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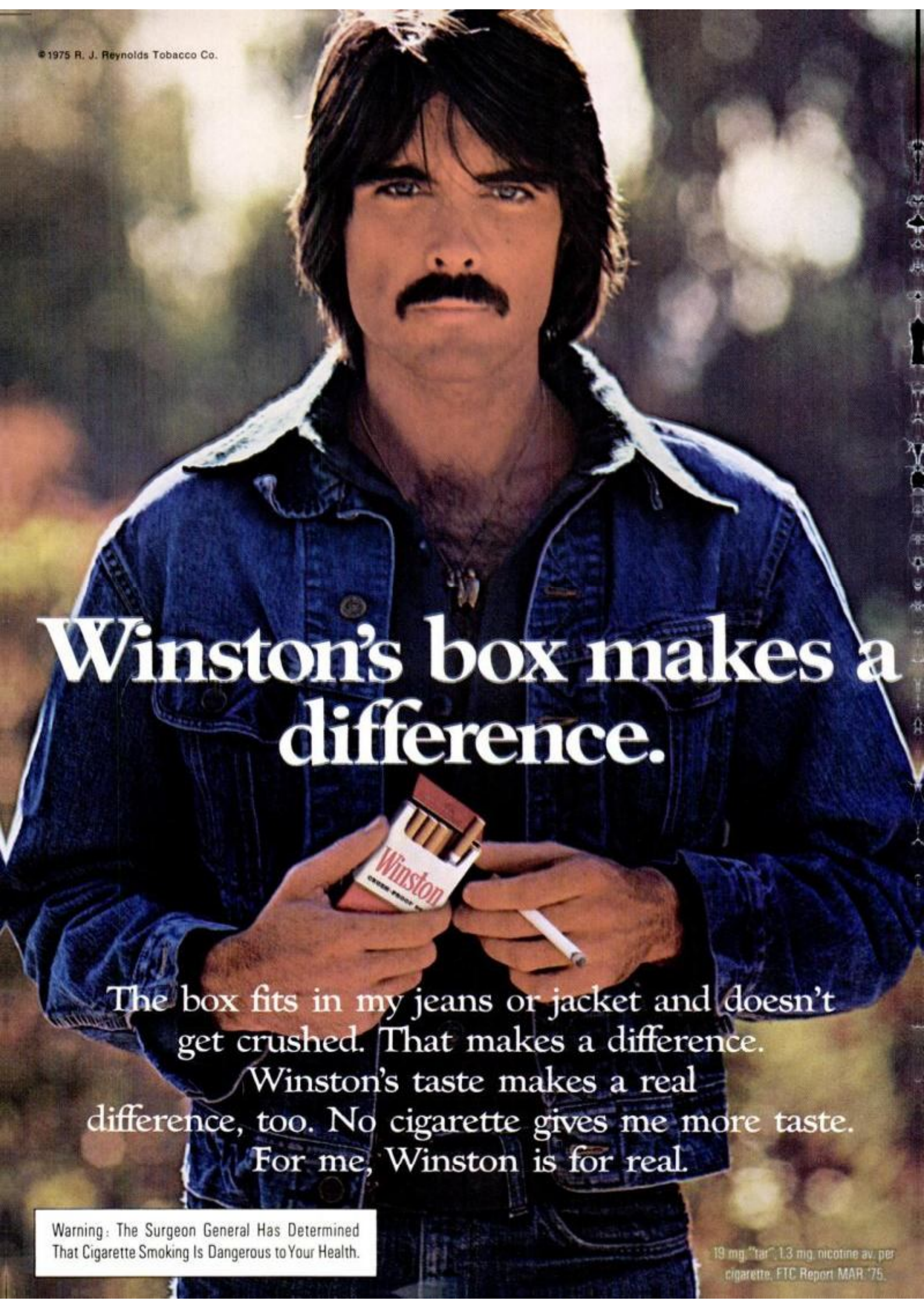
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AUGUST 1975 • Vol. 144 No. 2

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PM'S design-a-body contest. You'll win a $1700 Elcar Model 2000 electric-car chassis if you submit the winning car-body design for it. Page 46.

Nine patio partners you can make—complete plans given for five planters, grille fence, storage gazebo, hanging lamp and view divider. Page 90.

American Motors Pacer: Drivers plain-talk their likes and dislikes in PM's exclusive Owners Report based on a million owner-driven miles. Page 52.

Copy your color slides at home . . . and improve them by making better pictures from those slides that didn't quite make it originally. Page 64.

How to strip new cars down to old prices. You can save up to $1000 if you install some extras yourself and skip others you may never want. Page 60.

Radio control without the roar. Kit-built, wind-powered R/C model sailboats and sailplanes offer quiet excitement on water and in the air. Page 42.

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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Single copy for the United States and Canada, 75 cents. Subscription prices: United States and Possessions, $7.00 for one year; $13.00 for two years; $18.00 for three years. Canada, add $3.00 for each year. All other countries, add $5.00 for each year. Second-class postage paid at New York, N.Y., and at additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950.

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Printed in U.S.A.

POSTMASTER: Please send Forms 3579 to Popular Mechanics, P.O. Box 646, New York, N.Y. 10019.

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Published by The Hearst Corporation
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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A., John R. Miller, President; Randolph A. Hearst, Chairman; Harrison A. Mitnick, Treasurer; Harvey L. Lipton, Vice President and Secretary. Hearst Magazines Division: Richard E. Deems, President; Gilbert C. Maurer, Executive Vice President, Operations; Raymond J. Peterson, Executive Vice President, Advertising; William S. Campbell, Vice President and General Manager; John F. D'Avolio, Vice President and Resident Controller; Albert A. Rachol, Vice President and Director of Circulation; Joseph F. Kern, Vice President for Popular Mechanics.

ADDRESS ALL EDITORIAL COMMUNICATIONS to 224 West 57th St., New York, N.Y. 10019. For additional sources of information on the articles and products in this issue, write to the Bureau of Information, Popular Mechanics, for free "Where-to-Find-It" List.

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LETTERS

TO THE EDITOR

Transatlantic balloon

Readers of my article, *Transatlantic Balloon Jinx* (page 70, June '75) may be interested in the latest feat of Bob Sparks, who will try again this summer to fly a gas balloon across the Atlantic. On June 9, he made aviation history as the first to balloon over all five Great Lakes. Sparks flew the 75,000-cubic-foot Lark hot-air balloon (of cigaret ad fame) in these lake crossings as a warm-up for his upcoming transatlantic flight.

PAUL WAHL
TEANECK, N.J.

Who goes into space?

Your article *Cities in the Sky* (page 94, May '75) leaves some important questions unanswered. You say that the planners intend "to put entire human colonies into orbiting space habitats." Somehow I get the uneasy feeling that those doing the putting intend to stay here on dirty, noisy old earth.

Are those who will be "put" in outer space to be sent willingly or against their will?

LEO D. PATTERSON
BURLINGTON, W.VA.

Don't forget North Dakota

As a former North Dakotan who has enjoyed many lovely summers in the Peace Garden State, I read *257 Close-to-Home Vacationlands* (page 56, June '75) with considerable dismay. In the illustrated pages of the 50 states, only North Dakota was completely blocked out by a picture, giving the vacationing public the impression there is nothing to see or do in that state.

There are many state and federal campgrounds; Lake Sakakawea boasts excellent fishing, boating and resort areas, and the Badlands with its array of colors and panoramic view near the Theodore Roosevelt National Memorial Park is a scene never forgotten by the tourist.

Throughout the state are the friendly people ready to welcome you in the great traditions of the old West. I enjoy my adopted state of Montana, but let's not forget North Dakota.

LAVERNE CARROLL
DILLON, MONT.

New hope: new engine

Your article *A New Engine Can Save Old Betsy* (page 74, June '75) really hit the spot. I've had rebuilt engines put in two cars (a '39 Dodge and a '40 Chevrolet) and really had good results with them. Strange when I did it all people would tell you was it wasn't worth it. Or you'd never get the money out of the car when you sell it. I always figured it was the value to me and not whoever had the car after me. It *is* worth it!

JOHN L. CARLSON
SEATTLE, WASH.

The article gave me new hope that I can still afford a tow unit for full-time trailering when I retire soon by renewing the engine in my '67 Olds but the article did not mention the automatic transmission, the rear end, etc. My question—can these components last through a second engine without being renewed themselves?

GEORGE LANCASTER
OAKRIDGE, ORE.

They can fail, too. But replace them as necessary, not when you're doing the engine.

Fabulous phono cartridges

Fabulous Phono Cartridges (page 66, April '75) was very informative, especially in showing how discrete four-channel phono systems work using the new quadradiscs.

Can you answer a question about matrix phono systems? I've read that the different companies use different decoders and that you must use their own records or four channels will not be produced correctly with all channels in their right position. Is this true or are all companies using universal decoder?

DICK CAVENDER
PORTLAND, ORE.

There are two matrix systems in use: the QS system (originated by Sansui), which is sometimes called "RM"; and the SQ system originated by CBS. Decoders for one will yield inaccurate, but interesting, four-channel results from records made for the other—and will yield similar results from stereo records. As of this writing, SQ records are more

(Please turn to page 6)

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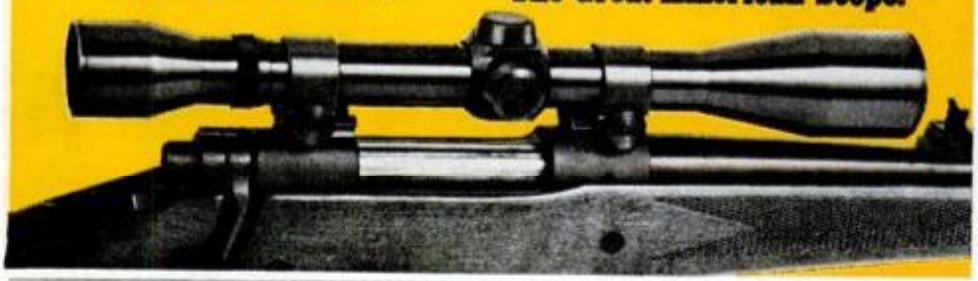

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LETTERS

(Continued from page 5)

common than QS. An exact rundown of what's available can be found in the front of the current Schwann record catalog, at most record stores.

Scanners

In regard to your article on *Scanners* (page 95, June '75), we have a Gladding Cheyenne 8. We didn't care much for the bands between 150-174 Mhz, so we had the set tuned down to 145-149 Mhz. We really enjoy listening to these "ham" bands. Anyway, I thought you might like to know that some of the better scanners can be retuned to different bands.

DON CRUMPTON
EL CAJON, CALIF.

You made an error in printing the *National 10 Codes*. These are obsolete! The danger comes from the very fact, as you pointed out, that various departments assign different meanings to the same signal. To eliminate this danger, the Associated Public-Safety Communications Officers, Inc. (APCO) developed the APCO Brevity Code of 10 Signals.

We would appreciate it if you would print the code. This will contribute to complete understanding when several departments are involved in mutual disaster aid.

EUGENE S. GOEBEL, CHAIRMAN
EMERGENCY PREPAREDNESS AND DISASTER OPERATIONS COMMITTEE
APCO
SPRINGFIELD, ILL.

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10-2 Signal good—continue
10-3 Radio silence/stop transmitting
10-4 Affirmative—acknowledgement —O.K.
10-5 Relay (to) _____
10-6 Busy
10-7 Out of service/ (at_____)
10-8 In service/(at_____)
10-9 Say again—repeat
10-10 Negative/denied
10-11 _____on duty/who is on duty?
10-12 Standy by (stop)
10-13 Existing conditions
10-14 Message/information
10-15 Message delivered
10-16 Reply to message _____
10-17 Enroute to assignment
10-18 Urgent
10-19 In contact with_____/ are you in contact with _____
10-20 Location
10-21 Call _____ by phone (at or number_____)
10-22 Disregard/cancel
10-23 Arrived at scene
10-24 Assignment completed
10-25 Report to (meet)_____
10-26 Estimated time of arrival
10-27 License/permit information
10-28 Ownership information
10-29 Records check
10-30 Danger/caution
10-31 Pick up _____
10-32 ___ Units needed (specify) (fire units, ambulance units, police units)
10-33 Help me quick
10-34 Time
10-35 through 10-39 Held for future: *Do Not Use*

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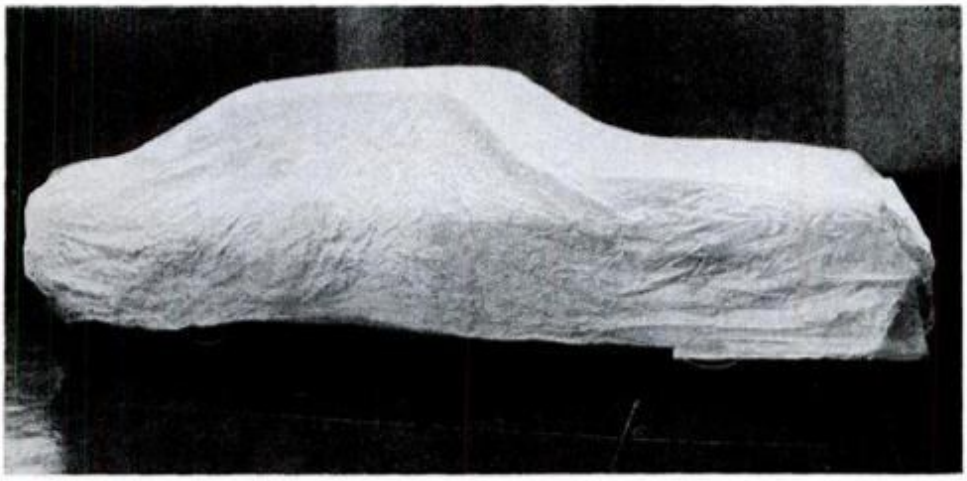

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At 26, Bill De Medio has more freedom, more security, and gets more respect than guys twice his age. (Photograph by Frank Cowan.)

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APPLIANCE CLINIC

BY PAUL MANN

Sudden spots

Our General Electric Filter-Flo washing machine (Model 1WA850A5W) worked perfectly for nine years. Suddenly, six months ago, clothes started coming out with grayish-white spots on them. The machine works fine and the water we're using is the same. I removed hoses and water pump on the chance that something was in them, but there wasn't anything. We have tried all different kinds of detergents. What now?—Ben Sernentilli Jr., Enfield, Conn.

I've received more than one letter like yours. GE and other manufacturers note that this is a widespread condition in areas where phosphate detergents have been banned. One company spokesman told me, "Detergents without phosphates in them, especially in the Northeast, are raising hell with washability."

At this point, the only thing I can suggest is that you try adding a water softener, such as Calgon, to the detergent. This appears to help to some extent.

Renaissance revival

We have a Renaissance model Tappan gas range, about six or seven years old. It's a fine unit, but last month everything electrical quit—timed outlet, oven light, timer, clock, fluorescent fixture, you name it. Is there a fuse that controls all this? If so, where is it?—E. B. Gajewski, Buffalo.

There is a fuse, but it controls only the timed outlet, and so has nothing to do with your trouble. The problem must lie somewhere between the wall outlet and the terminal block behind the range panel, into which the line cord connects.

Check that the wall receptacle is live by unplugging the range and plugging in a lamp you know is working. Next, check the line-cord plug, especially for a break in the wire where plug and cord connect. A slit here often goes unnoticed. Then make sure the plug is making good contact in the receptacle. Spread prongs slightly for a tight fit.

After this, test the line cord itself. Remove the range panel to reach the terminal block. See that the cord has not pulled loose from the terminals. Disconnect cord from the terminal block, making sure it's not plugged into the receptacle. Twist its ends together and use a continuity tester across the plug prongs. If the cord doesn't show continuity, replace it.

More on the manifold

Your item in the April '75 Appliance Clinic *entitled* Washer Perplexity *concerned a 1960 RCA Whirlpool Imperial clothes washer that drained properly after the wash cycle but left water in the tub after the spin cycle. You advised M. P. DeCruyenaere to disconnect and clean out the manifold (pump guard). I'm a factory-trained Whirlpool serviceman and I commend you for your diagnosis. Not too many people know about this. However, allow me to stress one important point. The manifold has a baffle under the outlet. In this baffle is a breather hole about 1/16 in. in diameter. This hole must be open or the problem will continue.—Lawrence Aaron, Atlanta, Ga.*

Thanks for the kind words and advice. Both are welcome.

Hamstrung

I have a Westinghouse electric slicing knife. My wife tried to carve a partly frozen ham with it and broke the small plastic gear that moves the knives back and forth. Is this gear replaceable? Where can I get it? How much does it cost?—Keith German, St. Louis.

The gear is replaceable—through a Westinghouse dealer or write to Westinghouse Parts Div., 1300 Belmont Ave., Philadelphia, Pa. 19104. Cost should be less than $1.

Stalled spin

I have too much money invested in my Maytag washing machine to get rid of it. This top-filled model is stalling at the start of the spin cycle. I can get it spinning by grabbing the pulleys and pulling them back. Servicemen have replaced belts, checked the clutch, replaced the timer, tightened wires, and made all sorts of tests. My tab for service calls is nearly $75. Now they tell me I need a new transmission. What should I do?—Stanley Wright, Modesto, Calif.

Here's another thing to check before installing a new transmission. When this machine shifts into spin, the motor reverses itself and pulls on the loose side of the belt, allowing it to slip until the tub gets up to full speed. If your model is like others, the motor is mounted on four plastic rollers, each the diameter of a nickel but about three times as thick. In time, these rollers can flatten, preventing the motor from reversing. Then, in essence, the motor stalls and the tub remains at a standstill.

After all you have been through, the solution may be nothing more complicated than replacement of the rollers. But let me give you a tip: Have a machinist make rollers for you from brass, instead of buying the plastic ones.

Gummed-up works

We have a General Electric dishwasher (Model SD200B2) which absolutely refuses to dispense detergent from its cup. The dispenser works, opening properly, but the detergent stays inside, gumming up into a semisolid mushy lump that won't wash out. To operate the unit, we must stop it and throw in a handful of detergent, then restart the dishwasher. Everything works well and dishes come clean. We have tried every detergent on the market. What's wrong with our pot scrubber? —George Kenoszt, Elmhurst, Ill.

Mechanically? Probably nothing. The dispenser is opening and there is no flaw in the cycle, because dishes are coming clean. The trouble, I suspect, is operational, and the solution is probably very simple. See that water is hot enough. Detergent may not dissolve in water that is cooler than 150° F.

If water temperature is okay, see that no dishware is placed in front of the dispenser. It's possible that whoever is loading the appliance is blocking water from the dispenser. Some water is getting through, accounting for the gummy mush, but detergent needs a full blast. ★★★

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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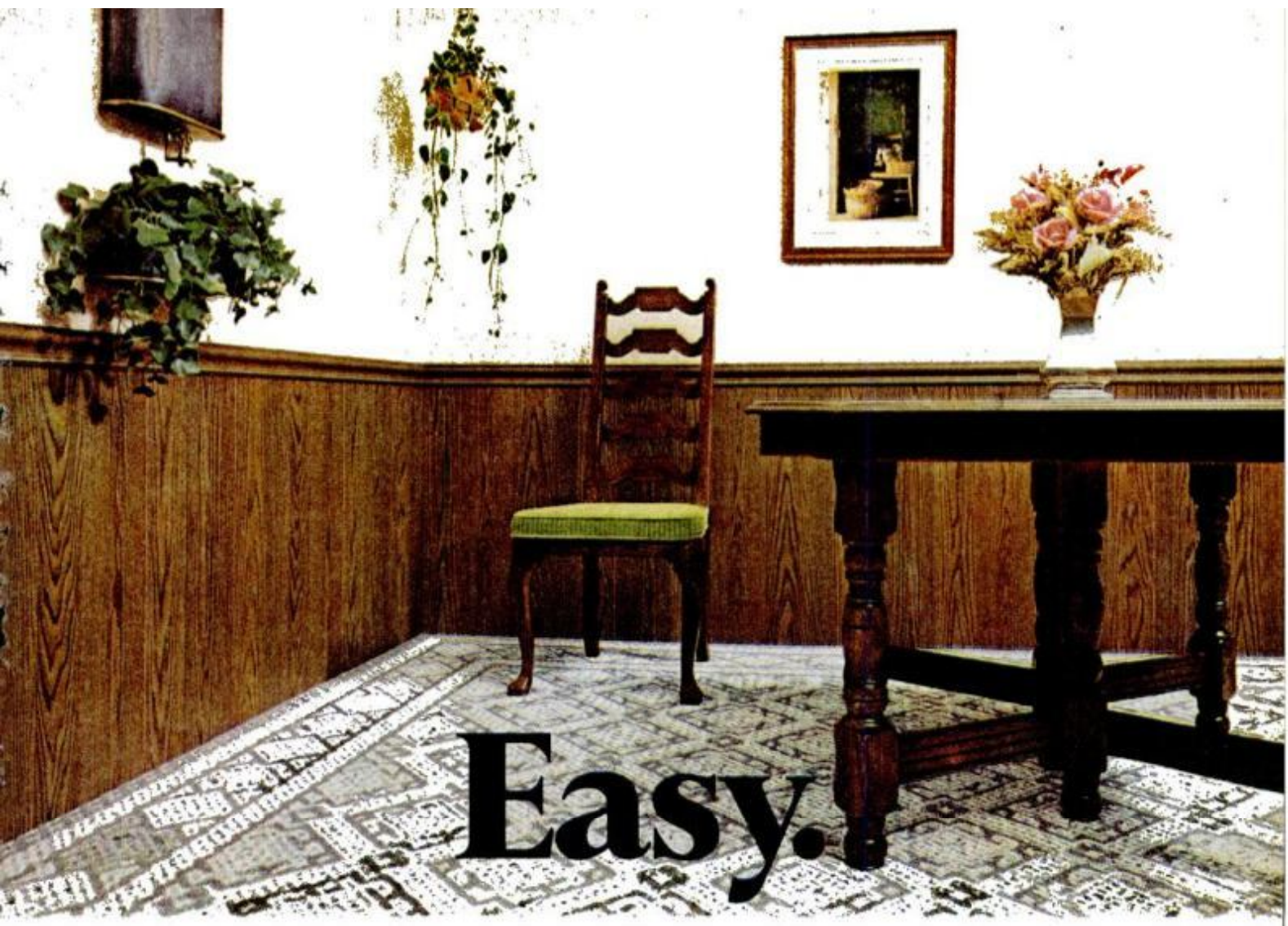

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DETROIT LISTENING POST

BY ROBERT LUND

GM mini ready in September

Chevrolet says all its cars will be introduced simultaneously this fall. This qualifies as news in that it means Chevrolet's new mini will be out in September. Earlier reports were that the car might not be ready for production until the end of the year or early in 1976. Present plans call for the first car to come off the line the third week of this month.

Chevy always tries to keep its new cars under wraps until A-Day (announcement day). As if the division didn't have enough problems trying to keep the cork on the mini, GM has disclosed it is working on an even smaller car—a one-seat, two-person job. This will be a Chevrolet product, although Pontiac will likely have a later-on version. The Chevy original is at least two years away.

Ford eyeing Spanish import

Ford's immediate response to the Chevrolet mini will be a stripped, lower-priced Pinto this fall. For the longer term, Ford has assigned agents to Spain to check the possibility of bringing a smaller-than-Pinto car in from that country until the company can tool up for a vehicle to counter the GM mini.

Meanwhile, Ford has adopted the code name Fox to cover a complete redo of its existing small cars and development of a new mini. Obviously, Ford won't keep the Fox name when the cars are ready because Audi already has the name. But use of the code name during the development program could be a tip-off that Ford has a high regard for the VW and Porsche/Audi product lines.

GM-full-sizers will be 118-inches

Cadillac's Seville will not be the largest car in the GM fleet when the company completes resizing its cars over the next two years. Seville has a wheelbase of 114.3 inches. GM will continue to make a Caddy and at least one car under each of the other nameplates—Buick, Chevrolet, Oldsmobile and Pontiac—with wheelbases of 118 inches.

Look-alike trend to continue

If you found fault with Detroit in the past for turning out cars that looked like they all came off the same drawing board, you may be even unhappier with cars coming over the next few years. They will be even more look-alike. Small, medium or large, most cars will take on the boxy lines of Ford's Granada/Monarch. You can blame or credit Mercedes for that, because Ford admits it borrowed the shape from Mercedes. Cadillac's Seville came out of the same Xerox machine, although Cadillac argues otherwise.

Don't blame the designers for the lack of distinctiveness and inspiration. Designers have very little to say about how cars look these days. The government tells Detroit what it wants in and on cars and the big wheels at the corporate level tell the designers what kind of box they want to hold the pieces. The designers are working under severe restrictions and limitations. There's very little freedom to exercise imagination—About as much as a kid has who is handed a coloring book and box of crayons and told "go ahead and draw, but stay inside the black lines."

Ford goal for '76: more MPG

Ford is expected to show greater improvement in gas mileage on its '76 cars than other automakers. Conceding that its '75 cars as a group lag behind GM makes as a group in fuel economy, Ford's goal is to equal or surpass GM's economy numbers on the '76 cars. It is aiming to add two to three miles per gallon for all cars.

Variations on Seville are in the works for other GM divisions. Here's possible Buick sedan version from drawing board of Harry Bradley. It could be on the market by mid-1976. More '76 Detroit models are shown on page 45.

Chevy has Houdini-proof lock

Someone broke into my car last month and tried to start it by jamming a screwdriver in the ignition. They didn't get the car, but they messed it up pretty bad. The screwdriver broke off in the ignition and the starter drive had to be replaced. While the car was being repaired, I borrowed one of the new Monza Towne Coupes from Chevrolet. I put about 250 miles on it and, as small cars go, it's a nice-handling machine. With a V8 engine, it's the zippiest small car I've ever put the pedal to.

But the thing that impressed me most about the Monza TC is where they put the door locks. The locks are the standard push-pull variety, but the button is recessed in the armrest about halfway down the door. The button does not go up and down vertically. It goes back and forth horizontally. On my car, the locks are in the usual position on the edge of the windowsill. It's easy to snake a coat hanger between the glass and the rubber seal and open the lock. You can't do that on the Monza sedan. There's no way of getting a coat hanger or wire in the car and then working it at the necessary angle to open the locks.

Another antitheft feature of the car is the ignition lock system. There's a small lever just under the ignition. The only way you can remove the key from the ignition is to press the lever down while holding the key in the lock position. It's awkward and takes two hands to press the lever and disengage the key. But it's a neat idea because it locks both the ignition and the steering mechanism. The car isn't stealproof, but a thief is going to shop around for an easier car to crack before he tries pinching one with the dual locking device. Chev has the same ignition setup on Vega.

One thing I learned as a result of this experience is how to start my make of car without a key and without crossing the ignition wires. The mechanic who installed the replacement ignition showed me how it's done. The rip-off guy who tried to take my car was obviously an amateur, because you can't start the car with one screwdriver. But it's a snap when you know how. ★★★

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ALL OUTDOORS

WITH BILL McKEOWN

Slicker kickers

Our exclusive preseason previews of next year's outboard motors show some amazing power jumps in the horses packed under the hoods.

Remember a few years ago when rumors went the rounds that some one had an experimental radial outboard that might spin out 100 hp? "But who would need it?" was one question. Since then we've found any boat big enough and well enough put together can use all of the horsepower it can handle from outboard motors and their close first cousins, the versatile stern drives. Lighter weight, tilt-up propellers, easy servicing, better steering, adjustable thrust angle for boat trim, plus poundage placement all the way aft are among advantages of outboards over inboards.

And now Outboard Marine Corp.'s Evinrude and Johnson motors will be making a bigger power increase in one year than they did in their first 50 years. For 1976, both will announce bicentennial 200-hp outboards at the top of their lines, up a magnum 65 hp from this year's 135s. Mercury, already at 150 hp, is rumored to be going up in power as well. Chrysler has a production engine of 135 horses and a racing mill at 150.

As impressive, perhaps, as all this new muscle is the fuel economy reportedly engineered into these big ones. Prototypes we have already test-run show less gas consumption for the same speed as the smaller current models. In some cases, this has also been accomplished with mills of greater displacement but smaller apparent outside dimensions and quieter operation. Next month we'll give a detailed report.

No fish story

Most of us don't rate record books with our catches, so the Newton Line Co. of Homer, N.Y. 13077, has announced an award for "average but proud" fishermen. If you use Newton's new E.S.P. or one of its five other lines and land one you especially like, send a picture of the fish, when and where caught, type and test of their line plus exciting details and they'll send you a "gold" certificate for framing. Who says lunker losers can't win?

Presidential sports award

The President's Council on Physical Fitness and Sports has lowered the minimum age from 18 to 15 years and opened the way for most high school students to earn the Presidential Sports Award.

Air rifle, rifle and clay-target shooting are included. Qualifying standards for the air rifle award require at least 2500 rounds fired, no more than 50 in any one day, and a minimum target distance of 33 feet. Rifle rounds fired have the same requirements, but at 75 feet minimum for rimfire and 100 yards for centerfire. Trap and skeet awards require 2500 targets over 50 sessions. Shooting must be conducted under safe, regulation conditions.

Qualifying standards and personal log-book supplies may be obtained free by schools and clubs from Presidential Sports Award, Box 129, Radio City Station, New York, N.Y. 10019.

Medical matters

The virulent Rocky Mountain spotted fever, once a rarity endangering western sheepherders, has been spreading recently with 135 cases reported last year in Virginia, 113 in North Carolina, and Oklahoma and Tennessee ranking third and fourth in the nation. The disease is carried by ticks that can attach to an outdoorsman or his dog—both should be checked before and after any outing. Remove ticks with tweezers, if possible, without touching them or leaving the head imbedded in the skin. Sometimes heat from a match or cigaret will force a tick to release its hold and back out. While most ticks do not transmit the disease, it is wise to treat them with caution.

An outdoorsman with special medical problems can do himself a favor, especially when traveling, for $7. That buys him a lifetime membership in the nonprofit Medic Alert Foundation International, Box K1, Turlock, Calif. 85380. He then wears the Medic Alert emblem on his wrist or neck—information on the hidden side can warn of conditions like a weak heart, diabetes, epilepsy or allergic reactions to various drugs. A telephone number is given so a collect call can provide immediate information for treatment.

For travelers, it's a small price for a lifesaving service.

Travel action

Some 9000 miles of trout streams, 2000 stocked lakes and 831 mountains over 11,000 feet high are waiting for outdoorsmen in Colorado. We prefer camping at Maroon Bells of Aspen and in Rocky Mountain National Park near our home town of Fort Collins, but a query to the Tourist Bureau, 986S State Capitol, Denver, Colo., will bring details of rodeos, rock climbs, pack trips and rockhounding as well.

For a combination exploring/yachting look at cruising, snorkeling and relaxing in the Virgin Islands, there is the Robinson Cruise-O Plan, with more details available from Rockresorts, 30 Rockefeller Plaza, New York, N.Y. And where and how to find great hunting, fishing, exploring and photography sites from Canada to Argentina is described in *Outdoor Adventures*, $1 from Braniff, Box 35001, Dallas, Tex.

National Hunting & Fishing Day

The date to remember: Saturday, Sept. 27. ★★★

Look closely at this Evinrude outboard being driven by the company's most experienced test driver, Ralph Evinrude, and you'll see 135. But inside is 200 hp!

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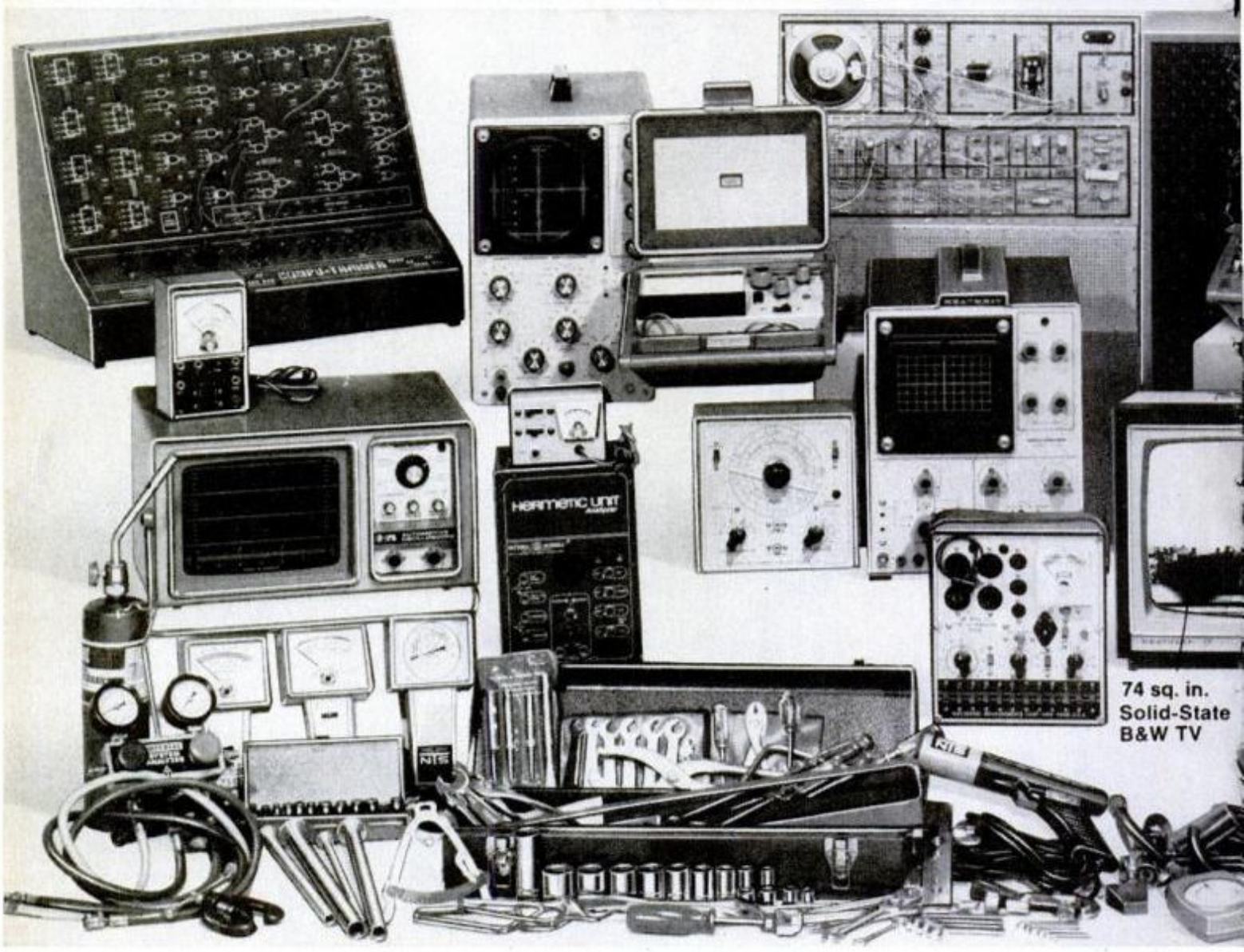

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CAR CLINIC

BY MORT SCHULTZ

Checking Chevy's 250 squeak

I own a 1974 Checker sedan that's equipped with a 250-cu.-in. Chevrolet L6 engine. We (the shop chief and I) have diagnosed that a squeak in this engine is coming from the rocker arms. We have replaced the assembly, but the squeak remains. I understand this is a common problem with the Chevy 250. Is there a solution?—Bill Dasheff, New York

You're right! Hopefully, there's a solution, but at this writing, that fix is new and in an experimental phase. Go to a Chevrolet dealer and order part No. 1051343, a kit containing a cleaning solvent and a product that will serve as a cushion between rockers and balls. The noise is coming from here. Some say it's happening because of insufficient lubrication; others contend it's because of overlubrication. Who cares as long as the fix works.

Remove all the rocker arms and examine balls and arms. Replace scored parts. Now, clean both the old *and replacement* parts thoroughly with the cleaner packed in the kit, paying special attention to the center of the rocker where the ball makes contact. The parts must be spotless.

Apply the cushioning material to the ball area, rocker arm, and unthreaded portion of the stud. Allow the compound to dry for at least 45 minutes. Then, put everything back together again and keep your fingers crossed, or pray, or stroke your rabbit's foot . . . whatever it takes.

Paying his dues

The coolant level of my 1969 Buick LeSabre is supposed to maintain itself 3½ inches below the top of the radiator filler neck, or so the book says. But when I drive 30 miles after filling the radiator, the coolant level drops 7 inches. I have checked all hoses and the radiator, but can find no leak. I admit I haven't drained the radiator in six years.—Ernest Piller, Cincinnati

You're lucky your cooling system hasn't blown sky high. Whether lack of maintenance has anything to do with your problem is academic. The point is that cooling-system service should be done every two years.

Anyway, you don't state whether the engine is overheating, but I assume it isn't, because you probably would have said so. If the coolant level shows a 7-inch drop below the top of the radiator neck when the engine is *cold* and there is no overheating, the extra coolant you're installing may not be needed. However, I would still do that cooling-system maintenance.

Suppose there is a coolant loss and overheating condition. You should have the entire cooling system, including the radiator cap, examined with a cooling-system pressure tester to uncover a defective part or leak. Small leaks aren't always detectable by eye—that's the reason for the pressure test. The system is put under the amount of pressure it's under during operation. This permits a minor leak to reveal itself.

This examination should be followed by draining and flushing the radiator and cylinder block. Install fresh coolant. Now, if coolant is being lost out the overflow tube because of excessive pressure being built up inside the system, it might be a good idea to install a radiator overflow bottle and the new radiator cap it requires. This bottle will keep this expensive liquid from being lost.

Tire mixing dos and don'ts

While reading the April, 1975, issue of Car Clinic I came across your item Tire Topics *in which Elwood Long of Oley, Pa., asked whether steel-belted radials can be used on the same car as cord-belted radials, and if bias-belted tires could be used on the same car with plain bias tires. Your answer was "yes" to both questions. However, there are some exceptions as radial, bias-belted and bias tires are built in different construction series, and there are combinations which cannot be used. I am enclosing a copy of a tire application guide which shows acceptable, preferred, and no-nos in tire mixing. —J. V. Compton, Consumer Relations Director, Cooper Tire Co., Findlay, Ohio*

Thank you for this solid information. I wish I could publish the guide here, but limited space makes that difficult, so I suggest that any reader thinking of mixing different types of tires on his car write for this guide. It may be obtained from the Rubber Manufacturers Assn., 1901 Pennsylvania Ave. N.W., Washington, D.C. 20006 and is entitled *Tire Application Guide for Passenger Cars.* Other sound data offered includes the proper way to rotate tires and a clear explanation of bias, bias-belted and radial construction.

Dim, but worrisome

My 1971 Matador with 304-cu.-in. V8 engine is a great car, but has one problem that is bothering me. No one has been able to tell me why the alternator warning light on the dash stays dimly lit whenever the engine is running. The electrical system has been checked thoroughly. Nothing bad was uncovered, and I was told to forget the glow. But it stares at me like some evil eye, and I won't be satisfied unless you tell me to forget it.—Newton Tripp, Conklin, N. Y.

Sit tight, and let's go. There are

PM CAR CARE **tip**

Save oil

Why throw away perfectly good engine oil just because your crankcase won't take more and you're left with a partially filled quart can. You can't store this open can because it will become contaminated. The solution is to use a plastic lid from a one-pound can of coffee. It will fit a one-quart can of oil snugly. The oil can then be stored for future use in your engine, or you may want to save it for use in your lawnmower next year.

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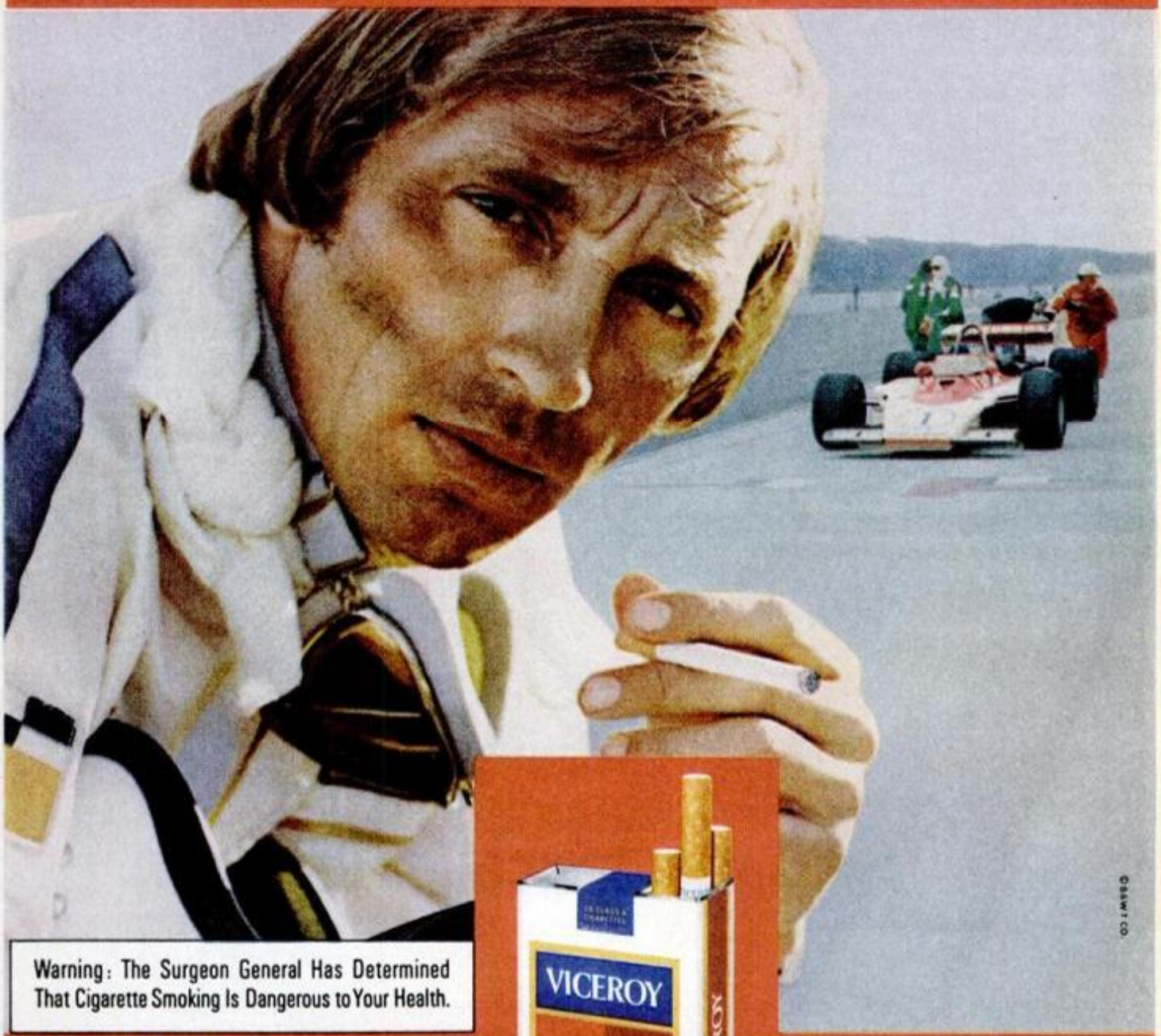
"Why Viceroy? Because I'd never smoke a boring cigarette."



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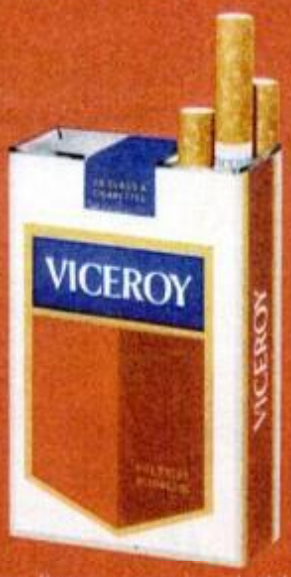

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(Continued from page 22)

several reasons why that dash light is giving you the evil look. Generally, they are centered at the alternator, or in a harness or connection. Here's the rundown:

1. The most common trouble area is at a place called the diode trio—a protective device for the rectifier diodes.

To determine if the diode trio is causing the glow, run the car about 10 minutes with heater and headlights on. This will cause the diode trio to heat up. After 10 minutes, turn off heater and headlights, and connect a voltmeter between the alternator and diode trio. A reading in excess of 0.3 volts indicates the diode trio is breaking down or there's a poor solder connection at the rectifier diodes.

2. If the alternator checks out okay, test the 4-amp. fuse in the fuse box for a tight connection. If the fuse is okay, hook a jumper wire from the alternator output terminal to the 4-amp. fuse. If this causes the indicator light to go out, the trouble is in the harness from the alternator to the key switch, or from the key switch to the fuse panel.

If the jumper wire doesn't put out the light, the problem is with the yellow wire from the 4-amp. fuse, or a poor pin terminal at the printed circuit.

3. Now, before going through all the above work, give that evil eye your own evil stare. Can you classify it as a "very dim glow"? If you can, then install a GE 168 bulb in place of the No. 158 bulb. This may be all you need.

There are other reasons for the glow, but the three mentioned cover 9 of 10 cases. If they fail to solve the problem, get back to me and I'll outline the other possible causes.

Pop gun

I have a 1969 Chevelle with a 307-cu.-in. V8 engine. When I go downhill and remove my foot from the accelerator, I hear a popping coming from the muffler. It is not a loud backfire. Trying to overcome the noise, I installed new sparkplugs, points, condenser and distributor cap, and set the timing exactly. No dice. Do I have a restricted exhaust system?—J. F. Nolan, Seattle.

I doubt it, because a restricted exhaust would tend to muffle noise coming from the exhaust. I think your

(Please turn to page 27)

PM CAR CARE tip

An oldie, but a goodie

You may not know the plunger trick, so here goes. If your vehicle shows up one day with a shallow, dish-shaped dent, duck downstairs and find the old plumber's helper. Wet it, press it against the dent and pull. The dent might just pop right out. The trick will serve especially well for dents in door panels and similar places where you can't get your hand behind to push out.

SQUEAK

INTRODUCING INSTANT SILENCE: PERMATEX SILICONE LUBRICANT

Open the car door. Hear that squeak? Roll down the windows. There it is again! Try the trunk. Curses! Squeaks, squeaks everywhere. Ear muffs are not the answer. You need the squeak squelcher from Permatex: Silicone Lubricant.

Just shoot a quick spray of Permatex Silicone Lubricant on the source of your squeak, and you've got instant silence. Permatex Silicone Lubricant doesn't melt, doesn't gum, doesn't fail in bad weather. It's also great for just making things slide easily and will also protect battery terminals from corrosion.

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Permatex®

MADE FOR THE PROFESSIONAL

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Datsun Li'l Hustler. First, it's built to last.

Nowadays, good long-term investments are hard to find. Datsun's Li'l Hustler is one exception. Sure, it's a gas saver. In fact, according to the EPA's 1975 test results, Li'l Hustler gets better mileage (31 mpg*) than any other pickup in America, import or domestic. But the real test of an investment is how it holds up in the long run.

Example 1: Our '75 Li'l Hustler has a new, more powerful 2000cc overhead cam engine. **Benefits:** Less internal friction than in a pushrod engine, and about 43% fewer moving parts. More efficient power.

Example 2: Our cam is driven by a twin chain, completely covered and bathed in engine oil. **Benefits:** Less subject to wear and stretching than semi-exposed belt-drives. Tension adjustment is automatic, too.

Example 3: For '75 our axle ratio is an economical 4.37. **Benefits:** Fewer engine revs per mile, longer engine life and great gas mileage.

Example 4: Improved ferrite stainless steel exhaust components and improved muffler construction. **Benefits:** Extra corrosion protection and reduced back pressure for more efficiency, longer life.

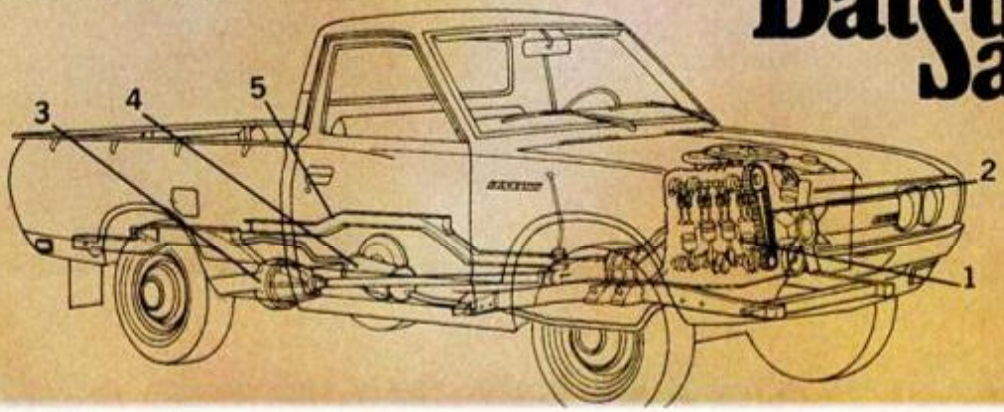
Example 5: A nearly indestructible welded lattice frame. **Benefits:** The strength and support to endure a lifetime of rocks and ruts and grinding bumps.

Add 1400 lbs. of payload and passenger capacity, plus options like factory-approved air and 3-speed automatic transmission, and you've got one investment that just won't quit ... Datsun's Li'l Hustler. Available in two models: Standard 6-ft. load bed or the new 7-ft. Li'l Hustler Stretch.

America's #1 Selling Small Pickup

(*1975 EPA highway test results, all states except California.)

Datsun Saves



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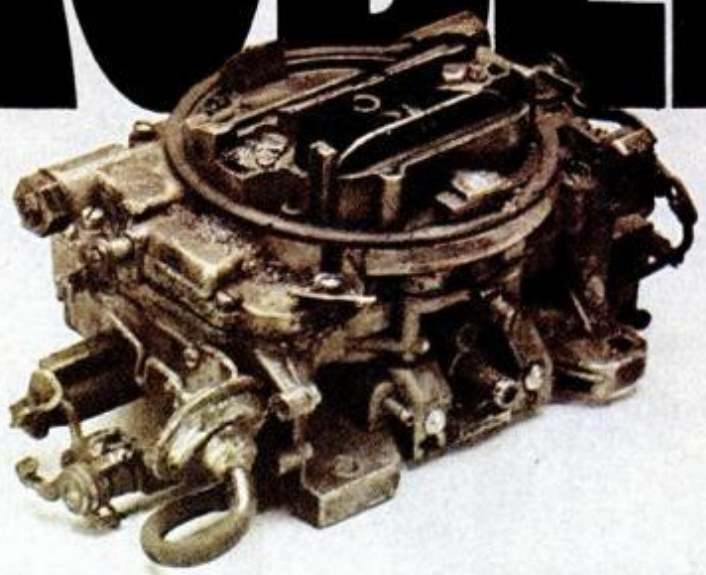
PROBLEM



SOLUTION

A dirty carburetor is a pretty sticky problem. But there is a solution: STP Carburetor Spray Cleaner.

Very simply, here's how it works. A spray can with a handy nozzle helps you get into the tight spots, the throttle plate, choke, linkage and PCV valve.

The spray itself has two powerful cleaning agents that blast away sludge, varnish and gum. Those filthy deposits your car is better off without. And STP Spray Cleaner has a surface detergent to keep those deposits from building up again.

