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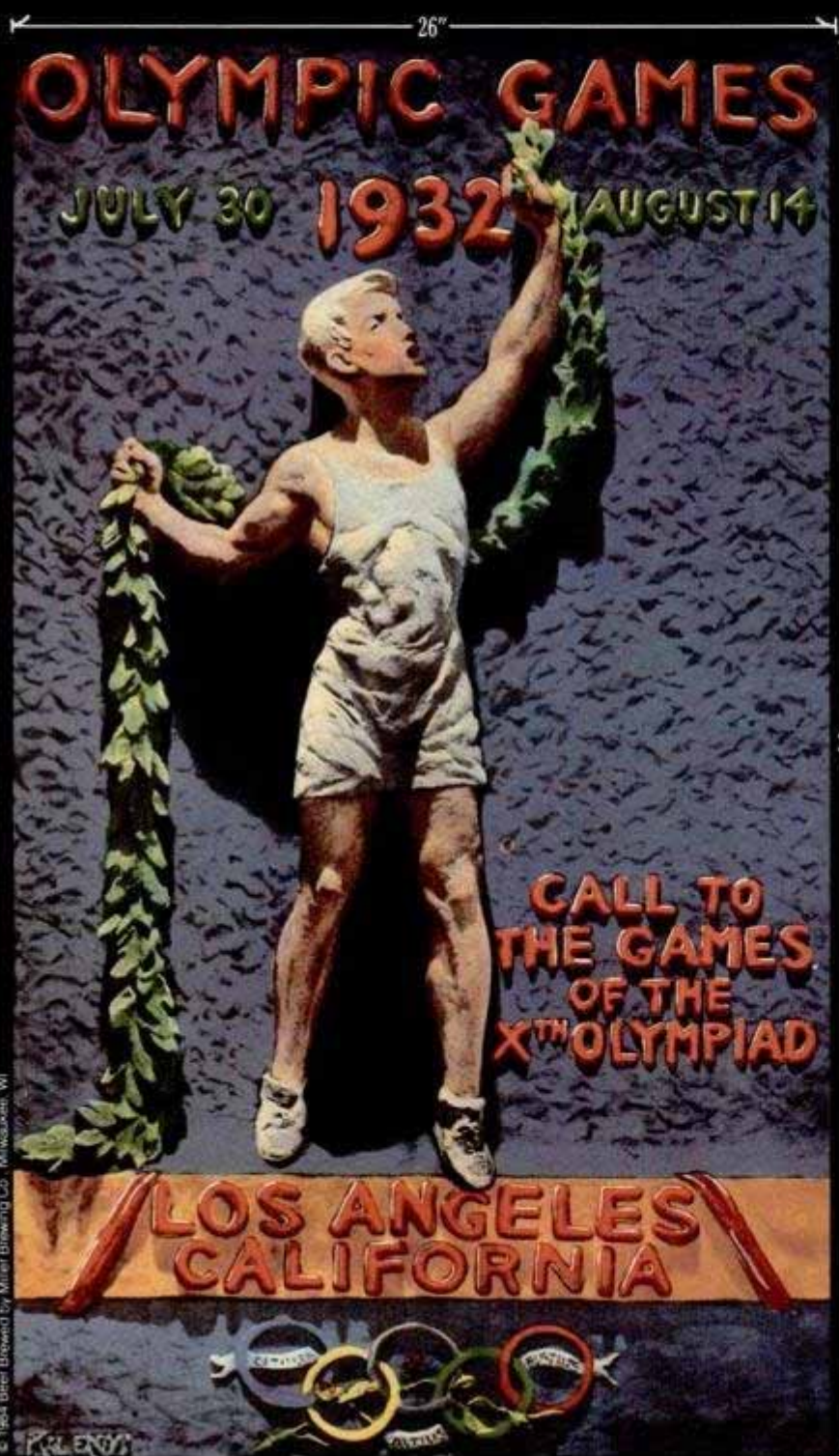
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ON THE COVER

After two years of troubles, San Francisco's famous cable cars are back in operation and better than ever. Read how these and other streetcars around the country are making a nostalgic comeback in the story on page 78.

—PM painting by Gary Meyer



Popular Mechanics®

VOLUME 161 NO. 7

JULY 1984

INTERNATIONAL EDITIONS: CARIBBEAN, MEXICO, SOUTHERN HEMISPHERE



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POPULAR MECHANICS (ISSN 0032-4558) is published monthly by The Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Subscription prices: United States and possessions, \$11.97 for one year, \$21.97 for two years. Canada and all other countries, add \$16.00 for each year. Second-class postage paid at New York, N.Y. and additional mailing offices. Authorized second class mailing-in-Canada privileges by Canada Post, Windsor, Ont. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 1984 by The Hearst Corporation. All rights reserved. Printed in U.S.A. POSTMASTER: Please send address changes to Popular Mechanics, P.O. Box 10064, Des Moines, Iowa 50350.

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Editorial offices: 224 West 57th St., New York, N.Y. 10019. We cannot be responsible for loss of unsolicited queries, manuscripts, or photos. For return, they must be accompanied by adequate postage.

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Published by The Hearst Corporation

President: Frank A. Bennack Jr.

Chairman: Randolph A. Hearst

President, Magazines Division: Gilbert C. Maurer

Publisher, Popular Mechanics: Daniel J. Coleman

Publishing Consultant: Richard E. Deems

POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 959 Eighth Avenue, New York, N.Y. 10019, U.S.A. Frank A. Bennack Jr., President; Randolph A. Hearst, Chairman; Harvey L. Lipton, Vice President and Secretary; Hearst Magazines Division: Gilbert C. Maurer, President; K. Robert Brink, Executive Vice President and General Manager; Raymond J. Petersen, Executive Vice President; Thomas J. Hughes, Vice President and Resident Controller; William S. Campbell, Vice President, Director of Circulation; Daniel J. Coleman, Vice President for Popular Mechanics.

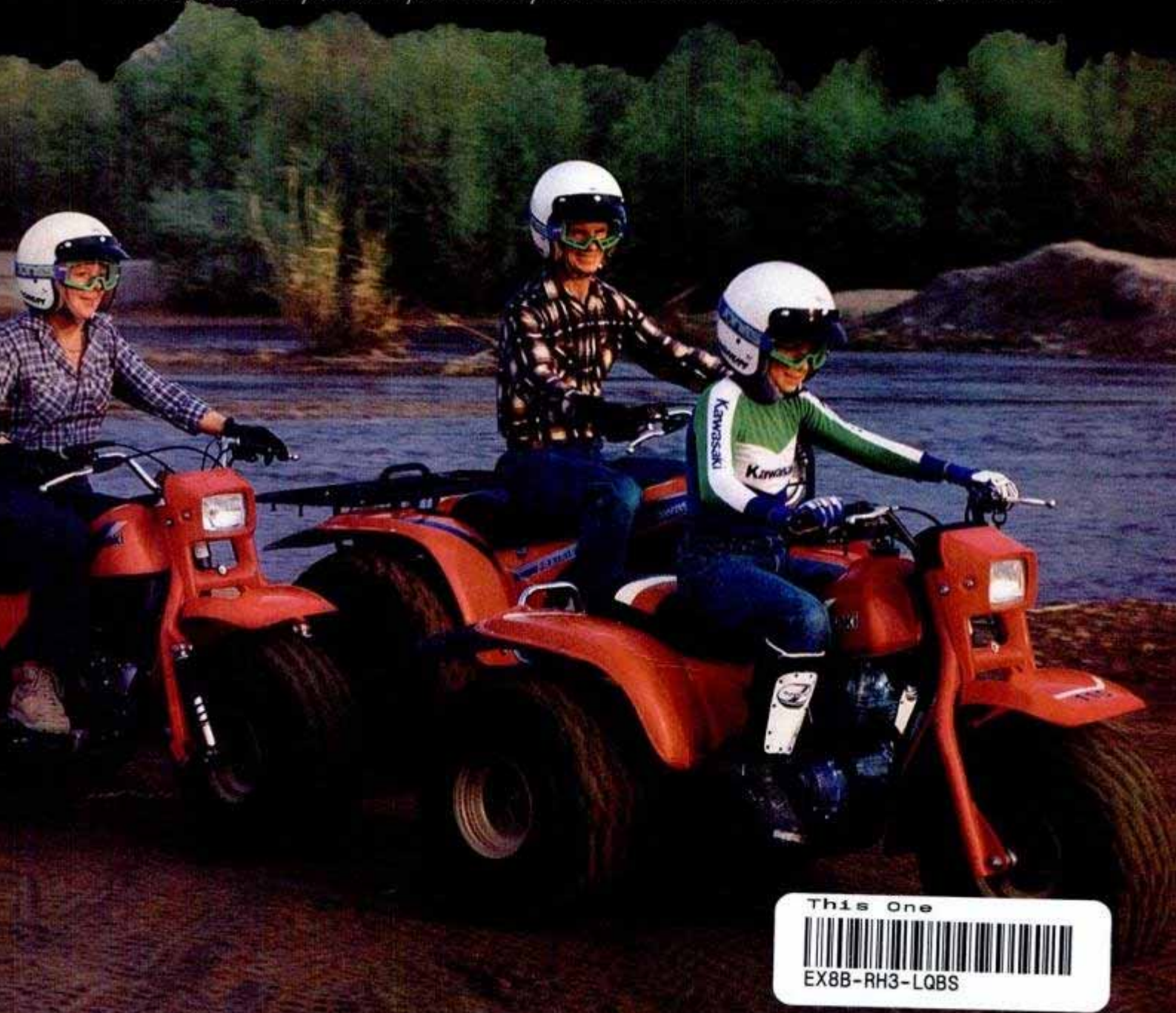
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EDITOR'S NOTES

Georgia State Trooper Sam Patrick now knows that the life of a photographer's model isn't all that glamorous. Posing in shirtsleeves in frigid 15° weather for the lead photo of *Why Police Can't Get The Cars They Need* (page 75), he had to remain the very picture of an officer and a gentleman as a brisk 35-mph wind battered his Smokey hat. Trooper Patrick, who came north to help us run our five-car test on the Chrysler Proving Grounds, arrived at about the same time as a late-winter storm. In all of the turmoil, we were able to determine that his Mustang is about the best car police have nowadays. We blame him not at all for hotfooting that dandy car back to Georgia's 80°



PM's Oldham and Georgia's Patrick huddle over the trooper's 5.0-liter Mustang.

weather as a final 6-inch snowfall hit Detroit at the conclusion of the tests. . . . **Compared to those fast police cars**, bicycles would be easy to test. Right? Well, not really. It took Executive Editor Joe Oldham some five months to gather the information and specifications for *Biking The Badlands* (page 82). It took two months to assemble the 13 mountain bicycles we took to Saddleback Park in Irvine, Calif., for testing. Photographer Randy Leffingwell spent three days shooting the bikes. And expert rider R.L. Osborn of the *BMX Action Trick Team* spent one day testing all of the bikes. But it required just one ride for



Canniff, Osborn and Oldham map strategy while Richie Chavez unloads the bikes.

Graphics Director Bryan Canniff to put himself out of commission with a very stiff back. So bicycles are easy? . . . **After two years of renovation**, San Francisco's cable-car system is back conquering those hills again this summer (*Halfway To The Stars*, page 78). Its under-the-street cable bed has been totally rebuilt and the power system improved. But let's not slight other cities enamored of their iron rail transportation. Both Philadelphia and San Diego have street-car systems carrying folks to work even now—and there are a number of

other such rail systems proposed for other cities. Somehow subways—which are nothing but underground streetcars—lack the nostalgia and romance necessary for mention in this context. Guess it's the *Stars* part that's missing. . . . **The term "Star Wars"** has been applied to President Reagan's proposed defensive system. But, as Edward Teller points out in *Bringing Star Wars Down To Earth* (page 84), it was really the President's critics who gave that description to his proposal. No matter, Weapons in space are too vulnerable, says Teller. Better a ground-based beam-weapon system, he concludes.

John A. Littleton

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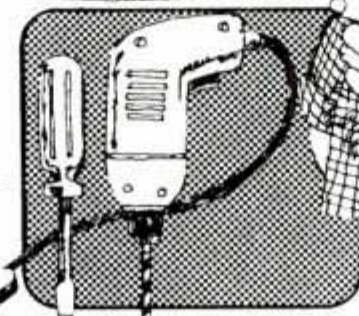
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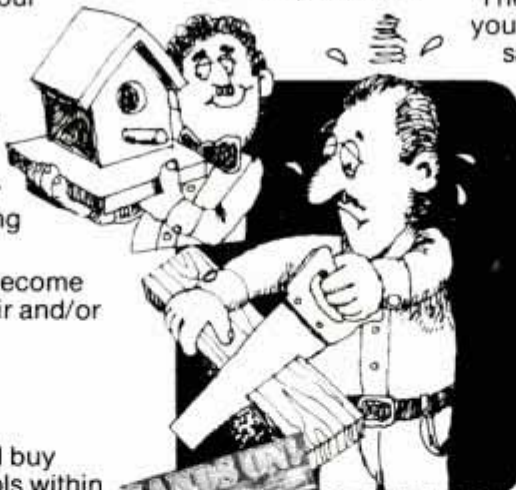
So grab a pen or pencil and get started!

Circle A, B or C for each question:

- How much experience do you have in woodworking, home repair and/or home maintenance?
 - Little or no experience.
 - Some experience.
 - A great deal of experience.
- Which phrase best describes your workshop?
 - A selection of hand tools and portable power tools.
 - A table saw or radial arm saw, along with hand tools and portable power tools.
 - A good selection of stationary and portable power tools, along with hand tools.
- How involved do you want to become with woodworking, home repair and/or home maintenance?
 - Not very involved.
 - Moderately involved.
 - Heavily involved.
- What's the likelihood that you'll buy some kind of woodworking tools within the next year?
 - Not likely.
 - Somewhat likely.
 - Highly likely.
- Which describes you?
 - I do home repairs and maintenance only when it can't be done any other way.
 - I do some woodworking and a variety of home repairs and maintenance.
 - I'm primarily interested in fine craftsmanship woodworking.



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LETTERS TO THE EDITOR



Two PM projects for lazy summer lounging

I thought you might like to see a photo (near right) of the outdoor furniture I built from your plans (*Build PM's Adirondack Lawn Furniture Set*, page 116, June '82). The plans were very well presented, and the furniture looks beautiful in our garden. Everybody loves it.

TATEOS SOMOUNDJIAN
MONROVIA, LIBERIA

I don't even have a porch, but I very much enjoyed making your classic porch swing (*Build PM's Old-Fashioned Porch Swing*, page 94, July '83). I made only two changes in the design. I used button plugs over all screwheads instead of flush plugs, and to suspend the swing I made an



How does PM's Adirondack furniture do in West Africa? Reader Somoundjian seems pleased with his handiwork (above, left). At right is reader Snyder's porch swing.

A-frame support from pipe. It looks great, porch or no porch. Thanks.

BOB SNYDER
WESLEYVILLE, PA.

Thank you both for letting us know.



For others who may be interested, photocopies of the plans are available from *Popular Mechanics*, Box 1014, Radio City Station, New York, N.Y. 10101. The furniture plans are \$3 postpaid; the swing plans, \$3.50 postpaid.

Aw shucks, fellows

As a veteran airline pilot with 29 years of service, I'm prompted to comment on your excellent article "We Made It!" (page 77, Apr. '84). While your praise is welcome and flattering, we pilots don't consider ourselves heroes. We are not supermen. We do not have nerves of steel. We get worried at times just like the trusting passengers in the cabin behind us.

The difference lies in our training and experience. When an emergency arises, we deal with it routinely the way we've been taught. I still think the most dangerous part of my job is driving to and from the airport.

BARRY SYRETT
FIRST OFFICER, AMERICAN AIRLINES
RANCHO PALOS VERDES, CALIF.

Clarifying commands

As a naval officer, I very much enjoyed your article *Our Fast New Armada* (page 83, Jan. '84). However, it contained some inaccuracies regarding naval command authority that your readers may have found confusing.

The newly created Central Command (CENTCOM) that you mentioned does not have control over the Atlantic Ocean, Indian Ocean or Mediterranean Sea. Its area of responsibility is the Middle East, including the

Persian Gulf and Red Sea. The other major naval commands are the Pacific Command (PACOM), Atlantic Command (LANTCOM) and European Command (EUCOM).

LOUIS J. FILLMON
LT. CMDR. U.S. NAVY
HONOLULU

Austin, not Boston

In my article *The 10 Scariest Places To Drive* (page 84, Apr. '84), Boston, Mass., was inadvertently included in a National Safety Council listing of the 10 most dangerous cities according to deaths per 10,000 cars.

Austin, Tex., not Boston, should have appeared in the list as having 3.1 deaths per 10,000 cars. Boston, despite its heavy traffic, actually deserves credit for being among the 10 safest cities to drive in, according to NSC statistics.

ED FALES
FALLS VILLAGE, CONN.

As a transportation engineer, I agree with Ed Fales that the carnage occurring regularly on our highways is a national tragedy. But I don't agree on merely pointing the finger of blame at engineers and transportation officials. The vast majority of our highways function safely and efficiently. The dangerous stretches can, and should, be rebuilt, but this will take money. We can have safer highways if we want them. It's up

to us taxpayers to decide whether we want them badly enough to pay for them.

JOSEPH HUMMER
OKEMOS, MICH.

Something is being done about those dangerous highway spots. Many states are using federal funding provided by the nickel-a-gallon gas tax to install impact attenuators at hazardous locations. It's estimated that these energy-absorbing crash cushions are saving some 2,000 lives a year.

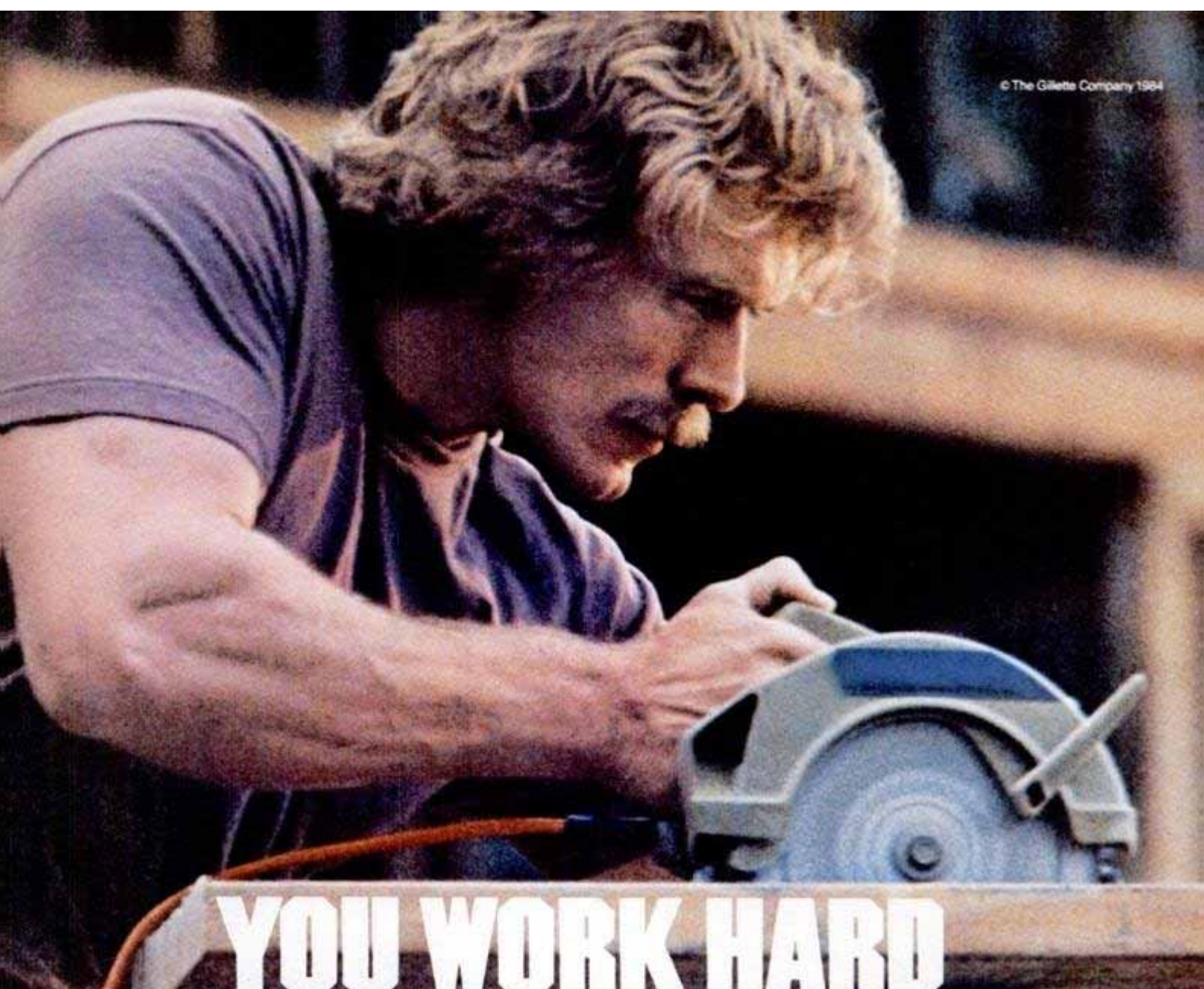
MAGGIE SMITH
ENERGY ABSORPTION SYSTEMS INC.
CHICAGO

Crossed wires

In your article *Build PM's Audio/Video Cable Tester* (page 154, Mar. '84), you say it's important to observe proper polarity in connecting the LEDs to the battery. But the wiring diagram seems to show incorrect polarity for either the LEDs or the battery. What's wrong?

TOM HERBSTTRIT
SPRINGDALE, PA.

The battery's polarity was inadvertently reversed on the diagram. The positive leads of the LEDs should be connected to battery's positive terminal. Sorry for the mixup. **PM**



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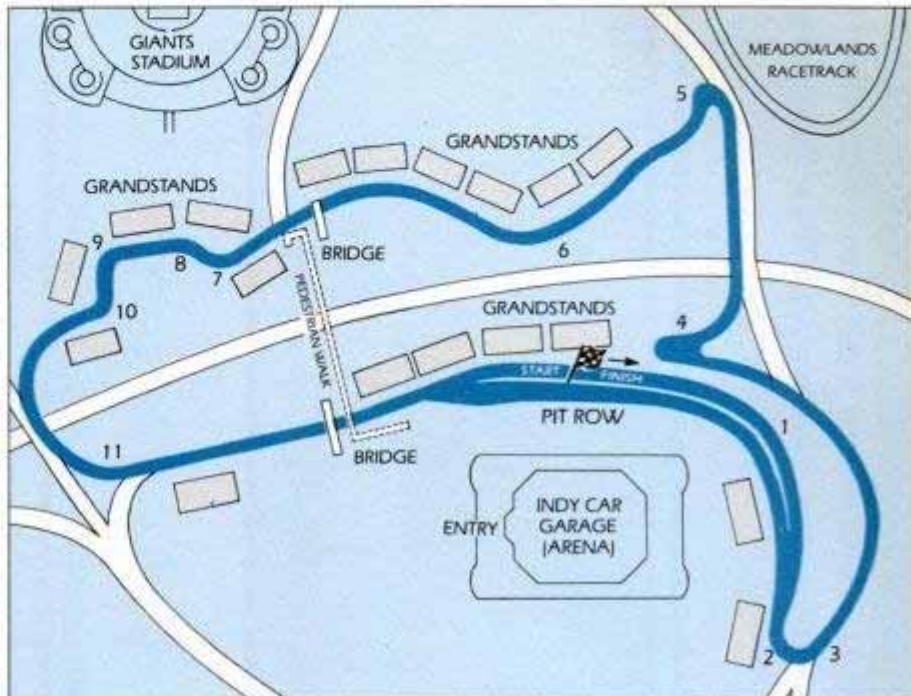


Indy car racing at New Jersey's Meadowlands

You can be sure that whenever there's a new venue for a major motorsports event, PM will bring you the circuit diagram. The road-racing circuit shown here is just a few minutes from New York City, at the Meadowlands Sports Complex in East Rutherford, N.J., and on July 1 it will be the site of one of the Championship Auto Racing Teams' big races.

The U.S. Grand Prix at the Meadowlands is the sixth race on the CART schedule (for Indy cars, remember, not for international GP cars and the World Driving Championship). The 200 miler has a purse of close to \$600,000, which ranks up there with the Long Beach race and second only to the \$2 million-plus Indy 500. It's a historic event, too: the first major motorsports contest in the New York area since the Vanderbilt Cup races of the '30s.

Ticket information is from the Meadowlands Grand Prix, Box 512, East Rutherford, N.J. 07073. Better yet, call (201) 935-3900



A 1.68-mile circuit is laid out at the Meadowlands for Indy car racing on July 1.

Don't call it trivia

When someone asks you a trivia question about *Taxi*, do you give the wheelbase of a Checker? If so, you're a specifications junkie. That's okay—there's nothing trivial about having a high car I.Q.

It's been found that if you're interested in imports, you have a better-than-average knowledge of cars. If you own a certain import or are looking to buy one, you're likely a wizard about the marque. Just ask a salesperson in an imports dealership: They'll tell you that their customers have done all their homework.

If you're into specs, you can probably answer all sorts of questions about the current lineup of imports—like what

car stretches longest from bumper to bumper? Rolls-Royce is a good guess, but which model? The Silver Spur's got the edge on the Mulsanne: 211.8 in. vs. 209.2. Then come the "little" Silver Spirit (207.8 in.) and the Corniche and Camargue (both at 207.5). Biggest block goes to Rolls, too, with its 6.8-liter V8. But Rolls doesn't have top hp—that's Jaguar's honor with its V12, which does 262 on the dyno. Does the Silver Spur have the widest turning circle? No. The Ferrari Mondial needs 41 ft.

The shortest import for '84 is easy. Honda's CRX is 144.6 in. and turning circle is a tight 28.2 ft. The CRX also has the smallest engine: a 1.3-liter Four. (Of course you're aware that rotary engine displacement is different. That's why the Mazda RX-7 and GLS-SE are rated 1.1 and 1.3 liters, respectively.)

What models offer 4wd? Subaru, Audi and Toyota's Tercel wagon.

Want to go on? You're on your own! The Checker wheelbase, by the way, is 120.0 in.

A chance to race

All you have to do is pick up the phone and call (800) 772-7272 before Aug. 31 and you could be on your way to racing driver's school. If you're 18 years old and have a valid driver's license, you could be one of three winners chosen at random from those who call. You'll



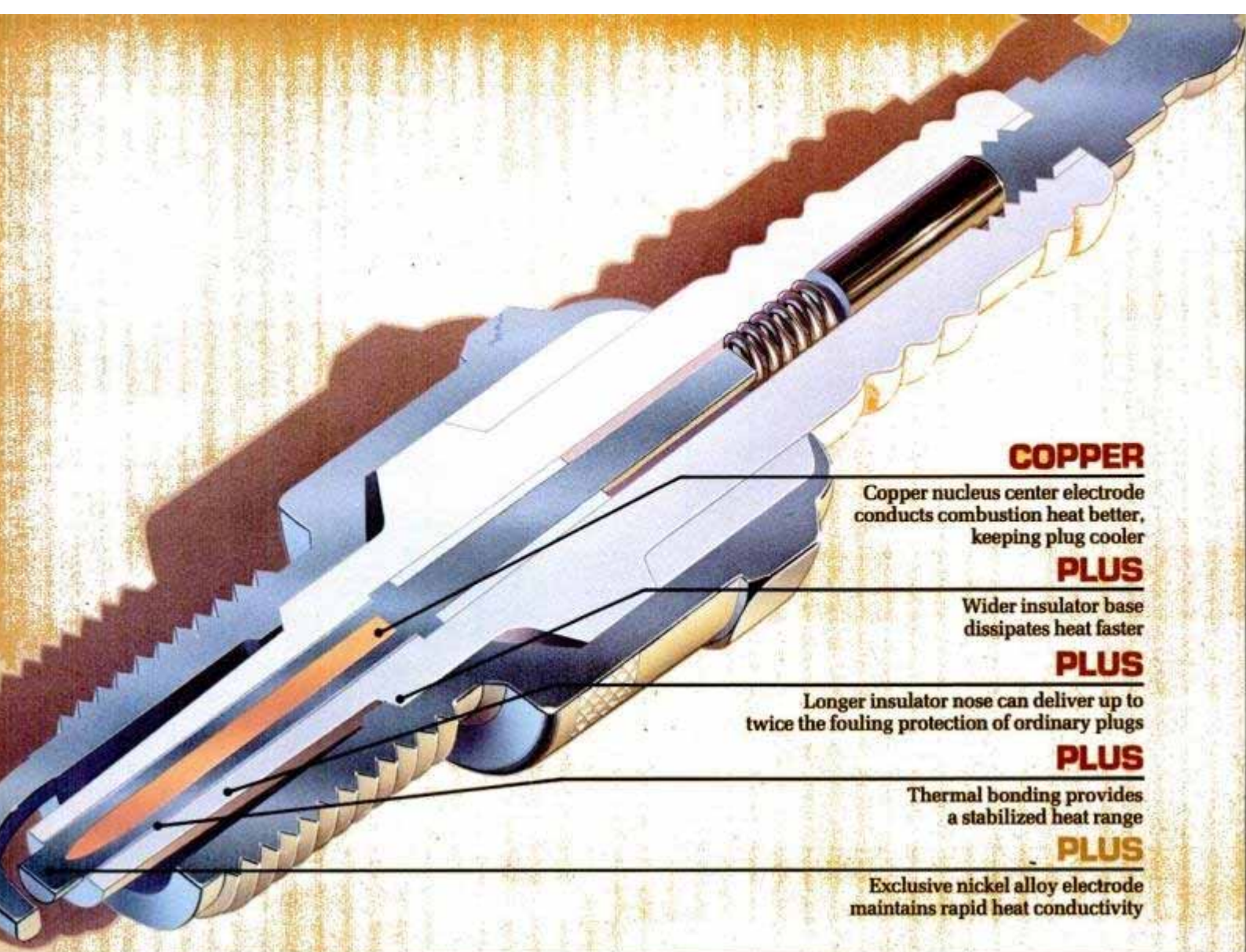
Formula Russell racer will be your ride if you win an ND Spark Plug scholarship.

spend one week at the Jim Russell British School of Motor Racing at Laguna Seca, Calif. Who's footing the bill? ND Spark Plugs. If you want to see a Nippondenso plug, just look at the business end of almost any Japanese car or motorcycle.



Longest import: Rolls Silver Spur is 211.8 in. overall.

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PLUS

Wider insulator base dissipates heat faster

PLUS

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PLUS

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PLUS

Exclusive nickel alloy electrode maintains rapid heat conductivity

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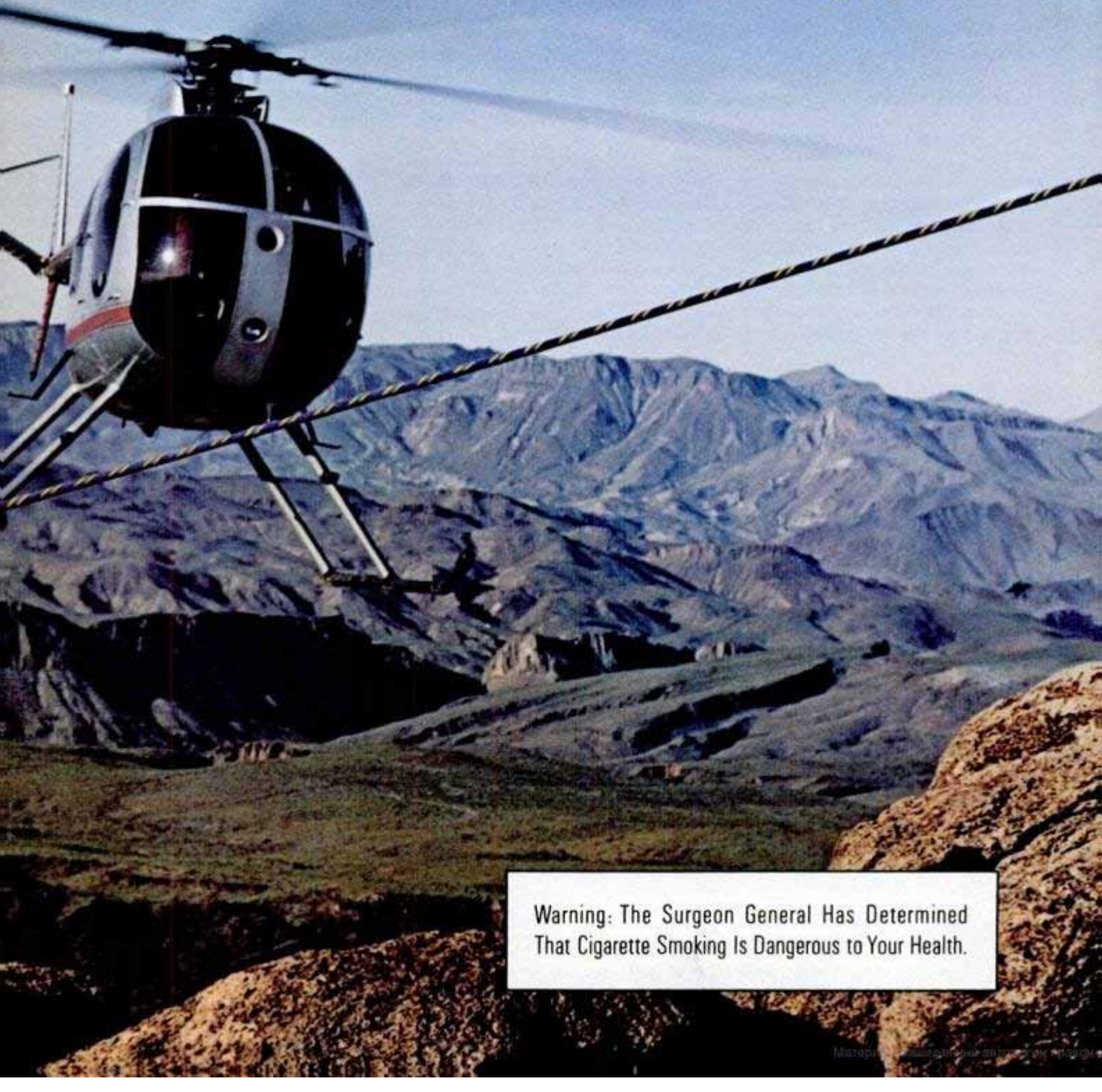
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Winston. America's

LIGHTS: 11 mg. "tar", 0.7 mg. nicotine, LIGHTS 100's: 12 mg. "tar",
1.0 mg. nicotine, av. per cigarette by FTC method.

s Best.

Excellence.
The best live up to it.



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

Announcing

THE NATIONAL HISTORICAL SOCIETY

CIVIL WAR CHESS SET



Richly detailed portrait sculptures of great American heroes
—in solid pewter, solid brass and fine enamels.

A heirloom chess set to be enjoyed for generations.

Created by the world-famous craftsmen of The Franklin Mint.

THE NATIONAL HISTORICAL SOCIETY is dedicated to bringing the excitement and power of American history—as well as its significance—to people in every part of the land.

It is in keeping with this purpose that the Society is about to issue its own Civil War Chess Set. A dramatic tribute to the heroes of both North and South—and a work all the more intriguing because the playing pieces include richly detailed three-dimensional *portrait sculptures* of the great Generals of Union and Confederacy, captured for the ages in solid pewter, solid brass and fine enamels.

This extraordinary new chess set will be crafted to the highest standards of quality and historical authenticity. The National Historical Society has appointed The Franklin Mint to create the sculptures, each of which will be a new and original design. Some figures will be shown standing, some seated, some kneeling, some mounted on horseback. And each figure will be painstakingly crafted of solid pewter, hand-finished, then set atop a solid brass pedestal base embellished with a circular band of richly colored enamel—*blue* for the soldiers of the North, *gray* for those of the South.

Every sculpture, moreover, will be so rich with authentic detail that only the artists and master craftsmen of The Franklin Mint, steeped as they are in the tradition of *precision coinage*, could have achieved it. Indeed, every nuance of facial expression, uniform and weaponry—right down to the buttons, braiding, sabers and carbines—will be depicted with meticulous accuracy.

Thus, The National Historical Society Civil War Chess Set is also a magnificent collection. A triumphant achievement of portrait sculpture—and the ultimate in micro-detailed miniaturization.

ALL FIGURES SHOWN ACTUAL SIZE.



Major General
William Tecumseh Sherman
BISHOP



General in Chief
Ulysses S. Grant
KING



General in Chief
Robert E. Lee
KING



Major General
J.E.B. Stuart
KNIGHT

Available only by direct subscription. Issue Price: \$17.50 per sculptured chess piece.
Limit: One complete set per subscriber. Please enter your subscription by July 31, 1984.



This handsome pewter-finished chessboard and fitted presentation case will be provided as part of the set.

A dramatic showpiece for your home or office

The chessmen themselves are scaled so that each one will suit the function assigned to it in the game of chess. And the handsomely crafted, pewter-finished playing board has been sized with equal care. Specially fitted, to also serve as the cover for the case which will house all 32 playing pieces, the board completes a presentation so attractive that the chess set will be played and displayed with pride and satisfaction. A Certificate of Authenticity, and specially written reference materials, will also be provided.

Exhibited on a table or cabinet in your living room, family room, den or office, this is a possession certain to evoke both admiration and respect from all who see it. A unique tribute to unique Americans. A work of heirloom quality, that will bring you endless pleasure through the years. And a chess set eminently worthy of being passed on from generation to generation.

The subscription rolls are now open. The work may be obtained *only* by direct subscription, with a limit of one complete set per subscriber.

The chessmen will be issued to you at the attractive price of \$17.50 each, with the specially designed playing board and protective case provided at no additional charge. As a subscriber, you will receive two sculptured pieces every *other* month. You will, however, be billed for only *one* chessman at a time—a total of just \$17.50 per month. In addition, you will have the option to complete your set earlier, if you wish—but you will be under no obligation to do so.

Here, then, is a work that will bring lasting pleasure to chess enthusiasts, history buffs, collectors of military miniatures—to anyone who appreciates our nation's heritage. Indeed, it is an unmistakably American chess set, that will make a dramatic addition to any room. And an exciting showpiece that will be displayed, enjoyed and treasured by each succeeding generation.

To acquire The National Historical Society Civil War Chess Set, no advance payment is required. But please note that the accompanying Subscription Application is dated and should be returned postmarked by July 31, 1984.

© 1984 FM
SUBSCRIPTION APPLICATION*

The National Historical Society CIVIL WAR CHESS SET

Please mail by July 31, 1984.

The National Historical Society
c/o The Franklin Mint
Franklin Center, Pennsylvania 19091

Please enter my subscription for The National Historical Society Civil War Chess Set, consisting of 32 chessmen.

I need send no money now. I will receive two new playing pieces every *other* month, but will be billed for just one piece at a time—\$17.50* per month—beginning when my first shipment is ready to be sent. I will receive the fitted presentation case and pewter-finished chess board at no additional charge.

*Plus my state sales tax and \$5.00 per chessman for shipping and handling.

Signature _____
ALL APPLICATIONS ARE SUBJECT TO ACCEPTANCE

Mr./Mrs./Miss _____
PLEASE PRINT CLEARLY

Address _____

City _____

State, Zip _____

Limit: One complete set per subscriber.

222



When stick is shiftless

My problem is shifting the manual transmission of a 1982 Plymouth Reliant (2.2-liter engine) into REVERSE. The condition is sporadic, occurring primarily when the engine runs at fast idle. This morning, for example, I had to wait and wait with the clutch pedal to the floor for gears to stop spinning. I finally turned off the engine, shifted into REVERSE, and restarted the engine so I could move back.

The dealer has made adjustments, but has not corrected the problem. Now he wants to drop the transaxle. Before I

let him, I want to know if there are any service bulletins about this.—Jim Fitz Morris, Rochester, N.Y.

There aren't, Jim, so let him pull the transaxle to replace the clutch disc. He probably won't have to disassemble the transaxle if that's his intention, but he has to drop the assembly to reach the clutch.

The trouble is probably being caused by a disc that has been contaminated with grease or oil. Or, perhaps disc facings are worn to within less than .015-in. of the rivet heads.

Sidewidin' critter

Some of us diesel owners here in the South are being hampered by a substance in our car and pickup truck fuel tanks that is clogging fuel systems. Twice this year I've had to drain my fuel tank.

I took a sample of fuel containing ribbons of the stuff, resembling tar, to the agricultural department for testing and was told it was algae. It occurs, they said, if fuel stays in a fuel tank too long. We would appreciate your suggestions for solving this problem.—Ben Eason, Raleigh, N.C.

The condition is often called "slime," "diesel goo," and "the critters." It's a microorganism (bacteria) buildup that forms a gelatinous substance that clogs the fuel filter. The condition prevails in a warm, humid climate.

It is not algae, although it's often referred to as such. Algae breeds in the presence of light. There's no light in a fuel tank. Bacteria, on the other hand, thrive in darkness, and it's pitch black in a fuel tank.

There's also a lot of confusion concerning where the bacteria comes from. You were told that they develop if fuel stays in the fuel tank too long. That's not so. The bacteria actually are introduced into vehicles from the storage tanks at fuel filling stations. Once the bacteria get into your tank, they multiply.

How can you get rid of them? You don't have to drain your tank. Install a new fuel filter. Then, buy a biocide additive, such as Biobar made by U.S. Borax Co. It's available at a diesel or

home heating fuel dealer or marina.

Follow instructions that come with the product. If there are no instructions, pour two ounces into the fuel tank and fill the tank. Do this for three tankfuls and then every other tankful until the slime is gone. You can tell when this day occurs by carefully inserting a clean length of wood dowel into the fuel tank through the filler pipe until it meets resistance. Pull it out. If the stick is free of slime, you have achieved success.

Some final advice: Don't buy a biostat, which is a different type of fuel additive. This will retard bacteria growth, but it won't kill the microorganisms which will continue to multiply after the biostat treatment has been completed.

Service bulletins

Here's an answer to a question a lot of readers have asked: Chrysler's policy regarding public distribution of service bulletins is different from GM's (see *Car Clinic*, page 28, May '84) and FoMoCo's (see *Car Clinic*, page 20, June '84). Chrysler publishes service bulletins in book form for a particular model year one year after the final bulletin for that year has been issued. You can currently order service bulletins for 1982 and earlier models.

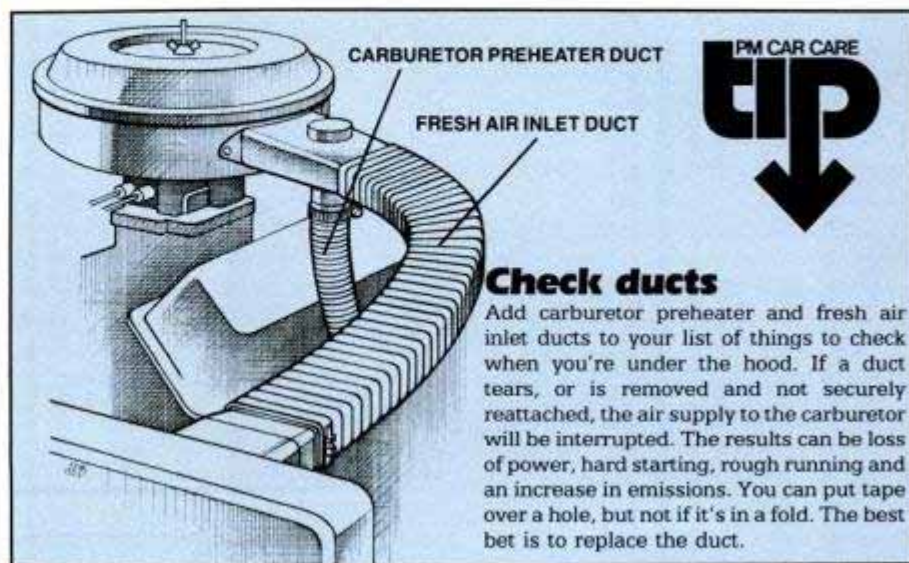
The charge is \$7.25 per book. In the United States, send requests to Chrysler Corp., 20026 Progress Drive, Strongsville, Ohio 44136, Attention: Service Bulletins. In Canada, contact Chrysler Canada Ltd., 36 Overlea Blvd., Toronto, Ont. M4H1B7, Attention: Service Bulletins.

Wright turns

I have a 1977 Dodge 100 Tradesman Van. The 318-cu.-in. engine dies when you make normal right turns—just as if you turned off the key. The engine starts right up, but the stall's enough to scare you to death if there's traffic. If I ease around the corner, it goes okay, but I get plenty of angry horns telling me to get my butt moving. There's no stalling on left turns or straightaways. What's wrong?—Edward Wright, Middletown, Conn.

Body flexing on normally made right

(Please turn to page 20)



Check ducts

Add carburetor preheater and fresh air inlet ducts to your list of things to check when you're under the hood. If a duct tears, or is removed and not securely reattached, the air supply to the carburetor will be interrupted. The results can be loss of power, hard starting, rough running and an increase in emissions. You can put tape over a hole, but not if it's in a fold. The best bet is to replace the duct.

Designed to do everything a modern car should. It just looks better doing it.



Get it together—Buckle up.

Technology never looked so good.

Tempo, the car that combines form and function.

Tempo's aerodynamic shape manages the flow of air over and around it to reduce overall lift and improve stability and directional control.

Tempo technology includes features like front-wheel drive for all-weather traction, four-wheel independent suspension for a smooth ride, and a High Swirl Combustion engine for quick power response.

Tempo's new tach.



You can now get a new tachometer and new low-back bucket

sport seats, as part of the optional Sports Appearance Group. This package adds a sporty new flair for those who like their Tempo a bit more upbeat.

New diesel option.

Ford Tempo now has a new optional diesel engine.

Ford Tempo

It is a true diesel engine, not merely a modified gas engine. This new diesel has additional sound insulation. Cold weather starting problems usually associated with most diesels are eliminated. And, of course, it has strong diesel mileage:

41 EPA EST. MPG* **56** EST. HWY. LITWY.

Front-wheel drive.

Tempo's front-wheel drive configuration is practical for

all driving conditions. It gives you good traction in rain, snow and mud.

Reduced insurance rates.

The Allstate Insurance Company offers reduced rates on collision and comprehensive coverages to Tempo owners, because of Tempo's construction with features like 5 mph impact bumpers. Reduced rates are realistic testimony to Tempo's structural integrity.



Available in 4-door and 2-door models.

Best-built American cars.

When we say "Quality is Job 1," we are talking about more than a commitment. We are talking about results. A recent survey concluded Ford makes the best-built American cars. The survey measured owner-reported problems during the first three months of ownership of 1983 cars designed and built in the U.S., and the commitment continues in 1984.

Lifetime Service Guarantee.

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

See your participating Ford Dealer for details.

*For comparison. Your mileage may differ depending on speed, distance and weather. Actual highway ratings will probably be lower. Not available with A/C.

Have you driven a Ford... lately?



CAR CLINIC

(Continued from page 18)

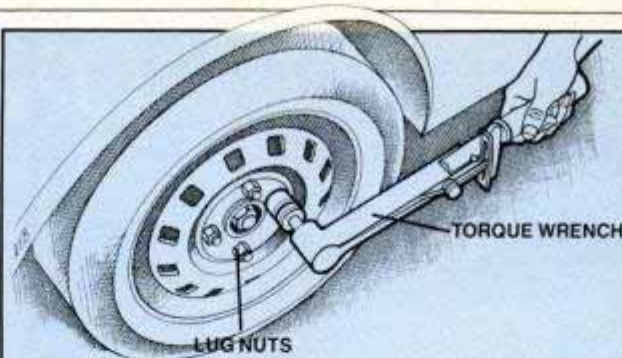
turns is probably causing a bulkhead or body connector to pull apart, turning off ignition current. When the vehicle rights itself, the electrical connection is remade—that's why you don't have trouble restarting. So check all connectors for loose pins.

You'll have to suspect every connector and probably will have to make unnecessary repairs. There's no way to troubleshoot this condition.

Someone may tell you the problem is being caused by a bad carburetor float. I doubt it. First of all, the brass float in the BBD carburetor in your van is reliable. Second, if a heavy float were causing the engine to flood on turns, the engine wouldn't be easy to restart. And third, when it did restart, you'd probably get a billow of black exhaust smoke.

It's a holdup

The trunk lid of my 1982 Buick LeSabre won't stay up unless I hold it. The dealer replaced the lifters soon after I bought the car. Is there anything I can do about this?—Francis J. Garbarino, Norman, Okla.



Happy torque torque

Read what Don Denison of New Castle, Ind., has to say about the importance of correct torque:

"My 1980 Phoenix had a vibration from day one. We went through three new wheels, six new tires and 16 wheel bal-

ances before I gave up. One evening someone on public television explained how to balance tires. The man said wheels, particularly on front-wheel-drive cars, are sensitive and must be torqued to factory specs. So I had them balanced once again and torqued to 100-ft.-lbs. Guess what? I had a smooth-running car for the first time in 30,000 miles."

Terrific!

The lifters he used weren't strong enough to support the lid. Recently, a new deck-lid support (part No. 20477733) was issued for 1980-83 GM B- and C-body cars. It will do the job, so have a set installed.

People's court

I am turning to you as my court of last resort with a 1982 Buick Regal Ltd.,

3.8-liter V6 engine, which was purchased new in October 1981. From the beginning, it's hesitated and sagged prior to accelerating from a stop or when shifting out of first gear. It also runs rough at idle and occasionally dies in traffic.

This all happens primarily when the engine is partially warm. To date, the dealer has replaced the computer, rebuilt the carburetor, and adjusted near-

How to Tow With Today's Car and save up to \$15 at Hitch World



New cars are built lighter to save gas. So when you tow, you want added protection. Here are a few tips to follow:

1. THE RIGHT HITCH.

Hitches differ. The wrong one can cause body damage, or tear out. Hitch World provides the hitch to fit your towing needs, using top brands like Draw-Tite and Reese. Each hitch has a nationwide warranty, good as long as you own your tow vehicle.

2. A TRANSMISSION COOLER.

Towing with a downsized car causes heat build-up in the transmission. That can burn the transmission's fluid and shorten its life. Hitch World selects and installs a transmission cooler, like Hayden, that extends the transmission's life by releasing the towing-caused heat.

3. A TOWING SUSPENSION.

A standard suspension is basically made to carry passengers. Frequent trailer towing can reduce the life of your springs and shocks. Hitch World installs air lifts or air shocks, such as Monroe and Hellwig, that give your tow vehicle added frame support, and reduce suspension and tire wear.

NOW SAVE UP TO \$15

This ad is good for \$5 off the price of a hitch, a transmission cooler, and a suspension system (\$15 maximum discount, offer expires 12/31/84). It's all at your nearest Hitch World. Look in the White Pages under U-Haul Centers. Write for a FREE HITCH GUIDE: HITCH WORLD, Dept PM, P.O. Box 21503, Phoenix, AZ 85306



at your **U-HAUL** Center

For diesels only.

The stress of a diesel engine can take the heart out of a motor oil. But Kendall Super DSL is engineered with tough friction fighters and rugged anti-thickening agents. It stands up to higher diesel compression. Hotter diesel temperatures. Helps starting on cold winter mornings. Next time you change oil in your diesel van, pickup or car, change to Kendall Super DSL.



Kendall
KENDALL REFINING CO.
Div. of Witco Chemical Corporation
Bradford, PA 16701



Free from Kendall: A pamphlet with tips on diesel maintenance. Write Kendall Refining Co., Bradford, PA 16701, Attn: Advertising Dept.

ly everything on the car (I'm enclosing a list). Nothing helps. Can you tell me what should be done before I have an accident?—Dr. Floyd H. Holmgrain Jr., Bowie, Md.

Tell your dealer that the "needle" in this haystack will be found by looking at service bulletin 82-T-6. He'll have to install a different EGR valve (part No. 17078431) and PROM (No. 1225704). In addition, he should test certain systems and parts to see that they're working. Some parts he already has tested; however, here's a complete list anyway:

- EGR system.
- PARK-NEUTRAL backup light switch.
- Thermac air cleaner.
- High-energy ignition system.
- Evaporative emission control system.
- Base timing and electronic spark timing.
- Early fuel evaporation system.
- Sparkplugs and cables.

Resurrecting a hot subject

In the March 1984 Car Clinic (page 40), George Walters complained about lack of heat in his 1981 Escort. Your advice about using the right thermostat and installing it correctly was on the mon-

ey, however, I would like to add my two cents' worth.

My 1981 Lynx had the same problem. The cause was found to be a blown head gasket, which resulted in coolant loss. This is not an unusual condition for the 1981 Escort and Lynx.

Mr. Walters should press to have the head gasket replaced under the warranty. Until he gets this done, he should check coolant level often. The heater won't work efficiently unless the radiator is full.

I hope I've been of some help.—Jim Heeks, Bellmore, N.Y.

You've been a lot help. But I would like to add another cent's worth to this problem.

A low coolant level for whatever reason—not only because of a bad head gasket—causes heater output to drop considerably. Therefore, if you are losing coolant, you should pressure-test the cooling system. The trouble may, indeed, be a blown head gasket, but it could also be something as minor as a leaking hose.

FM

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

- When is a car's fuel tank filled? According to FoMoCo, when the automatic release on the gas pump shuts off three times. Insert the pump nozzle into the car filler pipe as far as it goes and fill the tank at the highest pump speed possible without having fuel spit back. When the nozzle shuts off, wait five seconds. Then, dispense fuel at one-half the speed you used initially. When the nozzle shuts off again, wait five more seconds and then add fuel. When the nozzle shuts off, the tank is full.
- If a "clunk" comes from the rear brakes of your 1984 GM A-, J-, or X-body car when you step lightly on the pedal, it may be caused by in and out movement of the rear brake shoes. No harm is done, but if it's annoying, have both rear drums turned on a brake lathe by about .005-in.
- Owners of 1984 Dodge Colt Turbos will find it hard to change the oil filter unless they remove the mud guard at the lower left-front corner of the engine compartment. It's held by three bolts.
- Your 1984 Honda Accord should not stall as it warms up. Nor should it foul sparkplugs. If the car is doing this, tell the dealer to install the applicable cold start/driveability kit listed in service bulletin 84-012. By the way, warranty coverage to correct these problems has been extended to five years or 50,000 miles, whichever comes up first.

**HOW BF GOODRICH
MAKES TRUCKS PERFORM.
THE RADIAL ALL-TERRAIN T/A.™**

The Radial All-Terrain T/A is built strong and rugged to maximize truck dependability—off the road or around town. Its tread pattern delivers remarkable wet and dry traction on all kinds of terrain and a quiet ride on-the-road.

BF GOODRICH **T/A** HIGH TECH
RADIALS

The Radial All-Terrain T/A™ was designed specifically with your truck's performance in mind. The Radial All-Terrain T/A was recently evaluated on a specially modified truck. The result: impressive performance. When equipped with the durable Radial All-Terrain T/A, the test vehicle provided remarkable traction. Even while completing a 135-yard hill climb over deeply rutted terrain with up to a 45° slope.



- The BFGoodrich Radial All-Terrain T/A is available in sizes for direct application on most original equipment wheels.
- A. Three carcass plies help resist sidewall bruising to optimize truck dependability.
 - B. Folded belt system provides excellent handling plus strength.
 - C. Tread pitch sequencing offers quiet ride.
 - D. Dual compound tread imparts outstanding mileage.



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WE MAKE TRUCKS PERFORM

APPLIANCE CLINIC



Dishwasher sluggish on drain

Our 11-year-old General Electric built-in dishwasher, Model GGSD431-03, Serial RH642378B, has seen a lot of reliable service. However, in the last six to eight months, it takes longer and longer to activate the initial drain cycle. From the start, it now takes 15 to 20 seconds for the drain pump to reach full momentum. I fear that this will worsen and eventually the washer will not operate at all. Once under full power, it continues through all cycles just like new. Is there some easy service or parts repair that can be done?—Ralph H. Meinel, Blairsden, Calif.

You could have a weeping water seal

in the motor/pump assembly. Over the years, the water seal could have developed a leak and slowly weeped water through to the motor shaft, which caused the shaft to begin rusting. Then as the shaft grew in size because of the rust, the buildup rubbed on the inside diameter of the seal faces, which caused a drag on the motor.

Once the motor gets up to speed, the rust is worn away and all seems to be well again. Eventually, the rust may build up to a point where the motor will not start at all.

The motor/pump assembly will have to be taken apart to determine if rust is

causing the problem. Depending on the degree of rust present, you may be able to rebuild the assembly by cleaning the motor shaft and replacing the seals; or you may have to replace the entire motor/pump assembly.

I suggest you get a copy of GE's step-by-step repair manual for dishwashers. Read pages 52 through 54. Then determine whether or not you want to tackle the job or have a pro do the work. Get the manual, part No. WX10X58, at any GE parts service center or call the GE answer center at 1-800-626-2000 to have it sent to you. The price is \$6.95 plus tax and postage.

Replacing clock motor

I own a Frigidaire range RDE 3-20W Cook Master Unit. I'm having trouble with the clock and need a replacement motor. Frigidaire parts outlets don't have the clock motors. Clerks there say I'll need to buy the entire Cook Master Unit. Do you know where I might locate this small, but very hard to find, part? Any help would be appreciated.—Roger L. Wills, Milwaukee, Ore.

You're in luck! There is a company in Ohio that can help you with your problem. It will repair any international register range timer and it still has parts in stock for timers that go as far back as 1947.

To get the clock motor, send a letter requesting clock motor Model No. WG180-1 to International Service Center, 425 Xenia Ave., Dayton, Ohio 45410. The cost is approximately \$13.60 plus postage and handling. If the motor doesn't solve the problem, the company suggests that you send the whole timer. It will rebuild the device for \$30 less the price of the timer motor.

Vacuum belts breaking

For the past year our old Hoover upright vacuum cleaner, Model 1060, has been breaking belts at the rate of one every two or three hours. New bearings, brushes and even rollers have been installed and various belts, including those made by Hoover, have been used. All attempts to deal with the problem have failed. Furthermore, ser-

vicemen, including those at the Hoover service center, tell me that the machine is in very good condition and that they can't find anything wrong with it. Can you help me solve this problem?—Theodore J. Storm, Berlin, N.J.

I contacted the Hoover Co., which suggested that your problem could be remedied by changing the brushes as well as the drive belt. The original brushes were made of a hard-bristle nylon, whereas the replacement brushes are made of horsehair and are a little more flexible. The replacement part number for the brushes is 164-178. The replacement drive belt is a little thinner than the original part and has a different part number—44780.

These parts are readily available at any Hoover Service Center. Or write to

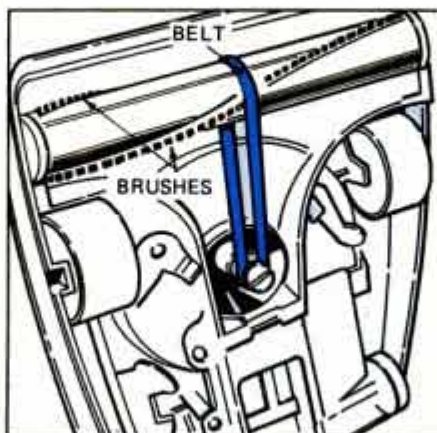
the Hoover Co., North Canton, Ohio 44720, Attention: Customer Service. Another suggestion Hoover had is to be sure that the front of the cleaner is adjusted high enough for the type of carpet you're cleaning.

Chambers stove parts

I have a 30-year-old Chambers range, Model 90C-61C, Serial 1-29748. It's a beautiful stove but is reaching the stage where repairs or replacements are needed. I can't seem to locate a source of supply or the original manufacturer. Can you help me?—E.J. McCoy, Enid, Okla.

Chambers still is a popular stove manufacturer, but it does not make free-standing stoves anymore, only built-ins. Your Model 90C was made back in the 1950s. Most replacement parts are no longer available from Chambers, but there is a company in Texas that has a large stock of both new and used parts for your range. It can even supply you with a reprint of the original service manual for your Chambers range.

For more information, write to Macy's Texas Stove Works, 5515 Alameda Rd., Houston, Tex. 77004. You will receive a parts list along with prices of those hard-to-get parts. **PM**



Changing brushes and drive belt may be the cure for constantly breaking belts on certain Hoover vacuums. The new belt is thinner; the new brushes more flexible.

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

DRIVE A DIESEL OVER YOUR LAWN.

It looks like a riding mower. It cuts like a riding mower. But this Kubota is something else.

We call it a Kubota G. You might just call it great. Because it's the first lawn and garden tractor of such remarkably small size to have a diesel engine.

A Kubota G tractor comes with a powerful 2- or 3-cylinder water-cooled diesel engine. The engines are built to the same exacting standards as our bigger tractors. And the advantages of a diesel engine vs. gas are many.

Diesel is thriftier on fuel.

Maintenance is cheaper, too, with no spark plugs, carburetor or distributor to wear out. So you can just concentrate on maintaining your lawn instead of your lawn mower.

Most important, a Kubota diesel will last longer. A good

deal longer than any gas mower.

Other big tractor features include a live front PTO shaft drive to the mower. Unlike a belt drive, the shaft can't stretch and is unlikely to break. The result is a smooth, more even cut.

