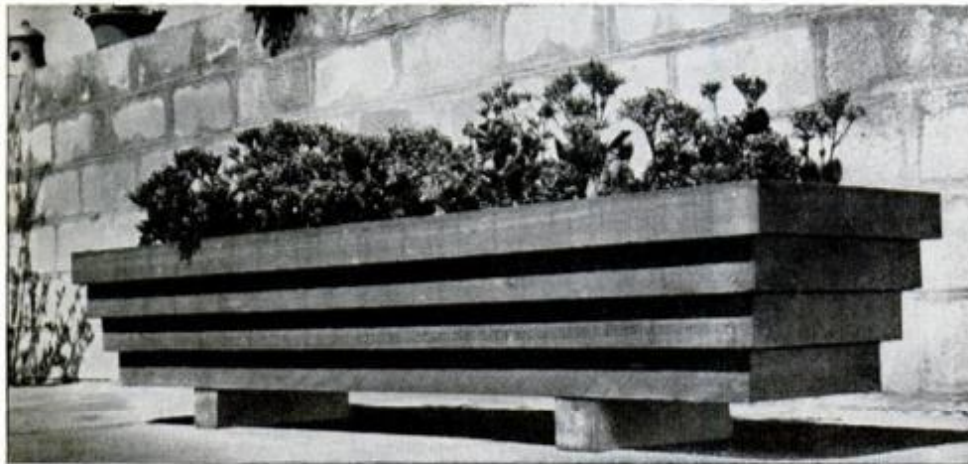


5 EASY PLANTERS, BENCHES

(Continued from page 135)

redwood contains natural chemical extractives that repel termites and decay-producing fungi and for this reason it's a natural wood to use for your deck benches and planters.

Left unfinished, redwood weathers to an attractive driftwood gray. If you stain it, use a sealer-type stain that is specifically formulated for furniture and decks to prevent soiling of clothing. ★ ★ ★



SECTION

Four telescoping 2x4 redwood frames mitered at corners overlap for interesting shadow lines. Drain holes are in bottom. 4x4s act as feet; hold planter off deck.

Snapper is fast.



This means Snapper mowers combine outstanding design features that help you get through with the work of caring for your lawn faster, and easier.

Whatever size lawn you've got, we've got a Snapper to match it. With a Snapper you'll finish it beautifully. And fast.

SNAPPER

McDonough Power Equipment, Inc. Dept. PM, McDonough, Georgia 30253. A Fuqua Industry.
See your Yellow Pages or write for a free brochure. All Snapper mowers meet A.N.S.I. safety specifications.

Pump some extra life into your paint job... **CAULK ACRYLIC**

Housepaint failure. The tell-tale signs are peeling and blistering around door and window frames. If you're faced with a costly repaint job before you expected it, chances are it's the caulk—not the paint—that's at fault.

You can prevent this deterioration next time by sealing all exposed joints and seams beforehand with a quality *acrylic* caulk. Today's acrylic latex caulks are products of the same technology that led to the development of durable, easy-on acrylic latex paints. With a number of useful properties in common.

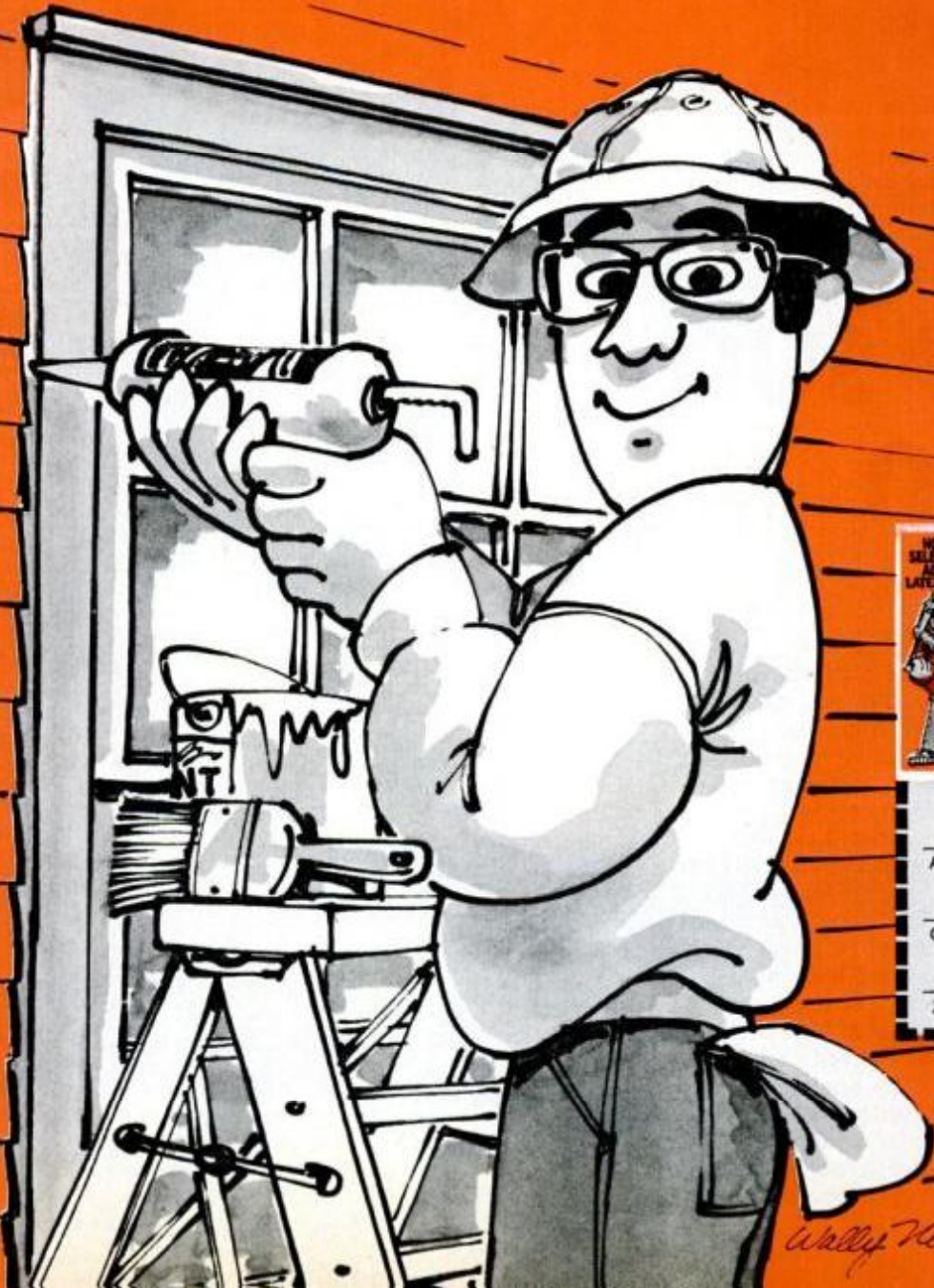
Unlike other caulks on the market, acrylic latex won't dis-

color, crack or lose adhesion on exposure to the elements. You can paint within an hour after applying an acrylic caulk, and it's compatible with either alkyd or water-based paint. You'll get good adhesion, easy clean-up, and add years to painted surfaces.

When you go to buy your paint, ask your dealer which caulk lines include high-performance acrylic latex. They're worth the extra cost. Meanwhile, for more tips on caulking, return this coupon now.



Where
quality acrylics
come from



R. M. Mooney
ROHM AND HAAS COMPANY
Independence Mall West
Philadelphia, PA 19105
Please rush your
caulk brochure.

NAME _____
ADDRESS _____
CITY _____ STATE _____
ZIP _____ PM _____

Wally Keibart '75



One big skylight turned this enclosed porch into a solarium that is bright on the dreariest days. At night you can stay warm while you count the stars.

Let the sun shine in

by Mike McClintock

ASSOCIATE HOME AND SHOP EDITOR

As a builder I've installed many different skylights in many different locations. I'm still amazed at the difference one can make in a room. The enclosed porch in these pictures was added onto the house, and although there are windows all along the outside wall, little light was transmitted across the porch into the adjacent living room. And dark wood on walls and ceilings made the porch seem smaller than it really was.

Lift the lid for the greatest comfort

A dormer might have worked here, or a raised roof. But of all possibilities, the easiest and least expensive was also the best. A neighbor and I opened the ceiling with the largest skylight available, a 46-inch-square unit from Ventarama Corp., 40 Haven Ave., Port Washington, N.Y. I think they're the best units going and have never had a callback on a job where I've used them. They're fully assembled and framed, use integral copper flashing and have a screen and an operator mechanism to lift the bubble for summer







Rain, ice and snow don't bother the Ventarama unit shown above. You can leave it open for ventilation and not run home to close it if it starts to rain. A curved flange at the base keeps water from dripping into the opening. The hardware is strong enough to break through a crust of ice after a storm (left). Check your job with a hose test (right).

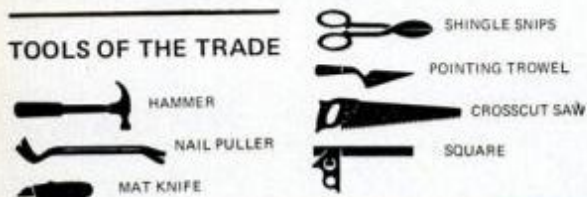
venting. I recommend this type instead of a fixed unit because it is less susceptible to condensation caused by hot, humid air collecting near the ceiling. For a vaulted ceiling or crawlspace over a flat ceiling, the roof installation is the same. A dropped ceiling needs more framing to close off the crawlspace.

Get professional results

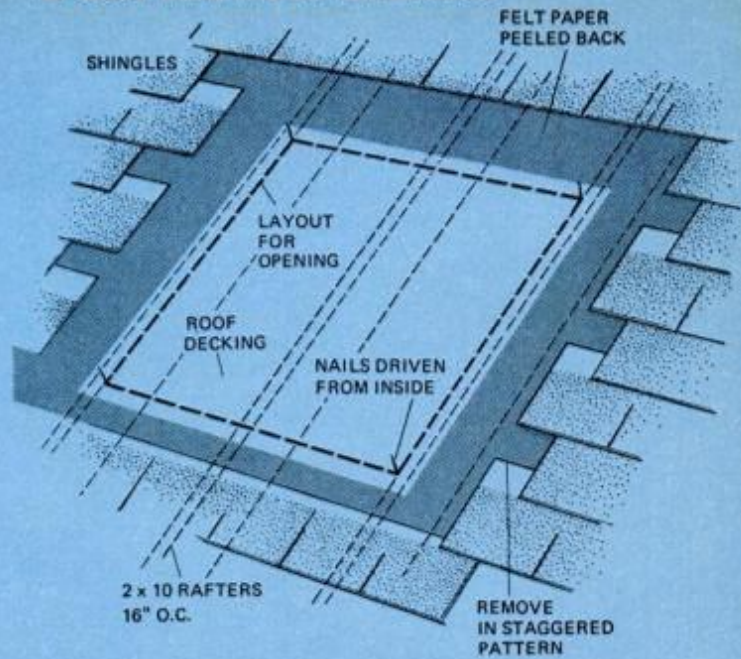
To start, we located the skylight area inside and made corresponding measurements to get the exact location on the roof. On a vaulted ceiling, after cutting away the Sheetrock, drive a 10d nail up through the roof at each corner of the opening to mark the cutout. With the area outlined, we pulled off shingles and felt paper and cut through the roof deck with a sabre saw (drawing 1). Then we cut away the center rafter. Be sure to cut an extra 3 inches at each end to allow for double headers that frame the opening and carry the load from the interrupted rafter (drawing 2). We repeated this cut in the wooden ceiling below but increased the depth of the opening to let in more light. We then nailed 2x4 uprights along edges of the two openings to frame the short tunnel between outer and inner roofs.

Keeping out rain

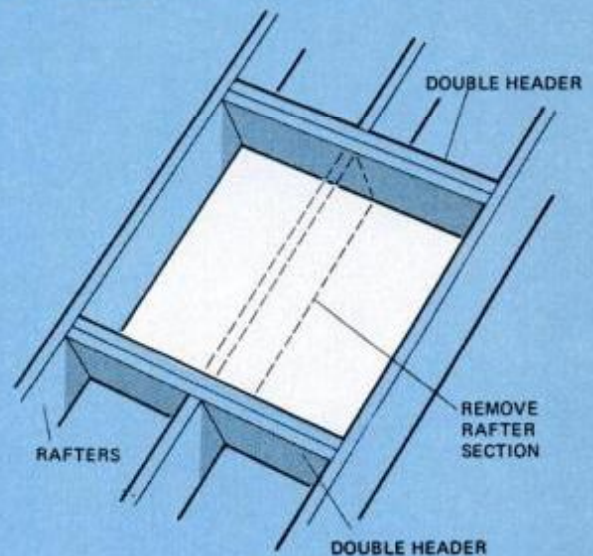
For a more waterproof condition, we set flashing



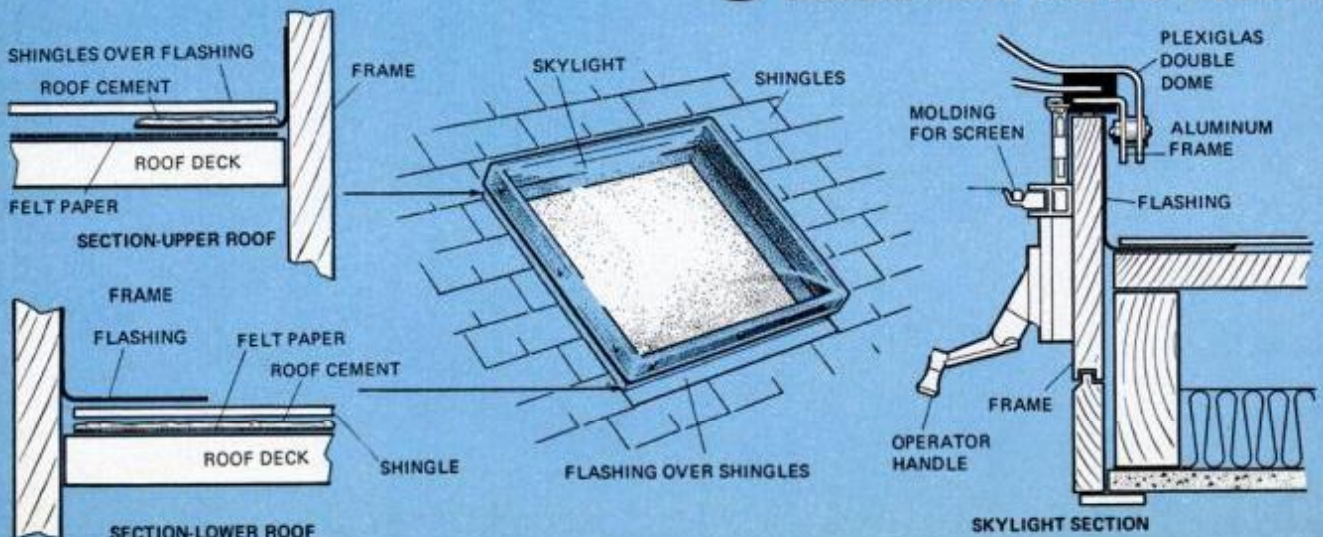
1 CUT THE ROOF OPENING



2 FRAME THE OPENING



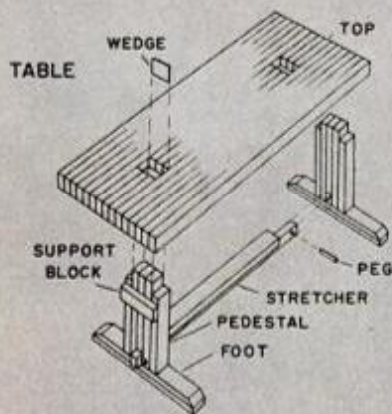
3 WATERPROOF THE INSTALLATION



Stanley gives you more of a hammer. Free plans prove it.

Is a hammer just a hammer? No way! Take this butcher-block table for instance, where you've got a lot of 8 penny nails to drive in. Your arm will tell you, right away, that you'd better use a quality hammer — a Stanley.

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won't end up with a tired, shaky arm or a sore, tingling grip.

Along with a better design, Stanley gives its hammers a rim tempered face. That's a feature no other hammer



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Find a store with a good tool department, you'll find Stanley hammers. Look at them.

help you do things right.

As for the butcher-block table and benches, you can put them together for around \$60 in materials. And



Heft them. You'll see that Stanley packs a lot of quality into its hammers. Quality you *know* will



you'll have a lot of pleasure doing it. To get the free plan, send your name and address, plus 25¢ to cover postage, to Stanley Tools, Dept. TM, New Britain, Conn. 06050.

STANLEY helps
you do things
right.

LET THE SUN SHINE IN

(Continued from page 140)

around the unit in a bed of roof cement and secured the bubble with nails through the frame into the adjacent rafters (drawing 3). The final step outside is to lace the shingles (use the ones you removed) back into the roofing pattern and cut them to fit the flashing. Above the unit we set the shingles in a second bed of cement over the copper flange to prevent water from backing up underneath. Along sides, shingles should run 2 to 3 in. past the lip of the flashing that is secured to the roof with copper clips. On the lower edge, the flashing sits in a bed of

roof cement spread on top of the shingles so all water will run onto the roof surface. While the frame is open, check the installation for leaks by simulating a downpour with a garden hose.

Shed more light on the subject

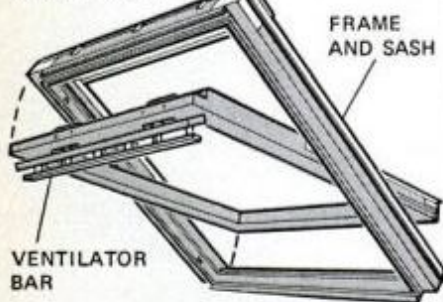
We used 1/4-inch A-C plywood over the tunnel frame and painted it white to reflect as much light as possible. Molding strips along edges of the ceiling cutout gave a final finishing touch. You can treat the interior many ways (even with mirrors) but you must make the exterior waterproof. Follow the maker's instructions and the steps outlined. Pinpointing the source of a leak later on is, at

best, a guessing game; you may have to redo all the flashing. On our job we angled the back wall of the tunnel to let the sun's rays stream directly through double glass doors into the living room. The porch is now so bright that we converted it into a solarium with plants, flowers and small trees. ★★★

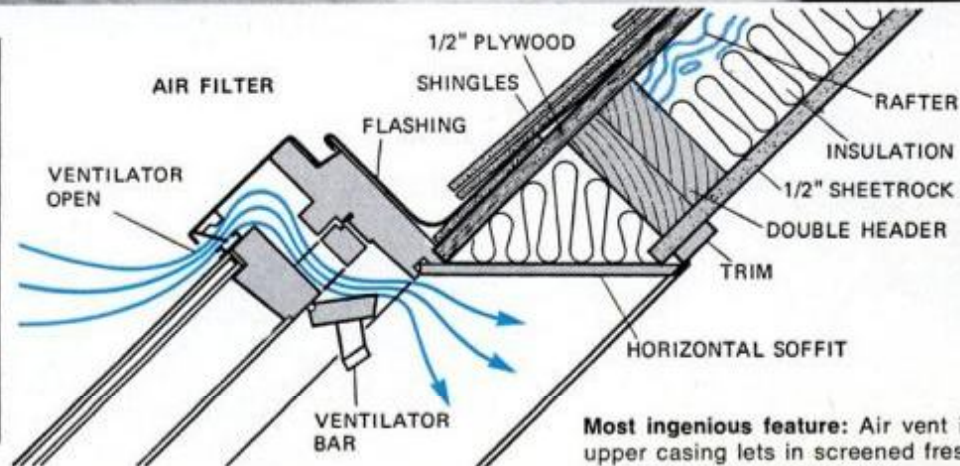
Roof window made in Denmark (below) is the No. 1 seller in Europe. It is very well made but lacks some American practicality (tilting operation precludes use of screen; glass is glazed in frame instead of plastic being molded over it). Overall quality is excellent and hardware good-looking, strong, functional, easy to use. Available from Velux-American, Inc., 80 Cummings Park, Woburn, Mass.



ROOF WINDOW



One big advantage of Velux unit is that sash can be flipped on its pivot hinge for easy cleaning inside or out.



Most ingenious feature: Air vent in upper casing lets in screened fresh air even when unit is closed.

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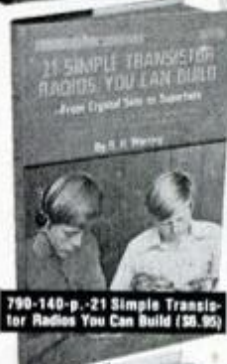
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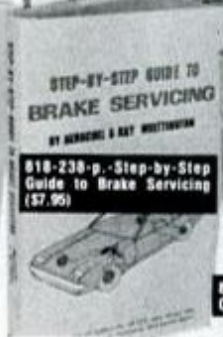
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You can lay an entryway floor that'll never wear out

A quarry tile floor inside your front door can stand up under the heaviest traffic.

by Mike McClintock
ASSOCIATE HOME AND SHOP EDITOR

If you have wood floors, there are probably a few spots that are dull and worn. This is most likely to happen just inside your front or back door where traffic is heaviest. These areas take the worst beating in bad weather because they're the principal targets of muddy shoes, snow-covered boots and dripping raincoats. Quarry tile can provide a long-term solution. It's available in good-looking colors and a varied selection of sizes and patterns.

No matter which setting system you use, prepare the job by thoroughly cleaning the subfloor and squaring up your layout to minimize any cutting. Most tile suppliers have cutters and chippers that you can

(Please turn to page 146)

Snow-covered boots and mittens won't hurt this floor; neither will constant traffic. When you put down a top-quality material like this, you reap the rewards of low maintenance and durability.

Photo: Tom Grill



If this isn't one of the most incredible tool inventions of the century, our name isn't Black & Decker.

It's called the Workmate.TM It's part bench, part vise. It's lightweight, portable and remarkably strong.

It holds up to 350 lbs. of dead weight, it's got an incredible variety of clamping positions and it folds up to the size of a suitcase, so you can tuck it away when you're not using it.

From the top of its laminated birch-ply work surface to the bottom of its sturdy steel legs, it stands practically unrivaled in ingenuity and cleverness of design.

The Vise Jaws and Clamps

The top of the Workmate is, in effect, a giant 29"-long vise. The jaws are controlled by two separate clamps that work

independently. This means you can open one end wider than the other to hold an irregularly shaped object, like a bicycle. An extremely handy feature. (Another handy feature is the V-groove in the vise jaws, for firmly clamping pipes.)

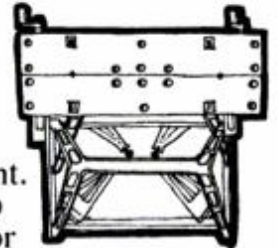


The Swivel Pegs

There are 20 holes in the Workmate's top. These holes are "stops" in which swivel pegs are placed. Because the pegs turn to grip at any angle, you get an adaptability of clamping positions most regular workbenches don't have.


The Frame

The Workmate's frame is a combination of steel and die-cast aluminum. Its skeletal quality gives it great strength, but surprising lightness in weight. It can be easily carried from job to job. The bottom legs fold in or out, giving you a choice of two working heights. And, of course, the whole frame folds up completely, for amazingly handy storage.



The incredible Workmate. Only from Black & Decker.



A tool you can work with at a price you can work with.  **Black & Decker.**

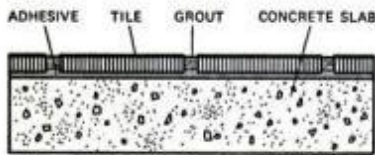
YOU CAN LAY AN ENTRYWAY FLOOR THAT'LL NEVER WEAR OUT

(Continued from page 144)

rent to avoid buying the tools for a one-shot job. Here's a rundown of the different applications that will give you a solid, long-lasting job.

Application over concrete

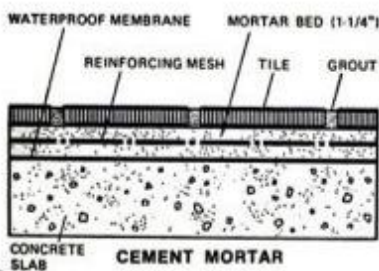
■ **Organic adhesive** is a prepared material that comes in tubes or cans and is usually applied with a notched trowel. This method is clean, fast, and gives you flexibility in correcting tile placement. *Read the label cautions.* Most recommend thorough ventilation during use; some are flammable and their solvents may cause skin irritation. The recom-



ORGANIC ADHESIVE

mended grout is a 1:2 ratio of portland cement and sand. It should be wet-cured by covering the entire floor with polyethylene sheeting for three days. Water is spread on the surface the second day and the sheet replaced.

■ **Cement mortar** is a mixture of portland cement and sand in the proportion of 1:6. The mortar can be reinforced with metal lath or mesh. This installation can withstand prolonged contact with water. The

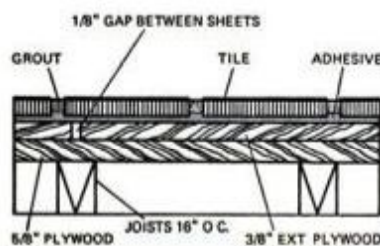


CEMENT MORTAR

thickness of the bed (3/4 to 1 1/4 inches) gives you enough room to compensate for depressed or irregular areas. Use the same 1:2 cement-to-sand ratio for grout.

Application over wood

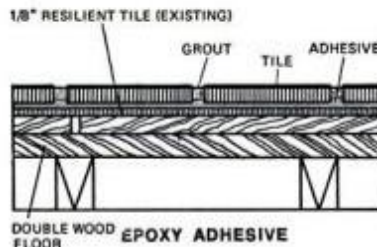
■ **Organic adhesive** is ideal here, too. Many homeowners are already familiar with this process because it



ORGANIC ADHESIVE

is similar to installing vinyl tile. The recommended grout over a wood subfloor is latex-portland cement. The latex additive makes it less rigid than regular cement grout. The Tile Council of America sets standards calling for a 5/8-inch plywood subfloor and a 3/8-inch exterior-grade plywood underlayment.

■ **Epoxy adhesive** combines resins and hardeners to provide high bond



strength. It is recommended for renovations where ceramic tile is to be installed over existing resilient tile. This eliminates the need for a new layer of plywood. A latex-portland cement grout should be used.

The installation methods detailed above are rated for residential and light industrial use. There are even more elaborate procedures (although you won't need them) that use chemically resistant mortar on an acid-proof membrane that can withstand 300-pound loads on steel wheels as well as severe chemical exposure. Durability and low maintenance are the qualities that make ceramic tile more desirable than resilient tile. For these reasons, all of the platforms built for the new rapid transit system in Washington, D.C., will use ceramic tile. So don't worry when the kids come home covered with mud or snow—your quarry-tile floor can take it. ★★★

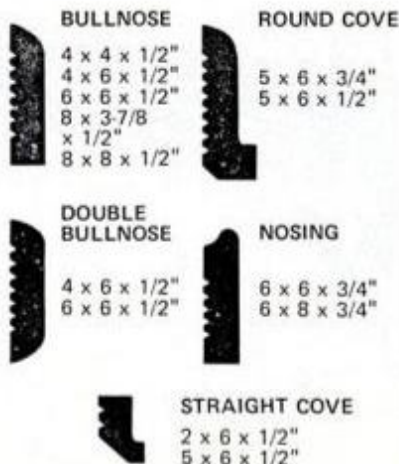
Cleaning and sealing

The best cleaner I've used is Hillyard Super Shine-All. Mix one part with four parts of water, mop on and let dry. This cleaner leaves virtually no residue and does a good job on the grout and the tile. Most makers don't insist that quarry tile be sealed because it's so dense it resists staining. However, cement mortar grout, usually a light gray, will show dirt and stains much more readily. There are two popular methods for sealing quarry tile:

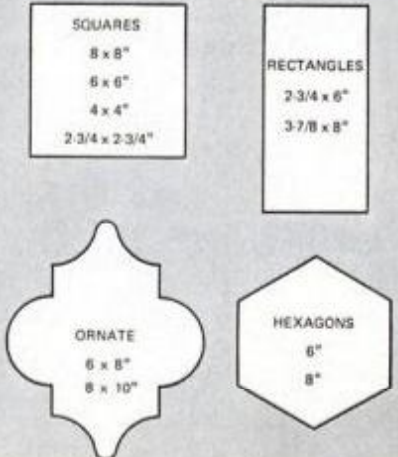
■ **Hillyard Lok-Guard**, a top-quality product, is an acrylic sealer-polisher. Use a clean, damp cloth to apply it. Spread out a very thin film, undiluted, and let dry (about one hour). Repeat this procedure for a second and third coat. Avoid excessive rubbing. It creates bubbles in the sealer and makes it permanently cloudy.

■ **Boiled linseed oil**. This method uses a solution of two parts of turpentine and one part of boiled linseed oil. Sponge it on liberally. After it has had time to soak in (one hour), wipe off excess with clean toweling. Let it stand for 24 hours before applying the second coat. Boiled linseed oil tends to oxidize, so a fresh coat may be needed every six months to keep the floor looking good.

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So no matter what the job you have to do, look for Red Devil at your local home center, hardware or paint store, or wherever home fix-up products are sold. Big Red's a handy man to have around the house.