Try STP Carburetor Spray Cleaner. See how beautiful a carburetor can be.

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CAR CLINIC

(Continued from page 24)

problem is caused by something we've discussed several times before—the AIR system. Give it a thorough inspection, seeing that vacuum hoses are in good shape and connected tightly and properly. AIR components —valves, pump and other plumbing —have to be top drawer, and engine idle speed setting must be set right to specification. Once the AIR system and carburetor are squared away, there should be no more shootin'.

Steering-gear grunt

For some time my 1973 Cougar power-steering system has been emitting a noise I can only describe as a grunt or groan. Is there a solution? —Louis Harrow, Manchester, N.H.

Here comes GM to the rescue with GM power-steering fluid, which you have to buy from a GM source. Flush and refill the system—you'll need two gallons of fluid. If this fails to get rid of the groans, install a new spool valve actuator assembly (part No. D1ZZ-3812-B). When the new valve actuator has been installed, fill the system with GM fluid.

This noise can also strike 1971 and 1972 Cougars, some 1974 Montegos, 1971-73 Mustangs and some 1974 Torinos. All are equipped with Saginaw power-steering gears, and Saginaw happens to be a GM division.

Going screwy

I own a 1966 Plymouth 'Cuda which has the automatic shift on the floor. The entire shift console has come loose. The shifting lever is tight and works fine, but the vibrating console is driving me nuts. Can I tighten it? —Mike Courtney, Mobile.

Easy does it, Mike. You will find the screws in the console glove box. Just tighten them. If stripped, replace them with oversize screws.

CC rider

What happens if I run low on gas with my 1975 Cadillac equipped with catalytic converter? And what happens if I'm in a burg where service stations don't sell unleaded gas?— Fred Wolff, Natchez, Miss.

You pour as little leaded gas as you need into your fuel tank and hope you can reach some other burg (like the size of Pittsburgh) where stations stock unleaded gas. Use of leaded fuel will decrease the effectiveness of the catalyst, but a little won't hurt. Contrary to what some believe, leaded gas won't plug the converter, harm or restrict the exhaust system, kill the engine or cause warts. It will simply, in time, destroy the catalyst and cause any service station found putting leaded gas into a catalytic-converter-equipped car to be heavily fined—if caught.

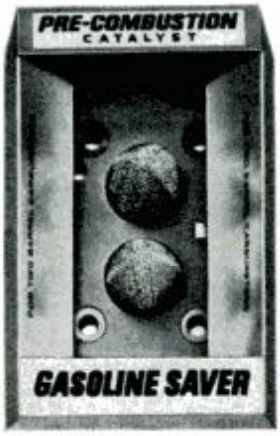
SERVICE TIPS

■ **Don't be fooled** into an expensive replacement of a part of your Chevy High Energy Ignition system because of a loose coil. Chevrolet tells us that some servicemen are replacing HEI coils on L4 and L6 engines because the parts seem loose in their cores. This is the way it's supposed to be, because there's a built-in clearance between coil and coil housing. If the coil tests good, keep it—loose or not.

■ **Are you getting a squeal** from up front on your new Dodge Colt with air conditioner? I bet someone forgot to tighten the compressor drive belt at the 600 mile service. The belt should be torqued to 100 to 110 ft.-lb., using a belt tension gauge. ★★★

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.

IT'S LIKE GETTING EVERY FIFTH TANKFUL OF GAS FREE!



Install an MBI Catalyst and a unique engineering principle goes to work for you . . . it actually ELECTRO-CHARGES your gas so you can get up to 22% more mileage from every gallon when installed as instructed.

You should know two facts from the start. One, the MBI Pre-combustion Catalyst is **not** a mechanical gimmick or gadget. It is a scientific device based on an exclusive design protected by a U.S. Patent.

Secondly, you should know its remarkable mileage economy has been proved by exhaustive, independent tests. Leaded gasoline is required. And normally, full economy is realized only after a break-in period of 1000 to 1500 miles following installation. Effectiveness reports from Scott Laboratory, national magazines, fleet and municipal users are available.

HOW THE CATALYST WORKS

What makes the MBI Catalyst so effective is its unique electro-chemical charging action.

You install the device between the carburetor and the intake manifold. It is a specially molded gasket incorporating two separate cone-shaped screens — one of cadmium fitting within another of nickel, with air space between.

As gasoline is injected, the dual screens give each drop a positive electrical charge, drawing it instantly to the negatively charged walls of the manifold.

On contact, manifold heat completely vaporizes the fuel so it enters all cylinders much more evenly than before.

HOW YOU BENEFIT

You get a totally clean burn. There are no rich or lean cylinders. Carbon build-up is prevented. Your gasoline burns with maximum efficiency. Hesitation, pre-ignition and dieseling are usually eliminated.

Your engine operates with smooth, even power all the time. So efficiently in fact that if your car now requires high octane gas, you can probably switch to regular leaded gasoline without knocking or pinging.*

Regular or premium, you can get up to 22% better mileage when the MBI Catalyst is properly installed, according to simple instructions in the package. That's like getting every fifth tankful FREE. Mail the coupon and start saving.

YES, I'D LIKE TO GET EVERY FIFTH TANKFUL FREE.

Send me prepaid the proper model MBI Catalyst for my car.

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Address _____

City _____ State _____ Zip _____

Car make _____ Model _____ Year _____

Engine size (cu. inches) _____ Carburetor make & number of barrels _____

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Mail with check or money order to:

MBI Mo-Bile Industries, Inc.
244 NORTH RANDOLPHVILLE RD.
PISCATAWAY, N.J. 08854

*Note: The MBI Catalyst is not yet available for 1975 cars, which require unleaded gas.

Doing anything interesting after work?

If you're spending more time at home these days, why not use some of it constructively? Send for details about this fascinating learn-at-home program from Bell & Howell Schools. Find out how interesting it can be to build new occupational skills in electronics—at home, after work.

Look into it. Mail the card now.

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Let Bell & Howell Schools help you discover electronics at home.

These days, it seems like almost everything is "going electronic." If you've got time after work, spend some of it learning electronics.

Mail the card for details about this fascinating learn-at-home program from Bell & Howell Schools.

Why this program is designed to make learning electronics especially interesting.

Electronics is a fascinating subject! But, let's face it, learning at home means you're on your own a good part of the time. There's no teacher to prod and coax you.

That's why we planned this learn-at-home program to hold your attention and make each principle you learn more vivid... easier to remember!

We'd like to think you'll rush home from work each evening—anxious to haul out your course materials and get down to business!

Let's talk about what we do to keep you interested.

For one thing, we don't just send you books.

Oh, books are important. In fact, this program includes a complete set of carefully prepared texts. And there's no way you can get along without them.

But if you decide to spend some of your time learning electronics at home, you're going to get a lot more than books. You're going to take your jacket off, roll up your sleeves and actually get your hands on modern electronic equipment. You're going to explore it... experiment with it... put it together yourself!

If that doesn't *already* sound like something pretty interesting to do after a day at work, take a closer look.

With the very first lesson, you get a Lab Starter Kit to help you grasp the basics.

If you're a complete beginner at electronics, this Kit will help you make a good start.

It's not complicated. Just a simple voltmeter and "breadboard" you use for basic experiments that help you understand the fundamentals. Now, you're ready to move on to something more advanced.

(By the way, if you're *not* a beginner, we'll arrange advanced standing in the program so you start at the point that's right for you.)

You actually build your own Electro Lab® electronics training system.

One evening, when you get home from work, you'll find a large package waiting for you. When you open it, you'll find a set of electronic components.

Probably that same evening, you'll want to start working with these components. Following the instruction manuals and course materials—and using the principles you've learned—you'll actually begin to build three modern test instruments. Once assembled, they make up a complete home electronics laboratory you'll use for testing, troubleshooting and circuit analyzing.

Use the design console... to set up and examine circuits. It's completely modular... no soldering!

Use the digital multimeter... to measure voltage, current and resistance. Read data in big, clear numbers—just like on a digital clock!

Use the solid-state "triggered sweep" oscilloscope... to analyze modern, "state-of-the-art" integrated circuits. Triggered sweep feature locks in signals for easier observation!

By now, you've spent many fascinating evenings at home learning electronics. And you're really making progress. In fact, you're ready to get into "state-of-the-art" integrated circuitry—even some applications of *digital* circuitry!

At this point, you start building a remarkable color TV.

As you build this 25" diagonal color TV, you investigate the digital circuitry that allows the automatic channel selector to go directly to preselected channels—as well as discovering the circuitry behind channel numbers and a digital clock that appear on the screen. You find out why the Black Matrix picture tube makes for such exceptional color clarity. You explore "state-of-the-art" integrated circuitry and the 100 percent solid-state chassis.

Once you've built this TV, you've rounded out your electronic training and gained new occupational skills.

Bell & Howell Schools' step-by-step methods smooth your progress.

Since you're learning at home, on your own, we do everything possible to keep your progress trouble-free.

For example, since it's easier to grasp new ideas one at a time, we send you texts that break the subject of electronics into small segments. You can take your time to master each one before moving on to the next.

Special learning opportunities give you extra help and attention.

In case you do run into a problem or two, we're ready to give you more help and personal attention than you'd expect from most learn-at-home programs.

For example, many home study schools ask you to mail in your questions. Bell & Howell Schools gives you a toll-free number to call for answers you need right away.

Few home study schools offer personal contact with instructors. Bell & Howell Schools organizes "help sessions" in 50 major cities at various times during the year—where you can discuss problems with fellow students and instructors in person.

The skills you develop could lead you in exciting new directions.

No school can promise you a job or income opportunity. But the skills you learn from this Bell & Howell Schools' program could help you look for a job in the electronics industry... or upgrade your present job... or use these skills as a base for continuing your education in electronics programs.

Taken for vocational purposes, this program is approved by the state approval agency for Veterans' Benefits.

Send for details today.

Why not find out how constructive and interesting it can be to spend time learning electronics. Mail the card now.

For more details, mail the postage-paid card today!

"Electro-Lab®" is a registered trademark of the Bell & Howell Company.

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If card has been removed, write:

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HOMEOWNERS' CLINIC

Spotted faucet

I have hard water (no softener) and I've tried just about everything to clean the spotting off my new chrome-plated kitchen-sink faucet. Those horrid spots defy all my efforts and cleaners! Please, will you suggest something I can use without wearing myself out?—Mrs. Charles Wilson, Ottawa, Ill.

Must be you haven't tried cider vinegar. It takes some rub-a-dub with a soft cloth, as do most cleaners, but usually clears off the spots with minimum effort. Rinse off the vinegar residue after each cleaning with a soft cloth and wipe dry.

This is not a preventive; the spotting will come back. But if you wipe the plated parts dry after each use it will lengthen the time between periodic cleanings with the vinegar. Use it full strength, by the way.

Chalking paint

My older home needs painting. The present paint still seems to be in fairly good condition, but is beginning to fail. I'm thinking of using the new latex paint, but am told it should never be applied over old oil paints. What do you say?—M. Arnold, Erie, Pa.

I would consider the condition of the old surface in determining what paint to use. Nearly all older paints tend to "chalk" after years of service; the vehicle (oil) has oxidized and the pigment comes to the surface as a powder. If you draw your fingers over the surface, they will probably be coated with this pigment.

Where chalking exists, I think you would be wise to use oil-base paint for the new coating. However, you can get a sealer for use as a base coat over old oil paint before applying latex paint.

Recoloring streaked wood

I'm refinishing a table of cherry wood. A narrow, yellowish streak has turned up in the top. I've tried coloring it to match the reddish-colored wood with stains, but without satisfaction. Can you suggest a stain that will color the light wood to match?—Robert Woodson, Marietta, Ohio.

For coloring sapwood to match a darker heartwood, I've found artist's colors (oils) invariably produce excellent results. Often two or more colors must be combined to get the right shade, with colors applied direct from the tube with a fingertip and a darker or lighter color added as you go. A drop or two of turpentine makes the colors spread and blend more uniformly. It's a rub-in-and-rub-off procedure until the light and dark areas of wood match. Allow the applied color to dry for at least a week before you apply any final finishing material.

'Mold' on plaster

What will remove what looks like mold from plastered walls? What paint should I use to refinish the walls?—Robert Woolsey, Salem, Ore.

I assume that the "mold" you refer to is mildew. Most any household cleanser in a strong solution will remove it. My preference is for trisodium phosphate, applied with a scrubbing brush. Be sure to wear rubber gloves and protect your eyes from spatters. But removal is only temporary unless you correct the conditions that produce the mildew. Usually it results from a lack of ventilation and excess moisture in room air. A ventilating fan installed in the kitchen or bath, or one in each, operated after meal preparation or bathing will help prevent new mildew. The wall can then be repainted with any interior wall coating, such as water-based paint.

Repairing sewing cabinet

I have what used to be called a Martha Washington sewing cabinet, with half-octagonal end storage pockets. Several pieces of veneer have come off the flats. How can I glue them back? There seems no way to apply clamps.—George Tilman, Madison, Wis.

You won't need clamps if you use contact cement. Scrape off all old glue to the bare wood on the areas originally joined, on both the veneer and the panel to which it is fitted. Then coat both surfaces uniformly with the cement, spreading it to the edges, but be careful not to get any on finished surfaces it can damage. Allow it to dry as package instructions require, then locate veneer exactly as it was. Press the veneer into full contact and go over it with a roller or wood block and hammer to assure good adhesion to the surface. By the way, there are now nonflammable contact cements on the market; you might look for one of these to use.

Mix wood and oil?

I recently installed a wood-burning stove in my basement venting into the same flue as my oil burner. I'm told such venting is dangerous. Is this so, and will a stove vented this way affect draft control of my oil burner?—Joseph Filtz, Bangor, Me.

I hesitate to recommend this installation, because of potential hazard and reduced efficiency of both units. There is the perhaps remote possibility of inducing "blow-back" in the oil furnace owing to draft interference, and reduced efficiency of either unit or both will cost you fuel money. I think you would be wise to plan a means of venting the stove with its own flue.

A separate prefabricated chimney might serve the purpose.

Warping mantel

The mantel over my fireplace is an unfinished walnut plank, 3 in. x 7 in. x 10 ft., and it tends to warp, the center rising about ½ in. If we turn it over it levels temporarily, but warps again in time. What can correct this? Will finishing prevent warping? What finish?—Kenneth Hafner, Fowler, Mich.

You don't say how long the mantel has been installed, but insufficient air drying is a likely cause. Planks of this size usually stabilize when thoroughly dried to a low moisture content. Before taking any corrective action, such as planing the surface, I suggest you give the plank a little more time, as it might level of its own accord. Then it might be smoothed and given a clear finish such as used on bar tops. ★★★

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. HH5, Box 1014, New York, N.Y. 10019.*

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BY JOHN F. PEARSON

SCIENCE WORLDWIDE

Airliners 'gasp' for air

GASP is the catchy acronym for Global Air Sampling Program, a new NASA study designed to determine worldwide levels of air pollution. Pan American World Airways was chosen to collect samples in various parts of the world. A number of its 747s have had a special scoop installed (arrow) that automatically opens at 20,000 feet to gulp in samples of air. The air flows through a tube (middle photo above) to a device that filters out impurities. A computer and associated gear (directly above) control the sampling apparatus and record navigational data.

Air over the United States is collected by similarly equipped United Airlines 747s. NASA says that the GASP study, which is expected to last for at least 5 years and possibly for 10 years, will serve to establish the levels of various contaminants in the atmosphere and determine pollution trends.

New way of treating coal

A problem in converting most American-mined coals into gas is that they swell and cake when burned, clogging fixed-bed gasifiers. To get around this, General Electric researchers grind coal into a fine dust, which they mix with ashes and other substances. The mixture is then extruded directly into a pressurized gasifier in the form of evenly sized pellets, like those shown in the photo below. The method will be tested in a Schenectady, N.Y., pilot plant capable of converting a ton of coal per hour into 100,000 cubic feet of gas. The gas will be used to generate electricity.

Jojoba bush holds promise

If the potentials of the jojoba bush can be realized, there will be an immediate benefit to the Indians of the Sonoran Desert in California and to the world's whale population. Beans from the bush, which grows wild in the desert, contain an easily extractable oil with properties almost identical to the oil of the sperm whale, an endangered species, according to a report by the National Research Council.

Jojoba oil has potential use as a lubricant for automatic transmissions, high-grade machinery and precision instruments, and in the manufacture of industrial products. Up until 1970, when the importation of sperm whale products was banned by the United States, sperm oil was used for automatic transmissions. No satisfactory substitute has been found. The successful cultivation of the jojoba bush in the Sonoran Desert could give an economic boost to the impoverished Indians of that area.

Carbon keeps cool under fire

When it lands (at about 140 mph) the Air Force's new 21,500-pound F-16 fighter will be brought to a stop by carbon-composite brakes that weigh less than the brakes on many cars. To demonstrate the brake's tolerance for high temperatures, technicians recently applied a 3000° acetylene flame to a carbon brake disc and a steel aircraft disc of the same relative size. The steel disc burned and melted, as the photo shows, but the carbon disc showed little effect.

Another advantage is that the carbon-composite is 50 percent lighter than its steel cousin, according to Goodyear, manufacturer of the improved brake. ★★★

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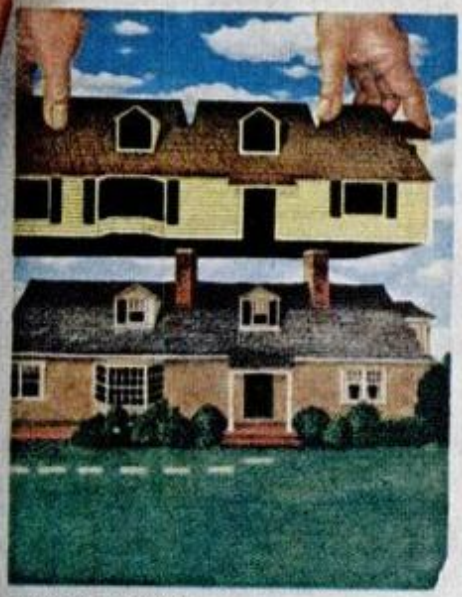
Remodeling with GAF doesn't have to have you climbing the walls or going through the roof.

HOMEOWNER'S GUIDE
TO SUCCESSFUL REMODELING
WITH TIPS ON ROOFING & SIDING



by A. M. Watkins,
author of The Complete
Book of Home Remodeling,
Improvement, and Repair.

CONTENTS
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Build the Mini-Indy racer

Capable of up to 40 mph, this flashy little speedster offers fun and thrills for all ages. You can build it from easy-to-follow plans.

Driving this wild little racer is a real thrill, and would you believe 90 mpg on the way to the finish line? Powered by a lawnmower engine, it's hot enough to hit a top speed of 40 mph to give racing buffs, young and old, a mini-sensation of the Indianapolis 500.

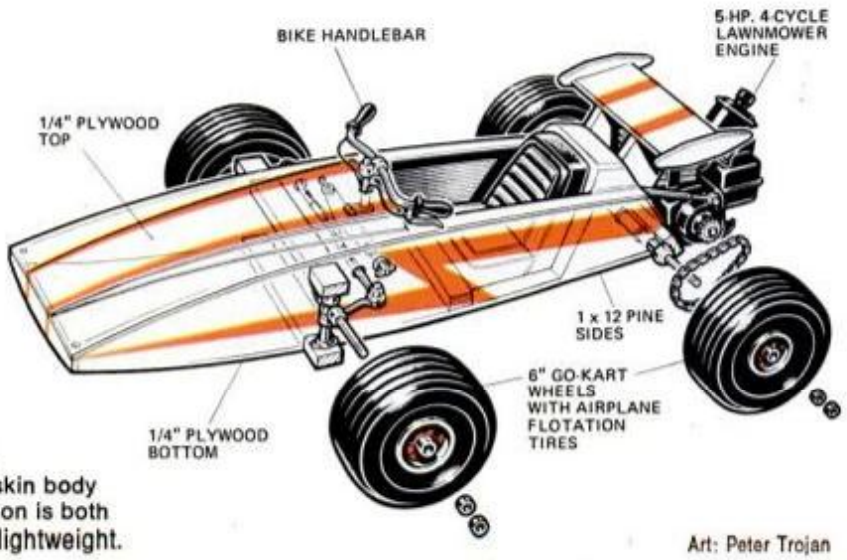
No welding is involved in building the Mini-Indy. All parts are off-the-shelf items available at lumberyards, hardware stores, bike and kart shops. Wheels are standard kart rims fitted with air flotation tires. The engine is a horizontal-shaft, 5-hp. Briggs & Stratton. Most of the steering and suspension system comprises threaded iron-pipe fittings. You steer by the handlebars and work brake and throttle with hand-grip controls. ★★★

HOW TO ORDER PLANS

To order plans, instructions and materials list for building the Mini-Indy, send $5 (check or money order) to PM's Indy Racer, Stevenson Projects & Publications, Box 584, Del Mar, Calif. 92014. Make checks payable to Stevenson Projects & Publications, and allow three weeks for delivery.

Small enough to fit into station wagon, light enough (130 pounds) for two men to lift, Mini-Indy is easily carted to parking lot or track.

Lawnmower engine is bolted to solid cantilevered platform that extends back from the bottom of the body.



All wood, stressed-skin body construction is both rigid and lightweight.

Art: Peter Trojan

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Over 3,000,000 Continental Insurance policies sold last year.

What's the reason people bought so many Continental policies?

In some cases, it's low price.

Today, insurance companies don't all charge the same rates. In fact, several recently published surveys show rates vary widely. So now, more than ever, it pays to shop and compare.

In some cases, it's better coverage.

Take our unique PCP Plan, the all-in-one plan. It lets you combine separate policies on your home, your car, and yourself all into one neat little package that actually gives you more insurance coverage for your insurance dollar.

In some cases, it's quality service.

With a Continental policy, you get 24-hour toll-free Dial-A-Claim Service—backed by over 1600 claims adjusters located throughout the United States and Canada.

In some cases, it's our product line.

We sell more kinds of personal and business insurance than most other insurance companies.

In some cases, it's the idea behind The Insurance Store.

Each Store is owned by an independent agent. Unlike agents who represent Allstate or State Farm only, independent agents offer you a variety of companies, including Continental. So under one roof, you can do all your shopping. Then select. Not merely settle.

In some cases, it's all of the above.

If any or all of them interest you, visit your nearest Insurance Store. To find it, just check the Agent listing under Continental Insurance in the Yellow Pages.

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The Insurance Store

The Insurance Store is a service mark of The Continental Insurance Company.

The proud smoke.

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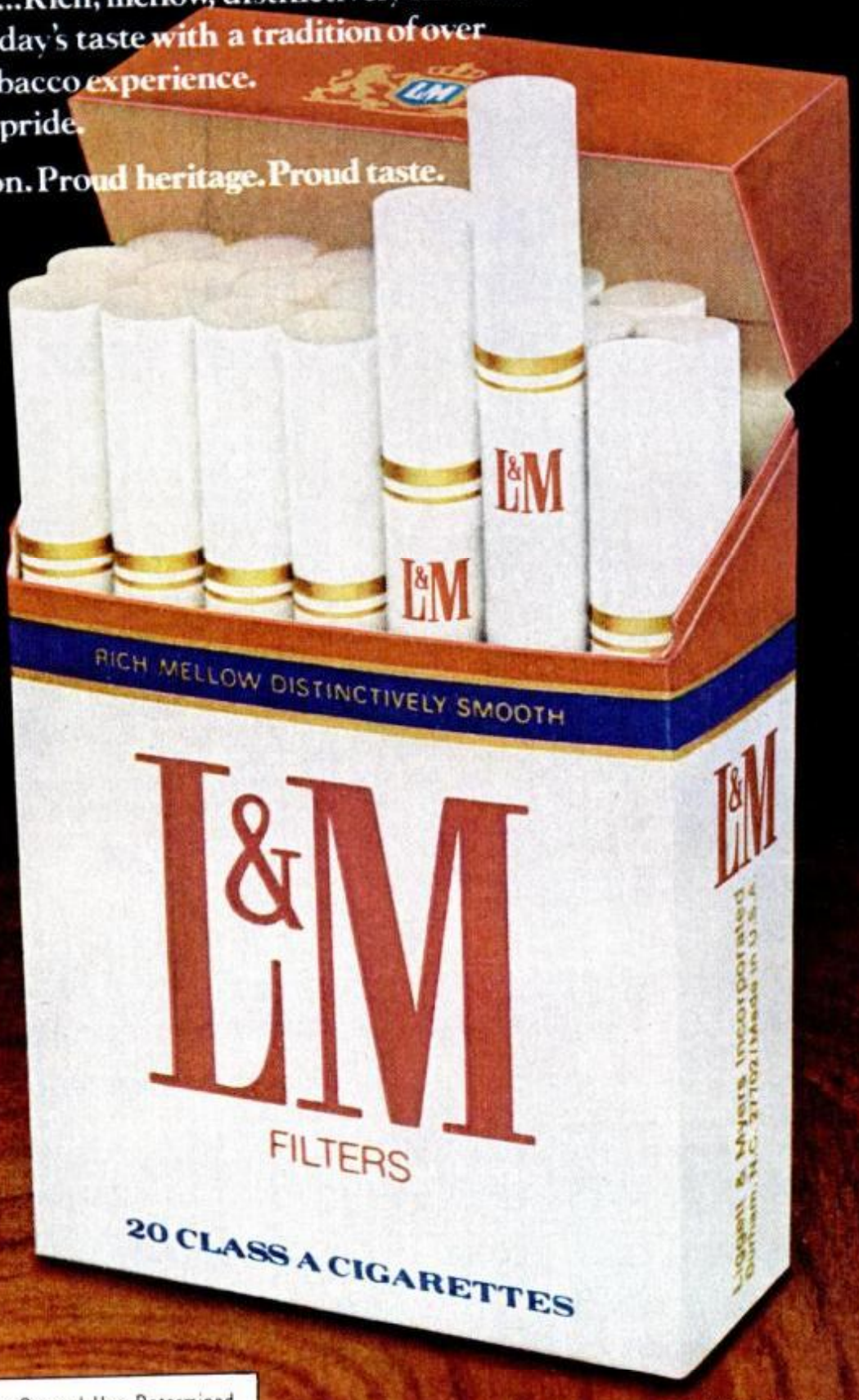
100 years of tobacco experience.
It's a matter of pride.

Proud tradition. Proud heritage. Proud taste.



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

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Filter (Box): 17 mg. "tar", 1.1 mg. nicotine av. per cigarette, by FTC Method.

How to stay alive in a small car

Don't trust traffic lights totally. Be aware of light-shooters who could demolish you.

by Bill Hartford
AUTO EDITOR
Illustrations: Roy Grinnell

Even the obituary didn't settle the score: ". . . Mr. Hartford was killed when his small station wagon was hit from the side at the intersection of . . ." No mention that I was crossing under a green traffic light! No mention that the other driver ran the red! No mention that I was wearing a lap and shoulder belt! Even though belts wouldn't have helped in this side-impact situation (nor would have an air bag), I won't leave the driveway without belting up.

The beginning of the end for me (almost) began when the traffic light turned green. As shown above, I was part way into the intersection crossing a six-lane highway. Cars in the two right-hand lanes were stopped. I glanced left again: A car was coming up to the light in the third lane, but it was a blur! The driver wasn't even on the brakes! I stopped with a squeal.

The huge car flashed by my front bumper without even slowing down. My heart sped up and didn't stop pounding for minutes.

Was I lucky? I prefer not to think of it that way. I would hope that my life means more to me than to trust it to luck, to other drivers or to any traffic-control device.

Staying alive in a small car on roads heavy with cars twice your weight, and trucks whose wheel hubs are at your eye level, takes more than luck. If you drive a small car you must have, or develop, an attitude toward driving, and driving skills that will keep you from being involved in an accident in the first place.

While good driving habits are important in any car, they are especially essential for drivers of compacts and subcompacts. Many small cars lack the power and acceleration of their bigger brothers—the quick burst of speed that can get you out of a hazardous situation in a hurry. Their light weight tends to make them more wind-sensitive and their lower profile makes them harder to see. Drivers of small cars must take special precautions to avoid getting into scrapes. Here, such drivers often have an advantage because of the superior evasive capability of small cars.

Don't tangle with anything else on the road—or along the road. Trees don't budge and neither do such marvelous, man-made tombstones designed into highways as concrete supports and nonbreakaway utility poles. And it doesn't take much knowledge of physics to appreciate that in an accident involving a small car and a big car, the driver of the small car is going to come off on the short end of the stick. A small car and a truck we won't even talk about!

The statistics are numbing. Last year more than 46,000 people died in traffic accidents. While this represents a decline from the previous year (attributed mainly to lowered national speed limits and less driving), the trend is back up again this year. One factor cited is increased use of smaller cars.

Just as alarming are the factors in highway safety over which you have little or no control. You can't eliminate the safety hazards that exist on the highways you drive; you can't govern the unpredictable actions of other drivers, and so on.

That leaves just you—and your car. Assuming you keep both in good working order and fit to be on the

How to stay alive in a small car

road, you've got only that one thing to keep you alive: your skill behind the wheel.

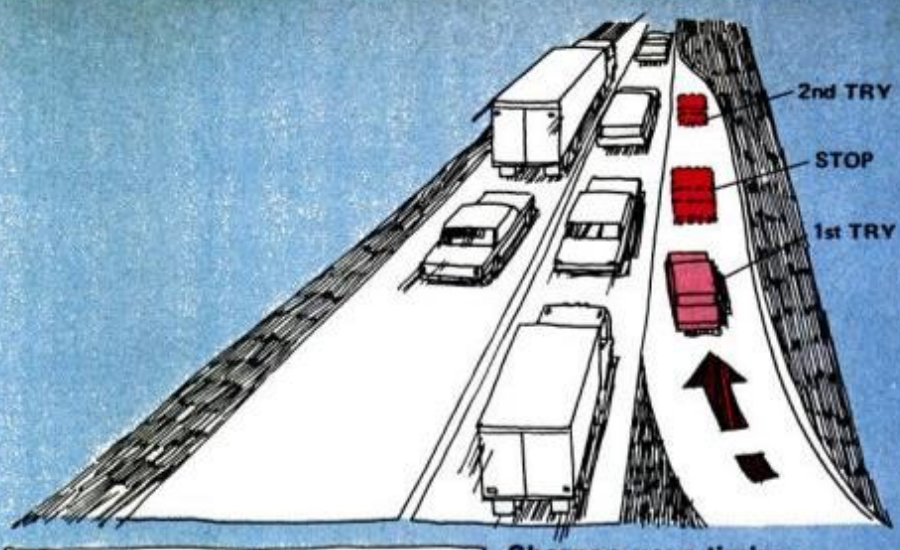
The incentive to develop that skill can only come from you: Driver license examinations test you for only the most basic knowledge of driving, and few driver-training programs have the resources to teach you how to cope with situations that will most seriously threaten you when you get into real-life—or death—driving emergencies. Skidding and skid control, for example, is almost always explained, but the classroom is a long way from personal instruction in a test car on a skid pan.

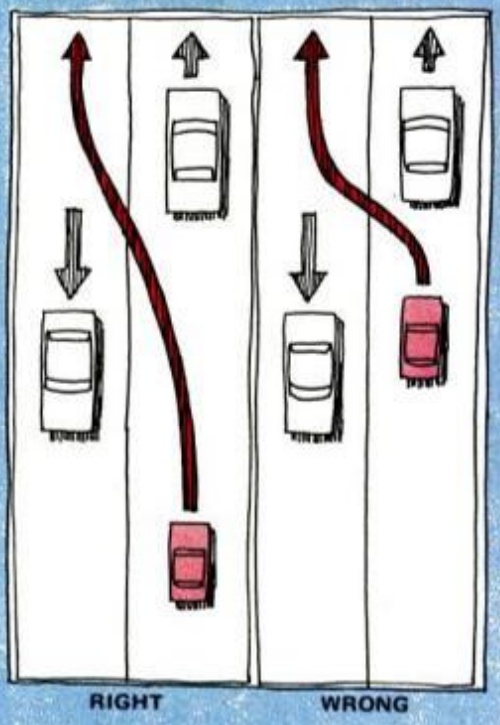
The technique of controlling skids and other advanced driving skills can only be learned by doing. (For advanced driving courses or schools, check the driver-education instructors at your local school.) Even specific lifesaving tips and driving techniques shown on these pages and page 106 must be practiced over and over to become part of your regular behavior at the wheel.

All actions at the wheel, whether those shown here, specifically, or others that contributed to your safety, reflect your judgment and ability to anticipate. Of course, acting on your judgment can be done only when you are concentrating on your driving.

So, ultimately, it is your judgment, concentration and ability to "read the

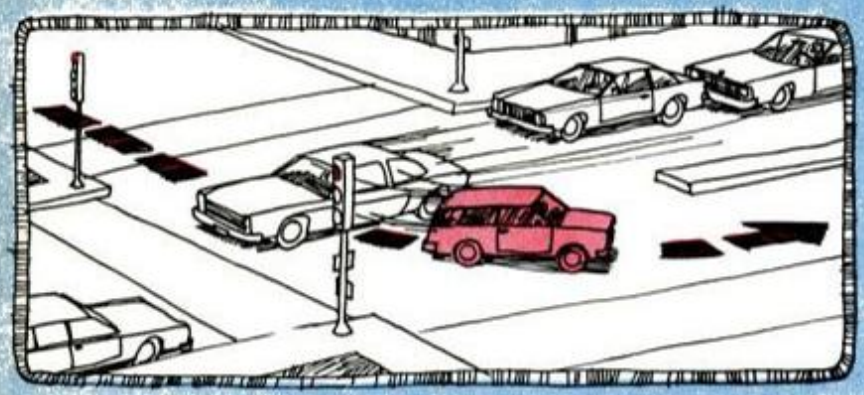
(Please turn to page 106)

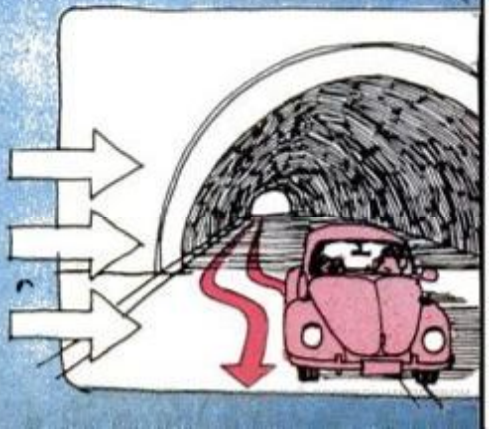




Sharpen your timing

Take pride in driving smoothly and with rhythm. Any car, no matter how small or how low the horsepower, now can overtake, pass and enter high-speed parkways safely if the driver has a developed sense of timing. On entrance ramps (above) you should gauge speed of the other vehicles, accelerate in proper gear, determine the opening you can take safely and turn on your left directional signal. If traffic is so thick you must stop, do so before you reach the end of the ramp; leave room for a second try. On overtaking and passing (left) do not pull up close behind the vehicle: it blocks your vision, forcing you to make an abrupt, gas-wasting effort to pass. Lay well back from the car you wish to pass, and accelerate so that your speed approaches passing speed as your opening appears. It's the safe, quick, smooth way around. Anticipate the buffeting you'll get when passing trucks and buses, and, if it's raining, set your wipers at high-speed before passing to handle the heavy spray you'll run into.



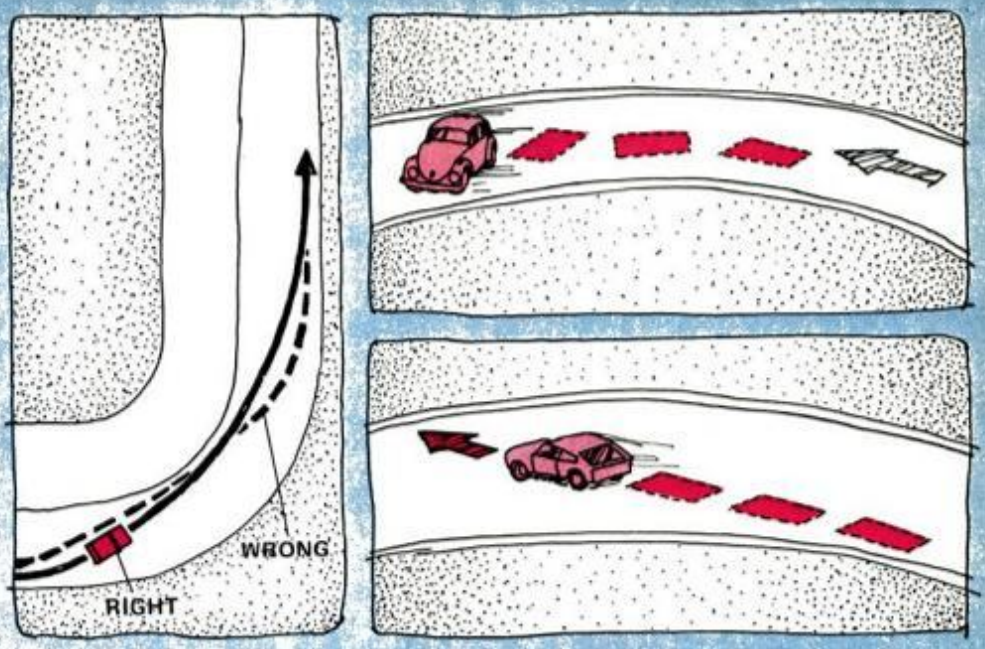


Know when to hit the gas

Be just as ready to hit the gas as you are to hit the brakes. Your split-second judgment and reaction time must encompass all of your car's controls and not just the brakes. Here, the driver of the small car (who started across the intersection from a stop when the light turned green) was already in the path of the car running the light when he saw it. Only getting on the gas fast enough prevented a serious broadside accident. This is an actual situation I found myself in not too long ago. It affirmed two other rules for safe driving—especially for drivers of small cars, most of which have standard, manual transmissions: Don't shift gears while in an intersection and be in the right gear for forward speed at all times. If I had been between gears or had just gone into second, I would not have the torque available as I did when I put my foot to the floor in first gear. As more small cars become available with five-speed transmissions, it's especially important to know the shift pattern instinctively and to know the torque and power characteristics of your drive train.

Keep your balance

When you read that a driver "lost control of his vehicle," you get only part of the story. What happened was that the driver, through improper use of his controls unbalanced his car and could not regain balance. Total control over the dynamics affecting a moving car is one joy of driving. At right are shown the right and wrong paths through a bend. After braking while the car is still going straight (do not brake *in* the bend) start on the right side to improve visibility around the bend. Move toward the centerline to straighten the angle of the curve and minimize centrifugal force. At far right, top, is a rear-wheel skid caused by braking while in the turn or by excessive speed. To correct, turn the steering wheel into the skid (direction rear wheels are traveling). At far right, bottom, is a front-wheel skid, usually caused by excessive speed. To recover, get off the gas and straighten front wheels to reduce centrifugal force. Braking and accelerating cause weight shifts affecting balance. When loading your car, distribute weight evenly.

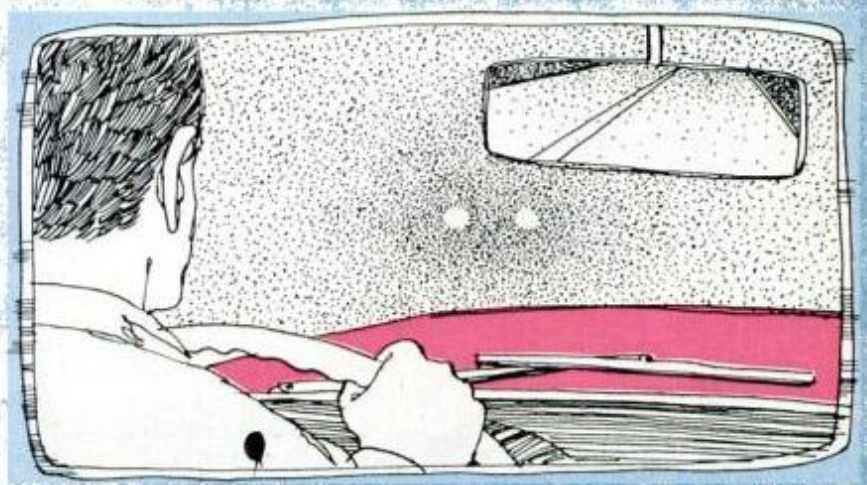


Let 'em pass

We've all been tailgaters at one time or another—probably out of impatience with a slow driver ahead. On a multilane road, the slow driver is often in the left or high-speed lane. It's law that all drivers keep right except when passing. If this basic rule of lane discipline were followed—and enforced—there would be a safer, smoother flow of traffic. Obviously, on a wide road there's a way around this type of unsafe and inconsiderate lawbreaker—if he doesn't move over after you turn on your headlights and flash your highbeams. On a narrow, winding road, however, there's only one lane, and if you're the one driving slowly, or even at a moderate speed (as you're entitled to do), you'll block drivers behind who wish to maintain a somewhat faster clip. Let 'em by! There's nothing to be gained and danger has a way of spreading: You could be involved in an overtaking and passing accident. So don't blithely watch the chain of cars behind you getting longer while tempers get shorter. When there's a break in oncoming traffic, ease over to the right side of the lane or even onto the shoulder if it's paved, and wave on the driver behind. Put on your emergency flashers if you intend to slow drastically or even stop completely to let by a chain of cars. You'll get rid of the aggressive tailgaters and will be able to resume a safe, leisurely pace, and you'll be sure to get a wave of thanks from considerate, but faster, drivers who, like yourself, have a sense of sharing the road with others and are aware of good road etiquette.

Know your car

Different cars have different handling characteristics. In strong crosswinds, small rear-engine cars like that shown at the left, below, are easily deflected from their paths, especially when they encounter a sudden gust situation. Front-engine, front-wheel-drive cars, on the other hand, like that shown at the left, top, track very well, even in strong crosswinds. Know your car and anticipate road and weather conditions that would affect its handling. The driver of the rear-engine car who is forced over the road's centerline, as shown here, could be involved in a head-on collision that would jeopardize the life of the other driver as well. If you're the other driver, however, you could take evasive action and be hard against the curb side of the road before the rear-engine car was deflected into your path. So, know your own car, and know about the other cars on the road!



Be seen and heard

Use your headlights to light up your car for other drivers. Under conditions of limited visibility (rain, snow, fog) you don't need them to see ahead, but other drivers need them to see you. In some states it's law. Be first to turn on your headlights at dusk and last to turn them off at sunrise. In these partial daylight conditions when it isn't fully dark, you might even use high beams. Use your lights to communicate: Flash them rapidly at drivers who loom up in the semi-darkness ahead—unseen because they haven't turned on their lights. Do the same to alert other drivers to a dangerous situation. Use your emergency flashers to alert drivers behind you. Buy a car painted a "safe" color; light colors show best. Use horn only for emergency and then with a series of rapid taps; don't lean on it. Recognize drivers who communicate with you; a wave of the hand does wonders.

Radio control without the roar

Wind-powered R/C models offer quiet excitement on water and in the air.

by Stephen Walton
ASSISTANT EDITOR, HOME AND SHOP

Photos: below, Jose Corte; others, except 4, Diana

If you like the idea of using nothing but the wind for motive power and making it put graceful vehicles through maneuvers, for fun or for competition, you can try sailing and soaring in miniature with sophisticated radio-control models assembled from kits.

R/C model yachting is an appealing sport because it combines craftmanship and seamanship, with the payoff of head-to-head competition under rules virtually identical to those used in full-size yacht racing. Several classes of model yachts are well established, with class championship regattas held annually, and you can put a raceable boat into the water for considerably less than the price of a full-size sailing dinghy.

R/C model soaring has been around for a while, but the introduction of the Hobie Hawk sailplane promises to create a boom in the sport. Made by Coast Catamaran (the Hobie Cat people), the Hawk is sturdy, competitive and available both in kit form and ready to fly.

Although I'm strictly a novice modeler, I was able to build and successfully operate both a kit-version Hobie Hawk and a Huson 36 model yacht, a kit-built boat in a recognized racing class.

What are they like to operate? Very different.

Learning to fly the Hawk without an instructor would be like learning to ski without one—you could expect to break something. A Hawk flight starts into the wind with a toss from the top of a ridge (that produces an updraft) or on a towline hauled in either by an elastic shock cord or a motor-driven winch. Once it's up there—1000 ft. on a shock-cord launch is not uncommon—and off the tow, a beginner can take the stick. First you learn to keep the sailplane pointed into the wind with the rudder alone, then you progress to making wide, sweeping turns—moving the rudder to initiate the turn, adding some up-stick to compensate for the tendency of the nose to dip (because the rudder is also acting partly like an elevator while the plane is banked, and lift from wings is reduced), then returning rudder to neutral while holding the elevator position to complete the turn.

Learning to handle stalls and dives comes later, as do tow launches (when an otherwise stable plane can display quirky behavior) and non-violent landings. Make sure your teacher is near enough that he can grab the stick if you go into a spiral dive—and you're bound to go into a few while learning. An expert pilot can put the Hawk through some pretty fancy aerobatic paces and bring it in for a one-handed catch—and he can use thermal updrafts to stay aloft as long as the charge in his radio-control batteries will permit. That and precision landings are what sailplane competition is about.

You can solo with an R/C yacht right away. Once you get your jib-slot adjusted so that the boat sails straight with minimal rudder correction, you can practice running a figure-eight course between two marks, learning when to ease out and when to haul in the sails. Then you can start practicing on a triangular course and learning the racing rules. And you will benefit from getting a seasoned skipper's advice before you start racing.

The American Model Yachting Assn. is a young, aggressive organization with about 1500 members, nearly 50 member clubs nationwide, and 65 sanctioned regattas on its 1975 schedule. Annual dues are $5, and AMYA's new-members packet provides a thorough introduction to the sport, with information you'll

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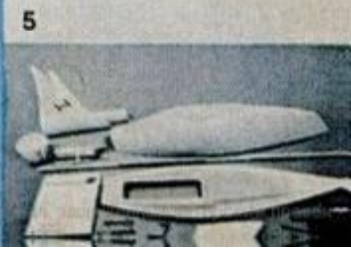
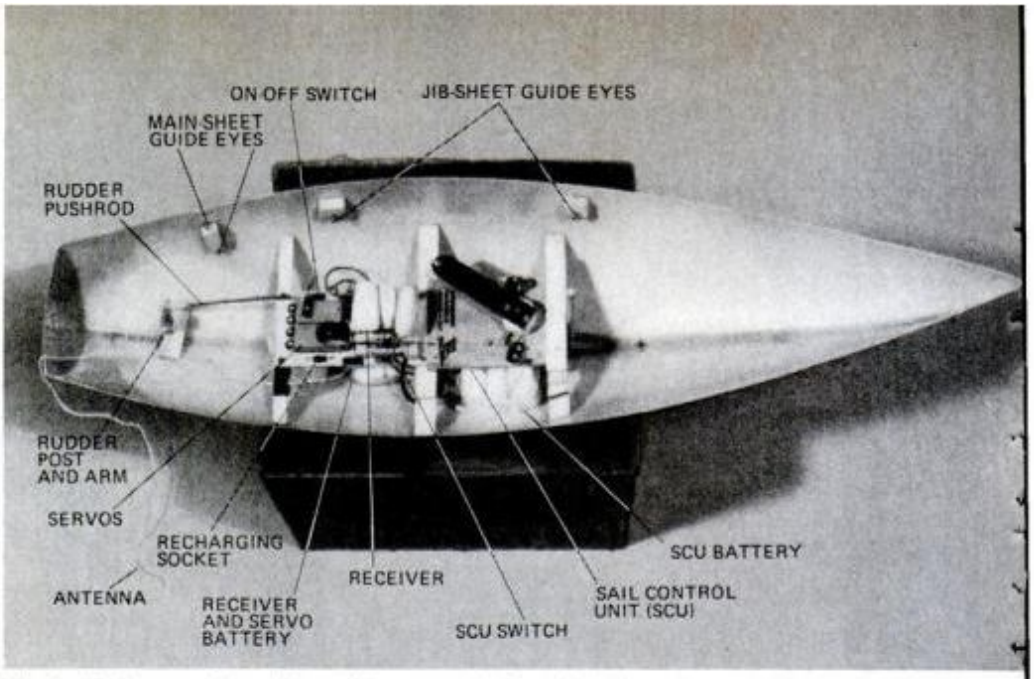


1. Action with 50/800-class yachts during a club race. 2. Author's Hobie Hawk sailplane ready for towline launch. 3. Hobie Hawk in flight. 4. Huson 36 yacht, one of few boats available in full-kit form. 5. Hobie Hawk kit contents. 6. Huson 36 kit contents, with Harris sail control unit, sold separately, at lower right.

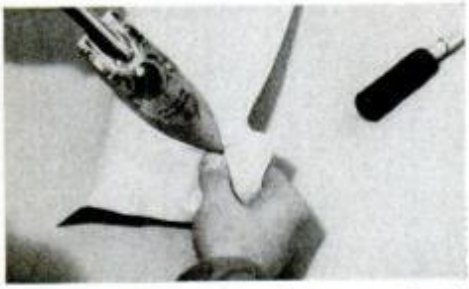
probably want before you begin to build a boat.

Building the 8-ft.-wingspan Hobie Hawk from the $99 kit is relatively simple, as major sections are pre-assembled—three-part fuselage (polyethylene nose, fiberglass tail cone, ABS tail) and wings and tail surfaces (1/32 and 1/64-in. plywood over-high-density foam). You finish the fuselage, attach wing, rudder and elevator tips, sand surfaces and cover them with plastic film such as Super Monokote, and install radio gear (control linkages are provided). The two-channel RS system I installed, designed for sailplanes, sells for $170. (If you're in a hurry, you can buy the finished Hawk, less radio, for $149, or ready-to-fly for $339.)

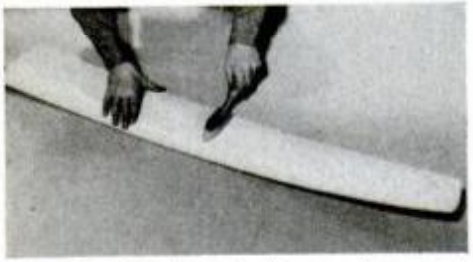
The Huson 36 yacht kit, at $125, includes fiberglass hull, deck and keel, wood for mountings, spars and 4-ft. mast (you laminate it), all fittings, rigging cable, running lines and ready-made Carr sails. You add a sail-control unit (R/C servos lack the power needed), like the Harris Engineering Little Herc ($46 assembled, $34.95 as kit), ballast and radio gear. I used a Kraft system ($219.95 retail) with heavy-duty servos and a three-channel transmitter (unused third channel is sometimes set up for separate control of jib-sail) with separate sticks for the rudder and sail-control unit. ★★★



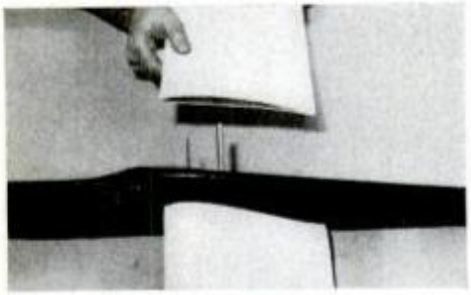
Mechanical crew of model yacht as seen before deck is put on; radio gear and SCU will be removable through hatch. Sheets are attached to SCU with deck in place.