You can also attach a front

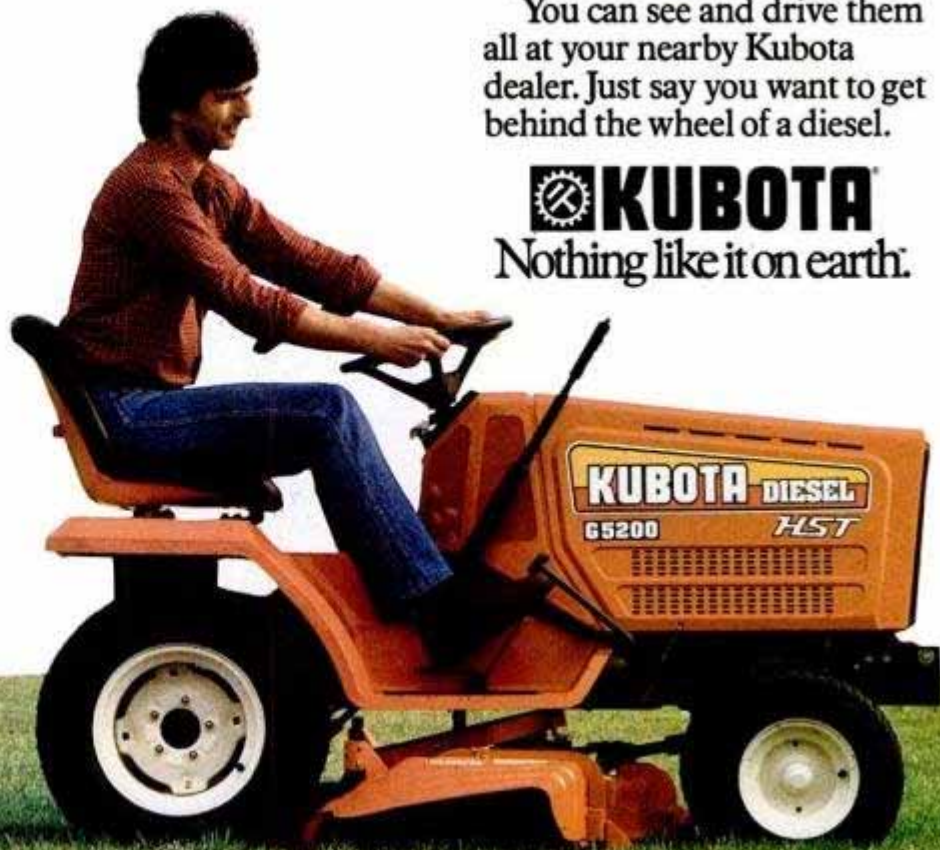
blade or snow blower. While an optional rear power take-off lets you operate a tiller.

There are four Kubota G lawn and garden tractors, from 10 to 14 horsepower. Two models come with an easy-to-drive hydrostatic transmission.

You can see and drive them all at your nearby Kubota dealer. Just say you want to get behind the wheel of a diesel.

 **KUBOTA**

Nothing like it on earth.



THE PM WORKBENCH



Radial-arm miter gauge

The Radial-Miter attachment enables you to cut precise 45° left and right miters on a radial-arm saw without moving the saw's arm. It's made of sturdy aluminum with the guide edges machined to a true 90° for producing square joints. The Radial-Miter has a built-in C-clamp for mounting to the front edge of the saw table. A wood cam is supplied for securing the workpiece against the guide edge to prevent creeping and kickback. It's available by sending \$32 postpaid to Topper Manufacturing Co., 1230 Racine St., Racine, Wis. 53403.—Rosario Capotosto



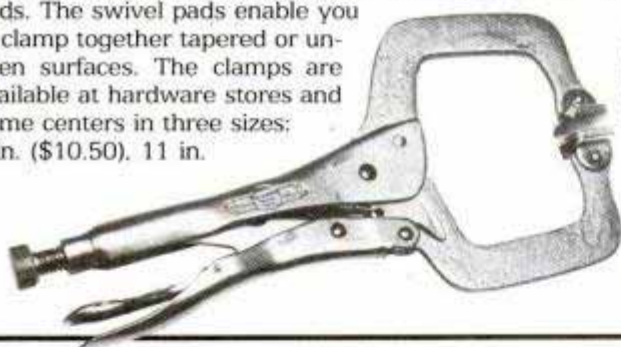
Clamp the miter gauge to the front edge of the saw table (left). Note that the wood cam holds the workpiece securely against guide edge to prevent kickbacks. Cam and gauge are shown above.

Quick-lock clamp

The Petersen Manufacturing Co., makers of Vise-Grip hand tools, has introduced a new line of quick-locking C-clamps that feature self-leveling swivel pads. The swivel pads enable you to clamp together tapered or uneven surfaces. The clamps are available at hardware stores and home centers in three sizes: 6 in. (\$10.50), 11 in.

(\$16) and 18 in. (\$22), with clamping capacities of 2 in., 3 3/4 in. and 7 in.

For details, contact Petersen Manufacturing Co. Inc., Box 337, DeWitt, Neb. 68341.—Rosario Capotosto



Locking C-clamp with quick-release lever features swiveling pads for angled work (below).



A popular-priced plane

Skil now offers an affordable power plane with features usually found on professional planes. The Model 94 (\$55) 3 1/4-in., 4/10-hp plane features an adjustable depth-of-cut knob, rabbet cutting capabilities, a double V-groove footplate for chamfering and two reversible high-speed steel cutters. For details, contact Skil Corp., 4801 West Peterson Ave., Chicago, Ill. 60646.

—J.T.



Use the power plane (above) for planing and jointing lumber to exact dimensions, removing old paint and rabbeting.

Professional levels



Heavy-duty aluminum, professional-quality levels are lightweight and long-lasting.

Stanley's new line of professional levels features two bent glass vials per station for a greater range of determining true plumb and level. Removable vial covers make it easy to adjust or replace the vials. Four sizes are available: 24 in. (\$30.69), 36 in. (\$35.09), 48 in. (\$51.65) and 72 in. (\$77.49). For details, contact William Shanahan, Stanley, Box 1800, New Britain, Conn. 06050.—J.T.

Exterior superscrew

Philstone Nail Corp., 35 Turnpike St., West Bridgewater, Mass. 02379, has developed a galvanized exterior screw with the features of a drywall screw including a Phillips bugle head, coarse threads and a sharp, nonwalking point. Called the Weather Challenger, it's designed for deck building and other outdoor uses. Available in sizes from 1-in. No. 6 to 4-in. No. 10.—J.T.



Unique galvanization process on exterior screw prevents rough, uneven zinc buildup.

Update

The dimension of the handle on the barbecue scraper shown in the May '84 issue (*Make A Barbecue Grill Scraper*, page 183) should read 1 in. dia. x 4 1/2 in. You can also use a short section of a broom handle. **PM**

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

FIRST IN POWER: \$5999* NISSAN.



1984 NISSAN REGULAR BED:

Number One in power, with the most horsepower and torque of any standard engine in its class. For just \$5,999*.

That's major muscle at a minor price! Only Nissan gives you so much for so little. Plus:

- Biggest standard engine (2389cc); the only one with twin-sparkplug-per-cylinder hemihead.

- Bigger standard payload (1,460 lbs.) than Toyota, Chevy S-10 or Ford Ranger.

- Double-wall cargo bed (not in Toyota base model).

- Overdrive 5-speed, standard (not in Toyota, Chevy S-10 or Ford Ranger base models).

- 3-across seating; more legroom than a Lincoln Continental.

- Steel-belted radials, halogen quadbeams and a truckful of extra comfort and convenience features at no extra charge.

That's Nissan: major toughness and value from advanced technology. Why settle for just transportation when you can drive Major Motion?

AT YOUR DATSUN DEALER.

COME ALIVE, COME AND DRIVE

TRUCKS

MAJOR MOTION
FROM NISSAN

*Mfr's. sug. retail price excluding title, tax, license and destination charges.



THE PM GARAGE



Probing the balance of power



Cylinder Power Analyzer from Kal-Equip makes quick work of power balance checks. Just push a button to short out each cylinder and note the rpm dropoff.

Before plug-wire terminals were recessed into rubber nipples, grounding out the terminals one by one to check for a weak cylinder was a standard test. The pro still could do the test (even short out a V-engine bank to check fuel

distribution) because his expensive equipment was specially designed for the job.

I've found a small tester from Kal-Equip that does the test—called power balance checks—and it's \$145.76 in auto parts stores. It takes just four hookups: two to the battery, one to coil negative and one to No. 1 plug wire.

Run the engine at about 900 rpm and press a button for the cylinder you want to ground out. Read the tester tach and note the rpm drop for each cylinder, which should be consistent from cylinder to cylinder. Or press three or four buttons to ground out a V6 or V8 bank (maximum of 15 seconds to prevent catalytic converter damage).

The tester also has an ohmmeter and voltmeter for general automotive tests. Though not wide enough scale for precision work, the additional meters get you extra mileage from the tester. From Kal-Equip Company, Box 188, Otsego, Mich. 49078. —Pete Warren

Bin waiting for this?



A four-shelf storage bin from Crafcro screws in behind the seat of your pickup to stow tools or hardware neatly. The shelves are carpeted to quiet rattles.

Had your fill of screwdrivers rolling out from under the seat of your pickup truck every time you hit the brakes? I certainly have. Crafcro's compact TOOL-BIN can bring an end to all of those hassles. The four-shelf storage unit snuggles into your truck's cab behind the seat and gives you plenty of room to organize your tools, sports equipment or camping gear.

Tapered to fit the seatback contour, this storage box is available in three sizes: 54 in. long for full-size trucks, 45 in. for mid-size trucks and a pair of 15-in. racks which fit behind the bucket seats in vans, jeeps and minitrucks. Constructed of 26-gauge rustproof steel, the TOOL-BIN also puts your gear out of sight to discourage theft. Retail price is \$79.95 for any of the three sizes.

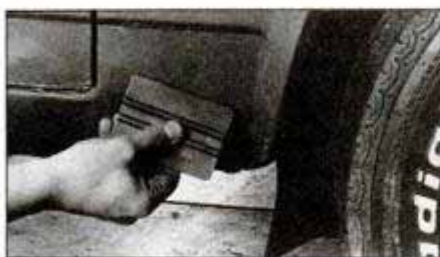
You can find the TOOL-BIN in parts and automotive equipment stores or order it directly from Crafcro Manufacturing Inc., 3639 East Superior, Phoenix, Ariz. 85040. Or call them at 800-528-4548. —N.M.

A chip in time . . .

will surely start a rust spot in your car's rocker panel. Flying stones won't take a nick out of the finish, though, if you cover it with Stone Chip Protection Film. A thick, adhesive-backed material, it is nearly invisible after application, or you can paint over it.

Stone Chip Protection Film installs quickly after removing the film's backing liner and spraying it with a water/rubbing alcohol solution.

The SCR 90 kit of film (8 in. wide × 90 in. long), applicator and instructions sells for \$19.95. It's available from Argent Fabricating Inc., 26202 West Seven Mile Rd., Redford, Mich. 48240. —N.M.



Protective Stone Chip film absorbs the hard knocks of road debris, protects your car's flanks from chipping.

The unchrome alternative

Yards of sparkling chrome are no longer the auto stylist's cure-all for dull



The latest look of blacked-out chrome can be added to any car at home with Black Tech adhesive-backed vinyl film.

designs. Today's fashion is the European look of blacked-out trim, and I'd say it's a welcome change. D.P. Designs' Black Tech adhesive-backed vinyl film kits let you apply that up-to-the-minute touch yourself.

The \$29.95 kit contains a sufficient supply of black matte finish film to cover the brightwork of most cars or small trucks. You can order it directly by mail by contacting D.P. Designs, 306 Linda Vista, Ann Arbor, Mich. 48103. —W.H.



STP[®] Oil Treatment fights motor oil breakdown.

Parts of your car's engine can reach 450 degrees Fahrenheit after only 10 miles of driving. This kind of intense engine heat weakens your oil's vital protective properties. That's motor oil breakdown. STP Oil Treatment fights motor oil breakdown. Here's how:

STP scientists specially formulated STP Oil Treatment to strengthen your oil's high



temperature performance properties. To put extra lubricants and antiwear agents to work... just where they're needed. STP contains a special chemical additive, ZDDP, that helps reduce engine wear, oil oxidation, bearing corrosion and engine sludge. Whenever you change or add oil, get STP Oil Treatment and fight motor oil breakdown.

Depend on STP proven performance. 

©1983 STP Corporation, an ESMARK Company, Boca Raton, Florida 33431

Wagner® revolutionizes

Introducing the Wagner® Power Twin™ airless sprayer/roller.

Imagine painting an entire wall and never once coating your roller in a paint tray.

Or tackling some intricate staining chore like shake shingles without the endless tedium of dabbing and poking with a brush.

Think about how nice it would be to never again have to pour paint from a can to a tray.

Now you're beginning to see the beauty of a versatile, new tool that stands to revolutionize painting around the house.

The Wagner® Power Twin™ airless sprayer/roller.

A Choice of Rolling or Spraying.

Created especially for home owners, the Wagner Power Twin is the first and only product of its kind.

It gives you the flexibility of an interchangeable spray gun and roller, both on a twenty-five foot hose.

The roller looks like the usual kind, but that's where the similarity ends. With this roller, a squeeze of the trigger pumps paint from the can, straight to the inside of the roller cover. Specially designed perforations distribute the paint evenly to the outside. So you can paint wall after wall nonstop, in smooth, even strokes. But

that's only half the story.

For covering large areas of hard-to-paint surfaces, you can attach the spray gun.

You'll be amazed how fast you can paint siding, shutters, decks, furniture, and more—all with a smooth, even finish and no brush marks.

The spray gun comes with a tough, tungsten carbide tip that lets you adjust the fan width of the spray for added precision.

And because it's powered by a piston pump, there's no bulky air compressor.

Applies Virtually All Kinds of Paint.

The Wagner Power Twin will spray oil-based paints and even heavy latex paints.

You can also apply stains, varnishes and lacquers. Or almost any other liquid, including sprayable pesticides.

Helpful Accessories.

A variety of accessories can help make painting with a Wagner Power Roller®

even more
convenient



2 hrs. 10 mins.

We painted this house, excluding trim, in 2 hrs. 10 minutes with the Wagner Power Twin. It took us 6 hours, 32 minutes with a brush.



24 mins.

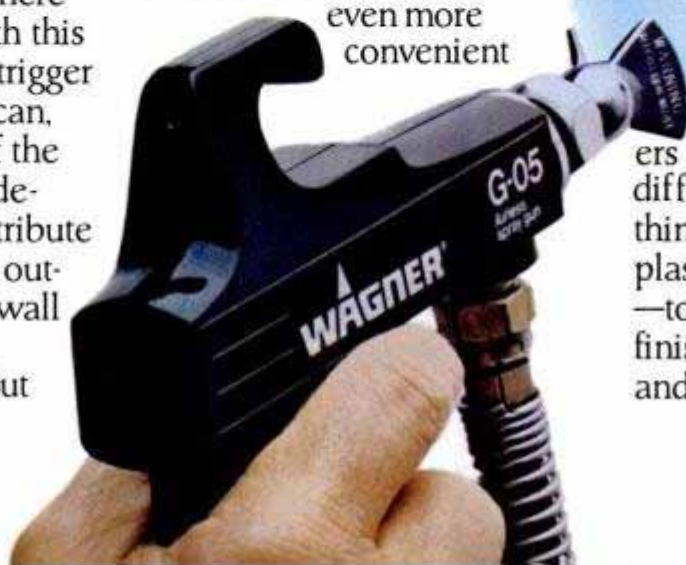
We painted this porch floor and adjoining outside deck in just 24 minutes with the Power Twin. It took us 34 minutes (and 32 dunks!) with a conventional roller.

and efficient.

For painting the ceiling or for reaching the top of a wall, you can avoid using a ladder by adding an eighteen inch extension to the roller.

An optional spatter shield will make the job all but speckle free.

Power Twin roller covers are also available in four different naps to give you everything from a very fine finish on plaster, drywall and woodwork—to a more heavily textured finish on stucco, rough plaster and cinder blocks.



painting. Again.



30 mins.

We painted this bedroom, excluding trim, in just 30 minutes with the Power Twin. It took us 57 minutes (and 81 dunks into the paint tray) with a conventional roller.



2 mins.

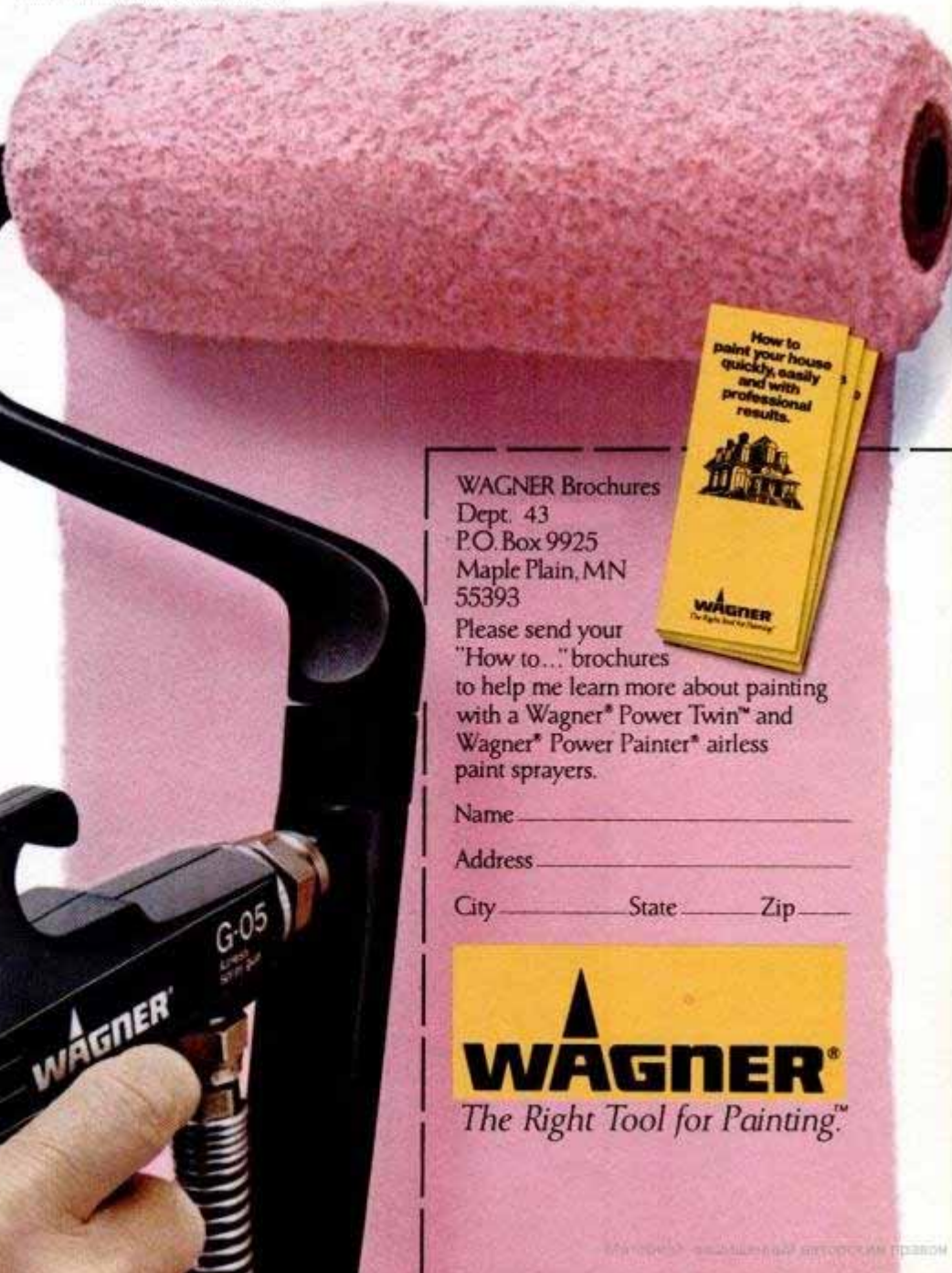
With the Power Twin, this porch swing took us only 2 minutes to paint. With a brush, it took 36 minutes.

next painting project, whether it's the new baby room or the old shed out back, consider the incredible Wagner Power Twin.

It's the kind of blue chip investment that'll pay for itself over and over again in time savings, ease and professional-looking results.



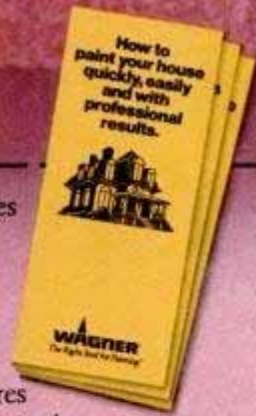
©1983 Wagner Spray Tech Corp. Power Twin® is a trademark and Power Painter® and Power Roller® are registered trademarks of Wagner Spray Tech Corp.



For working outside, 12 and 24 inch spray tip extensions will let you paint overhangs without having to climb on scaffolding or up a ladder.

There's also a 25 foot hose extension that increases the total length to 50 feet. So you can easily reach the top of even a large two story house.

The Right Tool for Painting™
Inside or Outside.
 When you consider your



WAGNER Brochures
 Dept. 43
 P.O. Box 9925
 Maple Plain, MN
 55393

Please send your "How to..." brochures to help me learn more about painting with a Wagner® Power Twin™ and Wagner® Power Painter® airless paint sprayers.

Name _____

Address _____

City _____ State _____ Zip _____

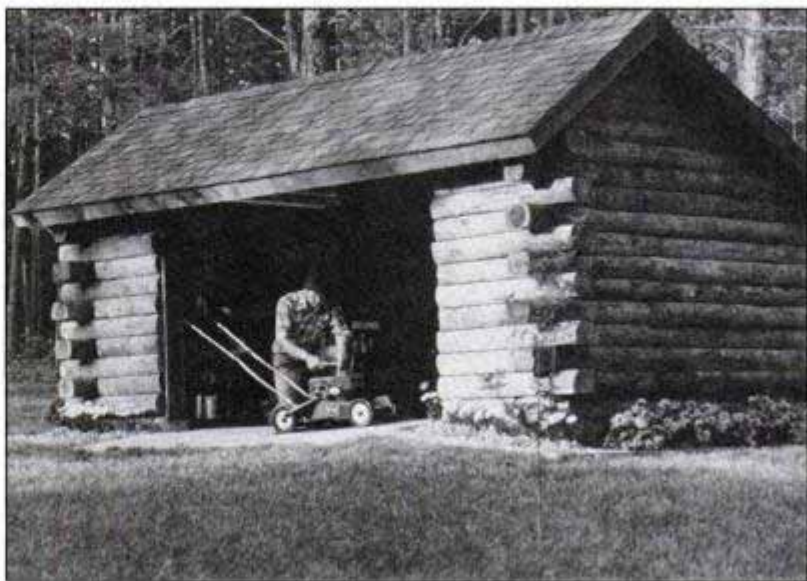


Mini-cabin in a kit

Real Log Homes offers easy-to-build precut log outbuildings in kit form. Shown here is the lean-to model, which is available in four sizes: 10×10 ft. (\$2,400), 10×12 ft. (\$2,500), 10×14 ft. (\$2,700) and 10×16 ft. (\$2,800).

The lean-to provides an attractive alternative for storing garden tools, lawn equipment and outdoor furniture. It can also be used as an animal shelter.

The kits include precut logs, 10-in. spikes, locksplines, PVC foam, rafters and three sets of blueprints. Included in the price are four hours of technical assistance from a Real Log Homes representative. For details, contact Real Log Homes, National Information Center, Box 202, Hartland, Vt. 05048.



Digital door opener



Stanley has introduced a digital keyless entry system (\$48.40) for garage doors that have automatic openers. You can open the door by pushing a four-digit code. Repeat the code to close the door. To stop a moving door, press the last digit of the code a second time. The system works with all Stanley U-Install openers and many other makes. Contact Stanley Automatic Openers, Marketing Dept., 5740 East Nevada, Detroit, Mich. 48234.

Thinking sprinkler



The Time-A-Matic Model 136 oscillating sprinkler (\$29.99) has a 48-position timer that shuts off the sprinkler automatically after delivering up to 1,600 gallons of water. A spray area control dial covers over 3,600 sq. ft. (52×70 ft.). Contact Melnor Industries Inc., 1 Carol Pl., Moonachie, N.J. 07074.



Extra-long cord reel

Black & Decker's outdoor cord reels provide an easy way for you to store and use long extension cords. The Model 84-012 (\$35) is equipped with 100 ft. of 16-gauge, three-wire outdoor cord. The Model 84-011 (\$15) comes without a cord for anyone who already owns one. For more information, contact Black & Decker, 500 Hanover Pike, Hampstead, Md. 21074.

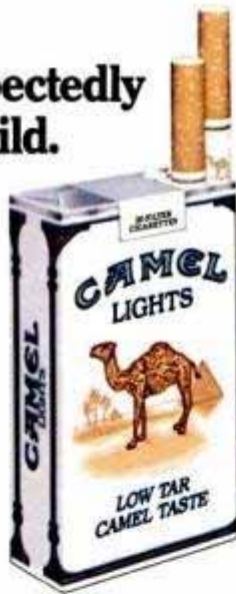
Computerized timer

The Sears RainMatic electronic water timer provides the exact amount of water for your lawn, garden, pool or livestock. The timer can be programmed to turn water on and off up to eight times a day or on prescheduled days. It runs on four D-size batteries and a sensor turns off the timer when the batteries are low. A built-in locking device will discourage thieves. The timer is available at the larger Sears stores and by mail order through the Sears catalog for about \$60. For details, contact Sears, Roebuck and Co., Dept. 703, Sears Tower, Chicago, Ill. 60684. **PM**



Enjoy Today's Camel Lights and Filters.

Unexpectedly
mild.



Surprisingly
smooth.



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

LIGHTS: 9 mg. "tar", 0.8 mg. nicotine, FILTERS: 16 mg. "tar",
1.2 mg. nicotine, av. per cigarette by FTC method.

DETROIT LISTENING POST



Dodge's Porsche killer

This night-fighter black Dodge Daytona Z derivative is in the final approval stages at Highland Park. Though originally suggested as a late '84 special addition, it won't be ready until '86 at the earliest. According to one Chrysler insider, "We're about 80 percent certain we're going to build it."

Note the radical Porsche 944-like fender flares and ground-effects side

skirts. The small photo shows the exhaust exiting just before the rear wheel. Surprisingly, the bodywork is all metal—no fiberglass—done in a specialty shop in California.

This car began life as a show car on the auto-show circuit. After appearing in two exhibitions, some Chrysler brass said, "Hey! We might be *building* this thing!" and hauled it back home under

Boy racer version of the Dodge Daytona Z features flared fenders, side exhaust and a 2.2 turbo engine with up to 175 hp. Four-wheel drive is also possible.



wraps. Forward thinkers prevailed, and it went back out to gauge public opinion at the Chicago Auto Show.

The wheel well flares aren't just for decoration. They permit more wheel offset, bigger disc brakes and radical, low-profile tires. The engine choice isn't etched in stone yet, but you *know* it will carry a variation of Chrysler's 2.2-liter front-drive package.

Under development at the Chrysler/Shelby Performance Center is an inter-cooled turbo, port-fuel-injected 2.2-liter Four with 16 valves. Chrysler sources suggest that this engine can put an estimated 175 hp and teeth-jarring torque to the tires through a five-speed transaxle.

Overheard but unconfirmed for this Porsche destroyer: *four-wheel drive*. It might be necessary to get all that power to the ground. Chrysler/Shelby has already worked on two 4wd conversions, a Dodge 600ES and a Chrysler Laser, as feasibility studies for the bosses in Detroit, so this isn't just pie-in-the-sky speculation. At 175 hp, the Wide Body Daytona, (as it's known in Detroit) will be right up there at the limits of what a front-drive chassis can be expected to handle.

Weekend Golf?

This year, Volkswagen of America is introducing its Golf, a smoothly recontoured version of the Rabbit that was introduced in Europe last year. With recent VW sales not setting the world afire, the Pennsylvania-made Golf is the car VWoA hopes will generate some excitement.

Enthusiasts will have to wait until 1986 for the wildest GTI yet—a 16-valve, 1.9-liter road hugger with a suspension tuned to keep its undisclosed power on the pavement. Fat, low profile tires and digital instruments will complement the performance image—but will we get a brand new *song*? *Kleiner GTI*, the wildly successful VW television commercial, continues to sell Rabbit GTIs as this is written.

CAFE, anyone?

In a bid to blunt government ire over General Motors' corporate average fuel economy figures, the General will hold over production of three high-mileage 1984 models until as late as November.

By continuing to produce '84 J-bodys (Chevy Cavalier, Pontiac 2000, Cadillac Cimarron, Buick Skylark, Olds Firenza), the Pontiac Fiero and Chevy Chevettes further into the 1984 calendar year, GM will acquire an estimated 227,000 additional fuel-efficient cars it can use for CAFE purposes.

This bumps GM's CAFE to 25 mpg—still under the 27 mpg mandated for '84, but GM had planned to make up the remaining shortfall with credits it earned in past years when its CAFE exceeded required levels. GM's other option would have been to close some assembly plants to avoid adding more big cars to the CAFE equation.

Buick sports car firmed

In the 1986-'87 model year, Buick will finally have the two-seat luxury sports car it's been seeking corporate approval for. The car, the GM33, is a derivative of the GM30 front-drive Riviera replacement. It's powered by a 3.8-liter V6 with port-fuel injection, coupled to a German-built Getrag five-speed. On-

board computers will feed data to a touch-sensitive video monitor, electronically controlling climate, stereo options and other functions.

T-van! T-van!

Chrysler brass have been basking in the warm glow of positive publicity from New York, where a \$15,500 taxicab version of the Dodge Caravan was recently unveiled. It wowed 'em in the Big Apple, where the roomy old Checkers are fading fast and all the new cabs have tiny back seats that are difficult to squirm in and out of.

Conversions are being done by Air Surrey Inc. of Brecksville, Ohio, which expects to deliver 30 to 40 a month to one of New York's biggest taxi fleets. Air Surrey raises the roof and adds a hinged rear door to each side of the van to permit curbside entry on the city's many one-way streets.

Privately, Chrysler engineers are worried about the long-range effects of slicing up the T-van's unibody and then

(Please turn to page 38)

Is everyone else asking too much? Or are we asking too little?

At Subaru, we truly believe in giving you the most car for the least amount of money.

The Subaru version of more car.

Some automakers talk about leg and shoulder room. Some talk about rack and pinion steering or front wheel drive. Others talk about durability and reliability.

Yet all that and more can be had in a Subaru Hatchback for a mere \$4,989.*

And that's just the beginning.

We've proven that advanced cars don't have to be expensive cars.

Standard on every Subaru is front wheel drive for improved road holding. And only Subaru has a

full line of vehicles that can go from front to "On Demand"™ Four Wheel Drive. We also offer Turbo-Traction™ — a combination of fuel injected turbo charging, "On Demand" Four Wheel Drive and automatic transmission. Both are innovations we pioneered.

At Subaru, being a pioneer in technology means we've discovered new ways to give you more for your money.

You save a lot when you buy a Subaru. And a lot more when you drive it.

Every Subaru — (Our practical Hatchback, family size Wagon, sporty Two Door Hardtop, open

back Brat, even our luxury Four Door Sedan) is designed to meet the demands of the economy as well as it meets the demands of the road. The engineering that goes into a Subaru, and the high mileage** you get out of one, make it inexpensive to own. And drive.

What's more, many dealers also offer Subaru Added Security. It's the only extended service contract backed directly by Subaru.

So think about it. Is Subaru offering too much for the money? Or is everyone else offering too little?

SUBARU.
Inexpensive. And
built to stay that way.



Seatbelts save lives.

*Suggested retail price for our STD Hatchback. Dealer's actual price may vary. Price does not include dealer prep, inland transportation, taxes, license, and title fees. Certain items shown optional at extra cost.

**EPA EST. MPG, 46 EPA EST. HWY. 1984 EPA estimate for our STD Hatchback. Use EST. MPG for comparisons. Your actual mileage will probably be less.

© Subaru of America, Inc. 1983

DETROIT LISTENING POST

(Continued from page 36)

pounding over the Apple's infamous potholes for several hundred thousand miles. Will it result in a split-T formation, leading perhaps to Apple turn-overs?

Chrysler mini pickup

During a recent intelligence-gathering operation, we came across a first edition mock-up of Chrysler's new N-body baby pickup truck. A Chrysler engineer told us that the truck will have a 5,000-

or perhaps even a 6,000-pound GVW rating.

The prototype is significantly longer and wider than either the Chevy S-10 or Ford Ranger. It has a newly built small pickup bed and chassis, with a Chevy S-10 cab lengthened by about 2 inches and grafted onto the front for development work. The bow-tie logo on the grille was carefully shaved off, however. Under the Chevy hood is a normally aspirated Chrysler 2.2-liter Four. Transmissions will include automatic and five-speed manual versions. It's still too early for the engine guys to have given thought to a turbocharged

sport truck model, and Chrysler sentiment seems to be running lukewarm over rumored development of a home-built Six.

Until the Highland Park Six can be developed, *Chrysler de Mexico* will be the sole supplier of slant-Sixes and V8s for Chrysler products in the immediate future. They will be used in Fifth Avenues and light trucks.

GM's better idea

In an attempt to encourage seat belt use, GM will supply every new car and light truck buyer with a one-year insurance policy that will pay \$10,000 to the estate of any occupant who suffers fatal accident injuries, but only if he or she was wearing safety belts at the time of the accident.

This is a more positive approach than the common practice in England of reducing court settlements to unbelted victims because of their own contributory negligence.

Ear to the ground

Sunbelt testing: Chrysler Corp. has begun construction of a new *desert proving ground* in Wittman, Ariz. The 3,800-acre testing facility will cost \$12 million and add to the test capacity of Chrysler's Chelsea, Mich., operation.

Protection perk: GM will *extend the warranty period* for 1985 fwd C-cars to four years/50,000 miles for Cadillac and three years/36,000 miles for Buick and Olds. Diesel-powered Cs continue to carry the company's routine three-year/50,000-mile engine warranty.

Car costs down: Hertz Corp. says the cost of owning and operating a new compact car in the U.S. *went down 1.4 cents per mile* in 1983, the first such decline since 1971 and the second in history. The cost is now down to 46.53 cents a mile.

Golden Oldies: Cars & Concepts, the Brighton, Mich., customizer, and its subsidiary, Hurst Performance, will sponsor a *Hurst/Olds Car Club* for collectors and owners of the many editions of the venerable street performer. For info, contact Cars & Concepts at (313) 229-1400.

Limo phase-out: Cadillac will quit the factory-built *limousine business* in 1985, and turn the chore over to Cincinnati's Hess & Eisenhardt. H&E will establish a Detroit plant to build limos from fwd C-body Sedan de Villes and Fleetwoods.

Last X-it: A Mazda 626 lookalike is what the 1987 *Chevy Citation II* will look like. Its code name will be switched from the notorious X-car to the L-car. Reports indicate it'll be smaller, lighter and more fuel-efficient and powered by a 2-liter Four. **PM**

THE ORIGINAL. COPIED BUT UNMATCHED.

We invented this style of plier. Improved it with patented can't-slip adjustment. Improved it again with our patented stress resisting flange. And still again with our new PERMALOCK fastener. All of which is why tongue and groove pliers by any other name can't match CHANNELLOCK. Be sure that name is on the pliers you buy. Send for free catalog. Channellock, Inc., Meadville, Pa. 16335

Tools by

CHAN NEL LOCK

For you who want the best.



INTRODUCING A HONDA YOU DRIVE ON THE GRASS.

You know all about Hondas you drive on the street—cars and motorcycles with a long-standing reputation for engine superiority.



Well, now you can drive a Honda on the grass, too. It's a lawn tractor. The newest entry in our Lawn and Garden line.

And it's all Honda, designed and built from the grass, up.

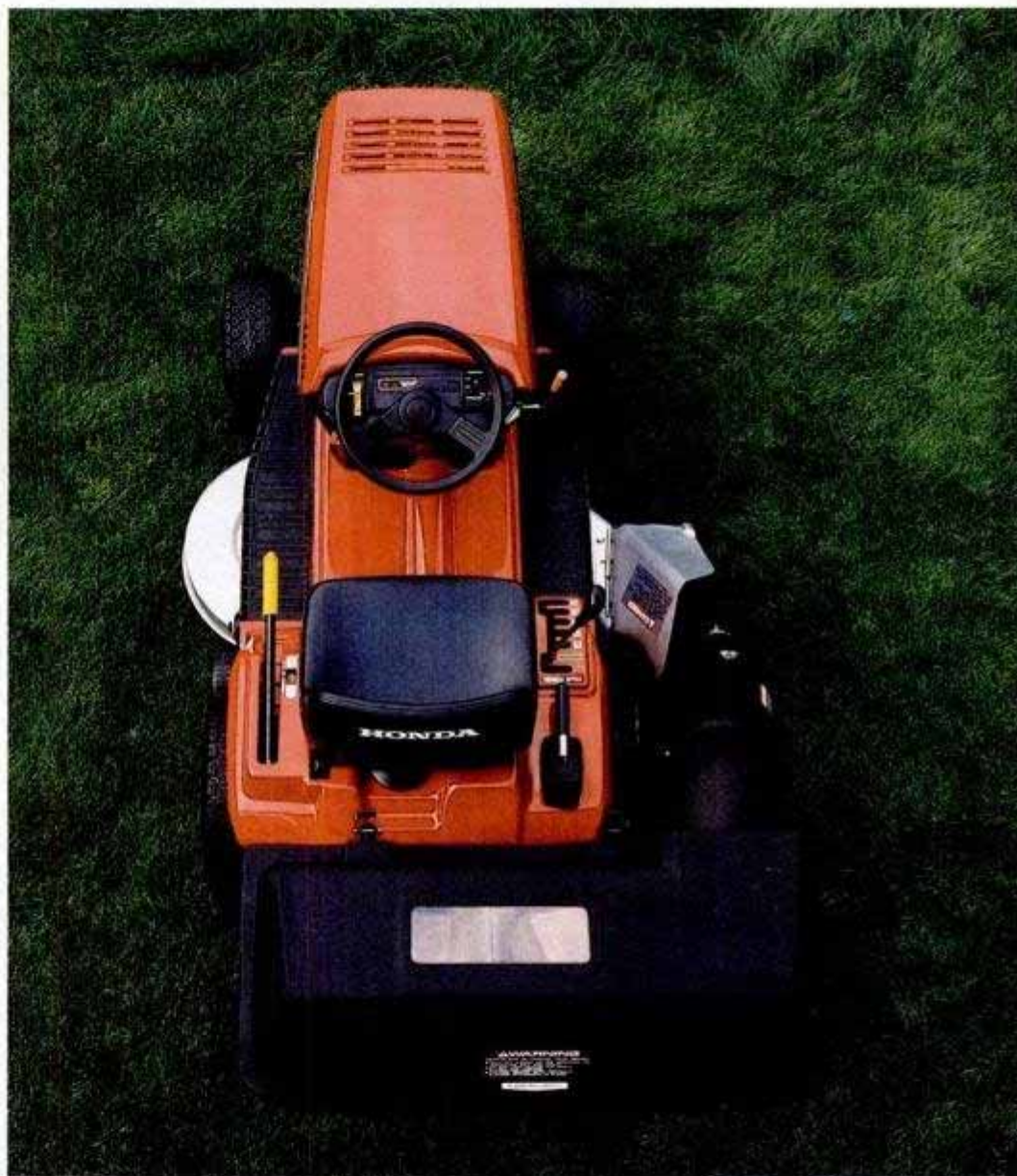
It's easy to drive. Just move the shift lever to any of the five forward gears and the clutch engages automatically.

It starts with the turn of a key.

It's got Roto-Stop™, the blade brake system that stops the blade within seconds while the engine continues to run.

It's got a 10HP engine that's built rugged and built to last. With a cast iron cylinder sleeve. A ball bearing-supported crankshaft. A chrome top piston ring. And an electronic ignition.

But don't think for a minute that Honda's expertise stops with engines. For years our walk-behind mowers have



been widely acclaimed as the "world's most advanced rotary mowers."

The Honda lawn tractor can be equipped with attachments like a snow thrower, a front blade or a utility cart for hauling.

To get behind the wheel

IT'S A HONDA

of the Honda you drive on the grass,



call your nearest Honda Power Equipment dealer. He's listed in the Yellow Pages.

ALL OUTDOORS



Bump-R-Ride inflatables are so tough, you can even tow them behind a speeding powerboat. The heavy-duty grip straps will allow you to ride seated or standing up.

Super tube for water sports

The old inner tube may now be gone from our automobile tires, but it's still very much alive and well on lakes and

waterways all over the country. Thousands of outdoor-loving people have made the pleasant discovery that tub-

ing down rivers, or even floating on a pond, can be a lot of fun.

Now there's a tube designed especially for water sports. The Bump-R-Ride consists of a heavy-duty rubber tube with a rugged fabric cover that includes a sturdy bottom panel. There's also a built-in tow strap provided for towing behind a powerboat.

The Bump-R-Ride lets anyone—even pets—get in on the thrills of water skiing, as well as river tubing, surf tubing or just plain floating.

The bottom section of the tube lets you sit or stand, and provides protection while you're floating down rock rivers or even sliding down snow-covered hills.

Bump-R-Ride is also ideal for commercial applications and, in fact, many boat rental and resort locations offer Bump-R-Ride to their guests.

The Bump-R-Ride is offered for \$100, and is available in three colors: red, yellow or blue. Also new on the market is a larger, four-man version, which is called Quadra-Ride. Both of the models are manufactured by Water Wonders of Orlando, Fla.

Fooling fish



It looks, acts, smells and tastes like real fish.

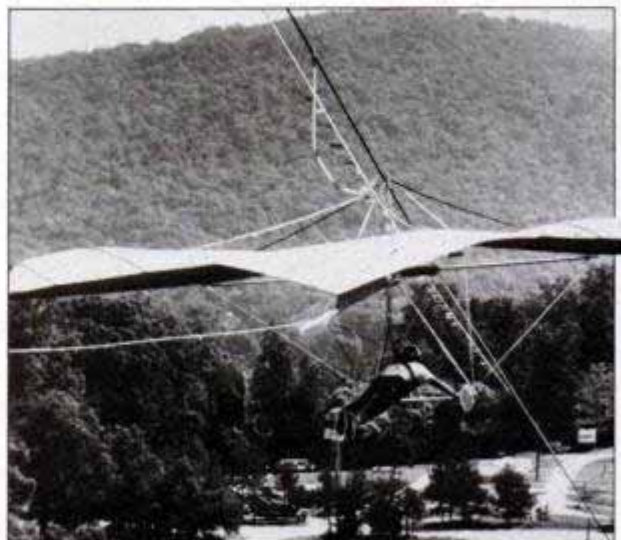
It doesn't take much to hook most people on a meal of fresh caught fish—and the same goes for the fish. A new lure, Chum'n Minnow, tempts its prey with the smell and taste of live fish. The secret is a nontoxic plastic-like material called Flavorol from fish extract and stabilizers. Its fishy scent will not wash or wear off. In three sizes and three colors, the lures are by Bass Buster Lures. They're in fishing and bait shops for about \$1.50. Or write Johnson Fishing Inc., 1531 Madison Ave., Box 3129, Mankato, Minn. 56001-5498.

The hang of gliding

Hang gliding may be as close as man will come to soaring like a bird, but the natural flyers hold the edge in airborne—and landing—safety. Crystal Air Sports in Chattanooga, Tenn., is trying to close the safety gap by training fledgling hand-glider pilots and sharpening skills of thin-air veterans.

It uses a unique simulator—a hang glider suspended from a 750-foot cable between two hills. During a 25-second ride you never get more than 60 feet above the ground. Forward speed is enough to make the glider's airfoil work so you get the feel of controls under actual flying conditions. You can climb or dive up to nine feet without the worry of making your own personal crater in

Mother Earth. A minicourse—instruction and two tethered flights—costs \$20, while thrill seekers can fly the simulator for \$10. For more information, you can contact Crystal Air Sports at (615) 825-2995. **PM**



The Crystal Air Simulator: overcoming the fear of flying.



ST/O/P

— Statistical
— Operations
— Processor

ESCORT finds radar before radar finds you

You may have been a passenger in a car equipped with a radar detector. Unless the detector was an ESCORT, you probably came away unimpressed.

A Good Idea, But...

The fact is, most radar detectors create more problems than they solve. They buzz and beep for no reason. And when they do pick up radar you're close enough to see the patrol car. But not all detectors are created equal.

Does it work?

Listen to the experts. When Car and Driver magazine first tested ESCORT, they said "You will be pleased to know that the radar detector concept has finally lived up to its promise...once you try the ESCORT, all the rest seem a bit primitive." Their most recent test adds "All things considered, the ESCORT is the best piece of electronic protection on the market."

Red Alert

Other detectors simply sound an alarm. You have to go on full alert, because you don't have enough information. How close is the radar? Just over the hill, or a mile away? Is it ahead or behind? X band or the insidious K band?

And how is it being used? "Instant-On" from a stationary trap? A moving radar unit approaching rapidly from ahead? You have no way of knowing.

Advantage ESCORT

Upon radar contact, ESCORT's alert lamp responds and the analog meter shows radar signal strength. At the same time, you will hear an audio warning—pulsing slowly when the radar is weak, quicker as it strengthens, then constant as you approach the radar unit.

ESCORT even uses a separate warning tone for each radar band. "Beep" for X band, a more urgent "brap" for K band because you have less time to act.

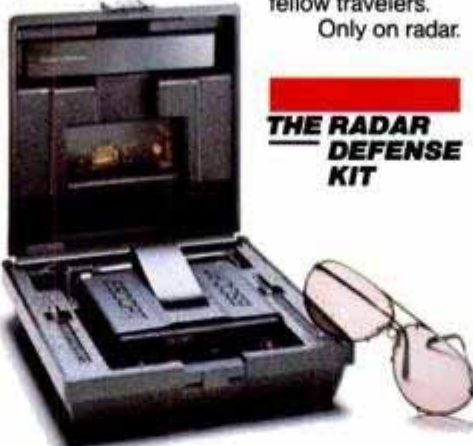
Quite simply, ESCORT tells you everything you need to know about radar encounters.

Informed Source

Another problem with most detectors is false alarms. They sound off so often you're never sure if it's radar or something else. Most frequently they're set off by "polluting" radar detectors, cheap imports so carelessly designed they actually *transmit* on radar frequencies. These "polluters" can set off an ordinary detector up to a mile away.

But not ESCORT. Our special ST/O/P™ (Statistical Operations Processor) circuitry recognizes and rejects these spurious signals. With ST/O/P, ESCORT does not report on fellow travelers.

Only on radar.



**THE RADAR
DEFENSE
KIT**

User Friendly

And when the warning does come, it's in a friendly voice. The audible warning is the same frequency used for Morse code (1024 Hz). And a fully adjustable volume control lets you set the level—ESCORT can cut through a Ferrari's interior noise, or leave a resting passenger undisturbed. Even the alert lamp is carefully thought out. It's bright enough to be seen in direct sunlight, but is automatically dimmed during nighttime operation.

A quick glance at the red LED assures you that ESCORT is on, and a City/Highway switch optimizes performance to either condition. All of this packaged in a low-profile aluminum case only 1½ inches high and 5¼ inches wide so you can have it, but not flaunt it.

The Bottom Line

It's easy to try ESCORT at no risk. Just dial our toll-free number; we're only a parcel delivery away. Take the first 30 days as a test. If you're not absolutely satisfied, we'll refund your purchase and pay return postage. We also back ESCORT with a full one-year limited warranty on parts and labor.

Let ESCORT find radar for you.

Order Today

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

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FIRESTONE LIGHT TRUCK RADIALS JUST ROLLED OVER 13,000 BRUTAL MILES FROM AFRICA TO THE ARCTIC TO PROVE THEIR TOUGHNESS TO YOU.

Rain, mud, rock, sand, heat, sleet, fog, wind, and frigid arctic ice and snow over washed out jungle trails, desert highways, twisting mountain roads, high speed autobahns, and no roads - Firestone's Steeltex ASR handled it all.

At Firestone, we don't just say we build light truck radials tough. We prove it. One example: The Africa-Arctic Challenge of world adventurers Ken Langley and Garry Sowerby. Perhaps the toughest test of a tire ever in a race against time, weather, and terrain from the tip of South Africa to 500 miles above the Arctic Circle to set a world speed record - a feat never before attempted by man.

Their tires? The same Firestone Steeltex ASR all season light truck radials you can buy. And a good choice they were. Because 28 days, 12 hours, and 10 minutes after pulling out of Cape Agulhas, South Africa, Ken and Garry's GMC Suburban pulled into Nordkapp, Norway in winter darkness to win them a place in the Guinness Book of World Records. A tribute to the courage of two men. And more proof that Firestone builds light truck radials tough. From our Steeltex ASR to our off-road race winning Radial ATX and ATX Radial 23° to our Steeltex RTH for on-highway use. Bolt a set on at your Firestone retailer, and we'll make a believer out of you.



Copenhagen to Nordkapp

It was smooth sailing from Copenhagen to Rovaniemi, Finland. Then, winter hit. Freezing temperatures, snow and ice, and bitter winds as the roads dwindled down from four lanes to no more than tracks. So bad, snow plows had to lead the way the last 10 miles to Nordkapp, victory, and a new world record. At last, the incredible journey had reached its end.



Djibouti to Turkey

Across the Red Sea by ferry. Then across the vast, arid desert of Saudi Arabia. High speed highway driving, a 2,000 pound axle load, and temperatures climbing towards 130°. Into Iraq, the mountains of Mosul, and terrain tougher still as Ken and Garry made their way to Istanbul, capital of Turkey.

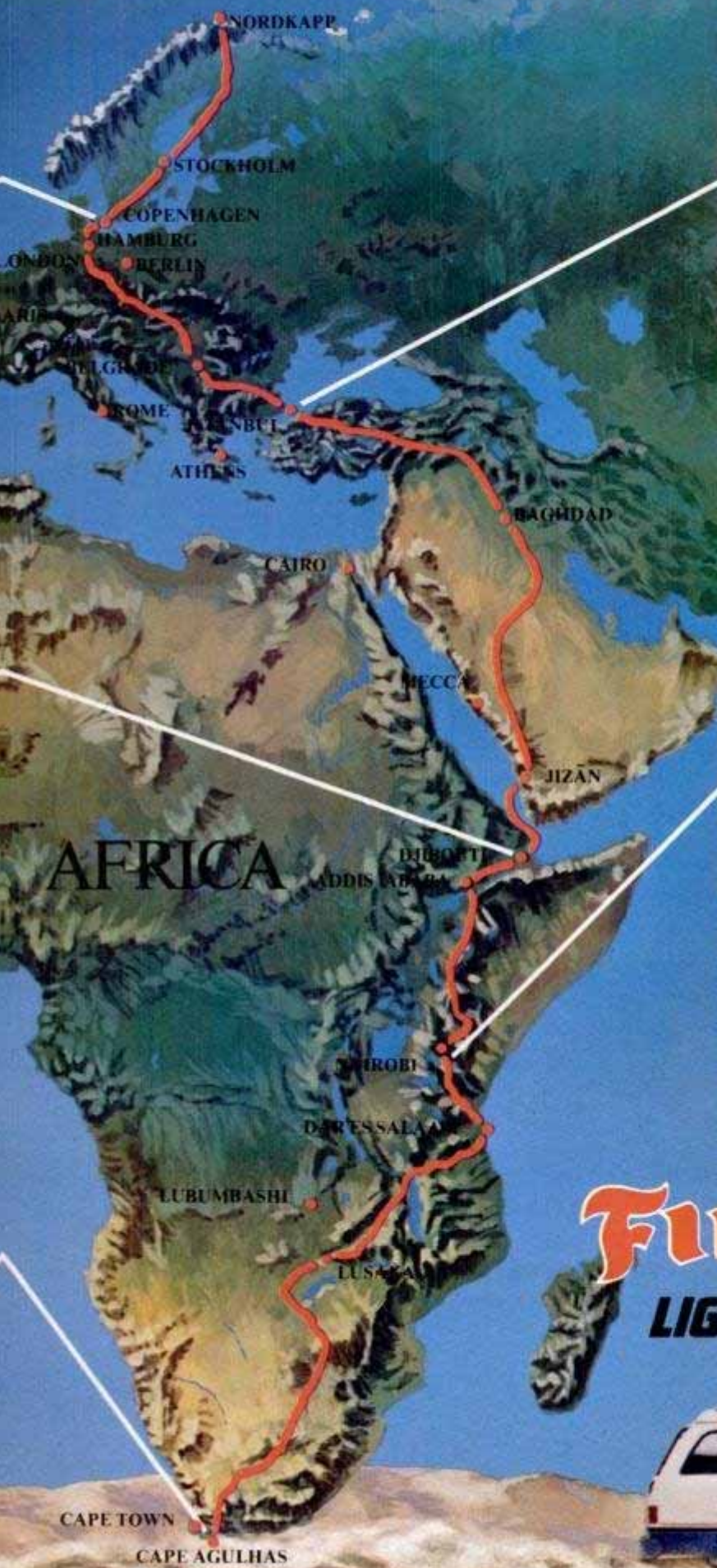


Cape Agulhas to Nairobi

From Cape Agulhas, the southernmost point in Africa, Ken and Garry raced over tarred roads and washboard roads, along the Kalahari Desert, through the steamy jungles of Zambia, over the axle-busting roads of Tanzania, north to Nairobi at the base of Mount Kilimanjaro.

Photography represents conditions encountered

THE AFRICA-ARCTIC CHALLENGE



Turkey to Copenhagen

Starting in Turkey, Firestone's Steelflex ASR's became snow tires. Barely passable mountain roads, near freezing temperatures, and a combination of rain, sleet, snow, mud, and slush that make some of the worst roads in the world even worse. Over the "Suicide Run" through Bulgaria and into Yugoslavia, Austria, and the Alps, 9,000 feet above sea level. Then it was high speed autobahns, slick with rain and snow, at speeds up to 100 miles per hour, all the way to Copenhagen.



Nairobi to Djibouti

Out of Nairobi, it was everything man and nature could throw at Ken and Garry. A rebel attack and a hail of bullets just south of Ethiopia, jungle highway, insect infested swamps where a truck could be literally sucked out of sight if it went off the road, roads passable only a few months of the year, steep mountain roads, and two perilous river fords before reaching the end of the African leg of their race.

Firestone

LIGHT TRUCK RADIALS



SCIENCE WORLDWIDE



Science as a video game



PHOTOS BY STEVE ESKOW

AtariLab screen shows the temperature in Fahrenheit and Celsius for its experiments.

Junior high school students will soon be playing a "video game" that teaches science. The AtariLab, designed by Atari and a team from Dickinson Col-

lege in Pennsylvania, is a keypad and software tape designed for the Atari computer. By next year it will be available for Apple and Commodore users.



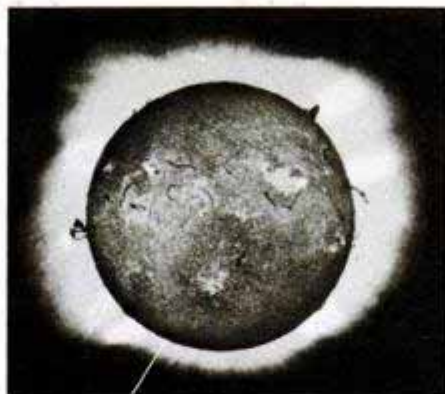
Hand-held thermistor records temperatures.

Plug the keypad into your system and insert the software—your screen lights up with the graphic of a thermometer. A thermistor (temperature sensor) attached to the keypad takes readings of temperature changes in any experimental sample—the air, a flask of water, a sample of skin tissue or what have you. Temperature changes show on the screen in Fahrenheit and Celsius. The readings first appear as a thermometer, and then as a bar graph. We tried the set and it was fun to use.

New York City has received the first 50 AtariLabs for its junior high schools. Atari says labs that measure light and moisture changes will be next on the agenda.

Spotting the sun

Solar Max, the satellite repaired by a Space Shuttle crew in orbit in April, has sent back some of the most dramatic and important photos ever taken of the sun's surface. Lockheed scientists have assembled a composite of three X-ray solar photos taken by Solar Max. They show two solar prominences (massive streams of electrons). One, a quiet prominence, is a hydrogen explosion that is receding. The other, an active prominence is a new explosion just beginning. The blasts take days to explode and recede. Meanwhile, Solar Max continues to photograph our sun.



Solar Max reveals sun's quiet prominence at 1 o'clock and active prominence at 9.

Cold Antarctic facts

Did many of Earth's life forms originate in the Antarctic region? They may have. Purdue University geologist William Zinsmeister has found fossils of small plants and animals dating back about 40 million years. The small fish

and primitive plants he and other team members found last year represented living species still found in tropical regions. Until now, however, these plants and fish had no fossil record. Zinsmeister will resume his Antarctic research early next year.

Lasers against blemishes

Argon lasers have been used in minor surgery for several years. Now doctors at the Albert Einstein College of Medicine in New York have begun using more powerful and precise carbon dioxide lasers to remove blemishes and tattoos from human skin. The new technique is expected to make heretofore impossible skin operations commonplace in the next few years.

Red Cloud's Folk

Rarely do we get to read in detail the story of American Indians and the way they migrated. Now a new paperback from the University of Oklahoma Press, *Red Cloud's Folk* (\$12.95), uses findings from archaeological digs to piece together the Oglala Sioux migration across the Mississippi Valley to the Dakotas.

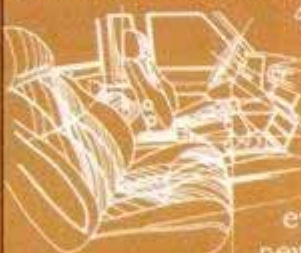
It's excellent history and good science rolled into one. **FM**

The all-new Toyota 4x4's are turning the truck world upside down!



Because they're part of the new generation of Toyota trucks for 1984, the most advanced trucks ever built! None of them is commanding more respect than these rugged, high-stepping 4x4's, designed to bring off-road performance to new heights. Toyota 4x4's have a big, powerful 2.4 liter SOHC engine and the highest running ground clearance of any small 4x4 truck with exclusive, fully enclosed front axles. No matter what kind of geography you're up against, these 4x4's can tame it. And look great while they're doing it. You can see the improved

aerodynamics in the stylish new wedge-shaped front end with flared fender design and in the new flush surfaces on larger front and side windows. All the 4x4's have new improved rear suspension for more smoothness in the ride than you'd expect from a truck! More room and comfort too, more leg room, and standard on the SR5 4x4, AM/FM/MPX stereo and wall-to-wall carpeting. Most 4x4's also have rugged double-wall bed construction. You can even get the new, 7-way adjustable driver's sport seat. If you choose the big new Xtra Cab 4x4, you get even more luxury and



adjustable driver's sport seat. If you choose the big new Xtra Cab 4x4, you get even more luxury and

OH WHAT A FEELING! TOYOTA

room, starring the personal cargo space behind the seats that'll hold anything from tool boxes to water skis. Also in the SR5



Xtracab, the convenience and efficiency of automatic locking front hubs, standard!

Toyotas have been the best-selling import 4x4 trucks in America. But Toyota engineering moved ahead anyway. Now this will be the tough act to follow in 4x4's for quite a while!

MOST ADVANCED TRUCKS EVER BUILT!

THE NEW TOYOTA FOUR-WHEEL DRIVE TRUCK. IT CAN HANDLE ANYTHING IT CAN PUT ITS FOUR WHEELS ON.



MUSCLE!



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Available in Regular
and Menthol.

Win This Truck!

WIN PM'S FOREST RANGER PICKUP



As you leave the pavement and swing onto the dirt road that leads to your favorite campsite beside the river, you feel a little apprehensive because of the recent heavy rains. The road might be impassable for normal vehicles. But not for your PM Forest Ranger. You shift into four-wheel drive and confidently maneuver around, over and through some of the roughest, slipperiest terrain around. All the while, you feel confident and safe.

Finally, you're at the campsite. As always, it's beautiful. The river gurgles by, the air is clear and crisp. You can almost hear the trout beckoning.

Setting up camp is a snap thanks to the well-organized and completely equipped storage units in the back of your Ranger. And you know you'll be comfortable and dry tonight no matter what the weather because you're going to bunk *in* the Ranger. And tomorrow's trip back home will be just as thrilling and as much fun as getting here.

Sound like a dream? Have you dreamed about owning a pickup equipped like our PM Forest Ranger? It does have lots of features that make a trip to the outback more pleasurable

You could be the proud owner of our customized Ford Ranger pickup if you're our contest winner.

and memorable. In fact, our editors have built the Forest Ranger to be *the* ideal vehicle for the outdoorsman.

Well, now your dream can come true, if you're the winner of our Win A Forest Ranger contest. All you have to do to win is tell us what you think our next project vehicle should be and how we should build it. If our judges select your idea, you will be the proud owner of the PM Forest Ranger, the neatest pickup truck ever for the outdoor enthusiast.

As an added bonus, if you live outside the New York area, we'll fly you to New York and you'll be our guest at a luxury hotel for the night. After breakfast the next day, you'll come to the *Popular Mechanics* offices, meet our editors, and take possession of your Forest Ranger Ford pickup. The winner's name and photo will also appear in the December 1984 issue of *Popular Mechanics*.

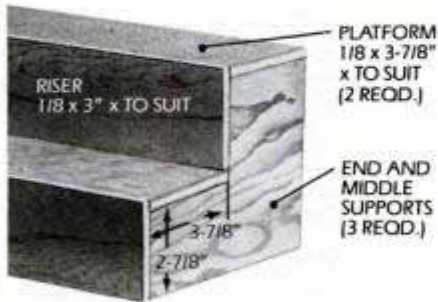
In case you missed our March 1984 story on the Forest Ranger (page 98), the vehicle is our editors' idea of what the ideal outdoorsman's pickup truck should be. It's based on a 1983 Ford Ranger 4x4 pickup with such factory options as XLT interior, four-speed manual transmission, power steering, power brakes, air conditioning, rear step bumper, sliding rear window, vent windows, tilt wheel, AM-FM/cassette stereo radio, exterior protection group, convenience group, interior lighting group, 13-gal. auxiliary gas tank, heavy duty alternator, heavy duty battery and camper package with 1,600-pound payload capacity.

If that wasn't enough, we added a few little items ourselves—like a ground-clearance kit to the suspension, Monroe off-road shock absorbers, American Racing 15x8 chrome wheels with McGard locking lug nuts, B.F. Goodrich P235/70R15 All-Terrain Radial T/A tires, Warn M6000 electric winch, Warn driving and fog lights, Saturn translucent sun visor, Cobra CB radio, Mag-Lite super duty flashlight, Range 1 Steel rollbar, Glasstite camper

[\(Please turn to page 57\)](#)

HINTS FROM READERS

Storage system for cans

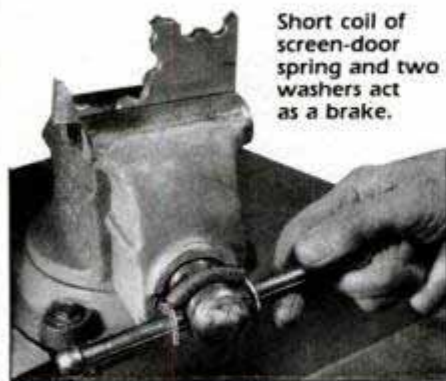


This stair-step approach to storing cans makes it easy to see the entire selection of canned goods in a kitchen cabinet.