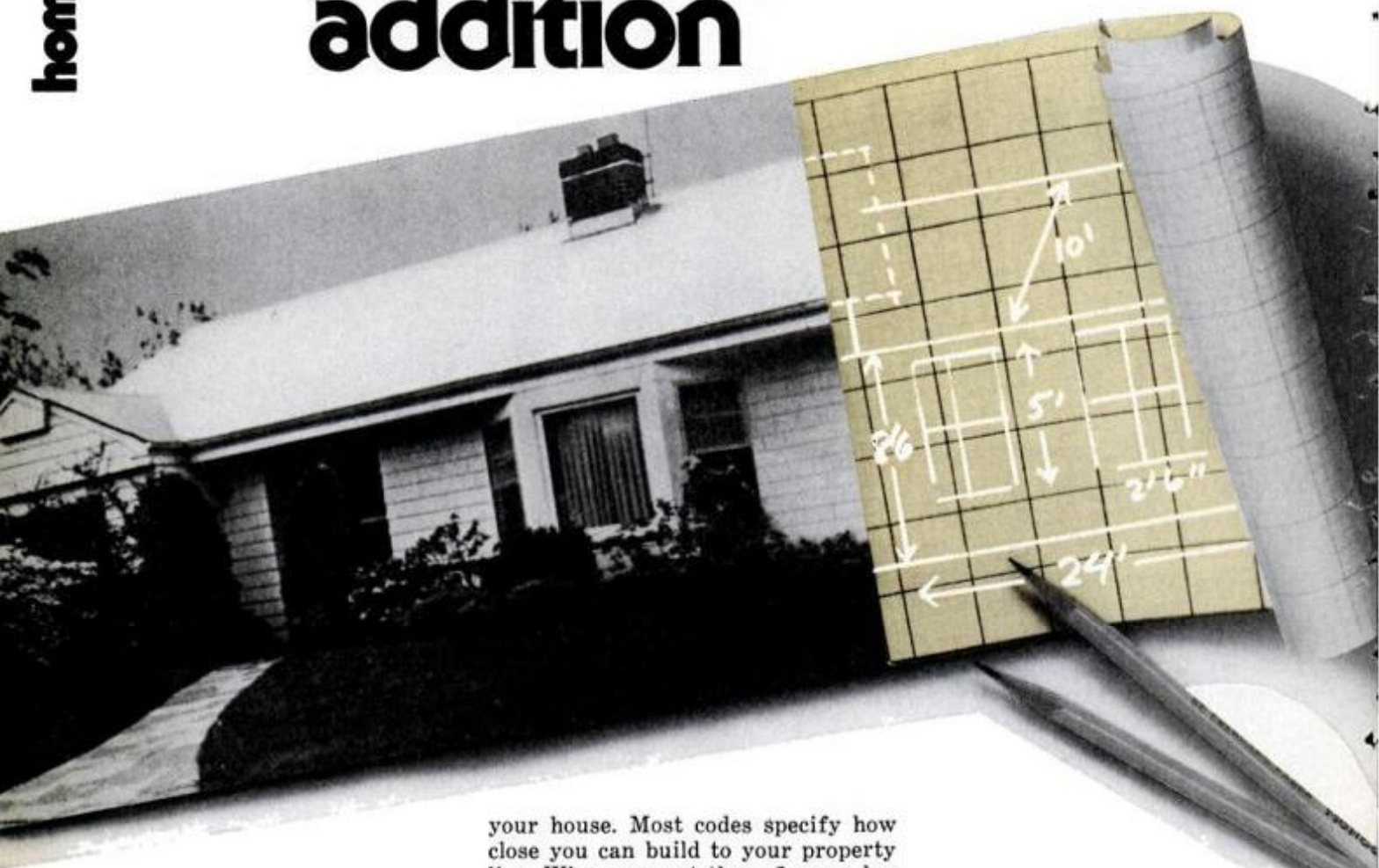


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Big Red.™ A handy man to have around the house

Plan your own addition



by Mike McClintock
ASSOCIATE HOME AND SHOP EDITOR

With this guide you'll get the space that's best for you because you do the planning.

How many times have you wished you could alter the layout of your house? Whether it's relocating a door or closet, widening a hall or raising a roof, most houses have an area that should and could have been planned better. If you're thinking about an addition, now's the time to consider all your options and work all the bugs out of the plan.

The first step is to set up some limits to plan within. Many assessors' offices will have a tax map for your area that shows the size of your property and location of your house. Get a few copies so you know what you're working with. Next, ask your local building department about limitations on yard spaces around

your house. Most codes specify how close you can build to your property line. When you get these figures, lay them out on your tax map using the map scale.

Now you have some boundaries. As you think about your addition—how big and where it will be—pencil it in on the map adjoining the house. Even though you may be planning your dream room, remember that you may be giving up something like a shade tree or natural runoff for ground water. Make sure you locate the septic tank and underground piping such as a gas line, I've heard horror stories about porches with special cuts, fittings and hinges to get at the septic tank that was forgotten while the porch was built. Balance your wildest dreams with a practical solution and pick the best site available.

Make the first plan

Start working at a larger scale. Get a pad of ¼-inch graph paper and lay out the dimensions of your house, one square for one foot. Include interior room sizes and mark door openings. Put a thin piece of tracing paper over this and sketch out a

rough plan for the overall size of your addition. Do one sketch of the biggest and best, one of the smallest, and as many variations as you can think of in between. Even if you decide that you don't like the overall idea in a drawing, keep it. You may find it contains a good idea that you'll wind up putting into the final plan.

The easy way to move furniture

Take some colored construction paper and measure out, to scale, the approximate sizes of furniture you expect to use in a room. Pick out a few sketches you like best and try different arrangements in them. This is likely to cut down on the number of designs because you'll find some layouts are a natural for the furniture you have in mind—and some just won't work at all. Now go back to the graph paper and put in more details. Locate windows, closets and doors exactly and the thickness of all

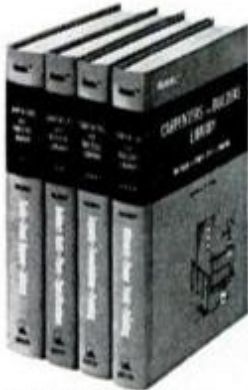
(Please turn to page 150)



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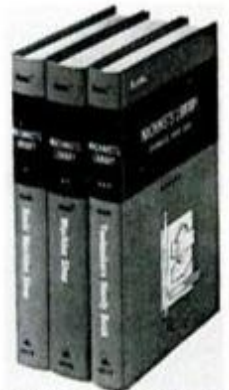
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home ideas **guide** PLAN YOUR ADDITION

(Continued from page 148)

interior walls (figure 4 to 5 inches to scale). If your sketch starts to look messy, retrace it on a clean sheet of paper using a ruler.

You'll have to compromise

Here come the first big decisions. The easiest way to compromise is to multiply the total floor area of your addition by \$25 or \$30 a square foot to estimate construction costs. If you contemplate using expensive materials like plaster, tile, parquet floors and hardwood cabinets, you'd better figure \$35. This system makes it somewhat easier to eliminate your more elaborate designs. Your addition should be just what you want, but it should also be practical and it has to be affordable or you've got no addition at all.

Make the second plan

Here are some new rules. They'll save construction time and material costs. If you're figuring the width of a room at 17 feet, try 16. This way, two sheets of 4x8 plywood and 16-foot joists will fit. You'll be saving a bundle on materials by eliminating waste. Get a copy of local building

codes or contact your building inspector. You may find that by making your room 6 inches narrower you can use 2x8 joists instead of 2x10s. Before you put all this into a final plan, find out about materials. See what's available at local lumberyards. Get some catalogs (with prices) and look at flooring, tile, windows and doors. You may find a good-looking siding like Texture 1-11 that comes in 4-foot widths. It eliminates the need for plywood sheathing (in most areas) and will cut costs considerably. This may buy you back that extra few feet of space you want in the room.

A time for final decisions

Hopefully you've picked your location and you should have a sketch that's very close to the final plan. Considering materials, costs, availability and your needs, make the last adjustments and draw the final sketch neatly. Before proceeding with a contractor or starting the job if you're doing it yourself, make an appointment with the building inspector. His job is to be sure you live in a safe, secure house, so take his advice.

Don't rush it

Take your time with planning. Give yourself an opportunity to make

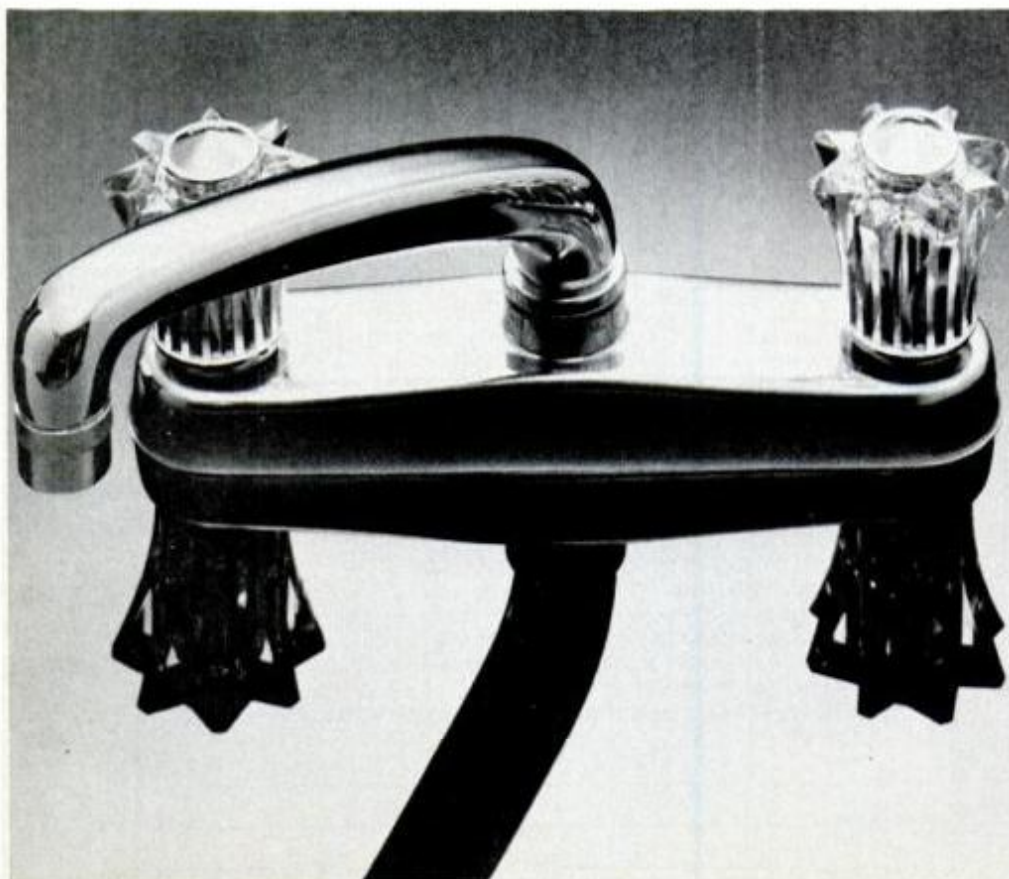
mistakes now, on paper. Moving a wall later on is expensive. Since you're going to live in the addition, you're really better equipped than anyone else to plan its layout. Even if you expect to see an architect for a design, you'll have something specific to show him that reflects your needs.

How will it look? It may be hard to visualize the addition from a floor plan. Drawing a simple elevation of each exposed side will help. Work from dimensions on your plan to get the length of each wall. It's important that the addition looks like part of the house; not like a box stuck against it. So make the heights of all doors, windowsills and fascias the same as they are in the house. Sticking with the same siding and paint color helps, and definitely use the same color shingles.

For your drawings, get dimensions from your existing house and transfer them, to scale, to your elevations. Orient the drawings by marking each one north, south, east or west elevation. If you are really ambitious, use the plan dimensions to build a scale model.

Take your time. Make a good plan now, and you won't want to change anything after it's built. ★★★

Beautiful to install, too.



Rockwell's Tempo faucet comes with step-by-step directions right on the package. The only tool you need is a wrench to do it yourself. Installation's so quick and easy, there's no need to be a hesitant handyman.

The Tempo faucet features a classic design that adds to the decor of any kitchen, lav, or bath. And Rockwell quality engineering assures years of trouble-free service.

Building Components Division, Rockwell International, Morgantown, WV 26505.

 **Rockwell International**

Try steel framing home ideas **guide** for fast wall building

Proven by industry as short on cost and long on durability, steel is starting to go residential.

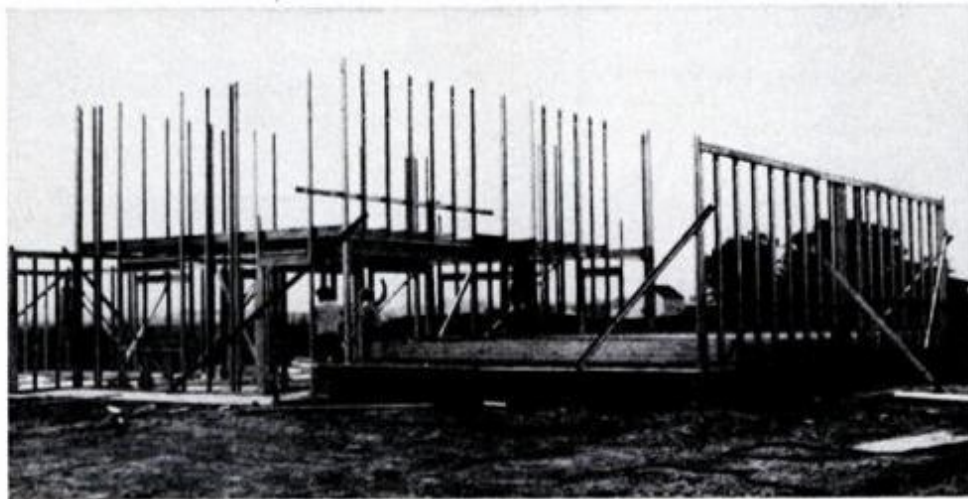


Photo: USG

By Mike McClintock ASSOCIATE HOME AND SHOP EDITOR

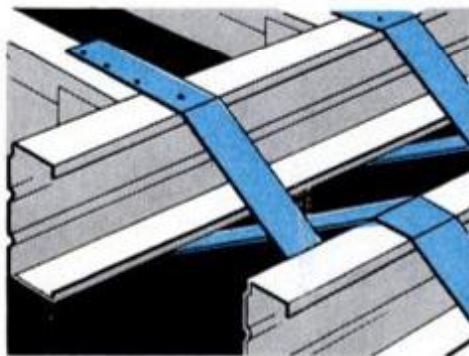
How would you like to frame an addition with a material that won't burn, warp or shrink; that is impervious to rust, rot and termites, and lighter and stronger than wood? If this sounds good, you're in agreement with many manufacturing and construction companies that have been using and producing steel members for industrial buildings. There are so many advantages to this material that its use in residential construction is inevitable.

An economical system

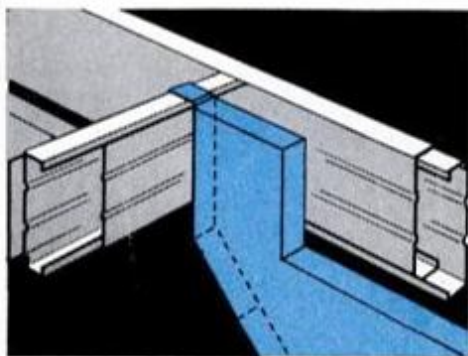
Steel joints and studs can be set 24 inches on center and will support the same load as wood framing on 16-inch centers. Steel joints will carry for a 20 percent longer span than wood, and bridging is installed by weaving a continuous metal band between each beam.

Once you break away from the idea of hammer and nail, you'll find that the installation process is easy and efficient. All members are pre-cut

(Please turn to page 152)



Woven steel strap bridging for joists.



Stairwell opening and steel stringer.

STEEL VS. WOOD COMPARISON

	Steel Joist	2x10 Wood Joist
Weight per linear foot	3.71 lbs.	3.85 lbs.
Spacing of joists	24"	16"
Maximum allowable span	19'7"	17'9"
Dimensionally stable	Yes	No
Knot-free	Yes	No
Termiteproof	Yes	No
Rot-resistant	Yes	No



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You don't need masonry to build a barbecue, wishing well planter, storage shed, garden screen or planter boxes with lightweight, easy-to-use Z-Brick. Weatherproof and fireproof, Z-Brick will give your projects a professional look at a do-it-yourself price.

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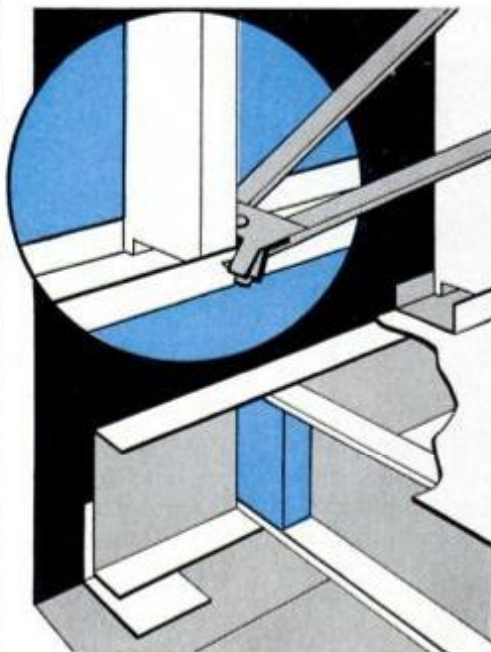


STEEL (Continued from page 151)

at the factory so there's complete uniformity and no waste. By a series of heavy-duty clips and brackets (all prepunched) the frame is assembled with an electric screwdriver and case-hardened drive screws. This process eliminates toe-nailing, end-grain splitting and making repetitive square cuts.

What's in store

For plumbing and heating, all members are punched at the factory to accommodate supply and drain



Crimping tool for steel connections.

pipes. Wiring is pulled through the holes in the studs and either BX or Romex can be protected at metal contact points with plastic antishort bushings. The big questions are cost and availability. Because an equally strong frame can be built with less steel than wood and with no waste, steel members price out competitively with wood. But this material is just now making the transition from industrial to residential use, so you may have to look beyond your local lumber yard to find it.

I recommend that you familiarize yourself with all steps and tools needed for installation before attempting to use steel framing since even many contractors have not used it before. As of now, the main application is in development building that takes advantage of the uniformity, durability and lack of waste. Even 5 percent waste in a 20-house development is enough to build the 21st house. Advantages of steel framing are so numerous that it's just a question of time before it becomes common practice in home-building. ★★★

Bathrooms and kitchens have again this year generated a large number of new products. The trend is to more color, streamlined styling and easy maintenance. Also, many companies are offering new energy-saving devices to help conserve fuel. Here's a selection of products covering your house top to bottom, inside and out.

New products

A healthful habit



It's a sauna for two in kit form. The door unit includes heater, light, ventilator, and all controls. Redwood interior is all precut. From Viking Sauna, Box 6298, San Jose, Calif. 95150.

Save that space



Here is a kitchen storage system shown by Hotpoint at the National Assn. of Home Builders Show. Organizing "dead" corner space prevents clutter.

Sprays all of you



The selection of different sprays is not unique, but the shape is. Crossover jets concentrate the water in an oval pattern to cover your body. From Chicago Specialty, 7500 North Linder Ave., Skokie, Ill. 60076.

A watched pot that boils



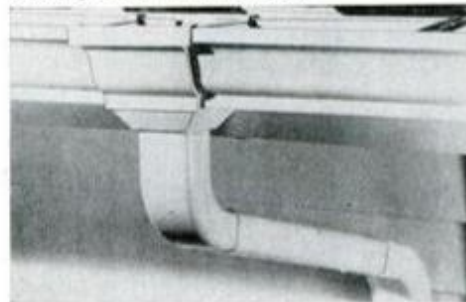
Save the stove for cooking. A thermostat keeps the 2½-quart reservoir beneath the sink up to 190° F. From KitchenAid, Troy, Ohio 45374.

A new look



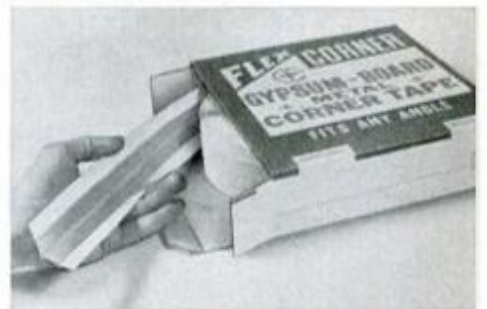
Panasonic's new countertop microwave oven (with a five-year warranty) comes in an innovative slant-front design. The two-stage door opens for access or flips fully open for easy cleaning.

One piece won't leak



Bird and Son, Washington St., East Walpole, Mass. 02032, has introduced vinyl drain systems into its line of roofing products. The single downspout connection eliminates one of those most-likely-to-leak spots.

How to cut corners



Goldblatt Tool Co., 513 Osage, Kansas City, Kans. 66110, has developed a new drywall tape. Two ½-inch galvanized steel strips are joined to a flexible center for easy, durable corner taping.

The heavy grip cement that works where nails or screws won't.



Whatever your adhesive problem, 1 of Elmer's® 11 special cements can solve it.



New products

How far can it go?



A fiberglass soaking tub centers this luxurious (almost a living room) bath. American Standard, New Brunswick, N.J. 08903, has introduced new shapes in warm colors.

Ductwork made easy



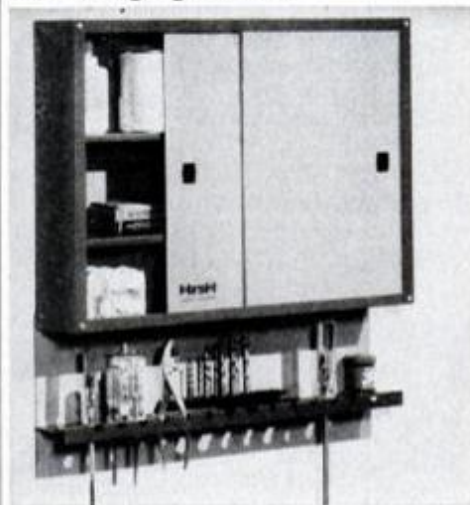
Running metal ducts for a hot-air heat system can be time consuming and practically impossible in a tight space. Kaiser Aluminum, 300 Lakeside Drive, Oakland, Calif. 94643, has developed a new, continuously flexible duct. It will conform to irregular shapes and make sharp, 90° turns.

A clever devil



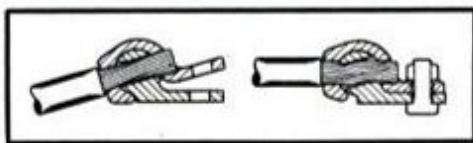
This new applicator is specially designed for rough masonry surfaces. Long fibers put paint into the irregular pockets and seams. The handle will take an extension pole. From Red Devil, Union, N.J.

Just hanging around

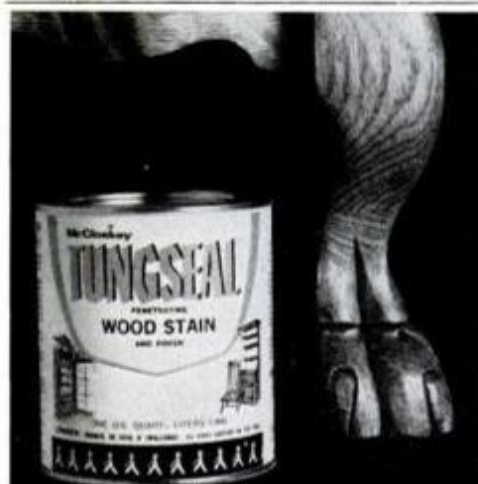


Hirsch Co., 8051 Central Park Ave., Skokie, Ill. 60076, makes a storage cabinet and a slotted tool rack that'll help keep your work surface clear. Frame and shelves are steel for heavy-duty use.

Lug that wire



Gamm Tech, 2730 South Main, Santa Ana, Calif. 92707, has a new, two-piece terminal lug that needs no soldering. Built-in crimps hold connector on cable and a bolt draws lug plates together tightly.



Restore Your American Heritage

All of us have a favorite piece of furniture. One that has been in the family for years or something special that we've found in an out-of-the-way place. To us, it's a bit of Americana. McCloskey's Tungseal Wood Stain can restore it to its original beauty and keep it that way. Simply apply it straight from the can, it'll penetrate deep into the wood and bind the fibers together producing a soft satin sheen. Choose from a variety of stains or one of our special Bi-Centennial colors. Preserving one's heritage is something Tungseal Wood Stains and Polyurethanes do best.

McCloskey Philadelphia, Pa.
Varnish Company Los Angeles, Cal.

A beautiful Norwegian

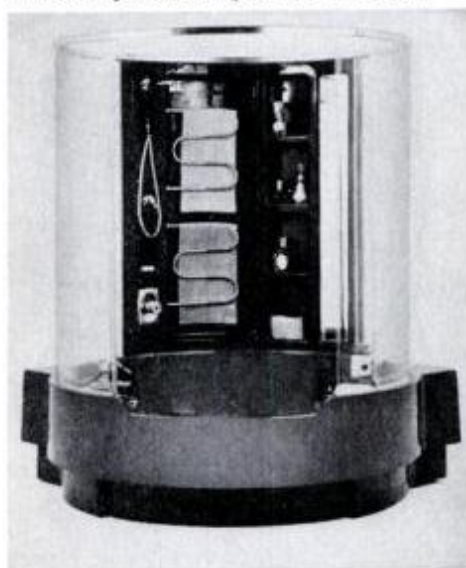


Some of the most beautiful small stoves in the world are made by Jotul of Norway—a combination of folk art, efficiency and top-quality craftsmanship. (We'll cover their full line soon.) For a good-looking catalog, write Kristia Assn., Box 1461, Portland, Me.

Clean water at the tap

If you have sediment or rust traces in your water, install the Aqua-Guard faucet filter. It's corrosion-resistant. From ABS Plastic, West Chicago, Ill.

Modern, modern, more modern



Hastings Tile, 964 Third Ave., New York, N.Y., is importing a wild line of bath fixtures from Italy. Sculptured vitreous china pieces in bold colors complement an incredible tub-shower group with curved plastic doors, built-in heated towel racks.

Beautiful landscaping yourself with LIGHTING



Enhance the beauty of your landscaping and add to your home's security economically with Starbrite outdoor lighting. Starbrite low voltage can't harm children or pets. Sets of two, three, six and 12 lights — clear and colors — install without tools. Automatic timers also available. Mushroom pathway models feature opaque covers for downward lighting. Garden area lamp has translucent cover for downward lighting and top glow. Either with 2-inch or 4-foot post. Mail coupon for details.

FOUNTAINS

This new Little Giant ready-for-the-pool Fountain of Light features a submersible light with built-in, adjustable fountainhead, 12-volt recirculating pump, transformer and 20' of low-voltage cable. Little Giant's variety of fountain sets for your choice of water displays include everything you need for installation without tools. Mail coupon for brochure.

Model SBFL



Here's the all purpose utility pump for your tool box!

When water's where it shouldn't be, move it fast with this light weight Little Giant UL listed Potent Pump! Drain pools, boats, tanks, basements. 115-volt AC model or 12-volt DC set available. Both sets include two sections of vinyl hose, hand carrying strap; 12-volt model includes battery cables. Mail coupon for details.



Model PPS-1

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Patch a wall

Make invisible repairs to plaster and drywall with DAP Vinyl Paste Spackling Compound. Spreads smoothly. Fills fine line cracks and large holes. Dries fast, sands to a feather edge. Takes paint perfectly.



Panel a room

It's easy when you use DAP Panel and Dry Wall Adhesive. It saves time and work. Fastens paneling and wallboard to studs and furring faster, easier than nailing. Simplifies panel alignment.



The name people know best in home fix-up

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Subsidiary of Plough, Inc.

New products

It feels so good



Dual shower heads make you feel good all over. A few minutes and a pair of pliers converts standard enclosure into luxury shower. Imaginality Products, 2821 Pinewood Ave., West Palm Beach, Fla. 33407.

Library stairs

Steps like these are usually industrial-looking with metal treads and railings. Now Stair-Pak, Rt. 22, Union, N.J. 07083, has a knock-down circular stairway made totally of wood.

Hey, bartender



Hotpoint has taken the refrigerator door one step further by adding an automatic ice server below its water dispenser.

Triple spray



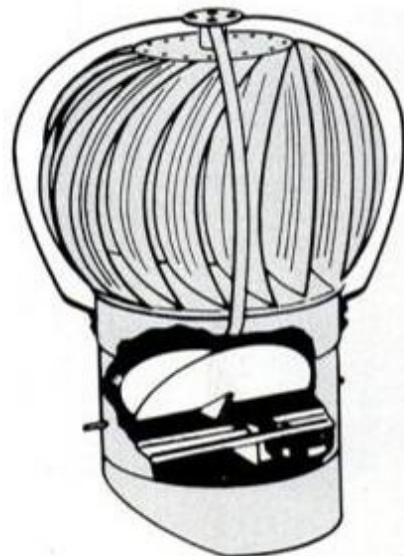
Three spray nozzles (normal, massage, aerated) are built into one head. Rotate it to the one you want. In four colors from Ondine, El Monte, Calif.

A matched set



These faucet insets are new from Bradley, Box 309, Menomonee Falls, Wis. 53051, in 13 varieties to match marbled and solid-color vanity tops.

A smart ventilator



This attic turbine ventilator has a built-in damper. A temperature-sensitive coil closes the damper at 75° F., opens it at 100°. From Energy Saving Products, Box 13276, San Antonio, Tex. 78213.

Upside down air



You might not like its looks, but the idea is great. A small fan pulls warm ceiling air down to the floor where you can feel it. The Thermocycler is portable, and Brown Manufacturing, Hartford, Wis. 53027, says the floor-to-ceiling temperature difference will be less than 5° F.

Portable softener



For softer water, try fitting this softener to your sink faucet. The unit is recharged with common table salt. From Bissel, Grand Rapids, Mich. 49501.

Do it with Deft

stain and finish all in one day.



Deft makes it easy to stain and finish furniture, panels, cabinets. So easy it's fun. And fast. Our Vinyl Wood Stains dry in 60 minutes, clean up with water. Our Clear Wood Finish dries in 2 hours, leaves no brush marks, won't yellow. Beginner or expert, stain and give a bartop finish in a single day—and that evening, proudly show friends the beautiful job you and Deft just finished.

FREE BOOKLET gives tips on easy wood staining and finishing. Send self-addressed envelope, stamped with 26¢ postage, to Deft, Inc., Dept. PM-4, 17451 Von Karman Avenue, Irvine, CA 92714



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Now it's easy and inexpensive to have the fresh aroma of real cedar in your closets. Giles & Kendall Cedar Panels are applied with nails like any paneling and butt snugly at joints. They're 100% red cedar flakes compressed in an attractive pattern. No finishing needed. No tedious fitting of tongue and groove cedar boards. Send 25¢ for this booklet of easy cedar closet plans.