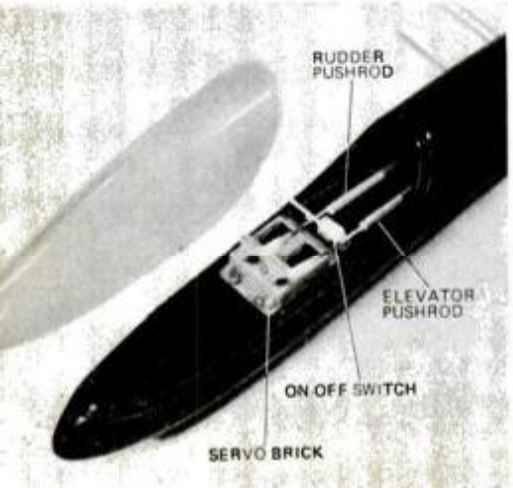
Iron-heated Super Monokote covering is stretched and sealed to wingtip curve.



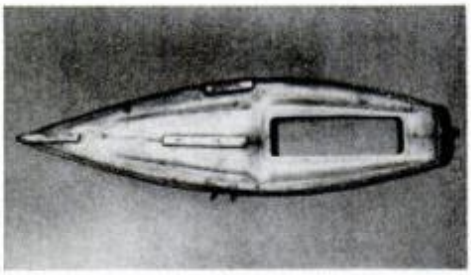
Film stretches drum-tight over wing panel with heat; makes smooth, glossy surface.



Wings slide onto rods through fuselage—factory-finished wing roots give correct angle of attack for flight.

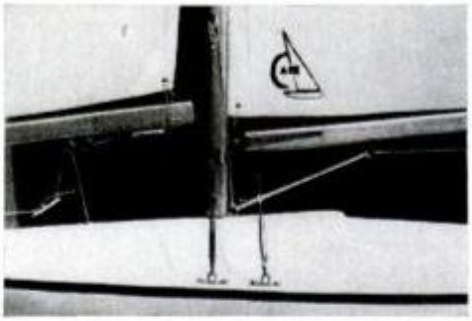


Hawk cockpit with radio system installed looks uncluttered—receiver and battery are in the nose below the deck, and the charging plug is on the fuselage belly.



Wood blocks are fastened to underside of deck and fittings screwed into them.

Deck, hull are permanently joined with epoxy or resin mixed with powdered glass.



Turnbuckles, cleats, bowsers provide for adjustment of rigging, sail tension.

With transmitter and receiver on, hatch cover secured, author launches yacht.

For more information: AMYA, Eugene "Bud" Salika, 3917 Sunnyside Ave., Brookfield, Ill. 60513. Model Yacht Racing Assn. of America (sanctions nonradio racing as well), Jerry Dunham, 83 High St., Orange, N.J. League of Silent Flight (membership earned by demonstrating soaring skill), Box 39068, Chicago, Ill. 60639. National Soaring Society (competition-sanctioning body), 46 Oakcrest Dr., Dover, Del. 19901. Academy of Model Aeronautics (provides liability insurance for members), 806 15th St. N.W., Washington, D.C. 20005. **Manufacturers:** Coast Catamaran (Hobie Hawk), 2026 McGaw Ave., Irvine, Calif. 92705. Leisure Products (Huson 36), 6920 Braddock Rd., Annandale, Va. 22003. Harris Engineering (sail-control units), 7628 Dunston St., Springfield, Va. 22151. RS Systems, 850 West Barkley Ave., Orange, Calif. 92667. Kraft Systems, Inc., 450 West California Ave., Vista, Calif. 92083. Carr Sails, 7607 Gresham St., Springfield, Va. 22151.

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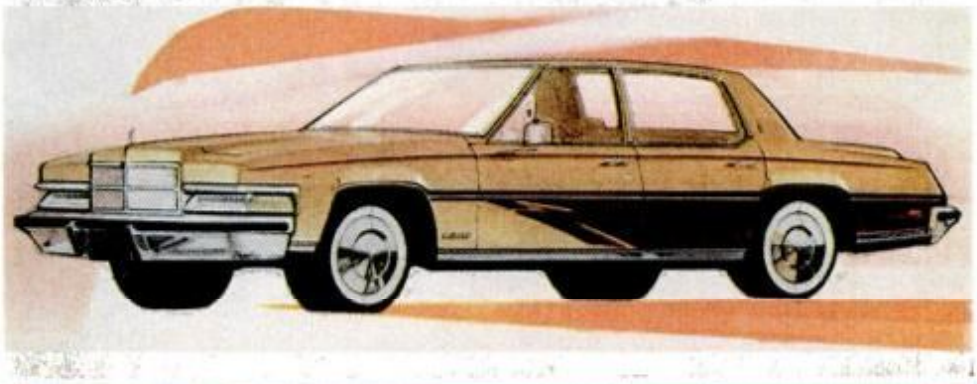
Preview of Detroit's '76 models

Yes, there will be a 1976 model year for the Detroit automakers. Some cars obviously are just variations on a theme, but they are still worth looking at. Others, which no one outside the factory has seen, won't be ready until later in the year. But enough is known to visualize them—as artist Harry Bradley has done here.—*Bill Hartford*

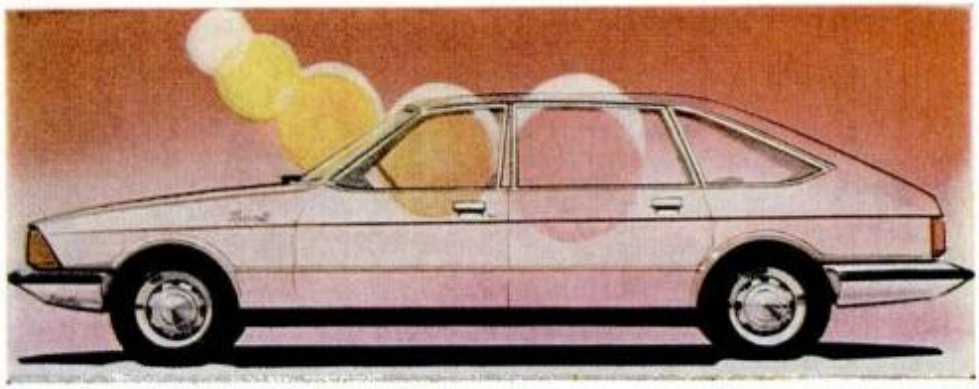
Cadillac Seville coupe

GM has a hot one in the new Cadillac Seville. Now there's a coupe version in the works that might be ready as early as spring '76. The Seville (or "M" body) will have to be shared with the other GM divisions. Buick and Olds will have their "Sevilles" soon.



Compact Lincoln

Seville's success will force the Linc-Merc. Div. to go small with a luxury model. It can't be much like a Monarch and can't be a Continental/Mark mishmash. A stretched Monarch shell (Seville is a stretched Nova shell) with clever exterior styling might carry off the masquerade.

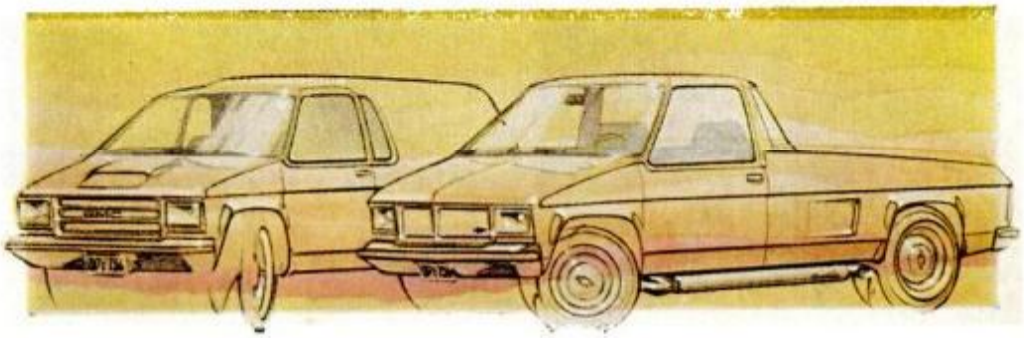


Plymouth/Simca hatchback

The Chrysler-Plymouth and Dodge boys have strong compact-line models, but are short in subcompacts. Dodge does have the Colt from Mitsubishi, but Plymouth is wanting—the new front-wheel-drive Simca 1300 could be just what Plymouth needs. All it would require for the United States is an engine of about 1900-cc displacement.

Dodge Aspen

Among the Chrysler-Plymouth and Dodge models that'll be introduced soon (and shown in the October issue) are two brand-new entries: the Dodge Aspen and Plymouth Volare. Essentially they'll be Darts and Valiants given a luxury treatment.



GM mini-van and pickup

Street rods, dune buggies and other oddballs have moved over to make room for the latest fad: the van. Van people have been doing such slick work with their big boxes that Detroit had to take notice. Enter the mini-van from GM which has a "now" look and will be more economical to own and operate.

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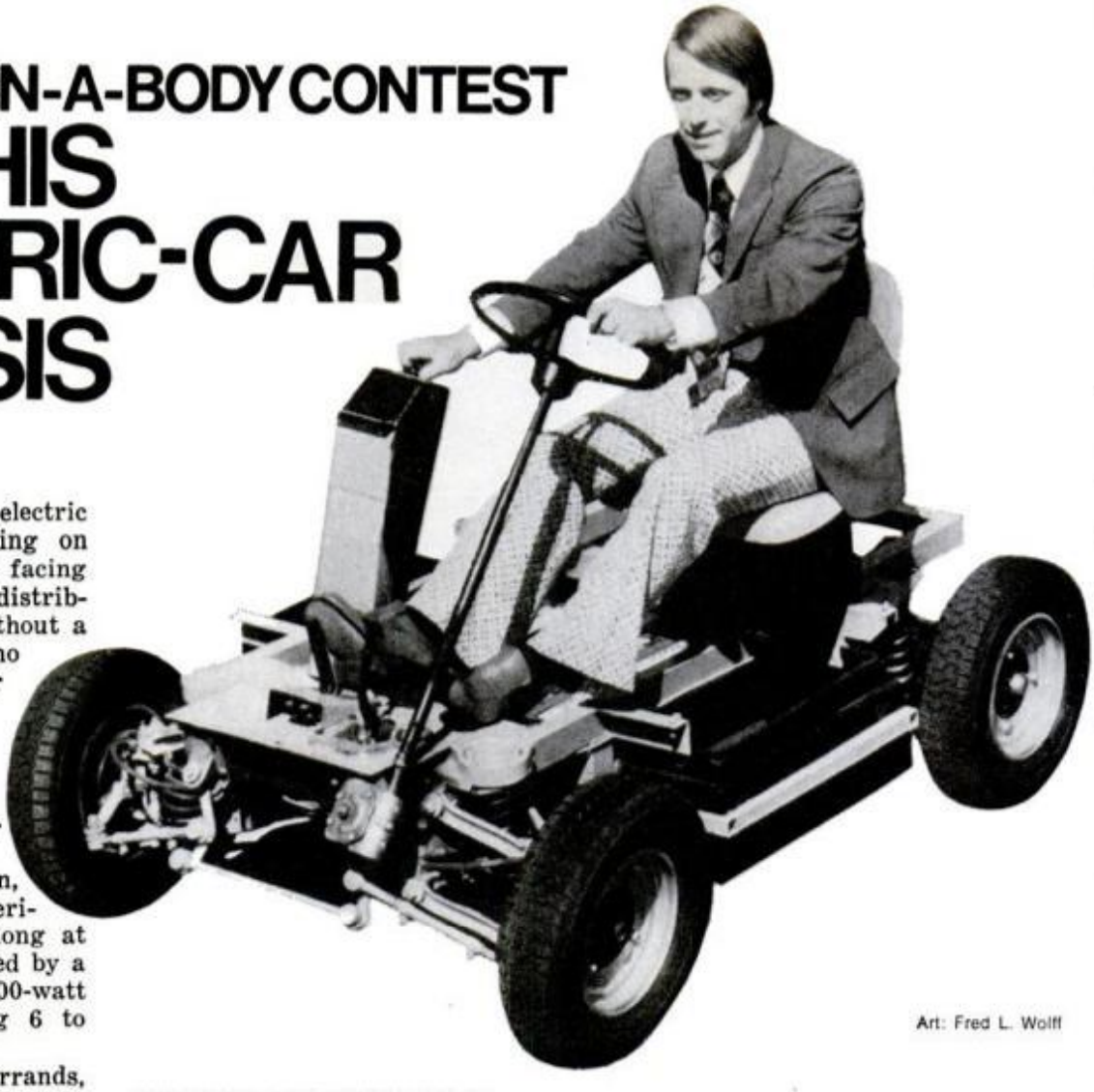
PM'S DESIGN-A-BODY CONTEST

WIN THIS ELECTRIC-CAR CHASSIS



Art: Fred L. Wolff

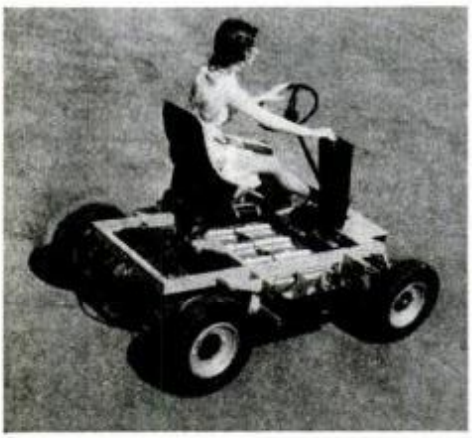
With its successful little electric Elcar already appearing on the streets of America (see facing page), the Elcar Corp. now distributes and sells its chassis without a body for do-it-yourselfers who want to design the exterior and finish the car.

It's this $1700 unit pictured here that you can win if the body you design is judged best in *PM*'s Design-a-Body Contest.

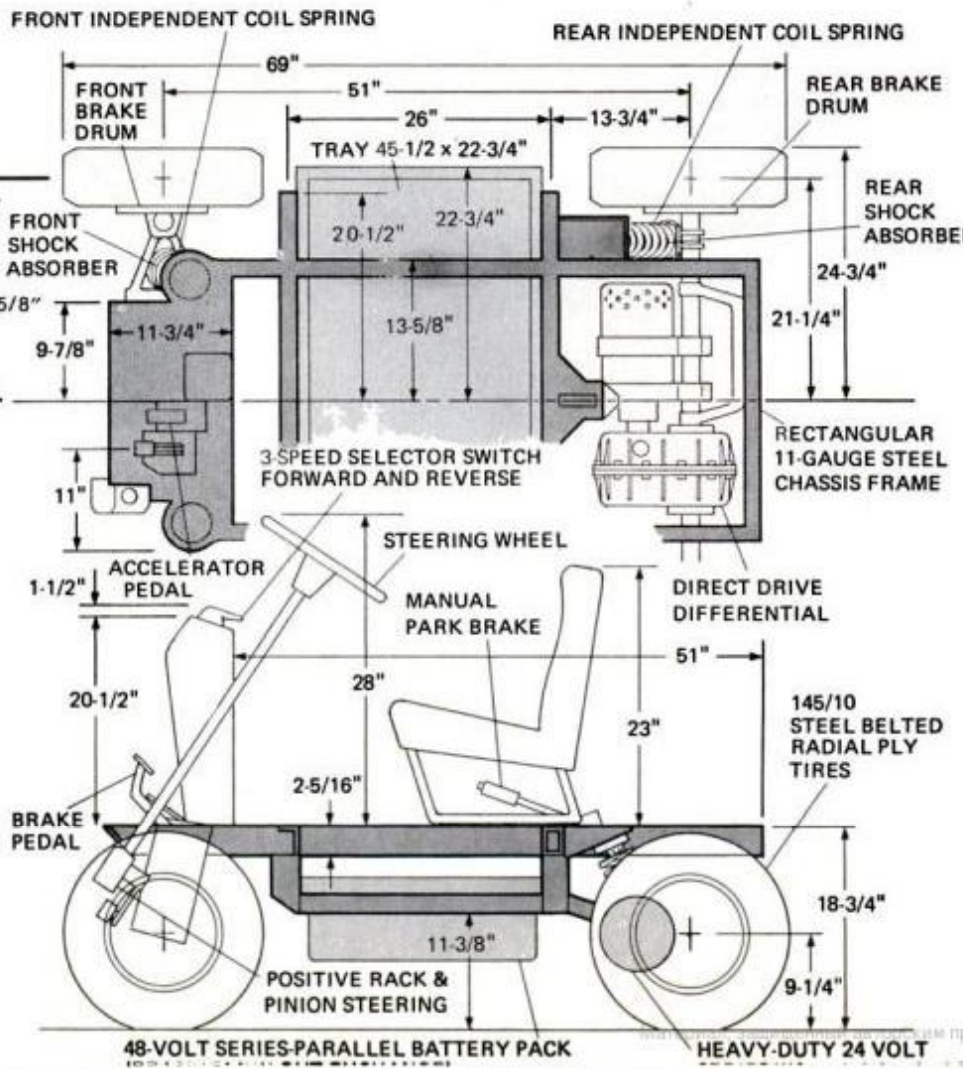
In a car of your own design, you'll enjoy the unique experience of humming silently along at speeds up to 35 mph, propelled by a battery-driven 3½-hp, 2000-watt motor capable of developing 6 to 7 hp.

After some 30 miles of errands, plug the charger cord into any handy 110-v. outlet and in seven or eight hours you'll be all set to start rolling again—at an energy cost of about ½ cent a mile.

This rugged little vehicle is no golf cart conversion. Its tough chassis, steering and suspension are adapted from the small Fiats, and it is manufactured by Zagato. The Model 2000 chassis has independent coil-spring suspension in front and semi-independent in the rear, with shocks all around anchored to frame of 11-gauge channel and angle steel. The tires are Michelin X2 145 SR10s,



Elcar Model 2000 chassis will go to the PM reader who submits best body design.



good for 40,000 miles. *That* is the basic unit you can win!

Using chassis diagrams and dimensions at right, design a body for it according to the rules set forth, and send your scale drawings to PM Electric Car Body Contest, 224 West 57th St., New York, N.Y. 10019.

There's no need to buy anything but paper and pencil; this is a *design* contest, not a building project. If your design is judged best, the Elcar chassis shown here will be shipped exactly as it is sold for the do-it-yourselfer (that's minus batteries and charger) to the address you designate.

The winning chassis will come to you with all the control wiring installed. Diagrams and instructions for tying in the few remaining wires for lights, turn indicators, wipers, radio and other elements that may be included in the body you design, will be provided by the Elcar distributors with the chassis.

You don't need professional design experience to win this contest. The judges will not be looking for polished art, nor will "professional quality" in the design sketches be a consideration in picking the winner. Concept and practicality (including do-it-yourself simplicity) are the vital factors.

Contest rules are as follows:

1. All entries must be postmarked on or before Sept. 15, 1975.

2. Sketches must be drawn to accurate scale—one inch equal to one foot.

3. All entries must include the following:
   a. Top view, with passenger seating arrangement and cargo stowage areas indicated by dotted lines.
   b. One side elevation (driver's side); one front and one rear elevation—all showing seat configuration in dotted lines.
   c. All diagrams must be drawn to conform to given dimensions of the chassis diagram shown here, and body attachment points to the chassis should be indicated.
   d. Materials used to make the body, and methods of fabricating the various panels and parts, must be indicated in the legends on the drawings. Hardware must be specified and ways of mounting body indicated.

4. Your name and address must appear on every sheet of drawings and descriptive data submitted, and must be inscribed on any scale model you may volunteer to send in.

5. Automotive or other industrial designers who make a living at either profession and *Popular Mechanics* employees and members of their families are not eligible to compete in this contest.

6. The contest is void in states, counties or localities where such contests are legally prohibited or restricted.

7. All entries become the property of *Popular Mechanics*, and only one prize will be awarded.

There are no rules against building a scale model or prototype to prove the viability of your design. But they are not required. Your de-

(Please turn to page 121)

ROAD TESTING THE ELECTRIC CAR

by Richard F. Dempewolff

When you climb aboard the boxy little two-passenger, fiberglass-bodied Elcar, as I did recently at its American home base in Elkhart, Ind., new driving sensations begin.

The Elcar is an import from Italy, made in Milan by Carrozzeria Zagato, noted producer of prototype sports cars. In Europe, it's known as the Zele. It comes in two models—series 1000 and 2000. In the back of Elcar's Indiana headquarters there's a prototype four-passenger model of the car which will be produced in this country by early next year. But more about that later.

The one I drove was the Model 2000, which sports a 3½-hp motor, has a claimed top speed of 35 mph and maximum range of 30 miles before you have to plug it in and recharge the batteries. The series 1000 has a 2½-hp motor, a top speed of 25 mph, but a range of up to 50 miles between chargings. Both models work off a solenoid-operated speed-control system feeding, in successive stages, 24, 36 and 48 volts to the motor from a pack of eight standard 12-volt lead acid automobile batteries.

While I wouldn't exactly call the Elcar "cute," it has definite eye appeal and "character." It looks like a mini-tractor for a missing mini-trailer, brightly colored (choice of seven shades) with sliding windows, headliner and a roomy, uncluttered interior. For all its compactness, the boxy little cabin boasts a surprising amount of leg and headroom. But the real surprises come when you get in and start driving.

When I turned the key, nothing whirred, hummed or started going. All I'd done was unlock the steering and open the circuits for subsequent procedures. At the top of a squarish post on my right there's a dial with a hand-rotated pointer arm. The dial is labeled R O 1 2 3—obviously the transmission switch: reverse, neutral, and three forward speeds.

Each dial position, I discovered, has two progressive speeds, for a total of six speeds forward and two in reverse. As you climb through the forward ranges, accelerating as you go, the throttle must be let up for each position change on the dial control—like shifting gears without a clutch. There's a lusty whine from the motor as it labors to gain speed in each range. But once I hit top speed the

(Please turn to page 121)

PM reporter Dick Dempewolff prepares his test drive of Model 2000 Elcar (upper left). Note central control console containing knob with which you dial choice of neutral, reverse or three forward speed ranges. Bank of eight batteries slides out in tray under body for easy access (lower left). At upper right the mini electric is plugged in for an overnight recharge. Photos at lower right show expanded four-seater hatchback model in prototype form.

Материал...

How science sees with sound

Using ultrasound, says a researcher, is like putting the doctor's eyes inside the patient.

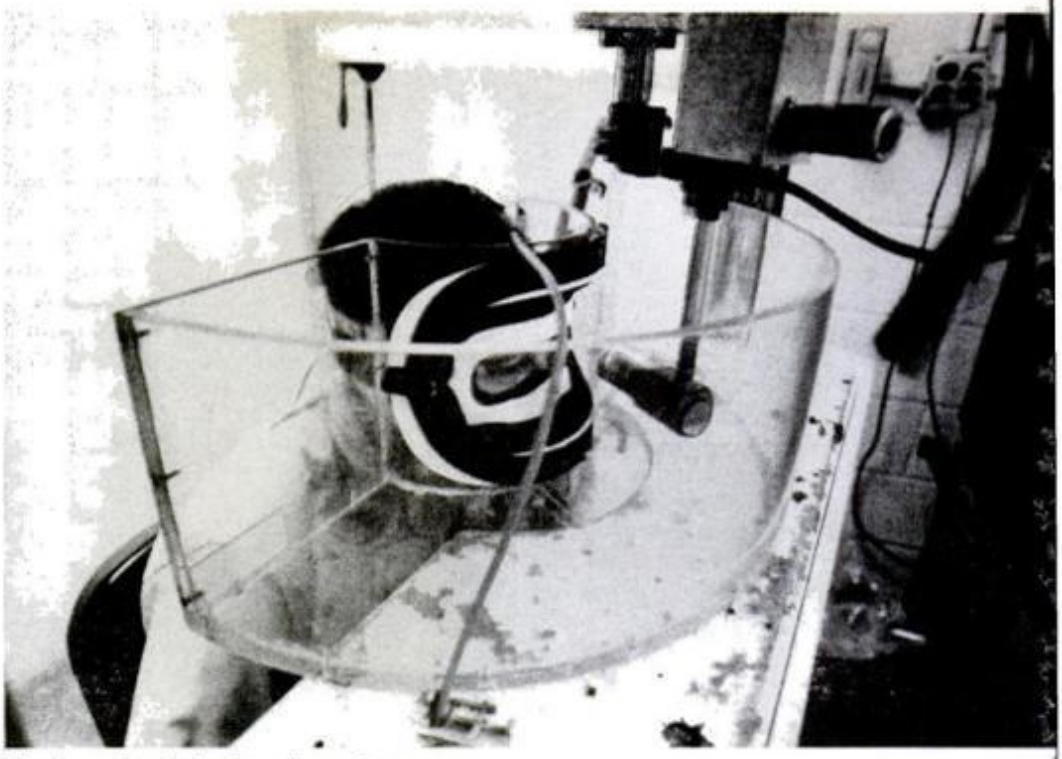
by Hans Fantel

Kelly N., like a lot of 11-year-old boys, got into a fight at school. When the other boy hit him on the right side of the head, Kelly collapsed. At the emergency room of San Francisco's Mount Zion Hospital, he was X-rayed for a possible skull fracture. No fracture showed and Kelly was sent home.

Later in the day, Kelly became groggy and his father brought him back to the hospital. Suspecting internal bleeding, the doctors drilled into Kelly's skull to relieve the pressure on the brain. By this time it was too late. Permanent brain damage left Kelly mute and paralyzed from the neck down.

The boy's family sued the hospital for not having diagnosed the internal bleeding in the initial examination, when immediate surgery might have saved Kelly from being crippled. They were awarded more than $4 million—one of the largest settlements of its kind, but small comfort to Kelly.

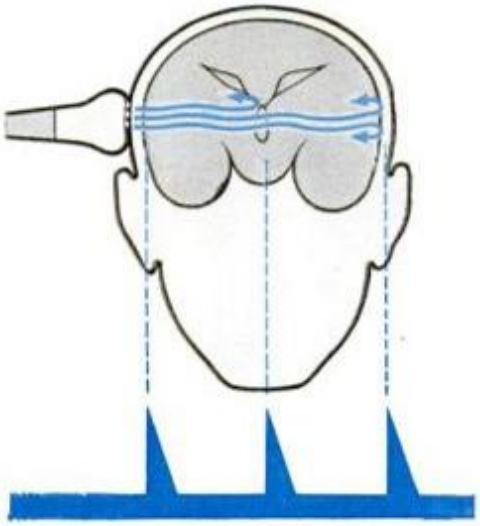
The tragedy might have been averted through the use of ultrasound, the newest medical technique to detect hidden injuries and ailments.



Silently and painlessly, ultrasonic waves from transducer probe a patient's eye.

Contrast the case of Kathy R., a one-year-old Pittsburgh girl who was just learning to walk when she slipped and fell on a freshly waxed floor. Since the child suffered no apparent injury, her mother felt certain that a hug and a kiss were all the remedies needed. But when Kathy grew dizzy and listless, her mother called the doctor who immediately took her to Presbyterian-University Hospital for an ultrasound checkup. There, Dr. Charles Grossman, one of the pioneers in ultrasound diagnosis, sat Kathy next to a knob-studded device resembling an elaborate TV set. He picked up a small pencil-like probe connected to the unit and just held it to the side of Kathy's head.

Ultrasound—sound waves beyond the range of human hearing—were now pulsing through Kathy's brain. The child felt nothing whatever, for ultrasound is imperceptible to any of the human senses. But on the monitor-tube screen, three luminous blips sprang up. "The two outside blips are sound reflections from the sides of her head," the doctor told Kathy's mother. "The center blip is the midline echo."



Probe against side of head sends ultrasonic energy through the brain. By timing return echoes, the ultrasound machine indicates distance of reflecting objects. Doctors read blips on cathode-ray tube.

The midline echo, he explained, stems from the cleft dividing the left and right halves of the brain. Because this cleft is filled with spinal fluid, its density is different from that of the jellylike brain mass. When the sound beam hits this density difference along its path, some of its energy is reflected, just as light reflects from water or glass. By timing the returning echoes, ultrasound equipment tells the distance of the reflecting object.

Normally the doctor would have seen the midline echo exactly at the center between the two outer blips. In Kathy's case, however, the center blip had shifted to the right. Something was pushing Kathy's brain off center. Apparently, when she hit her head, a blood vessel ruptured on the left side and the resulting blood puddle in the confined space of her skull was pressing on the brain, a condition called subdural hematoma.

Thanks to this quick diagnosis, surgeons were able to drain off the accumulated blood before the pressure damaged Kathy's brain, and she recovered completely.

Until ultrasound, doctors had no fast and simple way of spotting such injuries. But with the ultrasonic device, the diagnosis can be made easily and without risk or pain.

"Each week we get about a dozen kids who've been hit by cars," says Dr. Marc S. Lapayowker at Temple University Hospital in Philadelphia. "We now do ultrasound on all of

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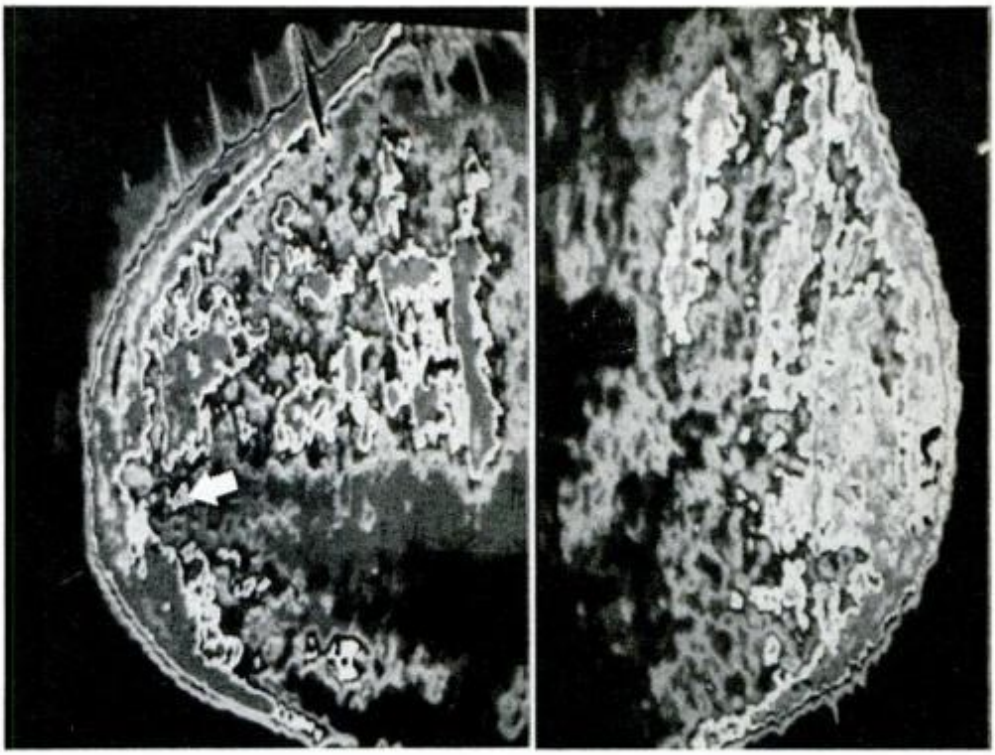
When high-frequency sound waves "slice" into tissue, a mass like a tumor reflects a different echo than does normal tissue. The two sonograms shown here reveal a normal breast (far right) and one with a tumor (arrow) diagnosed as malignant.



Dr. Gilbert Baum runs an eye-scan at Albert Einstein Medical College in New York.

them." He urges ultrasound checks of all traffic injuries. "Nearly every car crash or motorcycle spill involves some degree of head injury. When victims arrive in the emergency room, they are often unconscious, in shock, or plain confused. You can't ask them what happened or where it hurts. Ultrasound examination takes only a few minutes and may save serious complications later."

The principle of sonography, as this technique is called, is basically simple. High-pitched sound waves, as any bat knows, define objects in their path with considerable detail. At extremely high frequencies, ranging beyond a million cycles per second, sound also has the ability to "shine" through solids as if they were translucent. Consequently, ultrasound can be used to "see" into the human body if the sound reflections are electronically processed as video signals and displayed on a cathode-ray screen.

Unlike X-ray, ultrasound registers not only strong density contrast, such as bone against flesh. It also discerns more subtle differences in the texture of soft organs, such as the kidney, liver, spleen and heart, and can detect lumps, swellings and cysts deep in the body. "It's like putting the doctor's eyes inside the patient," says Dr. Grossman.

The first device to make use of ultrasound was the "silent" dog whistle, invented nearly 100 years ago. Present ultrasound techniques are an outgrowth of Navy sonar. The doctor "sees" the inner anatomy of the fluid-filled body in the same way submarine hunters "see" their prey in the waters of the ocean on the sonar scope. Similar electronic methods are used to turn the echoes of searching sound waves into a picture of the "target."

Before they are aimed into the body through the transducer—the probe held against the skin—the high-pitched sound is electronically chopped into millions of very short tone bursts. After shooting off each burst, the ultrasonic device waits for the returning echoes, which are then picked up by the transducer. The return time of the echo determines its position on the monitor screen.

"This type of information is often more useful than anything X-ray can show," says Dr. Murray G. Smyth, director of biomedical research for the Smith-Kline Instrument Co. "Suppose we're looking at a tumor. All you can see by X-ray—if you can see at all—is a shadow picture, the kind you get by holding your hand between a light and the wall. Ultrasound, by contrast, tells you at once the depth at which the tumor lies within the body. And by sliding the transducer along the patient's skin, you can outline the tumor in all three dimensions."

The most recent advance in sonography—first demonstrated in 1974—is a new type of visual display called "gray scale." By this technique, the relative strength of the echoes is reproduced by different shades of brightness on the screen. Moreover, the display is not just a set of blip-echoes. As the transducer is moved across the body, a memory device in the monitor stores the different echo-images. The stored echoes from different points are then combined to build up a composite image showing a total cross section of the body. "It's like slicing across a salami to see what's inside," quips one doctor. "Only the slicing is done with sound, not with a knife."

This type of sound imaging opens up important new diagnostic possibilities. A liquid-filled cyst or a fibroid mass, for example, throws back a different "gray scale" echo than a hard-packed lump, such as a tumor. Doctors can draw vital diagnostic clues from these differences. Eventually, they hope to be able to distinguish between benign tumors and cancerous growth by ultrasound alone. Some doctors speak of this concept as "sonic biopsy"—a way of sampling tissue without having to cut.

At Albert Einstein College of Medicine, Bronx, N.Y., Dr. Gilbert Baum uses a refinement of this technique for early detection of breast cancer. He assigns different colors to each shade of a gray in the sonogram (sound picture) and can then spot the presence of a tumor inside the breast by a characteristic color pattern. He is also working on a method to translate color and location on the sonogram into numerical data to be analyzed by computer. The computer would automatically print out a warning whenever it rec-

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ognizes the typical tumor pattern. By putting the sound scans on video tape to be processed at a computer center, a large number of women could be screened quickly and inexpensively by lab technicians, and early detection of possible breast cancers could save many lives.

Women also benefit from ultrasound in other ways. It is one of the best ways to monitor a pregnancy—"by far the least troublesome kind of obstetric examination," observes Dr. Lester T. Hibbard of the University of Southern California. "No poking, no discomfort to the mother. Besides," he adds ungallantly, "most women in pregnancy are too fat to let the doctor feel the baby properly through the abdominal wall."

Ultrasound senses the fetal heartbeat as early as the eighth week of life, long before conventional stethoscopes pick it up, confirming whether or not the baby is alive. It also predicts the sex of the infant as early as the third month. Later in pregnancy, fetal position and head size can be checked simply by placing the transducer on the woman's abdomen, all without damaging X-ray. In that way, doctors can anticipate birth complications.

"We can arrange for cesarian delivery long before an emergency situation develops," says Doctor Hibbard. Ultrasound also discloses fetal abnormalties at an early stage, and the parents can then decide ahead of time whether to let a defective baby be born.

New medical applications of ultrasound are constantly being perfected:

- Heart specialists bounce ultrasound off the moving heart valves to watch their action and detect leakage or clogging. The sonogram also shows accumulations of fluid in the heart sack, which sometimes follows a hard blow on the chest and may have dangerous consequences. This type of hidden injury often occurs in car accidents when the steering wheel rams the rib cage.
- Internists sound out abdominal organs, often sparing their patients from the pain and cost of exploratory surgery.
- Eye doctors use ultrasound to locate foreign bodies that have entered the eyeball, especially when hemorrhage within the eye prevents the use of normal methods of examination.

Ultrasound also helps doctors see *behind* the eye. One kind of cancerous tumor—melanoma—grows at the rear of the eyeball and often looks deceptively like a detached retina, a blood clot, or just a harmless swelling. If a doctor has reason to suspect melanoma, he usually removes the eye rather than risk a life. But statistics (released by the Armed Forces Institute of Pathology) reveal that one out of five such eye removals proves unnecessary.

Fetus image builds up on cathode screen as probe moves across patient's abdomen.

Blood vessels and other details of fingertip are revealed in ultrasound "picture."

Ultrasound may stop this pitiful waste. A Finnish researcher, Dr. Arvo Oksala, has proposed methods to distinguish melanoma by ultrasound from other conditions that do not threaten life. Other ophthalmologists have joined this research which, if successful, could save countless eyes.

Telling harmless cysts from dangerous tumors by ultrasound is already an established routine in kidney examinations. At Downstate Medical Center in Brooklyn, N.Y., Dr. Joshua A. Becker has worked extensively in this field and also designed a new kind of ultrasonically guided surgical instrument. If he finds that a kidney swelling is merely a fluid-filled cyst, he uses a hollow needle equipped with an ultrasound transducer to drain off the liquid. Rather than having to poke blindly in the kidney, the ultrasound image on the screen lets him aim the needle directly at the cyst, thereby reducing the surgical trauma. In effect, the surgical instrument is sonar-guided toward its target like a torpedo is directed against the side of a ship.

Some ultrasound devices make use of the Doppler principle—the train-whistle effect of frequency shift from a moving sound source. If ultrasound is bounced off the blood corpuscles within an artery, the frequency shift of the echo tells the rate of blood flow. An ultrasonic flowmeter can thus be used to check the condition of blood vessels, particularly to examine blood flow in the legs and spot clot formation in the early stages.

The same technique is also helpful in locating aneurisms—thin places in the arterial wall that threaten to result in a "blowout." In such cases, a plastic bypass can be installed to prevent the risk of a massive internal hemorrhage.

Despite recent progress, ultrasound diagnosis still faces problems. Not enough doctors have yet been trained in it. As one of them puts it, "Ultrasound is no smarter than the people who run it." In many cases, the sonogram provides only indirect clues, and doctors must learn to interpret the sound images in terms of the patient's illness. But sonography is steadily growing.

Inevitably this raises the question: Will ultrasound replace X-ray? Most doctors doubt it. "I regard ultrasound as a supplement, not a substitute for X-ray," says Doctor Smyth, voicing the majority opinion. "Ultrasound can do things X-ray can't, and vice versa."

But the long-range outlook seems bright. "Historically this is the age in which we must join the link between medicine and technology," says Doctor Grossman. "Within five years, I'm convinced, advanced ultrasound techniques will revolutionize diagnostic medicine. We still don't know the limits of what is possible." ★★★

OTHER USES FOR ULTRASOUND

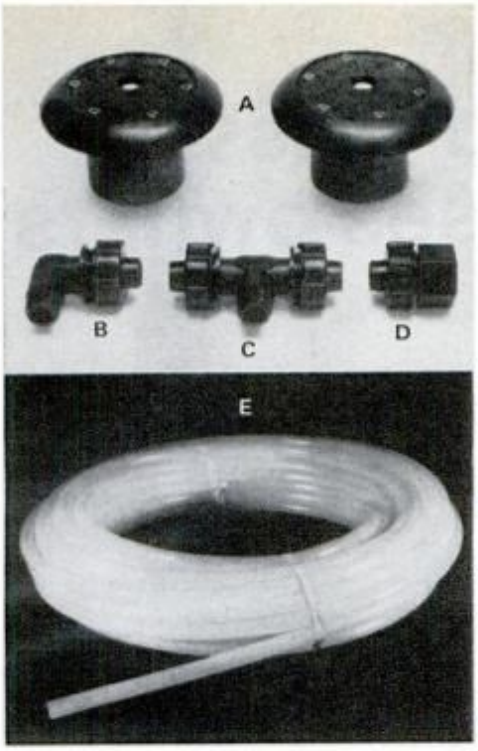
Frequencies beyond human hearing—that is, above 20,000 Hz—are widely used in industry for nondestructive testing. Rather than stressing materials to the breaking point, engineers now find hidden cracks and other faults by pulsing through the tested part. Having a different density, the crack or fault will return a telltale echo. Structural steel, aircraft parts, crankshafts and axles are among the many parts now routinely tested in this way.

Ultrasound is also used for cleaning and degreasing precision parts, since the sound vibrations bounce dirt and grease away from metal surfaces better than any cleaning agent. Ultrasonic drills, which are cutting tools vibrating at high frequencies, are used to drill teeth and jewels, and are very useful in drilling square holes. Ultrasound vibrations also help tenderize meat, "age" whiskey, homogenize liquids, kill bacteria and detect burglars. Scientists believe that many other applications remain to be discovered.

Материал, защищенный авторским правом

'Plant' this $60 sprinkler system in just 4 hours

It attaches to an outside faucet and requires only a spade and garden shears to install.



Kit contains two rotary sprinkler heads (A), elbow fitting (B), tee fitting (C), faucet connector (D), 100 ft. of tubing (E), and instructions.

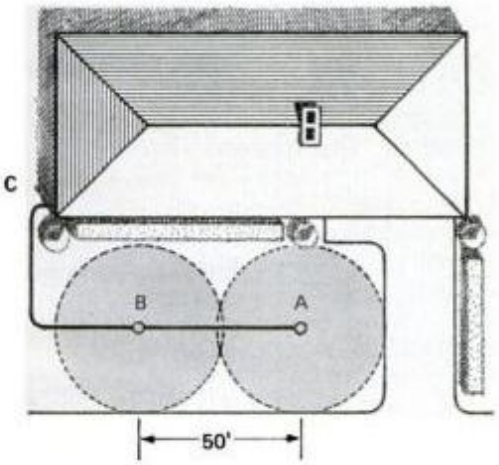
Simple enough to install yourself in a few hours with little more than a spade, a new lost-cost, in-ground lawn-sprinkling system called Spra-Rite goes together with connectors you simply tighten by hand.

A starter kit ($59.95) contains two pop-up rotary sprinkler heads, 100 ft. of flexible polyethylene tubing and three click-and-seal fittings to provide a system which will water a 50 x 100-ft. area. Extra add-on heads are available for use where greater lawn coverage is desired.

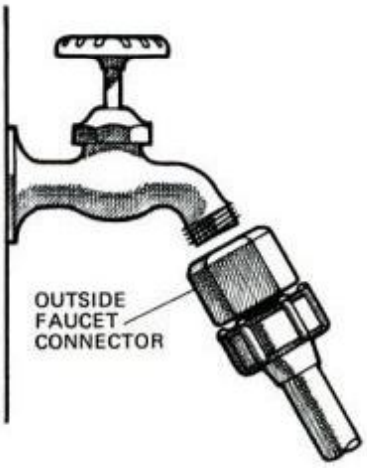
The system connects to an outside faucet like a garden hose and it will run on normal house water pressure.

The key to the system's simplicity is its unique nylon connectors. You simply push the plastic tubing into the fitting until it clicks, then turn the nut until it's hand tight.

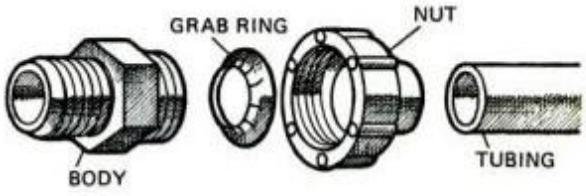
The system is assembled and tested on top of the ground. Then when the sprinkler heads are placed where you want them, you bury the line in a slit made with a spade—no need to dig up the lawn. The manufacturer is Mobile International, Inc., 16291 West 14 Mile Rd., Birmingham, Mich. 48009.—*Wayne C. Leckey, Home and Shop Editor.*



Position sprinkler heads A and B on lawn, connect with tubing, attach to outside faucet (C), then test until you find the best spray pattern.

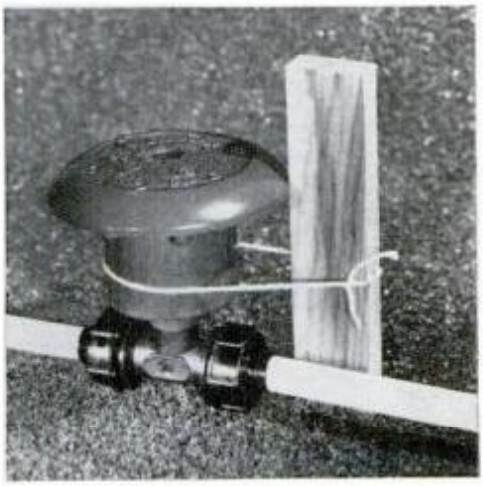


Flexible tubing running to sprinkler heads is attached to outside faucet like an ordinary garden hose with special click-and-seal connector.

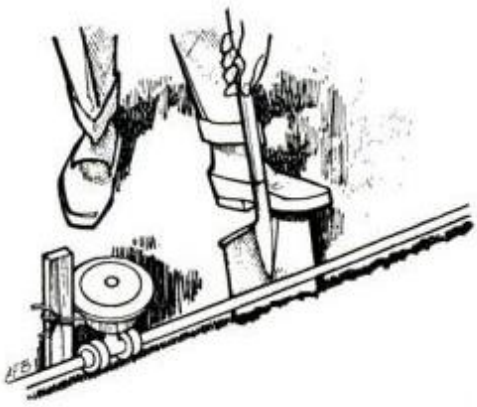


Photos: Robert D. Borst

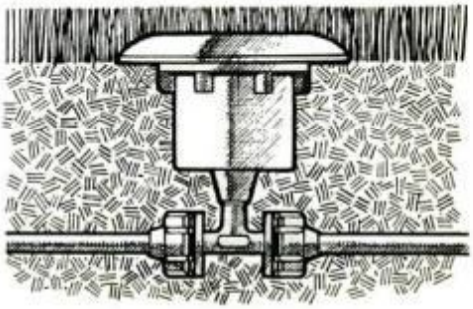
Watertight seal is made in seconds without solder or plastic cement. Simply insert pipe in fitting until it seats and locks by grab ring, then turn nut finger-tight. Below, sprinkler's ¾-in.-high turf guard protects head from lawnmower.



Full-circle sprinkler heads are temporarily staked in position to determine best spray pattern before complete system is buried.



Except for sprinkler heads, there's no need to dig up the lawn to bury the tubing. You just form a 6-in.-deep slit in the turf with a spade by working it back and forth. Tamp the soil back into place with your feet.



Материал, защищенный авторским правом

With lots of room and glass, Pacer has style that pleases owners

by Michael Lamm
WEST COAST EDITOR

Passengers find my Pacer very roomy and comfortable," says a New York engineer, and that fact is one of the Pacer's biggest selling points.

Styling and roominess sold most Pacers to begin with—63.0 and 41.3 percent respectively. Here are some typical comments: "After seeing the actual Pacer and taking it for a test drive, we were very impressed with the roominess and ride."—Missouri airline supervisor. "I liked the design and shape of the car."—Indiana veterinarian. "I was taken with the **new look** and the inside room."—Alabama contractor. "Roomy; no blind spots; almost the same as a station wagon."—Illinois steelworker. "Vision is outstanding front and rear."—Texas technical manager.

Hand-in-hand with roominess, comfort came in for high praise. "Rear passengers find that they are not cramped," says a Texas insurer. "Has big bucket seats."—Illinois housewife. "Rear passengers get a very comfortable ride; very quiet."—Colorado retiree. "Easy to get into; good leg space."—Vermont publisher. "The only small car that doesn't give my wife a backache."—Wisconsin surgeon. "The first thing said as a **passenger enters** this car is: 'How can they put so much room into a little car?' "—Utah theater manager.

What about ride and handling? "The car rides hard—almost as hard as my VW," comments a Michigan collegian. But an Arkansas retiree counters, "Rides like a big, heavy car." "Bounces a little in the rear but handles very well, and I'm really surprised at how well it drives on both dry and wet roads."—New York hematologist. "It's maneuverable, easy to park, and smooth riding. I think the Pacer is one of the **greatest compact** cars to come on the market, bar none."—Michigan real estate saleslady.

Of specific complaints, gas mileage (lower than expected) came in No. 1, and power (not enough) ranked No. 4 at 20.2 and 7.6 percent, respectively. A Florida retiree noted, "It has less pickup from a dead standstill than other AMC cars I've owned, although my Pacer has the larger Six." "I would have liked a small V8," observes an Iowa teacher, "and I'd like a better under-hood arrangement. Sleek styling makes the engine hard to work on. Even changing the oil is quite an ordeal, and so is changing the filter."

A Georgia insurance adjuster: "Gas mileage is not sufficient at 17 mpg average." And an Alabama restaurateur: "Doesn't come up to the economy level we anticipated. We expected to get closer to 20 mpg in town and 25 on the road. So far it's between 14 and 18 mpg."

An oft-repeated comment—just not enough air going into the passenger compartment.

More minor gripes included: "No discount on sticker price."—Arkansas farmer. "With all that glass it's too hot in summertime. **Needs better ventilation.**" — Indiana stockbroker. "Poor grade of carpeting."—Missouri chemist. "Changing the No. 6 sparkplug amounts to a sporting proposition."—California electrical engineer.

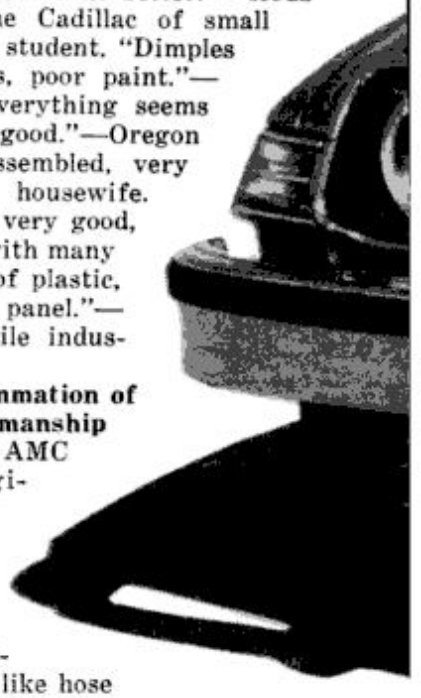
Many owners feel the Pacer's modern look will usher in a "futuristic" era of Detroit styling.

Turning now to specific praises, the following are representative: "Easy to get around in."—Texas corrections officer. "Holds the road like a Mack truck, especially during local windstorms."—California specialty shop manager. "Ride is great, looks likewise, room is ideal."—Louisiana student. "Good roadability, spaciousness, visibility, ease of entry."—Illinois nurse. "I love it for the way it handles." —Illinois golf pro. And a California grader operator enthused, "The persons at American Motors should have high praise for their workmanship of the Pacer."

Lapses in workmanship were mostly on appearance items.

