

SEPTEMBER 1984 \$1.50

Popular Mechanics



FIRST '85s
World Class
Sport Sedans
From Chrysler

Step-By-Step **7 WAYS TO MAKE BUTCHER BLOCK**

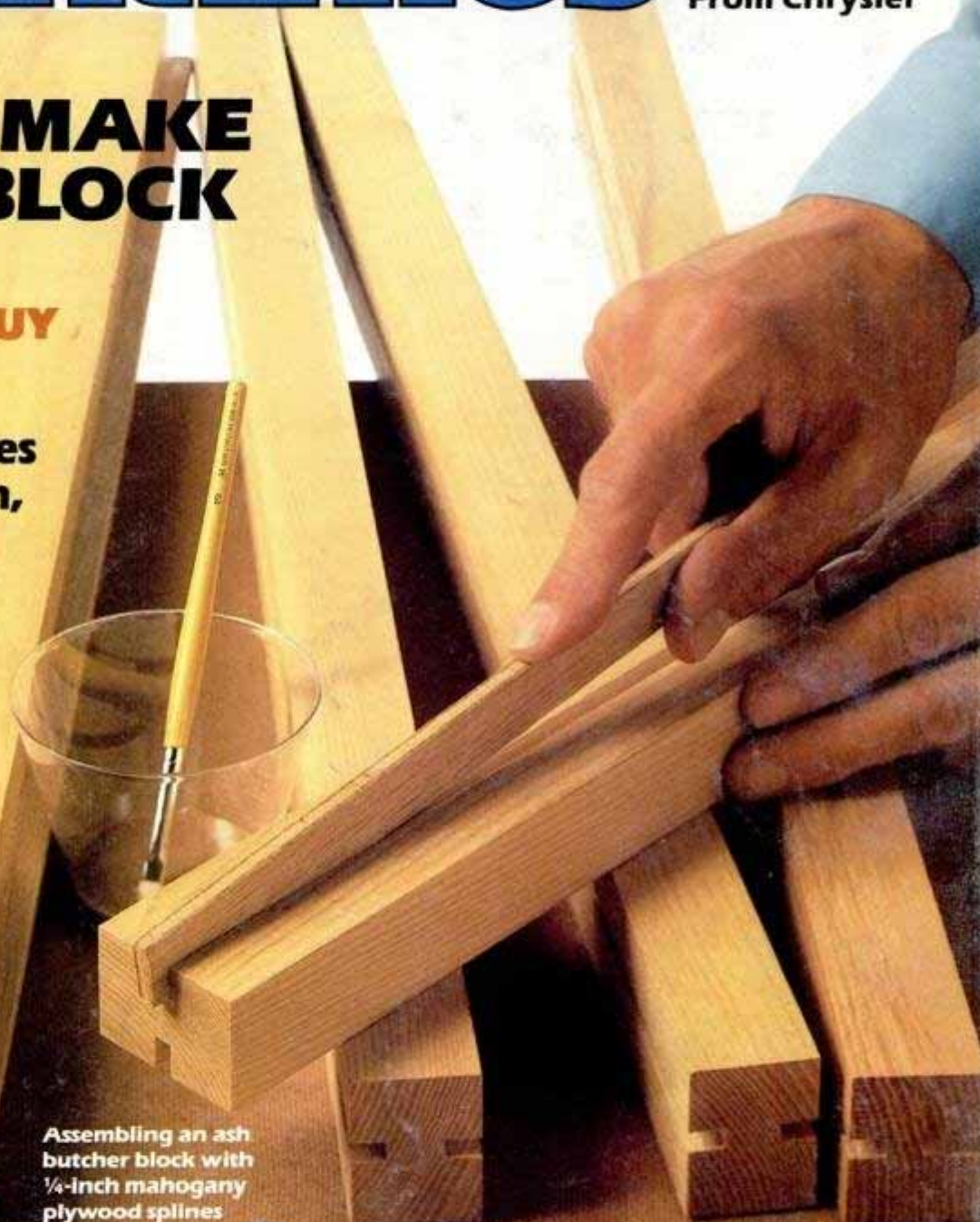
**8 LOW-COST CARS
CANADIANS CAN BUY**
But We Can't

EXCLUSIVE: My Hopes
For Our Space Station,
By President Reagan

PM GUIDE: What's
Really New About
Home Insulation

TINY COLOR TVs
That Fit In The
Palm Of Your Hand

PM Takes On The
World's Toughest
Road Rally



Assembling an ash
butcher block with
1/4-inch mahogany
plywood splines



PLANS OFFER
Build Our 2-Car
Country-Barn
Garage With
A Giant Loft



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.

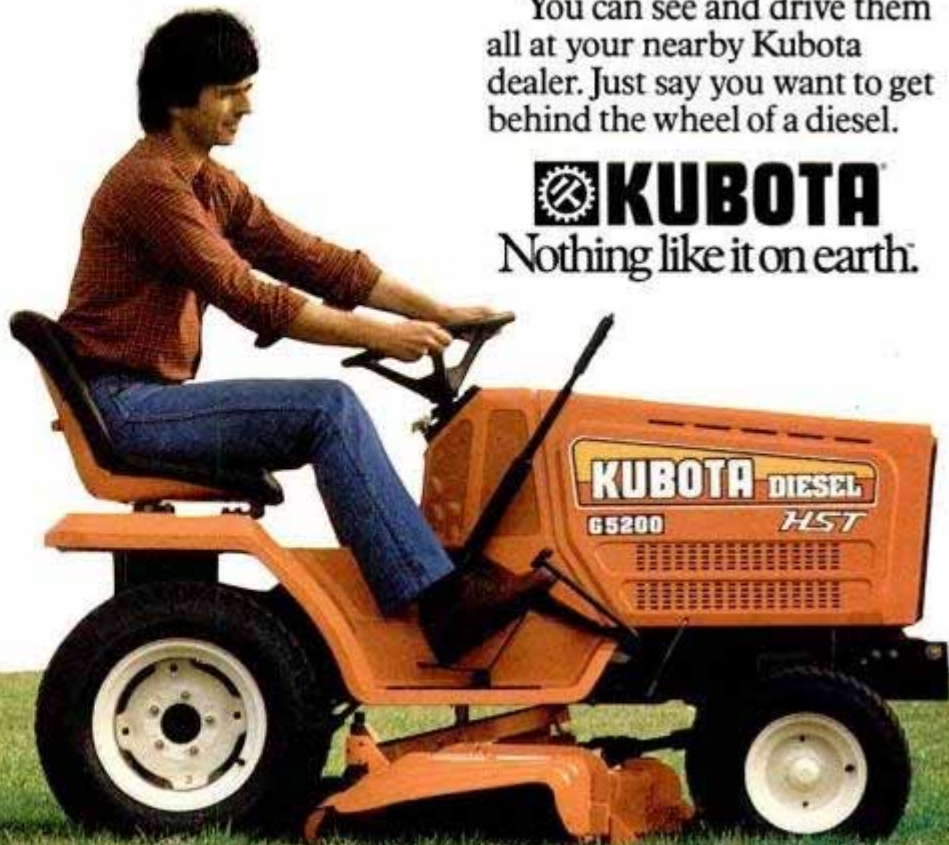
There are four Kubota G lawn and garden tractors, from 10 to 14 horsepower. Two models come with an easy-to-drive hydrostatic transmission.

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.

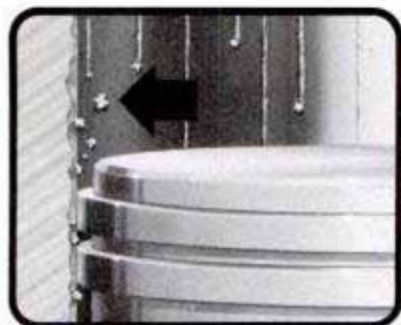


PROBLEM: Friction and wear cut thousands of scratches in the metal surfaces inside every car's engine. Scratches leak power and rob you of compression and gas mileage

New Engine Restorer & Lubricant restores power and gas mileage

As seen on T.V., when added to oil, this amazing new product actually fills scratches to seal power-robbing leaks with millions of microscopic, "soft-metal" particles

As moving metal parts rub together, tiny, sharp metal fragments break off and circulate inside your car's engine. These fragments cut thousands of scratches in metal surfaces that "leak power" and rob your engine of compression and gas mileage.



Sharp metal fragments cut thousands of scratches inside your car's engine.

New ENGINE RESTORER & LUBRICANT is an exclusive, secret formula that was developed by a metallurgist. He discovered a way to meld copper, silver and lead into tiny "soft-metal" particles called * CSL. There are millions of these microscopic particles in every can of New ENGINE RESTORER & LUBRICANT. These particles are blended in a quality lubricant that is compatible with all motor oil products.

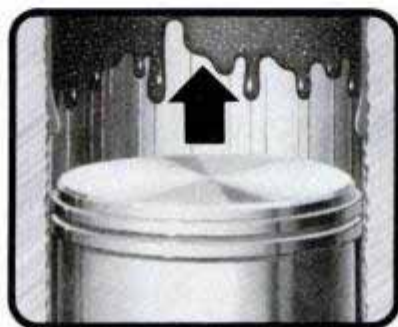


You add new ENGINE RESTORER & LUBRICANT to your oil.

As it circulates inside your engine, these tiny, soft CSL particles seek out the scratches caused by friction and wear. The millions of microscopic metal particles work to fill, pack and seal the damaged metal surfaces, restoring them to near-original condition.

SATISFACTION GUARANTEED, OR YOUR MONEY BACK. © 1983 RESTORE, INC.

New ENGINE RESTORER & LUBRICANT actually rebuilds metal surfaces, which seals power robbing leaks. This restores compression and gives you better gas mileage. Other tiny CSL particles, which have not been smoothed into scratches, work with your engine oil to lubricate like millions of tiny ball bearings even under extreme temperatures and pressures.

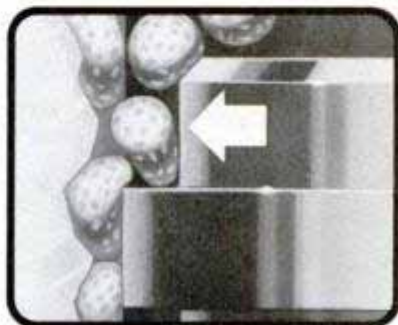


Millions of tiny "soft-metal" particles circulate with the oil inside your engine.

New ENGINE RESTORER & LUBRICANT will increase engine performance to a point where you can actually feel the difference as you drive. Engines which have been disassembled before and after use, show how scratched metal surfaces have been filled and sealed.

New ENGINE RESTORER & LUBRICANT is totally unique. No ordinary oil-

additive product contains the secret formula of tiny CSL particles. New ENGINE RESTORER & LUBRICANT is the only product in the world that works this way.



CSL particles magnified thousands of times, show how scratches are filled and sealed.

New ENGINE RESTORER & LUBRICANT represents a breakthrough in "add to oil" technology that will improve the way drivers care for their car's engines. It works effectively wherever friction and wear cut scratches in metal surfaces, such as cylinder walls, crankshaft and bearings.



Metal surfaces are restored to near original condition.

New ENGINE RESTORER & LUBRICANT is available in a formula for 4, 6 and 8 cylinder cars.

\$1.00 CASH REFUND

to encourage you to add a can of New ENGINE RESTORER & LUBRICANT to your oil without delay. RESTORE INC., will refund \$1.00 on the purchase price of any size can. To get your \$1.00 refund send your cash register receipt with your purchase price circled. Also, write RESTORE's UPC code = from the white patch on the back of the can on your receipt. Send receipt with your name, address and zip code to RESTORE, INC., 3000 N.E. 30th Place, Ft. Lauderdale, Fla. 33306. Offer limited to one can per family or mailing address.

* CSL is the RESTORE, INC. trademark for the microscopic "soft-metal" particles in this product, which contain copper, silver and lead. Distributed by RESTORE, INC., Ft. Lauderdale, Florida 33306.



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

ON THE COVER

The warm, rich look of real butcher block is back in style for kitchen counters and other work surfaces. Here are seven ways to make your own laminated tops, plus plans for a handsome roll-around serving cart. Story begins on page 76.

—PM photo by
George Ratkai



Popular Mechanics

VOLUME 161 NO. 9

SEPTEMBER 1984

INTERNATIONAL EDITIONS: CARIBBEAN, MEXICO, SOUTHERN HEMISPHERE



P. 74

AUTOMOBILES AND BIKES

- 20 Car Clinic
- 26 The PM Garage
- 37 Saturday Mechanic: Servicing disc brakes
- 48 Detroit Listening Post
- 58 Imports and Motorsports
- 61 The Canadian connection: Cars you can't buy here
- 68 Mud, sweat and gears
- 70 Chrysler turns up the wick



P. 70

- 74 Slick scooters
- 101 Flexi-wheeler goes anywhere

BOATING AND OUTDOORS

- 14 All Outdoors P. 68



SHOP AND CRAFTS

- 54 The PM Workbench
- 76 7 ways to make butcher block
- 118 Workshop Minicourse: Reglazing windows
- 148 Hints from readers



P. 76

HOME AND YARD

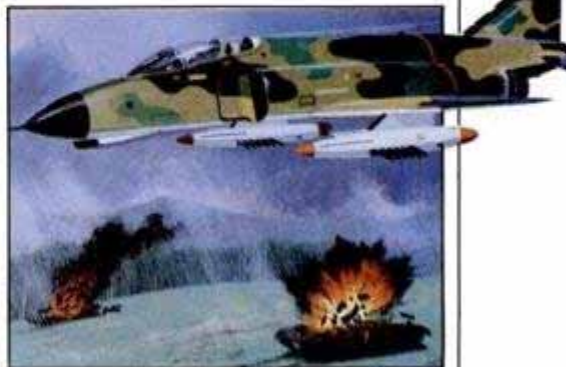
- 16B New Now for home and shop
- 16D Improve your wood stove
- 30 Ready-made chimneys
- 46 Appliance Clinic
- 56 Homeowners' Clinic
- 80 Best new homes under the sun
- 84 How to spot home energy wasters
- 86 PM's guide to home insulation
- 90 Build our "country barn" garage



P. 98

AVIATION

- 98 Tilt-engine jet flies like a copter
- 98 Coming: Smaller jetliners
- 99 Parachute drop from 30 miles away



P. 101

SCIENCE AND ENGINEERING

- 24 Science Worldwide
- 64 Space station: The next step
- 99 Drinking water from the sea
- 100 Catching a comet
- 100 Antacid shot revives trees
- 100 Low-cost solar energy
- 100 Gunning for oil
- 100 Safer metal-milling process
- 100 Living video game
- 101 Hands-off bombing
- 101 Simulated atom bomb



P. 80

ELECTRONICS, RADIO AND TV

- 44 PM Electronics Monitor
- 72 Color for tiny TVs
- 99 Computerized gas
- 99 Gyroscope with fiberoptics

PHOTOGRAPHY

- 16P Photo Hints

EVERY MONTH

- 6 Editor's Notes
- 10 Letters to the Editor
- 98 Technology Update
- 116 PM's Time Machine

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*94% to 97% efficiency, depending on model size, based on D.O.E. test procedures.

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Executive Editor: Joe Oldham

Managing Editor: Bill Hartford

Graphics Director: Bryan Canniff

Special Editorial Features: Sheldon M. Gallager, editor

Automotive: Wade A. Hoyt, SAE, editor; Norman S. Mayersohn, assistant; Michael Lamm (West Coast); Daniel Charles Ross (Detroit)

Home and Shop: Steven Willson, editor; Penelope Spangler, Home Improvement editor; Joseph Truini, Shop and Tools editor.

Boating, Outdoors and Travel: Ray Hill, editor

Science: Dennis Eskow, editor

Editorial Production: Peter Francesconi, chief; John Bostonian Jr., art; Rebecca Harth, David Meyer, assistants.

Design Director: Ira Herrick

Art: John Johaneck, director; Alan Andresen, Ann Bennett, assistants

Special Publications: Clifford B. Hicks

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.

Reader Service Department: John Ginsberg, manager; 224 West 57th St., New York, N.Y. 10019; (212) 262-4292.

Advertising Offices:

New York: 224 West 57th St., New York, N.Y. 10019; (212) 262-8824

Chicago: 520 North Michigan Ave., Chicago, Ill. 60611; (312) 527-2400

Detroit: 377 Fisher Rd., Grosse Pointe, Mich. 48230; (313) 881-3520

Cleveland: PDC Building, 3659 Green Rd., Cleveland, Ohio 44122; (216) 292-7334

Los Angeles: 460 East Carson Plaza Dr., Carson, Calif. 90746; (213) 532-8101

Director of Marketing: Edward Vaquero

Production Manager: Lori Ellwood

Advertising Production: Patricia Woods; (212) 262-4800

Classified Sales Manager: Sophie Gronowicz; (212) 262-4825

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Vac-N-Sac™ converts your Paramount Power Blower into a powerful vacuum to pick up clippings, litter and leaves. It vacuums, mulches and bags in one, clean, fast operation. The Vac-N-Sac™ is included with the Paramount PB-350 Power Blower.



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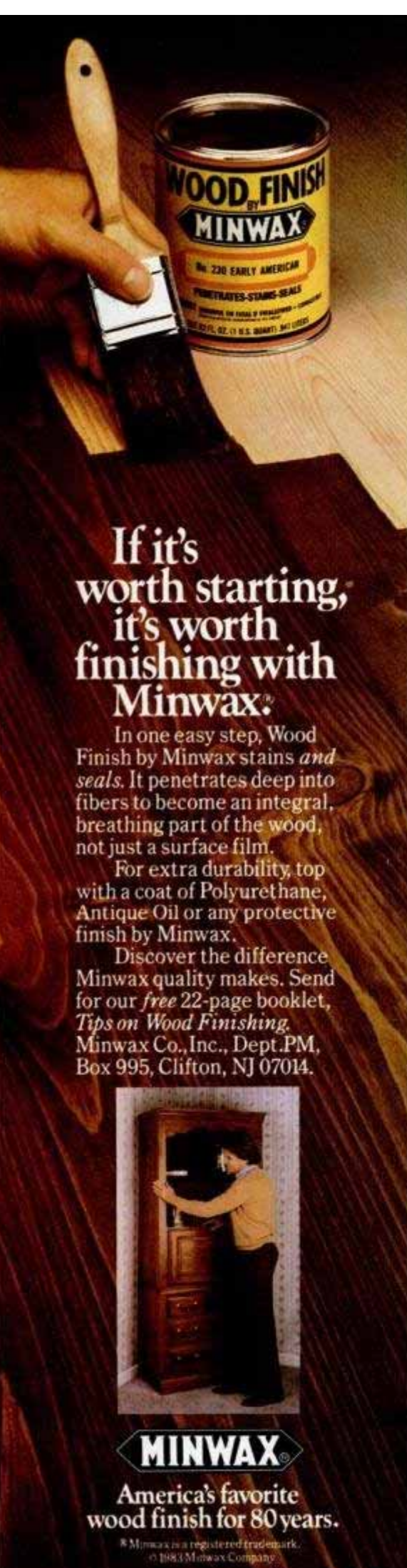
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EDITOR'S NOTES

When Star Trek's Captain Kirk asks Mr. Spock to run a computer analysis, the pointy-eared Vulcan hops to it with confidence. In real life, Spock (Leonard Nimoy, as all fans know) just started using a computer this year—and finds it fascinating. Nimoy, with Science Editor Dennis Eskow, constructed by computer the space station in *Science Worldwide* (page 24)

Long-time readers of PM will note a familiar byline under the title, *Build Our 'Country Barn' Garage* (page 90). It's Richard Dempewolff, former executive director of PM as well as editor of *Science Digest*. Dick, now retired, built the garage that we're sure many readers will want to copy. See the article for plans information

Now we know how to build a Russian space station. Just take some bottle caps, panty-hose containers and disposable razor parts and glue them together with other "found" items.

That's the way artist Brian Sullivan made the Soyuz model that he photographed against a painted background for this issue (page 66). The Russian article follows *Space Station: 'The Next Bold Step'* written exclusively for PM by President Ronald Reagan. If you want a shot of optimism for the future, read about President Reagan's hopes for the American station

Speaking of Russians, they make a four-wheel-drive Lada Niva that Canadians can buy, but we can't. Toronto journalist Jim Kenzie writes of that one and others in *Cars You Can't Buy Here* on page 61. His conclusion: We probably shouldn't worry about it

The Austin A40 got 32 miles per gallon. Not bad for 1959, when PM did a survey of imports (see *PM's Time Machine*, page 116). And we hadn't even heard of oil embargoes then!

John A. Siskel



Spock and Eskow building spaceships.



Richard Dempewolff, master barn builder.



Artist Sullivan orbits Soyuz in my office.



Canadian Jim Kenzie leans on a Lada Niva.

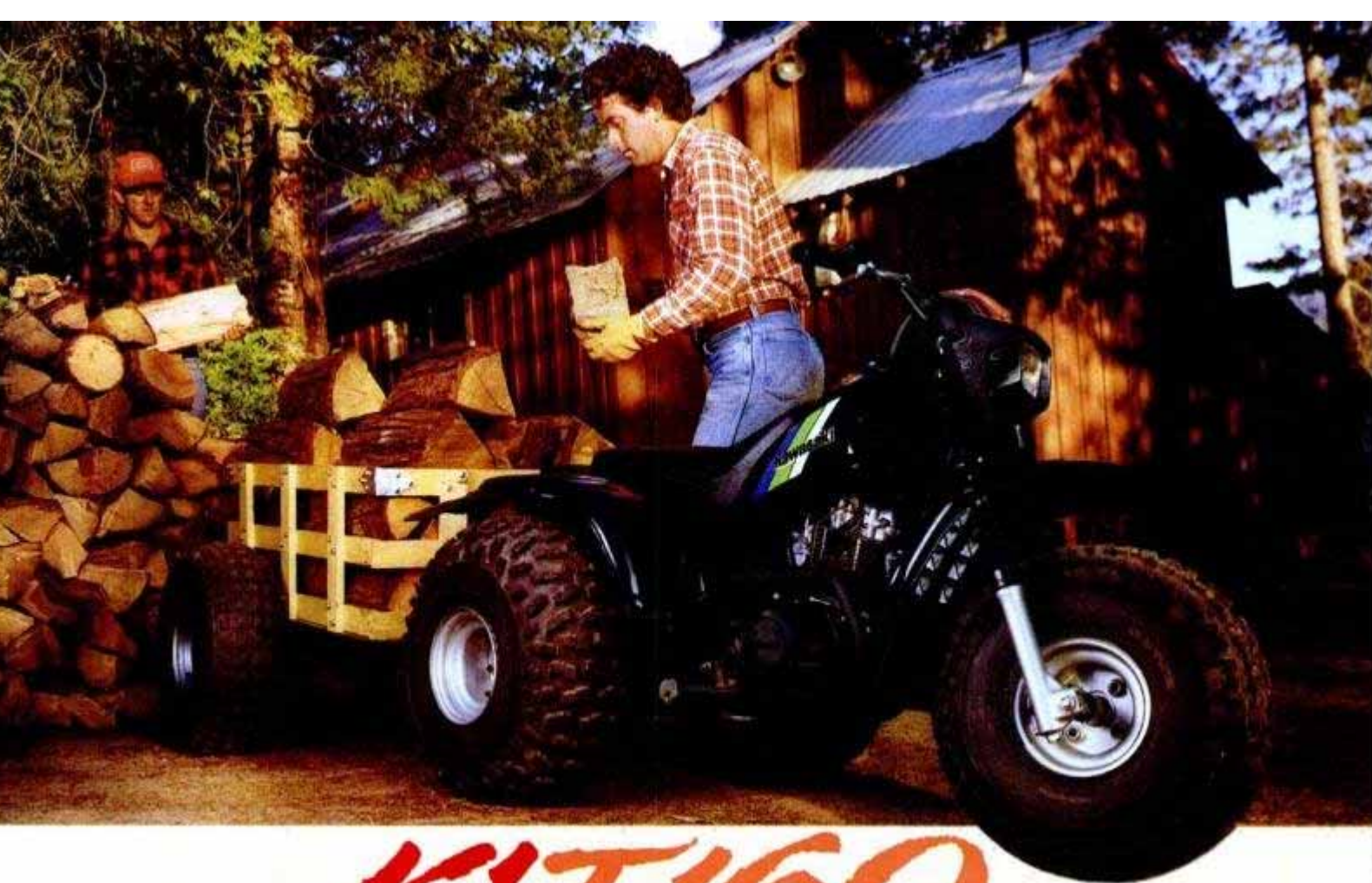
Which Gives Best Gas Mileage Over-All?

	Miles Per Gallon*
Austin A40 2 dr. sedan wagon	32.0
Volvo 460 GLE 4 dr. sedan	31.5
Ford Mustang 4 dr. station wagon	31.0
Oldsmobile 2 dr. sedan	30.0
Dodge 2 dr. sedan	29.8
Subaru 2 dr. sedan	29.8
Mercury Marauder 2 dr. sedan	29.0
Jeep Cherokee 4 dr. sedan	28.0
Oldsmobile Delta 4 dr. sedan	27.0
VW Jetta 2 dr. sedan	26.0
Volvo 460 GLE 4 dr. sedan	25.0
Oldsmobile Delta 4 dr. sedan	24.0
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Volvo 460 GLE 4 dr. sedan	7.0
Volvo 460 GLE 4 dr. sedan	6.0
Volvo 460 GLE 4 dr. sedan	5.0
Volvo 460 GLE 4 dr. sedan	4.0
Volvo 460 GLE 4 dr. sedan	3.0
Volvo 460 GLE 4 dr. sedan	2.0
Volvo 460 GLE 4 dr. sedan	1.0
Volvo 460 GLE 4 dr. sedan	0.0

*Based on a 20-mile road test, including city and country driving.

SEPTEMBER 1983

Austin: The 1959 winner by a half mile.



KLT160

SHAFT DRIVE WITH MORE POWER TO WORK OR PLAY. AND WE CAN BACK IT UP.

Kawasaki launches the next generation of 3-wheelers.

Anywhere this new shaft-drive five-speed can get you, there's a reverse gear to get you back. Forward or backward...feel that Kawasaki power. Seems more like a 185 than a 160. And you know how important power is...whether you're hauling firewood or putting the boat in the lake. For work or play...the KLT160 has more new features than any other 3-wheeler in its class.

Start with the engine...an engine Kawasaki specifically designed for a 3-wheeler. For easier starting, there's the exclusive Kawasaki Automatic Compression Release (KACR). And a no-maintenance, hot-sparking CDI ignition. The new shaft-drive is durable. More reliable. No chain to oil. And for the easiest take-off on 3-wheels, you can't beat KLT's automatic dual-clutch system. To top it

off, Kawasaki assembles the 160 in Lincoln, Nebraska, and gives it an unbeatable six-month limited warranty.

Now, get goin'! There's work to be done and fun to be had on Kawasaki's new shaft-drive, five-speed, dual-clutch KLT160. It's at your Kawasaki dealer

now. And you **Kawasaki** can back it up. Let the good times roll.

For off-road use only. Specifications subject to change without notice. Check local laws before you ride. Availability may be limited. Kawasaki believes in riding safely. Member AMA, MSF and SVIA.

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MAKES SPORT VEHICLES PERFORM:
THE RADIAL MUD-TERRAIN T/A.**

The Radial Mud-Terrain T/A is built strong and rugged to maximize truck dependability—off the road or around town. Its tread has self-cleaning grooves for remarkable traction in deep mud or snow.

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



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- The BFGoodrich Radial Mud-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. Tread pitch sequencing offers quiet ride.
 - C. Deep self-cleaning grooves provide excellent traction.
 - D. Dual compound tread imparts outstanding mileage.

The Radial Mud-Terrain T/A® was designed specifically for outstanding truck performance. In fact, professional drivers recently tested the Radial Mud-Terrain T/A on a specially modified off-road truck. The result: outstanding rugged performance. When equipped with the Radial Mud-Terrain T/A, the test vehicle demonstrated remarkable traction capabilities. Even through mud bogs with the viscosity of wet cement under two feet of water.

This One



SSCR-K1Y-X2UD

WE MAKE TRUCKS PERFORM

LETTERS TO THE EDITOR



Still going strong

I thought you might like to see a picture (right) of the little electric car we built from plans you published in two installments way back in 1963 (*Sidewalk Classic*, page 146, Nov.; page 128, Dec.). The car has been in use for three years now and still runs like a charm. Our two young grandsons really love to drive it.

For added safety, I installed a remote-control switch on the electric motor that's operated by a model-airplane R/C radio control. This way, I can stop the car from a distance if the kids stray too far away.

Thanks for a great design that's still good after 20 years.

FORREST R. BAINBRIDGE
JAMESTOWN, N.Y.

Thanks for the photo. It's good to know that PM projects can stand the test of time. For others who may be interested, the plans are available for

\$7.70 postpaid from Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101.



PM's electric-powered Sidewalk Classic built by reader Forrest Bainbridge—a 20-year-old design that's still going strong.

Who needs a computer?

In your article on using a computer to keep track of cattle (*Computer Literacy For Cattle*, page 58F, Apr. '84), you said "When you're herding 100 cows, you can't always remember which is which." We have more than 100 cows and we know each one by name. Not only that, but a good herdsman knows the correct dam and sire (mother and father) for every calf!

DAN KING
ATHENS, N.Y.

Import update

In your article *PM's Dollarwise Guide To 1984 Imports* (page 94, Mar. '84), there were some errors in regard to cars imported by us. While Bertone is always exploring ways to improve its X1/9, I can assure you that a twin-turbo version is not one of them.

Secondly, the Pininfarina Spider (not Spider 2000) has been renamed Azurra for 1984. A turbo version of the Pininfarina is not available.

ANTHONY T. CIMINERA
INTERNATIONAL AUTOMOBILE IMPORTERS
MONTVALE, N.J.

Carburetor caution

As a part-time auto mechanic, I enjoyed reading your article *How To Rebuild A Carburetor* (page 49, Mar. '84). As a firefighter, however, I must question your suggestion of using a kitchen table as a work area. Because of the flammability of carburetor cleaning fluid and the residual gasoline likely to be remaining in the float bowl, such work should be performed only in well-ventilated areas away from machinery or appliances that could cause explosive sparks.

Anyone failing to heed this caution may find himself needing a rebuilt house, not just a carburetor.

JAMES E. HURD
ENON VALLEY, PA.

Although we mentioned that a kitchen table is convenient, we actually did not recommend its use. We pointed out that a better location is in a garage or basement. You are indeed right in emphasizing the need for working only in well-ventilated areas away from sources of sparks.

PM

Giving away secrets?

Your article *Coming: Jump Jets That Break The Sound Barrier* (page 59, June '84) was highly technical and very thorough—so much so that I bet the Russians loved it. Just because we enjoy living in a free society, why do we insist on giving away vital military secrets that could help the Communist nations save billions of dollars in research?

With magazines like yours, the Russians don't need spies—they can read it all in PM.

E. R. RISTVEDT
WADENA, MINN.

We appreciate the importance of secrecy when the need is genuine. Our article, however, was based on unclassified information available to anyone. It contained nothing that the Russians don't already know—or we wouldn't have published it.

Want more on robotics?

Since my article *The Smartest Home-built Robots* appeared (page 88, Apr. '84), I've received nearly 900 letters asking for more information on home

robotics. I will be happy to provide additional information, but to facilitate the handling of such requests, I must ask that readers please supply a business-size self-addressed, stamped envelope. Thank you.

THOMAS W. CARROLL
BOX 3227
SEAL BEACH, CALIF. 90740

Which diver's flag?

In your November '83 issue (*Letters*, page 6), you stated that the traditional red-and-white diver's flag was no longer legal and had been replaced by the blue-and-white Alpha flag. This is incorrect. The red-and-white flag has always been, and still is, the proper one for a diver to display.

FRED CALHOUN
BOSTON

Since we published that notice, the Coast Guard has clarified its ruling. The blue-and-white Alpha flag is required on small vessels lying stationary in the water near a dive site. Divers actually in the water, however, may continue to display the familiar red-and-white flag. This is not an official navigation flag and thus cannot be exhibited on vessels.



**There's only one
way to play it.**

Wherever the music is hot,
the taste is Kool. At any 'tar' level,
there's only one sensation
this refreshing.



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

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Milds Kings, 11 mg. "tar", 0.8 mg. nicotine; Filter Kings, 17 mg. "tar",
1.1 mg. nicotine av. per cigarette, FTC Report Mar. '84.

Popular Mechanics PLANS

ALL UNDER ONE ROOF

Barn/Garden Shed

Our well-designed yard building provides handsome storage for yard tools, hand tools, power equipment, gardening supplies and a gardening center for the whole family. It also has an upstairs loft without using extra lumber! Dim.: 12 x 16 ft. Plans, instruction manual & material list.

(1 plan: PL-1278—\$10.50)
(2 plans: PL-1278A—\$17.50)

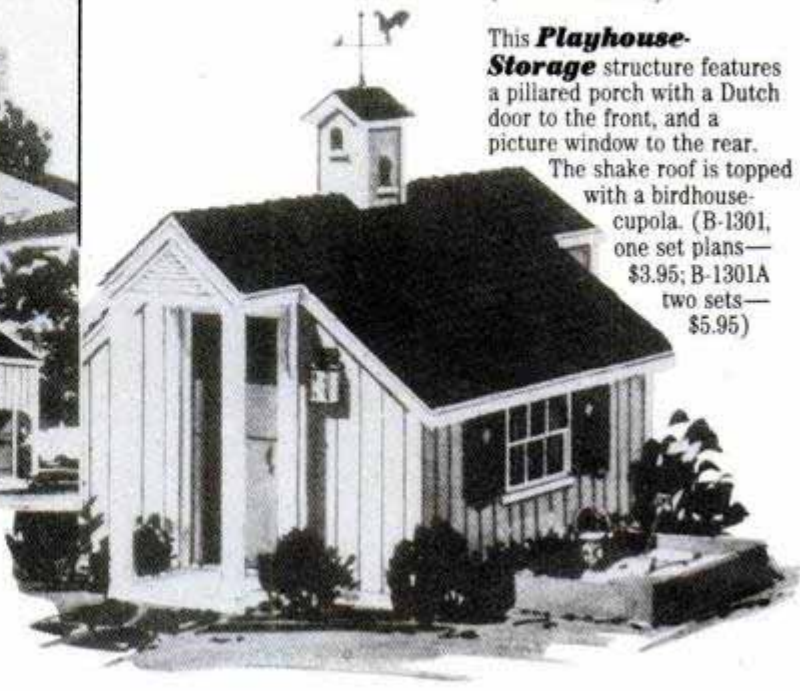
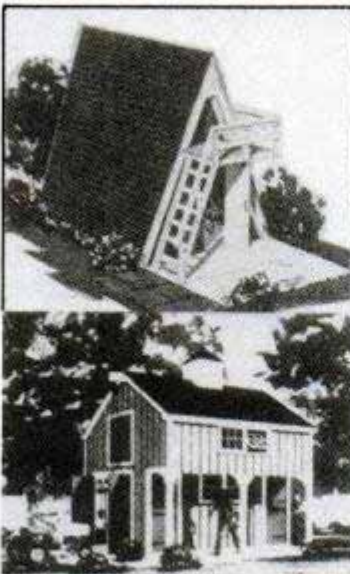
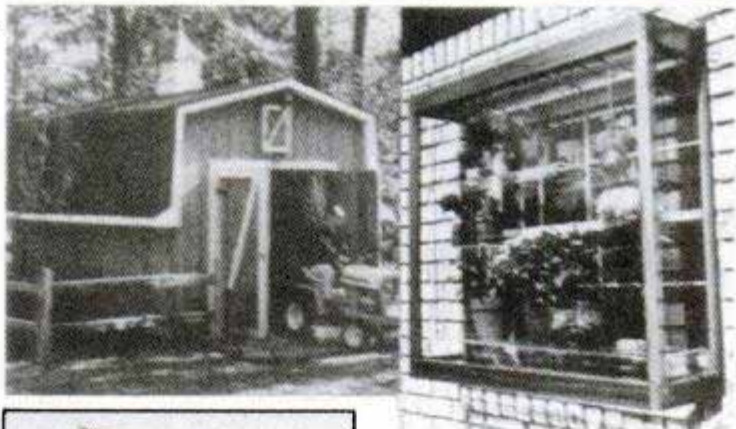
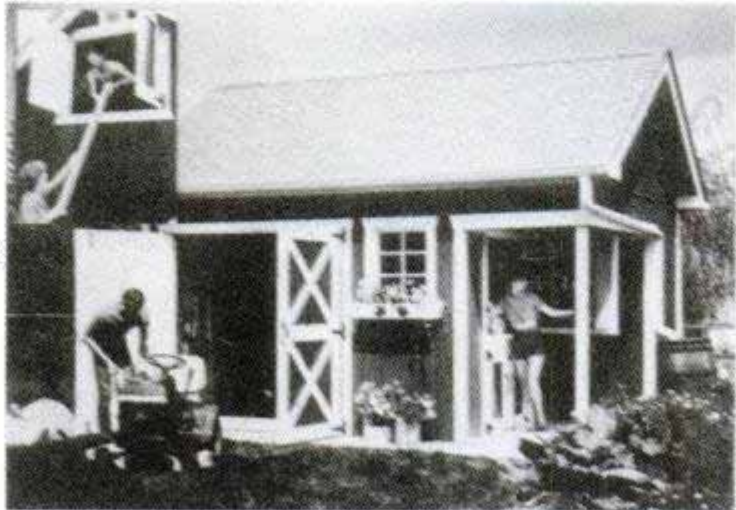
Dutch Mini Barn is fairly large (10 ft. by 13½ ft.), yet it looks small. It's quite attractive and makes a great addition to your yard. And, the roof is designed to give this "barn" 8 ft. of headroom inside. (B-1279, one set of plans—\$3.95; B-1279A, two sets of plans—\$5.95)

Here's the cutest little **A-Frame** ever designed. The structure measures 8 ft. wide, 12 ft. long and almost 13 ft. high. An outside stairway leads up to a balcony, providing access to the crawl-in loft. Framing is easy, construction relatively inexpensive. (B-1302, one set of plans—\$3.95; B-1302A, two sets—\$5.49)

"Carriage House"

It's a two-story structure measuring 8 ft. wide by more than 12 ft. long. In addition, there's a covered walkway that runs the length, widening the second floor by 2 ft. 4 in. The first floor is designed as a storage area.

However, our plans also show you how to equip it as a workshop or an office. Build the second floor as a bunkhouse sleeping two kids. (B-1277, one set—\$3.95; B-1277A, two sets—\$5.49)



Home Care Guide

A must for every homeowner! To save you money Popular Mechanics has prepared this fact-filled, most concise and authoritative guide that covers most every common home repair problem. Tells you how to cut fuel bills, weatherstrip, insulate, take care of electrical emergencies. Hang a door, install a lock. Repair scratches in furniture. Paint inside and outside your home, and more. Contains more than 135 illustrations and ten tables and charts. All information is on 12 double-sided plastic-coated wipe clean cards, spiral-bound. Properly used this guide can save you hundreds of dollars! (B-1701—\$5.45)

Window Greenhouse

is as attractive inside as it is on the outside. Fashioned of clear all-heart redwood and plexiglas. Window stays intact. Just add screweyes to the frame. No drafts in winter, no need for caulking. Can be used to start seeds or to show off your prize plants. (PL-1719—\$2.50)

This **Playhouse-Storage** structure features a pillared porch with a Dutch door to the front, and a picture window to the rear.

The shake roof is topped with a birdhouse-cupola. (B-1301, one set plans—\$3.95; B-1301A two sets—\$5.95)

Send your name and address with check or money order payable to POPULAR MECHANICS. Mail to: Popular Mechanics, Box 1014 Radio City Station, New York, N.Y. 10101

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.

This is how it really happened,
A true story by: William Turnbow

"I got tired of punching a time clock, having somebody always telling me to do this and do that. I wanted to be my own boss. So I took the plunge." That's how William Turnbow describes a decision that changed his life.

"Let me backtrack a bit. I was always a farm boy ... born and raised on a farm. Even had my own farm after doing a hitch in the Marine Corps. But it got harder and harder to make enough to support a wife and three growing boys, and I had to get out.

"Then I got into managing a food store. One day while reading a magazine, I saw a message like this one, that opened a new door of opportunity for me, a message about becoming a Von Schrader Associate. Frankly I was kind of skeptical, but sent for the information. When it came it sounded good, just what I was looking for. No big investment. No licensing or franchise fee. No waiting, no training needed. The only requirement was a real desire to get ahead and devote the necessary effort. What really appealed to me is that you pay no dues, fees or royalties—every single penny you earn is yours to keep!

WORK PART-TIME/MAKE FULL TIME

"I started out part-time kept working for the food store. In a couple of years my business had grown so much that I went full time. As I said, being my own boss is something I had always wanted. But another big payoff is that I enjoy a sense of accomplishment doing a job, getting compliments. I always like that pat on the back.

"My first job was for a neighbor. Then jobs for friends, neighbors and relatives ... and they started telling other people. It started to snowball and pretty soon I had as much business as I could handle. Our best advertising came from satisfied customers—and it's still that way today.

"**NOW I MAKE MORE IN ONE DAY THAN I USED TO MAKE IN A WEEK.** Believe it or not, I made \$43 per hour on one job recently ... and have made as much as \$1,600 in a week. And I've got four men working for me.

"Another thing I like is being able to go hunting and fishing all I want. I've got the time and the

money for it. We've got our own camper, and my wife and I go camping a lot. We recently moved to a new larger house, too.

"To say that Von Schrader really helped make all this possible would be an understatement. From Mr. Von Schrader on down, I have been treated as good or better than any company could treat anyone. I've never called about any problem without getting number one service.

THREE MONEY MAKING BUSINESSES

"As a Von Schrader Associate you can really 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.

"It's no wonder leading home furnishing companies in every state endorse the Von Schrader method.

"And believe me, I wouldn't trade being a Von Schrader Associate for anything! This is the only thing I've ever done I've been completely satisfied with—only thing I've never had second thoughts about."

That's William Turnbow's story in his own words. Now how would you like to earn big money, starting out in your spare time, just like him? Wouldn't you like to be your own boss? Become financially independent? We'll be happy to mail you all the facts. Just send in the coupon. That's how William got started. You'll get our FREE booklet and see how we guide you completely every step of the way. How to line up customers. How to estimate jobs. How to make big money.

Yes, you can keep your present job and work part-time until you build up enough customers to go full time. Make really big money like you never dreamed of before.

It takes so little to get started. Only a few hundred dollars puts you in business. Just compare that to our typical competitors ... one offering a franchise charges *ten times as much!* You can start in business for yourself using your home as a base. Everything you need on a job

fits easily in your car.

The easy-to-follow instructions tell you step-by-step how to set up and operate your Von Schrader equipment. Absolutely no mechanical experience or special training is necessary. It's that easy, that quick.

But that's just the beginning. Von Schrader helps you each step of the way. The exclusive Von Schrader Business Manual guides you completely in the "business" side of your new business. Plus we give you all kinds of business-building materials and promotion aids to help you bring in the customers.

Our tested and proven sales and servicing methods are backed by over 50 years of experience with satisfied customers and Associates—you get all the know-how you need to become a home furnishings maintenance expert.

**Send coupon today for FREE booklet
— No obligation.**

This is your chance to build a career for yourself with rewards far beyond your imagination. So don't wait. Send in the coupon below, NOW. Get all the facts. Study them in the privacy of your own home and make your own choice. Of course there's no obligation, and no salesman will call on you. But don't delay. Mail the coupon today so you don't lose any time finding out about this remarkable way to make big money!

MAIL TODAY FOR FREE BOOKLET

VON SCHRADER COMPANY, Dept. 1095
1600 Junction Avenue
Racine, Wisconsin 53403

WITHOUT OBLIGATION send free booklet that tells me how I can have a high-income business as a Von Schrader Associate in my spare time and at no risk to my present job. No salesman will call.
(PLEASE PRINT)

Name _____

Address _____

City _____

State _____ Zip _____

To expedite call toll-free 1-800-558-2484
Ask for operator 1095

ALL OUTDOORS



Air craft that's built for two

If you're an airboat fan and enjoy building your own craft, you'll be interested in plans for Hydro-Rat II, a two-man airboat from Rocky Mountain Airboats.

A larger version of their one-man Hydro-Rat, the Hydro-Rat II airboat measures 12 feet long and 5 feet wide and weighs 390 pounds. Hull construction is fiberglass-covered 1/4-in. plywood, while power comes from a 20-hp, two-cycle engine driving a 52-in. wooden propeller that develops 110 pounds of thrust. The boat will skim over the water at about 25 mph and will skim about \$800 out of your wallet for materials.

The Hydro-Rat II will easily carry two



Hydro-Rat II airboat can carry two and is powered by a 20 hp, two-cycle engine.

men and their hunting equipment to remote areas and back, thanks to the increased width of the hull and the

increased power of the engine. You can order plans from Rocky Mountain Airboats, Box 119, Morgan, Utah 84050.

Dome away from home

Cross a pickup bed cap with a tent and you get the Mini-Dome, a budget-priced alternative to the pickup truck cap. One person can set up this truck tent in about 10 minutes.

Construction is shock-corded aluminum poles and waterproof nylon cover. The entry flap and windows are fully screened to keep your dome away from home bug-free. After tenting to your



The total weight of the whole Mini-Dome assembly is just five pounds.

heart's content, all you have to do is fold up the whole shebang into a small 5-pound bundle that fits behind the seat of the pickup.

Mini-Domes are priced from under \$200 and are available in short- and long-bed models. The manufacturer is Engle Design, Box 16766, Seattle, Wash. 98116.

Plastic slugs

It seems that a day doesn't go by when some product traditionally made of metal isn't replaced by the same thing made of plastic. So guess what's happened to the brass-cased .38-cal. bullet? That's right, plastic.

The new cartridge from United States Ammunition Co. uses a plastic case with a metal bead cap. The case holds the bullet firmly until fired, and when fired, easily unseats the bullet and expands to the chamber walls for better sealing.

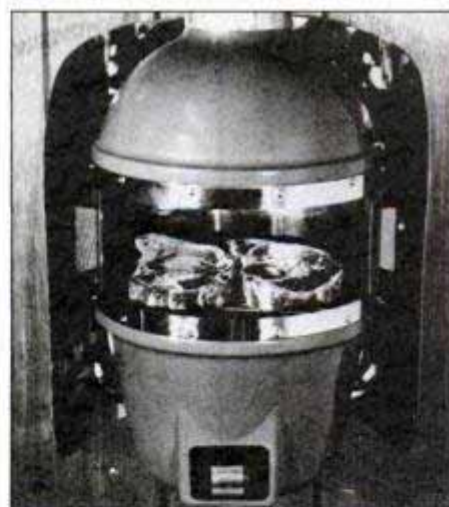
The plastic case withstands the same pressures as standard .38 Special brass, while giving velocities in the 700- to 770-feet-per-second range in four- and six-inch barrels. The plastic cases can even be reloaded several times and they do not have to be resized, trimmed or crimped.

Reloading equipment is simple and inexpensive. Four basic tools—a priming tool, powder measure, shell holder block and the USAC depriming and bullet seating hand tool—all sell for less than \$60.

If the mouth of the cartridge expands after firing, dropping it into boiling water for several minutes brings back the original shape.

The plastic cartridges should be available at your local sporting goods outfitter, or you can write to the United States Ammunition Co., 1476 Thorne Road, Tacoma, Wash. 98421.

Cabin chill chaser



Heat from Minibachi won't fog windows.

Cold water cruising can create chilly cabins. But you can stay toasty warm with an install-it-yourself cabin heater that burns coal, charcoal or wood. The Minibachi costs less than \$400 and generates dry, high-temperature heat that won't fog up the inside of your cabin windows.

The stainless steel/ceramic wall constructed unit also will broil, smoke or bake those fresh-caught fish or other gastronomic delights.

For more information or to order the Minibachi, contact Meredith Co., Box 6907, San Diego, Calif. 92106; (619) 224-7099.

PM

Warning: Major Car Manufacturers Have Determined That Gasolines Containing Methanol May Be Hazardous To Your New Car's Health.

Many new car manuals are warning about the damage gasolines containing methanol could do to your car.

They cite possible fuel system damage and performance problems. And those are just two of the hazards caused by methanol—a cheap ingredient added to some gasolines.

Fortunately, there's a safe solution: Amoco® gasoline. Because Amoco doesn't add methanol to any of its gasolines. None of them.

It's another way that Amoco goes that extra mile. For you and your car.



We go that extra mile

Save Gas, Save Engine with 'POLY'

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

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

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

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

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

Perhaps most dramatic of all is a tor-



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

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

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

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

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

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

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

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

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

I enclose \$34.95 + \$4.00 shipping and handling.
 I want 2 or more (free shipping and handling).
 Check C.O.D. Visa/MasterCard
 Card No. _____ Exp. Date _____
 Name _____
 Address _____
(Give street address if possible for UPS delivery)

Phone Company's Revenge

Gone are the cheap one-piece phones. But, memory dialing, tone/pulse switching, speaker-phones and comfortable phone company design handsets are the legacy of the fight.

It was a battle. Last year, with millions of cheap one-piece phones around, the Phone Company was under siege.

But revenge is sweet. Because, as fast as they appeared, most of the cheap manufacturers have gone.

One-piece phones that didn't feel like our familiar American phones are gone. And, millions of Americans have simply kept renting their old phones.

So, the Phone Company's revenge is complete. Its great feeling handsets, reliability and America's complacency, have won the Phone Company a major round.

But, with 70 million American homes at stake, you can bet that the real war is just beginning. So, while the Phone Company relaxes after the battle, a second wave of 'smart phones' is arriving.

INDEPENDENT'S REVENGE

Everyone's learned a lot. The Phone Company is offering features and the Independents have gotten the license of a regular Phone Company handset.

But, this time the Independents are way ahead. Now you can have a standard phone with a standard feeling handset just like you've had for years.

Plus, look at this. You can have 10 memory dialing, tone/pulse switching and you'll even get a great sounding speakerphone, all for just \$59.

LOADED

Imagine the convenience of having a phone that dials for you in either Tone or Pulse at the touch of a switch. It will remember and dial any 10 numbers, including last number redial.

And, best of all, you can dial your numbers without ever lifting the receiver. Just push the hands free button and you'll be using your all new, super clear, totally automatic speakerphone.

If you do decide to lift the receiver, you'll find it cradles right on your shoulder just like a Phone Company phone.

So, using this phone is like finding an old friend who's been educated since the last time you saw one another.

PERFECT MARRIAGE

The real claim to fame of this phone is its marriage of Phone Company fit and feel with super convenience features.

Imagine walking around the room, taking notes or even washing the dishes while you talk on the phone.

And, with a speakerphone, anyone else in the room can join in too. You'll be heard loud and clear whether you are nearby or across the room, because this phone has a built-in condenser mike.

This speakerphone uses a new lightning fast auto-simplex design. It's one of the reasons that it sounds so good. You see, instead of talking and listening at the same time and sometimes getting feedback and hollow sound, this phone only does one at a time.

But, don't be misled. You won't even know it's happening. The computer brain in this speakerphone switches back and forth automatically with such lightning



speed, it took us about 10 minutes of conversation to be sure.

Of course, there are no push-to-talk buttons. Everything is automatic. And, you're in full control. You'll have a full range volume control, and you can switch to the comfortable handset at any time.

The handset has its own condenser microphone and a headphone quality speaker in the earpiece to let you hear and be heard with astonishing clarity.

THERE'S MORE

You'll love dialing with this phone. There are no cheap flat buttons. You'll have sculptured keys that fit your finger and feel solid. But, the best part of this phone is not dialing at all.

You'll have a super fast 10 number automatic dialer that works with both the handset and the speakerphone.

Dialing with the speakerphone is really nice because you don't have to lift the receiver unless you reach the person you want to talk to.



Each number you store may have up to 16 digits and you can switch from Pulse to Tone at any time. So, if you live in a Pulse area and want to use Sprint or MCI, just dial your local access code in Pulse, then switch to Tone.

Don't worry about this memory dialer forgetting. When you put in 3 standard AA batteries, all your memory is protected. And, because this phone is totally telephone line powered, it doesn't require an AC plug. So, local power failures won't affect your ability to use your phone.

THE FINAL FACTS

This phone is loaded with all the latest phone features. Its electronic ringer has high, low and 'off for privacy' settings.

Both its handset and phone line cords are disconnecting modular cords. So, just plug it in and start talking.

The phone is slanted toward you for ease of use. A stand flips out to give you a comfortable dialing angle for desk or counter use.

The phone also mounts easily on the wall with two screws. There's a mute button for privacy and LED indicators show various operations.

It's made by Unitech, the large personal stereo and telephone manufacturer. You can be sure that the circuitry and sound quality are state of the art. It's backed by their limited warranty.

UNITECH'S REVENGE RISK FREE

Wait till you hear the sound. Wait till you feel the handset against your ear or cradled on your shoulder. Talk on the speakerphone and use the automatic dialer risk free.

If you're not 100% satisfied, simply return the phone in its original box within 30 days for a courteous refund.

To order your Unitech Automatic Dialing SpeakerPhone risk free with your credit card, call toll free or send your check for DAK's incredible breakthrough price of just \$59 plus \$3.50 for postage and handling. Use Order Number 9801. CA res add Sales Tax.

Well, the Phone Company has had its revenge against the cheap one-piece manufacturers. But, with the marriage of fit, feel and technology, the real winner is going to be you, the phone user.

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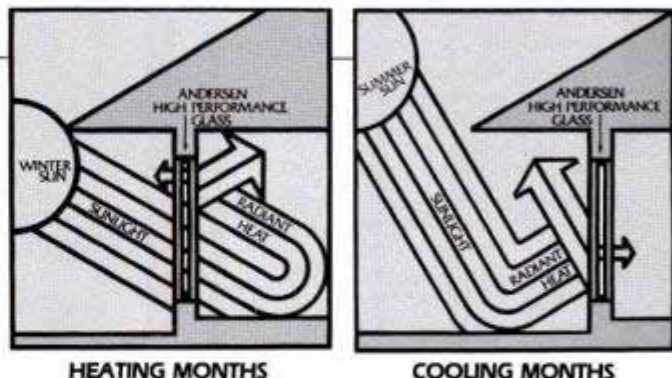


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INDUSTRIES INCORPORATED

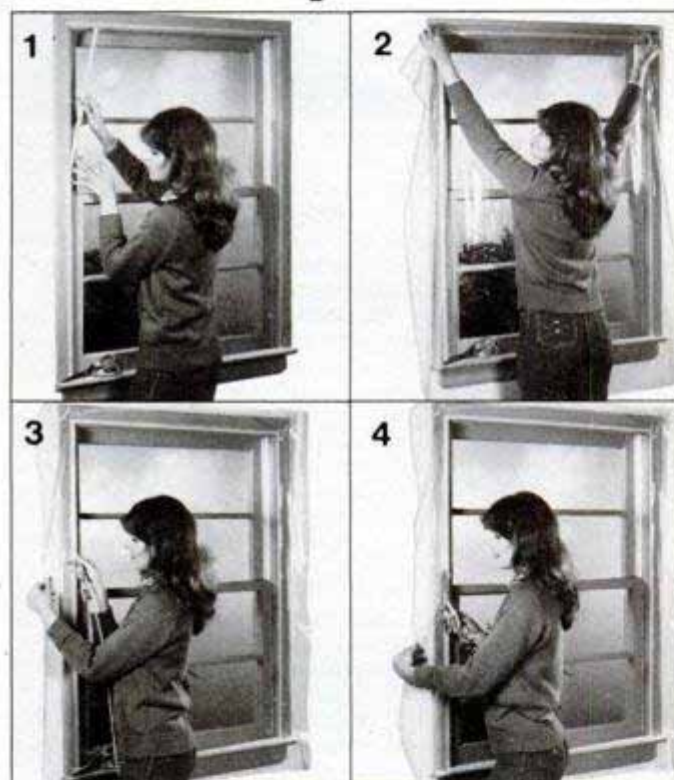
TOLL-FREE ORDER LINE
For credit card orders call 24 hours a day 7 days a week
CALL TOLL-FREE. . . 1-800-325-0800
10845 Vanowen St., N. Hollywood CA 91605

High-tech glazing

Andersen Corp. of Bayport, Minn. 55003, has developed glass that gives double-glazed windows more insulating value than triple glazing, according to Andersen. A thin metallic coating is bonded to the outer surface of the inner pane. As the drawings illustrate, in winter the glass admits the sun, yet blocks the escape of interior radiant heat. In summer, outdoor radiant heat is kept from reflecting into the house. Andersen's High-Performance glass costs 10 to 12 percent more than its uncoated double-glazing.