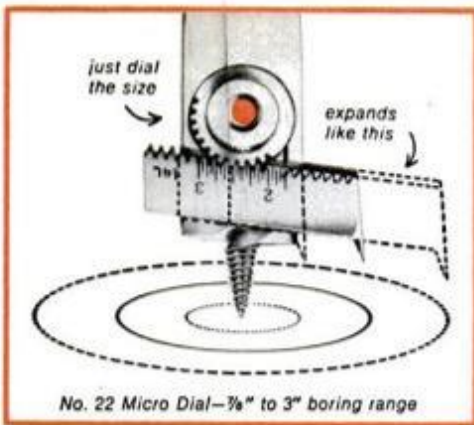
GILES & KENDALL, INC.
P.O. Box 188, Huntsville, Alabama 35804

Please send me your Cedar Closet Plans Booklet. I enclose 25¢.

Name _____
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New products

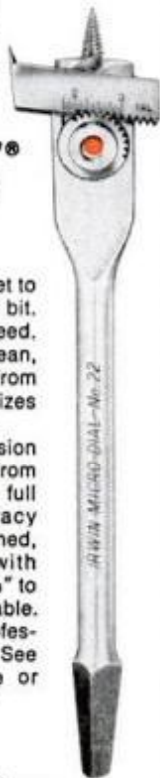


Stop hunting for bit sizes!

Irwin's "Micro-Dial"® Expansive Bit bores 35 standard holes.

Just turn the dial and you're set to go with this Irwin Expansive bit. No hunting for the size you need. Fits all hand bit braces. Clean, fast, accurate boring action from $\frac{3}{8}$ " to 3"—35 standard hole sizes in all!

And what a really fine precision tool to own. It's drop-forged from special bit steel, heat treated full length, machined for accuracy and sharpness, highly polished, too. Two cutters supplied with each bit. Model No. 21 with $\frac{3}{8}$ " to 1 $\frac{3}{4}$ " boring range also available. Ideal for home handyman, professional woodworker, or farm. See your independent hardware or building supply dealer soon.



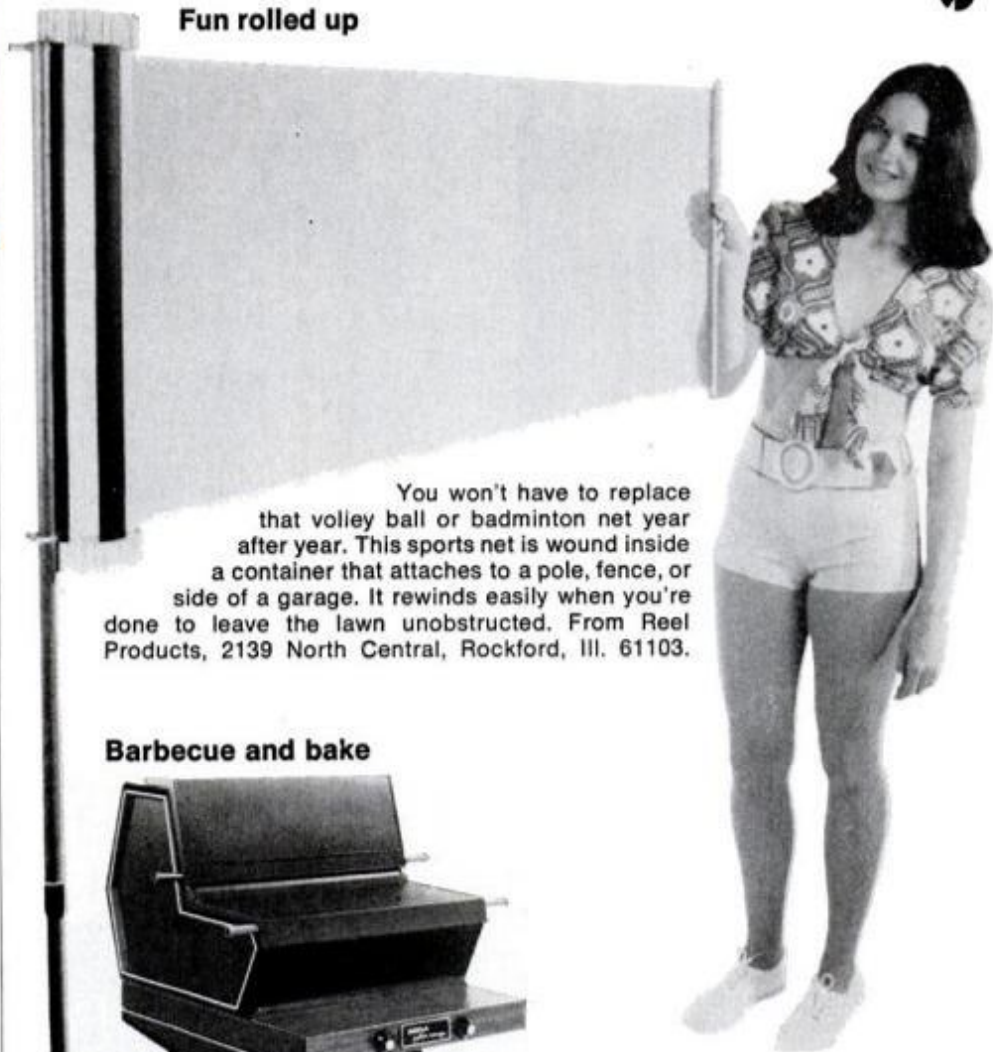
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LOOK FOR
OUR "CAR
CARE GUIDE"
IN THE MAY
1976 ISSUE

Fun rolled up



You won't have to replace that volley ball or badminton net year after year. This sports net is wound inside a container that attaches to a pole, fence, or side of a garage. It rewinds easily when you're done to leave the lawn unobstructed. From Reel Products, 2139 North Central, Rockford, Ill. 61103.

Barbecue and bake

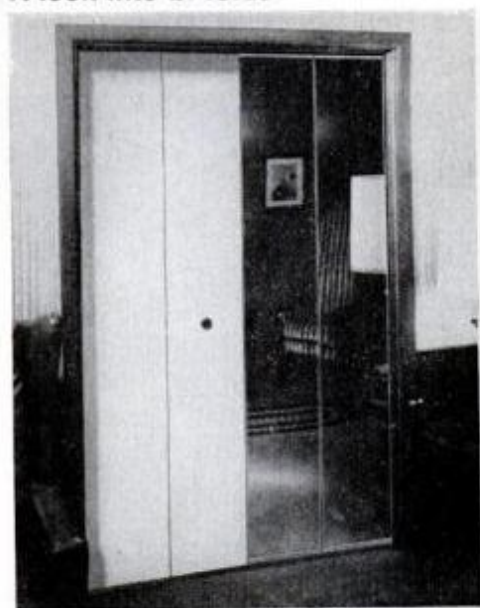


Arkla Industries, 400 East Capital, Little Rock, Ark., has added an oven to its 732 square-inch grill. It's said to handle any dish outside that you can cook in the kitchen.

Pickproof pushbutton lock

A burglar will have pretty bad odds—1 out of 15,625—of "picking" a keyless, five-button, combination lock. It takes conventional installation and the number sequence can be changed. Hope there'll be someone home if you forget it. From Unican Security Systems, Box 307, Plattsburgh, N.Y. 12901.

A look into bi-folds



Leigh Products of Coopersville, Mich. 49404, is selling full-mirror mounting kits for bi-fold doors with brackets, screws, mounting tape, and adhesive-backed knobs.

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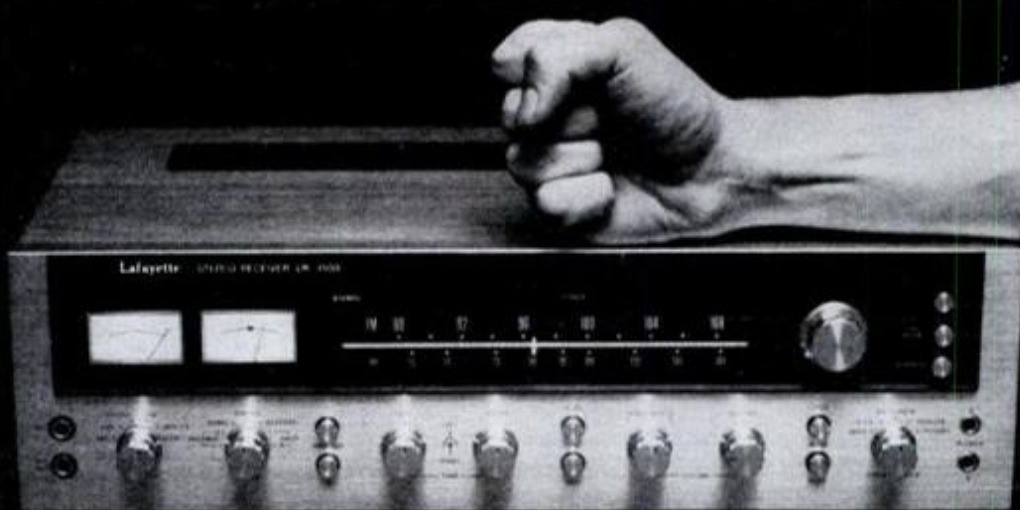
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Less work.



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FMC Consumer Products

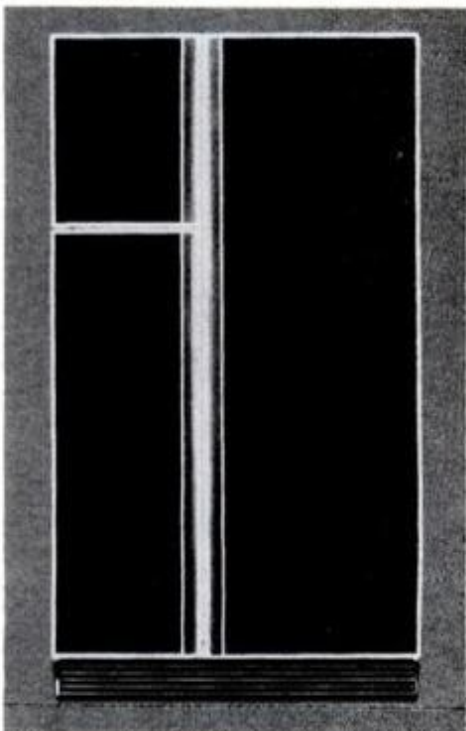
home ideas New products **guide**

Mini refrigerator

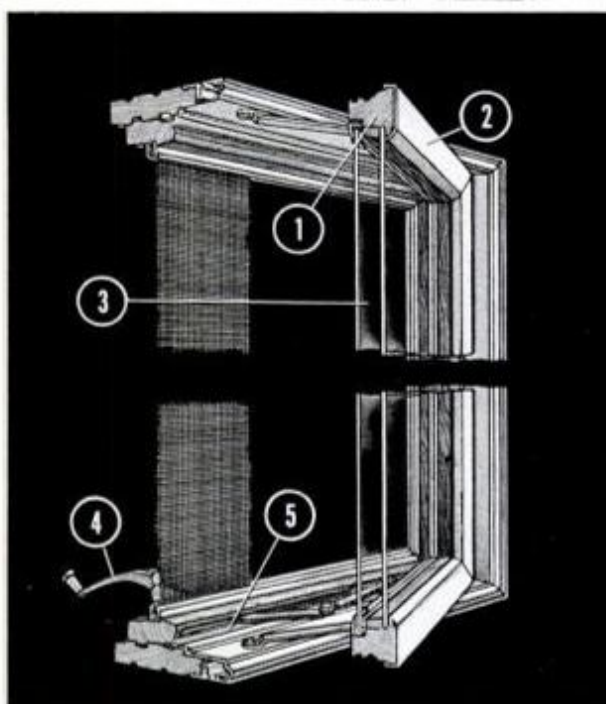


This new 6-cubic-foot model has two adjustable shelves and a crisper. The freezer capacity is 0.4 cubic feet—good for small apartments or entertaining away from the kitchen. From Sears.

Glass all over



Modern-looking black glass, used in oven doors, is now available to fit refrigerator doors. From Admiral, 1701 East Woodfield Rd., Schaumburg, Ill. 60172.



Remodeling or building? Consider Pella "Energy-Tight" Wood Windows.

Reduce heating and cooling costs, and cut maintenance with (1) the natural insulating qualities of Pella's wood construction, (2) an aluminum clad exterior in attractive colors that needs no painting, (3) Double Glass Insulation System with full $\frac{3}{16}$ " dead air space between the panes that out-performs ordinary insulating glass and costs you less per window, (4) sash that cranks out a full 90° to the center of the frame for easy washing of outside glass, (5) soft vinyl weatherstripping that seals entire perimeter.

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New products

All built in



Here's a bathtub with a built-in whirlpool. It uses standard plumbing connections and one electrical line. The factory-assembled unit has four self-cleaning jets. From Briggs, Box 22622, Tampa, Fla. 33622.

House in a blanket



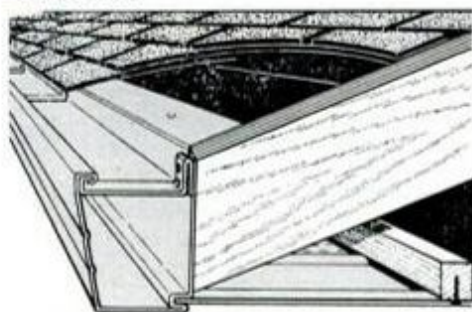
Dow Chemical, 1880 Mackenzie Drive, Columbus, Ohio 43220, has developed a code-approved, one-inch-thick, Styrofoam sheathing. It's applied to all exterior surfaces, including foundation walls below grade. It does such a good insulating job on its own that conventional 3½-inch batts in the wall become more efficient. You can carry about twelve 4x8 sheets under your arm quite easily.

Shampoo sink



Lots of space (25½ x 16 in.) and a pull-out spray head make this sink ideal for hair washing or, with care, a baby bath. From Eljer, 3 Gateway Ctr., Pittsburgh, Pa. 15222.

Let it rain



Omni Products, 1550 West Fullerton, Addison, Ill. 60101, is marketing a rain-carrying fascia. The roll-formed aluminum gutter has a beaded fascia and the back is notched to accept the ventilated soffit.

This FREE book can help you save over \$1,000 on a complete woodworking shop!

If you are like many men and women, you've often dreamed about having a complete woodworking shop. But, you may have put off getting started because of costs or you believed you didn't have enough space.

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YES, please send me my FREE copy of "What to look for when you buy power tools." I understand there is no obligation.

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This 24-page booklet provides a short course in natural wood finishing. It covers tools and equipment, staining, priming, filling and more for both old and new surfaces. Only 25¢ from Pierce & Stevens Chemical Corp.

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From the pride you'll feel at having done it yourself when you install Armstrong's handsome staple-down Tredway flooring. Two free brochures from Armstrong Cork show how and give color illustrations of design choices.

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Rockwell offers a 45-page, softcover book that provides step-by-step instructions and illustrations on all the "how-to's"

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501. These Babies Really Hoe The Line!

The big, tough tractors in this 16-page color brochure make short work of gardening chores. Their all-gear drive makes them gas frugal, too. Free from Engineering Products Company.

502. Need Help To "How-To"?

Howard Sams book catalog lists over 400 titles, authored by experts, in simple easy-to-understand terms, with photos and drawings. Free.

503. Six Great American Looks. . . .

In wall paneling are shown in individual full color brochures. A seventh one, "How To Install Wall Paneling", makes it easy to achieve these great effects. All seven only 25¢ from Georgia-Pacific.

504. Popular Mechanics Complete Appliance Repair Manual

Fix virtually any household appliance—even shop tools—following the thorough, step-by-step instructions in this comprehensive volume. Irons, toasters, humidifiers, vacuum cleaners—you'll handle them all and much, much more. This 320-page book can save you far more than its modest \$8.95 price.

505. Window and Gliding Door Instructions

"Easy Window Installation" is a fully illustrated guide to professional-looking window installation. "Easy Gliding Door Installation" offers step-by-step instructions to building indoor-outdoor living into a home with gliding doors. You can't miss for free. Andersen Corp.

"Hello. I'm your Georgia-Pacific Registered Dealer. And I've got plans for your summer. All kinds of plans for all kinds of do-it-yourself projects. They're in a big 32-page, fully illustrated book that's free. The plans are easy to follow. And the projects are simple to build.

planter, decks, storage, fencing units, paneling projects—all kinds of things. There're plans for a bench like this. Neat, eh? And **you** can build it!

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WORTH WRITING FOR

506. Hentschel Clock Company offers a free four-color brochure describing their line of handsome, classic grandfather clock kits. You'll be proud to build these elegant heirloom pieces.

507. Bird Tells All!
 "What You Should Know About Roofing and Siding Before You Build or Remodel" is a beautiful, 32-page booklet packed with ideas, money-saving consumer advice, and full-color illustrations. 50¢ from Bird & Son, Inc.

508. Take The Pain Out Of Reglazing Windows!
 New Handi-Glaze caulking cartridge and special Glaz-Master nozzle fit any standard caulking gun. Free 4-page, illustrated brochure explains how to use this new system that takes the mess out of reglazing, making it a fast, convenient operation.

509. Popular Mechanic's Picture-Tools
 A great way to end workshop clutter! Seven big sheets with sure-stick adhesive backs depict 74 tools for instant organization. Only \$4.95 plus 50¢ postage and handling.

510. You'll Have A Deft Hand . . .
 At wood staining and finishing. This 24-page, four-color primer covers preparation, staining, and finishing coats for new and previously finished interior and exterior wood surfaces. Only 25¢.

511. Z-Brick Projects
 This 12-page booklet gives complete plans for 10 easy projects—from rustic walls, to charming plant stands, to range hoods—you can make with Z-Brick decorative brick and stone wall facings. Only 50¢.

512. PM's Complete Gardening Guide
 Here is every bit of information needed to have a beautiful lawn and garden. All the basics with more than 20 fact-packed tables and charts, and 130 "show-how" drawings. 12 heavy plastic-coated cards—24 pages in all—spiral bound for quick reference. Only \$4.95 + 50¢ for postage and handling.

513. Don't Ignore The Sewage System
 Here's an informative 16-page booklet about the functions, problems, and care of septic tanks and cesspools. It tells how Rid-X can help avoid costly and unsanitary problems. Free from d-CON.

514. Straight Talk On Caulk
 Macco answers caulking questions in a quick reference brochure which describes types of caulk and methods of application. From Macco Adhesives. Free.

515. Professional Results!
 A photo-illustrated, step-by-step guide to natural wood finishing! Floors, furniture, antiques, exteriors, boats—any wood surface. This thirty-one page brochure shows you how. From McCloskey. 25¢.

516. The Easy Way . . .
 To cope with thatching problems and grass clippings is just part of what's in these booklets on the Parker line of sweepers and lawn care equipment and tips for a "green thumb" fill "Lawn Grooming Made Easy". Both are free.

517. Do-It-Yourself Ceilings Add Interest Overhead
 Four informative booklets show how to install beautiful Armstrong Chandelier and Trendsetter ceilings yourself. Plus, detailed instructions on using Integrid Suspension and Furring Channel installation methods. Free from Armstrong Cork.

518. Popular Mechanics Complete Manual Of Home Repair And Improvement
 All the "how-to" information for your home—from "quickie" repairs to room additions—gathered into one complete reference source! Over 1,000 illustrations, graphs, charts, etc! Indexed and cross referenced, too, for easy use. 480 pages. Only \$8.95.

519. Add Elegance To Your Garden!
 "How To Enjoy The Beauty Of Moving Water." is the theme of this 34-page, full-color booklet from Little Giant Pump Company. It covers planning and building garden pools, waterfalls, lighting, pump selection and more. Free.

520. How To Caulk
 Elmer's Acrylic Latex Caulk offers a free 8-page, two color folder on caulking. Step-by-step illustrations and instructions take you from surface preparation to final clean-up.

521. Yard Work Doesn't Have To Be Hard Work . . .
 With Bolens Power Equipment to help. Free four-color brochure describes Bolens garden tractors, tillers, riders, and attachments, and the unique Bolens Mulching Mower that eliminates the need to bag grass clippings.

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496	500 (\$1.50)	504 (\$8.95)	508	512 (\$5.45)	516	520
497 (25¢)	501	505	509 (\$5.45)	513	517	521
498 (\$5.45)	502	506	510 (25¢)	514	518 (\$8.95)	

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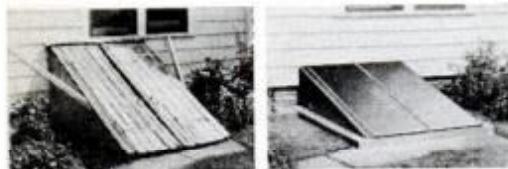


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home ideas New products

guide

One at a time



The Decro-Wall Corp., 375 Executive Blvd., Elmsford, N.Y. 10523, is marketing vinyl-coated wallpaper in individual squares (16x16 in.). These are good for the homeowner who might have difficulty if he had to handle full-size sheets and especially good for working around cabinets or fixtures. A package of 18 squares sell for \$6.98.

Three in one

Tectum II is an insulating, structural and acoustical material being used for roof decking and some exterior walls on a solar test house at the University of Texas, Arlington, Tex. It's a rigid composition, wood fiberboard with a layer of urethane foam bonded to one side. From Gold Bond.

A fireplace where?

Believe it or not, there are free-standing fireplaces, UL-approved, available for mobile homes. Insulated pipe and through-the-floor venting make it possible. From Empire Stove, Belleville, Ill. 62221.

who says
the shortest
distance between
two points
has to be
a straight line?



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home ideas
guide

New products

A hundred years of brass



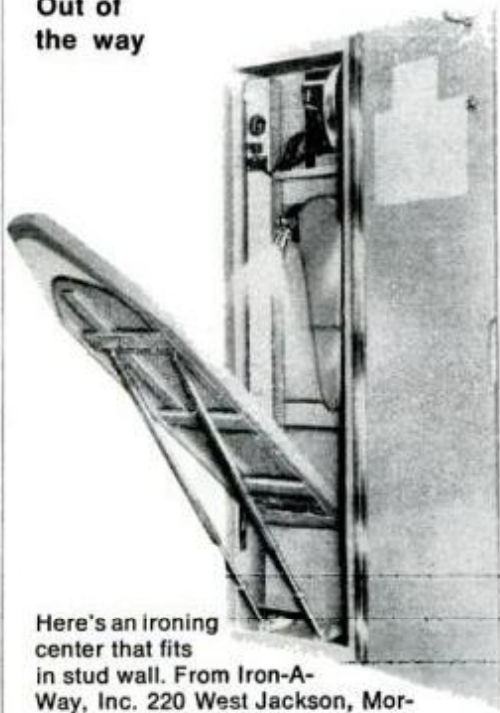
Beardmore & Co. has introduced a new line of knob and locksets for the American market. For an elegant and complete catalog of high-quality hardware, write them at 3-5 Perry St., London WIP OEJ, England.

Washerless faucet



This single-lever faucet is leakproof. Sealed inside are two hard ceramic discs like those shown. Sand, silt or grease won't bother them. From American Standard, Box 2003, New Brunswick, N.J. 08903.

Out of
the way



Here's an ironing center that fits in stud wall. From Iron-A-Way, Inc. 220 West Jackson, Morton, Ill. 61556.



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savers**

**cut home fuel
cost as much
as 30%**

You can easily apply M-D sealants and caulking around your doors and windows and stop costly drafts!



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Stop those costly drafts around your house now. Use M-D caulking and sealants. Available at hardware, building supply and home center dealers.

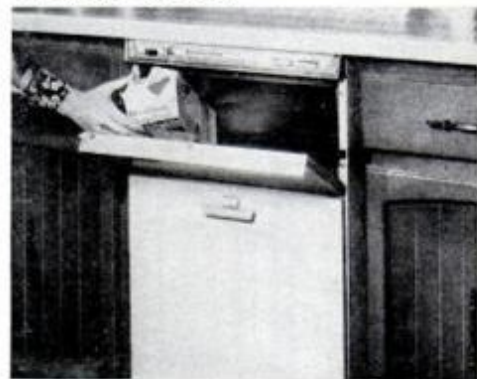
Ask for M-D by name.

Macklanburg-Duncan Co.

P. O. BOX 25188 OKLAHOMA CITY, OKLA. 73125

New products

Garbage galore



The Kitchen Aid Division of Hobart, Troy, Ohio 45374, has a built-in toe-space trash unit to match surrounding cabinets. Features include a litter bin and an activated charcoal filter.

Easy to get at

Bemis Mfg. Co., Sheboygan Falls, Wis. 53085, is making a polyethylene toilet-seat hinge. The plastic bolt and nut are top-mounted for easy installation.

Stick to it

U.S. Plywood, 1 Landmark Square, Stamford, Conn. 06904, has a nonskid, textured-surface plywood. It's called Tex-deck Sanspray, ideal for outdoor decks, ramps or docks.

Find the refrigerator



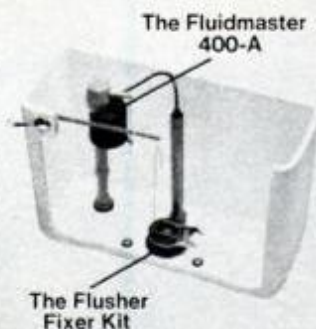
A new line of decorator refrigerators include 1/4-inch side panels as well as door panels. From Admiral, 1701 East Woodfield, Schaumburg, Ill. 60172.

You've tried to fix him before. Yet John's hisses, squeaks and leaks persist. To cure his tank inlet problems, install the new Fluidmaster® 400-A. It's adjustable, fills quickly and quietly, and won't leak because it uses incoming water pressure to shut itself off.

If John has a weeping flush valve, just install a Fluidmaster Flusher Fixer™ Kit. This non-rotting, non-corroding flush valve always seats properly, and has no guides of lift wires to bend, jam, and corrode.

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WINNEBAGO ANNOUNCES A HOMEOWNERS PLAN FOR THE ROAD.



Buying a motor home is a very big investment. At Winnebago, we think we offer you more protection for that investment than any other manufacturer.

It's called the Winnebago Homeowners Plan.

Better Protection.

Winnebago's limited warranty is designed to comply with recent Federal legislation. Further, we've made some substantial improvements. Items previously covered for only 90 days are now included in our standard 12-month/12,000 mile coverage periods. This includes carpets, electrical systems, plumbing, seats, cushion fabrics and windows.

Service, Service Everywhere.

No one buys a motor home to sit in the driveway. So Winnebago has put together a network of over 300 coast-to-coast service centers. From Miami, Florida to Anchorage, Alaska.

A Friend at the Factory.

If a Winnebago owner ever has any questions, suggestions or complaints, he can get in touch with our Customer Relations Department at headquarters in Forest City, Iowa.

Safety First.

You'd never hoist your motor home several feet in the air and then deliberately drop it. But that's what Winnebago did recently to test the limits of structural integrity of their exclusive Thermo-Steel® construction. That test is only one part of an extensive safety program initiated by Winnebago.

More Money Back.

Every smart homeowner should consider resale value. Based on a comparison of three-year-old motor home prices in the May-August, 1975 N.A.D.A. Recreational Vehicle Appraisal Guide, Winnebago held a higher resale value than the average of all listed competitive models.

All this, on all Winnebagos.

For 1976, we try to give you more to choose from in motor home size, style and price. And we think our Homeowners Plan gives you a lot more to drive away with.



The name that means the most in motor homes.
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TRUCKWATCHER'S GUIDE TO THE BIG RIGS (Continued from page 70)

are engineered primarily for western use. East Coast trucks—Marmon, Brockway, Autocar, Oshkosh—run best in the East. In fact, you rarely see those makes west of the Rockies.

However, Whites, Macks, Internationals, Fords, Chevrolets, GMCs and Dodges are fairly evenly distributed, particularly Macks, Internationals, and Fords. Wherever you see them, though, you can be sure they were ordered with engines, transmissions, axles and wheels best suited for specific regions and uses.

Steeper grades and wide-open spaces in the West, for instance, demand greater horsepower, more transmission gears, plus deeper or higher axle ratios. In Nevada, where there used to be no open-road speed limit, I'm told the highway patrol still cites trucks only above 70 mph. If a trooper sees a truck doing more than 70, he gives him a warning on his CB radio (big rigs all have CBs now.) If the truck breaks 70 again, though, the driver gets a ticket.

The point is that out West, a rig still has to be able to hold 70 through Nevada and then has to be able to climb Donner Summit at 7227 feet without crawling. On the Great Plains, a truck that easily gets by with an unturbocharged engine and single five-speed gearbox couldn't make it out West.

There's also an East/West difference caused by weather. In the East, so-called "California" wheels predominate. These are the spoked variety made by Dayton. Despite their "California" appellation, West Coast drivers don't like them and call spoked wheels "manure spreaders." The advantage of California wheels back East is that snow doesn't pack in beside the brake drums, and the wheels don't crack or break with the expansion of ice. But they're hard to align and easy to strip with an air wrench.

Disc wheels, preferred in the West, are made mostly by Budd. They're no good in snow, but chrome up nicely.

Fleets and owner-operators

There are basically two types of truck owners: fleet owners and owner-operators (O-O). Companies that buy or lease large truck fleets ordinarily choose the least expensive, starkest, plainest-Jane models. Fleet operators, naturally, want minimum expense for maximum profit.

Owner-operators, on the other hand, don't mind spending a little extra to make their trucks comfortable and glamorous. The average O-O owns just one rig, and he spends more time in the cab than at home. He's an independent businessman

whose truck represents his total livelihood, so he doesn't mind paying for convenience options, luxury touches, custom paint jobs, extra chrome, fancy upholstery—in short, the items that truckers call simply "class." Class sums up a certain combination of poshness, power and general extravagance.