Speaking of workmanship and general quality, 64.4 percent of our respondents rated it good to excellent and 35.7 **average to poor.** "Windows and trim could fit better."—Houston retiree. "It's the Cadillac of small cars."—Colorado art student. "Dimples in metal, weld spots, poor paint."—Detroit busman. "Everything seems put together very good."—Oregon railroader. "Well assembled, very solid." — Wisconsin housewife. "The mechanics are very good, but my Pacer came with many loose screws, strips of plastic, and a loose door panel."—North Carolina textile industrialist.

Huge doors (passenger's bigger than driver's) make getting into the back seat easy.



Mostly rave reviews, with surprisingly few grumbles for a first-year car.

Here's a frank appraisal from a guy who ought to know.

An interesting **summation of the Pacer's workmanship** came from a retired AMC manufacturing engineer who lives in Kenosha, Wis. He wrote, "Workmanship is fair by my standards and average by others'. Sloppy in areas like hose routings and wiring. Quality problems in final assembly are typical of the auto industry in general, due to tight production schedules, ill-trained workers and poor attitudes. Improvements can perhaps be achieved through cooperation between management and the

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A nationwide survey based on 1,000,000 owner-driven miles

Styling and comfort rank tops with Pacer owners, but fixed windows and meager ventilation came in for some black marks. Door-lock buttons are convenient.

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unions." When asked **changes** they'd like to see, Pacer owners told us, "I'd like front-wheel drive."—Minnesota student. "A four or five-speed transmission."—Ohio clerk. "Four-wheel disc brakes."—Kentucky grower. "Some sort of trunk so small items can be hidden out of sight."—Illinois electrician. "A four-door Pacer."—New York milkman. "A Pacer station wagon."—New Jersey bottler. "Larger glove compartment, better fresh-air intake, shorter turning radius, and remove the blind spots at main door pillars."—Indiana aviation technician. "Better gas mileage."—New York manufacturer. **"Driveshaft tunnel is too high and too wide."**—New York engineer. "Give us an eight-cylinder engine and stiffer suspension."—New York electrician. "I would prefer a four-cylinder engine."—Illinois student.

◀ **Many owners said they wouldn't change a thing about the Pacer.**

◀ **If Pacer had gotten a Wankel and fwd as originally planned, there'd be no hump.**

More suggested changes: "Optional sunroof and a place for a ski rack."—Michigan promoter. "Ashtray should be higher so you don't have to reach to put out a cigaret."—Michigan teacher. **"The cost.** As with all American and foreign cars, it's too expensive."—Minnesota warehouseman. "Tailpipe should run over the rear axle instead of under it."—California student.

◀ **Too expensive—people simply feel they're not getting their car dollar's worth any more.**

On the topic of dealer service, 67.7 percent of our owners rated it good to excellent. AMC's **Owner Protection Plan** got good reviews and was often mentioned. "I took my car in on a hot day with no appointment," states an Illinois engineer, "and they fixed my airconditioner in five minutes. Thanks, AMC." "My dealer offered me a loan car without me asking, and I got immediate service."—Wisconsin patternmaker. "We were *very* impressed with the dealer's service personnel and his evident desire to correct our binding shift linkage and clouded windshield."—Illinois student. "I rate service as good, but **parts had to be ordered** for my next visit to the dealer."—New York methods engineer.

◀ **Most owners say they get same-day service or loaners when they have to leave their car overnight.**

◀ **Dealer stocks of Pacer body and trim parts were still low when we sent questionnaires.**

To conclude, here are random comments by assorted owners. One in Georgia says, "As an interior designer, I needed a small car with good gas mileage. I've always driven Cadillacs, Oldses, and most recently a Buick Riviera. The Pacer is as comfortable as any of them and as roomy as the Riviera."

"The Pacer fits our family like a shoe. My wife wanted a small car, and this is the only one we could find with room for our two large boys in the rear. I also like the silence and the styling."—California traffic engineer.

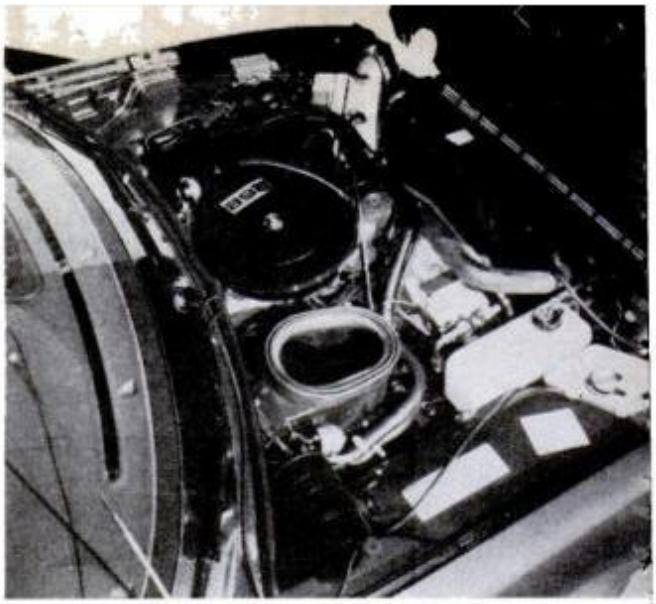
Only a telephone switchman would think of something like this. ▶

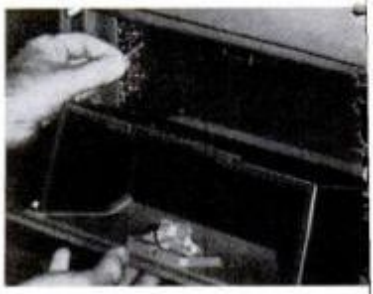
"Pacer **spelled backwards** is Recap."—Georgia telephone switchman.

"It's my wife's car. It's one of the quietest riding and easiest handling cars I've ever driven. We like the performance and get a lot of second looks. Our three kids—practically teenagers—have plenty of room in the back. We get quite a kick out of having a **family fun car.**"—Alabama paperworker.

Families consider it more a fun car than the family bus, but it does well as both. ▶

No fewer than 87.7 percent of our respondents said they'd buy another Pacer next time—quite a high figure considering the size of the car and the fact that many owners have growing families. ★★★





Changing the No. 6 sparkplug makes a "sporting proposition," according to one owner. The oil filter is also tough to get at. The spare is hidden, but owners would like to have a hidden lockable storage compartment. The fuse panel is within easy reach in too-small glovebox.

Summary of 1975 AMC Pacer Owners Reports*

Total miles driven 1,003,639

Average miles per gallon:
- 232-cu.-in. Six: Local driving ... 17.2
- Long trips ... 21.8
- 258-cu.-in. Six: Local driving ... 16.3
- Long trips ... 19.9

Engines
- 232-cu.-in. Six ... 36.0%
- 258-cu.-in. Six ... 64.0

Transmission
- Automatic ... 72.3%
- Manual ... 27.7

Why the Pacer?
- Style ... 63.0%
- Room/Comfort ... 41.3
- Economy ... 40.6
- Size ... 24.9
- Ride ... 18.1
- Handling ... 23.8

Specific likes:
- Handling ... 56.9%
- Style ... 48.3
- Comfort ... 42.4
- Room ... 30.0
- Visibility ... 27.2
- Ride ... 25.5

Specific dislikes:
- Fuel economy ... 20.2%
- Workmanship ... 12.6
- Rattles ... 7.6
- Lack of power ... 7.6

What changes would you like?
- Gas mileage ... 11.8%
- Vent system ... 7.2
- Style (windows) ... 5.7
- Workmanship ... 5.7

Number of vehicles owned:
- Pacer only ... 41.8%
- Two cars ... 44.9
- Three cars ... 11.2
- Four or more cars ... 2.0

Other cars owned:
- Chevrolet ... 14.0%
- Buick ... 10.5
- Oldsmobile ... 9.9
- Ford ... 7.6
- Pontiac ... 6.4
- Volkswagen ... 6.4

Workmanship opinion:
- Good to excellent ... 64.4%
- Average to poor ... 35.7

Dealer service opinion:
- Good to excellent ... 67.7%
- Average to poor ... 32.3

Had any mechanical trouble?
- Yes ... 59.5%
- No ... 40.5

What type of trouble?
- Transmission ... 10.9%
- Airconditioning ... 9.1
- Oil leaks ... 9.1
- Shift ... 8.0
- Power steering ... 8.0

Did you repair it yourself?
- No ... 98.3%
- Yes ... 1.7

Dealers repairs satisfactory?
- Yes ... 73.9%
- No ... 26.1

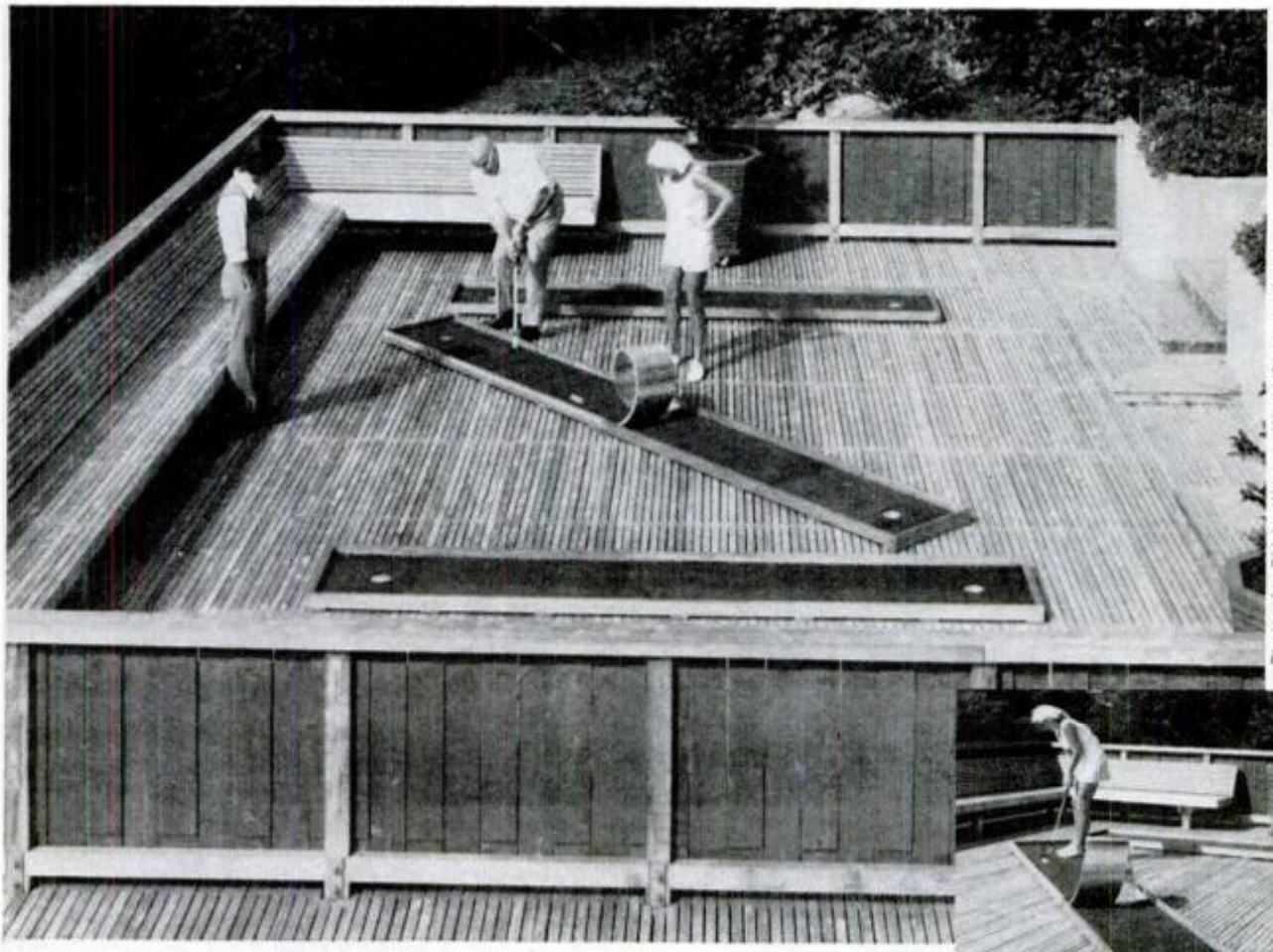
Age distribution of owners:
- 15-29 years ... 30.4%
- 30-49 years ... 44.7
- 50 plus ... 24.7

Family size:
- 1-2 people ... 43.8%
- 3-4 people ... 42.5
- 5-6 people ... 12.2

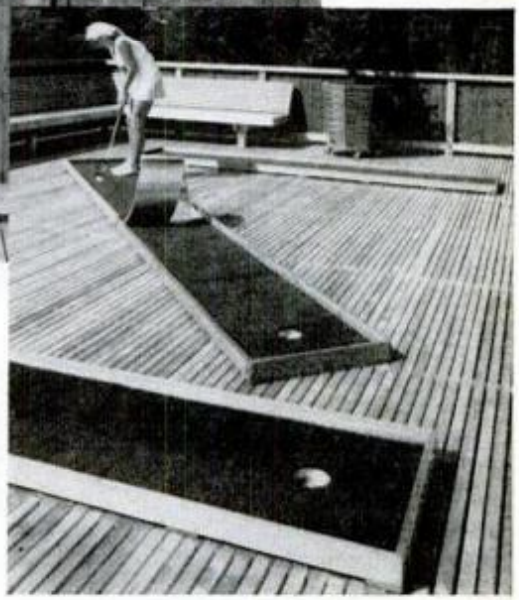
Would you buy another Pacer?
- Yes ... 87.7%
- No ... 12.3

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

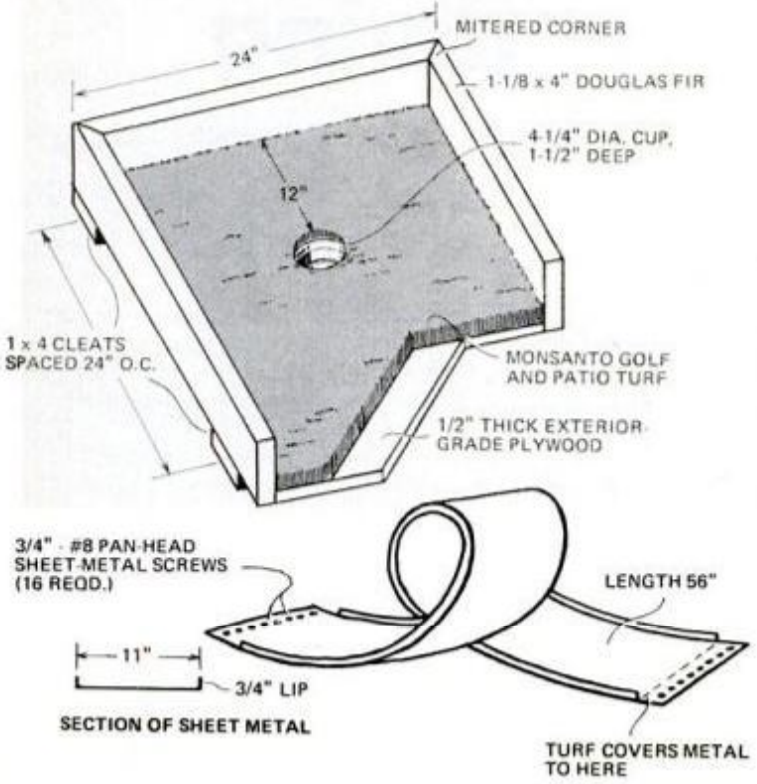
Patio putting green you can build in a day



Photos for PM by Western Wood Products Assn.



Inclement weather won't force you to cancel your golf practice sessions if you build one or more of these portable putting strips. Use them on deck, lawn or in your family room.



Twelve months a year golfer Al Disdero of Portland, Ore., plays on his putting green, almost daily, indoors or out. The designer and builder of the putting strips shown here says any patio putter or deck duffer can do the same. Two strips are 12 ft. long with 10-ft. putts, while the trickier version is 14 ft. long—with a 16-ft. putt. This is achieved with a loop-the-loop fashioned from sheet metal that's intended to be a hazard unlike anything you're likely to encounter on the golf course. **The artificial green is Monsanto's golf and patio turf; each strip is 2 ft. wide and has cups set in 1 ft. from both ends. The cups are made by cutting 1½-in.-deep sections from coffee or juice cans about 4¼ in. in diameter. The turf is glued to a base of ½-in. exterior-grade plywood. To keep errant balls on the greens, strips are framed with 5/4 x 4-in. (nominal) Douglas fir nailed to plywood edges. A 12-ft. putting strip can be built for about $50 worth of materials, Disdero says. The longer strip will cost slightly more.**—*Mel Blais*

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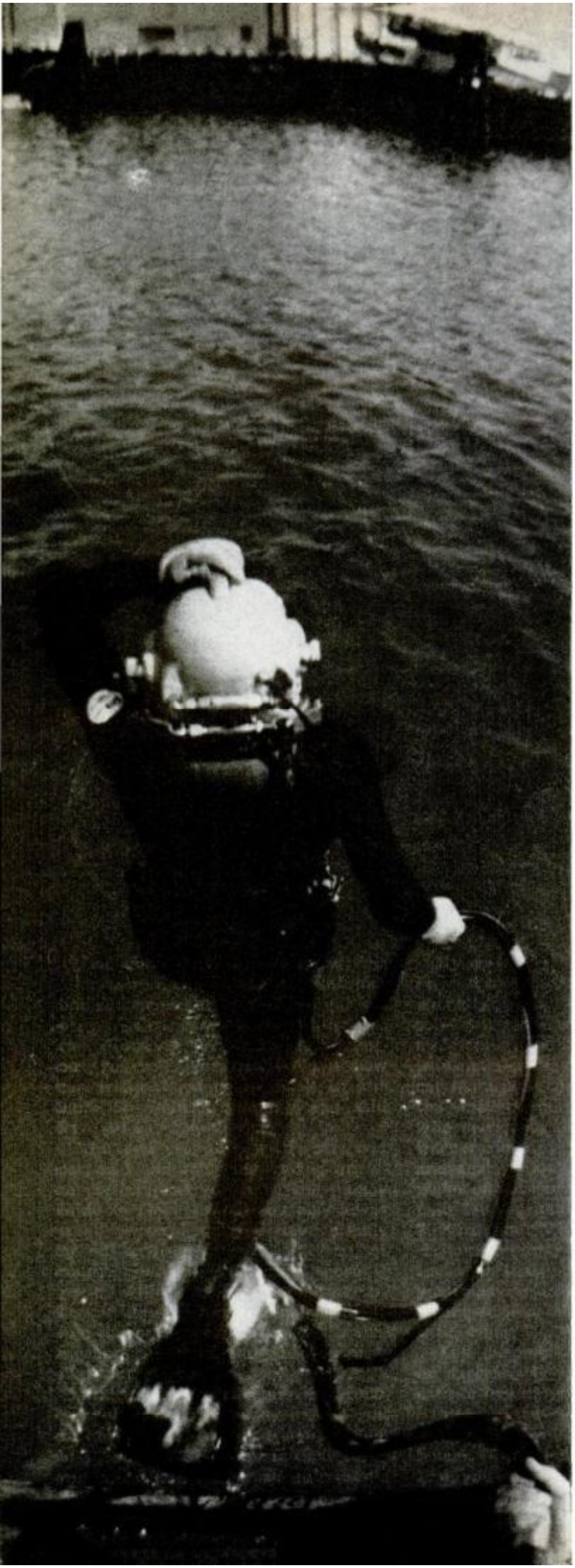

The training is tough, but so is the work: offshore diving

by John F. Pearson SCIENCE EDITOR

"Gone are the days when you could take almost any dum-dum off the street, put him in a suit and send him down to blow bubbles. Diving—especially in the offshore oil fields—has become too sophisticated and expensive for that."

The speaker was Jim Joiner, director of the Commercial Diving Center in Wilmington, Calif., one of a handful of schools that train men to make a living as professional divers. "Seventy percent of our graduates have jobs waiting for them when they get out," Joiner told me. "And most of those men—about 80 percent—go overseas immediately." The accelerated drive to tap offshore oil all over the world has created a shortage of qualified diving personnel.

Last year, CDC received inquiries from some 9000 prospective students, 700 of whom followed up with a personal visit. About 400 students are trained

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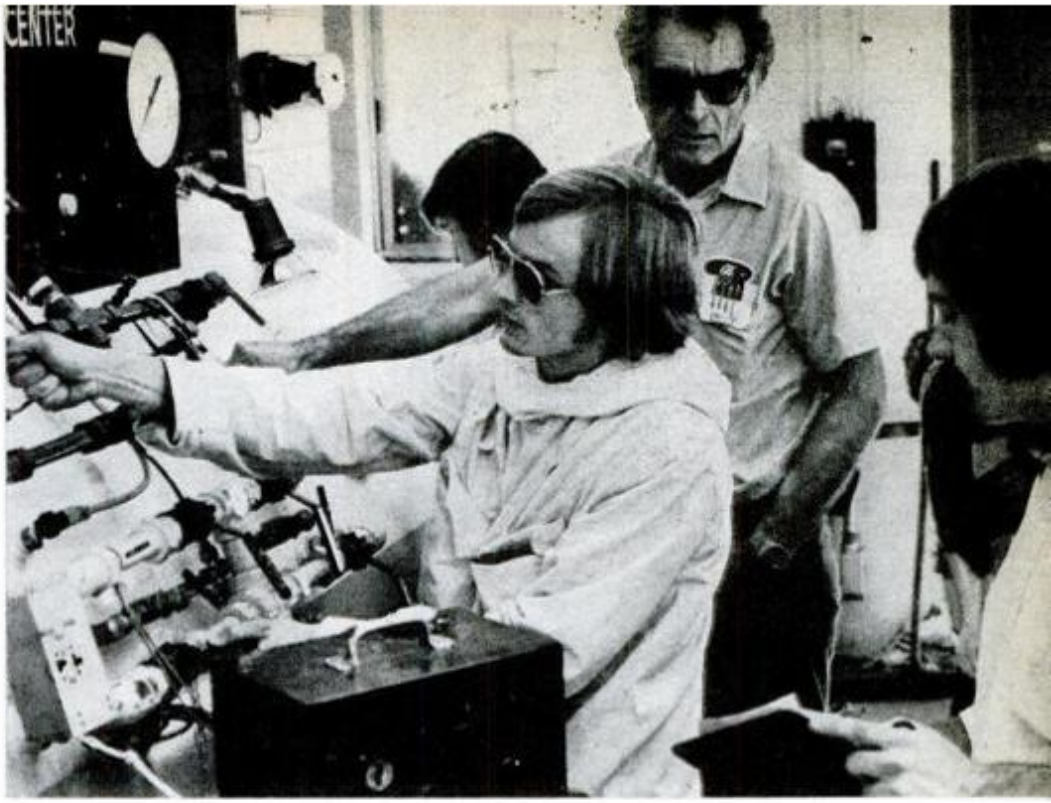


annually in two main courses: air/mixed-gas diving (the primary course) and bell/saturation diving. Underwater photography is an optional offering.

The first obstacle encountered by the aspiring diver is in the person of Warren Mahr, admissions director, a peppery retired Army officer who talks in machine-gun bursts as he gives out information about the school, veterans' benefits, possible student loans.

I got a sample of his style early on the first day of my visit to the school when he broke off our conversation to take a call from a young man in Michigan.

"You say you've done some sport diving," Mahr said. "Okay, let me tell you a few things about the diving business. There's an abominable bomb-out rate. Diving's a harsh life. You've got to put up with isolation, boredom—no women, no booze, no fun. If you're married, you've got to accept the fact that you'll be offshore and away from your family some 250 days a year. The divorce rate is terrific.

"It all adds up to this: Out of every 10 men who come into the business, only four are left after two years."

Mahr warned the caller that it would take time and experience before he could hope to earn good money.

"You work as a diver's tender for six months, a year or maybe more. You look after the diver's gear, help him suit up, handle his lines. It's an apprenticeship."

Mahr never fails to stress that the tuition at CDC—$1700 for the air/mixed-gas course—works out to $4.04 per hour. "You probably won't even be making that much six months after you graduate."

(A full-fledged diver can make from about $15,000 to $25,000 a year. A few top ones earn more.)

Joiner, Mahr and Gene Aaron, supervisor of training activities, do their best to weed out unlikely candidates. At an orientation lecture for a starting class, I heard Aaron tell the students that anyone who had second thoughts about the training should come to his office to hash them out. These efforts pay off in a low (5 percent) dropout rate.

Mahr recalls an Australian who changed his mind after attending one day of classes. I've made a mistake," he told Mahr, "and it's my own fault—not the school's. I realize I belong back home with my family." His tuition was refunded before he flew back to Australia.

Written tests in shop arithmetic and mechanical comprehension eliminate some potential students.

Commercial diving is a young man's game. Though the school accepts applications from candidates up to age 35 (18 is the lower limit), persons above 30 are discouraged unless their goal is to use a knowledge of diving to enhance a career in a related field.

The ideal candidate is in his early twenties, has a college education, demonstrated mechanical abilities and no medical problems. If he's made a living as a mechanic or welder, say, that's a good indication he can handle tools underwater.

Using tools is what commercial div-

Dressed in lightweight gear—wet suit and fiberglass helmet—student (opposite page) jumps off barge to carry out diving assignment. This equipment is used in much of the offshore-oil work. Student in heavy gear (top, left) replaces valve in section of pipeline located in the school's harbor-training area. Class (top) learns the workings of hyperbaric chamber under eagle eye of senior instructor Allen Nesbitt, former Navy diving instructor. The Navy is well represented on the Commercial Diving Center faculty. Diver (above) wears a popular lightweight helmet.

With the search for oil a global affair, increasing numbers of foreign students attend CDC. Photo below shows trainees from Israel, Finland, the Netherlands and Norway. Here they function as a bell-diving team. The decompression chamber is behind them and the bell can be seen in back of standing student. The fully operational system can be used for diving to depths of 300 feet. Author (center photos) is shown before (wearing helmet) and after his dunking in training tank. The heavy gear he wears weighs about 200 pounds. The 40-foot training barge is used for open-water work. Below it, students repair valve systems, pipelines and other oil-field installations, and learn how to burn and weld with oxy-arc equipment.

ing is all about. The ability to dive is meaningless if a man can't perform useful work after he's reached the desired depth. Essentially, diving is just a means of transportation to the worksite.

The variety of knowledge and skills the offshore diver must have is reflected in the curriculum, which includes courses in physics and physiology, diesel engines and air compressors, diving techniques, explosives, repair of diving equipment, underwater burning and welding, salvage and rigging, and using the hyperbaric chamber. All these subjects are crammed into the 14-week air/mixed-gas course.

Not only must a capable diver be a rigger, plumber, electrician, mechanic and carpenter; he must also know his way around an offshore oil field. Under a platform, for example, it's only too easy for the inexperienced diver to get confused and inspect the wrong pipe or "fix" the wrong valve. Often, visibility is so poor that the diver must work by "feel."

Gene Aaron—a former master diver in the Navy—recalls one old-timer who covered the face of his mask with tape. "He said he couldn't see anything down below anyway," Aaron explains. "So why in hell should he strain his eyes trying!"

Students learn to use all types of diving gear including scuba, lightweight equipment (wet suits and modern fiberglass helmets), and heavy gear (bronze hard hats and dry suits).

In a rash moment, I said I'd like to suit up in the heavy gear and within minutes I found myself seated on a wire crate while three "tenders" pulled on a rubber and canvas suit, dropped a copper breastplate over my head, fastened a variety of straps, tightened wingnuts on the breastplate, screwed on the helmet, hung a weight belt around my middle and attached weighted straps to each ankle.

With my normal weight of 180 pounds now doubled, it was a struggle (even with the help of my tenders) to get to a standing position. I walked with the grace of Frankenstein's monster.

After making sure that the helmet communications gear was working, that air was indeed flowing into my helmet and that the exhaust valve was functioning, I descended a ladder into a 10-foot-deep training tank. My debut as a hard-hat diver, I am happy to report, was accomplished without incident.

The weight of the heavy-gear outfit has been the stumbling block for the few women who have applied for admission to CDC. "After we've suited up a gal, we say, 'Okay, now get up and walk over to that ladder,'" Jim Joiner explains. "She can't even move."

The average air/mixed-gas class has 30 students; the bell/saturation class, from 12 to 16. The 12-week bell/saturation course is available to the top graduates of the primary course and to experienced commercial and former military divers.

Diving bells are used for most of the deep diving in the offshore oil fields. Norway, one of the nations exploiting North Sea oil deposits, requires bells for operations deeper than 165 feet. The term "saturation" refers to a diver's tissues, which become saturated with an inert gas such as helium after he has spent a certain period in a pressurized oxygen-helium atmosphere.

But before a diver can hope to be taken on for saturation work in, say, the North Sea, he's got to prove that he can do more than blow bubbles underwater. In one of the CDC flyers prepared for distribution to prospective students, there appears this warning:

Diving "is hard manual labor—you don't rassle octopi, and you don't find any chests of treasure—you work!" ★★★

Материал, защищенный авторским правом

PM visits a house full of energy-saving ideas

by John F. Pearson SCIENCE EDITOR

Is there a better place for the furnace than the traditional locations—the basement or separate furnace room? Can energy savings be realized from the heat exhausted by an airconditioning unit?

The answer to both questions is yes, as I learned in a recent visit to Homelab, an experimental house located on the grounds of the Westinghouse Research Laboratories near Pittsburgh.

Homelab is used for testing products and systems under conditions approximating those of everyday living, explains Hilary W. Szymanowski, manager of a Westinghouse research group concerned with energy conservation.

"We not only evaluate a product on its own merits, but we also see how it reacts with the overall complexity of a house."

A British-born mechanical engineer, Szymanowski is as enthusiastic about his work as he is dedicated to his pipe. Trailing wisps of smoke, he took me on a tour of the small ranch house.

The heating-cooling module was indeed outside, enclosed in the base of the chimney, which was not the solid structure it appeared but a shell covered with siding material. Two doors that swung up provided access.

"A gas furnace," he explained, "to heat air and coils, a condenser and compressor for cooling." There was also an electrostatic unit for cleaning the air and a small reverse-osmosis device that purified the water before it was delivered to a humidification unit.

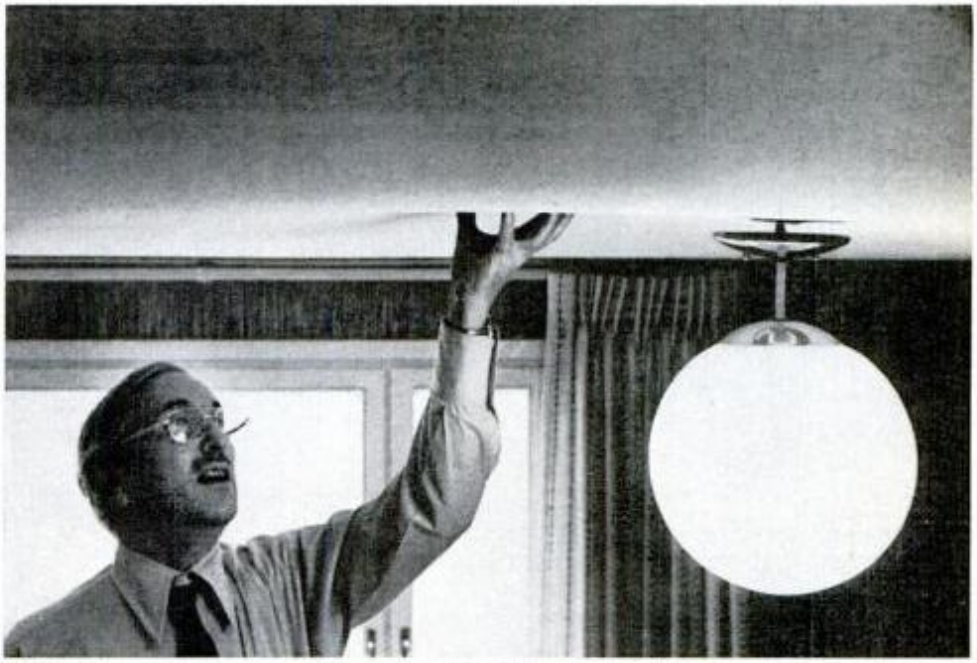
Szymanowski pointed to the hot-water tank and a heat exchanger. "In the summer," he said, "waste heat from the airconditioning system goes into the heat exchanger and heats water before it passes into the tank. We estimate that this system produces seven times the amount of hot water needed by a typical family. It adds up to a saving of about eight kilowatt hours per day."

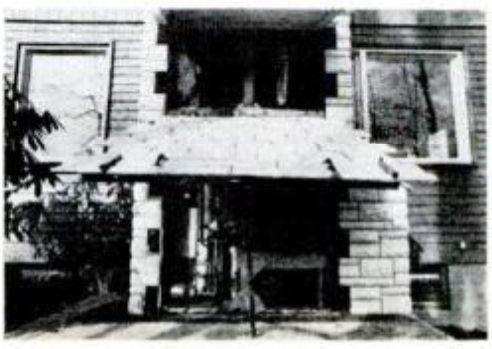
There are real advantages in having the heating-cooling system outside. It:

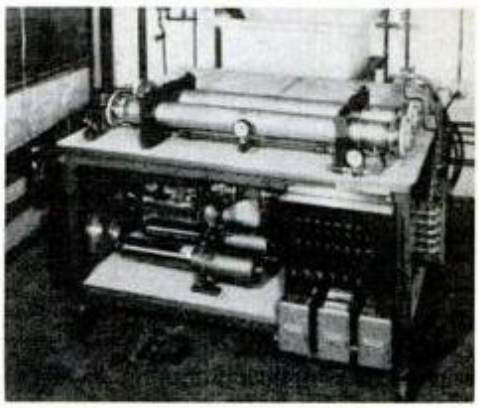
- Frees up valuable space in the

(Please turn to page 101)

Among items under study in Homelab is baseboard (as seen in living room) that conceals electrical wiring, contains power outlets and incorporates intakes and outlets for the heating-cooling system. Hilary Szymanowski (below) demonstrates "give" in ceiling composed of a single sheet of plastic.







Two doors in base of false chimney give access (left) to heating and cooling module. Three separate systems supply water for drinking, washing and sewage. Wash water is recycled by filtering through reverse-osmosis unit (above) and sterilized by ultraviolet radiation. Sewage water is recycled by means of another system, and drinking water is collected from the roof of house.

Материал, защищенный авторским правом

You don't have to give up all the extras that make an automobile fun or easier to drive to get the price of a car down to something you can afford. If you install the hang-ons yourself, you can have a new car without going in hock to the bank or finance company and still have all the trimmings.

The trick is to start with a stripped car, and add the gadgets and accessories later as you have the money to do so. Some extras you may never want or need, so you save simply by not adding them at all. And, of course, you can save even more if you're willing to forgo some of the bigger luxury items like power steering, power brakes, automatic transmission, airconditioning and so on—it's your choice.

You can save as much as $1000, depending on how many extras you decide to add. For an outlay of $3000 to $3500—cost of the car included—you can end up with an automobile that a dealer would list for $4000 to $4500.

By doing the work yourself, you will cut out three middlemen: the factory worker who installs the equipment, the car manufacturer who marks up the worker's labor and the dealer who marks up the price charged by the car company. The auto companies and dealers don't disclose what they make on accessories, but the going rate for a production-line worker is $6.33 an hour. The car companies and dealers don't pay themselves anything less than that, so if you figure what you're saving in terms of labor time, it amounts to about $19 an hour—three times $6.33.

You needn't be a crack mechanic or particularly knowledgeable about cars to install most accessories. Most hang-on hardware can be installed with tools you have around the house. If you need a special-purpose tool, you can rent or borrow it from a friendly guy at the gas station. Some mail-order houses and auto supply stores catering to do-it-your-selfers loan tools free. If you want to install a muffler, for example, Sears will loan you all the necessary tools for the price of the postage.

Installation instructions are no problem because all hang-on hardware for automobiles comes with a direction sheet packed in the box or printed on the carton. The do-it-yourself auto accessory business is worth billions of dollars a year to companies supplying the market, so they write easy-to-follow instructions.

The car itself will run you anywhere from $2700 to $3200. Lowest-priced American cars are Ford's Pinto at $2769, Chevrolet's Vega at $2786, American Motors' Gremlin at $2798 and Plymouth's Duster at $3243—all two-door sedans. These

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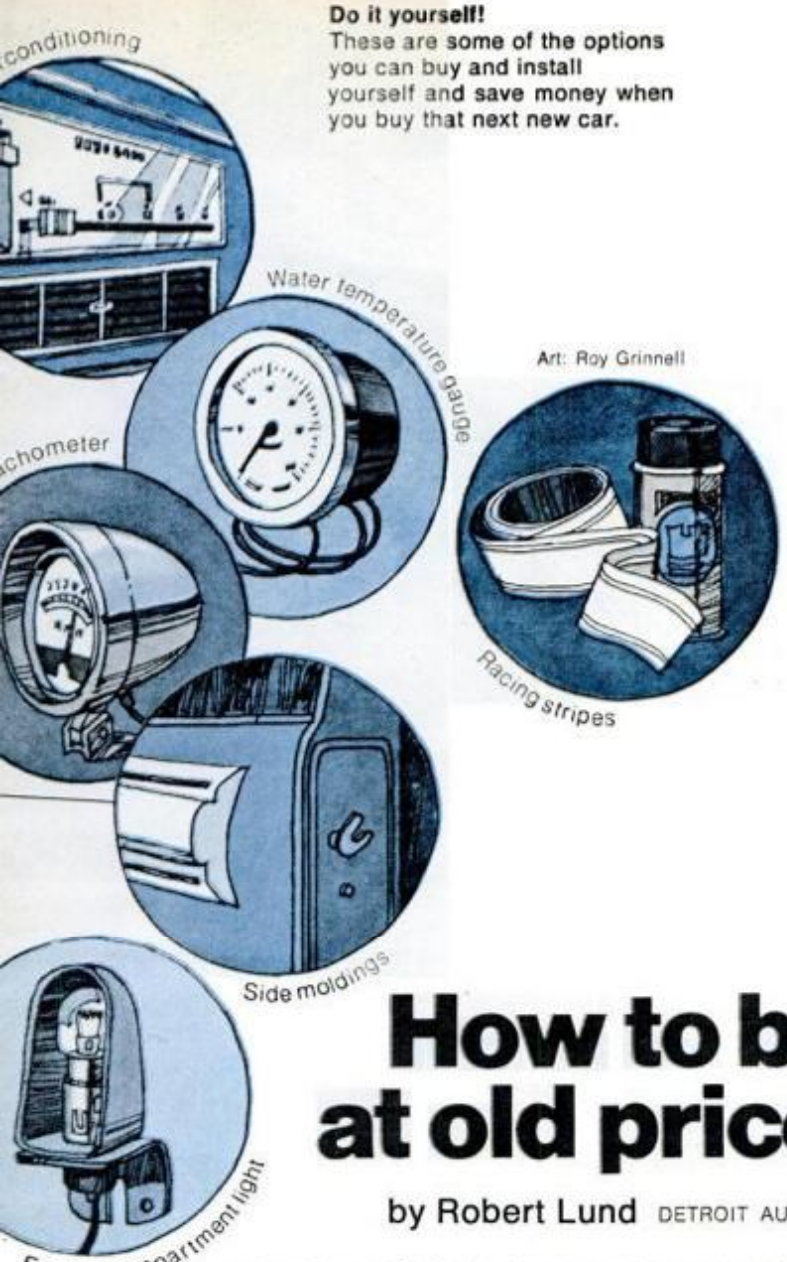

Do it yourself! These are some of the options you can buy and install yourself and save money when you buy that next new car.

How to buy a new car at old prices

by Robert Lund DETROIT AUTO EDITOR

prices do not include freight and local taxes.

You will have to shop around to find the car. Factories don't like to produce stripped models and dealers aren't eager to sell them. Not enough profit. But when you find a dealer with a stripped car or place an order for one, you can probably do better than the full retail prices given above with a little bargaining.

You can go only so far in stripping a car of factory-installed equipment. You can't delete directional signals, outside rear-view mirror and tires, even though you could easily install them yourself. Directional signals and the outside mirror are required by law, and Detroit won't ship a new car without tires. You can spot the "must take" items because they are included in the price of the car. They do not appear on a separate list of options.

Car companies and dealers will tell you that if you want extra equipment on an automobile, you should have it installed at the factory. The arguments are pretty convincing. The accessory will be mated to your particular car, the job will be done right, the equipment will be covered under the guarantee on the new car and so on. All true—but it's not the way to save money.

On some options, the dealer will tell you it costs no more to have the gear installed at the factory than it would to install it yourself. That's true. What he doesn't tell you is that even though prices of the items may be the same, factory-installed or do-it-yourself, the do-it-yourself item is of superior quality. If the factory price for the add-on is, say, $20 or $30, you get a $20 or $30 item. If you do it yourself, you still pay $20 or $30, but you get an accessory that would be worth $40 or $60 at Detroit prices.

With the aid of two mechanics, PM has put together two lists of optional equipment. One consists of items you should have installed at the factory, assuming you want them on your car. Don't try to install these items yourself. It's easier or cheaper to have them built in when the car is made. You could install some of the equipment yourself, but it doesn't make sense. Take dual exhausts, for instance. You would have to pull the original pipe out of the car and re-

(Please turn to page 119)

Stripped Gremlin at the top isn't much to look at, but it costs hundreds of dollars less than the loaded model below it. You can save a bundle of cash by adding many options and accessories yourself.

Материал защищен авторским правом

Legendary Fred Bear, old-time expert, tests the newest of developments, the compound bow. His company now has both tournament and bow hunting models on this year's market.

Archery today: more strings attached

They've trussed up Robin's trusty long bow, but the bonus is in more bucks and bull's-eyes.

by Ray Gill

Archery today rates as the fastest growing sport—even faster than tennis or ice hockey, and it's changing the fastest, too. Though it scores as only 18th in the money-spent-on-equipment category, it can claim development of more radically new gear in the last few years than any other outdoor activity.

Robin Hood would hardly recognize the way they've trussed up his trusty long bow. Archers, like fishermen, have mourned the passing of their simple stick-and-string equipment. First came laminated bows that gave more strength, bow-life and warp resistance. Aiming sights, aluminum tube and fiberglass arrows, fletching of plastic feathers, and bowstrings of synthetics have all resulted in much higher performance levels for the ancient weapon. Take-down design makes modern bows easier to carry than to wear. And now science has added the mechanical advantage of eccentric wheels to provide extra power when you shoot an arrow through the air. The bow is called a compound, and while William Tell might not rate the cats-cradle-rigging look as the apple of his eye, traditionalists admire the payoff in more bucks and bull's-eyes.

Ever since the original development work and patents by H. W. Allen of Billings, Mo., in the late 1960s, interest has grown in the compounds and several manufacturers now produce them. Some early models had a mechanical-monster look and were assembled from up to 75 assorted wheels, cables and hardware items. Latest compounds, however, have been streamlined back toward the graceful look of the original bow. Weight has been reduced through the use of magnesium for the mid-section casting, and the added power allows lighter arrows. The upper and lower recurve limbs are usually a combination of fiberglass and wood treated with a plastic monomer which is impregnated to add great strength with minimum weight. More speed and power are obtained with less pull and inertia to overcome.

Looking like a cat's-cradle, new bows, like Ben Pearson 250, have extra power.

The secret to the built-in power of the compound lies in stability of the block-and-tackle criss-cross of the cables as well as the leverage added by the offcenter eccentric wheels. The distributed pull of the cables makes it impossible to bend one limb more than the other. The cables' length adds a greater and more sustained foot-pounds-per-inch push than the

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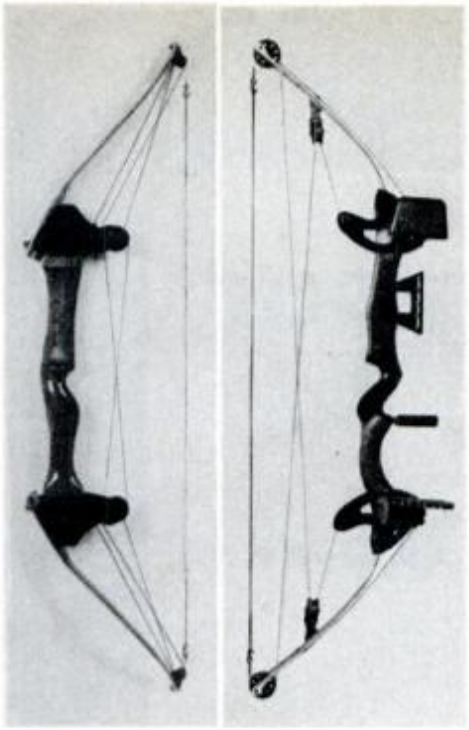


Variation in cable position puts Herter's eccentrics (left) next to handgrip. Compound Hunter from Carroll's (right) has glass limbs, magnesium handle, sight.

conventional bow. This has been compared to the velocity of a bullet shot from a handgun rather than a rifle of equal caliber using the same bullet weight and powder charge. The rifle, applying the available gas pressure for 20 inches rather than perhaps six inches down the handgun barrel has greater muzzle velocity giving the bullet more speed and greater distance with flatter trajectory of flight.

The offcenter eccentric wheels can be tuned and adjusted for the unique power supplement. The wheels, when their narrowest point is reached, say at full draw, reduce the weight pull and drive the arrow with a smooth compound force-draw curve. The arrow shoots straight, of course; the "compound force-draw curve" refers to the force pattern as it would be charted on a graph. For a conventional bow, the charted curve would show a decrease in force from full-draw to rest. But the compound builds in power from release draw to full power at middle draw, then declines to rest. In addition to greater power, the compound delivers it with less shock and distortion and allows use of lighter arrows.

The take-down feature of the compound makes it easy to pack and carry, it can also be left assembled with less damage due to warping. An ordinary archery glove may be used due to the decrease in pull at full draw, ending the need for hooks and other shooting releases.

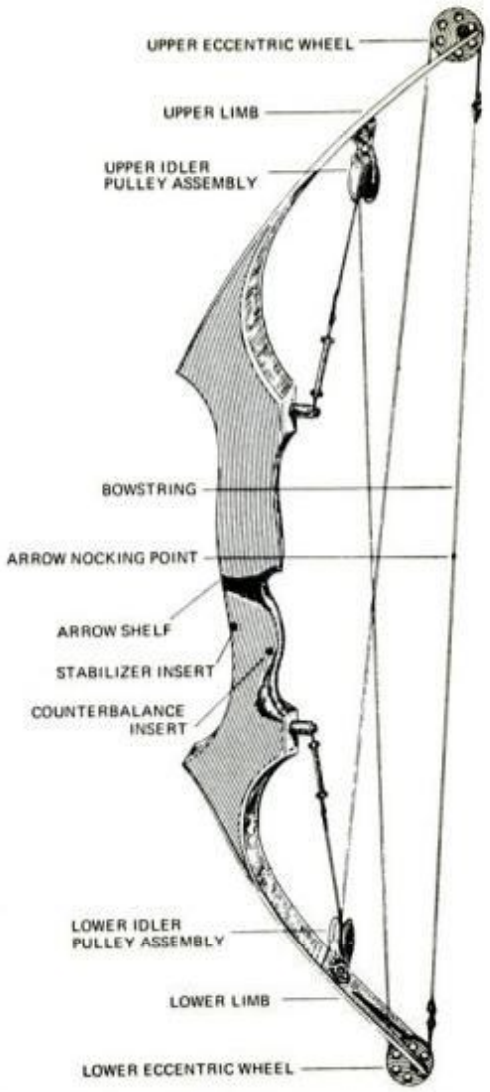
Typical of new compounds are Fred Bear's Alaskan Hunting Bow and the Tamerlane II Tournament Model, with accessories and features such as micrometer-click adjustment tuning, magnesium handle and glass limbs, eccentric-wheel assembly with dual needle bearings plus timing marks, and recessed low-profile weight adjustment assembly. Both the 3-lb., 10-oz., 50-inch Alaskan and the 4-lb., 4-oz., 56-inch Bear Tamerlane II come apart to fit bow cases slightly larger than an attache case.

From the Ben Pearson Div. of Brunswick, the newly introduced one-piece Model 250 compound has an axle-to-axle bow length of 50 inches and draw weights of 50, 55 and 60 pounds. Browning now offers three compounds, the Hunter and Woodsman, plus the Bushmaster with only a 38½-inch length for ease in stalking through underbrush. Herter's has developed and patented its own compound bow, with two added double-sheeve wheels that position the eccentrics near the handle. Limbs are adjustable so that tension can be relaxed for storage, and pull is reported to be reduced by 50 percent. Carroll's Archery Products have the C.A.P. 2000 Target model and C.A.P. 1500 Hunter and a "Super H.P." C.A.P. 1200 available in pull weights of 20 to 70 pounds, all for under $200.

The new compounds are most intriguing, but improvements have been lavished on conventional bows and arrows too. Most archery equipment makers have a full line of bows ranging from beginners' sets in fiberglass to computer-designed center-shot models combining beautifully grained wood with colored fiberglass. Some bows appear attractive enough to purchase and hang up as a decoration. Today's pretty archery shapes, however, have been scientifically designed for maximum balance and power. Mathematicians have computor-checked the designs, and the bulging midsections, contoured handgrips and recurved limbs provide a build-up of energy not possible in a traditional bow. The "Hyper-Kinetic" limb design for the Ben Pearson line, for example, claims a three-stage build-up of power, storage and release which produces a maximum uniform rectilinear velocity. That's only the limbs; midsections are designed to carry the weight, distribute the power and help eliminate the shock.

Conventional bows are still made of wood alone—from maple, sandlewood, rosewood, and zebra wood, to exotics like benge, freijo, bubinja and imbuya. Because solid wood can be heavy, however, these are often used in laminated combinations with fiberglass and other materials. Less expensive bows are solid fiberglass.

The popular take-down bows use the same designs but offer ease of



New compounds have latest refinements in accessories plus mechanical advantage.

packing and portage plus the opportunity to stick with a favorite handgrip midsection while changing recurved limbs. This makes possible employing the same hand riser for hunting and target shooting. Special left-handed grips are available.

Though DuPont's polyester Dacron is popular for bow strings, their Kevlar with even less stretch is also being introduced. Compound bows use steel cables with S hooks to which bowstrings are attached.

Arrows, too, have been upgraded—there are over 20 weight choices in aluminum alone. Fiberglass is favored for resistance to moisture and temperature, while cedar is popular still with the novice and traditionalist. Arrow tips range from sharp steel for hunting and blunt tips for birds and small game, on through target and field tips to fishing barbs and harpoons. Accessories grow every year to include more gloves, arm guards, sights, counterweights and stabilizers, clickers, kisser buttons, quivers and cases. Fred Bear's advice seems best: "Don't overbuy at the beginning, but pick quality equipment." ★★★

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Copy your slides at home... and improve them

by Ivan Berger PHOTOGRAPHY EDITOR

Photos by the author

Copying your color slides at home is:

- ☐ immensely helpful
- ☐ cheap
- ☐ expensive
- ☐ fun
- ☐ exasperating
- ☒ all of the above

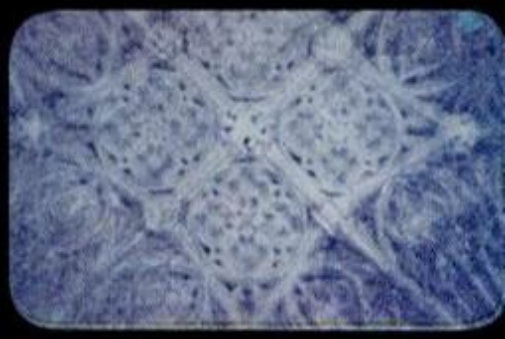
Copying slides means more than simply making extras you can send off to friends and family. It also means a second chance at making a good picture from one that didn't quite make it originally. You can enlarge small details to fill your frame (or reduce large transparencies for projection in a smaller format), straighten tilted verticals, and correct errors in color balance and exposure. Your slide copies needn't be slides, either: The same basic techniques will give you color or black-and-white negatives for easy printing.