To make this stair-step storage system for canned goods, cut risers and platforms out of 1/8- or 1/4-in. plywood to a length suitable for your cabinets. Cut one middle and two end support sections. Assemble the pieces with white glue and 3/4-in. brads.—Fred Haitz

Vise handle brake



Short coil of screen-door spring and two washers act as a brake.

To hold a bench vise handle in place as the vise screw is turned, I made a brake of two steel washers and a coil of screen-door spring. Drill a small hole in each washer for the spring ends. If needed, ream the washers slightly so they fit somewhat loosely around the handle. Cut the spring to size so it exerts slight tension on the washers when it straddles the vise-screw head.—Walter E. Burton

I Earn More Per Day Now...



than I used to make in a week.

I started my own business part-time as a Von Schrader Associate . . . got step-by-step help and success beyond my dreams.

How it really happened, by William Turnbow

"Fresh out of the Marines I bought a farm. Unfortunately, it wouldn't support a wife and three growing boys. Next I managed a food store. But I got tired of having somebody always telling me to do this and do that. I wanted to be my own boss.

"So I answered a Von Schrader message like this one, which opened the door to new opportunity for me. It was just what I was looking for. No big investment. No licensing or franchise fee. No waiting, no training needed. What really appealed to me is that you pay no dues, fees or royalties—every single penny you earn is yours to keep!

"I started out part-time. Jobs started to snowball and pretty soon I had as much business as I could handle. Before long I went full time.

"Now I make more in one day than I used to make in a week. I made \$43 per hour on one job recently . . . have made \$1,600 in a week. Now I have the time and the money to go hunting and fishing all I want. Recently we moved to a new, larger house."

How would you like to earn big money, starting out spare time, like William Turnbow? Be your own boss? Become financially independent? You can start in business for yourself using your home as a base. Everything you need on a job fits easily in your car.

As a Von Schrader Associate you can have three money-making businesses in one, if you want! Carpet

cleaning, with the only foam machine that cleans and vacuums carpets in one pass. Upholstery cleaning, that quickly results in bright, sparkling clean upholstery without harmful overwetting. And wall cleaning, almost 5 times faster than bucket-and-sponge, with little effort, no streaking.

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When you build the rugged Popular Mechanics air compressor, you'll get one of the most versatile shop tools around. It's a tough workhorse that can tackle jobs you never dreamed of doing before—riveting, sandblasting, spray painting, inflating and countless other projects. And, unlike ordinary compressors, the PM air compressor can evacuate your car's air conditioning system. But best of all, it's affordable. With plans from the Popular Mechanics Plans Library, you can build the PM air compressor yourself and save up to \$200.

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PM ELECTRONICS MONITOR

PM's electronics Hall of Fame

In 1952, when Popular Mechanics celebrated its 50th anniversary, we cast a plaque in bronze to celebrate the achievements of the country's great inventors. In the field of electricity and electronics, Thomas Alva Edison and Alexander Graham Bell are mentioned, and the list on the Hall of Fame plaque goes on to include other great names, such as Lee deForest and Charles Steinmetz. One name that may not be easily recognized is Nicola Tesla.

This month is the anniversary of Tesla's birth in 1856 in a small town in the old Austro-Hungarian empire. His leapfrogging intuition and curiosity gave us alternating current, induction motors, multiphase power transmission and motors, our worldwide electric power grid, neon and fluorescent light, and radio remote control.

He also, in 1892, laid the ground rules for work on antennas and grounds, "sympathetically" tuned receivers and transmitters, and other aspects of radio, though someone else (Marconi) got the patents for work not demonstrated until five years later.

After jobs in Budapest (where he invented the telephone repeater and amplifier circuit) and Paris (Continental Edison), he left Europe for America and became a naturalized citizen in 1889. At the height of World War I, in 1917, he lectured on the principles which became pulse radar, for the detection of enemy vessels and planes. He was laughed at, and serious development of radar waited until a panic development program in 1939 and 1940.

Nicola Tesla never enjoyed the finan-

cial fruits of the majority of his discoveries. He sold some of the alternating currents patents to George Westinghouse, who made millions with them.

Tesla's a.c. lighting system and many a multiphase motor illuminated and powered the Columbian Exhibition of Chicago in 1893. His VTOL airplane design was the direct ancestor of the 1950s Convair Pogo and the hard-working Harrier jet of the Falklands war, but no one listened in 1921.

In 1914, after costly litigation, the U.S. Supreme Court denied Tesla's suit to invalidate Marconi's radio patents on the basis of Tesla's own work during the five years previous to Marconi's 1897 public demonstrations. In 1943, the year Tesla died, the Supreme Court reversed the earlier decision, but the recognition was too little, too late.

However, Tesla's name is honored: It is used as the international standard unit of measurement for magnetic flux density, a permanent memorial to his work with current fields.

Looking at the plaque recently, we wondered: "What names might we add today?" We thought of several, and we'll mention their accomplishments in this column from time to time. The person we'll start with is someone you've probably never heard of.

Alan Dower Blumlein was only 38 when he died in 1942, when his Halifax bomber carrying an experimental radar team crashed. Since much of his most impressive work was shrouded by the Official Secrets Act then in force in Britain, and since his employer, EMI, is close-mouthed about even its early



Hall of Fame plaque honors achievements during PM's first 50 years: 1902 to 1952.

technical work, Blumlein's pioneering will remain largely unpublished.

He worked on the world's first all-electronic television system (regular broadcasts started in 1936 and used a 405-line system), developed high-performance phonograph equipment and a stereo single-groove disc, and navigational and airborne radar. We in America had to wait until 1948 to see regular TV, 1958 for stereo records, and the 1970s for the highly acclaimed moving coil phono cartridge—all Blumlein work from the early '30s!

Recording engineers have linked his name with a popular microphone technique. The Blumlein microphone array involves two coincident directional microphones at 90° to each other. His early death 42 years ago last month robbed us of his genius. It also cost him the recognition that, had he survived the war, would undoubtedly have been his. Without him, though, things today just wouldn't be the same.

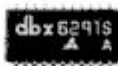
Stereo sound for your television

By the end of this year, the sound coming from your television can go from low-fi to hi-fi.

The Federal Communications Commission has just approved a wide-range stereo TV broadcasting and decoding format that will make this development possible.

The electronics companies that devised the format are Zenith and dbx. The dbx firm is located near Boston and regularly gives the electronics industry in the United States something to crow about.

The stereo television sound system will allow full, rich stereo sound to come from your TV with the use of an adapter soon to be available. TV stations are already gearing up for transmission of a stereo audio signal. It'll be compatible with the monophonic signal now transmitted, so don't worry about your TV being antiquated.



Heart of the adapter that will give your TV stereo sound is this IC chip from dbx, shown here actual size.

With a stereo adapter, however, or a new TV wired for stereo reception, you'll get noise-free stereo from any station or cable TV source broadcasting in stereo.

The heart of the adapter, or the circuit in new TVs that will be manufactured, is an integrated circuit that is from dbx.

When the stereo adapters become available, we expect them to be priced at about \$150. You'll also need a pair of speakers, of course, but you probably already have them as part of your stereo sound system.

PM

Easy-To-Install Attic Fan

Put in this unit without cutting a joist and spend the hot days in comfort.

Now that summer is here, are you beginning to have nightmares about last summer? Was your home as comfortable as it could have been? Did the heat and humidity make your family miserable? If so, an attic fan may solve this summer's woes.

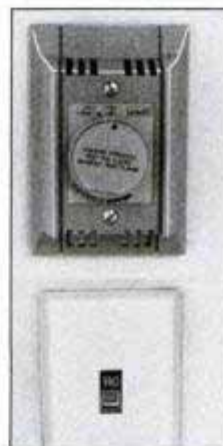
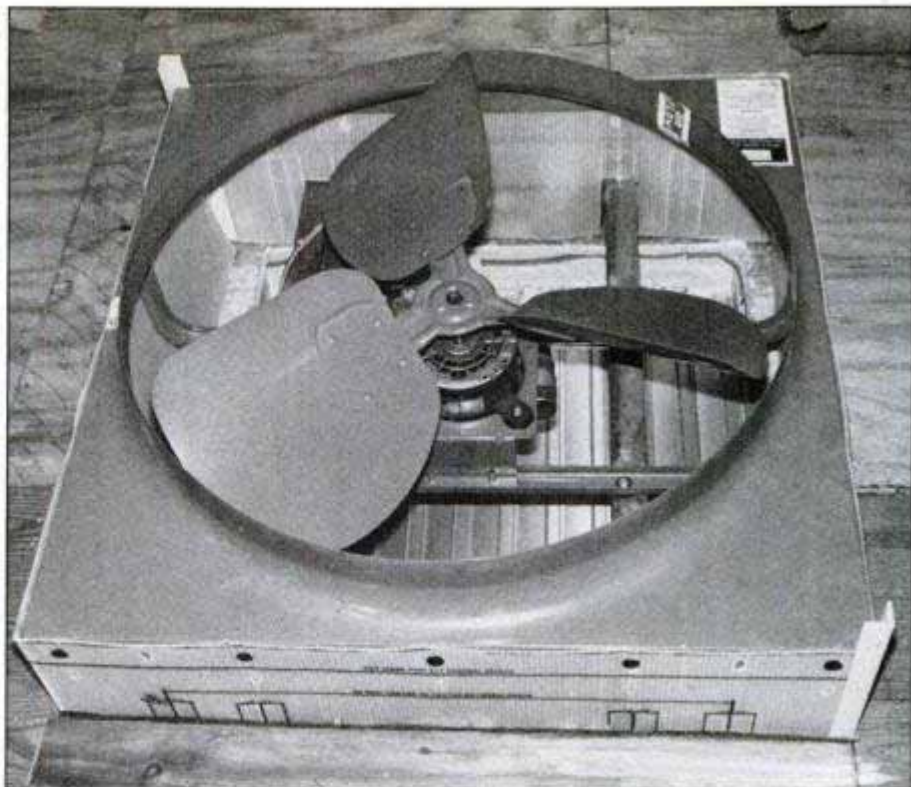
My family suffered last summer, so I decided to install an attic fan. Looking for one that didn't require cutting ceiling joists, I chose the Sears' Model 64077 30-in. fan, which is rated at 5,100 c.f.m. (cubic feet per minute of airflow), priced at \$249.99. (Sears also markets a 24-in., 3,600-c.f.m. fan—Model 64066—at \$229.99.)

The job, not counting most of the wiring, took my father and me about eight hours, but we have a house with a number of idiosyncrasies. For instance, the fan is designed to sit on joists placed either 16 or 24 in. on centers. Since the joists above the hallway in our 43-year-old home are approximately 18 in. on centers, I had to narrow the space between joists by nailing a length of 2x4 to one of them. In addition, the screws that Sears provided to attach the shutter cover to the fan are the proper length only if the ceiling is made of plasterboard; with thicker plaster ceiling (like mine), you have to substitute longer screws.

To begin the installation, find the proper location for the fan. The best spot is in the ceiling of a central hallway near the bedrooms. However, the fan also can be installed vertically in a wall or attic gable.

Cut the template out of the cardboard fan box. Center the template and drill a hole through its center and into the attic. Pass a length of wire or coat hanger through the hole to locate and mark the center of the hallway and establish the general location of the shutter. If your attic has floor covering, you'll have to pull some of it up (carefully, so you can re-lay it) in order to locate the wire.

Draw a straight line perpendicular to the joists and over the wire. Measure the distance between the joists, locate the center of the line you drew, drill another hole and pass the wire back



Fan extending into the attic (above) is surrounded by a corrugated plastic plenum sleeve liner. Once you position shutter on ceiling joists (far left), drill pilot holes through screw-hole locations in joists. Then it will be easy to drive in screws and cover holes in shutter with plastic plugs. After wiring outlet box, attach control switch and add cover (left).



One of the first steps is to locate the template and drill a hole through its center into the attic. Pass a wire through the hole.



Wire shows through in attic, indicating center of the hallway. It also establishes the general location of the shutter.

down through the hole from the attic.

Back in the hallway, center the template on the wire in the second hole and, following the outline of the template, mark the cutting lines on the ceiling. Hold the shutter up to the cutting lines to make sure that it covers what will be the ceiling opening.

Cut the ceiling along the marked

lines with a saw. To prevent debris from falling into your eyes and mouth, wear goggles and a mask. Remove all leftover nails and bits of plaster or plasterboard from the exposed joints.

Before you lift the fan through the hole, slip four rubber cushioning and noise- and vibration-reducing grom-

(Please turn to page 52)



Why Buy A Big, Expensive Tiller...

For a Small Back Yard Garden?

You wouldn't buy expensive road equipment just to lay a blacktop driveway... or a big rig to drill a water well... or a pick-up truck to haul in a few loads of manure.

So why buy a big, expensive tiller for a back yard vegetable garden and a few flower beds? Hire someone once a year with a farm tractor or a big Troy-Bilt tiller.

Then buy a Mantis Tiller/Cultivator — the 20 lb. wonder — to do all the rest of your gardening for you! Mantis starts with the flick of a wrist... tills and weeds and cultivates a practical 6"-9" wide (big tillers till 20" or more!)... turns on a dime... and runs all day on a gallon of gas!

Mantis is wonderfully light in weight and easy to operate. Our files are filled with letters from lady gardeners and older folks telling us that Mantis is the answer to their prayers.

Discover the miracle of Mantis... and make gardening fun again!



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Mantis

Mantis Manufacturing Co.
1458 County Line Rd., Dept. 457
Huntingdon Valley, PA 19006

Please RUSH information on the Mantis Tiller/Cultivator and Early Order Bonus.

Name _____

Address _____

City _____

State _____ Zip _____



After marking the outline of the template, cut a hole with a saw. Wear goggles and a mask to protect against falling debris.



Remove all leftover nails and bits of plaster or plasterboard from the exposed joists. The edges of the hole should be smooth.

ATTIC FAN

(Continued from page 51)

fits into the pre-existing holes in the fan frame. Now lift the fan up through the ceiling hole (you'll need a helper for this, of course) and center it in the opening and on the joists. See that the grommets rest on the joists.

The fan comes with a high-temperature limit switch and an on-off speed-control switch. Make sure your wiring conforms to local electrical codes. The fan wiring comes ready to connect to electrical cable. Attach the wire to the cable and secure it to the joists to keep it out of the way of the blades. Run the wire to the limit switch.

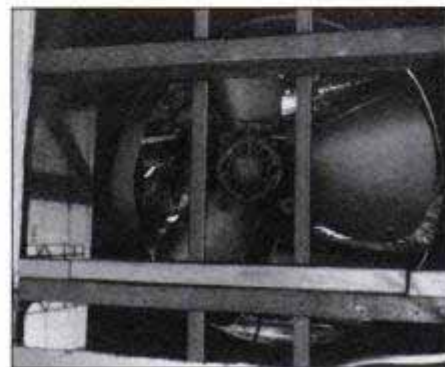
From the limit switch, run the wire to the on-off switch, which should be in a convenient location. The control switch requires a flush-mount, square-corner, 3-in.-deep metal outlet box, to be placed between the wall studs. Cut the hole, install wiring to the outlet box and from there to a power source, such as a nearby light switch, outlet or junction box.

Since you'll be running the wire from the limit switch in the attic through the attic floor to the control switch below, you may save time by enlarging the hole in the attic floor.

Once the wiring is complete, attach the control switch to the outlet box and install the cover plate.

In the attic, cut along the appropriate lines on the corrugated plastic plenum sleeve liner, which prevents dust on the attic floor from being drawn into the fan. The liner has dotted lines to follow based on 16- and 24-in. joists. I had to improvise here, too. Secure the liner to the fan housing, then attach the fan to the joists with screws through the grommets. Cut and re-lay your attic flooring around the liner.

Back in the hallway, lay the shutter flat on the floor. Push two brackets into the sides of the shutter and attach springs to them. Adjust spring tension to allow the shutter to open and close freely.



The construction of my house required me to narrow the width between joists by nailing a piece of 2x4 to one of them.

Mount the shutter to the joists in the ceiling opening. Drill pilot holes into the joists by having someone hold the shutter over the opening. Drill one side and insert the screws sufficiently to hold up the shutter, then do the other side. Tighten the four screws. Make sure you use screws of the right length for your ceiling.

If the shutter louvers don't open and close freely, and spring tension is not equal on both brackets, the problem may be uneven tightening of the mounting screws. In that case, loosen the screws slightly until the louvers close properly.

You shouldn't install a fan without adequate venting area. The air that the fan draws out of the house must be pushed out of the attic through vents. Generally, you should provide 1 sq. ft. of vent area for each 750 c.f.m. delivered by the fan. Thus, Sears recommends that its 30-in. model be provided with at least 6.8 sq. ft. of open vent area.

Since my attic did not contain sufficient venting area, I installed a Sears automatic gable shutter (Model 42-6426, \$54.99), which contains a 6.3-sq.-ft. venting area. Soffit vents and roof louvers also can provide ventilation.

After following installation and wiring steps carefully, read Sears' suggestions for proper fan use. Then you'll be confident that last summer's muggy memories will remain just that—memories.

—Richard E. Grayson

SERVICING AUTOMATIC TRANSMISSIONS



BY MORT SCHULTZ

Does automatic transmission maintenance pay? "Not usually," say the automakers. "Absolutely," say transmission repair shops.

Since the early 1970s, carmakers have dismissed regular A/T maintenance as a waste of time and money for cars that are driven under normal conditions. For example, Chrysler and Ford contend that it never has to be done. GM says to do it once every 100,000 miles.

"Our durability tests prove that given the quality of present-day transmission fluids, maintenance

beyond what is recommended in GM maintenance schedules will not prolong the life of a transmission," an official at GM Service Research told me.

Those who run transmission repair shops don't agree. Jerry Lowen, owner of the AAMCO transmission facility in Bridgewater, N.J., contends that servicing every 20,000 miles helps extend transmission life in several ways. First, you are able to determine if a problem has developed that could, if not treated, lead to extensive damage. Second, as fluid is drained small particles that can slip through the filter and enter the heart of the transmission to has-

Checking fluid level regularly and replenishing when necessary is vital for long automatic transmission life.

ten wear are also drained. Third, some of the new compact transmission filters eventually clog and need replacement. Finally, owners may not be aware that the way they use their cars is considered "severe" by automakers. Scheduled maintenance will provide the needed protection.

'Severe' versus 'normal'

There is no disagreement that high temperature brought about by severe usage causes A/T fluid to oxidize and its additives to break



1. To drain transmission pan, loosen bolts that hold the pan to the transmission body and lower one corner of the pan.

down, and car manufacturers encourage transmission maintenance under these conditions. Chrysler and GM, for example, recommend service every 15,000 miles—Ford every 20,000 to 22,500 miles—in vehicles that are subjected to severe usage. They define severe usage as follows:

- Vehicles used more than half the time in city traffic when the temperature is 90° F. or more.
- Vehicles that tow trailers.
- Vehicles operated in dusty areas.
- Vehicles driven frequently on hills and mountains.
- Vehicles that are used for taxi, police, limousine or commercial operation.

Early detection

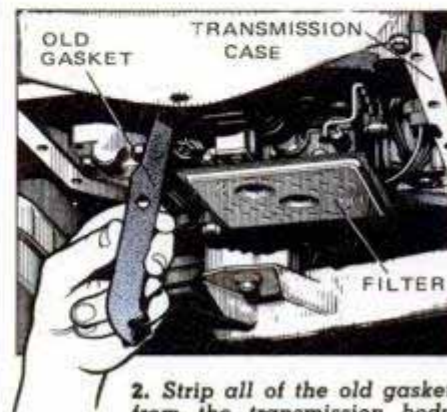
By performing regular A/T service, you may detect a developing transmission problem early enough to save a lot of money. When you drop the transmission pan to drain fluid, you can see if brass or white metal particles are present, then you can replace the affected part before the damage progresses past the danger point.

Lowen's AAMCO shop charges \$650 to \$850 to overhaul the transmission of a rear-wheel-drive car; \$850 to \$1,050 if the car has front-wheel drive. To replace a single planetary gear that is breaking down and depositing metal particles in the fluid, Lowen charges about \$350.

It's important to remember that there will always be some clutch

material in the bottom of a transmission pan and that this does not necessarily indicate excessive wear. With some cars, a small amount of powdered brass may even be considered normal.

More than one car owner has been talked into unnecessary repairs after being shown a transmission pan that contained only normal wear material.



2. Strip all of the old gasket from the transmission body and pan. Use a scraper if necessary.

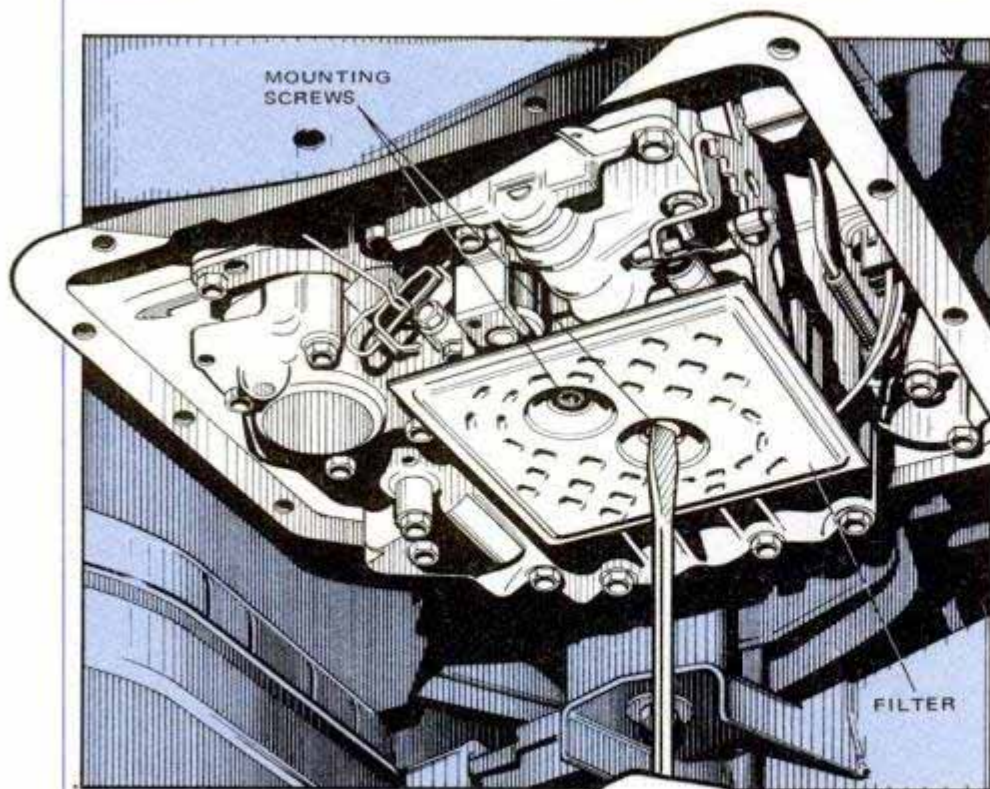
Here are the steps to follow for periodic A/T service:

1. Warm the transmission to operating temperature, shut off the engine, and raise the car. If you've put a drain plug in the pan (see below), place stands under the front wheels and chocks behind the rear wheels. This way, the pan is pitched toward the rear so the fluid will drain freely. Drain plug or not, you'll be working under the car, so make sure it's securely supported.

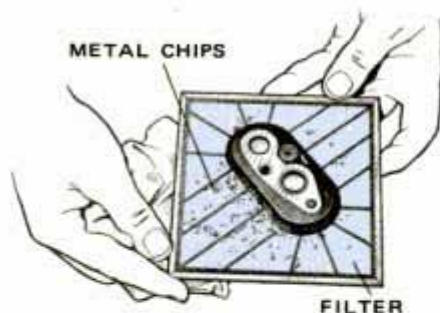
2. Place a drain pan under the transmission and loosen bolts holding the pan in place. If you don't have a drain plug, drop one corner of the pan lower than the others and allow it to drain (see Fig. 1). Once the flow stops, remove the remaining bolts, being careful not to spill the fluid still in the pan. *Caution:* Be careful not to get fluid in your eyes. Wear eye protection.

3. When the pan is down, examine the fluid left in it. It should be red. If it's dirty and smells like varnish, the fluid is worn out and has oxidized. If the fluid oxidation is accompanied by large deposits of clutch material, it may be the result of slipping clutches. Any condition that causes excessive fluid temperature can cause oxidation. Remember, some clutch wear is normal.

Severe usage can cause fluid oxidation. The installation of an auxiliary transmission oil cooler can help



3. Transmission filter is held by one or two screws. Replace the filter if it's paper. Wash metal filters in solvent and reuse.



4. Metal particles on the back of this filter could have circulated through the transmission, causing unnecessary wear.

prevent overheating that occurs due to trailer towing, mountain driving or other severe use.

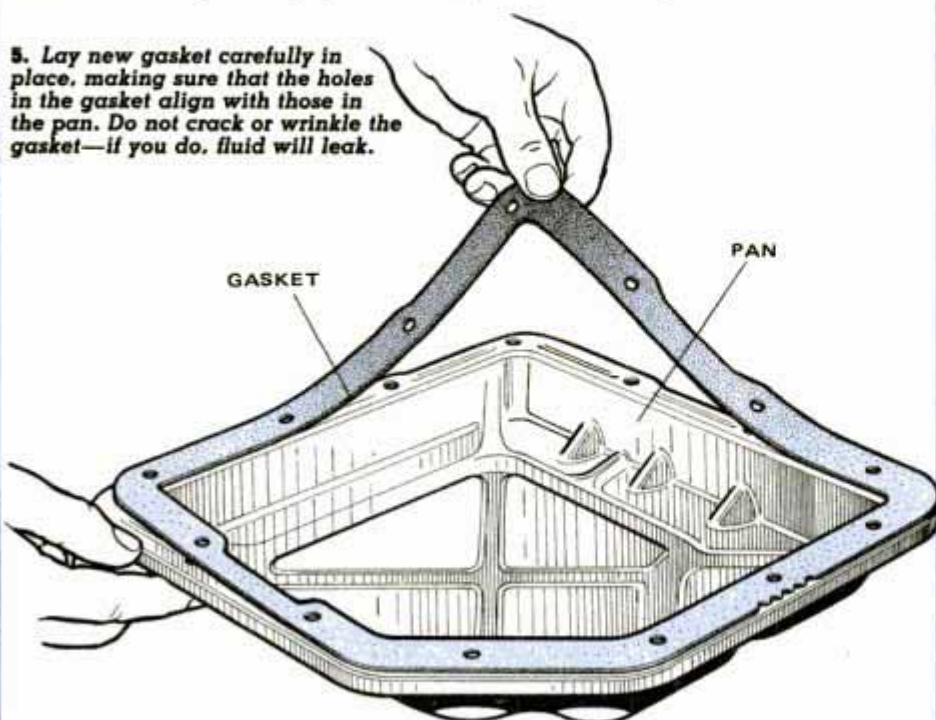
If the fluid looks milky, the transmission oil cooler has sprung a leak and coolant is mixing with A/T fluid. Drain coolant as well as A/T fluid. Remove the radiator and have a radiator repair shop replace the cooler.

Continue fluid inspection by holding the pan to sunlight or shining a light over it. See if you can spot white metal or brass particles. If you find them, you can have the transmission disassembled and the deteriorating part replaced before it leads to more extensive damage, or you can gamble that greater damage won't occur—it may not.

4. Strip the old gasket from the transmission and pan (Fig. 2). Then wash the pan in a nonflammable solvent.

5. Remove the filter (Figs. 3 and 4). Discard and replace a paper or felt

5. Lay new gasket carefully in place, making sure that the holes in the gasket align with those in the pan. Do not crack or wrinkle the gasket—if you do, fluid will leak.



filter. Clean a metal filter in solvent and reuse it. When you install the filter, make screws snug without overtightening them.

6. Place a new gasket on the transmission pan (Fig. 5) and carefully lay the pan against the transmission case so the gasket doesn't crimp or tear. Install bolts fingertight. Then, using a wrench, tighten bolts snugly in an alternating pattern. Do not overtighten. You may crush the gasket and cause a leak.

7. Remove the A/T fluid dipstick and place a clean funnel in the dipstick tube. Add fluid, a quart or two at a time. Reinstall the dipstick each time to get a reading until the fluid level shows FULL. Start the engine and let it get warm. Move the transmission shift lever slowly through the shifting pattern, stopping for a few seconds at each gear. Check fluid level again and, if necessary, add fluid to bring the level back to FULL.

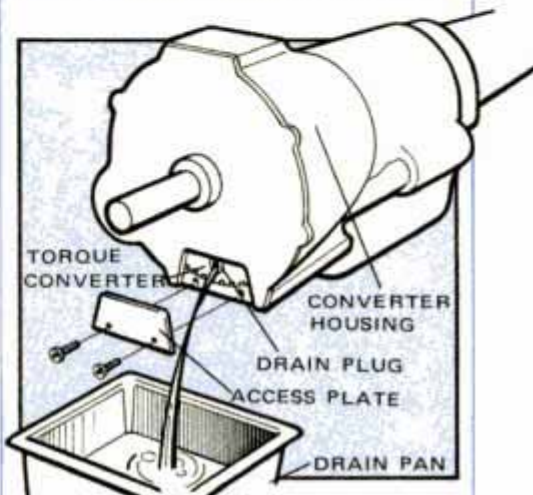
There are two important facts you should be aware of. First, dirt is an A/T's worst enemy. Take steps to see that none is introduced into the transmission through the dipstick tube. Second, don't overfill the transmission. Excess fluid can cause the transmission to slip.

To make sure you haven't botched up and caused a fluid leak, keep an eye on the fluid level for a few days. If it drops below the FULL mark on the dipstick or you see signs of fluid on the ground, find the leak

and fix it. Transmission fluid doesn't evaporate. If the level ever drops, look for a leak.

Transmission drain plugs

When you drop the transmission pan to drain fluid, only some of the fluid pours out. A considerable amount remains in the torque converter. Most torque converters don't have drain plugs. To drain all of the fluid remaining in the torque converter, the transmission and torque converter have to be removed from



6. Most Fords have torque converter drain plugs, which allow you to empty the converter for a complete change.

the car and the converter has to be power-flushed on a special machine. Generally, many Ford-built cars have a torque converter drain plug. GM models don't, and neither do most Chrysler-built cars from 1977 on.

There is a way around this problem, but first find out if there is a drain plug in your torque converter. Look for an access plate on the converter housing. Unscrew the attachment bolts and remove the plate. Then, have someone in the car click the starter motor in short bursts to see if a drain plug comes into view. (Keep the engine from starting by disconnecting the ignition coil.) If the torque converter has a drain plug, remove it to drain all the fluid (Fig. 6).

Even if your car doesn't have a drain plug in the torque converter you can still do a good job of removing dirty fluid and replenishing additives with two or three successive pan drainings and refills. Installing a plug in the pan will allow you to do this easily. To install a universal drain plug, drop the pan, pour off fluid and wash the pan in

solvent. Drill a 1/2-inch hole near a rear corner of the pan.

Clean off all burrs and bolt the fitting through the 1/2-inch hole. Screw the drain plug into the fitting (Fig. 7) and reinstall the pan. Make the plug secure, but don't overtighten it or you'll damage the plug or fitting. (B&M Automotive Products, 9152 Independence Ave., Chatsworth, Calif. 91311, sells a drain plug kit through auto parts stores.)

Pour in enough fresh A/T fluid to fill the transmission. Drive the car for a day or two, so fresh fluid mixes with the old fluid that was trapped in the torque converter. Then unscrew the new transmission drain plug and allow the fluid to drain. Refill the transmission and repeat this filling-driving-draining procedure two or three times to replace most of the old fluid with new fluid. Of course, you will still have to remove the pan to inspect or replace the filter.

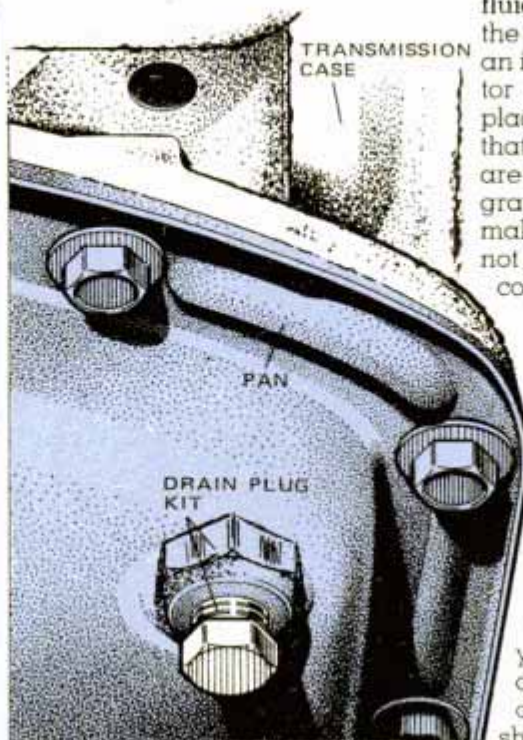
Band adjustment

Should transmission bands be adjusted as part of a servicing program? That depends. Most GM transmissions are nonadjustable—bands are adjusted automatically. Manufacturers of transmissions that have adjustable bands stipulate that an adjustment is not necessary unless the transmission is used under severe conditions. Ford, for example, calls for an adjustment on some vehicles every 7,500 miles when severe usage is evident. However, if you follow a periodic maintenance program with a transmission that's used under normal conditions, it's usually not necessary to adjust bands.

Transmissions that call for a band adjustment usually have an adjustment mechanism on the outside of the transmission housing that tightens the front bands. The rear band adjustment mechanism is usually inside the transmission, and in many cases you have to remove the valve body to reach it. Bands should be adjusted to manufacturer specification, which is normally given in inch-pounds. A torque wrench and a shop manual are needed.

Vacuum modulators

In some cars—those made by Chrysler, for example—the linkage or cable between the carburetor and transmission allows the car to respond to driving demands. This



7. Installing a drain plug on the pan will let you dilute and drain most of the dirty fluid from the torque converter.

linkage usually needs no adjustment unless the transmission is removed from the car.

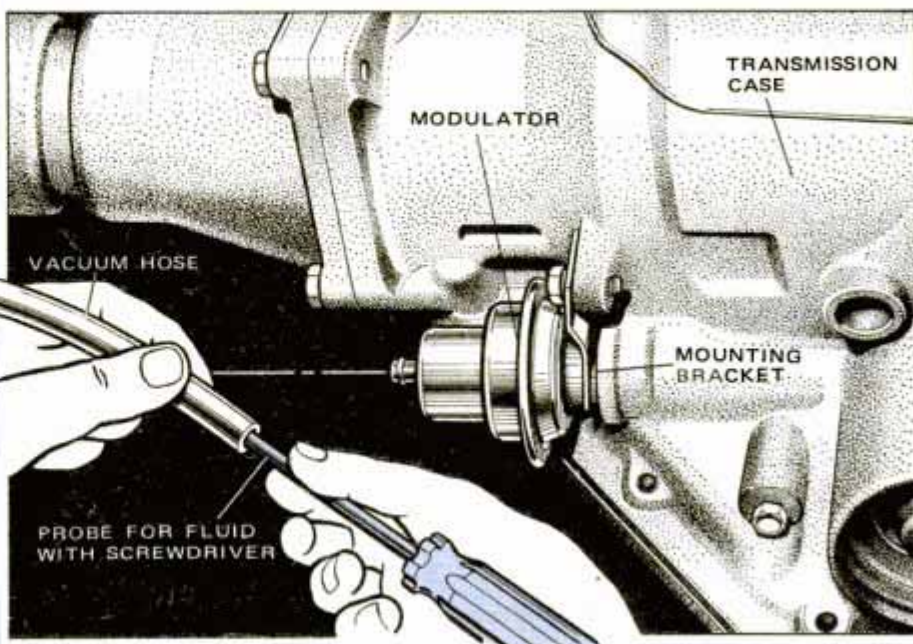
The other control, used primarily by GM and Ford, is a vacuum modulator. If there is a sudden change in the way the transmission shifts, pull the vacuum line from the vacuum modulator, which is on the side of the transmission (Fig. 8). If A/T

fluid drips out, you've uncovered the trouble and, luckily, can make an inexpensive repair. The modulator diaphragm has failed, so replace the modulator. Other signs that the modulator has gone bad are a drop in fluid level and white or gray engine exhaust smoke. Also, make certain that the vacuum line is not leaking at the other end where it connects to the carburetor.

Choosing fluid

It's important to follow the manufacturer's recommendation for the type of A/T fluid, since improper fluid may cause malfunctions. Ford calls for Type H fluid to be used in its C5 transmission. Otherwise, manufacturers recommend either Dexron II or Type F. Check your owner's manual before you add or replace fluid. If you can't find the information in your owner's manual, look it up in a shop manual or ask a mechanic at a dealership or transmission shop. Be sure you know the transmission model and year of manufacture. Some carmakers (like Ford) use Type F fluid in older models and Dexron II in new ones.

If you service your automatic transmission periodically, it should never let you down. You are less likely to be victimized by an unscrupulous transmission shop if you can shop around, rather than having to settle for the most convenient shop after a breakdown. **PM**



8. To test a vacuum modulator for leaks, remove the vacuum hose and look for fluid inside. The hose should be dry. If it's wet, unscrew or unbolt modulator and replace it.

WIN PM'S FOREST RANGER

(Continued from page 48)

shell, Coleman cook kit, cooler, propane stove and lanterns and, of course, the special storage units.

All this, plus the trip to New York if you live outside the area, can be yours if you're our contest winner. Below are

the official rules for the contest. *Read them carefully.* Then fill in your official entry form and mail it before midnight Aug. 1, 1984.

So hurry. Fill out your entry and send it in today. **PM**

CONTEST RULES

1. On the entry blank printed below, or on a separate sheet of paper, give us your suggestion for the next *Popular Mechanics* vehicle modification project, and tell us why you think it would be a good project.

In other words, if you could customize any car or light truck, which one would you choose, how would you change it, and why? For instance, our Forest Ranger is a Ford Ranger pickup that we've modified to be the ideal utility vehicle for the outdoorsman. Should our next project vehicle be, perhaps, the transformation of a standard Detroit sedan into a sporty car that handles like a Porsche? Or what about taking a standard economy sedan and making it into the ideal urban commuter vehicle? Those are just two examples. You can probably think of better ones. Don't forget to tell why you think it would be a good project.

2. You must be of legal driving age in your state to enter. All entrants must sign the entry blank and verify that they are of legal driving age in their state.

3. While there is no limit to the length of your suggestion, please be to the point and as brief as possible.

4. One entry per family is permitted. All entries become the property of *Popular Mechanics* and cannot be returned.

5. Entries will be judged on originality, imagination, practicality and usefulness.

6. Preliminary judging will be done by the automotive department editors of *Popular Mechanics*. From initial selections, the final winner will be selected by *Popular Mechanics* Editor-in-Chief John Linkletter.

7. The decision of the judges is final. No correspondence or telephone calls regarding the contest will be accepted or entered into.

8. The winner will receive the Forest Ranger, a 1983 Ford Ranger pickup truck modified by the *Popular Mechanics* staff. In addition, the winner will receive certain equipment that has been added to the Forest Ranger to enhance its value and usefulness. The Forest Ranger will be turned over to the winner in as-is condition at the time the prize is awarded. All taxes, licenses, insurance and other fees are the responsibility of the winner. If applicable, we will provide coach travel with a commercial air or rail carrier to New York and provide one night's accommodations in order to accept the prize.

9. No cash payment will be made in place of the prize.

10. The contest is open to anyone residing in any of the 50 United States except employees of The Hearst Corp. and their families.

11. Entries should be mailed to: Forest Ranger Contest, *Popular Mechanics*, 224 West 57 St., New York, N.Y. 10019.

12. Entries must be postmarked before Aug. 1, 1984, and received by Aug. 6, 1984.

13. The winner will be notified by Sept. 3, 1984, and may be asked to execute a qualifying affidavit.

14. After the winner is notified, *Popular Mechanics* will provide the winner's name to anyone who wishes it and who sends us a stamped, self-addressed envelope with the request.

15. The winner must agree in writing to be photographed with the Forest Ranger truck and various members of the *Popular Mechanics* staff, and consent to his name and photos being used in conjunction with this contest and its result in a future issue of *Popular Mechanics* and for all media, advertising and/or trade.

16. This contest is void where prohibited.

OFFICIAL POPULAR MECHANICS FOREST RANGER ENTRY BLANK

Here is my entry. I agree to abide by the rules.

I think the next *Popular Mechanics* vehicle project should be

Name _____
 Street Address _____
 City _____ State _____ ZIP _____

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PM'S TIME MACHINE

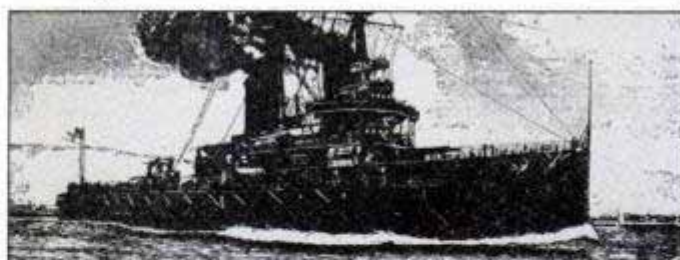
75 YEARS AGO: July 1909



Dynamos may harness wind.

Wind power

Wind power is a form of energy which costs nothing to produce, but this advantage is seriously diminished by the fact that the wind is not under human control. The possibility, however, of combining the power of the wind with specially governed dynamos and batteries in such manner that this erratic power can be transformed into a perfectly steady flow available for use at any moment, may mean a new future for the windmill.



Heavy battleship

The "Vanguard" (above), is England's greatest battleship yet launched. She is a "Dreadnought" 500 ft. long with a beam of 84 ft. and a draught of 27 ft. Her displacement is 19,500 tons.

Tickets on demand

With a view of reducing the workload of a railroad ticket office . . . an ingenious printing machine which prints the tickets is in use in Germany. Tickets are printed with lightning rapidity.

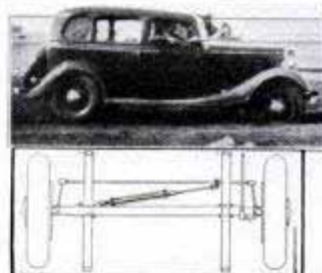
50 YEARS AGO: July 1934

West Point pilots?

Flyers who win their wings at Randolph Field, Texas, "the West Point of the air," differ as greatly from the old-time, war-trained aviators as the ancient Jennys differ from the modern bombers. The old-timer was a rugged individualist. Not so the young flyers at Randolph Field. These youngsters, termed the "shock troops of the air," live for a year under strict Army discipline. They learn to obey the least command of a superior.

Auto stabilizer

Preventing the automobile from turning over or swerving after a tire blows out, a hydraulic stabilizer is available for making the steering gear safer. The device takes charge of the steering gear in an emergency, holding the car straight. It's mounted between the front axle and steering rod.



A test car has a blowout at high speed (top). The hydraulic stabilizer (above) keeps it from swerving.



New pilots are disciplined.

New color photos

Dual-tone photographs may be produced by a system calling for the use

of only one toning solution. Several colors may be obtained on ordinary white photo paper.

25 YEARS AGO: July 1959

All American

You'll have good chances of breaking the world's speed record with a copy of the "All American." Even though the lightninglike plane holds the world's record of 172 mph for propeller-driven models, it has been timed unofficially at speeds as high as 180 mph. Those who build this speed model will find it very easy to fly. The original All American uses a Magna magnesium pan, a Stanzel Class B control unit and a McCoy 60 Redhead racing engine.



Disneyland rides

Forty-passenger submarines, a bobsled ride down a replica of the Matterhorn and 82-passenger monorail trains are features of a new addition to Disneyland. The monorail is the first of its kind in the United States. Its trains ride on rubber tires on concrete beams.



Model plane files at 172 mph.

Small car house

For the traveler who likes to sleep outdoors, the British have designed a waterproof, ventilated sleeping compartment

that fits even small European cars. Six feet long and four feet wide, the sleeper accommodates two. It folds down to the size of an autotop carrier. **PM**

PM PHOTO HINTS



Don't waste film

When you have to take a half-exposed roll of film out of your camera to switch to another type, there's no need to waste the rest of the roll. Note the number of frames already exposed, then wind the film back into the cassette until it just slips off the take-up spool. Remove the film and write the number of exposed frames on the protruding tab. When you reload the film, advance it two frames past the exposed portion and start shooting.

—Bob Grewell

Reducing darkroom dust



If dust on your negatives is a problem, try grounding your enlarger. Attach one end of an insulated wire to a screw in your enlarger head and run the other end to a water pipe or grounded wall outlet. The wire will drain off static electricity and help to keep dust from being attracted to your negatives.

—Bob Grewell

Label the caps, too

When you label chemical jugs to identify their contents, remember to label the caps as well. Residues build up inside the caps and can contaminate other chemicals if the caps are inadvertently switched.—Kenn Oberrecht



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PM SNEAK PREVIEW

THE 1985 CARS

This fall, it will be hard to tell the imports from the domestics. Some cars will be a little of both! Here's what you'll see in the showrooms.



Dodge Lancer is a world-class sport sedan with a 150-hp turbo.



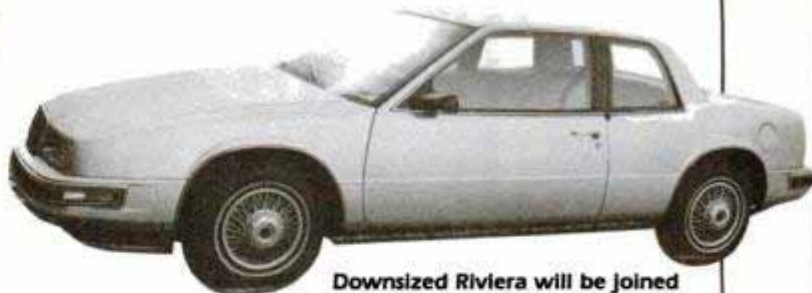
Merkur XR4Ti is a German import with a South American engine.



Pontiac Grand Am is one of three X-car replacements from GM.



Sprint is a three-cylinder Honda clone made by Suzuki for Chevy.



Downsized Riviera will be joined by Eldorado and Toronado twins.

Come 1985, the person determined to buy American (or to buy an import) will be faced with a problem—he won't be able to tell the imports from the domestics without a score card.

Many American cars now contain Japanese engines or transmissions, European fuel-injection systems, and other imported parts. On the other hand, many foreign cars sport headlights, windshields, air conditioners, trim and accessories that were made in America.

Then there are the "captive imports," foreign cars sold with familiar U.S. nameplates. Not to mention the imported nameplates that are now assembled in American factories—VWs, Hondas, Renaults and Toyotas. And the "Detroit" cars that are actually built in Canada or Mexico.

The year 1985 will show revolutionary as well as evolutionary changes. There will be at least nine all-new

models, a third of them captive imports. A number of familiar-looking cars will have worthwhile changes under the skin.

General Motors has apparently quit trying to match import quality and price in the small-car segment. It will bring in Japanese cars and hang Chevrolet bow ties on them. Chevy dealers in nine western states will sell a front-drive, two-door hatchback built by Suzuki. Its three-cylinder gasoline engine is said to be a real roughhouse, but it will show more than 50 mpg in EPA tests. Only 17,000 of them will be let in under current import restrictions, and we'll know it as the Chevy Sprint. Chevy dealers in 16 eastern states will get to sell 30,000 Isuzu two-door hatchbacks and four-door sedans under the Chevy Spectrum label.

By 1985½, the Chevrolet-Toyota joint venture in

(Please turn to page 62)

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29-pc. High Speed DRILL BIT SET

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These drill bits are made of industrial grade high speed steel, specially hardened at high furnace temperatures for super strength and cutting power. You can count on any one of the 29 drill bits in this set (sizes 1/16" thru 1/2") to bore right through the toughest of metals, without frequent sharpening!

You can select the proper drill bit with ease! All 29 drill bits are individually housed in a handy index-type metal case. Lift the lid and 3 index sections raise to vertically present the drills and their sizes! Close the lid and index sections fold compactly!

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- Blade guard with anti-kickback feature!
- Dependable 4,800 rpm, 1 1/2-hp. ball-bearing motor. Double insulated for safety!
- Handwheel raises/lowers blade! Also tilts blade to exact angle setting 0° to 45°!

To help pay for operating expenses, a manufacturer liquidated a portion of its production capacity, to ensure a large amount of business for an extended period of time. As a result, we obtained these versatile 10" Table Saws!

Switch it on for fast, accurate saw cuts! Easily do tough jobs like sawing at a 45° bevel, or cuts like compound angles! Set it up for: crosscutting material, ripping stock, mitering angles, cutting repetitively without marking each piece and rabbeting corners in two easy steps! This saw is also capable of dadoing or cutting a wide groove into stock. (Saw blades and dado head NOT incl. with saw. Can be purchased at your local hardware store.)

This dependable saw is ideal for household fix-it jobs! It cuts paneling, molding, 2 x 4's, and all types of wood up to 3 1/4" thick at a 90° angle!

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- Backed by 1 year limited warranty!

Anytime of year, a storm could knock out your electric power for hours, or even days! Food could spoil in your refrigerator. The motor in your furnace could stop running, leaving your family shivering in the cold of winter. A well could stop pumping water needed for cooking or bathroom facilities. Such losses could cost you hundreds of dollars, or maybe even more! And think of the discomfort and inconvenience for you and your family!

But you NEVER have to worry when you have this excellent portable generator. It's U.S. made and provides you with 3 convenient plug-in outlets for 115V and 230V service . . . 15 amps at each outlet!

Use this reliable Power Generator to run your lights, sump pump, well pump, power tools, etc. Plug in small kitchen appliances, a refrigerator, freezer, etc. Of course, you can't operate everything at one time (remember the 4000 watt limit). But you CAN run enough things to keep vital functions operating as you need them!

- 4-cycle gas engine.
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- Manual choke.
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- Designed to dissipate heat for cooler running.
- Size: 17 1/2" W x 25" L x 18" H.
- Wt.: approx. 140 lbs.

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State _____ ZIP _____

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THE 1985 CARS

(Continued from page 60)

Fremont, Calif., will be onstream, assembling a fwd four-door Corolla derivative. By then, GM may also be importing minicars from Daewoo Motors in Korea (GM owns half of Daewoo).

The General's American-made new cars include yet more variations on their front-drive four- and six-cylinder packages. First of the '85s were the Buick, Cadillac and the Olds C-cars, which are actually delayed '84 models that were introduced in April (see *GM's New C-Cars: Front Drive Hits Top Of The Line*, page 76, May '84).

Next up are the N-cars, or GM-20s, to use the latest code-name system. These cars will slowly replace GM's trouble-prone X-car in every division but Chevrolet. The Olds Calais version will replace the Omega and Pontiac's Grand Am will nudge out the Phoenix, but Buick's Somerset Regal will be sold alongside the Skylark X-car.

Engines include Pontiac's 92-hp, 2.5-liter Iron Duke Four and Buick's 120-hp, 3.0-liter even-firing 90° V6. This slick V6 uses Buick's multiport-fuel injection (MFI) system. It has six injectors that squirt intermittently, but simultaneously, once every revolution of the crankshaft.

Olds will build the cars for all three divisions starting this fall when the two-door coupes will be introduced. A four-door is definitely in the works, perhaps as an '85½ model.

The downsized Buick Riviera/Cadillac Eldorado/Olds Toronado (code-named E-car or GM-30) features the same front-drive package with only one engine—Buick's 3.8-liter V6, this time with sequential fuel injection (SFI), a timed system that injects a measured squirt of fuel into each intake port just before the valve opens. These triplets can be distinguished by their different grilles, taillights and rooflines—the Caddy getting a more formal, half-vinyl "brougham" roof. Both the GM-20s and -30s will have four-speed overdrive automatic transaxles.

GM is showing the most conservative stance of all with its frumpy Chevrolet Astro minivan (see *Detroit Listening Post*, page 26, June '84). With a V6 option and 5,600-pound GVW rating, the front-engine/rear-drive layout is best suited for towing and other heavy-duty use. Seating for eight people or up to 150 cubic feet of cargo will make the Astro a topnotch utility vehicle.

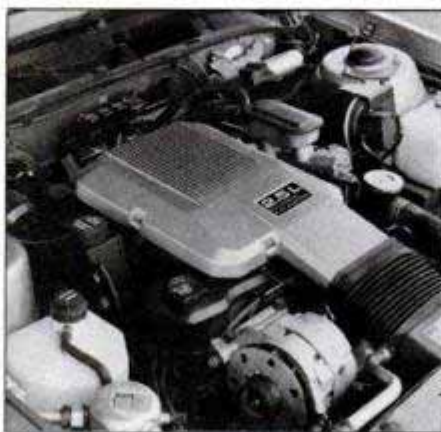
Ford entries

The big news from Ford in 1985 is the U.S. introduction of the Merkur XR4Ti, built in Germany and sold in Europe as the Sierra since 1982. Its German 2.8-liter V6 will be replaced by

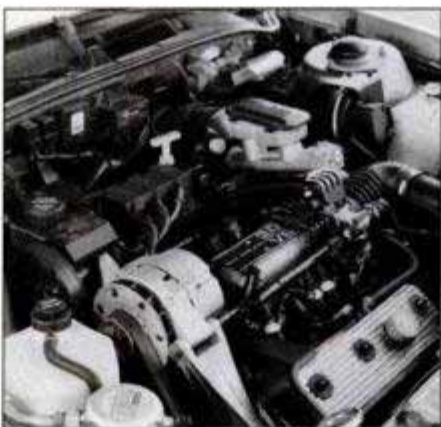
the 2.3-liter turbo Four currently available in the Thunderbird. This American-spec engine comes from Brazil!

Most significant about the Merkur is the use of rear-wheel drive. Ford claims that steering and propulsion are best handled by separate sets of wheels on high-performance cars. Lincoln-Mercury dealers will sell Merkurs.

Ford's new minivan will debut in



Pontiac's Iron Duke gets a new intake system for its throttle-body fuel injection.



GM's three-liter V6 with multiport-fuel injection was used on '84 Century and Clera.

February (see *Detroit Listening Post*, page 14, May '84). The slope-nosed Aerostar is based on the Ranger truck platform. It will have rear-wheel drive for superior load and towing capacity.

Chrysler's four-door sportster

Chrysler's 1985 new model is the H-body sports sedan, which replaces the Dodge 600 and Chrysler E-Class sporty cars. Called the Dodge Lancer and Chrysler Commander, they are front-drive, four-door hatchbacks powered by a 150-hp turbocharged version of Chrysler's 2.2-liter Four. A three-speed automatic and five-speed manual are its only transmission options. Handling, performance and interior amenities are aimed at the import buyer.

Recently, we accompanied Chrysler's tire, chassis and powertrain engineers on a ride-and-drive shakedown through the Blue Ridge Mountains, comparing

their new H-body to a Mazda 626, Pontiac 6000 STE, Audi 5000S turbo and BMW 528e. The Lancer/Commander is a world-class sport sedan, up there with the world's best in terms of comfort, handling and performance.

Updated old models

To commemorate the revival of the International Race of Champions series, there will be an IROC-Z/28 Camaro, but the package is more than fancy trim. Cross Fire Injection has been replaced with a tuned port system on the 305 engine. The P245-series 16-inch tires give the F-car a skidpad grip of .92 g.

The Corvette gets a boost up from 205 to 240 hp via new Rochester/Bosch port injection that closely resembles the Porsche 928 system. To counteract complaints of suspension harshness, the spring rates have been lowered at both ends and shock valving adjusted to compensate. Top-speed potential is now closing in on the 150-mph mark.

Pontiac's Fiero two-seater will finally get a 140-hp, fuel-injected V6 and revised suspension in a special GT model.

Refinement is the name of the game throughout most of the Ford lineup. The Mustang, now entering its 21st year of production, gets a nose job. The 5.0-liter GT model benefits from an increase to 210 hp through the installation of a roller tappet camshaft. A declutching accessory belt arrangement will save power at high rpm.

The front-drive Tempo/Topaz will get a Sport Pack option on five-speed two-doors only, good for an extra 15 hp. And the rear-drive LTD/Marquis will benefit from improved suspension, bigger tires and a grand touring package that includes a 165-hp, throttle-body fuel injection version of the 302-cu.-in. V8.

The Continental Mark VII will continue as the test vehicle for leading-edge electronics, including a hands-off cellular telephone with microphone built into the sun visor. Later in the year a limited run of computerized dashboards with a touch screen display and infrared grid will be built. Call up any of a dozen "menus," then just put your finger on the screen to set radio stations, air conditioning controls or work the trip computer. A 200-hp 302 V8 option on the Mark VII LSC and an antilock braking system will add to enjoyment.

The coming sales season will be a period of regrouping for AMC. While there is work going on toward the company's first two-wheel-drive pickup truck, the most exciting news for '85 is the announcement of an Alliance convertible. The car's dire lack of horsepower will be relieved by a standard 1.7-liter Four instead of the 1.4.

The recently downsized Wagoneer and Cherokee will get the option of a 2.1-liter turbodiesel from Renault. **PM**

A cowboy wearing a light-colored hat, a white shirt, and a brown vest is riding a dark brown horse. He is holding a lasso in his hands. The background is a field of tall grass. In the foreground, two packs of Marlboro cigarettes are visible: a red pack labeled 'Marlboro' and a gold pack labeled 'Marlboro 100's'.

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FIRSTHAND REPORT



The newest BMW looks just like the 318i on the outside, but has the 2.7-liter Six under the hood.

DRIVING THE BMW 325e

Six cylinders instead of four make BMW's small sedan a real smoothie.

BY NORMAN MAYERSOHN
Assistant Auto Editor

The difference is noticeable from the moment you first step on the accelerator: Compared to the high-revving Four of the 318i, the 325e's torquey Six is silky smooth and pulls away from stoplights in effortless silence.

BMW has created a new model, the 325e, by transplanting the six-cylinder 528e engine into the small 3-Series body. But this isn't the classic American big-engine/small-car hot-rod swap. Instead, it's a more refined and staid version of a high-spirited and highly respected sports sedan.

The 325e is an addition to the BMW line, and it goes a long way to advance the legacy begun 16 years ago with the introduction of the 2002. That car was the archetypal sports sedan, a quick and responsive four-seater that didn't carry the drawbacks of traditional sports cars—things like leaky tops, cramped cockpits and assorted oil drips.

With the release of the 325e, though, BMW's strategy in car building takes a



Battery is now mounted in trunk to help offset the extra weight of Six up front.

sharp turn. The 2.7-liter Six makes 20 hp more than the 318i's 1.8-liter Four and the torque increase is even more impressive—a whopping 65 percent. But the 325e also outweighs the 318i by 300 pounds, and the power increases are all biased toward the low end of the rpm scale.

High-efficiency engineering

The reason for the dramatic jump in low-speed power stems from the fact that this engine belongs to the high-torque, low-rpm "eta" engine family, named for the Greek letter engineers use to denote efficiency. BMW's thinking goes like this: By using a relatively large displacement engine at a lower crankshaft speed with a wider throttle opening, fuel efficiency is improved. That's the big difference in the 325e. It's programmed for an upscale buyer who is more interested in a competent

sedan which doesn't require the amount of driver involvement that the peaky-engined 318i demands.

The broad powerband of the eta Six is the result of careful engine component choices, from the long intake manifold runners that favor low-end performance to the revised combustion chamber design and intake valve size. Internal engine friction gets a lot of attention, too. Camshaft bearings were cut from seven to four, and low-tension piston rings and valve springs installed. The result: Maximum power (121 hp) comes at 4,250 rpm, versus the Four's 101 hp at 5,800 rpm. Torque peaks at a very usable 3,250 rpm. Consistent with all this effort at low-rpm power, the final drive ratio has been dropped from the 318i's 3.91:1 down to 2.79. At 55 mph in high gear, the engine of an automatic-equipped 325e turns over at a lazy 1,700 rpm.

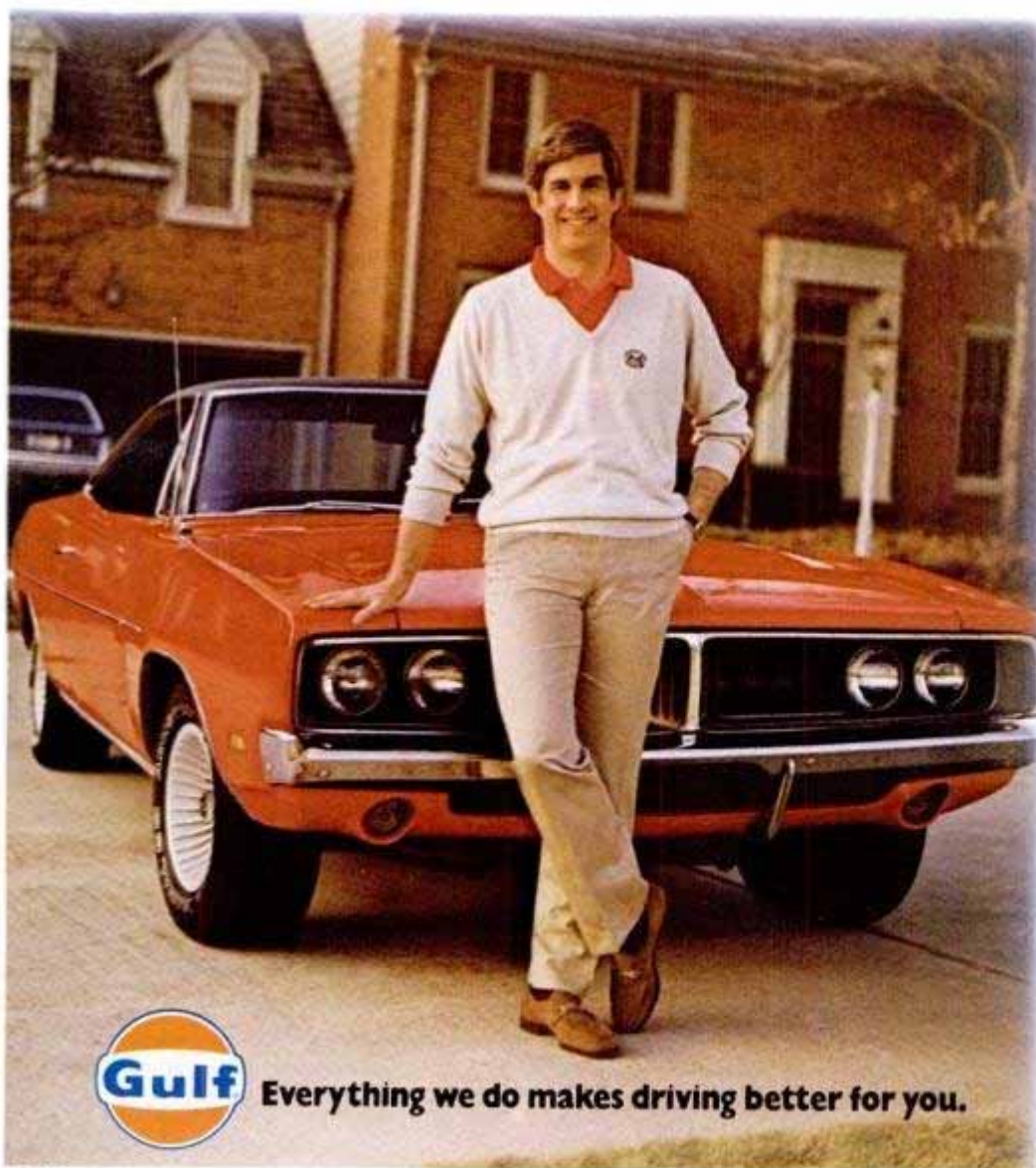
A four-speed automatic overdrive transmission is available now in all six-cylinder BMWs and is particularly well-suited to the flat torque curve of the eta engine. Built by ZF with a hydraulically actuated lockup torque converter, the gearbox is not revolutionary in design, but is a remarkable performer. Mileage (from EPA figures) is only 1 mpg off the five-speed stick-shift numbers and actually *better* than the automatic version of the four-cylinder 318i. So, the high-

(Please turn to page 66)

Senior year, Dad lent me the money for this car.