O-Os take great pride in their rigs, and there's always a bit of rivalry to see who has the classiest truck. A few smaller fleets also compete. The customizing of trucks has in some ways replaced the custom car craze of the Barris era—the late '40s and '50s.

Buying a new truck

You don't just walk into a truck dealership and buy a new rig off the showroom floor; at least most truckers don't. New trucks are custom-built, and the variety of choices is staggering.

You choose the make and type of engine you want; likewise transmission, axles, wheels, fuel tanks, plus comfort and appearance options.

A Class 8, 400-bhp Freightliner or Peterbilt equipped for an O-O now costs around \$45,000. A typical Kenworth with 350-bhp Cummins engine, Fuller seven-speed transmission, and Timken twin axle would go for \$42,500. Fleet-use Mack, Internationals, Fords and such, carry stickers of \$33,000 to \$35,000. And that's just for the tractors, excluding trailers.

Diesel engine a big favorite

Big trucks use diesel engines almost exclusively (a tiny percentage have experimental gas turbines). The most popular Class 7-8 powerplant is a Cummins—an in-line 6—followed by GM's Detroit Diesel V8s and V6s, and then Caterpillar straight 6s and V8s. Detroit Diesels are all two-stroke engines; the rest are four-stroke.

When you order a new truck, you specify engine make and horsepower. Suppose, for example, that you're ordering a new Peterbilt or Freightliner. Neither company manufactures its own engines, so you'd likely order either a Cummins, Detroit Diesel, or Caterpillar powerplant.

If you're buying a Mack or International, say, you'd probably go with Mack or International engines—both companies do make their own. But you could again specify Cummins, DD or Cat if you want. In Chevrolet, GMC and Ford trucks, since all these truckmakers build engines, you'd likely also go with factory power, but not necessarily.

Other engine manufacturers that
(Please turn to page 162)

Coleman Bags: tough enough to stay gentle... from backwoods to backyards.

Before you put your bucks (and your body) into a sleeping bag, make sure it's good for more than a short slumber. Go with Coleman.

You can choose a Coleman bag for any age or activity. (We make some 25 models, 18 of them washable. With patterns from hunter brown to contemporary denims, even some new patriotic beauties.)

And whatever the use Coleman value makes sense. After all, why put your youngster into a "slumber" bag that can't go along if he takes to the great outdoors?

The value starts when we build in the warm, with Acryfil,* Insul 200* polyester, DuPont Dacron* 88 or Dacron* II polyester. We scroll-stitch, so the filling won't bunch up or thin out. We insist on sheet-soft liners and tough outer covers.

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* Acryfil is a trademark of Coleman for their specification synthetic filling material. Insul 200 is a Coleman specification polyester filling material. Dacron is a trademark of DuPont.

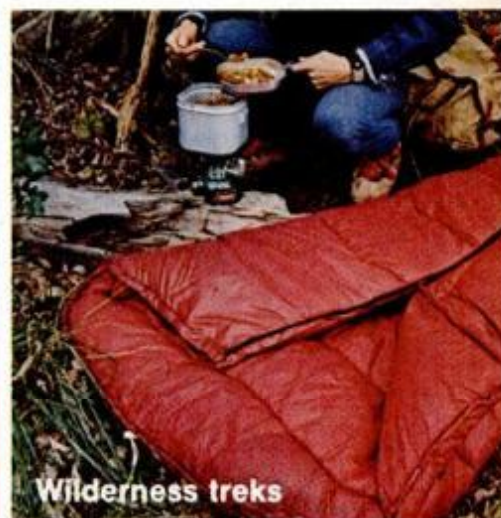
The fun is out there. Let yourself go... with Coleman.



Backyard camp-outs



Family camping



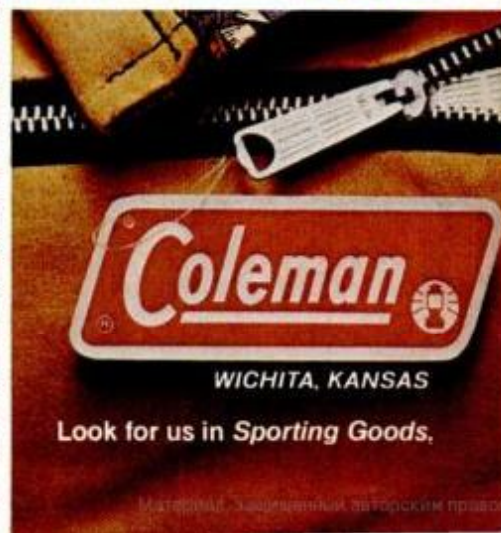
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Fishing and hunting trips



Slumber parties



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ESKA motors also feature a drainless crankcase to protect fish and water, a quiet underwater exhaust and are compact enough to fit your car's trunk.

ESKA motors have convenient twist grip speed controls. Our solid state ignition lets you forget about tune-ups, spark plug or point problems, and you can count on sure starts every time regardless of the weather.

We've built fisherman features into ESKA silent electric motors too. They let you slip quietly through hushed waters at the trolling speed you want —without noise or vibration.

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 2400 Kerper Boulevard
 Dubuque, Iowa 52001
 A Talley Industries Company

TRUCKWATCHER'S GUIDE

(Continued from page 160)

supply diesels to truckmakers, although more rarely, are Allis-Chalmers, Hercules and Mercedes-Benz.

Up until the energy crunch, the trucking industry had a horsepower race on its hands. The big West Coast rigs were pushing 500 bhp and up. Fuel prices put a stop to that, though, and power ratings now run 180 to 250 in Class 7, with Class 8 spanning 250 to 450 bhp.

Turbochargers are popular in the higher horsepower ratings, particularly on trucks that travel a wide range of altitude. Two-stroke diesels require a mechanical supercharger to boost the turbocharger at higher elevations.

'Miser kits' save fuel

There's great emphasis today on fuel economy, and most truck manufacturers offer "miser kits." These consist of roof spoilers, radial tires, thermostatic fans, lower governed engine speeds, internal engine modifications that produce more torque at lower rpm, plus higher axle ratios (numerically lower). Miser kits boost a loaded rig's average four to five-mpg by one mpg—a 20 to 25 percent increase. A typical 1975 miser kit costing \$1880 saves roughly \$2075 in fuel per year at 100,000 miles.

It's not uncommon for a truck to rack up a million miles during its lifetime. Fleets usually sell their rigs at 500,000 miles. With normal maintenance, 350,000 miles between engine overhauls is the figure fleets shoot for, and most diesels do give that uncomplainingly. Turbochargers actually lengthen engine life by burning fuel more completely, thus cutting down harmful oil contaminants and sludge.

The most popular big-rig transmissions are Fuller and Spicer, beginning with five-speeds and running up to as many as 15. New Process, Clark, Allison, Warner Gear, I-H and Ford also build truck transmissions. Auxiliary two, three, and four-speed gearboxes, called "Brownies," are also popular.

Three companies are now building automatic transmissions for trucks, and automatics seem to be the coming thing. Allison automatics are the most popular, followed by Cummins-Sunstrand and Caterpillar.

Diesel engines have very narrow torque bands, which means much more shifting than in automobiles. Truck automatics usually have five forward ranges; the upper ones being "lockup" or direct drive.

Rockwell-Standard, Eaton, Spicer and Clark are the biggest independ-

(Please turn to page 164)

3 GRACIOUS GARDEN HOUSES (Continued from page 124)

leave it unsealed. It's outside all year round.

■ **Do protect trees and foliage** while building. They will be intact when you're done.

■ **Do use preservative-treated timbers** for all framing in contact with the ground.

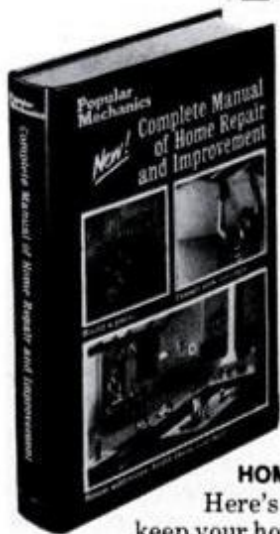
■ **Do install ground fault indicator fused circuits.** It's national code for exteriors.

Don't be what I call a fair-weather

er carpenter. Make those toenails count. Use galvanized nails to avoid rust streaks on the wood. Try 10d nails on face-nailed decking instead of 8s. The extra bite will help minimize warping and cupping. In short, build your garden house to withstand the worst storm in 20 years. In the end, you'll save on maintenance and repairs and be able to see the results of your labors on a good-looking job. ★★★

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your reference shelf with four from Popular Mechanics



A must for the wise home owner

THE POPULAR MECHANICS COMPLETE MANUAL OF HOME REPAIR AND IMPROVEMENT.

Here's everything you need to know to keep your home in top shape—from "quickie" repairs to room additions, even how to finance home improvements. Professional shortcuts and techniques are explained in simple layman's language and 1,000 photos, drawings, graphs and charts show how to make home repairs easier, cheaper, and better. This big manual—480—pages, 6" x 9½"—is indexed and cross-referenced so you can find instant answers to any home repair problem. **Only \$8.95.**

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dent manufacturers of drive axles, but many truckmakers do manufacture their own.

There's another way to buy a new truck, and that's in the form of a "glider kit." Glider kits are whole trucks, fresh from the factory, but without engine, transmission or rear axles. Suppose, for example, that you had a truck but lost it in an accident. The running gear is probably still good. So you buy a glider kit and you're back in business. Glider kits cost about 35 percent of the price of a whole new truck.

Class and comfort

A big part of an O-O's truck-buying decision involves the paint job. The big truck manufacturers paint most cabs in basic white, because white is nearly always one color in any combination. Owner-operators, though, will ask to see hefty sales books showing hundreds of different factory custom paint treatments. These paint jobs range in price from \$125 for a simple two-tone to \$1500 for wilder schemes with pinstriping, metal flake, gold leaf and intricate patterns.

Factory treatments come with names—usually the names of cities, like "Stockton" and "Denver." If you don't see what you like in the books, you can create your own unique paint job. The factories supply head-on and side-view outline drawings of their cabs, rendered to scale, with little dots all over the cabs at scale six-inch spacings. You pencil and crayon in your own color scheme. And if you need help decorating your cab, you can call on design consultants hired by the factories. They're equivalent to interior designers for homes.

Cabs get lavish treatment

Cab interiors get the same lavish attention and care. It used to be that the driver was the last thing considered when building a truck. Not so today. Cabs are heavily insulated against noise and heat. Air seats, adjustable for driver weight, cushion the ride. Factory catalogs show plush upholstery treatments, and the colors of Naugahyde now available in trucks are much brighter and greater than in cars. Custom instrument panels, power windows, consoles, fancy steering wheels, stereo, airconditioning

and CB radios are the norm in O-O rigs. Sleeper cabs often include TV plus most home comforts.

Fleet trucks, on the other hand, stand out on the road by their plainness. Most have a stark dashboard, some without tachometer or even a gas gauge (fleet trucks usually fill up at predetermined terminals). Interiors are often painted in flat aluminum, and about the only comfort is an air seat. Even airconditioning is missing in single-driver fleet rigs, because the unions demand air only in trucks that use a driver plus co-driver. Since sleepers cost money and airconditioning tends to cause downtime, fleet operators have gone more and more into single-driver, non-sleeper cabs in plain-Jane attire. Many are even left factory white outside.

Now that you've read this spotter's guide, you're obviously going to have to do some spotting. Watch to see how many cabs are all-white or predominantly white. Check the custom paint jobs that separate the O-Os from the fleet jobs. And identifying the big rigs as they whistle past is a lot more challenging and entertaining these days, I feel, than identifying cars. ★★



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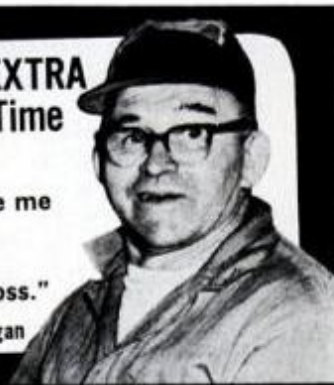
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SCIENCE TAPS STAR POWER (Continued from page 74)

in the doughnut, away from its walls. In this manner, the plasma is held in a "magnetic bottle." In theory, anyway.

"It would work fine if the plasma moved in an even flow," Dr. Gottlieb explains plaintively. But in fact, the agitated incandescent stuff often gallops about with the unruly energy of a mountain stream in springtime, often breaking through the invisible magnetic shield. "It's like trying to hold jiggling Jell-O in a cage of rubber bands," says famed physicist Dr. Edward Teller, whose pioneer work on the hydrogen bomb sparked this whole development.

Problem: Stop the 'leak'

In short, the magnetic bottle leaks. One of the main goals of the Princeton research group is to find ways of stopping such "leaks" and achieve stable conditions of "contained" plasma flow. "An enormous amount of effort has gone into designing the exact magnetic configuration to accomplish this," says Dr. Gottlieb. "Much of our magnetic design work is based on computer analysis of force fields interacting within the torus."

In the Tokamak, a ring-shaped magnetic field within the doughnut is supplemented by another magnetic field winding around the ring like stripes around a barber pole. With this magnetic pattern, plus the sophisticated triple-phase heating, the Princeton research group hopes to sustain reactions long enough to point the way toward making atomic fusion a practical power source. The longest reactions obtained so far, in smaller and less elaborate machines, lasted only a fraction of a second.

Dr. Gottlieb stresses that this Tokamak—called the PLT (Princeton Large Tokamak)—is not a working powerplant. It is merely a research tool for obtaining the basic knowledge necessary to build an actual fusion powerplant. "We know already that such a plant will work," Dr. Gottlieb declares confidently. It is no longer a question of *if* but a question of *when*.

A few other questions also remain to be answered: How big does a reactor have to be for practical powerplant operation? Bigger machines work more efficiently, but they also cost more. The problem is to find the right combination of cost and efficiency to produce energy at the lowest possible price to the consumer.

Bigger reactor coming

The next step beyond the PLT Tokamak is already planned and

budgeted at \$215 million, which seems like a lot of money. But it's a bargain when you consider that it may well be our best bet to assure sufficient energy for the survival of our industrial civilization. ERDA—the Energy Research and Development Agency of the United States—is well aware of this and regards the prospect of fusion energy as a main hope for the world's continued economic development.

The future device, now in the planning stage, is called the TFTR (Tokamak Fusion Test Reactor) and will be twice as big as the present Tokamak. Size itself is important, and not just for efficiency. Bigger

Also in the running...

In addition to the Tokamak, several other types of experimental fusion reactors have been built at various research centers both in the United States and abroad. Perhaps the most interesting among these is a laser fusion reactor at KMS Fusion, Inc., Ann Arbor, Mich. In this device, high-powered laser beams converge within the plasma to activate a fusion reaction.

At Los Alamos, a reactor called SCILLAC relies on a bank of large condensers to jolt the plasma into reaction with a great surge of electricity. The result is a magnetic "pinch," a sudden compression of the plasma that raises it to reaction temperature.

At General Atomic in La Jolla, Calif., a reactor shaped like a huge peanut triggers reactions by squeezing the plasma through the narrow waist at its middle.

None of these approaches has progressed beyond the early experimental stages, and it now appears that Princeton's Tokamak is the most likely to lead beyond experimentation and evolve into a practical powerplant.

reactors have thicker plasma streams, which are easier to control because turbulent particles have greater leeway for their random motion within a thicker stream. In addition, the TFTR will feature newly developed particle injectors to shoot high-energy particles into the plasma. This will reduce the necessary reaction temperature from a searing 100 million° C. to a more manageable 50 million.

If all goes well (and Congress votes the money), the TFTR will be ready by 1980 to operate under conditions like those in a practical powerplant, although only in short bursts.

The first working fusion powerplant is projected for the late 1990s,

just ahead of the predicted oil famine. It will consist of a reactor similar to the TFTR, which yields its energy in the form of neutrons shooting out of the central torus. These particles will be captured in a solid shield—a so-called blanket—fitted around the reactor. The blanket heats up under the impact of the high-energy particles and the heat can then be used to make steam to drive the powerplant turbines.

Laser checks plasma

Before this ultimate goal is attained, many intermediate problems must be solved. One of these has to do with observing and measuring exactly what goes on within the swirling inferno. Standard instruments inserted into the plasma stream would simply disintegrate under its heat and force. Besides, their presence would disturb the flow. One recent approach to this problem has already proved successful. A laser beam is focused on the plasma through a port in the torus. The way the laser beam is reflected by the plasma particles tells a great deal about reaction conditions. The beam reflection is therefore analyzed by on-

line computers, which furnish almost instant readouts of reaction parameters.

With Dr. Gottlieb clarifying details for me, the looming segments of the Tokamak gradually began to make sense. I marveled at the massive steel frame supporting the huge magnetic coils. "They've got to be strong," Dr. Gottlieb said, explaining that the magnetic forces acting between the plasma and the coils tend to knock over the coils with a push of 3 million pounds.

As I walked amid rows of computers (for monitoring every detail of the Tokamak's operation) and looked at the huge motor-generators that provide the heating power and feed the magnetic coils, I was amazed at the babel of languages I heard: English, German, French, Japanese, and some I couldn't identify. Obviously, the place was something of an international gathering point.

Russian-U.S. cooperation

The Tokamak itself is the product of shared technical know-how between America and the Soviet Union. The original concept for a fusion reactor sprang from the work of Dr.

Lyman Spitzer, an astrophysicist at Princeton. Exploring the process by which the sun and the stars produce energy, Dr. Spitzer came up with the idea of building an "artificial star" in miniature to use as an energy generator. Such a device, called a Stellator, was actually built at Princeton. Scientists proudly point out that it was literally the most "far out" theoretical research—the study of stars—that led to this eminently practical outcome. But the Stellator was beset by problems, and it remained for the Russians to provide an improved design that forms the basis of the Tokamak.

International cooperation is important for the long-range outlook. Time was when such developments would have remained top secret. Fortunately, governments are beginning to realize that secrecy in science is self-defeating. As a result, Russians and Americans are now freely sharing information in this field, and many other countries are making important contributions to fusion technology. Their joint efforts add up to a splendid prospect: an era of inexhaustible energy for our increasingly crowded world. ★★

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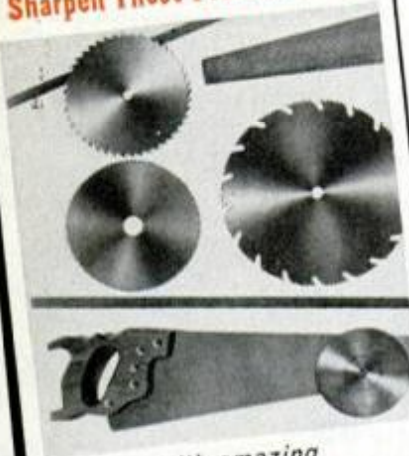
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How do you find the metric size of a certain screw—its thread pitch, for example? It's easy with a unique new tool called Metric Screw Chek'r. You simply select the tapped hole into which you can turn the screw and, quick as a wink, you know its metric pitch—fine, medium or coarse. Not only do you know the pitch but also the diameter in thousandths of an inch, the clearance drill-bit size, tap-drill size and length in millimeters and inches.

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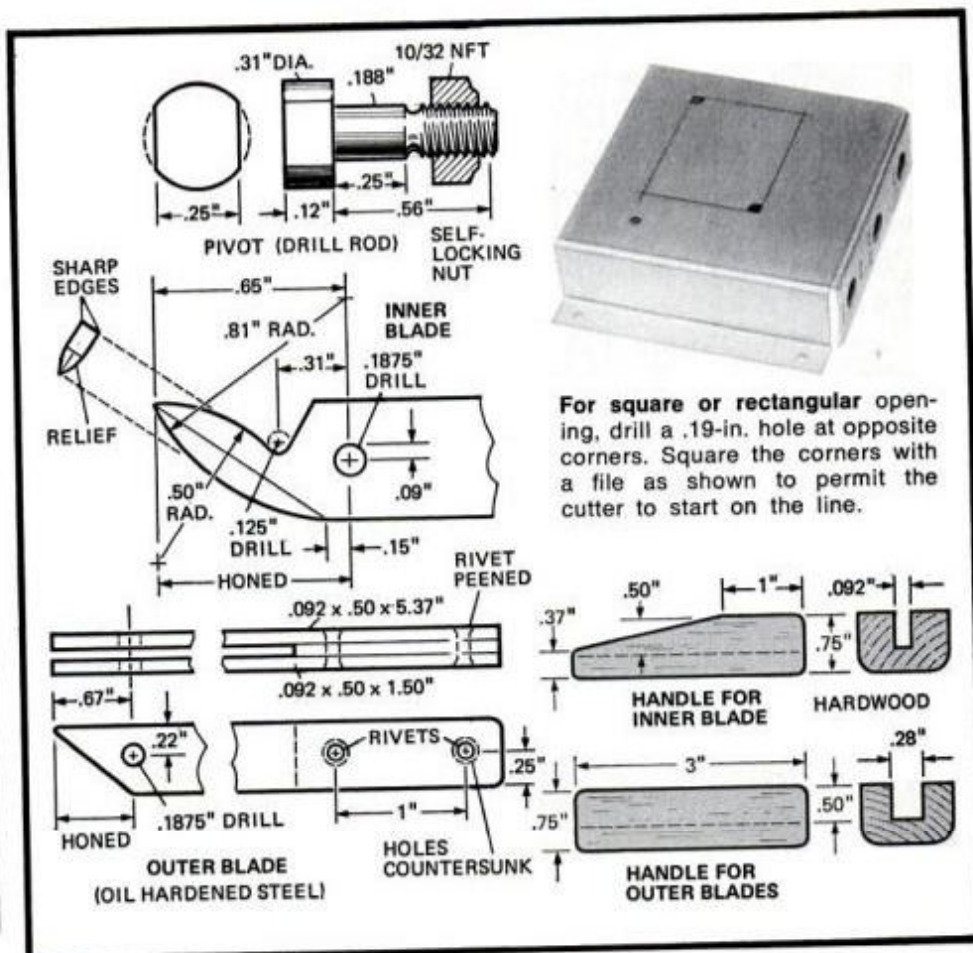
This easy-to-make sheet-metal cutter will do things you can't do with regular snips. It will cut in the center of a sheet with a .19-in.-dia. starting hole and cut on either the upper or lower side of the sheet, whichever is more convenient. It works best on straight cuts but it will cut a large radius.

As the blades cut, they curl a strip of metal ahead of the cutter. There is practically no distortion of the metal from the cutting action. The cutter will handle up to .06-in. aluminum or .02-in. soft-steel sheet.

The blades are made of oil-hardening tool steel. This steel is sold at

machine-shop supply houses in strips two feet long. One strip is enough for one cutter. Finish the blades completely before heat treating as the steel will not distort during heating. To harden the blades, heat to a bright red (1475°F. to 1525°F.) and quench in motor oil. Draw the blades in a kitchen oven at 350°F. for an hour. Following the heat treatment, polish the blades and hone the cutting edges.

The hardwood handles are fastened to the blades with epoxy cement. Use a self-locking nut on the pivot bolt and adjust it so the blades work freely.—R. S. Hedin



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The center holes in the ends of motor shafts, boring bars, arbors and the like have a way of becoming clogged with dirt. This must be removed before the work can be mounted between lathe centers. The tool shown is made to do it with a few twists of the fingers.

The tool is little more than a handle for holding a standard center drill. It has a loosely fitting knob at one end for steadying the tool while it is rotated. A setscrew holds the drill in its socket. In use, the tool is used with one hand—the knob is held between the little finger and palm and the shank rotated with the thumb and index finger. In addition to clearing center holes, the tool is handy for countersinking holes in wood and other soft material for flathead screws.

I turned mine from 1/2-in. mild steel to the shape shown. I peened the end knob to the shaft to turn freely and knurled a 1-in. section of the shaft to provide a nonslip finger grip. The diameter of the end which holds the drill should be large enough to provide a wall thickness for a 1/8-in.-long setscrew. If your center drill is 1/4-in. diameter, for example, the end of the tool should be no smaller than 1/2-in. diameter. Hold the work in a lathe chuck for drilling the hole for the center drill, then drill one wall with a No. 29 drill and thread with an 8/32 tap.—Walter E. Burton

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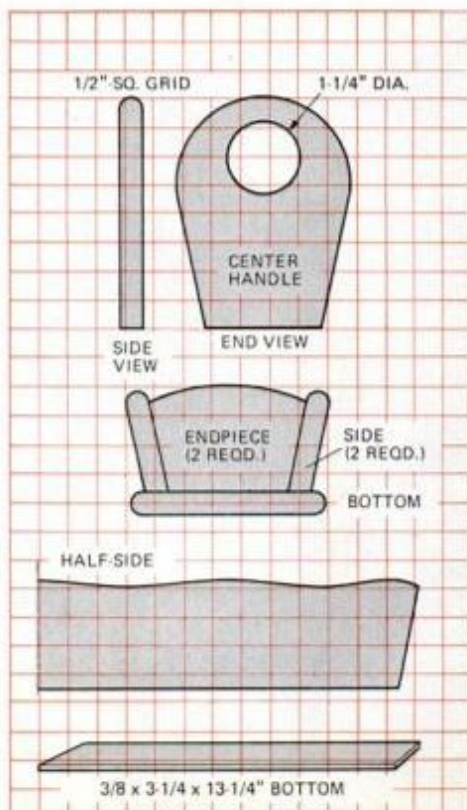
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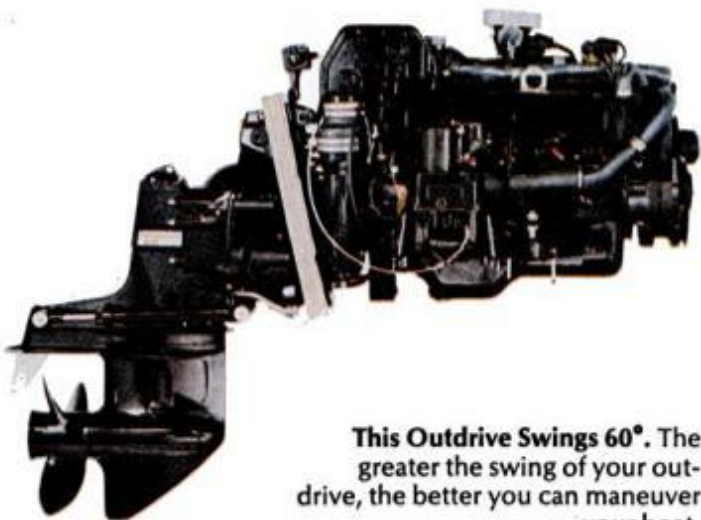
Cracker tray



This little cracker tray looks a lot trickier to build than it actually is. Though the angle on the sides and ends is 7°, construction is kept simple because all the joints are butted. The tray is created from pine stock. To prevent any chance of dried glue showing up on the finished project, I use the following method of construction. First, I cut out all parts and sand them smooth. Next, I temporarily tack the pieces together to check fit. Then, I disassemble the parts and apply stain (except on glue joints). Twenty-four hours later, I reassemble the stained parts using white glue. This way, any glue that squeezes out will not keep the stain from covering the wood evenly. Finally, I fill the nail holes with wood putty the same color as the stain and apply a couple coats of thinned shellac.—Mel Crosby.



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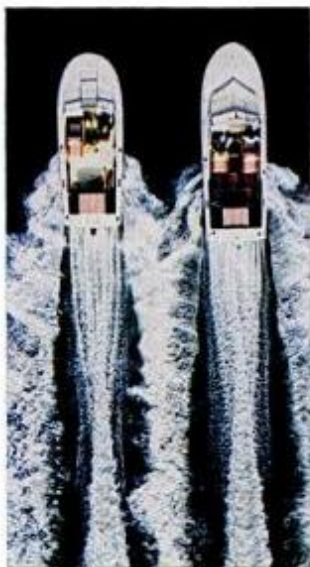
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STOL AIRCRAFT
(Continued from page 98)

gers a year. One-way fare between Montreal and Ottawa is \$24, including taxes, and there's a \$5 surcharge during peak hours. Airtransit is a premium service, the most expensive way to travel between the two cities. The route was chosen so that the STOL service could try its wings against the competition of regular airline service, bus and rail service, and the private automobile.

Since Airtransit was set up as a convenience service, it figures that it would offer the best travel time—and it does. The clocking of door-to-door travel between downtown hotels in Montreal and Ottawa produced these track records: 2 hours and 35 minutes by bus; 2 hours, 24 minutes by train; 2 hours, 20 minutes by car; 2 hours by commercial jet (with only 30 minutes in the air), and less than 1 hour, 30 minutes by Twin Otter STOL (with 45 minutes in the air).

31 flights a day—each way

The weekday schedule calls for 31 flights a day in each direction, with planes leaving every half hour during morning and evening peak periods. As you might expect, businessmen make up the majority of passengers.

Capt. Tonkin explained that Airtransit is unusual in that it is a complete, integrated system from beginning to end—not just another shuttle service that happens to use STOL planes.

The STOLmobiles, for example, are radio-equipped so that the driver can contact the airport should he be delayed. (All-day free parking is provided at both terminals for passengers who prefer to drive.) Passenger handling at the terminals is simplified, so that passengers can check in as late as 10 minutes before flight time.

Each STOLport covers only 44.5 acres of land (compared with hundreds of acres occupied by most primary airports) and is located close to the center of town.

Routes flown by Airtransit take the aircraft away from conventional airways and dense traffic. Planes are guided by means of a special RNAV (area navigation) system.

Noise was never a problem, Capt. Tonkin told me. Once the service was in daily operation, people living in communities near the two airports found that noise from takeoffs and landings did not intrude. Studies have shown that the loudest noise inflicted on residents in the two areas is rated at 68 decibels, equivalent to the noise you would hear at a point

100 feet away from a city bus traveling at 30 mph.

Not only does Airtransit's flight path keep planes away from residential areas, it was explained, but the Twin Otter is relatively quiet.

The twin-engine Otter is a rugged craft that was modified and beefed up for its Airtransit assignment. Safety factors were improved with add-ons like increased capacity wheel brakes, antiskid wing spoilers, birdproof windshield and several de-icing mechanisms.