Window cover-up kit



Step-by-step installation: 1) Apply self-stick frame. 2) Position vinyl sheet over frame. 3) Snap in retainer. 4) Trim excess vinyl.

Tyz-All Plastics Inc., 240 Glen Head Rd., Glen Head, N.Y. 11545, has introduced the Cold-Stopper Weather Window system—a do-it-yourself plastic storm window kit. It's a simple means of insulating windows to prevent drafts, frost buildup and heat loss. The kit consists of an adhesive-backed frame, clear vinyl sheet and snap-in retainer strip.

To install the system, first apply the adhesive-backed frame to the window opening. Then position the vinyl sheet over the frame and snap in the retainer strip. Finally, trim the excess vinyl from around the frame. The Cold-Stopper is available at hardware stores and home centers in four sizes: 24 x 40-in. (\$5), 40 x 50-in. (\$7), 50 x 80-in. (\$10) and 72 x 82-in. (\$14). For summertime use, tinted sheets and fiberglass screens are also available.

Kit form tiller

The Groundhog II is a rear-tine tiller that comes in semi-kit form—you must mount the engine, belt guard and handles. The 5-hp, 4-cycle engine has three forward gears, and reverse, for cutting a 14-in.-deep x 26-in.-wide swath. It's available in semi-kit form (\$600) from Carl Heald Inc., Box 1148, Benton Harbor, Mich. 49022, or assembled (\$690) from Heald dealers.



Energy-saving thermostat

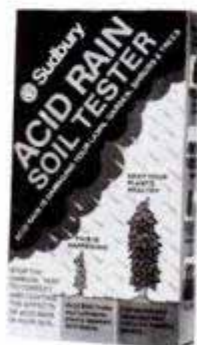
The Hunter Energy Monitor programmable setback thermostat (\$100) displays the amount of time a heating or cooling system has operated during the current day or week versus the previous day or week, thus, allowing you to measure and



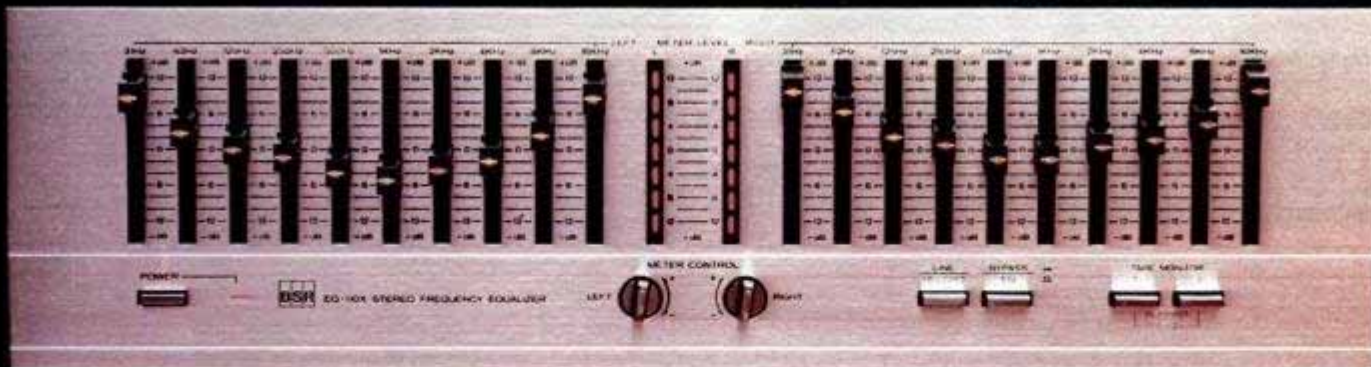
manage your energy usage. The do-it-yourself installation takes only 30 minutes, according to the maker. For details, contact Robbins and Myers Inc., 2500 Frisco Ave., Memphis, Tenn. 38114.

Acid rain equalizer

Acid rain contains nitric and sulfuric acids which lower the soil pH, the measure of acidity and alkalinity which is critical to plant tissue growth and development. Sudbury Laboratory Inc., 6 October Hill Rd., Holliston, Mass. 01746, offers a soil test kit for determining soil pH and correcting the problem. It's available at lawn and garden shops for about \$4.



\$89 CLOSE-OUT



Sound Detonator Plus

Make your stereo system's sound explode with life. Improve the sound quality by 30 to 50%. Plus, you'll add tape dubbing too with this limited BSR \$89 close-out.

It's like night and day. Crashing cymbals, the depth of a string bass, more trumpets or more voice will come bursting forth from your stereo at your command.

You'll make your music so vibrant that it will virtually knock your socks off when you use this professional quality 10 band stereo Sound Detonator Plus Equalizer.

It has a frequency response from 5hz to 100,000hz \pm 1 db. BSR, the ADC equalizer people, make this super equalizer and back it with a 2 year limited warranty. Our \$89 close-out price is just a fraction of its true \$249 retail value.

CAN YOUR STEREO SOUND BETTER?

Incredibly better. Equalizers are different from regular bass and treble controls. And, 10 band EQs are the best.

Bass controls turn up the entire low end as well as the low mid-range, making the sound muddy and heavy. With an equalizer, you simply pick the exact frequencies you want to enhance.

You can boost the low-bass at 31hz, 62hz and/or 125hz, and the mid-bass at 250hz and 500hz to animate specific areas of the musical spectrum.

And, when you boost the part of the bass you like, you don't disturb the mid-range frequencies and make your favorite singer sound like he has a sore throat.

The high frequencies really determine the clarity and brilliance of your music.

You can boost the mid-range and highs at 1,000hz, 2,000hz, 4,000hz, 8,000hz and 16,000hz. So, you can bring crashing cymbals to life at 16,000hz while at the same time you cut tape hiss or annoying record scratches at 8000hz.

You can also boost or cut specific mid-range frequency areas to add or subtract vocal, trumpets, guitars or whatever instrument ranges you prefer.

GREAT FOR 2 TAPE DECKS

You can push a button and transfer all the equalization power to the inputs of two tape decks. So, if you have a cassette deck in your car or a personal stereo that you wear, now you can pre-equalize your cassettes as you record them.

Now you can get all the dramatically enhanced sound wherever you are. This

is an especially great feature for bass starved portables and high-end starved car stereos to make them come alive.



And, look at this. There are two tape inputs and outputs, so you can dub from tape deck A to B, or make two tapes at once with or without equalization.

EASY HOOK UP

Use your tape monitor circuit, but don't lose it. Now your one tape monitor circuit lets you connect two tape decks.

Just plug the equalizer into the tape 'in' and 'out' jacks on your receiver. We even supply the cables.

As you listen to your records, FM or 'aux', any time you push the tape monitor switch on your receiver you'll hear your music jump to life.

The output from your receiver is always fed directly to your tape decks for recording, and with the touch of a button, you can choose to send equalized or non-equalized signal to your recorders.

When you want to listen to a tape deck, just press a tape monitor button on the equalizer and your tape deck will work exactly as it did before. Except, that now you can choose to listen with or without equalization and you can dub.

You won't be listening to any distortion or hum. The Sound Detonator Plus has a 95db signal to noise ratio and total harmonic distortion of just 0.018%

Once you've set your equalizer controls, switch it in and out of the system. You'll hear such an explosive improvement in sound, you'll think you've added thousands of dollars of new equipment.

WHY A CLOSE-OUT?

Last year DAK closed out over 18,000 of BSR's 7 band equalizers because BSR had decided to only sell equalizers under their ADC name and they still had some left with the BSR name on them.

Well, as Detroit comes out with new cars each year, ADC comes out with new equalizers. We got them to supply us

with just 15,000 of last year's model before they shut down for the new one.

They had already paid for all the tooling, all the research and design, so we were able to buy these for less than half the normal price, for cold hard cash.

So, you can go to any HiFi store and buy this year's design in an ADC equalizer made by the parent company BSR, or you can get this \$249 value BSR equalizer while our limited supply lasts, for \$89.

THE FINAL FACTS

There are 20 slide controls, each with a bright LED to clearly show its position. Each control will add or subtract up to 12db. (That's a 24db range!)

There are separate sound detonation slide controls for each channel at 31hz, 62hz, 125hz, 250hz, 500hz, 1,000hz, 2,000hz, 4,000hz, 8,000hz, and 16,000hz.

LED VU meters with \pm 0.5db accuracy show levels for each channel. It is 17" wide, 6 1/2" deep and 4 1/2" tall.

PUT LIFE INTO YOUR MUSIC RISK FREE

Prepare for a shock the first time you switch in this equalizer. Instruments you never heard in your music will emerge and bring a lifelike sound that will envelop you and revolutionize your stereo system.

If your system doesn't spring to life, simply return the equalizer within 30 days in its original box for a refund.

To order your Sound Detonator Plus Tape Dubbing BSR 110X 10 Band Stereo Frequency Equalizer risk free with your credit card, call toll free or send your check not for ADC's \$249 value, but for only \$89 plus \$7 for postage and handling. Order No. 9724. CA res add 6% tax.

Wake up the sound in your stereo. Your sound will explode with life as you detonate each frequency band with new musical life. And now you'll be in control of two tape decks as an added plus.



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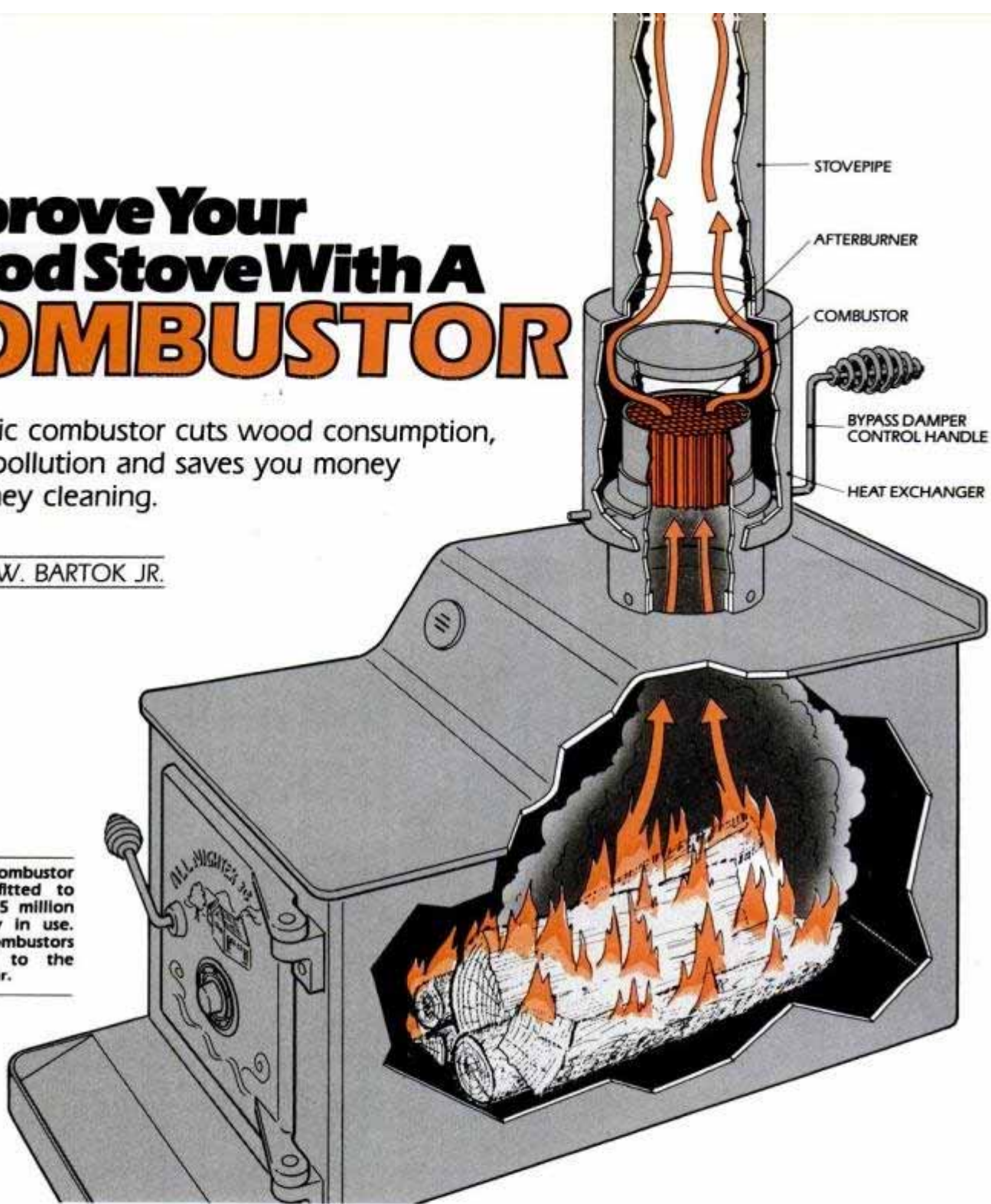
For credit card orders call 24 hours a day 7 days a week
CALL TOLL-FREE. . . 1-800-325-0800
10845 Vanowen St., N. Hollywood CA 91605

Improve Your Wood Stove With A COMBUSTOR

A catalytic combustor cuts wood consumption, reduces pollution and saves you money on chimney cleaning.

BY JOHN W. BARTOK JR.

A catalytic combustor can be retrofitted to most of the 15 million stoves already in use. Most retrofit combustors are fastened to the stovepipe collar.



New, longer lasting retrofit catalytic combustors that can improve stove efficiency by 10 to 25 percent are now available. Besides substantially reducing the amount of wood needed during a heating season (if you rely heavily on a wood stove), these combustors also cut back creosote formation and pollution by as much as 80 percent, thereby lessening the potential for chimney fires and acid rain.

Priced under \$150, the typical retrofit unit will pay for itself in two years if you count the savings on wood and the fee for one chimney cleaning per year. Improvements in design and manufacture have corrected problems that caused cracking, catalyst flake-off and

early burnout in earlier models. The service life expectancy of the new catalytic combustors is now realistically set at three to six years.

A combustor unit consists of a cast-iron or sheet-metal housing and a damper mechanism that contains the element. Surfaces of the element are coated with a noble metal catalyst—either platinum or palladium. Some models also have a view port that lets you see the combustor in operation and a thermometer to measure the temperature of flue gases.

When hot gases contained in the smoke of a wood fire pass through the combustor element, it heats up. A chemical reaction promoted by the cat-

alyst coating lowers the ignition temperature of the hydrocarbon gases in the smoke to about 600° F. When the element temperature reaches that point—known as light-off—the smoke literally burns, releasing latent energy that goes up and out the chimney when stoves aren't equipped with catalytic combustors.

After light-off occurs, the element temperature may increase to 1,700° F. and above. At temperatures above 1,100°, the combustor glows red. If

(Please turn to page 16F)

John W. Bartok Jr. is an associate research professor and an extension agricultural engineer at the University of Connecticut. He has written numerous articles on solid-fuel heating.

Thunder Lizard Mistake Plus

Earlier this year we offered a 15" BSR speaker system with the wrong tweeter at a close-out price. Now, here's a super improved version of the same speaker for the exact same close-out price.

It was a mistake. Somebody goofed and put the wrong tweeter in 3500 of BSR's best 15" 3-way speaker systems.

THUNDER LIZARDS

BSR's salesman referred to the speakers as Thunder Lizards because the 15" acoustic suspension bass driver is so powerfully dramatic that it can literally recreate the power of an earthquake or explosion in your living room.

Unfortunately, without the brilliant and powerful exponential horn tweeter, the bass simply overwhelmed the highs and so the name Thunder Lizard was born.

But, DAK came to the rescue. We not only bought all 3500 of the speakers, we bought the exponential horn tweeters that BSR had left out and let our customers install the correct tweeter themselves. The highs and lows this system created were nothing short of awesome.

BUT, THERE'S A PROBLEM

We thought we'd have enough speakers for the rest of the year, but we sold over 3300 in just our Spring Catalogs. So, we went back to BSR and tried to buy more of the speakers. But, they only sold us the first batch at a close-out price because they had put in the wrong tweeters and didn't know what to do with them.

BSR said that luckily they didn't make mistakes very often and the only other 'problem' they had was an inventory of 6000 too many super tweak 8" midrange drivers with an exotic polypropylene cone they used for an expensive BSR tower system.

LOOK NO FURTHER

Well, to make a long story short, we got BSR to replace the plain paper 5" midrange in the Thunder Lizard Mistake with the new exotic 8" polypropylene midrange driver. And, they put the correct tweeter in for us too.

So, for exactly the same close-out price, we have 6000 speaker systems that produce a kaleidoscopic panorama of sound that is nothing sort of incredible. You're in for an earthshaking, bone jarring musical experience.

The exponential horn tweeter gives you startling dramatic highs to 20Khz. You won't just hear cymbal crashes, you will experience them. The highs are simply brilliant. Plus, a brilliance control lets you decide just how powerful you want the highs to be.

The bass, all the way down to 20hz is reproduced with thundering accuracy by



the pride of the BSR line, a 15" acoustic suspension bass driver. The lows seem to have life of their own.

You'll hear string basses emerge that you never knew were in your recordings. Just a bass drum is an experience.

And finally, the midrange from 1000hz to 4000hz is flawlessly reproduced by the newest development in high-tech speakers. Instead of using paper, polypropylene is used.

Its characteristics give incredible purity to the entire midrange. It's much more accurate than a paper midrange.

And, it's a perfect match for the dramatic thundering bass and startling highs these speaker systems produce. There's a presence control that lets you adjust the midrange level to suit your taste.

GREAT LOOKS AND GREAT SOUND

The beautifully crafted wood-grain appearance cabinet is 29" tall, 18" wide and 10½" deep. It comes with a beautiful removable real cloth speaker grill.

BSR backs this system with a 2 year limited warranty, and speaking of protection, the tweeter is fuse protected. The system can handle 180 watts peak, 90 watts continuous and requires 15 watts.

NEVER AGAIN?

BSR says that this is it. When these 6000 speakers are gone, there'll be no more. They say they have no more mistakes and no more extra speakers.

Well, we're delighted they make mistakes. And, we know once you've heard these 15" three-way speaker systems you'll be delighted too.

**'THUNDER LIZARDS NO MORE'
RISK FREE**

Soft listening will give you a fullness and realism of sound not possible with conventional 10" and 12" speaker systems.

And, wait till you (and your neighbors) hear the thundering realism of high volume listening with these incredibly pure audiophile speaker systems.

Normally, only the most sophisticated audiophile can afford the ultimate, a 15" 3-way system. But now, due to BSR's errors, anyone can experience the incredible realism of a truly great speaker.

If for any reason you're not 100% overwhelmed by these speaker systems, simply return them to DAK in their original boxes within 30 days for a refund.

To order your BSR top of the line 15" 3-way loudspeaker system with the exponential horn tweeter and the new 8" polypropylene midrange already installed by BSR risk free with your credit card, call toll free, or send a check not for the suggested retail price of \$199 for the system with the 5" midrange but for only \$119 each plus \$12.50 each for postage and handling. Order Number 9717. CA res add 6% sales tax.

Now, without even having to install your own tweeter, you'll experience dramatic earthshaking musical sound that's so startlingly alive, it'll send shivers through your body for years to come.



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IMPROVE YOUR WOOD STOVE WITH A COMBUSTOR

(Continued from page 16D)

adequate smoke and air are present, the combustor will continue to work even if smoke temperature drops to 300° F. because the element generates its own heat.

Catalytic combustors are most effective on airtight stoves that tend to produce a lot of creosote, and perform best at low to medium burn rates typical of overnight stove operation in fall and spring. At a high burn rate, a stove firebox often attains temperatures high enough to consume a lot of smoke without any assistance from the combustor.

Not everyone who has a wood stove should rush out and buy a catalytic combustor. Franklin-type stoves, fireplace inserts with screen fronts and other stoves that burn hot produce very little creosote and will benefit little from a catalytic combustor retrofit. Retrofit combustors installed on stoves

used only occasionally will take longer to pay back their cost. Although combustors can be added to most stoves, they will not perform equally well in all installations. Nor will a retrofit unit generally perform as well as a combustor that's built into the stove. Combustor design, location and smoke/air mixture influence efficiency.

In some cases, installation of a combustor voids a stove's UL listing. Check your local building inspector or fire marshal before modifying your stove. To date there are no nationwide safety standards for testing catalytic combustors. Efficiency and emission standards have been developed by the Wood Heating Alliance, the Oregon Department of Environmental Quality and several independent testing laboratories.

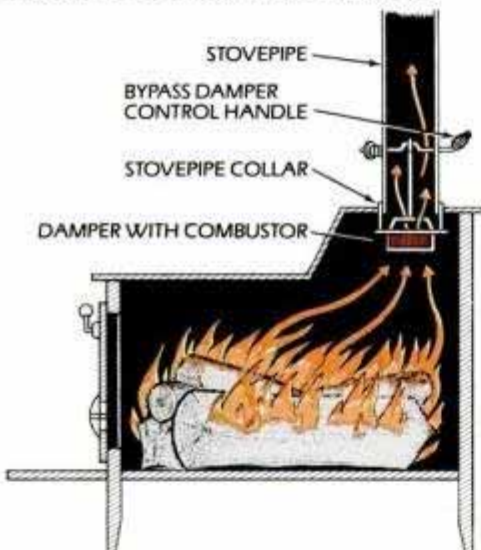
Before you purchase a combustor, inspect your stove's design and loca-

tion. Combustors do not work well on stoves with very efficient heat exchangers or baffles because most of the heat is removed from the gases before they leave the stove. With such stoves, it is more difficult for a flue-mounted combustor to attain light-off temperature. Combustor units that mount inside a stove may reduce the length and overall volume of wood that will fit.

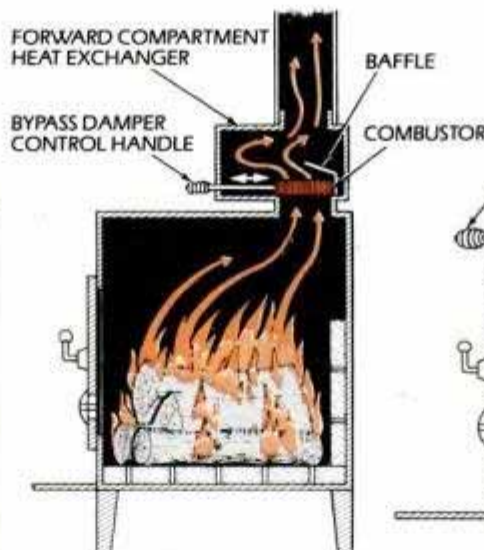
Most externally installed combustors are 8 to 12 inches long. To make the connection, the flue pipe will need to be shortened or the stove moved. There must be an 18-in. clearance from the flue-installed combustor to any combustible material. Since most retrofit combustors have diameters 2 to 8 in. larger than the stovepipe, where the existing flue has just an 18-in. clearance, adding a combustor would be unsafe unless the stove and flue were moved.

If you decide to buy a catalytic combustor, (Please turn to page 16H)

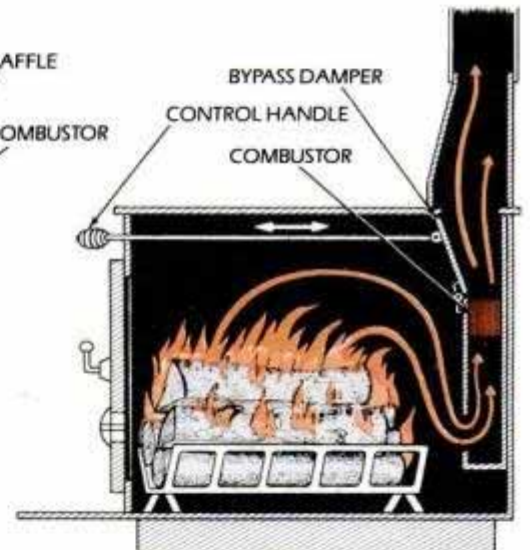
CATALYTIC COMBUSTOR LOCATIONS



THE RETROFIT UNIT FOR FISHER AND SIMILAR STOVES MOUNTS BELOW THE STOVEPIPE COLLAR.

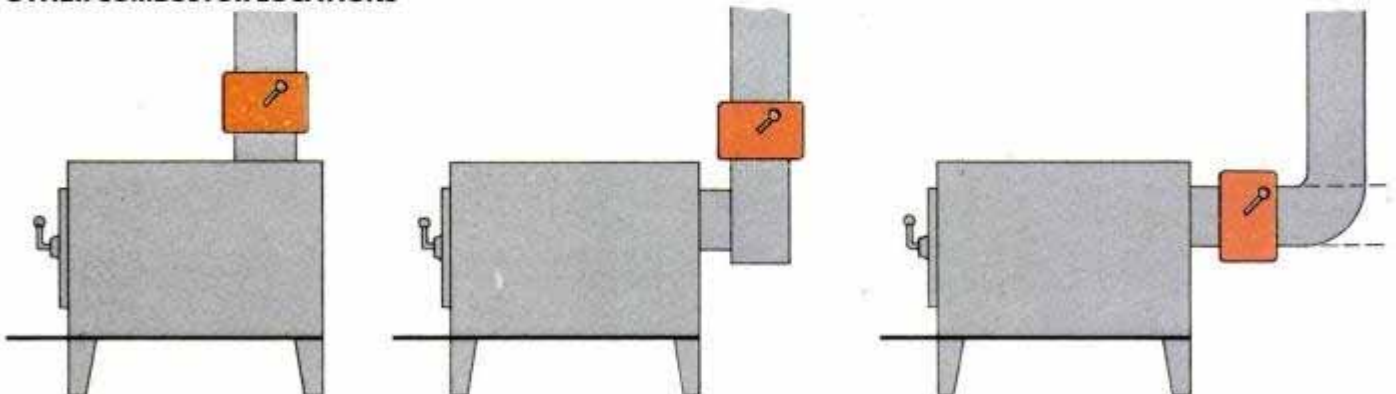


THE BAFFLE ON THE DORWOOD SMOKEMASTER FORCES GASES TO THE FORWARD COMPARTMENT WHERE HEAT IS EXTRACTED.



THE ARDEN SMOKE GENIE RETROFIT FOR FIREPLACE INSERTS AND FREESTANDING MODELS FITS INSIDE FIREBOX. BYPASS DAMPER IS OPENED DURING START-UP AND REFUELING.

OTHER COMBUSTOR LOCATIONS



AN ADD-ON COMBUSTOR SHOULD BE LOCATED CLOSE TO THE STOVE TO ACHIEVE AND MAINTAIN A 500° F. OPERATING TEMPERATURE.

\$49.50 BREAKTHROUGH!



When you are at rest, so is your heart. A low resting heart rate usually means you're in good condition. Have you checked yours?



When you exercise, you should reach your heart's target zone. But, have I reached my exercise target zone, or just had too much coffee?

Heart Window

Now you can exercise, rest, swim or go out to dinner wearing the latest in computer pulse takers on your wrist. Plus, it's a talented sports watch and a formal dress watch too.

By Drew Kaplan

It's a fact. You can tell a lot about yourself from your heart rate. You can evaluate the condition you are in, how much stress you are under, and how hard you should be exercising.

Think about it. How fast does your heart beat when you climb a flight of stairs? And how long does it take for your heart rate to return to normal?

Well, if you're at all like me, you may be a little out of shape. While I'm only 37, several friends of my own age have recently had heart attacks. And frankly, I'm getting just a bit worried.

You see, I am getting past the point where I can simply say, "I'll get back into shape next year."

So, whether you're a long distance runner (this is the ultimate jogging companion), or just a few pounds overweight like I am, your heart rate will give you a picture of your heart and body's condition.

Now you can take your heart rate anytime, anywhere with the newest in sophisticated electronic pulse takers.

And best of all, this heart computer is contained in a beautiful 24 hour alarm, 24 hour chronograph, LCD watch, that you will be as proud to wear with a coat and tie as you are when you're running.



YOUR HEART'S TARGET ZONE

Your heart, just like any other muscle in your body, requires exercise. Unfortunately, unlike your arms, you can't see your heart's condition just by looking.

The type of exercise called aerobic exercise is specifically designed to exercise your heart. The purpose of aerobics is to reach your heart's target zone.

So what is your target zone? Your target exercise zone is between 60 and 80% of your maximum heart rate. And here's an easy way to figure it out.

Simply subtract your age from 220 beats per minute. So, for me at 37, my maximum heart rate is (220-37) or 183.

So when I exercise I should get my

heart rate up to at least (183 X 60%) or 110 beats per minute, and no higher than (183 X 80%) or 146 beats per minute.

With the Heart Window to help me, I can be sure that my workouts are valuable for my heart and neither dangerous escapades or total wastes of time. Of course, **before beginning any exercise program you should consult your own doctor.** Note: The Heart Window is designed to indicate your pulse rate and aid your exercise, not to make medical diagnoses. **BUT ISN'T EVERYONE DIFFERENT?**

Here's the really exciting part. The worse shape you're in, the faster you'll reach the target zone and the less work you'll have to do to stay in the zone.

You see, as you get in shape, your heart doesn't have to beat as hard to do the same amount of exercise. Just as when you work out with weights your arms become stronger, your heart becomes stronger with aerobic exercise.

So the Heart Window is safe for the beginner or the athlete. And, you'll really see your improvement as you exercise.

But you don't have to exercise. Just wearing the Heart Window and using it at the office when you're under stress, after you've walked up some stairs or around the block, will make and keep you aware of your body's physical condition.

And look at this. Sit down at your desk and take your pulse. Then drink a couple of cups of coffee and take your pulse again. You'll see just what your morning 'pickup' actually picks up, and if, God forbid, you smoke, take your pulse before and after a cigarette. Wow!

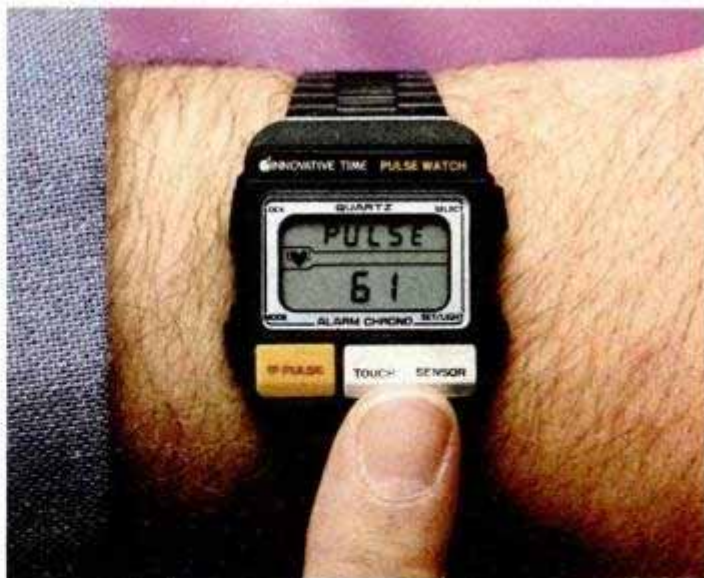
ALL ELECTRONIC

With Innovative's new Pulsemeter watch, you'll have supreme accuracy. It's like a direct electronic line to your heart.

You see, unlike other pulsemeters that use a light shining through your finger, or a microphone to take your pulse, this instrument actually measures the electrical impulses that cause your heart to beat.

The back of the watch is one receptor, and the metal touch sensor on the front of the watch acts as the other sensor. Just touch the sensor, and you'll see your pulse on the large LCD Display. **IS IT A DRESS OR SPORTS WATCH?**

Innovative Time thinks that everyone interested in their pulse must be a pro-



fessional athlete. So, they've built this watch with all the athletic extras.

It's not only water resistant, it's guaranteed to 60 feet (although you can't actually take your pulse underwater). It has a stopwatch, a lap timer, and dual finish mode. Its band is made of very tough polymers. So, it's a sports watch.

But wait, I don't like black watches for dress. So, I've gotten Innovative to add a deluxe matching stainless bracelet to the watch. It's rendered in stainless and black and is a perfect high fashion choice. So, it's a dress watch.

Plus, there's a 24 hour alarm and an hourly chirp. The stainless band is great for sports or dress. So, you'll get the watch with the black band on it and the high fashion band packed with it, compliments of Innovative Time's superb engineering and DAK's good taste.

The Heart Window is backed by Innovative Time's 1 year limited warranty and comes with a 1 year battery in place.

TRY THE HEART WINDOW RISK FREE

Now you can look at your heart as easily as the time. You'll see how you react to stress, foods and exercise. Don't let DAK's low price confuse you. Take this pulse watch to your own doctor and have him test it.

Try the Heart Window risk free. Try exercising and then check your cardiac recovery rate. If you don't like what you see, you'd better keep the watch. But if you just don't like the pulse watch, simply return it within 30 days in its original box for a courteous refund.

To order your Heart Window, Pulse Sports/Fashion Watch, complete with 2 bands risk free with your credit card, call toll free or send your check for just **\$49.50** plus **\$3** for postage and handling to DAK. Order No. 9844. CA res add sales tax.

In the gym, at the track or at the office, you'll have a direct connection to the condition of your heart.



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NRI can show you how to make money repairing small engines!

There's plenty of opportunity for the man who can service mowers, garden tractors, chain saws, outboards, mopeds, motorcycles, snowmobiles, etc.



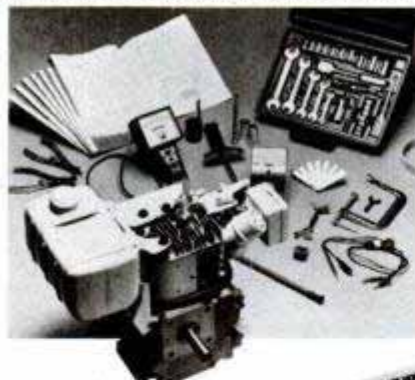
There are 50 million small engines out there, and many are waiting for qualified servicemen to fix them. NRI can give you the training you need to cash in on this opportunity, and you learn at home in your spare time, at your convenience.

Includes 5 HP Engine

You learn by doing with NRI "hands-on" training. As part of the NRI Master Course, you get a brand-new 5 HP Tecumseh commercial engine to work on. You learn to diagnose problems, tuneup and adjust, even tear down for valve and ring jobs. And your training includes professional tools like an inductive tachometer, volt-ohm meter, torque wrench, valve spring and ring compressors, complete wrench set, and more...all to equip you for learning and earning.

Choice of Two Courses

NRI's Basic Course puts special emphasis on lawn and garden equipment, teaches you the theory and practice of ignition, lubrications, cooling, and starting



systems. Its 30 "bite-size" lessons concentrate on one subject at a time to let you move at your own pace, give you greater clarity and faster learning.

The same teaching techniques give you advanced training on the 45-lesson master course...training in the repair and servicing of a wide range of other motors including generators, industrial equipment, even motorcycles. You learn to service electrical systems, transmissions, clutches, power take-offs, and more.

Exclusive Factory Training

Although not required for graduation, your Master Course includes five intensive days of optional training at the Tecumseh Factory Service School. Here, you'll work with master technicians and instructors, getting first-hand experience in subjects like solid-state testing, transmissions and transaxles, engine teardown, two and four cycle carburetors, magneto theory, troubleshooting, and more. All designed to prepare you for success.

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COMBUSTOR

(Continued from page 16F)

bustor, review the instruction manual for each model your dealer offers. Some manufacturers provide only a couple of sentences of installation information while others offer several pages. Be sure that installation and operating instructions are clear. Also check on the assembly required for each model you are considering. Is everything that's needed to install the unit provided or will you have to buy extra components or tools? Above all, make sure the unit you select is compatible with your stove.

Evaluate the design, construction and materials used for each combustor unit. As a rule, cast-iron housings last longer than ones made from sheet metal. The bypass damper should be easy to operate and have a handle that remains cool. Look for a unit with an easily replaceable element.

When a unit you are considering has been tested by an independent lab, try to obtain the test data. They can indicate installation and operational problems prevalent in a particular model.

Evaluate warranty provisions. They vary from one to 10 years with most manufacturers prorating over a five-year period.

Installation problems

Installing most retrofit catalytic combustor units is relatively easy, especially if the maker supplies detailed instructions. Units designed to modify stoves themselves usually attach to the inside or top. External units made for installation on the stovepipe should be positioned as close to the stove as possible and therefore usually replace part of the first section of the existing flue. The stovepipe should be 24-gauge or heavier to meet the National Fire Protection Assn. code. Nongalvanized pipe is preferred.

When a catalytic combustor is being added to an existing stove installation, the stovepipe should first be cleaned. Dismantle the pipe, which is usually made up of 4-foot sections screwed together at the joints, and take the pieces outdoors. Remove the built-up creosote with a wire brush. Check the chimney at this time—if there's a creosote layer 1/8-in. thick or more, or if you find fist-size globs stuck to the flue liner, clean them away or have them removed by a chimney sweep.

Most combustor units come ready to install, but some require assembly of the damper mechanism or attachment of handles. Before mounting the combustor, make sure that all clearance requirements will be met. Unless oth-

(Please turn to page 16J)

Identity Crisis

\$99 BOMBSHELL



Here's the world's most unique clock radio. But, it's also the ideal Executive Link for your office. Either way, it's your link to the outside world.

You're at your desk. Soft beautiful FM music is gently caressing you. You feel your tensions melt, your mind clears, and you're ready to take on the world.

Plus, wouldn't you like to see the Space Shuttle Lift off, the 9th inning of the World Series, and the news as it happens?

OR

You're lying in bed. Your mate's asleep. You're watching the late late movie. An earphone gives you total privacy, and if you fall asleep, you know that the TV will turn itself off within the hour.

In the morning, you can wake to TV, FM, AM or alarm. If you wake at night, you'll see the time on the extra large LED display with high/low brightness.

And, you won't have to worry about losing the time if there's a power failure once you install the standard 9V battery (not included) for protection.

OR

You're in your car or camper (not driving). You've plugged this entertainment center into your cigarette lighter, using the optional cable. And, you're watching the last quarter of the Super Bowl.

Now, no matter where you are, you can have great sounding AM and FM radio, or VHF and UHF TV.

FITS ANYWHERE

This beautiful micro-entertainer measures a mere 9½" wide. Its space-age silver and black styling adds a stunning look to any room at home or at the office.

While it's certainly the ideal bedside companion, think of the late nights you've spent at the office. Don't you deserve to have a companion that's a direct link to the outside world on your desk, credenza, or even a bookshelf?

HAS EVERYTHING

First the alarm. You'll enjoy every stan-

dard feature. There're fast and slow time and alarm settings. A sleep switch that lets you have up to an hour of AM, FM or TV before it shuts down for the night.

A snooze bar lets you have 9 minutes of extra sleep in the morning before the TV, radio, or alarm attacks you again.

And look at this. 59 minutes after the alarm turns on the radio or the TV, it will automatically shut itself off. In 24 hours, the cycle will repeat itself, so there's no need to reset this clock radio TV.

GREAT SOUND SAYS IT ALL

You'll enjoy the full rich sound you'd expect from an Emerson clock radio when you switch to either AM or FM.

The FM tuner really pulls in the stations. And the full range speaker has a very pleasing and full rich sound.

Of course, with the touch of a button, you can also tune in your favorite AM stations. You can keep up with the latest news or music on AM.

In the dark, linear volume and tone controls are a real luxury. So whether you're listening to the built-in speaker or the included earphone, you'll be in easy control of your music or TV.

BUT IT'S THE TV

Imagine a 4½" black and white TV that's incredibly sharp and clear. While it's certainly not for a crowd, it's perfect for viewing on your desk or night stand.

A rod antenna really pulls in the stations, or you can connect your own antenna. An adjustable flip up stand (as pictured) lets you set the angle for desk viewing (up) or bed viewing (down).

You'll have full control of brightness and contrast as you'd expect. But it's particularly important with this TV, because you may be in a very bright office or a very dark bedroom.

Just choose any station 2-13 VHF or 14-83 UHF and enjoy your TV. It's made by Emerson and backed by their standard limited warranty.

TRY THE IDENTITY CRISIS RISK FREE

I've been moving my sample TV between my office and night stand for about a week. I seem to use the radio more during the day and the TV more at night.

But, it sure is nice to have a TV handy when world events happen. This ad is being written on April 24, and I've been keeping up with the news on the San Jose earthquake all day. (My wife's parents live in San Jose and they're OK).

So, try it where you like. If you're not 100% satisfied, simply return it to DAK within 30 days in its original box for a courteous refund.

To order your beautiful Emerson AM/FM Clock Radio TV risk free with your credit card, call toll free or send your check for just \$99 plus \$7 for postage and handling. Order No. 9846. You can order a 12V adaptor cable that plugs into your car's cigarette lighter for just \$6.50 (\$1 P&H) Order No. 9847. CA residents add sales tax.

It's small enough to sit on your desk, but it's big enough to bring you the world. Now you can have the world at your fingertips at the office where you work or at home where you rest.



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Skylighting with **VENTARAMA®**



Cutaway View of New LO-DOME™

FEATURES:

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COMBUSTOR

(Continued from page 16H)

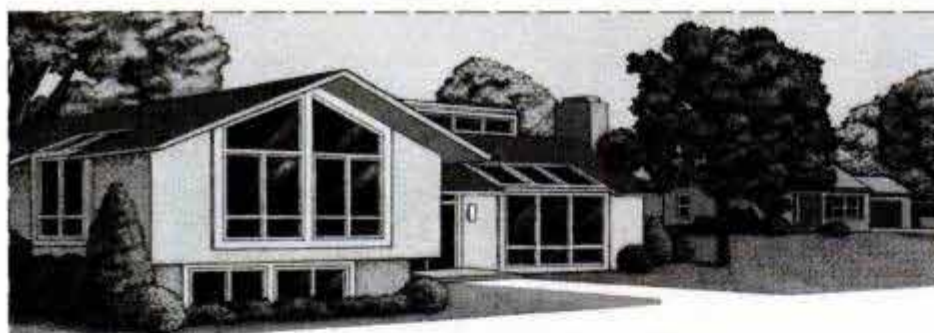
erwise specified by the manufacturer, maintain at least 18 in. from walls, drapes and any combustible materials. In some cases, especially fireplace installations, the stove may have to be relocated to allow room for the combustor. A larger floor mat may be needed.

Most units are designed to fit an 8-in. flue collar. Reducers, available at stove shops and plumbing suppliers, are needed for smaller stovepipe. To get the proper fit, the first section of pipe may have to be shortened. Cut from the top section of pipe, opposite from the end with the preformed lip.

Apply furnace cement at all connections between the pipe, combustor and flue collar. Fasten components with three sheet-metal screws or stovebolts at each joint.

Before completing the installation, add the accessories, if any. Some units have an integral thermometer. If yours doesn't, buy and attach a surface-

(Please turn to page 16L)



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This book's on passive solar homes. Handsome, comfortable homes where many owners report savings on heating ranging from 40 to 80 percent compared to traditional homes.

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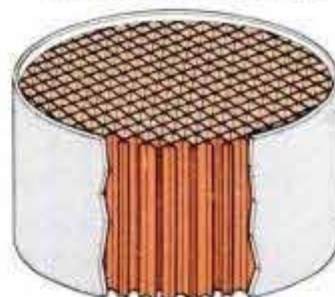
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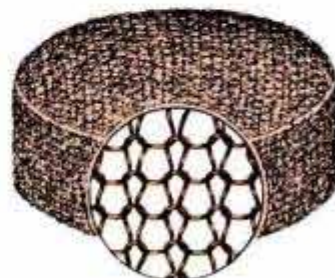
COMBUSTOR CONFIGURATIONS



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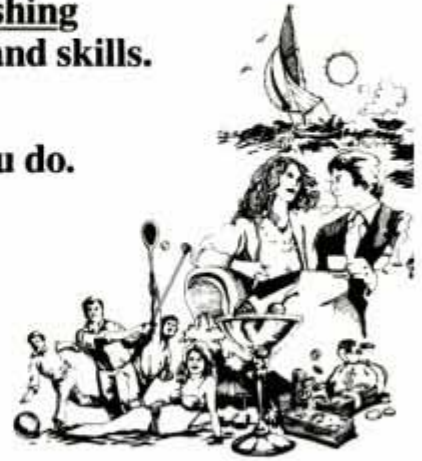


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IMPROVE YOUR WOOD STOVE WITH A COMBUSTOR

(Continued from page 16J)

mounted thermometer capable of measuring up to 1,000° F. It will help you operate the combustor properly by indicating the level at which the combustor should be used.

Operating tips

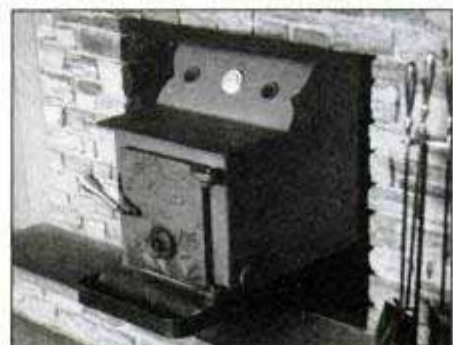
Because it acts like a damper restricting the flow of smoke, the combustor damper should be open when you start a fire and reload the stove. Close the damper when the thermometer reads 500° to 600° F. You may

need a large air-adjustor opening prior to closing the combustor damper and for a few minutes afterward to attain light-off.

Catalytic systems work best when a stove is filled to capacity, dampened down and left for eight to 12 hours before the next refueling. To operate this way, a good bed of coals must be established, and logs should be spaced to promote heat and air circulation.

The combustor needs both heat and
(Please turn to page 16N)

How To Install A Catalytic Combustor



An existing stove installation may have to be moved to create space for an add-on combustor. Stove above will be moved farther out into the room because the combustor unit will be mounted at rear.



Combustors like one shown above require assembly before installation. Be sure bypass damper moves freely before mounting assembled unit. A remote thermometer was substituted for one supplied by maker.

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Position the combustor as close to the stove thimble as possible to expose it to the highest possible temperatures for efficient operation. Here, unit is at back of stove. Note bypass handle at top.



If combustor is different diameter than stovepipe or thimble, a sheet-metal reducing coupling will be needed. Make connections tight by filling them with furnace cement and join them with screws.



A 90° elbow was joined to the reducer and then to vertical stovepipe running up chimney. Bore a hole in elbow near combustor for remote thermometer's probe.



Existing stovepipe needed shortening to accommodate combustor. Here, sheet-metal snips are used to cut pipe for the adjustment. Don't cut off the preformed lip.

What's this woman doing?

Several years ago, I was a teacher in Akron, Ohio. One evening my wife and I were visiting a group of faculty friends. One of them began discussing a very simple small business that a person can start at home — a "home money project", as he called it. But when he told me how much money it brought in, I almost dropped my coffee cup on my lap.

My wife and I discussed the project as we were driving home. We decided to try it.

The project kept us busy about 8-9 hours each week. We used our dining room as an office and kept supplies in one corner of our hall closet.

At first our income was small — \$75 to \$95 per week. But, as the months passed, we began making over \$700 A WEEK — all at home.

Let me emphasize one thing. This is very important. Our "money project" is moral, honest and downright enjoyable. And, it's 100% your own. It doesn't involve working for anyone else.

I explained the project to my mother in Akron, Ohio. She was 71 years old and lived by herself in an apartment on West Market Street. Within the first 90 days she made over \$3,000. All by herself!

As our curiosity grew, we discovered a variety of other people making money but with somewhat different projects...

I talked with an Iowa housewife who's been earning thousands of dollars for over six years. She uses one bay of her garage as a work area.

- She makes up to \$200 per week in her spare time.
- She provides a needed service to her community.
- She works exclusively at home... using a card table. She doesn't need a special office of any kind.
- She works for no one else. There is no selling involved. Most of her clients call her at home. In fact, she installed a phone in the garage.
- Her service is so simple that almost anyone with a flair for crafts could start the same business in their own neighborhood within 20 days.

OVER \$35,000 PER YEAR

Two New Jersey housewives I spoke with started a similar project two years ago. Both of them have young children at home and households to run — in addition to their home-based business. Currently, their part-time project is bringing in over \$35,000 a year.

A California couple using the same project we used made \$14,870 in just five months.

Obviously, this is exceptional income. What you make will be up to you. But the income potential from some of these projects can be staggering. A husband and wife team I spoke with started a money project similar to ours. Last year, operating full time, they earned over \$108,000 — all at home on their farm in western Wisconsin.



FEATURED ON NATIONAL TV

The complete story of several of our money projects recently appeared on a national television series. Other projects have been featured in numerous newspaper and magazine articles throughout the U.S. and Canada.

HOW TO START

First, you must be willing to work. All of these projects require time, energy and creativity.

Second, you'll need some working space in your home or apartment. A telephone will help, too.

Third, our projects are tested and workable. No envelope stuffing schemes, no "party plans", no door-to-door selling. None of that nonsense.

You won't need "money" to begin. Many of the projects can be started for as little as \$25 to \$50.

You won't need youth. Maturity and experience are excellent assets.

You won't have to wait. Most of these projects can be started in *just 15 days!*

Quite frankly, we're happy to share them with you. Because they involve creative projects that can be duplicated in thousands of neighborhoods all over America. The opportunity is nationwide. We won't be competing with you and you won't be competing with us. That's why we've put everything in a simple, easy-to-follow Starter Guide. It shows you how to begin each project — step by step.

TRY THIS TEST

1. When your Guide arrives, select one project. Read the directions carefully. Remember to begin slowly.
2. Try it for six months.
3. At the end of this trial period, examine your income. If you're not satisfied with the results, return the Guide and we will REFUND YOUR FULL PURCHASE PRICE... NO CONDITIONS... NO DELAYS.

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To prove that you can make extra money at home, you have our positive 100% money-back guarantee. Order your guide. Keep it for up to *six months*. This gives you time to actually *try* a project yourself. If you're not satisfied just return it. We'll send you a full refund within three working days... no nonsense... no excuses.

Also, feel free to *POST DATE YOUR CHECK 30 DAYS*. That way it's not cashable for a full month. I'll send your Guide right away. Read everything. Try a project. If you're not satisfied, return the materials and I'll return your original *UNCASHED* check. This way there is *absolutely no risk to you!*

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Dear Mary and Bud,

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Catalytic Monitor, a remote thermometer [above] from VT Group, RD 1, Morrisville, Vt. 05661, gives critical temperature data.

Extension legs and floor pad complete the installation (left). The pad should extend at least 12 in. from the sides and 18 in. from the inside of the fuel-feed door. Here, the fieldstone pad is in keeping with the hearth. The legs are of 1½-in.-square steel tubing that's cut to the correct length and fitted over the existing legs.

IMPROVE YOUR WOOD STOVE WITH A COMBUSTOR

(Continued from page 16L)

smoke to keep operating. Use a mixture of green and dry wood for fuel. When only green wood is used, gases are diluted with more combustion air, and smoke is cooled by the large amount of steam produced; the combustor may not operate as a result. This is true when only dry wood is burned since the oxygen-deficient condition that develops when the stove damper opening is reduced may drive heat output below the combustor's operating level.

Burning wood properly is more of an art than a science, and variations of wood species and weather conditions can affect day-to-day performance of a catalytic combustor. It is more difficult to get a fire started and build up temperature to light-off on a foggy fall morning than it is on a cold and windy winter day when there's a lot of natural draft.

Maintenance know-how

To extend combustor life, some makers suggest leaving the bypass damper open during the coldest part of the winter when the stove is operating 24 hours a day and a hot fire is continually maintained. Others also recommend operating the combustor at 1,200° to 1,500° F. for 15 to 20 minutes a day to burn off any carbon that may have collected on the element during the low-fire period.

From time to time, surfaces of the combustor element may need cleaning with a soft fiber paintbrush to remove ash buildup. Or you could blow it out with a hose attached to a vacuum cleaner's exhaust port.

If a combustor unit has a probe-type thermometer, carbon buildup should occasionally be scraped away. This will ensure that the readings remain accurate.

While catalytic combustors dramatically reduce the amount of creosote a wood stove produces, regular inspections of stovepipe and chimney are needed to ensure safe operation. Installing a catalytic combustor will reduce, but not totally eliminate, the number of chimney sweepings you will need.

Creosote formation, sluggish stove operation and more smoke than normal coming from the chimney indicate that a combustor element may need to be changed. Elements cost \$60 to \$100, and the replacement procedure is simple, once the combustor unit has been removed from the stove. Even when faced with replacement costs once in three years, you will still reap substantial savings for wood and chimney maintenance, and the reduction of pollutants will improve air quality in your neighborhood. **PM**

RETROFIT COMBUSTOR MAKERS

- Applied Ceramics, Box 29664, Atlanta, Ga. 30359.
- Versagrid
- Arden Industries Inc., 951 Sand Hill Rd., Asheville, N.C. 28806. *Smoke Genie*
- Catalytic Damper Corp., Front and Prairie Sts., Conway, Ark. 72032. *In-ten'si fire*
- CAT Engineering, 2112 North Roan, Suite 509, Johnson City, Tenn. 37601. *Catstack*
- Consolidated Dutchwest Inc., 10 Industrial Park Rd., Plymouth, Mass. 02360. *Catalytic Combustor*
- Dorwood Industries Ltd., 2901 Sturgeon Rd., Winnipeg, Man., Canada R2Y 0L4. *Smokemaster*
- Fisher Century Corp., Box 10605, Eugene, Ore. 97440. *In-stove retrofit unit*
- Jiffy Inc., Box 766, Old Saybrook, Conn. 06475. *Ultra-burn*
- Metal-Fab Inc., Box 1138, Wichita, Kan., 67201. *Smoke Consumer*
- Nu-Tec Inc., Box 908, East Greenwich, R.I. 02818. *Catalytic retrofit*
- Riteway Manufacturing Co. Inc., C & W Dr., Bridgewater, Va. 22812. *Uni-Com*
- Shenandoah Manufacturing Co. Inc., Box 839, Harrisonburg, Va. 22801. *Catalytic conversion kit*
- Sotz Inc., 13602 North Station Rd., Columbia Station, Ohio 44028. *Catalytic combustor*
- Suburban Manufacturing Co., Box 399, Dayton, Tenn. 37321. *Woodmaster Reclaimer*
- Vermont Castings, Randolph, Vt. 05060. *Catalytic Combustor*

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PM PHOTO HINTS

Handy cable holder



A length of coat-hanger wire bent to the shape shown at left above will keep a long shutter-release cable right at your fingertips. Clip the release plunger into the lower loop and hook the upper end over a tripod clamp knob.

— William J. Frazier

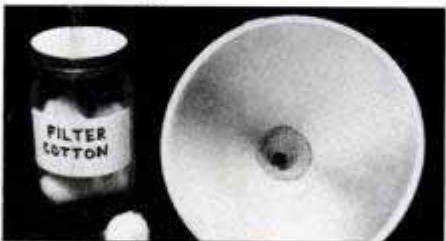
Spillproof bottle stand



You can keep small spotting jars from spilling with a nontip stand that you can make from a plastic coffee-can lid. Make two crisscross cuts in the lid and trim the points off the pie-shaped segments. The springy fingers will be able to grip your jars snugly.