I had to work construction all summer to pay him back.

Do you think I'd use just any motor oil?



A '69 Charger, raised on
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I put a lot of sweat into
buying it. You better believe I
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care of it. To change the oil fre-
quently. To use Gulfpride.

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switch. The driver's seat.

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DRIVING THE BMW 325e

(Continued from page 64)

efficiency design works not only in theory, but also in practice.

BMW did a thorough job in upgrading the chassis for the extra load of the Six. Springs and sway bars have been brought up to specs similar to the European 323i model, and disc brakes



High-torque, low-rpm "eta" engine gives the 325e a 20-hp advantage over the 318i.

are fitted to the rear wheels. The battery has been tucked into the trunk (well-concealed under a carpeted panel) to help bring front-to-rear weight distribution back to the balance found in four-cylinder models.

On the road the 325e has quite a different character from its four-cylinder sibling. The ride is slightly stiffer due to the uprated suspension, though that's no real drawback since the 318i has a most supple ride for its handling capability. But the 325e also carries 300 pounds more heft, which works against fast cornering. The power-assisted steering tends to be a little light at the limits of adhesion for my tastes. But, for the level of comfort it returns, the BMW's handling prowess can't be faulted at all.

What is hard to figure, though, is how this model fits the image of BMWs as drivers' machines. All of the delightful engine sounds that please the 318i driver have been muffled out, and the slow-revving Six does not encourage spirited driving the way the peaky Four does. Upshifting at as low as 2,500 rpm will suit the 325e just fine, and a factory rev limiter puts an unwelcome ceiling on the fun.

The 325e does come with a couple of standard equipment features worth noting. An on-board computer with time/speed functions is activated through the turn-signal stalk, letting you call up all displays without moving your hands far from the wheel. New

sport seats rival any on the aftermarket and let me find the perfect driving position I couldn't get in the 318i.

For all the sophistication of the BMW line there are still contradictions we can't square. There's no oil-pressure gauge on the dash, but there is an elaborate fuel-mileage readout and service-interval indicator. The ignition and door key has a built-in light as a mark of last-word gadgetry, but the window crank holes left in door panels when standard-equipment electric windows were installed are plugged with cheap covers. Do give BMW high marks, though, for the positive-locking shoulder harnesses, which I find more secure-feeling than the inertia-reel belts in most cars.

At \$20,970 list (compared to \$16,340 for the 318i) you have to look at the 325e as a special-purpose car—a fine touring sedan with sporty handling, intended more for the mature user than the sports-oriented 318i buyer.

A four-door version of the 3-Series body will be released in the fall—when the six-cylinder version will come into its own. Order your four-door with automatic transmission and you'll have an excellent-performing, comfortable sedan. For the buyer seeking a true soul-stirring sports sedan, though, the high-winding 318i seems to be a more desirable choice, at 300 pounds, two cylinders and thousands of dollars less. *That sounds more efficient to me!* **PM**

THE PM REPORT CARD

BMW 325e	GRADE	COMMENTS
Acceleration	B-	Adequate, though not inspiring, for a Six.
Handling	A	Top notch for such a comfy sedan; always predictable.
Braking	A	New 4-wheel discs improve fade resistance.
Steering	B	A touch light at high speeds with power assist.
Transmission	A-	New ZF 4-speed auto never hunts for right gear.
Ride	B+	Slightly stiffer with European 323i springs and shocks.
Fuel economy	B-	As good as 4-cylinder, EPA 22/35, automatic.
Seating	A+	Sport seats are hard but multiajustable and supportive.
Vision	A	Tall greenhouse gives great view all around.
Gauges/controls	C	Still no oil pressure gauge.
Ventilation	B+	Lots of choices but blower fan is noisy.
Noise @ 55 mph	B	Engine is well-muffled; slight axle whine.
Cargo capacity	B	Adequate for small sporting sedan.
Engine serviceability	C	Six in 4-cylinder engine bay makes things tight.
Fit and finish	A	Typically German craftsmanship.



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"I have a few used car lots that use my service, and Montgomery Ward, which really keeps me busy. I also have a Howard Johnson Restaurant and motel. It's all I can take care of."

Ralph Reiter, Fla.

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"This business is BIG. I did a large bar in a local restaurant. Am doing a job on one of the Bradford House restaurants at W. T. Grant, and they're referring me to other Grant managers. I'm swamped with business."

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MADE \$440 IN 9 HOURS

"I repaired 55 chairs at the NCO Club at \$8 each—\$440 for 9 hours work. Materials and transportation cost only \$35! On another job, made \$140 in 3 hours. I'm doing much better than VIP ads say you can!"

David Gagnon, S.C.



BIG, STEADY BUSINESS!

"After only 3 months, I'm doing repairs for 4 car dealers, 3 furniture stores, 6 restaurant/bars, 2 hospitals. Biggest week was \$954 for 1 restaurant, 3 car dealers, 1 mobile home. Now go to bank to put money in, not take it out!"

L. C. Rust, Okla.

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VIP's exclusive Vinyl Repair process puts you in a profitable business of your own, faster and with less money, than you ever dreamed possible. After just a few days' practice, you can repair holes, cuts or burns in any item made of vinyl . . . car tops, seats, furniture, booths . . . all the things that are made of vinyl these days.

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PM LONG-TERM CAR TESTS

BUICK REGAL T TYPE

Red hot and eager to go

OLDSMOBILE CUTLASS CRUISER

New class of front-drive wagon

JEEP CHEROKEE

Rugged yet comfortable

DODGE CARAVAN

The start of something great

VW VANAGON

No longer the slowpoke



Buick's turbo reminds us of those thrilling days of yesteryear.



Olds' front-drive family wagon needs a suspension transplant.

If you think you have trouble keeping the family fleet on the road, you can be happy that you didn't have to cope with our long-term test fleet during the past few months, when four of our five vehicles were sidelined with mechanical problems of varying seriousness. Significantly, all of the malfunctions sprang from new designs. The only vehicle that's been trouble-free—so far—is the rear-drive Buick Regal T Type with its proven 3.8-liter turbocharged V6 engine.

Buick Regal T Type

Reader letters started asking more turbo questions. Did they really give better performance with little sacrifice in fuel economy? Did a turbo engine hold up as well as a normally-aspirated engine over the long haul? Did a turbocharged engine demand more frequent and more expensive service? We set out to find the answers.

In looking over the field of potential test cars that have turbocharged engines, it wasn't too difficult to make a choice. It's generally conceded that Buick's 3.8-liter V6 is state-of-the-art as far as turbocharged production engines are concerned. Buick is the lead division at General Motors on turbocharged engines, and the engineering department's experience with last year's twin-turbo Indy pace car really gave them a quantum leap over just about anyone else using a turbocharged engine in regular production cars. In fact, Buick has been selling turbocharged engines since 1977 and has sold more of them than any other carmaker.

We asked Buick to supply us with a Regal T Type for this test. The T Type has a 3.8-liter V6 turbo engine as standard equipment. The Riviera T Type does also, but the trimmer size of the Regal body style offered the promise of more scintillating performance.

Advanced turbo technology developed by Buick has been employed to transform the 3.8-liter V6 into a truly potent

powerplant. The addition of the turbo gives the V6 an incredible 81 percent boost in horsepower, up to 200 versus 110 in normally aspirated form.

The Regal T Type's V6 bristles with other marvels of modern automotive technology. The sequential port fuel injection system (SFI), first seen on last year's Riviera pace car engine, uses six injectors at the intake ports. Each injector is activated once, one at a time, during each combustion cycle, having been programmed to the specific needs of that particular cylinder and completely controlled by one of the on-board computers. The result is even better fuel control than other fuel injection systems, which results in improved idle quality, more responsive low-speed operation and, of course, more power on top end.

This SFI system also uses a fuel rail to feed the six injectors, and a regulator to control the fuel pressure. Fuel is injected into the port just prior to the opening of the intake valve. Air enters the system through a throttle body after being evaluated by the mass airflow sensor. This device uses an electrically heated nickel film in the flow path, where the cooling effect of the passing air is measured and relayed to the engine's electronic control module. With this data on the actual mass of the incoming air, plus input from other sensors, the computer sets the amount of time each injector will remain open. The longer the opening, the more fuel that will be injected.

Other advances on this engine include closed-loop electronic control of the wastegate to regulate the turbo boost pressure and a completely computer-controlled coil ignition system, which eliminates the distributor. This system uses the camshaft and crankshaft sensors of the fuel-injection system to determine spark timing. This eliminates virtually all parts of the ignition system and means that there is nothing that ever needs adjustment.

How does all this high-tech hardware translate into a

(Please turn to page 70)

Save Gas, Save Engine with 'POLY'

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

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

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

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

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

Perhaps most dramatic of all is a tor-



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

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

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

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

WHAT ARE THE BENEFITS OF SLICK 50? Your actual benefits in percentages may vary, depending on the kind of driving you do, vehicle condition, weather, and geographic area. By reducing friction, Slick 50 does all of the following: It increases gas mileage. It increases horsepower—small economy cars and large RV's really need this! It reduces operating temperatures, thus increasing the lubrication and life of the oil and the engine. Last but not least, the drastic reduction in engine wear defrays or eliminates costly overhauls which could save you up to \$1,000. Slick 50 eliminates the "lubrication starvation" that all cars experience when first started before the oil has a chance to circulate. Up to 90% of the engine wear on a car can be caused by this lubrication starvation. You receive all of these benefits for \$34.95, less than the cost of two tanks of gas.

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

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

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

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

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 Card No. _____ Exp. Date _____
 Name _____
 Address _____
 (Give street address if possible for UPS delivery)

PM LONG-TERM CAR TESTS

(Continued from page 68)

driving machine? Very well, indeed. In fact, the Regal T Type is one of the fastest cars we've tested in recent months, capable of blowing the doors off about 98 percent of Detroit's cars.

If you love the musclecars of the '60s, you'll love driving this car. Bury your right foot into the plush carpeting and watch the waves of smoke pour off the rear tires. Yet, drive the car gently and it's smooth and silent, like a sleeping giant waiting to do your bidding. And that's the whole beauty of a turbo-charged engine—its dual personality. It can be a screaming tire-shredder or tranquil transport. It's all in your right foot—as the fuel gauge will let you know: 11 mpg is what we get driving hard, 20 mpg taking it easy.

So far, we haven't had the car long enough to find out much about durability or maintenance. Those facts will emerge in the months to come as we torture the turbo as part of our long-term test procedure. What we can tell you now is that, if you're looking for zero-to-60 times of around nine seconds flat, handling to match the performance, all wrapped up in a sporty two-door coupe, take a look at a Buick T Type.—J.O.

Oldsmobile Cutlass Cruiser

With the big family station wagon going the way of the dodo, and not everyone interested in buying a van (maxi or mini) as a replacement, we were intrigued when GM finally offered a wagon version of its popular A-car line (Buick Century, Chevy Celebrity, Olds Ciera and Pontiac 6000). Since we hadn't tested an Oldsmobile product in some time, we ordered up the Cutlass Cruiser wagon with a fair number of comfort and convenience items that boosted the base price of \$9,551 to an awe-inspiring \$13,553.

The \$4,002 worth of options includes a three-liter V6 engine with 2-bbl. carburetor (\$250), air conditioning (\$730), AM/FM stereo-tape system (\$505), roof rack (\$110), tilt wheel (\$110) and power everything. A few items that made us gasp were the \$61 outside mirrors (with remote control on the driver's side only), \$140 rear window defroster, \$348 power seats, \$175 power door locks, \$260 power windows and the \$190 fake wire wheel covers. This last caused us some frustration until we discovered that you can actually take pressure readings and pump air *through* the long valve caps that GM places on its short valve stems. The stem itself is hidden between the spokes and cannot be reached without unbolting the wheel covers from their security locks.

Our test car has been especially

troubleprone and proof that GM has a long way to go before it can hope to compete with import quality. Most of our Cruiser's problems revolved around the suspension.

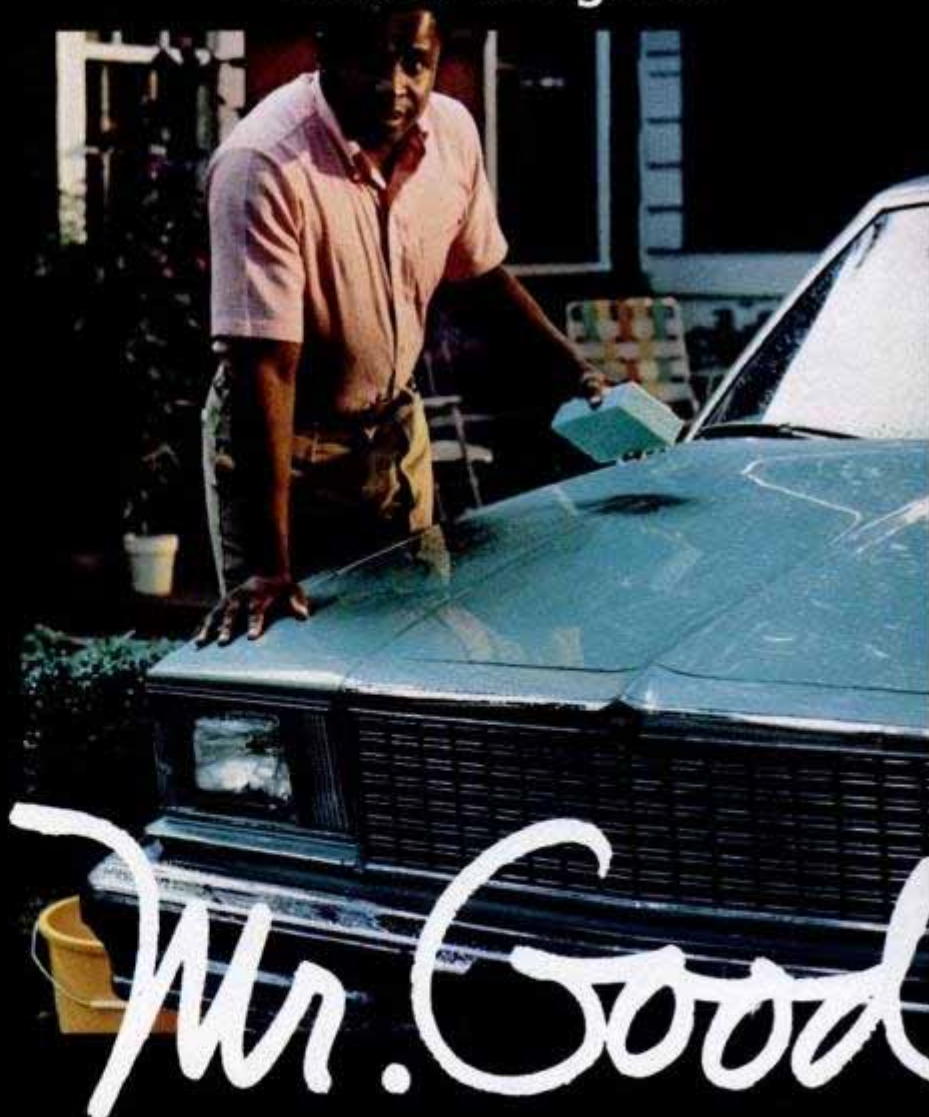
The left front strut made an alarming "thunk" over low-speed bumps, the steering shimmied and rattled, there was a groan from the transaxle at part throttle, a vibration under the dash, a clank somewhere under the car, and a wind/rain leak. The Uniroyal Tiger Paw radial on the left front wheel began to chunk tread in big pieces, exposing the steel belt. In addition, the rear suspension squeaked, the liftgate required a

mighty slam to shut properly, and the abrupt curve in the rear window glass caused annoying distortions.

Most disturbing, however, was the handling. The shock absorbers had little effect on bumps and the tail wagged the wagon every time we changed lanes. This wagon is a throwback to the overweight, undersprung, sloppy rear-drive wagons of another era. The Olds has the suspension of a Cadillac—flaccid. Under alternate acceleration and braking, the car squatted and dove on its soft springs so much that the fuel gauge needle fluctuated through a 1/4-tank arc!

The people at Oldsmobile's New

How to tell if your shocks are good.



York Zone Office kindly agreed to look into our long list of complaints, and after a lengthy stint at Sholz Olds in White Plains, N.Y., the car was returned with many of its annoying thunks and squeaks gone. What remained was a low-speed shimmy in the steering (though this was not as bad as it had been) and the boat-like handling—it answered the helm slowly and wallowed around corners like a rudderless ship in a high sea. Fuel economy has ranged from 13.6 to 20.8 mpg, averaging 17.7 mpg, not bad for a car this size. We'll fill you in on the Cruiser's progress in our next report.—W.H.

Jeep Cherokee

There's no quicker way to get in touch with a car than to pound it down Interstate 80 for 10 hours straight at 70 mph. That's what we did when we drove our Jeep Cherokee test vehicle from Detroit to New York.

The beginning of our trip was impeded somewhat by a minor problem—three flat tires within an hour. All were punctures. Happily, we weren't too far from Belle Tire Distributors in Woodhaven, Mich. Tony Ventimiglia, the manager, rescued us and had us on our way in record time.

During the first hour of the trip, the

Cherokee seemed to have seats that were too low, a steering wheel that was too high, all the wrong gear ratios, and tires unsuited to high-speed highway use. After about two hours, the seating position seemed fine, we didn't need to do too much shifting on Interstate 80, so the gear ratios didn't bother us, and we had learned to compensate for the constant nibbling of the tires.

The 2.5-liter Four in the Jeep was a bit wanting for high-speed passing and we had to downshift a lot to make it around 18-wheelers. But in cruising mode, the engine was fine and we couldn't complain about the fuel mileage, although our staff disagreed on what constituted good fuel mileage. Ours ranged from 14.3 mpg in strictly New York City driving to 22.9 mpg out on the highway.

The suspension wasn't our favorite part of the Jeep. It might be fine, offroad. We don't know. What we do know is that the springs are stiff so the ride is stiff. But the shocks are soft to try to make the ride better. So there's not enough control once you hit a bump or pothole. On smooth stretches of highway, the Cherokee felt smooth and stable, but otherwise, it felt like the suspension had too many compromises and just wasn't yet sorted out.

If we were AMC/Jeep engineers, we'd take another look at the suspension calibrations on the Cherokee.

Unresponsive tires

The steering was slow and vague, too, but that may have been mostly a function of the unresponsive tires fitted to our Cherokee.

Our Jeep has Command-Trac 4wd, which allows the wheels to be engaged on the fly merely by pulling up on a console-mounted lever. Though the owners manual claims this can be done at up to 55 mph, we found that entering 4wd at speeds higher than 35 mph created a bone-chilling protest from the transfer case. A dealer we spoke with couldn't suggest why this was so, but admitted that they encourage customers to enter 4wd at speeds below 30 mph.

Our test Cherokee was one of about 40,000 early production units recalled by AMC. Cherokees and Wagoneers built between July 1983 and February 1984 may have loose steering-bolt clamps. Though our truck wasn't supposed to be one of them, we had it checked anyway and the bolts were snugged up properly.

Ten thousand units within the 40,000 suspects had additional maladies. The press in the Toledo Jeep assembly plant that inserts the rear axle tube was maladjusted early on. Consequently, the axle tube was placed too far into the

(Please turn to page 135)

And what to do if they're not.

Here's a tip from Mr. Goodwrench on how to check shock absorbers. "Just push down on a corner of your car. Hard. Two or three times. Release. The car should rebound and then stop if your shock is O.K. Repeat on all four corners.

Even the finest shock absorbers wear. After 25,000 miles, you may notice other symptoms. Here are things to watch for. If your car leans after changing direction. Or keeps bouncing after a bump. Or if your tires show cupping or have unusual wear at any one spot you should do the shock test.

"Also look at each shock absorber. Is it leaking oil? Is a mounting broken? Is the shock dented? Are bushings worn?"

Good shocks mean more comfortable driving. So if you need



CUPPED TIRE

shock absorbers, see Mr. Goodwrench. He has the right training. GM training. And the right parts. Genuine GM Blue Line shock absorbers with a lifetime limited warranty for as long as you own your General Motors car or light-duty truck. You'll find him at participating independent GM dealers who sell Chevrolets, Pontiacs, Oldsmobiles, Buicks, Cadillacs, GMC and Chevy trucks.



LET'S GET IT TOGETHER...BUCKLE UP

Goodwrench

KEEP THAT GREAT GM FEELING WITH GENUINE GM PARTS

HOMEOWNERS' CLINIC



Peeling paint in the shower

I have had a continual problem with the paint in the shower peeling and flaking off. I've been using a concrete water-repellent paint which lasts for a period of time. What type of paint would you recommend to use in a shower with a poured concrete base and concrete walls? Should I place tile over the walls? The house was built with this type of shower in 1946.—Don Gress, Slater, Iowa

I believe you would be ahead of the game if you tiled the walls and floor of your shower rather than painted those surfaces. Tiles may cost more initially, but in the long run they will be less of a problem. They also provide you with a

wide selection of decorative patterns which are not available in a painted surface.

The peeling and flaking of the paint in this type of application is not unusual. Quite often the surface to be painted is not properly prepared. The surface must be clean and dry. All soap residue, dry salts and oily films on the surface must be removed. Depending on how much of a problem is presented, the cleaning may have to be done by washing the wall with a dilute solution of muriatic acid, possibly by mechanical scrubbing by means of a belt sander or wire brush.

The unpainted concrete surface may

feel dry to the touch but may still contain a lot of moisture, as a result of being wet from the shower.

An easy test to determine whether the wall is dry is to tape an 8-in.-square section of aluminum foil to the wall, sealing the perimeter with masking tape. Remove the foil 24 hours later and see if the side facing the wall is damp. If it is, that means the wall surface is damp and should not be painted.

Even when precautions are taken, periodic repainting of the shower walls and floor should be anticipated. On the other hand, with a tile surface the periodic maintenance is simply re-grouting cracked tile joints and occasionally resetting a loose tile. Tiling is your best bet.

Humidifier sediment

My hot-air furnace system is equipped with a power humidifier manufactured by Auto Flo. The water in our area is considered hard and no softener is used in my system. The plastic basin and carousel of the humidifier described above must be cleaned regularly and an attempt is always made to do so. Despite these efforts, a hard sediment forms on the basin and carousel, which is extremely difficult to remove. Do you have any suggestions as to how I can remove the hardened sediment? Also, how can I prevent it from recurring in the future without resorting to adding a complete water-softener setup to my entire water system?—Thomas B. Cumiskey, Cumberland, Md.

The hardened sediment that forms on the basin, carousel and float assembly in your humidifier can be softened by soaking those items in a 50 percent solution of white vinegar and warm water for about half an hour. The sediment can then be removed and the items cleaned. The components should be rinsed thoroughly before being replaced, otherwise a vinegar odor will be picked up by the circulating air.

There are commercially prepared liquids and/or tablets that can be used to help clean the humidifier and minimize the extent to which the sediment becomes hard. Sears sells a humidifier accessory kit for cleaning and softening scale. Auto Flo Co., 12085 Dixie, Detroit, Mich. 48239, sells tablets for this purpose under the designation Model

102. A vial of six tablets costs about \$4. Humidifier tablets are also available at plumbing supply stores.

A device that may be helpful in keeping the sediment soft is called the Hako Magnetic Field Water Conditioner model HR-1. This unit, about 1³/₈ in. in diameter and 5 in. long, can be inserted into the humidifier water supply. Although I have not tested this device, the manufacturer claims that water passing over the directional-controlled magnetic core in the device will cause the humidifier scale to remain soft so that it can be washed away easily. This product comes with a one-year, money-back policy on performance and costs about \$37. For further information write to Introdel Inc., 246 North Woodwork Lane, Palatine, Ill. 60067.

Unless you use distilled water, which is hardly practical, deposits will always build up in your humidifier. Even the use of a water softener will not eliminate this problem. In fact, in many cases it could aggravate it. Quite often the salts in softened water build up in the humidifier faster than the minerals in unsoftened water. Regular cleaning and tune-ups during the heating season is always necessary for effective operation of any humidifier. The frequency of cleaning, however, depends on the mineral content of the water.

Don't forget to clean your humidifier at the end of the heating season before the sediment becomes too hard, rather than at the beginning of the season, when it's as hard as a rock.

SERVICE TIP

Simplicity now offers homeowners do-it-yourself service manuals for its rear-engine riding mowers.

According to the company, the service manuals are written at three levels so that anyone, from novice to accomplished mechanic, can find appropriate instructions for their machines. Manuals now available cover 3100 Series riding mowers, 4200 and 5200 Series tractors, and walk-behind snowthrowers.

At Simplicity dealers, the do-it-yourself service manuals cost \$6.50 to \$8, depending on size and dealer. You should contact Simplicity Manufacturing Inc., Port Washington, Wis. 53074. **PM**



Supplementing operators' manuals, these do-it-yourself service manuals speak to novice and accomplished mechanics alike.

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



PESTS R GONE™ WITH DECIMATE

**Get rid of rats, mice, roaches, fleas, bats, spiders, flies,
mosquitos, crickets, moths, squirrels, etc. etc. . . .**

You can fumigate them, poison them, trap them, etc. But what do you do with those dead and unsightly things? And those poisons can be harmful to humans and pets. And pests can become immune to them. Bentley's knows a better way! DECIMATE 500C (the biggest unit) delivers an ultrasonic sound that cannot be heard by humans and pets. It is completely harmless. But it is another story to all those pests and varmints. It drives them looney! DECIMATE causes them extreme discomfort and pain. Would you take this kind of treatment? Heck no. And neither will they. In just a few weeks all those pests and varmints just leave and never come back.

Decimate 500C will help keep pests from inhabiting and nesting in vacation homes, campers, and boats both during summer and off season. Use it to control pests where food is kept and stored. Hard to seal areas, such as garages, toolsheds, and farm outbuildings will benefit most from Decimate Ultrasonic protection.

DECIMATE 500C is a home sized version of an electronic pest control used by professional exterminators. Bakeries, schools, hospitals, etc., use them. With a technological breakthrough the cost has been dramatically reduced. Now, every home or plant can afford DECIMATE.

There is no longer any question that ultrasonic sound at the right

frequency range and appropriate decible output is an effective way of ridding your home or plant of pests and varmints. The question is: how do you tell the best product from the rest? Check those other units for the following features and see if they measure up to Decimate 500C.

Decimate 500C has an EPA (Environmental Protection Agency) establishment number and is approved by City Building and Safety Departments. It is listed by Underwriter Laboratories (UL).

Decimate 500C has an ultrasonic intensity output of 152db. United States Testing Laboratories proved it thousands of times more powerful than the next leading competitor.

Decimate 500C sweeps two levels of frequency from 25,000 to 65,000 Hz in each cycle. (Beware of units of low intensity and constant frequency). The overall efficiency of the unit is greatly enhanced with the changing frequencies. Decimate 500C protects 3,500 ft.² (25,000 ft.³). Other units may cover as little as 1500 ft. or less.

If those other units do not have all these important features that DECIMATE 500C has than you should not buy them. Buy the best, Decimate 500C. This product should last for 10 years or more so why not get the best and the most powerful unit. And now, Decimate 500C also generates sound in the "infrasound" range. This is sound below humans

and pets range of hearing that can be bothersome to even more pests than before.

Just plug the DECIMATE 500C into any AC outlet and in a few short weeks those pests and varmints could be gone forever. Decimate, the pioneer and world leader, has rid tens of thousands of homes and plants of pests. One year limited manufacturers warranty. Try it in your home or plant for 30 days and if you are not 100% satisfied return it for a prompt and courteous refund. Major credit card holders ask for extension 37 and order #BG7 for Decimate 500C or send check for \$69.00 (U.S. dollars only) plus \$3.95 delivery. Canada, Hawaii, Alaska, Puerto Rico, Virgin Islands \$6.95 delivery. Add \$2.00 for each additional unit. California delivery add 6% sales tax.

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That Cigarette Smoking Is Dangerous to Your Health.



Georgia State Trooper Sam Patrick loves his Mustang pursuit car (foreground), which was the best performer in our test. Other patrol cars are (front to back) a front-drive Plymouth Reliant turbocharged 4-cylinder, front-drive Chevy Celebrity V6, Chevrolet Impala V8 and Dodge Diplomat V8.

WHY POLICE CAN'T GET THE CARS THEY NEED

PM track test reveals how federal regulations have hobbled today's sad-sack police cars.

It's not too hard to imagine yourself as a highway patrolman screaming down the interstate at 140 mph in hot pursuit of alleged perpetrators, siren wailing, blue lights flashing, traffic dodging out of your way like leaves before a tropical storm. You hit the accelerator and the big V8 under the hood blasts you effortlessly ahead of your prey. A shower of gravel and a hail of small arms fire, and you're ready for another personal commendation from the governor.

Well, maybe in the movies. In actual fact, today's troopers are hampered by driving some of the slowest cars on the road and, as a consequence, many of them have been ordered to break off pursuit when their speed exceeds 85 mph. In the glory days of the '50s and '60s—remember Broderick Crawford's Oldsmobile J-2, Ford's 406 Police Interceptor or the Chrysler 440 Wedge and 426 Hemi?—that would have been blasphemy.

In the old days, car manufacturers could build high-



SPECIFICATIONS AND DIMENSIONS

CAR	PRICE AS TESTED	VEHICLE TYPE	ENGINE	TRANSMISSION	WHEELBASE (in.)	OVERALL LENGTH (in.)	CURB WEIGHT (lbs.)
Chevrolet Celebrity	\$9,862	6-pass., 4-door sedan	OHV 2.8 V6	3-speed automatic	104.9	188.3	3,000
Chevrolet Impala	\$10,513	6-pass., 4-door sedan	OHV 5.7 V8	3-speed automatic	116.0	212.2	4,000
Dodge Diplomat	\$13,353	6-pass., 4-door sedan	OHV 5.2 V8	3-speed automatic	112.7	205.7	3,400
Ford Mustang	\$9,200	4-pass., 2-door sedan	OHV 5.0 V8	4-speed manual	100.4	179.1	3,000
Plymouth Reliant Turbo	Not for sale	6-pass., 4-door sedan	SOHC 2.2 Turbo-4	3-speed automatic	99.6	176.0	2,400

performance cars specially for police pursuit. These *looked* like normal American sedans, but they were really more like NASCAR Grand National racers painted black and white. Most of them carried high-compression engines with high-lift cams, multiple carburetors, higher numerical rear-axle ratios, track-inspired suspensions, and special tires.

For those police cars of 20 years ago, quarter-mile acceleration was in the 14-second range at 100 mph, and top speeds approached 150 mph for the hot Hemi-powered Dodges and Plymouths. The only cars faster were hand-built muscle cars and a handful of exotic European sports cars rarely seen in this country.

Not anymore. Today, *all* police cars must meet every federal safety and pollution control requirement, from side-guard door beams to NOx emissions and the Corporate Average Fuel Economy regulations. The sad result? Literally dozens of stock production cars sold in this country—not to mention any street motorcycle larger than 350 cc—can outrun any sedan the police can purchase. Loaded down with 200 pounds of radio and emergency gear and slowed by a roof-mounted light bar, today's pursuit vehicles are hard pressed to top 100 mph *period*, let alone in a quarter-mile.

This has changed the very nature of police work. No longer can a single trooper quickly and efficiently apprehend a fleeing suspect with a short burst of speed. A criminal in a moderately quick car can lead a merry chase for miles, endangering everyone in his path. The only way today's troopers can stop him is with roadblocks that are set up far ahead. But inevitably, a high percentage of malefactors will evade the net.

Still, there's a special mystique that surrounds any police car. To find out just how good the cars in which our troopers carry out their dangerous patrols are—and how difficult it would be to duplicate one of their cars for yourself—we assembled five 1984 police sedans at Chrysler's Chelsea Proving Grounds where we could drive them at high speeds without being cited for "reckless endangerment."

Representing the classic full-size, six-passenger V8 police cruiser, we had a Chevrolet Impala and a Dodge Diplomat. Representing the new breed of smaller front-wheel-drive cars, we had a Chevrolet Celebrity and a Plymouth Reliant which was fitted with an experimental factory turbocharger. As we'll explain, a similar setup will be available on 1985 models.

Last, but certainly not least, we were able to borrow a Mustang V8 from the Georgia State Patrol, which was delivered by Trooper First Class Sam Patrick, the most pleasant police officer you'd ever want to face over the wrong

end of a ticket book. Officer Patrick was a terrific help during our road testing, and an outstanding ambassador for the Georgia State Patrol.

There are some communities using Volkswagen Rabbits and Saab 900s for suburban patrol, but the five cars we tested are the only ones seriously offered in this country for high-speed roadwork. We put them through our normal series of road-test procedures to evaluate handling, braking, and acceleration, plus (with light bars removed) ran them as fast as they would go on Chrysler's high-speed test track. We also drove each car back-to-back over a course that simulated normal driving conditions. Here's what we found.

FORD MUSTANG

Last year, we tested a civilian Mustang GT—a fastback fitted with Michelin TRX tires—and found it a disappointing handful to drive fast. According to Officer Patrick, the Georgia State Patrol had the same reaction. So when they ordered their 10 Mustang pursuit vehicles, they specified a notch-back body which promised better weight distribution and stiffer chassis construction. Instead of the Michelins, Georgia fitted each car with 205/70R14 Goodyear Eagle GT tires, plus Ford's heavy-duty suspension and four-speed manual gearbox.

Ford's police package consists of a calibrated 0- to 140-mph speedometer, a small front spoiler to increase airflow to the radiator, a full-size spare tire,



Reliant Turbo is a Chrysler prototype.

TEST RESULTS

CAR	¼-MILE (sec. @ mph)	BRAKING (ft.) (60-0 mph)	SLALOM (mph)	200-FOOT SKIDPAD (cw/ccw)*	TOP SPEED OBSERVED (mph)
Chevrolet Celebrity	18.47 @ 75.5	146	57.25	662/ 689	98
Chevrolet Impala	17.81 @ 80.3	151	53.05	660/ 664	101
Dodge Diplomat	18.02 @ 77.0	158	52.93	687/ 694	105
Ford Mustang	16.20 @ 90.0	144	54.57	705/ 665	119
Plymouth Reliant Turbo	17.11 @ 84.1	154	59.17	708/ 746	103

*Skidpad figures measured in G-force, cw = clockwise, ccw = counterclockwise.



PM crew installs light bars (above). Would you stop for this cop?



heavy-duty front seat, heftier voltage regulator and no console, in addition to the chassis reinforcements. None of these items significantly increases the performance of the car, which is another way of saying that Ford's Mustang police car is mechanically identical to the civilian model that any citizen can purchase.

This is no bad thing. Officer Patrick's Mustang had 30,000 hard miles on it at the time of our testing, yet it was only a tick slower than the Mustang V8s tested by this and other magazines. It was also far and away the best all-around performer of all these police cars. It's the only one capable of outrunning a fast-moving sports car on either a straight or winding road, and while it's no Ferrari, it was quite a competent performer right up to its 120-mph top speed.

As a police car, the Mustang has only one drawback—two doors and a small back seat. In California, Mustangs are used for high-speed pursuit, then a backup four-door sedan is called in to haul the suspects away.

As far as civilian Mustangs go, our testing was a real eye-opener. Forget about the \$10,000 Mustang GT. Forget about the \$16,000 Mustang SVO. Ford's secret hot rod is a notchback Mustang LX, fitted with the 5.0-liter V8, heavy-duty suspension and a set of fat Eagle GTs. You'll have a quick, fast, enjoyable road car for under \$9,000. In today's performance car market, that's a bargain whether you have to answer

to a bill-paying spouse or the state legislature.

DODGE DIPLOMAT

As one of our test crew commented, "This is the nation's police car." And so it is. The Diplomat's identical twin, the Plymouth Gran Fury, won this year's annual State of Michigan police cruiser shoot-out, and since many other states base their buying decision on the Michigan results, it has become the vehicle of choice nationwide.

For police work, the Diplomat scores because it feels comfortable to drive, has a roomy back seat and, to be honest, is a known quantity. Fleet buyers are guaranteed that when ordered with a raft of heavy-duty options, the conventional Diplomat will withstand any imaginable punishment and keep on ticking.

It doesn't come cheap. The price negotiated by fleet buyers is one of the best-kept secrets in Detroit, but it's surely thousands of dollars less than the \$13,000 price tag on our test Diplomat. To be accurate, though, a civilian model wouldn't need the \$1,158 police package, roof reinforcement plate or police identification package. A civilian Dodge Diplomat equipped with heavy-duty *everything* should list for around \$11,500 and sell for even less.

In its way, the Diplomat is just as specialized a vehicle as the small but fast Mustang. It's certainly not a car you'd pick to drive for fun. It's more of a professional tool for doing a job. If your

daily driving is closer to running a taxi service or highway patrol than zipping around a racetrack, a Diplomat could be the answer. As one of our testers said, "If they'd just drop the 360 four-barrel back into it, or, heaven help us, the 440 Wedge, I'd buy it to commute."

And that points out the Diplomat's major failing. Despite a 5.2-liter V8, fat tires and a suspension hard enough to drive nails, the car is *slow*. The little 2.2-liter Reliant ran rings around it at the track, and it's obvious that the highway patrols that have purchased Mustangs for pursuit work have done so because the more versatile, but lack-luster, Diplomat simply doesn't have enough oomph. We never expected to be saying that about a descendant of the legendary Road Runner.

CHEVROLET IMPALA

Chevy's full-size Caprice/Impala has the reputation of being the best full-size sedan on the market. In police trim, it receives a beefed-up frame, heavier antisway bars front and rear, quicker steering, stiffer shocks and springs, station-wagon wheels and a 350 V8 with four-barrel carburetor in place of the civilian 305 engine. But you can't buy the police version unless you wear a badge.

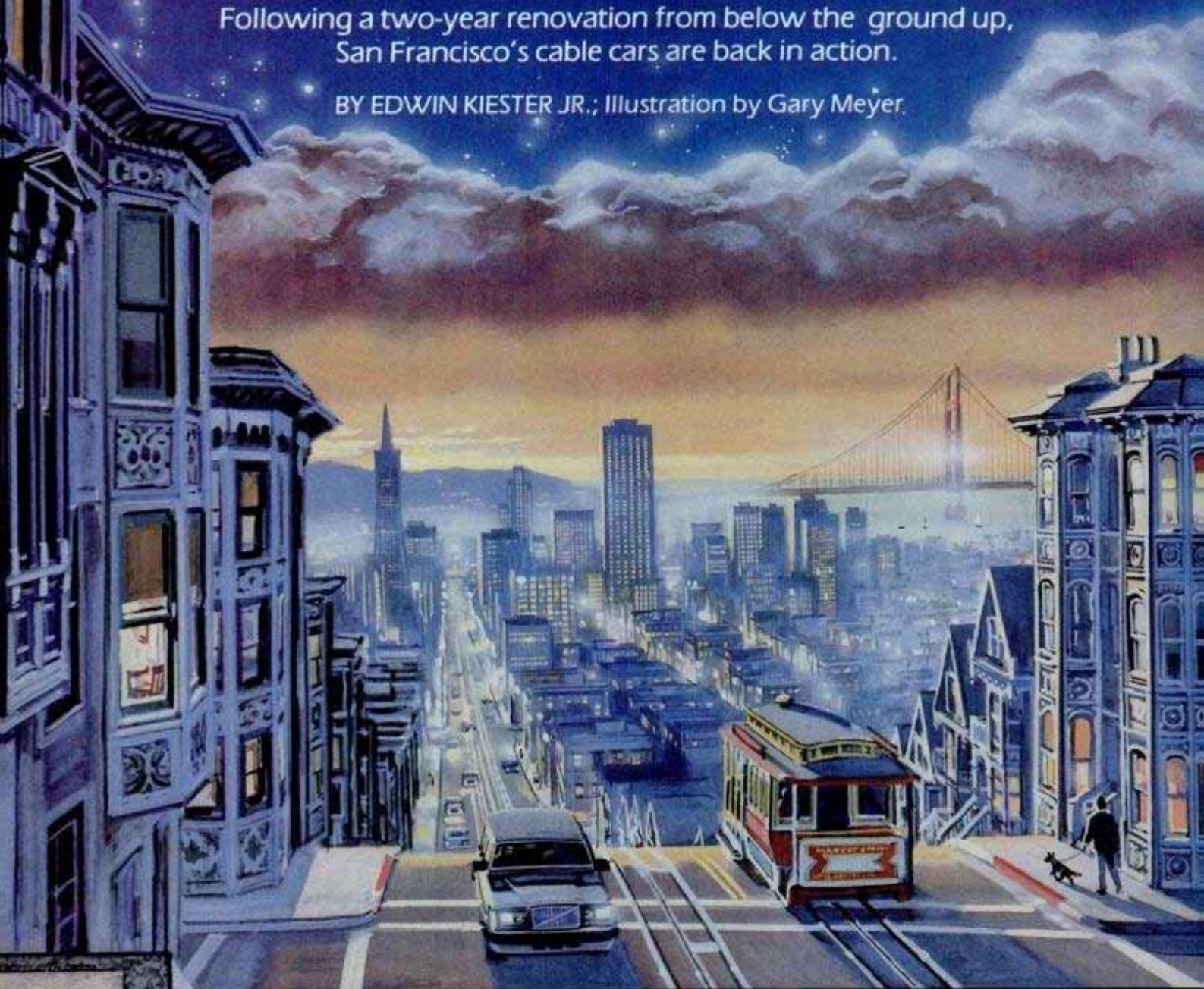
However, according to Chevy engineer Michele Pickering, if you order an Impala with the F41 suspension, then fit heavy-duty aftermarket shock absorbers and Goodyear Eagle GT tires on

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HALFWAY TO THE STARS

Following a two-year renovation from below the ground up, San Francisco's cable cars are back in action.

BY EDWIN KIESTER JR.; Illustration by Gary Meyer.



This summer, for the first time in nearly two years, one of San Francisco's beloved open-air cable cars will clatter out of the barn and begin to "climb halfway to the stars," as Tony Bennett sings. For passengers aboard the first ride up Nob Hill or down to Fisherman's Wharf, the journey will seem just as it always has, for 100 years or so. The underground cables will sing and click, the cars will rumble over switches, the gripman will improvise melodies with his bell.

Yet, out of sight, the old-fashioned cars, with their polished mahogany seats and riders clinging to the steps, will bump along to a very different technology. Beneath the city's challenging hillside streets, engineers have innovatively blended old

techniques with highly sophisticated 1980s technology to rebuild the nation's oldest powered street-railway system along the lines of the past.

"It would have been no challenge to build a new street-railway system from the ground up," says English-born John Hayes of the engineering firm of Chin and Hinsholt, project manager for the \$58.2 million renovation. "The trick was to produce a reliable, safe, efficient cable-car system using exactly the principles as had been used for 100 years."

Legend says that San Francisco's cable cars originated when Alexander Hallidie, a local wire-rope manufacturer, saw a horse stumble and break a leg trying to pull a street-railway coach up one of



Finishing a climb and entering a "pull curve," the gripman stands by to release the cable, allowing the car to drift into the curve on its own momentum. The rebuilt cableway beneath the street rests on a continuous reinforced concrete channel. Notched against the channel near the top are deep-flanged guide rails. Artist's conception shows unique depression beam to hold cable down at a change of grade. The beam swings out of the way automatically as a car passes and grips the cable.



PHOTOS BY BRUCE KLEWE

In keeping with tradition, cables are wound like rubber bands around underground pulleys (far left). Pulleys were upgraded with heavier bearings. The entire cable channelway was dug up (left) and replaced with a reinforced-concrete system. A gauntlet section (above) nears completion. At these points, passing cars share a center rail. These are flanged on either side to give the cars more stability. Some construction sites had to be reinforced when work was in progress due to flooding from two months of heavy rainfall.

the city's steep cobblestone hills. Hallidie went back to his factory and devised a system by which cars clamped onto an endless underground cable—"like a giant rubber band," one engineer says—and were pulled uphill, then allowed to descend gracefully down. Hallidie's invention was so successful that it was quickly adopted by other cities, and by the 1890s most municipal transportation operated by underground cable. But the coming of electric trolley lines, and later motorized buses, doomed the cable cars everywhere except on San Francisco's hills. Even there, they were retained only on three of the steepest routes.

In 1979 Chin and Hinsholt was commissioned to study the cable cars and recommend improvement. The firm quickly found the system was in even worse shape than had been believed. Over the years, the system had been so patched up and jury-rigged that more than 60 percent of it was beyond repair. In worse shape was the trackway. Because the traction cable must run down

the center of the right-of-way, cable-car rails cannot be supported by conventional crossties. Instead, U-shaped iron yokes on 4-foot centers, anchored to brick and concrete pillars, were used. Many of the yokes had rusted and the pillars had crumbled, so that rails floated free, giving the cars their characteristic rocking motion and causing frequent derailments. Settling of the streets had further misaligned the rails and increased the hazard.

The power plant, which had stood virtually unchanged at the edge of Chinatown since 1887, was, to say the least, antiquated. A single 700-hp motor drove the whole system. When one cable broke down, everything had to be stopped. Chin and Hinsholt recommended a complete overhaul. In October 1982, with federal aid, the system was closed and work began.

Not surprisingly, the biggest and most innovative changes are hidden from view—in the trackway itself. The rusted old yokes have been replaced with a continuous reinforced-concrete

channel through which the cable runs. The 5-foot-wide channel also supports the guide rails, which have a deeper flange than the old rails to reduce the threat of derailment. With a few key exceptions, the old bolt-plate rail has been replaced by stiff, heavy-bottom girder rail, joined every 60 feet by a thermite weld. The old rail gave the cars their romantic lurch and sway, but also could cause severe jolts and hazards.

The steep terrain and narrow streets have dictated some variation, however. For ease of repair, bolted rail has been retained in heavy-wear areas. A special high-silicon rail has been used on the outside arc of pull curves, and on steep slopes where sand must be dropped on the tracks to increase braking friction. A 100-pound T-rail replaces girder on gauntlet sections, where passing lines share a center rail, which thus must have a flange on either side.

Ever since Hallidie's day, pine tar has been used exclusively to lubricate the cable as it passed over underground

A Streetcar Named Desirable



Philadelphia's streetcars are lightweight and fuel-efficient.

They clang and lurch, get in the way of city traffic and cover painfully short distances at a frustratingly slow pace. But we Americans love streetcars. So much so, in fact, that the late urban transportation whiz Robert Moses once said: "You'll see the last of me long before you've seen the last of streetcars."

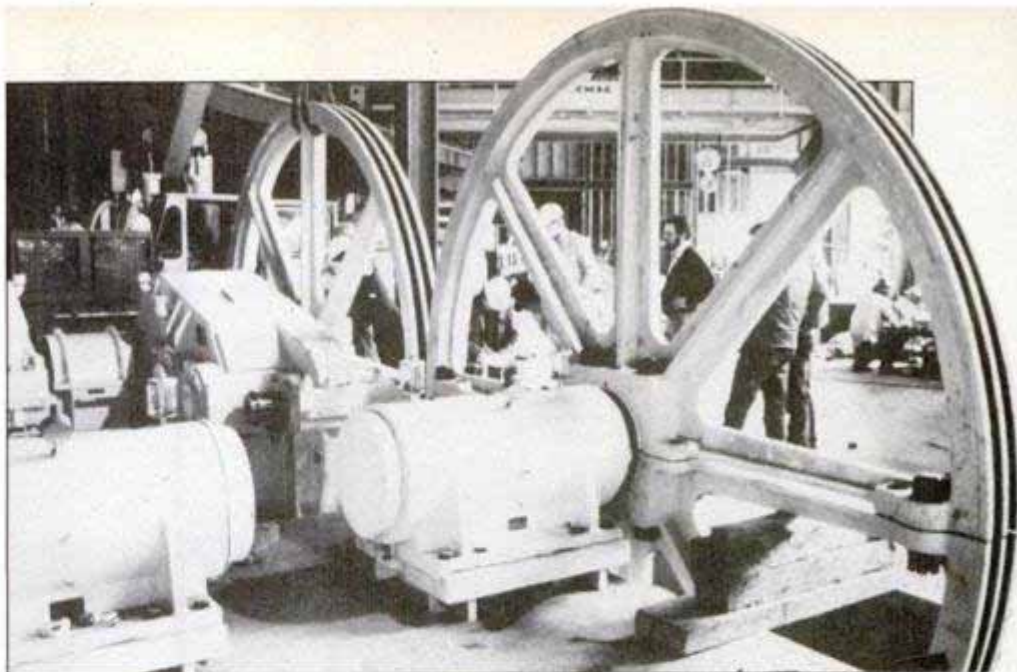
Romance aside, streetcars—trolleys, cable cars and trams—are going through a rebirth in urban America. Add to the list a new vehicle, the Light Rail Vehicle (LRV), and you have what many believe to be the early stages of a transportation revolution.

"Streetcar systems can play havoc in densely populated areas," says University of California engineer Lewis Renard. "But they require far less construction and consume far less fuel than other forms of mass transit." Among the cities enjoying a streetcar revival are San Francisco, San Diego and Philadelphia. New York is considering a mile-long trolley in the Times Square area, and Miami and Houston also have plans on the drawing boards.

The revival of streetcars in the Philadelphia area marked a last-ditch effort to save a dying mass-transit system back in 1980. With federal aid, the city has since undertaken a \$16 million program to rebuild 112 "Presidential Conference Committee Cars" (PCCs), which derived their name from the federal funding that resulted in



Cable car renovation was slowed down at times by suggestions that the cars be modernized. But in the end, the engineers opted for traditional cars (above). The only new equipment in the cars is a radio device that tells the gripman when a cable is loose. In a move to prevent major breakdowns, the cable car barn was completely rebuilt. Instead of running all cables off a single motor-pulley system, the four major cable car lines have independent motors and feeder lines. Two of the motors are shown in the photo at right.



pulleys. It produced a distinctive acrid smell, collected in what Hayes calls "great dams" covering the pulleys, and had a dismaying way of clinging to the clothes of passengers. Worse yet, it coagulated on wet days and caused "rope jump," in which the grip would suddenly fuse to the cable, causing the car to lurch violently forward, even throwing passengers from their seats.

"We wanted a new lubricant that would retain the qualities of high friction, as well as being very lubricating inside to allow the cable to flex," Hayes said. "But we wanted to reduce the tendency to build up and to cause rope jump." After two years of work, Chevron came up with a new petroleum-based lubricant which can be heated and dripped onto the cables. "It may cost five to 10 times as much," Hayes says, "but it can be applied in smaller quantities, and the net cost may be no different."

With its arched windows and Victorian fretwork, the cable-car barn at Washington and Mason streets has

been declared a national landmark. Engineers were required to retain its classic lines in the renovation. Not much stayed besides the shell, however. The building was completely gutted to house new power and control units.

Underneath the Washington-Mason corner, an underground sheave room was constructed, where each of the four cables (one each for the California and Hyde Street lines, and two for the Powell-Mason line) are aligned through a system of cables to feed into the tension runs to be reversed. Arranged diagonally across the main floor, these runs, terminating in a giant wheel, can be lengthened or shortened to adjust tension as a new cable slackens or an old one must be cut and spliced. Each of the cables is now powered independently by its own 400-hp motor, presumably bringing an end to systemwide shutdowns. Upstairs, a new control room will continuously monitor safety features throughout the system.

Yet for all that is new in the cable cars, many features would still be rec-

ognizable even to Hallidie. The cable, for example. In spite of extensive research, including contributions by Swiss specialists in aerial tramways, the redesigners found they could not improve on the existing cable configuration, which consists of six strands of 19 wires each, spirally wound around a flexible hemp core. About all that could be done was to install an improved alarm system to notify maintenance personnel when an individual wire snapped.

Depression beams are a unique feature which hold the cable down at a change of grade so that it does not ride up and damage itself against the channelway. The beam swings out of the way automatically as a car passes and grips the cable. Chin and Hinsholt's original report recommended that a new system be designed to replace the decades-old method. But in the end, the depression beams were retained. "We found that any alternative method would introduce problems of its own, so

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their design a generation ago. The city has also ordered and is almost completely stocked with 112 LRVs. The cars are equipped with electronic acceleration controls and a smooth-riding air-suspension system. The LRVs operate at up to 50 mph on 4 d.c. motors that provide 100 hp each.

San Diego has installed an LRV system to cover 16 miles between downtown San Diego and San Ysidro at the Mexican border. The streetcars are German-made of lightweight welded steel and fiberglass. The 24 LRVs travel at up to 50 mph, a great advancement over the 30 mph of traditional trolleys. Cabs are fully computerized.

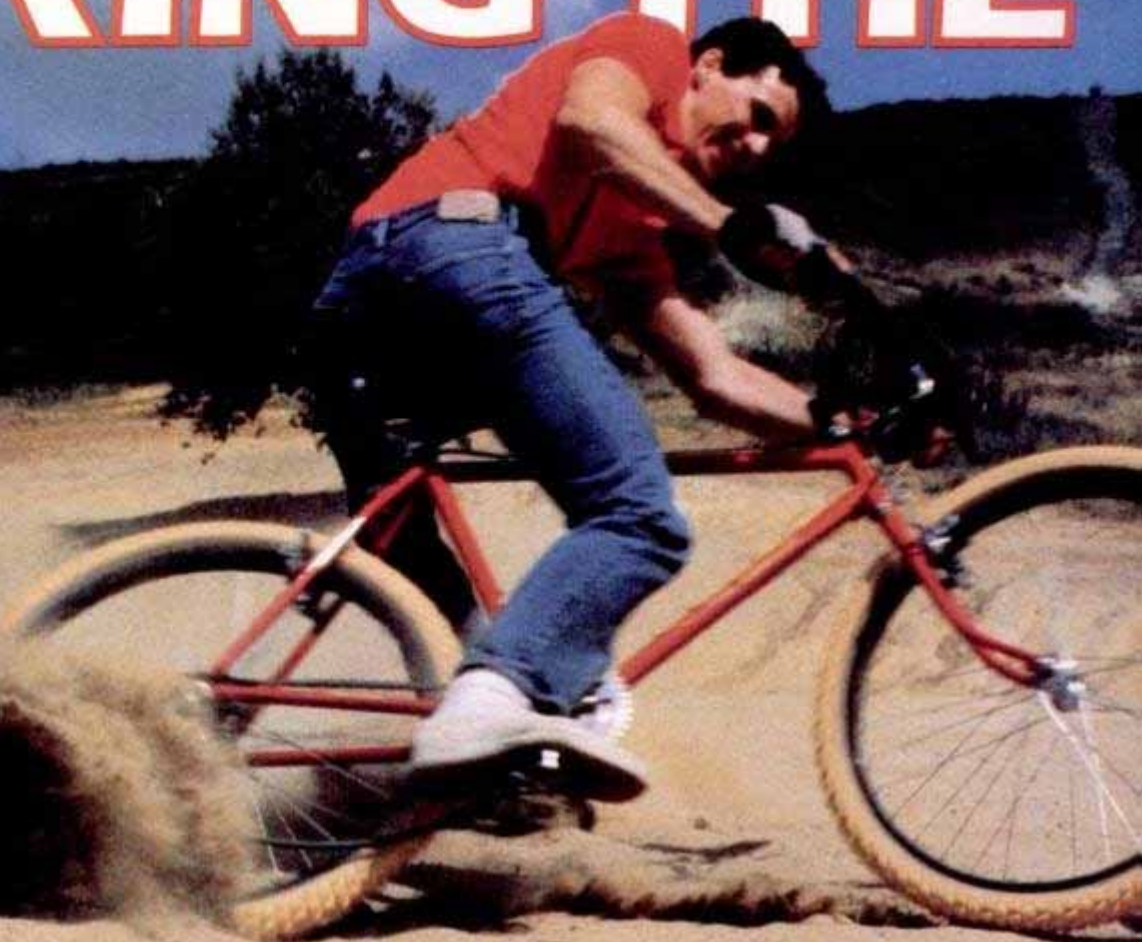
Earlier this year, at a Department of Transportation conference in Washington, D.C., a panel discussion on streetcar use in Europe revealed plans for new system construction in Paris, Rome and Frankfurt, West Germany. "Streetcar systems—especially LRVs—generally consume less than 60 percent of the energy required for subway, bus or automotive systems," one paper noted. "And, wherever such systems are planned, the human fascination with streetcars emerges as a point of support."—Dennis Eskow



San Diego's LRVs run from downtown to the Mexican border.

BIKING THE

By Angus Laidlaw



Fat-tire bikes, once looked down upon as kid stuff by the snooty riders of skinny-tire touring and road-racing 10-speeds, are the hottest thing going. But today's fat-tire bike is a far cry from the balloon-tired newsboy special of the 1950s and '60s. Known as all-terrain bikes (the preferred connotation), mountain bikes or city bikes, these descendants of the Schwinn Black Phantom and Whizzer Special are a cross between '50s-style balloon-tire flyers, lightweight racers and your kid's BMX off-road racing bike.

It's a whole new ball game, a fact you already know if you've been in a bike shop lately. The all-terrain bike is a thoroughbred all the way. What's more, it's increasingly being recognized as the ideal city bike because today's city streets can be even rougher on machinery than the dirt trails and mountain paths these rugged two-wheelers were first built to conquer. In fact, you may remember our report on the first of these all-terrain bikes (*The Bike That Ate New York*, page 166, Mar. '83). Since then, new technology and newly designed components for all-terrain bikes have made them truly specialized machines capable of wondrous things if you have the guts to put one of these guys through its paces.

Bicycles, at least most of the top-rated ones,

have ceased to be machines you buy like a car—as a complete vehicle with, perhaps, a few options. You purchase a custom off-roader or competition bike much the way a savvy truck fleet supervisor specifies a line-haul tractor—component by component to build up a machine than can do the job you require.

The frame sets the pace. Even the relatively inexpensive off-the-rack, all-terrain bikes sport oversize top and down tubes as well as different geometry than touring or road-racing bikes. The angle between the head and seat tubes is usually 70° or less, compared with 72° to 74° for road-racing and touring bikes.

Longer 42- to 44-inch wheelbases help bridge rough surfaces without jarring loose the rider's hind teeth. Raised bottom brackets increase ground clearance to about a foot from 10 inches. Brazed-on fittings that can't shake loose mount cable stops, water bottles and racks. The diamond-shaped frames inherited from the 10-speed road racer are often custom-built from exotic materials.

The steels used to build bike components tell you a lot about the general quality of the machine. Mild steel tubing or forgings have to be heavier to

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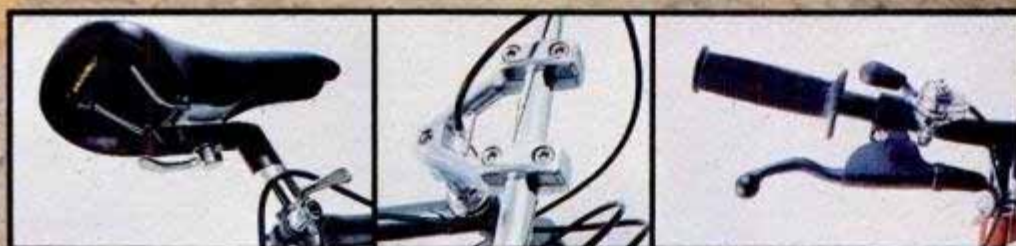
BADLANDS

Special equipment and design let you ride these all-terrain bicycles on the roughest of roads—in the boondocks or big cities.

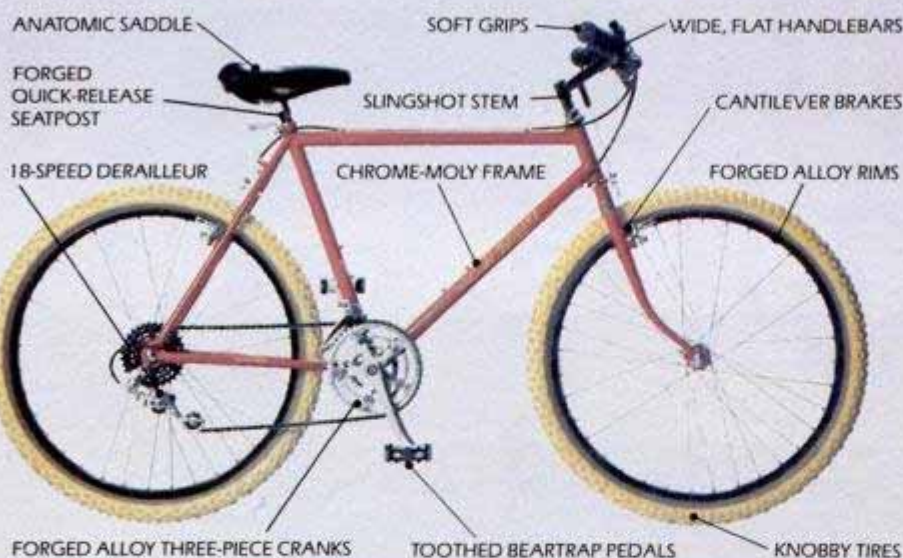
Photos taken at Saddleback Park, Irvine, Calif.