About the only thing you can't do with current slide duplicating equipment is duplicate a slide exactly. No matter how you try, you'll never get *precisely* the same color and contrast in your duplicate. That's the exasperating part. But the colors can still be good enough—and sometimes they're downright improvements on the originals.

How much slide copying will cost you depends largely on how much of it you do: Whether you make copies in the thousands or just one copy of a favorite slide, you'll have to invest in anywhere from $19 to $500 worth of hardware, plus film and processing for test shots to find what filters your setup requires. But once you're past that hurdle, you can duplicate—film and home processing included—for less than a commercial lab would charge—and you get the chance to make corrections and creative changes that only an expensive custom color lab would touch.

Once you've decided to start slide copying, though, you still have three decisions to make: What kind of film? Which type of illumination? What equipment?

Two decisions—film and light-source—are related. If the color film you copy onto is balanced for the same color of light as your



Bringing out detail on dim, shadowy church ceiling involved high-contrast Kodak 2483 film, lengthened exposure.

Four filter packs at once in Zone V mosaic filter let me determine from this one shot what correct filters were. Correct value lay between upper left, upper right packs.

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Retroactive telephoto: Enlarged copy let me magnify boat in shot made years before I ever owned a telephoto lens.

Enlarged and corrected: Crop-mounted slide (see text) now fills frame, green cast is gone.

Slight green cast of original has been replaced here by a slight magenta one—not perfect, but a better flesh tone.

All I had was daylight film, so I braced my camera against a slanted support to make this yellowish original. Duping with blue filters cured color and tilt.

light-source provides, your filtering problems will be made much easier (but not eliminated). So if you're copying on daylight slide or negative film, electronic flash will be your most manageable choice; if you use Kodak's special duplicating film, Ektachrome 5038, your simplest source is a 3200° K floodlamp. That doesn't mean you *must* use flash for daylight films and floodlights for others—but if you don't, you'll have to use an extra filter.

Both films have advantages. Daylight color is universally available in a wide choice of films, including color negative. And since you may often have daylight color in your camera, you can make a few duplicates whenever you wish, even in the middle of a roll. If you're the type who dashes off the last few shots in a roll just to get the rest of the pictures processed sooner, copying on those normally wasted final frames lets you duplicate your slides for, in effect, nothing. Regular camera film will pep up the contrast of slides that seemed a little flat the first time around.

But most of the time, that contrast buildup between original and copy isn't wanted. That's where Kodak's special duplicating film, Ektachrome 5038, comes in. Its inherent contrast is lower than that of camera films—and if processed as recommended, with reduced first development times, its contrast becomes even lower, though there's still a trace of contrast buildup and some consequent loss of subtle detail. In 100-foot rolls (the only way Kodak sells it), 5038 is about half the price of regular Ektachrome, too.

If you don't want to load your own cartridges, you can buy 36-exposure loads from Spiratone for $2.70, or 20-exposure loads for $1.98 from Porter's—still a bit cheaper than regular Ektachrome. But you're better off buying the big roll, loading what you need, and freezing the rest, so all shots will be on one emulsion batch of film for more consistent color. (Orders for several rolls from Spiratone are filled from the same emulsion batch, too.) Even count-

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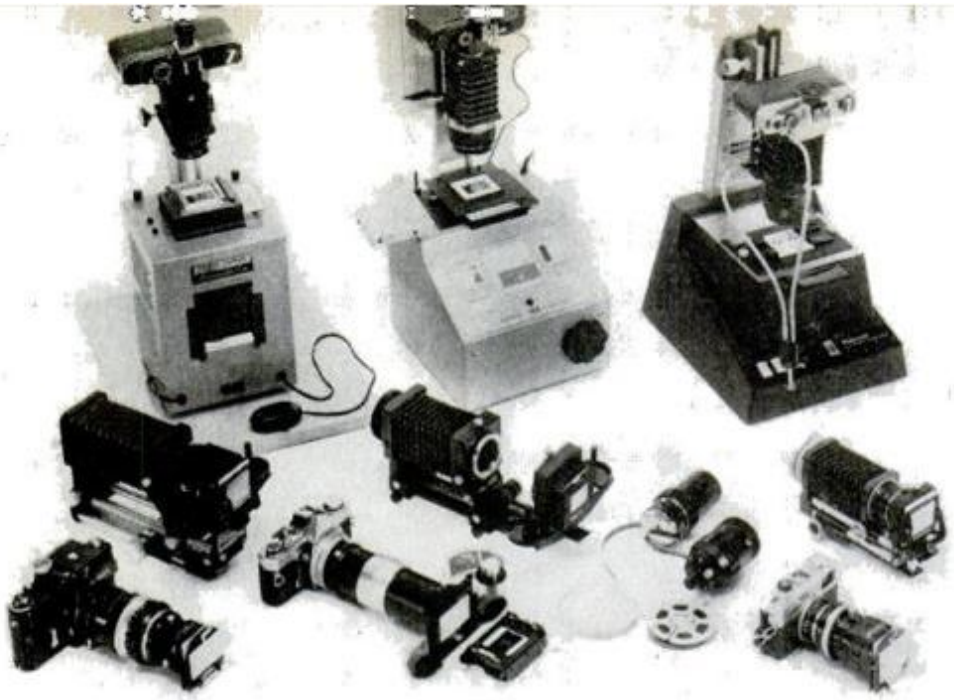
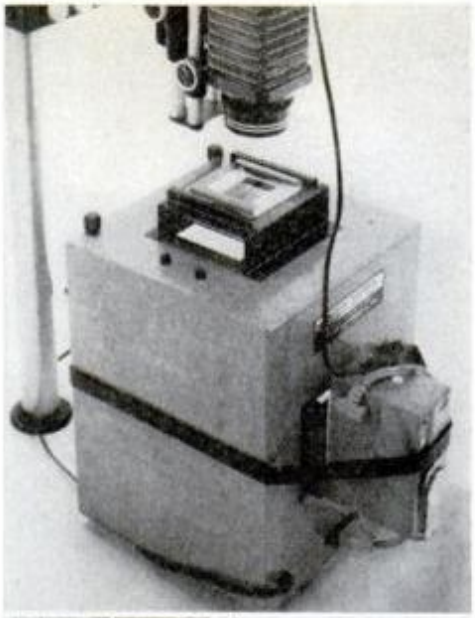


Slide duplicators vary in price, complexity. Large units in back row are (left to right): Testrite-Kingdon light box, $80, which requires separate copy stand or tripod and bellows; Bowens Illumitran, $495, with variable flash output, built-in meter and bellows; Honeywell Universal Repronar, $325, shown with optional bellows. Bellows with slide duplicators (second row) include (left to right): Vivitar, $125; Soligor Multiflex, $186, with auto diaphragm; compact Novoflex Model 201 with built-in focusing rail (Soligor and Vivitar focusing rails cost $50 and $40 respectively). Other attachments include (front row, left to right): Accura Variable Magnification Duplicator, $19, for use with extension tubes (as shown) or bellows; Spiratone 1X-2.5X Vario-Dupliscope, $45 (shown with optional, $13 strip film holder); Fujica and Rondo movie-film copiers (see below); and Samigon duplicator that fits any camera, $27.



Ingenious light boxes: Testrite-Kingdon (top right) has a built-in 3200° K. floodlight, but can be used with your electronic flash strapped to a window in the box. Bowens Illumitran (right) has built-in light-metering cell (shown over slide here, swung away in group shot, above); it also has variable flash output knob.

Photos: Benn Mitchell

ing the cost of cartridges and a bulk-loader (which you can use with other film), bulk-loading will save you money in the long run.

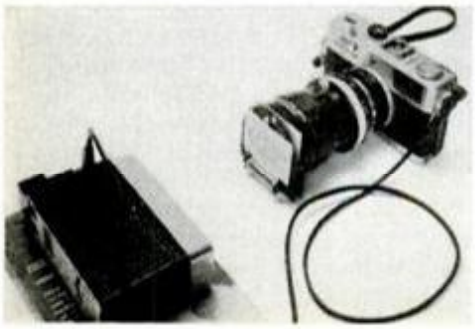
As to reduced first-development time, most labs won't do it for you—and custom labs that serve professional photographers charge about $5 per roll; but you can process the film at home for much less—and use the same E-4 chemical kit to process other films, including Ektachrome and Fujichrome.

For those occasional slides a great contrast increase would really improve—especially thin, overexposed shots, with washed-out colors—Kodak has another hard-to-find film worth knowing about: 2483. Designed originally for microscope photography, 2483 has higher contrast and more saturated, punchier colors.

Your dealer can order 2483. Balanced for daylight or electronic flash, it takes normal E-4 Ektachrome processing.

Whatever film and illumination you use, you'll almost certainly have to filter your light to get the color you want. Filters usually go between the light source and the slide you're copying (most slide-duplicators have filter slots there), though glass-

Wide range of light-source and equipment combinations possible includes: electronic flash (left, below, with Samigon duplicator that fits any camera), which closely matches daylight films; slide projectors (below, center), excellent for use with otherwise dim-viewing copiers like the Spiratone Vario-Dupliscope shown, but requiring warming filters with 5038 film, cooling filters with daylight film; and floodlight (right, below, with Accura attachment) available to match 5038 or Type A films.



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bound and CC gelatin filters can be used over some camera lenses.

These filters compensate for all variables in the color of your light source, response of the film you use, effect of your processing, and color transmission of the slide you're copying from. A typical filter pack will include an ultraviolet filter; color-correction (CC) or color-printing (CP) filters in small to large increments of yellow, magenta and occasionally cyan, red or blue (rarely more than two such colors simultaneously), plus, perhaps, a filter to match the film to the light source.

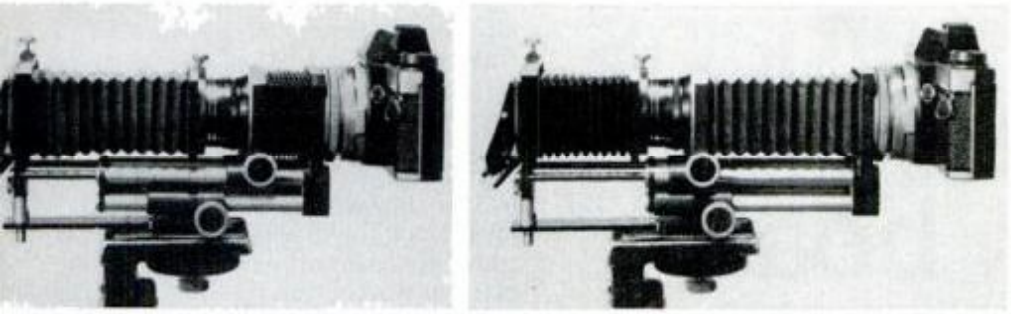
Because of all the variables we've mentioned, plus the variations between nominally identical filters, you'll have to shoot at least one test roll, perhaps several, to see what combination works for you.

Filter recommendations for various light sources are packed with Kodak 5038 in long rolls and with the Bowens Illumitran, Honeywell Repronar and Testrite Kingdom duplicators. (If you will send me a stamped, self-addressed envelope, I'll send other filter suggestions.) But because of variables mentioned, plus the variations between nominally identical filters, you'll have to shoot at least one test roll, and probably two or more, to find the filter pack that works best for you. Zone V, Inc., Box 811, Brookline, Mass. 02147, has a set of four-value filters for $8 that shortens the testing somewhat, but you'll still need other filters to shoot with. When you test, keep careful records of filters and exposures used for each shot—especially important with 5038, which has no frame numbers.

All the equipment you need to copy slides is a slide holder, a way of focusing your camera down to cover just the slide (or less, to blow up portions of the slide), a light that's evenly diffused across the slide, and a filter holder between the slide and the light. In a pinch, you can get away with extension tubes, daylight film, and a slide taped to a window pane on a bright sunny day.

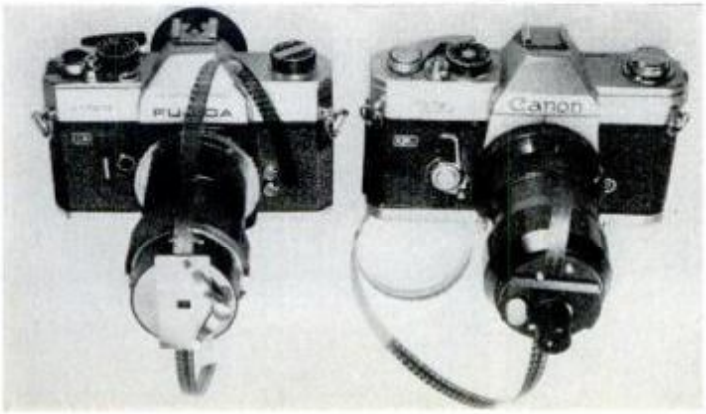
Photo: Charles Smith

Your enlarger, especially if it has a color head, can make a dandy slide copier, holding your camera at a convenient height. Fasten the camera *securely* below the enlarger lens, adjust its distance with extension tubes, and view through a periscope-type finder as shown above.



Bellows copiers give you flexible control of copy size; magnification range widens if you change focal lengths. Second bellows between slide (left) and lens keeps stray light reflections off slide. Novoflex outfit shown was especially easy to use.

You can copy projected images as shown, though sharpness suffers slightly. Use a longish (85 to 100-mm) camera lens, with camera as close as possible to projection beam, but not touching projector. Light beam is a bit blue for use with indoor films, a bit red for daylight types.



Home movie frames can be copied as slides or negatives with Fujica copier (far left) or Rondo (left). Fuji unit copies Super-8 or 16 mm, fits Pentax-thread reflexes (including Fujicas); Rondo fits all SLRs with "T" adapter.

But slide-copying attachments incorporating all but the light source aren't too expensive. The cheapest type holds slide, diffuser and filters in front of your lens, with extension tubes or bellows needed to focus the lens down to the slide's distance, such as the $19 Accura shown here. (We're not counting cost of tubes or bellows—you may already have them for close-up work.) Such copiers aren't too sharp, as even the best camera lenses aren't too good for extreme close-ups of flat objects (macro lenses are better); and you can only use these copiers with cameras whose lenses can be interchanged.

For fixed-lens cameras, you can get similar devices (like the $27 Samigon shown) that focus the lens down with a close-up lens—making sharpness even more of a problem.

Similar to the first type are attachments that mount on your bellows (if you have one). These let you vary your magnification over a wide range. Many bellows let you either reverse your camera lens to increase sharpness or, better yet, use an enlarging lens instead (enlarging lenses are superb for flat close-up work). Each make of bellows has its own attachment; prices are around $40 to $80.

Duplicators, like the Spiratone Vario-Dupliscope, attach in place of your lens, as they have their own lenses built in. Since same-size Dupliscopes cost around $20 to $25, and "zoom" types that enlarge up to 2 or 2½ times cost around $40 to $65, the built-in lenses can't be expensive; but since it's a very slow lens built

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Big bargains in little boats

Select the right small one and you can row and paddle, power and sail, fish, cruise and camp all with a model light enough to cartop home.

by Vic Harris

No boat is as much fun, as inexpensive, as easy to use in a variety of ways—and as dangerous—as a little one. Properly selected, prepared and handled, small craft have been rowed, paddled and sailed across oceans (though their skippers were also lucky to survive). But for what they were designed to do on sheltered waters, they can't be beat. From the hundreds of types available today, here's what you need to know to pick the one that's right for you.

You may be selecting a dinghy, pram, canoe or kayak, skiff or johnboat, dory, inflatable, foldboat, cartopper, punt, duckboat, sneakbox, raft, sailboard or guideboat, just to name a few. Sometimes the same design will have a different title depending on how it's used, or where. You won't need to learn all the names to make your choice from among the new models now available, but there are other important questions you'll need to answer.

First, decide how the boat will be used, and where and by whom. Figure what you can afford to spend. One big appeal of a small craft is its lower cost. But if you can't do with it what you like, then it's not a bargain. You may need something larger if you want a load of friends to anchor out with you for the weekend.

So let's agree our small boats will be 12 feet long or less. A good one of this size will cost from several hundred to several thousand dollars. This is more than you'd hoped to spend for "just a little boat"? Well, we'll look at what you should get for this money, and then some tips that allow you to spend considerably less.

Bargains that aren't

At a shop at almost any beach, you can buy for $10 "little boats" of brittle plastic or inflatable vinyl that are toys, but dangerous ones offshore. Fine for a small swimming pool and youngsters who are good swimmers. But in open water, they can drift kids far out into deep water and a lot of trouble. Some beaches and lifeguards do not allow them for this reason. Usually they can break, capsize or puncture and deflate easily. When the children beg for a little boat of their own, something more durable (though more expensive) with built-in flotation is much the better buy.

One step up from toys are the still inexpensive inflatable liferafts and kayaks that usually sell for under $100. Because of their flat bottoms and lack of keel, these doughnut and oval-shaped rafts are difficult to paddle or row in a straight line and tend to drift sideways or backward in a breeze. They can be useful for backpackers and fishermen, but often the flotation tubes will chafe and puncture easily on floating branches and sharp rocks. Many are not big or strong enough to mount a little outboard motor, and the Coast Guard tends to rank them as toys as well.

The sober fact about "rubber" boats is that good ones cost as much or more than rigid ones. A quality inflatable is made of long-wearing fabric, provides great flotation and carrying capacity, stores compactly, does not get damaged when banged into a dock or scar the topsides of a yacht when used as a tender. Its low center of gravity makes it stable and the low sides are an advantage for swimmers and skin divers. But being inexpensive is not one of its advantages when it is built to last, and pumping it up can be tiresome if you have to deflate it after every frequent use.

Particularly no bargains are the old wooden rowboats you can find in waterlogged condition along some waterfronts. Dry rot, a destructive wood fungus disease, may have set in and sections will require extensive rebuilding. In addition, they tend to leak and soak up water for a tremendous gain in weight. Tied up at your dock for the season, an old planked rowboat may be fine. But for constant launching and hauling out, it can be a backbreaker that will sell you quickly on the advantages of the new aluminum, fiberglass and ABS models.

Used how, where, by whom

Ideally, you want to pick the right boat for your requirements, made of the best modern materials, that gives you the most for your money. There is no such thing as an all-purpose boat, but a little one is capable of

Assorted aluminum models (below) are selections for Montreal's 1976 Olympics.

Cruising through Connecticut River chop, Sunfish sail out (left) for overnighting.

Rowing is still standard power for small craft like Sportyak dinghy shown below.

Camping can even be managed with Sunfish. Crew (right) stows gear on foredeck.

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Flotation foamed between cockpit and hull is feature of Boston Whaler and others.

Even inflatables, with rigid transoms and enough power clamped on, can tow skiers.

Catamaran design of Catyak (right) gives added stability and deck for small sailer.

Fishing is still the favorite activity on the water for skiffs and all smaller boats.

doing a wide variety of assignments.

How will you use it? Fishing? Day sailing? Gunkhole exploring upstream through the shallows? Water-skiing? Camping? Whitewater runs? Afternoon cruising? Sail regattas in summer and frostbite racing in winter? Ferry service out to a larger boat anchored offshore or at a mooring? Will it be rowed, paddled, powered or sailed? There are small craft suited to all these chores.

And what are the water conditions where it will be used? One good clue to the best choice is a careful look at successful small boats in your area. If experienced local boatmen seem to prefer a Boston Whaler or Chris-Craft dinghy, a Bonair or Zodiac inflatable to handle the short chop in a harbor, a Grumman or Old Town canoe for their wilderness trips—whatever it is, what's being used in your area will be worth considering. Do nearby boat livery outfits offer Alumacraft or Lund, Starcraft or Ouachita aluminum skiffs for day rental to fishermen, fiberglass Sunfish or Hobie 10 sailboats for beginner practice? Chances are these have been found to stand considerable abuse with minimum maintenance.

If, however, you need an extra-light hull that you can single-hand into the back of a station wagon or up onto a car roof, you may be willing to sacrifice some rugged strength in exchange for a little less poundage. But, again, note the flyweights that are successful on the waters you want to use. The ride is likely to be a little more seakindly. Selling or trading in a locally popular model is also easier should you decide you want to trade up or down.

In a small boat you learn quickly that "water" is not just water, and that an open bay on Lake Mead or Lake Huron, or off Maine, California or Louisiana is not the same. Size can add up to more safety. The car-topper that is big enough for the pond at the summer cottage is not likely to be the right choice for the Great Lakes. Decide in advance where most of your boating will be done. Take your little boat along if it will be suitable, but leave it home and rent the right boat on the spot if there's a chance you will run into rougher water. Small boats take extra skills and qualifications when the weather changes.

The question: "Who else will be using your little boat?" is usually answered: "Children and non-boatmen." It's no secret that more people drown while using small boats than any other kind. Generous flotation becomes particularly important in that boat you buy when there's a good chance that kid-horseplay may swamp your pram, a fisherman reaching out with his dip net can flip the canoe, a duck hunter standing up for a crossing shot can rock the boat and fall overboard.

Your small hull must be able to stay afloat with all passengers holding on, even when filled with water. It should have a plaque stating the maximum weight of passengers and gear it can carry, plus the most horsepower it should handle. Small boats almost always use an outboard motor with tiller steering because cockpit room and balance do not allow a steering wheel forward. But with a tiller, abrupt motions can be made so quickly that even a low-powered motor can capsize a little boat, or tip it enough so that water sloshes over the side and swamps it.

To figure the safe load for a small craft of normal shape, being used in calm seas with mild winds, you can make a passenger estimate with this formula: Multiply the overall length times the maximum width, divide by 15 and the result equals the number of people for a safe load.

A 10-foot-long dinghy with a 3-foot beam, for example, could carry you and one passenger. But carefully. If one of you is carrying big duffel bags or a 50-pound block of ice and steps on the gunnel, you're still likely to get in trouble. The formula obviously doesn't work with canoes or sailboards, among others, and doesn't tell you if your boat has enough freeboard (that essential height of the side above the waterline) to keep the waves out when the going gets rough. When in doubt, be conservative when you add up capacity. Remember, too, that a hull big enough to take a friend along is much safer; survival chances go down when you are out alone and fall overboard.

Building materials

Like big boats, small ones can be well made today of fiberglass, aluminum, ABS plastic and wood. Like large custom-built yachts, little ones can still be beautifully crafted in wood. They will require more maintenance and tender loving care, but a canvas-covered canoe, wooden guide boat, miniature mahogany or plywood runabout can be a pleasure to own.

Fiberglass and aluminum boats are

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IT'S NEW NOW

Mini camper for pickups

This mini camper for pickups fits snugly behind the truck cab, leaving room for hauling cargo or a larger fifth-wheel trailer. Called Kid-Napper, it provides extra seating space for four children or two adults and converts to sleeping quarters. It has its own door, but can also be entered directly from cab. Available in several sizes and styles depending on needs. For additional information, write Finch Camper Sales, Highway 385 South, Alliance, Neb. 69301.

Quick, one-step finishes

Stain 'n Buff is an easy, one-step, no-mess finish in paste form you just wipe on for rich, lustrous effects in any of six wood tones. A similar paste finish, Rub 'n Buff, comes in 18 colors. Made by American Art Clay Co., ½-ounce tubes are sold at paint and craft stores.

One-piece spiral staircase for easy installation

Designed especially for a do-it-yourself installation, this modern spiral staircase comes preassembled as a single unit. You just set it up, plumb the central column and anchor it in place with five bolts. The steel stairway, finished in satin black, has no visible welds. It's available in any height and with the steps turning either to left or right. Standard Model 44-9 for typical home is $378. American Ornamental Metal Co. of Austin, Inc., 5013 North Loop Freeway East, Houston, Tex. 77026.

Intercom-phone pages, plays music

Versatile intercom-telephone lets you talk to anyone in the house, play music, hold group conversations and page others quietly without having to shout. Speakeasy system consists of a central control station and four extension phones. Hooked into your phone line, it handles both outside calls and internal calls. About $900. North American Telephone Corp., Box 241, Point Clear, Ala. 36564. (Not intended for homeowner installation.)

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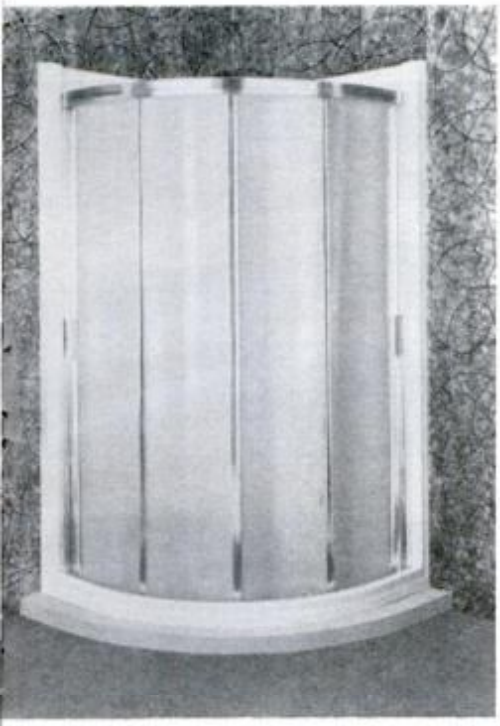
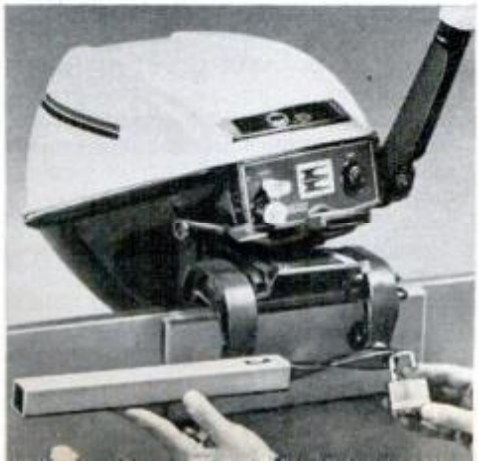


Small shower with a big look

Smartly styled curved corner shower shown above and at left saves space in a small bathroom, yet has a large, elegant look. The one-piece molded fiberglass enclosure has a radius of only 38 inches, comes ready to install in a choice of several color combinations. Its accordion-fold door slides from either side and latches in both open and closed positions. Price of Showerfold is about $396. Kinkead Industries, United States Gypsum Co., 101 South Wacker Drive, Chicago, Ill. 60606.

Thiefproof lock for outboards

Easy-to-steal outboard motors can be made theftproof with this locking bar that slips over the clamp-screw handles, preventing an engine from being removed. It stops accidental loosening of clamps through vibration and serves as carrying handle. Fits most outboards with clamp mounts. $10.95, Master Lock Co., 2600 North 32nd St., Milwaukee, Wis. 53210.



'People phones'—something to talk about!

Artist Bob Ebers thinks the standard telephone is too sterile-looking and lifeless. So he's created a series of "People Phones"—humorous characterizations made of plywood and odds and ends of hardware. The figures—in about a dozen types—all incorporate actual working phones. They've attracted so much attention they're now selling for $150 to $300 from Bob Ebers, 35 West 20th St., New York, N.Y. 10011.

Hones speed sharpening

It looks more like a rabbit-ear TV antenna, but it's really a hone for sharpening knives. Two ceramic honing sticks are set in a base at proper sharpening angle. You run the knife blade alternately along the twin hones to produce a razor-sharp edge. Sticks slip out of base for easy storage. $9.80 postpaid, Indian Mountain Whetstones, Box 276, Hot Springs, Ark. 71901.

New waterborne 'motorcycle'

It's a Kawasaki, but you wouldn't recognize it without its wheels. A sort of cross between a waterborne motorcycle and self-powered surfboard, the sport craft skims along at speeds up to 35 mph. Called Jet Ski, it's powered by a 26-hp engine with jet drive and has a unique safety feature: If you take a spill, it automatically rights itself, slows down and circles back so you can remount. Price not yet announced. Kawasaki Motors, 1062 McGraw Ave., Santa Ana, Calif. 92705.

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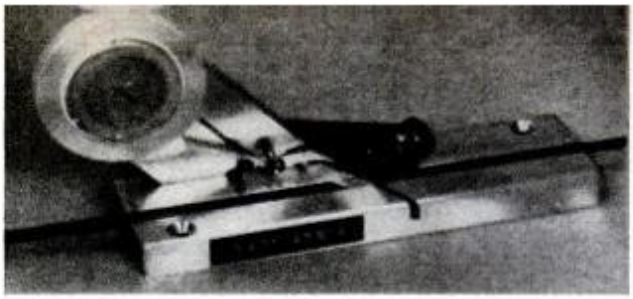
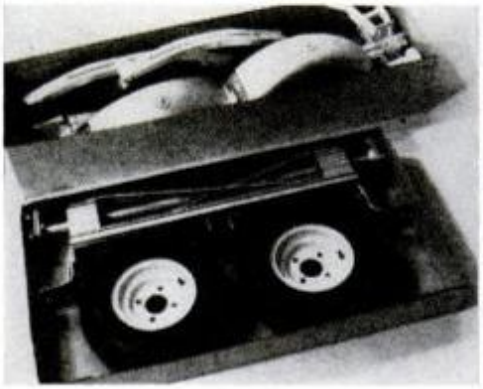


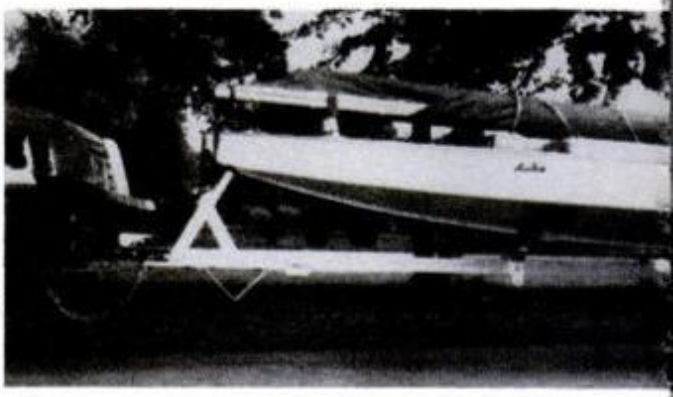
Tape splicers get fancy

Those simple splicing blocks professional tape editors use are now available with extras such as built-in cutters, splicing-tape holders, and more. Nagy Research, Box 289, McLean, Va. 22101, has cassette and ¼-inch tape models from $17 to $50; model shown, $26.50 postpaid.

Kit-built boat trailer

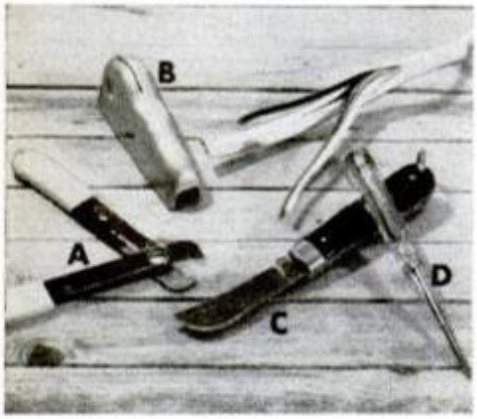
This lightweight boat trailer comes as a kit, can be assembled or disassembled in minutes. It holds 250 pounds, carries small fishing and sailboats up to 14 feet long. Knocked down, it can be stowed in a closet—handy for those who lack storage for a conventional trailer. $215, including prepaid shipping to anywhere in continental United States. Trailex, Inc., 60 Industrial Park Dr., Canfield, Ohio 44406.





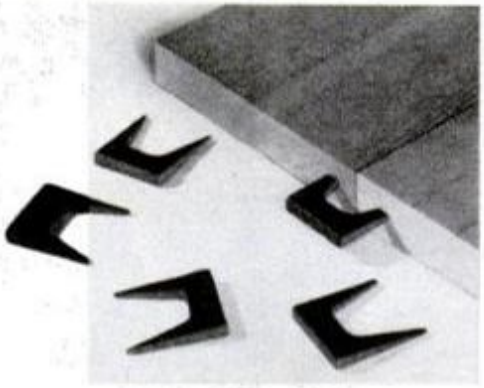
Quartet of electrician's tools

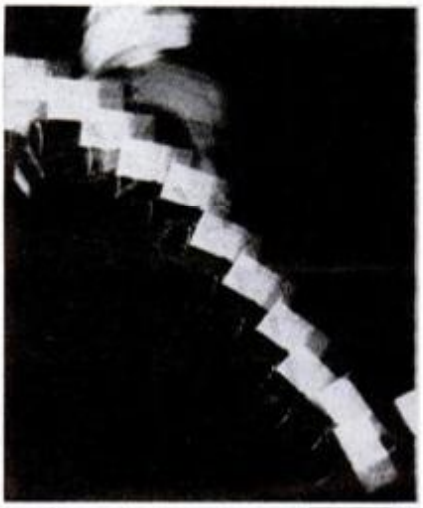
For electrical work: A. Spring-loaded wire stripper cuts solid and stranded wire from 10 to 24 gauge; $1.99 list. B. Captain Hook cable ripper allows continuous ripping of Romex; $3.19. C. Tradesman Knife has wire-stripper, screwdriver blades, safety lock; $3.59. D. Screwdriver tester handles 80 to 330 v.; $1.39 Ric-Nor Co., Inc., Box 164, Somerville, Mass. 02143.

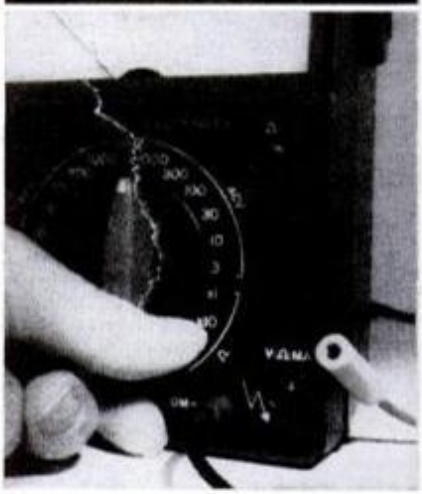


Drive-in clamps for gluing up

Pinch dogs driven into end grain draw boards together tightly for gluing up table or bench tops, can be used again and again. Size shown, 1 in., sells for $8.60 per dozen postpaid. Other sizes available: 1½ in., $9.90; 2 in., $10.60; 3 in., $12.50; lightweight pinch dogs, ½-in. size, $1.20 per dozen. Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801.

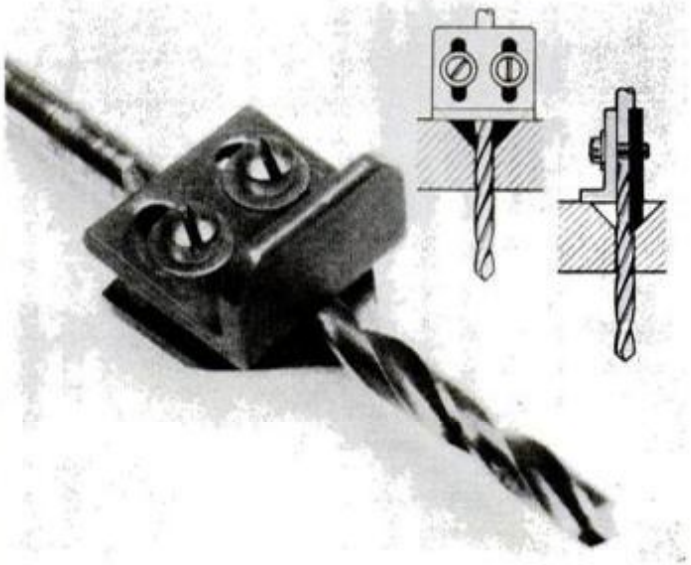






Adjustable countersink holder for drill bits

One-operation drilling of countersunk screw holes with standard twist drill bits is made possible by countersink holder that also acts as a depth stop. Slot in holder fits bits from 1/16 to ⅜ in. dia.; stop slides to position for desired countersink depth; setscrews hold assembly firmly. $3.75 retail, in hardware stores, or from manufacturer (plus 50 cents postage), Connecticut Valley Manufacturing Co., 265 Newington Ave., New Britain, Conn. 06051.



Bouncy, burnout-proof meter

Drop this volt-ohm-milliammeter and it not only keeps working but lets you check how accurately it still works and readjust it. Fuses prevent burnouts. Probes have recessed connections at meter end to prevent shocks, insulation-piercing needle tips with removable alligator clips at the other. Modular for easy repair. Triplett Model 60 is $90. Triplett, Bluffton, Ohio 45817.

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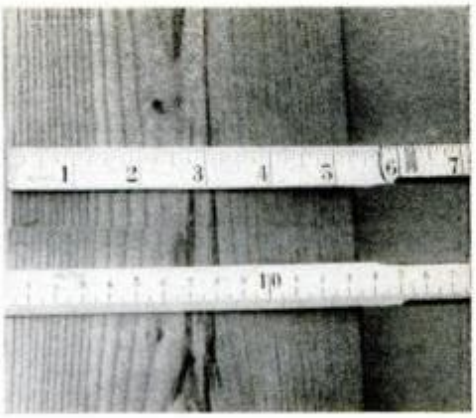
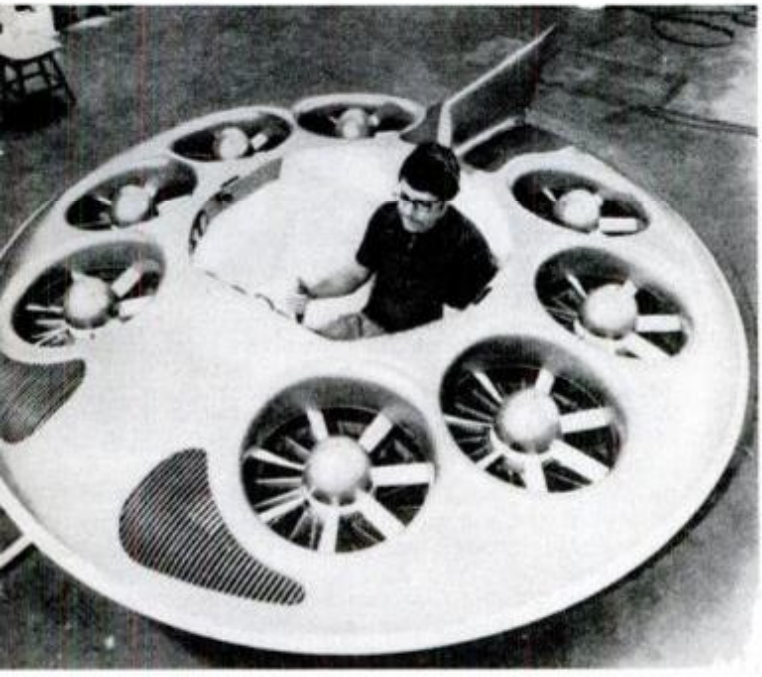
Frameless picture-hangers

You don't have to frame your photos to display them. Just mat or mount them on stiff board and slip them into Falcon Photo Gallery Wall Brackets; you can change pictures any time. Brackets are $3.50 per pair at photo stores, in black or white. They stick or screw to walls.



English-metric folding rule

For working in either English or metric measurements or for quick conversion of one system to the other, Lufkin offers a 6-foot folding rule with inches and sixteenths on one side, centimeters and millimeters on the other. You just flip it over to read either equivalent. $3.80, Lufkin Rules, Box 728, Apex, N.C. 27502.



A 'flying saucer' that may really fly

Small planes of the future may look like this saucer-shaped craft designed by Paul Moller of Davis, Calif. Powered by eight 24-hp Wankel-type rotary engines turning props in the rim, the two-seater VTOL Discojet is expected to cruise at 165 mph, is gyroscopically stabilized, can be flown by a single control stick and throttle. Its low cost and simplicity of design are said to make it ideal for sport pilots. Estimated price: $10,000.

More beer, less foam

Beer drinkers don't like a big head of foam when they're paying for a full measure of brew. But when you drink from a mug, you can't see what you're getting. This bothered German inventor Ernst Binder of Pfaffenhofen near Munich who, like most of his countrymen, prefers a mug to a glass and doesn't like foam either. So he devised this mug with a built-in sight glass to show the true level of liquid. It also tells when you're running low.

Sparkplug socket set

For use on cars, boats and small engines, chrome-plated, sparkplug socket set includes flex-head ratchet with 180° swing, 13/16 and ⅝-inch sockets with oil-resistant Neoprene inserts, 1¾ and 3-inch extensions for reaching in tight spots. About $12; Bernzomatic Corp., 740 Driving Park Ave., Rochester, N.Y. 14613.

Mobile medic: Have hospital, will travel

Most doctors don't make house calls any more, but this one not only visits patients at home but brings a whole mini hospital along with him. The mobile medical van was outfitted by Dr. James W. Turpin and his wife Mollie, also a doctor, of Clarkrange, Tenn. It contains an examining table, emergency heart and respiratory equipment, full stock of medicines and facilities for minor surgery, setting fractures and treating wounds. A similar unit for on-the-road dental work is also in use.

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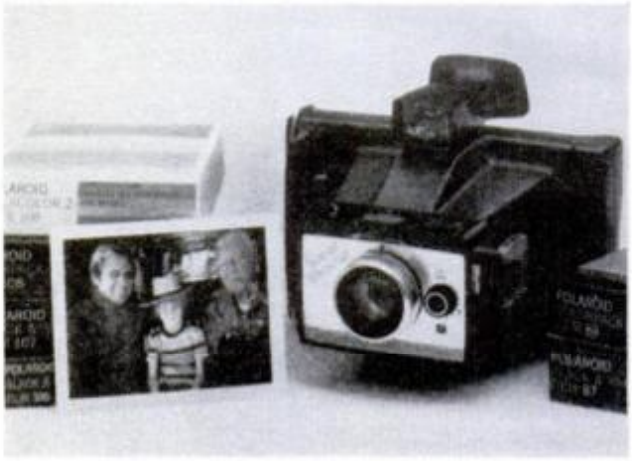
NOW

A World War I Camel comes to life—the hard way

Restoration experts at the Air Force Museum near Dayton, Ohio, were shocked when they learned they were to produce a genuine World War I Sopwith Camel, famed British fighter flown by American pilots. The craftsmen were accustomed to restoring relics, but all known original Camels were in other museums or privately owned. So they had to start from scratch. Working from authentic plans, they recreated every rib, spar and rivet exactly. A few parts, like the French Clerget rotary engine and twin Vickers machine guns, are originals. Construction time: about 10 years. While the ship is operational, there are no plans to fly it: "Too great a risk of loss after so much hard work," say officials.

Deluxe tire gauge

This dial-type tire pressure gauge has several features that make it handy for taking accurate pressure readings. The gauge has a range of 0 to 60 pounds with a stop-action pointer that holds the indicated reading for as long as you want. There's also a bleeder valve that lets you release excess air until exact desired pressure is reached. $9.95 ppd., Dick Cepek, Inc., 9201 California Ave., South Gate, Calif. 90280.

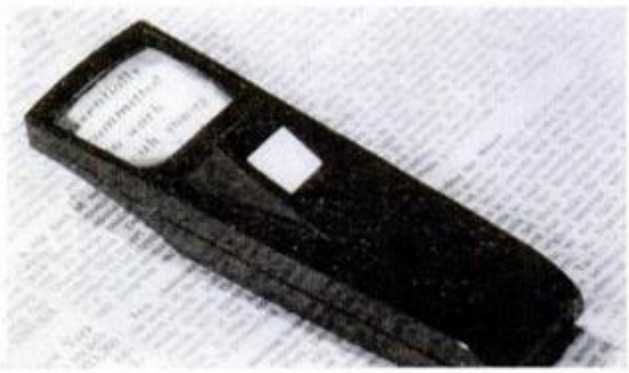


New Polaroid takes six film sizes

Super-Shooter takes both small 3¼ by 3⅜-inch and bigger 3¼ by 4¼-inch Polarcids, depending on which size film pack you load; its viewfinder adapts automatically to match film in use. That gives you a choice of six film types: small, economical Type 87 black-and-white (fast, but with good image tone); Type 88 color; larger Polacolor 108 (Type 1 and the more colorful, but more expensive Type 2); 3000-speed 107 black-and-white; and 105 black-and-white that gives you a negative as well as an instant print (*New From Polaroid*, page 142, May '74). It has electric-eye shutter, adjustable focus, built-in flashcube holder that rotates—all for $25.

Slimming mirror

If appearing to look thinner makes you feel better psychologically, you can get your wish with this trick mirror made of flexible plastic. Turning knobs at edges changes its curvature to make your image as slim as you want. Not just for laughs, it's designed to show dieters what they could look like if they really try. Price isn't for laughs, either: $695 from Hammacher Schlemmer, 147 East 57th St., New York, N.Y. 10022.



Pocket-sized illuminated magnifier

Convenient for modelmaking, reading fine print and other close work, Magna-Lite pocket flashlight magnifier weighs 1½ ounces and measures 1½ by 5 inches. Laid flat, as above, lens is automatically at correct height for reading print or studying small photo contacts. $6.20, complete with two AAA batteries and bulb. Thomas Specialties, 1409 West 77th St., Darien, Ill. 60559.

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Driving Subaru's 4wd station wagon

by Michael Lamm
WEST COAST EDITOR

Four-wheel drive Subaru station wagon is a one-of-a-kind. Other Subaru models are front-wheel drive, and all use a horizontally opposed four-cylinder, water-cooled engine. Stowage of spare tire in engine compartment adds to luggage space.

Subaru has taken its conventional front-wheel-drive station wagon and converted it to four-wheel drive (4wd). How? By simply planting a power takeoff on the back of the four-speed transmission and running a driveshaft to a deDion differential at the rear. Why? For use in snow, on ice, in the wet, and in the rough.

Does it work? It surely does, and better than many other 4wd setups I've driven. A simple in/out lever on the floor ahead of the stick shift makes going into and out of 4wd a snap. And 4wd may be engaged or disengaged at any speed below 50 mph. Subaru recommends driving under 50 in 4wd anyway.

Hard cornering in 4wd, on smooth pavement and in a plowed field, felt the same to me as in fwd (front-wheel-drive) only. I suspect, though, that on any icy or wet road, you'd notice a difference in traction and cornering power. Of course, fwd alone is more stable, generally, than conventional rear drive.

The only thing you have to get used to in 4wd is a slight braking force at low speeds in tight turns, such as parking. This comes because of different gear speeds between the front and rear axles with one set of wheels cocked. Otherwise, though, steering is remarkably light.

The 4wd Subaru wagon negotiates

(Please turn to page 103)

Specifications—Subaru 4wd

Engine type: Horizontally opposed Four, water-cooled, four-stroke
Bore, stroke (in./mm): 3.35x2.36/85x60
Displacement (cu. in./cc): 83/1361
Compression ratio: 9.0:1
Transmission: Four-speed manual, floor lever
Ratios: 1st, 4.091:1
2nd, 2.312:1 4th, 1.029:1
3rd, 1.464:1 Reverse, 4.100:1
Differential ratio: 4.125:1
Wheelbase (in.): 96.1
Overall length (in.): 158.7
Overall width (in.): 59.1
Overall height (in.): 57.5
Ground clearance (in.): 8.3
Steering type: Rack and pinion
Steering ratio: 19.2:1
Tires: 155 SR-13 tubeless

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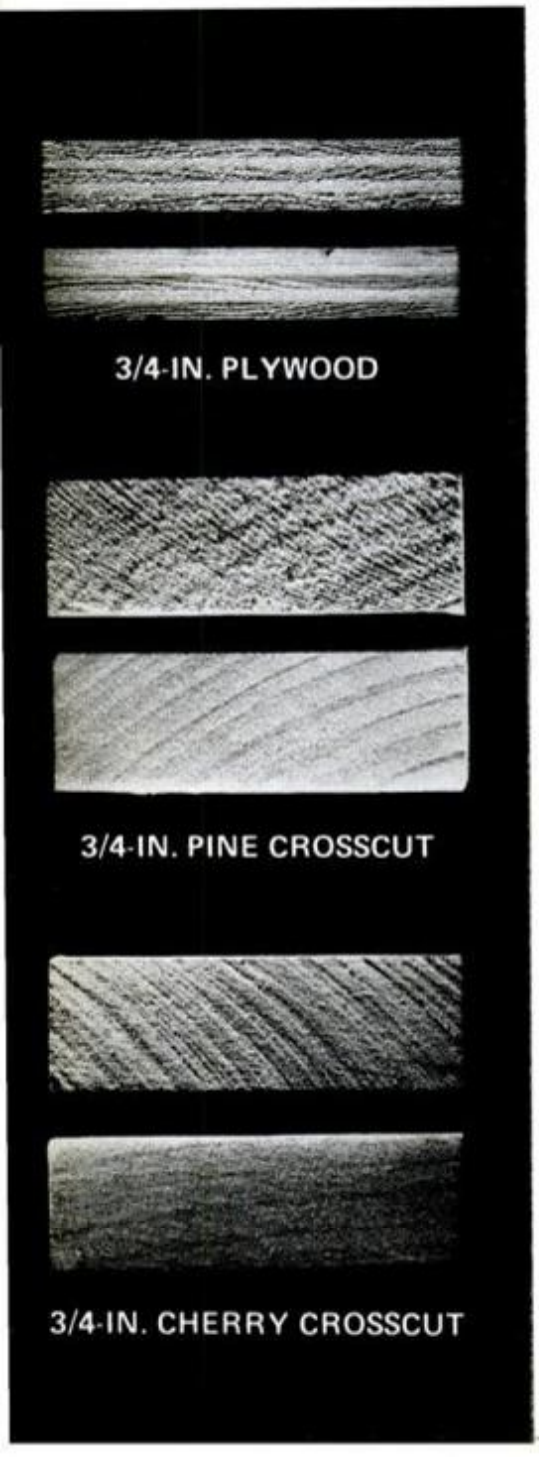
Deburring jig makes saw cut smoother

Photos: John Capotosto



Removing a burr makes for butter-smooth saw cuts—the differences (left) are amazing.

by E. A. Franks

You're probably not getting the smooth cuts you should from your circular-saw blades. Even a blade that has just been ground or filed properly has a residual burr that chews up edges and leaves a rough-cut surface. This burr can be eliminated with a jig like the one I made to give my saw blades a final dressing. Dimensions must suit the saw-blade diameter you use.

Blades must be absolutely free of gum and pitch before deburring. The stones are not oiled. The jig is intended for use only with blades that have no set (those with a set do not require deburring); I have found it produces excellent results with plywood blades and combination blades.

It's essential to use a regular (commercial) saw arbor, which must be mounted so that it is at exactly 90° to the stone-carrying slide, in both horizontal and vertical planes. The arbor is secured with a blunt-tipped Phillips-head screw, turned just snug, as a setscrew; the cap atop the post hides the screwhead. A suitable handle is attached to the rear of the arbor.