Full equipment carried

The most expensive "extra" was \$350,000 worth of avionics. In addition to standard equipment needed for flying under instrument flight rules (IFR), the flossy package includes items like Dual Very High Frequency Omni Range (VOR) receivers for navigation; Dual Very High Frequency Communications receivers (VHF); Air Traffic Control transponder for identification on radar; auto pilot; Air Data Acquisition system (ADAS); digital tape recorder for collecting flight information for future evaluation; and standard flight recorder. Thus, the Airtransit version of the Twin Otter is as well equipped electronically as a typical big commercial jet.

On-board computer

But what really sets the Airtransit operation apart is the sophisticated RNAV (area navigation) system used to keep the planes on routes restricted to their use. As demonstrated by Capt. Jim Fitzsimmons as we sat in the pilots' seats of an Otter, prior to takeoff a small on-board computer is programmed to the specific route—one among several—to be flown. The pilot does this by inserting a magnetic program card into the computer.

Once airborne, the computer relays a continuous flow of information on the aircraft's position, direction, altitude and corrections necessary to stay on course. Information is displayed on a small screen.

16 ground signal stations

The route doesn't follow a straight line, Capt. Fitzsimmons explained, but is made up of a series of legs. Along the way 16 ground-based stations transmit navigational signals. The computer switches automatically from one station to the next as the aircraft passes them. Should one station fail or its signals weaken, the computer automatically switches to the next one.

A series of audible "beeps" warns the pilot to change heading for the next leg. The computer can be linked

(Please turn to page 176)



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Yes, a GMC is a fine pickup. It should be. Because it comes from people who've specialized in trucks for over 70 years. In other words, if you're itching to get in on America's growing love affair with the pickup, your GMC dealer is the logical place to go.

(The rather special pickup shown here includes some equipment not available from GMC.)

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STOL AIRCRAFT

(Continued from page 174)

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Microwaves check approach path

Signals are picked up by an airborne receiver that gives the pilot a visual indication of whether he's on the correct approach path. The plane must come in on a steep 6° to 9° approach due to the short runway. The system permits takeoffs and landings in all but the heaviest weather.

The entire system works as smooth as silk—if my round trip is any criterion. It was my first STOL flight and I paid close attention. To my surprise, the takeoff did not seem excessively steep. In flight, the plane was no noisier than other small propeller-driven planes I'd flown on.

Though there was no stewardess and no food, drinks, newspapers or magazines, I did not feel the least bit deprived. Flying at 5000 feet was pleasant: I enjoyed looking down at farmlands, lakes, snaking rivers, autos crawling along narrow roads. It was reassuring to note that our two pilots were more than disembodied voices over a loudspeaker. With the door to the cockpit open, as it is on all Airtransit flights, my front seat afforded a clear view of the two calm, capable-looking fliers at the controls.

Restricted route

Our approach at Ottawa was through a completely uncluttered air space—no competition from other aircraft. That's the beauty of a restricted route and a reason why Airtransit can maintain close schedules. The descent gave me more of a sense of steepness than the takeoff had, but it wasn't half the "drop" experienced in some New York express elevators.

Airtransit officials believe the demonstration has proved a success and look forward to adding equipment and routes. The most immediate possibilities are a Montreal-Ottawa-Toronto linkup, and Victoria-Vancouver and Montreal-Quebec City routes. Further in the future is possible service to cities like Buffalo, Detroit and Chicago.

The STOL plane that could make such routes pay off, say Airtransit officials, is De Havilland's new Dash 7, a four-engine, 50-passenger air-

liner with a 935-mile range. Test-flown last spring, it is expected to be ready in 1977.

U.S. Air Force interested

Meanwhile, significant developments in STOL flights are taking place in the United States, where the Air Force is in the market for an AMST (Advanced Medium STOL Transport) that can use 2000-foot fields and carry a 27,000-pound payload on a mission radius of 400 nautical miles. A cruising speed of 500 mph is required.

Jet prototypes have been built by McDonnell Douglas and Boeing. The McDonnell Douglas YC-15, like its Boeing rival, employs the supercritical wing—a low-drag, thick wing—for aerodynamic efficiency. It will use the wing, four engines and large flaps to produce about twice the lift of a conventional transport.

The twin-engine Boeing YC-14 will use "upper surface blowing" (USB) to generate the extra lift needed for STOL operations. Boeing engineers say this is how the USB works: The engines are attached to the leading edge of the wing, causing them to blow across the wing's upper surface. USB flaps are attached to the trailing edge and, when extended, curve down almost 90°.

Exhaust air from the engines blows across the top of the wing and down the curved flaps, the way water from a faucet follows the back of a spoon. The high-speed flow can be turned almost 90° and directed downward for a powerful lifting force.

The YC-14 and YC-15 will be test-flown at least a year before the Air Force decides between them.

150-seat airliner version

The development program also may have implications for the commercial market. McDonnell Douglas officials are talking up a 150-passenger airliner version of the YC-15, capable of using secondary fields (with runways of about 4000 feet).

The plane the jet STOL would replace as a military equipment and cargo carrier—the C-130 Hercules—may be going the STOL route, too, according to an announcement by the Lockheed-Georgia Co. A STOL/stretch version of the four-engine turboprop Hercules would fill the bill for the Air Force, say Lockheed officials, and save a lot of money.

The various developments described here add up to this: STOL applications are on the rise. It may well be that this slower, more economical form of air transportation will help to alleviate two big problems: airspace congestion and a continuing energy shortage. ★★

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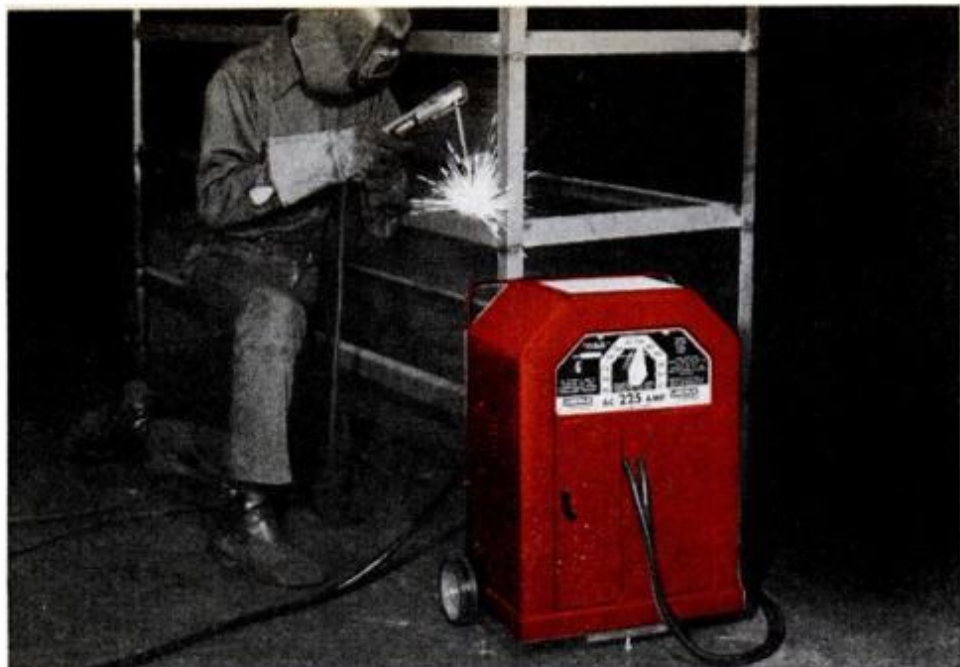
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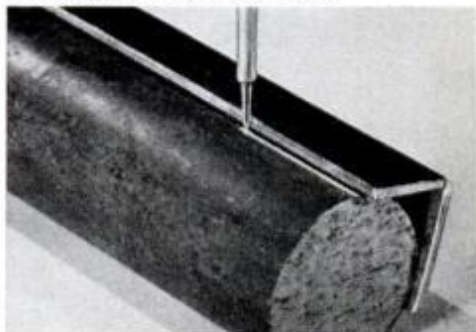
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HINTS

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An angle does the trick



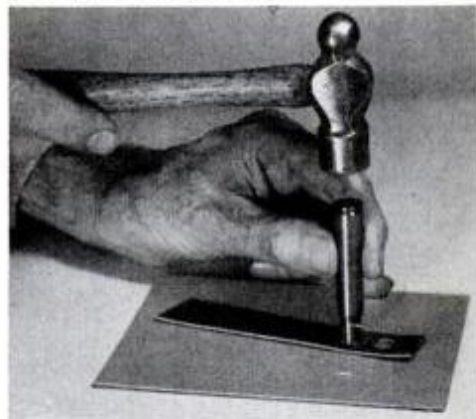
How do you scribe a line along the axis of a rod when you lack a key-seat rule? Simple: Use a length of metal angle and scribe along the edge. Its V shape automatically centers the rod.—*David L. McCoy*

Comfortable grip for file



Save a piece when you toss out that old hose. It will come in handy for many things, one being a rubber grip for the end of a flat file. Cut a slot in a 3-in. piece and slip it over the end.—*Bobbie M. Cooley*

Ready-made punch



Keep a few spent high-powered rifle cartridges in your workbench drawer—they make fine paper and leather punches. Use a soft surface for backing and sharpen end of the cartridge with a file.—*Frank Kupfner*

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leakage is normal) could spell bills soon.

9. After the diagnostician gets the car back on the ground, let him take it for a short test drive. Ask him to check transmission operation, noting smoothness of shifting, delay in going into gear, and play in universal joints and rear axle. At some point he should also remove the transmission dipstick and sniff the fluid for the odor of scorching. That simple test can often tell volumes about an automatic transmission's condition.

In cars with manual gearboxes, clutch action should be smooth and positive. Shifts shouldn't demand struggle or guesswork. If the stick ever pops out of gear during acceleration or deceleration, or if you hear growling or rapping sounds from the transmission, be wary.

10. During a test drive, even if it's only to the shop making your professional inspection, listen for odd noises, rattles and hums. Mention these to the mechanic. Also check brakes for veer, steering for play, suspension for bounciness or looseness. Accelerate and decelerate sharply to conduct your own test for sloppy U-joints and rear axle.

11. Try to avoid cars with four-barrel carburetors. Four barrels almost always take hard-to-find and expensive premium fuel. Engines with two-barrel and single-barrel carbs get by on regular gas. It's not the four-barrel carb that makes a car burn premium—it's the higher compression ratio and advanced ignition timing that go along with four-barrels.

Big-car bargains

12. Keep in mind that the used-car market has done a complete flipflop since the energy crisis. It used to be that the full-sized American cars—particularly Fords, Chevys and Plymouths—were hot sellers before the oil embargo.

Today, though, big Detroit sedans and wagons go begging on used-car lots. You can often pick up a late-model, low-mileage, full-sized Detroit for a good deal less than a minicar or compact of the same year and mileage.

The popular (thus expensive) used cars nowadays fall into seven specific categories: 1. economy imports like VW, Datsun, Toyota, Opel, Colt and Capri, but also to a lesser extent Mazda, Renault, Peugeot and Subaru; 2. used domestic economy cars, particularly Pinto; 3. used American ponycars, the hot-

test being Camaro, Mustang and Firebird; 4. used sports cars—Corvette, MG, TR-6, 240-Z and 260-Z, and the big Austin-Healeys; 5. luxury "heavies" such as Cadillacs and Mark IVs; 6. some intermediate-sized U.S. cars like Chevelle and Skylark; and 7. all four-wheel-drive vehicles—Jeep, Blazer, Scout and the like.

13. When you buy a used car, try to avoid financing if you possibly can. Pay cash instead. You nearly always up the cost of a used car by a third or so through financing and mandatory insurance.

Shop for best terms

14. If you must finance, shop for terms as you shop for the car. Life insurance and credit union loans are least expensive; dealer and finance-company loans are most expensive, with banks in the middle. Pay off a loan as quickly as possible.

And set a ceiling on what you plan to pay for a car.

15. You've probably asked yourself whether you should buy from a private party, a used-car dealer, or a new-car dealer who carries used cars. All three have good and bad points, but experts pretty much agree that you get the best cars from small, clean, neat, independent used-car lots. These dealers often buy the cream-puffs of new-car trade-ins. Try to deal with the lot owner directly, not one of his commissioned salesmen.

Buying from a private party can lead to heartaches, especially if something goes grossly wrong with the car or deal. Buying from a new-car dealer usually means paying more than at an independent lot, because the new-car dealer has greater overhead,—but you'll usually get some type of warranty on the car, usually 60 to 90 days. These, though, are generalities and don't apply in every situation. You probably ought to shop all three before you decide.

16. Don't be afraid to dicker, but never get huffy or nasty during price negotiations. Again, be patient—use time to your advantage. Never panic when the salesman urges you to buy today. Prices don't change or cars vanish that quickly.

Don't trade old car in

17. Avoid trading in your present car if possible. Sell your old car privately before you buy a newer one. Be shopping, though, while you're selling your present car. If you can sell it privately, you'll be more likely to get "retail" for it.

As a trade-in, though, you'll never get more than "wholesale." Also, the cash from a private sale will give you a price and financing advantage.

18. Where do you find out what used cars are worth? Banks and finance companies can and will lend you used-car price guides—so-called "blue books." These are much more accurate than the ones you can buy on newsstands. Ask one of the bank loan officers to lend you a blue book. Figures shown will let you check asking prices of cars for sale and will also let you put a realistic value on your present car when selling or trading it.

19. Put no faith in used-car warranties of any sort. They might or might not prove worth the paper they're written on. Never let a warranty sway you toward a purchase. A used-car dealer's reputation counts for a lot more than any warranty. Remember that you never get any sort of warranty from a private seller; also that your best warranty is the used-car inspection I mentioned in No. 6 (page 101).

20. Sign nothing—no sale contract, no power of attorney, no credit application—until you've read it completely and understood every word. Now that's easy to say and hard to do. If you have questions, let the salesman explain. And if his explanations don't make sense, take a copy of the document to your attorney for interpretation.

All blanks in a contract should be filled in before you sign it. Leave no deposits while test driving a car or having it inspected. Do not let the dealer "park" or drive your car for you if you're not planning to trade it in. Your car might end up being a "hostage" while the dealer wears your patience and resistance by keeping you waiting.

The best years to look for

The best used cars are usually from two to four years old, with between 10,000 and 15,000 miles a year on the odometer. The average American car, properly treated and maintained, will give 100,000 miles of service before a major mechanical breakdown. Body longevity varies with locality and depends largely on salt corrosion.

If you keep these 20 points in mind, your chances of finding a good, reliable, trouble-free used car are around 80 percent. Which means there's still a risk. But then there's a risk in buying a new car, too, and considering how much less used cars cost than new ones, their risk factor at 80 percent still makes them more attractive. ★★★

Dodge is 3 up on every other pickup made in America.

1. Dodge has the lowest-priced pickup. Lower than Ford. Lower than Chevy.

If you know trucks, then you know Dodge. You know all about how tough we build our trucks. And you know how well we engineer them. But maybe you didn't know that Dodge makes America's lowest-priced full-sized pickup. The Dodge D-100.* (Based on comparison of manufacturers' suggested retail prices for 6 cylinder half-ton pickups excluding optional equipment, state and local taxes, destination charges.)

2. Dodge got the best gas mileage. Better than Ford. Better than Chevy.

Getting great gas mileage is getting to be a habit with Dodge.

In the latest EPA tests, a '76 Dodge D-100 powered by a 225/6 cylinder engine with a manual transmission turned in an estimated mileage of 25 miles per gallon on the highway. And 18 in the city. Of course, the actual mileage you get will vary depending on the type of driving you do, your driving habits, your truck's condition and optional equipment. In California, see your dealer for mileage data for California equipped vehicles.

3. Dodge has the biggest standard payload. Bigger than Ford. Bigger than Chevy.

Dodge has a payload that can make small work of the biggest jobs. Without beefing it up one bit, you can haul off a whopping 1,505 pounds.



*Pickup shown — The Dodge D-100 Adventurer
Price priced higher because of optional equipment

3 big reasons why
the man who'd rather
drive a truck than a car
would rather drive a Dodge.



LOW-COST TURNTABLES

(Continued from page 92)

where your turntable's flutter is equal to that on the record band.

To check feedback isolation, I put the speakers next to the turntable, turned up volume and measured it at the point where feedback began to become audible. To check isolation from mechanical shock, I dropped a dictionary from a one-foot height next to the turntable, to see if it would make the arm jump.

To test tone arm tracking, I mounted a Pickering XV-15/400E cartridge in each arm (except the BSR's, which comes with an ADC cartridge already mounted), and determined the minimum tracking force at which this cartridge would cleanly track a massively orchestrated musical passage. The lower the tracking force, the better the arm.

I picked the Pickering for several reasons: List-priced at \$55 but usually sold for less, it's the type of cartridge most likely to be used with this type of turntable. Its sound is excellent. Also, its neat plastic mounting shims make the cartridges easiest to mount—and I had to mount 10 of them.

How they all compared

The two models with the most automation turned out to be the worst performers: The Garrard's arm requires twice as much tracking force as the others, and its flimsy platter rumbles like the New York subway. You can't reach the cue control without jolting the arm, the cartridge shell has no finger lift and the unhinged lid is a bulky nuisance. The BSR is advertised as "the silent performer." It isn't. Rumble cuts right through the music when you crank up the gain. The controls are so clunky that everything shakes when you push the start switch. And if you use the cue control to lift the arm, the arm flies up sideways like a frisbee. Also, BSR and Garrard were the only models in the group with perceptible flutter.

Pick of the lot, dollarwise, is Pioneer's PL-12D/II. In all performance

factors it ranks with the best. And because Pioneer just introduced an improved version (the PL-112D, with improved suspension), the PL-12D/II will now be widely discounted to around \$70. The Pioneer is more compact than most, neatly styled in a no-nonsense way, and has two control features I admired: the single-lever operating control for start, stop and cue; and the stylus-alignment gauge. Its only drawback is that it has no automatic arm return.

The Acoustic Research AR-XA also lacks automatic arm return, has no cue control and no antiskate adjustment. Instead of the cue control (available on the slightly more expensive AR-XB), the arm has a viscous, slow-drop feature. The design is Spartan, but the performance is excellent, and an ingenious spring suspension resists feedback and mechanical shock superbly.

The same fancy suspension, a floating subframe for both platter and arm, is also used by the Philips 427, with the result that it remained rock-steady when blasted point blank by the speaker or my dictionary test. If you like to dance and have shaky floorboards, that's something to consider. Consider also its design of simple elegance, the most compact of the group by far, and that it works well in other respects, with an exceptionally precise cue control.

The Toshiba was a standout in every way but two—feedback and shock resistance—which was a pity. But the controls are velvet-smooth, and if floor shake is not a problem for you, you might find it well worth your while.

The remaining units tested were basically similar, all good performers, with only minor differences between them. I particularly liked Sansui's very precise cue control, which puts the arm back in the original groove after you lift and lower it—most of the others swung the arm back a groove or two. I also liked Rotel's single-lever control, and Kenwood's variable arm-return speed. The Sanyo, though, was just a trifle below par in shock and feedback isolation. ★ ★ ★

LOW-COST SINGLE-PLAY TURNTABLES

Make and Model	Arm Position	Arm Return	Minimum Tracking Force (grams)	Feedback and Shock Resistance	Rumble Level	Dimensions With Lid Closed (inches)	Price
Acoustic Research AR-XA	Manual	Manual	0.75	Excellent	Excellent	16½ x 12½ x 5¾	\$115
BSR 20 BPX*	Auto	Auto	1.5	Fair	Fair	17 x 14½ x 7½	100
Concord BA 300	Manual	Auto	0.75	Fair	Good	17¾ x 14 x 6½	130
Garrard 125SB	Auto	Auto	2.00	Excellent	Poor	15½ x 14 x 8¼	110
Kenwood KD-2033	Manual	Auto	0.75	Good	Excellent	18¾ x 13¾ x 6¾	130
Philips GA-427	Manual	Auto	0.75	Excellent	Excellent	15 x 12½ x 5	100
Pioneer PL-12D-II	Manual	Manual	0.75	Good	Excellent	16¼ x 12¾ x 6¾	100
Rotel RP-1000	Manual	Auto	0.75	Good	Excellent	18½ x 13¾ x 7¾	130
Sansui SR-212	Manual	Auto	0.75	Good	Excellent	17½ x 14 x 6½	130
Sanyo TP600A	Manual	Auto	0.75	Fair	Good	17 x 14 x 6½	100
Toshiba	Manual	Auto	0.75	Poor	Excellent	17 x 14 x 6½	130

* The BSR comes equipped with a factory-mounted ADC K6E cartridge and was tested with it.

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*U.S. Dept. of Labor Bulletin 1824

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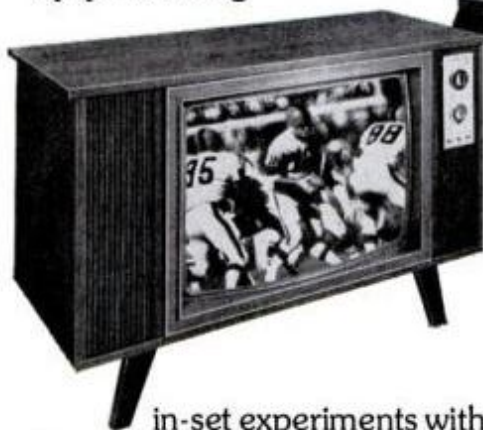
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OCEAN FLIGHT BY JETFOIL (Continued from page 75)

sands are operating on rivers in Russia, Europe, South America, Japan and other places. These designs, however, have surface-piercing foils and are restricted to relatively calm waters. Since surface-piercing foils depend on a constant depth and smooth surface for stable lift, they can't handle rough seas without danger of losing support. Also, their diesel engines can only get them up to about 20 mph.

Jets make the difference

The Boeing Jetfoil I rode, on the other hand, is a commercial derivative of the *Tucumcari*, a 60-ton gunboat built for the U.S. Navy. Her foils are fully submerged, unaffected by surface conditions. She can handle waves up to 15 feet high, making it possible for her to operate in open ocean. Her two powerful jet-turbine engines drive a water-jet propulsion system that can move the giant at better than 50 knots.

Hinged to the trailing edge of each foil is a movable flap, much like the elevator on an airplane. These surfaces control the ship's takeoff and the height at which she "flies." In smooth water, she flies higher to keep more of the vertical struts out of the water, reducing drag. In rough water, she rides lower to lessen the chance of the foils breaking through the surface, causing sudden loss of lift.

Steering controls are linked to the bow foil. The flaps on the stern foils operate collectively or differentially as needed. Operated differentially—like ailerons—they help provide directional control and enable the craft to bank into turns, rolling the hull as much as 12°. This banking permits high-speed maneuvers without centrifugal force causing passenger discomfort—just as in an airplane.

Control by computer

One of the most fascinating technical achievements is an Automatic Control System (ACS) that continuously monitors control functions. A complex system of gyros, accelerometers and height and motion detectors constantly senses the slightest changes in course or attitude and sends out signals. These signals are combined with manual commands from the helm, then fed to a computer that automatically and instantly makes control-surface corrections by means of electro-hydraulic servo actuators. It's like an automatic pilot—and has to be. The Jetfoil cannot be flown manually in ocean waters, I was told, because no human

could react fast enough to split-second changes in conditions.

Other safety features are automated, too. The water intake ports are located in the leading edges of the foil struts. If the struts should ride up too high out of the water, the intakes suck in air. In this event, a cutoff switch shuts down the jet engines instantly to keep them from overspeeding.

Passengers get a thrill

Takeoff speed is 26 knots and is reached in 30 seconds. Near the end of each ride, passengers get a thrill as the crew demonstrates the ship's uncanny maneuverability. Putting her into a steep bank, they go through a series of high-speed turns, topping off the trip with an exciting finish.

Landings are made by gradually reducing speed until the hull glides down off the foils and settles gently in the water. Normal landing time is about the same as for takeoff—30 seconds. In an emergency, fast landings can be made by using the foil-depth controls to drop the hull in two seconds.

Practical hydrofoil travel

To give an idea of the Jetfoil's tremendous power, her twin engines consume 450 to 500 gallons of jet fuel an hour. It takes as much fuel to do 20 knots on the hull as 40 knots on the foils—dramatic evidence of the efficiency and economy of hydrofoil travel.

The Hawaiian Jetfoils, operated by Pacific Sea Transportation, are the first interisland passenger boats since the 1940s, the earlier ones being outmoded by air service. But now the fast, new Jetfoils are promising stiff competition for air travel. Although fares for both are roughly the same, the hydrofoil liner offers advantages. It delivers passengers directly to downtown harbor points, saving the cost and time of getting to and from outlying airports. And the spectacular ride with its breathtaking scenic views makes a two-hour sea voyage seem as short as a 20-minute plane hop—getting there is half the fun.

Jetfoils aren't cheap—up to \$6 million each, depending on inflation—but that's still less than the cost of a medium airliner carrying the same number of people. What it all adds up to is that the hydrofoil liner may usher in a whole new era of fast, convenient ocean transportation—something we haven't seen in a long time. ★★★

LETTERS (Continued from page 7)

miniature school clocks, which open from bottom to top. Did builder Dan Fales goof?

DAVE ANDERSON
ELGIN, ILL.

Fales, a first-time clock builder, replies: "The bezel does open from the right—a condition created when I inadvertently glued the hexagonal frame the wrong way, too."

Great plans!

Thanks for publishing plans such as those in *6 Fun-to-Make Toys for Christmas* (page 118, Nov. '75) that are designed for those of us without expensive shops. Keep it up!

ALAN L. BOYD
RAPID CITY, S.D.

That February cover

You have outdone yourselves with the cover of the February 1976 issue. The degrading image of women and the egotistical view of men portrayed is absolutely disgusting.

ROGER E. COFFMAN
WILMINGTON, DEL.

This pulp-type, comic book style of art is not only in poor taste for a magazine of your caliber, but is downright crude, if not immoral. I'd rather see no art on the cover, instead of this.

RICHARD B. DRISCOLL
YOUNGSTOWN, OHIO

Smutty cartoons have their place—and I enjoy them as much as anyone—but not on the cover of *PM*.

GREG PAGE
OAKLAND, CALIF.

Good grief!

MARSHALL LINCOLN
WICKENBURG, ARIZ.

A workshop workout

Your mini-Indy racer (*Build the Mini-Indy Racer*, page 36, Aug. '75) was my first project from any magazine. My son, his friend and even my



10-year-old daughter, who helped by cutting out the stars, spent two months of very spare time modifying and building this racer with a Bicentennial theme. We used simple

shop tools, and I'll tell anybody the boys really got a workout. And so did I!

In the 30 years I've been reading your magazine, I'd never before had the inclination to try some of the beautiful and practical projects offered to the amateur builder. Now I know that your plans really work.

Keep up the terrific work; I think you've got the greatest magazine around.

TED PRUS
BELLWOOD, ILL.

To order plans, send \$5 (check or money order) to PM's Indy Racer, Stevenson Projects and Publications, Box 584, Del Mar, Calif. 92014.

A 'shocking error'

In the past, I have found that the accuracy of writers in *Popular Mechanics* has been surprising in a day and age when general quality has taken a severe downward swing.

With this in mind, you can understand why I was so shocked when I found in *Popular Mechanics* one of the worst errors I have discovered in a magazine in a long time. In *Warm Gear* (page 58, Jan. '76) the subject of body core temperature is discussed very briefly. The commonly recognized term for this condition is hypothermia. Unfortunately, you used the word hypothermia, which is totally inaccurate.

JEFFREY L. DAVIS
CORVALLIS, ORE.

Not only inaccurate—it's not even in our dictionaries. You and several other sharp-eyed readers caught the error—and froze us in our tracks.

A history lesson

In your January *Saturday Mechanic* (*How to Replace Disc Brake Pads*, page 86), Mort Schultz states that Studebaker, from 1963 to 1966, was the first U.S. car to offer discs.

I refer you to *Motor's Auto Repair Manual* covering 1935 through 1953. Chrysler Imperials had disc brakes by Tombert from 1949 to 1953, and in 1949 and 1950 Crosley had Good-year Hawley disc-type brakes.

GEORGE WEEKS
LEESBURG, GA.

You're right, but discs were used even earlier. The British used them in 1902 on the Lanchester, American-LaFrance used them throughout the 1920s, and the 1911 Metz (U.S.) had multiple discs, so even Crosley and Chrysler were way behind the pack. Studebaker, however, was the first American car to make discs available on a large scale. ★★

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NOW FINGERPRINTS ARE TRAPPING OCEAN POLLUTERS

(Continued from page 82)

or accidentally discharged from a ship passing through the Florida Straits sometime between July 14 and 18, and that the spill was not reported. This stretch of water between the United States and Cuba is one of the busiest shipping lanes in the world, with over 400 oceangoing vessels flying scores of different national flags passing through it in the four and a half days before the spill was first sighted 10 miles south of Key West.

Hundreds of ships suspected

Over half of these 400 ships were tankers carrying petroleum products, or dry cargoes such as grain, phosphates or bauxite. More than 100 of them sailed on to foreign ports without stopping anywhere in the United States. Under international maritime law they could not be investigated for any possible violation of U.S. laws as long as they didn't touch land in this country. The Coast Guard, however, had to track almost 300 other vessels to where they eventually docked in U.S. harbors from Portland, Me. to Portland, Ore., where they were subject to search and study.

Over the next several weeks, Coast Guard teams, in a monumental task involving nearly 5000 man-hours, boarded every one of the 284 possible suspects, quizzing captains and crews, as well as examining records and cargo tanks.

They were looking for evidence to support either of two propositions. First, the vessel was carrying heavy crude oil at the time it passed through the Florida Straits, when some of it could have been spilled accidentally. Second, the ship had recently carried a cargo of heavy crude and, while steaming empty to pick up another consignment at another port, had cleaned out its tanks south of Key West, flushing the old waste oil illegally into the sea.