Photos by Randy Leffingwell

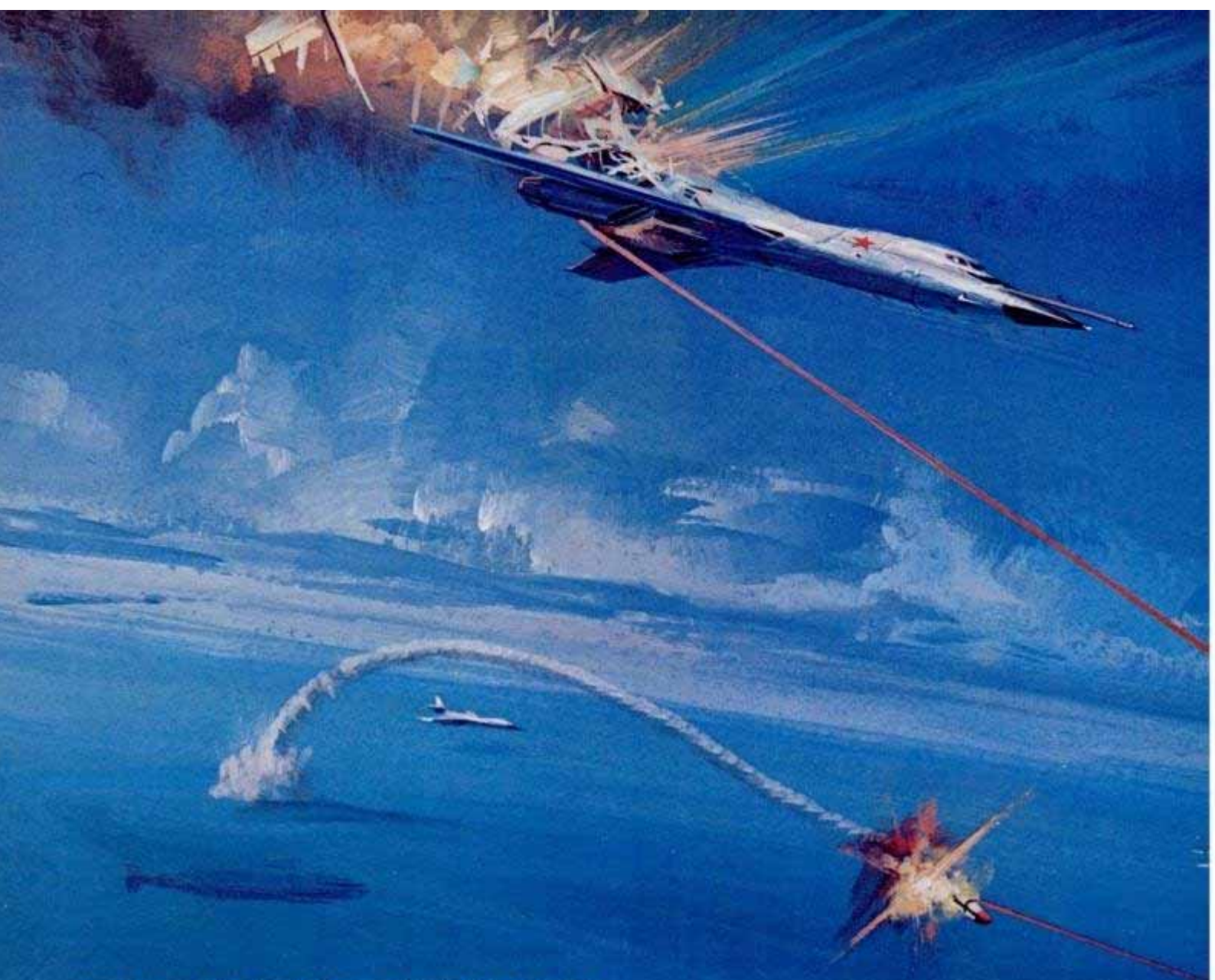


Specialized All-Terrain Bike Components



At top and on the opposite page, R.L. Osborn, top rider for the *BMX Action Trick Team*, puts the *Fat Chance* through its paces. The special components at left make the difference between a wimpy street cruiser and a brawny all-terrain bike. Clockwise from top left: The saddle is lightweight and anatomic in design. The seatpost is made of forged alloy and any adjustments can be made quickly and easily. The wide handlebars mount in an alloy slingshot stem. Grips are soft and non-abrasive, while the bike's controls remain protected from dirt. The brakes are alloy and cantilever in design. The bike's frame is made of lightweight alloy that is sometimes braced at stress points. Cranks are forged and the pedals are toothed.





BRINGING STAR WARS DOWN TO EARTH

BY EDWARD TELLER; Illustration by Attila Hejja

Physicist Edward Teller, senior research fellow of the Hoover Institute in California, was one of the chief scientists involved in the development of the hydrogen bomb. A former member of the President's Foreign Intelligence Advisory Board, Teller has been cited by President Reagan as his beam weapons adviser. Prof. Teller answers important questions about defense.

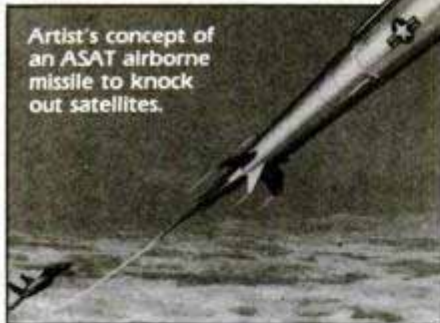
Is an effective defense possible in an age of atomic weapons?

The idea that the weapons of offense are too powerful to allow for an effective defense began with Hitler's early blitzkrieg victories in World War II. The Nazi attack, using a combination of fast-moving tanks, dive bombers and motorized artillery equipment, defeated Poland in days, and within six weeks

French and British without a toehold on the continent. Later in the war, the inaccuracy in bomb targeting led to vast urban destruction, and the atomic bomb—the "ultimate" weapon—seemed to be the final confirmation of the idea that no defense is possible. The destructive power of the atomic bomb, a thousandfold greater than conventional bombs, was soon surpassed by another thousandfold with the advent of



A "Star Wars" defense places the emphasis on space-based beam weapons, but also important are land-based beam weapons to defend inland and coastal areas, and ship-based and airborne lasers that will hit missiles before they reach their targets.



Artist's concept of an ASAT airborne missile to knock out satellites.

The attackers did not win the Second World War. Defense, in the original meaning of the word, was not obsolete then, nor has it become so now. To ignore defense, to place all emphasis on retaliation, was a political decision made effective almost a quarter of a century ago.

On March 23, 1983, President Reagan questioned the completely lopsided policy of deterrence that is our current national policy. In his speech, the President made no specific proposals and offered no suggestions about the nature of protective systems. He simply suggested in a justified manner that we place more emphasis on defense.

Unfortunately, the increasing importance of technology to military affairs has caused a proliferation of secrecy. The contemporary discussion of defense proposals is carried out in an environment where the best publicized plans are those that are least feasible, and the excellent plans are unknown to the public.

Is the term Star Wars, a good description of this kind of defensive effort?

To many, Star Wars seems an appropriate description of modern defenses because thorough technological innovation is connected in the popular mind with science fiction. Although President Reagan's proposal was dubbed Star Wars so its opponents could ridicule it, remarkably enough, a considerable portion of the population took that designation in a most positive manner.

What technologies are available to build modern weapons of defense?

It has been proposed to populate space with defensive battle stations.

While this proposal fully justifies the designation Star Wars, its disadvantages are numerous and obvious. One most important consideration is that a proper defense must be less expensive than the countermeasures that would render it ineffective. Establishing the proposed battle station would be expensive and difficult, but it would be comparatively easy and inexpensive to shoot down. Already the United States has tested Anti-Satellite (ASAT) missiles designed to knock out offensive satellites.

But, imagine if you will an alternative method. There are half a dozen ingenious proposals that appear to satisfy the requirements for defense. Unfortunately, they are classified. We are trying to keep ideas secret even though we have excellent evidence that these same ideas are available to the leaders in the Kremlin.

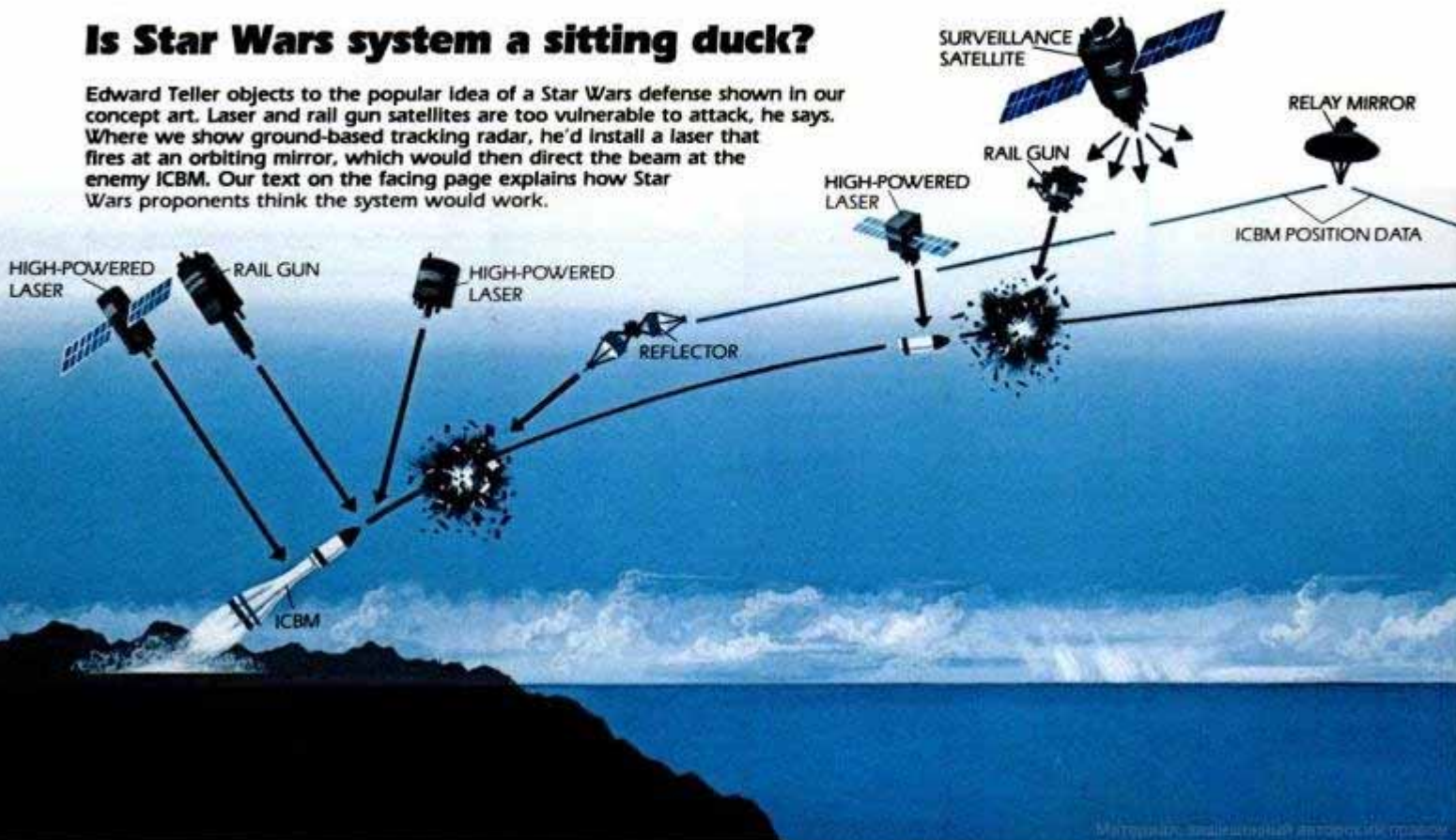
The Soviet people have no need to know since they have no possibility of influencing public policy. The American people have a need to know. They cannot possibly arrive at reasonable decisions if they are kept ignorant of the ideas that underlie defense. This does not mean that secrecy is completely useless and should be forthwith abolished. Details, blueprints, know-how can and should be kept secret at least for a while. Such limited secrecy has been practiced by industries for many years without interfering with informed decision-making.

Even though details cannot be given, one general idea is sound. Lasers, directional weapons that project energy in a

(Please turn to page 122)

Is Star Wars system a sitting duck?

Edward Teller objects to the popular idea of a Star Wars defense shown in our concept art. Laser and rail gun satellites are too vulnerable to attack, he says. Where we show ground-based tracking radar, he'd install a laser that fires at an orbiting mirror, which would then direct the beam at the enemy ICBM. Our text on the facing page explains how Star Wars proponents think the system would work.



Lasers and rail guns arrive

The future has arrived. Beam weapons are currently undergoing tests on Air Force aircraft and Army tanks. Last year, the message rang loud and clear after an Air Force C-135 with a strange-looking bubble-top shot down a Navy drone off the California coast. The weapon: a laser. Meanwhile, the Army is using an experimental track vehicle on a secret range to shatter small antitank missiles with a blast of laser light. And this summer, the Defense Department will conduct several tests on yet a new weapon in the unusual arsenal. Using a laser tracking device, the new Anti-Satellite missile (ASAT) will be launched from a souped-up F-15E flying out of Edwards Air Force Base in California.

Earlier this year one of the 18-ft.-long missiles was launched from an F-15E,

which fired the device down the Pacific testing range. Radio Moscow quickly accused the United States of planning to hit Soviet space satellites with ASATs. The weapons have no explosives in their warheads. Instead, the missile is designed to break up an enemy satellite by collision.

While laser anti-aircraft guns and ASATs are undergoing further tests, labs across the nation are working on a slew of beam weapons designed to operate from land bases, ships, aircraft and other vehicles.

"It takes six millionths of a second for laser light to travel one mile," a declassified Defense Department report says. "And in that time a supersonic airplane traveling at twice the speed of sound will travel only a little more than one-eighth inch."

The next generation is rail guns—weapons that fire electrons or neutron beams at a target with far greater power than any laser could muster. Officials of the Defense Advanced Research Projects Agency (DARPA) say rail guns could be ready for deployment some time after 1995.

The basic laser being used today is the Gas Dynamic Laser, or GDL. Burning carbon dioxide with nitrous oxide, the GDL produces high energy carbon dioxide that sheds powerful bundles of

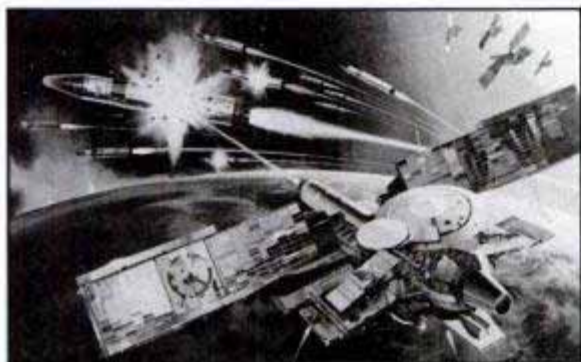


Air Force C-135 (top) with a domed top carries a prototype laser gun. Inside dome (above) laser mirror swivels and fires.

light on a target. Some experiments underway this summer involve an even more powerful Electric Discharge Laser (EDL). The more powerful weapon can burn a hole through an aircraft's skin in fractions of a second. The weaker GDL penetrates some aircraft materials, but there are ways to "harden" a plane or missile against it.

Still, DARPA officials favor the GDL because, in addition to being able to kill some aircraft, its waves of energy can disrupt radio signals and take a guided missile off course.

In testimony before the Senate Armed Services Committee, DARPA officials have said the Soviet Union may already have deployed high-energy GDLs around land bases near Moscow and perhaps aboard orbiting satellites. But they emphasize that the United States has taken an early lead in the technology, and if there is a beam weapons race, the Soviet Union is playing catchup.—D.E.



Artist Paul Alexander's idea of Star Wars (*Quantum War: Beam Weapons in Orbit!* page 98, Nov. '81).

An ICBM launch (facing page) is detected and a series of high-powered laser and rail gun satellites goes into action. A surveillance satellite at about 60,000 miles altitude tracks the missile and positions beam weapons for the kill. If any weapon fails to destroy the missile, other weapons back it up farther down the tracking range. Reflectors can pick up kill beams deflected from the ICBM and send them back to the target. Near the end of the ICBM's trajectory, or early in the launch of a submarine-based missile, a laser/rangefinder can track the ICBM to make a quick kill. Missiles that get through the defensive layers and close to their target can be destroyed by airborne lasers. Even proponents of this Star Wars defense acknowledge that some missiles could get through the net.

DRAWING BY DEAN ELLIS

ALTITUDE
60,000 MILES
30,000 MILES
3,000 MILES
1,000 MILES

HIGH-POWERED LASER

RANGE-FINDING BEAM

LASER/RANGE FINDER

SUB-LAUNCHED MISSILE

AIRBORNE LASER

GROUND-BASED TRACKING RADAR

How To Customize



Minivans—like minicars—aren't designed for minipeople with minibudgets. You can personalize them in a big way.

BY DANIEL CHARLES ROSS
Detroit Editor
Photos by George Nagher

With fuel prices stabilized for the moment, recreational vehicles are making a strong comeback. Leading the way are personal-use vans, especially the Dodge Caravan/Plymouth Voyager (same vehicle, different trim).

The Caravan/Voyager was the first small garageable American van out of the chute, and as such, has captured America's fancy. Already Chrysler has sponsored a competition for recreational van conversion companies, and 49 participants recently showed what they could do with the T-van. Results ran the gamut

from full-dress police paddy wagon to executive commuter limo to full-luxe traveler.

Shown here is the vehicle we thought was the best of show in the personal use category, the Mini Ram by Advanced Creations of Romulus, Mich. Bob Wolf and his crew have turned a regular-issue Caravan into a plush tourer which has the advantage of added interior storage space under the seat/bed.

So while Chrysler is still adjusting to the demand wrought by its new products, and Chevrolet and Ford are just now getting ready to introduce their new

The New Minivans



Dodge Mini Ram commercial van has lots of potential for customizing. This example features TV, minibed and a handy rooftop bin.

small vans, the rec vehicle people are breaking new ground in adapting the downsized people movers to personal use. It isn't as easy as it appears.

The construction of the Caravan presents conversion shops with a whole new set of problems. Locating places where holes may be safely drilled is primary among those difficulties. To permit customizing with as little drilling as possible, the Mini Ram was the beneficiary of Silkaflex adhesive, a latex-based compound formulated to permit expansion and contrac-



Trak-Rak looks like a standard rooftop luggage bin when it's in its stowed position.



Clever linkage swings the bin down to waist level for loading or unloading of luggage.



Lightweight bin holds 15 cu. ft. of cargo (three to six suitcases), expanding van's capacity.

tion with temperature fluctuations. Superglues, the cyanoacrylics, don't allow for these extremes, and are particularly susceptible to failure when the bond is wood-to-metal.

The exterior of the Mini Ram has obviously received great care. The murals were airbrushed by a local Detroit artist, and even up close, the work is extremely well done. The immediate attention getter, though, is the raised roof and the neat Trak-Rak storage compartment.

Raised roof draws interest

The raised roof is a modification of a new full-length roof section made for the T-115s by Viking Formed Products, Middlebury, Ind. Wolf trimmed it to the desired length and finished it to conform with the dimensions of the Trak-Rak from Pivot Mfg. Co.

The fiberglass roof is bonded glass-to-metal with putty tape to provide a watertight and flexible seal. It's fastened to the Caravan roof and the seam underneath and on top is covered with a silicone molding.

The unique Trak-Rak completes the roof treatment and significantly increases storage space. The Trak-Rak swings off the top of the Mini Ram on rails mounted to the roof. Depressing a lock button permits the brace to tilt further, until it's at waist level for easy stowing of gear in its 15-cu.-ft. compartment. The unit itself is lightweight fiberglass and anodized aluminum, with a locking hasp to prevent accidental tilt or tampering. The entire assembly requires only a single threaded fastener in the vehicle.

Not all customizing kits are created equal, or even practical. Case in point: The ground-effects running boards and wheelwell flares displayed on the Mini Ram completely cover the jacking points. So the frame pads where a

hydraulic lift would pick up the vehicle are now useless. Wolf knew this in advance, but used them on his show vehicle anyway for display purposes only. Be careful to determine your own needs before installing customizing products.

The roof-mounted Sony television antenna leads inside to a jewel-like Sony KV-5300 color TV receiver. The Sony is mounted in Wolf's unique center console behind a lockable door. The TV uses a one-touch toggle to initiate a channel scan from its current setting to the next strongest signal, and receives both UHF and VHF signals with remarkable clarity.

Center console changes

The center console is cleverly done. Finished in wood-grain Formica, it provides efficient ducting of hot or cold air to grateful passengers in the rear. Advanced Creations will soon market an improved version of the console in rugged ABS plastic, which will incorporate the ducting, a cooler under the armrest and will also relocate the Chrysler radio to a handier position.

Wolf uses and recommends to customizers that only *automotive-grade* fabrics be used in rec vehicle conversions. Auto grade fabrics are of consistent quality, durability and color, even though swatches of material may come from batches manufactured months apart. So-called *auto-type* material isn't up to the task, may not be able to be color-matched later, or may have a weave that's impossible to duplicate.

Built into the interior of the Mini Ram are storage spaces in the side pods and cup holders for drinks dispensed by the Telco drink dispenser. Manufactured by Thomas Electronic Corp. in Nashville, Tenn., the dispenser is energized by a dash-mounted switch. When turned on at the dispenser, it then can pump your

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senger from acq
speeding tickets, th
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glass roof section. Thoug
light is only slightly visible
vision, the Escort's warning
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up as long as the button

Six-way powered chairs

Even the Dynaflex captain's seats are specially made for the Caravan/Voyager. They are downsized to fit the narrower T-115, and in the Mini Ram offer six-way power adjustment. At their lowest setting, tall drivers will note that eye level falls right at the top reach of the wiper blade. A lower mounting position, or longer wiper blades, will cure this problem.

These are just a few of the add-ons now becoming available for Chrysler's small vans. As the Ford Aerostar and Chevy Astro vans come on-stream, the small van will become a haven for families searching for a recreational vehicle with more than a toy's utility. Customizing is the way to turn the routine into the unique, while at the same time providing a fun project for the entire family. **PM**



Tiny Sony color TV is mounted in custom center console. Locking door hides TV when not in use. Console ducts heat to rear seats.

Where To Get Custom Minivan Parts

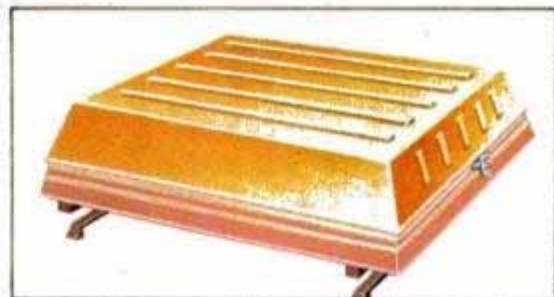
The Recreation Vehicle Industry Assn. (RVIA) is an organization of companies in the United States and Canada in the business of building, modifying or supplying parts or services for rec vehicles of all kinds. The RVIA sticker on a vehicle or part is the industry's official sanction that it meets federal motor vehicle and RVIA safety standards. Following is a brief list of companies with products for customizing the Dodge Caravan/Plymouth Voyager and similar RVs:

Advanced Creations, 30415 Ecorse Rd., Romulus, Mich. 48174. (313) 728-7000. Products: center consoles, electrical switching systems, seat-bed units, finishing panels, captain's chairs, total van conversions to Mini Ram specs.
A & E Systems Inc., 3100 West Segerstrom Ave., Santa Ana, Calif. 92704. (800)

854-3172. Products: sinks, faucets, drawers, circulating fans, ductwork, thermostats, hand water pumps, running boards.
A.R.A. Motorola Mfg. Co., 606 Fountain Parkway, Box 870, Grand Prairie, Tex. 75050. (214) 647-4111. Products: air-conditioning systems, burglar alarm systems, antennas, engine and transmission cooling devices.

Air Lift Co., Box 12150, 2710 Snow Rd., Lansing, Mich. 48901. (800) 248-0892. Products: air lift springs.
American Honda Motor Co. Inc., 100 West Alondra Blvd., Gardena, Calif. 90247. (213) 327-8280. Products: RV generators.
Amfridge, 23892 Cooper Dr., Box 2267, Elkhart, Ind. 46515. (219) 262-2521. Products: iceboxes, a.c./d.c. refrigerators, van accessories, overhead and wall consoles.

Personal touch can be lent to any minivan with a wide range of add-ons supplied by the firms listed below. Some have to be installed by a pro, others can be ordered from catalogs for do-it-yourself installation. Some can be built by any good craftsman. Many are mutually exclusive—you can't install a raised roof and a luggage bin.



Rooftop bin expands mini's limited cargo capacity.

RAISED CAB-OVER CAMPER ROOF

CUSTOM CONSOLE

FOLD-OUT PICNIC TABLE

SPEAKER BANK

CUSTOM CAPTAIN'S CHAIR

TV

REFRIGERATOR



Full-size bed folds in two places to make a bench seat.

Chuck Wagon ensemble folds out from fixed bench seat for lavish tailgate entertaining.



B-W Mfrs. Inc., 721 North Webster St., Box 739, Kokomo, Ind. 46901. (317) 452-5444. Products: intercom systems, power converters, 12-volt accessories, electrical control centers.

Theodore Bargman Co., 129 Industrial Ave., Coldwater, Mich. 49036. (517) 279-7594. Products: lamps, lighting fixtures, electrical switches and connectors, exterior lighting, water pumps.

Carriage Carpet Mills Inc., Box 542, South Industrial Blvd., Calhoun, Ga. 30701. (800) 241-4211. Products: carpeting.

Douglas Corp., 620 12th Ave., Minneapolis, Minn. 55415. (612) 333-8911. Products: plastic and chrome plated nameplates, vinyl and Mylar decals, thermal die-cut designs, decorative striping.

Dow Chemical U.S.A. (see phone book for local dealer), 2020 Dow Center, Midland, Mich. 48640. (517) 636-1412. Products: foam-type insulation.

Draw-Tite Inc., 14857 Martinsville Rd., Belleville, Mich. 48111. (313) 697-8081. Products: Hitches, hitch equipment, tire carriers, tow bars, electrical equipment.

Dygert Seating, 53379 C.R. 113, Elkhart, Ind. 46514. (219) 262-4675. Products: van seats, sofas, sun visors, tire covers, pedestals.

Elixir Industries, 17925 South Broadway, Box 470, Gardena, Calif. 90248. (213) 321-1191. Products: adhesives and sealants, laminate, laminated products, roof vents, van windows, sunroofs.

Cincinnati Microwave (Escort), One Microwave Plaza, Cincinnati, Ohio 45242. Products: radar detector.

Flexsteel Industries Inc., Box 877, Brunswick Industrial Block, Dubuque, Iowa 52001. (319) 556-7730. Products: beds, chairs, cushions, dinettes, convertible-type seating, sofas, tables.

Pivot Mfg. Co., 12685 Stout Ave., Detroit,

Mich. 48223. (313) 531-7500. Products: luggage racks, Trak-Rak off-vehicle loading system.

Thomas Electronic Co., 507 Napoleon Ave., Nashville, Tenn. 37211. (615) 259-3737. Products: drink dispensers, electronic bars, musical horns/vehicle alarms.

Todd Engineering Sales Inc., 28706 Holiday Pl., Elkhart, Ind. 46514. (219) 293-8633. Products: power converter/battery chargers, fuse blocks and panels, generator changeover switches, RV electrical supplies, battery isolators.

Viking Formed Products, Box 319, Middlebury, Ind. 46540. Products: fiberglass reinforcements, roofs, van accessories, fiberglass van tops, custom parts.

Weyerhaeuser Co. (see local listing in phone book), 201 Dexter St., Box 1188, Chesapeake, Va. 23320. (804) 543-1601. Products: board-type insulation, lumber, paneling, tile, vinyl and wood wall cover.

Compact Disc Players

Your Choices Grow As Prices Fall

The drawer glides open without a sound, inviting you to drop in your latest laser disc. It slides closed just as quietly, and the disc spins up to speed. You can then listen to the music without lifting a finger, or you can take over, playing the panel controls to pick off the disc just what you want to hear: Select any track with the touch of a button; skim through all the selections, hearing a snippet of each; or punch in a program to hear the tracks in the order you want.

Easy operation and versatile manipulation of the laser disc are common to all the second-generation \$500 to \$700 Compact Disc players, sometimes called laser turntables. The newest players are technically better and lower priced than their \$1,000 ancestors, which were introduced

(Please turn to page 114)

Yamaha CD-X1 \$599



Sanyo CP 200 \$550



Here come the \$500 to \$700 laser turntables—with controls that let you cue your music with the skill of a disc jockey.

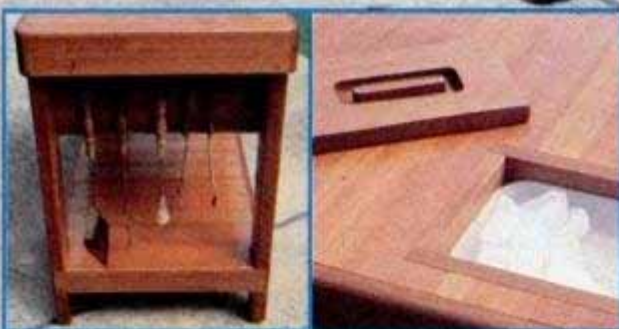
BY CHRISTOPHER GREENLEAF; Photos by Brian Kasoff

Technics SL-P7 \$600



When a Compact Disc lands in the front-loading drawer of any one of these second-generation players, it'll deliver the purest sound you've ever heard from your stereo system.

Sony CDP-200 \$700



Simple cup hooks, mounted on one end rail (left), provide a convenient place to hang long barbecue utensils. The built-in ice chest (right) is lined with Styrofoam insulation and has a lift-out plastic bowl.



One side of the cart has a center drop-down door (left) that covers a slide-out cutting board and broiler pan. A built-in bottle rack (right) provides storage for wine, spirits and mixers close to the ice chest.

6 Outdoor Classics In Redwood

BY ROSARIO CAPOTOSTO



Our lightweight tray (left), sized to fit on the pull-out shelf, has ample room for both glassware and bottles. The small caddy (right) was designed to hold a portable phone and other items often used outdoors.

Here's a set of attractive and versatile outdoor furniture that'll be perfect for your back yard, patio, deck or sunroom.



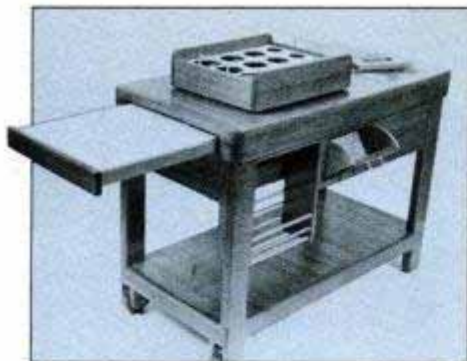
Adjustable chaise back (left) features five positions for maximum comfort: flat, 15°, 30°, 45° and 60°. One side panel of our planter (right) comes off to make installing or removing large potted plants easier.

These six pieces of outdoor furniture—barbecue cart, chaise, coffee table, telephone caddy, tray and planter—were all designed to withstand exposure to heat and moisture, to fulfill specific outdoor living needs, and to share the common design elements seen in the photos above. To begin with, kiln-dried, clear, heartwood redwood was used throughout. This grade is very smooth and free of blemishes and warps. It's also lightweight, structurally stable and highly water-resistant.

The specific utility of each piece is also shown in the photos here. For just one example, note that the sides of the barbecue cart are defined by function. On the food preparation side, there are two drawers

for cooking aids and a pull-out maple cutting board and broiler pan. And, on the opposite side, there's a bottle storage rack and a built-in ice chest for beverage preparation.

Furniture design: Rosario Capotosto and Steven Willson
Color photos: Harry Hartman **Photo stylist:** Gabe Herrick
Black and white photos: Rosario Capotosto
Technical art: Eugene Thompson
Redwood: California Redwood Assn.



This combination barbecue-and-bar cart has room for two people. Extra space is provided by a slide-out shelf covered with plastic laminate for easy cleaning.

Barbecue cart

This unit is constructed of two separate assemblies: a case that contains the drawers, storage bin, cutting board and broiler pan; and a framework that acts as the basic structural support for the case and for the top and shelf boards. When reviewing the materials list for this project (page 123), keep in mind that architectural-grade 2 x 4s were used for the legs. These measure 1⁵/₈ x 3¹/₂ in. If you use construction-grade stock instead, adjust the materials list to reflect the narrower 1¹/₂-in. thickness.

Also note that this cart and the other

five projects were all assembled with waterproof resorcinol glue and finished with three coats of UGL Imperial Zar satin finish to help them withstand the elements.

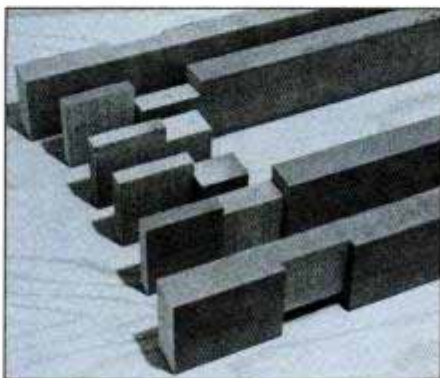
Construction details

Begin building the framework by cutting the legs and rails to size. Then cut the dadoes in the legs as shown on the drawing to receive the lower shelf rails. The end rails are let completely into the legs and the side rails are joined with half-lap joints. Also, cut to size the add-on wheel blocks that form

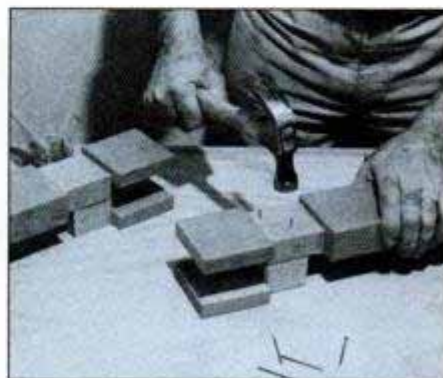
(Please turn to page 123)



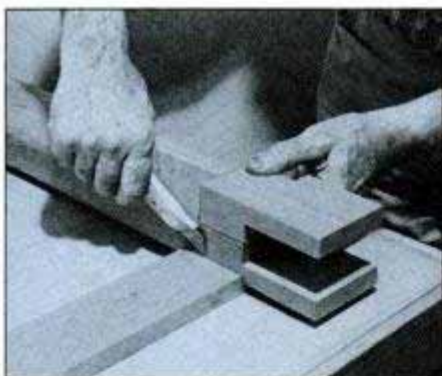
Use a dado head in a radial-arm saw to cut shelf rail dadoes in legs. By installing a higher fence in the table, the cut through it serves as a leg cut alignment guide.



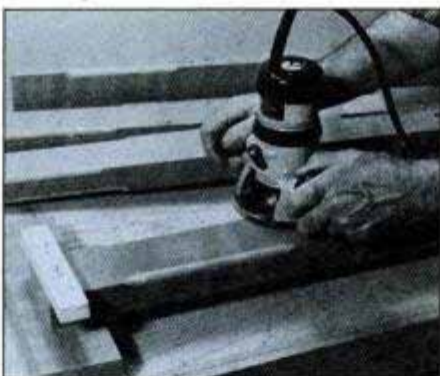
The cut leg parts are ready for assembly. The two center legs, and blocks between, form the axle support for wheels. The others are single legs for cart front.



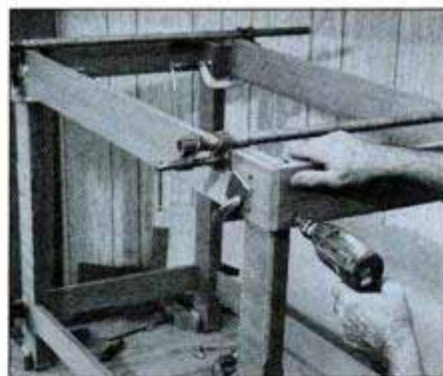
Join the wheel blocks to the rear legs using glue and four 4d finishing nails per joint. Set nailheads and let the assembly dry overnight before continuing.



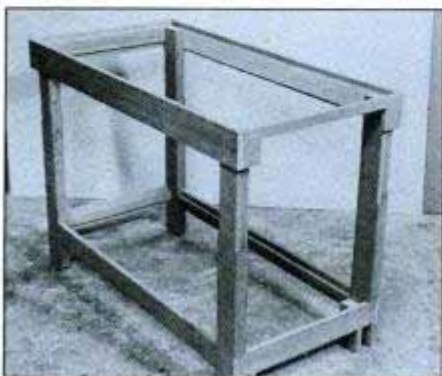
Slide each rail completely into its proper leg dado. Then use a utility knife to mark the precise width of the half-lap joint on the inside surface of the rail.



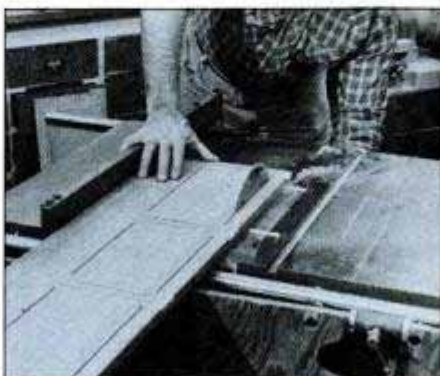
Use a router to round corners on the upper section of each leg before top rails are attached. Nail a block in place to stop the cutter 3/4 in. below the leg top.



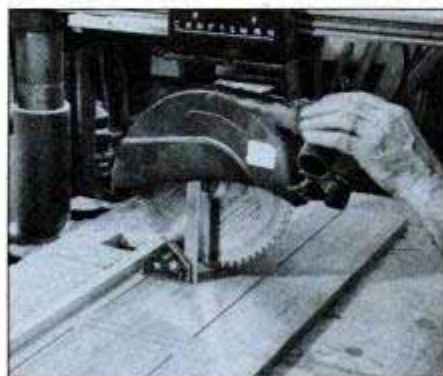
Glue and clamp the long bottom rails to legs. Let dry, then clamp the other rails in place. Bore screw plug, shank and pilot holes through the rails and into the legs.



Here is the completed frame. Note support cleats for the top and shelf boards on the inside surface of the rails, and the cutout on the end rail for the sliding shelf.



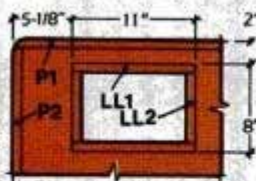
Begin case construction by gluing up stock for the facing panels. Then, using a table saw, cut out drawer openings by holding board in place and raising blade.



Make vertical drawer cuts on a radial-arm saw. Use a square to align the blade center over opening center. Lock carriage in place, then lower blade into stock.

BARBECUE CART

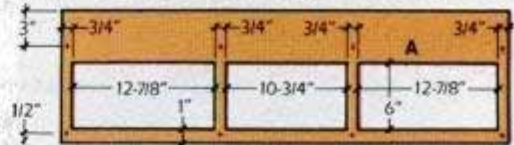
24" WIDE x 34" HIGH x 48" LONG



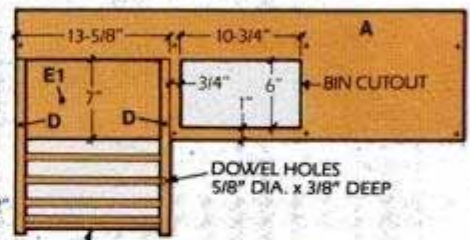
DETAIL 2
ICE BOX POSITION



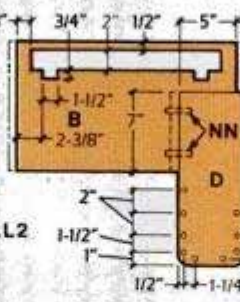
DETAIL 1
ICE BOX LID



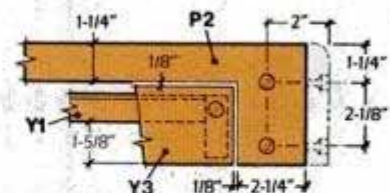
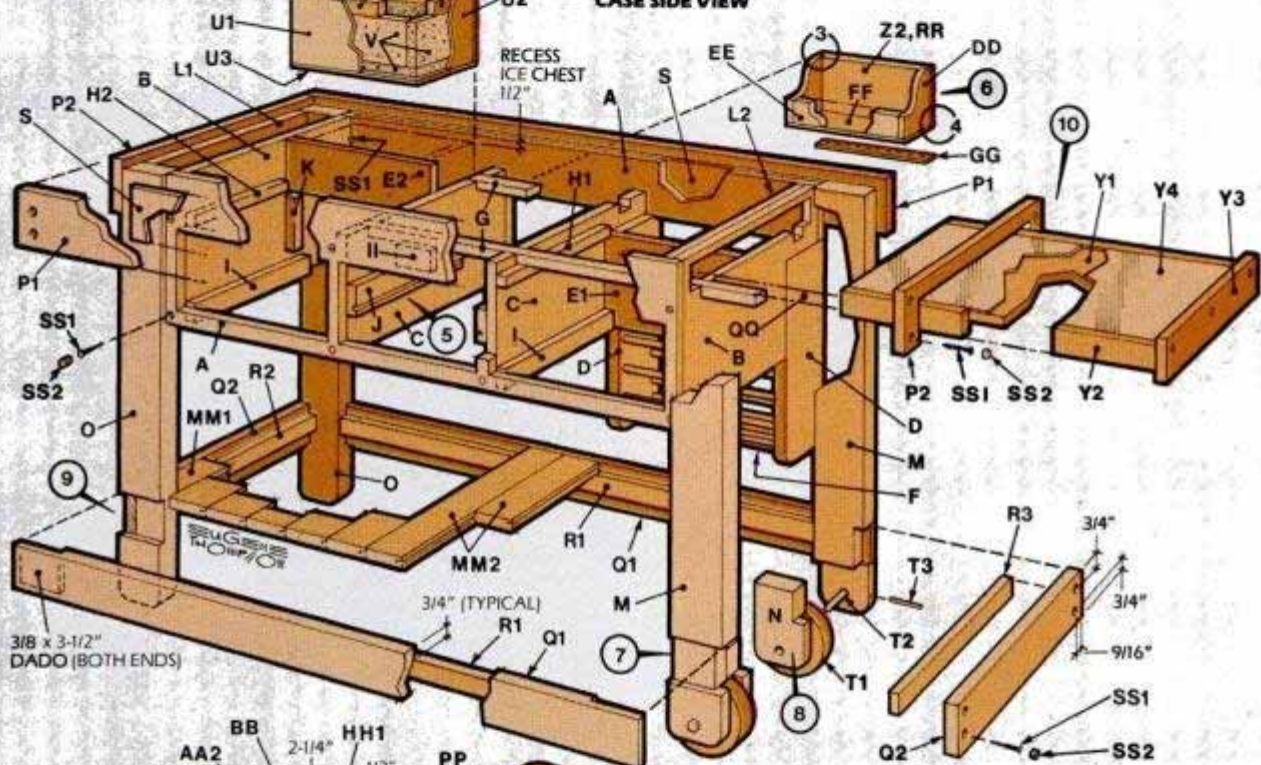
CASE FRONT VIEW



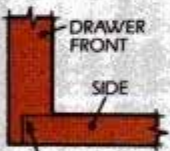
CASE BACK VIEW



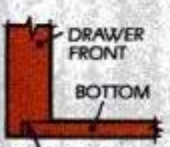
CASE SIDE VIEW



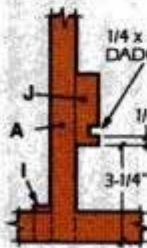
DETAIL 10
PULL-OUT SHELF AND END RAIL



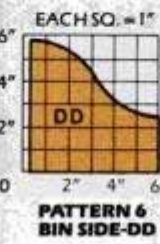
DETAIL 3
DRAWER FRONT
SIDE



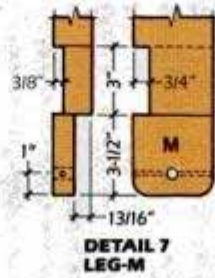
DETAIL 4
DRAWER FRONT
BOTTOM



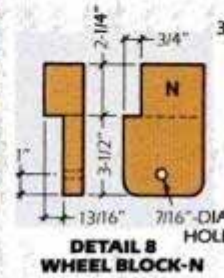
DETAIL 5
TRACK-J



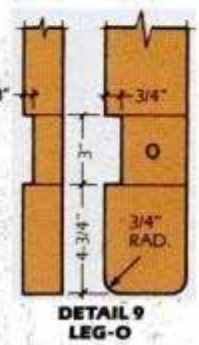
PATTERN 6
BIN SIDE-DD



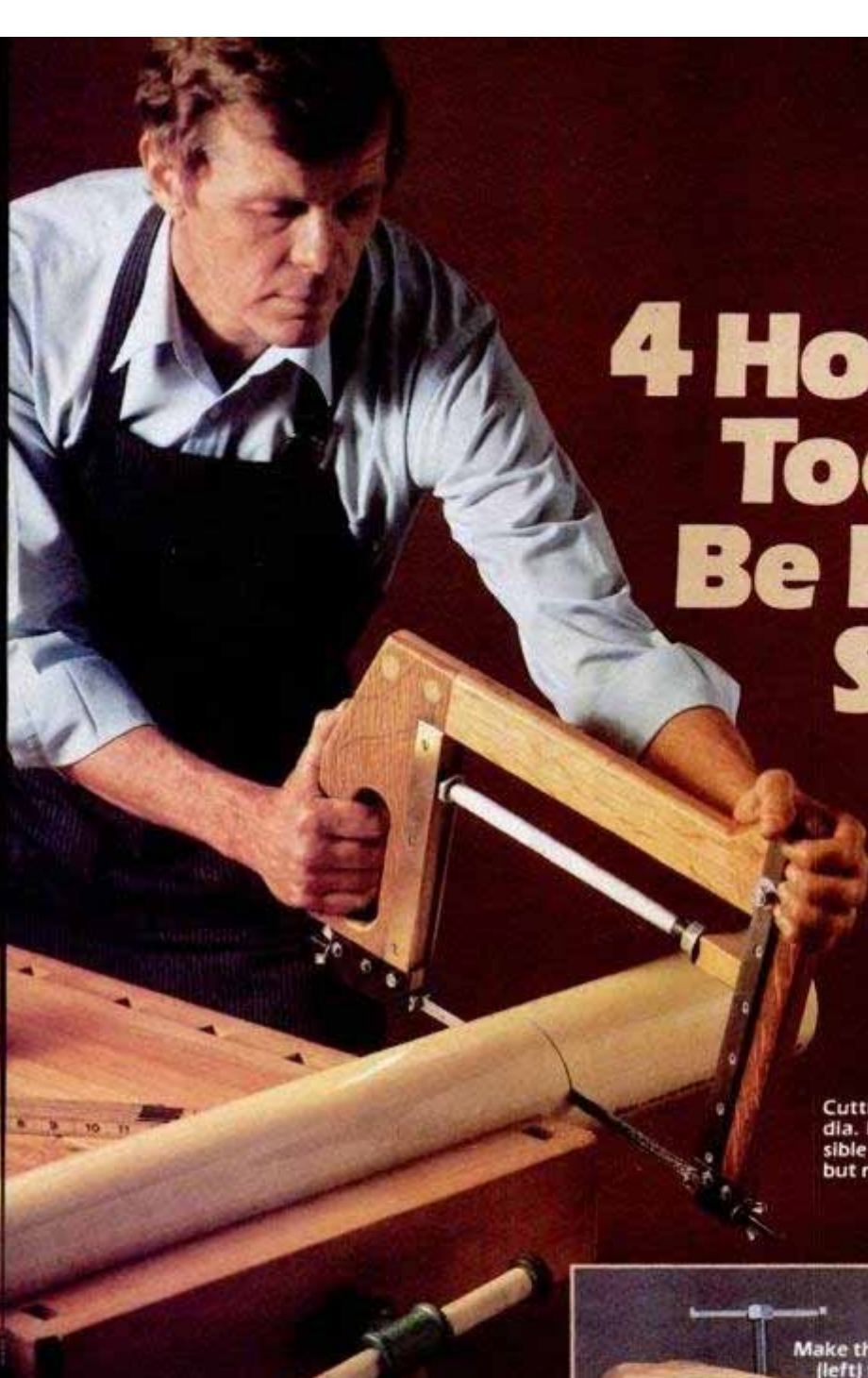
DETAIL 7
LEG-M



DETAIL 8
WHEEL BLOCK-N



DETAIL 9
LEG-O



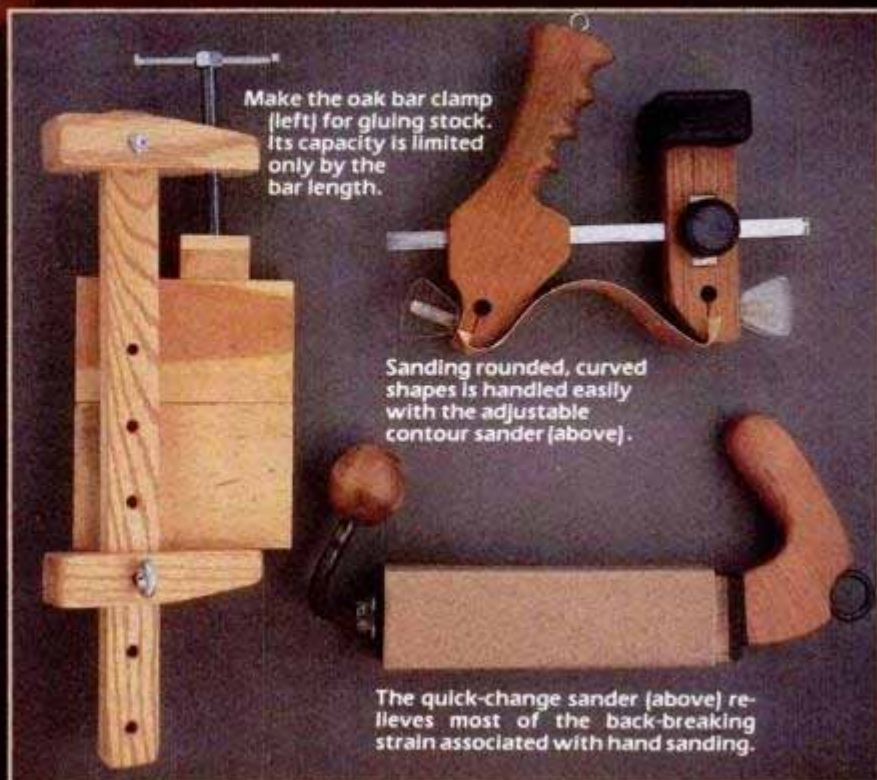
4 Homemade Tools You'll Be Proud To Show Off

Make these handsome, ingeniously designed hand tools for your shop.

Cutting entirely through this 4-in.-dia. PVC pipe would be an impossible task for a standard hacksaw, but not for our deep-cut version.

There is a great feeling of pride and accomplishment that comes from creating a project with your own hands—as most PM readers know. Well, now you can take that special feeling one step farther by making the tools shown here to use in creating the project.

The tools are a deep-cut hacksaw, an adjustable contour sander, a quick-change full-sheet sander and an oak bar clamp. Not only are these tools functional, they're handsome as well. The unique combination of rich wood grains with shiny brass and steel makes for a tool that you'll be proud to use and show off. Also, the tools are a bargain, since they're made mostly from shop scraps.



Make the oak bar clamp (left) for gluing stock. Its capacity is limited only by the bar length.

Sanding rounded, curved shapes is handled easily with the adjustable contour sander (above).

The quick-change sander (above) relieves most of the back-breaking strain associated with hand sanding.

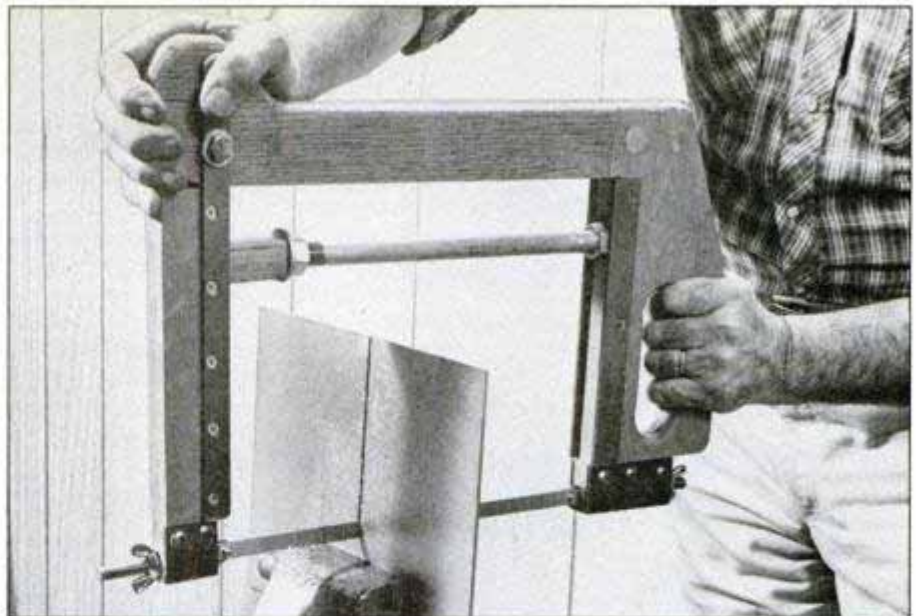
1 Deep-cut hacksaw

It's no secret that a hacksaw is essential in any shop. But standard hacksaws share a common shortcoming: depth-of-cut is limited usually to less than 4 in. Make the deep-cut hacksaw shown here to complement your standard model saw. With an 8½-in. depth-of-cut, it tackles jobs other hacksaws can't.

First, cut the three saw frame members (parts A, B and C) from 1-in.-thick oak. Next, cut a ¾-in.-wide × 2-in.-deep open mortise through the handle (A) and a mating tenon in the top frame (B). Also bore and notch the bottom of both the handle and front frame (C) to accept the angle-irons and steel plates (K, L, M, N), and the threaded rods (H1,I1) of blade holders. Join handle to top frame using carpenter's glue and two ¾-in.-dia. hardwood dowel plugs.

Attach the two steel pivot bars (G) and the two brass bars (F) as shown. Note that the bars extend into the frame about ¼ in. to form a channel for the tension bar hexnut (D) and the maple pressure block (E). Attach the angle-irons and steel plates to form a shaft for the blade holders (H,I). Drill and tap each blade holder to accept threaded rods (H1,I1). Now notch holders and drill ½-in.-dia. holes for the steel roll pins (J) which hold the blade in place.

Attach front frame to top frame with a machine bolt (Q). Then assemble tension bar and pressure block. Finish



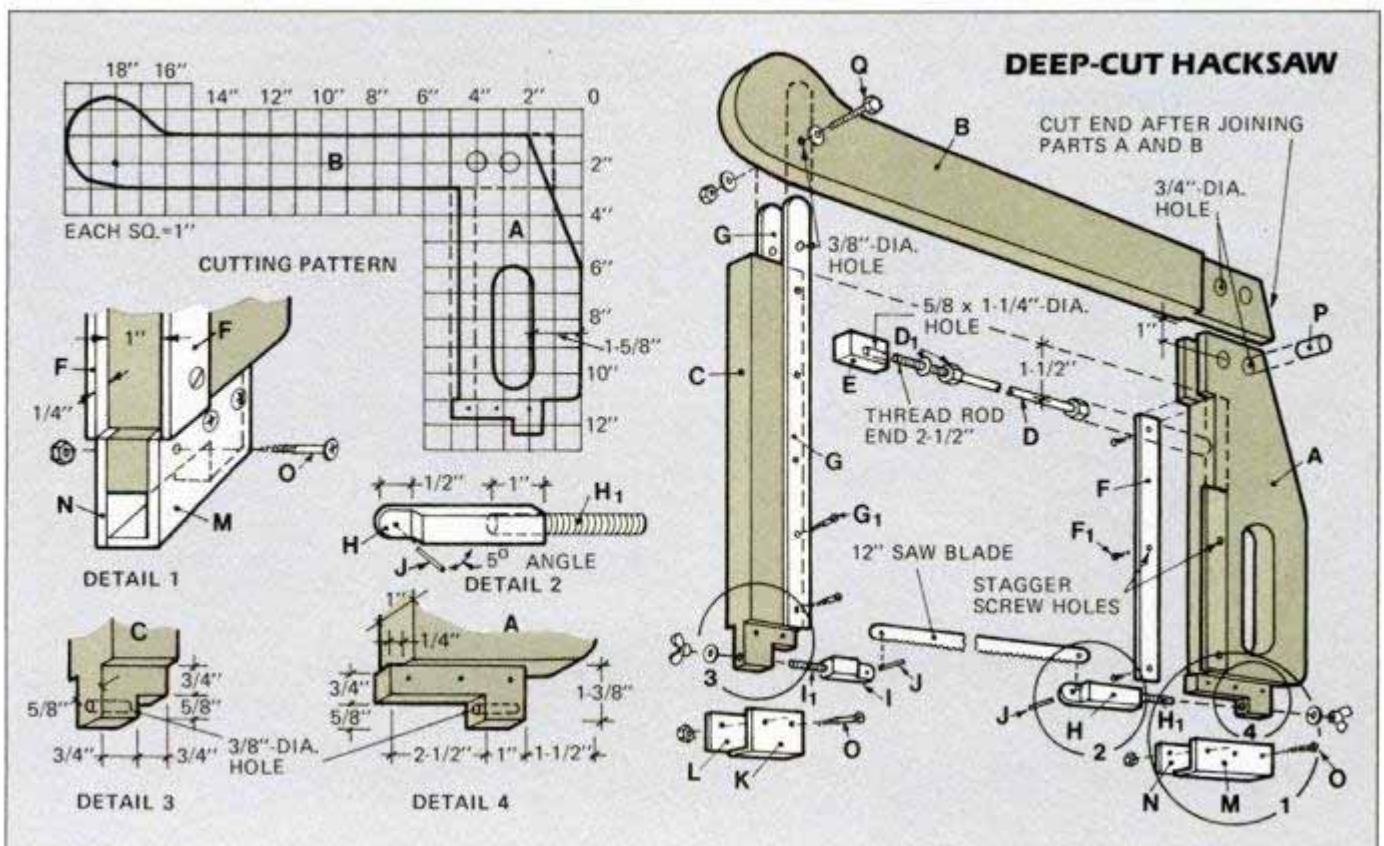
The hefty 6-pound deep-cut hacksaw (above) cuts at least twice as deep as a standard hacksaw. The heavy-duty construction of oak and steel ensures many years of service.

saw frame with three coats of wood sealer; apply paste wax to all surfaces.

In use, position the tension bar as close to the blade as possible. The deeper the cut, the higher you must position this bar.—Robert Bessmer

MATERIALS LIST—DEEP-CUT HACKSAW

Key No.	Size and description (use)	I	1	5/8 × 5/8 × 13/4" steel (blade holder)
A	1 × 5 × 11 3/4" oak (handle)	II	1	3/8"-dia. × 3" threaded rod with washer and wingnut
B	1 × 1 × 35/8 × 19" oak (top frame)	J	2	1/8"-dia. × 7/8" steel pin
C	1 × 1 × 1 1/2 × 9 3/4" oak (front frame)	K	1	3/4" × 1 1/2 × 1 1/2" angle-iron
D	5/8"-dia. × 11 3/4" steel rod, two hexnuts, one washer (tension bar)	L	1	1/8 × 1 1/2 × 1 1/2" steel plate
E	1 × 1 × 2" maple (pressure block)	M	1	3/4" × 1 1/2 × 3/8" angle-iron
F	2 1/8 × 1 × 8 1/4" brass bar	N	1	1/8 × 1 1/2 × 3/8" steel plate
F1	6 3/4" No. 8 fh brass screw	O	5	1/4"-dia. × 1 1/4" brass screw and hexnut
G	2 3/16 × 3/4 × 11 1/2" steel (pivot bar)	P	2	3/4"-dia. × 1" hardwood dowel
G1	10 3/4" No. 8 fh screw	Q	1	3/8"-dia. × 2" machine bolt with hexnut and two washers
H	1 5/8 × 5/8 × 3" steel (blade holder)			*Cut from one side of a 1 1/2 × 1 1/2" angle-iron.
H1	1 3/8"-dia. × 3" threaded rod, washer, wingnut			



2 Contour sander

Trying to smooth curved or circular-shaped workpieces by hand sanding is a slow and tedious chore. But the contour sander illustrated below will solve that problem by making the finish-sanding of such shapes a quick and easy procedure.

The contour sander features an adjustable handgrip (A) and front post (B)

which hold a cloth-backed abrasive strip.

By adjusting the handgrip and post on the rail (D), the abrasive paper will conform to a specific diameter. You can increase the maximum sanding diameter of the tool by substituting a longer abrasive strip and steel rail.