— A. Weber

Corralling filter cotton



A mesh strainer cemented into the throat of a funnel will prevent small wads of filter cotton from slipping through the spout. Use a round piece of nylon screening slightly larger than the opening. — Robert Hertzberg

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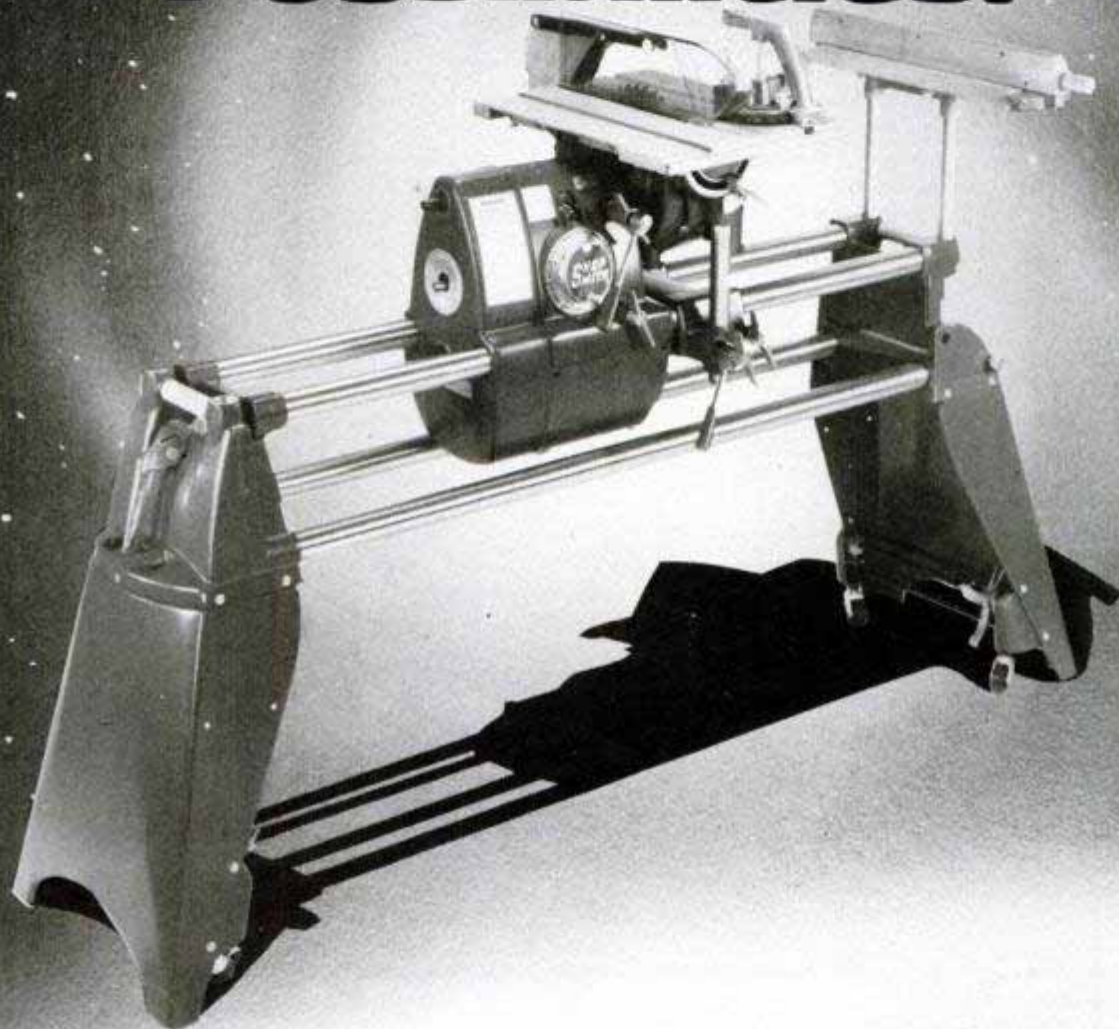
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Surge and drop back in Omni

Hope you can solve a problem with my 1980 Dodge Omni that three mechanics couldn't. While I'm driving at a steady speed, the car surges 2 to 5 mph and then drops back. This happens particularly in FIRST and SECOND gears, and is annoying in city driving. What's the solution?—L.W. Loewen, Wallace, Idaho

This problem should be diagnosed on a chassis dyno that is equipped with an emissions analyzer and an oscilloscope. With the car under load, the mechanic watches for changes in the spark pattern that would signal an ignition problem, or changes in emission levels which can indicate mixture problems if they occur while spark is normal.

Readings on the machines can help pinpoint the problem. Spark-dwell variation would indicate worn distributor bushings—a common problem on these engines. Intermittent loss of spark would indicate a loose connection or a potential pickup or control module

problem. High HC when spark is normal indicates a lean condition due to an air leak (vacuum leak), EGR malfunction or fuel-system blockage. Worn throttle-shaft bushings are a common problem on this engine that can cause an intermittent lean misfire. A mechanic can test for this and other vacuum leaks by applying propane gas to suspected leak areas with his idle-mix propane adjustment tool.

Sometimes this type of problem can be diagnosed on normal engine analyzers, without a chassis dyno. However, if the condition only appears under load, the dyno is necessary.

The only other alternative is a hit-and-miss approach. If you have to rely on this method, check the ignition timing at idle, 2,000 rpm and 3,500 rpm, and make sure it conforms to specs at each speed. If it's okay, check the distributor bushings and carb-throttle shaft bushings. If they're okay, try an EGR system test.

He's undecided now

After being driven 5,000 miles, the V6 engine in my new 1983 Chevrolet S-10 truck developed a knock that seemed to be coming from up front. The dealer thought it was the timing chain, then the fuel pump, then he didn't know. So he called Detroit and, 14,000 miles later, we're still waiting for an answer. Although the knock sounds terrible, performance isn't affected. But I'm worried. My warranty is about over. Can you offer any advice?—Milton T. Walker, Sophia, N.C.

Tell your dealer there are four parts known to produce knocks in this truck's engine:

1. Crank pulley. Remove the drive belt and run the engine at 2,500-3,000 rpm. If the knock has disappeared, you've found the offending part.

2. Connecting-rod bearings. Short out each sparkplug, in turn, with the engine running so you can hear the knock. When and if the engine stops knocking, you've located the cylinder with the noisy connecting rod.

3. Oil pump driveshaft. Drop the oil pan and inspect the shaft and surrounding area for witness marks. These indicate that the driveshaft is hitting up against an adjacent part.

4. Main bearing. Drop the oil pan and.

(Please turn to page 22)

Top to bottom

Two 1981 Ford Thunderbirds—my friend's and my son's—bottom badly. The dealer told them to live with the problem. Is he right?—G.V. Bates, Lancaster, Pa.

No, he isn't. Bottoming and topping out were aggravating problems with 1980 and 1981 T-Birds and Cougars because of short suspension-system travel. But heck, that was corrected two years ago by technical service bulletin (TSB) 81-19-4.

The TSB gives a list of things to check, including ride height measurements, to determine if new springs are needed before replacing the struts with ones that have different valving. The valving restricts the amount of fluid flow through the strut to lengthen suspension travel. In other words, to beef up the car's suspension. The struts have been in use on T-Birds and Cougars since 1982.

If your vehicle was manufactured before Dec. 5, 1981, and has standard or TRX suspension, the new strut has part No. E1SZ-18124-E. If the car has heavy-duty suspension, the number is E1SZ-18124-F.

If the car was manufactured on or

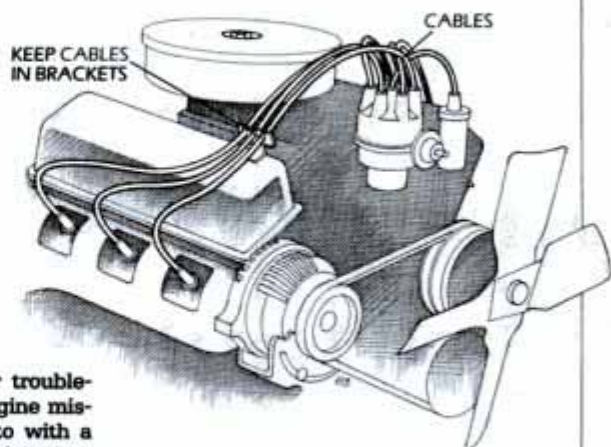
after Dec. 5, 1981, and is equipped with standard suspension, the new strut has No. E2SZ-18124-B. If the vehicle has heavy-duty suspension, the part number is E2SZ-18124-A.



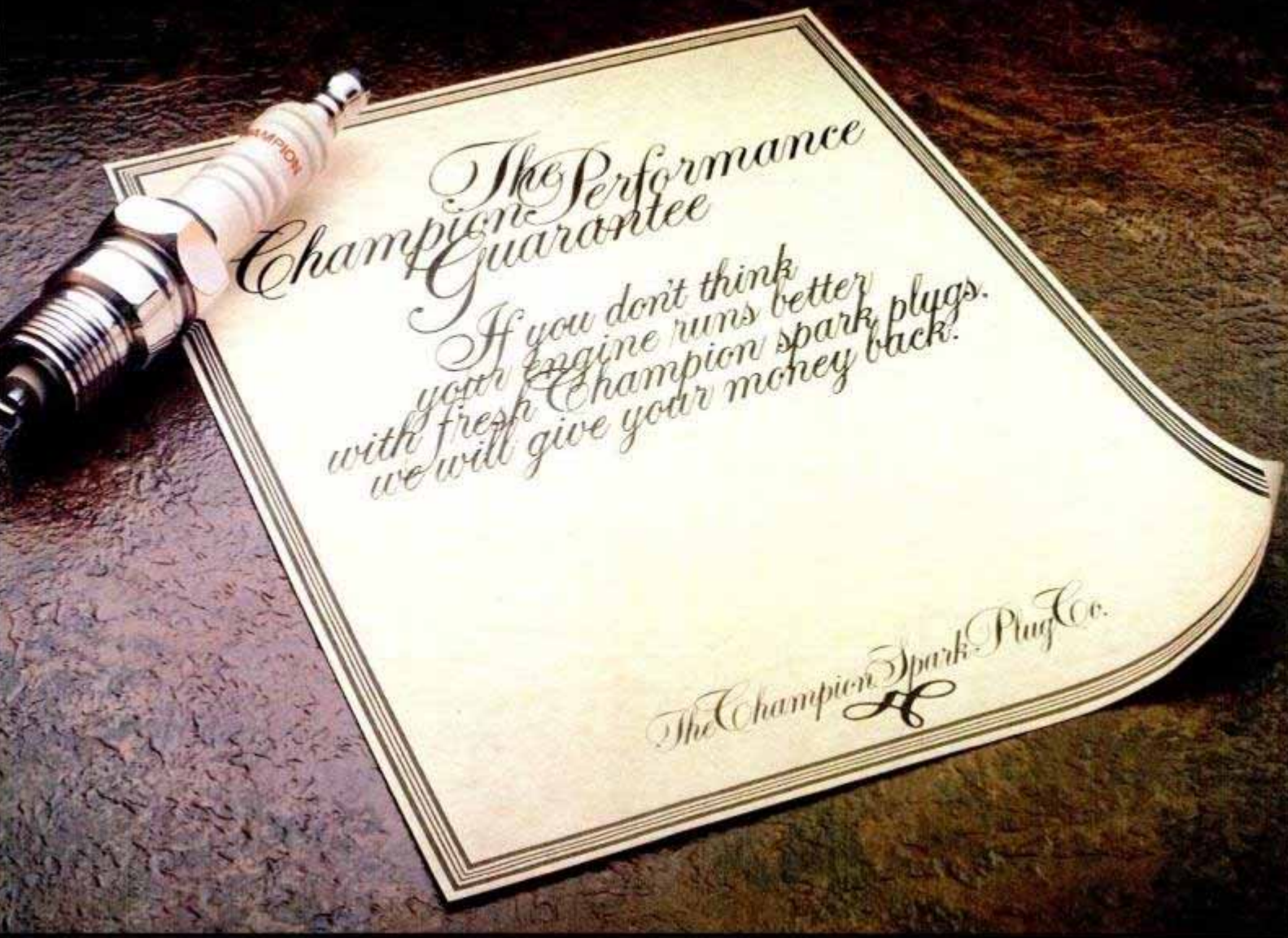
Firing line

Here's something to add to your troubleshooting repertoire concerning engine misfire. It's a situation that I ran into with a 1982 Grand Prix V6. Immediately after I had serviced the sparkplugs, the engine started to misfire like mad on acceleration. I traced down one after another of the usual causes for this problem, but to no avail.

Then, last week, as I was using a flashlight to find that elusive oil dipstick hole, the light just happened to fall on the sparkplug



cables. I noticed that one of the cables had drooped and was resting—and grounding—on a bracket bolt. I shoved the cable up and away from the bracket bolt, and ever since that time there hasn't been so much as a skipped beat coming from the engine.



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CAR CLINIC

(Continued from page 20)

using a gauge, check bearing play against the specification.

About your warranty: It stays in effect after the specified mileage or time for any problem you report during the warranty period. That's the law. It's wise, therefore, to put a complaint reported during the warranty period in writing. Have an official at the dealership sign and date a copy of the complaint, which should show the date the complaint is made and the mileage on the vehicle at that time. Retain this copy until the problem is taken care of.

'Oil's' well

Page 5-4 of the owner's manual for my 1983 Chevrolet Celebrity states, "SAE 5W-30 is the preferred viscosity grade." I've tried all over Omaha to obtain SAE 5W-30 oil. I called the dealer and GM zone office, but have drawn a complete blank. Is this a misprint in the manual?—Richard F. Svoboda, Omaha, Neb.

SAE 5W-30 has been the preferred viscosity for all small GM gasoline engines manufactured since 1980. That means all four-cylinder engines and the 2.8-liter V6 engine. SAE 5W-30 is pre-

PM CAR CARE

TIP

↓

Keep your digital display

Our thanks to Ford Motor Co. for this important advice:

More and more engines, especially those with four cylinders, are equipped with electronically controlled fans that begin to operate when coolant temperature reaches a pre-set level or whenever the air conditioning is turned on. Many of these electro-fan motors will even start functioning with the engine off and ignition key removed if the engine reaches hot soak temperature (coolant heat increases after shutdown).

Without trying to list those cars that can trigger the fan motor with the key off (some do, some don't), it's a good idea to disconnect the battery ground cable whenever it's necessary to work around the area of the fan blades.

Remember, some fans spin up to 35 revolutions per second. If your fingers are in the way, well, you may no longer have them.

ferred because it helps smaller engines start easier when ambient temperature is at or below 0° F.

What if you can't find SAE 5W-30? First of all, you should be able to get it. GM recently introduced the Good-

wrench line of engine oils that meets GM standards. Dealers should have SAE 5W-30 and other oil specified for GM engines under this label. If your dealer doesn't have it, he can order it.

If, by some chance, you're far removed from a GM dealer and need oil, use SAE 10W-30 as long as the temperature isn't 0° F. or lower. In fact, if you live in a place where the temperature never dips that low, you can safely use SAE 10W-30 in your small GM engine all the time.

GM's policy regarding oil for its passenger cars is unique in other respects. For example, SAE 10W-30 is recommended for larger gasoline engines (3.0-liter and larger V6s and V8s) and also for small diesel engines (1.8- and 2.2-liter). SAE 30 is preferred for 4.3-, 5.7- and 6.2-liter diesel engines, except at or below freezing when SAE 10W-30 and SAE 15W-40 is acceptable.

SAE 10W-40 is *not* recommended for GM gasoline and diesel engines under any circumstances. If you use SAE 10W-40 in a 1984 gasoline engine, you won't be covered by the warranty if an engine repair becomes necessary. The warranty is not affected for gasoline engines produced before 1984, since the non-SAE 10W-40 policy wasn't in force at the time. But, just the same, it's wise not to use it. As for GM diesel

engines, SAE 10W-40 has never been recommended. Therefore, if you use it and your warrantied diesel poops out, tough. GM says SAE 10W-40 leaves deposits that cause piston rings to stick and increases oil consumption.

Your warranty would also be voided by using the wrong quality oil in your GM engine. Use oil designated SFCC, or SF in a gasoline engine, and use oil designated SF/CD (preferred) or SF/CC in a GM diesel.

Avoiding higher authority

In the Service Tips part of the February 1984 Car Clinic (page 22), you gave part No. 3992372 for a restrictor to get rid of a fuel-line knock in GM 2.8-liter V6 engines. My Buick dealer told me he couldn't install it without getting approval from GM. What gives?—Walter Walka, Secaucus, N.J.

What gives is a change. That restrictor, originally sanctioned by GM, has been superseded by a thermal valve (part No. 14077716) that's installed in the fuel-return hose.

PM

DO YOU HAVE A CAR PROBLEM?

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

SERVICE TIPS

■ Those experiencing outer-edge tire wear on a 1982-84 Crown Victoria, Grand Marquis, Lincoln Town Car or 1982-83 Mark VI should rotate tires, set pressure (cold) to the maximum specified on sidewalls and adjust wheel alignment as follows: +4° caster, -0.25° camber, -1/16-inch toe-out. Maintain side-to-side caster and camber within ±0.75°.

■ Does the five-speed transaxle of your 1983-84 GM J-body car give you difficult FIRST or SECOND gear shifting, or gear clash when you upshift? This is most likely caused by excessive input shaft bearing preload that can be corrected by a thinner (.04-inch) input shaft shim. The procedure is outlined in technical service bulletins issued by the GM divisions under different numbers. To give you a frame of reference, tell the service department that Pontiac's TSB number is 84-7-20.

■ Honda considers the use of more than one quart of oil every 1,000 miles excessive for its 1982-83 Civic 1.5-liter engine. If you have this problem, get the newly designed pistons Honda now has available. In case the problem wasn't reported to the dealer during the 24-month or 24,000-mile warranty period, ask your dealer to request goodwill consideration from the district service manager so that you can recover the cost of the repair.



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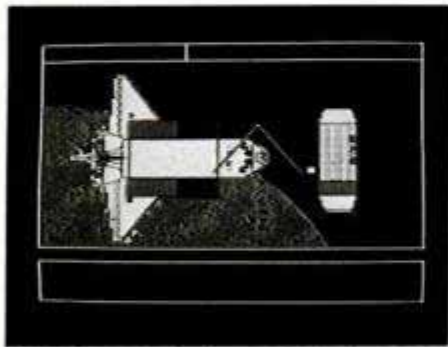
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With new software, an Apple or Commodore user can design a space station.



Leonard Nimoy, *Star Trek's* Mr. Spock, helped PM's science editor build a station.

PHOTOS BY STEVE ESKOW

I stood by as Mr. Spock docked our new space station by computer. "This is the correct way of programming," he said. "There's no emotion." The others aboard the retired aircraft carrier *Intrepid* laughed.

Leonard Nimoy, the screen's Mr. Spock of *Star Trek*, was on board the floating USS *Intrepid* museum in New York to introduce new personal computer software from Human Engineered Software (HES). Nimoy and I used it to create a space station. The software was designed with NASA's help. It is authentic and fun to use.

PM space experiment

Engineering studies are under way at New York Institute of Technology to prepare the packaging for *Popular Mechanics'* Space Shuttle experiment. The rig will contain the winning proposals from PM readers entering our Space Shuttle contest (see *Launch Your Experiment On The Space Shuttle*, page 68, June '84). Final entries are to be postmarked no later than midnight, Sept. 15. I hope you send yours in on time. First prize is a trip to the launch site.

Weakness for ice

We all know that ice is stronger than water. But does all ice have the same tensile strength? The question arose at Lawrence Livermore Labs after Voyager spacecraft photos in 1979 gave us close-up views of Jupiter's outer moons, Callisto and Ganymede. Both had patches of craters, but Ganymede's surface showed an apparent flow of matter. Since the surfaces of both moons consist largely of frozen water, researchers wondered why Ganymede's surface appeared to be different.

The answer may be that Ganymede's ice was formed at far lower temperatures than those of Callisto. Experimenting with ice formed at different temperatures, Livermore scientists discovered that the closer you get to absolute zero, the weaker the ice seems to be. The floes on Ganymede now seem to be accounted for.

Plastic steel

Automakers soon will be able to replace many fiberglass parts with a new kind of "plastic" steel developed at Stanford University. Oleg Sherby and his colleagues report that by mixing carbon with steel and heating the alloy to a relatively cool 1,200° F., they can bond six to 12 layers to form a sheet of easily moldable metal. Look for it in auto fenders of the 1990s.

Science sinks to a new low



Coast Guard demolition experts set off a midships explosion aboard this 435-ft. freighter, sinking it off the Florida coast. It's a reef where schools of fish are breeding.

Lowrance Reef off Port Everglades, Fla., literally exploded onto the map of the United States earlier this year. The 435-ft. reef was created when Coast Guard demolition experts set off an explosion on the former freighter *Mazon*. Engineers had torched a series of gaping holes just above the waterline before the blast.

Make-believe machines

A computer program developed by Sandia National Laboratories let's the designer of a machine run it through tests even before building a working model. The MULTAX-PLOT program provides 3-D images of the machine going through the processes for which it is designed. If the machine can't live up to specifications in reality, it will fail to do its job on the computer screen first.

The holes ensured that the ship would sink straight down to the bottom in over 200 ft. of water. Lowrance Electronics of Tulsa, Okla., provided the funding for the sinking. Now Lowrance reef is a breeding ground for schools of fish living off the Florida coast. Officials expect the new reef to enhance local sport fishing. **PM**

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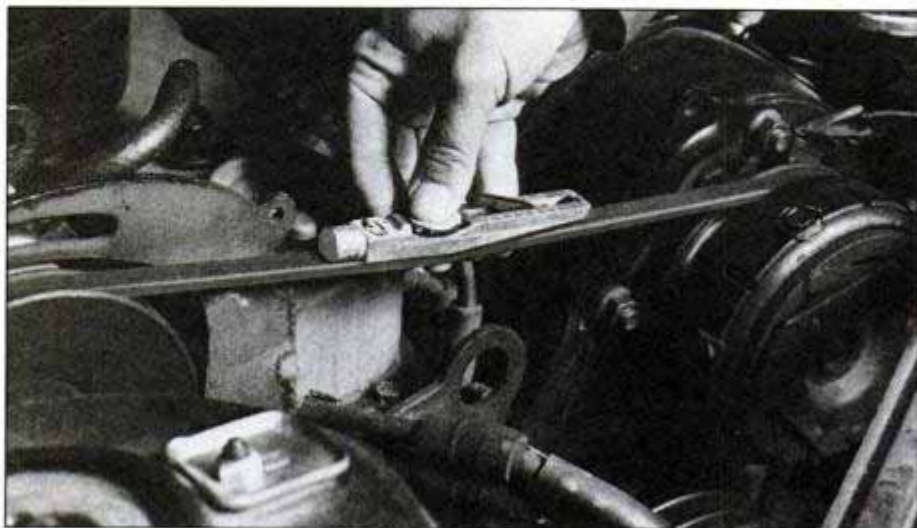
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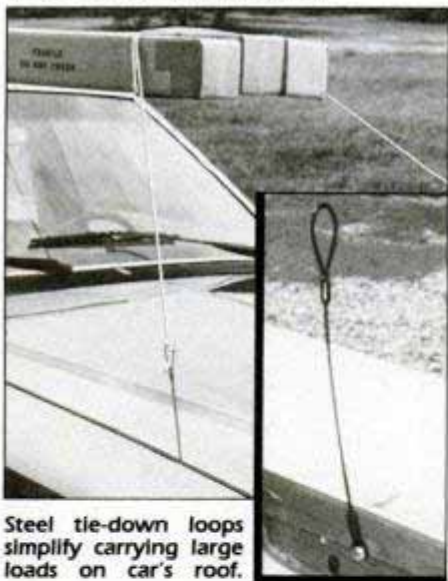
End tension headaches

You've read it here dozens of times—proper tensioning is crucial to fan belt longevity and performance. But, even some of the most serious home mechanics are reluctant to buy a special-purpose drive-belt tension gauge. The Gates Rubber Co. just took away your best excuse by introducing the Kriket. Lay this tool on a span of drive belt midway between two pulleys and push down on the checker button until you hear a loud click. Then read the tension off the calibrated scale, which runs from 30 to 160 pounds. Gates part No. 91107 is for standard automotive V-belts. Kriket II (No. 91132) is for V-ribbed belts requiring settings from 100 to 300 pounds. Kriket gauges cost \$11 each at auto parts stores and jobbers that stock Gates belts.—*W.H.*



Kriket V-belt tension gauge sounds off with a click when the gauge is ready to read.

Terms of attachment



Steel tie-down loops simplify carrying large loads on car's roof.

With trunk sizes shrinking and body styles getting smoother, it's certainly harder to carry big loads with new cars. Securz-it car top tie-downs give me four attachment points handy for hauling an occasional bulky load, such as plywood. The $\frac{1}{16}$ -inch stranded aircraft cables mount in hood and trunk gutter wells. Securz-it cables tuck out of the way when not in use. They are \$4.95 per set of four from Patent Products Inc., 19-F Gardner Rd., Fairfield, N.J. 07006.—*N.M.*

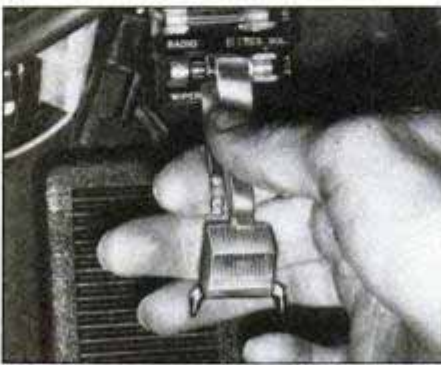
Three-way threat

For \$4.95, you can get this triple-threat fuse tool. It allows you to (1) remove, (2) install, and (3) test blade-type and glass fuses.

To test a blade-type fuse, turn on the car's ignition and all other switches. Insert the tool's contacts, which are adjustable, into the fuse slots. A red light glows if the fuse is bad.

To remove or install a blade-type fuse, snap the slotted handle end of the tool onto the fuse and pull or push. Use the hooked arm to remove a glass fuse and the slotted handle end to install a new glass fuse.

Refer to part No. J34764 when ordering the tool from Kent-Moore Automotive Allied Div., 29784 Little Mack, Roseville, Mich. 48066.—*Mort Schultz*



Fuse puller and installer also tests for continuity, glows red if fuse is bad.

Yanking the plug



Hard-to-reach terminals require a special hollow-sleeve tool in order to disconnect.

If anything proves working on new cars is tough, it's the once-simple job of disconnecting a wire. After you struggle to open the plastic connector, you still can't get the wire terminal out without some kind of tool.

Many terminals have a single tab that projects outward to lock the terminal in place. If you have an appropriate jeweler's screwdriver, you may be able to insert it and depress the tab. On some terminals under the hood, you need a hollow-sleeve tool that is a push-fit into the plastic connector and onto the terminals. A pair of tools for both kinds of terminals is now available for \$9 at auto parts stores. The maker is Thexton Manufacturing Co., Box 35008, Minneapolis, Minn. 55435.—*Pete Warren*

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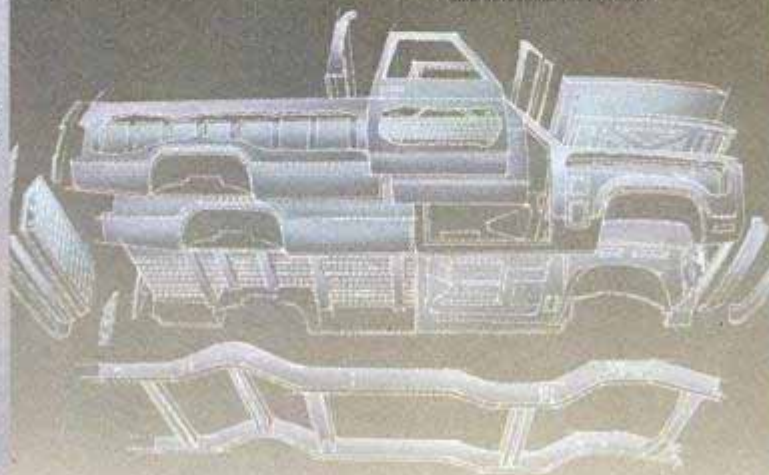
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Kings & 100's: 17 mg "tar," 1.1 mg nicotine
av. per cigarette, FTC Report Mar '84

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

Ready-Made Chimneys

You Can Install Yourself

Prefab metal stacks meet higher safety standards than their masonry counterparts and simplify adding a stove or fireplace.

BY PAUL B. STEGMEIR

Prefabricated metal chimneys are not only easier and less expensive to install than masonry chimneys, they must also pass rigid safety tests before they can be sold for use with oil, coal and wood-burning stoves, fireplaces and furnaces. When properly sized and correctly installed, metal chimneys offer excellent performance and safety benefits.

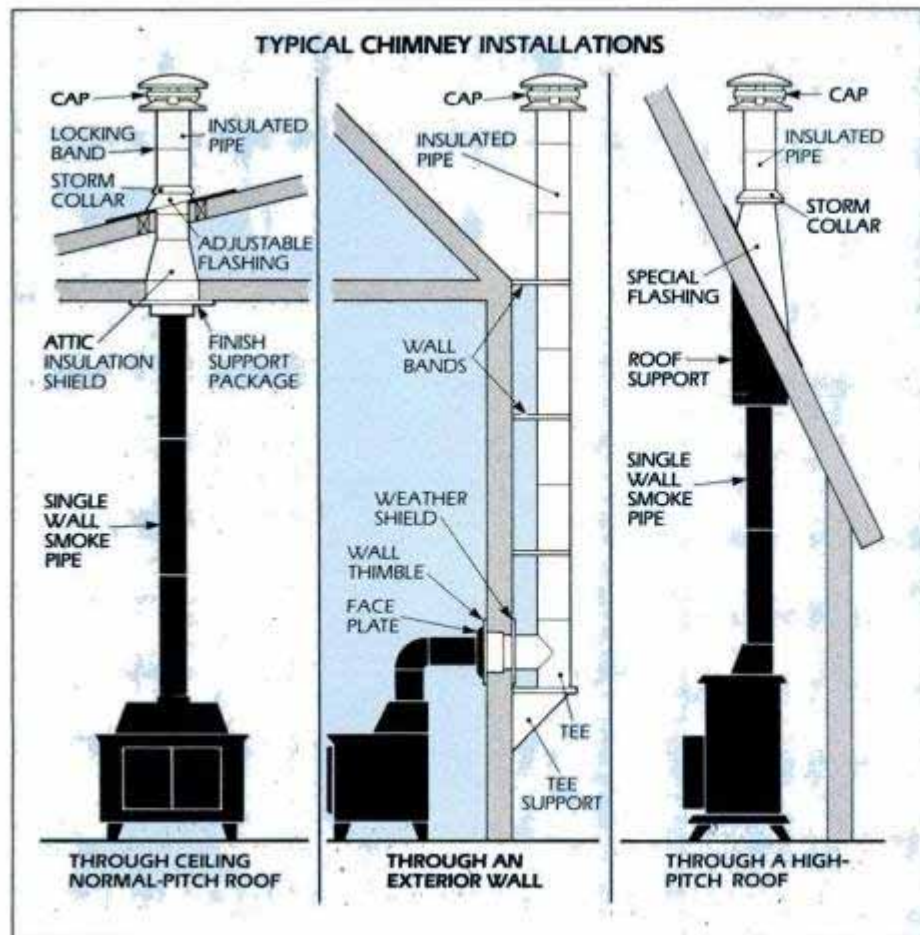
There are three basic types of factory-built chimneys. Each of the types uses a different means to insulate the stovepipe.

■ *Triple-wall thermal siphon* chimneys have three separate passages arranged

concentrically. Through a special cap fixture, the chimney draws cool air into the outermost passage. Because cool air is heavier than warm air, it flows downward to a support box near the chimney base where it mixes with air occupying the second ring inside the chimney. Smoke and hot flue gases flowing up through the third, inner-most chimney passage heat up air in the second ring. Heated air in the second ring flows up and out through a separate opening in the cap. The siphoning action created by the heavy, cool air in the outer ring and the lighter, heated air in the second ring provides constant cooling and two air



Careful installation of a metal factory-built chimney involves much less labor than the construction of a masonry unit.



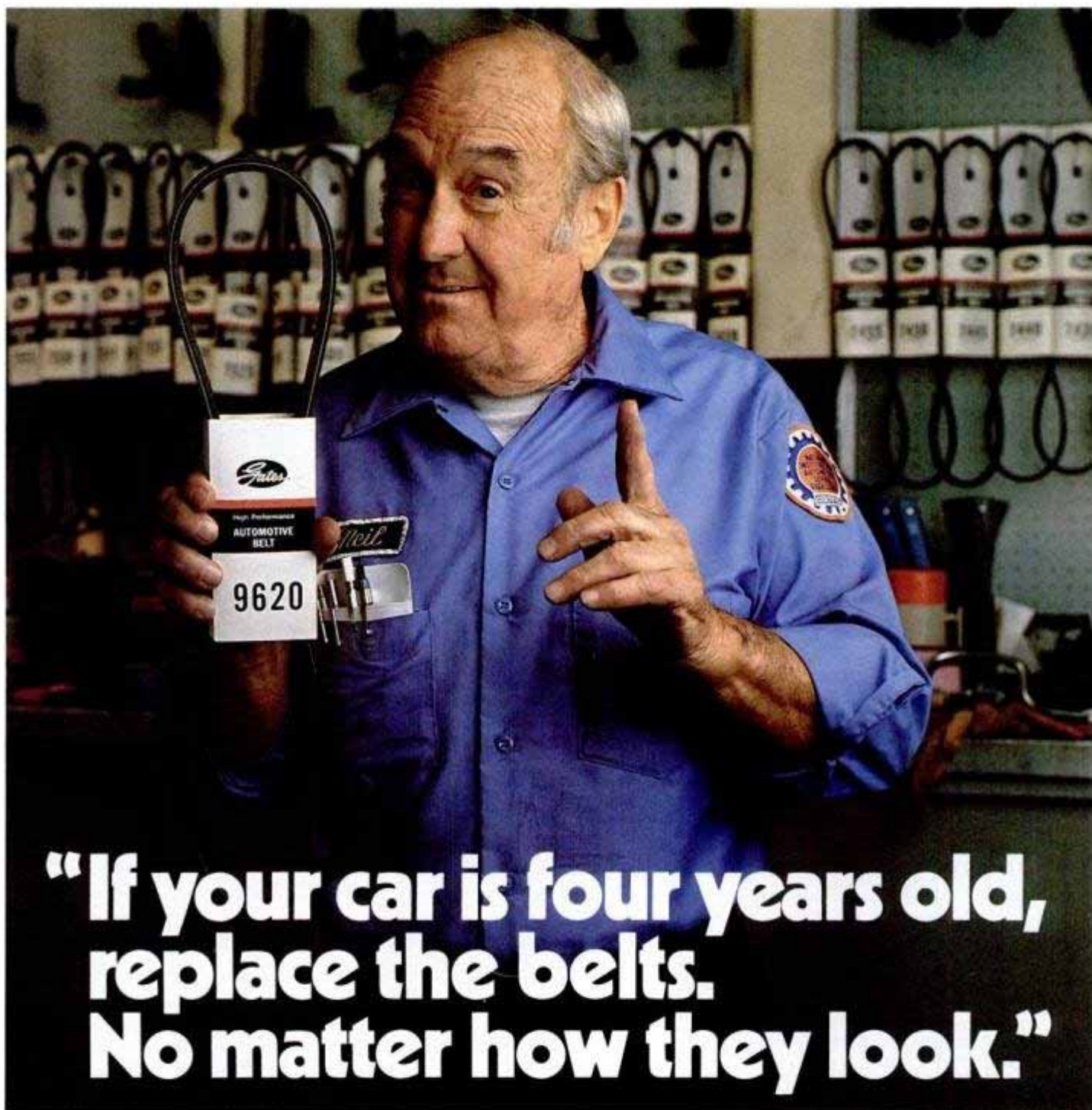
layers to insulate against the high temperatures at the chimney center. Triple-wall thermal siphon chimneys are most often used with zero-clearance fireplaces and open fireplace-like appliances. There are also some double-wall chimneys that use the thermal siphon principle. These are used only with appliances specially designed, tested and listed for compatibility.

■ *Triple-wall air-insulated* chimneys are similar in appearance to thermal siphon but do not rely on air movement to cool the inner chambers. Instead, the two layers of air surrounding the smoke passage merely insulate. Limited thermo-siphon cooling may take place in these types of chimneys.

■ *Double-wall insulated* chimneys, also known as solid-packed systems, are constructed with two layers of metal separated by a layer of insulation material. The insulating material limits heat transfer from the flue to the outside of the chimney. The insulating materials commonly used are ceramic fiber, mineral wool or a combination of silica

(Please turn to page 32)

Paul B. Stegmeir is a consultant, author and lecturer on residential energy alternatives, and an authority on solid-fuel appliance safety.



**“If your car is four years old,
replace the belts.
No matter how they look.”**

Today's engine belts don't show wear the way they used to. Even an experienced mechanic can't always tell if they're about to go, just by looking. And strangely enough, most car owner manuals don't say when to change them.

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READY-MADE CHIMNEYS

(Continued from page 30)

powders and fibers. In most factory-built chimneys, the flue lining is stainless steel. Most double-wall, solid-packed chimneys have a stainless outer wall as well, although in some of the less expensive double-wall units, the outer wall is galvanized steel. Triple-

wall systems most often have a mid-wall section of aluminized steel and an outer wall of galvanized steel.

Choosing types and sizes

It is generally best to select a double-wall solid-packed or triple-wall air-insulated chimney for a stove or furnace whose manufacturer makes no specific chimney brand recommendation. These types operate with higher flue temperatures under low fire conditions than thermal siphon types and are therefore less susceptible to condensation of moisture and creosote.

Choosing the correct-size chimney is important. The flue size should be the same as the flue outlet on the heating appliance. When a flue is larger than the diameter of the appliance outlet,

there is a tendency for poor draft at startup and cool flue temperatures under low fire conditions which promote the condensation of moisture and creosote. Excess flue size can also lead to overdraft under high fire conditions which could cause built-up creosote to ignite and result in a chimney fire.

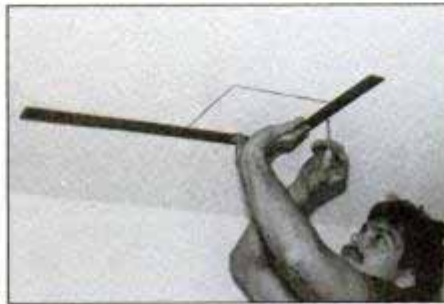
Choosing a chimney with a smaller flue diameter than that of the appliance outlet can result in smoke spillage into the room where the stove or fireplace is situated. A flue that is too small may not induce enough draft for the appliance to operate properly.

The way a chimney will be installed is an important factor in your selection. Chimney performance is best when the bulk of the run is inside the home and

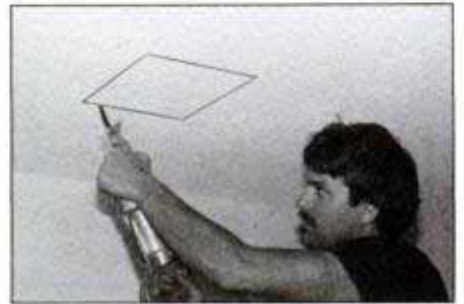
(Please turn to page 120)



1 After centering the stove and marking the floor, drop a plumb line to find the desired ceiling penetration point.



2 Use a large square to mark edges of ceiling cutout required for the chimney you're installing, according to maker's specs.



3 You can use a reciprocating saw, sabre saw or handsaw to cut a hole in the ceiling for the chimney to penetrate.



4 Working from above the finished ceiling, cut and install 2x4 lumber to bridge the joists and frame the opening.



5 Lift the chimney support into place from below while your helper in the attic grasps it and positions it properly.



6 Have the helper in the attic secure the chimney support to the frame with screws or nails as instructions specify.



7 Place the first chimney section into the support base. Check the chimney for plumb. Add sections to approach roof.



8 Using a level as a guide, scribe a circle at least 2 in. greater in diameter than chimney on roof deck's underside.



9 Pound four nails up through the roof to serve as guides for transferring the circle layout to the roof shingles.

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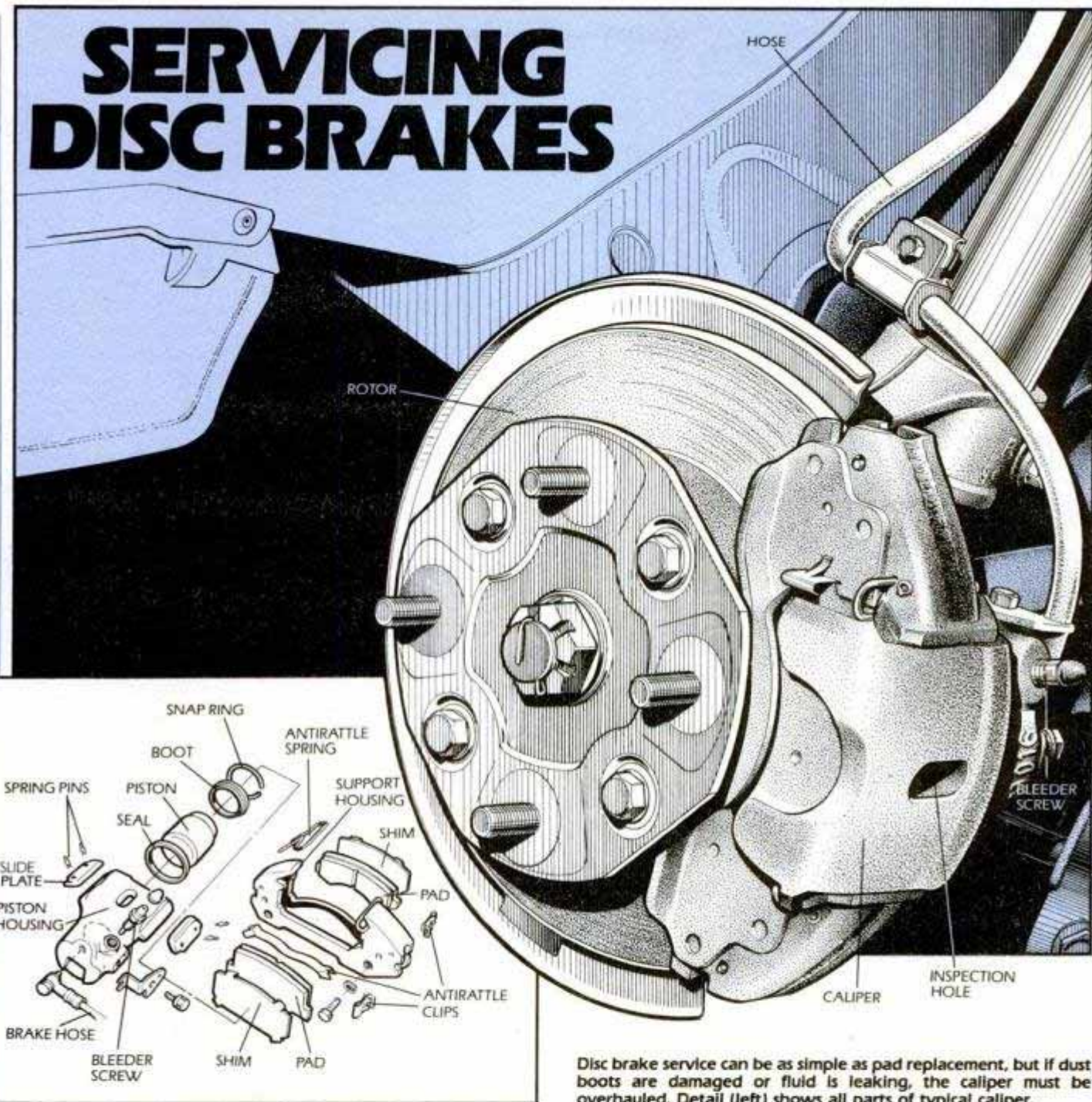
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SERVICING DISC BRAKES



Disc brake service can be as simple as pad replacement, but if dust boots are damaged or fluid is leaking, the caliper must be overhauled. Detail (left) shows all parts of typical caliper.

BY MORT SCHULTZ

Most of the routine service on disc brakes is a do-it-yourself job. You can certainly replace linings (pads)—plus the shims and antirattle springs or clips that may be attached to pads. You can probably rebuild calipers, too. If a caliper has to be replaced—another job you can do yourself—rebuilt units cost about \$20 each.

It's when you get into disc brake *overhaul* that you'll need some professional help. For rotor work, for exam-

ple, you'll need measuring instruments (a micrometer and dial gauge) and an \$850 rotor machining tool. Rather than make such an investment, most of us will admit the limitations of a home garage and pay to have the work done.

Before you start brake work it's suggested that you have the factory service manual or general auto repair manual for specific instructions, and specs for your car.

When is overhaul needed?

There are two ways to determine if disc brakes need repair before the lin-

ings are worn enough to cause extensive rotor damage. Brakes in Ford and GM cars and light trucks manufactured since the early 70's have pad-wear sensors. When a lining gets to within .03 inch of the rivet heads, this spring-steel sensor comes in contact with the rotor and a high-frequency squeak is emitted. The warning sound continues until the brakes are applied and the sound changes pitch or ceases.

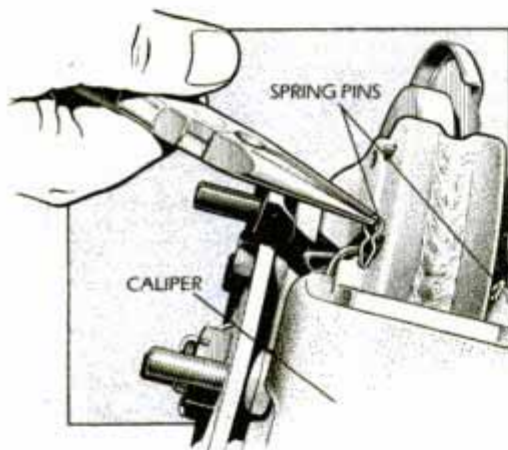
If the warning is ignored, wear progresses, but the raucous sound eventually ceases. By then, it's probably too late to save the rotor from extensive

damage. A new rotor costs about \$90 and, because pad wear often progresses equally on both front wheels, this means the damage costs you \$180.

If your vehicle is a Chrysler model, it probably doesn't have wear sensors. Most imported cars don't have wear-sensor-equipped disc brakes either, although they have begun to appear on some of the newest models.

Checking wear visually

To find out if a vehicle without wear sensors requires pad replacement, remove the wheels and calipers and take out the pads to check the amount of friction material remaining. Nonmetallic pads should not be allowed to wear beyond the point where $\frac{1}{16}$ inch of friction material protrudes



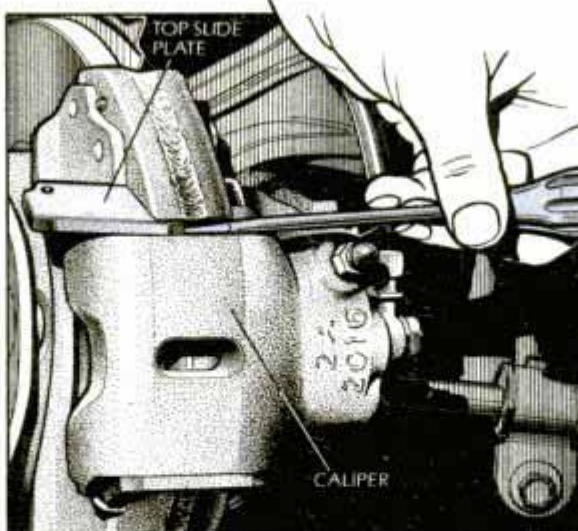
1 Two spring pins in each slide plate must be removed to release the caliper.

above the rivets. Semimetallic pads can wear to within $\frac{1}{32}$ inch of the rivets. If the pads are not riveted to the backing plates, the amount of friction material should equal the thickness of the backing plates.

If you have a late-model import vehicle, it may have a swivel-mount caliper. By removing a bolt, you can swivel the head of the caliper away from the main body. You can then measure the lining thickness without removing the pads. The swivel head also makes it easier to replace the pads, since you don't have to remove the caliper.

Inspect nonsensor-equipped pads at 30,000 miles. If they're okay, check them every 15,000 miles until they need replacing.

Most calipers equipped with nonsensor-type pads have inspection holes that let you view



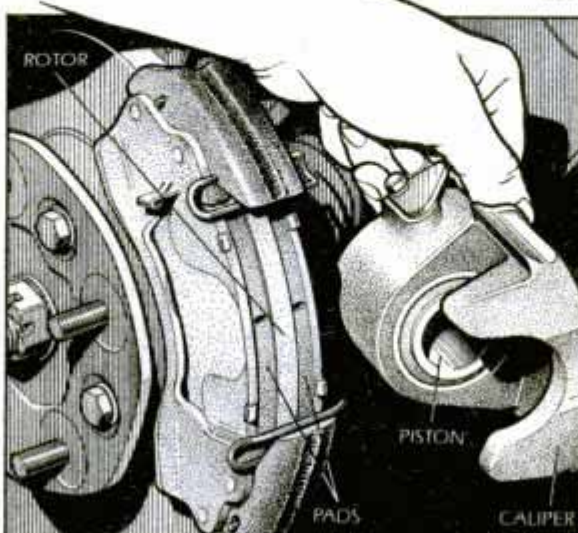
2 After the spring pins are removed, tap the top and bottom slide plates out sideways to disengage caliper.

one or both linings, so you can judge the extent of wear without disassembling everything—if you know for certain that your pads are bonded to the backing plates and do not have rivets. *Caution:* To inspect and overhaul front-disc brakes, have the vehicle resting on jackstands with the rear wheels blocked.

Metal or phenolic

Let's review some things you should know in order to remove pads for inspection and replacement. I'm only going to deal with single-piston disc brakes. They've been used on most cars since 1970.

The piston in the caliper, which is activated hydraulically and presses pads against the rotor when you step on the brake pedal, is made of nickel chrome-plated steel or plastic (a phenolic material similar in hardness and smoothness to Bakelite).



3 When caliper is removed, don't let it hang by the brake hose. Support it with a wire hooked to the chassis.

Introduced around 1975, phenolic pistons have been increasing in popularity. They weigh less, are less expensive and provide better insulation than metal, thus protecting brake fluid from heat generated by metallic disc pads. And they don't corrode as metal pistons can. However, phenolic pistons have to be treated more gently than metal because they can crack and chip.

You can't easily distinguish piston composition with the disc brake unit assembled. So treat pistons as if they are phenolic unless you are certain that they aren't.

Retracting pistons

The caution to take is simple enough. When pushing the piston back into its bore, don't slip a screwdriver or pry bar under the pad so it's directly on a piston.

You have to push the piston into its bore to free the pads on GM vehicles. To do this, place a C-clamp so the flat on the end of the screw rests on the pad, and the stationary part of the clamp rests on the rear of the caliper. Tighten the clamp to push the piston back into its bore just enough for the pads to clear the rotor.

On Ford calipers, you'll need a $\frac{3}{4} \times 1 \times 2\frac{3}{4}$ -inch block of wood to retract the piston once the caliper is off.

Note: Even if the piston is metal, it's not wise to push it back with a screwdriver. You might nick the plating.

Before pushing the piston into the bore, drain about half the fluid from the master cylinder. Discard it and have a sealed container of fresh brake fluid ready to add to the master cylinder when the job is done. Buy the brand of fluid recommended by the carmaker or another high-quality replacement that conforms to Department of Transportation (DOT) specification 3, 4 or 5.

About brake fluids

The significant difference between the three DOT grades is in boiling point—DOT 3 has the lowest boiling point, and DOT 5 the highest. DOT 3 will also thicken more readily in subzero weather.

The major benefit provided by DOT 4 and 5 fluids is in severe service conditions, such as hauling trailers. If you plan to keep your car for many years, you may benefit from using DOT 4 or

5 fluids, which offer greater corrosion protection.

Despite its inability to withstand extremes of temperature as well as the other two, DOT 3 fluid is recommended by most carmakers. However, most have no objection to DOT 4 or DOT 5 fluid. Check your service manual for recommendations.

If you decide to upgrade from DOT 3 to DOT 4 or 5, empty the hydraulic system and flush with the new fluid before adding the final fill. Fluids may not mix chemically, especially the glycol-base DOT 3 and 4 fluids if they are mixed with the silicone-base DOT 5 fluid.

Bolts or plates

Most carmakers secure calipers to their supports in one of two ways: with bolts or with pin-held retaining plates.

If the calipers on your disc brakes use bolts, push the piston back into the bore and see if the bolts are fastened on the outboard end of the caliper with retaining clips. If so, pull them off. The outboard end of the caliper is the side resting on the outside surface of the rotor.

Determine how to remove the bolts. Those that have hex or Allen heads should be unscrewed with the appropriate wrench. Other bolts may be tapped out with a hammer and drift. These are the ones usually retained by clips.

If there are no bolts, the caliper is probably being retained at the top and bottom by slide plates. Look for spring pins holding these plates. There are probably four of them—two holding the top slide plate and two holding the bottom plate. Pull the pin out and save them (see Fig. 1). Then, tap out the top and bottom slide plates (Fig. 2).

Many Ford and AMC calipers are retained on their machined guides by a support key and screw. After removing the screw, drive the key out of the anchor with a hammer and drift.

Again, check a service manual for specific instructions. If you're still not sure how to do the job, get professional help. Don't take chances when it comes to brake work.

When the bolts or slide plates have been removed, lift the caliper off the rotor (Fig. 3). You may have to push the caliper down and then pull it away from the rotor so it clears the antirattle



4 Clips that hold antirattle springs may require replacement. If so, they'll be supplied in the pad kit.

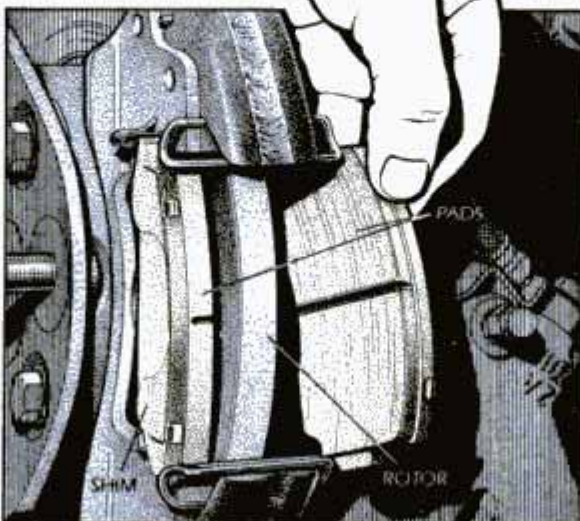
springs. With some setups, you don't have to replace the antirattle springs. However, they may be held by clips that often have to be replaced (Fig. 4).

The best way to know which parts to replace and which to retain is by purchasing a brake pad kit for your particular vehicle. It will contain pads and all of the hardware that should be replaced when doing an overhaul. It also provides installation and lubrication instructions.

Caliper care

If you're only replacing pads and hardware, you don't have to disconnect the brake hose from the caliper. However, if you do remove the caliper, don't let it hang by the brake hose, which can split under the weight. Fashion a hook from a wire coat hanger, slip one end into one of the caliper bolt holes and hang the caliper on a part of the chassis.

Pads are held in calipers by support



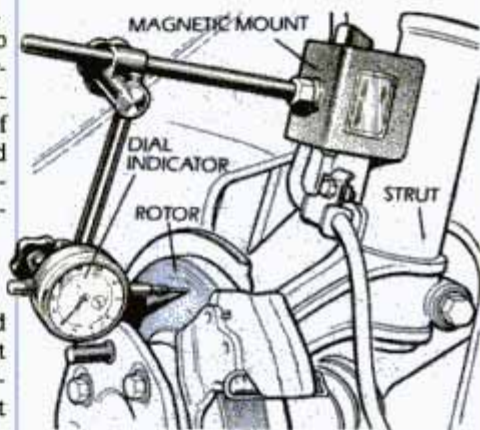
5 Before removing pads, sketch the exact position of all shims, hardware, retaining clips and springs.

springs, retaining clips or retaining pins. They may also have shims (Fig. 5). Before removing pieces of hardware, make a note or sketch of how they lie in relation to the pads. Then, take the old pads off and throw them away.

Check around the piston bore for signs of moisture, which indicate that fluid is leaking. Also, inspect the dust boot for cracks and cuts. If leaks are present or the boot is damaged, overhaul or replace the caliper.

Overhauling a caliper

Calipers have a small square-cut rubber O-ring that helps draw the piston back away from the pads when pressure on the brake pedal is released. If this O-ring loses elasticity, which it will in time, the piston won't draw back and the pads



6 Rotor runout can be checked with a dial indicator while spinning the rotor by hand.

won't release. The result will be slight pad-to-rotor contact and premature pad wear, noise, fading and/or uneven braking. For this reason it is wise, though not essential, to overhaul a caliper when replacing pads.

Now the question arises: Should you overhaul the calipers yourself, replace them with rebuilt units or turn the job over to a pro? The least expensive approach is to overhaul them yourself. The next in line, costwise, is to install rebuilt calipers, which you can buy from an auto parts dealer. Obviously, a pro is going to be the most expensive.

Overhaul procedures

Here's a general idea of the overhauling procedure to help you decide whether you want to tackle the job. If you do it your-

self, make sure you have specific instructions for your vehicle.

Note: If one caliper has to be overhauled or replaced, the caliper on the other side should also be overhauled or replaced. Also, when replacing pads, replace them on both sides of the car.