Bevel natural stones to allow easy insertion of blades between them. I particularly like the stones supplied by Hindostan Whetstone Co., Bedford, Ind. 47421. Use glue sparingly when attaching the stones. Allow complete drying between gluing operations to keep foam spongy. ★★★

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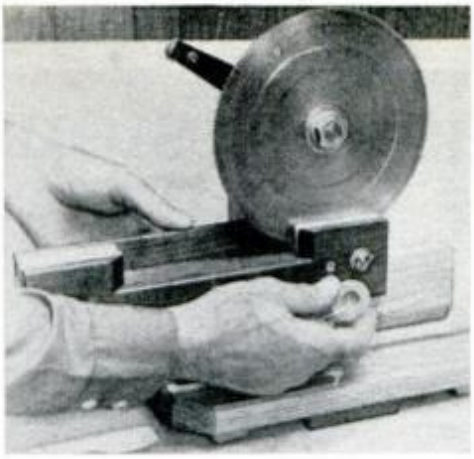
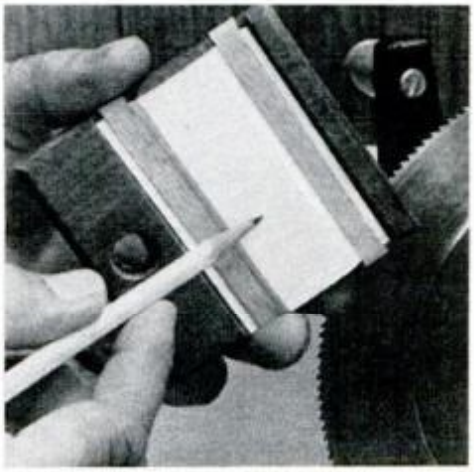
Chisel tool separates foam-sprung stones for insertion of the saw blade, is kept in the spool at the rear of the jig.



Slide is pinned into position with blade between stones. Pin is mounted in cutoff thread spool attached with cord keeper.

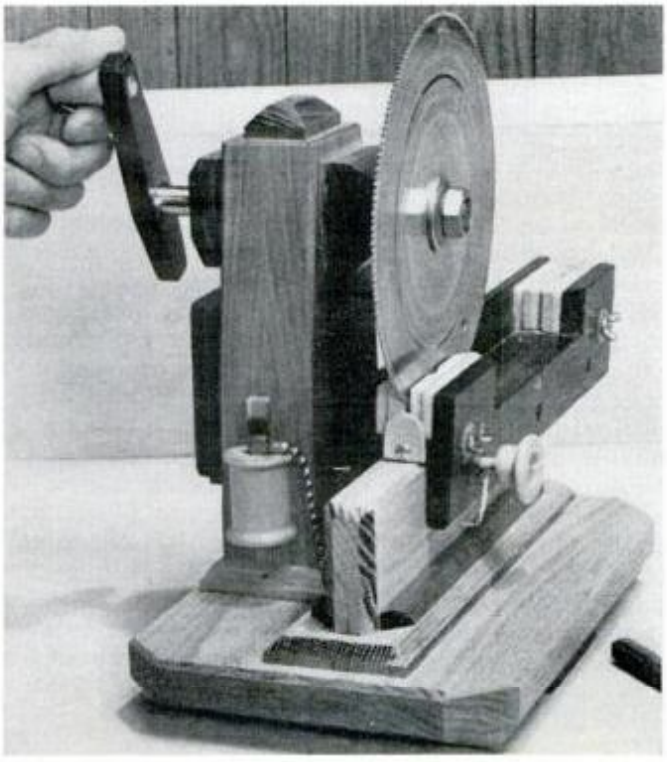
Blade gets five or six turns between soft stones first, in direction *counter* to that in which it normally cuts.

After another half-dozen turns between hard stones, blade is turned against paper on block to test for smoothness.

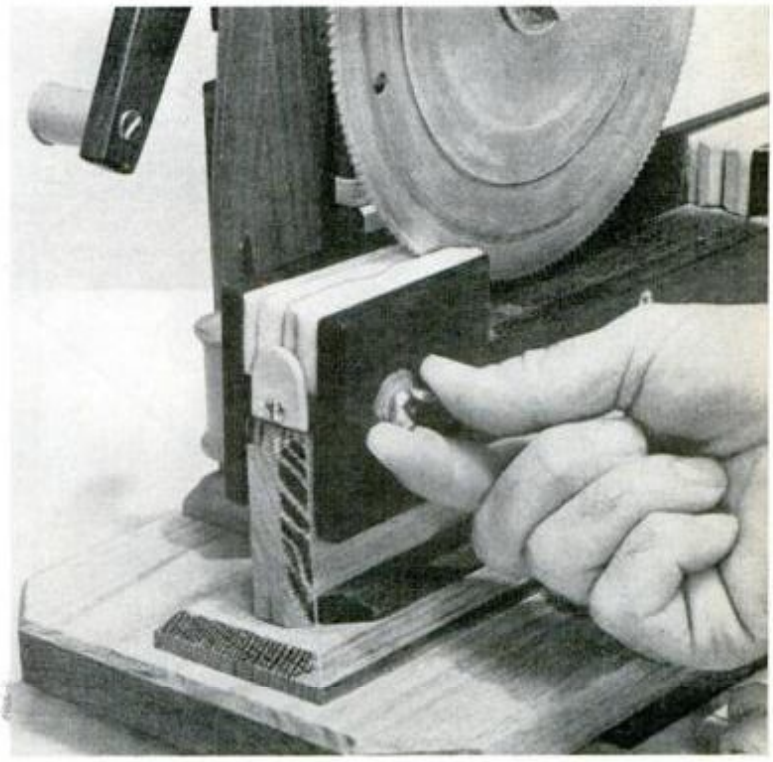


Cutting or scratches on paper surface indicate that deburring is incomplete and that the process must be repeated.

Stones measure 3/8 x 7/8 x 3 in., are lightly glued to 3/8-in. polyurethane foam blocks lightly glued, in turn, to slide.



Hard stones grip blade for second stage of deburring. Three-quarter view shows fitting of slide to rail and spool holder for stone-opening chisel tool.



Wingnuts fasten rear face of slide in place, allowing it to be removed when stones must be replaced. Front face is attached to the center piece with three Phillips-head screws.

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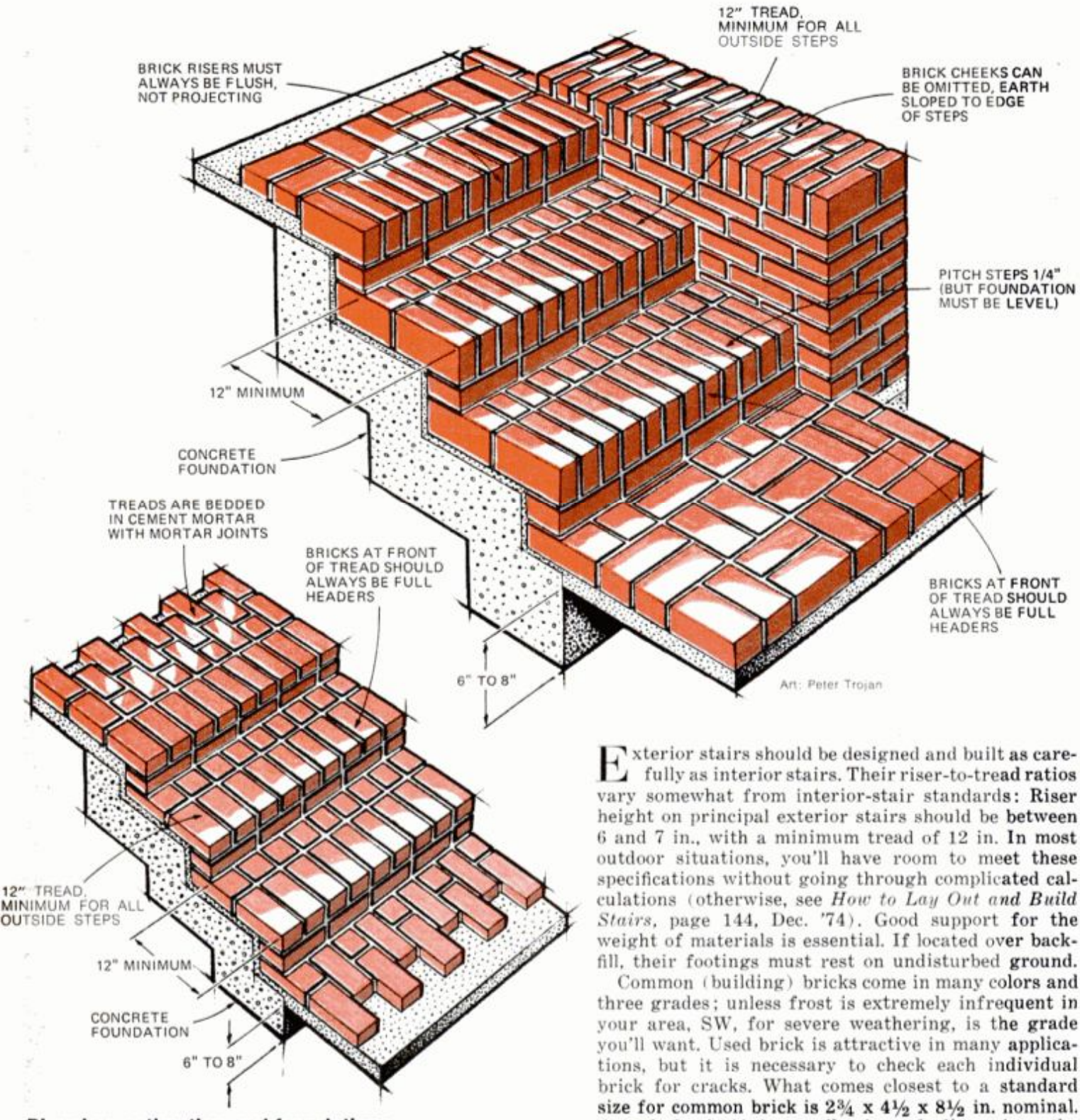
How to build brick and masonry steps



Planning, estimating and foundations

First of all, especially if steps are to be a permanent part of your home, check your municipality's building department on local code requirements. It may stipulate, for instance, that steps must be tied to house foundation. Since steps are more complex than walls, it's best to make scale sketches so you can count the number of bricks needed—then add 5 percent for waste to your order. Foundations (footings) shown above and at the top of the next page are probably best left to professionals to pour, but you can make them yourself if you're willing to handle the complicated formwork involved.

Exterior stairs should be designed and built as carefully as interior stairs. Their riser-to-tread ratios vary somewhat from interior-stair standards: Riser height on principal exterior stairs should be between 6 and 7 in., with a minimum tread of 12 in. In most outdoor situations, you'll have room to meet these specifications without going through complicated calculations (otherwise, see *How to Lay Out and Build Stairs*, page 144, Dec. '74). Good support for the weight of materials is essential. If located over backfill, their footings must rest on undisturbed ground.

Common (building) bricks come in many colors and three grades; unless frost is extremely infrequent in your area, SW, for severe weathering, is the grade you'll want. Used brick is attractive in many applications, but it is necessary to check each individual brick for cracks. What comes closest to a standard size for common brick is 2¾ x 4½ x 8½ in. nominal. Actual size is ½ in. smaller in each dimension—the space taken up by ½-in. mortar joints between bricks. By using the nominal size in estimating the number of bricks needed, you get an automatic allowance for joint space—but check on the sizes stocked locally before estimating.

The space between your finished steps and house foundation must be sealed. This is done by filling the joint with oakum (a fibrous material), then applying tar or mortar caulk.

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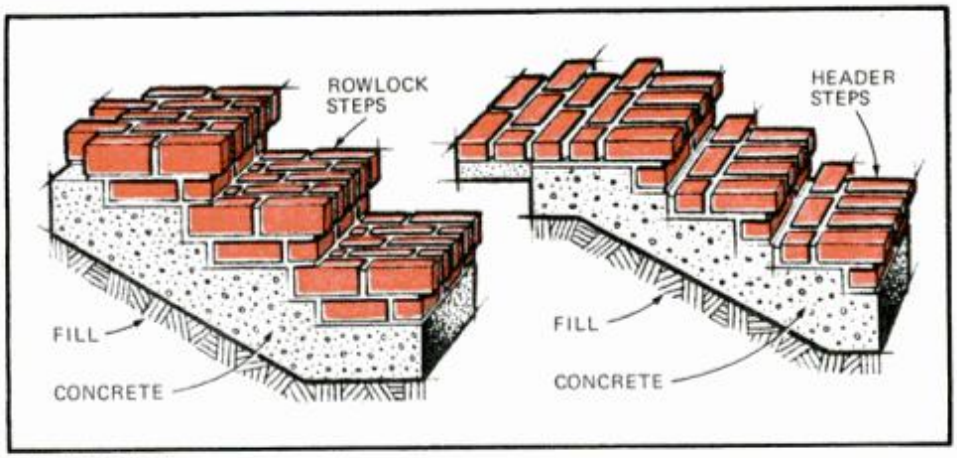
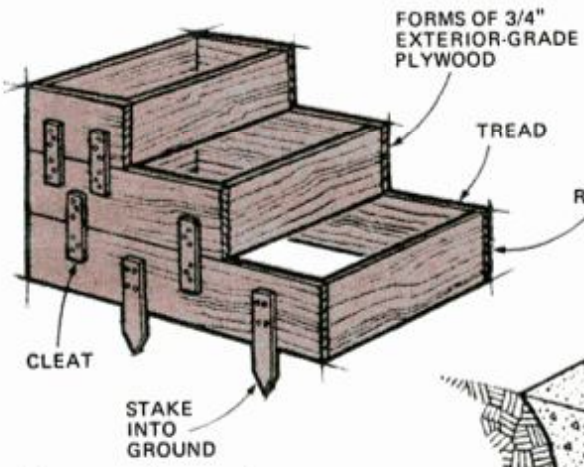
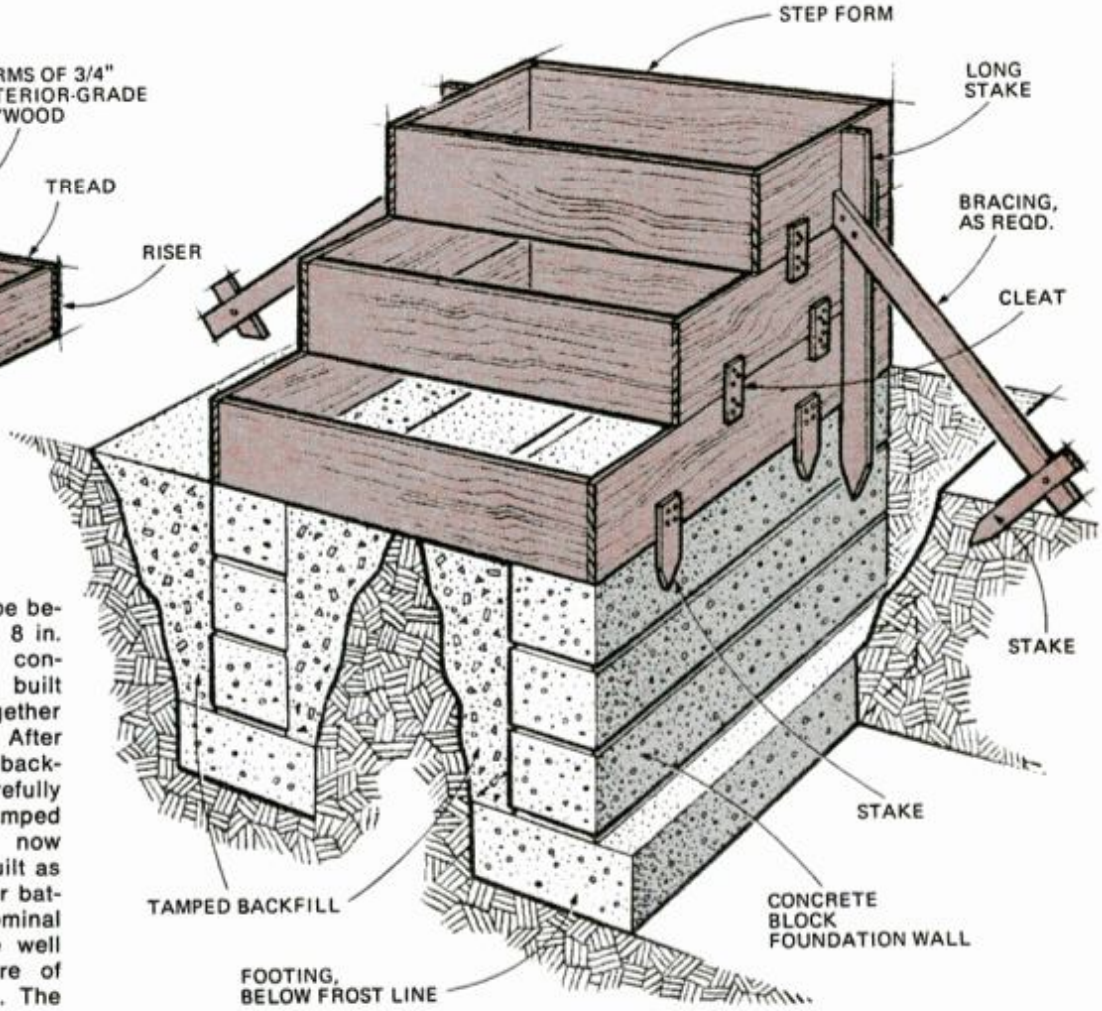


Data: John Gaynor

Bonds, mortar and joints

Rowlock steps and header steps are the two basic brick-step bonds. Either can be laid with slight nosing (overlap of tread); this should not exceed ½ in. Note that foundation for header steps on opposite page is simpler. Type M (high-strength) mortar should be used according to directions; mix only what you can use in 2½ hours. Mortar can be colored with lampblack or pigments. Work from the bottom up, laying bricks on a ⅜-in. mortar bed and checking with a level as you go. Flush mortar joints made with trowel edge will weather best. When mortar has set, rub with a clean brick to remove excess.



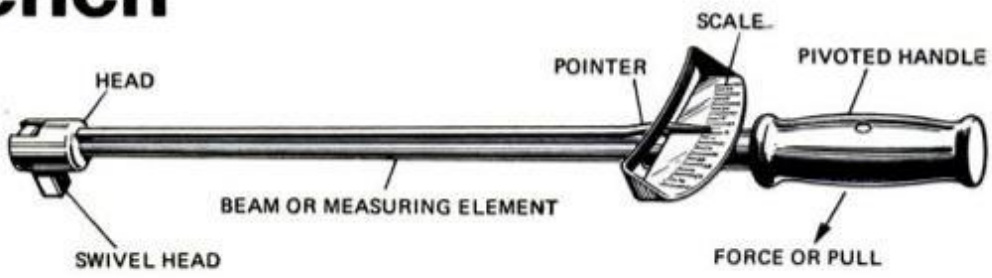


Formwork, pouring, finishing for concrete steps

Footings for concrete steps should be below the area frost line and at least 8 in. thick. When the footing has set, a concrete-block foundation wall can be built up to grade with blocks mortared together and their cores filled with mortar. After the mortar has set (about 24 hours), backfill the soil around the wall, carefully tamping each 6-in. layer, until tamped backfill is at grade. The site is now ready for forms, which should be built as shown above with ¾-in. plywood for batter boards and 1-in. and 2-in. nominal stock for bracing. Forms must be well nailed and solid, so that pressure of concrete will not force them apart. The form is held in place on the foundation with braces as shown at right above.

Since steps of this type require a large amount of concrete, you are well advised to use transit-mix (truck-mixed) concrete, pouring the steps monolithically (as a single unit); the stiffness of the mix should make it unnecessary to close in lower-step treads. You *can* hand-mix and pour one layer at a time, but this is not really worth the extra effort, as it raises the problem of tying the layers together. Estimate the amount of concrete needed by finding the volume of the steps in cubic feet and dividing by 27 to convert to cubic yards, and add 5 percent for waste. One cu. yd. is usually the minimum order for transit-mix concrete. Before pouring, give the inside of the forms a thin coat of form oil to keep concrete from adhering to wood. When the pour is complete, rap forms vigorously all over with a hammer; this helps the mix to settle and fill voids (honeycombs) that may occur next to the form boards. You should *not* pour if the temperature is below 40°F. or if it is raining. Use a wood float to finish the steps—a steel trowel would give too slick a surface. When concrete has set for at least 36 hours, carefully remove forms. Rough spots can be rubbed smooth with a carborundum stone and water. Fill any voids at this time with a cement-and-sand mix, troweled and rubbed smooth with the stone while still wet. To cure, keep steps moist and covered (to retain moisture) for five to seven days. ★★★

It's about time you bought a torque wrench



Technical art: Fred L. Wolff

by Robert Taylor
and Curt Wolfe

Whether you are a beginner or an advanced do-it-yourselfer, you should have a torque wrench. Not only should you own one, you should use it!

For some reason, a torque wrench is the tool most Saturday Mechanics and even professional mechanics put off buying. It's haste, perhaps, that leads to tightening nuts and bolts by "feel." But feel is not a good practice when accurate torque values are specified.

Various problems arise when fasteners are not torqued to specification, and some of them can relate to safety and involve major repair. More oil leaks, for example, are caused by overtightening than by fasteners that are too loose.

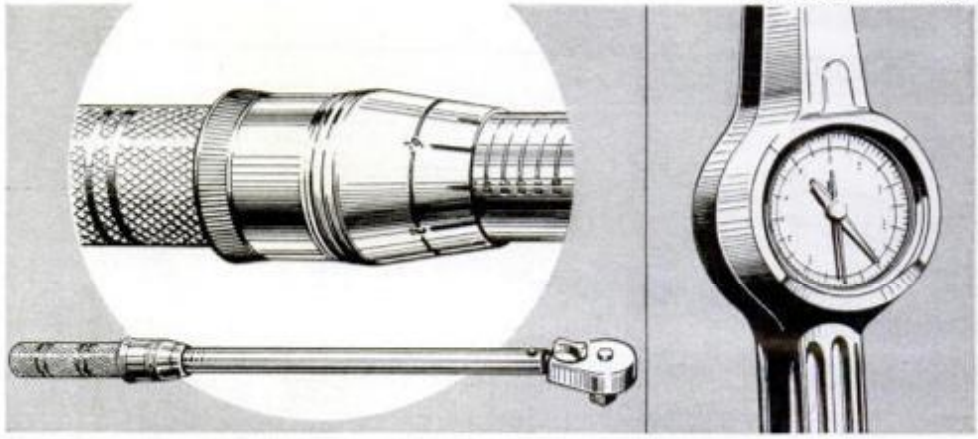
The prime example is leaky valve cover gaskets. Many of these gaskets allow leaks only because the screw or bolt holding the cover is too tight. The gasket itself is fine. What happens is that the valve cover gets bent out of shape and the gasket will not conform to the distorted shape. The result, of course, is a leak.

It's not exaggeration when one torque wrench manufacturer describes his wrench as a gauge tool that can be compared with a micrometer, dial indicator, level and many other precision instruments. It's that important to torque fasteners to spec.

Types of torque wrenches

You can find a torque wrench for almost any size job. They range from the very large to the very small. They come in various sizes, lengths and shapes. The round and double-round beam models, for example, are the types most often used in the automotive service field.

The tapered beam model, on the other hand, is more likely to be found in industrial use.



Round-beam type of torque wrench is shown at top. This is the common automotive torque wrench available in standard foot-pound models or metric, meter-kilogram models. The round-beam torque wrench is also available in various ranges: Zero to 100 foot-pounds, for example, for cars and small engines. Most have ⅜-inch square drives for use with your socket set. Prices range from $10 to $20. The scale on the round-beam type at top indicates torque when the pointer is deflected in either direction. Other types of scales are shown above. At left is the micro-adjusting type which can be set to a specified torque: A click indicates when you reach the preset torque. Above, right, is the dial used on many commercial heavy-duty types. Most have memory pointers and read up to 250 foot-pounds.

Some manufacturers make torque wrenches that have built-in sensory devices so you can feel when the specified torque value has been reached. You preset the specified value before you start work. You feel a click when you reach the right torque.

Many of these types also use direct reading scales so you can use it either as a direct reading or sensory model.

Torque wrench terminology

To be used correctly, it's important to know and recognize all the parts of the torque wrench. Torque-wrench manufacturers refer to these parts in operation and service instruction literature. So before using a new torque wrench it's important to study the owner's brochure carefully.

The illustrations on this page show the basic parts of the typical beam-type torque wrench.

On the beam type, a pointer moves across the scale as you apply force to the handle. You stop when the pointer hits the torque value you want.

Torque law

Torque is based on the law of the lever. Distance multiplied by force equals the torque around a point. This is illustrated on the opposite page. The distance between the centerline of the drive square and the centerline of the force being applied at the handle is the lever length of the torque wrench.

Most torque wrenches are made with a male driver or square at the end. The drive is used to fasten various attachments to the end of the

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wrench. For automotive work, the ⅜-inch or ½-inch-square drive is most common.

Attachments can be divided into several classifications — extensions, sockets and adapters. Typical attachments are for slots, gears, shafts, drive pins, screwdrivers and various size sockets, of course.

With some torque wrenches, accurate readings can be made with any attachment even though applied lever strength may vary. With a bending beam type of torque wrench, however, the measuring element must have a fixed lever length. This is accomplished by designing it with a pivoted handle or having some kind of concentrated load position which will determine the applied load lever length.

The popular pivoted handle, sometimes called a floating handle, is designed so that your hand will fit around it a certain way: This positions the pulling force at a fixed point on the wrench.

Using the torque wrench

There are times when you'll be using a torque wrench right up to its limits for measuring foot-pounds. Other times you'll be using it at the low end of the scale. Still, you should select the wrench best for you, in terms of size and range, by considering the particular application you'll use it for. Always check the service manual for your car to see the specified torque values for the jobs you'll be doing most. Then select a torque wrench with a capacity so that the working range you most often use will be within the mid two-quarters of the scale.

For example, if 150 to 450 inch-pounds will be the torque range you will be using often, select a wrench with a 600-inch-pound capacity.

Torque multipliers

Through the use of planetary gears, a torque multiplier will boost torque and at the same time allow a shorter lever length to be used.

The most popular torque multipliers use a gear ratio of 4 to 1. You can multiply the torque for a given leverage length and force by four. Or you can use one-fourth of the lever length.

Torque calibrations, incidentally, on better torque wrenches, are set in accordance with the National Bureau of Standards.

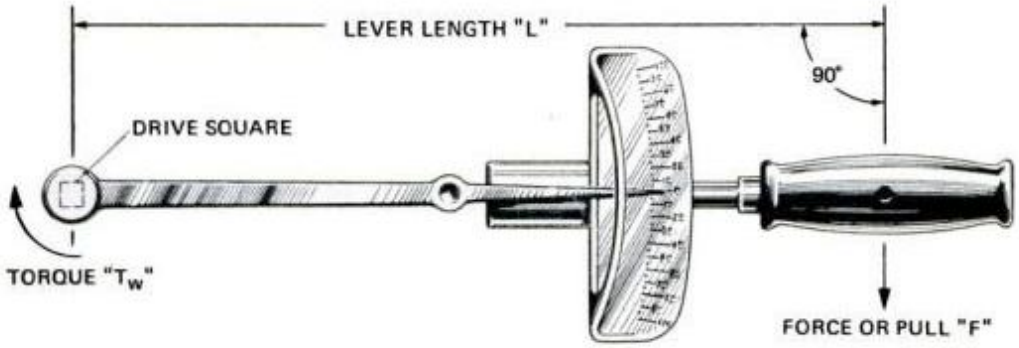
Adapters, attachments, extensions

Adapters and extensions can make a torque wrench multirange and multipurpose. One torque wrench can be made to do the work of several with the use of adapters. For instance, an adapter equal to the lever length of the torque wrench will multiply the torque by two. Therefore a 100-foot-pound torque wrench can be used to tighten bolts up to 200 foot-pounds.

You'll encounter special jobs where conventional adapters, attachments and/or extensions still make it awkward or almost impossible to reach the work. For very special applications, you'll find that irregularly shaped and designed accessories are available.

Special attachments are relatively expensive, and you shouldn't invest in them until you know you're going to need them. What you do need before you can even accurately tighten your sparkplugs the next time you replace them is a torque wrench!

An investment of $10 to $20 will buy a good torque wrench for Saturday Mechanic use. It's important for doing the job right, and when you have one you'll find that you'll more readily move on to more difficult automotive servicing with the knowledge that you've got the right tools for the job. ★★★



Torque law is based on the lever principle. You multiply force by lever length to get torque. Torque is measured in foot-pounds (or inch-pounds at smaller values) or in meter-kilograms if the scale is in metric. A standard round-beam type with a 0-100 foot-pound range is best for automotive use. However, before buying a torque wrench, check the range of torque values specified for the various parts of your car in your service manual.

Some of the fasteners on your car that should be torqued

BODY
- Engine compartment hood mounting bolts
- Radiator mounting bolts
- Shock absorber mounting bolts
- Wheel-to-drum mounting bolts (front and rear)
- Front-wheel-bearing adjusting nut (both sides)
- Door-to-body mounting bolts (front and/or rear)
- Trunk-to-body mounting bolts
- Body-to-frame mounting bolts
- Bumper-bracket-to-frame mounting bolts (front and rear)

ENGINE
- Sparkplugs
- Engine head bolts and pan bolts
- Valve-cover screws
- Main-bearing cap bolts and connecting rod cap bolts
- Carburetor to intake manifold stud nuts
- Fuel-pump attaching bolts
- Alternator/generator bracket to engine bolts
- Starter attaching bolts
- Airconditioner mounting bolts
- Power steering mounting bolts
- Flywheel-to-crankshaft mounting bolts
- Motor-mounts-to-engine bolts
- Motor-mounts-to-cross member bolts
- Transmission-to-engine mounting bolts
- Distributor-to-engine mounting bolts
- Exhaust manifold(s) to engine mounting bolts

POWER TRAIN
- Front U-joint yoke to transmission mounting bolts (some cars)
- Rear U-joint yoke to third member attaching nuts or bolts
- Third member to differential housing mounting bolts

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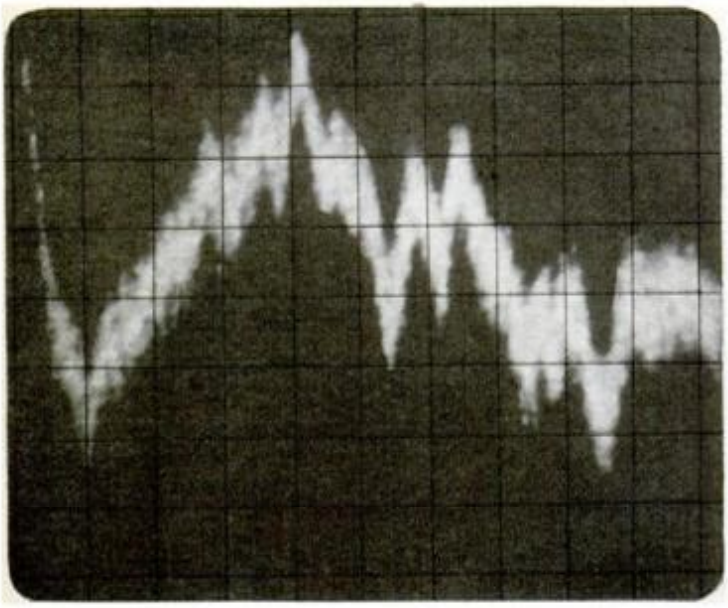
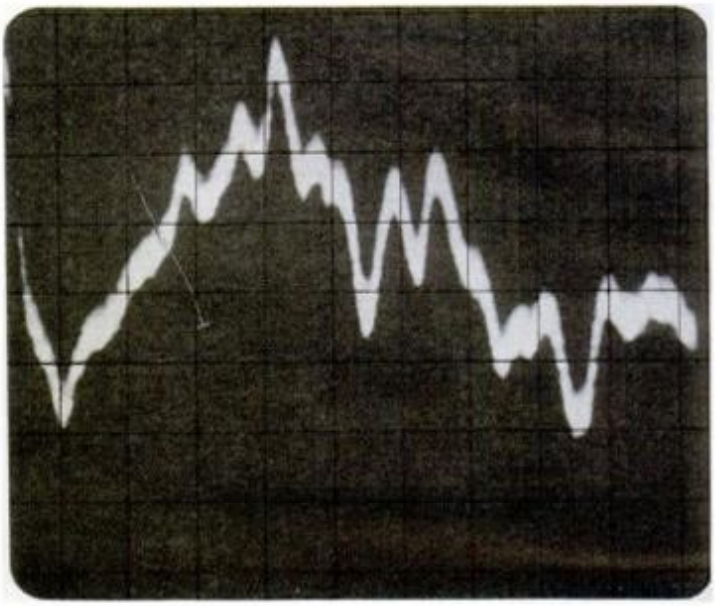
Sssh! Noise reducers at work

Built-in and add-on systems cut hum, hiss and other hi-fi system noises.



Fuzzy sound-wave (above) is a very low-level symphonic passage carrying unwanted noise, chiefly hiss.



With hiss diminished (above), waveform looks and, more important, sounds better thanks to noise reduction.

by Larry Zide

Noise—record scratch, static, tape hiss—has plagued sound reproduction systems since Edison first recorded *Mary Had a Little Lamb* on tinfoil.

The problem isn't as acute today, of course: Smoother record materials, FM broadcasting, improved tapes and quieter electronic circuits have all dramatically increased the signal-to-noise (S/N) ratio. So now, major leaps in S/N require new techniques and equipment. (Signal-to-noise ratio is the difference in decibels between the loudest signal a system can handle without unacceptable distortion and the quietest signal audible above the system's built-in noise.) Today's hi-fi listener has a whole gallery of such new equipment to choose from: Dolby, dbx, DNL, Burwen, RG, ANRS, autocorrelation, and perhaps still others to come.

But before discussing how these systems solve the problem, let's see just how severe the problem is. An ideal home music system would have an S/N of at least 80 db—the range between the quietest sounds that average home noises won't mask and the loudest ones the average ear can take before it begs for relief.

Unassisted, today's home sound systems aren't quite that good. The best of our present systems is the phonograph disc, which can achieve an S/N of as much as 75 db—not counting clicks, pops and the noise it gradually acquires if you don't care for it properly. The disc, in fact, is more than good enough for you to hear the noise of the master tape (less than 70 db in final form) through it.

Home tape machines range from 60 db signal-to-noise ratios for the best open-reel models (55 db is far more typical) to a low of 35 or 40 db for slow-speed, narrow-track systems such as cartridge and cassette (high-quality cassette units barely make it up to 50 db). And in FM, practical limitations reduce the available S/N to about 55 db.

But your ears hear noise, not numbers: At the low sound levels typical of hi-fi noise, the ear is most sensitive to middle frequencies, least sensitive to low ones. That means hum, turntable rumble, and other low-frequency noises will be less annoying than the broadband hiss typical of tape and FM but also audible on records—and that's the noise today's noise-reduction systems work hardest at eliminating.

In general, a system with a 50 db of S/N will be quite audibly hissy when it's played loud. With an S/N between 50 and 60 db, hiss will be audible, perhaps obtrusive, but not a prime annoyance to most listeners. When the signal-to-noise ratio gets up into the 60 to 70 db range, noise becomes barely audible, even in quiet surroundings; beyond 70 db, noise begins to vanish.

The first approach to making that noise vanish was the *compander*—actually matched compressor and expander circuits. The compressor narrows the signal's dynamic range in recording, making soft sounds proportionately louder and loud sounds a bit softer, so that the softest sound in the original signal is always above the noise level of the recording medium (see diagram above). Matched expansion in playback resoftens the soft sounds and reboosts loud ones. Noise—softest signal on the record—is softened to near inaudibility.

But companders tended to produce

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"pumping" or "breathing" noises, in part because compression and expansion were never quite a perfect match, also because background noise level would rise and fall with the music.

Then came Dolby. It divided the signal into frequency bands, each compressed and expanded separately so that noise in one part of the spectrum wouldn't "breathe" with changes in levels of the other frequencies. Since our ears can't pick up soft sounds when there are louder sounds of similar frequency to be heard, changes in noise level within each frequency band will be masked by changes in signal level within that band. Only low-level signals likely to be lost in the noise are affected; high-level signals aren't touched.

By now, most professional master tapes, especially of classical music, are made with this Dolby "A" system. For home use, there's a less expensive Dolby "B" system that affects only one band of high and middle frequencies to reduce hiss.

JVC makes a somewhat similar system, called ANRS, which it claims produces less distortion and is compatible with Dolby (tapes made with one type of processing can be played back with the other).

Still another system is the dbx. It's a broad-band compander, but unlike earlier ones, it matches compression and expansion automatically, with such accuracy that pumping and breathing are no longer problems.

Dolby, ANRS and dbx, all "double-ended" systems, must be used in both recording and playback. That means a built-in compatibility problem: Since the signal is altered in recording and altered back in playback, it will sound altered unless it's processed by the system at both ends.

In the case of Dolby B, straight playback of an encoded signal without reprocessing seems only to sharpen the treble unnaturally; on good equipment, turning down the treble control will more or less correct for this—and on portable recorders with small speakers, the extra highs are an improvement. The same should be true of ANRS.

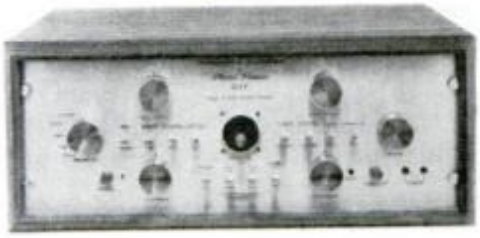
With dbx, the story's different. Its broad-band compression approach has the advantage of offering more noise reduction (30 db to Dolby B's 10 db) and of keeping its home and studio systems compatible with each other. But it also has the disadvantage that its encoded signal, compressed to half its original dynamic range, sounds as if someone were sitting on the music when it's heard without a dbx decoder.

Dolby decoders are now very easy to get. They're available as acces-

(Please turn to page 100)

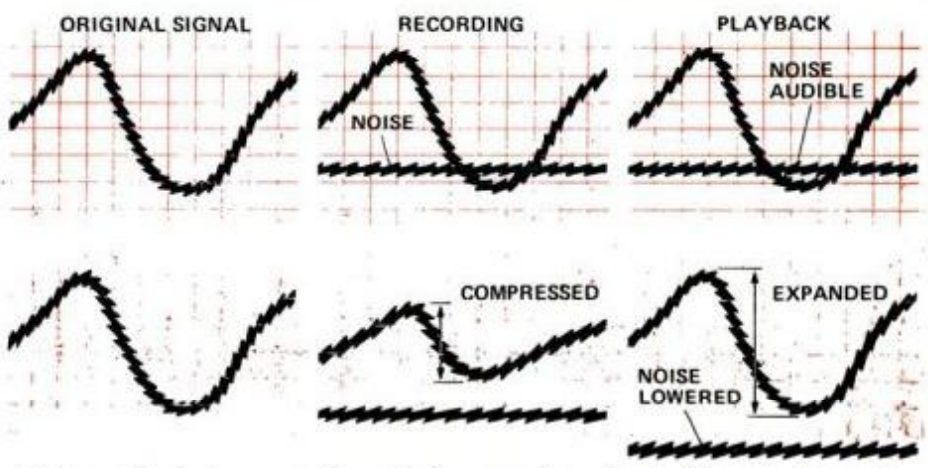
Dolby circuits are built into many cassette decks like this Teac (left), other components like Marantz receiver (above).

Autocorrelator built into Phase Linear 4000 preamp is now also available separately.



The dbx companders compress signal in recording, expand in playback as in diagram below, have noise filters to reduce "breathing" effects (see text).

Burwen dynamic noise filter reduces high-frequency response when there are no signal highs to mask noise.



Noise added in recording (top) is heard only when signal isn't loud enough to mask it. Compressing signal (above) keeps it above noise; expansion restores signal, cuts noise.

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Inside tips to protect outside surfaces

Exposed outdoor masonry and metal structures often need refinishing—and the procedures can be tricky. Here's what the experts do.

Forgotten like stepchildren in the usual painting manuals are techniques for refinishing concrete and metal fixtures used outdoors. Wood has always claimed attention as the favorite. But concrete patios, porches, stoops and walls, plus metal railings, lampposts, fences and furniture need equal attention from the concerned homeowner.

Guesswork or erroneous answers to questions of paint selection and surface preparation have forced many a handyman to make the wrong move —such as applying fresh paint to dry (yes, dry) concrete when in most cases it actually should be damp.

What follows are some inside answers to some outside problems.

Painting masonry is simple enough, but there are right and wrong ways. Purpose, surface condition, and expected exposure all combine to dictate the right paint to use.

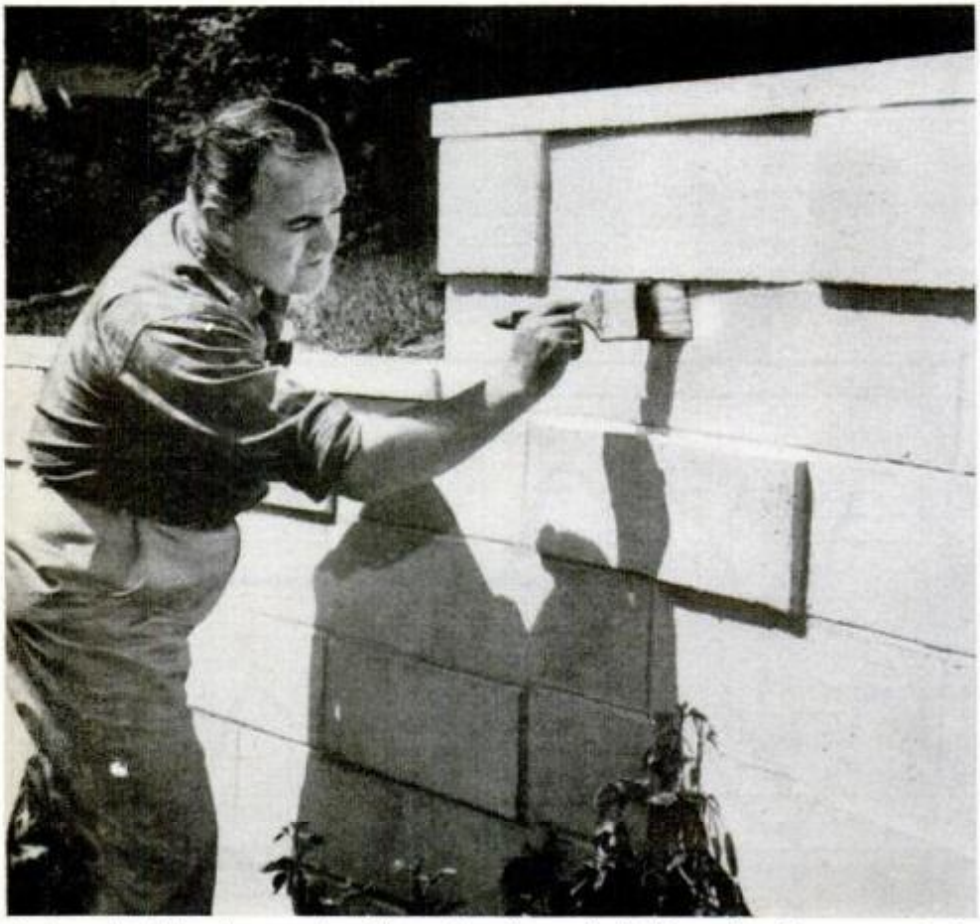
Concrete is quite alkaline, and alkali is an enemy of many paints. Portland cement is not only in concrete, but in brick and stone mortar, concrete and cinder blocks and stucco. While the alkalinity at the surface decreases with weathering and age, moisture in the concrete may bring more alkali to the surface. Well aged and dry masonry surfaces may be considered comparatively free of this alkali, but you must be sure there is no water present.

In this latter condition, almost any suitable paint (conventional house paints) can be employed with good results. But in case of doubt, a paint with built-in resistance to alkali should be used, and for the best assurance of satisfactory results no matter what the age of the concrete, these special resistant paints must be used.

Of the many alkali-resistant paints on the market today, the one selected should be for the expected exposure. For example, if protection is required rather than beauty, select a type of paint designed for the protection needed. Floor paints should be selected for floors and exterior paints for exterior surfaces. In general, a careful study of the instructions on the labels should be your guide. Here are available types of alkali-resistant paints:

Latex paints. These paints, inherently resistant to alkali, are made from emulsions of resinous materials in water. While other ingredients used in the paint may affect the degree of resistance, any latex paint designed for use on masonry may be used with confidence. Just be sure that the latex paint selected is intended for the surface to be painted, since latex paints come in a wide variety of colors and types for interior or exterior walls, ceilings, floors and other surfaces. Alkyd emulsions (read the label) are not alkali-resistant, so avoid their use on new masonry surfaces. Since latex paints are water-thinned, the surface to be painted need not be absolutely dry. Indeed, it should be dampened before applying the first coat.

Portland cement paints. Purchased as dry powders and mixed with water before use, these paints set by the hydration of the cement and should be applied to damp surfaces which must be kept damp until the cement in the paint matures (48 to 72 hours). Portland cement paints contain little organic material and are not subject to attack by alkali. They have a long history of success in painting masonry, but there are points to remember: 1. They may require treatment with a surface conditioner if other types of paints are applied over them, or



Surface should be dampened and free of peeling and chalking paint when you apply latex to concrete. New concrete should be allowed to weather a year or so before coating.

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may need complete removal if peeling has developed. 2. They are not suitable for floors and other surfaces where abrasion is anticipated.

Oil-base stucco, masonry paints. These types are similar to conventional house paints in most respects, but are usually reinforced with certain resins to improve their alkali resistance. Their application, effectiveness and general behavior are similar to conventional house paints, but they are least resistant to alkali.

Solvent-thinned rubber-base paint. These contain a synthetic rubber-type resin and are thinned with an organic solvent, these provide excellent resistance to alkali and water penetration and resist abrasion. They are available in a wide range of colors for basement and porch floors, swimming pools and walks exposed to the weather.

Regardless of the type of paint you choose, preparing masonry surfaces for painting is important: 1. Clean that surface! This rule applies whether the surface is new or old.

2. Use a wire brush to remove all dirt, loose particles and other extraneous materials which might interfere with paint adhesion. If there is a white saltlike material adhering to concrete, stucco or mortar, it is probably efflorescence. Efflorescence is caused by moisture which dissolves salts in the interior of alkaline materials and carries them to the surface. Efflorescence must be removed before painting or repainting. Since it is caused by the presence of moisture, preventing moisture from entering the masonry material will prevent efflorescence and also prevent damp walls.

3. Remove all grease or oil by washing with a cleaner made for the purpose or detergent and water. Poured or precast concrete may have a "release agent" on the surface which must be removed by solvent or by several months of weathering action.

4. Finally, wash off or hose off surfaces unless efflorescence is present. Allow the surface to dry unless a water-thinned paint (latex or Portland cement) is to be used. If efflorescence is present, dry-brush it away along with all dirt, dust or other extraneous material.

5. For porous surfaces, as with some forms of concrete masonry, a fill coat or grout coat is necessary before painting. Whether or not the fill coat dries with hairline cracks, the finish paint coat will provide a good seal. To prevent the cracks from showing through the finish paint, allow the fill coat to mature before painting it.

Before you start painting. Check the following points: 1. If the concrete, other masonry material or the mortar is well aged (one to two years exposed to the weather except for unusually massive concrete), the chances are that most of the alkali has been washed out or neutralized by the atmosphere. However, age increases the likelihood of contamination by dirt, oil and grease, depending on environment. Hence, make doubly sure your cleaning job is thorough.

2. If the surface has been previously painted, and the paint is in fair condition, use a wire brush to remove loose extraneous materials such as dirt. If the old paint is loose, peeling or heavily chalked, then you must sandblast or otherwise remove all old paint before repainting.

3. If the surface is to be repainted, and the old paint is just moderately chalked but otherwise "tight" and nonflaking, and you intend to repaint with a water-thinned coating (latex, Portland cement), a surface conditioner should be used before painting. The manufacturer of the paint may recommend adding a conditioner to the first coat. In any case, follow his directions.

4. If a water-thinned paint is used, stains may develop when in contact with metals. Thus, iron, copper or other metallic objects imbedded in the masonry surface, or adjacent to it, should be primed with a good anti-corrosive primer before painting. Look for nails and other metallic objects. Always prime them before applying a water-thinned paint.

Painting ornamental iron

Being metal, ornamental porch railings, window airconditioners, gym sets, lampposts and galvanized gutters are subject to rust and bleed-through once the painted surface is chipped. Before repainting, wire-brush bare metal spots thoroughly to remove all loose paint. A flat file will remove the little domes of rust a wire brush can't. Handy for use on metal railings is a long-handled wire brush most paint and hardware stores sell for about $1.75.

Clean and coat all chipped areas on metal with a red-lead primer. This rust inhibitor permits most any good-quality, oil-base enamel to be used on exterior ornamental railings and the like. Your paint dealer will help you pick one to withstand sharp temperature changes without chipping or cracking and that will resist moisture. Some makers offer a one-coat combination primer-finish in a choice of colors in spray cans. One coat is said to give good protection. ★★★

New water-based varnish: boon to home finishers

The old dilemma of how to create an elegant patina for wood surfaces without the frustration of applying varnish that sags, runs, crawls or dries too fast has been solved with a new water-based varnish as easy to apply as any latex paint. PPG Industries, manufacturer of Pittsburgh Paints and Rez wood finishes, has developed the clear varnish satin finish that uses water as the primary solvent.

According to PPG, a unique characteristic of the Rez water-based clear varnish is its milky appearance during application. This helps the finisher avoid the skips and misses often associated with conventional varnish application, because he can clearly see exactly where the new varnish has been applied. The finish dries to a clear satin-gloss finish, which the company maintains is as durable as conventional varnish under normal conditions.