Failure to report is a crime

Worldwide, it is estimated that roughly a million tons of such worthless petroleum refuse is dumped into the oceans every year as the result of ships cleaning their tanks or deballasting. The Gulf Stream off Key West is a favorite dumping ground for the big tankers which have discharged their oil at East Coast re-

fineries and are returning to Gulf of Mexico ports for new loads of oil or grain. Under the U.S. Federal Water Pollution Act of 1972, such dumping is a civil offense, punishable by a \$5000 fine. But failure to report a spill is a criminal charge; the ship's captain can be fined up to \$10,000, get up to a year in jail, and the owners can be forced to pay for all clean-up costs.

75 leads to nowhere

The Coast Guard's Seventh District Headquarters in Miami, with the overall job of trying to track down the vessel responsible for the Florida Keys spill, was kept busy following up leads from all over the country. A cab driver in Bayonne, N. J., called to say he had picked up two seamen from a tanker and overheard them talking about spilling lots of oil off Florida as they were cleaning the ship's tanks. A commercial fisherman from Mobile, Ala., reported monitoring a radio conversation in the Florida Straits from a tanker to its agents in Texas about a split cargo tank needing repairs when they docked. A military pilot said he had seen a tanker trailing a long slick of oil off the Keys. Another caller insisted he had evidence the oil was spilled by flying saucers. The Coast Guard dismissed the outer space tip, but between the last week in July and Labor Day it logged and investigated more than 75 other leads to the source of the spill. None of them proved to be the key to solving the mystery.

Search continues

Meanwhile, the laborious job of finding and examining the 284 vessels as they docked in widely scattered U.S. ports—some of them after first making foreign stops—plugged ahead. By mid-September, 12 suspected ships had been isolated. Any one of them, on surface evidence of time and cargo, could have been responsible. It was up to the Coast Guard's laboratory detectives to nail down the right one.

Oil fingerprinting, a process largely developed and perfected over the past three years by the Coast Guard's Research and Development Center in Groton, Conn., is technology's newest tool to help pin guilt on environmental polluters. The first step in this test-tube sleuthing started in the Florida Keys long before the dozen suspected ships were finally identified. Using a rake about the size of the ordinary garden variety, with its tines made from two-inch wide strips of Teflon rather than from metal or bamboo, the investigators carefully dragged the surface of oil coming

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ashore. A thin film of oil adhered to the Teflon fingers, which were then detached and stowed in tightly sealed glass sample bottles with aluminum-lined lids to prevent any kind of outside contamination.

A dozen and a half of these samples, taken from as many different locations in the affected areas of the Florida Keys, were sent north as evidence to the Coast Guard's Research and Development labs near the Navy's big nuclear submarine base on the banks of the Thames River in Connecticut. Before the end of September, 34 other samples that had been taken from the 12 suspected ships, also arrived.

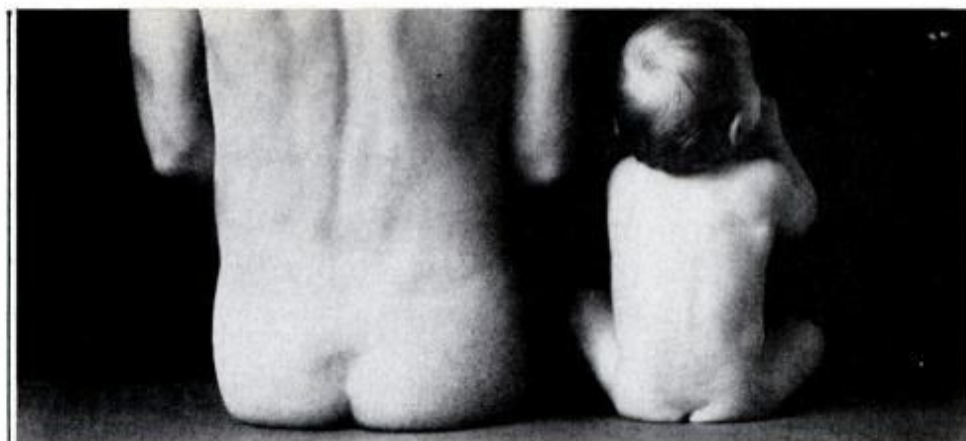
All samples tested four ways

For the next few weeks the laboratory detectives bombarded these 52 different samples repeatedly with infrared and ultraviolet light, iodine vapors, superhigh pressure, and temperatures as low as 321° F. below zero and as hot as flaming hydrogen. In the end, involving over 1000 hours of scientific analysis, each of the samples was subjected to four different tests:

■ **Fluorescence spectroscopy.** A one-milligram sample, diluted 40 parts of oil to 1-million parts of a solvent, is placed in a small quartz container and exposed to a beam of ultraviolet light. This radiation is absorbed by the oil and then reemitted at longer wavelengths which are recorded and measured by a light detector. The result is charted as a spectrum, giving what amounts to an easily read profile of the fluorescent components of the oil.

■ **Infrared spectroscopy.** In this optical method, an infrared beam is passed through an oil smear held between two thin sheets of solid salt. The transmitted beam is then measured for the amount of energy absorbed in the bonds of the molecules in the sample. Because different types of oil contain varying types and proportions of molecules, just as all fingerprints are different in their markings, the resulting charts would not be alike unless two of the samples came from the same source. All oil, of course, is a complex mixture of hydrocarbon molecules. Over 400 of these molecules have already been identified, but oil scientists are certain these represent a small fraction of all the components in petroleum.

■ **Gas chromatography.** This test works by turning the oil sample into a vapor by heating and then forcing the gas through a 50-foot-long column of coiled .02-inch-diameter stainless steel tubes and coils filled with silicone liquid. It is really a sophisticated still, the major difference



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being that by the time the oil sample goes through the process it has had the equivalent of about 50,000 distillations, compared to the only one distillation needed to make moonshine whiskey. Because the different components of all oil have different boiling points, their molecules emerge from the chromatograph at different times, according to their chemical makeup. As each component comes out, it is detected, measured and recorded on a chart. If the peaks and valleys of the graphs from two different samples are exactly alike, it's good evidence that both batches were originally from the same source.

■ **Thin-layer chromatography.** A drop of oil is placed on a glass plate coated with silica gel. The plate is placed in a developing chamber which feeds solvent from a trough to the silica gel surface through a wick. As the solvent migrates across the surface of the plate, the oils are fractionated since the different compounds in each move at different rates. Later, under ultraviolet light, the lab detectives can see the different fluorescing colored bands of the various separated compounds. When

the location, the colors and the intensity of these bands from two different samples match exactly, the odds are again almost certain they are from the same original oil.

All samples in oil fingerprinting get this battery of four basic analyses, but the Coast Guard scientists often apply more sophisticated tests for additional proof. One such analytical method, which was used in the Key West testing, is called low-temperature spectroscopy. The oil sample and solvent are first frozen to 321° F. below zero to form a clear, solid mass which is then bathed in ultraviolet light with the emission then recorded for more definite fingerprinting. In other tests, trace metals in the oil samples are analyzed and quantified. By this method, it is often possible to tell the particular tanks in which oil has been stored or transported.

Similarly, lab tests can reveal the approximate time oil has been in the water, helping to determine the time of a spill or leak. In other cases, the geographical area of the world from where the oil originated can be told

(Please turn to page 190)

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TRAPPING OCEAN POLLUTERS

(Continued from page 189)

by matching such things as sulfur content and other geochemical information. If oil has been agitated, as it is by high-pressure liquids or steam in the cleaning of tanks, this will produce a change in chemical composition which will be apparent in the fingerprint. If chemical cleaning agents are used, traces that are left in the waste can be tracked down and matched by the oil detectives.

Still under development at the Coast Guard Research and Development Center are even more advanced offshoots of basic oil fingerprinting. One test is already able to prove in early experiments whether a sample of oil comes from a natural seep from the ocean floor rather than from a man-dug well, a ship's cargo tank, or a pipeline.

Advanced fingerprinting tests

As part of a permanent library at its Research and Development Center, the Coast Guard now maintains a collection of over 1000 samples of oil gathered from all over the world as a readily available reference file. Each sample is labeled with relevant information: the area of the world it comes from; primary elements; the refinery where it was processed.

When test samples from spills arrive, a quick cross-reference with the library specimens can provide information on the oil type and thus can often narrow down the basic matching process from days to less than an hour. Says Dr. Lloyd R. Breslau, assistant director for Physical Science and Technology at the Coast Guard's R&D Center: "Any ship spilling oil in U.S. waters leaves a mark as damning as a fingerprint at the scene of a crime."

So far, the oil fingerprinting evidence has been used informally several times to convince polluters they were guilty beyond any doubt, leading to out-of-court settlements for cleanup costs. When the Key West spill case is tried, it will mark the first time the results of such scientific sleuthing have actually been tested before a judge and jury.

With Coast Guard scientists, however, reporting better than a 90 percent rate of success in matching samples from spills with original sources in over 100 previous episodes since 1973, Rear Admiral Austin C. Wagner, Commander of the Coast Guard's Seventh District in Miami, is confident when he predicts: "Oil fingerprinting can be expected to be used with increasing frequency to identify sources of future oil pollution." ★★



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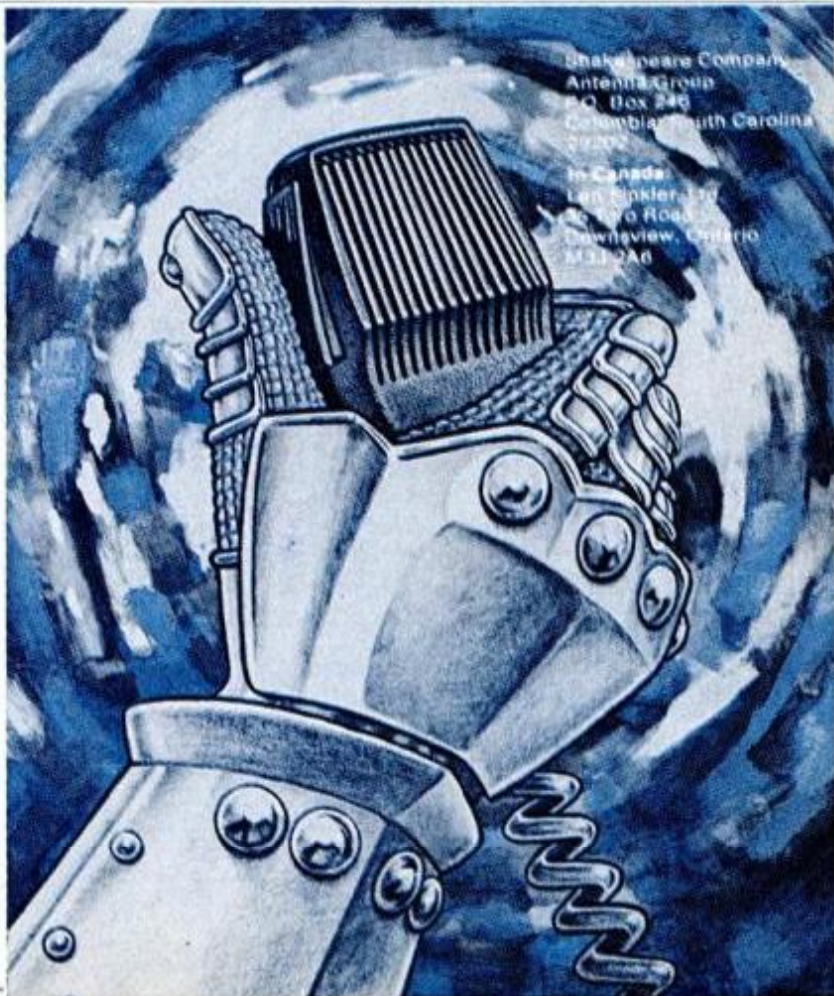
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Like I say, I took the course and it turned out to be even better than they



said it would be. Sure they pay me for writing this ad, but it ain't much, believe me. I could make more in a month by fixing things for the neighbors . . . and I'm not kidding. It's just that I believe in seeing guys make it on their own. If you follow the simple texts and the big pictures, you can be a technician in no time. They even send you a professional appliance tester with the course.

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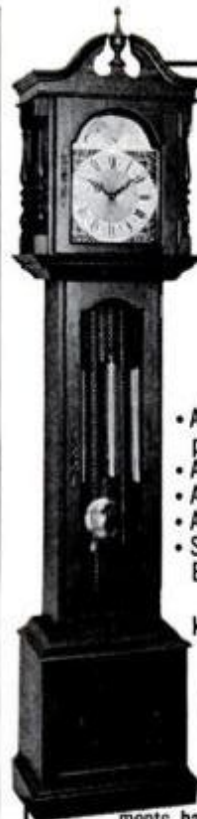
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Signs of the times point every which way

Road sign directions can be unbelievable. Here's the lament of one countrywide motorist

by Nino LoBello

Whether the type of highway sign found in Connecticut helped the state achieve the lowest automobile fatality rate in the country last year, I do not know. I do know that Connecticut's traffic signs are among the very best in the country and probably contribute to the state's admirable traffic safety record.

Until I had driven through each of the 50 states, I had always assumed that road signs were supposed to tell a motorist what to do so that he could go where he wanted to as quickly and as safely as possible. But I found otherwise. During a five-month auto trip, my wife and I drank in a lot of scenery, but what often gave us the jitters was the "signery." Although we never had to worry about bumping into a cow, we grew to fear America's misleading and often unsafe road signs. We discovered that you cannot always depend upon seeing the right markings in the right place, and that many signs and traffic signals invite accidents.

Having motored some 40,000 miles and visited nearly 200 major cities, I believe certain local governments deserve booby prizes for bad traffic signs, while others deserve "Oscars."

My nomination for the booby prize would go either to New York City or Dallas for what are probably the worst traffic signs in the country. On the other hand, I would award "Oscars" both to Los Angeles

and Houston. For entire states, my "Oscar" nod would go to either Connecticut or New Jersey for having the most readable and functional sign systems. West Virginia, however, rates a big boo for maintaining the most horrendous traffic directions of all. But West Virginia is not alone.

Too many cities and states suffer from equally abominable shortcomings. In too many places there are too many signs that are missing, badly damaged or defaced, while too many other signs are either too dirty or too smudged to be read. Nearly everywhere we found that the letters on signs are not large enough to be read at a great distance or at the legal speed limit.

There are, moreover, an untold number of signs which have too many words on them to be read at high speed. In Washington this type of overloaded sign is repeated a few

hundred yards down the highway to enable a driver to at least finish reading the message.

Blind signs

Finally, there are the most intolerable and yet seemingly the most common type of bad signs—those that are not properly lighted or reflective at night, making them not only difficult to read but difficult to see. I also shudder to think of how many signs are obscured by overgrown trees or are partially blocked or completely covered by other traffic signs, to say nothing of that Frankenstein of all roadway signs (of which there were multiple examples)—the sign that is just plain missing.

Such oversights can create havoc on the highway. Unread or unseen, a sign could mean a lost traveler, in some instances a lost life. Is it

(Please turn to page 194)



Art: Sandy Kossin

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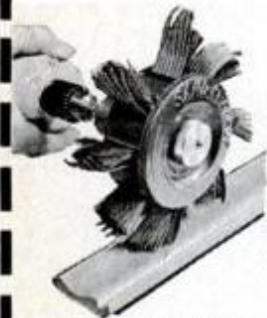
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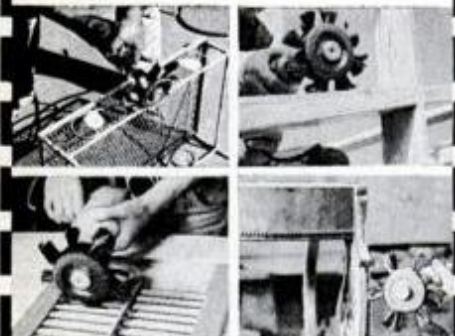
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SIGNS OF THE TIMES

(Continued from page 193)

any wonder that 12 percent of all fatal auto accidents involve out-of-state motorists? In the last 10 years, according to American Automobile Assn. figures, more than 475,000 U.S. motorists were killed, while 17 million other people were injured in car accidents. Although difficult to get specific statistics, the A.A.A. estimates that during the last decade there was about \$12 billion in property damage.

When you consider that four out of every five people old enough to drive have licenses, and that more than 82 million automobiles and another 18 million other vehicles are in operation, then good signs on our highways and in our cities are absolutely imperative. Consider also that 94 million Americans are expected to make extended driving trips sometime this year, racking up an estimated 3 trillion miles of travel on the 4 million miles of highways, streets and roads that lie across the country.

Yet in spite of the fact that America is truly a nation on wheels, it staggers the imagination to see that we are still plagued by antiquated, unreliable, misleading and poor traffic signs and lights, often bordering on the stupid.

In addition, driving from state to state, we found that highway markings are different and that traffic signals and signs have different meanings.

Good luck

Chicago has one of the most befuddling signs I have ever come upon. You would have to have a Ph.D. to understand just what is meant by the following:

EAST-NORTH-WEST HIGHWAY. After getting lost because of it, I asked and found out that it meant a driver could go east at that point on the Northwest Highway. That hyphen between the words *North* and *West* not only is, punctuation-wise, incorrect, but confusing.

And here's another baffler supreme found in Killington, Vt:

NO LEFT TURN INTO CLOVERLEAF ALLEY EXCEPT FROM THE MIDDLE LANE OF THE OUTER ROADWAY—SUNDAYS AND ALTERNATE HOLIDAYS EXCLUDED UNLESS CHURCH SERVICES ARE IN PROGRESS

On the Washington-Baltimore Parkway is a sign that reads:

INTERSTATE 495 (WASHINGTON BELTWAY) EAST-WEST NEXT RIGHT Unfortunately, the sign is placed at a bad spot. It is opposite the exit ramp for Greenbelt, Md., and every

month—I was told after I untangled myself from being lost—hundreds of drivers go up that ramp thinking they are about to enter the 495, whereas they are on the road to Greenbelt instead.

One of the traffic indications that has become standardized—well, 99 percent standardized—is the matter of putting the red light on top and the green light below it. Such a thing is a boon to motorists who are colorblind, for this enables them to know when to stop or go merely by noticing if the light on top or the light beneath is lit. Yet in Chicago I discovered that the green light was on top and the red light was on the bottom—just the opposite. I don't have any statistics, but I wonder how many colorblind out-of-towners driving in Chicago have been involved in major accidents because the traffic light colors have been reversed?

On the Ohio Turnpike, the first sign telling you to reduce your speed for your upcoming exit is posted too late. Before you know it, you are upon the exit. And to compound the error, the circular road leading you off is far too short, not to mention the most frightening part of all—the road curvature is too sharp. And where were the signs to warn you?

Thus, because of inadequate signs, you have a car reaching its exit at too high a speed with a turnoff stretch that is too short and dangerous because of the continued sharp curve. During our brief stay in Ohio we saw three trailer trucks turned over and their cargoes strewn about on Turnpike exit traps. It seems to me that Ohio could cut down on the danger potential of its Turnpike by posting the exit speed limit about a mile up the road before the exit itself—something which every other state in the union does.

Dallas goes down in my book as having the worst street and traffic signs of any city, with the possible exception of New York City. I can go easy on New York because it is my home town and am therefore familiar with its signs and/or lack of them, but if it were not for Dallas's below-par street signs, Fun City would get the booby prize.

Street signs in Dallas are poorly placed on poles. Quite often you will find no signs displayed. I remember one major six-corner intersection in the heart of the city where none of the streets emptying out into each other are marked. Residents of Dallas know which street is which among the six, but I did not, and even with a street map I got lost. Bewildered, I not only blocked traffic in trying to figure out where I

was, but I almost had three separate accidents before I scooted up one street just to get away.

Can't get off

With its inadequate traffic signs, Dallas also had the distinction of leading me, against my wishes, onto the Dallas-Fort Worth speedway where I then had to pay a toll to go where I did not want to go. Once on, I could not get off, nor could I make a U-turn to go back to downtown Dallas. At the point where I paid the toll, there was ample room and safe conditions for a car to make a U-turn, but the police had erected signs saying it was a no-no.

Ironically enough, the next day when I really wanted to go to Fort Worth and tried to follow some signs to take me to the speedway (the one I had tried to get off the previous day), I could not zero-in on it, even by asking questions of pedestrians who gave clear directions.

Dallas is also the city where one-way signs have been erected in such a way as to block your reading of the signs behind them. Also, when is Dallas going to replace those antiquated street signs which are (1) too small to read; (2) with print too light to read, and (3) totally invisible at night?

On the other hand, New Orleans seems to have given some thought to drivers' problems, but unfortunately one innovation just does not cut the mustard. I am referring to the city's frequent use of putting street names on vertical cement posts, with the words spelled out downward. Trying to read these vertically spelled names quickly, while handling a steering wheel, is Herculean.

Nice try

Jackson, Miss., also seems to have tried to give some thought to a motorist's easy comprehension, but like New Orleans may have overstepped its bounds. Certain areas of Jackson have come up with a variation on street signs—names painted on curbs. But in too many places a motorist cannot read the street name because (1) the paint has been worn off by weather; (2) pedestrians waiting to cross the street block your view, and (3) if you are in the left lane and a car is moving alongside on the right, you cannot see the name of the street.

In just about every city we visited, with one or two exceptions, we noted that "Reduce Speed" signs are rarely followed up by signs telling a driver to resume speed. This was especially the case whenever we had to slow down because of a school zone or hospital area.

On far too many U.S. highways, an arrow at turnoffs might indicate, say, Route 5 going in both directions (either left or right). But the sign will give no indication as to which way is north or south, or which is east or west. Although many people may have a good sense of direction and can tell north from south or east from west, there are still quite a few million motorists (myself and wife included) who cannot always figure out instantly which is which. If a sign tells a hesitating driver the difference between Route 5 East and Route 5 West, he will be sure not to make a mistake, nor will he hesitate on a main artery before making a turn.

No rest rooms

I think the West Virginia Turnpike was the worst toll road in the United States. I do not believe I have ever seen any major road as dangerous and as bad. Here is a high-speed superhighway that keeps changing from one lane to two lanes to three lanes, which forces you to weave from the right lane to the left lane and again into a middle lane, even though you may not have wanted to shift lanes at all. Turnpike signs never announce how many miles the next exit is, nor do they tell about upcoming curves (and there are plenty of them as you drive through this Appalachian region). Insofar as I know, there are no service stations on the Turnpike where you can stop to get gasoline or find a rest room.

Despite Connecticut's superior "signery," its Merritt Parkway, one of the most highly traversed roads in the United States, is dangerous because there is no painted white line to separate the lanes going in the same direction. To add to the danger of two cars sideswiping each other (especially at night when a motorist has to guess if he is in his own lane) is the line cut into the asphalt. Should an out-of-towner innocently use this cut line to guide himself on the assumption he is keeping himself in lane, he will discover that every so often he is "out" of his lane and that he is now an easy target for someone's bumper. Since reflectors are sadly missing along great stretches of the Merritt, you are forced to use bright lights to see where you are going, even when traffic is coming at you from the other side of the road.

Needed facts

However inadequate many of our traffic signs may be, there are in some locales a number of excellent ideas and innovations in use.

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(Please turn to page 196)

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SIGNS OF THE TIMES

(Continued from page 195)

especially in the downtown sections of our major cities, is the kind of street sign I discovered in cities like Los Angeles and Houston. In the middle of the block the motorist is informed by a large-lettered sign of the name of the street upcoming at the next corner. How wonderful for a stranger in town to know before he actually comes to an intersection whether or not he should be getting into the right or left lane to make a turn.

The signs on too many freeways in some cities do not give information as to what streets or exits or connection points are upcoming. This leaves many out-of-town motorists in the dark. Both Chicago and Los Angeles do a good job of providing such facts.

New Orleans has a particular gimmick that should be adopted universally. There are no left turns allowed at major intersections downtown, but provisions are made for a left turn immediately after the intersection. By staying in the left lane, you come upon a protected left turn lane that curves into the other side of the road. This takes you back to the intersection you wanted to turn left at, but now since you are turned the other way, you have only to make an easy right turn. (Shreveport, La., by the way, allows a driver to make a U-turn on its speedway, using something like the New Orleans left-turn lane and curve.)

Other cities solve the left-turn-at-an-intersection problem by staggering the traffic lights. Virginia's Richmond and Lexington have a delayed green light setup (also known as "advance green") which moves traffic beautifully and cuts down on accident possibilities. If you are the left-turning motorist, the light will change to green for you (sometimes with a green arrow) while cars facing you on the other side are kept waiting because their traffic signal is still red.

Map City

Lexington also has a new wrinkle that deserves attention. On the outskirts of town you will see a sign on a major highway saying: MAP 1000 FEET AHEAD. Sure enough, you soon come upon a billboard-sized map, off the road and with ample parking space. "You are here!" says the printed legend next to an arrow. Variations of this are to be found on entering such states as Florida and Texas, which provide tourist centers, free maps plus up-to-date and accurate highway information.

Another thing that could be copied

all over the nation is a method used in both Winston-Salem, N.C., and Austin, Tex. Overhead traffic lights in the center of the road also bear the street name. That way a motorist does not have to slow down at the intersection to find the name of a street posted at one of the four corners.

Even better, Salt Lake City has a system on street signs that is highly commendable. Nearly all of the



streets are numbered or lettered and categorized according to North, East, South and West. Thus, if you want to go to the city's Pioneer Park at 4th South St. and 2nd West St., you need not scratch your head or stop to ask somebody. Merely follow the logic of the street signs—they tell you in what sector or quarter of the city you are. Hence, you will know in which direction to go according to the street numbers and the points of the compass.

Block system

A variation of this type of street sign and street setup, which provides virtually instant map orientation to any driver, is to be found in Denver, as well as in a number of other cities. The street sign on every corner tells you which "hundred block" you are passing, thus giving an out-of-towner an immediate address reference to the house numbers to be found on that block. Also, for driving convenience, how easy it is to be given a direction which sounds something like this: "Follow Sheridan Boulevard to the 1200 block and turn right." Thus you know how many blocks you have to go before making your right turn, since simple arithmetic tells you when the 1200 block will come up.

Reno has a roadway warning signal relating to school areas that should be put in everywhere. For four hours every day during the school year a "Priority School Children" alert goes into effect. From 8:00 a.m. to 9:00 a.m., from 11:00 a.m. to 1:00 p.m., and from 3:00 p.m. to 4:00 p.m. traffic signs near the schools light up, reading: SCHOOL

SPEED LIMIT 15. At other times the sign panels revert to reveal the standard speed limit of 40. A built-in time clock changes the messages automatically.

Good clue

Another idea that rang bells with me in quite a few cities is having the size of the red light much bigger in format than the green, making it more visible from afar—not to mention the break it gives color-blind people. Still another red light variation is the law in both Texas and Florida that allows a motorist to make a right turn while the red light is still red after a mandatory full stop.

The Nimitz Freeway near Oakland, Calif., bears raised reflector lane markers, "bumps" in the asphalt that serve as markers by day and as a line of reflectors by night. They also provide an added safety factor by creating a "rumble" as a car drives over them, telling the driver that he has strayed out of line. A number of U.S. cities have a variation of this that strikes me as being quite good—the use of raised markers or ridges across the whole road in front of him to warn that something coming up is either a full stop sign or a traffic signal.

One way that could surely diminish accidents at busy intersections is what Abilene, Tex., has done with a "countdown amber traffic signal." As you approach the light when it is green, it looks like an ordinary traffic signal, but 10 seconds before it is due to change to red, an amber light comes on, blinking numbers from nine to one at one-second intervals. Printed a foot high, the countdown numbers are visible for about 200 feet. This method tips off motorists, letting them know in advance whether they have time to make the light.

If the above suggestions to improve the "signery" are not put in operation in other cities and states, I think the U.S. traffic sign system contributes to making a long auto trip the American version of Russian roulette.

Perhaps the point was best brought home when, toward the end of my U.S. swing, I visited a traffic-control officer in one of the Eastern seaboard jurisdictions. He related a recent experiment undertaken by a highway department in a bordering state.

Several groups of government employees were given maps and directions for a trip. Sent off into the night, nearly every crew got lost during the first hour, but one crew lost its way nine times. In each case they reported that the errors were caused by faulty signs. ★ ★ ★

CAR SAFETY

(Continued from page 107)

cost to the consumer is often not apparent to him. So he finds it hard to understand why the industry is opposed to something that seems to increase safety. Not until introduction day when his car costs \$100 to \$300 more does he know that something's happened. But then it's too late.

Chrysler: We don't have any evidence whatsoever that roofs being crushed are a major cause of injury or death. We *do* know that people are killed in roll-overs when they ejected from the car. How strong should the roof be? We feel that roof integrity is satisfactory today. No one has been able to measure any benefit out of having side door beams. Today General Motors, which introduced that extra piece in the door, is criticizing it, saying it doesn't offer any benefit. It seems clear there's nothing left but the regulation to keep this extra piece which costs you several dollars and several pounds in extra weight. It's there because of a regulation that had no justification to start with but *might* help make cars safer. If we kept on writing regulations on that basis, where would we end?

Ford: We can't find any evidence that they would have any substantial effect on the safety of automobiles.

General Motors: The roof strength standards seems simple: The upper corner of the windshield must have a certain strength as measured in a laboratory. Everyone knows roll-overs are dangerous and that if the roof isn't strong enough you're going to get hurt. But our position is that there are no data that show that additional strength is important to the safety of the occupants. We've been building cars a few years; we know how strong the front of that car needs to be. The government says: "We want it stronger." We have shown by tests and field data that there's no evidence to support the government's position for that much strength in the upper corner of the car. Nevertheless, we're not saying that the standard should immediately be canceled. We're saying let's put some effort into looking at the field data in greater depth and find out if our studies are correct or not.

GM added the side beam to doors because we thought it would be helpful. The government immediately made it a standard and made every company put in the beams. We're now studying field data and it's difficult to determine whether it's worth that much weight. We're not certain that the tests required by the standard are the right way of defining what

the side protection should be. Is the lab-pressure test on the door really improving the safety of the car, or is the test making it do something to save the car but not the occupants?

■ How can the car buyer voice his opinion about what should go into his car?