1. After removing the caliper from the rotor, keep the caliper on the car with the brake hose attached. Place a rag in the caliper to catch the piston and brake fluid. Make sure no one is near the car and carefully push on the brake pedal to ease the piston out of the bore. Don't get brake fluid on your car's fender—it will take off the paint.

This is a reasonably safe way to remove a piston and is recommended if calipers have phenolic pistons. If a caliper is already off the vehicle and has a metal piston, you can apply spurts of compressed air through the bleed screw to ease out the piston. Place a shop rag in the caliper to catch the piston and keep your fingers clear.

Much greater air pressure might be needed to get out a phenolic piston, but it could expel the piston with such force that it would be destroyed or else injure anyone in its way. To remove a phenolic piston from a caliper, it's best to attach the caliper to the brake hose and force the piston from the bore using hydraulic pressure.

In a few cars—Toyota Supra, for example—pistons have to be unscrewed using a special tool. They cannot be removed by applying hydraulic or air pressure.

2. Remove the caliper. When you disconnect the brake hose, cap it to prevent fluid loss.

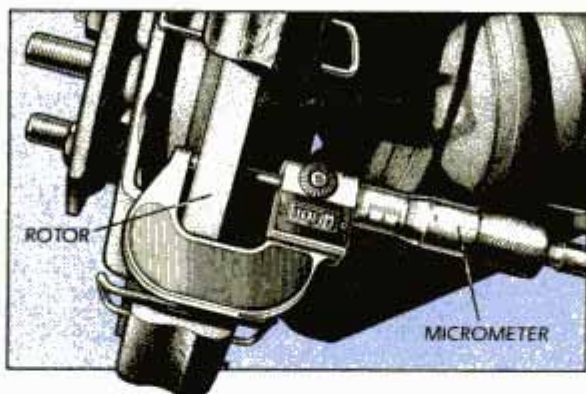
3. Open the bleed screw to drain brake fluid. Remove the bleed screw and clean or replace it.

4. Remove the dust boot, following the manufacturer's instructions. Some dust boots are difficult to reinstall without special tools. In all cases, the dust boot must be replaced.

5. The rubber O-ring is more difficult to remove. Use a pointed wooden or plastic stick—a toothpick might work—to pry the seal out of the bore. Then, discard it.

Do not use a screwdriver or any other metal tool. You may scratch the bore or cause a burred edge on the O-ring groove and ruin the caliper.

6. Wash the caliper, bore and piston with denatured alcohol or clean brake fluid. Don't use kerosene, gasoline or any petroleum



7 Check rotor parallelism by taking measurements on the circumference. Machine rotor if it doesn't meet specs.

solvent. Residue left by these fluids can cause rubber brake parts to deteriorate.

Dry parts with a clean, lint-free cloth and an air hose aimed at the bore and other passages. If you don't have a compressor, let parts air-dry.

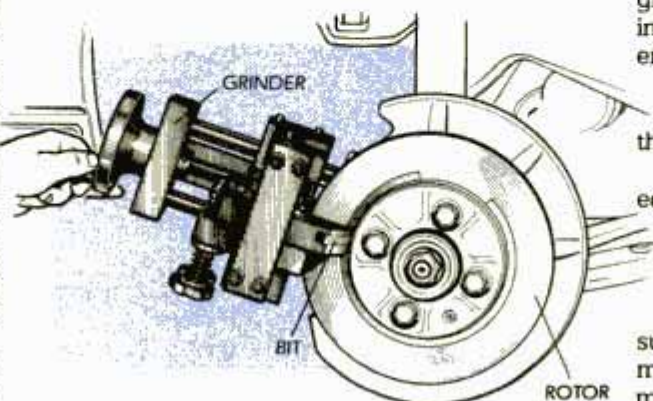
7. Examine the piston. If it is metal and is rusted, pitted or scored, throw it away. If it's phenolic and chipped or cracked, get rid of it, too.

Don't try to polish a metal piston. Any attempt to sand or buff away damage will destroy the plating.

8. Examine the bore. If it's scored or corroded, replace the caliper. But if it's only slightly stained, clean it by rotating a piece of crocus cloth, by hand, in the bore. Don't use a lot of pressure, and make sure you polish the bore all the way around. Don't slide the abrasive in and out, and don't use any abrasive except crocus cloth.

Incidentally, black stains on the bore wall are not something to get alarmed over. They're caused by the O-ring seal and aren't harmful.

9. Reinstall the bleed screw and lubricate a new O-ring with clean brake fluid. Push the O-ring into place at one spot in the groove and then gently work it inch-by-inch into the groove with your fingers. Make sure you don't twist the O-ring.



8 On-the-car rotor grinding is required on some models, notably Hondas, to get vibration-free brake operation.

10. After lubricating both parts, start the piston into the bore. You may have to fit the dust boot over the piston before pushing it in all the way. Check your service manual instructions. If you need a special tool for dust boot installation, it's probably available at the parts store where you bought the pads.

11. After the new pads and caliper are in place, bleed the brake system.

Rotor service

Don't be misled by the fact that the rotors may look perfect. True, they might not be scored, but thickness variation (parallelism) and runout may be such that failure to catch something now will mean a problem like vibration or chatter later. You can't detect excessive parallelism or runout by eye. Measuring instruments are needed.

To find the extent of runout a pro will mount a dial indicator and slowly rotate the rotor, taking readings at several points (Fig. 6). He should also check parallelism by placing a micrometer at four or more points around the circumference of the rotor, each the same distance in from the edge of the rotor (Fig. 7). The findings should be checked against the manufacturer's allowable specification for the car. If the rotor fails to meet the spec, it will be machined.

When it comes to machining rotors, make sure your brake shop is aware of the latest technology. Rotors can be machined off the car on a brake lathe or on the car by using a special grinder. Some manufacturers—Honda, for one—require on-the-car grinding, since near-perfect parallelism is obtained with this equipment. Honda finds this necessary to eliminate a vibration that faulty parallelism causes.

When using an on-the-car grinder on a front-wheel-drive car, the transmission is placed in **THIRD** gear or **D** after the grinder is attached and the rotating rotor turns against the grinder's machining bits. If the car has rear-wheel drive, a drive mechanism is used to turn the rotors.

Obviously, if you have a car equipped with rotors that *must* be ground on a car, let a pro handle the entire brake job.

After machining a rotor, a pro should remeasure it to make sure grinding hasn't removed metal beyond the minimum dimension stamped on the rotor by the manufacturer. If the rotor is too thin, you must replace it. **PM**

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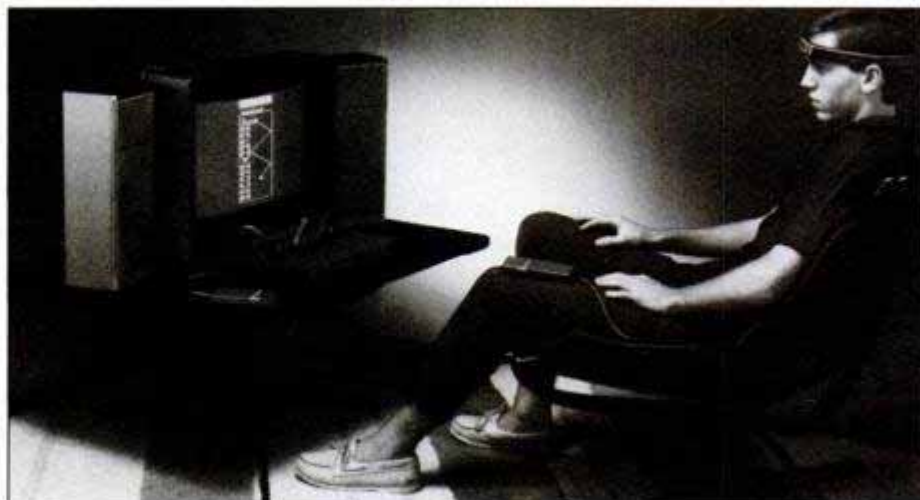
PM ELECTRONICS MONITOR

New frontiers for video games

Atari has pushed back the frontier of video-game technology with two new products. Their MindLink system lets you control game action without conventional hand controllers. Instead, you slip on a special headband with attached infrared sensors that pick up slight electrical impulses generated by muscle movement in your forehead. The signals are sent remotely from an attached transmitter to a receiver connected to the Atari video game or computer.

It's the closest thing yet to controlling the action with your mind. You can sit up to 20 feet away from the video screen and still control the action. If someone walks between you and the infrared receiver, the program automatically pauses. This is the first totally new development in home video games since the craze began.

On the hardware side, Atari's 7800



Startling new MindLink game is the closest thing yet to video-game mind control.

ProSystem video-game console, with 256 color shadings, sets new standards in color graphics and resolution and can display more than 100 video characters simultaneously. The system plays a new line of software and game cartridges designed for the Atari 2600, and can be expanded into an introduc-

tory computer by adding an optional full-stroke keyboard. The keyboard operates with 4K RAM, expandable to 20K.

Obviously, Atari is trying to pump some new life into a rather flat video-game market, and these two new goodies just may do it.

Mouse in the house



WICO's mouse setup doesn't require special software to control the cursor.

One of the important features of some of the new computers is the mouse, a delightfully easy-to-use pointing device. It's a tiny box about the size of a pack of cigarettes, and you run it around a bare area of your desk, instead of using the keyboard, to move the cursor on the screen.

Because of the mouse's popularity on the Macintosh, Apple produced one for the ubiquitous Apple II series of computers, with a plug-in interface card that fills one internal expansion slot.

There are other mouse entries from companies like joystick-maker WICO and monitor-maker U.S.I. In both cases, while a plug-in card is also used, special software isn't needed, and in fact, the mouse can be used to control the cursor on most kinds of programs.

The controller cards for the Apple and IBM mice are costly—typically \$199 to \$249—but have the advantage of not needing special software and being able to work with other controllers besides the mouse.

New circuitry for snappy photos

Photography hobbyists have traditionally been polarized into two segments: those who want high-quality photos and are willing to fiddle with sophisticated equipment to get them, and those who want high-quality photos from an aim-and-shoot box.

Now, electronic technology has made the newest breed of 35mm cameras so automatic that, finally, high-quality photos are possible with no effort on the part of the photographer.

We recently tried the newest of these 35mm automatic cameras—the Olympus Quick Flash AFL. This camera has a Zuiko 38mm F2.8 lens and electric programmed shutter (1/8 to 1/500 sec-

ond). Operation is totally automatic. The camera loads, winds and rewinds the film, focuses and sets the exposure.

The feature we liked best is the quick 1.5-second recycling time of the automatic flash. Other cameras of this type take seven to eight seconds to recycle for each flash. A newly designed condenser that's smaller in size but with a larger capacity, special electronic circuitry that allows superquick response time, and more powerful lithium batteries all combine to allow the Quick Flash to recycle so quickly.

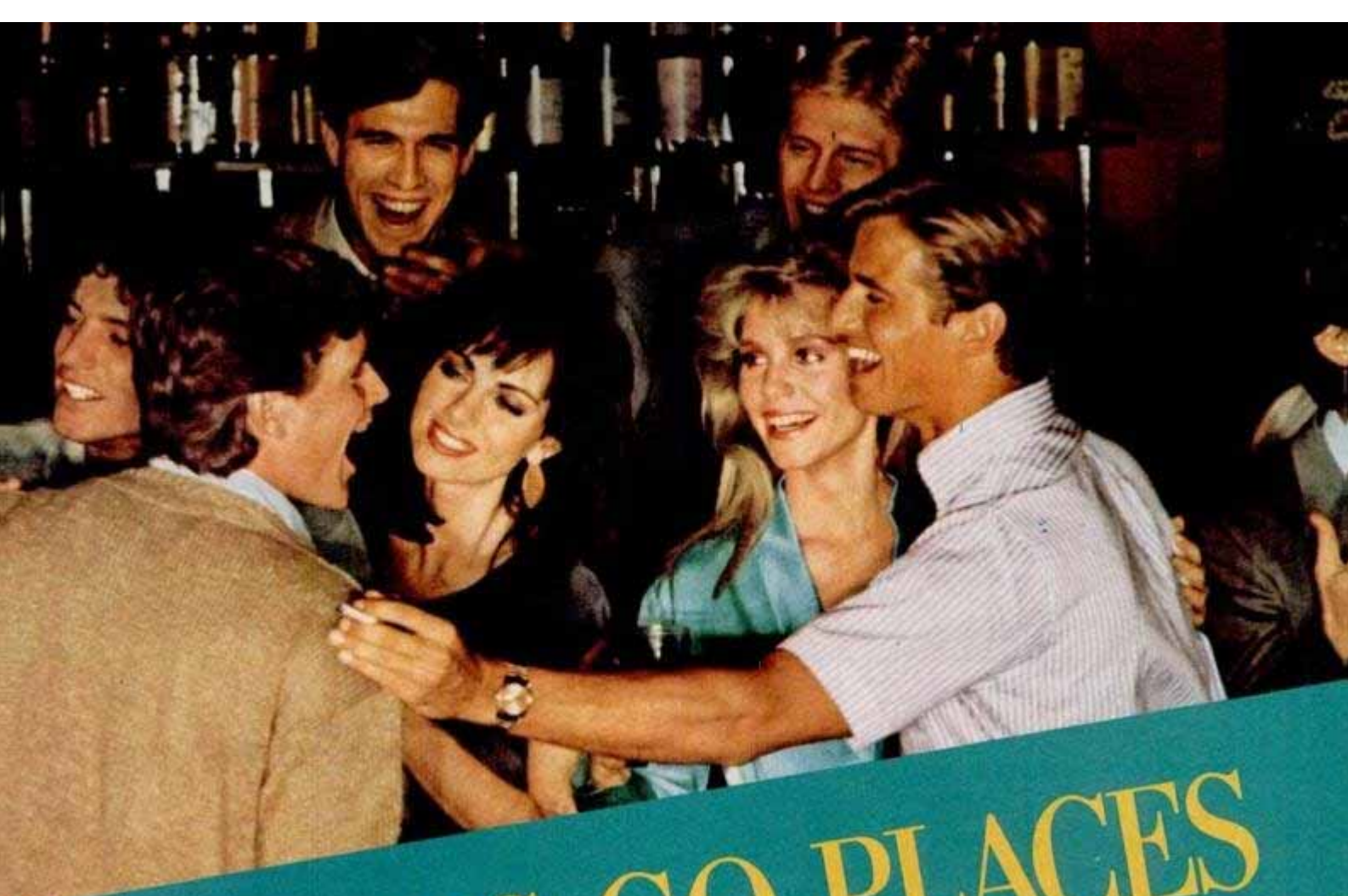
During our test, the Olympus delivered sharp pictures with excellent exposure control in a variety of lighting



Quick Flash AFL's strobe can recycle in just 1.5 seconds.

conditions, including a series of shots that we banged off as quickly as the camera would fire. The Olympus lists for \$235 and it's one camera you'll use a lot. We did.

PM



PLAYERS GO PLACES

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Kings: 12 mg "tar," 1.0 mg nicotine—100's: 14 mg "tar,"
1.1 mg nicotine av. per cigarette, by FTC method.

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

APPLIANCE CLINIC



Iceberg at Pigeon Forge

I have a 1979 Whirlpool refrigerator/freezer, model No. EED221MT, serial No. S8160M35, with an icemaker of the type that makes a 360° rotation.

When the tray is upside down the cubes fail to drop out as they should. Consequently, when the tray returns rightside up and refills, the water runs out and over the cubes that failed to fall. This causes the refill water to run into the box with the extra cubes. The

whole ice storage freezes into a solid mass.—Bob Britton, Pigeon Forge, Tenn.

It sounds as if it's time to replace your ice-cube tray. Apparently, a mineral deposit may have been building up on the inside surface of the tray over the past several years. This could prevent the cubes from releasing when the tray flexes, or the tray may not flex sufficiently to eject the ice

cubes. For an almost always sure cure, install a new tray.

In rare cases, a shim kit may increase the flex of the new tray. The kit includes two shims and installation instructions. The tray, part No. 627500, costs approximately \$5 plus tax. The shim kit, No. 876493, costs \$2 plus tax. You can buy them at any Whirlpool parts distributor, or write to the Whirlpool Corp., 200 U.S. 33 North, Benton Harbor, Mich. 49022. Attention: Customer Relations Dept.

Stove clock repair

I have a Frigidaire super electric range, model No. RSE36N, serial No. 64C24650. The clock which regulates the oven and timing stops and goes. Therefore, I cannot use it for the cleaning cycle or timing anything that's being heated in the oven. I would like to know how to get the clock out from the front.

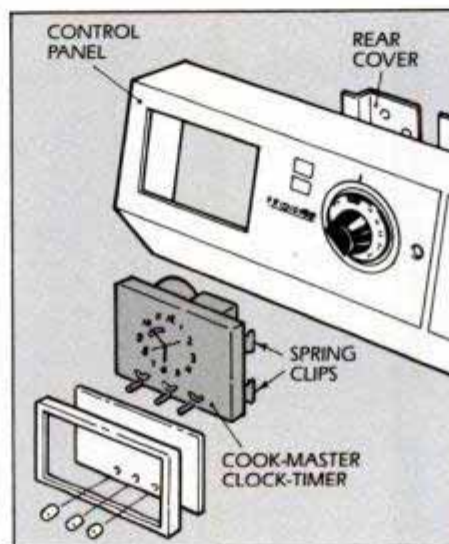
It is covered by a glass cover. It appears that the screws which hold the clock are under the glass cover. Could you tell me why the clock stops and starts on its own?—Charles Clark, New Castle, Pa.

The gears in the clock mechanism may have worn over the years, or possibly the clock shaft is binding. The clock motor for your clock assembly, or Cook-Master as it is called, is no longer available from Frigidaire as a separate part. You must purchase the entire Cook-Master as one unit.

The Cook-Master can still be ordered from your local Frigidaire parts dealer or contact Frigidaire Parts and Service Co., 3599 Meadow Lane, Cornwells Heights, Pa. 19020. The part No. for your Cook-Master is 995-7102; it costs approximately \$77.40 plus tax and shipping.

The best way to remove the Cook-Master unit is to first disconnect the electrical power to the range. Then pull the range out from the wall. Remove the rear cover from the control panel.

Next, remove all the wires from the back of the Cook-Master, attaching identification labels as you go. Now locate the four spring clips, two on each side, which hold the Cook-Master to the control panel. Using your fingers to squeeze the clips, push



The Cook-Master is held by spring clips. To remove it, take off rear control panel and wires, squeeze and push clips forward.

the device out through the front of the panel. Reverse the procedure to install this unit.

Dryer maintenance

We own a Sears Lady Kenmore gas dryer, model No. 110.77694600, serial No. 76946. We haven't had any problems with it yet. However, isn't there something we should check or oil or grease? Is there such a thing as a PM program? We would like to take care of the unit before it breaks.—Don Jorgensen, Conroe, Tex.

Of all the laundry products to maintain, the dryer probably requires the least attention. Probably the most important maintenance you should perform on it is to check periodically for any signs of lint buildup.

To do this, disconnect the dryer

from its power source, then remove the lower panel from the front of the dryer. On most dryers lint tends to get in and around the base of the dryer as well as in the cooling air slats of the drive motor. When these holes are blocked, you risk overheating the motor. Use a vacuum cleaner or a brush to remove any lint that is visible. Be particularly careful around the gas burner. The ignitor is made of a very delicate material.

While you are cleaning this area, check the drive belt for dryness or cracking. If either of these signs appears, replace the belt before it breaks. As for oil and grease, the bearings are permanently lubricated for the life of the motor. They should need no further attention.

Bearing surfaces can be serviced by lubrication, but it is not mandatory. You could add a drop or two of turbine oil or a 20-weight nondetergent motor oil to the two rear-drum roller shafts and to the idler pulley shaft.

The drum is supported in front by a Delrin plastic bearing and felt. You can use a spray lubricating silicone in this area to help the drum move more freely.

Other checkpoints for lint buildup are the exhaust duct and the vent hood, especially if your dryer has a flexible plastic-type vent attached. Lint tends to collect more readily on the inside surface of this type duct than on smooth or flexible metal ducts. **PM**

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

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"I want a kerosene heater that's cleaner burning."



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The double-chamber concept has another benefit. This exclusive design gives you precise control over room temperatures. With the twist of a knob, you can raise or lower heat output so you're always just comfortable. And you'll never waste fuel by having your heater deliver more heat than you need.

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DETROIT LISTENING POST



Z24 on the way

When people talk of performance from Chevrolet, comment normally turns to Corvette and Camaro. Shown here is a prototype 1985 Cavalier J-car featuring the regular production option (RPO) Z24. "But I wouldn't be surprised to see it emerge as the tag for the car, à la Z28," a Chevy source confided.

The Z24 could be as important as the Z28. The convertible shown packs Chevy's 2.8-liter multipoint electronic fuel-injected V6, rated at 140 hp and 160 lb.-ft. of torque. Its heavy-duty suspension has new spring rates, larger antisway bars and stiffer bushings, a refinement of the 1984 F-41 sports handling suspension option.

Fitted to the car caught in the spy shot are fat P215-60R14 Goodyear Eagle GTs on 14-inch wheels. A Chevy source suggested that such a radical tire might not be the production choice, and that a smaller wheel/tire combination would be used.

Cosmetically, the Z24 will receive aerodynamic wheel opening flares, a

deeper front air dam and blacked-out trim. The hood scoop on this prototype is probably part of its disguise. Inside, a new electronic instrument cluster features electronic tach and digital speedometer. Headlight and wiper switches are



Pocket rocket from Chevy: This 140-hp convertible Cavalier will be a 1985½ model.

built into the instrument pod, as on Mazda 626 and Audi 4000. The center console sweeps forward and up to join

the dashboard, and houses radio and climate controls.

It could be spring before the car emerges from Lordstown Assembly, though. GM will hold over its high-mileage J-cars until late 1984 to conserve credits to-

ward its corporate average fuel economy (see *Detroit Listening Post*, page 36, July '84).

Korean Kadette in '87

General Motors will import an Opel-designed subcompact from its Korean car partner, Daewoo, in 1987 (see *Coming: Cars From Korea*, page 86, Aug. '84). The new model, dubbed the Kadette, will likely be sold first through Pontiac dealers in direct competition with the Chevrolet Sprint, imported from Suzuki. The Korean Kadette will be sold this year in Europe, then in selected U.S. markets in 1987.

Fiero T-top

Pontiac is evaluating a Cars & Concepts proposal for a fully removable T-top option on the Fiero 2M4. The prototype is quite slick looking, and its commercial appeal has been tested to rave reviews in consumer clinics held in Atlanta. In Pontiac engineering circles, however, we hear there are as many critics of the concept as supporters. There is some question whether the little two-seater can take normal road stresses over the long term with a major portion of its roof cut away.

Pontiac engineers, as well as marketing types, are test driving the piece as

this is written. A full convertible, displayed to wild enthusiasm in the press and at auto shows, is still on hold. A significant factor impeding both open-air proposals: The production capacity of the Pontiac assembly plant currently churning out Fieros probably can't support the addition of another model, let alone two. A Pontiac source indicates the jobs might have to be done out-of-house.

Offshore Chryslers

Chrysler will import some 3,000 Mexican-made two-door Dodge Aries and Plymouth Reliants in 1984 because U.S. plants can't keep up with demand. Chrysler intends to clearly identify the cars' foreign origin (as they have done since 1970 on Mitsubishi-made "Dodges" and "Plymouths"). Although the move was called a "one-shot deal," Chrysler spokesmen admitted that the program will also test the logistics of Mexican importation as well as consumer reaction to south-of-the-border K-cars. If all goes smoothly, Chrysler may use more Mexican imports to counter offshore plays by GM and Ford.

Chrysler confirms an earlier *DLP* report (page 30, Jan. '84) of cooperation between Lee Iacocca and Alessandro de Tomaso, the men who created the Pantera for Ford. Chrysler has purchased a 5 percent share of Maserati (one of de Tomaso's companies), and the two firms will jointly develop "sporty, performance-oriented cars with a European flair" for the U.S. and Canadian markets. As part of a broad technical cooperation pact, Maserati will build a small number of "Chrysler" sportscars in Italy by 1987 or '88.

Chrysler's coming V6s

One of the "frills" lost in the shuffle to make the New Chrysler Corp. a lean, mean profit machine was a six-cylinder passenger car engine. The old reliable Slant-Six was dropped from the car line because it didn't fit into the front-drive models and wasn't powerful enough for the big rear-drive luxu-cruisers.

Back in the gas-crunch days, Mitsubishi's 2.6-liter Four made a sensible "big" engine alongside Chrysler's home-built 2.2-liter and Peugeot's 1.6-

(Please turn to page 50)

If you've got something really heavy to carry, let the Toyota SR5 Sport Truck carry it. There's a

1400 lbs.

standard 1400 lb. payload,* so stack those logs. The sturdy, full box frame with double wall bed construction can take whatever you dish out. But this truck isn't just made strong, it's made right. There's a wind-cheating front-end design and a new, soft-ride rear suspension system with staggered mount shock absorbers for car-like ride, handling, and confident control.

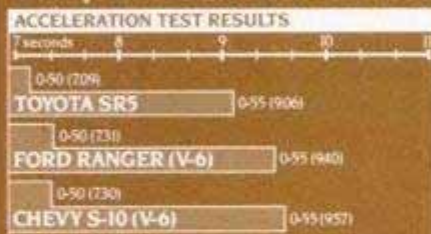
You won't believe you're driving a truck after you drive this baby. One look at the inside and you'll be amazed at just how much comfort there is. Sit down and stretch out. There's 41.5 inches of legroom. More than ever before. There's luxuriant carpeting, AM/FM/MPX stereo, full instrumentation.



You can even get a 7-way adjustable driver's sport seat. And if you're hungry for power, there's a standard state-of-the-art electronic fuel injection system which gives the already potent 2.4 liter engine

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MOST ADVANCED TRUCKS EVER BUILT!

THE TOYOTA SR5 SPORT TRUCK. MIGHT MADE RIGHT!



BRAWN!

DETROIT LISTENING POST

(Continued from page 48)

liter Fours. But no more. What Chrysler needs is a compact V6. What they don't need is a multi-billion dollar development program. So, they have once again turned to their oriental partner, and Mitsubishi will pull a V6 out of its hat for the 1987 model year.

First to benefit will be the underpowered Dodge Caravan and Plymouth Voyager minivans. Mits's V6 will eventually replace the 2.6 Four as the optional engine on all of Chrysler's K-car variants, from the Aries/Reliant to

the big Executive limo. Development continues on a domestic 3.9-liter push-rod V6 for truck use, which is simply a cut-down version of the 318-cu.-in. V8.

More sticker shock?

Look for only *interim* pricing strategies from Generous Motors this fall. The UAW labor talks, though begun last July, loom large as you read this. Sources indicate GM wants to raise prices an expected \$200 to \$300 for 1985, but doesn't want to do so before contracts are signed for fear of having to give some of the money to the

workers. Conventional wisdom says GM should announce a moderate price increase, sign the labor contracts, then bring on the big price surge and blame it all on the UAW agreement.

Ear to the ground

Chrysler P-car: Lee Iacocca says Chrysler will spend up to \$600 million on its *P-car replacement* for the Omni/Horizon. He said it "will be American-made," without specifying where. This eliminates Mexican assembly, which is what Chrysler had threatened to do.

Ford sportster: Ford Motor continues to study a proposal for a \$30,000 sports car. It will compete with Chrysler's Maserati project and the Italian-bodied Cadillac Callisto. Two programs are under consideration: one an exotic from Italy, the other a home-grown car from Ford's Special Vehicle Operations (SVO) department.

Ford fones: Have you dialed a Ford—lately? Ford Motor purchased a controlling interest in *Starnet*, a company specializing in long-distance telephone and data services. It joins Ford Aerospace & Communications, makers of communications satellites.

Empire State belts up: New York has become the first state in the nation to pass a *mandatory seatbelt use law*. Come Jan. 1, 1985, all front-seat occupants (and kids under 10 seated anywhere) must be buckled up or face fines up to \$50. It is estimated that the law—if enforced and observed—could save 300 to 400 lives a year in New York alone, using proven technology that is now available just over your shoulder.

Short drives: The *Pontiac 2000 Sunbird Turbo* in convertible trim with three-speed automatic is a genuinely nice summertime cruiser. I lost no time putting the fuel-injected Four's power down, though 150 hp is at the ragged edge of what the Sunbird suspension can deal with. Torque steer and bump steer were a problem. Quality was not.

Another turbo-car, the *Ford Mustang SVO*, showed good manners and fair mileage at 14 mpg, even considering our usual enthusiastic driving style. The engine-control computer can be switched for either premium unleaded or regular unleaded fuel, and its driving position is one of the best arrangements of seat, shifter, steering wheel and instrument clarity in Detroit.

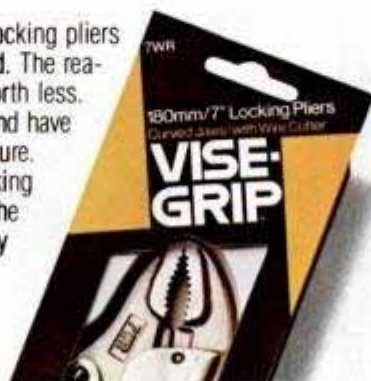
For old-style muscle-driving, we drove the *Chevrolet Monte Carlo SS*. Its suspension isn't quite up to the NASCAR standards after which the car is modeled, but it was Chevy-comfortable and has lots of go-power with its H.O. Z28 5.0-liter V8. Throaty exhaust rumble failed to hide the many trim rattles, primarily in the doors. **PM**

CONFUCIUS SAY: MAN WHO BUYS CHEAP LOCKING PLIERS GETS ALL THE BREAKS



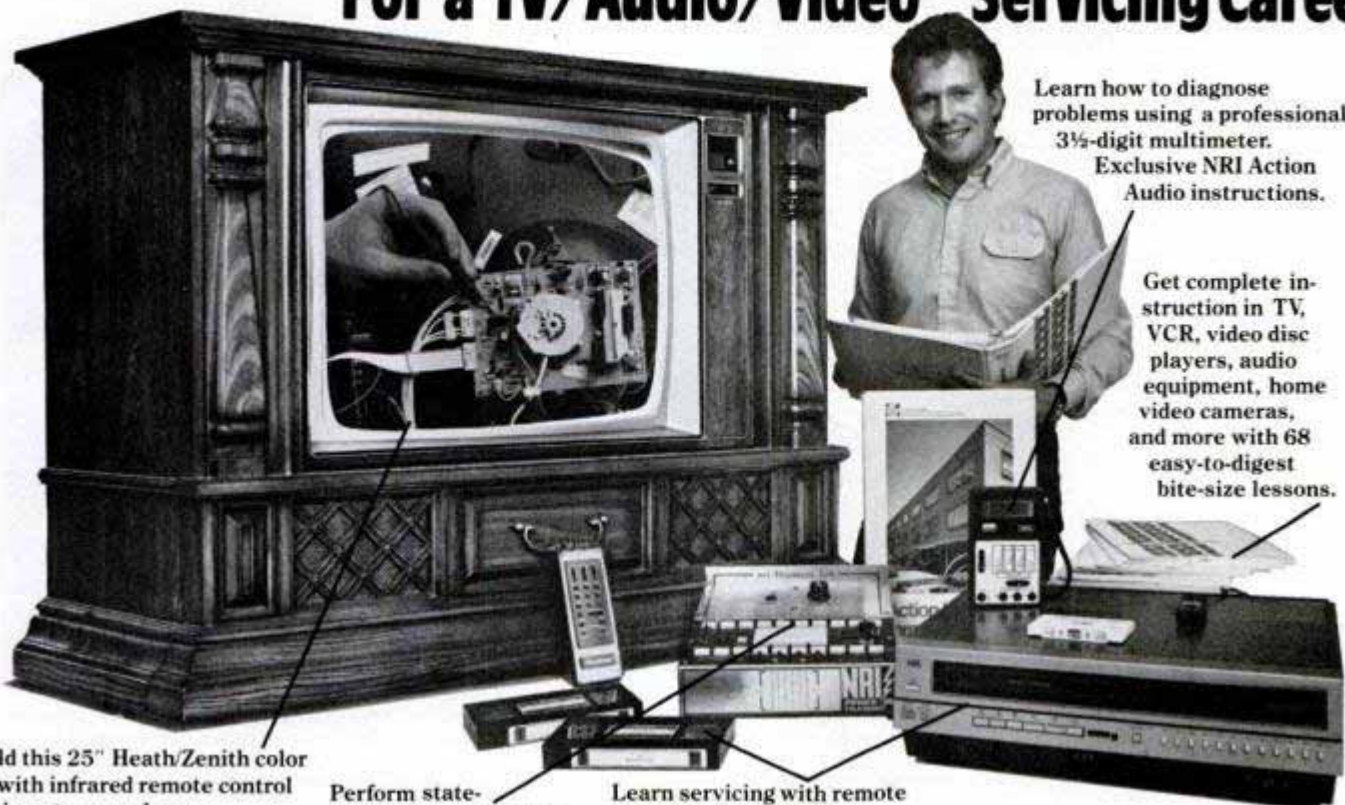
There are many imitations of VISE-GRIP® locking pliers on the market today. Most are "bargain" priced. The reason the copies cost less is because they're worth less. They're usually made from inferior materials and have a woeful tendency to self-destruct under pressure.

Don't waste your money on disposable locking pliers. Look for the VISE-GRIP trademark on the package. It assures you'll end up with a quality product, not a broken promise.



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You also build your own 25" Heath/Zenith color TV, a state-of-the-art unit that includes infrared remote control, a Time Control Programmer and the incredible Advanced Space Phone that lets you telephone from your chair. Using the videocassette recorder that's included as part of your training, you learn how to adjust, service and repair these fast-selling units. Your front-loading VCR features up to 6-hour recording capacity, remote control, and programmable touch-button tuning.

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THE PM WORKBENCH

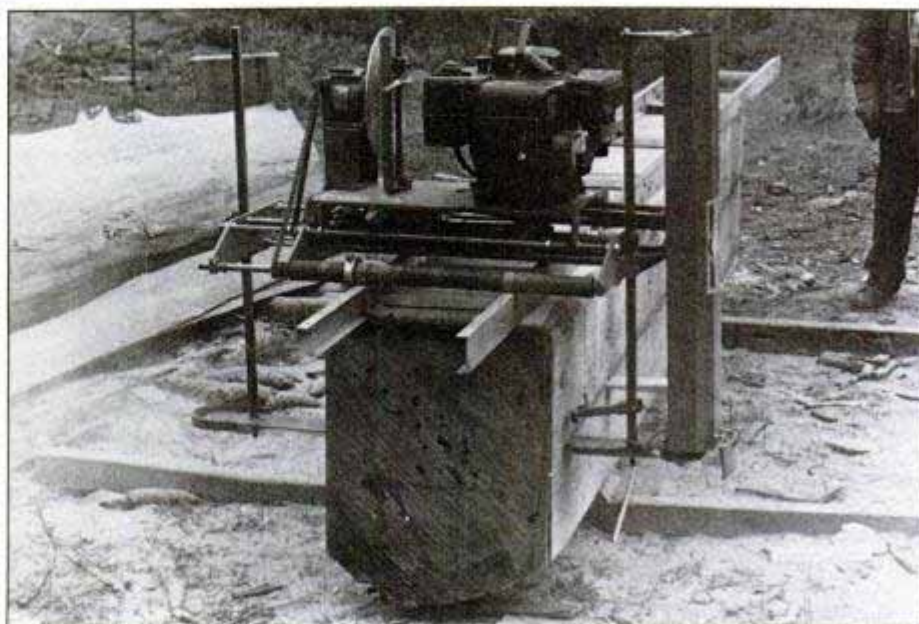


Portable sawmill

The Lumberjack sawmill Model 800 is designed for those who want to mill their own lumber, but have found that most precision-cutting sawmills are too expensive and difficult to operate and transport.

The Model 800 is compact, portable (only 165 pounds) and self-propelled—no pushing or pulling the mill through the log. And it works in forward and reverse for continuous cutting without removing the mill after each pass. The sawmill is guided by an aluminum channel bolted to the log.

A 10-hp. four-cycle engine powers a 42-in. chainsaw bar and chain for cutting any length log up to 36-in. dia. The mill can cut a slab up to 28 in. thick. The Model 800 costs \$1,675, plus shipping. For more information, contact Brown Engineering Co., Box 40-73, Winton Rd., West Point, Calif. 95255.—J.T.



The portable, self-propelled sawmill rides on three rubber-covered rollers along an aluminum channel which is bolted to the log. A homemade guide can be made from 2x4s.

A mightier miter saw

The increased popularity of the power miter saw has led to the production of a larger saw by Ryobi. The Model TS-380 is a 14-in. miter saw with greater cutting capacities than the more common 9- and 10-in. saws. The 14-in. blade can cut 4 $\frac{3}{8}$ in. wide at 45° and 6 $\frac{3}{16}$ in. wide at 90°.

The Model TS-380 features a slotted metal table that turns with the blade for accurate cuts; positive stops at 22 $\frac{1}{2}$ °, 45° and 90° right and left; an electric blade brake; and a sawdust ejection system. The TS-380 costs approximately \$525.

For details, contact Ryobi America Corp., 1158 Tower La., Bensenville, Ill. 60106.—J.T.



Miter saw is shown with three optional accessories: dustbag, extension arms, vise.

Cordless power case

Skil has taken the convenience of cordless drills one step farther with the introduction of their Boar Gun carrying kit. Each kit is equipped with a $\frac{3}{8}$ -in. variable-speed cordless drill, a battery charger and two battery packs so you'll never be left powerless. The carrying case is made of high-impact plastic.

The Boar Gun carrying kit sells for about \$150. For details, contact Skil Corp. 4801 W. Peterson Ave., Chicago, Ill. 60646.—J.T.

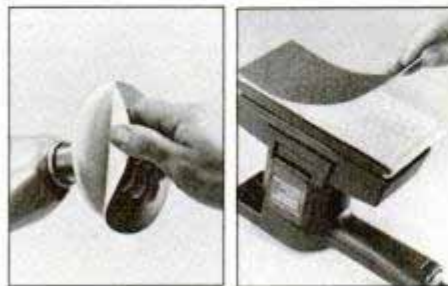


Cordless drill kit is ideal for workshop and job-site use.

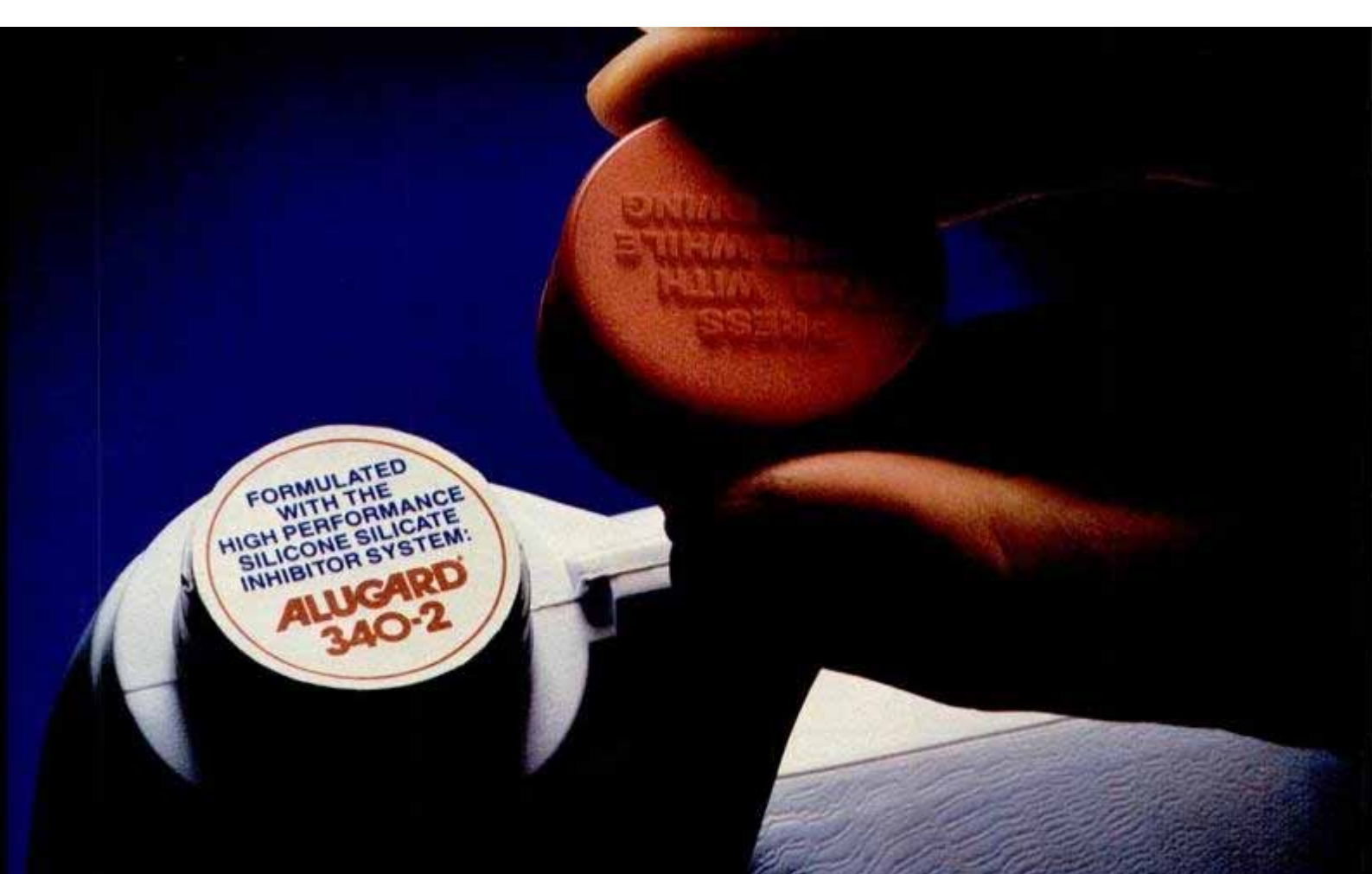
If you've come across a new product with some special features, let us know about it. Write to PM Workbench, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019.

Quick-change sandpaper

Black & Decker has developed a system of applying sandpaper to disc and finishing sanders using hook and loop fasteners. The fasteners grip instantly, and changing sanding surfaces is as simple as peel and press. A 5-in.-dia. backing pad with three discs costs about \$7. Three pieces of sandpaper with fabric backing come in $\frac{1}{4}$ (\$3.50), $\frac{1}{3}$ (\$4) and $\frac{1}{2}$ (\$4.50) sheet sizes. For details, contact Black & Decker, Box 297, Hampstead, Md. 21074.—J.T.



Sanding discs and sheets are backed with hook and loop fasteners. Changing sanding surfaces is a quick and easy process.



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HOMEOWNERS' CLINIC



Insulation for ductwork

Our 2-year-old house is fairly energy efficient. However, we have two large return ducts in the attic with only about 1 in. of insulation on them. I feel that I am losing a good deal of heat through them, but contractors and others don't think so. I think that the air-conditioning ducts suffer similarly. What's your opinion?—Bill Lewis, Norman, Okla.

I agree with you. Contractors were using 1 in. of insulation on ducts before the 1973 oil embargo. Since then, everyone has become conscious of the

need to conserve energy. Attics that had previously been insulated with 3 in. of fiberglass for an R-value of R-11 are now being insulated with 6 to 9 in. of fiberglass (R-19 to R-30).

The more insulation on a duct, the less heat loss there will be in the winter and heat gain (for air-conditioning ducts) in the summer. However, there is a break-even point beyond which there are no economic benefits.

Because of the many variables involved—such as degree-days, the effi-

ciency of the heating system, the number of hours the system operates, the velocity of the air moving within the ducts, and the cost per kilowatt-hour or per therm—you would need a computer to determine the optimum amount of insulation needed.

Nevertheless, the Small Homes Council-Building Research Council at the University of Illinois recommends a minimum overwrap around a duct of 3 in. of insulation. If the duct is to be used for air conditioning, it should be covered with a vapor barrier to prevent condensation within the insulation.

Spalling brick

I have a brick wall about 3 ft. high on either side of the driveway. Behind the wall is a grassy area. Quite a few of the bricks have spalled—the face has broken away, leaving cavities all over. Probably each broken brick will have to be chiseled out and a new brick inserted with mortar. What can I do?—Willard Spalding, Pittsburgh

Apparently water is being absorbed by the bricks. During winter this water freezes and thaws—a cyclical frost action that causes the bricks to spall.

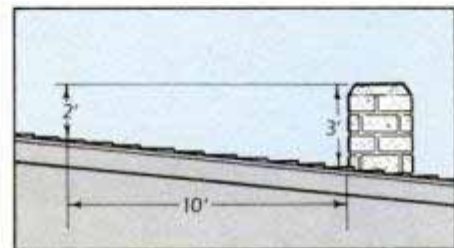
Prior to replacing the deteriorated bricks you should eliminate the source of the water. Seal and repoint all cracked and open joints in the coping on top of the wall and also between the exposed bricks.

Perhaps the grassy area does not drain properly. If that soil periodically stays wet it could also cause the spalling. In this case the area should be excavated and filled with gravel to a level about 6 in. below finished grade. Cover the gravel with polyethylene sheets and then with top-soil. Install weep holes in the bottom of the wall if there aren't any.

Low-level chimney

The top of my chimney (I have a gas furnace) is quite a bit below the level of the top of my roof. I have heard that this could be dangerous in the event of a moderate wind that could cause a back flow of gases into my home. I would appreciate any comments you might have on this subject. —D.R. McGillivray, East Liverpool, Ohio

The fact that the top of the chimney



Chimneys should extend at least 3 ft. past the highest point where they pass through the roof and 2 ft. higher than any roof part within 10 ft. measured horizontally.

is below the top of the roof ridge is not necessarily a problem—as long as the chimney is terminated properly. The National Fire Protection Assn. (NFPA) Standard #211 states that chimneys for residential-type appliances must extend at least 3 ft. above the highest point where they pass through the roof of a building, and must be at least 2 ft. higher than any part of the roof within 10 ft. measured horizontally. The measurements are made from the high side of the roof to the top of the chimney. This is sometimes referred to as the 3-ft., 2-ft., 10-ft. rule. It applies to both masonry and metal chimneys, whether the chimney is connected to a central heating system, fireplace or stove. You can extend the top of the chimney to provide additional height.

Dry, cracked board siding

Two years ago, I bought an 18-year-old house with board and batten siding (vertical 1×10-in. boards with 1×3-in. strips covering the joints). I think the wood is cedar. It is very dry and has cracked and warped in many places. When I nail the wood back down, it only

cracks more. I plan to replace the 1×3 strips, and hope this will hold the warped boards tight. What kind of finish should I use?—Dave Landgraf, Benbrook, Tex.

Based on your description it sounds as if any attempt to correct the problems would be fruitless. Pulling the boards down using new 1×3 batten strips may straighten them temporarily, but it will also crack them. Warping of the siding is probably a result of inadequate nailing. With vertical siding, backer blocks are normally installed between the studs to provide a good nailing base. With a poor nailing base, when one side of the board is more moist than the other, it expands, pulls the nails loose and warps.

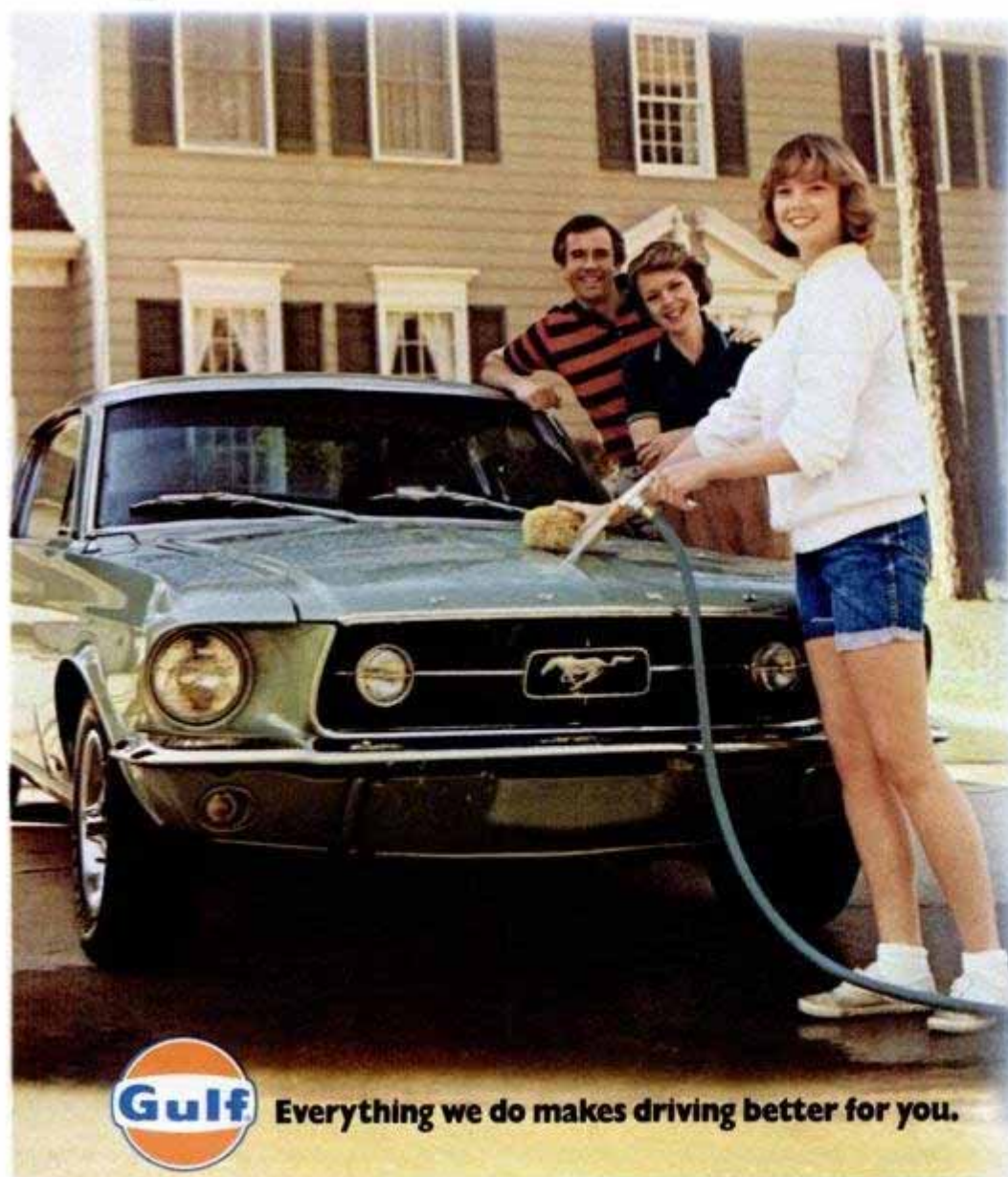
I don't think the siding is cedar. The warping and cracking that you describe is not typical of cedar. It may be spruce or hemlock. In any event, the badly distorted boards and battens should be replaced and fastened into a good nailing base. If more than one-third of the siding needs work, you would be better off re-siding completely. If you only replace sections you will be unable to match the weathered look of the original boards. To minimize this, coat all walls with a semitransparent penetrating oil-base stain such as Cabot's (Samuel Cabot Inc., 1 Union St., Boston, Mass. 02108). **PM**

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

My daughter was practically born in this car.

Now she wants the keys to it.

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



A '67 Mustang, raised on Gulfpride.*

I was 18 and just married when I bought it. I was 19 and over in the next county when my wife called to say she was in labor.

You never saw anyone drive so fast.

I dropped her off at the emergency room, and by the time I'd parked the car, I was a daddy.

Now I've got a teenage daughter with a new driver's license. And a teenage Mustang with a new driver.

Should I trust a car that old with someone so special? No problem. I've always taken good care of it. Frequent tune-ups. And frequent oil changes, always with Gulfpride. Maybe that's why it's always taken good care of me.

So I know I can trust the car with my daughter. The question is whether I can trust my daughter with the car.



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More convertibles, chop-chop

VW Polo sets up four ways: roll-bar convertible, targa, pickup and wagon.



Who's torching the tops off all those sedans? It's usually custom shops catering to convertible fans. But carmakers are at it, too, finding that it makes sense to do the work right on the assembly line and include a soft top in their model lineups. The customizers



Saab's Turbo Cabriolet will be factory-built and will join other models for '86.

and automakers are keeping the convertibles coming at such a pace that there are few models that have not been "convertible-ized."

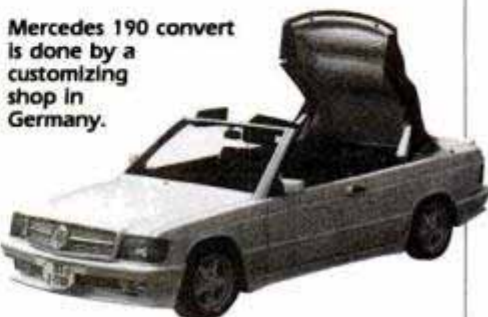
The latest factory job is from Saab with its Cabrio 900 Turbo. The prototype is cruising the States right now—you may have seen it in L.A. at the Olympics. The production soft-top will be an '86 model along with the hard-roof 900s and new 9000 (see below). Our question to safety-conscious Saab: Where's the roll bar?

You might recognize the Polo (above), but not above the beltline: The open Polo is not a legitimate VW model,

but the idea of the Styling Garage in Hamburg. They take the popular little model and set it up to switch from full convertible (shown) to targa to pickup to station wagon, depending on what roof pieces and panels are in place at the time. The multiple-use Polo—call it the Four-In-One—costs German buyers a bit under \$5,000, if they have their own Polo to start with.

Another German customizer, Car Styling, did the convertible version of

Mercedes 190 convert is done by a customizing shop in Germany.



the Mercedes 190. The plush top on this one is hydraulically operated by a quick-acting Bosch pump. Special rubber reinforcers in the top keep it from ballooning at speed, an annoyance that owners of lesser convertibles have to put up with.

Saab's big one

The most conventional-looking Saab ever goes on sale in Europe in two months.

The 9000 is also the roomiest and most expensive car ever made by the small Swedish automaker. For the U.S., the 9000 will be an '86 model, to be here a year from now.

For \$20,000-plus, an import buyer expects above-average performance, accommodation, road manners and workmanship. From our European preview we can say that in all these respects the 9000 will intimidate its

competition. It offers tremendous space for occupants—it's EPA rated as a "large car." For cargo, the tailgate opens to bumper level, and the split rear seats fold down. Within an overall length of 182.0 in., Saab has designed a very roomy cabin. The 9000 is wider than the 900 (69.5 in. vs. 66.5) and the passenger compartment also gets the space saved by installing the engine transversely.

The fuel-injected, 2.0-liter Turbo 16 is Saab's third-generation turbo Four and it's refined to the nth degree. It gets 175 high-torque hp from its twin-



The 9000 head-on shows wide stance, familiar grille; drag coefficient is a low 0.34.

cam and intercooler design, and runs with a steady beat on any octane from 98 down to 92.

It's easy to like practical family cars, especially those that hit 60 mph in 8 sec. and top out at 130 mph-plus. All Saab idiosyncrasies are gone, by the way. Even the ignition key has been moved from its transmission-locking position between the front seats to the steering column.

FM



Sixteen-valve turbo powers five-door hatchback.

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**Extra Mild!
Low Tar!
Great Taste!**

*100's:
Only 9 mgs. tar.
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*Kings:
Only 8 mgs. tar.
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Warning: The Surgeon General Has Determined
That Cigarette Smoking Is Dangerous to Your Health.

Lights: 8 mg. "tar", 0.7 mg. nicotine; 100's: 9 mg.
"tar", 0.8 mg. nicotine av. per cigarette by FTC method.



The Korean-built Hyundai Pony, though old-fashioned, is a bad example of cheap wheels.

THE CANADIAN CONNECTION

Cars You Can't Buy Here

Americans can't buy any of these exotic imports sold in Canada. Do we want them?

BY JIM KENZIE

Back in the '50s, we used to enjoy family jaunts from Canada to Cleveland to visit relatives. As Canadians, we loved the looks on the faces of American gas station attendants when we pulled in to fill up our Dad's 1954 Meteor two-door sedan. Now you, like those pump jockeys, will be excused for asking: "What's a Meteor?"

Meteors were face-lifted Fords that were sold by Lincoln-Mercury dealers in Canada. It seems that, with our widely dispersed population, an L-M store couldn't make a living selling only up-market cars. So they applied some chromium lipstick to the Ford and the Meteor was born. For similar reasons, Canadian Ford dealerships sold a Mercury clone called the Monarch.