It dries to the touch in an hour, can be recoated in four hours, and is available in all Pittsburgh decorating centers and dealer stores in pints, quarts and gallons for residential and commercial use. It may be custom-tinted to provide color as well as surface protection. About $2.87 per pint and $4.49 per quart. ★★★

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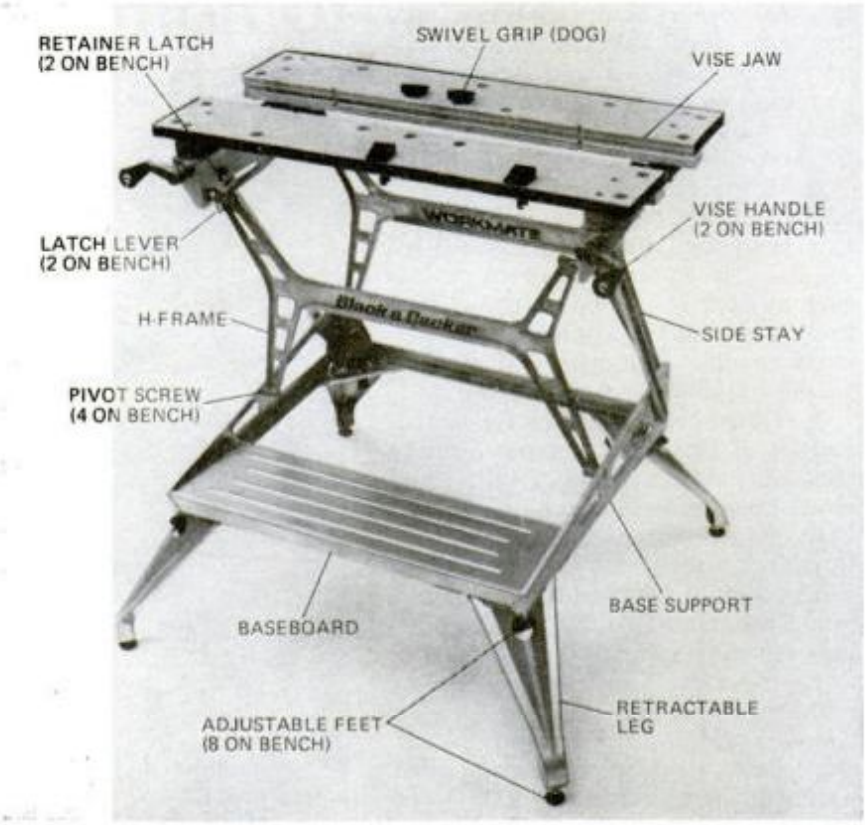
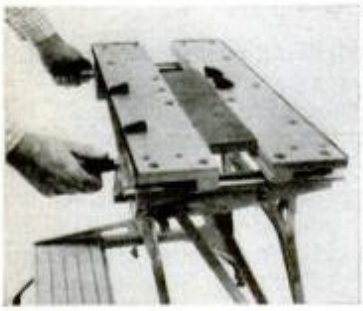
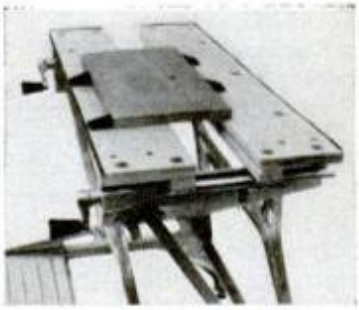
SHOP-TEST REPORT

B&D's new portable workbench







Using independent vise handles, you can open top to desired width. Half-top away from operator moves; near half is fixed. Four vise pegs extend vise capacity. Photo below demonstrates Workmate's versatility in holding odd shapes.

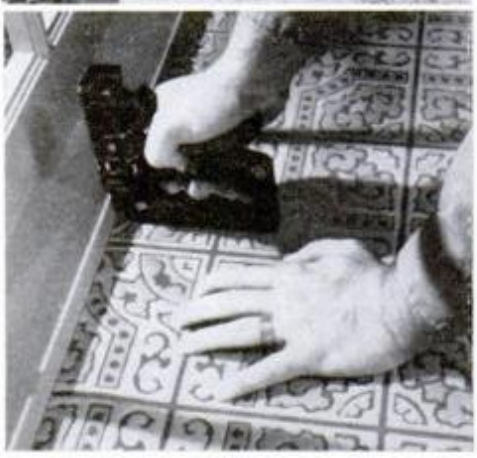
Though a bit unlikely looking, the Workmate from Black & Decker Mfg. Co. has to be one of the most exciting new shop tools I've ever tested. Ever since I set it up, the device has been an asset in my shop: After using it—primarily as an auxiliary work surface—I can report it does many things so well that I'd now find it inconvenient if I had to get along without it.

The tool had impressive sales records in England and Canada before it was introduced here last August. Despite its $90 price tag, it appears that acceptance is just as enthusiastic on these shores.

The bench features two working levels for maximum comfort (note the four adjustable feet for each level). The Workmate folds relatively flat for on-the-wall storage, but since its vise-top accepts just about any size and shape material, I opt to leave mine set up full time. Conclusion: You owe it to yourself to give the tool a long, hard look.—*Harry Wicks, Workshop Editor*

SPECIFICATIONS—Workmate 79-001

Weight: 24 lbs.
Dimensions: 29 in. W; 26 in. D; 32¼ in. H. (alternate work height, 23¼ in.)
Vise capacity: 10 in.
Price: $89.99.
Manufacturer: Black & Decker Manufacturing Co., Towson, Md. 21204



Vinyl is stapled along edges or cemented where there's no molding to hide staples.

New vinyl flooring forgives mistakes

A tough new sheet-vinyl flooring by Armstrong called Tredway has what chemists call a "memory." When the product is rolled face-side out at the factory, the outer circumference of the roll is stretched and the backing is compressed. After installation, the floor covering, because of its memory, gently returns to its original dimensions before it was rolled. This action assures a tight, smooth fit, making it easier than ever for the do-it-yourselfer to install. If vinyl is slightly undercut, it can be stretched. If overcut, wrinkles will gradually disappear. It forgives mistakes.

It has a clear vinyl "wear layer," foam inner-cushion and special backing, yet is easy to cut and trim. It's available in two widths—6 ft., primarily for professional installation; and 12 ft., preferred by most do-it-yourselfers. The 12-ft. width covers an average room in one piece. It comes in two patterns, four colors. ★★★

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We could all use less friction.

Friction? Who needs it? Friction leads to wear and tear.

STP Oil Treatment does something about friction by helping to protect your engine from it. Just add a can to the crankcase when the oil is changed, and the first time it's down.

That'll help the oil lubricate better than it would without STP. And a well lubricated motor is the best way to help reduce oil consumption, bearing wear and prolong engine life.

Try a can of STP Oil Treatment. See what driving's like when everything's running smoothly.

It helps your oil do a better job.

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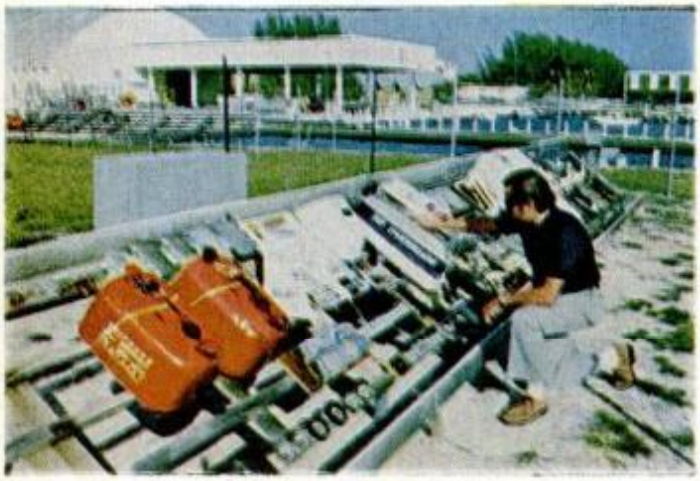
PORT FOR PEAK PERFORMANCE

At secret marine laboratories on Florida's southeast coast, next year's outboards are getting rugged graduation exercises.

by Bill McKeown
BOATING EDITOR

From over 100 runabouts, racing hulls and cruisers stored four levels high, plus up to 70 in the water, any model can be rigged for immediate testing with suitable motors or engines.

Photos: Jim Jost and Earl Prince



Sun and salt, two of the most destructive enemies of marine equipment, meet OMC equipment head-on all year on special exposure racks. Test-base manager Jim McFarland checks gear for signs of corrosion.

One hundred nautical miles down the Intracoastal Waterway from Cape Canaveral, where futuristic space vehicles are tested, outboards of the future are out and running in tests to improve water travel on Earth. From big unmarked buildings hidden behind a breakwater near Stuart, Fla., research and development engineers launch models that may power pleasure boats for next year and the 1980s as well.

Boatmen will never see many of these experimental motors, but Outboard Marine Corp., largest manufacturer in the field, has allowed its

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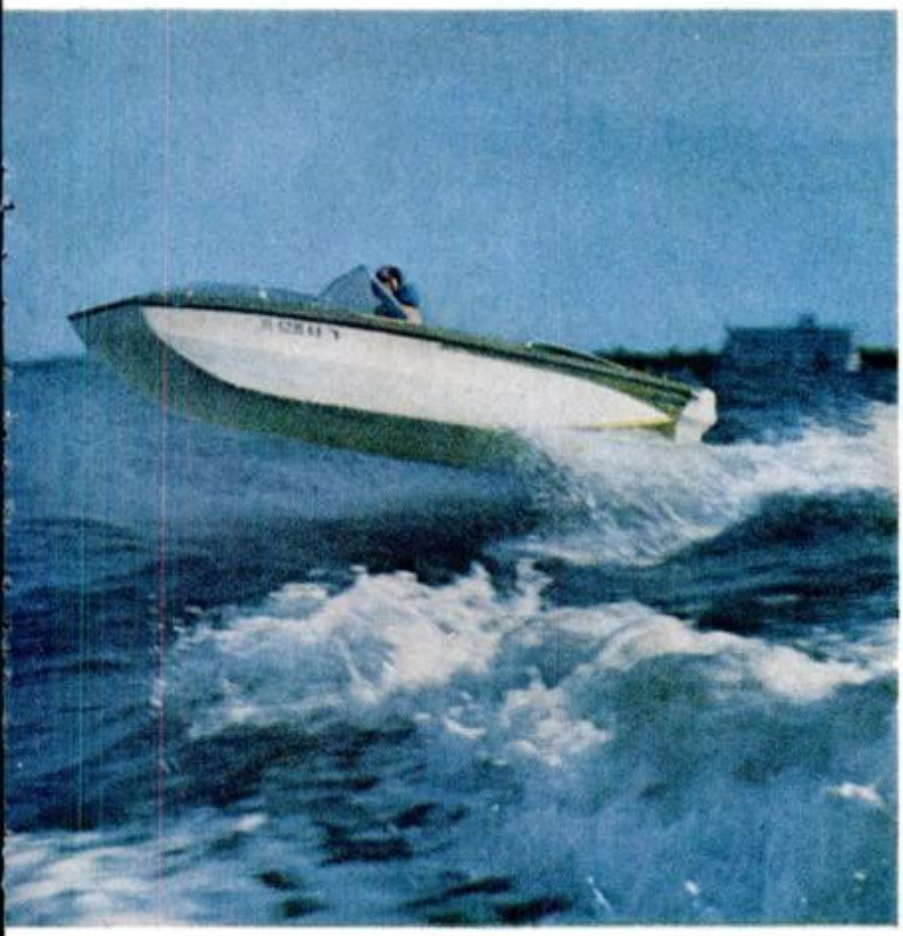


In-water oscilloscope readings give test engineers a chance to study ignition for low and high-rpm peak fuel economy.

Blasting a Glastron off a wake, PM's test reporter-driver McKeown repeats test-driver Evinrude's photo feat of 50 years ago.

Wheeling a well-battered but sturdy Boston Whaler into take-off position from a wave, PM's McKeown noted 25-hp shrouds hid new 35s.

PM's high-powered test team: OMC chairman Ralph Evinrude, "Mr. Two-Cycle Himself" OMC president Charles Strang and PM's McKeown.

Evinrude Div. to give PM readers an exclusive inside look at where the new power for so many pleasure craft comes from.

Here outboard motors, OMC ingines and stern drives, components, cowls, wiring harnesses, tanks, props —every item that can wear from use or corrode from salt—are given performance and exposure testing under tropic sun and water conditions.

In one large storehouse, over 100 runabouts, racing hulls and outboard cruisers are stacked on racks four levels high, each ready for instant forklift launching. Set up with various motors and props, the rigs are slammed through the punishing chop of open bays, given speed endurance runs down sheltered backwaters, skimmed over sand and oyster-shell shoals that flip up lower units and scour props with the equivalent of years of normal use.

Then offshore, surging hour after hour into the open Atlantic swells, the motors get commando course treatment. The engineers hope that any weakness will show up or break down. Complete reports go back to Evinrude in Milwaukee, Johnson and OMC Stern Drives in Waukegan, and OMC Parts and Accessories in Galesburg, Ill. Corrections are made to prevent any failures once production motors go out in the field.

Testing here, however, is much more than full-throttle heroics. Test center chief Jim McFarland and his crew of 45 specialists maintain complete paperwork records on the life of every test item. Most performance for the least fuel consumption is a primary goal; output of all engines at various rpm settings is monitored. Carburetion refinement receives continuous attention. Oscilloscopes study

(Please turn to page 112)

Patio Partners you can make

Striking and easy to build, these handsome structures add a special touch to your yard.

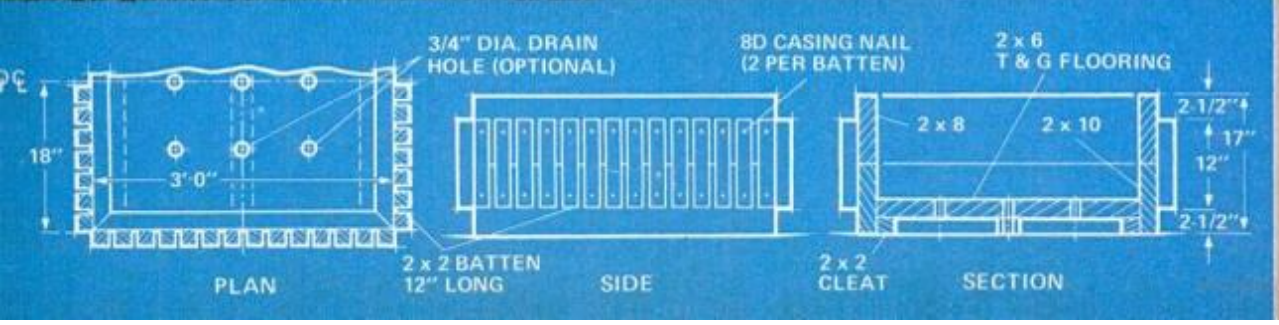
by Harry Wicks
WORKSHOP EDITOR

Art: Peter Trojan

Photo: Western Wood Products Assn.

Planter

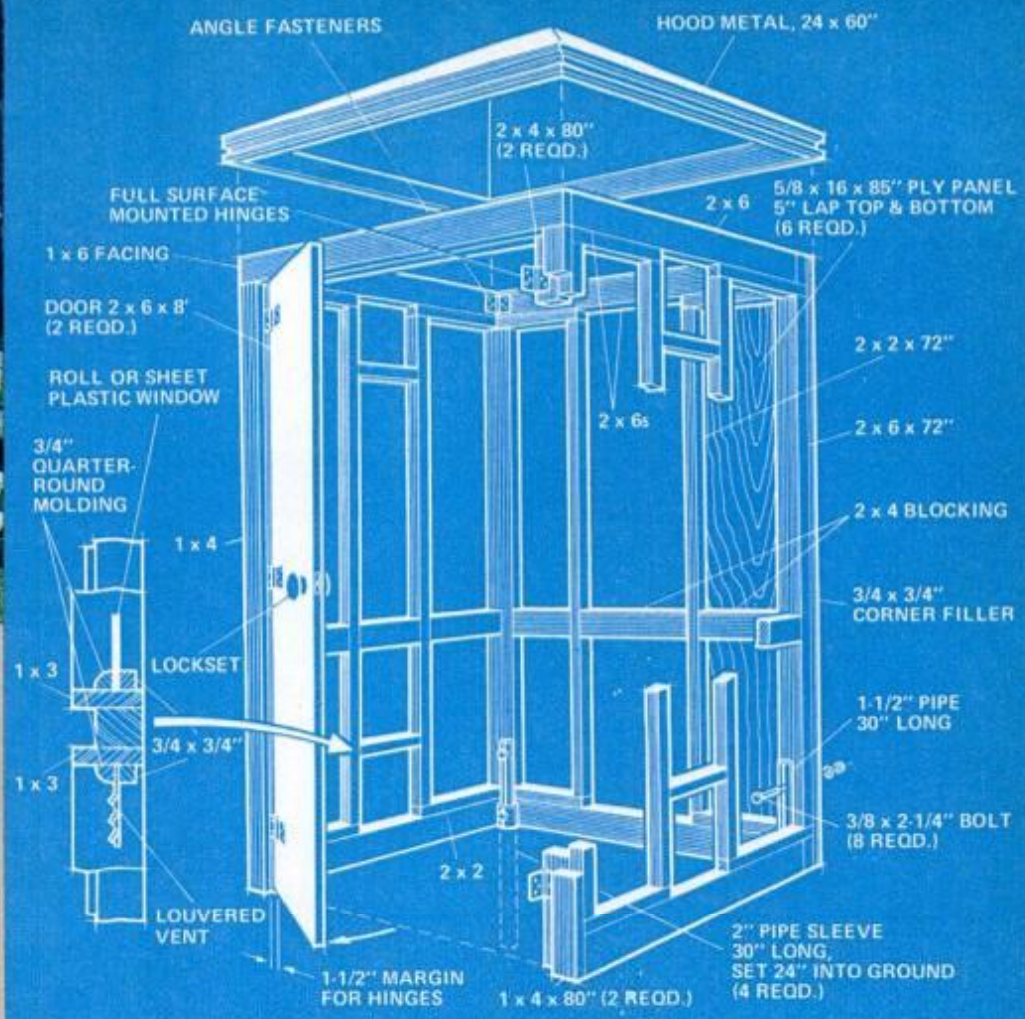
Quickly built, this planter's bottom and sides can be of 1½-in.-thick (actual) tongue-and-groove construction lumber such as Douglas fir or ponderosa pine. Join parts as shown using 8 and 16d galvanized nails; finish planter with either latex or oil-based exterior stain.



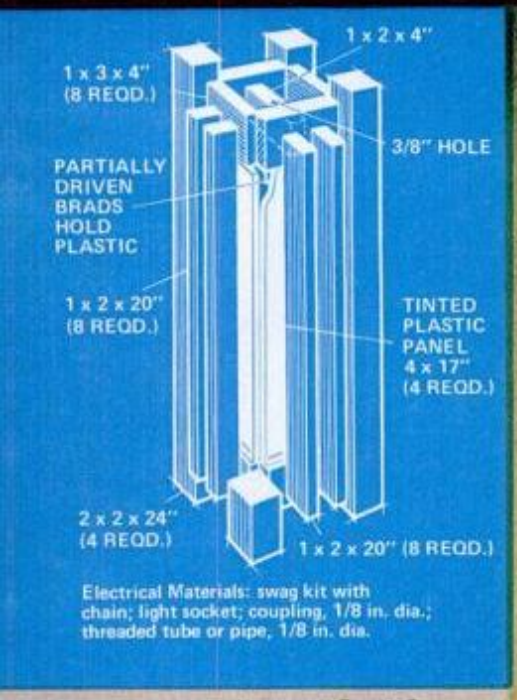
Photos: California Redwood Assn.

Storage gazebo

The key to construction of this gazebo is the simplicity of the roof design—the joining of two metal hoods or awnings. Since the metal roof will dictate the gazebo's overall dimensions, have it fabricated at your local sheet-metal dealer and determine your building's size from it.



Plans courtesy of Chevron Chemical Co., Ortho Div.

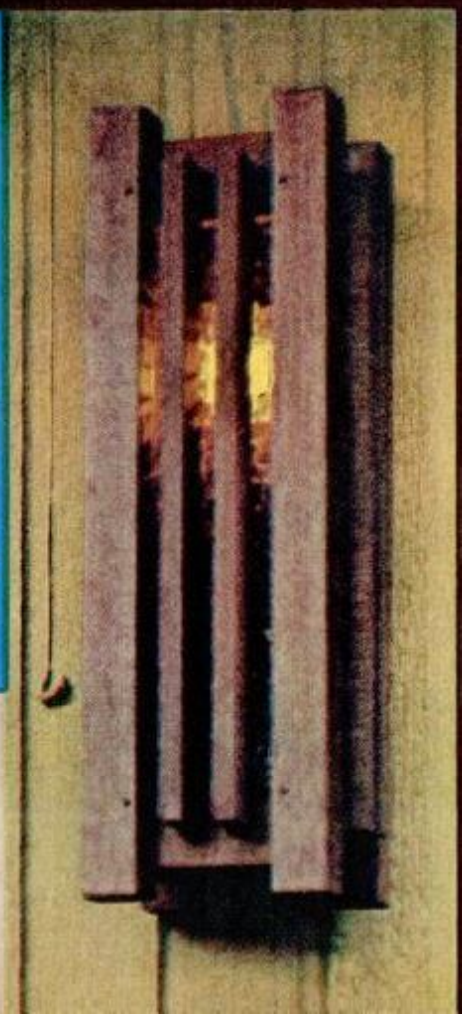


Electrical Materials: swag kit with chain; light socket; coupling, 1/8 in. dia.; threaded tube or pipe, 1/8 in. dia.

Photo: Simpson Timber Co.

Hanging lamp

Contemporary lamp of redwood adds a bright note to patio or entry. Use clear window glass or, for a softer light, frosted glass or opaque sheet plastic.

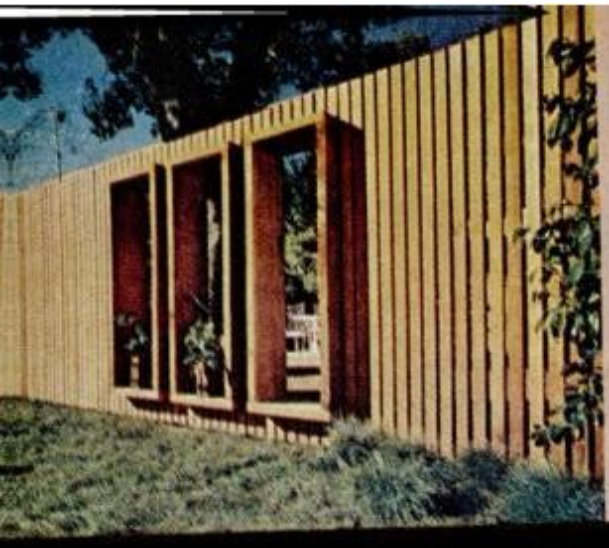


Upgrading your deck, patio or back yard is a sure way to guarantee more enjoyable use of that space. To help provide ideas you can use, we've rounded up nine attractive projects that dress up any outdoor area. Some projects require a little more know-how than others, but all are in the do-it-yourself category. Several of the planters, for example, can be built in a Saturday work session. Plans for all yard ideas are given.

The usual woods used for outdoor construction include redwood, Douglas fir, ponderosa pine and Idaho white pine. Each has a color of its own and this, probably more than any other factor, will determine which lumber to use. You might well apply stain or treat outdoor projects with a clear water repellent. Use only galvanized or aluminum nails for all construction. Otherwise, you will have ugly rust stains.

Storage gazebo

The roof dictates the overall dimensions of the shed. The length of the gazebo will be the length of the



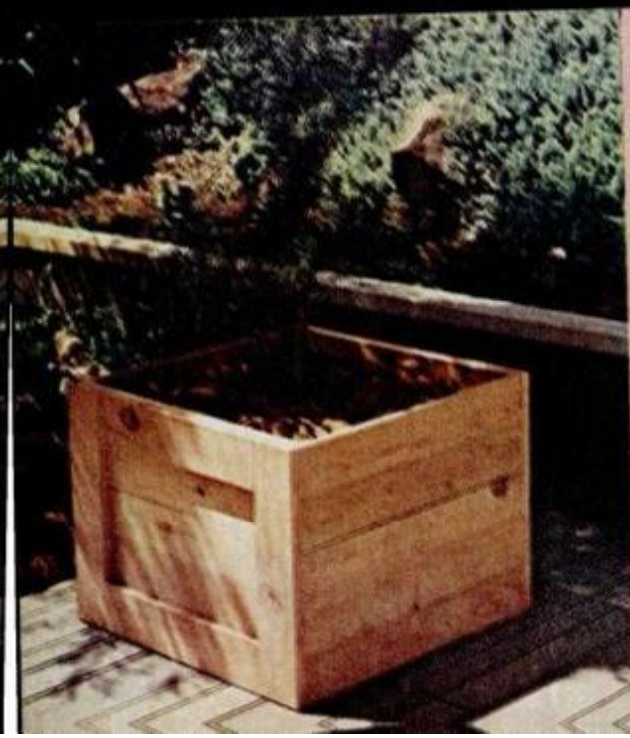
View divider

Clean lines of this redwood fence make it adaptable to almost any back yard. The cutouts in the privacy screen serve a dual function—they let breezes pass and provide a place to display plants.

Photos: California Redwood Assn.

Grille fence

Geometric pattern created by latticework is pleasing to look at, doesn't block airflow.



Redwood planter

Simplicity is the design key here. One pair of box sides is framed with heavy 1½-in.-thick stiles and rails, while the second pair of sides is without any decorative treatment. Clear wood preservative adds esthetically pleasing finish.

Courtesy Western Wood Products Assn.

Post lamp

Good lighting is essential for any deck. If the lamp is entirely of wood, it's sure to go with any outdoor decor. Simply stain wood to blend with patio.

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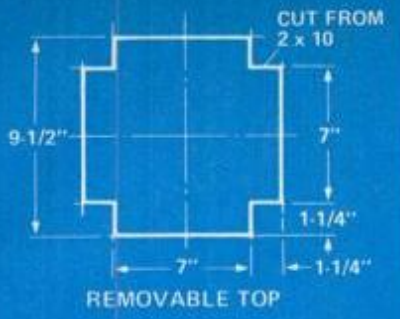
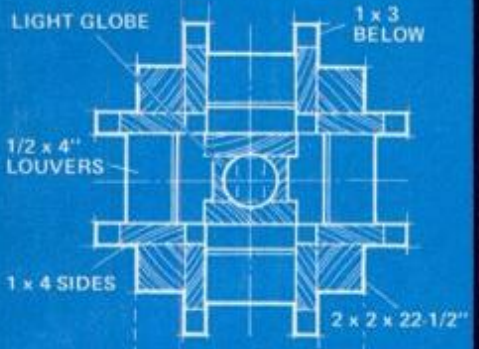
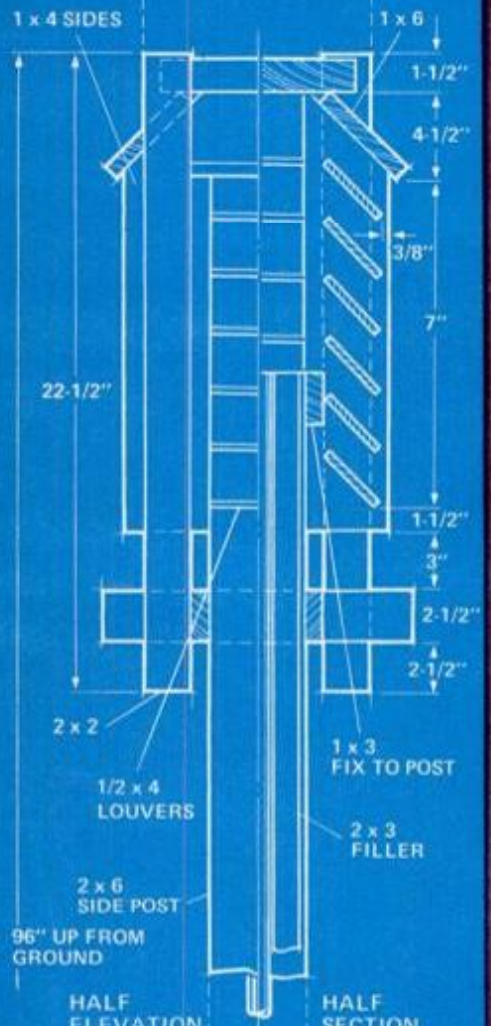


REMOVABLE TOP

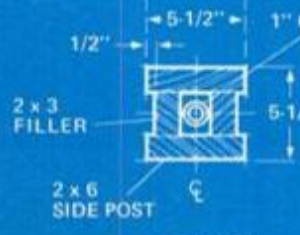


PLAN AT LAMP

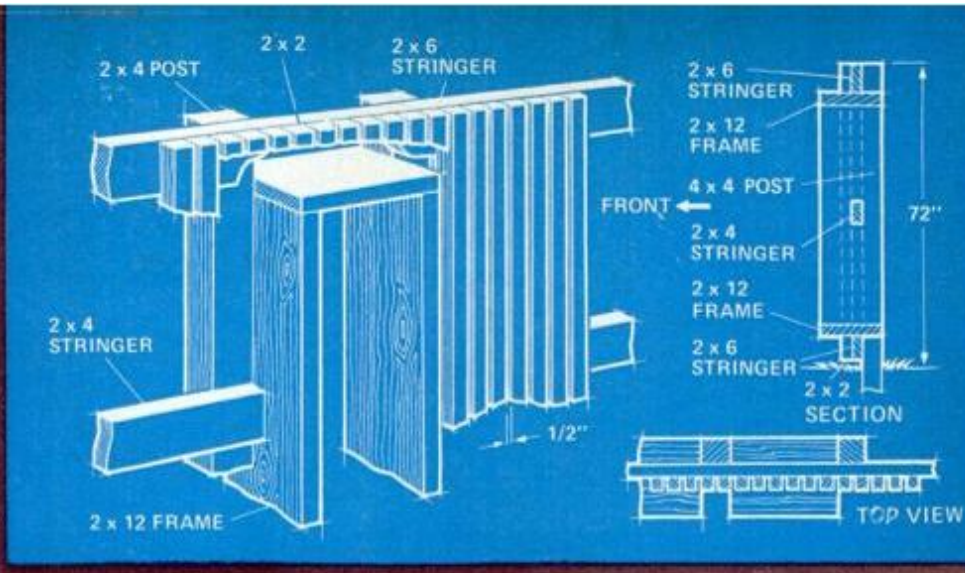


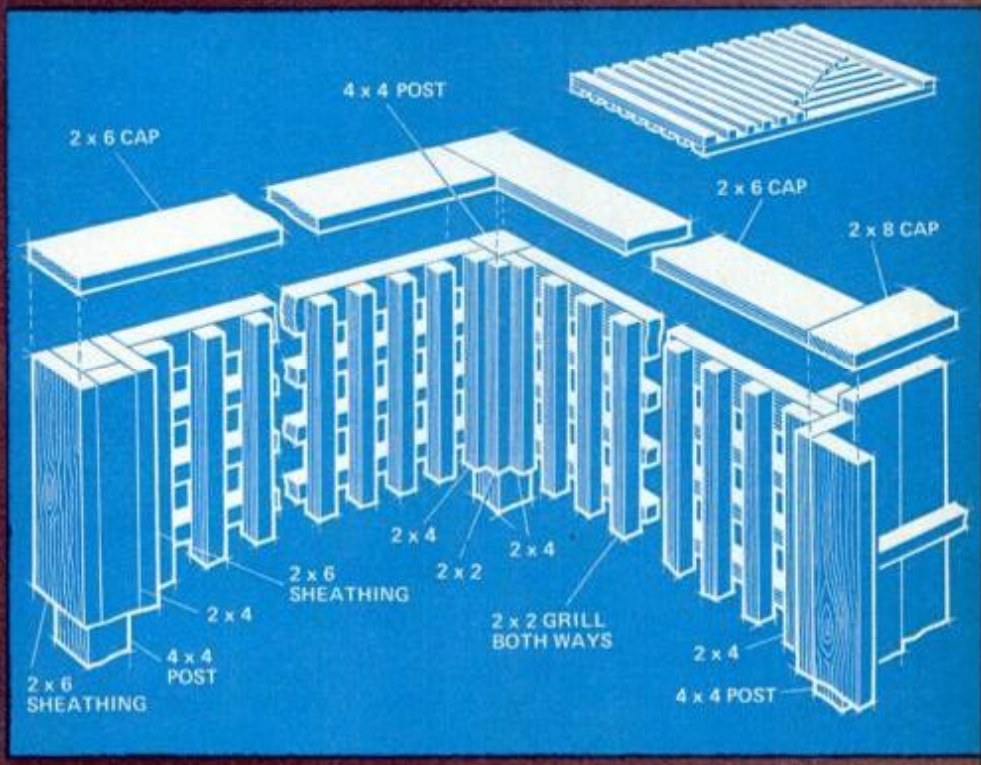
HALF ELEVATION

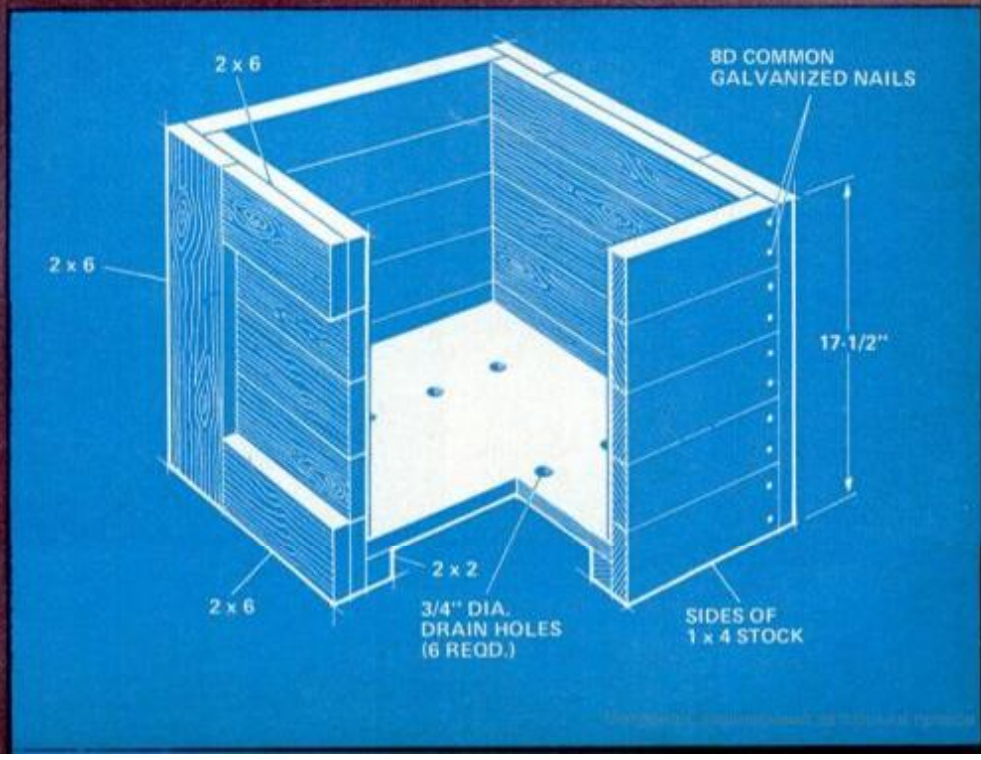
HALF SECTION



POST PLAN



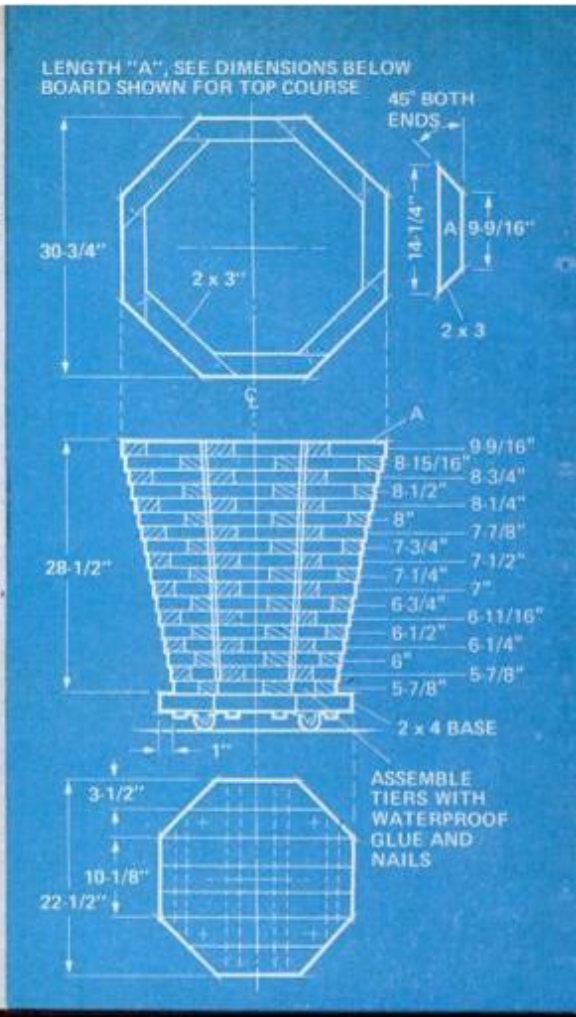




Octagon planter

It can be built of western red cedar for less than $50. Planter shown has 30½-in. dia. at top and stands about 32 in. high on casters. The 18 courses that form the sides are 2x3 (nominal) lumber. Note dimension "A" for each course: This is the inside measurement as shown. The easiest way to assemble the planter is to work upside down, starting with the top course.

Photo: Western Wood Products Assn.



hood minus material thickness, while width is double the awning projection. Height, of course, is determined by the pair of 80-in. doors plus the door header above.

The least expensive way to get the roof is to join two metal hoods or awnings that are commercially available, or you can have the roof fabricated at a local sheet-metal dealer using the photos and drawings as guides.

Redwood planter

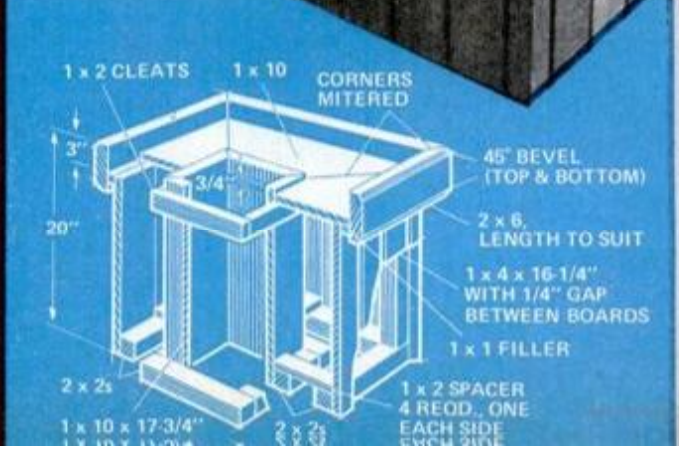
Because of its large size, this box is built of tongue-and-groove stock. Assemble as shown in the drawing using galvanized nails; weatherproof glue is optional.

Hanging lamp

Constructed of redwood, this lamp is perfect for entryway or patio. Set plastic or glass behind the 1x2 verticals and fasten the panes with brads partially driven into the horizontal members (1x3s) at top and bottom. Attach the 2x2 corners by drilling and nailing to the horizontal members as well. Drill a hole in the spacer block to accommodate the electrical threaded tube, and nail the block in place. Install electrical components as shown, and finish with

(Please turn to page 111)

Photo: Stephen Walton



Stained planter

Well suited for holding shrubs or plants, box has sides capped by 2x6s; outside edges of 2x6s are chamfered for pleasing effect.

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MPORTS AND MOTORSPORTS

ise you a hundred

ugeot's new luxury sedan, the 604, ll be here in the fall, and will join e French automaker's 504 models the U.S. market. The 504 is avail-le as a four-door sedan or wagon either gasoline or diesel versions. e 604 will be a single model—a ur-door sedan with a new 2.7-liter engine that develops a strong 150 . This engine, developed jointly by ugeot, Renault and Volvo for their -of-the-line cars, is also used in e new Renault 30TS and will power e '76 Volvo 264.

Shown earlier this year at the Ge-va Auto Show, the 110-inch-wheel-se 604 is conservative in styling, ough done by Pininfarina, and con-ntional in drive-train layout (front gine/rear-wheel drive). The 604 is pected to be in the $8000 to $9000-nge and will have as standard uipment: airconditioning, power ndows, power sunroof and other xury items in addition to the en-neering features such as four-wheel c brakes, fully independent sus-nson and more. Like so many other rs today, the 604 is targeted to al some of the Mercedes market: s a luxury car offered at a lot less oney.

The 3300-pound 604 has a top speed slightly over 100 mph—good to ow you can safely pass a car going mph.

ttlest wagon

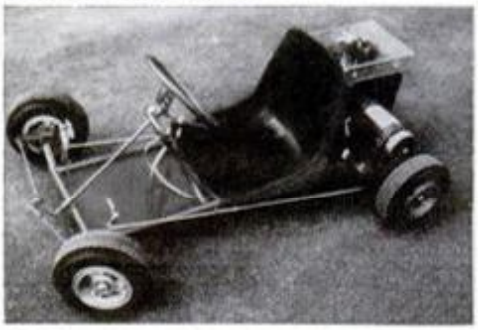
ow there's a station-wagon model the Honda Civic. It has fwd, CC engine and other features of e CVCC sedan. The 2000-pound gon has a cargo volume of 49 cu. ft. and is a welcome addition to the ranks of small, sensible station wagons. Styling of the rear quarter, however, is not very appealing.

Shoot the competition

The laser-beam speed gun being aimed by Mario Andretti during practice at Indy doesn't disable other drivers, it just gives an instant read-out of their speed. The instrument is used by the Vel's-Parnelli Racing Team to check the speed of their competition and that of their own cars on the straights and through the turns.

Mario hit the wall during the 500 and didn't finish the race, but he just (at this writing) won the SCCA/USAC Formula 5000 race at Mosport, Ont., and he placed fourth in the Swedish Formula One Grand Prix to log his first points in the World Driver Championship standings.

Toy transportation



Getting there is half the fun, but you might think twice about taking public roads if you're driving either one of these electric vehicles. The first all-electric kart is called Taboo II and is $500 from Electric Fuel Propulsion dealers. Write to EFP at 366 West Eight Mile Rd., Detroit, Mich. 48220.

The Runabout, circa 1910, is a half-scale replica that's 79 inches in overall length. The chassis is welded steel, tires are pneumatic, drum brakes are on the rear and transmission is automatic. A not-too-big adult or not-too-small child can drive the car comfortably from the adjustable single seat. It's $3750 from Hammacher Schlemmer, 147 East 57th St., New York, N.Y. 10022. ★★★

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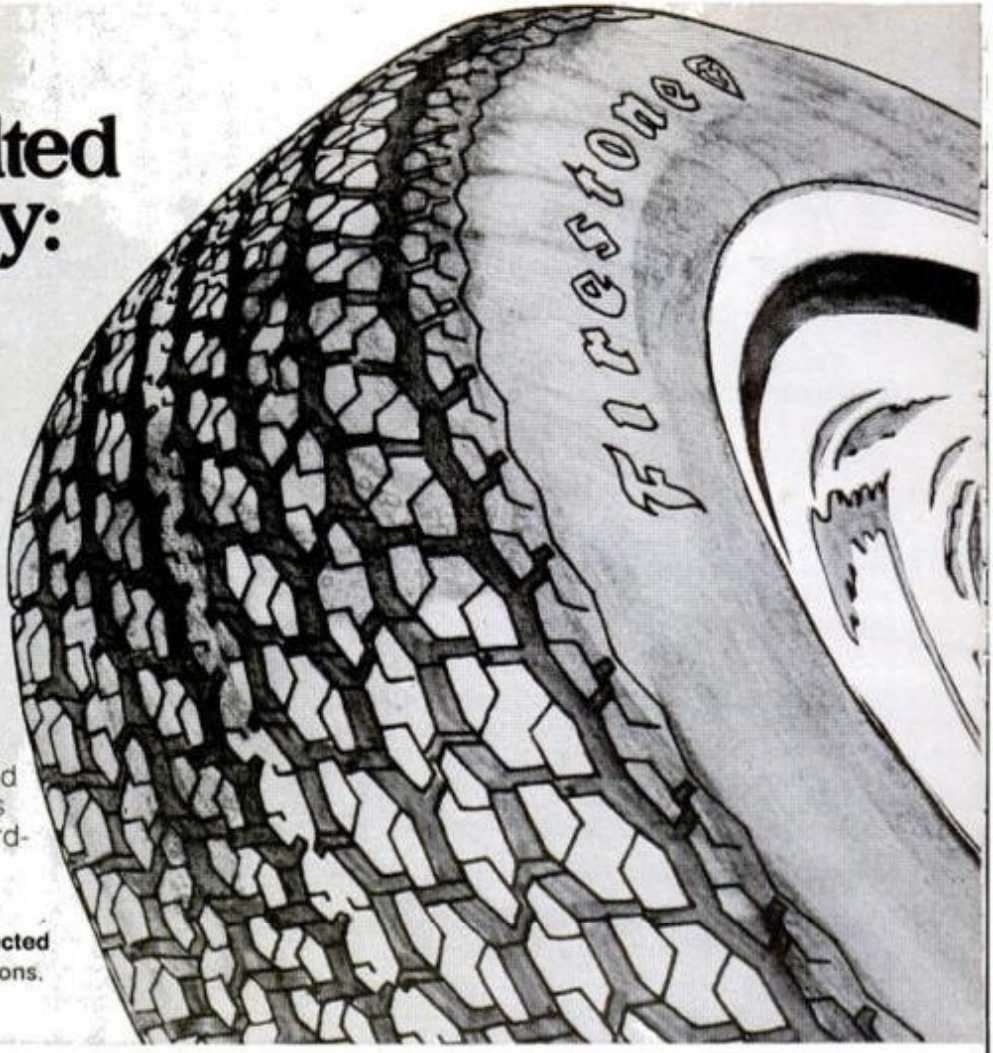

NOISE REDUCERS AT WORK

(Continued from page 83)

sories to add to existing hi-fi systems and they're built into most high-end cassette machines (and some moderate-price ones) and into several FM tuners and receivers, a few open-reel recorders, and one or two preamplifiers and amps. Decoders for dbx are only available from dbx, but receivers and other components with built-in dbx are reportedly coming.

Once you have a decoder for either system, what can you decode? Your own tapes, of course—but there's more. Most commercially recorded cassettes are already encoded with Dolby B noise reduction during manufacture; many commercial open-reel tapes—chiefly classical—are made that way, too. Over the years, FM stations (100 of them, at this writing) have begun broadcasting with Dolby B encoding, too.

Here, there's even less of a compatibility problem, because stations broadcasting with Dolby B now cut back on the high-frequency boost they normally add to their signals (and which FM sets automatically compensate for) just enough to offset the sharper sound of undecoded Dolby. The newest FM tuners and receivers with Dolby built in now adjust automatically for both the normal (75 μsec) and special Dolby (25 μsec) treble equalizations. For other setups, inexpensive add-ons are available from Switchcraft.

Records aren't available with Dolby encoding—but are available with dbx encoding, from a California label called Klavier, from Stan Kenton's Creative World jazz label and from others soon.

These dbx-encoded discs have to be heard to be believed. Imagine hearing the usual clunk as you set the stylus down into the lead-in grooves, then hearing *utter* silence (even with your ear up to the speaker) until the music starts. The dbx system can't entirely eliminate clicks and pops due to defects on the disc, but even these are minimized.

Closed systems such as dbx and Dolby, which require encoding and decoding, are as much for noise prevention as for noise reduction: They keep a signal from acquiring more audible noise in recording, but do nothing to banish noise already in that signal. To clean up that noise there are "single-ended" systems requiring no special signal pretreatment in recording.

Like Dolby, these take advantage of sound masking: Since noise is only audible when there is no signal of similar frequency to mask it, then cutting the system's high-frequency output when there's no high-frequency signal will keep troublesome hiss from getting through.

The Burwen Dynamic Noise Filter and the Philips DNL system now used by Uher in its new CG-320 and by Nakamichi in its Model 1000 (which also uses Dolby, since the two do different things), work just this way. I haven't heard recent DNL circuits, but I have heard the Burwen, which works well but requires very careful control setting to keep it from being heard in action on some types of music signal, and to keep high frequencies from disappearing.

Phase Linear's more elaborate Autocorrelator sorts out high frequency tones we want to hear (overtones of the music's fundamental notes) from undesired highs of random noise that correspond to nothing in the music, opening a series of high-frequency gates to pass only the desired highs. My listening tests so far show the system to work exceedingly well, without detectable side effects, and with no control fiddling needed after the initial setup.

Pioneer's new RG-1 system is ba-

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sically an expander: It makes signals above a given level proportionately louder, while signals below that point (mostly noise, if you set that point correctly) get softer; the degree of expansion is adjustable.

Single-ended noise reduction systems like these require complex, sophisticated circuitry. But as new techniques, such as integrated circuits, make such systems far more practical, we'll see more of them.

All noise-reduction systems, though, are simply crutches needed to support recording or transmission systems that aren't quite good enough by themselves. Already there are some systems, such as 15-inch-per-second open-reel recording that need little such help in home use. There will be more such systems as time goes on. Single-ended systems will still be used, of course, to clean up old recordings.

But eventually, I think we'll switch to digital recording (already being tinkered with for studio use); digital systems, which record a train of pulses representing the signal numerically instead of an electronic model of the signal, are immune to noise. But whether that will be five years away, or 10, or more is anybody's guess. ★★★

HOME ENERGY-SAVING IDEAS

(Continued from page 59)

basement or separate furnace room.

- Cuts down on noise inside the house.
- Removes a possible fire hazard from within the house.
- Permits your serviceman, who would have a key to the heating-cooling module, to make repairs even when you are not home.

Though this type of system can be found in apartment buildings and big stores, it has never been made available to the individual homeowner.

"Now that the name of the game is the conservation of energy, this type of thing will surely come," says Szymanowski. "In time, the homeowner will be able to buy a module that is simply bolted to the house."

The house is impressively stingy with water. Drinking water is collected from the roof and run through a charcoal filter. Water for washing clothes, dishes and people is contained in a closed system and is used over and over. Water for flushing the toilet is in another closed system.

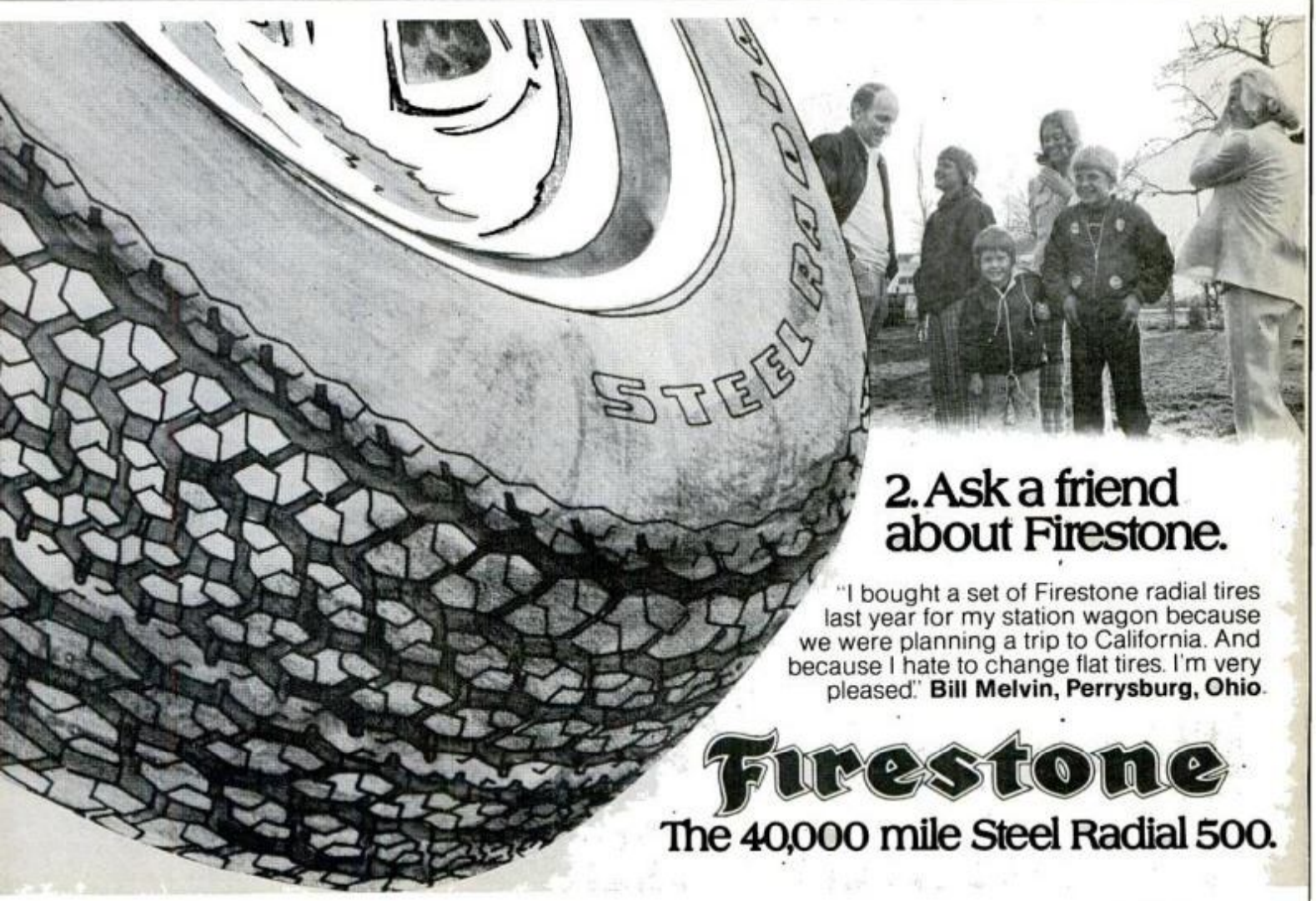
"What you really have in any house is three different qualities of water," says Szymanowski. "The toilet is a prime source of water waste. You contaminate five gallons of pure drinking water with a few ounces of urine. Then you flush the lot away."