American Motors: He can't always effectively express his reactions to standards. When the item is visible, when the impact is clearly negative and there are enough people who feel that way, then something can be done. But when the item is not visible to the consumer and it's not clear to him that it's harmful, then nothing will be done. But when there's a ground swell of unhappiness that results in letters to congressmen to the effect that "this regulatory agency has overstepped itself and gotten into where I live," then the results are very effective—as in the case of the ignition interlock reaction.

Chrysler: Regulation robs the buyer of freedom of choice because somebody else decides what he ought to have, what he ought to pay. This has been going on for 10 years. Before that, carmakers were competing, trying to figure out what they could put in their car to make people buy it rather than their competitor's. Today we have the government deciding what ought to be in cars—whether people want it or not.

Ford: When there's a pending regulation that will add appreciably to the cost of the car, the buyer should be told what's involved. Some of the confrontation between the industry and the regulators has been on that issue. The automakers have said in effect: "There are many things we can do, but they'll increase the cost of the product and we wonder if you have the backing of the consumer because you haven't *told* the consumer that you're going to cause this increase." That's why we're insisting that they develop some sort of cost-benefit relationship prior to promulgating a new safety standard. It's difficult to quantify the benefits in dollars, but there can be some sort of sensible relationship established and the Department of Transportation is now starting to do that. Hopefully, in the future the cost-benefit support for a proposed regulation will be something we can know about and react to. It would be well if consumer groups were more responsive to the cost-benefit implications prior to the completion of rule-making.

General Motors: The most positive way is for the car buyers to make his concern—either support or challenge—known to his congressman. ★★★

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HOW TO REPLACE YOUR EXHAUST SYSTEM (Continued from page 111)

Comets and Mavericks with eight-cylinder engines, single exhaust systems and no catalytic converters.

Procedures basically similar

No matter what kind of car you own, you will find many similarities and few minor differences between the procedure you have to use and the procedures outlined here.

To replace the exhaust systems of Valiants and Darts with six-cylinder engines and without catalytic converters:

1. **Disconnect the two nuts** holding the exhaust pipe flange to the exhaust manifold. Discard the gasket.

2. **Remove the two U-bolt nuts** of the U-bolt holding the front of the exhaust pipe at its neck.

3. **Inspect the exhaust pipe U-bolt** and U-bolt hanger assembly, and replace it if damaged or deteriorated.

4. **Turn your attention to the muffler**, and note that the muffler and exhaust pipe in this car is an integral, one-piece assembly. When you have to replace one, you have to replace both.

5. **At the rear of the muffler**, remove the U-bolt holding the muffler and tailpipe together, and slide the muffler forward, disengaging it from the tailpipe. Lower the muffler and exhaust-pipe assembly to the ground.

6. **Inspect the muffler-tailpipe U-bolt** and U-bolt hanger; replace it if damaged or deteriorated.

7. **Remove the bolt** holding the tailpipe support to the car's frame and lower the tailpipe to the ground.

Some models have a resonator as an integral part of the tailpipe. If either has been damaged, both have to be replaced.

8. **Inspect the tailpipe support**, and replace it with a new one if the support is damaged or deteriorated.

9. **Begin installation** by attaching the exhaust pipe to its U-bolt. Engage the U-bolt nuts loosely.

Caution: If the exhaust pipe and muffler are an integrated unit, be sure to support the muffler in some way as you work on the exhaust pipe, so the muffler doesn't fall and get damaged.

10. **Install a new gasket** at the exhaust pipe flange and exhaust manifold connection. Engage the two connecting nuts loosely.

11. **Notice the small pipe extension** at the rear of the muffler. Engage it in its U-bolt hanger assembly and connect it to the tailpipe as securely as possible.

12. **Secure the tailpipe** to its support, engaging the bolt loosely.

13. **Install the U-bolt** at the muffler-tailpipe joint and engage the two U-bolt nuts loosely.

14. **Coat all joints** with exhaust-system sealer, and make certain the entire exhaust system is properly aligned so there is no strain on any part before tightening fasteners. If you have a torque wrench, here are the specifications to follow:

- Exhaust pipe-to-exhaust manifold nuts: 35 ft.-lb.
- Exhaust pipe U-bolt nuts: 95 in.-lb.
- Muffler-to-tailpipe U-bolt nuts: 150 in.-lb.
- Tailpipe support bolt: 200 in.-lb.

Tackling 8-cylinder systems

To replace the exhaust systems of Granadas, Monarchs, Comets and Mavericks with eight-cylinder engines, single exhausts and no catalytic converters:

1. **At about the middle** of the crossover pipe, remove fasteners from the hanger that holds the pipe. Support the pipe to keep it from falling and being damaged as you continue your work elsewhere if the pipe can be salvaged.

2. **Remove the nuts** attaching the crossover pipe to the resonator inlet pipe, and remove the nuts attaching the crossover pipe flanges to the exhaust manifolds. This releases the crossover pipe, which can now be removed.

3. **Notice that if this is the car's** original exhaust system the resonator inlet pipe, resonator, resonator-to-muffler pipe, muffler and tailpipe are all welded together in an integrated unit. It is removed by removing the two bolts holding the resonator to its hanger assembly at the rear of the resonator.

4. **At the rear of the muffler**, loosen and remove the two bolts holding the muffler-tailpipe to its hanger assembly. The assembly is now free and can be removed.

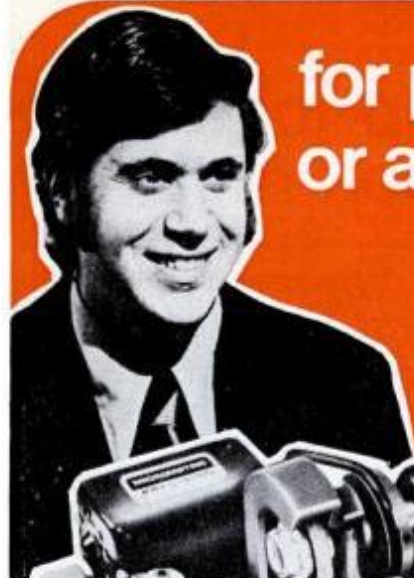
5. **Inspect hangers** and replace any which look shot.

Important: Replacement exhaust system parts for these cars are normally provided in separate, rather than integrated pieces, which are secured together with clamps. The parts normally furnished are exhaust pipe, resonator and resonator inlet pipe, muffler-tailpipe assembly, and crossover pipe.

6. **Begin reassembly** by attaching the crossover pipe loosely to its hanger and connecting the crossover pipe flanges loosely to the exhaust manifolds.

7. **Connect the resonator inlet pipe-resonator** assembly to the rear

(Please turn to page 213)



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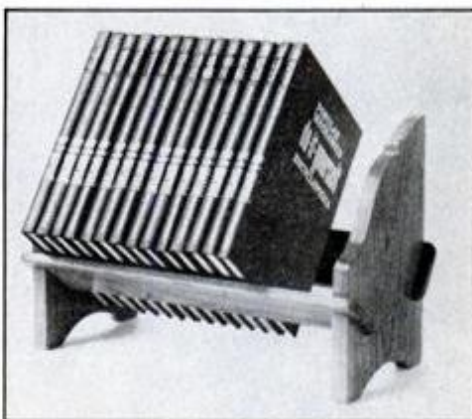
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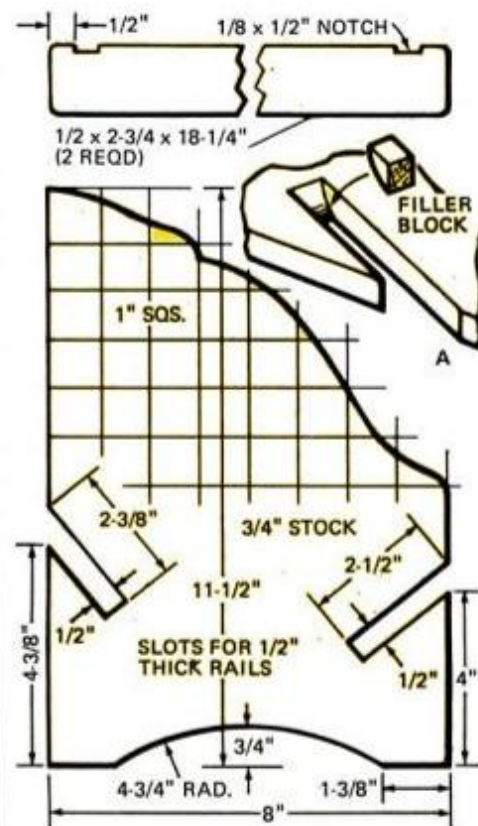
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WORKSHOP SPECIAL

Slip-joint book rack



You may prefer it for books, but we think it's just right for all those magazines that pile up around the house. It can be built in a couple of hours from the plans below. Cut the ends from 1x8 cherry or other hardwood with a bandsaw, jigsaw or saber saw. Crosspieces of 1/2-in. stock fit into the end-piece slots, which are easily cut with a dado blade (set for a 1/2-in. wide cut) on a table saw. Set the miter gauge to 35° and make the cuts with the outside surface of the work facing up. Fill the curved kerf left by the dado blade at the end of each slot with a small block (detail A). —Rosario Capotosto



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PRESERVE YOUR FAMILY PHOTOS

(Continued from page 109)

til there's no residual hypo in the print or its paper backing.

The best print washer around is made and distributed by the East Street Gallery in Grinnell, Iowa. (It also puts out an excellent book of information on archival processing, treatment, storage and formulas.) Mechanical washers, rotary or rocking, are not very efficient: They don't replace water very quickly.

You can wash very well in a tray, but it takes more effort. Use a tray one size larger than the largest print you're washing, wash no more than 12 prints at a time, and fill the tray just deep enough to easily cover the top print.

With prints face up, slide the bottom print out, drain it outside the tray, and set it face up on top of the stack. Continue to do this until the print that was originally on the bottom is now on top for the second time. Drain the water, refill the tray, and start over. Repeat every five minutes for an hour.

■ The best way to dry prints is first to squeegee excess water off the print with a rubber blade or roller used *only* for prints that have been archival washed as described above—other prints might leave chemicals on the squeegee. Air-dry prints face down on neoprene or fiberglass screening bought at a hardware store. Stretch the screening over frames for flatness, then stack them, with air spaces between, in a box like East Street's dryer (page 109) or hang the frames in a stack from your ceiling—not in your darkroom, where chemical dust is in the air. Prints dry flattest in warm, humid air.

New, plastic-coated RC printing papers soak up less chemicals, take less time to process (about 40 percent less fixing, 80 percent less washing, and 25 percent less developing) and will probably last longer than conventional papers. Dry RC papers face up; don't stack them until totally dry.

■ Protective solutions such as gold, sulfur or selenium toners, or Kodak's GP-1 solution, are a further precaution for long print life. Large photo stores usually stock toners or books that tell you how to make them.

■ Color prints are most stable when processed correctly; you can also rewash commercial prints and soak them in their appropriate stabilizers (look behind the print to find which paper was used, then use the stabilizer made for it). But if you really want to pass these pictures on to posterity, make stable, black-and-white copies of them. ★★

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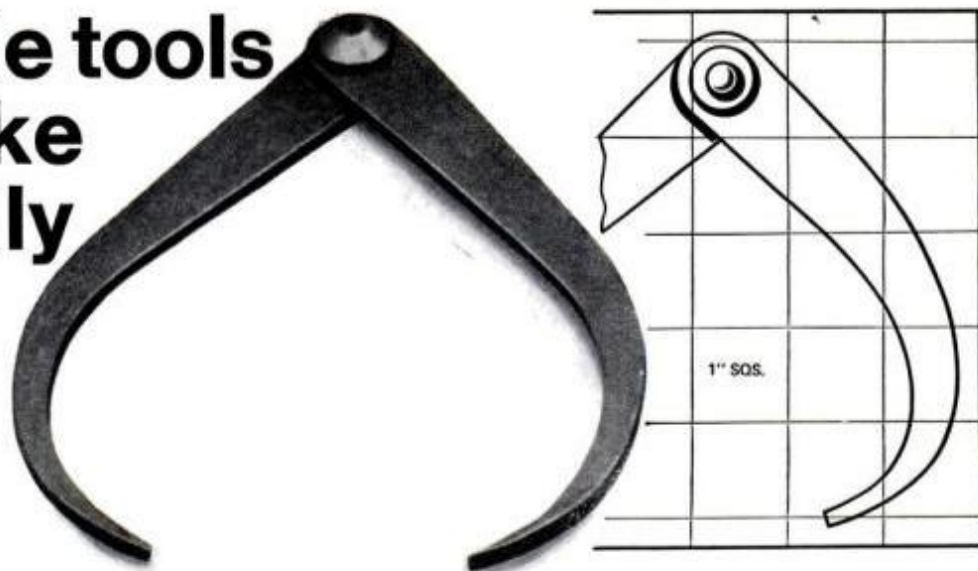
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HELPING TO DEVELOP AMERICA'S TECHNOLOGY FOR OVER 30 YEARS.

8 homemade tools you can make for practically nothing

by David Warren

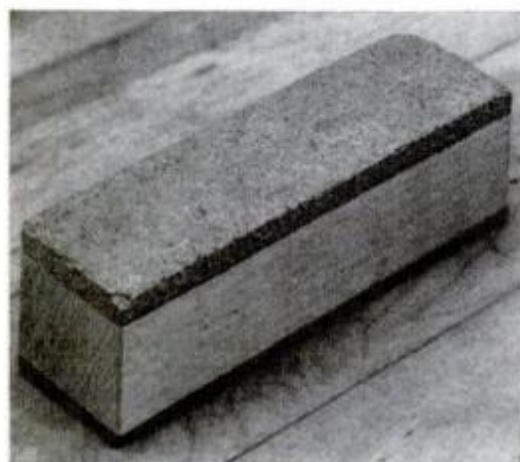


There are any number of hand tools and fixtures you can make for little or nothing. The eight shown here will prove extra handy at your drill press, lathe and bench. Among them is a fixture called a bench hook that hooks over a bench to hold small work for sawing, filing and the like. Shown in its simplest form, it can be made in a few minutes.

Another simple item to make is a V-block which is used to cradle and hold dowels and other round turnings when the job calls for drilling a hole through a piece dead-center. Old worn-out bastard mill files makes great scraping tools for woodturning when bevel-ground and fitted with a long handle. And you can't beat a pair of friction-type calipers for fast adjusting. It's a tool you can make from a couple of pieces of flat metal and a rivet. ★★★

Friction-fit calipers are fast-adjusting

If you have a wood lathe and haven't bought a pair of calipers, don't. You can make a dandy 6-in. pair of friction calipers for far less than you can buy them. They're fast-adjusting for you simply pull them open or squeeze them shut. The legs are held with a round-head rivet and spring washer. Make a pattern following the drawing above on blue $\frac{3}{16}$ -in. Starret-ground flat stock. Scribe the outline on it and cut out with a metal-cutting blade. Finish the sharp edges with a file. Be sure to use a spring washer under the rivet to provide the necessary friction fit.



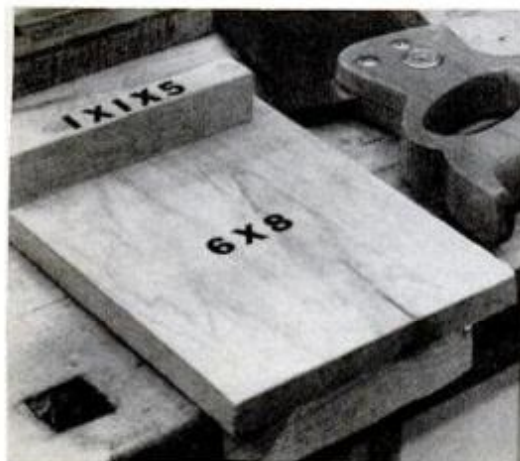
Two-faced sander

With $\frac{1}{4}$ -in. cork glued to one side and $\frac{3}{16}$ -in. leather to the other, this sanding block keeps sandpaper from clogging and glazing. A $1 \times 1\frac{1}{2} \times 5\frac{1}{2}$ -in. wood block fits the hand nicely and is the right size to take a quarter sheet of sandpaper. Use white glue to attach the leather and cork facings. Your hand holds the paper when you grip the block.



Lathe chisels from old files

You can make a scraping tool for your lathe from an old file, particularly useful when you want a shape that's not standard. If the file is long, shorten it to about 10 in. by snapping it off in a vise. Grind it smooth at the tip, then grind a 60° bevel. Hone the bevel on a coarse oil stone, but don't remove the wire edge—it helps the scraping action. Fit it with an 11-in. hardwood handle.



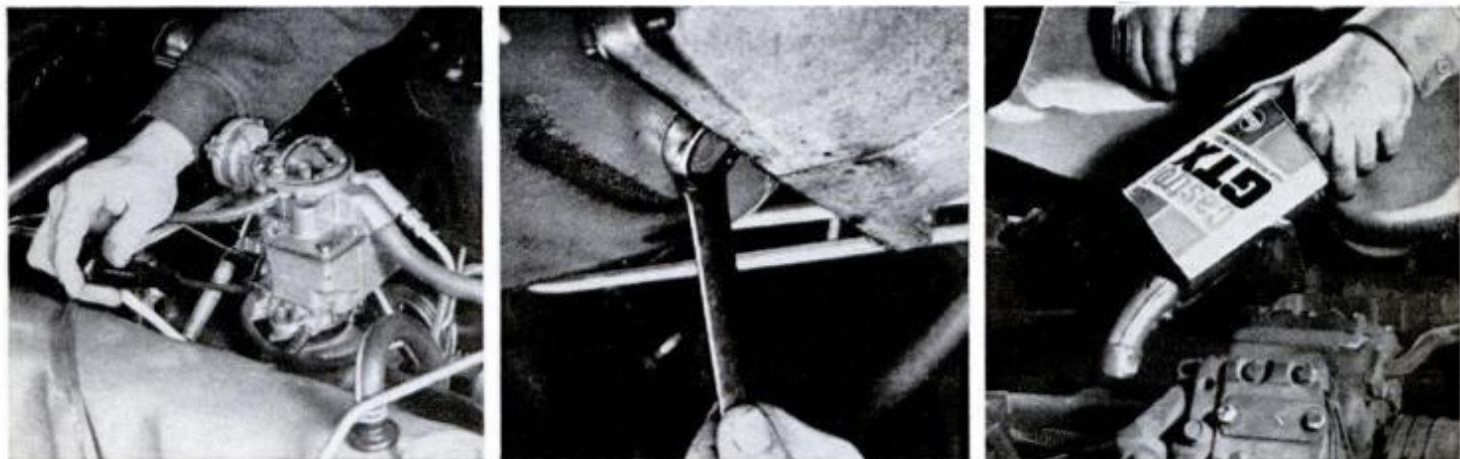
Handy bench hook

For hand work at the bench you can't beat a bench hook for holding work and protecting the bench's top. Generally it is used with a backsaw, but you won't be using it just to saw—you'll be filing on it, chiseling and the like. It's nothing more than a flat board with cleats attached to opposite sides and ends so you can flip it over and use both sides. It's easy to replace.

(Please turn to page 204)

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Save that broken sledge handle

When you're swinging a sledge and wind up with a handle in your hand and no sledge, don't toss it away. The broken handle from a sledge, ax or ball bat provides the best kind of wood (hickory and ash) for turning new handles for files and beat-up chisels. The handle for a socket chisel is a simple tapered turning, and when fitting a handle to a chisel with a tang, you can size the collar for a drive-fit ferrule cut from thinwall conduit or brass tubing. Apply a 50/50 solution of shellac and linseed oil to the wood and that old chisel will be as good as new.

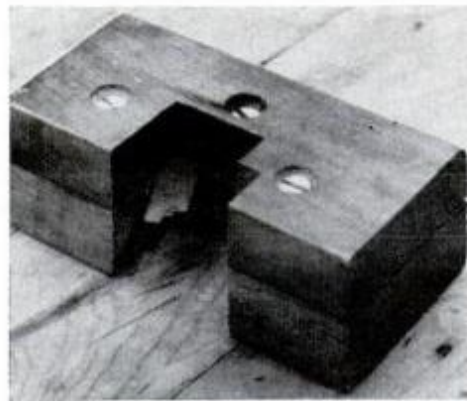


Your drill press should have a V-block

V-blocks are needed at the drill press to hold round stock securely and facilitate drilling through the exact center. To make one, cut a 1 x 2 x 6-in. hardwood block and run it through your table saw with the blade tilted 45°. Then run it a second time to form a V-groove. If you lack a table saw, you can mark the V and cut it by hand with a backsaw. Finish with shellac and bore a hole in it to hang by your drill press.

Scratch stock forms bead by scratching surface

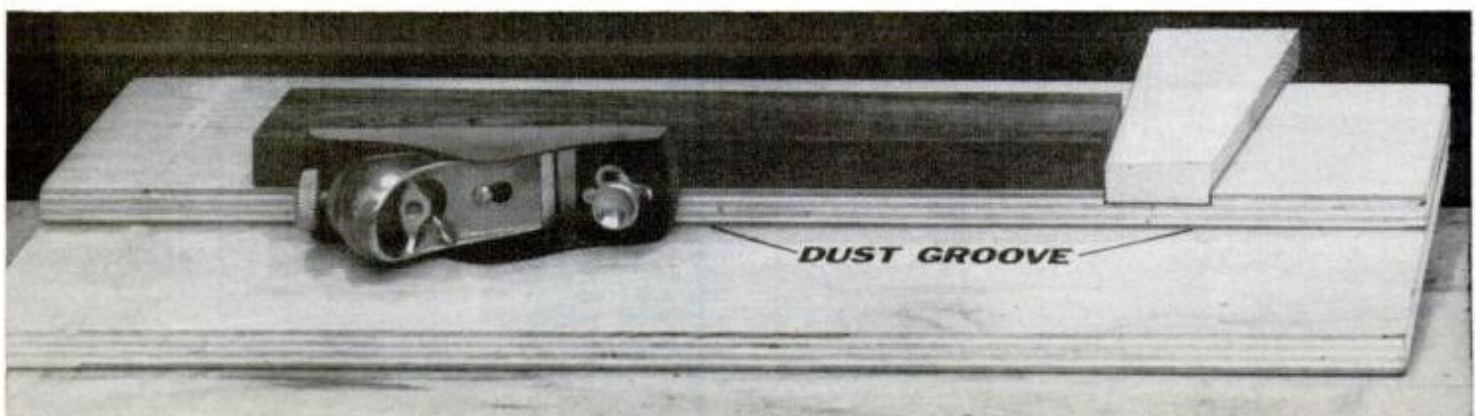
When you want to form a small bead along the edge of a table leg or apron, you can do it with a homemade tool called a scratch stock. It's made to fit over the edge of the work and cuts by scraping. All it consists of are two pieces of wood with a blade clamped between. The blade is made from a short piece of hacksaw blade ground to the shape you want. The photo shows the blade pulled out so you can see it. In use, only the tip is exposed in the very corner of the U-shaped block. It makes the neatest beading you ever saw.



Shooting board produces square edges

A shooting board is a handy gadget for squaring the edge of a board when you don't have a jointer. Like slicing cheese, the plane is used on its side and is pushed back and forth along a wood fence. The work

is placed against a stop and on top of the fence. The plane removes the stock overhanging the fence and planes it perfectly square. The tapered stop fits a tapered dado and wedges in place. The lower edge of the fence is chamfered to form a dust groove.





New little Olympus does a very full-sized job

by Ivan Berger
PHOTOGRAPHY EDITOR

Photos: Benn Mitchell

The first thing anyone ever notices about an Olympus OM reflex is its size—shown life-size here, it looks bigger than life till you compare it with another camera. But the features are even more worth noticing—especially those hidden within the new, automatic, Olympus OM-2.

The OM-1, with manual metering, was basically a conventional reflex made smaller (though with a bigger, brighter viewfinder than most) and quieter; otherwise, its most unconventional feature was provision for interchanging viewing screens without removing the built-in viewfinder prism (page 160, Oct. '75).

The OM-2 is precisely the same size as the OM-1, weighs just 10 grams more—the weight of two nickels—and has virtually all the OM-1's features, plus a second, independent metering system that's truly unique.

Normal metering

Most 35-mm single-lens reflex cameras having cadmium-sulfide

Less size, more features seem to be Olympus's motto. Even my average-sized hands dwarf new OM-2, shown life-size (for comparison, lay your camera over it).

(CdS) light cells in their viewing screens, mirrors or prisms to measure the light coming through the lens. The OM-2 uses just such a system to drive the meter visible in its viewfinder. In manual metering mode, you adjust your f-stop and shutter speed until the needle is centered between two triangular markers at the left to the field (when the meter's off, the markers disappear from view). Switch to "Auto" metering, though, and a new scale pops into view to indicate approximately which shutter speed the camera will automatically select when you click the shutter.

Metering backward

The shutter-speed indication is only approximate, though, because the metering system that controls the needle is not the one that actually controls the shutter. The light cells for the automatic exposure

(Please turn to page 206)

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NEW LITTLE OLYMPUS

(Continued from page 205)

system are new "silicon blue" types, more sensitive and faster-acting than CdS cells. Instead of through the lens, the cells point backward, toward the film plane.

At shutter speeds of 1/30 second or slower, when all of the film is uncovered by the shutter at one time, the cells read the light actually reflected back from the film; at speeds of 1/60 or faster where the film is never wholly uncovered, the cells read light from a pattern of white dots on the black shutter curtain that averages out to the same reflectivity as film.

The disadvantage to all this, of course, is that the silicon cells see nothing till the mirror lifts and the finder goes dark—which is why there's still a CdS system to run the meter in the finder. But the advantages are manifold.

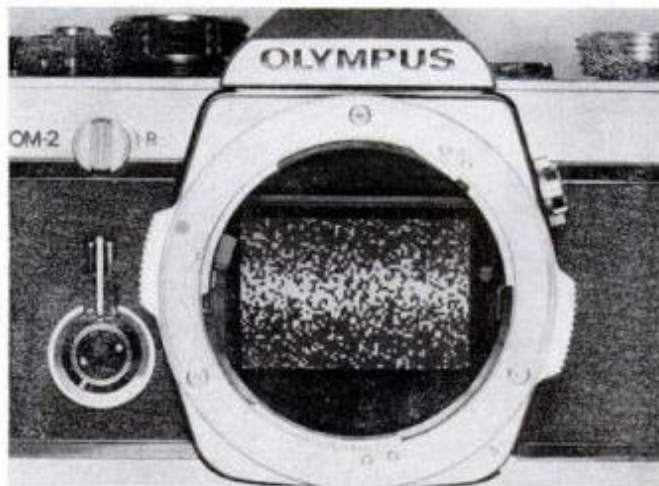
Theoretically, the closer to the film plane the measurement is made, the more accurate it will be. More important in terms of accuracy is that the measurement is made as close as possible to the actual time of exposure, so that if lighting conditions change while the shutter is open, exposure will be lengthened or shortened accordingly. So if one

of your lights burns out during a time exposure, or if the sun comes out from behind the clouds between the moment that you press the button and the time the shutter opens, your exposure will still be correct. Even when shooting with the optional, five-frame-per-second motor drive, each frame will get exactly the right exposure.

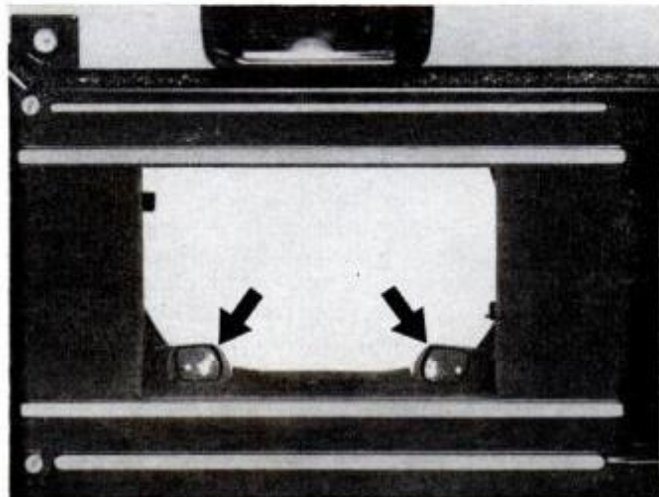
The system is even quick enough to work with flash exposures as short as 1/40,000 second. A special-flash shoe screws into the top of the OM-2 to link its meter system to a special flash gun (not yet available in the U.S.). When enough light has hit the film for proper exposure, the meter will tell the flash to turn itself off.

Electronic shutter, too

Most cameras with automatically controlled shutter speeds have elec-



Top view shows new meter switch (to left of prism), film-speed and exposure adjustment knob (to right of prism). Shutter-speed dial is ring around lens mount. Holes atop prism are for special flash shoe (see text). Inside, two silicon blue meter cells in film chamber (left, below) point backward toward film plane. For speeds from 1/60 to 1/1000 second, they read light reflected from white dot pattern on shutter curtain (left); for slower speeds, they read light reflected from the film itself.



tronically controlled shutters, and the OM-2 is no exception.

One reason is the ease with which such shutters can be controlled by a meter's electrical output. Another is that electronic control can be stepless, so that the meter can select not just the standard 1/30 or 1/60 second, for example, but any precise in-between speed—say, 1/47—needed for correct exposure. And the control range can be long (up to 60 seconds under auto control).

Electronic circuits are also at least potentially cheaper and more



New accessories include auto-flash (below), which OM-2's built-in light cells can control, and new single-shot motor drive (above) for OM-1 and OM-2—but high-speed motor drive is virtually as small.



reliable than the gear trains and escapements controlling regular shutters. Certainly, they make a bit less noise—without the buzz of timing gears during long exposures.

But electronic shutters do have an Achilles heel—batteries. If the battery goes dead in an ordinary camera, the meter stops working, but you can still take pictures. With an electronic shutter, though, a dead battery means a dead shutter (or, at best, one which will only work at one or two speeds). With dead batteries, the OM-2 will only operate on Bulb.

Olympus predicts, however, that the two 1.5-volt batteries used will last about a year. Even if you leave the camera turned on when it is not

in use, the battery drain is low.