Today, the Canadian Ford lineup is virtually identical to its U.S. counterpart. But market differences still create variations in the Canadian product mix. Plymouth dealers sell a front-drive Caravelle (actually the Dodge 600 with different nameplates) and a rear-drive Caravelle Salon (Dodge Diplomat). Pontiac has had a Chevette called the Acadian for years. And the Canadian full-size Pontiac, the Parisienne, survived even after the U.S. Bonneville—the real Bonny—was dropped for the

1982 model year. In fact, it's now exported to the United States.

Canadian safety regulations are essentially the same as those in the United States, except that Canadians have retained the 5-mph bumper, while the U.S. regulation has dropped to 2½ mph.

Exhaust emissions are a different story. Canada continues with the 1975 U.S. standards: 2.0 grams hydrocarbons, 25 grams carbon monoxide, and 3.1 grams NOx, compared with the present, (49-state) levels of 0.41, 3.4 and 1.0 grams respectively. Conventional wisdom holds that less restrictive emission standards bring better performance and fuel economy. The Honda Civic 1.5-liter engine produces 83 hp in Canadian trim while the U.S.-spec version produces only 76. And the normally aspirated Audi 5000 has 110 horses in Canada, 10 more than in the U.S.

"But it's changing," warns Lui Hrobelsky, chief of Energy and Emissions Engineering for Transport Canada, the federal agency responsible for vehicle standards. "The really tough U.S. limits now in effect forced carmakers to make a quantum leap in engine management

technology. Today's feedback carburetors and electronic fuel-injection systems not only give better emission control, but better economy and performance to boot. The United States gets this stuff. Usually, we don't.

"Of course, this hardware doesn't come free," he adds. "We estimate that it costs between \$200 and \$400 to upgrade a Canadian-spec car to meet U.S. levels, depending on whether the car in question already has a catalytic converter. The price to the consumer would, naturally, be higher than that."

Cars that meet the Canadian limits without catalytic converters not only save Canadians money at purchase time and at exhaust system replacement time, but every gallon of leaded fuel saves about 9 cents over the cost of a gallon of unleaded.

You might think that Canada's relaxed stance on air quality might make the Great White North a wonderland for high-performance automobiles that couldn't squeeze into the States. But remember: In Canada, summer is defined as two weeks of bad skiing. Who wants to drive a Lamborghini under those conditions? And the relatively small market makes it economically difficult for exotic carmakers to main-



Russian models are the most popular communist cars imported by Canada. Lada sedan (left) and Niva 4x4 are cheap, but primitive.

tain a sales and service organization. Heck, General Motors has a tough enough time of it.

One tasty exception is Porsche, which brings in the mighty 930 Turbo. "The emission laws in Canada are about the

ingly ugly we cannot print pictures of them in a family magazine.

When most automotive experts make up their lists of what the world needs now, a 1,200-cc, rear-engined sedan with swing-axle suspension is rarely

debut in 1979. Its Russian engineers have retained the worst features of the Fiat 124—the long-arm, short-leg gorilla driving position and the spotty reliability record—and added a few of their own. The rough and noisy engine seems better suited to an Order of Lenin tractor. The steering gear would give Arnold Schwarzenegger pause. Still, by communist standards, the Lada is Mercedes-Benz.

Lada also imports the cute, rugged but rough-running four-wheel-drive Niva. Rumor has it that Porsche had a hand in the design of this rig, but nobody's talking. Equipped with Hakkapeliitta tires and lock-up differentials, the Niva will take you just about anywhere, providing it doesn't make you deaf first.

In case you're wondering about the political ramifications of selling Russian cars in Canada, you should know that the importing company is wholly Canadian. It is also involved in arranging other trade deals between Canada and the Soviet Union.

Understand that Russia is no more popular in Canada than it is in the United States. We see our share of bumper stickers reading, "Tour Afghanistan—Buy a Lada."

The South Korean-built Hyundai Pony is a 1973 Giorgetto Giugiaro design that still looks pretty despite its age



Japanese odd couple: 45-hp Suzuki 4x4 (left) and the perfectly modern fwd Nissan Micra.

same as Sweden and Australia," says Bernice Holman of VW-Porsche-Audi (Canada). "So we bring in the same version of the Turbo as those countries get." Which means that Canadians get a fully air-dammed, whale-tailed terror of the tundra whose 300 hp is nearly sufficient to melt the polar ice cap. The list price of more than \$61,000 tempers the demand to some extent.

If your taste—or your budget—runs to the lower end of the price scale, Canada gets quite a few exclusive cars that you can't have if you live in the United States. Included are three from Iron Curtain countries whose primary function seems to be earning capitalist dollars for their governments so they can pay for Canadian wheat. All three bear impressively low list prices at or near the \$4,000 mark.

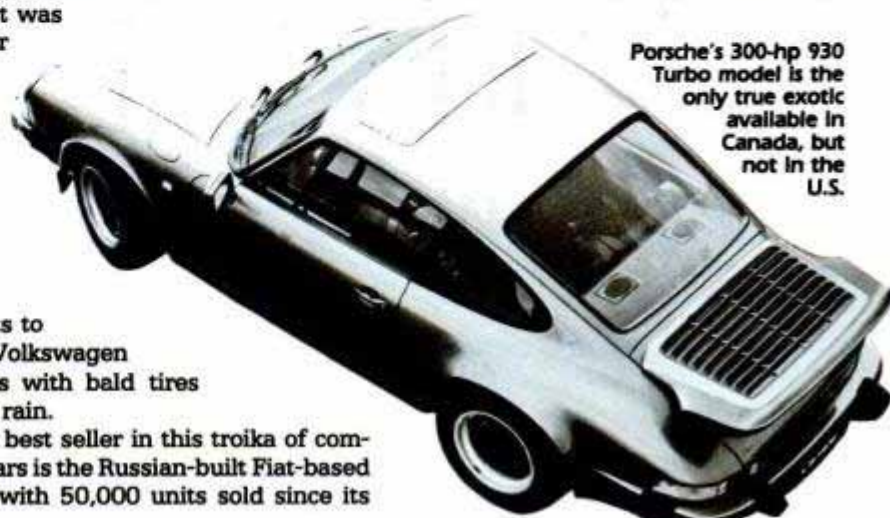
The Dacia, built in Romania, is a straight remake of the front-wheel-drive Renault 12. Like its French ancestor, the Dacia has a soft ride and fairly smooth engine. But quality control is conspicuous by its absence. "Fit and finish" is a phrase that seems to have no translation in Romanian.

Dacia also sells some four-wheel-drive utility vehicles that are so stupefy-

mentioned. But that's what you get with the Czechoslovakian Skoda. No one at Skoda will confirm or deny it, but the car looks like a rebodied Renault 8 from the mid-'60s. The seats are comfortable, the ride is acceptable, and the car is better finished than the Dacia, which is faint praise, indeed. The Skoda is prodigiously noisy on the highway. Its sensitivity to sidewinds and tail-happiness in any sort of cornering will give Canadian children a chance to learn what it was like for

their parents to drive Volkswagen Beetles with bald tires in the rain.

The best seller in this troika of comrade cars is the Russian-built Fiat-based Lada, with 50,000 units sold since its



Porsche's 300-hp 930 Turbo model is the only true exotic available in Canada, but not in the U.S.



Two unusual coupes are the rear-engined Czechoslovakian Skoda Rapidé (left) and the three-cylinder front-drive Innocenti from Italy.

(see *Coming: Cars From Korea*, page 86, Aug. '84). The old-fashioned front-engine rear-drive layout results in a rather cramped interior, given the car's overall size. But the Mitsubishi-designed drive train plus good, if not terrific, quality make the Pony a solid little runabout that sells for \$4,530.

Innocenti makes the Tre Cilindri, a tiny subcompact that looks like an updated Austin Mini. This is not surprising, since Innocenti used to build the Mini under license in Italy. Alessandro de Tomaso took over the company, re-engineered the chassis, hired Bertone to style the body, and installed a three-cylinder 993-cc engine bought from Daihatsu, an affiliate of Toyota. The engine is as rough as an old boot, but the car's attractive lines and Italian spirit help to compensate.

Suzuki, the motorcycle maker and supplier of Chevrolet's upcoming Sprint, sells its line of tiny four-wheel-drive vehicles in Canada—also in Hawaii and Puerto Rico, by the way. It is hard to figure out where these overgrown Tonka Toys fit into the larger scheme of things. The beautifully engineered but undersized 45-hp engine doesn't produce enough poop for serious off-road use. And the low gearing,

frightening engine noise and choppy ride make the Suzuki ill-suited for highway work. Does an urban off-road vehicle make any sense to you?

Nissan brings in their subcompact Micra, a three-door hatchback called

instance, Canadians get no Isuzus, which means no lovely Impulse. Canada gets only the Mitsubishi's that Chrysler imports, and then, not even the Conquest. Nissan figures Canada has enough prairie without them adding



Low-ball sedans include the \$4,000 Dacia GTL from Romania (left) and the Skoda 120 GLS.

the March in Japan and Europe. It is a thoroughly modern front-wheel-drive car with plenty of room for four plus a good ride. Since it costs around \$4,600, it makes things tough for the antediluvian competition from the Second and Third Worlds.

It is hard to say whether these worthy denizens of the automotive world make up for the cars Canadians don't get. For

any more, so their clever little wagon/van of the same name is among the missing. And there is no gray market at all. There are no provisions in Canadian law for individual modification and certification of a nonlegal model, as is done in the United States.

Wonder what the pump jockey's reaction would be if you pulled up in a Skoda 120 GLS? **PM**

Warranties, Canadian Style

Early in the mid-1970s, Canadian car owners were steamed. It seemed like their cars were rusting through faster than they could buy them. So, in 1977, auto manufacturers drew up minimum rustproofing standards for new cars sold in North America. Now, all automakers voluntarily offer warranties against surface corrosion for 12 months or 25,000 miles and warranties against perforation for 36 months or 75,000 miles. "These have become the minimum acceptable standards in all of North America," says Peter Ferguson, spokesman for Canada's Consumer Service Branch of the Federal Department of Consumer and Corporate Affairs.

Canada's American neighbors benefit from the standards, too, since cars sold in the United States meet the same standards. "Corrosion protection is the same whether a car's built in Canada or in St. Louis," Ferguson said.

In 1982, Audi introduced another innovative warranty, the Audi Card, a no-excuses warranty for all Audis sold in Canada. For three years, regardless of mileage, Audi pays for anything that wears out, including tires, wiper blades, fan belts and lightbulbs. All you have to do is bring the car in for free maintenance checks to your friendly Audi dealer. Audi even pays for the oil.

The Audi Card also enrolls you in the

Canadian Automobile Assn. which, through its affiliation with the AAA, provides its familiar club services throughout North America. Should you decide to sell the car, the Audi Card is transferable to any subsequent owner.

Audi went this dramatic route partially to test the market, but also to counter the image that Audis are fragile. The program is still being offered, so presumably it has been reasonably successful.

The Ford Motor Co. of Canada thinks so, anyway. It introduced the Lincoln Card, which is standard equipment on all 1984 Lincolns. Although similar to the Audi system, the Lincoln program doesn't cover tires or provide CAA membership. But, like the Audi Card, the Lincoln Card is available only in Canada.

SPACE STATION:

'The Next Bold Step'



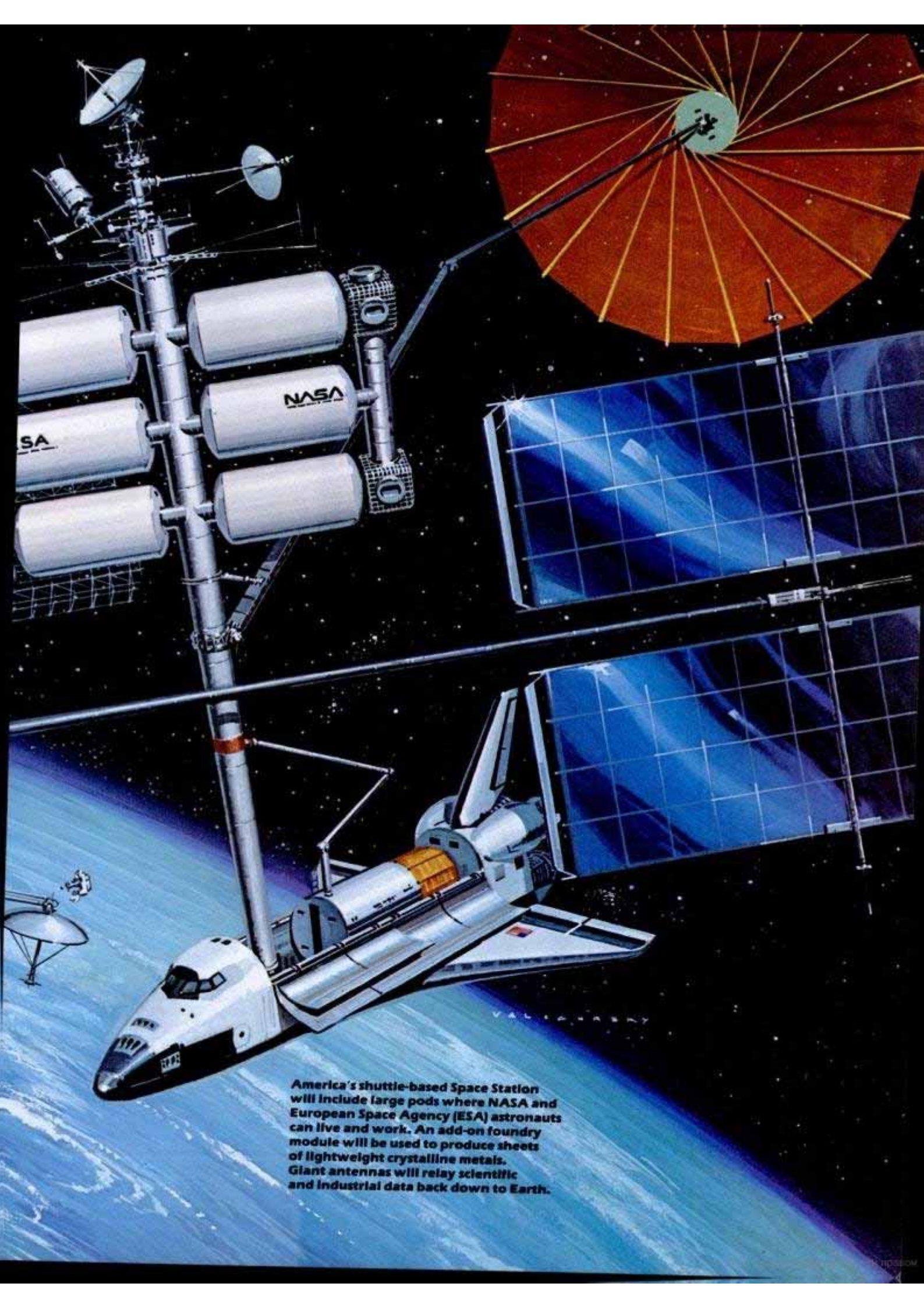
'Now we are ready for man to live and work in space on a more permanent basis.'

BY RONALD REAGAN
President of the United States

In my State of the Union address, I spoke about taking on the challenge of mankind's next frontier—space. It is time for this nation to take the next bold step into that frontier. We all held our breath as the original Mercury astronauts ventured on their short flights into the unknown. Now we are ready for man to live and work in space on a more permanent basis. The space frontier must be tamed and developed as a resource for all who remain earthbound. Conquering this frontier will reap unimaginable rewards for our quality of life and will help us preserve the legacy of our forefathers,



A roll of crystalline metal floats outside foundry module as an astronaut in a jet-powered chair prepares to load it onto a Japanese ferry rocket. Production of lightweight metals that can be made only in space will be a mainstay of our Space Station. Japan has successfully tested ferry rockets.



America's shuttle-based Space Station will include large pods where NASA and European Space Agency (ESA) astronauts can live and work. An add-on foundry module will be used to produce sheets of lightweight crystalline metals. Giant antennas will relay scientific and industrial data back down to Earth.

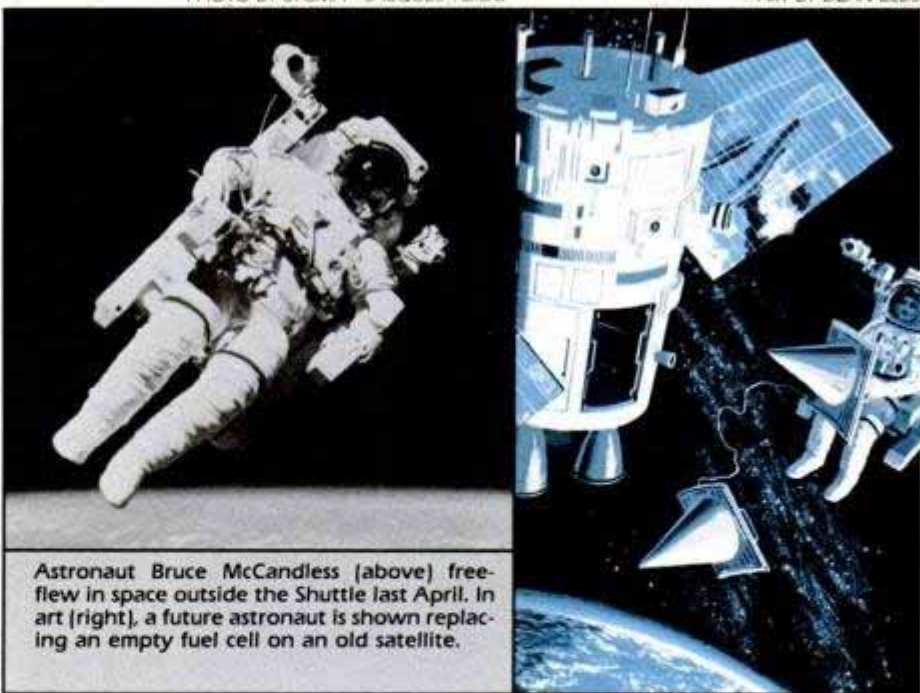
who were pathfinders, innovators and always willing to go just beyond the next ridge.

Our decision to build a permanently manned Space Station is in this same spirit. The groundwork for this endeavor has already been laid by previous chief executives. Under President Eisenhower's leadership in the mid-1950s, our country's initial decision to embark on a space program was a small, but important, beginning. But it opened broad possibilities—most of which in retrospect were not foreseen: communications satellites, Earth-remote sensing satellites, national defense applications and technology spin-offs.

President Kennedy declared that

**'We will be able
to refuel and
repair satellites.'**

Americans would visit the moon and return safely to Earth. That magnificent decision uplifted America's spirit and brought us together long after Kennedy was gone. And the Apollo program established the technological base for all manned space ventures to follow. President Nixon, believing that the



Astronaut Bruce McCandless (above) free-flew in space outside the Shuttle last April. In art (right), a future astronaut is shown replacing an empty fuel cell on an old satellite.

United States needed a ready and economical access to space, approved the development of the Space Shuttle program. He understood that the Shuttle would be a great accomplishment for America and could also include the involvement of other nations. Those leaders making the decisions to go into space had faith that once moving toward the goal, new and unforeseen potential would be discovered and brought on line to benefit all mankind.

These visionary decisions catapulted our nation into the forefront of the conquest of space. Now we stand on the verge of realizing one of mankind's most ambitious dreams, that of building a permanently manned base in space. Such a Space Station will assure U.S. leadership in space into the next century.

The Space Station is a major part of our strategy for conquering the frontier of space. NASA will oversee the project,

Russia Starts The Race

While plans for America's permanent Space Station of the 1990s are flying high, so is an actual Soviet orbital outpost—the Salyut-7. The Russians have been concentrating on this project since 1969, when they lost the moon race, and are now on the verge of completing what looks like a major breakthrough in the new space race. While America talks and plans, the Soviets have actually been launching, launching and launching more.

Currently, there are three cosmonauts aboard the Salyut-7. New crews will be sent aloft to relieve the cosmonauts who are finishing their months-long tours. While in flight, the Russian spacemen map and survey their own country's natural resources. And they develop special materials, including crystals, alloys and drugs. When people set out for Mars, it will be because Soviet cosmonauts paved the way with medical and life support studies lasting a year or more under space conditions.

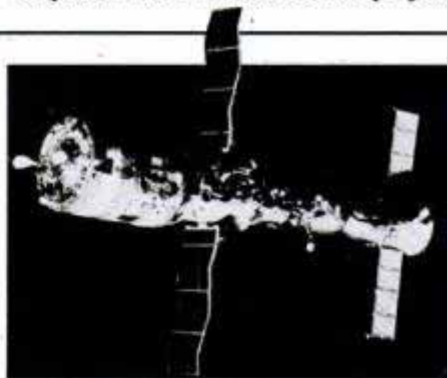
But the current Salyut space workshop is only a prototype compared to the

ones—both Soviet and American—which will be flying in the 1990s. Salyut's electrical power supplies are extremely limited,

PHOTOS BY SOVFOTO



Voshkod rocket lifts off to ferry supplies to cosmonauts who have been in orbit for months. The Soviets are planning a shuttle based on American designs.

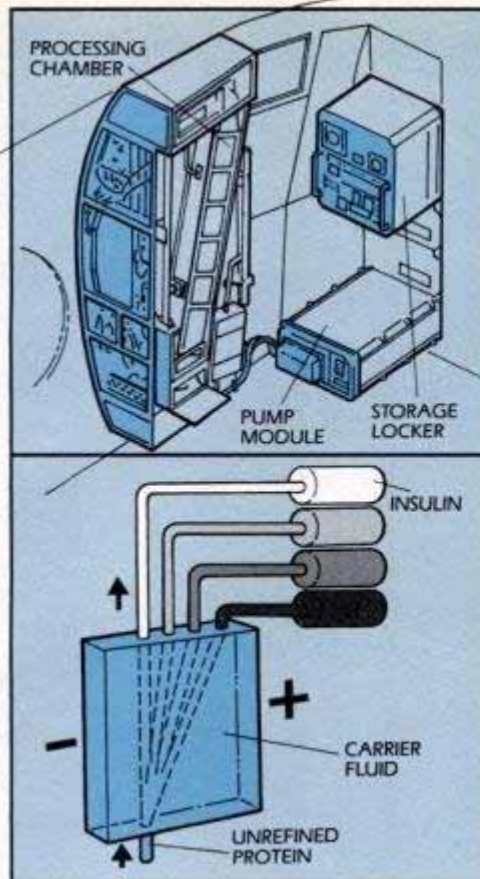


Soyuz 7 space station was photographed by French cosmonauts as they approached the docking module last year. Add-ons to this station are being launched this winter.

as is its living space for crew members.

The Soviets already have add-on modules that can provide additional living space and specialized laboratories for orbiting cosmonauts, while bringing up supplemental solar power panels. New landing craft can carry a half ton of "down-cargo" at a time.

But the Soviets are planning two types of "space shuttles" for the 1990s. The first is a small craft designed to replace the cramped, underpowered Soyuz manned space capsule. It has already been tested in space, in the form of an unmanned quarter-scale model. The second is a



McDonnell Douglas/NASA Shuttle payload specialist Charles Walker starts electrophoresis unit (above). The machinery (top, left) makes pure protein. Under strict temperature control, the unit can make insulin. The diagram (left) shows an unrefined protein as it enters a carrier fluid. This will flow up and separate under an electric field.

ART BY ED LIPINSKI

which we plan to have in orbit around the Earth within a decade. It will be a base for scientific and commercial activities. Scientists will do research that is only possible in the zero-gravity and

vacuum of space. Private industry will manufacture new products and provide new services. But, most importantly, the Space Station will open the door to even greater progress in the future. It

will provide new opportunities for human commerce, for further exploration of our universe, and for expanding our understanding of the Earth and ourselves.

The second element of our plan for space is cooperation with our allies and friends. International cooperation has been a guiding principle of the U.S. Space Program since its beginning, and

'Medicines will be manufactured that will help us cure ... cancer.'

a Space Station will add a new dimension to this multinational approach. Once completed, our Space Station will offer a place for us to live and work with our friends, exploring the universe and using space for peaceful goals that benefit all mankind.

Our third goal is the development of the commercial potential of space by encouraging American industry to move beyond the Earth. Obstacles to private sector space activities will be removed and active steps will be taken to spur private investment. We expect heavy growth in space-related invest-

(Please turn to page 112)

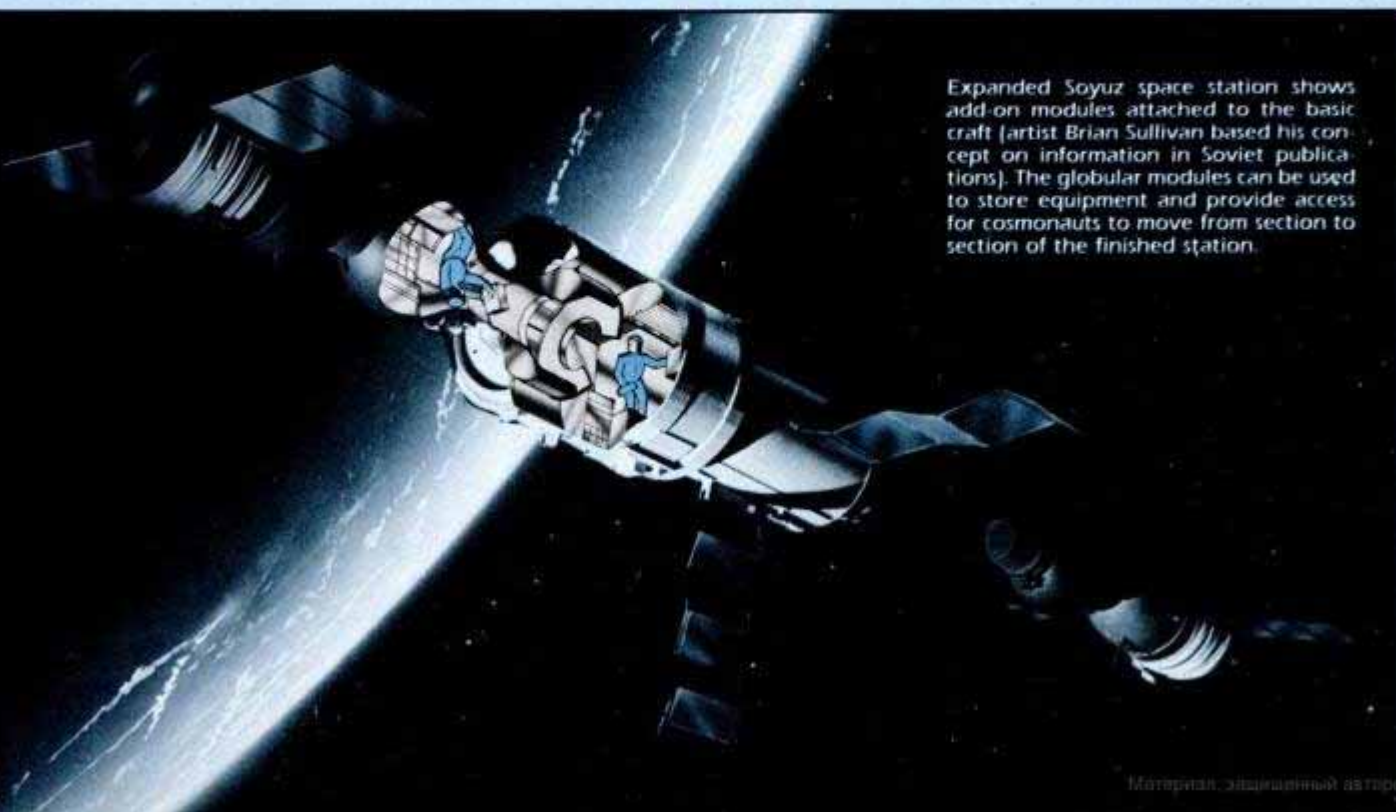
large winged vehicle copied almost directly from American designs.

By the 1990s, a new "super booster" will be available to carry 100-ton, 20-man space stations into orbit. In every way, these Soviet space laboratories, obser-

vatories and workshops will be comparable to those now being planned by American space engineers.

After a decade of racing along separate courses (for them, a small station; for us, a space shuttle), the goals of the world's

two space powers will again be converging. A new round of the "space race" is on, and the prize is not merely fame and prestige, but wealth and power. It is a race the United States literally cannot afford to lose.—James Oberg



Expanded Soyuz space station shows add-on modules attached to the basic craft (artist Brian Sullivan based his concept on information in Soviet publications). The globular modules can be used to store equipment and provide access for cosmonauts to move from section to section of the finished station.

MUD, SWEAT AND GEARS



The Camel Trophy is not your usual Sunday drive. It's a two-week adventure testing man and machine.

BY DANIEL CHARLES ROSS
Detroit Editor

Why would anyone want to spend two weeks bouncing around in a Land-Rover through the foulest, densest, most insect-ridden, malaria-infested jungles of the world? I really don't know. But every year for the past five years, that's exactly what a hardy group of adventurers has done in competition for something called the Camel Trophy.

The Camel Trophy isn't really a trophy; it's an off-road adventure that was born five years ago in Germany at the headquarters of R.J. Reynolds Tobacco. Speed is important, but courage, driving skill, team spirit and the ability to adjust to local conditions are the first requirements.

Only Germans participated in the first two contests—Camel Trophy 1980 through the Amazon jungle of Brazil and Camel Trophy '81 in the oppressive heat and humidity of Sumatra. Based on the popularity of the event, Camel Trophy '82 in Papua, New Guinea, was expanded to eight teams

representing four countries. Last year, the Camel Trophy took place in the heat of Africa.

For Camel Trophy '84, as in past years, the site was selected to provide the utmost challenge—the jungles of Brazil. The competitors this year consisted of 12 teams from six countries—two teams each from Italy, Germany, Netherlands, Spain, Switzerland and Belgium.

There was one journalist along from North America to chronicle the event for posterity. Me.

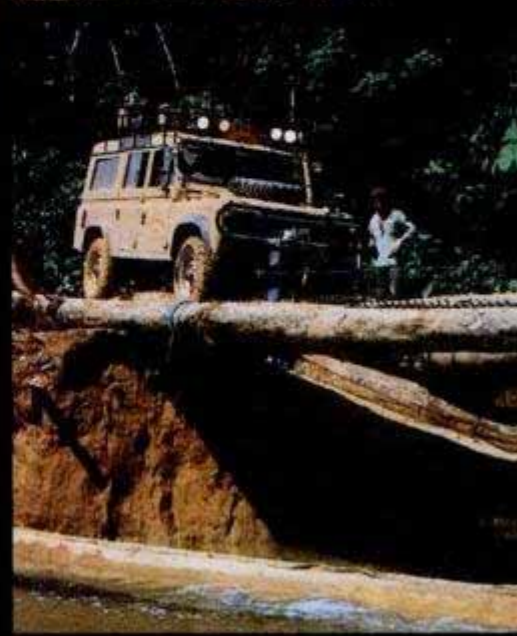
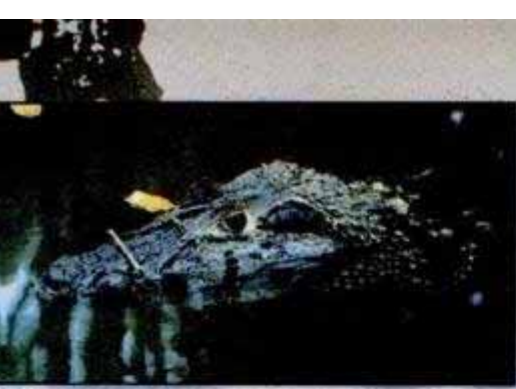
I arrive at the international airport in Manaus, Brazil, at about 4 a.m. local time. It's been a 10½-hour trip from Detroit, including the time spent in airports. And I am dead. After a sleepy walk through the Brazilian Customs line and rubber stamps from the federal police officials, I wander out of the terminal to figure out how I'm supposed to get to the Tropical Hotel. Do I speak Portuguese? *Nein*.

A cab driver hails me over and shows

(Please turn to page 102)

(Please turn to page 102)





Bridge negotiation was one of 12 graded skills, but the exercise was for real when a bridge collapsed (above). After a jury-rigged rebuild, vehicles were winched across the remaining sound timber. Numb, sunburned competitors (far left) try to enjoy a meal after yet another day of adventure and agony. Falling off the road (left) was common.





CHRYSLER:

In its survival era, they made a little go a long way. Now they've made it fast.

BY WADE HOYT, Auto Editor
Photos by Don Hunter and Wes Bobbitt



Dodge H-body:
Lancer has a "gunsight" grille motif that echoes Chrysler 300 styling of years past.



Minor face-lifts typify most of Chrysler's '85 lineup, including new sheet metal on the Plymouth Reliant (top). Shelby Charger moves up in the performance heap with a 146-hp turbo Four.

If anyone in Detroit is responsible for the rebirth of the American performance car, it's the feisty "new" Chrysler Corp. Starting with the bread-and-butter Omni-Horizon and K-car economy/survival models, Chairman Lee Iacocca's legions have squeezed more excitement and performance than anyone else could have imagined out of these utilitarian front-drive platforms. For 1985, they have outdone themselves by transforming the K-car's generic transportation module into a world-class sports sedan code-named "H-body."

The Dodge Lancer and Chrysler LeBaron GTS are four-door hatchbacks that cram an amazing amount of performance, comfort and practicality into a relatively small package. With 116 cu. ft. of interior volume, the H-bodies fit into the EPA's "Mid-Size" category, along with the Audi 5000, Pontiac 6000, Ford LTD and Mercedes' big 500SEL, all of which look much

TURNING UP THE PERFORMANCE WICK



larger than the H-body on the outside.

The Lancer/LeBaron GTS is aimed right at the heart of the upwardly mobile "yuppies" (young urban professionals), the very people who buy entry-level Audis, BMWs, Saabs, Volvos and even the baby Mercedes 190. The incredible thing about the H-body is that it's in the performance ballpark with these expensive imports, for thousands of dollars less.

Part of the secret is the optional turbocharged 2.2-liter overhead-cam Four that Chrysler and Carroll Shelby have been refining for several years now. And part of it is an uncanny suspension and steering package.

A clever dual-level turbo boost system delivers up to 9 p.s.i. for as long as 10 seconds, giving peak power and torque figures of 146 hp at 5,200 rpm and 168 lb.-ft. of torque at 3,600 rpm. After 10 seconds of flat-out power, boost drops back to the '84 level of 7.2

(Please turn to page 140)



Chrysler's version of the H-body sports sedan is called the LeBaron GTS. Both cars are four-door hatchbacks with split rear bench seats. Turbo engine is optional. New instrument cluster is a big improvement.



COLOR FOR TINY TVs

The world's first flat-screen, liquid-crystal, color TVs give you a remarkable picture while on the go.

BY WALTER SALM; Photo by Layman/Newman

Move over, Sony Watchman. You've got some serious competition now—superportable color TV sets that go everywhere and fit into any pocket that's handy. If you don't see them in the stores just yet, you will soon. They've been promised for the Christmas buying rush and will be a sure winner to those looking for the newest gadget going.

We had a chance to test two of the newcomers—the Epson Elf and the Seiko TFT (Thin Film Technology), retail priced at \$500 and \$550, respectively. Considering the complexity of the screen fabrication process, we're not surprised at the cost. But as with most new electronics technology, the price tag is bound to drop.

Color sandwich

Getting a workable liquid-crystal display (LCD) image on a black-and-white screen is child's play compared to getting it in color. Unlike regular TV picture tubes, an LCD display doesn't generate its own light, so an external light source is needed. LCD watches and clocks have a tiny light bulb that reflects its light from the front of the crystal display. The technology for the tiny TV was developed by Seiko and the company holds all patents for the sandwich-type television screen.

In the Epson and Seiko TVs, transmitted light is used instead of reflected light. Light

coming from a built-in fluorescent bulb, or reflected from a fold-down mirror, passes through the LCD elements. The screen uses polarized light in order to operate. Light coming through the rear glass of the screen's sandwich is filtered into parallel light waves by passing through the glass's polarizing structure. The light can be stopped by another screen or screen element that is polarized at a 90° angle.

The tiny TV's 2-inch (diagonal measure) screen is made up of 52,800 pixels or picture elements, and each of these is a fast-acting liquid-crystal element. The manufacturer has gone to great lengths to develop a special invisible transistor that's mounted on each

picture element. This transistor provides the voltage to change the crystal's alignment in about 300 milliseconds (thousandths of a second). The transistors are indeed invisible, or at least transparent, and are deposited as thin films on the LCD elements. According to the manufacturer, each transistor is only 0.3 micron thick.

Each of the screen elements has a color filter in front—one of the three primary TV colors of red, blue and green. These in turn are grouped in threes, and each group is a triad.

Light shining through the screen from behind passes through one of these positions, and the filter gives that element its particular color. Where color

is not called for (image is supposed to be dark), the LCD element rotates its axis 90° and the light is blocked by the second polarizer (see the drawing at left).

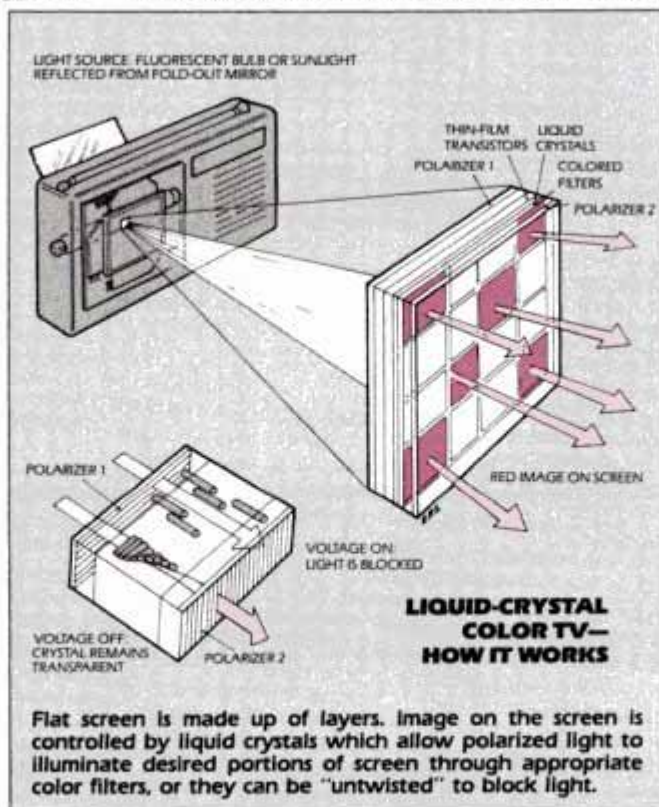
Light sources

The light source can be ordinary daylight, reflected from a fold-down mirror, or it can come from an internal fluorescent source, which you can switch on as needed. The battery drain is considerably lower when the set is sun-powered (1.1 watts vs. 1.9 watts in the Epson Elf).

The system runs on five AA-size penlight batteries or from an a.c. adapter that comes with the set. Optional power sources include a rechargeable battery pack and a cigaret lighter plug-in for the car.

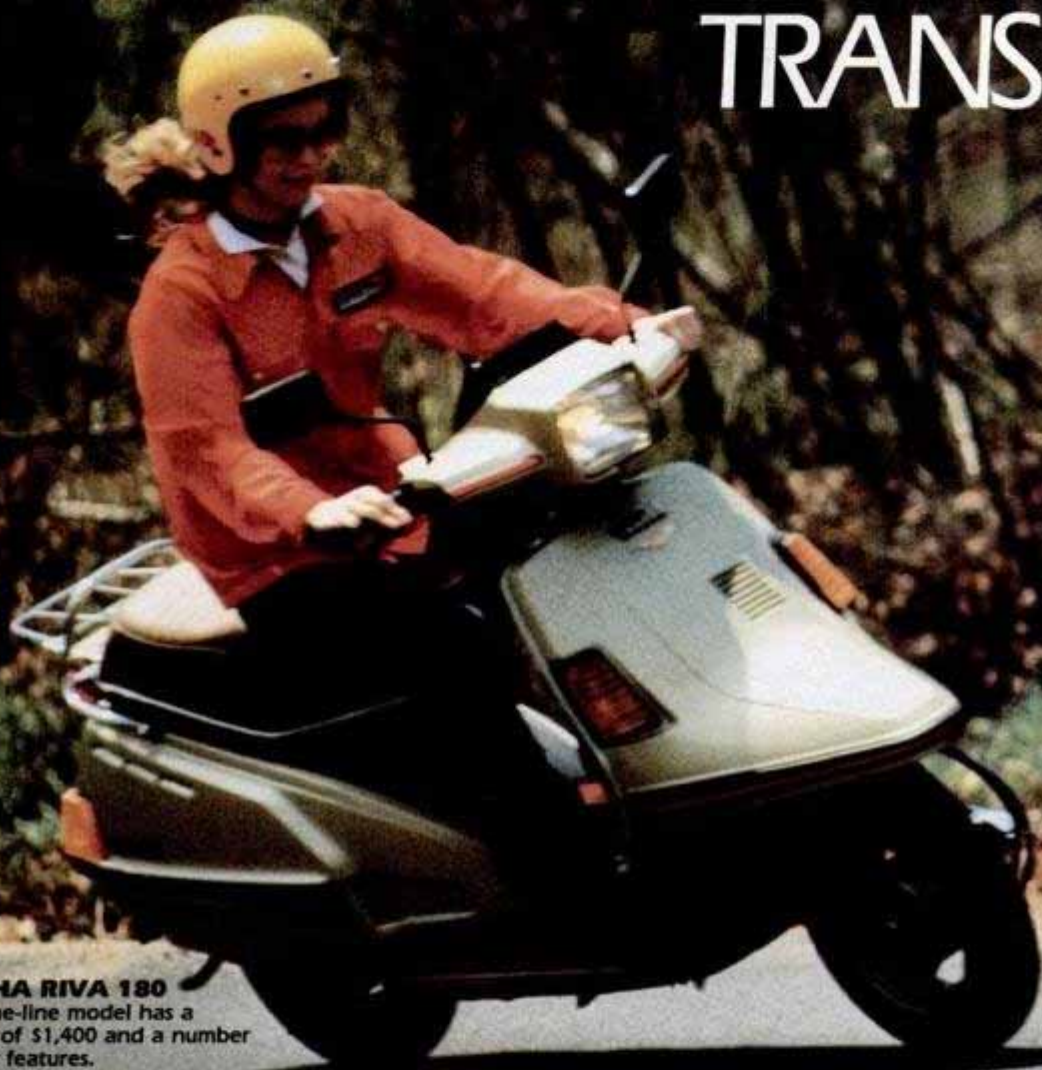
The pocket-size wonder is only slightly larger than a standard microcassette tape

(Please turn to page 111)



In actual use, flat screens of Seiko TFT and Epson Elf color television sets are illuminated from behind, but simulated images were used for this photograph (left).

SLICK SCOOTERS FOR TWO-WHEEL TRANSPORT



YAMAHA RIVA 180
Top-of-the-line model has a list price of \$1,400 and a number of luxury features.

These shiftless wonders of the '80s are a far cry from the Vespas and Lambrettas of 25 years ago.

BY FRANK W. COGGINS
Photos by Peter Tenzer

They were bulbous, ugly, unstable in wet weather or on sand. But mention motor scooter today and everyone has a tale of adventure to tell. Back in the '50s and '60s, there were almost a dozen companies producing them, but with the advent of lightweight small-bore motorcycles, production of scooters narrowed to two companies—Vespa and Lambretta. Lambretta foundered,

manufactured in Brazil and India, and finally disappeared from the American scene. Vespa still shows signs of strength, with plans to offer a new model late in 1984.

Now, suddenly, the scooters are back and gaining in popularity. Today's Japanese versions are sleek, easy to ride, economical and require no premixing of oil and gas.

Yamaha introduced 50-, 80- and 180-cc scooters about a year ago. These are a far cry from their ancestors. The new models feature electric starters, automatic V-belt transmissions and fancy instrument clusters like the modern big bikes. Honda has been even more prolific with six models ranging from 50-through 125 cc. All of them are sharp-looking and feature the latest in motorcycle technology. High-tech has caught up with the motor scooter.



Yamaha Riva sports a carlike dash (with idiot lights) and an illuminated keyhole.

Today's new breed of scooter will appeal to a wide range of potential owners. For one thing, you don't have to straddle a motor scooter to mount it or kick your brains out to start the engine. Anyone, whether young or old, male or female, can ride to the shopping center or to a PTA meeting when someone else



HONDA ELITE
Space-age scooter features liquid-cooled engine, a heater and pop-up headlight.



Honda's impressive dashboard has a digital speedometer and clock plus three gauges.

has made off with the family car.

All of the Hondas and Yamahas have automatic transmissions, which eliminate the awkward business of clutching with the left hand and shifting. And, for those who are concerned about stability, Honda offers the unique three-wheeled Gyro that you can ride without

ever having to put a foot on the pavement. It's so stable that 90° turns can be made at an unbelievably slow pace without a hint of tilting, tipping or dumping the bike. The front end tilts, or leans right or left, without the rear being affected because of an unusual joint in the frame. Our only gripe with this particular model is that the biggest Gyro engine is a 49-cc two-stroke, which drops it into the moped class.

There are two other 49-cc two-strokes in the Honda line—the Aero 50 and the Spree. The Spree is faster, being 40 pounds lighter than the 125-pound Aero, which is likely to make the Spree popular with the younger rider.

The registration and insurance regulations for motor scooters vary from state to state. But in general, scooters with engines of 80 cc or larger must be registered as motorcycles. This means

that, in many states, the fastest and most attractive of these scooters cannot be driven by riders under 17. By then, many of them are thinking about automobiles for transportation.

Yet, there is a slot out there in the marketplace for the new scooters. Gasoline will never get any cheaper than it is now, nor will automobiles or insurance premiums. The first of the new breed of scooters we spotted on the street was being flailed through New York City by a messenger at rush hour. Others have been seen at Newport, R.I., and resort areas up and down the East Coast. In other words, the first motor scooters sold will see yeoman service as workhorses or be ridden for sheer pleasure.

The old, original scooters may have been ugly, but they sure were durable. A Vespa could do wheelies in first gear and move out quickly from a standing start. The tires never seemed to wear out and engines were noted for their longevity. It seemed the only problem with them—and the Lambretta, too, for that matter—was that, if allowed to sit for more than a month or so, the battery ran down.

High-tech runabouts

Today's scooters have all the latest in electronics built right in, including transistorized ignitions. Our test Yamaha started up after sitting through two months of cold weather. Honda says their scooters will start after standing still for *up to six months*. This means that you'll be able to catch that unexpectedly warm January day for a quick ride.

These new little bikes—and trikes—may not do wheelies, but for a very valid reason. Their automatic transmissions make them just a hair slower than the old scooters when moving off from a dead stop. The transmissions are, however, almost maintenance-free and do pull amazingly well once the scooter is rolling. Top speeds with the 125-cc and larger versions are more than enough for riding on the highways without getting run over by faster traffic.

Automatic transmissions are not really new on little bikes. The Honda Passport could be shifted up or down without a clutch control and the older Honda 90 has a similar semi-automatic arrangement. The '84 models, however, require nothing more than rolling the throttle grip back to move out into traffic. Both Honda and Yamaha do it with V-belt and pulley transmissions. Like the variable ratio transmissions found in snowmobiles and soon in cars, the inside half of these pulleys is movable and can pull away from the other half whenever vehicle speed is increased or decreased (see *Get Ready*

(Please turn to page 137)

7 EXPERT WAYS TO MAKE BUTCHER BLOCK

Discover seven wood-joining techniques for building butcher block tops. Then build the PM kitchen cart from the plans included.



Build this maple butcher block cart with utensil drawer (inset) for wherever an extra work surface is needed.

After surviving the plastic laminate revolution of the 1960s and 70s, butcher block tops are now enjoying a renaissance. These attractive hardwood surfaces are durable, versatile and, as you'll see, easy to make.

Butcher blocks are most commonly used for active work surfaces such as kitchen countertops, chopping blocks and workbenches. The warm, hand-crafted look of butcher blocks also makes them a popular choice for furniture. And virtually any hardwood species can be used to make butcher blocks, either alone or in combination with other species for a contrasting appearance.

The seven butcher block techniques shown here are: dowel pins, through-bolt, spline-joint, nail pins, glue-joint, direct-nailing and a top made using teak parquet flooring. Each technique provides an easy way to assemble strong, durable butcher block tops. The particular technique you choose depends on the size and function of the butcher block, the available tools and the desired finished appearance. For example, the through-bolt technique provides the strongest top and is recommended for large surfaces subjected to heavy poundings. If thin boards are used to make a smaller butcher block top, try the easy, direct-nailing method. In most situations, though, many of the techniques shown would be suitable.

Assembly

After milling the butcher block pieces to the same width and thickness, cut them $\frac{1}{2}$ in. longer than needed to allow for final trimming with a portable circular saw or radial-arm saw. Next, ar-



1. Dowel pins—Fluted dowel pins are used to join lengths of $\frac{3}{4}$ × 2-in. cherry. Note that they're joined in pairs first. Cross section (top) reveals dowel locations.



2. Through-bolt—For the strongest butcher block joint, bolt each part together with a threaded rod. Counterbore end pieces (top) to accept a nut, washer and plug.



3. Spline-joint—Assemble spline joints using mahogany plywood splines. Groove each member on both sides, except the end pieces (top), to accept the splines.



4. Nail pins—Cut pins from finishing nails using a pair of end-cut nippers. The pins strengthen the glued joint and prevent the wood from slipping when clamped.



5. Glue-joint—Use a glue-joint bit to cut mating edges on all parts. Then glue the parts to a plywood base. Cross section (top) shows tight-fitting joints.



6. Direct-nailing—Here's a quick and easy way to make a strong joint. Simply glue and nail one board to the next until the desired width butcher block top is formed.



7. Parquet flooring—Glue hardwood parquet flooring to a plywood base. After assembly, add trim around the butcher block to conceal the plywood edge (top).

range the pieces on edge with the best side up. Then orient the pieces so that the wood grain of each piece is pointing in the same direction. Mark an arrow on each piece to indicate grain direction. By pointing the grain in the same direction, the plane won't gouge the wood.

Now mark each board with a number or letter to aid in rearranging for final

assembly and to assure that you machine each piece from the same face or edge. This is especially important for techniques that require boring holes or cutting grooves.

Since most butcher block surfaces are exposed to water, use a water-resistant glue during assembly, such as plastic resin. Simply mix the powdered resin

with water as per label instructions. Use a miniature paint roller to apply the glue evenly and quickly.

After planing and sanding the assembled top smooth, apply several coats of mineral oil or Wood Bowl Seal, a non-toxic sealer available from Constantine's, 2050 Eastchester Rd., Bronx, N.Y. 10461.

Kitchen cart

This easy-to-build maple kitchen cart is a stylish way to gain additional counter space and storage in your kitchen. The roll-about cart also serves as a barbecue wagon or cocktail bar for use on a sun deck, porch or patio.

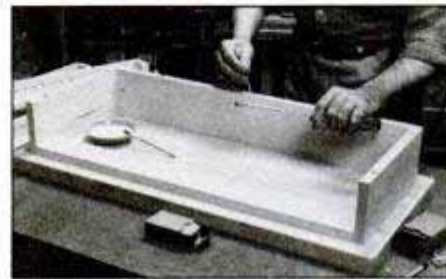
Start by making the butcher block top from $1\frac{1}{4} \times 1\frac{1}{2}$ -in.-thick maple. Nail pins were used to assemble the butcher block (see page 128 for details), but any of the first four techniques shown would work as well. Cut the remaining cart members as shown. Note that the side and back aprons are counterbored to receive 4-in. No. 10 mounting screws. Install the front rail in place of a front apron. This creates space for installing the drawer.

Next, make the four L-shaped leg assemblies. Bore the $\frac{1}{4}$ -in.-dia. shelf peg holes in the legs before nailing the leg assemblies together. Then, with the butcher block upside down, screw the apron in place. Now screw the back legs to the apron, install the fixed shelf and add the two front legs.

Next, make the drawer sides, back and front from $\frac{1}{2}$ -in.-thick poplar or birch plywood. Use $\frac{1}{4}$ -in. birch plywood for the drawer bottom and dividers. Add spacers to each side apron for mounting 12-in. drawer slides (Grant No. 528 full-extension slide). Install the drawer and then add a maple drawer face. Add 2-in.-dia. casters and finish all wood surfaces with several coats of mineral oil.



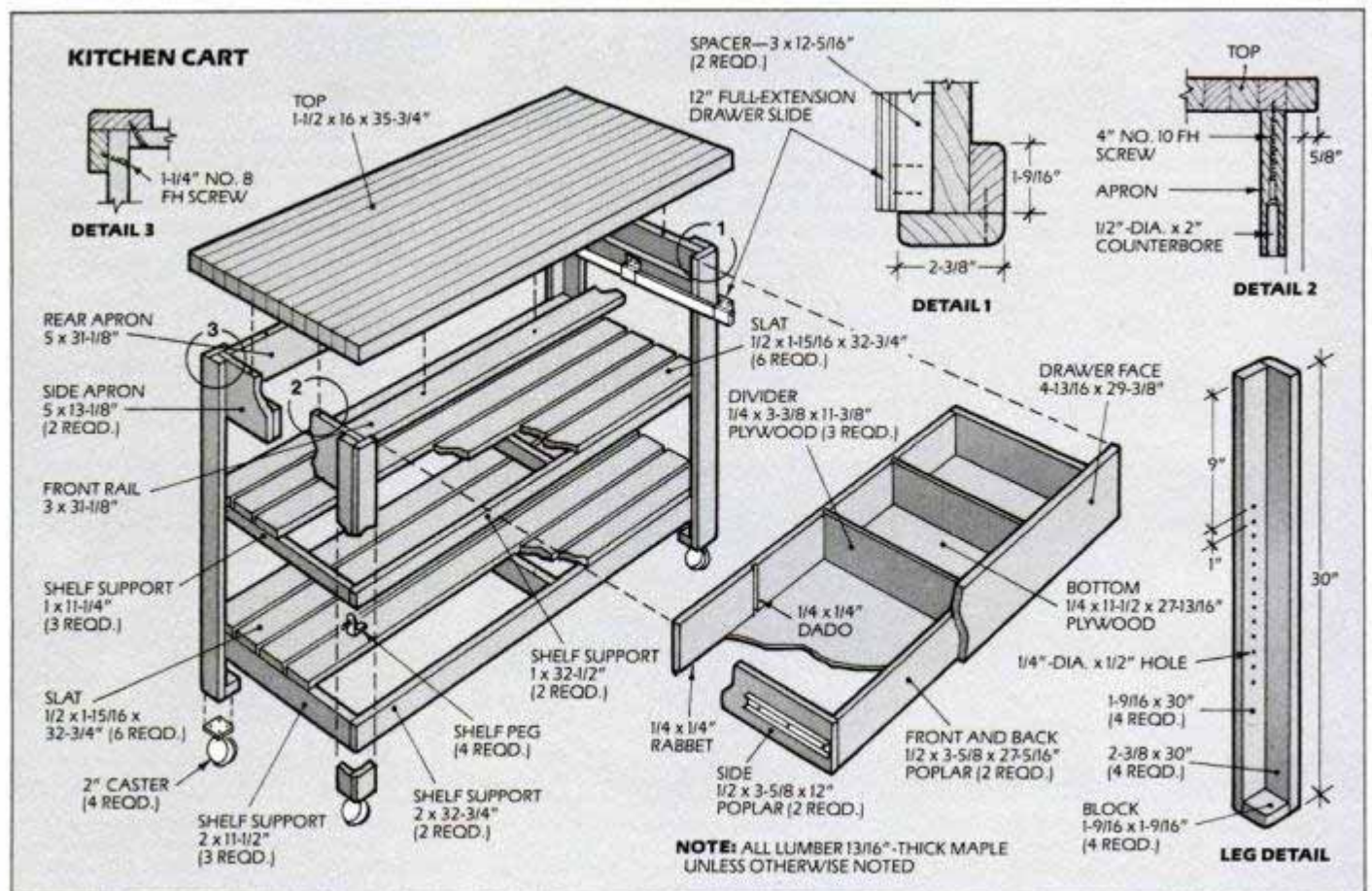
Kitchen cart features a full-length utensil drawer hidden under $1\frac{1}{2}$ -in.-thick maple butcher block top.