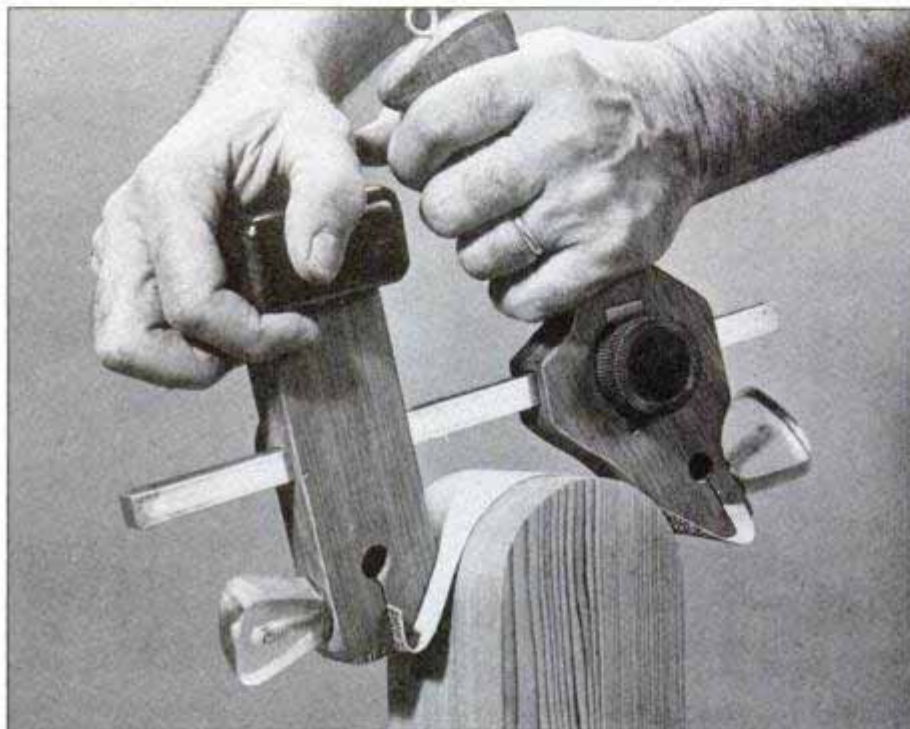
Start by gluing-up the handgrip and post *after* routing a 1/4-in.-deep \times 1/2-in. groove in each piece to form the rail channel. Next, chisel out the recesses for the steel plates (F) and make the locking knobs (G) by epoxying a 1/4-20 bolt into plastic caps from two gallon

jugs. Now bore and tap threads into the handgrip and post to accept the thumb-screws (E).

Bore the two 1/2-in.-dia. relief holes in the handgrip and post as shown. The holes prevent splitting and provide the spring that's necessary to grip the abrasive strip firmly. Finally, cut the abrasive strip slots into the bottom of the handgrip and post using a dovetail saw or hacksaw.

Apply two coats of polyurethane varnish to all wood surfaces.

—Robert Bessmer

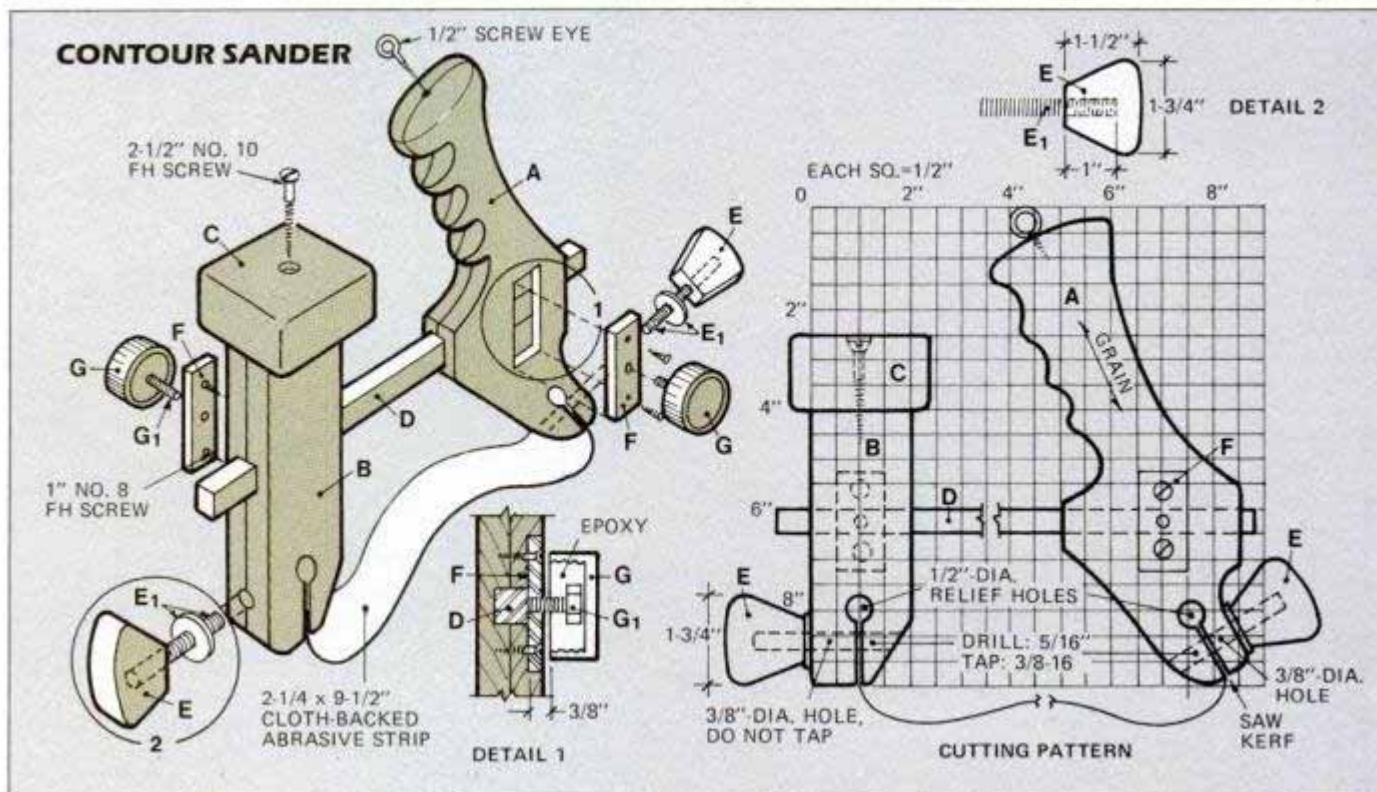


MATERIALS LIST—CONTOUR SANDER

Key	No.	Size and description (use)
A	1	1" \times 3 5/8" \times 9 3/4" oak (handgrip)
B	1	1" \times 2" \times 5 5/8" oak (front post)
C	1	1 1/2" \times 2 3/4" \times 2 3/4" oak (knob)
D	1	1/2" \times 1/2" \times 12" steel keystone (rail)
E	2	3/4" \times 1 1/2" \times 1 3/4" acrylic (thumbscrew)
E1	2	3/8-16 \times 2 3/4" threaded rod and washer
F	2	1/4" \times 3/4" \times 2" steel plate and two 1" No. 8 screws
G	2	3/4" \times 1 5/8"-dia. plastic cap
G1	2	1/4-20 \times 7/8" machine bolt set in epoxy

*Made from gluing-up 1/2"-thick stock.

The front post and back handle of the contour sander slide on a steel rail to adjust for sanding small-diameter workpieces (left) or for larger pieces (below).



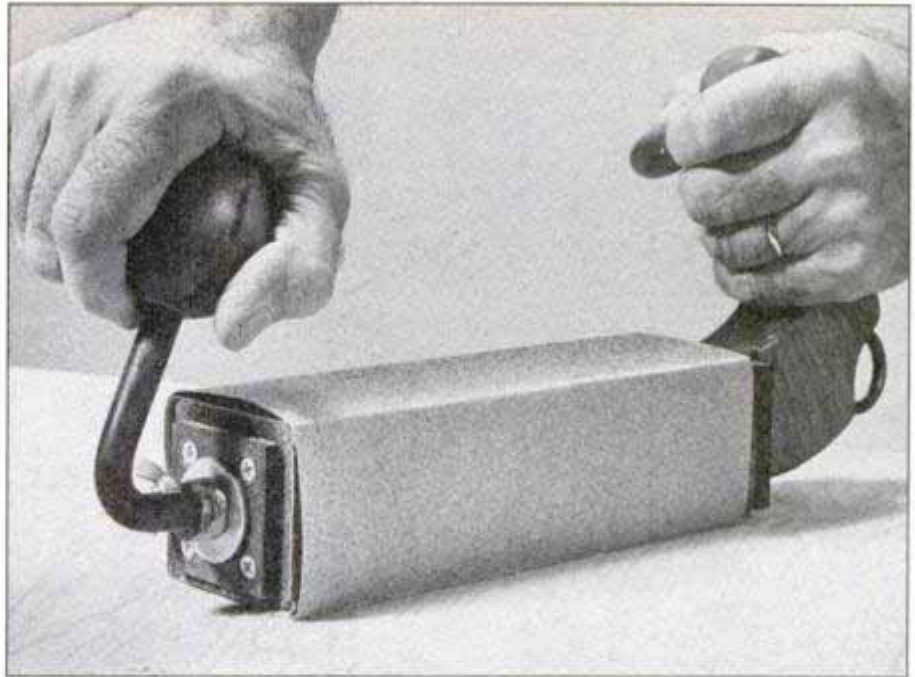
3 Quick-change sander

The simplest of all sanding tools, the sanding block, has just reached state-of-the-art proportions—thanks to the quick-change sander. It features a two-handed grip and a rotating body (A) that holds a full 9 × 11-in. sheet of abrasive paper. To eliminate sandpaper waste, all four sides of the body are used. Simply pull the spring-loaded engaging pin (E) and rotate the body a quarter of a turn for a fresh sanding surface. There is no need to reposition the abrasive paper.

Cut the body from a 2½-in.-thick solid or glued-up block of hardwood. Carefully sand each side as flat as possible. Then, cut a groove for the clamping rod (J). Centerbore a 3/16-in.-dia. hole through the body for the handle shaft (D). Shape this shaft by first heating the rod with a propane torch and then, while bending it in a vise, pound the rod with a heavy ball-peen hammer. *Caution:* Be sure to wear safety glasses. Now cut and shape the handle, knob (C) and remaining parts.

Next, bore and tap the knob and cut matching threads on the shaft end. Then bore a stepped hole in the handle for the engaging pin assembly. Note that three different diameter bits are used. First, bore a hole ½-in.-dia. × 1½ in., then bore a 3/16-in.-dia. × 3/4 in. hole for the compression spring and finally bore a 3/16-in.-dia. through hole.

Next, fasten the hardwood block (G)



Use the quick-change sander (above) for the sanding of large, flat areas. The body rotates to utilize each of the four sanding surfaces, without repositioning the abrasive paper.

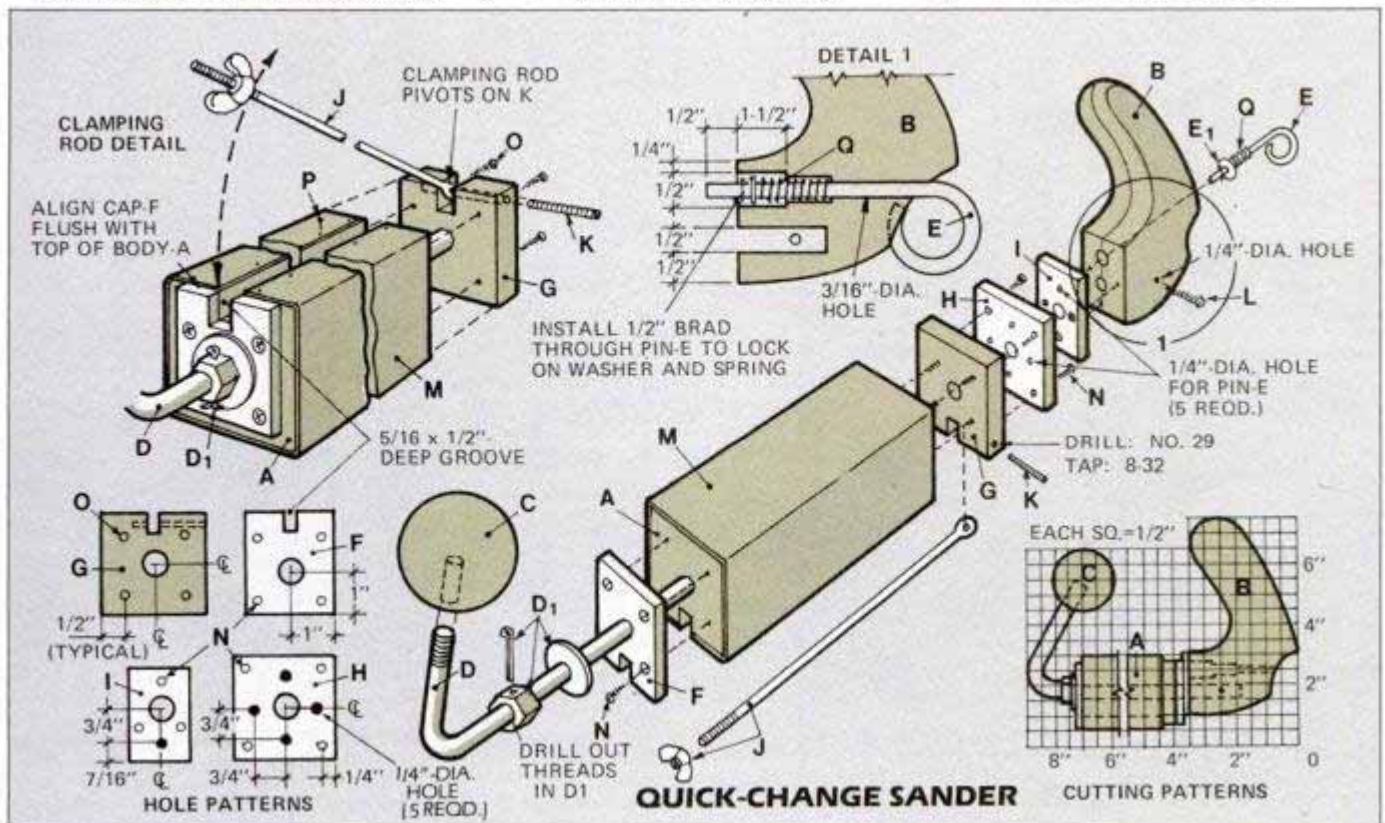
and cut and fasten the plastic caps (F,H). Make the pivot rod (K) by cutting the head from a 3/16-in.-dia. bolt and install it to hold the clamping rod (J) in

place. Attach rubber backing (M) to the body with contact cement and ½-in. wire nails.—Robert Bessmer

(Please turn to page 113)

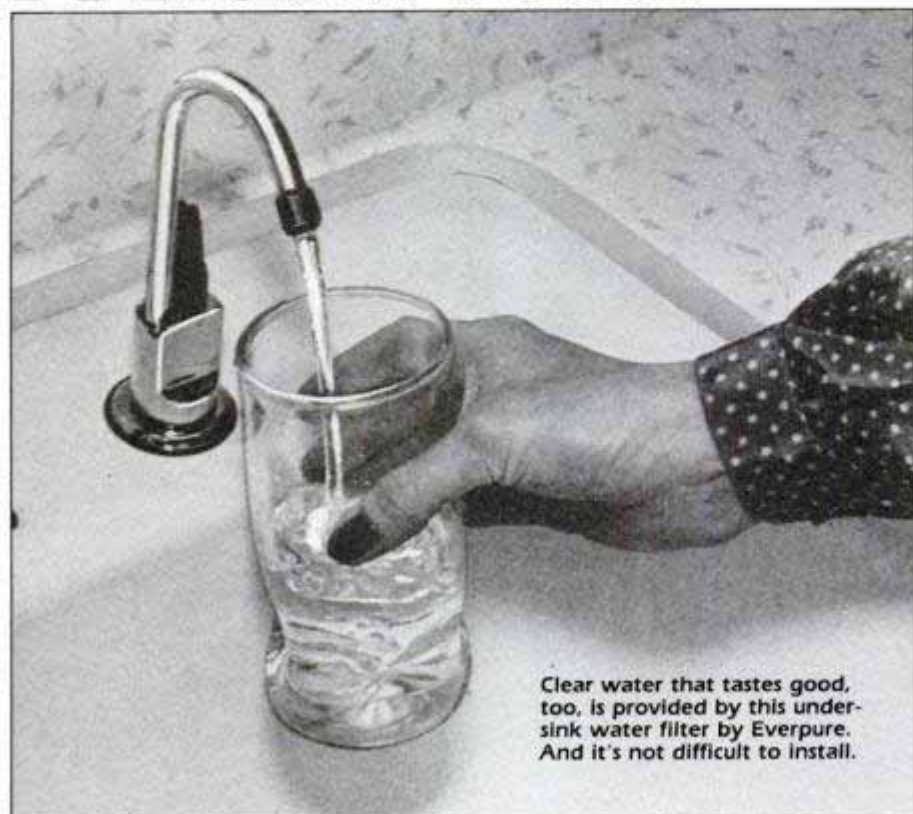
MATERIALS LIST—QUICK-CHANGE SANDER

Key	No.	Size and description (use)		Qty.	Description
A	1	2½ × 2½ × 9" hardwood (body)	H	1	¼ × 2¼ × 2¼" plastic (rear cap)
B	1	1½ × 4 × 7" maple (handle)	I	1	3/16 × 13/8 × 2" plastic (handle cap)
C	1	2¼"-dia. maple (knob)	J	1	¼"-dia. × 10½" steel rod and wingnut (clamping rod)
D	1	½"-dia. × 17" steel rod (shaft)	K	1	3/16"-dia. × 1½" threaded rod (pivot rod)
D1	1	½"-dia. hexnut, washer, 1½" cotter pin	L	1	¼"-dia. × 3/4" rh mach. bolt (shaft lock)
E	1	3/16"-dia. × 8" steel rod (engaging pin)	M	1	9 × 10" thin rubber sheet (backing)
E1	1	½" brad with ½"-dia. washer (retaining pin)	N	11	3/4" No. 6 fh screw
F	1	¼ × 2 × 2¼" acrylic or phenolic sheet plastic (front cap)	O	4	1" No. 6 fh screw
G	1	½ × 2¼ × 2¼" hardwood (block)	P	20	½" wire nail
			Q	1	½"-dia. × 1½" compression spring



How To Install A Water Filter

Whether your filter is a main-line or undercounter hookup, follow these steps to cleaner, clearer water.



Clear water that tastes good, too, is provided by this under-sink water filter by Everpure. And it's not difficult to install.

It's no secret that the purchase of household water-treating equipment has skyrocketed in ten years. In the last two years alone, this sales volume—mostly water filters—has tripled, according to the Water Quality Assn.

This surge in filter sales is a result of people's increased awareness of the hazardous by-products of our civilization—industrial waste, herbicide and pesticide runoff—and the effect of other pollutants on the water we drink. The discovery that chlorine, the purifying agent used to treat water, can also aid in forming trihalomethanes (THMs), perhaps harmful to humans, has been another boost to filter sales.

City dwellers who want clearer water than the aged municipal water mains can provide are also turning toward

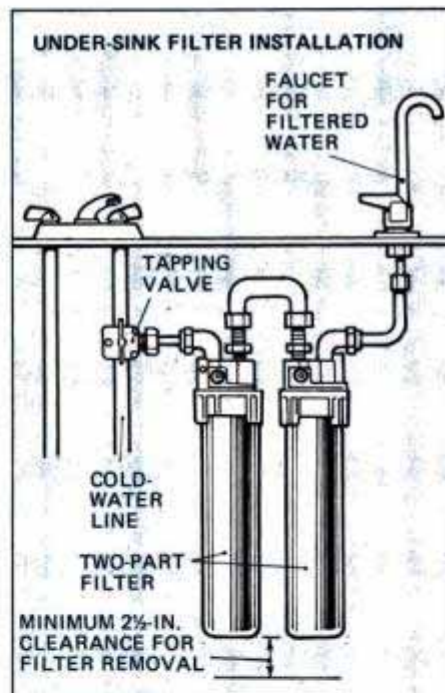
How To Install An Undersink Filter



1 A separate faucet, such as Everpure's unit, maximizes filter life by providing a separate source for drinking and cooking water. Kit has self-tapping valve, faucet with escutcheon, tubing and all fittings.



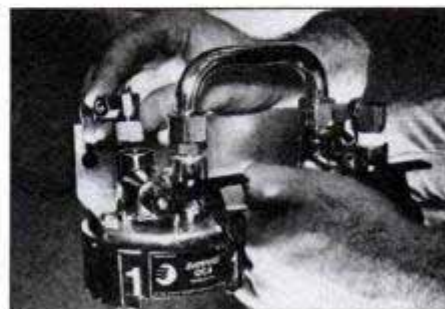
2 To drill a 1/2-in.-dia. hole in a porcelain sink, first use a center punch over a taped area to prevent chipping. For stainless-steel sink, drill a pilot hole first. Use a carbide bit to drill the hole.



3 Insert the stem of faucet with its rubber gasket through a hole in the countertop. Place flat washer, lock washer and nut on stem above counter. Orient faucet until handle is in position, then tighten nut.



4 To test position, select and mark the installation point on the cabinet wall. Be sure the unit mounts vertically, with a 2 1/2-in. clearance from the finished floor for easy replacement of filter cartridges.



5 Install 1/4-in. elbow compression fittings on the dual filter head, first wrapping all pipe threads with Teflon tape or a good grade of taste-free pipe dope. The fittings should face the cold-water riser.

water filters. Others who rely on bottled water for drinking and cooking, are trying water filters for their relative cost savings. Such savings mount up when the homeowner installs the filter.

Common water problems

A certain amount of taste in drinking water is welcome, as most people who have drunk virtually tasteless distilled water will agree. The fresh taste of bottled water comes from the minerals it contains. However, other tastes in water such as chlorine or fish are unpleasant. Many communities compound the problem by adding more chlorine to the water to ensure its safety. A fishy or musty odor is closely tied to unpleasant taste. An improvement in taste and odor are among the major benefits of water filters.

However, studies have shown that a common unpleasant odor, the rotten-egg smell of hydrogen sulfide, is not effectively removed by a water filter. Yet, chlorine, which leaves its own unpleasant taste but can be filtered out, removes hydrogen sulfide odor.

Deteriorating water mains and lowering water tables across the country contribute to sediment and particles (turbidity) in water. Filters can help remove them to leave water clear.

Organic contaminants that aren't apparent are another problem. The THMs mentioned above are among the major organic contaminants. Many filters can

help remove such organic chemicals, if the filter cartridge is changed often enough.

During extended periods of nonuse, bacteria can develop in a water system. A filter cannot remove bacteria. A moist filter that isn't used daily also encourages bacteria—one reason why it is important to change the cartridge regularly. It's a good idea to let water flow for a half-minute through the filter before use.

Water-filter cartridges

All water filters have a cartridge which must be replaced periodically, or in some cases backwashed, for it to be effective. Cartridge life depends on the amount of water passing through the filter, the amount of impurities in the water, and size of the cartridge. They may last from one month for smaller units to several years. Replacement is advisable when water flow seems restricted, and taste or odor returns.

Types of installations

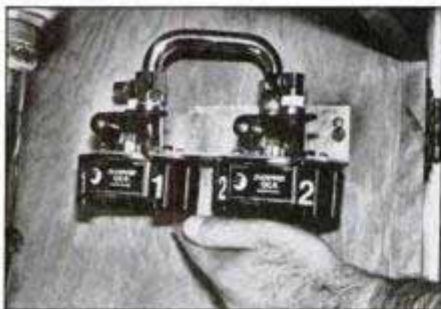
The easiest filter to install is a faucet-attached unit. This is either attached directly onto the faucet outlet or placed on the counter and attached to the outlet via a hose. Generally, these filters are smaller, less expensive and less effective than those discussed later. Some faucet-attached filters have a lever that routes water into the filter only on demand, thus prolonging useful life.

Installing a faucet-attached filter is usually simply a matter of unfastening the faucet aerator and screwing or clamping the filter to the faucet outlet.

Another installation takes place under the sink, where the filter is connected to the cold water line. Generally, the undersink filter is between the faucet-attached filter and a main-line filter in size and cost. Some, such as the Everpure model shown, have their own separate faucet. Since only the cold water coming from this faucet is filtered, the filter is used only when desired, for example when cooking or drinking. Any undersink filter can be hooked up to a separate faucet.

Undersink filters are designed to give cleaner-looking, better tasting and smelling water, and to reduce organic chemicals and contaminants. The medium in the cartridge that filters the water in undersink units is often activated carbon. Studies indicate that the most effective cartridge design forces water to travel downward along the cartridge sides to the bottom, then upward through the interior cartridge for thorough filtration.

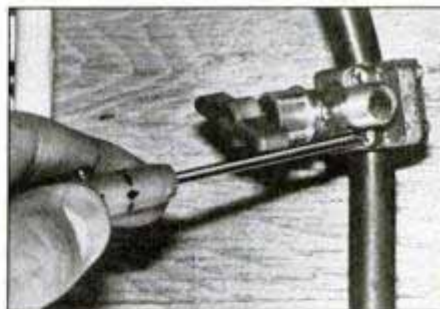
Installing a filter under the sink yourself can save up to \$50 in labor cost. This usually involves securing a bracket for the filter at the appropriate level on an inside cabinet wall. Generally, the filter must be raised off the cabinet floor for easy cartridge replacement. A tap valve is positioned on the cold water



6 Mount filter head to wall with four screws provided. The entire unit, when filled with water, weighs 15 pounds. If wall construction permits, you may wish to substitute bolts or other mounting devices.



7 Select the proper tap valve insert— $\frac{1}{8}$ -, $\frac{1}{2}$ -, or $\frac{3}{8}$ -in. O.D., depending on the size of the cold-water risers under your sink—and fit to riser. The inserts come with the company's separate faucet kit.



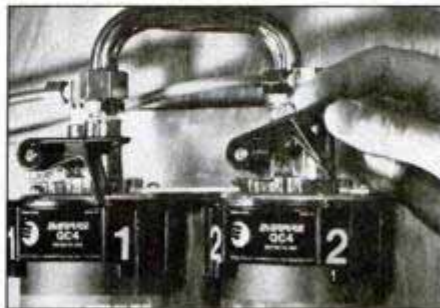
8 Fasten the tap valve around the cold-water riser in a convenient location. Do not tap the water line at this point. Run tubing from tap valve to filter inlet and from filter outlet to separate faucet.



9 To connect compression fitting, remove nut and brass ferrule. Slip nut, then plastic ferrule over tubing. Place tube insert in tubing end; then insert tubing end into the fitting and tighten nut.

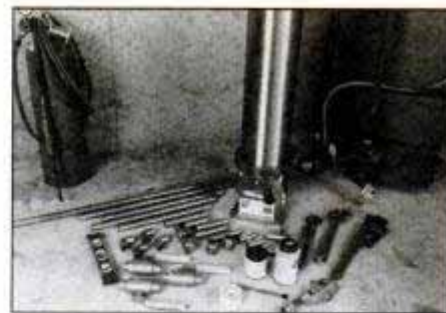
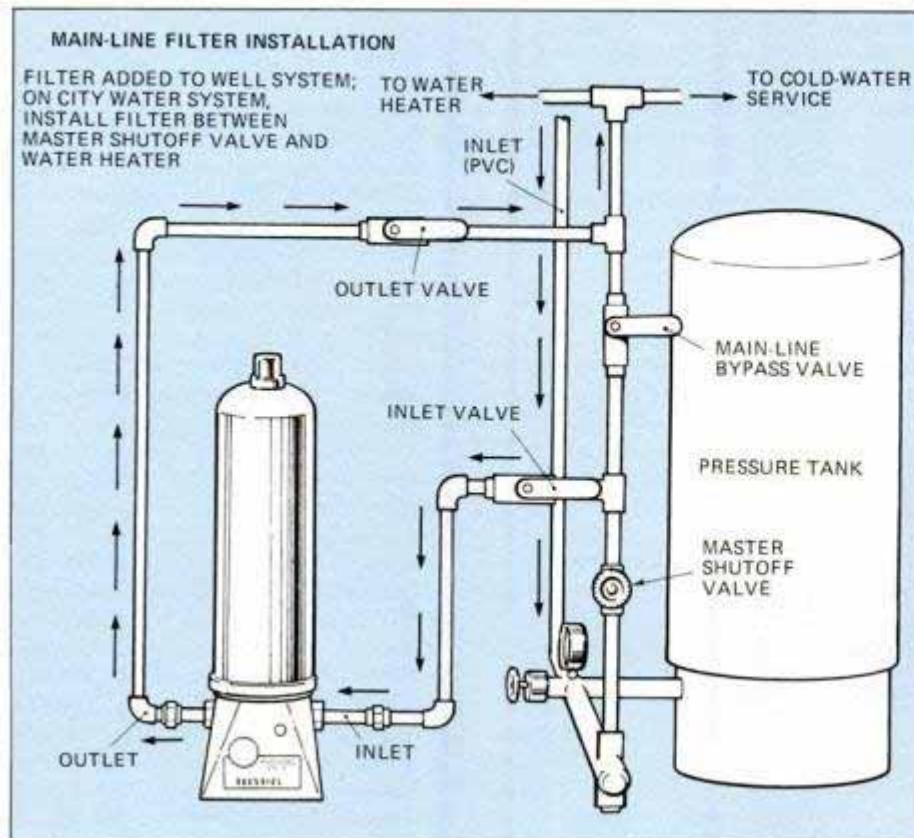


10 Shut off water filters by moving black handle counterclockwise as far as possible. Install filter cartridges (No. 1 on left). Turn tap valve handle clockwise to pierce water line; reverse for water flow.

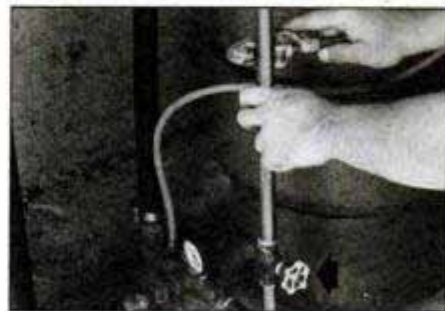


11 Allow the water to flow through the cartridges by lowering the black handles clockwise until they lock in place. Be sure to check for leaks between filter and faucet, and in the entire installation.

How To Install A Main-Line Filter



1 For a main-line installation you need copper pipe, pipe cutter, open wrench, torch, flux, solder, Teflon tape, filter, threaded fittings, ball valves, unions, tees, elbows and a carpenter's level.



2 Close the master shutoff valve [arrow]. Cut the main-line pipe above the shutoff valve. Pipe leading to the filter inlet later attaches to the main line at this location with a tee connection.

line and joined via tubing to the filter inlet. Tubing from the filter outlet carries filtered water back to the cold water line or previously installed separate faucet.

The Everpure QC4-THM water filter shown in the photos is a two-cartridge filter containing activated carbon for the filtering medium. Designed for use with a separate faucet, it is priced at \$285. The faucet kit is \$42.

Installing a main-line filter

A third type of filter can be placed on the main water line where it enters the house. The main-line water filter treats all household water. The filter medium is often cellulose, but may be string or pleated paper. This filter is designed to remove rust, dirt and sediment.

Installing a main-line filter is somewhat more complex than an undersink job. You can cut the cost \$50 to \$100 if you tackle the job yourself. Essentially, water is diverted from the main line

through the filter and back to the main line. However, valves should be installed on pipes leading in and out of the filter, and on the main line between filter-inlet and outlet-pipe connections. By closing the first two valves, you can change the filter cartridge without shutting off the water supply, if the filter has no shutoff valve. The latter valve helps water flow from the source (well or city system), bypassing the filter.

To install a main-line filter, turn off the water supply, cut the main water line at a height to install a valve and piping leading to the filter inlet. Install a valve and piping leading from the filter outlet back to the main line. Complete the circuit by cutting the main water line, joining the free end of the outlet pipe to the main line and installing a bypass valve on the main line. This work usually involves sweat soldering. Follow directions on positioning the filter for an easy cartridge change.

The main-line filter shown in the

photos is an Aqua-Pure AP600 by AMF Cuno. The cartridge contains activated carbon granules to remove tastes and odors, and rigid porous cellulose fibers to trap dirt, silt, rust particles, sand and other sediment. An unusual feature is a button that pops up when a new cartridge is needed. The unit is priced at about \$580.

Filtering mediums

There are several filtering mediums found in water filter cartridges. Activated carbon (charcoal) is most common in home water filters. Activated carbon filters designed to improve taste and remove odor also filter chlorine, some chloroform and other organic contaminants. They can also filter out rust particles, pesticides and cloudiness. But they don't remove minerals that make hard water, nor chlorides, fluorides or nitrates. And they won't filter out bacteria, either.

A second filter medium, cellulose or

SOURCES—WATER FILTERS

Following are manufacturers of home water filters. Many of their products are available at hardware stores and home centers. For more information, write directly to the maker. Types of filters that each company offers are keyed as follows: faucet-attached filter (F), undersink filter (U), main-line filter (M), ice-maker filter (I) and portable filter (P).

Advanced Filtration Technology, 2424 Bates Ave., Concord, Calif. 94520 (F, U, P)

Ametek, Plymouth Products Div., 502 Indiana Ave., Sheboygan, Wis. 53081 (U, M, I)

AMF Cuno, Aqua-Pure filters, General Filter Products Div., 400 Research Pkwy., Meriden, Conn. 06450 (U, M, I)

Aquatron International, 119 Enterprise Dr., Gretna, La. 70053 (U)

Astro-Pure Water Purifiers, 4900 N.W. 15th St., Margate, Fla. 33063 (U, M, I, P)

Brunswick Technetics, Filterite Consumer Products, 5 W. Aylesbury Rd., Timonium, Md. 21093 (U, M, I)

Chicago Specialty Manufacturing Co., Kleen-Stream filter, 7500 Linder Ave., Skokie, Ill. 60077 (F)

Commercial Filters, Fulflo Filters, Box 1300, Lebanon, Ind. 46052 (M, U)

Crystalab Inc., 612 Capitol Ave., Hartford, Conn. 06106 (F, P)

Culligan USA, 1 Culligan Pkwy., Northbrook, Ill. 60062 (U)

Everpure Inc., 660 North Blackhawk Dr., Westmont, Ill. 60559 (U)

Facet Enterprises Inc., Box 1637, Henderson, N.C. 27536 (U, M, I)

Keystone Filter Div., Met Pro Corp. 2385 North Penn

Manville Products Corp., Ken-Caryl Ranch, Denver, Colo. 80217 (U, M)

Neolife Water Dome, Paradigm Marketing, R.D. 3, Box 777, Putney, Vt. 05346 (F, U, I, P)

Nimbus Water Systems Inc., 3094 National Ave., San Diego, Calif. 92113 (U, I, P)

Norelco, Clean Water Machine, High Ridge Park, Stamford, Conn. 06904 (Electric P)

Omni Corp., 16928 West View, South Holland, Ill. 60473 (U)

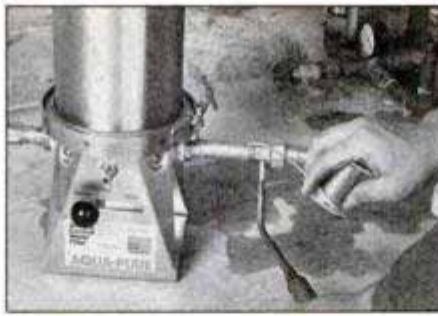
Rock Valley Water Conditioning Inc., 702 North Madison St., Rockford, Ill. 61107 (F, U, M, I)

Rush Hampton Industries Inc., Ecologizer Water Treatment System, 3000 Industrial Park, Longwood, Fla. 32750 (F)

Teledyne Water Pik, Instapure filters, 1730 E. Prospect St., Fort Collins, Colo. 80525 (F)



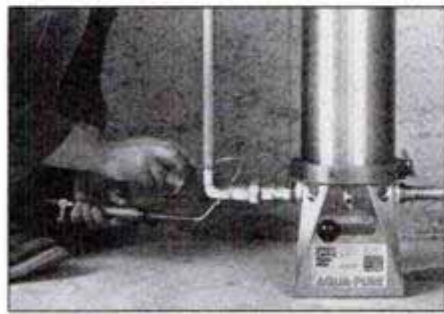
3 Wrap Teflon tape over threaded fittings and connect to filter head. Make a tight connection but do not overtighten. If space is limited, remove sump (top part) from base while making the connection.



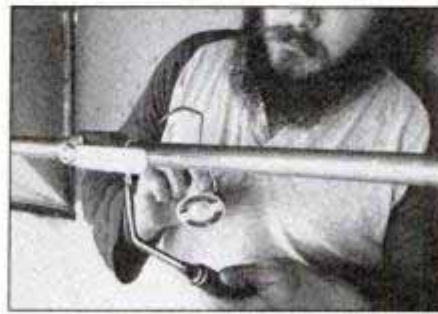
4 Install unions to the filter inlet and outlet lines. Sweat-solder the connections. The housing is made of stainless steel rather than a plastic, and can readily withstand the heat of the torch.



5 Position the filter inlet so it is facing toward the main line. Then install the inlet tee and ball valve to the main line. You must sweat-solder these connections in order to assure a tight seal.



6 Install the necessary risers. The first riser connects the inlet (right, not shown) to the main line. The second riser, connected to the outlet pipe, is long enough to allow clearance for filter removal (photo 10).



7 After the outlet riser is in position, add an elbow and pipe section returning to the main line. Install the filter outlet ball valve approximately at the midpoint of the horizontal stretch of pipe.



8 Cut main line at a height to allow installation of bypass valve between filter inlet and outlet tees. Use either threaded or sweated fittings. When bypass is open, unfiltered water goes to house system.



9 Install the main water-line bypass ball valve and filter outlet tee. When you want water to flow through the filter, the main-line bypass valve should be in the closed (handle horizontal) position.



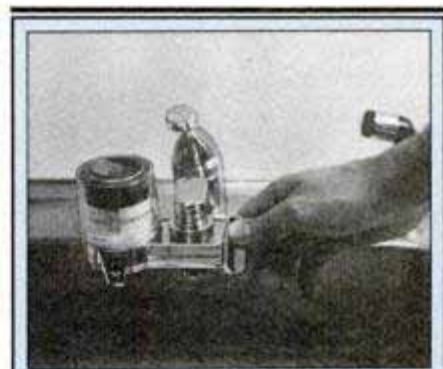
10 Install the filter cartridge housing as shown. To test connections, check that all the ball valves are in the closed position. Then open the main valve slowly, followed by each ball valve in sequence.

string, is used primarily to remove rust and sediment. These filters can reduce particles ranging from 30 to 50 microns down to three or five microns. A few makers claim their units will remove particles no larger than one micron (for comparison the size of a smoke particle is 25 microns). Some filters also contain activated carbon for taste and odor.

Then there are reverse osmosis filters which contain membranes through which water is forced by pressure. These filters reduce dissolved elements: calcium, magnesium, sodium and chlorine, chlorides, fluorides and nitrates other filters can't handle. A pressurized reservoir is needed to accumulate enough water for use and to provide pressure to dispense it. Culligan and Nimbus are two companies that make such units. If used in water

having a lot of sediment, these filters must be preceded by a sediment filter to prevent clogging.

Purchase of a particular filter will be governed by the problems you have and the money you want to spend. But regular cartridge replacement is a must for any filter to do its job well. **FM**



Faucet-Installed Water Filter

The Instapure threads directly onto the faucet to filter tap water. A lever on the filter diverts water through it on demand, for example, for drinking or cooking purposes. A clear plastic dome placed over the activated carbon filter allows you to see accumulated dirt particles, rust and sediment. This serves to remind the reader that it's time to install a new filter.

The major problem with this user's water was rust particles, which made it impossible to fill a crystal vase with water clear enough to hold flowers attractively. The Instapure cleared up the water for appealing display and appetizing drinking.

The F-1C Instapure is priced at \$34. Replacement cartridges are about \$4. It's made by Teledyne Water Pik, 1730 East Prospect St., Fort Collins, Colo. 80525.—P.S.

WORKSHOP MINICOURSE



Measuring and marking

Good craftsmanship begins with careful measuring and marking. It doesn't matter how careful and consistent you are at cutting "right on the line." If the line itself is off, you make a bad cut.

Accuracy in measuring and marking is mostly a matter of using the right tool in the proper manner. The most common choices of marking and measuring tools are the ones you see here. When using any of these tools, be conscious of your angle of view, or you may err because of the parallax effect. This is the apparent displacement of two points (the desired point on the rule and the corresponding point you want to make on the workpiece) caused by different angles of view. This is why some rules have graduation marks on a bevel that runs down as close to the work surface as possible. Most sturdy metal rules don't have bevels, so turn these rules on edge to bring the graduation mark closer to the work surface.

To make your mark, use a medium-hard lead such as 2H. This produces a thin line that is much easier to work with than a bold, irregular line.

The way you hold most tools is also very important. Hold a pencil at about 80° to the work surface so the point rides in the corner formed by the rule edge and the work.

When marking a line with a square or T-bevel, place the pencil point on the measured mark and slide the other tool up to it.

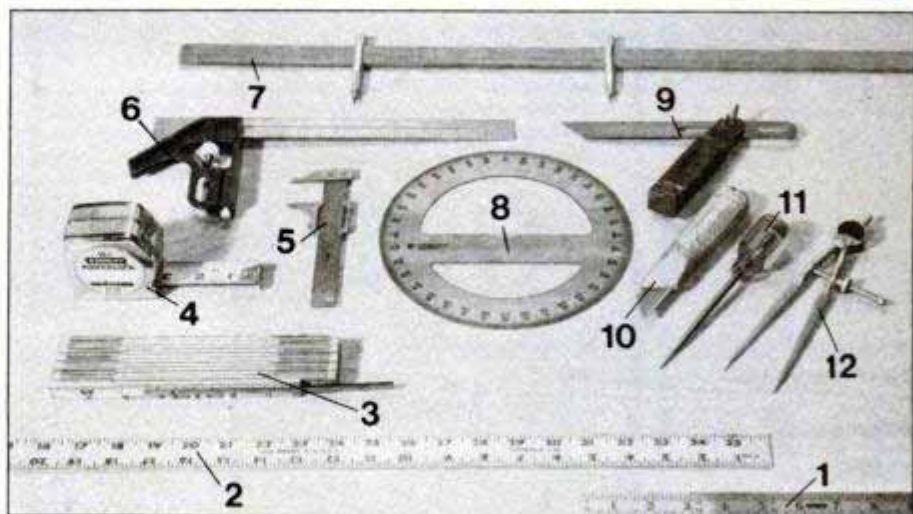
Some jobs require greater accuracy than is possible with a pencil. Laying out lines for good-fitting joints requires the greater accuracy you get with a utility knife or artist's blade. Blades produce very fine lines that also aid in starting the cutting tool and avoiding ragged edges. An awl does the same kind of job when you mark points.

Use a compass or trammel points to mark out circles or curved lines. Measure diameters with a caliper rule. Use a protractor for angles.

—Rosario Capotosto

Address update

In April's *Workshop Minicourse*, we gave an incorrect address for Garrett Wade Co. The current address is: 161 Avenue of the Americas, New York, N.Y. 10013.



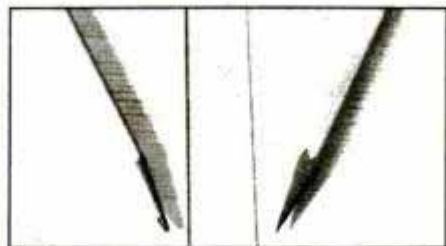
Most common tools for measuring and marking: 1, bench rule; 2, metal yardstick; 3, folding extension rule; 4, steel tape measure; 5, caliper rule; 6, combination square; 7, trammel points; 8, protractor; 9, T-bevel; 10, utility knife; 11, awl; 12, dividers.



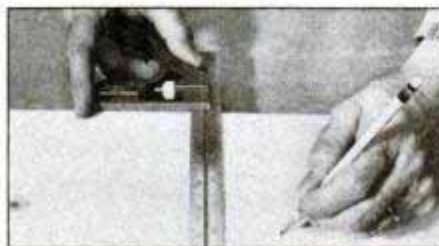
Hold a thick rule on edge to strike off a measurement for greatest accuracy. Distortion from viewing angle is minimized.



Hold your pencil so that the lead point rides in the corner. Always use hard lead pencils and keep the point sharp.



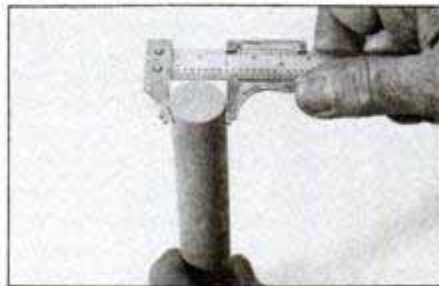
Avoid striking wide lines (left). These are usually caused by soft dull leads. A good lead to use is rated 2H (right).



Hold the pencil point on the measured mark and carefully slide the square up to the point. Then strike your line.



Marking dovetails with a utility knife gives you greater accuracy than a pencil. Score also aids in beginning cutting work.



Use the caliper rule to measure diameters or thickness of stock. The stepped jaw projections are for inside measuring.

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

ULTRA LIGHTS, 5 mg. "tar", 0.4 mg. nicotine,
FILTER, 9 mg. "tar", 0.7 mg. nicotine, av. per cigarette, FTC Report FEB. '84.

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four-door sedans with just enough room for two patrolmen and two alleged perpetrators, and quick performance by 1984 standards. You can expect to see more and more police departments downsize to cars such as this in the next couple of years.

CHEVROLET CELEBRITY

We love the Pontiac 6000STE. We love the Buick Century T-Type. We love the Chevrolet Celebrity Eurosport. What have they got that this car hasn't got? Power. Chevrolet's Celebrity police package has the 110-hp V6 rather than the 135-hp high-output (H.O.) V6 that anyone can buy in the 6000STE or Eurosport.

The sad result? This is one instance in which the civilian sedan is significantly better in handling and performance than the police car. That's right. Go out and buy a Chevy Celebrity Eurosport with the H.O. V6 and you'll run rings around any Celebrity police car. According to Chevrolet engineer Michele Pickering, there are some durability questions on the H.O. V6 that keep it out of police work. She refused to elaborate, but we'd suspect valve-train wear.

Too bad, because otherwise the Celebrity is right on. It's a good compromise between the too-big Impala or Diplomat and the too-small Mustang or Reliant. It's comfortable, economical and inexpensive.

Alleged perpetrators would be especially comfortable in the back seat, though the civilian-level cloth upholstery doesn't seem durable enough for government work.

With the H.O. engine and more neutral handling, the front-wheel-drive Celebrity would be our favorite police vehicle. Right now, however, police departments can't buy it that way. But, ironically, you can.

Epilogue

The police officers of America need help. Except for the Mustang, not one of the cars we tested is really quick enough for safe pursuit work. And that endangers everyone except the escaping criminal.

Surely the number of police cars compared to the general automotive population is insignificant in terms of pollution output or fuel usage.

Let's make police pursuit vehicles exempt from the EPA emissions certification and the Corporate Average Fuel Economy regulations. Without the threat of gas-guzzler penalties or the expense of certifying special police-only engine/body packages, Detroit can install its most powerful engines in body shells appropriate for police work and give highway patrols the tools they need to do their job. **PM**

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Portable Cordless Handset



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HANDY CHARGING CRADLE! When not in use outdoors, Cordless Handset rests in a small, slender Cradle that plugs into 110V outlet for recharging Handset. Put Charging Cradle in any room you like. Or quickly move it anytime.



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From Japan, world-renowned for the superior quality of their electronic products, comes this outstanding Phone—mate system that includes a Base Transceiver, Charging Cradle and PORTABLE CORDLESS HANDSET!

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To keep the Handset fully-powered for portable indoor/outdoor use, there's a sleek little Charging Cradle. It plugs into a standard 110V outlet to recharge the Handset.

Because the Transceiver is SEPARATE from the Charging Cradle, the Transceiver can be installed in an out-of-the-way room... OUT OF SIGHT! The attractive Charging Cradle stays conveniently close at hand, in any room you desire. Move the Cradle anytime you like.

PUSHBUTTON OPERATION! Works on rotary and pushbutton systems.

LAST NUMBER REDIAL! Press button to automatically call last busy number you tried to reach. A real timesaver!

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BIKING THE BADLANDS

(Continued from page 82)

develop enough strength and so are used on the bottom-line models to keep their prices down.

Chrome-manganese steels almost equal chrome-molybdenum (chrome-moly) in strength and lightness. And they cost less and can be brazed at higher temperatures, making mass production possible. Thus, a chrome-manganese frame is far more desirable than a mild steel frame, yet should not raise the price nearly so much as chrome-moly tubing. Still, chrome-moly is the material of choice on high-line premium and competition bikes where cost is no object and performance is everything.

Putting it together

The way the frame is put together means as much as its materials. Plain-gauge mild steel tubing that is T.I.G. (tungsten inert gas) welded, or with joints reinforced by stamped-steel collars called lugs, make the heaviest and least expensive frames.

By making the tubing thinner in the center and thicker at the ends and then using investment-cast chrome-moly steel lugs at the joints, a lighter, stronger, equally rigid but more resilient frame can be constructed. Smooth finishing around the joints and removal of brazing spatter reflects quality assembly. Roughness on one frame may not

be repeated on others of the same make and model, so it's worth checking.

American-made and designed custom frames can cost \$400 or more before you add a single component to turn the frame into a complete bike. Custom machines can run up to \$2,000 or more and are, obviously, for fanatics or competitors. However, a lot of mass-produced bikes are available at prices ranging from \$155 to \$800 or \$900. And \$400 to \$500 will buy a completely adequate, high quality machine.

The whole story

Oversize frame tubes, straight handlebars and fat tires don't tell the whole all-terrain bike story. Tires with cleats are great for the soft stuff like mud and sand. If all your riding will be on trails and off-road courses, these are what you want.

Smoother tires work well on the road but may not have the traction for real boondock bashing. Many all-terrain bikes come with dual-purpose tires which make for easier pedaling and smoother riding on pavement but have small cleats for off-road traction. These have a narrow center rib with cleats on both sides. When inflated to 60 p.s.i., you ride the roads on the rib with hardly any more drag than a skinny-tire bike. Drop to 25 p.s.i and you get traction for all but competitive off-roading.

Aside from the fat, knobby tires, the handlebars are the easy way to spot—

and tell a lot about—any all-terrain bike. Most look as if they were swiped from a moped or dirt motorcycle. On early designs, they were. But now, special all-terrain designs have evolved. They're straight to give you the upright riding position you need to spot irregularities in the trail or potholes in city streets. They also have the width for quick maneuvers, and the strength to take the strain when you lean on them to shift weight for better control. Motorcycle-like brake levers increase braking force while decreasing effort.

Check the neck

The least expensive mass-produced all-terrain bikes have standard stems clamping their handlebars. Better ones have Ritchey triangulated one-piece reinforced stems with a pair of welded-on braces to take the load when you lean on the bars. The strongest stems have two- or four-bolt forged aluminum stem clamps, called a slingshot stem.

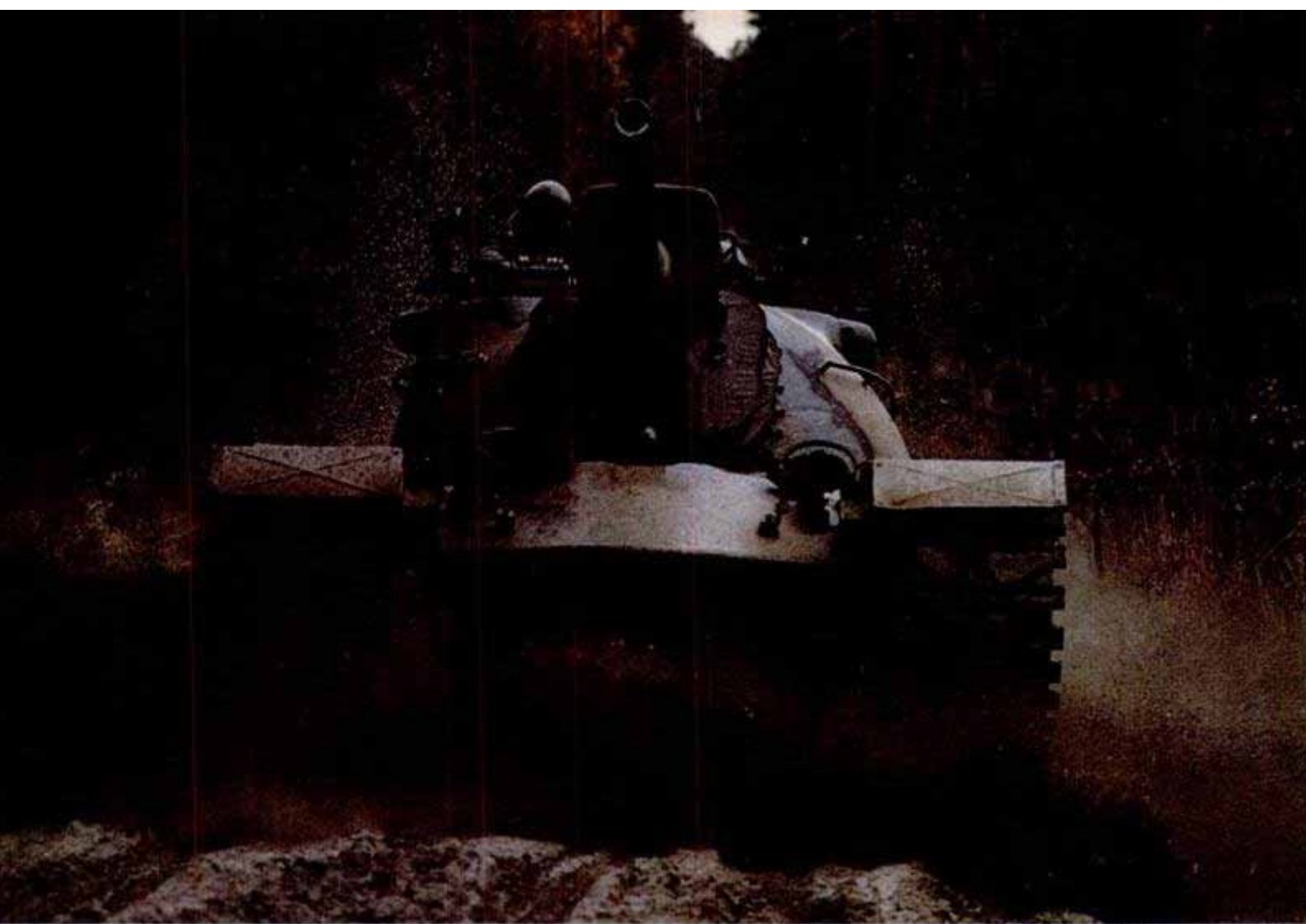
Shift levers for thumb-and-forefinger operation clamp directly onto the straight handlebars. These thumb-shifters operate wide-range 15- or 18-speed triple-front-chainwheel derailleurs. Dirt trail hillclimbers need every one of these speeds for real mountain biking, while city riders appreciate the power for steep driveways and hilly sidestreets.

Sealed bearings keep dust and mud

(Please turn to page 112)

A RANGE OF ALL-TERRAIN BIKES—FROM \$300 TO \$900

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Model	Sherpa	Ram	Mean Streak	Fat Chance	Pegasus	Northstar	Canyon Express	Mountain Tour Elkhorn	Sierra
Frame	Chrome-moly all tubes	Chrome-moly all tubes	Chrome-moly main tubes	531 Chrome manganese	Chrome-moly all tubes	Chrome-manganese all tubes	Chrome-moly main tubes	Chrome-moly main tubes	Chrome-moly main tubes
Fork	Chrome-moly	High-tensile steel, chrome-moly steerer tube	Mangalloy	531 Chrome manganese	Chrome-moly	Chrome-moly	Mangalloy	High-tensile steel	High-tensile steel
Speeds	18	15	15	18	15	15	18	18	12
Crankset	Sugino TAT 3-piece	Sugino TGT 3-piece	Sugino AT 3-piece	Shimano 3-piece	Sugino RT 3-piece	SR Aerox 3-piece	Sugino TAT 3-piece	Takate 3-piece	Sugino BT 3-piece
Pedals	SunTour beartrap	SunTour beartrap	SunTour beartrap	SunTour beartrap	SR beartrap	SR platform	Shimano platform	Shimano platform	SR platform
Derailleurs (f=front; r=rear)	SunTour Mountech (f) SunTour Superbe Tech (r)	SunTour Mountech (f, r)	SunTour LeTech (f) SunTour LeTech LL (r)	Shimano Deure XT (f, r)	SunTour Mountech (f, r)	SunTour Mountech (f, r)	SunTour Mountech (f, r)	SunTour Mountech (f, r)	Shimano FD-AL II (f) Shimano RD-AL II (r)
Brakes	Dia Compe 981 cantilever	Dia Compe 981 cantilever	Dia Compe 980 cantilever	Shimano Deure XT	Dia Compe cantilever	Dia Compe 980 cantilever	Dia Compe cantilever	Raleigh cantilever	Dia Compe 980 cantilever
Rims (in.)	Araya 7X 26 x 2.175	Araya 26 x 2.125	Araya 7X 26 x 1.75	Ukai 26 x 1.75	Araya 26 x 1.75	Araya 7X 26 x 2.125	Araya 7X 26 x 1.75	Raleigh 26 x 1.125	Araya 7C 26 x 1.75
Tires (in.)	National 26 x 2.125	Cycle Pro 26 x 2.125	IRC X-1 26 x 2.125	Carlisle Aggressor R/T 26 x 2.10	IRC 26 x 2.125	National/Panasonic 26 x 2.125	Canyon Express 26 x 2.125	Raleigh 26 x 1.125	Cheng-Shin 26 x 1.75
Handlebar/Stem	Chrome-moly/alloy 2-piece slingshot	Steel 1-piece	Diamond Back 1-piece	Bullmoose 1-piece	Chrome-moly 2-piece slingshot	SR 2-piece slingshot	Chrome-moly 1-piece	Chrome-moly 1-piece	Chrome-moly 1-piece
Weight (lbs.)	32.75	30	30	28	29	30	29.9	30.5	31.5
Price	\$497	\$479.95	\$475	\$895	\$479	\$389	\$469	\$425	\$289.95



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BIKING THE BADLANDS

(Continued from page 110)

from turning lube to grinding compound and destroying the bearings. On the best bikes, even the control levers are sealed. But on any off-road bike, you should look for seals on hubs, rear derailleur jockey wheels and bottom bracket pedal bearings. Some front head sets are also sealed.

Quick-release clamps

For different conditions or riders of varying size, quick-release clamps on the seatpost—some are even spring-loaded so you can adjust them while riding—let you easily raise or lower the seat. Some seats also adjust easily for fore-and-aft position and angle.

Raising the saddle allows enough leg extension for power on hills. Lowering the seat increases stability by lowering the center of gravity and eases the fast spin of a downhill run. For rough riding, a lower seat makes it easier to brace a foot against the ground and can save you from a spill.

Pedals are the same as those used by many BMX racers. Street riders like toe clips for the up-pull they provide while cruising. Toothed pedals, called rat traps, or the newly introduced bigger-toothed beartraps, are popular. For serious trail riding, plain pedals make it easier to step off the bike or put down a foot in bad going. Shimano's new parallelogram DX pedals have non-skid studs instead of teeth for grip, the studs making it faster to get your feet back flat on them.

Bikes for all seasons

Like motorcycles, sports cars or any other competitive sporting equipment, it's easy to go overboard on mechanical details when choosing components for all-terrain bikes. Some riders get more of a kick out of the machinery than the riding of it. But with mountain biking or any other on/off-road cycling, the riding itself has much to offer.

You can join clubs for trail rides and take all-terrain bikes on street tours. Specialized magazines such as *Bicycle Sport* are written by experts and provide lots of ideas on how to enjoy your all-terrain bike.

Soon, you'll find that your all-terrain bike has become a super general-purpose bike for local transportation and exercise as well as for off-road sport. The fast-handling qualities that make it work off the road also make it safer and easier to ride in cities and suburbs where most people live and must do most of their riding.

In fact, we're sure you'll find that today's new breed of all-terrain bike is about as close as you can come to the ideal all-around, all-purpose bicycle. **PM**

4 HANDSOME TOOLS

(Continued from page 101)

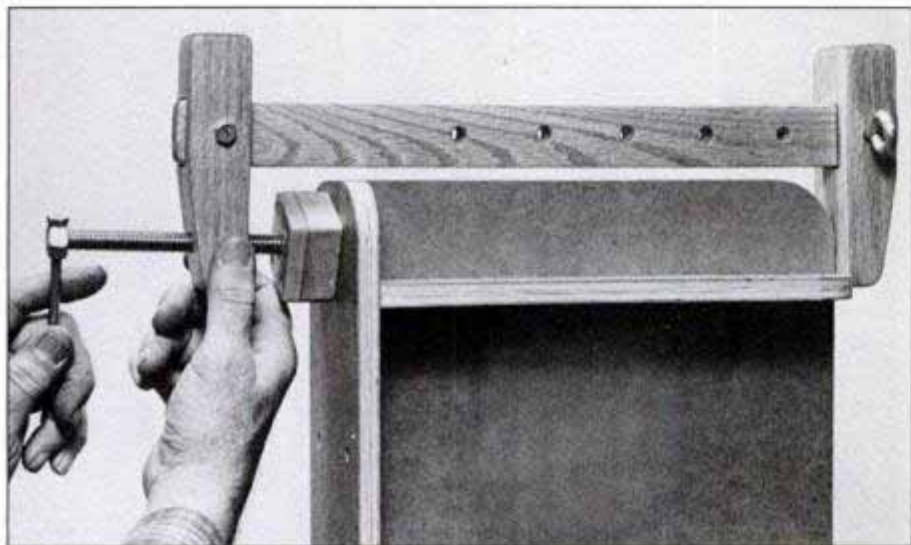
4 Oak bar clamp

Bar clamps are one accessory that a workshop never seems to have enough of. But now you can make your own oak bar clamps using mostly scrap lumber. The clamp consists of a bar and two jaws—one fixed and one adjustable. Its capacity is limited only by bar length.