In Homelab, the toilet flushes into a steel tank in the basement. Injected air supplies oxygen, which stimulates bacterial action that breaks down solids. Liquids pass into another unit where they are treated with ozone to remove color and odor and kill bacteria. After passing through a carbon filter, the water gets a squirt of chlorine before it goes into a tank from which the toilet is supplied.

Szymanowski thinks the sewage system could be made competitive with the conventional septic tank system, but he says the wash-water setup would make economic sense only in apartment houses.

Homelab is full of surprises: a gadget that uses heat from the refrigerator coils to warm water for coffee or tea; plastic staircase treads that look like oak but promise to be cheaper; an advanced security system that uses seismic sensors to trigger an alarm.

But nothing is permanent in Homelab. "When a better method or product comes along," says Szymanowski, "we rip out the old and try the new. Otherwise, we'd have a museum, not an experiment." ★★★



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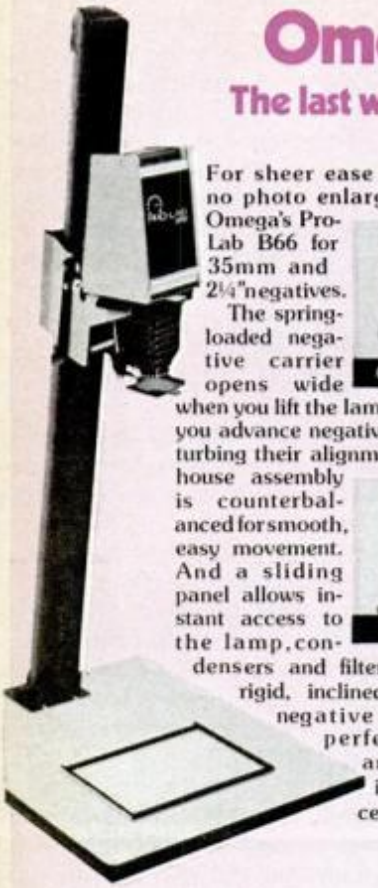

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The B66 comes with three condensers, for optimum light distribution with negs to 35mm; or switch to two condensers to match the 2¼" format optical requirement. Or get the optional dichroic color head and dial in the exact filtration needed for color or variable-contrast printing.

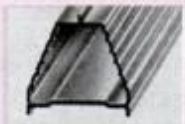
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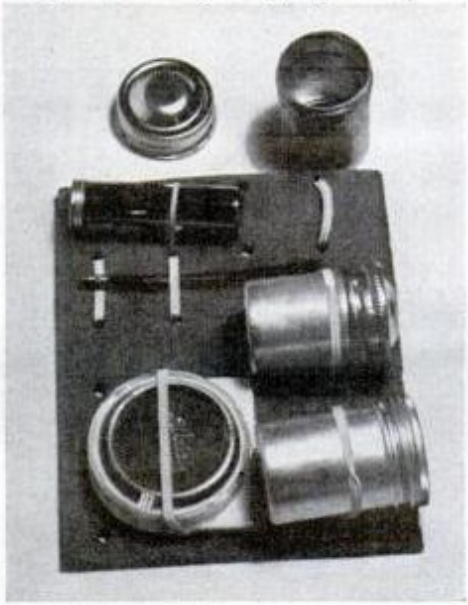
PHOTO HINTS

FROM READERS

Coin purse protects filters

Small plastic squeeze-type coin purses can protect your filters and close-up lenses from damage in your gadget bag. You can label the purses with label-gum tape, or buy purses in several colors to signify which filter or accessory is in which.—*Charles F. Dayton, Akron, Ohio.*

Organizer for your gadget bag



A scrap of perforated hardboard cut to fit your bag can end the jumble of small accessories and film cans that usually swirls around the bottom of the bag. First figure out the best place in the bag for the board, and cut it to fit there. Then shift the items you want to mount till you find the arrangement that holds the most in the least space, and fasten them in place with strips of ⅛-in. elastic from a sewing-notions counter. When you cut the elastic, leave enough to tie the ends together in a loop that will fit the accessory but hold it snugly. Some accessories may take two or three loops—*Gary Cosand, San Bernardino, Calif.*

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DRIVING SUBARU'S 4WD WAGON

(Continued from page 75)

sand and really steep grades that no 2wd car could handle. Loose sand up to its hubs did slow the wagon, but we made it through. Likewise, I drove up and down some motorcycle jumps that no car without 4wd could scale.

On the freeway at 55 mph in 2wd, there's no gear noise. Ride feels as comfortable as in any subcompact. In 4wd on dry pavement, there's a slight gear whine and a tiny bit of howl from the heavily ribbed tires. I've heard worse from bigger 4wds.

The Subaru Super Star 4wd uses Fuji's conventional 1400-cc opposed Four engine, and I found the wagon a little underpowered for really rough going. I understand there's a 1600 in the works for next year. Also being considered is an automatic transmission for the 4wd, as is Subaru's five-speed manual. And naturally there's no reason why other body styles—the Subaru sedan and hardtop—can't be converted to 4wd, too.

This 1400-cc engine tends to bog down on fast acceleration, especially at low rpm. You have to keep it wound up pretty tight. Sweeping right-hand bends, such as freeway entrances, cause some cutting out, probably because of carburetor slosh. But the wagon did manage 24.7 mpg in all sorts of driving, so it's certainly one of the most miserly 4wds around.

Miscellaneous things I feel merit comment are the Subaru's overall workmanship—very good in my opinion—and the independent rear axles, which make for less unsprung weight and probably improve cornering, traction and ride. Base price of the 4wd Subaru wagon is $3999 p.o.e., and there's a waiting list. ★★★

Overall workmanship is good; interior is nicely appointed. Four-wheel-drive lever is on floor ahead of stick shift.

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BY EUGENE A. SLOANE

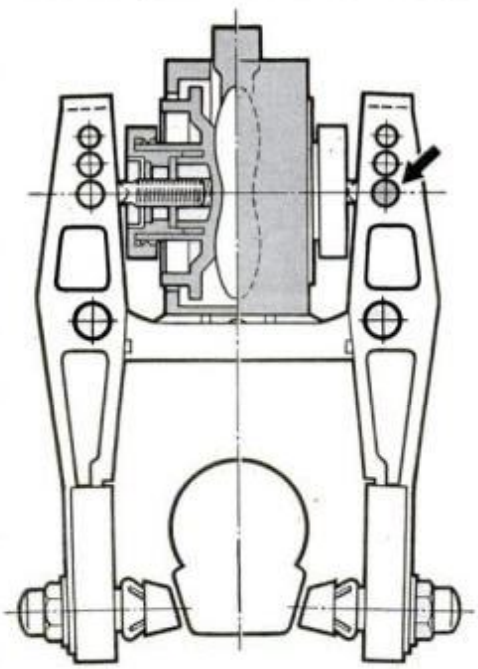
THE BICYCLE SHOP

GENE ANSWERS READERS' QUESTIONS THIS MONTH

Fluid stopping power

I heard that someone is developing a new type of bicycle hydraulic brake. Can you tell me about it?—Charles Adams, Ames, Iowa.

A new hydraulic brake has been



introduced by Williams Hydraulic Brakes, Elk Grove Village, Ill. 60007. I have not tested these brakes extensively as yet, but the manufacturer claims they exceed by 40 percent the proposed stopping power standards of the federal Consumer Products Safety Commission. The dual-caliper hydraulic brake will stop a 190-lb. rider in about 11 ft. from 15 mph, as compared with the proposed federal requirement of 19 ft. The Williams brake is being made for Murray-Ohio and will appear on Sears bicycles this year.

The arrow in the illustration above shows a nice feature, an adjustment point that allows you to apportion braking force between front and rear brakes. I did briefly ride a bike equipped with the Williams brake, and on the basis of this short test can report smooth brake operation and firm stopping power, all with one lever controlling both front and rear brakes.

On flange height

What is your advice on high-flange versus low-flange hubs, for general bicycling and some touring?—Barry Knapp, Boulder, Colo.

High-flange hubs were originally designed to provide maximum transmission of muscular energy to forward movement of the bicycle. High-flange hubs use shorter spokes, give less distortion but a stiffer, harder ride. Owing to their popularity with the European racing fraternity, these hubs have appeared on non-racing bikes exported to the United States and on U.S.-made 10-speeds.

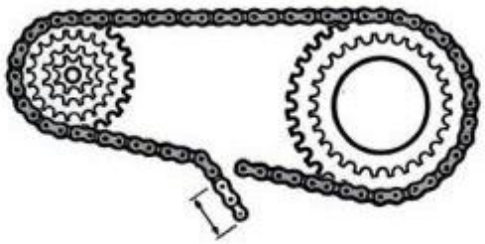
I much prefer low-flange hubs, which permit use of longer spokes, and I lace mine cross four, allowing even more spoke length. This combination makes for a more flexible wheel and a softer ride. You may not need a soft ride for short trips, but when you're on that bike for five to eight hours on long trips you definitely will appreciate it and the resulting reduced fatigue.

Rocky-crossing gears

My chainwheel has 44-52 teeth, my freewheel 14-28 teeth. These are okay here, but I want gears so I can cross the Rockies.—Bill Neubauer, North Tonawanda, N.Y.

Keep the chainwheel, but change the freewheel to a 14-34-tooth cluster. I prefer the Shimano alternate-tooth freewheel, which makes shifting to the lower gears easier. Chances are, you'll also have to change to a rear derailleur that will handle the added teeth. I suggest the Shimano Crane GS wide-range derailleur.

You will also have to add one or two chain links of the same make



chain, as shown in the drawing, so when the chain is on the front 52-tooth and rear 34-tooth gears the derailleur is taken up almost parallel to the chain, for correct tension. Remember to adjust derailleur travel stops so the chain stays on outer gears. ★★★

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HOW TO STAY ALIVE IN A SMALL CAR

(Continued from page 40)

road"—not any specific example or tip—that will save your life. A classic example of superior anticipation and judgment is the way Juan Manuel Fangio, one of the greatest race drivers of all time, saved his life driving an Alfa Romeo Grand Prix car at Monte Carlo in 1950. As he approached a dangerous corner at high speed, he noticed something different—no whitish blur of faces indicating that the spectators were watching him approach the corner. With no other sensory input on which to base a decision, he braked hard. Just around the bend was a pile-up of race cars; it was the pile-up that had turned the race fans' heads!

You'll never race on the streets of Monte Carlo, but you'll be driving in far more dangerous surroundings: the streets of your home town. Unless all your concentration is on your driving, there's no way you can exercise the anticipation and judgment that will keep you alive at the wheel of a small car. As soon as you become careless and sloppy, you leave yourself vulnerable to the unexpected ("He came out of nowhere!") that will do you in.

Drive behind you

At any given moment you should know exactly what vehicles are behind you and what are their relative speeds. A vehicle overtaking you carelessly can involve you in an accident not of your making; if you have to brake or swerve suddenly, you'll be able to do so with consideration for the traffic behind and possibly avoid being rear-ended. Also, you should continue to check your rear-view mirror when stopped at a traffic light until all traffic behind has come to a stop. It doesn't matter that it's the other guy's fault if he hits you from behind—nothing matters if he kills you. If you can see what's bearing down on you from behind, you can take action to minimize the impact or escape altogether. If you see in time that you are going to be rear-ended you can accelerate ahead, pull over to the side or turn the corner, depending on traffic. Such a quick action may be something you never have to do, but even if you do it only once in a lifetime, driving with your rear-view mirror will have paid off.

Concentration is not a fatiguing, white-knuckled grip on the steering wheel. It is, in fact, an antidote to the fatigue and boredom that attacks drivers for whom driving is a chore. Concentration can become a good habit—so much so that you will be doing the right things "without thinking."

I had forgotten the degree of my own concentration until one night on a particularly dull stretch of road my 8-year-old daughter asked me a question. To her I was apparently hypnotized at the wheel, and she asked, "Isn't driving along here boring?" My answer surprised me.

"I'm too busy to be bored."

"Busy!"

"You can't see how busy I am."

"What are you doing?"

"Moving my eyes, listening with my ears, feeling with the seat of my pants."

I started to explain—itemizing everything I was doing:

"My eyes are in a continual scan or sweep that goes from the road just ahead, watching for fallen mufflers, other debris, broken pavement and so on; to the road farther ahead and the cars up there; over to the shoulders and the brush where I might see a deer, rabbit, cat or dog about to dart out onto the road; up to the rear-view mirror to check the positions of the cars behind; and then to the instruments that tell me how fast we're going, how much gas we have and if certain parts of the car are working properly. I have to speed up this scan when we are going faster. The fingers of my left hand are moving, too: switching on the high beams as necessary, and dipping them as I see the glow of headlights that tell me a car is coming over the next hill. I'm listening to the sound of the engine and feeling the vibrations of the car going over the road, always alert for odd sounds or shimmy or shakes that mean something is wrong."

I didn't go so far as to explain that a sudden failure in the 93,000-mile-old engine might result in a locking of the rear wheels and I would instantly have to depress the clutch pedal to prevent a skid! (Driving researchers say, and I believe it, that children start learning to drive at age two—by observing their parents at the wheel.)

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COPY YOUR SLIDES AT HOME . . . AND IMPROVE THEM

(Continued from page 67)

specifically for this task, it will give very good results.

Some duplicators attach the slide holder to the light box, not the camera. Since most reflex camera finders show you a little less than the film will see, setting up one of these duplicators requires an extra step: After focusing, but before loading your film, open the camera back and sight in with a "ground glass"—made of matte acetate, waxed paper, underdeveloped film or even real ground glass—that has been spread over the film opening.

Cheapest of the "light-box" duplicators is the Testrite-Kingdon, $80, plus your bellows and a tripod or copy stand. It has a dim light for focusing, a 3200° K floodlight for exposure, and a filter holder consisting of a glass-and-plastic 2¼ x 2¼-inch slide holder (which eventually melts; get a glass-and-metal one). You can mount it upright or on its side, and there's a removable, 45°-angled white reflector and a coverable window so you can strap on your electronic flash instead. The 35-mm slide holder removes, too, for copying 2¼ x 2¼ slides. The setup is flexible—you can shift it and the camera independently to copy just a portion of a slide—but mark the "centered" position carefully, as the box is easy to shift accidentally.

If you're really going in for duping, you might consider the $495 Bowens Illumitran, and the $325 Honeywell Universal Repronar. Both have bellows rigidly mounted above slide-holding light boxes that incorporate focusing lights, electronic flash units for exposure and filter drawers. Both have two, switch-selected flash-output levels, and the Bowens also has a variable dimmer plus a built-in light meter (the Repronar uses your camera's meter). The Bowens will also let you copy from negatives or transparencies up to 2¼ x 2¾ inches (to 4x5, with an accessory).

But the main ingredients won't be equipment: They'll be the sweat you put into your test rolls before you get your first good copies—and the satisfaction you'll get from copies better than the slides your originally shot. ★★★

Overexposed, washed-out slides can be improved by making a slightly *under*exposed copy. Kodak's 2483 film will add contrast, deepen colors, for even more "punch."

Underexposed slides reveal unsuspected detail if an overexposed copy is made. As with overexposure, only mild corrections can be made—some slides are unsavable.

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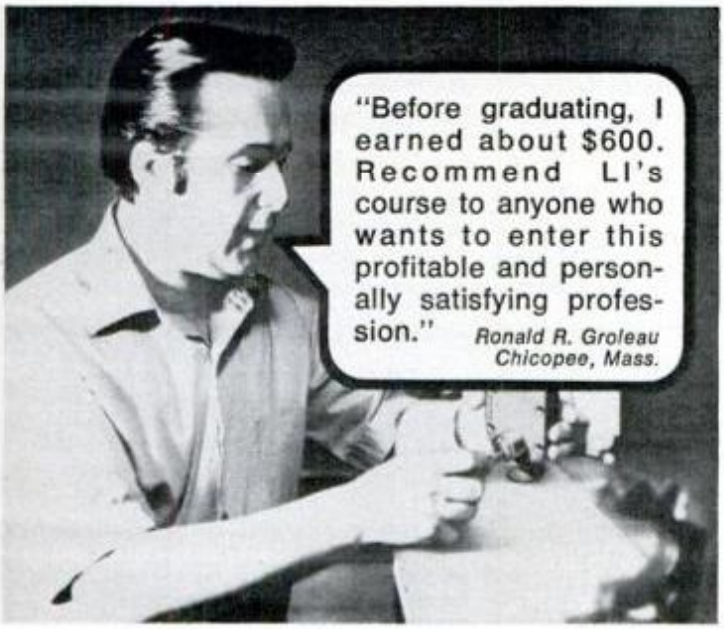

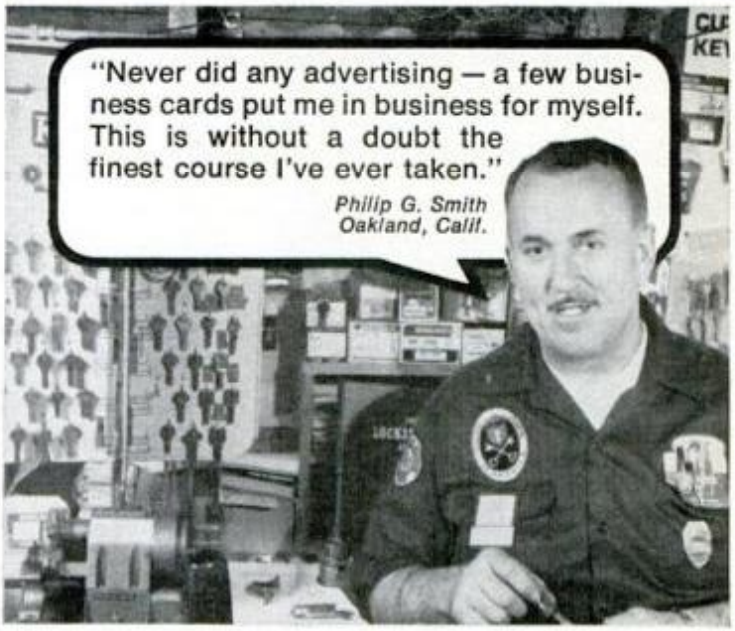

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BARGAINS IN LITTLE BOATS

(Continued from page 69)

sturdy and cost less to keep up. The lightness of marine aluminum is also an advantage when you're portaging or loading up on a car roof rack. A hull of ABS plastic is usually well made because it takes larger, more expensive machines to heat-form it, and it can't be cranked out carelessly in someone's back yard. The smaller price of smaller boats often makes building and shipping them cross-country too expensive for a big boat company, so many are made locally. Ask friends and knowledgeable boatmen who own one about the builder's reputation.

Power

Tiny craft come in so many shapes that it is hard to recommend the best choice of power. In order to row or paddle easily, the hull must be designed for rowing and paddling. Often an outboard motor or sail can be added, but a boat performs best when pushed along in the way it was intended. But since you may get tired of muscle work, it's usually best to pick the cockleshell that can be rigged with an auxiliary outboard motor. Even if you never use a motor, the boat is more valuable for resale if the transom is able to take an outboard, or a stern bracket for one.

Remember that adding a sail is not enough to turn a rowboat into a sloop. Your hull will slide sideways and the sail will try to tip you over unless you also add some form of keel or leeboards. A true sailboat is always easier to handle than a makeshift one.

Added moneysavers

You'd planned to pick a small boat to match your modest budget, but the price for the good little model you've picked is $500 instead of the $50 you'd imagined? There still is hope if you consider some of the following cost-cutters.

If there is a special design you feel that you must have, consider building it. Plans and kits are available from a variety of sources, most are not difficult to construct, and there is the satisfaction of doing it yourself. Study and patience are as important as skill; some of the best homebuilts we have seen were made by owners who admitted they had flunked birdhouse building in shop class at school.

If you figure in your time (and the time is often twice your first estimate), the boat will cost you plenty. But if you put no price on your hours of work, you can build your boat at approximately half the expense of buying a new one.

You have no time or urge to build one for yourself? Consider buying it second hand. Small used boats are harder to find in classified listings, but are easier to locate on a boat or yacht club's bulletin board or by word of mouth from boating friends, boat-yard managers and marine store workers. Walk along a waterfront and you're likely to spot some appealing "for sale" signs.

Want a boat for your vacation, but you aren't sure just what it should be? Often you can rent one from a boat shop or a friend and learn plenty while you're saving plenty.

Need a small boat for your summer camp on a river or lake? Frequently your next door camping neighbor also does. Check, and if his vacation falls at a different time, there is a good chance he may chip in half the price and share the boat on alternate weeks or weekends.

And if you can be patient, wait for a storm this fall or the end of the season and hauling-out time, particularly if you know something about the simple process of fiberglass repair. Often a banged-up boat can be as strong as new after some epoxy patching. Many a happy boatowner started out with a small craft with a hole in the hull—one he bought from its discouraged skipper. Your repair kit may be your key to going afloat right now. ★★★

For sailing action, pick a class that is locally popular, like these fast Force 5s.

Small-boat buying guide

A little boat can cost a lot or be a bargain, depending on the questions you ask before you buy. Here are 10 key queries you should answer when you shop this year:

1. Is a small boat big enough? Many beginning boatmen endanger their families by selecting a model that will be overloaded once they pile gear, friends and kids aboard. Even on calm water, a 12-footer should probably hold no more than three or four.

2. Is it right for local waters? Look at other boats in use. An Eastern seaboard harbor with rocky shores, marinas, docks, can be handled by a rowing dinghy, for example. Pacific beaches with surf can be easier to reach with an outboard-powered inflatable. A skiff with low sides or a sailboat that cannot cut through chop will waste your money in areas where conditions are usually breezy or rough. The types of boats popular in your area are usually the best buys, and easier to resell later. Seaworthiness is essential in small craft as well as large.

3. Is it a boat, or really a toy? The price may be low because the boat belongs in a swimming pool and will break up or swamp if ever hit by a wave. Inexpensively made inflatables are sometimes in this class, and will puncture easily if given rough handling. Foam-hull craft should have a hard protective surface.

4. Is it portable? Little boats are handy and versatile because they are light to move around. If you find a bargain in a heavy old wooden skiff, be sure you won't want to cartop it or need to launch and haul it every day.

5. Wood, plastic or metal? Quality of construction is more important than material. Wood requires more care, but there is no maintenance-free boat. Buy the one that is well designed and well made.

6. Is the boat suitable for several uses? Small boats need to be versatile. A dinghy may be used for fishing, water-skiing, makeshift sailing or as a duck boat. Multi-purpose features make a boat a better value.

7. Will it be resalable? Though you love the boat now, you will be disappointed if you find it does not keep its market value. Boatmen continually trade up and down.

8. Does it have plentiful flotation? Small boats are often overloaded and handled carelessly. Since they tip over more easily, it is important that the swamped boat can still support you and all gear. Ideally, it should be easy to turn upright.

9. Is it in good condition? Inspect both new and used hulls carefully. Be sure a used model has no hidden flaws. If in doubt, consult an expert.

10. Is the boat good-looking? If you don't really like the lines of a boat, you will be unhappy whenever you look at her. Boats should be beautiful.

Don't lower your standards just because a little boat costs less. It still has to give you pleasure and keep you safely afloat.

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PATIO PARTNERS

(Continued from page 94)

clear sealer intended for outdoor use.

View divider

Garden grades of redwood—construction heart and construction common—are ideal for building this privacy screen. Use the former for posts and bottom stringer and the latter for all remaining parts. Posts are set at 4-ft. intervals; posts also flank each window. Since the width of each window is 15½ in., set the flanking posts 15½ in. apart or 19 in. on center. Plant posts at least 2 ft. in ground (or below area frost line) and anchor them in concrete.

Nail top and bottom stringers to posts and position the 2x4 stringer midway between. Finally, predrill holes in the 2x2 vertical members and nail them to stringers using a nail at each stringer. Fasten all members with 16d nails.

Grille fence

Construction is similar to the previously described fence. Open latticework is spotted here and there in a closed fence to guarantee passage of cooling breezes. Build the lattice section as shown in the drawing on page 93.

Post lamp

This design is particularly well suited for construction with clear Idaho pine followed by a stain to suit patio or entry decor. Construction of the lamp is easier than it may appear. Start by marking and nailing louvers and top pieces to the sides to create four units. After adding the 1x1 filler strips to inside edges of two of the louver units, secure units together by nailing through the filler strips. Next, toenail the four lengths of 2x2s into the four corners formed by the louver units. Fabricate the post, install in ground and slip in lamp. Collar of 1x3s at top of post and 1x3 strips below hold lamp assembly in place.

Redwood planter

This is basically a simple box. Complete plans for building it are shown on page 93. Notice that the box design includes two different pairs of sides. Construction of redwood planters requires two basic precautions to make them maintenance-free. First, be sure to drill holes in, or leave narrow spaces between, bottom boards to assure adequate drainage. Second, use only corrosion-resistant nails and fasteners.

Octagonal planter

The 18 courses that form the sides of this planter are cut from nominal 2x3 cedar lumber. Measurements are easy—see the example of one length (A) shown for the top course. Measurements in the drawing are for the dimension shown in the example—that is, the short length between the 45° miter cuts at both ends.

To build the planter shown, you'll need 144 linear feet of lumber for the sides. Two galvanized 12d nails in each piece holds it firmly to the piece under it. Though it's optional, it would be wise to use waterproof glue. Vertical grooves at corners help to hide uneven cuts. Making them requires careful use of a portable circular saw and a tacked-on guide. Painting is not advised for this planter; rather, stain it to match house or patio. For simplicity, assemble pieces with planter upside down.

Stained planter

Basically a box, this planter can be made of either construction grade (knotty) or clear pine. As seen in the construction drawing, a second box is created on the inside to receive the plant container. This box, of course, can be sized to suit the plant of your choice. If desired, a shelf can be added here to raise the pot height. ★★★

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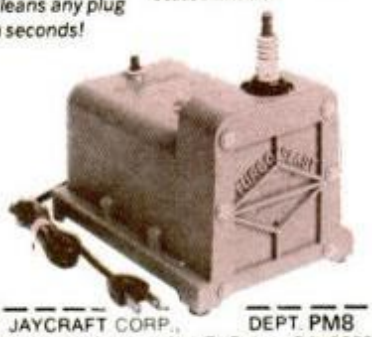

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PORT FOR PEAK PERFORMANCE

(Continued from page 89)

powerpack output curves and ignition patterns of the secondary voltage while engines are actually mounted and running offshore.

Unique among test craft is a 30-foot creation with dual inboard engines port and starboard and a special transom-stress plate amidships for mounting an outboard motor. Clamped in place, the outboard's thrust and drag can be measured, torque curves plotted, resistance of the lower unit studied, propeller efficiency computed at various speeds. A forward cockpit seat is used by the driver plus one passenger, while in the rear cockpit, two engineers can record dynamometer measurements in pounds of thrust and drag from the load cells of the mounting plate.

Oversize speedometers give simultaneous readings, one for zero to 30 mph and a second covering 20 to 60 mph. Even the trim of the dyno boat is shown so corrections in readings can be introduced according to the measurement of incline caused by engine weight. Intercom headsets between driver and back-seat engineers allow coordination of the dyno boat's speed from internal engines and thrust of the test outboard as varied from its rear control panel.

Test-base facilities allow the 150 to 200 boats usually available to be moored at slips for immersion and static testing, or launched by overhead hoist, test run offshore, lifted out again immediately and brought by overhead railway into the machine shop for instant adjustment. At this test base factory-team racing setups are perfected; their wins over recent years have helped make possible the big new outboards reported ready to join OMC lines next year.

To check some of the hottest rigs, we joined two frequent test-base visitors, engineers Ralph Evinrude, board chairman of OMC, and former MIT professor and racing driver Charles Strang, OMC president, to form one of PM's more impressive test teams. Speed from several outboards left no doubt that under some hoods were bigger muscle prototypes. Their performance pointed out neatly how outboards are adding power without increasing in size or noise. Finally, we wake-jumped a Glastron, Boston Whaler and Slickcraft from among the base's favorite test models, while drivers Evinrude and Strang ran the chase boat. Ralph Evinrude had been the first ever to jump a boat for newspaper photos, in 1926. Getting better performance is still the name of the game. ★★★

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GET RICH SLOWLY

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The world is filled with get-rich-quick schemes. Most of them, alas, don't work—and cause unwary investors to lose millions of dollars every year.

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For instance, did you know that if you started investing just a little more than $80 every month at the age of 30, and got a 15% return compounded annually, by the time you were 65 it would add up to $1,013,346? *Over a million dollars from about $80 a month!*

Of course, this does not take into account the income tax you would pay on the return from your investment. But sound tax planning can reduce this factor to a minimum.

And if you are older than 30, it is true that you do not have as long a period of time to pyramid your savings, but you probably are earning more than you did at 30 and can afford to save and invest more than $80 a month.

$80 a month, admittedly, is not "small change." But with shrewd money management, many families can save that amount. And getting a return of 15% on an investment, although very good, is not as impossible as it may sound.

According to statistics, in one recent 20-year period, the combined annual return from dividends and capital appreciation on all common stocks averaged 14.3%. That's a figure that's all the more meaningful right now, when stocks are at a level where some experts think they may be bargains.

Similar returns may be found in well-chosen real estate investments or in a carefully managed family business.

Then why don't most of us end up with at least a million dollars by the time we're 65?

Sometimes it is due to unavoidable circumstances—unemployment, family illnesses, and so forth. But surely an important factor is simply a lack of knowledgeable planning and sound money management.

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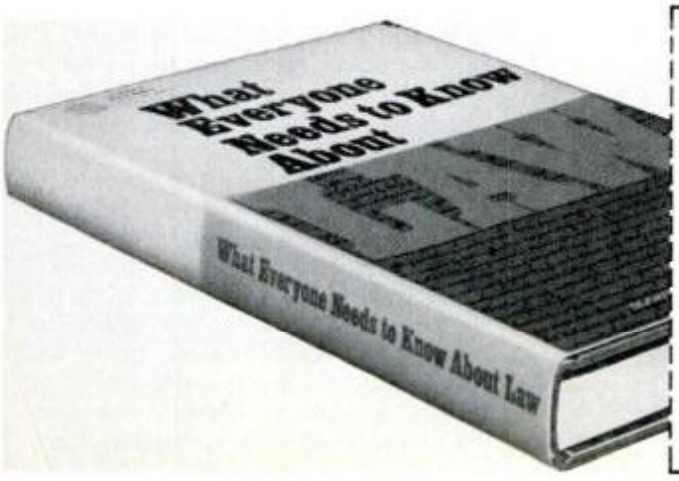

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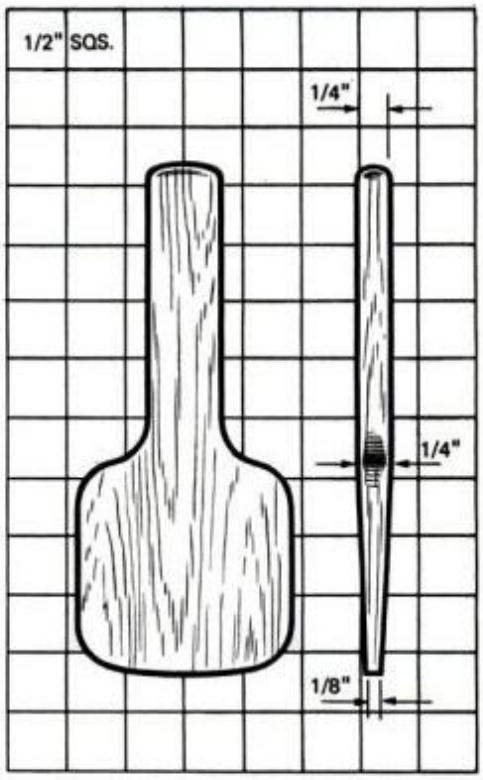
Jam paddle



A good project for one of those puttering-around-the-shop nights is this jam paddle which can be turned out in quantity in very little time. The best part is that they can be made from scraps of hardwood left over from big projects. Start by making a master, reusable pattern of $\frac{1}{8}$-in. tempered hardboard. (Drill a hole through its handle and you can hang it on a nail between paddle-making sessions.) Cut hardwood blanks to size—$\frac{1}{4}$ x 2 x 4-$\frac{1}{2}$ in. and taper the lower 1$\frac{3}{4}$ in. as shown, using either a belt sander or sander/grinder. Finally, trace the paddle and cut it out with coping or jigsaw. Finish by sanding the paddle smooth.—*Al Sittner, Manhasset, N.Y.*

Материал, защищенный авторским правом

I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest $15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

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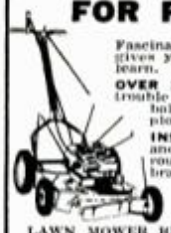

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NEW CAR AT OLD PRICES

(Continued from page 61)

place it with duals. But what do you do with the plumbing you pulled out of the car?

The second list consists of accessories you can install yourself (see the drawing on pages 60 and 61). This is basically a screwdriver and pliers list. The necessary wiring or components you will hook up with are already on the car. There's no major mechanical surgery involved.

One item, a remote-control, side-view mirror, has been omitted from both lists. The reason is that it falls in the either-or category. You can have it installed at the factory or install it yourself. You come out about the same either way. There's no choice.

One of the mechanics who worked with PM in compiling the lists is a professional. Bob Swailes is service manager for a large Shell station. He is a car buff and has participated in racing events.

After working over the lists with Swailes, PM submitted them to a non-expert. Doug Collins works for a fire department in a small town in Michigan. Doug is a typical do-it-yourselfer. He works on his own car and has a home-handyman set of tools. He does not have the specialized tools available to Bob Swailes. Collins said he would be game to tackle any job listed in the do-it-yourself column.

If you aren't in the market for a new car but are considering fixing up the old car, one item on the factory-installed list can be transferred to the do-it-yourself column. There's now a kit on the market for attaching the radio antenna to the windshield. It's on the windshield, rather than in the glass as in a factory-installed unit, but it's just as effective as the in-the-glass version. ★★★

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If you want the following accessories on your car, you should have them installed at the factory.

- Automatic transmission
- Dual exhausts
- Engine of proper size (6 or 8 cylinders)
- Fluid-level indicator for windshield washer
- Heavy-duty charging system
- Heavy-duty cooling system
- Hydraulic steering stabilizer
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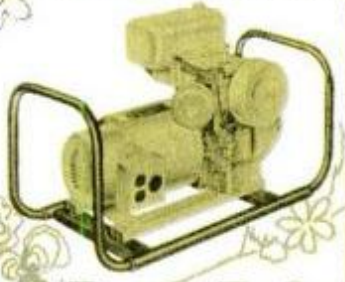

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WIN THIS ELECTRIC CHASSIS

(Continued from page 47)

sign alone, produced according to the rules specified, is all that will be judged.

Judging will be based on the following factors:

How it looks. The two-passenger fiberglass body designed for the Elcar Model No. 2000 by Zagato is simple and practical, and attracts a lot of smiles and horn-blowing reactions. Yours can be as different and innovative as you wish, but should produce similar reactions. If you can figure a way to put a sports car, utility wagon or streamlined sedan body on a 63-inch frame, more power to you. It needn't be "beautiful" but should be distinctive.

Easy to build. The materials you specify must be readily available and easily worked to achieve your design, without complicated or expensive processes. They should not, for instance, call for special castings or stampings. The use of several different materials to achieve particular purposes is allowable. But it should be possible to build the entire body with hand or power tools commonly used in home workshops rather than industrial shops. Such factors will be considered in the judging.

Utility. Vehicle dynamics should be carefully considered. The Elcar No. 2000 chassis was designed to carry a payload of 640 pounds, including 300 pounds for the Zagato fiberglass body and 340 pounds for two passengers and a suitcase or some groceries. (Curb weight of the chassis is 1290 pounds, turning diameter 21 feet.) You are free to divide the total 640-pound payload allowance in any way you wish between body weight and useful payload. Judges will consider the most efficient use of total chassis payload, as well as space utilization for seating and storage, ease of passenger entrance and exit, and overall passenger comfort factors.

Cost. While there are no contest limits on the cost of materials to build the body you design, judges will take into account how that cost affects the total value of the vehicle compared with Elcar's $3395 for its complete two-passenger car. If you are able to design a more interesting or attractive body that brings the total value of your car to less than the retail cost of a complete Elcar No. 2000, it will gain more points with the judges than if it should run much higher.

Safety. To conform with safety regulations, your car should meet street legality requirements and have the following equipment if you hope to license it for use on local roads: headlights, taillights, brake lights, turn-indicator lights, windshield wipers, safety glass for the windshield, seat belts and substantial bumpers anchored to the frame.

The judging will be performed by a panel of experts: Jay Doblin, Chicago industrial designer and former executive designer for Raymond Loewy as well as director (14 years) of the Institute of Design at the Illinois Institute of Technology; Harry Bradley, automotive designer associated with the Art Center College of Design in Los Angeles, and former senior automotive designer for General Motors; Robert Culver, technical director of Elcar Corp.; Bill Hartford, automotive editor of *PM*; Robert Lund, Detroit automotive editor of *PM*; Michael Lamm, West Coast editor of *PM*. (Should any judge be unable to serve, a qualified alternate will be selected by *PM*.)

The decision of the judges will be final, conclusive and binding on the contestants. The winner of the PM Electric Car Body Design Contest will be announced in the December issue of *Popular Mechanics*. The prize-winning design will be published in the same issue. Plans and instructions for building the winner will be published in a subsequent issue to be announced. ★★★

ROAD-TESTING THE ELECTRIC CAR

(Continued from page 47)

little car hummed along quietly and happily.

Actually, it's hard to know what speed you are making in an Elcar, since the speedometer is calibrated in kilometers—which gives the illusion that you are going much faster than you really are. But with a top speed of 35 or so it's academic—almost.

I found 35 mph was more than fast enough to keep up with the morning traffic in downtown Elkhart when I drove around down there with Dan Gegax, Elcar's manager of consumer sales, who served as my check pilot from the passenger's seat. We rumbled over wavy, chuck-holed brick paving with no more pitching than you might expect with an ultrashort wheelbase (51 inches). It took me a while to learn to drop the range dial to second speed when going into the corners, and into first when approaching stop signs.

The 2000 also has a booster switch on the dash that you can throw after achieving top speed. It weakens the magnetic field in the coils and allows the armature of the motor to develop more torque. This drops the car into a sort of "overdrive" and you can feel the surge as it gains another few mph. Using this device on a long straight

(Please turn to page 122)

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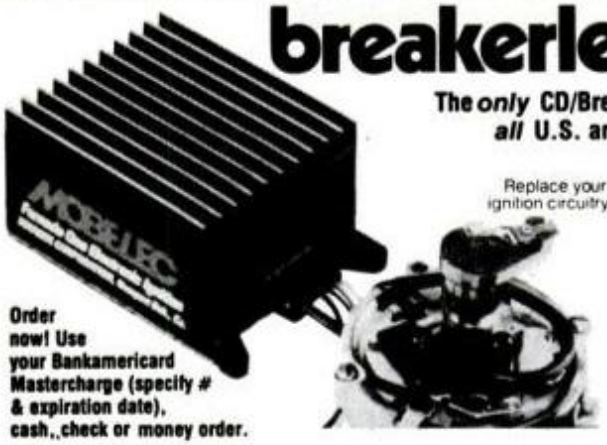

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ROAD-TESTING THE ELECTRIC CAR

(Continued from page 121)

stretch, I actually got the electric up to 60 kilometers, or 40 mph. Once on to this wrinkle, I really had fun with the thing, racing it over lumpy pavement and up and down slopes. With a running start, most of Elkhart's modest hills offered no problem, though starting on them from a standstill was pretty pokey.

While the car brakes to a stop within 65 feet from top speeds, which seemed fair enough, the sensation was something else. There's no engine compression to help; it feels like braking while coasting downhill in neutral in a normal car. And when you come to a stop at a light there's a tendency to reach for the starter key. It's like you've stalled. There's no idling; just dead quiet.

Leon Shahnasarian, president of Elcar, does not plan to settle for just novelty and a two-man pop-about. He's convinced that practical electric transportation for the family is possible. His four-passenger version of the Elcar is a first step in this direction. What he has done is to have fiberglass experts build an extension on the rear of the present design, with a hatchback and room for two more seats (with pretty good legroom). I drove the vehicle around the parking areas just for fun—not testing. The car is still a prototype; production is planned for 1976.

"It simply bounced away . . ."

How safe are the little shopper-hoppers? While no one, including Shahnasarian, recommends taking them out on high-speed freeways, they do conform to the safety specs of most states. And the cars have a few safety characteristics of their own. "One of our cars was in an accident recently," Shahnasarian reveals. "It was rammed from the rear by a big Detroit car, which sustained $300 damages. There was no damage at all to the Elcar—it simply bounced away from the impact. This was due to a combination of its weight, its tough, rubber-trimmed bumper anchored to the rugged chassis, and the 'give' of the fiberglass body."

As far as Shahnasarian is concerned, the electric car is a vehicle whose time has come.

Should *you* buy one? Well, they *are* a lot of fun. But for their limited use the price isn't exactly low. The 1000 starts at $2995; the 2000 bottoms at $3395. You can be sure that the four-passenger model, when it's ready, will top that.

Shahnasarian insists that if you use it regularly for short hops, either of the two-passenger models will pay for itself in three years—in gasoline and maintenance savings. The basic car should last a lifetime, he points out, if properly cared for. Batteries, if properly maintained, should be good for 14,000 or 15,000 miles. That, in a car used only for short local hops, should see you through two or three years. Then a new battery pack will run you approximately $400.

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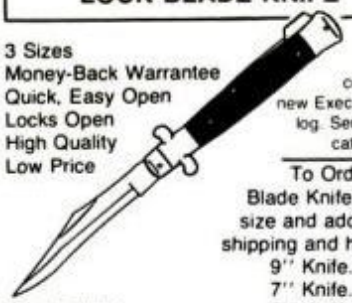

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In short, **Moneysworth** is a live wire sparking off hot information on the current money scene. It galvanizes readers all over the country into sending ardent letters like these:

• "The government has proven itself completely impotent in the fight against inflation. My only salvation comes from advice I find in **Moneysworth**. It save me as much as I lose through inflation."—*Theresa Ramseier; San Francisco.*

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• "Thanks to **Moneysworth**, I am $5,417 richer. I battled the Social Security Administration unsuccessfully for 18 months, then finally won out by following the advice of your article 'By All Means, Appeal'."—*S. Dominguez; Waterbury, Conn.*

• "Your article on air-fare 'triangular' routes was an astonisher. My wife and I saved $100 *each* on a trip to New York by stopping off at Las Vegas as you suggested."—*H. Kesselman; Los Angeles.*

• "Boys, you are not going to believe this, but I have parlayed $146 into *$90,000* thanks to your informative article on breaking into real estate."—*Horace T. Pinrose; Montgomery, Iowa.*

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• "Your tip on flying to Europe via Afghanistan saved me $450. You've made me a subscriber for life."—*Charles B. Fager, M.D.; Harrisburg, Pa.*

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• "Your article 'How to Avoid Paying an Exorbitant Doctor Bill' saved me $65."—*Carl Wagner; Yorktown Heights, N.Y.*

• "Your expose of charity rackets was a shocker. I've crossed several well-known organizations off my list, saving hundreds of dollars."—*Freida McMullin; Steilacoom, Wash.*

• "Your article on how to save $100 on a color TV worked. **Moneysworth** sure knows how to hold onto the green."—*P. Allen; Dir. Student Union; Henderson College; Arkadelphia, Ark.*

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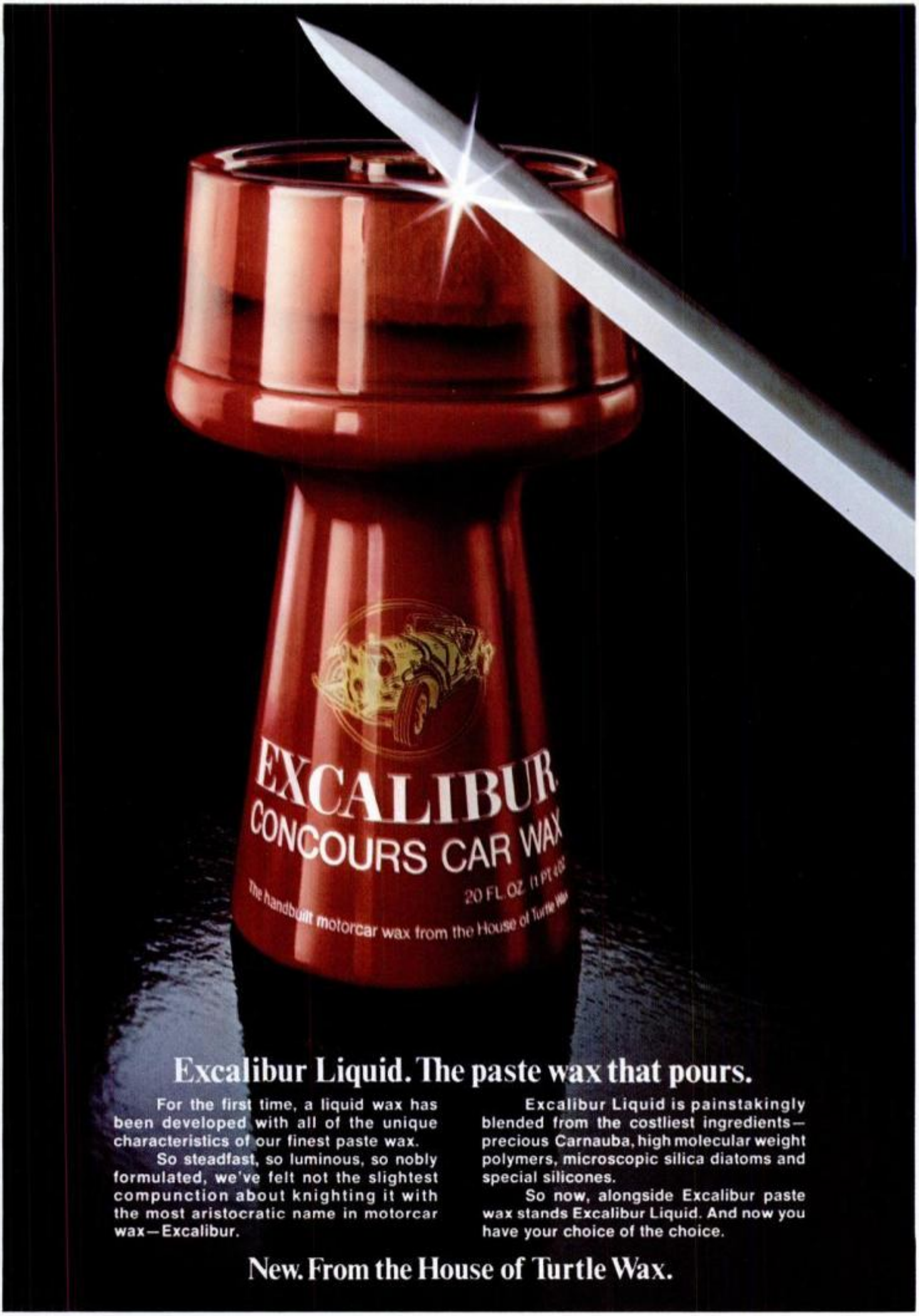

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	tar, mg/cig	nicotine, mg/cig
Brand D (Filter)	15	1.0
Brand R (Filter)	14	0.9
Brand K (Menthol)	13	0.8
Brand D (Menthol)	13	0.9
Brand M (Filter)	12	0.8
Brand T (Menthol)	12	0.7
Brand V (Filter)	12	0.8
Brand V (Menthol)	11	0.8
Brand T (Filter)	11	0.6
Carlton Filter	**4**	**0.3**
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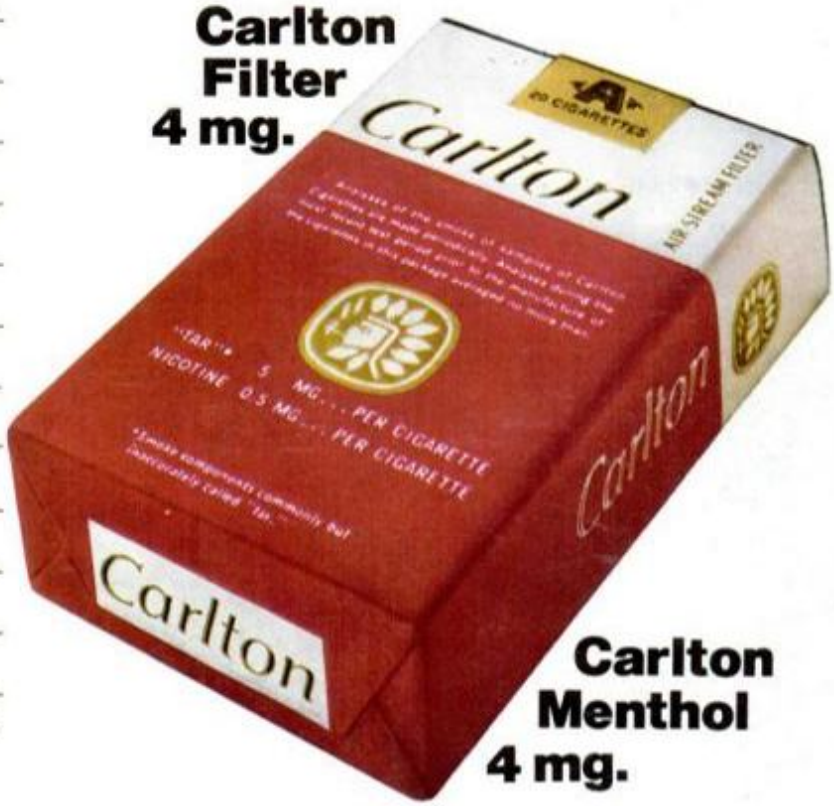

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