Attach the aprons to the underside of the butcher block with 4-in. screws. Be sure to counterbore $\frac{1}{2} \times 2$ -in.-deep screw holes.



After nailing together the four L-shaped leg assemblies, round all outside corners with a router and a $\frac{1}{2}$ -in. rounding-over bit.



1 Dowel pins

This technique uses hardwood dowel pins to join the butcher block members. The wood members are first joined in pairs, and then into blocks of four using a staggered dowel pattern. Continue joining the pieces in this manner until the desired width butcher block is obtained. It's important to use only fluted or spiral-grooved dowel pins, not sections of ordinary hardwood dowels. The flutes and spirals cut into the pins allow excess glue to escape the dowel hole during clamping. Otherwise, clamping pressure may cause the trapped glue to split the wood.

First, lay the butcher block members edge-to-edge on a flat surface. Then,



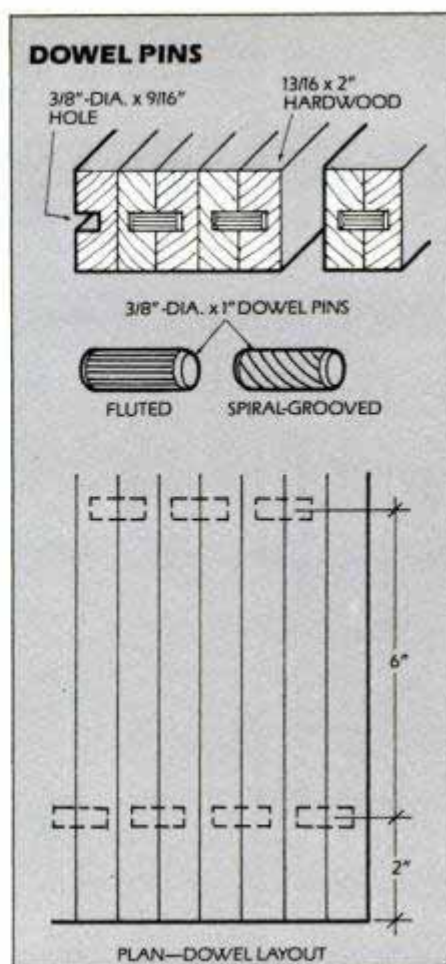
If you don't own a drill press, use a portable drill with a doweling jig to bore dowel pin holes. Note depth-stop collar on drill bit.

using a framing square or T-square, draw centerlines for the first set of dowel holes every 6 in. Be sure to code each board with a number or letter to aid the final assembly.

Now bore the dowel holes using a drill press or a portable drill with a doweling jig. Note that for a 1-in.-long dowel pin you must bore a $9/16$ -in.-deep hole in each member. The extra $1/16$ in. retains a small amount of glue; just enough to make a strong joint. During assembly, be certain to apply glue to the walls of the dowel holes and along the face of the mating boards. Clamp the pieces with bar or pipe clamps placed under and over the butcher block to prevent bowing. Be certain to scrape off hardened glue squeezeout before planing and sanding.



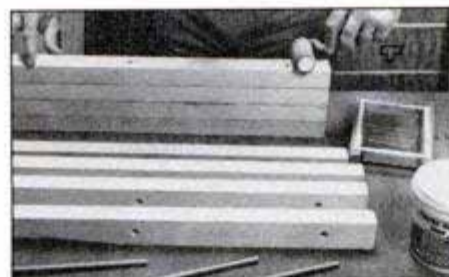
Apply glue to the walls of the holes and then tap in the pins using a wooden or plastic mallet to avoid damaging the ends.



2 Through-bolt

When you're building a butcher block surface that's going to get a lot of abuse, such as a workbench, the through-bolt technique shown here is the one to use. The wood members are held together solidly by threaded steel rods which pass through holes bored in each member. Space the rods between 12 and 16 in. apart, depending on the size of the butcher block. For very wide butcher blocks, you can save money by using plain steel rod and threading the ends yourself.

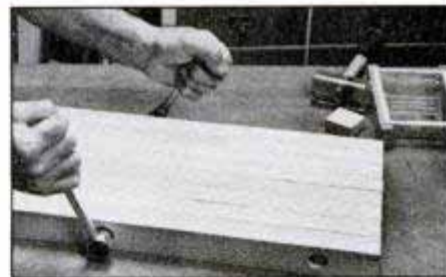
Start by carefully center-boring holes in each piece using a drill press and fence. If the holes don't align the error will produce an uneven butcher block top. Next, counterbore the two end



Use a small paint roller to spread the glue quickly and evenly. Glue and stack all pieces and then insert threaded rods.

boards to receive the washer, nut and wood plug. Then continue boring through the end pieces for the rod.

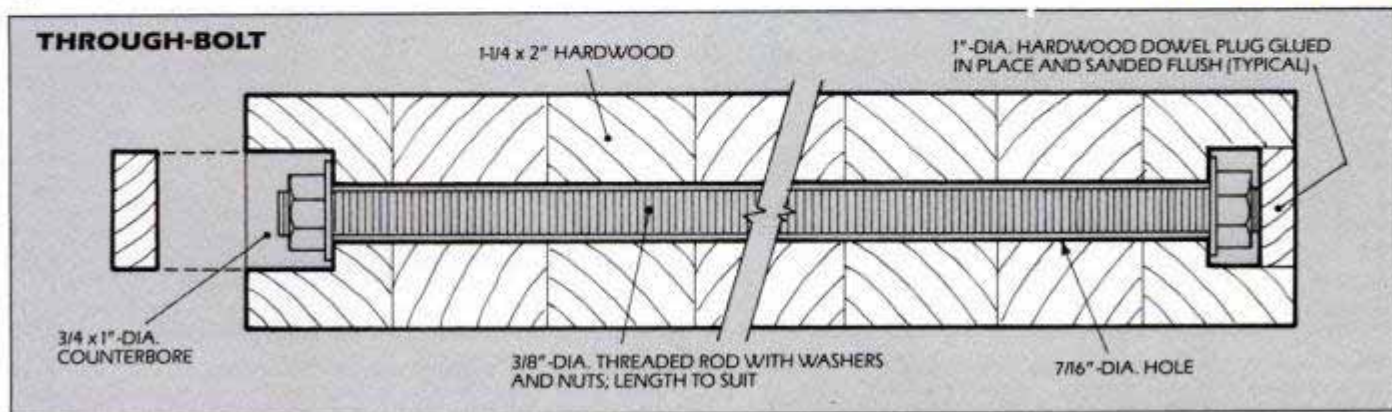
Now glue and stack all the pieces and insert the rods through the holes with a nut and washer on one end. Position the



Use two socket wrenches to draw the joints closed. Mark the threads on one rod end to prevent the nut from running off.

last end piece and add the washer and nut. Tighten each rod little by little until the wood joints are closed tight. Finally, glue the wood plugs in place and sand them flush.

(Please turn to page 128)





SERI PHOTO

Three-level modular home at New Orleans World's Fair has latest technologies in solar and electronic-controls fields. Energy-saving lighting and a whole-house wood-stove heater are used.



Denver-area house studied by the Solar Energy Research Institute could draw most of its heat from a south-facing sunroom. But tests show heat circulated only when sunroom doors were open.

BEST NEW HOMES UNDER THE SUN



Bob Vila, the Impact 2000 contractor, sits in the home's unique sunroom.

Some are high-tech. Some are low-tech.
All are energy savers.

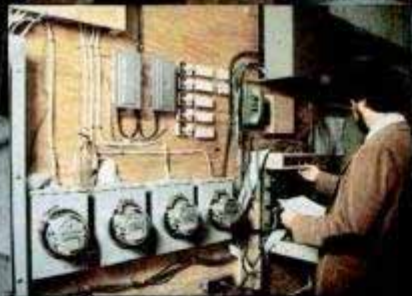
FOR SALE: eight-room glass and wood bilevel home nestled into a hill on a half-acre wooded lot in Brookline, Mass. Superinsulated west wall is built into the hill. Over 400 square feet of south-facing glass accommodates an earthen tile floor sunroom. Photovoltaics produce 4 kilowatts of electricity. Solar hot water and heat are augmented by a ground-couple heat system. Many other computerized energy-saving and monitoring devices throughout this three-bedroom home. Asking price: \$500,000.

"I think we could ask more for the house, but we'll get a half million easily," says Bob Vila, host of public television's *This Old House* program and

contractor on the extraordinary Impact 2000 home in Brookline. Completed this spring, the home is being used by Boston Edison for one year to demonstrate to the public the latest in home energy technologies. Whoever buys Impact 2000 will have to agree to allow Edison to continue monitoring the building for one year as part of a study aimed at finding out which home energy systems work best.

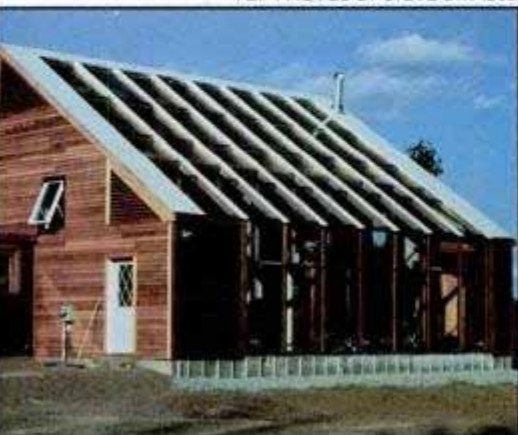
Experimental and demonstration homes are going up all over America in moves by utilities, energy laboratories, the federal Energy Department and independent inventors to find the best way to keep a home snug and warm in the winter and airy and cool in the sum-

BY DENNIS ESKOW, Science Editor



The south side of Boston Edison's Impact 2000 house receives ample sunlight. The roof is covered with solar collectors and photovoltaic arrays. The computer room in the basement (inset) monitors energy use.

TOP PHOTOS BY STEVE STRAUSS



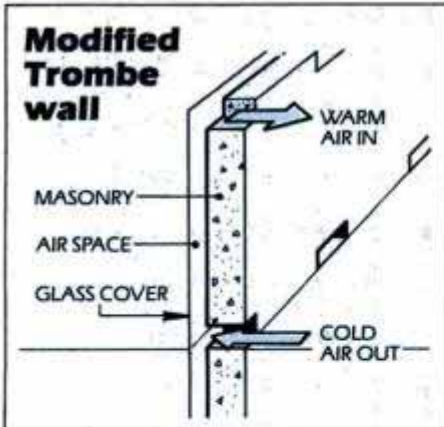
One of Norman Saunders' houses has fully exposed south sun area that's almost all glass. Louvered roof lets in sunlight.



American Gas Assn. house in Cleveland has a two-story core and two experimental wings. It takes advantage of basic solar design, facing a true solar south. AGA began using the house this summer to test heating, cooling and cooking appliances.

PHOTOS BY NORMAN B. SAUNDERS (LEFT) AND PAUL BURD (RIGHT)

Modified Trombe wall



Modified Trombe wall heats up air between a layer of glass and a masonry wall.

mer. Most of the experimenters are looking for the best new systems, and some say they already have found the best. Many of those responsible for the nation's energy show houses are also keeping their eyes on the bottom line.

Even as the landscaping was being finished at Impact 2000, the American Gas Assn. opened its demonstration and experiment home in Cleveland. The unique building has a two-story, five-room central core with two one-story wings dedicated to experiments on the latest in heating, cooling and cooking appliances.

In Denver, the Solar Energy Research Institute has designated several dozen existing solar houses to be outfitted with sensors and computers. The equipment is programmed to calculate the value of passive and active solar devices.

The World's Fair in New Orleans features a three-level, 12-room "Energy Saving House/Design Home" that dazzles hundreds of visitors each week

'A house should have very few moving parts.'

—Norman B. Saunders



PHOTO BY CAROL J. BOYLE

In Tampa, Fla., seven photovoltaic arrays and a backup propane-fired generator provide electricity for Solara II. Deep-cycle batteries store energy at night and on cloudy days.

with demonstrations of solar energy devices and energy-saving construction features.

The Solara II home in Tampa, Fla., is the work of independent builders Frank and Bernard Arenas. They have opened this luxurious three-bedroom, three-bath home to the public to demonstrate the latest twist in high-tech sunbelt *chic*: a centrally air-conditioned home not hooked up to a public utility.

Solara II uses passive solar design to limit electricity consumption to 300

kwh per month. All electricity is supplied by seven photovoltaic arrays and a backup propane-fired generator. Deep-cycle batteries store energy at night and on cloudy days so that the generator rarely has to run.

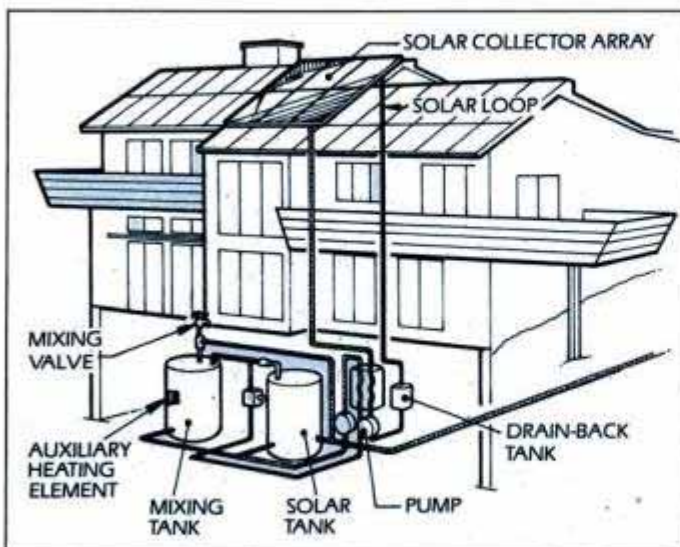
In the midst of all the institutional experimental homebuilding stands Norman B. Saunders, a Massachusetts inventor who builds houses that could easily be dubbed "low-tech." Constantly experimenting with the least expensive and most efficient passive solar concepts, Saunders has built sev-



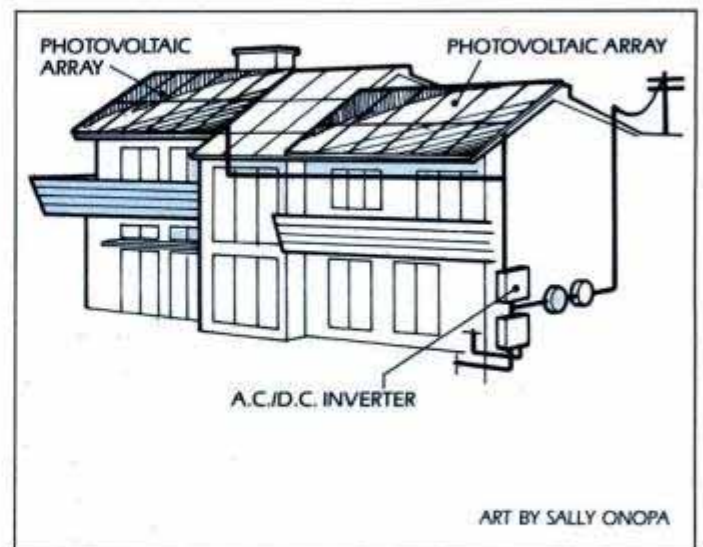
Sunroom in one of the houses under study by SERI provides warmth and good light.



Several experimental stoves are in the test kitchen of the American Gas Assn. house.



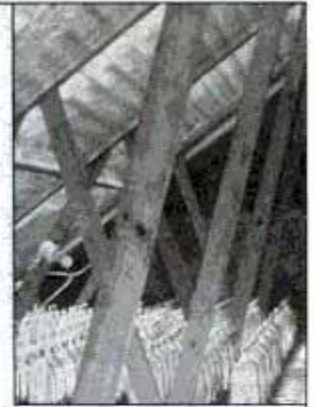
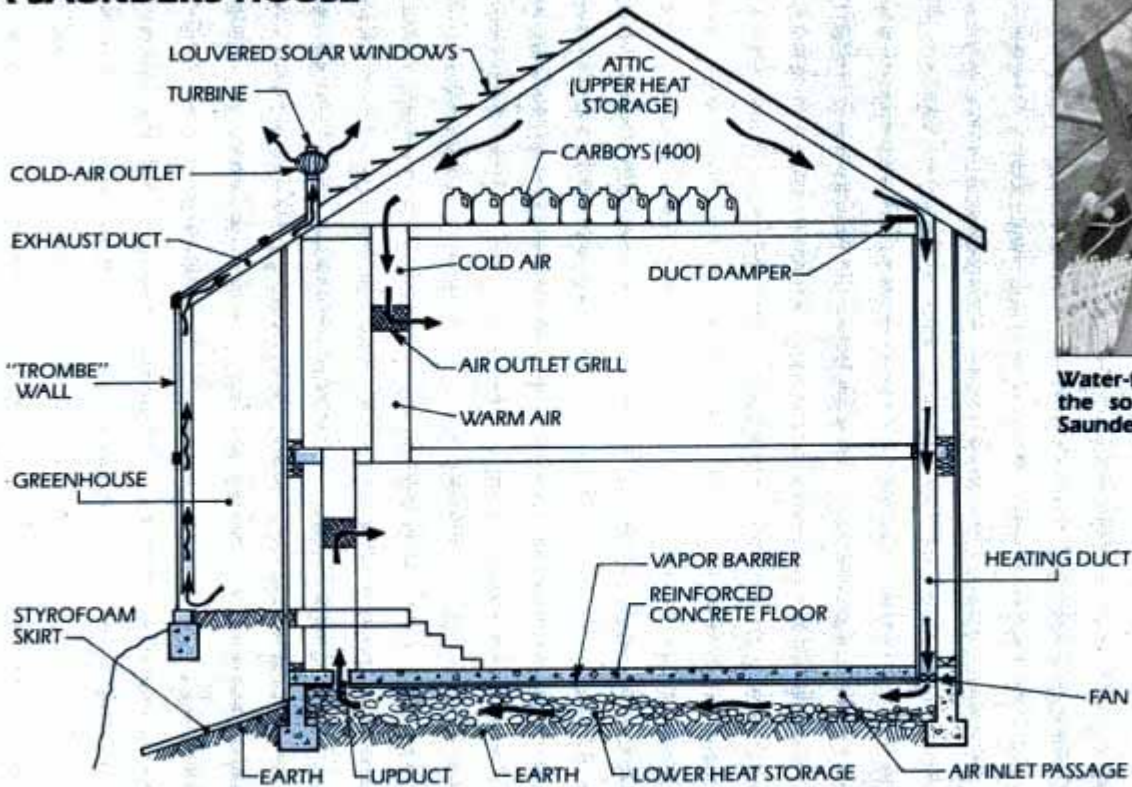
Impact 2000 solar heating system starts with array of rooftop collectors. Water circulates through solar loop, is heated at the roof and runs back to the solar tank. A mixing tank is used to warm the water when solar collectors can't do the job.



The Impact 2000 photovoltaic array provides 4 kwh of power to an a.c./d.c. converter that switches on and off automatically. It goes on a.c. when electricity is sent to the house. All excess power is sent as d.c. to the utility, which buys it.

ART BY SALLY ONOPA

A SAUNDERS HOUSE



Water-filled carboys are the solar collectors in Saunders' attics.

Typical Saunders house has a unique system for circulating hot air: Water-filled carboys store heat from sunlight coming through louvered roof. A fan draws heated air to a lower storage area. Air enters rooms through upducts with open grilles.

eral homes that get all their heat and hot water from the sun in cold New England winters. (He points out that some heat is generated by household lighting, cooking stoves and people. But by any building industry standard, the Saunders homes are 100 percent solar heated.)

"In one sense, solar energy has been with us since the earliest houses," says Boston Edison energy services expert Paul Shea. "But we're looking ahead to

the next century, and we want to see where technology fits into the picture."

Inside Impact 2000

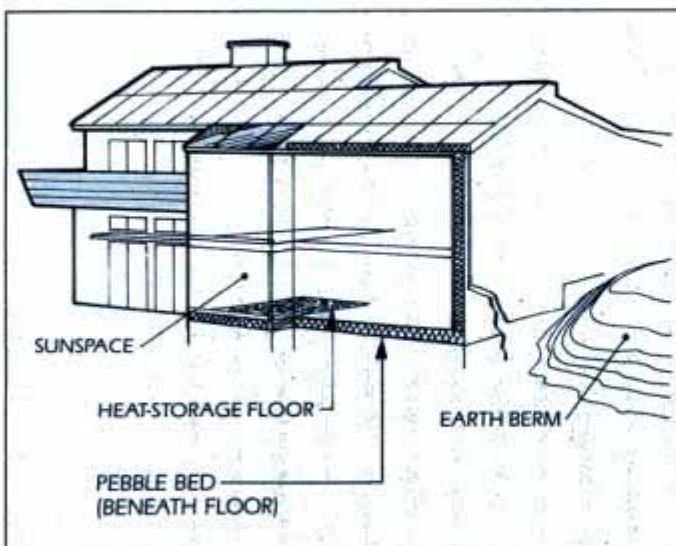
With the Impact 2000 home, technology is the main subject of the picture. True, standard passive solar techniques are built into the structure: the earth berm that partially covers and insulates the east wall; the sun room that sits on thick concrete flooring

topped with solar collecting tiles, and the subterranean west wall.

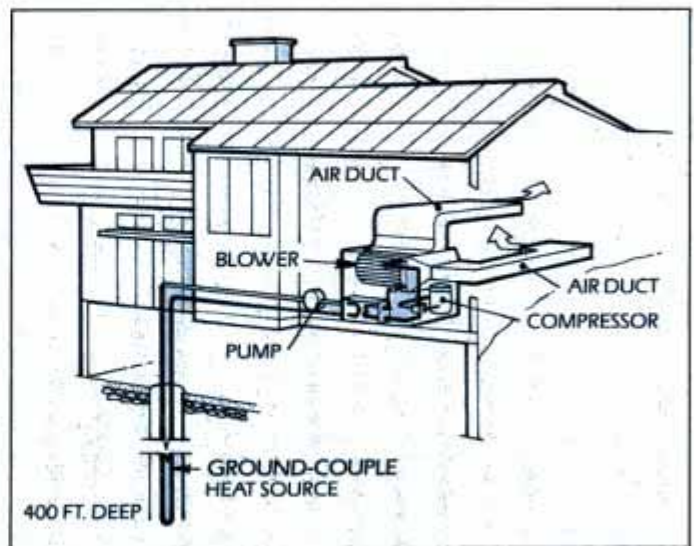
"There's a lot in here that isn't traditional," Vila points out. "Some of it hasn't even proved its worth yet."

Take the home's ground-couple heat source, for example. It's a system of pipes sunk into a 400-ft.-deep warm-water well. Brine circulating through the pipes warms up to 90° F. and higher. The hot brine is circulated to a heat

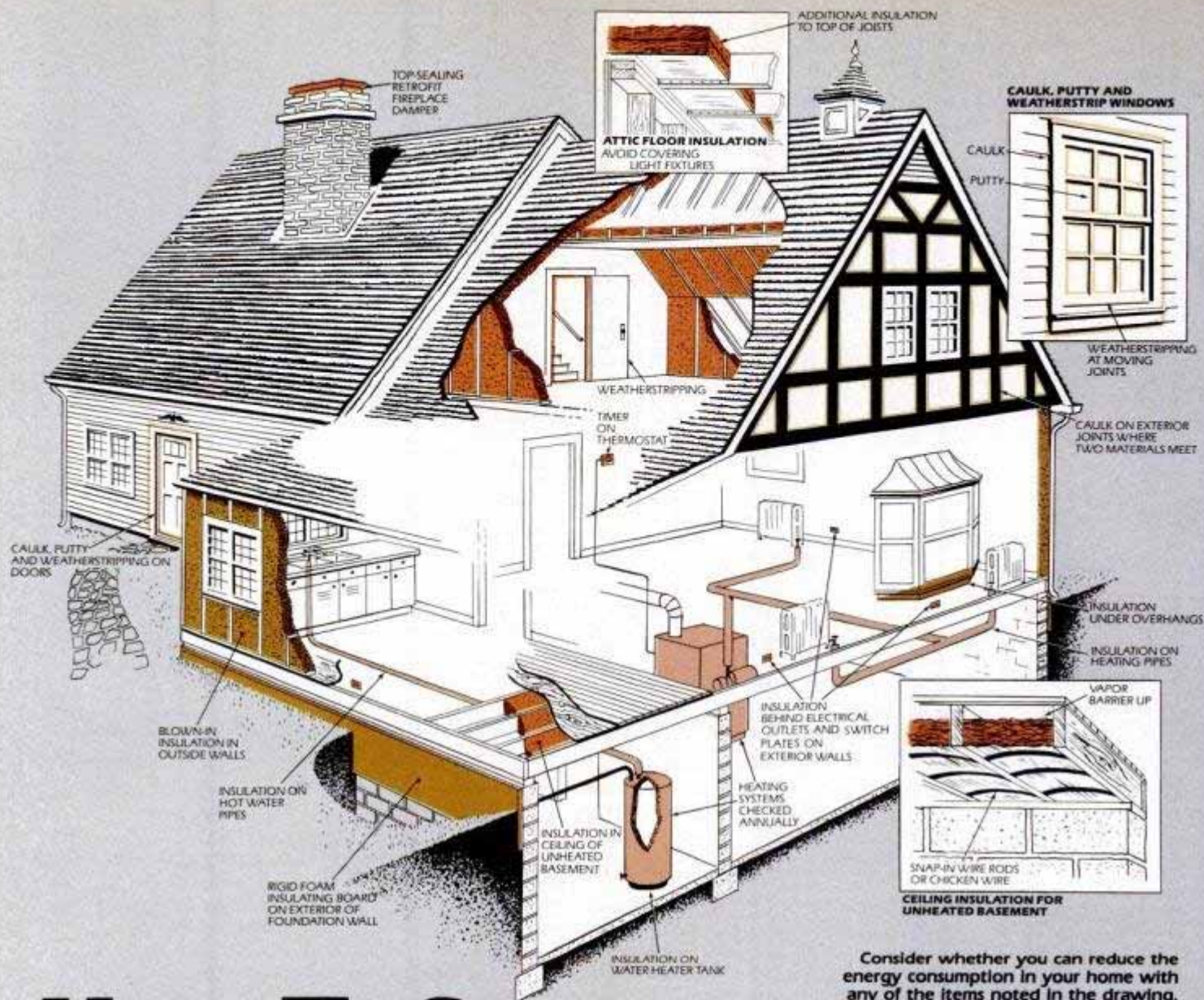
(Please turn to page 108)



Over 400 sq. ft. of glass covers south-facing sunspace of the home. A concrete heat-storage floor on a pebble bed stores solar heat. The rest of the floor is partly insulated with an earth berm and a superinsulated wall built into a hillside.



A ground-couple heat source is sunk 400 ft. in warm-water well in Impact 2000. Brine circulated through ground-couple pipes extracts heat from the well and carries it to the home's air blower system. Ground-couple also offers backup hot-water heat.



Consider whether you can reduce the energy consumption in your home with any of the items noted in the drawing.

How To Spot Home Energy Wasters

Here are some tips from a pro on conducting your own home energy audit.

To conserve energy and reduce utility bills, every homeowner should have an energy audit conducted by his local utility. However, as situations in your home change and weatherization products deteriorate, audits become outdated.

A professional energy auditor cannot reveal every area of energy loss, particularly if those areas are not visible. For example, a spot check can only reveal the general amount of insulation in an

exterior wall. It's up to you as the homeowner to check the temperature of every radiator and the caulking at every joint. Only you will be concerned about areas of minimal energy loss, and areas where the cost of correction might result in a very long payback period.

It is important for you to conduct an energy audit periodically. Arm yourself with a pad and pencil, flashlight, tape measure and screwdriver. Cover your house thoroughly and take notes as you go.

PM asked Norman Becker, a professional home inspector who answers your questions in PM's *Homeowners' Clinic*, to go through a home and point out areas to check in an energy audit. We began outdoors. Then we checked

the attic, the basement and finally the living area.

Caulk and weatherstripping

Sealing your home to prevent heat leaking out of the house and cold air entering through cracks and crevices is an easy and inexpensive, yet important, first step to conserve energy. You should seal the cracks and crevices of your home before you consider installing additional insulation to it. Caulk and weatherstripping are the materials that correct these infiltration problems.

Weatherstripping should be applied to movable joints. For example, weatherstrip around exterior doors, including attic and basement doors if unheated, and around attached garage doors. Also

OUTDOOR CHECKPOINTS



The floors of bay windows and other projections from the house should be insulated. If not, you can glue rigid insulation boards onto the underside of the structure.



Joints where two materials meet, such as stucco and wood trim or shingles and trim, should be sealed with caulking compound. If old caulk is brittle or broken, replace it.



Check that all windows are caulked at the joint made by the frame and house siding. Make sure that weep holes of storm units aren't sealed, as was done here.



Each year check weatherstripping on movable joints of windows and doors. Felt and foam products, less durable than the metal one shown, may need yearly replacement.



Small cracks in putty should be filled with fresh putty. Chisel out badly cracked or missing putty, then clean the area with a wire brush. Wear eye protection.



Patched holes in the stucco on the north rear side of the house indicate that a loose-fill insulation has been blown into the exterior wall cavities.

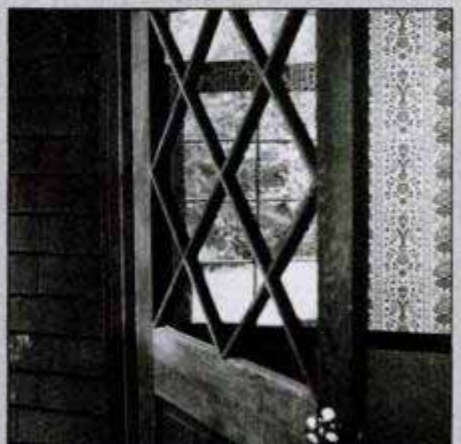
weatherstrip the underside and sides of window sashes and around sliding glass doors.

Caulk is used to seal the many immovable joints in a house. For example, caulk cracks around window and door frames and other openings, such as where pipes, wires and ducts enter the house; any place where two building materials meet, such as where brick meets stucco or trim meets siding; siding that is cracked or damaged; the joint made by the chimney sides and the frame of the house; and under metal or wood thresholds. For information on the types of caulk see *Caulk: Fuel Saver In A Tube*, page 122, Sept. '82.

Glazing compound, such as putty, [\(Please turn to page 130\)](#)



The joint made by the wood shingle siding and the brick chimney needs caulk. First, clean both surfaces with a scraper or a wire brush so the caulk will adhere.



Glass lets a great deal of heat escape. A less costly solution than adding a storm door here is to build a storm panel of plastic or glass to cover the glazing in winter.



PM's Guide To Home Insulation

In the past, the decision to increase the insulation in your house raised relatively simple questions: What material should I use? What will it cost? But in recent years, insulation in general, and the superinsulated house in particular, have come under much greater scrutiny. Questions concerning water-vapor damage, fire safety and indoor air quality now join the issues of product selection and cost. Here's a guide to the major retrofit materials—organized by area of the house—to help you decide how to put what where.

Attic

The attic space is the traditional starting point for most insulation retrofit projects. The materials are well known,

These days, adding insulation to your house involves more than just getting the highest R-value for your money.

their energy-saving potential is high, and their installation is relatively straightforward, well within the abilities of most homeowners.

The mineral fibers—fiberglass and rockwool—are the most common materials used in attics. Made of glass, rock or slag fibers, these products are available in batts (precut 4- or 8-ft. sections), blankets (continuous rolls) and as loose

fill material. When in batt or blanket form, they come with or without facers of kraft paper or aluminum foil which act as vapor barriers. While the mineral fibers themselves are noncombustible, the facers will burn. Cellulose, in loose fill form, is another common attic insulation. It's made from ground paper with fire retardants added.

All the materials above have similar, but not identical, R-values. Your choice depends on where you want to put the insulation, whether a suitable vapor barrier is already in place, and if you have adequate ventilation.

Vapor barriers

First, consider the vapor barrier. Every house generates water vapor from

INSULATION GUIDE

MATERIAL	R-VALUE*	COST**	DIMENSIONS	WHERE INSTALLED	ADVANTAGES	DISADVANTAGES	PRECAUTIONS
Mineral fibers in batt or blanket form (fiberglass, rockwool)	11 @ 3" to 3.5" thick	\$.023 to .027	<ul style="list-style-type: none"> 16" or 24" wide by various thicknesses Blankets: up to 70' long Batts: 4' to 8' long 	<ul style="list-style-type: none"> Ceilings Unfinished walls Foundation walls Floors over unheated spaces 	<ul style="list-style-type: none"> Easy application in ceilings, floors and over foundation walls Noncombustible when in unfaced form 	<ul style="list-style-type: none"> Cannot be installed in finished walls 	<ul style="list-style-type: none"> When installing, wear gloves, long-sleeved clothing and dust mask; contact lens wearers should wear safety goggles Maintain 3" clearance around recessed light fixtures Keep ventilation channels open
Mineral fibers in loose fill form	11 @ 3.75" to 5" thick	\$.026	<ul style="list-style-type: none"> 20-lb. to 30-lb. bags 	<ul style="list-style-type: none"> Ceilings Enclosed walls 	<ul style="list-style-type: none"> Easy attic floor application Easily fills hard-to-reach areas Noncombustible 	<ul style="list-style-type: none"> Finished walls are best insulated by a contractor Material may settle 	<ul style="list-style-type: none"> When installing, wear gloves, long-sleeved clothing and dust mask; contact lens wearers should wear safety goggles Maintain 3" clearance around recessed light fixtures Keep ventilation channels open Install correct weight per R-value Apply uniformly
Cellulose in loose fill form	3.13 to 3.7 per inch	\$.023	<ul style="list-style-type: none"> 20-lb. to 30-lb. bags 	<ul style="list-style-type: none"> Ceilings Enclosed walls 	<ul style="list-style-type: none"> Easy attic floor application Easily fills hard-to-reach areas 	<ul style="list-style-type: none"> Finished walls are best insulated by a contractor Material may settle 	<ul style="list-style-type: none"> Wear dust mask Maintain 3" clearance around recessed light fixtures Keep ventilation channels open Apply uniformly Only use products treated with fire retardants; untreated materials are highly flammable
Expanded polystyrene in rigid board form	3.57 to 5 per inch (R-values vary according to different product densities)	\$.026 to .033	<ul style="list-style-type: none"> 2' x 8' and 4' x 8' boards by various thicknesses 	<ul style="list-style-type: none"> Interior or exterior sheathing 	<ul style="list-style-type: none"> As exterior sheathing, provides a continuous air infiltration barrier Insulates entire wall, including framing members 	<ul style="list-style-type: none"> As interior sheathing, must be covered with fire-resistant barrier, such as 1/2"-thick gypsum board As exterior sheathing, application requires removal of existing finish material 	<ul style="list-style-type: none"> Follow specific manufacturer's instructions for nailing in place Protect against prolonged direct exposure to the sun
Extruded polystyrene in rigid board form	5 per inch (R-values vary according to different product densities)	\$.061	<ul style="list-style-type: none"> 2' x 8' boards by various thicknesses Square edge or tongue-and-groove configuration 	<ul style="list-style-type: none"> Interior or exterior sheathing 	<ul style="list-style-type: none"> As exterior sheathing, provides a continuous air infiltration barrier Insulates entire wall, including framing members 	<ul style="list-style-type: none"> As interior sheathing, must be covered with fire-resistant barrier, such as 1/2"-thick gypsum board As exterior sheathing, application requires removal of existing finish material Low perm rating has raised questions about vapor entrapment in wall cavities 	<ul style="list-style-type: none"> Follow specific manufacturer's instructions for nailing in place Protect against prolonged direct exposure to the sun Purchase product based on "aged" R-value
Polyurethane (A) polyisocyanurate (B) in rigid board form	A-6.25 per inch B-7.04 per inch	\$.049	<ul style="list-style-type: none"> 4' x 8' boards by various thicknesses Available with foil facers 	<ul style="list-style-type: none"> Interior or exterior sheathing 	<ul style="list-style-type: none"> As exterior sheathing, provides a continuous air infiltration barrier Insulates entire wall, including framing members As interior sheathing, foil-faced material provides good vapor barrier Can be used as structural sheathing 	<ul style="list-style-type: none"> As interior sheathing, must be covered with fire-resistant barrier, such as 1/2"-thick gypsum board As exterior sheathing, application requires removal of existing finish material Low perm rating has raised questions about vapor entrapment in wall cavities 	<ul style="list-style-type: none"> When used as structural sheathing, diagonal wall bracing must be installed Purchase product based on "aged" R-value Follow specific manufacturer's instructions for nailing in place
Poly urea in foam form	3.4 per inch	Varies widely depending on region and contractor	<ul style="list-style-type: none"> Foam product poured into wall cavities in thick liquid form 	<ul style="list-style-type: none"> Enclosed walls 	<ul style="list-style-type: none"> Designed specifically for retrofit applications Seals off wall cavities from air infiltration 	<ul style="list-style-type: none"> Material must be installed by a contractor Not universally available Does not have as much in-use experience as other wall insulations 	<ul style="list-style-type: none"> Seal all cracks in wall finish and trim before product is installed Check contractor's experience with the product before agreeing to installation

*R-values taken from *The American Society For Heating, Refrigerating And Air-Conditioning Engineers Handbook Of Fundamentals*, 1981 edition. To determine approximate R-values for your geographical location, consult PM map on page 131 of this issue.

**Approximate materials costs are based on U.S. dollars per sq. ft. per 1 R-value. To figure overall approximate cost of project, multiply cost x the number of sq. ft. of area x the R-value of the product you are using. Source: the *National Construction Estimator*, 1984 edition, Craftsman Book Co., Carlsbad, Calif. 92008.

such activities as bathing, cooking and as a byproduct of human respiration. In winter, if this vapor goes unchecked, it will move from inside the house toward the outside through the exterior walls and attic. This happens because of the air-pressure difference between the two: Inside the house the pressure is greater; outside it is less.

When this vapor hits a cold surface like the wall or roof sheathing, it can condense. This will lead to wetting any existing insulation, which dramatically reduces its effectiveness, and wetting the wood framing members, which can lead to rot.

Vapor barriers—called retarders in

the industry—resist the movement of this moisture. They are classified by a perm-rating. Any material with a rating of less than 1 perm is considered adequate. For example, 6-mil-thick polyethylene has a perm-rating of .06.

The rule of thumb says that a vapor barrier—whether attached to the insulation or installed separately—should be placed on the warm side of the insulation, that is, the side facing toward the heated house rooms. For most applications this rule works just fine. But as we'll see later, occasionally adjustments have to be made.

Also keep in mind that no vapor barrier is perfect. Some moisture will

always reach the sheathing and condense. Because of this, adequate ventilation is just as crucial as the vapor barrier. A free movement of air, especially in the attic, will evaporate any moisture before it can cause damage. Specific ventilation requirements will be discussed later.

Between rafters or joists?

If you are insulating as part of an attic remodeling project, then you'll want to add the insulation between the rafters so the finished space will retain heat. For this application the mineral fibers—in batt or blanket form, with a kraft paper or aluminum foil vapor barrier

attached—are the wisest choice. They are made in 16- and 24-in. widths to fit snugly between the framing members, and they are easily stapled in place.

However, if you install the batts or blankets with numerous gaps between

the edges of the insulation and the rafters, you will substantially reduce the insulation's effectiveness. For instance, if such gaps total only 4 percent of the square footage of the insulated surface, you can lose 50 percent more

heat, at R-19 thickness, than a job without gaps. Also, when choosing the insulation thickness, be sure to allow at least 1 in. of free airspace between the insulation and the roof sheathing for

(Please turn to page 126)

Cashing In On Energy Tax Credits

The money you spend to boost the energy efficiency of your home can do more than lower monthly fuel costs—it can substantially slash your federal and, in many cases, state tax bills.

At the federal level, two attractive energy credits are available. You can take a 15 percent credit—up to a \$300 maximum—on the first \$2,000 invested in such energy-conservation items as storm and thermal windows and doors, caulking and weatherstripping materials, furnace replacement burners, flue-opening modifications and virtually all types of insulation.

However, don't automatically assume that any energy-related item qualifies for a credit. For instance, if you buy a replacement burner for your furnace, you get the credit, but if you buy a new furnace, you don't. Other popular energy-conservation devices that don't qualify for federal credits include heat pumps, wood-burning stoves and attic fans.

The IRS also offers a hefty 40 percent credit—with a \$4,000 maximum—on the first \$10,000 spent on solar, wind-powered or geothermal equipment for your home. Both active and passive solar equipment used for heating, cooling or for providing hot water or electricity qualify for the credit. But for the passive solar system, the IRS requires it contain the following: a solar collection area, an absorber, a storage mass, a heat distribution system and a heat regulation device.

Houses built prior to Apr. 20, 1977, can get the 15 percent credit; only renewable energy source equipment installed after Apr. 19, 1977, can take the 40 percent cut. Also, the house must be your principal residence; you can take both credits but only once, unless you move to another house; and renters as well as homeowners qualify. Be sure to include the cost of installing the equipment when figuring the credit.

Remember, these are tax credits, not deductions. A \$300 credit takes \$300 off your tax bill, regardless of your tax bracket. The most a \$300 deduction could cut your taxes is \$150, and that's only if you're in the highest tax bracket.

Upwards of 40 states also offer a grab bag of tax incentives. Colorado residents,

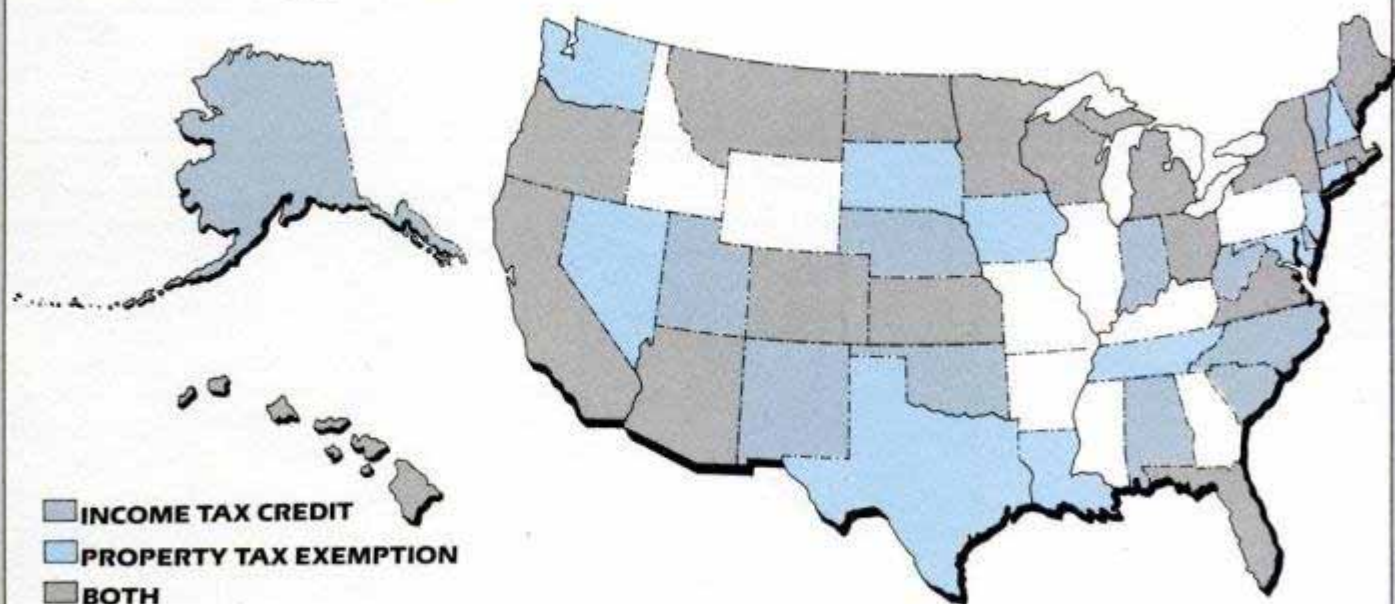
for instance, can take up to a \$3,000 income tax credit for installing renewable energy source equipment and \$400 for measures such as insulation. These can be added on top of the federal credit. Other states, such as Florida, allow exemptions on sales and/or property taxes for energy-related investments, while others, like Arkansas, give residents tax deductions instead of credits.

Of course, what the government gives, it can also take away. There's a move in Congress to extend the 40 percent credit through 1987 and to eliminate the 15 percent credit at the end of 1985. As PM went to press, both credits still stood. The status of state credits also changes with the shifting mood of legislators. So, check with the local IRS office and your state tax office before you start banking on any tax savings.—Walter L. Updegrave

FEDERAL INCOME TAX CREDITS

TYPE	WHAT QUALIFIES	MAX. AMT.	RESTRICTIONS
15% energy conservation credit	Insulation; storm or thermal windows and doors; caulking and weatherstripping; clock thermostats and setback thermostats; furnace replacement burners and flue opening modifications; meters showing cost of energy use.	\$300	For principal residence only; house must have been built prior to Apr. 20, 1977.
40% renewable energy source credit	Solar energy equipment used for heating, cooling, providing hot water or electricity; wind energy equipment that provides electricity or other energy for home use; geothermal energy equipment.	\$4,000	Energy equipment must have at least a 5-year life and be installed after Apr. 19, 1977; equipment that is a significant structural component of a house does not qualify; for principal residence only.

State Energy Credits And Incentives



The two most common incentives offered by states for energy investment are tax credits and property tax exemptions. However, some states may offer other incentives as well, such as sales tax rebates and income tax deductions. Sources: the Solar Energy Industries Assoc. and *The All States Tax Handbook* (Prentice-Hall).

Energy Efficiency As An Investment

Improving the energy efficiency of your home could be the wisest investment decision you'll ever make—one that pays higher and more reliable dividends than you'd get with money market funds or the stock market.

But energy-conservation investments can also backfire. Often, they're high on promise and appeal, but short on performance. And, in some cases, conservation measures simply don't lower fuel bills enough to justify their cost.

The key, says Wayne Gathers of the National Alliance to Save Energy, is to weed out the duds from those that really deliver and to target the money you spend—be it a few hundred dollars or a few thousand—to items that cut costs most and give you the biggest savings for your dollar.

How do you do that? One way is to compare the payback periods of different energy-saving items—the length of time it takes for energy savings to equal the cost of buying and installing the item. An energy-saving measure that costs \$1,000 and saves \$100 a year in fuel bills has a payback period of 10 years, while \$200 per year savings equals a five-year payback. The lower the payback the better.

Compare to other investments

But this payback calculation doesn't let you compare an energy improvement to conventional investments, such as certificates of deposit. How would you know, for instance, if you're better off putting \$1,000 into an energy improvement with a 13-year payback period or into a CD paying 10 percent?

You would know by comparing the two on the same terms—the rate of return. If an energy-conservation measure costs \$1,000 and has a 13-year payback period, that means it should save approximately \$75 per year in energy costs. This translates to an annual return of 7.5 percent on the \$1,000 invested (75 divided by 1,000)—clearly less than the 10 percent you'd get on the CD. In short, by thinking of energy savings in the same way as you think of a return on a bond or a money market fund, you're able to decide where it makes more sense for you to invest your money.

But there are two important things to remember before deciding whether the CD or the energy improvement puts your money to better use.

First, the return on the CD is taxable, while the money you save on lower fuel bills isn't. So the taxable CD return has to be higher to equal the tax-free energy return. Just how high depends on your tax bracket. For those in the highest income-tax bracket, 50 percent, the CD would have to pay 15 percent to equal the energy improvement's tax free return. If you're in the 40-, 30- or 20-percent brackets, you'd need a CD paying 12.5, 10.7 or 9.4 percent, respectively, to compete with the energy improvement's return. Second, the energy investment's return is based on current fuel costs. If fuel costs go up in the

future, so do your savings and, therefore, the return on your investment.

Using either of these standards, you can go about the home looking to make those energy improvements that bring the highest return. While that will depend on a number of factors—where you live, what shape your home is in, your yearly energy costs—there are some general guidelines.

Best places to start

"The place where you get the biggest bang for your buck is in upgrading your present heating system," says Wayne Gathers. In fact, Gathers claims that a properly retrofitted heating system is usually more efficient than a new one. After conducting studies in several cities, the Alliance has found that the cost of retrofits such as secondary condensing heat exchangers and flame retention oil burners is low—usually between \$500 and \$700, including installation—and the savings are high—between 20 and 30 percent of annual heating costs for oil and gas heating systems.

Retrofits are also available for electric systems, says Gathers, but they tend to yield lower savings—between 10 and 15 percent. Naturally, actual dollar savings will vary according to different climate conditions.

Adding ceiling or attic insulation is usually the next best step. "That's almost always cost effective," Gathers says. And after that, he recommends tightening the envelope of the home through such simple

techniques as weatherstripping and caulking. "It only costs \$50 to \$100 and a weekend of your time," says Gathers, "and the return is very high."

Adding insulation to the walls of your home "tends to be very expensive" says Gathers, and "you're talking about a dramatically lower return." He claims storm windows also are often not cost effective: "A lot of people like to buy storm windows because it dresses up the house." Storm doors? "They're even worse," he claims, often requiring a payback period of 20 years or more. However, Gathers notes that in colder northern climates some of these measures do make sense.

Diminishing returns

It's important to realize that the law of diminishing returns applies to energy savings: If you start with an inefficient home, the first dollars you sink in should produce bigger savings than dollars you spend later. In other words, the more efficient the home becomes, the less wasted energy there is to save, which means each dollar you spend will bring a lower return. Your goal, then, is to get those big early savings with as little money as possible by investing in energy improvements that offer the highest rate of return.

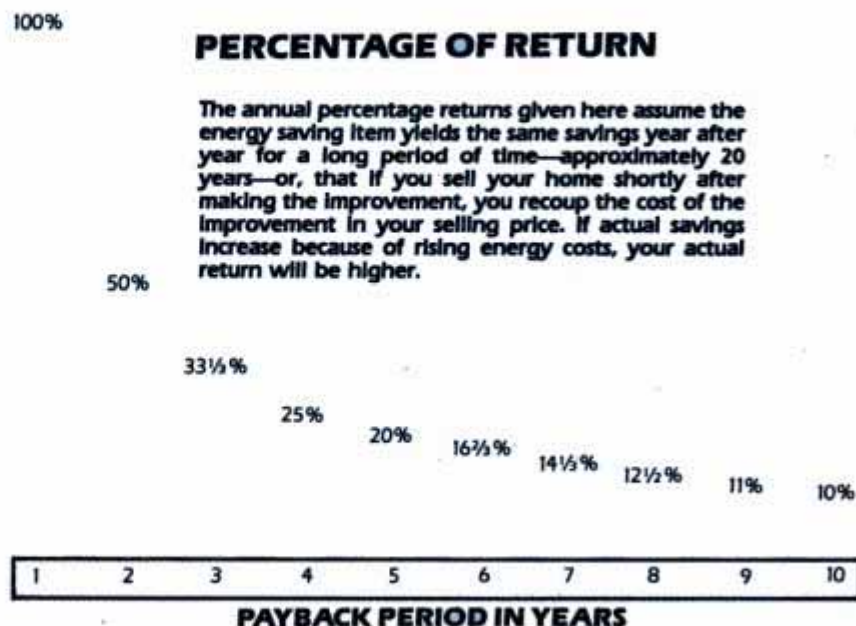
For more details on investing in home energy-efficiency, write The National Alliance To Save Energy, 1925 "K" St. N.W., Suite 206, Washington, D.C. 20006, and ask for a *Home Energy Portfolio*.

—Walter L. Updegrave

PAYBACK PERIOD AS RETURN ON INVESTMENT

The efficiency of many energy saving items is quoted in terms of payback period—the number of years an energy improvement must be in place until the money it saves in energy bills equals the cost to buy and install it. The chart below

converts that payback period into annual percentage return on investment, allowing you to compare the return on energy investment with the return on conventional investments such as money market funds and certificates of deposit.





BUILD OUR 'Country Barn' Garage

BY RICHARD F. DEMPEWOLFF AND STEVEN WILLSON

This thoughtfully designed two-car garage is at home both in town and country. Build it from plans you buy and the carpentry framing methods shown here.

If you live in a rural or suburban area and want a two-car garage, here's an attractive structure that will complement either location. Its modified salt-box shape is reminiscent of several traditional designs, but appearance is far from the whole story. This garage was planned to "work" well, too.

To begin with, it measures 24×26 ft. with two separate bays that can each hold a full-size car, with room left over

for a workbench or shop tools along the rear wall. The building also features a second floor with over 350 sq. ft. of usable floor space and an oversized access door on the gable end for hoisting large or heavy objects into the loft work area. For this purpose, the roof ridge board was doubled up and extended beyond the end of the building to support a block and tackle.

A substantial 3-ft. overhang fronts

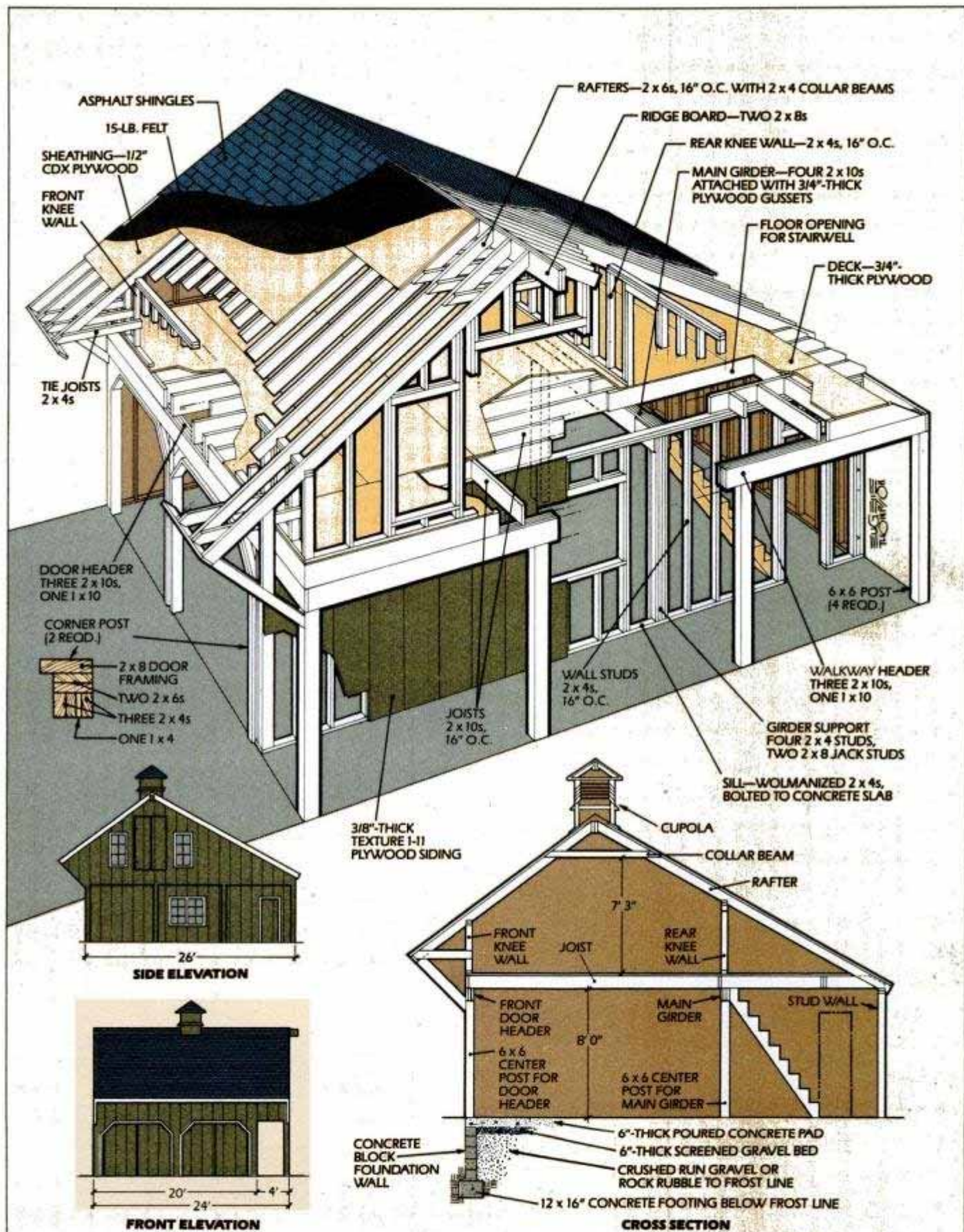


This garage not only has room for two vehicles (above), it also boasts a covered walkway (top) that can protect five full cords of firewood and a second-story loft for a workshop or storage.

the building to keep snow from accumulating next to the garage doors, and a 4-ft. recessed walkway along one side provides ample room for storing firewood and garden supplies.