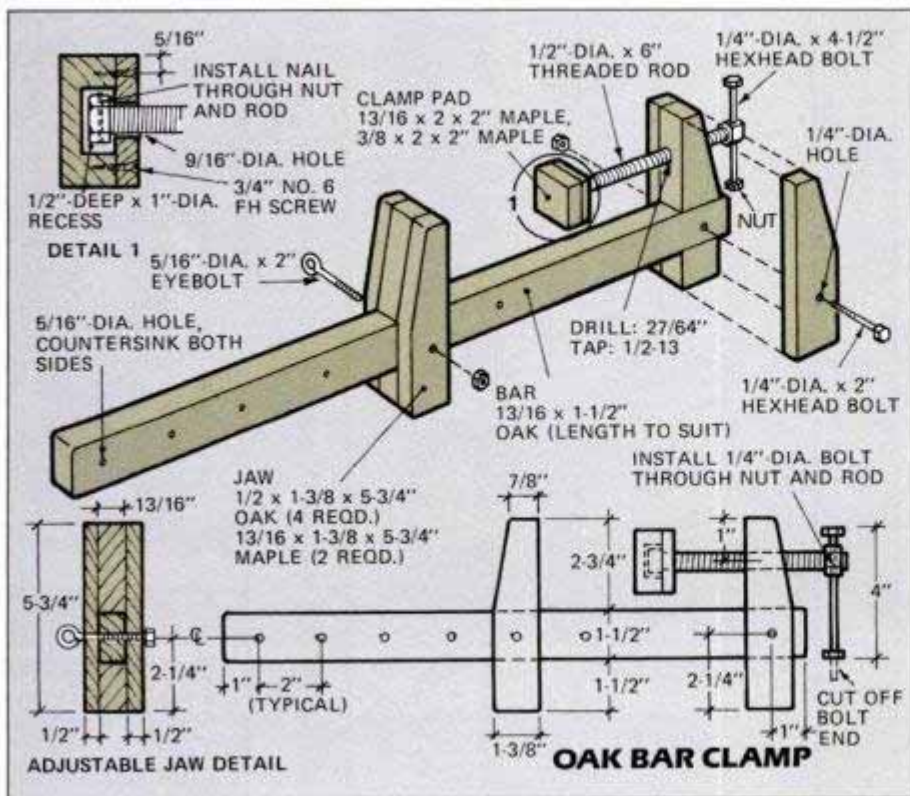
First, cut all the parts as shown. Note that maple is used for the center section of the fixed jaw because it accepts threading well. Also use maple for the

clamp pad. Assemble the jaws using glue and $\frac{3}{4}$ -in. brads as shown. Bore a hole in each jaw for the hexhead and eyebolts. To ensure precise alignment of the bar holes, use the adjustable jaw as a drill guide. Hold jaw in place and bore through bar. Repeat every 2 in.

Next, drill through the nuts on each end of the threaded rod. Hammer in a snug-fitting nail on one end to lock the nut in place. Then attach the two-piece maple clamping pad around the nut. Bore a $\frac{27}{64}$ -in.-dia. hole in the fixed jaw and thread the hole with a $\frac{1}{2}$ -13 tap. Screw the rod through the jaw, replace nut and install handle. Finally, apply a clear satin finish.—Rosario Capotosto



Here's an alternative to buying expensive metal bar clamps—make your own from scrap wood. Cut several bars of varying lengths for use in clamping work of different sizes.



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COMPACT DISC PLAYERS

(Continued from page 92)

only last year (see *Compact Disc Players—Is Now The Time To Buy?*, page 88, Nov. '83). Here's where you'll find some of the improvements.

■ **Strong nerves and muscles.** Optical guidance systems and electronics are more sophisticated: The lasers that read digital information off the disc and keep the beam on track, and the microprocessors that change light to sound, are cheaper to produce, lighter in weight and more reliable. Large-scale integrated circuits have replaced entire boards of electronic components. Tiny servos now guide the arm that carries the laser and do it more accurately than the massive mechanical linkages that were used originally.

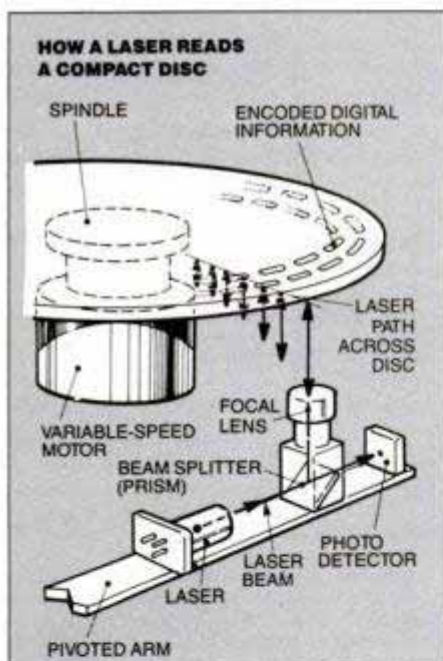
■ **Amazing memories.** The latest digital logic circuitry can track the tiny micro-pits engraved on the spinning CD with exceptional single-mindedness. When dirt or scratches cause brief information dropouts, the decoding circuitry pulls replacement information from computer memories to patch these

chuckholes before the audio circuits of the player get the shock or dead spots of silence. There is so much compensating circuitry that audible glitches are rare, except when playing damaged or unusually faulty discs.

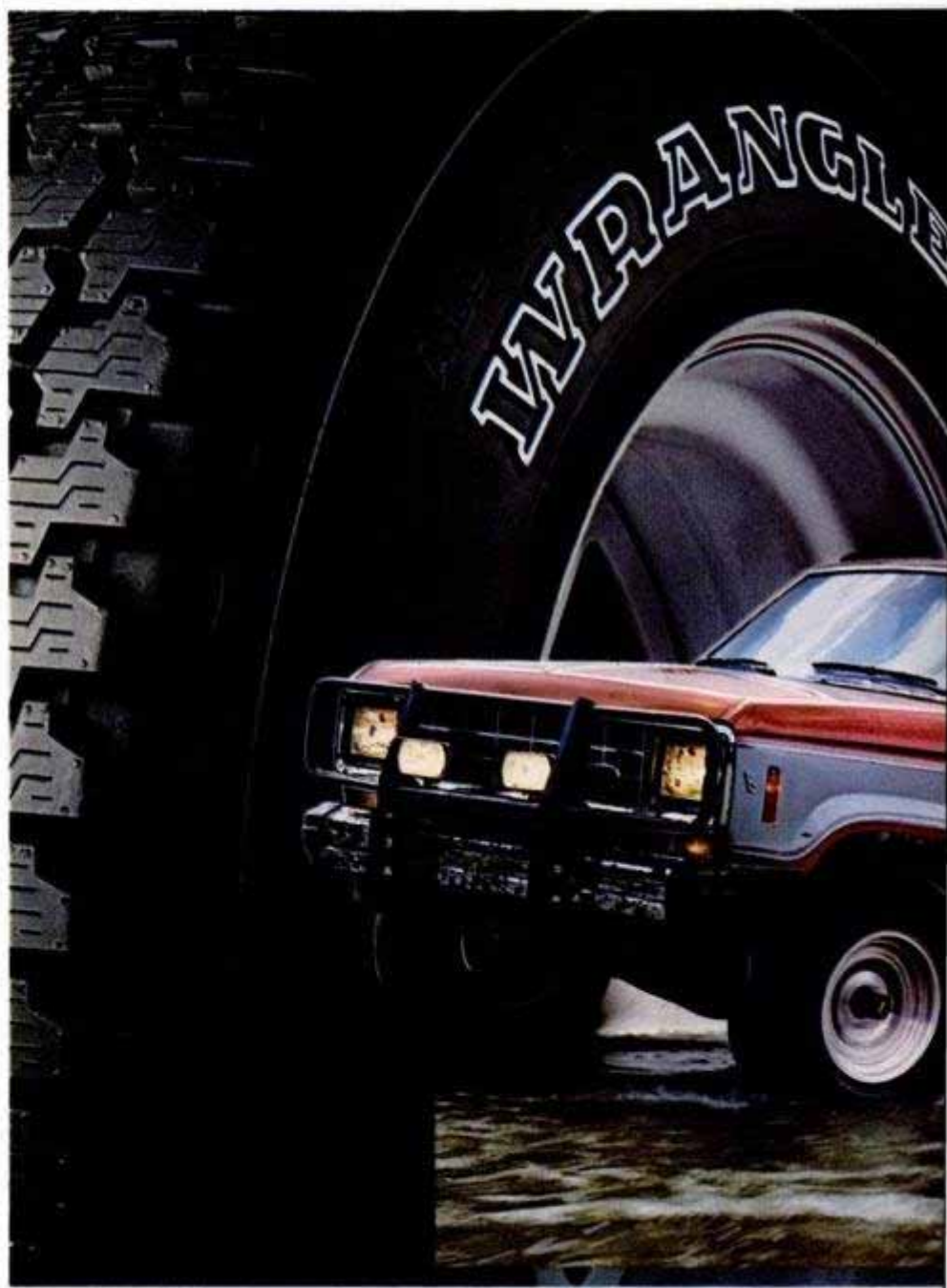
■ **Speed readers.** Readout panels show you how much time has elapsed or remains on a whole disc or just one track. All the information is on the discs, just waiting to be read. There are even four ways of repeating music: You can replay a whole disc, just one song, selections in the programmable memory, or all music between two programmed points (A-B repeat).

Some manufacturers design entire interrelated component systems, with the CD a part: Record synchronization lets you start a CD player and a cassette deck (set to record) with the touch of one button. Both stop at the same time, too. Two of our models shown here (Technics and Sanyo) have this feature. One final control feature is for the do-it-yourselfer who wants to locate his music manually, as opposed to programming it in. This is music search, which samples brief bits of the music as the laser skims over the disc.

We used and listened to four new players among the growing number of



Digitally recorded music is stored on the underside of a Compact Disc as microscopic pits etched into a perfectly reflective foil, which is laminated into the disc's transparent protective coating. The pits are arranged along a spiral, like a phonograph-record groove, but they start at the *inside* of the disc. The disc rotates slower when the laser moves out toward the edge because the pits must pass the finely focused laser beam at a constant linear velocity. The laser beam is reflected up through a prism and focused onto the whirling disc's reflective layer. The beam, interrupted by the speeding pits, is reflected back down through the lens and prism, and is perceived by the photo detector as incredibly rapid on/off pulses—pure digital information that provides flawless audio signals to your amplifier.



WRANGLER RULES THE ROAD.

units under \$700. We found all to have flawless sound reproducing qualities. But there are variations in their read-outs and controls. Here's a look at some of their features from our hands-on test.

Sanyo's CP 200 (\$500) features record synchronization with certain other Sanyo equipment, a couple of repeat options, and a memory that salts away up to 16 selections in any order. Like most recent players, it loads discs in a motorized front-panel tray, and takes up no more space than any other medium-sized audio component.

Remember that any piece of electronics needs some air circulation. Since

most CD players operate at a fairly warm temperature, nothing that could melt or warp (like LPs or CDs) should go on top. Not all players have a headphone jack, but there's one on the Sanyo. It doesn't have its own volume control though, so your headphones get the same signal that's sent to your amplifier.

Yamaha's CD-X1 (\$599) is among the most versatile and attractive of the new players. Three laser beams are used, one to read the disc and two for super-accurate tracking. The result is a spotlessly clean audio signal to your amplifier. Up to 23 selections go into

the memory to be played in any order in which they are entered. There's no need to be in the dark about the status of elapsed or remaining time, tracks, and index numbers, because the read-out panel shows them all. (CD players show a display only when there is a disc inserted. Time, track, and other information are displayed throughout the entire play time.) The CD-X1 has three repeat formats and music search, and it also comes with an excellent owner's manual.

The Technics SL-P7 (\$600) has large-scale integrated circuits and "smart" microprocessors to put record synchronization, timer adaptability, track/index/time displays, two repeat choices, and extra-fast track access at your fingertips. There are more functions, and it seems that each time you use the SL-P7, you discover additional feats this deck can pull off. The manual is clear and comprehensive. The SL-P7 has another interesting feature: The manual states that the DIN-format jack on the



Disc is placed in drawer with label up. The laser reads the reflective underside.

back is "for system connection with future components."

We contacted Technics and learned about the possibility of future audio and video information packed onto CDs in the future. Small as they are, compact discs have room enough for more than just the 70 minutes of stereo sound they currently can hold, and manufacturers have been searching for a technical standard for video images on CDs.

But all that is future stuff, and the here-and-now fact is that the SL-P7 does an excellent job with the audio on CDs as they exist now.

Sony's CDP-200 (\$700) boasts features and performance that could set standards for future players. With its miniature semiconductor laser and tiny, powerful, large-scale integrated circuits, this player is a very reliable performer. Among the precision controls are track and index buttons that work in both directions, elapsed/remaining time indicators, and pushbutton repetition of either the whole disc or a section whose start and end you can select during play. The CDP-200 has a headphone jack with its own wide-range volume control. It controls the signal sent to your headphones and adds a nice touch of flexibility. Another welcome feature is the unswitched a.c.

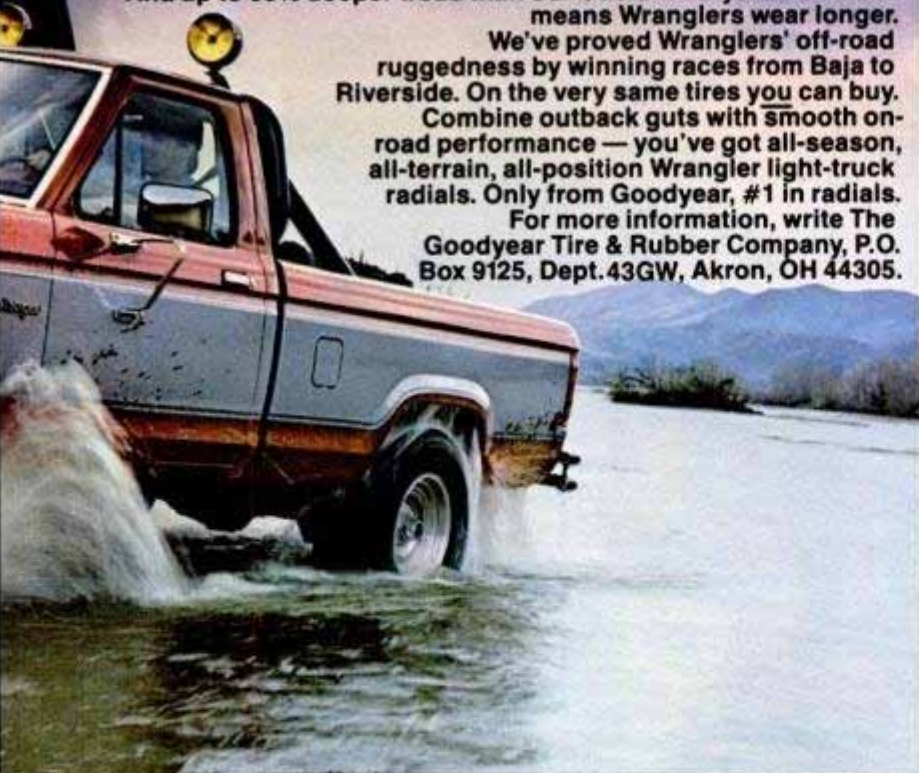
(Please turn to page 116)

WRANGLER ALL-SEASON RADIALS. OUT FRONT IN THE OUTBACK.

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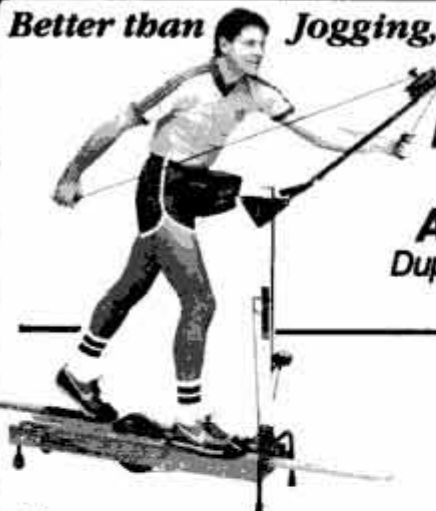
We've proved Wranglers' off-road ruggedness by winning races from Baja to Riverside. On the very same tires you can buy. Combine outback guts with smooth on-road performance — you've got all-season, all-terrain, all-position Wrangler light-truck radials. Only from Goodyear, #1 in radials.

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CABLE CARS

(Continued from page 81)

we stayed with the tried and tested method," Hayes says.

Also, the redesigners retained the two methods by which the cars are guided around curves. On drift curves, the gripman releases the cable and the car coasts through the curve on its own momentum. The cable is carried in a straight line to a large sheave, where it is redirected at a right angle, after which it is regripped by the car. Pull curves are used on grades where the car must be pulled through the turn. The cable then feeds through a series of small horizontal pulleys augmented by a chafing bar. A slight reverse curve swings the grip into position against the chafing bar and the cable pulls the car through the curve at full speed. Despite much research, these systems, too, were retained. The only changes were to install heavier bearings and to use sealed pulleys with a harder running surface.

Yet the renovation was not without difficulties. Two months after the project began, torrential rains swamped the construction ditches and threatened to undercut the walls of the historic powerhouse. Construction crews had to be called in to shore up the walls.

And throughout, engineers had to resist the temptation to "modernize" the system. Says Hayes, "People said to us, 'Why didn't you computerize the cars? Think of the labor that could have been saved!' San Francisco wasn't interested in labor-saving methods, but in preserving the unique qualities of the cable cars. That was what we set out to do, and that's what cable-car riders will find."

COMPACT DISC PLAYERS

(Continued from page 115)

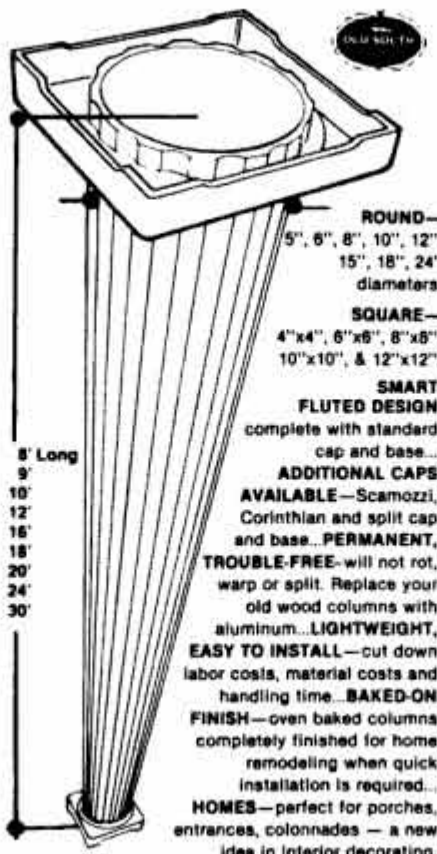
outlet on the back—perfect for those of us whose wall sockets won't take another plug.

The current CD players, even in the price range we've been discussing, have remote controls of awesome completeness and large memories for elaborate programming. They continue to be simpler to use, and have close tracking tolerances. And, of course they provide near sonic perfection. All that remains is that they be sold at record-player prices. We're sure that the \$400 Compact Disc player will be here soon, as increased production and competition drive prices steadily down. But we'll have to wait and see if someday you'll be able to pick up one, causing no more dent to your budget than would buying an old-fashion turntable.

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84-page, full-color Orvis 1984 fishing catalog contains a complete line of fly fishing tackle and accessories. Plus information on choosing the equipment best suited to your fishing needs. \$1.00

863 GET THE CONNECTION

Illustrated brochure from the Wiremold Company gives you a closer look at do-it-yourself on-wall wiring. Information on systems that offer an easy way to extend power without breaking into your walls. Free

864 GET THE EDGE

16-page Almanac from Schrade Cutlery features a variety of hunting and fishing knives and their uses. Also recipes for the outdoor gourmet. Free

865 CUT THE GRASS WITH DIESEL POWER

Kubota diesel lawn and garden tractors are a new way to cut grass. Brochure describes their Kubota G line and tells you how they require less maintenance, last longer and use less fuel. Free

866 CAR RESTORER'S BIBLE

The Eastwood Company's 64-page catalog contains everything for antique and specialty car restorers. Unusual tools, paints and polishes to help you get professional looking results. Also includes new tech articles. Free

867 REACH FOR THE STARS

National Microtech, pioneers in home satellite television offer a 6-page brochure introducing their system. Information includes becoming a home satellite distributor, 3 year limited warranty and more. Free

868 NEW WAY TO REMEMBER

A unique approach to memory improvement is provided by easy-to-read, easy-to-apply book entitled INSTANT MEMORY. Uses natural ability of your mind to recall. . . no word association. Introductory information. Free

869 TOP IT OFF

6-page, full-color catalog includes Brahma's line of durable lightweight pickup truck toppers of high-impact plastic. Available for all popular standard-size pickups; most long-bed, short-bed mini- and mid-size pickups. Free

870 BEAT THE HEAT

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871 VENTILATION WITH A VIEW

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28-page catalog from Lowrance Electronics includes product descriptions and photos plus usage information to help you select the appropriate sonar instrument for sportfishing. Free

874 WOODWORKER'S SPECIALTIES

24-page catalog of plans and hard-to-find hardware for the woodworker. Brass hardware, screws, cork products, wood turnings, canister liners, clock movements, picture frame supplies, lamp parts and more. From Meisel Hardware Specialties. \$1.00

875 THE HOUSEKEEPER'S FRIEND

"Total finish" seals, polishes, protects porcelains, ceramics, tiles, glass and polished metals. Makes them water, soil and stain repellent. From Unelko. Free

876 GET HOOKED

10-page, freshwater hook guide from VMC offers complete information on choosing the right hook and bait. Describes their entire line of hooks and shows the fish their suited for. Receive a deluxe embroidered fishing patch. All for \$1.00

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64-page catalog from Sintec has over 15,000 first quality electronic components and supplies for the electronic enthusiast! \$1.00 (refundable with first order.)

878 DO-IT-YOURSELF LIBRARY

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879 DISCOUNT CATALOG

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16-page, informative booklet from Buck Knives shows how to sharpen a knife, field-dress a deer, skin/filet fish. Also includes safety techniques and much more. Free

881 SLIM AND TRIM

Inertia Dynamic's 18-page, full-color brochure introduces the Lean Machine. This one exercising unit allows choice of 45 exercises for total body conditioning. Suggested exercise regime is illustrated showing how to build up specific areas or slim down. Free

882 TOOLS, TOOLS AND MORE TOOLS

All 196-pages of the U.S. General Supply catalog are filled with over 6,000 name brand tools and handyman supplies. Discounted prices too! \$1.00 (refundable on first order.)

883 START THE REVOLUTION

Brochure from Specialty Design describes the SPIN START system. Enables mower engines equipped with a vertical-pull cord to be started with a 3/8" electric drill. One kit fits all Briggs & Stratton, Tecumseh (Sears), and Lawn-Boy engines. Free

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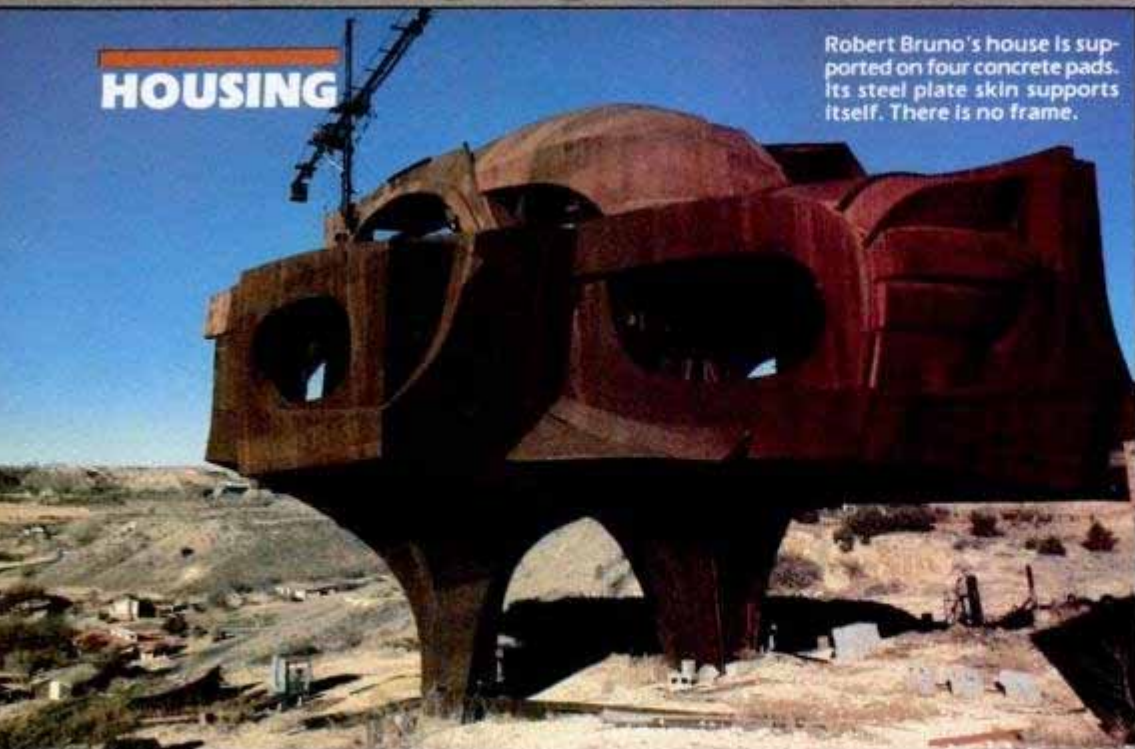
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TECHNOLOGY UPDATE

HOUSING



Robert Bruno's house is supported on four concrete pads. Its steel plate skin supports itself. There is no frame.



PHOTOS BY TODD JAMES

Sculpted house steels the scene

Robert Bruno's home looks like a UFO waiting to take off. It sits on four subterranean concrete pads—a gleaming mass of steel on the prairie of Lubbock, Tex. Sculpted of more than 10 tons of steel, the house has been in the works for 10 years and won't be finished for another three. It draws an average 150 visitors a weekend.

When we visited Bruno, he was welding a 1/4-inch sheet of steel on the inside skin. The house has no frame. Instead, its self-supporting walls are two sheet-steel skins sandwiching a layer of blown-in fiberglass. Bruno says he expects the structure will need the same cooling and heating as any three-story building of equal floor space—2,600 sq. ft.



Future I is a new all-electric house that runs on solar power.

Charged by the sun

After some major energy crunches, homebuilders are shying away from all-electric homes. But a new demonstration home outside Atlanta is all electric.

Called Future I, the two-story house runs on solar power most of the year. Heat and hot water are provided by rooftop solar collectors. Photovoltaic arrays produce electricity. The Westinghouse single-crystal silicon cells are formed from rectangular ribbon, a shape which allows more collecting power over less roof space than standard cells.

AUTOMOTIVE

The Lotus blossoms

The trouble with an ordinary auto suspension is that it always seems to be a compromise.

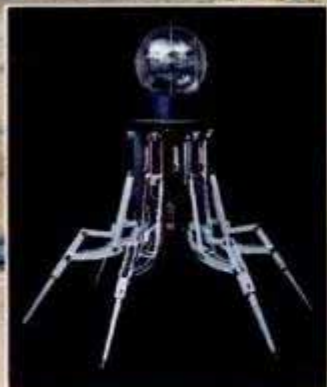
Design it for optimum ride and comfort and you hurt the handling. Set it up for smooth handling and it performs poorly on bumpy roads. Beef it up for a heavy load and it's too stiff with just the driver aboard.

But a new "active" suspension designed by Lotus holds out hope for the best of everything. Although it's not yet in production, the Lotus suspension will feature four hydraulic jacks, one at each wheel.

An engine-driven pump, regulated by computer, raises and lowers pressure on the wheels. A production version may be on the road next year.



Lotus suspension jack (left) is regulated by a computer (right).



GI of the future? Army's six-legged robot can carry nearly 900 pounds of armament or other gear at a brisk walk.



ROBOTICS

Remote-control GIs

Sending mechanical soldiers out to do your fighting for you may sound like comic-strip humor, but it's no joke to the U.S. Army. A six-legged, TV-eyed, remotely controlled robot, said to be the first to have true walking mobility, is currently undergoing tests to see if it can perform combat missions too hazardous for humans.

The spider-like creature, its articulated legs powered by 18 electric motors, can climb, stoop, squat, crawl and otherwise simulate most human contortions. An on-board computer

constantly monitors its center of gravity to keep it from losing its balance as it gleefully scampers over obstacles as high as 33 inches.

Called Odex I, the robot will initially be programmed to prowl suspected minefields, lay smoke screens, make reconnaissance patrols and do other relatively simple battlefield chores. Later, the Army hopes to be able to "train" the robot so that it can stalk enemy tanks, fire rockets, hurl hand grenades and serve as fearless medics to evacuate casualties under fire.

Made by Odetics Inc. of Anaheim, Calif., the Odex I is also expected to have important civilian applications in such dangerous jobs as firefighting, law enforcement, deep-level mining and nuclear waste disposal.



Two prototypes (left) and artist's conception (right) of prison robot.

Robot from cellblock H

His name is Denny. He's a prison guard. He stands just 4 ft. tall and weighs 400 pounds, but he moves fast. Denny is a robot designed by Denning Mobile Robotics of Woburn, Mass. By next year, the metal-clad droid will cruise prison halls in Massachusetts and other states at 3 mph. Microwave, infrared and chemical sensors will pick up heat, motion and even body odor of unauthorized personnel. By 1986, nearly 1,000 Dennys are expected to go on duty around the world.

INVENTIONS

Britannia rules the waves

We're talking about magnetic waves. Britain's Maglev car starts riding the rails this fall between the Birmingham airport and the National Exhibition Center. The system has the first magnetic switching tracks. It works by swiveling into position, pushing aside the rail from which the car is changing. The car carries nine passengers.



A Maglev switch track swings into place in Britain's system.



'Creep' show comes to an end

A locomotive speedometer often reads far higher than the car is actually traveling. That's due to "creep" on low-friction track. The wheels turn fast, but the car loses speed. GM Electromotive has introduced a locomotive that fires radar on the track. As the beam bounces back, true ground speed is measured and throttle can be adjusted to save fuel.

TECHNOLOGY UPDATE

AVIATION



New 400-mph twins are (clockwise from left): Beech Starship I, Gulfstream Commander Jetprop 1200, Piper Cheyenne IV and Fairchild 400.

Turboprops that hit 400 mph

Not too long ago, the best speed a twin-engine corporate turboprop could boast was about 300 mph. Now, suddenly, there's a whole new flock of fleet-winged twins casually advertising "400-mph performance." That's getting up into jet-speed territory at much less than what it could cost to operate a true bizjet.

Typical of these new 400-mph turboprops, which will accommodate eight to 10 passengers, are Beech's exotic Starship I (above, left), Gulfstream's Commander Jetprop 1200 (top right), Piper's Cheyenne IV (center right) and the Fairchild 400 (bottom right).

What accounts for a 100-mph boost in speed in just a couple of years? The answer lies in the use of more efficient engines, new high-lift, low-drag airfoils, lighter materials to save weight

and special four-bladed propellers that speed the movement of air. The engines are flat-rated down to 1,000 hp, a technique that increases power at high altitudes where turboprops typically lose power.

The most unusual of the new twins is Beech's tail-first Starship I, an 85 percent-scale prototype designed by Burt Rutan, famous for his canard-winged homebuilt sports planes. The Starship's canard adds lift, reduces drag, resists stalling and eliminates the power-robbing download imposed on a conventional aft-mounted tail. Vertical wingtip fins in effect increase wing area and thus lift without the drag that a longer span would produce.

But such high-tech advances don't come cheap. Prices for the new twin-engine turboprops range from \$2.1 million for the Piper Cheyenne IV to nearly \$3 million for the full-size Beech Starship.



Silent chopper

How about a helicopter that makes virtually no noise, produces no heat to attract heat-seeking missiles and has none of the complex engine parts found in a conventional chopper?

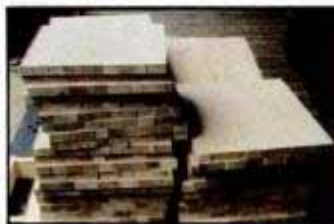
Give up? It's an electric-powered copter—the world's first—under development by Orlando Helicopter Airways of Orlando, Fla. Due for flight testing soon, it will use lithium hydroxide batteries that are quickly recharged by merely replacing their lithium plates.

Four electric motors drive rotor on this modified Sikorsky S-52.

ALTERNATIVES

Wood that we could

Good hardwood is, well, hard to find and expensive to buy. But a new process developed by University of Massachusetts Prof. William Rice may soon change all that. His System 6 cuts and shaves 6-foot logs from young trees. After 18 days of kiln drying, clear wood is separated from flawed wood both by crosscut and rip saws. The processed pieces are then glued together, forming solid standard blanks that can be worked like any piece of hardwood. The system is expected to be in commercial use by next year.



System 6 standard blanks (left) can be worked like standard hardwood. The pieces are glued together in a carrier press (right).

PHOTOS COURTESY WILLIAM W. RICE

MILITARY



Explosive protection

Israeli tanks operating in Lebanon have been fitted with "active" armor plates. They're steel boxes filled with high explosive. In the milliseconds after a High-Explosive Anti-Tank (HEAT) shell hits the Israeli vehicle, the tank's lining explodes into a high temperature plasma jet which burns its way through the armor. But with the active plate, the jet penetrates the steel box, which explodes, knocking out the round before it can penetrate.



Two concepts for a supersonic cruise interceptor are McDonnell Douglas's (left) and Boeing's (right).

SST technology pays off in faster fighters

Long-range, deep-strike fighters of the future will have to be able to cruise for hours at sustained supersonic speeds, says the U.S. Air Force. By contrast, present-day fighters are limited to short bursts of supersonic thrust used mainly during combat.

To meet the challenge, Boeing and McDonnell Douglas, working with NASA, have come up with preliminary proposals for a supersonic interceptor designed to cruise at

speeds up to Mach 2 and have an unrefueled combat range of as much as 1,500 miles.

Both concepts are based on technological advances originally made during the now-abandoned program to develop a U.S. civilian supersonic transport (SST). Each uses the thin, sharply tapered arrow wing derived from SST research. The arrow shape provides high lift and low drag over a wide range of speeds

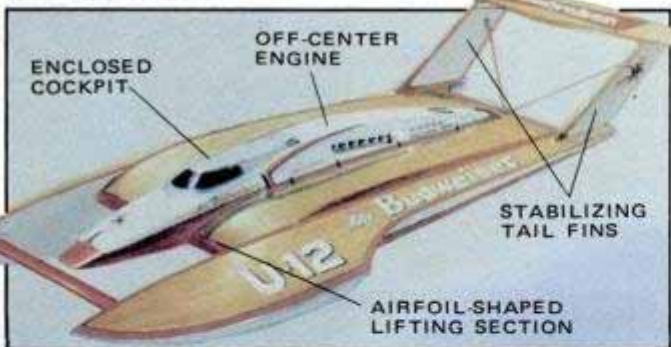
without the need for a complex variable-sweep wing such as is used on some of today's supersonic fighters.

New ultra-high-temperature turbofan engines will produce sustained supersonic thrust without having to resort to afterburners that consume large amounts of fuel. Both Boeing and McDonnell Douglas expect to have operational prototypes ready by the early 1990s.

America's SST never got off the ground, but it may not have died in vain.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager, Jack Hammond,
Howard Levy, Andrew Coe, Michael A. Fillon,
Fran Wenograd Golden, Kurt Lundgren

MARINE

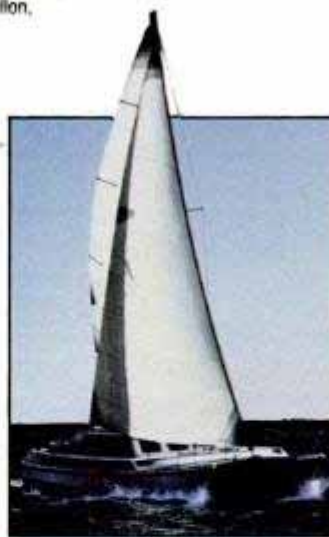


This Bud's for a champion

What the unlimited hydroplane racer of the future may look like is shown above. The rakish shape, planned for next year's *Miss Budweiser*, sports for the first time a sleek, fully enclosed, aircraft-style cockpit for improved streamlining and increased driver comfort.

A large tail is designed to prevent violent pitching at speeds approaching 200 mph. The engine is off-center to the left to provide greater stability in left-hand turns (unlimited races are run on a counterclockwise course).

Over the past two decades, the mighty *Miss Bud* in her various forms has racked up some 50 victories, making her the winningest hydro in unlimited racing history.




Fishing 'cat'

Catamarans would be great fishing vessels, but they have limited cargo space. Now, Logical Boat Co. has developed a "fat-hull" cat which quadruples storage volume. A wider hull slows the vessel a bit. But a computerized sail keeps it always in the wind for excellent fuel efficiency.

ENGINEERING



Safety canopy for jets

A new canopy for jets has passed crucial crash tests in Britain. Made of polycarbonate laminate, the canopy stretches up to 5 inches in high impact. In the latest test (above) a collision at 610 mph was simulated. A few scratches showed up but there was no shattering. 

STAR WARS

(Continued from page 86)

sharply defined manner, seem to be particularly useful in hitting specified objects such as enemy weapons in action, yet they are not weapons of mass destruction (see *Lasers And Rail Guns Arrive*, page 87). Lasers should not be predeployed in space.

An excellent possibility exists that appropriate mirrors (used to reflect laser beams at enemy missiles) can be deployed with sufficient speed after an attack begins. Any astronomer can guess some of the problems that are inherent in this new technology. However, the difficulties show promise of being overcome.

Can the enemy develop countermeasures against our defensive weapons?

In the United States, we are used to the idea that defense against nuclear weapons is not feasible, and many experts are vigorously defending their habits of thinking exclusively about retaliatory weapons.

In our country, the opinion among the experts still strongly favors weapons of attack. These people are actually doing a good job in pointing out weaknesses in defense systems and the ways in which some defense systems can be defeated.

All of us should be thinking of these countermeasures, and the best advocates of defensive techniques must look at their best proposals in this peculiar two-edged manner. After all, we can't know whether defensive systems are good until the countermeasures are explored and until we are convinced that countermeasures are more difficult and more expensive than the defense measures themselves.

In theory, this discussion has advanced far. In practice, it is given too little emphasis for a very simple reason. We are slow to accept the fact that the Soviet Union is developing defensive weapons. Therefore, protective measures on our part are deemed unnecessary.

The most primitive ideas of ballistic missile defense are old, but still with us. For example, the idea of defending a particular site with so-called "darts"—expensive defensive missiles—that would destroy an incoming ICBM has been available for more than a decade. Unfortunately, an incoming nuclear warhead can be set to explode on contact with the dart, blinding our radar detection system.

However, there is a more effective defense. Launching highly maneuverable vehicles with very tiny nuclear warheads into the path of an incoming

ICBM could destroy the missile or render its triggering and guidance systems useless, so there is no massive radar-blinding explosion.

Where would defensive weapons be stored and deployed?

In general, near the targets they are to defend. At the same time, in many cases, defensive weapons might be mobile. Uncertainty about their location could be helpful in frustrating an attacker's plans.

What are the objections against defensive weapons?

We need not anticipate objections against defensive weapons. We have already experienced them. The standard objection is a simple syllogism: All weapons are evil. This syllogism seems so primitive that it is hard to believe its wide usage. Yet, practically every objection I have heard to defensive weapons is based on this illogical line of reasoning.

To meet the objections against defensive weapons, I would adduce only one simple picture. Two camps armed with swords are apt to do more harm than two camps armed with shields.

Another answer—one for which I am indebted to President Reagan—can best be framed in the form of a question: Would it not be better to save lives than to avenge them? **PM**

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America, you're leaking. All over your garages, driveways and streets.

And those puddles could lead to repair bills that'll knock you off your feet.

Your car just won't run without oil or transmission fluid.

That's why you need Wynn's® Engine Stop-Leak and



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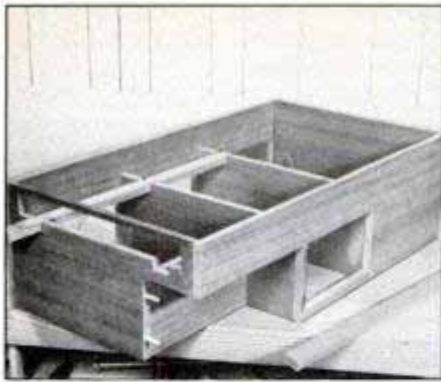
They'll help you rejuvenate rubber seals and o-rings, help stop leaks, get you running smoother. And get you back on your feet again.

So if you've got the puddles, we've got the solutions. Wynn's Engine Stop-Leak and Wynn's Transmission Treatment.

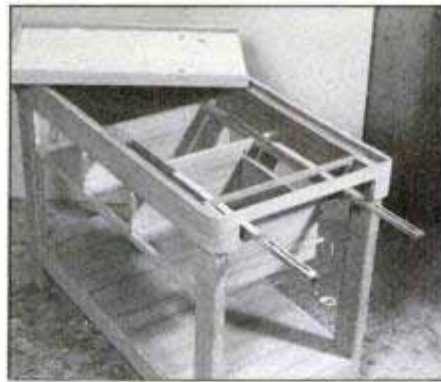
After all, your car should be expected to drive you a lot further than your knees.

Wynn Oil Company, P.O. Box 4370, Dept. PM, Fullerton, CA 92634.





Install bottle rack hanging dowels in case end, then join all parts with glue and screws. Test-fit extension slide tracks, then remove and finish-sand entire case.



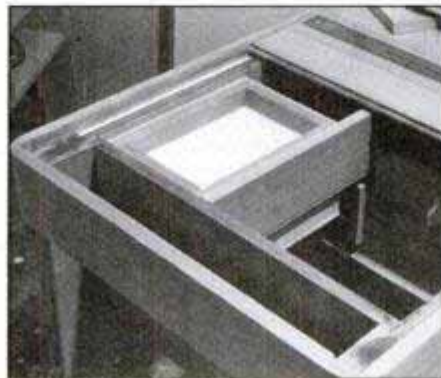
Attach case to frame by driving two screws through the inside of each case corner into the legs. Install slides, build shelf, then check shelf for proper fit.



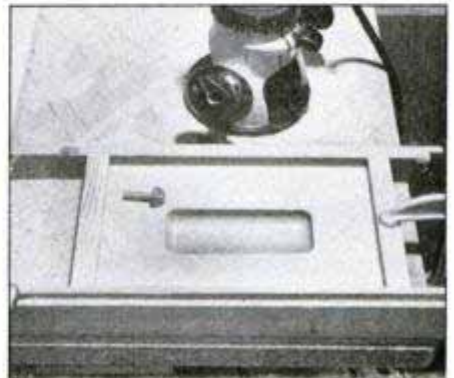
Install lower drawer guides, then build drawers and check for fit. Install upper guides, cutting board and pan track, and the bin on the opposite cart side.



Cut top boards to size, then install with glue and 1-in. brads driven through the tongue into the support cleats at a 45° angle. Keep V-joint side of boards down.



When boards reach ice-box partition, install small frame boards as shown in drawing (parts LL1 and LL2). Cut remaining top boards to conform to opening.



Cut ice-box top to size, then hold it in jig frame shown, made of 1-1/4-in.-wide stock. Install 3/4-in. core box bit in router and cut depression using jig as fence.

6 OUTDOOR CLASSICS

(Continued from page 96)

the support for the wheel axles. Join these blocks to the inside of the wheel legs with glue and four 4d finishing nails per joint. Clamp and let dry.

Then, using a router with a 3/8-in.-rad. rounding-over bit, ease the upper half of each leg edge as shown in the photo on page 96. Stop approximately 3 1/4 in. below the leg top. This will leave the leg top square for maximum gluing

surface later when the rails and case are attached to the legs. Also, by starting the cuts halfway up the legs, the lower half of each remains square for joining the lower rails. Later, when the rails are glued in place, finish the rounding job by moving the router down the legs and across the rails in one continuous cut.

Bore the wheel axle holes in the wheel legs as shown in the drawing on page 97. Then fabricate the wheels, cut the aluminum rod for the axles and test fit both. (For a detailed explanation of

how to make and install the wheels, see page 126. The wheels for the chaise are the same as those for the cart.)

Next, glue and clamp the lower side rails to the legs. Let dry, then join the lower end rails to the legs using glue and screws. Cut the sliding shelf notch in one end rail then clamp all upper rails onto the legs. Bore screw plug and shank holes into the rails and pilot holes into the legs. Separate, apply glue and attach the rails with screws.

(Please turn to page 124)

MATERIALS LIST—BARBECUE CART

Key No.	Size and description (use)
A	2 3/4 x 11 1/4 x 39 1/2" redwood (case side)
B	2 3/4 x 11 1/4 x 20 1/4" redwood (case end)
C	2 3/4 x 8 3/4 x 20 1/4" redwood (case partition)
D	2 3/4 x 5 3/4 x 15" redwood (bottle rack side)
E1	1 3/4 x 7 x 12 7/8" redwood (bottle rack partition)
E2	1 3/4 x 4 x 12 7/8" redwood (ice-box partition)
F	9 5/8"-dia. x 12 7/8" hardwood dowel
G	2 3/4 x 1 1/2 x 29 3/8" redwood (slide track)
H1	2 3/4 x 3/4 x 14 1/2" redwood (upper drawer guide)
H2	2 3/4 x 3/4 x 11 1/2" redwood (upper drawer guide)
I	4 3/4 x 1 1/8 x 14 1/2" redwood (lower drawer guide)
J	2 3/4 x 1 1/2 x 14 1/2" redwood (board, pan track)
K	2 3/4 x 3/4 x 5" redwood (drawer stop block)
L1	1 3/4 x 2 x 19 1/4" redwood (top cleat)
L2	1 3/8 x 3/4 x 19 1/4" redwood (top cleat)
M	2 1 5/8 x 3 1/2 x 32" redwood (wheel leg)
N	2 1 5/8 x 3 1/2 x 5 3/4" redwood (wheel block)
O	2 1 5/8 x 3 1/2 x 33 1/4" redwood (straight leg)
P1	2 3/4 x 4 x 48" redwood (top side rail)
P2	2 3/4 x 4 x 22 1/2" redwood (top end rail)
Q1	2 3/4 x 3 x 46 1/2" redwood (shelf side rail)
Q2	2 3/4 x 3 x 21 3/4" redwood (shelf end rail)
R1	2 3/4 x 1 1/4 x 39 1/2" redwood (shelf cleat)
R2	1 3/4 x 1 1/4 x 19 1/4" redwood (shelf cleat)

Key No.	Size and description (use)
R3	1 3/4 x 1 1/4 x 16" redwood (shelf cleat)
S	2 3/8 x 3 x 39 1/2" plywood (spacer)
T1	2 1 1/2" x 4 1/2"-dia. redwood (wheel)
T2	2 7/16"-dia. x 3 1/2" aluminum rod (axle)
T3	2 3/32"-dia. x 2 1/4" brass rod (axle pin)
U1	2 1/4 x 5 7/8 x 11" plywood (ice-box front, back)
U2	2 1/4 x 5 7/8 x 7 1/2" plywood (ice-box end)
U3	1 1/4 x 8 x 11" plywood (ice-box bottom)
V	2sq ft 3/4"-thick Styrofoam insulation, cut to fit
W1	2 3/4 x 1 1/4 x 10 1/2" redwood (block)
W2	2 3/4 x 1 1/4 x 6" redwood (block)
X	1 Freezette No. 336, 4 1/2-qt. plastic bowl
Y1	1 3/4 x 16 x 29 1/4" plywood (shell)
Y2	2 3/4 x 1 1/2 x 29 1/4" redwood (shell side rail)
Y3	1 3/4 x 2 5/8 x 17 3/4" redwood (shell end rail)
Y4	1 1/16 x 16 x 29 1/4" Wilsonart No. D30-6, Natural Almond plastic laminate
Z1	2 3/4 x 5 3/4 x 12 3/4" redwood (drawer front)
Z2	2 3/4 x 5 3/4 x 10 5/8" redwood (door, bin front)
AA1	2 1/2 x 5 1/2 x 15" plywood (drawer side)
AA2	2 1/2 x 5 1/2 x 12" plywood (drawer side)
BB	2 1/2 x 5 1/2 x 11 3/4" plywood (drawer back)
CC1	1 1/4 x 12 3/4 x 15" plywood (drawer bottom)
CC2	1 1/4 x 12 3/4 x 12" plywood (drawer bottom)

Key No.	Size and description (use)
DD	2 1/2 x 5 3/8 x 5 3/4" plywood (bin side)
EE	1 1/2 x 2 1/4 x 9 5/8" plywood (bin back)
FF	1 1/4 x 5 3/4 x 10 5/8" plywood (bin bottom)
GG	2 1 1/2 x 10 1/2" aluminum continuous hinge
HH1	2 1/2 x 1 1/2 x 3 1/2" redwood (drawer stop)
HH2	2 3/4" No. 8 fh screw
II	1 3/4 x 1 1/2 x 3" redwood (door catch block)
JJ1	1 3/4 x 6 1/2 x 9 1/2" redwood (ice-box top)
JJ2	1 1/2 x 3/4 x 3 3/4" redwood (ice-box handle)
KK1	2 1/2 x 3/4 x 22 1/2" redwood (top end slat)
KK2	14 3/4 x 3 1/4 x 22 1/2" redwood (top slat)
LL1	2 3/4 x 1 1/4 x 11" redwood (ice-box frame)
LL2	2 3/4 x 1 1/4 x 6 1/2" redwood (ice-box frame)
MM1	2 3/4 x 3 x 21" redwood (shelf end slat)
MM2	13 3/4 x 3 1/4 x 21" redwood (shelf slat)
NN	2 3/8"-dia. x 2" hardwood dowel
OO	1 13 1/8 x 10 1/2 x 14 1/2" maple (cutting board)
PP	1 Wearever broiler pan No. 2672
QQ	2 Grant 24" No. 308 full-extension drawer slide
RR	4 Stanley 3" No. 4483 aluminum pull with No. 4487 aluminum bases
SS1	51 1 1/2" No. 8 fh screw
SS2	43 1/2"-dia. x 1/4" redwood plug
UU	1 Stanley No. SP34 cabinet catch

6 OUTDOOR CLASSICS

(Continued from page 123)

Attach the shelf slat support cleats to the lower rails with glue and clamps. Then glue and clamp the cleats and the spacers to the upper rails.

Case assembly

Cut the case sides and ends to size. Cut out the drawer, door and bin pockets in the case sides using a table saw and a radial-arm saw as shown on page 96. You can also use a sabre saw to make these cuts. Just clamp a guide fence in the proper position for each cut so they will be straight and square. Also, bore a small hole in the corner of each opening—on the waste side of the lines—for blade entry.

Cut out the notch in the case side for the bottle rack and cut the bottle rack partition (part E1) to size. Then cut the opening for the sliding shelf in one case end as shown on the drawing. Also cut the bottle rack notch in the same board. Bore two $\frac{3}{8}$ -in.-dia. dowel holes—for supporting the bottle rack—in this notch, then glue the dowels in place.

Assemble the case ends and sides with glue and screws, check for square and let dry. Then cut the case partitions to size and install with glue and screws driven through the face of the case

sides. Use two screws for each partition end. Install the bottle rack partition, between the case end and the first partition, with glue and 6d finishing nails.

Joining case to frame

Slide the case into the frame assembly and attach by driving two screws through the inside of each case corner into the corner of each abutting leg. Next, glue and clamp the lower drawer guides, cutting board and pan track in place.

Cut the parts for and assemble the drawers, bin and ice box. Test fit each. Remove the drawers and install the upper guides. Attach the bin and drop-down door with continuous hinges and glue and clamp the bottle rack in place.

Install the ice-box partition with glue and 6d finishing nails. Then hang the box from this partition and the top side rail with $\frac{3}{4}$ -in. No. 8 fh screws driven through the inside of the box into these support members. Cut and fit the rigid insulation to the interior of the box. Make the fit tight so friction, instead of adhesive, holds the pieces in place.

Next, install the tracks for the pull-out shelf extension slides. Then build the shelf and cover it with plastic laminate. Attach the slides to the bottom of the shelf and the top of the tracks with

several mounting screws. Check for proper movement before installing the remaining screws.

Install the top and shelf boards with glue and 1-in. brads driven through the board tongues into the support cleats at a 45° angle. Set the heads. Be sure to install the boards with the V-joint face down so that you end up with a smooth surface on the top.

Fill all screw holes with redwood plugs and all nail holes with redwood or mahogany-colored wood filler. Then round over the outside corners of the top rails to a 1½-in. radius. Use a portable belt sander with an 80-grit abrasive belt to remove most of the stock, but stop short of the completed radius and finish the shaping by hand sanding with 150-grit sandpaper.

Complete the router work by easing all exposed edges with a $\frac{3}{8}$ -in.-rad. rounding-over bit. Finish-sand the entire piece with 150-grit paper. Remove the dust and apply the finish.

Install the wheels, attach the pulls to the drawers, door and bin, and mount the magnetic catch for the door. Make the cutting board and finish with mineral oil. Then slide it and the broiler pan into their tracks. Finish up by boring a $\frac{1}{2}$ -in.-dia. hole in the bottom of the ice box to provide drainage, and by inserting the plastic bowl into the box.

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Chaise longue



When the chaise back is placed in the down position, the piece will have a smooth, unobstructed surface. It functions well as a bench that can accommodate several people at one time.



Glue up two pieces of 2 x 4 stock for each leg, using nail pins to keep parts from sliding during clamping. Cut wheel rabbets in front legs before assembly.

Legs

Begin construction of the chaise longue by fabricating the four legs. Cut two pieces of 2x4 stock for each leg to the lengths given in the materials list. Keep in mind that the front legs are 1 1/4 in. shorter than the rear legs because of the wheels.

To form the wheel notches in the front legs, cut a 1 3/16 x 3 1/2-in. rabbet across the bottom of all four pieces of stock using a dado head in a table or radial-arm saw.

Sand the rabbets smooth, then glue the stock together using nail pins as shown. Glue and clamp until dry. The rear legs are straight, so just glue up the stock, again using the nail pins, and clamp until dry.

Cut 1-in.-rad. curves on the bottom

corners of all legs using a band, sabre or jig saw. Then cut the 3/4 x 10-in. rabbets across the upper inside surface of the back legs to receive the chaise back guide (assembly L1, L2).

Next, bore 1/2-in.-dia. axle holes through the front legs as shown in the photo on page 126. Then cut the aluminum axle rods to length and slide them into the leg holds. Bore a pinhole through the leg and into the axle using a drill press or a portable drill guide for accuracy.

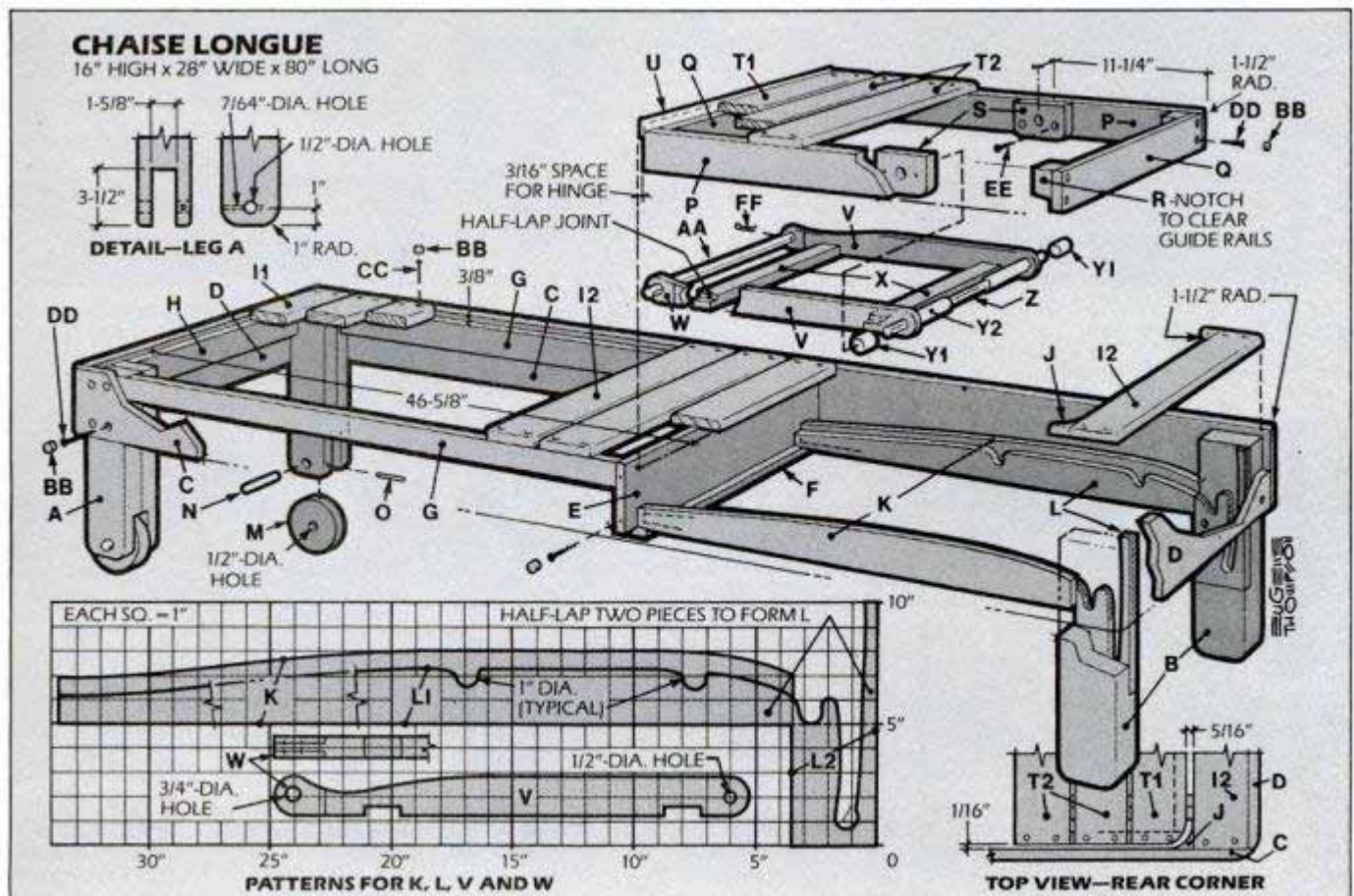
Wheels

Fabricate the wheels by gluing together two squares of 1x6 stock with the grain direction of each running at right angles to the other. Clamp until

(Please turn to page 126)

MATERIALS LIST—CHAISE LONGUE

Key No.	Size and description (use)	Key No.	Size and description (use)
A	2 3/4 x 3 1/2 x 14" redwood (wheel leg)	R	2 1 1/2 x 1 1/2 x 2 1/2" redwood (corner block)
B	2 3/4 x 3 1/2 x 15 1/4" redwood (straight leg)	S	2 3/4 x 2 1/2 x 4" redwood (pivot block)
C	2 3/4 x 5 1/4 x 80" redwood (side rail)	T1	2 3/4 x 3 x 26 3/8" redwood (back slat)
D	2 3/4 x 5 1/4 x 26 1/2" redwood (end rail)	T2	6 3/4 x 3 3/8 x 26 3/8" redwood (back slat)
E	1 3/4 x 4 7/8 x 26 1/2" redwood (cross member)	U	1 1 1/2 x 25 1/2" aluminum continuous hinge
F	1 3/4 x 1 1/2 x 23" redwood (support)	V	2 3/4 x 1 1/2 x 19 1/2" redwood (support arm)
G	2 3/4 x 2 x 40 1/2" redwood (side cleat)	W	4 1/4 x 2 x 2" maple (support reinforcement)
H	1 3/4 x 2 x 20" redwood (end cleat)	X	2 3/4 x 1 1/2 x 20" redwood (cross brace)
I1	1 3/4 x 3 1/8 x 26 1/2" redwood (end slat)	Y1	2 3/4"-dia. x 1 5/8" aluminum tubing (spacer)
I2	13 3/4 x 3 3/8 x 26 1/2" redwood (slat)	Y2	1 3/4"-dia. x 18 1/2" aluminum tubing (spacer)
J	2 3/4 x 2 x 2" redwood (contoured fillet)	Z	1 1/2"-dia. x 24 3/4" aluminum rod (pivot bar)
K	2 3/4 x 3 x 30 1/4" redwood (guide support)	AA	1 3/4"-dia. x 21 3/8" aluminum tubing (stop bar)
L1	2 3/4 x 3 1/2 x 10" redwood (vertical guide)	BB	140 1/2"-dia. x 1/4" redwood (plug)
L2	2 3/4 x 5 x 33 3/4" redwood (horizontal guide)	CC	* 4d common nails
M	2 1 1/2 x 4 1/2"-dia. redwood (wheel)	DD	52 1 1/2" No. 8 th screw
N	2 1/2"-dia. x 3 1/2" aluminum rod (axle)	EE	4 1 1/4" No. 8 th screw
O	2 3/32"-dia. x 2 1/4" brass rod (axle pin)	FF	2 Cotter pin
P	2 3/4 x 2 1/2 x 28" redwood (side rail)		* As required.
Q	2 3/4 x 2 1/2 x 24 7/8" redwood (end rail)		



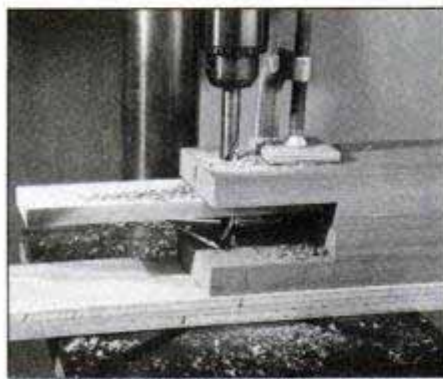
6 OUTDOOR CLASSICS

(Continued from page 125)

dry, then lay out a 4-1/2-in.-dia. circle on each block. Bore a 1-in.-dia. blade entry hole on the waste side of the circumference line, then cut out the wheel using a sabre saw with a pivot guide as shown. Sand the wheels smooth and bore an axle hole through the center of each. Test-fit the wheels in the leg notches, then set aside for installation later.

Seat and back rails

Cut the side and end rails to size and attach with glue and screws to the legs.



Clamp a backup block to the inside surface of the wheel notch and to the underside of the leg to prevent wood from splitting when the axle hole is bored.