Also, there's now a battery check (the one feature I felt was missing from the OM-1), and a very clever one, at that: an LED that not only glows when the batteries are good, but blinks when they have only enough juice left for about 10 rolls. That gives you plenty of warning to buy extras. The LED is near enough to the finder to be seen from the corner of your eye—but buried when the case is on the camera.

Just a few other differences remain between the OM-1 and OM-2: The metering system now includes a dial for deliberate over and under-exposures in 1/3-stop increments over a 4-stop range. A frame on the back of the camera holds a film-box lid as a reminder of what film is loaded. And the OM-1's least needed feature, the mirror lockup switch, is not found on the OM-2.

Aperture preference

Most reflex cameras with electric-eye are, like the OM-2, "aperture-preference" types: You set the aperture and let the camera pick a shutter speed.

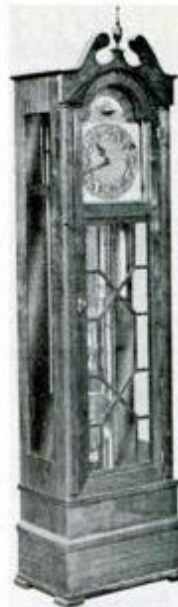
What it's like to use

The OM-2, like the OM-1, is easy to hold and carry and fairly quick to focus. The only disadvantage of its small size is that I have to swing it slightly away from my face when winding film so the lever will clear my glasses; with smaller glasses, or none, or a narrower face, I wouldn't have this problem.

Automatic metering makes it quicker to operate—instead of adjusting the camera till the needle is centered, I just glance to make sure that the camera's in auto mode and that I'm at a decent shutter speed (the scale, however, is a little cramped for quick reading).

This auto meter is the "aperture-preference" type—you pick the f-stop you prefer and the camera picks the shutter speed. I like that for available-light work (which I do a lot of), because it doesn't make me choose between a dark but sharp 1/30 second or a light but shaky 1/15—if 1/20 or 1/25 will do the job, that's the shutter speed I get. It also works in copy and close-up situations, and for time exposures.

I'd prefer shutter-preference automation, though, for action photography; that way I know I'd get an action-stopping shutter speed even if my subject went in shadow. The ideal would be a camera that offers both types of automation, and there are rumors that at least one is in the works. ★ ★ ★



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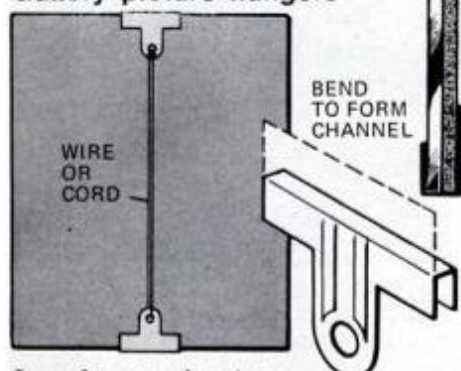
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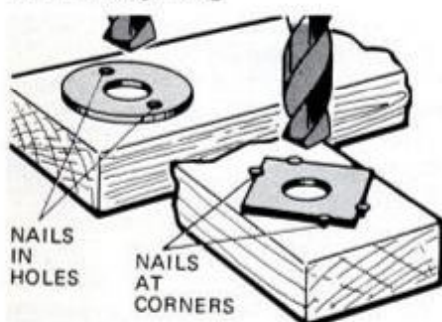
FROM READERS

Gallery picture hangers



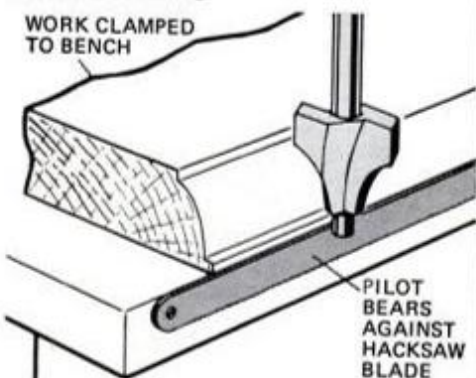
Jaws from spring-type paper clamps make neat gallery-type picture hangers. Bend them as shown to hook over glass, picture and backing, tie together with cord or wire, and hang by top eye.—*Jeff Hurn*

Hold everything



To enlarge the hole in a steel washer with my portable drill, I knew I'd have to hold it somehow. So I drilled two holes in it, nailed it to a board, stood on the board and drilled. For a square one, I'd place nails at the corners.—*Robert A. Blair*

No-rub routing



The pilot on a router bit will leave its mark on soft wood, but not if you tack an old hacksaw blade to the edge of your bench flush with top, and clamp workpiece to bench even with blade. Now pilot bears against blade, not the wood.—*W. C. Park*

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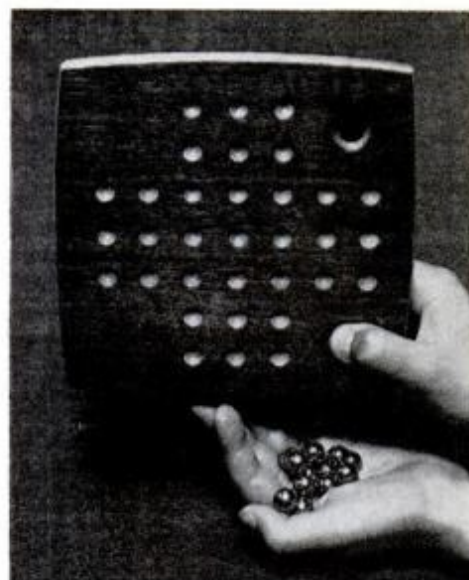
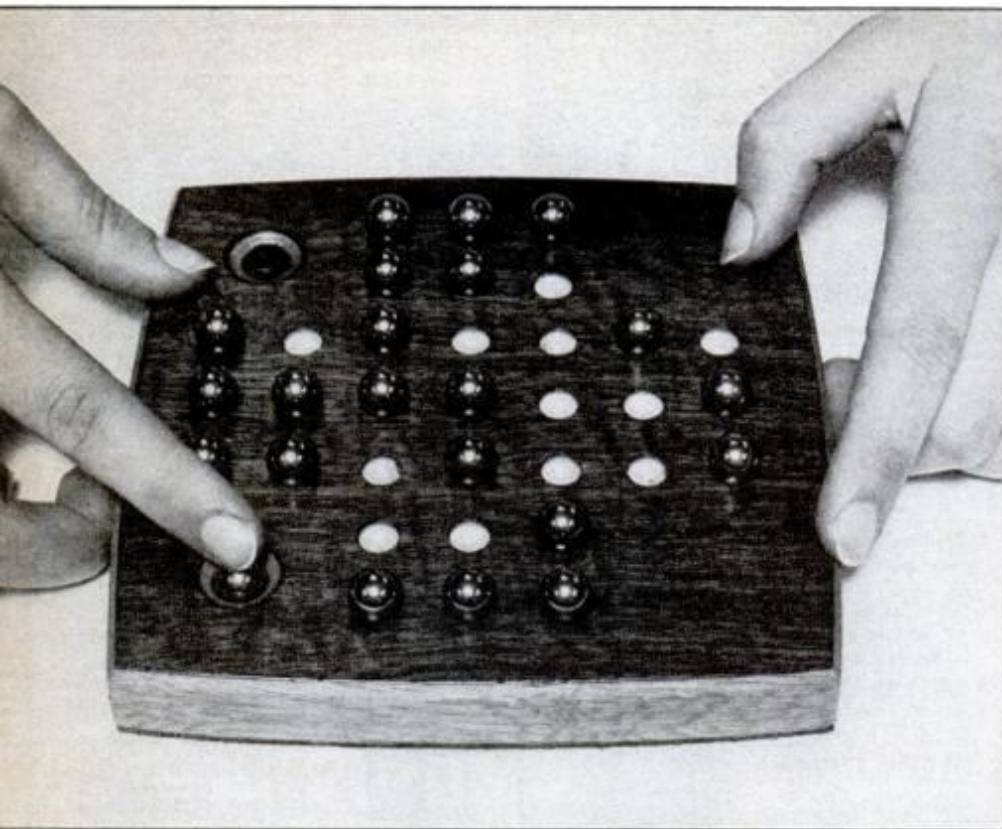
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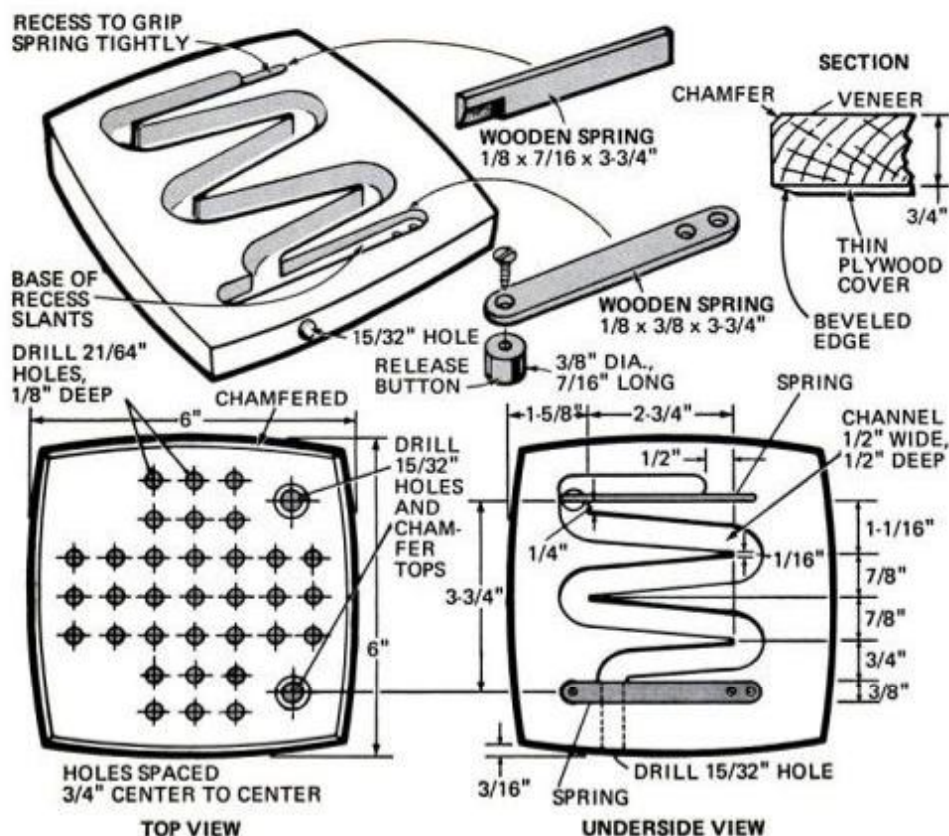
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Jumped balls are stored one by one in the base through a snap-fit hole in the top (left). Press release button (above), and the 32 balls pour out hole in the edge.

Travel solitaire— a game you'll learn to hate

by Kenneth Wells



Clearing the board of all balls except one by jumping one at a time may look easy, but try it. Mathematically it can be done, but after repeated attempts you may begin to think otherwise. The game is based on the fact that there are 33 holes in the board but only 32 balls, so you have one hole left open to start your jumping. The trick is to find the proper jumping sequence—and the possibilities are almost endless.

Travel solitaire is a fun game you can take anywhere because its playing pieces— $\frac{7}{16}$ -in. steel balls—are self-storing and can't get lost or broken. As each jumped ball is removed, you press it through a hole and into a storage compartment within the base for safekeeping. When ready for another round of play, you press a release button and the 32 balls pour into your hand.

To make the game, first glue and clamp a piece of dark veneer to your $\frac{3}{4}$ -in., solid wood base. Start out with a board larger than 6 x 6 in. and cut it to size later. Next lay out the 33-hole pattern on paper, center it on the block and stick the paper to the veneer with rubber cement and center-punch the holes. Chuck a $\frac{21}{64}$ -in. twist drill in your drill press, set the depth stop for $\frac{1}{8}$ in., run the press at its highest speed and drill the 33 holes. The dark veneer makes the light-color holes stand out. Drill the ball entry hole, starting with a tiny pilot drill to spot its position on the reverse side.

I used my drill press to rout the ball channels on the underside. First I made a guide template by jigsawing a $\frac{1}{4}$ -in.-wide slot in $\frac{3}{8}$ -in. ply-

(Please turn to page 212)

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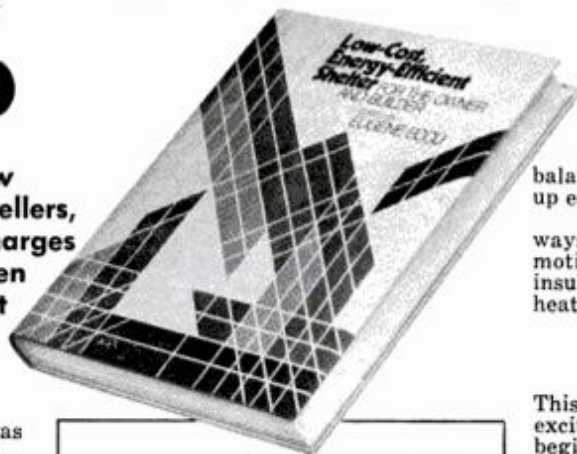
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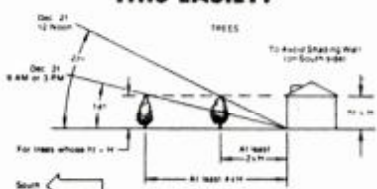
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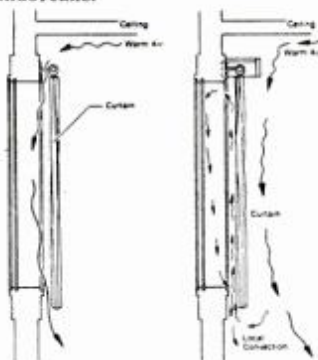
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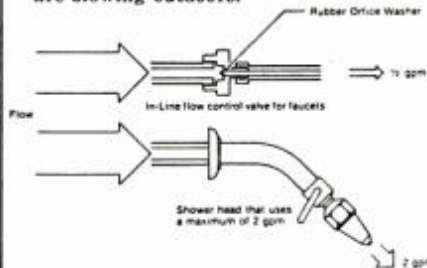
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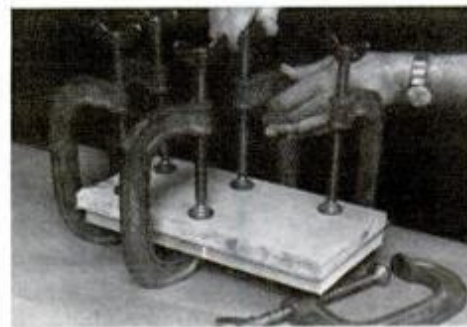
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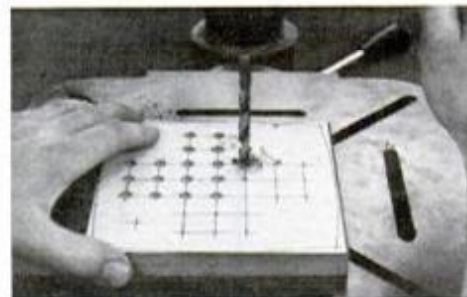
TRAVEL SOLITAIRE (Continued from page 210)



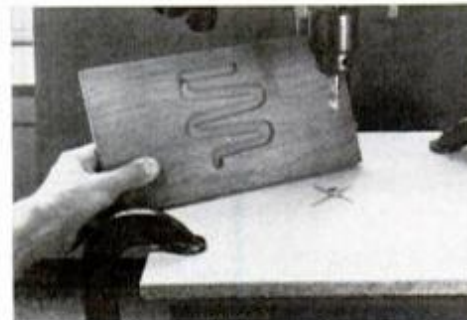
1. Spread white glue over top of the 3/4-in. base and cover with walnut veneer.



2. Place scrap blocks on top and bottom and clamp glued veneer firmly to surface.



3. Rubber-cement ball layout pattern to the veneer; drill 33 holes 1/8 in. deep.



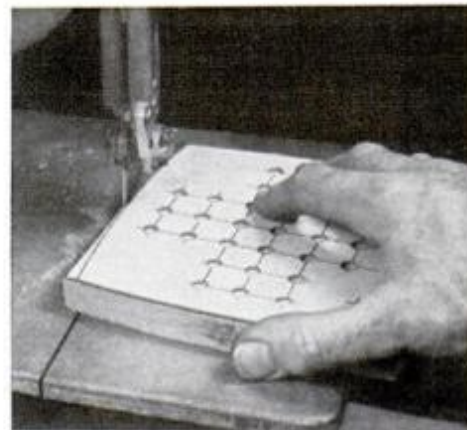
4. Guide router bit with template and pin projecting in wood drill-press table.



5. Rout 1/2-in.-wide ball channels in the base with drill press at high speed.



6. Fit ball-release spring in right-hand channel and nonrelease spring in left.



7. Glue thin plywood to bottom of base, bandsaw curved edges and sand smooth.

wood following the S-shape channel. Then I glued it to a backing piece to strengthen it and tacked it to the top of the base at the waste corners. Next, I clamped a board to the drill-press table, chucked a 1/2-in. router bit in the drill chuck and located a 1/4-in.-dia. steel pin in the board directly under the router bit. I set the template over the pin, turned on the press, lowered the bit 1/16 in. into the work and used the pin and template to guide the bit. Don't cut the 1/2-in.-deep channel with one pass. Lower the bit a little each time and make several passes.

Drill the ball entry, exit and release button holes with a 1 3/4-in. bit. Make the slot and recess for the wooden springs using a drill and a chisel. Hickory, walnut and rosewood make good wooden springs. Cut the release button from a piece of dowel, round the top and fasten it to the end of the release spring with glue and a small screw. Bandsaw the curved sides of the base, chamfer the top edges and sand smoothly. Finally cover the bottom with 1/8-in. plywood and green felt. I finished the edges and top with two coats of shellac polish; you could also use polyurethane seal.

The object of the game is to clear the board of all balls except one by leapfrogging them one at a time in

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any direction except diagonally. To begin play you place a ball in each hole except the center one. If you wind up thinking it's impossible to jump all but one ball, the solution below proves it can be done. By jump-

Solitaire solution

	1	2	3			
	4	5	6			
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
		28	29	30		
		31	32	33		
5	10	17	10	11	12	28
12	11	10	13	12	11	33
3	6	11	26	19	12	31
1	2	3	12	11	10	18
18	11	6	22	15	8	33
3	6	11	7	8	9	16
10	11	12	21	14	7	25
13	12	11	10	9	8	28
27	20	13	7	8	9	17
8	9	10	30	25	18	4
						15

ing ball 10 with ball 5 and landing in space 17, ball 11 with ball 12 and so on, you'll end up with ball 15 in the center hole.

If your hardware store does not have 7/16-in. steel balls, you can get 32 from Way-Mar Co., Box 164, Hartsdale, N.Y. 10530 for the price of \$3.95 postpaid. ★★

YOUR EXHAUST SYSTEM

(Continued from page 198)

of the crossover pipe. Coat the joint with exhaust-system sealer and attach the clamp loosely.

8. Attach resonator to hanger and secure the fasteners loosely.

9. Connect the front of the resonator-to-muffler pipe to the rear of the muffler, coat the joint with exhaust system sealer and attach the clamp loosely.

10. Attach the muffler-tailpipe assembly to its hanger and secure bolts loosely.

11. Join the rear of the resonator-to-muffler pipe to the front of the muffler, coat the joint with sealer and secure with a clamp.

12. Make sure the exhaust system is aligned straight and true so there's no strain on any point, and tighten fasteners securely. If you have a torque wrench, here are the torque values to abide by:

- Crossover pipe-to-exhaust manifold nuts: 25-35 ft.-lb.
- Crossover pipe support bracket nuts: 8-14 ft.-lb.
- Exhaust pipe-to-resonator inlet pipe flange: 20-30 ft.-lb.
- Resonator-to-resonator hanger bolts: 10-20 ft.-lb.
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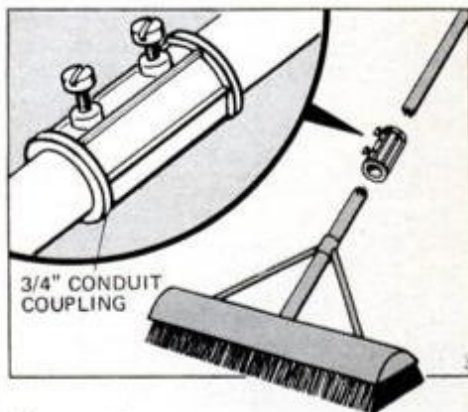


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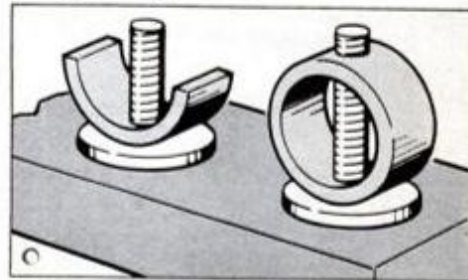
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Pushbroom fix



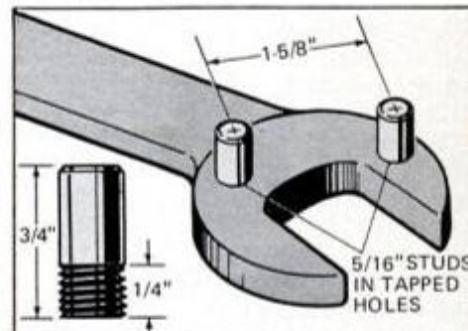
If you lean too hard on a pushbroom and break the handle, don't panic. Coat the broken ends with glue, insert in a 3/4-in. conduit coupling, and tighten the screws. It'll be as good as new.—Steve Gysendorfer

Wingnuts by the dozen



If you're fresh out of wingnuts, slice up a piece of pipe in 1/2-in. sections and drill and tap them crosswise to fit the bolt. Cut 'em in half and they'll even look like wingnuts.—Mike G. McMullen

Double-duty wrench



To have at hand a tool that would both turn in the spigots and remove the bungs from 50-gallon oil drums, I modified an open-end wrench by drilling and tapping two holes in the face to take 5/16-inch studs.—Mike G. McMullen

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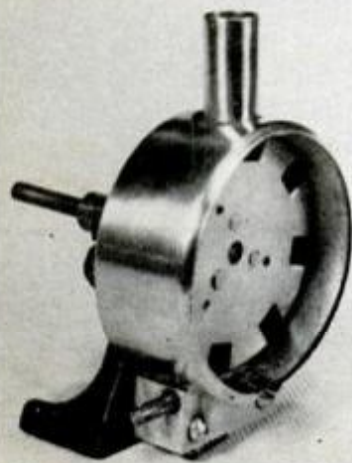
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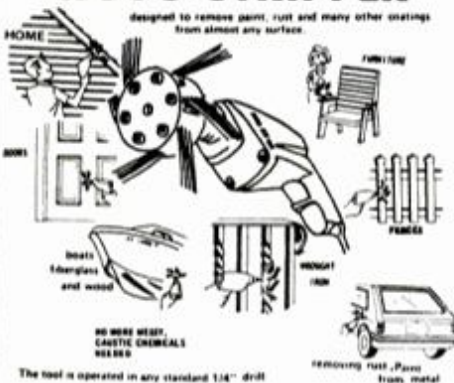
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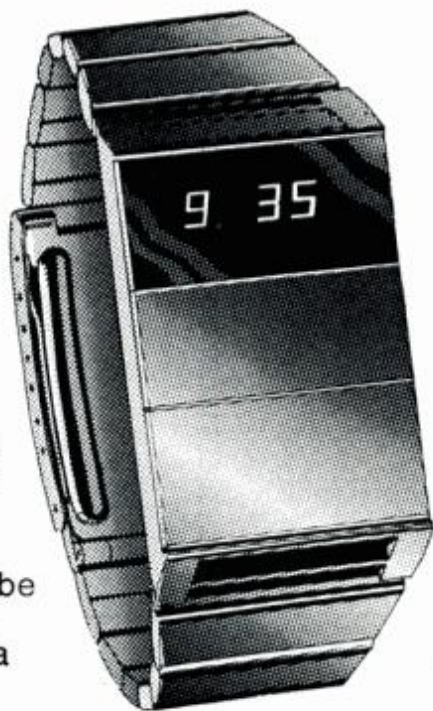
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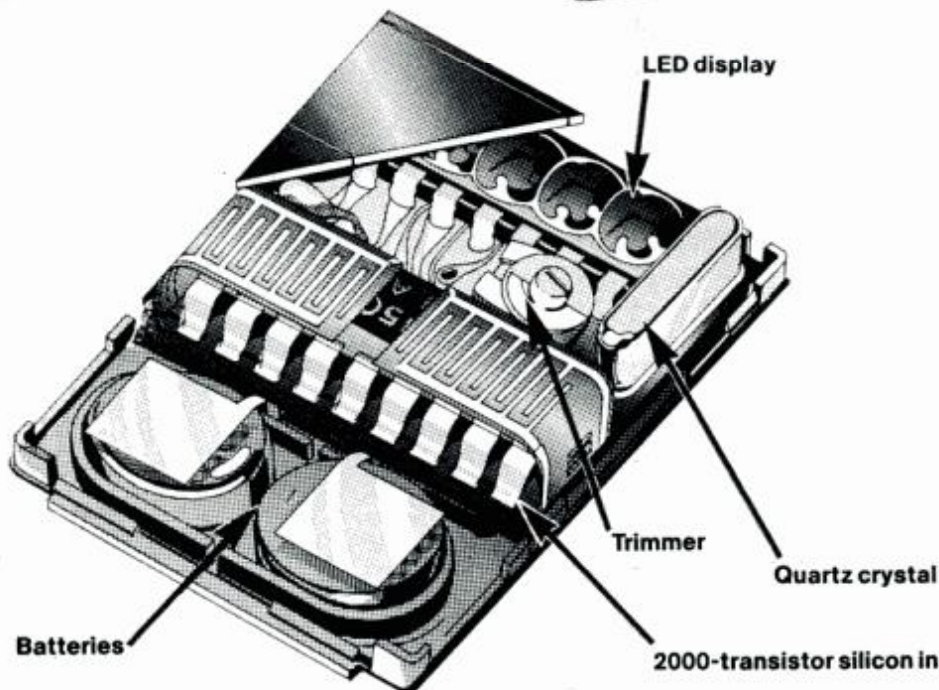
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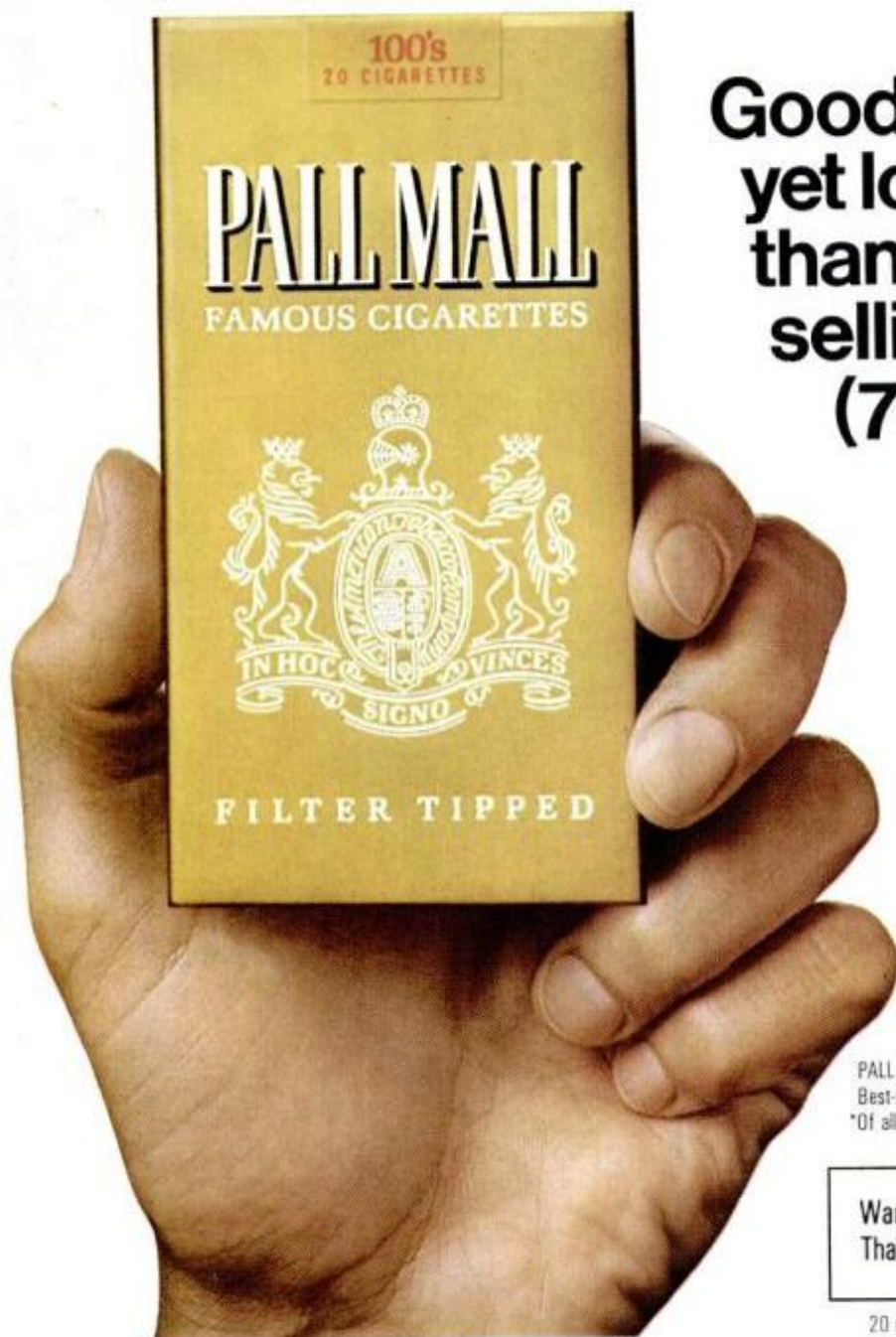
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