For information on ordering the plans, see the box on the facing page. As a bonus, the plans include drawings for building the cupola shown in the photos above. Alternate specifications are also included if you want a one- or

POPULAR MECHANICS • SEPTEMBER 1984



HOW TO ORDER PLANS

Plans for the PM Colonial Style Garage/Barn consist of four 17×22-in. drawing sheets, a detailed eight-page instruction manual and a materials list. A single set of plans costs \$30. You may need another set to file for a building permit or to give to a

contractor. Each additional plan is \$20 when ordered with the first plan. Send check or money order to: Colonial Garage/Barn, Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10101. Allow four weeks for delivery.

Building design: Richard F. Dempewolf; Color photos: Steve Strauss; Technical art: Eugene Thompson; Lawn tractor: Toro model No. 1132

three-bay garage with the same basic appearance.

Where to start

First, check your local building code to find what type of foundation is required in your area. Most places will allow a free-floating slab for outbuildings like this as long as it rests on a gravel base that goes below the frostline. If, however, a perimeter wall founda-

tion is required, construct it as shown on the previous page.

Excavate below the frostline and pour a concrete footing at least twice the width of the block you are using. Make sure the footing is square and level, then lay the blocks up to grade level. When the mortar is cured, fill the interior space with crushed gravel covered with 6 in. of screened gravel. Back fill the outside of the wall with gravel

and 8 in. of soil. Build form work around the perimeter of the walls so the finished slab will be 6 in. thick. Install reinforcing wire mesh and then pour the slab. During the pour, install anchor bolts—for attaching the wall plates—every 6 to 8 ft. On the walkway side of the slab, install an anchor bolt for each 6×6 support post. Later, during the framing, drill a hole in the bottom of each post and slide them over the bolts.

Rafter Layout With A Framing Square

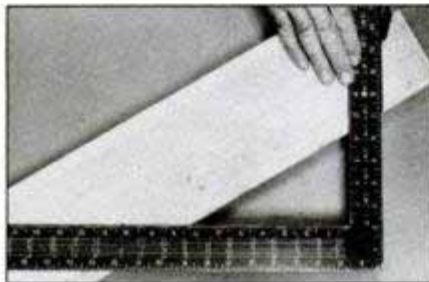
A framing square is an indispensable tool if you're doing rough carpentry. It holds a wealth of pertinent information on its body—the 2-in.-wide leg—and its tongue—the 1½-in.-wide leg. Fortunately, most squares are sold with an instruction booklet that explains how to use the tool fully. Still, many people have trouble using a square to lay out rafters like the ones used on this garage. The photos below show a simplified method.

To understand how a square works, you

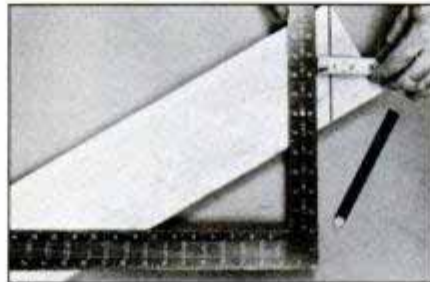
must first understand that roof pitch is described as a ratio of rise to run, that is, how much the roof moves up in elevation for every foot it moves over in span. Sometimes the pitch is represented as a fraction like ¼ (4 in. of rise for every 12 in. of run) or as a rise number, namely 4.

By placing the square on the rafter stock as shown, with the pitch number on the tongue and the 12-in. mark on the body both intersecting the same board edge, the proper pitch angle is automatically found.

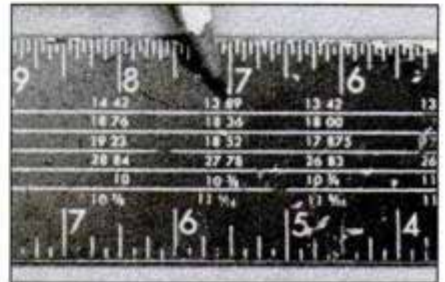
Then by reading below the pitch number on the body, the table gives the rafter length per foot of rafter run. In the case of a typical gable roof, you divide the overall span of the building from the outside edge of the front and back walls by two. Then take this figure and multiply it by the number found on the table. This is the rafter length from the center of the ridge to the outside of the wall plates. To establish the exact length, deduct half the ridge thickness and add the overhang width.



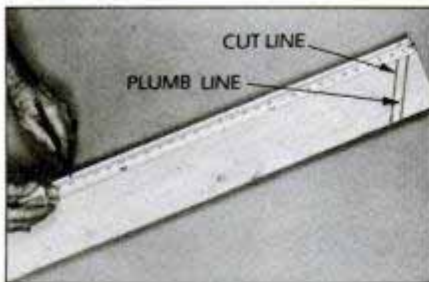
1 Place square on face of rafter stock so pitch number on tongue—7 in. here—and 12-in. mark on body meet board edge.



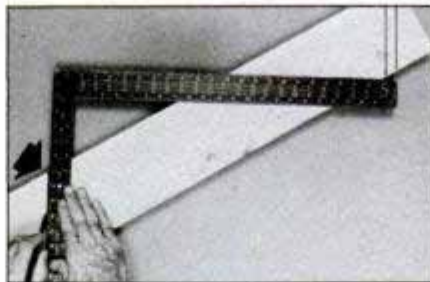
2 Deduct half of ridge thickness from rafter length by moving square down edge ¼ in. Maintain alignment of marks.



3 To determine rafter length, find multiplier located under pitch number on line named: LENGTH OF COMMON RAFTERS.



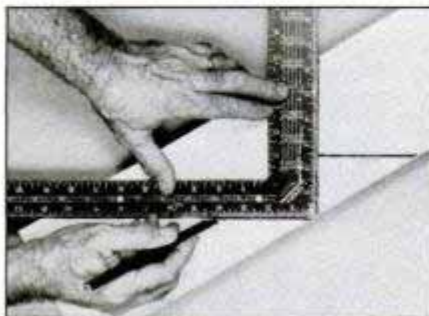
4 Multiply number from table by one-half building's span to find rafter length. Measure from plumb line not cut line.



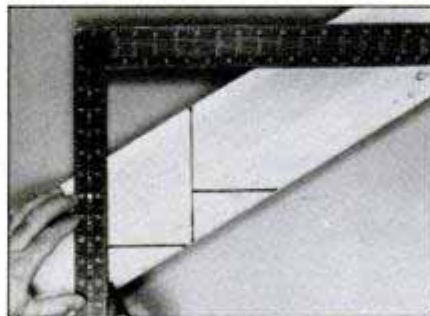
5 Reposition square on top edge so angle is the same as before and so tongue intersects rafter length mark (arrow).



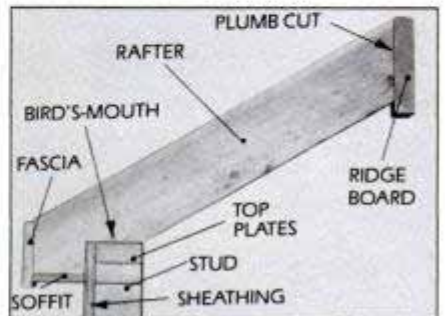
6 Hold square body perpendicular to lower plumb line and move up until 4-in. mark intersects bottom edge of rafter.



7 Move square perpendicular to other side of plumb line, with corner at bottom edge. Mark desired width of rafter tall.

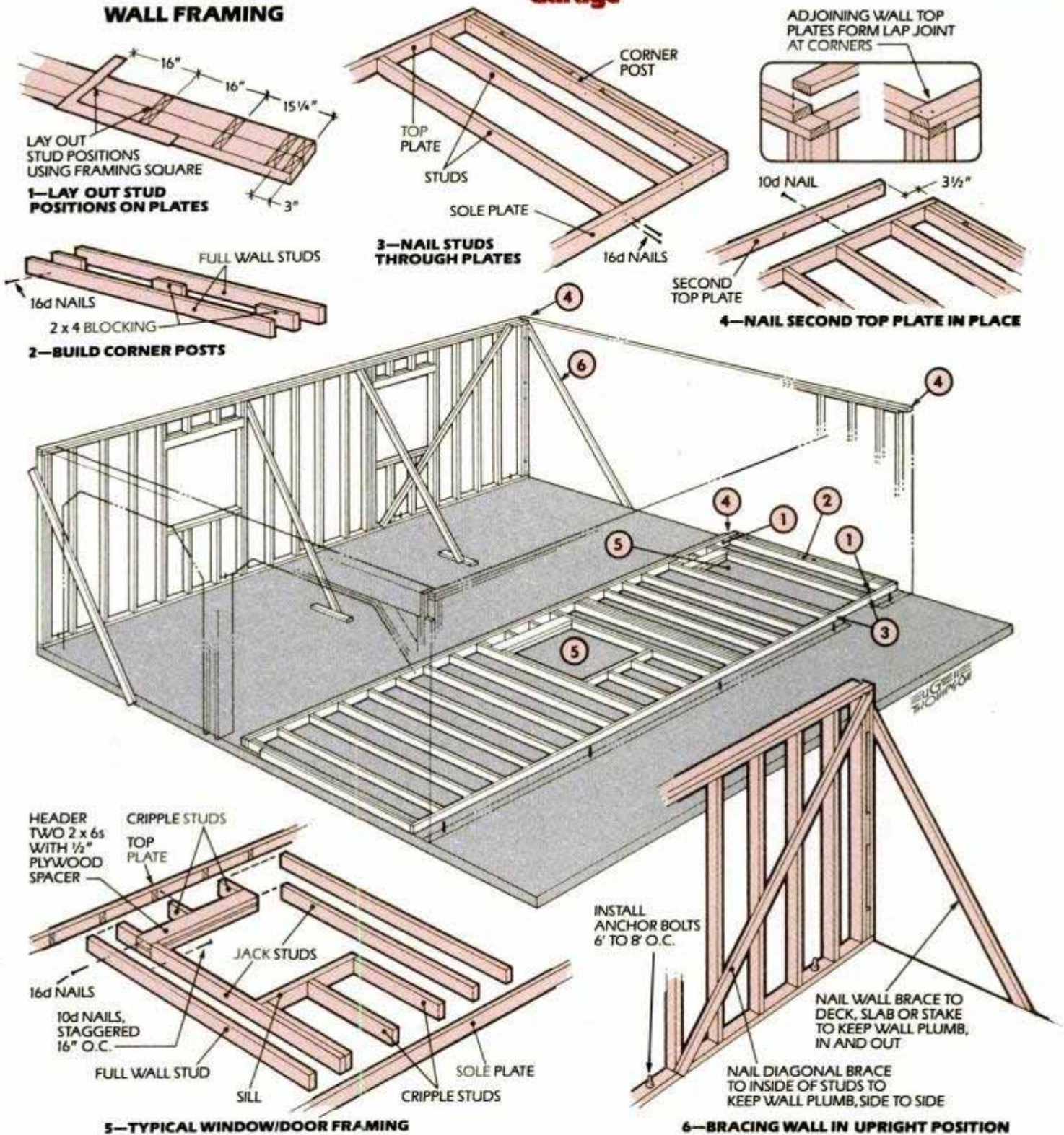


8 Reposition square so proper marks again meet top edge of board and so the tongue intersects end of tall width line.



9 Cut rafter shows proper fit of all components. Bird's mouth must sit flat on wall plate and plumb cut must be tight to ridge.

WALL FRAMING

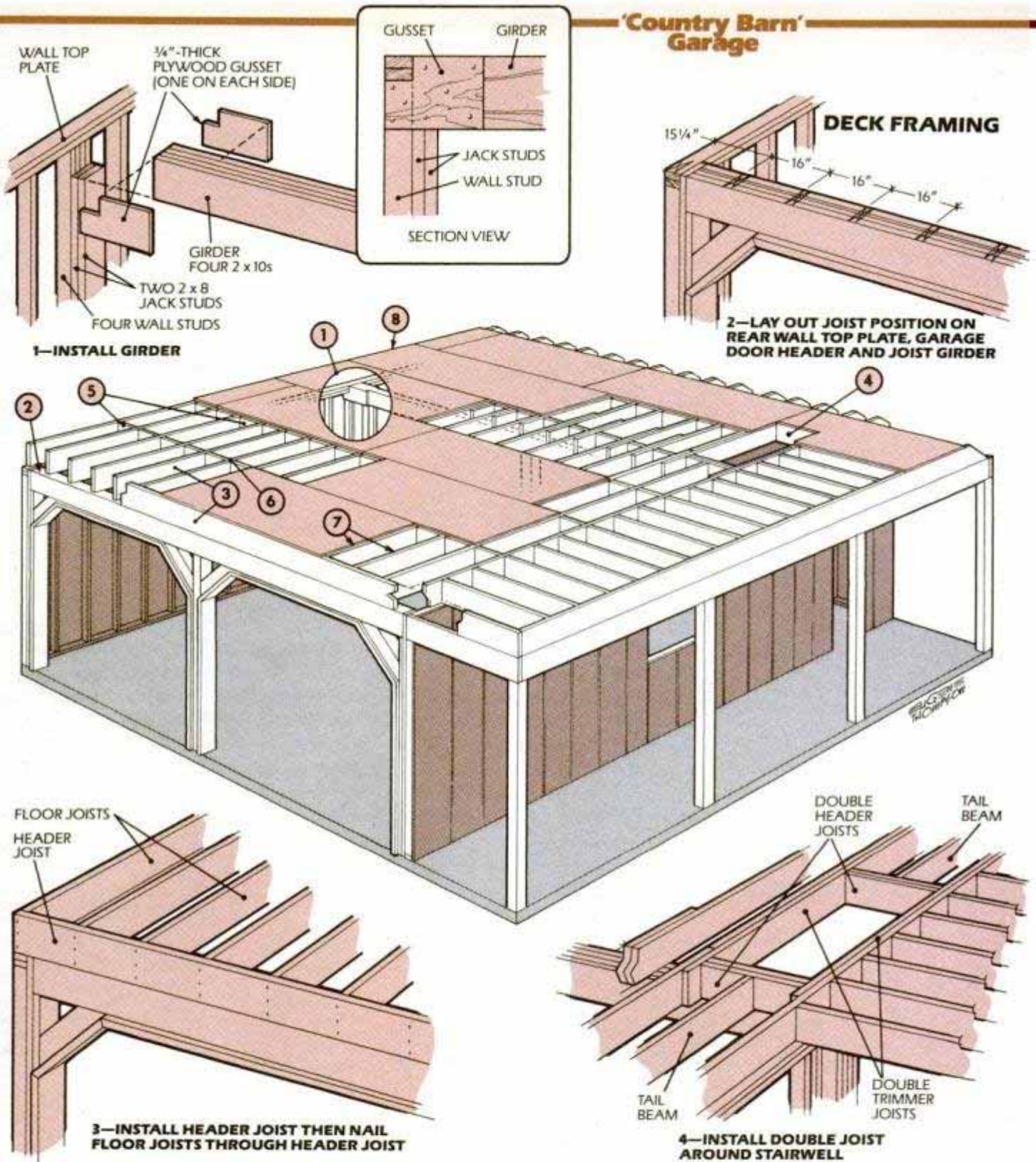


Wall framing

This garage rests directly on a poured concrete slab, so the first-floor walls are built first. However, if you are beginning with an open basement or crawl space, the first-floor deck would be constructed before the walls. Also, this structure has no interior partitions which would normally be built after the exterior walls were in place and before the second-floor deck is added.

The walls are 8 ft. high, including the bottom and top plates, which have a total thickness of 4 1/2 in. Because the standard stud length is 8 ft., cut down all the studs before you begin. Then, lay out their positions on the bottom and lower top plates together to ensure proper stud alignment. Use the longest and straightest 2x4s you have for the plates. Locate the first stud 15 1/4 in. in from the end of the wall, and the other

studs on 16-in. centers after that. These 16-in. centers allow the ends of standard plywood sheets to break in the middle of any stud to give adequate nailing at the seams. Start with 15 1/4 in. so the plywood will extend over the entire edge of the first stud. This same layout is repeated for the joists, second-floor walls and the rafters. Next, build a corner post for each end of the wall and construct any window



and door openings as shown. Position these parts, and the full studs that fall between them, against the bottom and top plates. Nail all components in place. Then, nail on the upper top plate, setting the rear end back $3\frac{1}{2}$ in. so the top plate on the adjoining wall can overlap the lower top plate. On this garage, only the rear corners lap this way. The front wall has no top plate over the header.

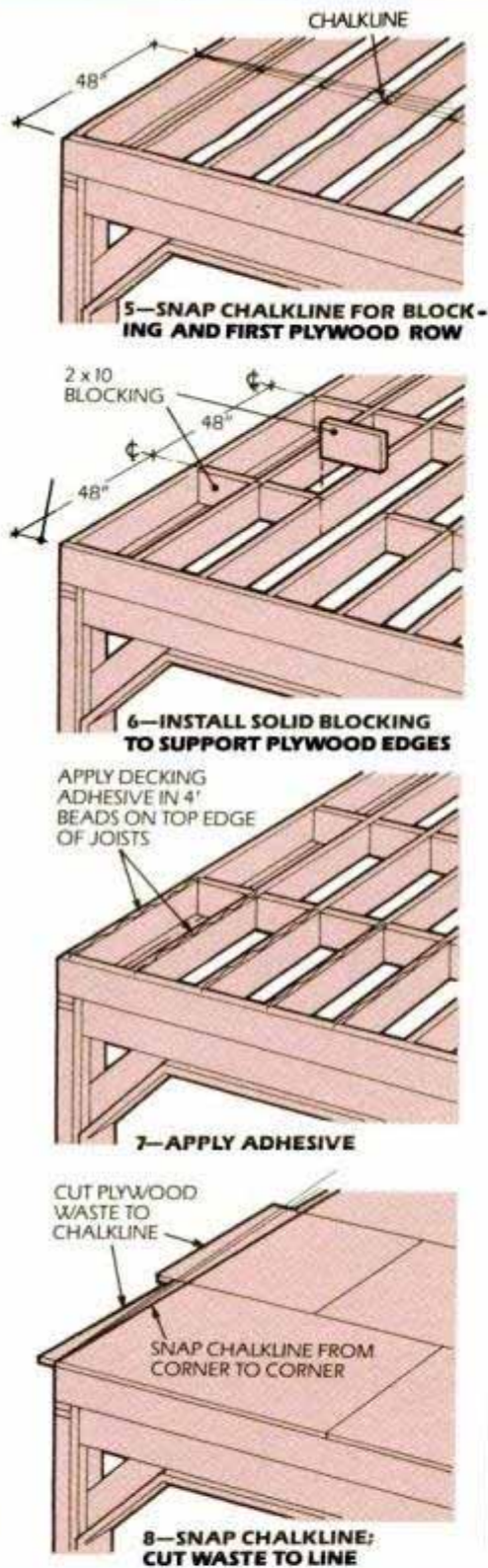
Raise one side wall and brace it in place as shown. Make sure the wall is plumb in both directions. Then, build the opposite side wall in the same manner, raise it into place, and continue with the front and back walls. The latter fits between the two side walls so it can be built in place, then raised. However, some side wall bracing must be removed temporarily for a clear raising path. Cover the walls with plywood

sheathing or, in this case, Texture 1-11 siding. Leave the wall braces until second floor deck is complete.

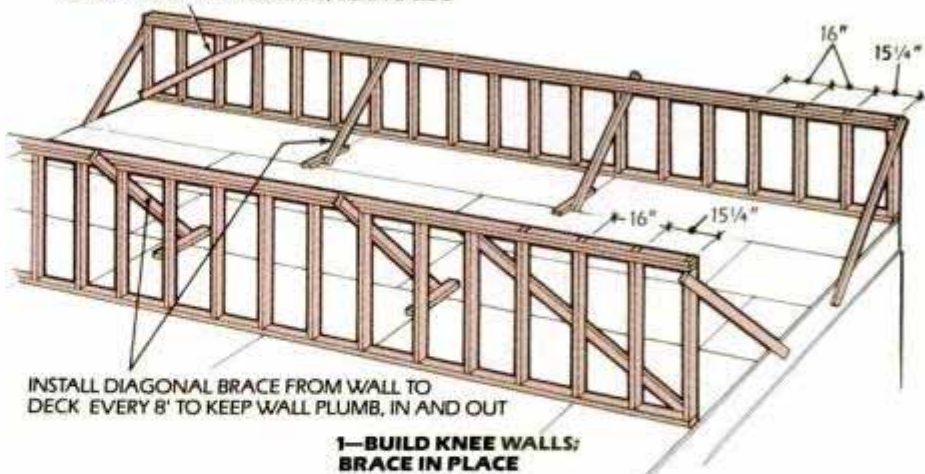
Floor framing

Select your straightest 2×10 s for the header joists that form the perimeter of the deck "box" and toenail them into the wall top plates. Then, install the remaining floor joists and frame the stairwell opening as shown. Before

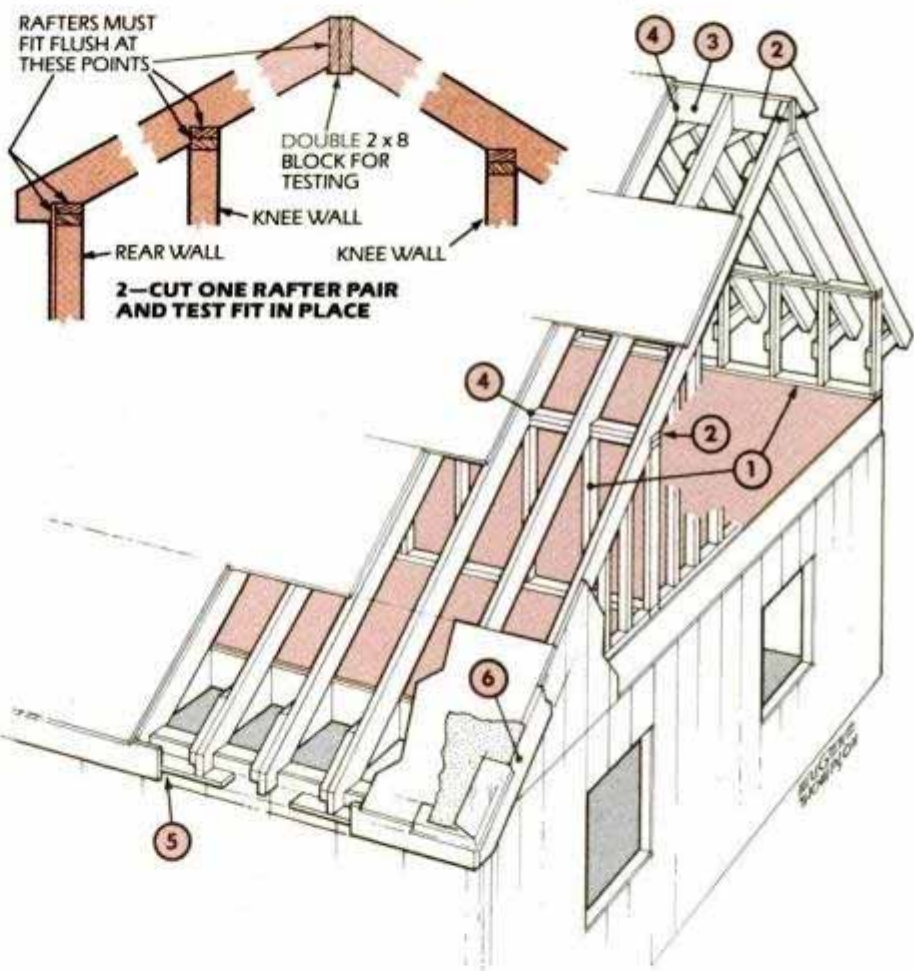
ROOF FRAMING (REAR VIEW)



INSTALL DIAGONAL BRACE ON INSIDE OF STUDS TO KEEP WALL PLUMB, SIDE TO SIDE



INSTALL DIAGONAL BRACE FROM WALL TO DECK EVERY 8' TO KEEP WALL PLUMB, IN AND OUT



each joist is nailed in place, sight down its edges to see which is crowned and place the crowned edge up.

Once all the joists are installed, snap a chalkline 48 in. in from the front to serve as a guide for the solid blocking that supports the plywood seams. In many areas of the country, tongue-and-groove plywood is available that eliminates the need for this blocking. Diagonal bridging is used instead, which is

much less time-consuming to install.

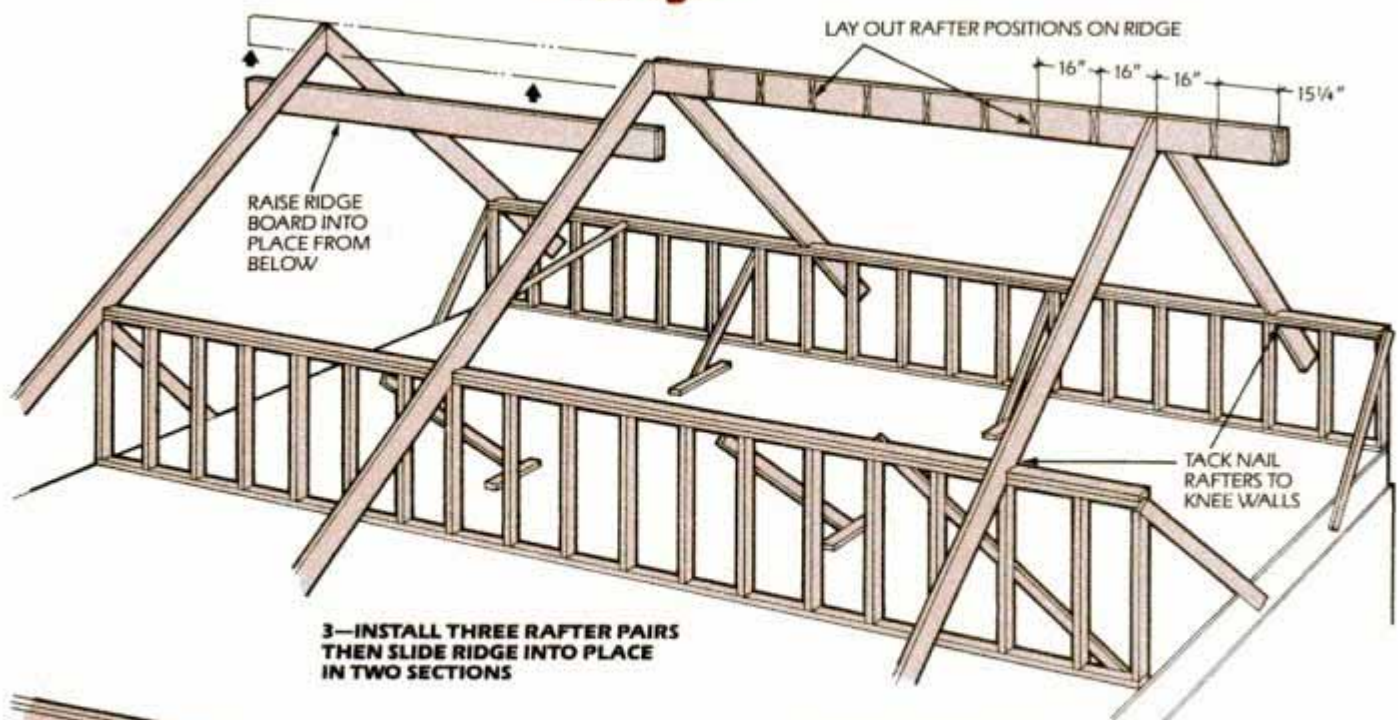
To minimize floor squeaks later, apply construction adhesive to the top edge of each joist, then lay the plywood sheets over the joists, nailing them in place with 8d nails. Do not nail into the perimeter header joists yet.

When all the plywood is installed, snap a chalkline from corner to corner of the deck, then cut off the waste with a circular saw. Make a straight cut to use

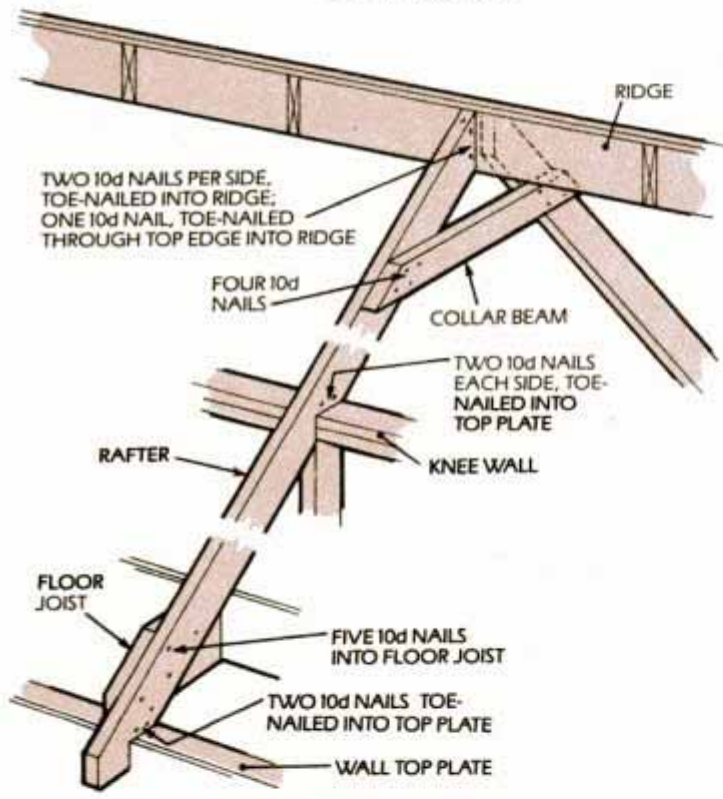
as a reference for straightening the header joists on both sides of the building. When the joists are straight, nail the plywood into them.

Roof framing

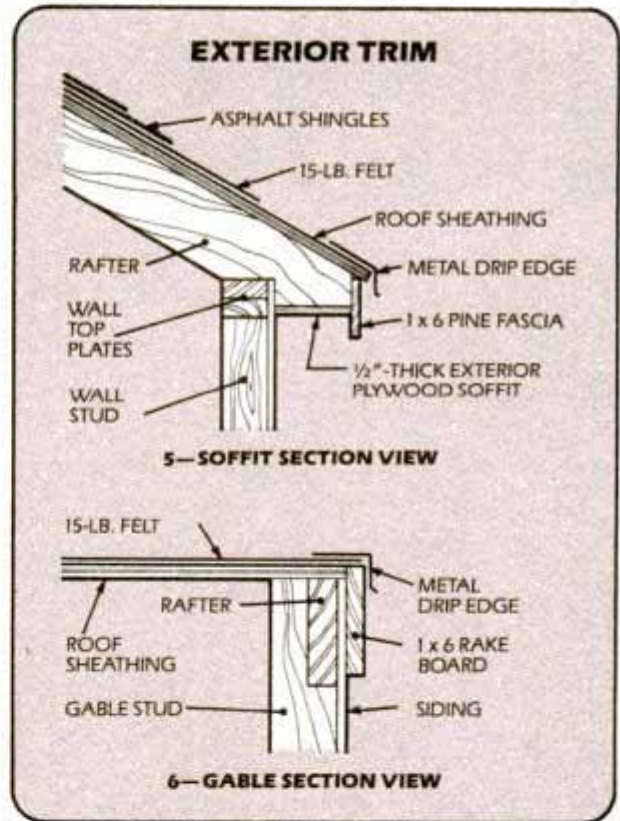
Lay out and construct the second-floor front and back kneewalls, then plumb and brace them in place as before. Lay out the rafter positions on top of these walls, then make the



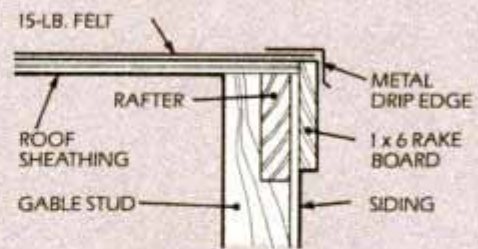
3—INSTALL THREE RAFTER PAIRS THEN SLIDE RIDGE INTO PLACE IN TWO SECTIONS



4—NAIL RAFTERS TO WALL PLATE, JOISTS, KNEE WALLS, RIDGE AND COLLAR BEAMS



5—SOFFIT SECTION VIEW



6—GABLE SECTION VIEW

rafters. The photos on page 92 show a good method for measuring and marking common rafters using a framing square. However, because this barn has an offset ridge—it's closer to the front of the building than the back—the length of the front and back rafters is not figured on half the total building span. Instead, the length is based on the span from each outside wall to the center of the ridge. The roof pitches are

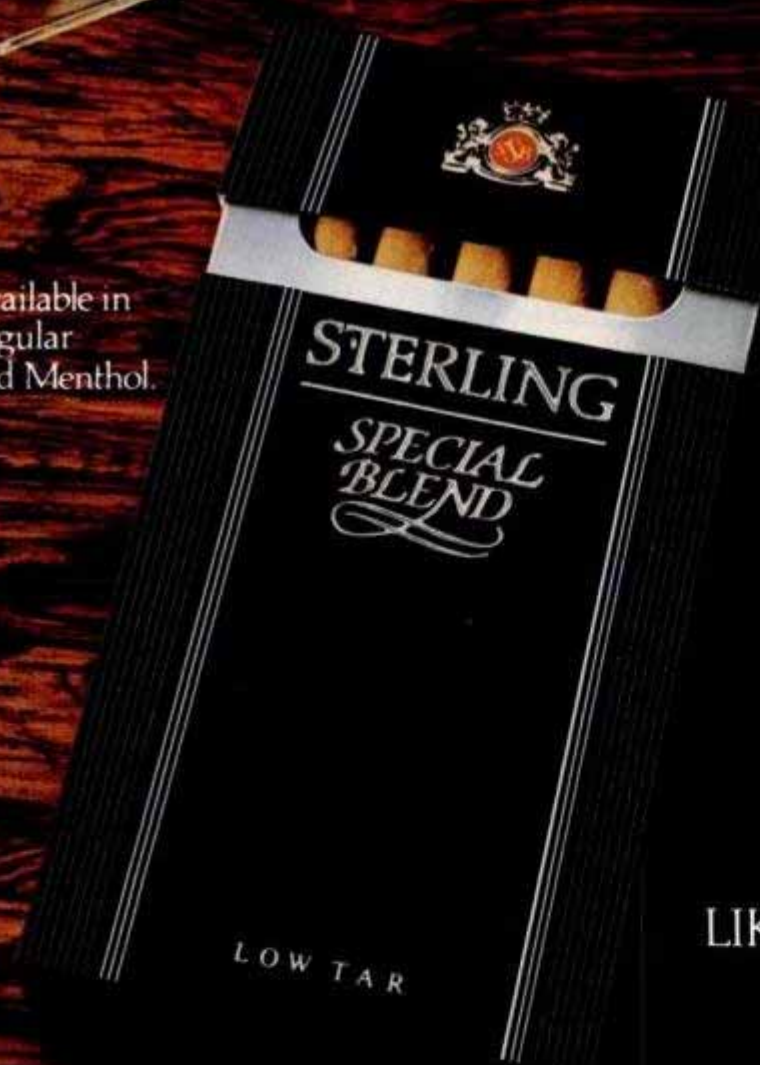
different: 9 in the front, $6\frac{2}{3}$ in the back. Cut one pair of rafters, test-fit them in place as shown, then use these rafters as patterns for marking the others. Next, nail three completed pairs in place, then fabricate the ridge in two sections and slide it up between each pair. Install the remaining rafters. Cut and install the gable studs on the two side walls, nailing the bottoms into a sole plate and the notched tops into

the side of the gable rafters. Plumb these walls and install diagonal braces back to the deck to keep them stationary. Apply sheathing or siding to these walls, then add the soffit and fascia material to the rafter tails. Cover the rafters with plywood using 6d nails spaced 6 to 8 in. apart. Install the rake board over the siding and the edge of the roof sheathing, then apply the roofing felt, drip edge and roof shingles. **PM**

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AVIATION



New tilt-engine jet flies like a helicopter

When you want to go up, you just tilt your engines upward in this dramatic new V/STOL concept under joint development by Grumman, NASA and the U.S. Navy. With the engines horizontal, it flies like a conventional airplane; with the engines vertical, it lands and takes off like a helicop-

ter. A full-scale mockup of the craft (inset at right) is already undergoing wind-tunnel tests.

Unlike other tilt-rotor designs requiring elaborate control mechanisms, the Grumman engines are mounted on a simple hinged spar that swings up like a trap

door, rotating the jets to any desired angle from horizontal to vertical.

Called the Design 698, the twin-turbofan craft will have a speed of 575 mph, a range of more than 1,600 miles and the ability to climb like an express elevator at 12,000 feet per minute.



In addition to its role as a military jump jet, the new plane is also expected to have important peacetime applications as a short-field business aircraft and a cargo plane for supplying offshore oil rigs.

Coming: Smaller jetliners

Airliners are getting smaller and smaller in an effort to reduce operating costs through the use of lighter, more fuel-efficient jet engines and the economic advantage of flying with full passenger loads instead of half-empty cabins. The latest to undergo the shrinkage treatment is the European-built Airbus A320, a downsized version of the A310 designed to seat only 150 passengers. (The A310 and the recently introduced Boeing 767 are both in the 200-plus-seat class.)

The twin-jet A320, shown in the artist's conception below, will have a range of more than 2,000 miles and is expected to burn 44 percent less fuel per passenger seat than today's jetliners. Due to

Two new downsized jetliners: Airbus A320 (right), BAe 146 (below).



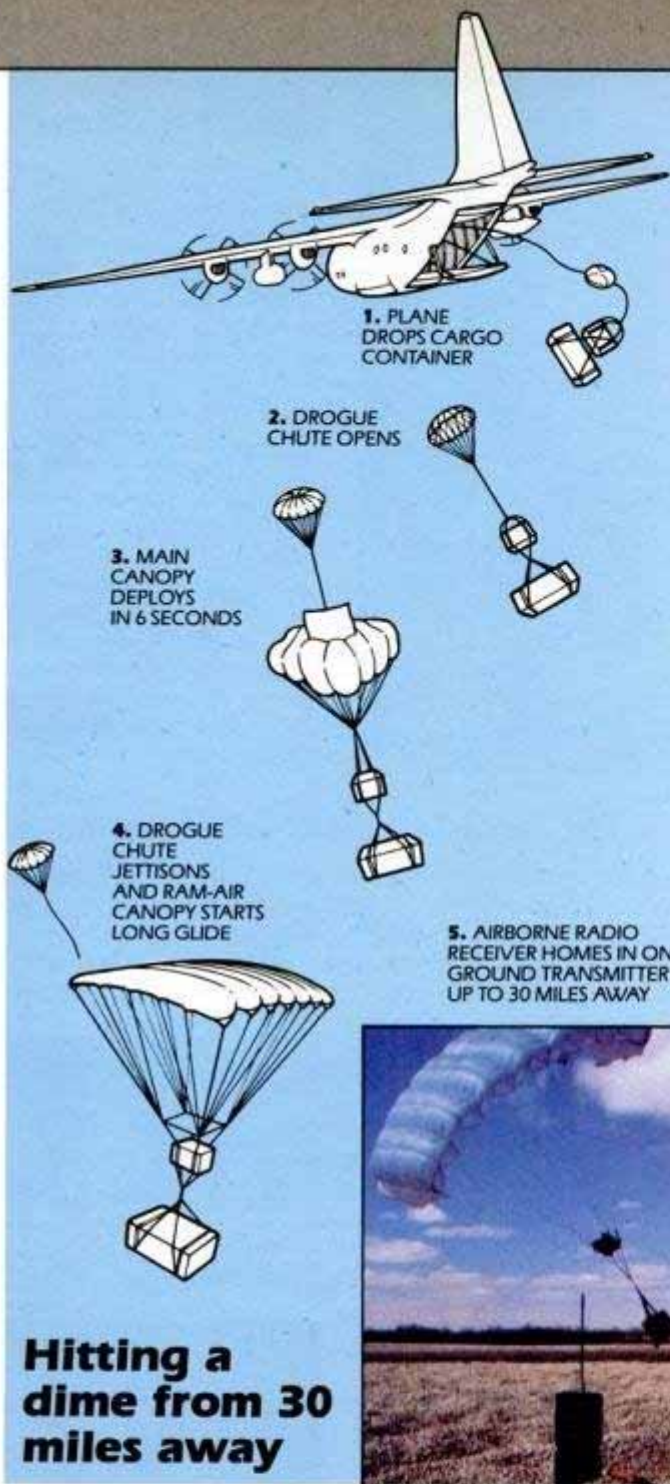
start production soon, it's scheduled to go into airline service in 1988. Boeing's answer is not yet known, but is rumored to be either a 150-seat version of its 737 or an all-new 150-seater cryptically designated the 7-7 (the dash stands for the as yet unspecified middle numeral).

Meanwhile, the British-built BAe 146 (lower left) is also making news as the world's quietest jetliner. Powered by four low-noise, high-thrust turbofan engines, the short-haul 100-seater can operate from small intercity airfields and is said to burn less fuel than twin-jet airliners, while being nearly twice as quiet as any jet. According to its maker, British Aerospace, it will, for the first time, bring the speed and luxury of jet travel to

short-run feeder routes now served only by slower, more spartan turboprops. Here in the United States, Air Wisconsin has already adopted the BAe 146 for its feeder-line operations.

For today's financially hard-pressed airline companies, the skies may be looking more friendly than ever. For U.S. aircraft manufacturers, however, some dark clouds are blowing in from abroad.

Editor: Dennis Eskow
Contributors: Sheldon M. Gallager, Jack Hammond, Bill Johnston, Jack M. Kneee Jr., Michael Bargo Jr., John Dornberg, Leif Robinson, Lee Green, Fran Wenograd Golden



Air-dropping supplies to embattled troops exposes the cargo plane to enemy fire and in bad weather may not be possible to do at all. With this long-range air-drop system, a plane can remain outside hazardous or weathered-in areas and still get vitally needed supplies to men at the front.

Payloads of up to 550 pounds are carried by a high-lift, ram-air parachute capable of gliding 30 miles. A radio direction finder attached to the chute homes in on guidance signals from a

ground-based transmitter and steers the canopy toward it by pulling on its shrouds.

So accurate is the system it can deliver a payload to within 200 feet of the ground transmitter from a plane flying at 30,000 feet 30 miles away. It can also be used on paratroop missions to assure that supplies dropped separately will arrive at the same point on the ground as the paratroopers.

Called Para-Point, it was developed by Para-Flite Inc. of Pennsauken, N.J.

ELECTRONICS

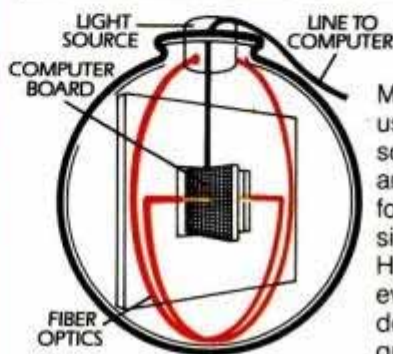
Computer fuel

If it costs \$10 million a year to fuel a truck fleet, about \$1 million of that fuel will "disappear" into unauthorized tanks, according to industry sources.

Now Systems Engineering Consultants of Miami has devised a computerized fuel tank. At the pump, an ID number is punched in. If the truck isn't authorized to get filled, the pump won't work.



Pump attendant hooks up computer line. No fuel flows unless computer gives the okay.



Light line

MIT Prof. Shaoul Ezekial is using fiber optics for a gyroscope more accurate than any mechanical model. It will focus light at a chip on either side of a computer board. How the lights line up will be evaluated by computer. The device won't be affected by quick gravitational changes.

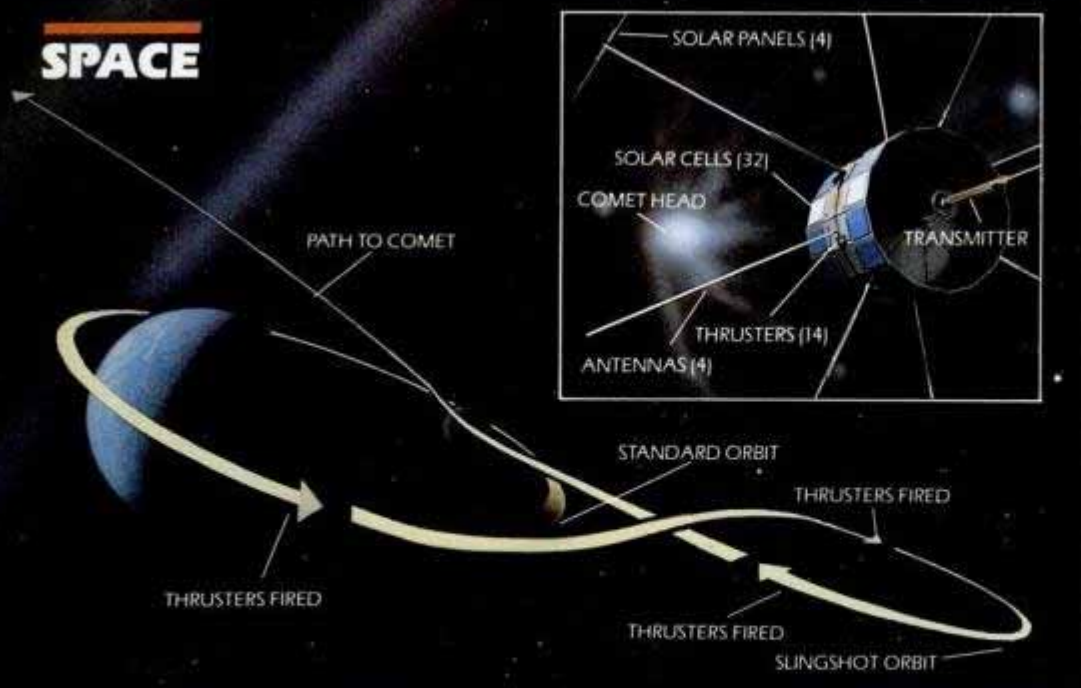


Drinking water from the sea

You're stranded at sea and running out of drinking water. But you have an inflatable raft with a GORE-TEX membrane on the bottom. The membrane, which filters out salt, is surrounded by a polyurethane material that condenses sea water vapor into drinking water. Two layers of wick cloth and the raft material itself act as solar collectors to vaporize the sea water. The new device produces three quarts of water per day.

TECHNOLOGY UPDATE

SPACE



ART BY BRIAN SULLIVAN

Catch a comet

Next year, America is scheduled to become the first nation to put a space vehicle inside a comet. The International Cometary Explorer had been in orbit around the Earth and moon collecting gravitational data. But last winter NASA fired the vehicle's 14 thrusters to put it on a complicated "slingshot" orbit, flinging it out of the Earth-moon system into the path of comet Giacobini-Zinner.

The ICE satellite will enter the comet's tail Sept. 11, 1985, where it will activate using a powerful transmitter to send to Earth man's first readings of the environment inside a comet.

ALTERNATIVES

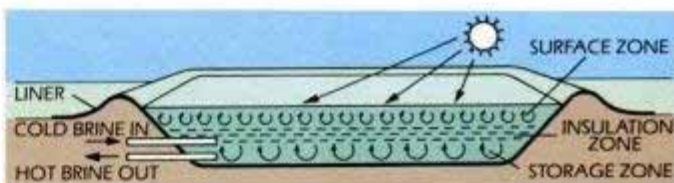
Antacid shot

West German scientists have devised a method to revive trees nearly destroyed by acid rain. To get a neutralizing agent to the tree roots, they've built a 3-foot-tall pneumatic injector that shoots the agents right to the root, reviving the tree.

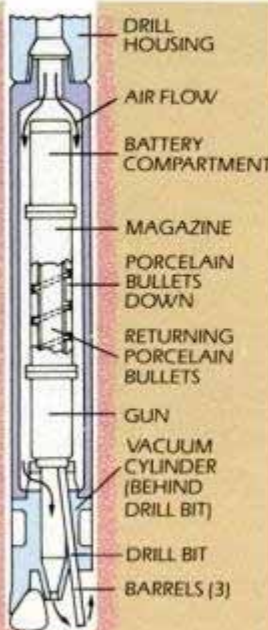


Solar recipe: Add pinch of salt

Solar-produced electricity at 2 cents a kilowatt-hour? That was thought impossible until this past winter when Argonne National Labs produced that energy from a quarter-acre pond of brine covered with solar-collecting insulation. The brine slows heat loss in the water, making low-cost energy use feasible.



ENGINEERING



Gun for oil

It sounds like a machine gun, but it looks like an oil well drill. Actually, it's both. The Tround drill pneumatically fires porcelain bullets into granite, saving wear on the drill bit. The porcelain rounds hit the granite and re-enter the drill through a suction chamber. The device speeds drilling, in addition to extending the life of a bit.



Let chips fly

Metal milling is a dangerous process because the metal chips fly every which way. Now the Kenametal company has developed a high-speed photographic system to help predict exactly where the chips will fly in a mass production process. By predicting the path of flight, workers can be stationed in positions out of harm's way.

GAMES



Tron revisited

In the Walt Disney film *Tron*, a computer engineer got zapped into his computer and became part of the game. That's no longer a tinsel fantasy. In Dallas you can play *Photon*, a 10,000-sq.-ft. living video game. Fire a ray gun to hit a sensor target and score points. But you can be "killed" first if an opponent's light hits sensors you wear.

MILITARY

BEAM DETECTS ENEMY TANK, AUTOMATICALLY TRIGGERS MISSILE RELEASE



MISSILE FIRED BACKWARD AT 45° ANGLE

MISSILE MOVES FORWARD AND DOWNWARD AT SAME RATE, PRODUCING VERTICAL TRAJECTORY

Hands-off bombing: No place to hide

A fighter pilot seeking out enemy tanks hidden by trees or darkness won't have to see his quarry to hit it—he'll hit it automatically without even pressing his bomb release.

In an ingenious new hands-off bombing system, known as Vebal Syndrom, an invisible beam scans the

ground ahead. The beam consists of three sensors: laser-ranging radar, which measures the size of a suspected target; radiometer frequencies, which tell if it's metal; and infrared, which records the heat it gives off. If all three sensors agree the target is a tank or similar

armored vehicle, a missile is fired within milliseconds.

Now comes the really clever part. If the missile were fired forward in the conventional manner, it would strike the tank head-on where its armor is the heaviest and least vulnerable. Instead, the missile is fired *backward* at a

45° downward angle. Its forward momentum and simultaneous rearward travel combine to produce, in effect, a vertical trajectory. Thus it strikes the top of the tank where its armor is thinnest. The system is being developed by Westinghouse and the West German firm of Messerschmitt-Bolkow-Blohm.

Flexi-wheeler to anywhere

This eight-wheeled monster does tricks that would turn lesser vehicles into wrecks. Each wheel is driven through a hinged trailing arm that allows it to move up and

down independently, enabling the vehicle to climb over steep obstructions with full traction. With the end wheels raised, it can pivot on the center ones.

The system is made for both military and civilian vehicles by the Standard Manufacturing Co. of Dallas.



Big bang theory

How would small tactical nuclear weapons effect a surrounding battlefield? Since the Defense Department is kept by treaty from setting off above-ground atomic tests, a high-explosive tower has been built instead. Using 1 million tons of ammonium nitrate, the tower creates blasts the size of a small A-bomb, letting scientists measure its ground effects.



Defense Department tower (inset) uses 1 million tons of ammonium nitrate to set off a blast that simulates an atom bomb.

MUD, SWEAT AND GEARS

(Continued from page 68)

me what looks like a bill for CR8,000. I haven't the slightest idea what 8,000 cruzeiros is in dollars. All I can think of is my first night in Germany 10 years ago when I paid \$250 for a bottle of champagne.

It turns out that CR8,000 is about \$5.94, in U.S. money, the standard fare from the airport to Manaus. I get in an ancient taxi of indeterminate make and we rattle through the humid South American night to the hotel.

The next morning, I watch Brazilian television while awaiting the arrival of the main party from Paris. There's nothing quite like watching the Three Stooges and Popeye the Sailor do their stuff in Portuguese. Finally, we depart Manaus for Santa Rem, where the ordeal begins.

All-night run

The main group flies off for a 45-minute milk run in a Boeing 737. I join a band of seven other adventurers who make a three-hour flight in a twin-engine Islander, arriving through rain and high winds after dark. We find that we have just enough time to bus over to town to begin the first leg of the run, a scheduled *all-night* "vehicle familiarization tour" of 380 kilometers to the gold-mining center of Itaituba. I wonder if this is how Indiana Jones got *his* start.

I'm pleased to be placed not in one of the journalist vehicles, but with Swiss No. 1, one of the first vehicles out. The drivers are Beat Studer and Othmar Wirth. Swiss journalist Peter Holenstein is also aboard. The run to Itaituba takes 10 hours, with an average speed of 23.75 mph. It's a very long first leg, and is on no road at all in the modern sense.

At one particularly dreadful section, dark red mud has been piled up to hip height on the roadside by the heavy vehicles plying the route. As we catch up with our colleagues, we are startled to come upon a monstrous Mercedes-Benz passenger bus, perhaps 50 feet long, sunk beyond its hubs in the soggy orange clay. Its bumpers are flat on the road, and it is just sitting there, silent in the thick, humid Brazilian night, full of people going nowhere. We regroup and roll impassively past like it isn't even there, like a clandestine pack of mercenaries en route to overthrow a country. The passengers watch us in wide-eyed curiosity.

At dawn, we arrive at a river crossing. The ferry isn't fired up yet. Across the river lies Itaituba, a *really* interesting place. Itaituba is a *garimpo* camp, a gold-rush town. We are instructed to buy hammocks, mosquito nets and whatever food and water we feel we'll need. There are no Golden Arches

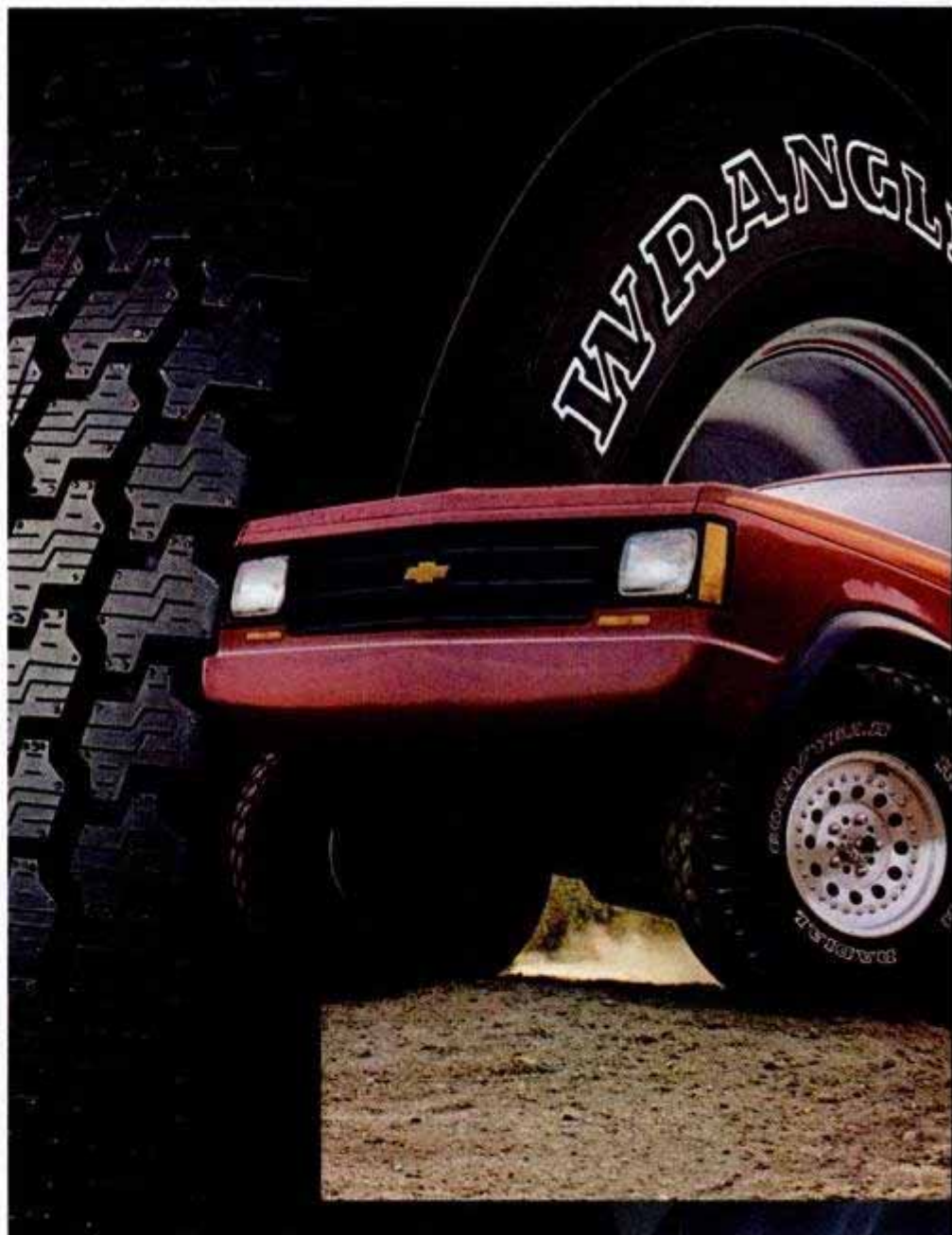
where we're going. Water and canned goods are suggested.