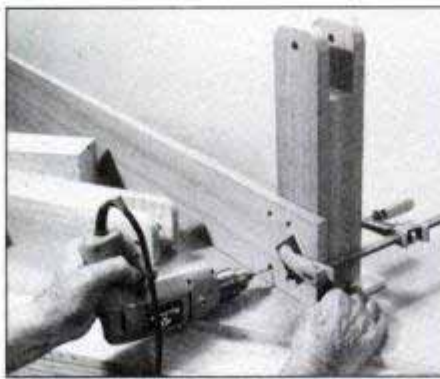
Keep the screws at least 1/2 in. in from the outside corner formed by the rails so they won't interfere with rounding the corners later. Glue and screw the cross member (part E) into place and attach the seat slat support cleats to the inside surface of the rails. Glue and clamp until dry.

Next, round the top edges of all rails using a router with a 3/8-in.-rad. rounding-over bit. Then shape the outside rail corners to a 1-1/2-in. radius. Because redwood is soft, these deep radii can be formed quickly using a portable belt sander. However, because the belt sander can be difficult to control, you

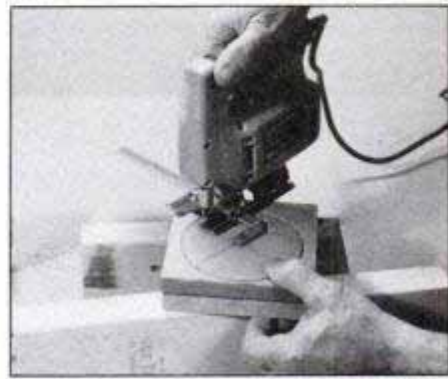
should stop slightly short of the finished shape and complete the job by hand to avoid accidentally removing too much stock. When the corners are shaped, glue and nail the support board (F) to the bottom of the cross member.

Guide rails

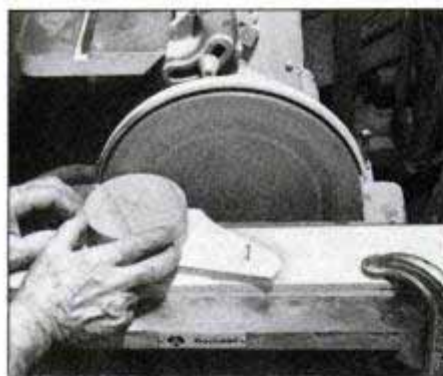
Glue and clamp stock to form the chaise back guide rails as shown. These are made of two pieces of redwood joined at right angles with a half-lap joint. This method provides a blank large enough to accommodate the irregular shape of the guides. It also provides the proper vertical grain align-



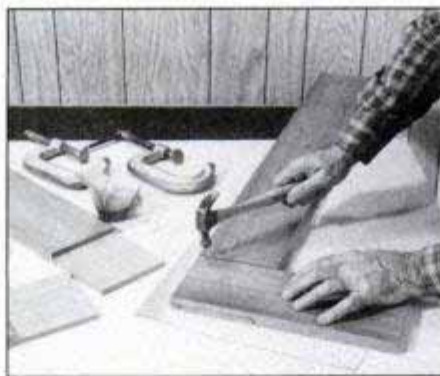
Clamp rail to leg and bore four evenly spaced plug holes in rail. Bore screw shank and pilot holes through rest of rail and into leg. Repeat for all rails and legs.



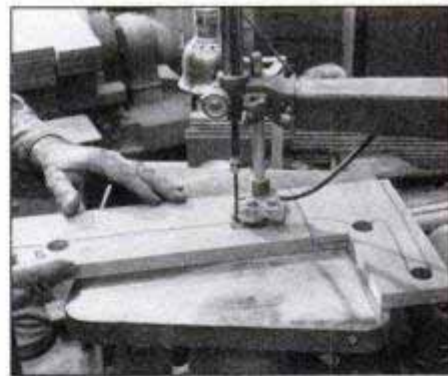
Glue up 1 x 6 stock for the wheel, let dry, then draw a 4-1/2-in.-dia. circle on block. Bore blade entry hole on waste side of line and cut using sabre saw with pivot guide.



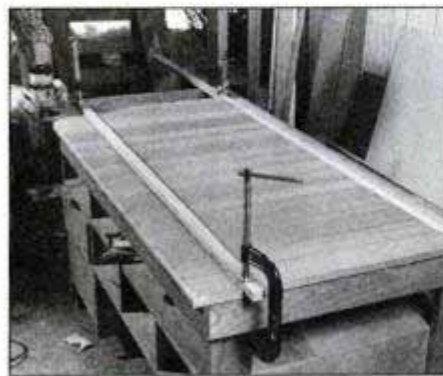
A simple disc-sander jig assures precise circular sanding. Place wheel onto projecting nail, then pivot jig until wheel touches disc. Rotate wheel until smooth.



Join vertical and horizontal back guides with half-lap joints. Apply glue, then drive 3/4-in. brads into both—away from saw cut line—for alignment when clamped.



Lay out guide shape using drawing pattern as reference. Prebore 1-in.-dia. holes to form depressions for backrest stop bar. Finish the cut with a jig, band or sabre saw.



Cut slats and bore nail holes near both ends, then align boards and clamp in place. Round over all edges in one pass using a router and 3/8-in. rounding-over bit.



Round over side edges of each slat individually using a router and this simple holding jig. Jig is made of two corner-notched plywood pieces clamped to bench.



Assemble back rails and temporarily attach to chaise. Fabricate support framework and test fit. When satisfied, join support to back by screwing pivot blocks into place.

ment for maximum strength on the vertical section of the guide.

Next, transfer the outline of the guide rails onto the stock using the grid pattern on the drawing as a guide. Bore 1-in.-dia. holes at the four stop bar locations and then cut the remaining contours with a band, sabre or jig saw. When the cut is complete, remove any saw ripples with a spokeshave and sandpaper to achieve a smooth surface.

Glue and clamp the guide rails to the guide supports (K). Let dry, then install the assemblies by gluing and screwing the vertical sections of the guide rails into the rabbets on the inside surface of both rear legs. Attach the opposite ends by screwing through the cross member into the ends of both assemblies.

Chaise back assembly

Assemble the chaise backrest frame and the support arm as shown in the drawing. When both assemblies are complete, temporarily attach the backrest to the chaise and check for proper fit. Then slide the support arm into place and check it for fit, too. When satisfied, attach it to the backrest by screwing the pivot blocks onto the back side rails as shown. Remove the whole assembly and set aside.

Next, cut all seat and back slats to the sizes given in the materials list. Bore

the nail plug holes in each and round the edges as shown. Join the last seat slat to the first back slat with the continuous hinge. Then attach this assembly to the back rails with glue and 4d common nails. Set the nailheads with a drift punch. Place the back assembly onto the chaise, in its proper position, and mark where the front edge of the last seat slat falls.

Remove the back and install the remaining boards on it, maintaining a uniform 1/4-in. space between the boards. Then install the seat slats in the same fashion, beginning 1/4 in. beyond the mark made earlier.

Cut the rear slat fillets (J) to size and glue and clamp to the single slat at the back of the chaise. When dry, cut a concave curve in the fillets to match the 1 1/2-in.-rad. convex curves on the top corners of the chaise back.

Complete the job by cutting the 1-in.-dia. finger hole in the middle of the last back slat and by installing the wheels, axles and brass locking pins. Flare the ends of the pins by striking each with a drift punch and hammer. The pins used here were cut from inexpensive toilet tank lift rods which are standard hardware store items. Finish-sand the entire piece with 150-grit abrasive paper, apply the finish and you're done.

(Please turn to page 128)



Support arm should move freely over notched guides and lock at 15°, 30°, 45° and 60° intervals. When flat, back rails should be 3/8 in. below top of side rails.



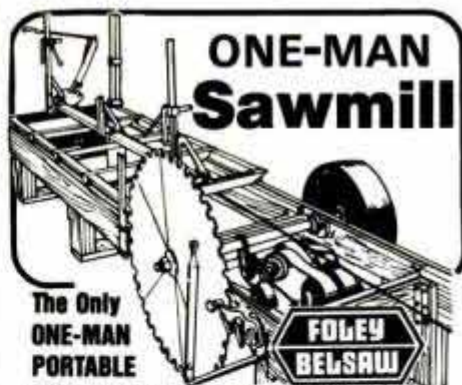
To position hinge, clamp the two mounting boards together with 1/16-in. shims between them. This method recesses the hinge below the seat surface.



Glue and nail slats into place using drift punch to set heads and two 1/4-in. blocks to maintain even spacing. Nails in block centers keep blocks from falling.



When all slats are attached to seat and back, complete the assembly by gluing and nailing the final seat slat—already attached to the back as shown—into place.



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6 OUTDOOR CLASSICS

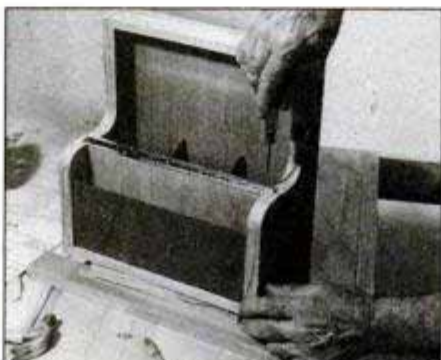
(Continued from page 127)

Telephone caddy

The front and rear panels of this box are made of 1/2-in.-thick stock obtained



Cut rabbets around perimeter of caddy side then lay out position of notch. Bore 2-in.-dia. hole so its circumference intersects both lines. Cut out waste on table saw.

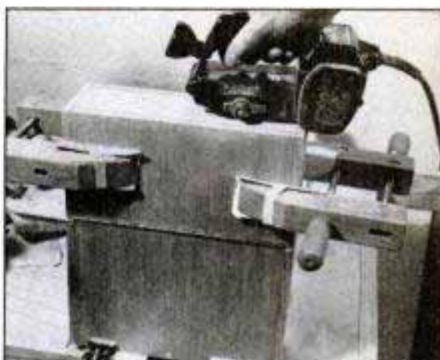


Join drop-down door to box with continuous hinge. Front panel of door is 1/8 in. shorter than door sides. This provides a built-in mortise for mounting hinge.

by thickness-planing 1 x 12 stock. If you don't have a thickness planer, rip 1 x 2 stock to 1/2-in. thickness, then edge-glue these smaller boards to form the panels. (Note: The same suggestion applies to the 1/2-in.-thick side panels on the planter project that follows.)

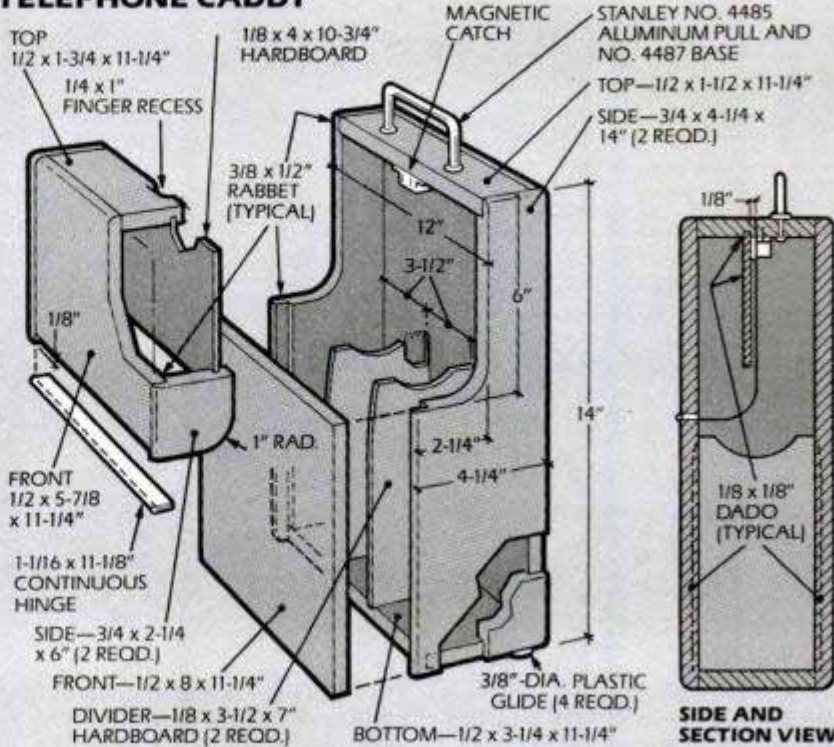
Begin by cutting the sides to size and by cutting the rabbets around their perimeters. Form the inside curve where the door and box join as shown. Then cut the divider dadoes in the back panel by making table saw blade kerf cuts. Cut the dividers to size and sand their top corners to match the dadoes. Now assemble the box with glue and nails. You should set the nailheads and fill the holes.

Cut and sand the door sides to fit the box curves. Cut the rabbets and grooves for the front panel and hardboard partition. Join with glue and nails. Finish-sand the piece, then install the handle, magnetic catch and plastic glides.



Once hinge is installed, clamp door tight to box and sand mating surfaces flush. Do this on top and sides, then round all corners to a uniform arc by hand sanding.

TELEPHONE CADDY



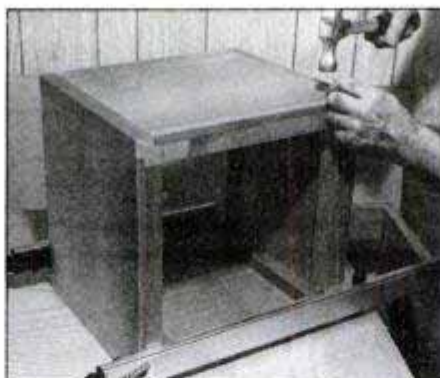
Planter

Cut all parts to the sizes given on the drawing. Then fabricate each side separately using glue and nails. When dry, assemble as shown.

Install the top trim boards with glue and nails, then bore the pinholes as shown. Remove the front panel and enlarge its holes to $\frac{7}{16}$ -in. diameter to make insertion easier. Use epoxy glue to set the pins.

Fill all nail holes with wood filler, round over all edges to a $\frac{1}{2}$ -in. radius and finish-sand the entire piece. Add four plastic glides to the bottom.

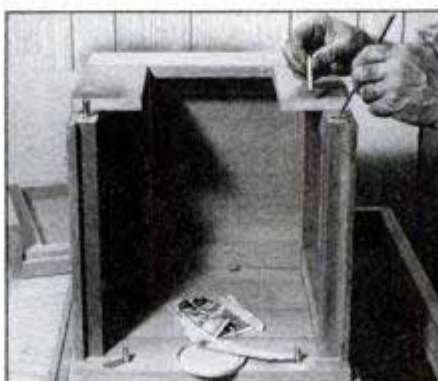
(Please turn to page 130)



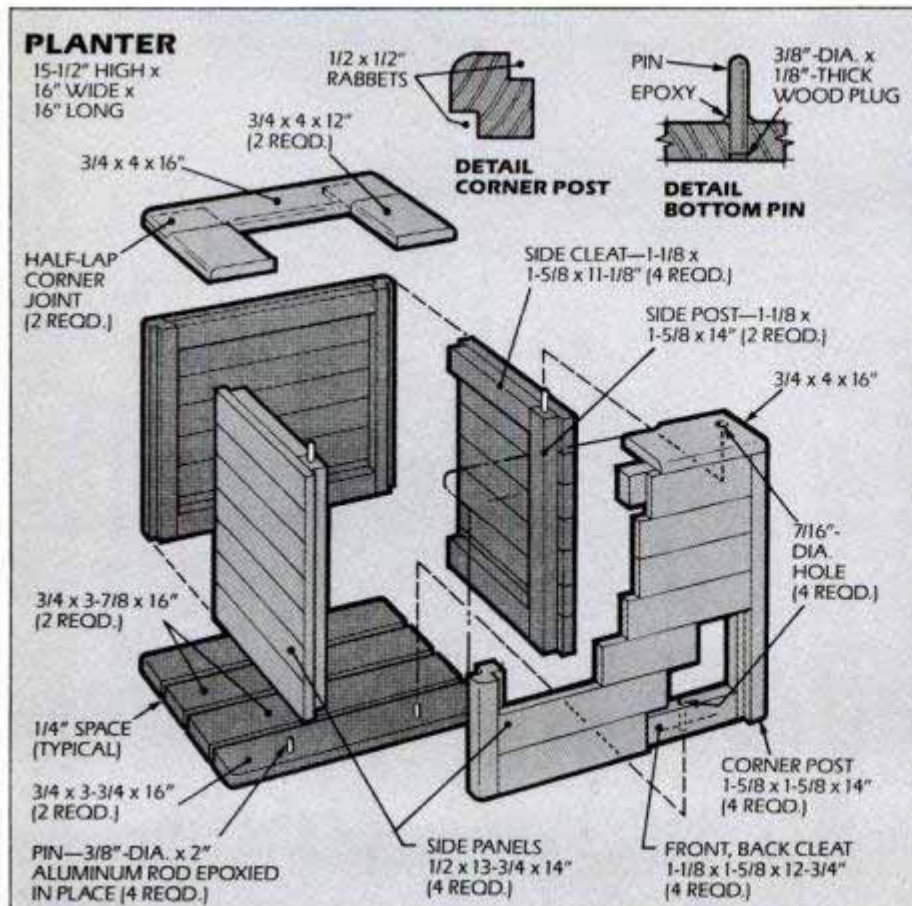
Assemble planter panels individually using glue and nails. Join together by clamping removable panel in place and gluing and nailing opposite panel between two sides.



Glue and nail top trim boards in place, then fill nail holes with wood filler. Tape or clamp front panel to box and bore pin holes using a drill guide for accuracy.



Install pins in side posts and bottom board using two-part epoxy. Before installing lower pins, fill bottom of holes with $\frac{1}{8}$ -in. wood plugs as shown on drawing.



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6 OUTDOOR CLASSICS

(Continued from page 129)

Beverage tray

Cut the sides and ends to size from redwood stock. Then cut the bottom rabbets and hole panel grooves in each piece. Cut a 1-in.-rad. curve on the top corners of both sides, then ease the top edges of all four boards with 120-grit abrasive paper.

Cut the bottom from 1/2-in.-thick plywood and the hole panel from 1/4-in.-



Lay out holes for tray on surface of hard-board panel. Then clamp panel securely in place and cut holes with an adjustable fly cutter or different size hole saws.



Apply plastic laminate to hole panel with contact cement. Then bore cutter entry holes through middle of each panel hole. Flush trimming bit in router removes waste.

thick tempered hardboard. Test-assemble the tray by clamping all parts together and checking for fit.

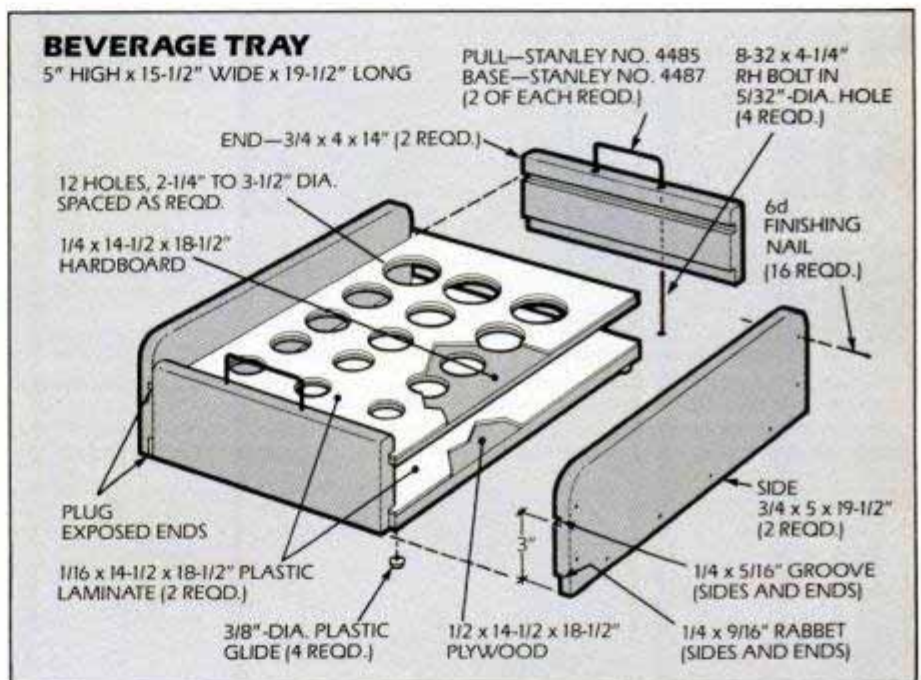
When satisfied, disassemble and lay out the holes for the hardboard panel in an even pattern. Choose a variety of holes to suit your own needs. You should cut the holes using an adjustable fly cutter as shown or a series of hole saws.

Apply plastic laminate to both the bottom and hole panel, then bore 1-in.-dia. bit entry holes into the middle of each panel hole. Cut out the waste around the holes with a flush-cutting laminate trimming bit followed by a beveled trimming bit to ease the sharp corners. To obtain a smooth, polished surface on the hole edges, sand with 320-grit abrasive paper. Then charge a

soft cloth with auto polishing compound and rub the edges briskly in a shoeshine motion.

Assemble the tray with glue and 4d finishing nails. Fill the nail holes with wood filler and the exposed ends of the bottom rabbet and panel groove with small redwood plugs. Sand the piece with 150-grit abrasive paper and apply the finish.

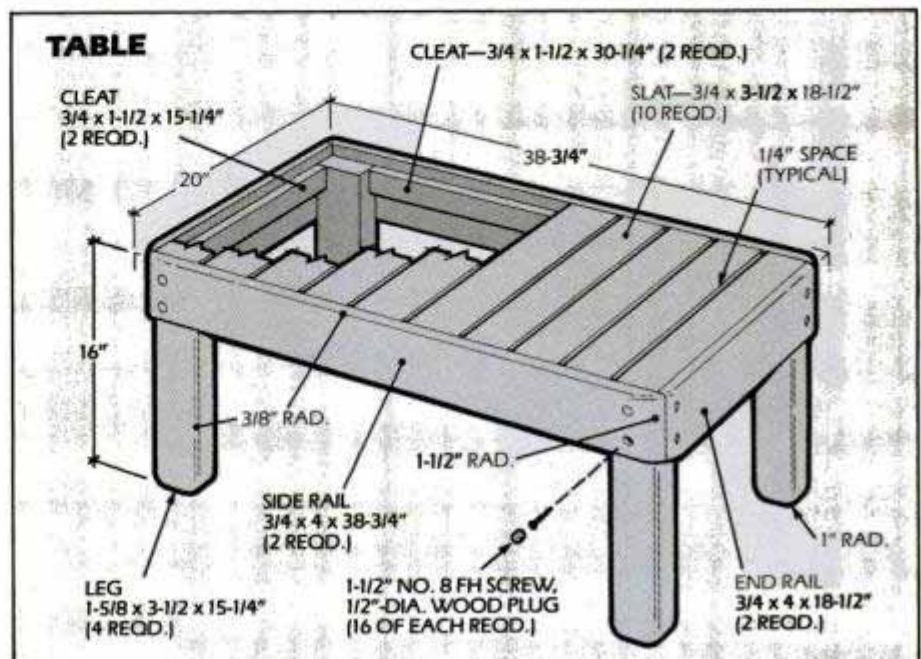
Install the aluminum handle pulls with screws driven up through the bottom edge of both ends. Bore 1/4-in.-dia. screw clearance holes and counter-sink the heads 1/8 in. below the surface. The screws supplied with the pulls are too short. You must substitute 4 1/4-in. No. 8-32 roundhead bolts in their place. Finally, install a plastic glide at each bottom corner. **FM**



Table

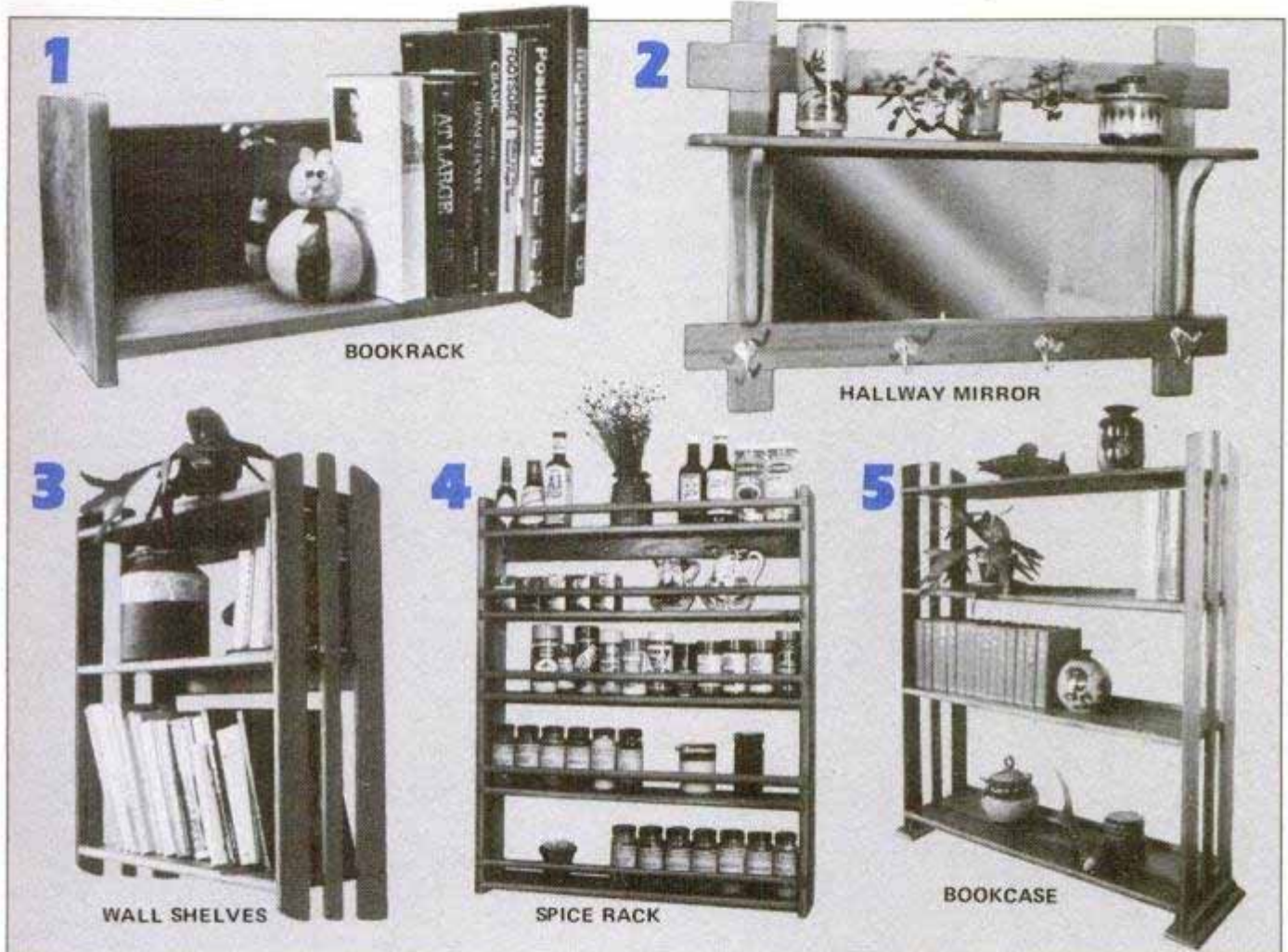
Cut the legs and rails to size. Then cut 1-in.-rad. curves on the bottom corners of each leg. Clamp the rails to the legs using the same method shown for the chaise on page 126. Bore screw plug clearance holes first, then shank holes and pilot holes into the leg. Position the end rail screws 1 3/4 in. in from the outside corner, and the side rail screws 2 1/2 in. in from the outside corner.

Join the rails to the legs with glue and screws. Let dry, then form a 1 1/2-in.-rad. curve on all four corners using a belt sander followed by hand finish sanding. Install the top support cleats to the inside of the rails and nail the top slats in place maintaining a uniform 1/4-in. space between boards. Fill all nail holes with wood filler and all screw holes with wood plugs. Sand the surfaces smooth with 150-grit paper and apply the finish. **FM**



5 Easy-To-Build Projects

You can complete any one of these simple home furnishing ideas in a weekend.

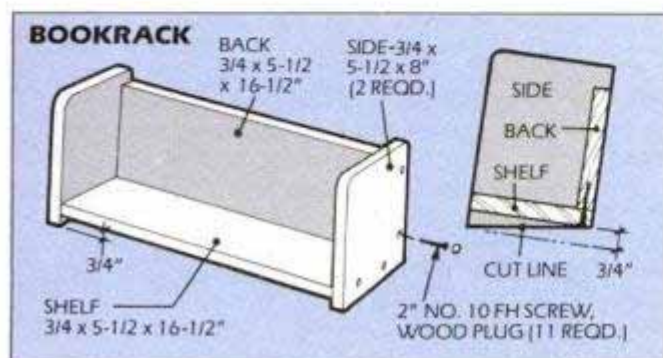


Choose one project for your next available weekend; then you'll want to make all five. Enjoy them at home or present them as gifts.

These five attractive and functional projects have several things in common. First, they were all designed by craftsmen of the Northwest Gallery of Fine Woodworking in Seattle, Wash. Second, they're all made of clear red-

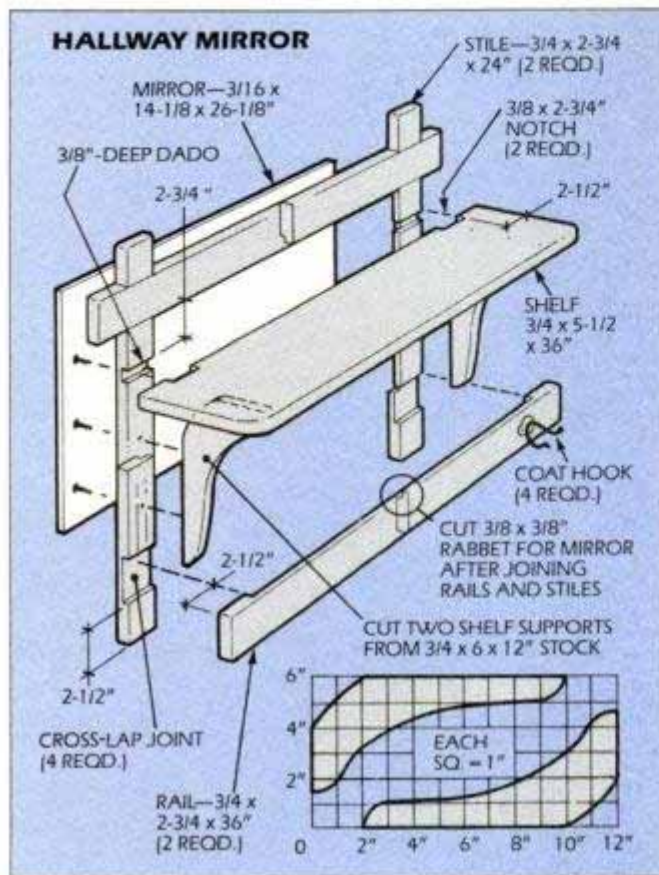
wood, and third, all are relatively easy-to-build. Each can be completed in just one weekend using only basic woodworking tools, and because of this, they provide specific challenges for beginning woodworkers. By closely following

the instructions for the individual projects and reviewing the three pertinent woodworking methods explained on page 136, you'll be able to duplicate these furnishings while you improve your woodworking skills.



1 Bookrack

This elegant little bookrack makes a great gift, so you may want to build two or three at a time. Begin by cutting the shelf and back to size; then join them with carpenter's glue and wood screws. Next, cut the sides to size and shape using a sabre saw or keyhole saw. Make sure each front edge is $\frac{3}{4}$ in. longer than the back. Attach sides to the shelf and back assembly, with glue and screws, but countersink the screw pilot holes at least $\frac{3}{16}$ in. and cover the screwheads with flush wood plugs. Smooth with 150-grit abrasive paper, dust and apply a thin coat of wood paste wax.



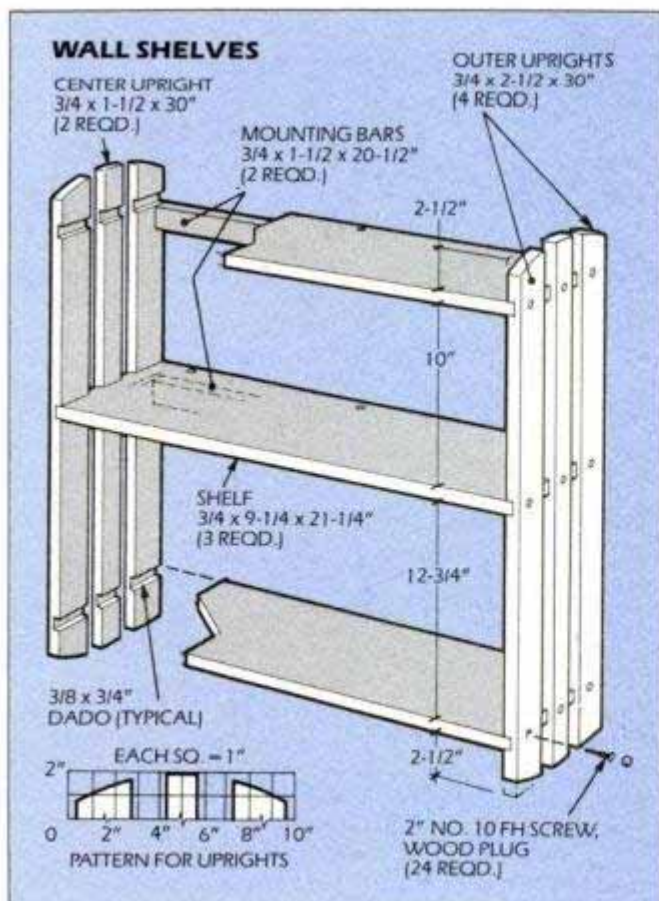
2 Hallway mirror

Mirrors are always appreciated in hallways, especially one with hooks for coats and hats and a shelf for car keys, curios and even small house plants. Begin construction by cutting all parts to the size given on the drawing. For help in transferring the support pattern we show, turn to page 136.

Next, cut the cross-lap joints in the rails and stiles using a radial-arm saw or fine-toothed cross-cut handsaw. Cut only halfway through the mating members, then clean out between cuts with a sharp chisel. Join rails and stiles with carpenter's glue, check for square and clamp overnight.

Cut the shelf dados in the rails and the corresponding notches in the back of the shelf. Test to make sure all the parts fit well. Then slightly round all edges to prevent splinters using either a block plane or coarse sandpaper.

Next, lay the rail and stile assembly face down on the workbench and using a router, cut the rabbet for the mirror around the inside opening. Clean out the corners so they are square, using a sharp chisel. When this is complete, attach the shelf and supports to the rails using glue and 2-in., No. 10 fh screws driven through the back of the rails into the back of the shelf and supports. Make sure that the lower screws—driven into the thinnest part of the support—do not break through the outside surface. Install the mirror; then cover the back with a 1/8-in.-thick hardboard panel attached with small wood screws. After applying paste wax, hang the mirror with screws driven through the rails—just above the shelf—into wall studs.



3 Wall shelves

These distinctively styled wall shelves have clean modern lines, yet their slatted sides are reminiscent of earlier American furniture. If you like this piece, you may also want to build its companion piece: No. 5 on the next page.

Although this project is fairly straightforward, you must be precise in cutting the shelf dados. If you plan to rip the uprights out of wider stock, then lay out and cut dados across the whole surface before you rip the board. Otherwise, just clamp the individual uprights together, lay out and mark them all at once; then cut them individually. Now you can transfer the pattern for the curved tops and bottoms and make the cuts using a sabre saw.

Next, lay out the screw positions for joining the uprights to the shelves, counterbore the screw-clearance holes about 1/4 in. below the surface of the uprights, then attach the parts with carpenter's glue and the screws shown. Fill screw-head holes with a wood plug glued in place. Clamp the assembly in a square position and let it dry overnight. Then sand the plugs flush to the surface. Keep in mind that you can make your own redwood plugs using a plug cutter in a drill press, or you can buy commercial ones. However, the latter are not generally available in redwood. If you can find mahogany plugs, the match will be close enough.

Next, attach the mounting bars with glue and screws driven down through the shelves, then finish-sand the whole piece with 150-grit sandpaper. Remove the dust and either leave it unfinished or apply lemon oil. Hang the unit on the wall by driving screws through the hangers into wall studs.

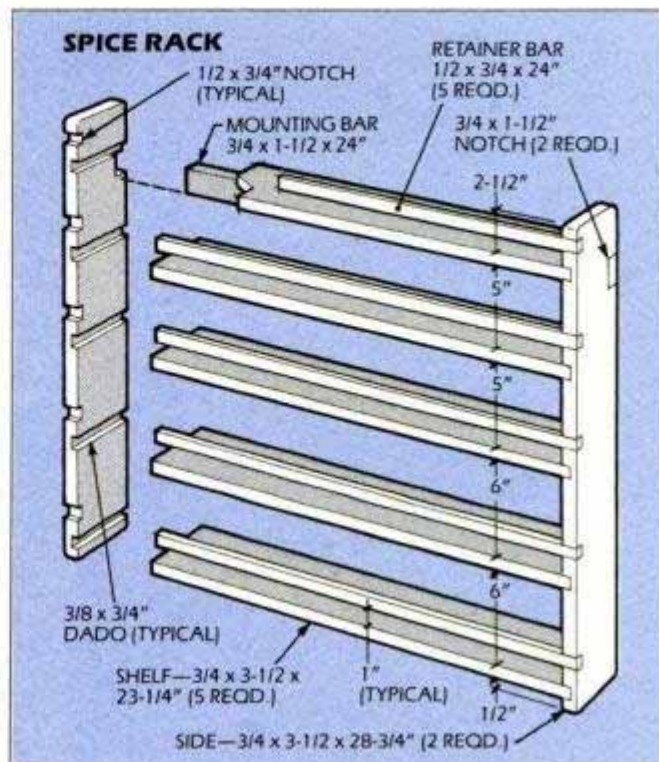
4 Spice rack

Begin building this rack by cutting the shelves, sides and mounting bar to size. Then cut five retainer bars $\frac{1}{4}$ in. longer than their 24-in. finished length. Cut dadoes for the shelves $\frac{3}{8}$ in. deep on the inside surface of the sides, and cut notches for the retainer bars $\frac{1}{2}$ in. deep on the front edge of the sides. Then cut notches for the mounting bar on the back edge of the sides directly below the top shelf dado.

Round over the top and bottom corners of both sides with 120-grit sandpaper. Lightly sand away any burrs along the edges of the dadoes using 150-grit abrasive. Assemble shelves and sides with carpenter's glue and clamps or use $1\frac{1}{2}$ in. No. 10 fh screws, and glue. Countersink the heads and fill with wood plugs. Whichever method you use, be sure to check squareness before you let the assembly dry overnight.

Now attach the retainer bars with glue and 4d finishing nails. Set nailheads and fill the holes above with redwood-colored wood putty; then glue and clamp the mounting bar in place.

After the assembly dries, sand ends of the retainer bars flush to the surface of the sides using 150-grit sandpaper. Remove dust, then wax or rub the rack with lemon oil. Hang it on the wall using $2\frac{1}{2}$ in. No. 10 fh screws driven through the mounting bar into the wall studs.



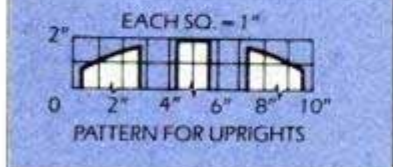
5 Bookcase

Designed in the same style as the wall shelves—project No. 3 on page 134—this bookcase makes an ideal companion piece. The construction details are the same except for the feet. Cut the uprights and shelves first and round only the tops of the uprights using the pattern shown below as a guide. Then assemble the shelves and uprights as before and let the assembly dry overnight.

Cut the blocks and feet to size. Then round the front and back corners of the blocks with 120-grit abrasive paper and make a clean chamfer around the upper edges of both feet using a block plane. Finish sand these parts with 150-grit abrasive before attaching them to the shelf assembly.

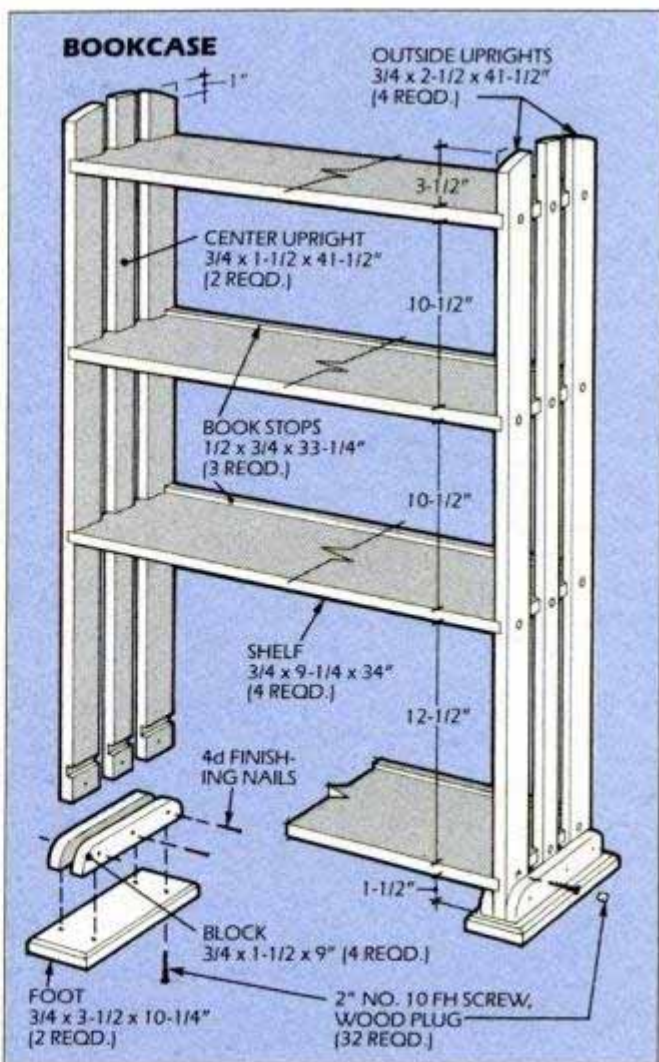
Now, attach the blocks flush to the bottom of the uprights with carpenter's glue and 4d finishing nails. Set the nail heads and fill the holes with wood putty. Allow the glue to dry overnight, then attach the feet from below with glue and screws as shown.

The final step is gluing the stops in place on the three lower shelves. While it is possible to omit this detail, it is much easier to keep books and other items neatly arranged on the shelves with this feature in place.



Project No. 1 by Grady Mathews; Nos. 2, 3, 4 and 5 by Rick Swanson, Northwest Gallery of Fine Woodworking, Seattle, Wash. All were taken from the Simpson Redwood Book of Wood/Could II, Simpson Timber Co., California Operations, Drawer V, Arcata, Calif. 95521.

Finish-sand the entire piece, remove the dust, and apply wax or a hand-rubbed lemon oil finish. If you would rather use another finish, try a semi-transparent stain followed by a satin polyurethane finish coat.



WEEKEND WORKSHOP

The five projects presented on the previous pages are straightforward to build. A shop full of expensive woodworking equipment is not needed. However, each requires thought and care for proper execution and a familiarity with certain building basics, three of which are explained in greater detail here: common shop glues, screw joinery and pattern transfer.

Common shop glues

When making furniture, building cabinetry, and installing interior wood trim, you have three basic choices of high-quality glues. One is aliphatic resin glue, often called carpenter's glue, which has a distinctive creamy yellow color. It sets in 5 to 20 minutes, cures in 24 hours and its strength is high when clamped during curing. It has good moisture and heat resistance and dries to a clear or pale amber color.

Liquid hide glue is light brown, has the strength properties of the aliphatics, but is more resistant to heat and less resistant to moisture. Its greatest advantage over the aliphatics is a slower setting time: two to three hours. If you have a lot of parts to assemble before you can clamp them together, this glue is the better choice.

Plastic resin glue, often called urea formaldehyde glue, has an even slower setting time: about four hours. When



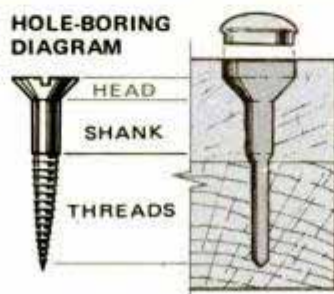
Three of the most common shop glues are shown above: aliphatic resin (left), hide glue (middle) and plastic resin (right). All are designed specifically for woodworking.

clamped, it is extremely strong and has excellent heat and moisture resistance. It comes in powder form and must be mixed with water to form glue.

Certain basics of use apply to all three glues. Spread only a thin coat of glue on the mating surfaces and be sure to clamp the assembly within the setting time listed on the product container. Also, never wipe the glue squeeze-out off the joint while the glue is wet. Let it dry, then carefully scrape it off the workpiece with a sharp chisel.

Wood screw joinery

Wood screws—like the flathead variety shown below—make strong and durable fasteners, but they must be installed properly to make the most of their attributes. This requires boring three different holes to match the three parts of the screw. First, bore a screwhead clearance hole to match the diameter of the wood plug you'll be using to fill the hole. The head should be recessed at least $\frac{1}{8}$ in. below the wood surface.



Next, bore the shank hole with a drill bit of the same diameter as the screw shank. Then bore the thread clearance hole to the total depth of the screw. For this last hole use a bit of the same diameter as the body of the screw in the threaded section, not the outside diameter of the threads.

Transferring a pattern

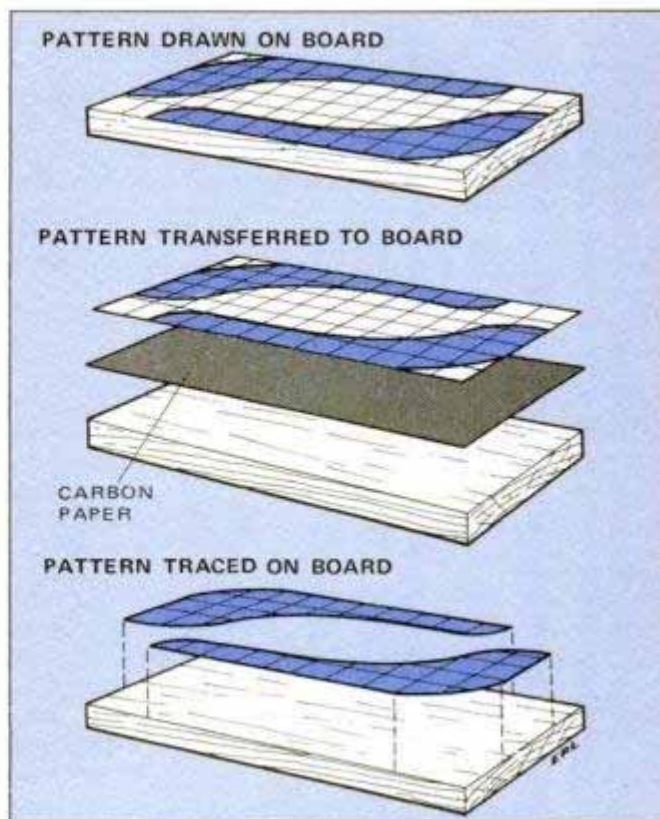
Two-dimensional grids are usually the best way to show how to form contours, curves and other irregular shapes in wood. However, unless they are full size, transferring these grid patterns onto the workpiece can be a problem. The drawings below show three approaches.

The first (top) shows the most basic approach. In this method you lightly draw a grid onto the surface of the wood using the scale given on the drawing grid. Here we used, as an example, the grid shown on page 134 for the shelf supports on the hallway mirror. It indicates that each square on the drawing should equal one square inch on the workpiece. Once the grid is enlarged, draw in the contours of the required parts with a free hand, then cut out the pieces to the contoured lines.

The second method requires that you enlarge the grid on paper first, then you can draw in the contours as before. When the outline is complete, place the paper on the workpiece with a sheet of carbon paper, or artist's transfer paper, between the two. Trace the contours onto the wood and cut the parts. This method reduces the marks on the wood surface which must be sanded out later.

The third option is to enlarge the grid on a sheet of heavier paper, then cut out the parts, position them on the workpiece, and draw around their perimeters. This method fouls the surface the least and therefore requires the least sanding to be done later.

PM



PM LONG-TERM CAR TESTS

(Continued from page 71)

differential case, causing interference between the axle shaft and differential pinion. This overloaded the outboard wheel bearing on the left side and resulted in premature bearing wear. AMC contacted us when 4,568 miles showed on the odometer and, upon inspection, the wheel bearing was almost totally worn out.

We experienced other failures in our 9,107.8 test miles. The outside swing-away spare-tire carrier is secured to the rear bumper by means of a hook inserted into an anchor plate bolted to the bumper. During a cold snap, we found that all four bolts had sheared off. Our best guess was that the bolts had been overtorqued when installed.

The switch that disengages cruise control as the clutch is depressed also needed replacement. It was quite a surprise to exit the turnpike, depress the clutch, and find the rpms zinging off the tach.

And, don't follow our lead in getting the swing-away spare carrier, available on two-door Cherokees only. It may maximize cargo space but it invites theft or vandalism and obscures the entire bottom half of the rear window.

Our thoughts when we returned the Cherokee were that the design works extremely well, from its rigid uniframe body to its virtually corrosion-proof one-piece fiberglass liftgate, and that this vehicle will help put struggling American Motors back in the black.

—D.C.R. and J.O.

Dodge Caravan SE

The Dodge Caravan minivan, which we just returned to Chrysler, was one of the most popular vehicles in our test fleet in spite of a number of minor annoyances and one major scare. As our mileage approached 2,000, we found a number of rattles were getting to us, the gas cap cover did not respond to the release lever near the driver's seat, the windshield wiper on the driver's side was streaking (apparently because of insufficient spring pressure), there was a minor wind whistle around the driver's outside mirror, the sliding side door was becoming balky, a seat belt was stuck in its housing, the engine whined at 65 mph and was a bit hesitant on cold mornings, and we were getting under 19 mpg, as opposed to an EPA city/highway rating of 21/28 mpg. None of this was enough to send us complaining to a Chrysler dealer, but it did take some of the fun out of driving what is otherwise a very practical and enjoyable vehicle.

The thing that did send us scurrying to the dealer was a brake failure, which occurred while driving the family home

from the New Jersey shore one night. The brake pedal went all the way to the floor, the BRAKE warning light came on, and the passengers went into their panic mode. We later discovered that a brake line bracket spot welded to the rear axle had come adrift and been swaying in the wind long enough to fracture the line.

Fortunately, when this sort of thing happens, the dual master cylinders on modern cars leave you with two working brakes.

Unfortunately, they work in such an abnormal way that many people would assume all the brakes had quit: The pedal goes almost to the floor before the brakes begin to work, power boost is lost, and stopping distance increases dramatically. Sometimes you can pump the pedal back up, but not with the massive leak we had.

We made it home without incident and, next day, the van was towed to Chrysler's Manhattan Service Center, where the brakes were fixed in record time and several other problems addressed.

Isolated incident

We are assured by Chrysler that our brake failure was an isolated incident (they suspect that a flying stone knocked the bracket loose). Had we looked under the van and seen the bracket dangling, we surely could have had it fixed before the brake line fatigued and broke.

Our less dramatic problems had less dramatic conclusions. The rattles continued unabated. They are minor, compared to those found in full-size vans, but annoying to people who want to think of the Caravan as a car. The gas filler cap continued to stick closed until an impatient staff member broke the latch, which is one solution. And our gas mileage dropped to an average 15.3 mpg, with a high of 18.2 mpg and a low of 10.4 mpg. We've had a few phone calls from readers complaining of similar problems with their T-vans.

The mileage gap is easy to explain—few cars meet their EPA estimates, especially a boxy van-like vehicle. Because of this, the EPA will change its published mileage figures on '85 cars to more closely match the public's experience. The simulated road test will remain the same, but EPA will subtract 10 percent from the city number and 22 percent from the highway result before publishing the figures.

Any new vehicle has a potential for teething problems and we assume that the 1985 T-vans will have fewer annoyances, as well as EPA figures that come closer to real-world conditions.

What was our overall impression of the Dodge Caravan? Chrysler wanted it back after 5,000 miles. We stalled them

past 6,900, and still didn't want to give it back!—W.H.

VW Vanagon

For us, the Vanagon proved to be a reliable workhorse, moving one new staffer into Manhattan, hauling lumber for shop projects and swallowing a newly purchased refrigerator without any complaint.

One thing is certain—if you liked your old Beetle, you'll already have a soft spot for the Vanagon. It makes the same familiar sounds and retains most of the VW family traits. The all-new water-cooled flat Four engine makes less racket than the old air-cooled motor and high-gear cruising is far less strained. This van still gives the feel of dependability, just like the early ones.

Our only mechanical trouble with the Vanagon resulted from a tiny leak in its new water-cooling system, and seems to be fixed at last after two trips to the dealer. The engine seeped a small amount of coolant from a hidden spot, and though we never encountered overheating, there was a maddening problem of the dashboard temperature warning light continually flashing in our eyes.

After pressure-checking the system, tightening the hose connection at the radiator inlet and topping off the coolant, the drip was stopped. Pressing the dealer for an explanation, we found that VW puts a fluid-level sensor in the radiator reserve tank. When the fluid level drops the red light goes on, regardless of engine temperature, we were told. With the leak stopped, the light stays off.

The leaks also caused the heater lines to become airborne, rendering the normally efficient heater useless. Bleeding the cooling system cured that problem.

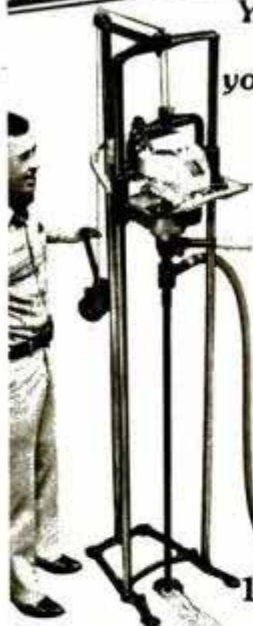
Surprisingly stable

One trait we're glad to report departed is the feeling of imminent disaster when driving the VW in high winds. During one trip down I-95 on a very stormy night the Vanagon was surprisingly (and thankfully) stable. That's remarkable for a slab-sided, lightweight rear-engine box.

After 7,349 miles of use at an average of 18.1 mpg for all types of driving, we returned the workhorse to VW. The only flaw we found in the Vanagon's usefulness was the hassle of removing the rear seats. Actually they unbolt in a couple of minutes, but require a ratchet and socket for the hold-down bolts and a Phillips screwdriver to undo the carpet panels. Certainly something more convenient can be engineered. And the carpet covering the seat-frame rails tears easily when pulling it back to reveal the bolts. We'd expect better from the Germans.—N.S.M.

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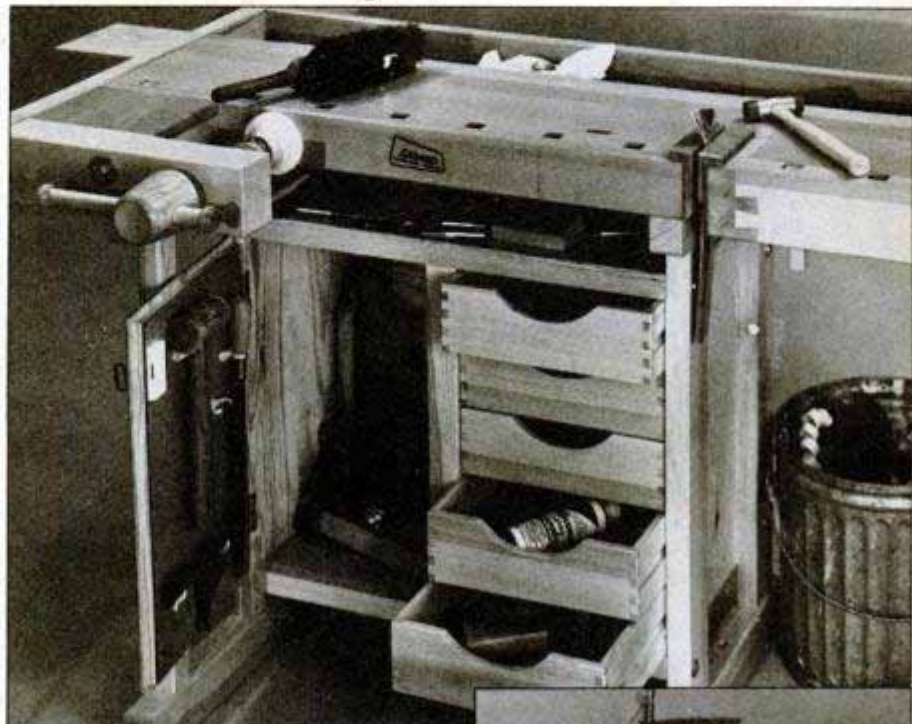


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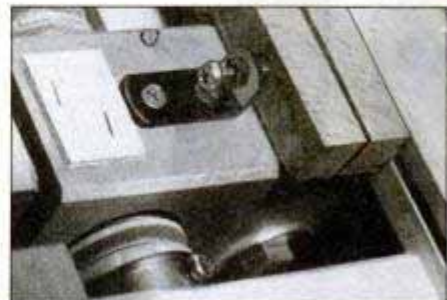
The screw adjustment systems in both the tail vise and the legs are features that should be included in the construction of any workbench that receives a lot of use. This capability also reduces wear over long-range use.

Model No. BS 1522 is about \$500, plus shipping. For more information, write to Chaselle Arts and Crafts Inc., 9645 Gerwig La., Columbia, Md. 21046, or The Fine Tool Shops Inc., 20 Backus Ave., Danbury, Conn. 06810.

—David Warren



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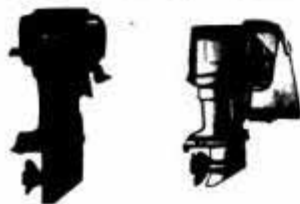
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8 Ton Electric Splitter
 1 1/2 HP vertical electric motor with direct mount 1.6 GPM 1-stage gear pump, 3 gal. hydraulic reservoir, in-tank suction strainer, heavy duty beam & slide with grease zirks, 3 1/2" X 18" X 1 1/4" rod - Tie rod cylinder. Has 8 X 1.75 semi-pneumatic tires and pin hitch with handle for easy portability. (Will Ship 48 States \$35) Item # 1110... **\$525**

12 1/2 Ton Homeowner Special

Heavy Duty Slide, 5 HP engine combined with 11 GPM 2 stage pump, Auto detent valve, 8" wedge, 3 Gallon Tank with Filter & Strainer, Large Pneumatic Low or High Speed wheels, 1 1/2" Hitch
 Item # 1125
 Low Speed #1128 **\$729**
 High Speed #1125 **\$749**
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15 1/2 Ton

High and low profile only **\$869**
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24 1/2 Ton Blockbuster

Low Profile Item # 1142 only **\$1399**
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Must include freight at time of order or we will ship Freight Collect

LOG SPLITTER PARTS

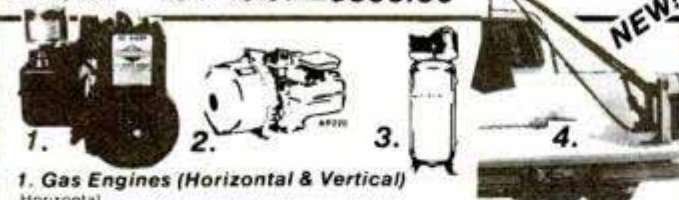
11 gal 2 Stage pump
 Use with 5 Hp Motor # 1011 **\$109**
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 use with 8 Hp or Larger Motor # 1015 **\$157**
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3 1/2 x 24 x 1 1/2" Cylinder
 Item # 909324 (Tie rod type) **\$92**
4 x 24 x 2 Cylinder
 (Welded Type) (Can go UPS) # 902424 **\$115**
5 x 24 x 2 Tie Rod
 Ship wt 100 lbs # 909524 **\$222**



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Improve productivity and profits during planting, fertilizing and harvesting. Dual polarity, weighs only 35 lbs. • Welds 18 gauge up to 1/2" steel in a single pass. • Welding current supplied by two 12 volt or one 24 volt battery. • Continuous wire electrode with flux core. • Comes with aluminum kit (Aluminum gun liner, drive roller, and a 2 lb. wire spool). Item # 16454... **\$599.50**



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 5 HP Tecumseh 1/2 shaft #6051 **\$134**
 5 HP Briggs 1/2 shaft #6052 **\$137**
 8 HP Tecumseh cast iron sleeve #6081 **\$186**
 10 HP Tecumseh cast iron sleeve #6010 **\$224**
 10 HP Tecumseh 1 shaft electric start #60101 **\$269**
 Vertical
 8 HP Tecumseh 1 shaft #7082 **\$199**
 8 HP Briggs 1 shaft #7080 **\$208**
 10 HP Tecumseh 1 shaft #7010 **\$214**
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Corrosion resistant construction ideal for water and chemical transfer. EPDM seal 2 suction 28 lift 120 head Will pump 8400 GPH 3 HP Briggs (Will ship these pumps 48 states for \$3)
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3. 5 HP 60 Gal. Air Compressor

Vertical Campbell Hausfeld Model #VT5587 two cylinder pressure gauge with safety relief valve 230 volts 11 B CFM at 40 PSI and 9.4 CFM at 90 PSI 25" X 22" X 65"
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 Designed for use on pickups, vans, light duty trucks or your workbench. One person is able to position the vehicle, adjust the boom, hook up the heavy item & load what would normally take two men to do. • Easy to install - stores out of the way. • Extendable boom makes attaching and loading easy. • Easy positioning of the load. • Constructed of heavy structural steel.

Item #	Sh Wt	Lifts	List	Price
14381	60Lbs	300Lbs	\$348	\$269
14382	70Lbs	500Lbs	\$459	\$359



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4 Hole Hubs & Spindles... **\$37.50/Set**
 Item # 1251 Trailer springs 2000 LB capacity **\$24/Pr**
 (5 Hole sets available)

6. Wheel & Tire Sets

Item #	Description	Wheel & Tire	Tire Only
1211	480x8 (4 Hole)	\$24.00/ea.	\$15.50/ea.
1216	480x12 (4 Hole)	\$36.00/ea.	\$22.00/ea.
1212	570x8 (4 Hole)	\$34.00/ea.	\$22.00/ea.

(Other 5 Hole Sizes Available)

7. Honda Generators

500 watt, 115 volt AC or 100 watt, 12 volt DC, wt. 40 lbs.
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Item #	Sh Wt	Length	Price
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159292	43Lbs	13'2"	\$119.95

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