We've managed to buy almost every liter bottle of pure *agua mineral grande* in town, and we're making serious inroads into Itaituba's supply of *Antartica cerveja* (cold beer) and the ever-present Coca-Cola.

Poverty here is endemic and all-encompassing. Itaituba's open-air marketplace isn't the quaint farmer's market we've come to favor, either. The stench is enough to knock a strong man

to his knees. Rotten fruits, vegetables and rancid meats hang in the open air without the benefit of refrigeration, while gnats and swarms of blackflies hover about in nervous formations.

We adopt the Restaurant St. Martin, just off Itaituba's main square. The food is more than passable—it's excellent. The Cokes are cold and the water is good. It's in bottles, of course. And the shade offered by the dining room is a welcome respite from the ache of the hot sun on sunburned necks and arms.



WRANGLER RULES THE ROAD.

My waiter brings over some lunch. He's wearing a T-shirt that reads Alcatraz Yacht Club.

The very next customer who comes in is wearing a shirt from Florida State University.

Late in the afternoon, a special task for competitors is announced. These are the tests on which the teams are scored. There are 12 scoring situations: jungle penetration, night orienteering, fuel economy run, mud negotiation, sand negotiation, water negotiation, equal-

time driving (matching times each way over a prescribed course), basic hill climb, slalom hill climb, high average speed, bridge negotiation and sand ladder practical application. Points are awarded to finishers in descending order, from 400 for first to 100. Points are *deducted*, however, when vehicles are damaged. Body damage is okay. It doesn't do any good to be fast if you lose points for breaking your truck.

On this task, the teams are to race an estimated 200 kilometers at an average

speed as close to 50 km/h (30 mph) as possible. We'll be en route to the next scheduled bit of organized civilization, Jacareacanga, on the task. I am to be the journalist/neutral judge for Germany No. 1 and keep elapsed time.

"The key to a successful ride, Dan," says Ulrich Schum, an eye surgeon when not traversing the jungles of South America, "is to not be nervous." When I tell them in my sincerest deadpan that I don't get nervous, Ulli and teammate/driver Volker Lapp look at each other for a moment and laugh.

We take off, scattering chickens, children and old men on mopeds. Much of the road surface is composed of enormous craters or narrow trenches, barely the width of our Land-Rover. Each trench is often 8 to 10 feet deep and level with dark water.

We are already averaging right about 50 km/h and we lunge into the holes without slowing, leaping high into the air on each exit, anticipating the shock to come when we land in the next hole. I don't have any seat belts like the men up front, only two vinyl-covered assist straps bolted to the roof rails. Without them, I'd be bouncing around like dice in a cup. Lapp drives like a madman.

After being keyed up to a fever pitch in preparation for four hours of crashing over a prehistoric rain forest road at top speed, we are stopped by Competition Manager Graham Fazakarley only 47 minutes, 55.50 seconds after the start. He asks for our time. We're told with disappointing finality that we are too fast. Giorgio Arcangeli, the RJR starter, has told us a *big fib*. Four hours, indeed!


The rain begins to fall with an intensity that brings new meaning to the word *torrential*. The drive on to Jacareacanga is a rolling torture test. Volker, Ulli and I frequently pass around liter bottles of *agua*. The hours tick off, the kilometers roll by, and there is little to relieve the impenetrable monotony.

Crumbling bridge

Suddenly there is movement up ahead. We can detect the red flash of a line of taillights through the dark trees. Can this be the town already? No. We arrive at a bridge of fat logs sliced flat on one side and sunk into the softening orange clay of a riverbank. Beneath the logs, a torrent of black water roars by under the hard rain. A single vehicle has managed to cross in four hours, this with injuries to Swiss journalist Yorn Pugmeister, who has fallen into the river and bounced shoulder-first off a wet log. Expedition leader Andreas Bender sits across the river, his Land-Rover pointed back toward us.


Arriving vehicles are stacking up at the bridge. The span is crumbling as

(Please turn to page 104)



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GOOD YEAR

MUD, SWEAT AND GEARS

(Continued from page 103)

the water tears away the clay beneath the logs in 100-pound chunks. Nothing can be done until morning, when our group will survey the site and decide how best to reinforce the bridge.

At about 9:30 p.m., after consulting with the other Trophy teams and viewing the precarious bridge firsthand, Volker, Ulli and I curl up as best we can in the cramped, steamy confines of the Land-Rover and fall into an uneasy sleep. Outside, the rain beats a rhythmic lullaby on the roof of the truck. Naturally, I have to go to the bathroom.

We awaken at 6:15 a.m., not long after first light. Around us, the other teams are also stirring. The rain has softened to a gentle drizzle.

Each vehicle is equipped with two sand ladders that may be our salvation. These are perforated metal panels that fit into one another lengthwise in a tab-A-into-slot-B fashion. The competitors string them together over the slimy wet surface of the log bridge, nailing them down to provide a hard metal surface for the river crossing.

A stout iron post is sunk deep in the clay on the far side of the bridge, and the cable from the first vehicle's powerful Warn winch is payed out and hooked

to it. The German journalist-adventurer Axel Thorer acts as a ground guide. Inch by adrenaline-charged inch, Othmar Wirth at the helm of Swiss No. 1 creeps across the makeshift bridge. All the event participants watch the slowly rolling, mud-encased tires. He crosses without major incident, and a cheer erupts from the spectators. Then Italy No. 1 has difficulty crossing.

Giancarlo Barocelli, dubbed Roy Rogers by some of the group for his wide, black cowboy hat and brash demeanor, has been gesturing wildly all morning. Once the river crossing begins, he becomes even more animated.

In obvious frustration at being largely ignored, he climbs behind the wheel of his truck and edges up to the bridge alone. Without benefit of winch or ground guide, Barocelli charges across the flimsy supports, engine racing, arms flailing. His vehicle catches the raised corner of a sand ladder in the final third of his crossing, and he drags it and three other sections off the log bridge while dislodging several others.

We figure there are eight or nine other vehicles yet to arrive, so we post a guide and the rest of us drive about a mile down the road to Montanha and the No-Name Restaurant and dormitorio for breakfast. We drink huge bottles of delightfully frigid *Cherpa Chopp*

beer, and I down a wonderful trio of fresh eggs bathed in the salty oil everyone here seems to cook with. It is too good. We cleanse our palates with *agua e sal biscoito*, a bland cracker, and drink more beer and Cokes.

It is 9:40 a.m. Outside, the sun is fully up and the heat is building to its normal sweaty intensity. Most of our tenuous bridge supports now clog the river somewhere downstream. We've managed to retrieve our sand ladders. However, the main logs are now in the rushing water and soon they, too, will be swept away. It appears obvious to us that no more Land-Rovers will come this way. The fate of the other eight teams, the support vehicle and the journalists' car is unknown to us. We spend the rest of the day waiting.

The next morning, six of the missing vehicles are lined up on the wrong side of the swollen river. Now, crossing the bridge even on foot is dangerous. Soon it will be impossible. What will happen now is open to question. Some of the talk centers on the necessity of pulling the plug on our adventure, and no one is very pleased about that prospect.

I'm sitting in the No-Name feeling pretty smug about my decision to accompany the competitors instead of the journalists. We've gotten across before

(Please turn to page 106)

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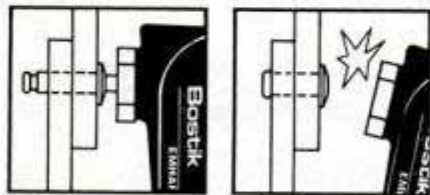
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EMHART

MUD, SWEAT AND GEARS

(Continued from page 104)

the demise of the bridge. The journalists' car, commanded by RJR's Peter Grunbaum, is somewhere on the wrong side. Suddenly, I am feeling not quite so smug. I remember that my hammock, mosquito net, insect repellent, dry clothing, *everything*, is with Grunbaum.

It takes two and a half days, but incredibly, the competitors completely rebuild the bridge! Without an engineer in the lot! The civil engineering is commanded by RJR's Dutch representative, Ronald Berg, and manned by the Dutch, Italian and German competitors. They work like maniacal beavers as they fell and trim enormous trees weighing several tons using chain saws, machetes and hand axes. The logs are dragged by cable to the river's edge and winched across with careful leadership from Volker Lapp, who is primarily responsible for on-site supervision.

Reunited at last

With our two groups finally reunited, we press on toward Jacareacanga. Gold diggers, called *garimpeiros*, occasionally pass as they go toward the uncertain bridge we've left behind.

We stop at a lovely European gasthof run by third-generation Germans. It's an oasis of clean wooden splendor on the dry roadside and near the cinder airstrip our Islander security plane is using today. We eat huge mounds of boiled potatoes, stewed tomatoes, rice, chicken and pork, then buy as much beer, water, Cokes and Fanta as we can.

We arrive, finally, in beautiful downtown Jacareacanga, where, because of pressing duties back in the United States, I'm to depart this crazy band of civilian adventurers.

Axel Thorer tells me Jacareacanga means alligator under a yoke. I can't decide if he's pulling my leg or not when he says the locals used to pull wagons here with 'gators.

I stop with the Belgian No. 1 team of air force pilot Polydore Stevens and factory owner Jean van der Elst at a little bar with no name. We drink that horrible Skol beer and Cokes and watch a fat girl and a tall, dark-haired boy play pool on a dilapidated table. In the background wafts the scratchy strains of The Fevers singing such old favorites as *Agora Eu Sei (I've Been Hurt)* and *Vem Me Ajuder (Get Me Some Help)*.

A few more shooters and I'm on a 747 winging back to the good old U.S.A. Later, back in Detroit, I'll learn that the Italy No. 2 team of Alfredo Redaelli and Maurizio Levi has taken top honors with 3,473 points. Germany No. 2 (Lapp/Schum) is second with Netherlands No. 2 (Haaksma/Krug) third. **PM**



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NEW HOMES UNDER THE SUN

(Continued from page 83)

exchanger that uses a compressor and blower mechanism to provide heat to the house. The brine can also be used to raise the heat of the home's hot-water heater, reducing the heater's fuel consumption up to 50 percent.

Augmenting that system is a solar water heater and mixing tank. The solar heater draws water from pipes heated by a series of solar collectors. The water, heated by the rooftop collectors, is piped down to the solar tank. When the solar system can't heat water to comfortable levels, a mixing tank with an electric heating element picks up the slack.

The Impact 2000 home has more than 60 sensors measuring air temperature, incidence of sunlight, presence of gases in the air and temperature changes—both household air and water—effected by changes in equipment used.

Starting this summer, Boston Edison plans to run a series of tests on household air pollution, a hot topic in the superinsulated research community. Several researchers have warned that houses can become too tightly insulated, paving the way for radon gas (emitted by insulation) and cooking gases to hang in the air. At an older experimental home of Brookhaven National Laboratory on Long Island, N.Y., tests have shown trace elements of radon. Medical scientists aren't certain whether the gas poses a health hazard. So, while tests continue at Brookhaven and Impact 2000, scientists at the National Institutes of Health are observing the impact of radon gas on laboratory animals.

Affordable solar

If all the computerized and advanced-designed equipment dazzles an on-looker at the Impact 2000 home, it gives Norman Saunders reason for concern about the future of less flashy experimental houses.

"It became apparent years ago that there were two groups going solar," he explains. "There were those with money who could read the handwriting on the wall and wanted to reduce their reliance on fossil fuels. And there were the anti-establishment youngsters doing very good work with whatever was available.

"The very high-tech houses are negative for solar energy," Saunders says. "They carry the image that solar is too expensive."

Expensive is the last thing Saunders wants. His homes cost an average \$50 per square foot to build, a reasonable price by current standards. The price looks even better when you consider

the low cost of operating a Saunders home.

Heating and cooling in any of his passive solar houses costs under \$100 per year—the price for electricity to run air-circulating fans, according to Harvard Prof. William Shurcliff. He studied three of Saunders' houses and presented his findings in the book *Super Solar Houses* (Brick House, \$11.95). Shurcliff also noted that these homes do their job efficiently without sacrificing aesthetic values and without complex machinery.

"A house should have very few moving parts," Saunders says. "And it shouldn't have any elements that keep you from looking outside."

Trombe walls

Saunders' superinsulated houses have ample window space on all four sides, unlike many "low-tech" solar homes. He shuns Trombe walls, which many low-tech buildings use on their south-facing greenhouses. He likes to point out that Trombe walls are nothing new. Samuel Morse took out a patent on such a system in 1859 and Felix Trombe reintroduced it in 1954.

The Trombe wall generally consists of a sheet of triple-glazed glass standing in front of a masonry wall. The glass is separated from the wall to provide a half-inch insulating air space. The Trombe wall has openings at top and bottom, permitting cold air to flow out and warm air to flow in. The trouble with such walls, Saunders notes, is that the masonry blocks the homeowner's view. Some of his greenhouses have modified Trombe walls, but these don't run above eye level.

A typical Saunders house is one big heating and cooling system. Among his half-dozen solar patents is one for a "Transparent Roof," consisting largely of louvered windows angled to let in maximum sunlight in winter and minimum sunlight in summer. Inside the attic he places a solar collection system. In the Pasolar House, he uses carboys—five-gallon glass bottles—filled with water as collectors. With 400 such bottles, he builds up heat in the attic storage area. Heated air is drawn down a duct by a fan and circulated to a heat storage area beneath the house. The lower area is filled with stones that sit on a bed of earth beneath a concrete floor and vapor barrier. Heat travels back up into the house through a series of "upducts," circulating into the rooms through grilles. As the heat rises toward the roof it mixes with cooler air providing moderate temperatures throughout the house. Since the attic heat is drawn down through ducting on the side with the fan, cooler air from the outside can enter from the attic

area opposite the heating duct. An exhaust duct leads household air to a turbine that speeds the outflow.

Despite the fact that Saunders houses are superinsulated, experts we talked to doubted the homes would have any problems with radon gas since there is a constant flow of fresh outside air.

"I have no problem with the old-fashioned buildings that practice passive solar," Bob Vila says. "In fact, my experience in building a new house has sort of reaffirmed my belief in old houses," he notes. He says 19th century houses he has worked on have the basic ingredients for passive solar. They face true solar south, are heavily insulated and have solar-storing floors.

Real-life test

In between the new houses with their flashy technology and the old houses with their pure simplicity lies the Denver homes under study by the Solar Energy Research Institute. SERI's latest report on its monitoring covers 40 houses, mostly in the Denver area, but some located at points across the nation. While the balance of the survey indicates that well-designed passive solar homes are highly efficient, some data point up the weakness in such designs.

For instance, one Denver-area home that included all major details needed for unassisted solar heating turned out to be highly inefficient when heat loss measurements were taken. The two-story frame house included a south-facing glass sunspace with tile floor. A thermostatically controlled fan system dumped heated sunspace air into the basement, where the hot air rose through a duct system. The design should have provided ample heat to the house, but a backup furnace had to be turned on nightly in the winter.

When SERI researchers tried to run an "infiltration test" on the house, they couldn't get up enough air pressure in the living areas.

A typical infiltration test begins with shutting the windows and doors. A huge fan is brought in and it blows air through the house. If the house is sealed up tightly, the pressure inside builds up. Then a smoke generator is turned on. As the smoke circulates through the house, it leaks through cracks and holes, revealing where the insulation fails. SERI engineers surmised that the building was constructed too loosely, with open seams in some corners. They also noted that the sunspace air dumping system could be cut off by homeowners when they closed the doors leading from the sunspace to the rest of the house.

Such findings tend to back up Saun-

(Please turn to page 110)

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NEW HOMES UNDER THE SUN

(Continued from page 108)

ders' point that passive houses should run automatically. Cutting off the hot air in a typical Saunders construction involves closing a damper near the attic heat-duct system. That can be done with a thermostat or manually.

SERI data on a monitored house in Topsham, Me., show that a house built like the one in Denver can be highly efficient. The Maine house received 40 percent of its heating and hot-water requirements from a greenhouse. It was a two-story frame building, too, but it performed more efficiently than the Denver building because of its tight construction. If the Maine building had a thermal storage mass—such as the rocks under the house in a Saunders home—SERI engineers felt it could have generated much more household heat, perhaps getting close to 100 percent.

Sans solar

The American Gas Assn. house in Cleveland makes no attempt to rely on solar energy. It does include a "great room" with a cathedral ceiling on the glass-covered south side. And the room is thermostatically controlled to let hot air pass into the home's ducting system on cold days. But the AGA building also includes gas and multi-fuel furnaces that will be tested for heating efficiency and air conditioning that will undergo similar testing over the next few years.

The Cleveland house also is designed to demonstrate and study other types of energy-consuming technologies. Space-heating systems are being studied in several rooms and two different circulation systems are under review; a forced-air system and a hydronic heating rig.

One new heating technology under study is a pulse combustion system that "makes use of intermittent combustion at 60 cycles per second, similar to an auto engine—except there are no moving parts," explains AGA researcher Doug Kirk. "It gives a pumping action that forces the exhaust product to exit without any need for blowers. We think pulse combustion furnaces run at 96 percent efficiency, compared with the 50 to 60 percent most people are getting with conventional furnaces."

The various systems in the AGA house will run at different times under the watchful eye of a computer-sensor system.

In addition to heating and cooling, the AGA house is a laboratory for the study of new types of kitchen appliances. Dynamic studies are expected to yield information on the efficiency of a

wide range of cooking stoves from the standard gas range to commercial size convection ovens. Some engineers have proposed replacing the traditional cooking stove with larger convection ovens for greater fuel economy. This theory is far from proven.

Building with modules

At the World's Fair site in New Orleans, the Energy Saving House/Design home shows off the latest in energy technology, and in modular construction. Such housing is growing in popularity among architects because it allows flexibility in home building. With a modular house, the owner can sit down at a computer with an architect and work out an almost infinite number of configurations of modules before coming up with the final plan. For the New Orleans house, the modular build means the structure will easily disassemble for moving to another location after the fair.

The home is built of 20-ft. modules that form a three-level, 7,500-sq.-ft. building. The house even includes a robot which can carry a mop and tell prerecorded jokes.

On the serious side are exhibits of energy-saving lighting devices and circulating fan systems designed to make one wood stove a whole-house heater. Triple-insulated glass with chemically treated inside panes will demonstrate a fast-growing, popular technology: efficient windows that let in full sunlight but keep heat-producing infrared rays from escaping back out through the window.

Do America's best energy houses indicate a change in design of new housing? California architect Floyd Kittle, speaking at an M.I.T. solar energy symposium, said the next 10 years will see a revolution in energy-efficient houses.

"We're building-in smaller living areas, and that alone will make for more efficient energy homes," he said. "But more important, I think the time has passed for new housing that doesn't pay careful attention to both traditional and innovative energy technologies. A homebuilder figures the monthly utility bill into his dreams of a perfect living space."

Saunders agrees with most of Kittle's remarks. But he adds wistfully, "I hope people planning a new home will avoid the temptation to squander their money on flash. I hope they'll take a practical view of building a new home."

FM

(Note: Norman Saunders invites inquiries on his solar home designs. For information, send a stamped, self-addressed envelope to: Saunders, Kendall Common, 15 Ellis Rd., Weston, Mass. 02193.)

COLOR FOR TINY TVs

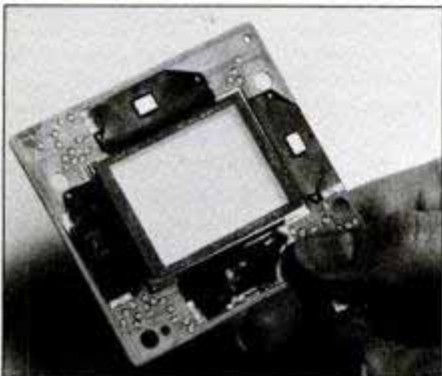
(Continued from page 73)

recorder. The Elf is 3 inches high by 6 1/4 inches wide by 1 1/8 inches thick, and weighs 1.1 pounds with the batteries in place. The Seiko TFT is 3.15 by 6.3 by 1.22 inches and is less than a pound. The Epson uses a single fluorescent bulb mounted at the top of the screen. The Seiko model has a pair of fluorescent bulbs mounted at the screen's two sides.

Conventional battery life is rated at about five hours for a set of alkalines. A collapsible monopole antenna is attached to the top of the set. Controls include on-off/volume, brightness, continuous-dial tuning and a light on-off switch.

Color and tint controls on the side of the set are difficult to adjust—made that way on purpose to prevent accidental changes in settings.

An easel snaps out of the back to support the set on a tabletop, and there are four jacks on the side: 7.5 volts d.c. input (from the a.c. or cigaret-lighter



Flat screen is sandwich of minicomponents.

adapter), earphone jack, and inputs for video and audio signals from such external sources as a videocassette.

We first turned on the Elf in the back seat of a Chicago taxi on the way to O'Hare Airport, and understandably the picture kept tearing and disappearing in a mountain of interference as the vehicle drove between tall buildings. But in a stationary environment, the Elf's reception was exceptionally good.

Tuning is continuous, but it wasn't hard at all to get a station centered on the dial to provide pleasing results.

Picture quality was remarkably good and crystal-clear for a screen that's slightly larger than a book of matches. But the viewing angle is very critical. Best results were obtained by watching it head-on. This is because the transmitted image light is polarized, and if you move off-axis, you lose it. With a video cassette recorder plugged into the video jack, we found that the results were pretty much as you'd expect—crisp, sharp pictures. **FM**

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R.S. Clark, Springfield, Ohio

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Stephen Schultz, Orangeville, Penna.

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JAY HEDDEN — Editor of WORKBENCH Magazine

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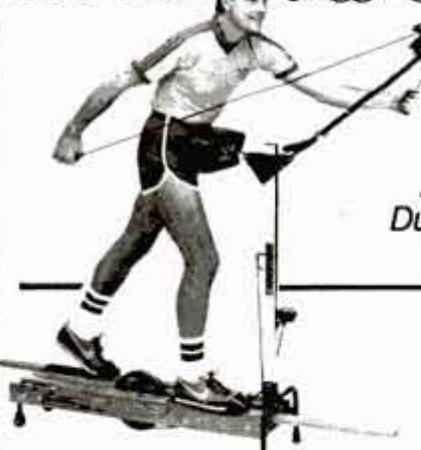
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SPACE STATION

(Continued from page 67)

ments creating new jobs, new opportunity and greater prosperity. Bringing into full play America's greatest asset—the vitality of our free enterprise system—will do more to spur development of space for the benefit of man than any of us can now imagine.

In accepting the vast challenge of space, the frontiers of knowledge, again, will be pushed back. At the same time, advancing technology will provide rewards to our country and mankind as a whole. The connection between scientific research, technology programs and a vigorous economy is easy to see, yet hard to measure.

There can be little doubt that the economic benefits of our space program have far outweighed the cost. Whole new industries—computers, solid-state electronics, medical electronics and communications satellites, to name a few—were spurred by activities related to our space program. New jobs, greater productivity and economic growth can be traced to our national investment in high technology.

More directly, our Space Station program has and is playing a major role in keeping our aerospace industry and broad segments of nonaerospace industry competitive and efficient. By stimulating the development of new technology, just as previous technological programs of this size have done, our space-related industries pull other enterprises into the future by the weight of their own innovation.

And let us remember that space exploration and utilization is a powerful stimulus to our young people to study science and engineering. This new blood will not only serve the space program, but these same young people will also focus their talents, enthusiasm and creativity on other challenges we face as a nation.

The Space Station will be a place where important things will be accomplished. It will give us capabilities that we do not have now. For example, we will be able to produce extremely pure materials that cannot be made on Earth. Medicines will be manufactured that will help us cure conditions like diabetes and diseases like cancer. We will be able to refuel and repair satellites, extending the useful life of expensive spacecraft. And this is just the beginning.

We have dreamed, we have dared, and we have succeeded. Once again, we are rising to the challenge and we will succeed. The peaceful use of space promises great benefits. America and her friends will reap those benefits and, together, build a better world for our children and our children's children. **PM**



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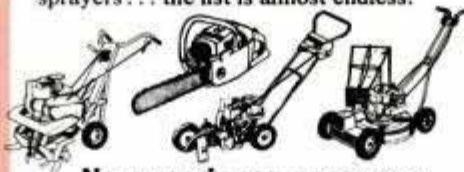
In just a short time, you can be ready to join one of the fastest growing industries in America...an industry where qualified men are making from \$10.00 to \$15.00 per hour...and that's just for labor. Parts, engines and accessories add even more to the profits.



Because the small engine industry has grown so quickly, an acute shortage of qualified Small Engine Professionals exists throughout the country. In fact, it's not unusual for a good small engine man to be three to four weeks behind in the summer and at least a week behind in the winter. When you see how many small engines are in use today, it's easy to understand why qualified men command such high prices—as much as \$17.50 for a simple tune-up that takes less than an hour!

65-million small engines are in service today!

That's right — there are over sixty-five million 2-cycle and 4-cycle small engines in service across the U.S.A. That's the official count from the Engine Service Assn., and new engines are being built at a rate of one-million per month! With fully accredited and approved Foley-Belsaw training, you can soon have the skill and knowledge to make top money servicing these engines. Home-owners and businessmen will seek you out and pay you well to service and repair their lawnmowers, tillers, edgers, power rakes, garden tractors, chain saws, mini-bikes, go-carts, snowmobiles, generators, snowblowers, paint sprayers... the list is almost endless.



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PM'S TIME MACHINE

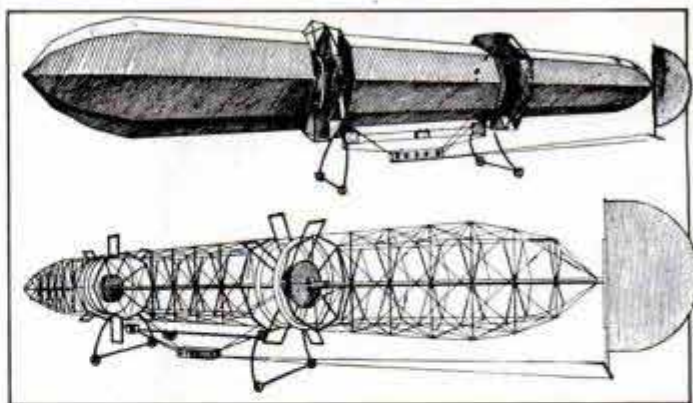
75 YEARS AGO: September 1909



Fireboats run on electricity.

New fireboats

Chicago's two new and powerful fireboats are controlled from the pilot house in the same manner that a motorman controls an electric car. The power plant consists in reality of two duplicate plants, which can be run alone or together, each unit consisting of a steam turbine of 660 hp., a 200-kw generator, a 4,500-gal.-per-minute force pump, and a 250-hp electric motor. The energy of the steam turbines is converted into electricity to propel the boat, while the generators also drive the pumps.



Heavy dirigible

The airship shown above is heavier than air, the lifting power of its gas being only sufficient to raise nine-tenths

of its weight. It flies on its propellers. The motors are suspended just under the propellers in the cab of the airship.

50 YEARS AGO: September 1934



Next: a long-range race car.

Long-range racer

How would you like to make a motor trip across the continent and back in less than three days? Automotive engineers in Europe are toying with ideas no less fantastic since breakdown tests with a Hotchkiss motor have shown that this engine is capable of such a performance if the car can be built to go with it. This motor on the test block ran for 52 hours and 46 minutes at 4,000 revolutions per minute, a speed which would have carried the car 5,000 miles. Fuel would be carried in in-body tanks.

Filling a vacuum

Giant "vacuum cleaners," designed to unload dried coconut meat from ships at the rate of 58 tons per hour, have been demonstrated on the Pacific Coast. The machines, which are built on the same principle as the familiar household vacuum cleaner, speed up the job of unloading cargo from the holds by suction. The pulverized cargo is piped to a train of miniature box-cars. In addition to reducing off-loading time, the equipment allows shippers to remove cargo with fewer workers.



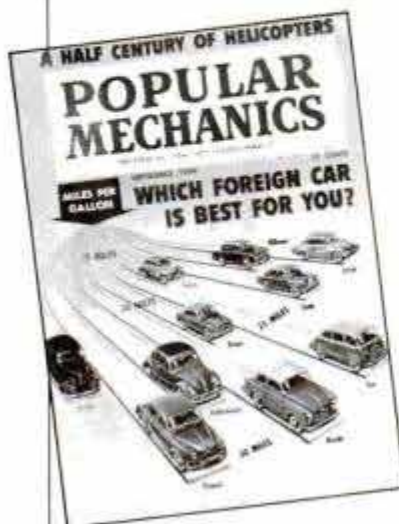
New hand router

Amateur craftsmen may decorate their work in a professional manner by using a simple hand router that works equally well in wood, leather and linoleum. It is especially suitable for simple inlay work.

25 YEARS AGO: September 1959

Owners' report

We surveyed 2,000 owners of 10 representative foreign cars. Included in their advantages are lower first cost (sometimes as much as \$600 under the cheap American cars), lower operating cost (25 or more miles per gallon overall), a minimum of petty "bugs" that often accompany a more complex machine, a smaller dollar loss in depreciation each year, easier parking, more nimbleness in traffic, more room in the garage, and an opportunity once again to putter around with the mechanism yourself.



We test high-mileage imports.

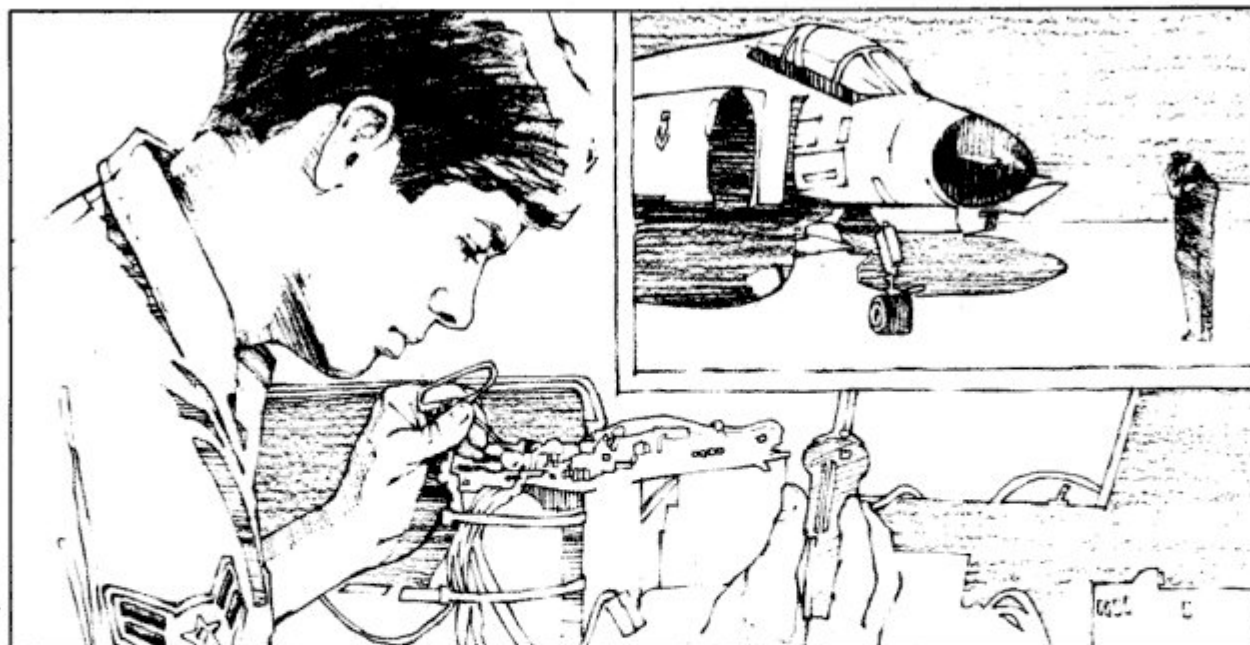


Saluting Sikorsky

Igor Sikorsky's thin, drooping moustache, gentle eyes and his famous fedora hat give him more the look of a pensive professor than a canny genius with a genuine love of people, who has more practical aeronautical engineering tucked away than any man alive. Fellow workers, however, are well aware of the stubborn tenacity and lionhearted courage with which he can tackle an idea. He's used to dire predictions about his ventures. **PM**

No-tube radio

An all-transistor car radio has been introduced in Switzerland.



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Reglazing windows

Replacing a broken pane of glass is a relatively straightforward task, but it can be dangerous. To begin with, always wear tough workgloves when handling the broken shards and the new glass. Also, because the glass is installed on the exterior side of the window, it's best to remove the sash and make the repair on a bench rather than from a ladder.

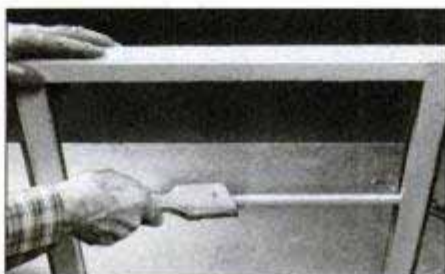
The steps shown apply to wood frame windows. On older metal frames the procedure is basically the same but spring clips instead of glazier's points are used to secure the glass. If you have a newer aluminum sash, replacement usually involves a rubber or plastic retaining gasket, not glazing compound. For all types, cut the glass $\frac{1}{8}$ in. shorter—in both dimensions—than the opening.—Rosario Capotosto



Remove loose glass pieces; then use an old but sharp chisel to chip off the hardened glazing compound. Do not gouge the frame.



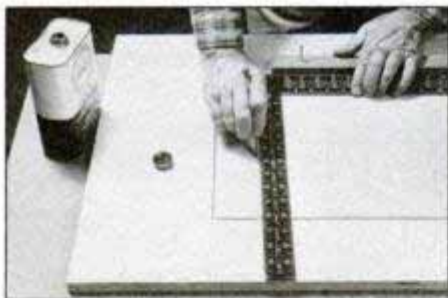
If the compound is too hard to chip away easily, use a hair dryer or flameless heat gun to soften it first. Be careful not to char the sash when using the heat gun.



Once the bulk of the compound and all the glass have been removed, use a paint scraper to clean the muntin and frame rabbets. For best results scrape down to bare wood.



Apply a light coat of linseed oil to the bare wood so it will not absorb oil in the fresh compound. Otherwise, new compound will dry, lose flexibility and crack sooner.



Score the glass in one quick stroke using a glass cutter and metal square. Butt glass and square to stop board as shown, and lubricate cut line with touch of kerosene.



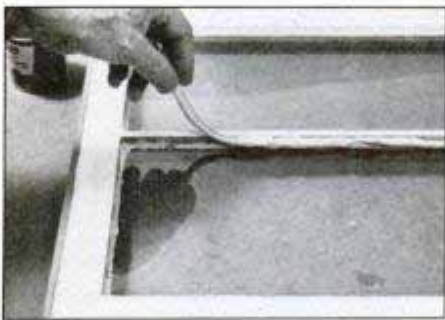
Move the score line over the edge of the cutting surface and snap the glass with a quick downward motion. Wear gloves when handling the glass to prevent cuts.



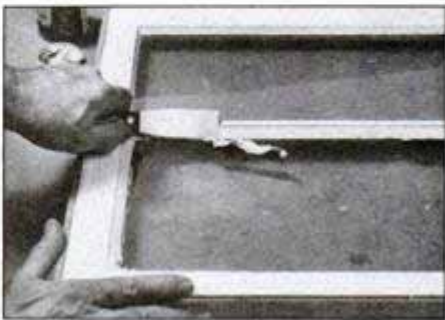
Apply a $\frac{1}{8}$ -in. bead of compound across all rabbets to form a tight interior seal and to act as a cushion for the glass. Lay the glass in place; press evenly into compound.



Secure glass with glazier's points pushed into the muntin and sash frame every 4 in. The push-type points shown are much easier to use than the flat triangular points.



Roll fresh compound between your hands to form an approximate $\frac{3}{8}$ -in.-dia. "rope." Lay the rope into the corner formed by the glass and frame, then press it into place.



Draw a flexible putty knife over compound to form a neat bevel. Allow compound to dry one week before painting, then let paint overlap glass $\frac{1}{8}$ in. for a good seal.

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- 8421 Chevy Racing Engine, prep small blk \$10.95
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- 9538 Chevy Big-Block, How to Rebuild \$8.95
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-



10. Loosen the shingles on the upper half of the roof cutout to facilitate the sliding of the roof flashing into place.



11. After sliding the roof flashing into place, you may have to trim the shingles a bit to center it on the opening.



12. Insert a section of chimney through the flashing fixture and return to the attic to check for proper alignment and clearances.

READY-MADE CHIMNEYS

(Continued from page 32)

when the configuration is straight up, without elbows. For indoor runs, double-wall solid-packed or triple-wall air-insulated chimneys are both good choices. For long outdoor runs, especially in colder climates, most experts recommend double-wall solid-packed chimneys. In any chimney exposed to cold outdoor temperatures, condensation of moisture and creosote will be greater than in indoor chimneys.

All chimneys installed for wood and coal stoves, fireplaces, oil burners and furnaces should have a Class A rating. Class B vents are intended only for use with gas appliances and should never be used with oil or solid-fuel heating devices.

Most state and local building authorities allow only chimney systems that have been tested and listed to be used. Many insurance companies specify chimney types and performance requirements affecting eligibility for coverage. In addition, model building-code



13. Besides checking for clearance, make sure no chimney section joints will be located inside a penetrated ceiling or wall.



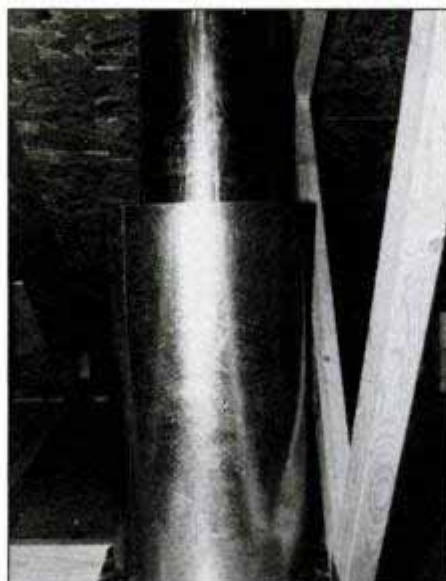
14. If locking bands are required according to the assembly instructions of the chimney manufacturer, install them.



15. Add remaining chimney sections, rain cap and locking bands. Plumb the chimney, then caulk and nail the flashing.



16. Seal shingles with roofing cement. Install rain collar. Seal it and the nailheads on lower flashing with silicone caulk.



17. Install insulation shield. Since none was available for this chimney, one was made from 26-ga. round galvanized duct.



18. Slide the stove into place, install the stovepipe connector assembly and secure the pipe joints with sheet-metal screws.

organizations such as the International Conference of Building Officials (I.C.B.O.), Building Officials and Code Administrators of America (B.O.C.A.) and Southern Building Code Congress International (S.B.C.C.I.) also set chimney use guidelines. Before selecting and installing a factory-built chimney, check with local building and fire officials and your insurance company to find out which chimneys are legal and insurable for your specific application.

U.L. or U.L.C.

All the groups mentioned rely on test data and standards as promulgated by Underwriters Laboratory (U.L.) or Underwriters Laboratory of Canada (U.L.C.). Labeling on a chimney system indicates that the product has performed satisfactorily under specific tests of mechanical and thermal integrity and durability.

Chimney systems bearing the U.L. 103 label have been subjected to a temperature of 1,000° F. for a sustained period, then 1,400° for one hour, and 1,700° for 10 minutes. To gain the 103 listing, the chimney sample tested must survive without deterioration and may not allow the temperature of surrounding combustibles (usually a minimum of 2 in. away) to rise above a safe level. To gain a U.L. 103HT listing, chimney units must meet a higher standard. This high-temperature test involves pushing the upper limit to 2,100° F. for three 10-minute periods.

The Canadian high-temperature test (U.L.C. 629M) is most stringent of all, with continuous temperatures of 1,200° F., an hour at 1,700° and three half-hour runs at 2,100°.

Selecting a chimney

It is tempting to translate these standards into an informal rating system of good, better and best, but that would not be particularly useful for selecting the best chimney for a specific application. It is better to select on the basis of what is permitted by law and insurance regulations, how the system will be used and maintained, and costs related to purchase and installation.

If the chimney is for use only with a wood stove or fireplace, consider the fact that flue temperatures exceed 1,700° F. only when a serious chimney fire occurs. If a wood heating appliance is used only as the manufacturer recommends, and if the chimney and vent connection are inspected and cleaned frequently, there is no need for a chimney that exceeds the performance standards of U.L. 103. Chimneys meeting test standards U.L. 103 HT and U.L.C. 629M add extra increments of reserve tolerance that you must pay for.

Whichever type of chimney you choose, be sure to follow the manufac-

turer's installation instructions implicitly. That is the only way to ensure that the product will work as it was meant to and to benefit from the safety features built into the unit. In all of the studies of fire losses related to metal chimneys over the last 10 years, improper installation was found to be the cause in 70 to 80 percent of all cases reported. As a stipulation for listing, each manufacturer is required to provide complete instructions for installation and use.

Metal chimneys are not and never were intended to be zero-clearance devices. This has been a great misconception about prefabricated metal chimneys. On the contrary, most units require a minimum of 2 in. of air space between the outer wall of the chimney and any combustible material. Where a chimney must penetrate a wall or floor, special components such as wall shields, spacers, fire stops and joist shields must be used. If you have any questions regarding clearance and shielding requirements for conditions not covered in the instructions, clarify them with your dealer before you install the chimney.

Penetrations of insulated ceilings and roofs pose special problems. Regardless of whether the insulating material is rated as "noncombustible," it may not touch the chimney nor occupy any part of the air space specified for clearance around the chimney.

Insulation shields

Since early this year, manufacturers have been required to provide approved insulation shields to hold batts, mineral wool, blown cellulose and other types of insulation away from prefab chimneys. If the chimney you select was manufactured prior to 1984, you can make a serviceable shield from galvanized round duct pipe with a diameter at least 4 in. greater than the overall outside chimney diameter. The shield should be installed in a way that creates at least 2 in. of air space around the chimney's outer walls and should extend at least 6 in. above the insulation. If insulation is installed after a chimney has been put in place, make sure the installer understands the chimney's clearance requirements and maintains the integrity of the shields.

Chimney support components must be installed exactly as the manufacturer instructs so that there is no chance of sagging or tipping. The overwhelming majority of house fires related to the use of metal chimneys result from insulation being packed around the chimneys.

While maintaining specified clearances is important for fire safety, the practice is also critical for ensuring the product's long-term durability. The air-space surrounding a chimney is part of

(Please turn to page 122)



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READY-MADE CHIMNEYS

(Continued from page 121)

the design and allows heat to dissipate at a calculated rate. If a metal chimney remains overheated for prolonged periods, it can lead to metal fatigue and premature deterioration.

Inspection and maintenance

The accompanying photos illustrate the basic procedures for installing a factory-built chimney. Once installation is completed, the job of maintaining the chimney to keep it safe and functioning as it was intended begins. If wood or coal is burned, fires must not be allowed to smolder for long periods of time. Low fire conditions promote rapid creosote buildup.

If a solid-fuel heating appliance is used continually, the chimney and stovepipe should be inspected at frequent intervals—as often as twice a month—to check for creosote buildup and restrictions of the flue.

If you find sooty or flaky deposits as thick as 1/4 in. or a glazed coating 1/8-in. thick, clean the chimney and stovepipe. Metal chimneys should be cleaned with brushes properly sized for the job.

Never clean a metal chimney with chains or heavy metal devices that can damage the flue liner. Take care not to catch brushes or cleaning rods on the liner joints. Many metal chimney manufacturers warn against the use of chemical cleaning agents. If you have any questions about the best way to clean a factory-built chimney, consult the instructions or ask your dealer.

A wisely chosen, properly installed metal chimney that is inspected frequently and cleaned when necessary can perform safely and efficiently for many, many years. **FM**

MANUFACTURERS FACTORY-BUILT CHIMNEYS

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Condensation Engineering Corp., 3511 West Potomac Ave., Chicago, Ill. 60651

General Products Co., Box 7387, Fredericksburg, Va. 22404

Hart & Cooley, 400 East Eighth St., Holland, Mich. 49423

Jacks Evans, 4427 Geraldine Ave., St. Louis, Mo. 63115

Madison Industries Ltd., 1511 Valour Rd., Winnipeg, Man., Canada R3E 2X1

Metal-Fab, Box 1138, Wichita, Kan. 67201

Oliver Macleod Ltd., 155 Edward St., Gravenhurst, Ont., Canada POC 1G0

Preway Inc., 1430 Second St., Wisconsin Rapids, Wis. 54494

Security Chimney, 2125 Monterey, Laval, Que., Canada H7L 3T6

Selkirk Metalbestos, 2 Robert Speck Pkwy., Mississauga, Ont., Canada L4Z 1H8

Simpson Dura-Vent, Box 1510, Vacaville, Calif. 95688

Van Packer, Box 307, Buda, Ill. 61314

White Metal Products, 5601 Leeds St., South Gate, Calif. 90280



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HOME INSULATION

(Continued from page 88)

ventilation. And, make sure each rafter cavity is vented both at the soffit and ridge. The combination of soffit and gable—or ridge—vents should yield 1 sq. ft. of free vent area to the outside for each 150 sq. ft. of attic floor space; 1 to 300 with a good vapor barrier in place. If you want to leave the attic unheated, install the insulation between the attic floor joists. For this, mineral fiber batts, blankets and loose fill all work, as does the cellulose loose fill. If some insulation is in place, with a vapor barrier on the warm side, then use the unfaced batts, blankets or loose fill materials. A second vapor barrier would trap moisture between the insulation layers and ruin the effectiveness of the lower layer.

Your goal is to fill the area between the joists to the top of the joists. Then if you want to add more, install unfaced batts or blankets across the top of the joists. This method gives the benefit of deeper insulation, and covers the tops of the joists which greatly reduces the heat loss through them.

When considering loose fill materials, keep in mind that there have been some problems with contractor-installed jobs in the past. Some contractors have used

too much air when blowing the material into place. The required inches per R-value were there, but not the required weight. The proper weight is printed on the product wrapping and should be checked whether you do it yourself or have it done.

When doing any attic insulation job, remember that the National Electric Code warns against covering recessed light fixtures or motor-driven devices—such as exhaust fans—with insulation. It mandates a 3-in. clearance on all sides of the units, which protects them from overheating and possibly igniting surrounding framing members. If you are installing loose fill, be especially careful. Place a sheet-metal frame around the fixture to maintain the proper 3-in. clearance.

Walls

Retrofitting above-grade wall cavities is a high-ticket item. Many experts say you should insulate the attic, weather-strip doors and windows, and caulk all cracks before even thinking about adding insulation to enclosed walls. The product options include blowing either loose fill or foam insulation. Because both require specialized and expensive equipment, this job is generally the province of insulation contractors.

Applicators first bore holes through

the siding and sheathing between the wall studs. Then the insulation is either blown or, in some cases, poured into the cavities until they are full. One chronic problem with loose fill material is its tendency to settle over time and leave areas at the top of the cavities uninsulated. Foam, on the other hand, does not settle. This improves its insulating effectiveness and radically reduces air infiltration around such fixtures as electrical switch and receptacle plates.

The problem with foam is product selection. In the past, the most common type was urea formaldehyde, but it was banned by the Consumer Product Safety Commission (CPSC) in April 1982 because it found that formaldehyde was a potential carcinogen. Last year, a federal judge overturned this ban even though the CPSC has not changed its position on the potential hazards. A relatively new foam, called poly urea, is a good substitute. It's made of urethane, not formaldehyde, and yields an R-value of 11.3 at a 3½-in. thickness.

Rigid insulation boards

Rigid insulation boards fall into two major categories, called styrenes and urethanes. The styrenes are made of either expanded or extruded polystyrene. The urethanes are made of either polyurethane or of polyisocyanurates.

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All Kent products incorporate a unique combination of futuristic design and technology, high quality materials, unsurpassed workmanship and state-of-the-art engineering.

A combination which makes Kent one of the most practical, efficient and effective wood burners found anywhere in the world. So much so that a panel of independent judges voted The Tile Fire **Space Heater Of The Year** in an award program sponsored by Wood 'n Energy Magazine, one of the industry's leading trade publications.

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Wood 'n Energy Magazine
Space Heater Of The Year

The Tile Fire

The Log Fire

The Sherwood

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All Kent stoves  listed.

future looks.

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Both types of boards come in a variety of sizes, as shown on the chart, and all can be used as either interior or exterior sheathing. However, they are combustible and do give off toxic gases when burned. For this reason, they must be covered with a fire-resistant barrier, such as 1/2-in.-thick gypsum board, if they are used as interior sheathing. This limits their practical utility to interior sheathing in an unfinished basement. The cost of the gypsum board installation and finishing, when combined with the cost of the insulation, represents a substantial remodeling investment. In most cases, the payback period would be very long.

But it's a different story when they're used as part of a re-siding project. Because the boards are installed over the existing sheathing, they insulate the entire wall including the framing members which cavity-fill insulations do not do. The boards also cut down air infiltration dramatically.

Some of these boards are available with a foil vapor barrier attached, which may cause a problem. When used as exterior sheathing, this built-in vapor barrier may tend to trap moisture within the wall cavities instead of letting it pass through. The manufacturers, however, claim that the insulation keeps the cavity warm enough to prevent any

vapor from condensing behind the boards. Of course, if you already have an adequate vapor barrier on the warm side of the wall, the moisture penetration into the wall cavity should be effectively controlled.

Another thing to consider when selecting the extruded polystyrene and the urethanes is to make sure you buy the product based on its "aged" R-value, not the "just manufactured" R-value. (This does not apply to the expanded polystyrene; it has only one R-value.) These products are manufactured with a blowing agent that is trapped in the board's cells. Over time some of this seeps out of the cells and is replaced with air, which reduces the product's effectiveness. The listed aged R-value compensates for this process.

All these boards can be successfully installed below grade on the exterior of foundation walls. But when using the polystyrenes for this application, cover them completely with siding to protect them against prolonged direct exposure to sunlight which can degrade the chemical structure.

Floors

Insulating floors over an unheated basement or crawl space is best done with faced mineral fiber batts or blankets. Staple them in place with the

vapor barrier on top, then support the insulation with galvanized screen or wire nailed to the bottom of the joists.

This application does not protect the insulation itself from moisture that may come up from the ground in crawl spaces. To do the job right, the exposed ground must be covered with a 6-mil-thick polyethylene vapor barrier. The crawl space should have opposite-wall vents that total 1 sq. ft. for every 1,500 sq. ft. of ground area.

Indoor air quality

The newest topic in energy-related research centers is on the quality of air inside our homes. The issue is: Do the steps people take to cut fuel bills by making their homes "tighter" come at the expense of increasing indoor pollutants? The list of possible pollutants ranges from formaldehyde to combustion gases. One area of particular concern is with radon gas, a decay product of uranium, which all soil contains to varying degrees. It seeps through porous or cracked foundation walls and is thought to cause lung cancer.

In the past the natural exchange of air between the inside and outside of the house dissipated the gas. Many houses had one or more complete air changes per hour (ACH). But today's

(Please turn to page 129)

What sets a Kent stove apart from others is a scientific combustion system that redirects carbon rich gases, normally lost up the chimney as smoke, down through the firebed and up into a secondary combustion chamber where complete combustion occurs.

The result is a more efficient and thorough burning of the wood, producing maximum heat output.

The same process which creates better performance, also eliminates many of the naturally occurring pollutants caused by wood burning.

In fact, this combustion system has passed some of the most stringent emissions and efficiency testing yet devised without the need for a catalytic system.

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Easy clean vitreous enamel finish.

Fingertip control.

High quality cold-rolled steel.

Cool air is circulated over the firebox and returned to the room as hot air.

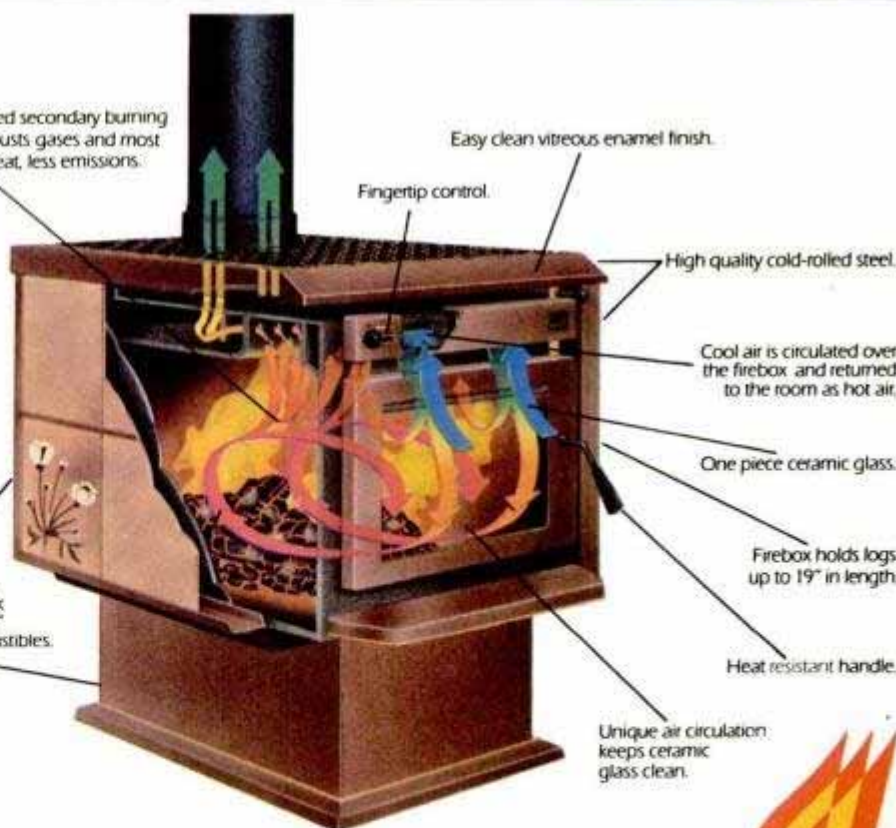
One piece ceramic glass.

Firebox holds logs up to 19" in length.

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Double walled back and base allows 11" clearance to combustibles.



a clean approach to wood burning



KENT

future logic.

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BUTCHER BLOCK

(Continued from page 79)

3 Spline joint

The spline-reinforced joint is one of the easiest to cut and assemble, yet it produces one of the strongest butcher blocks. Note that 1/4-in. mahogany plywood is used for the splines because the inner plies run crosswise and resist splitting. Start by cutting 3/8-in.-deep grooves in both sides of each wood member using a 1/4-in.-wide dado blade on a table saw. Don't be concerned with cutting the grooves in the exact center of the piece. It's more important to keep the same face of the piece against the saw fence when cutting both grooves. Simply flip the piece end for end so that the grooves will match, centered or not.

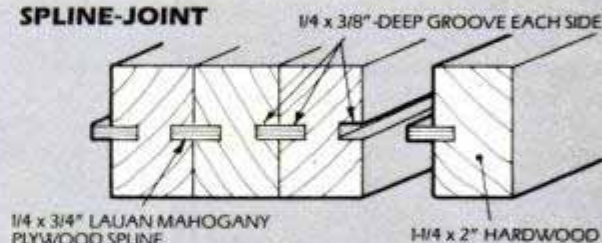
There are two ways to assemble spline-joint butcher blocks. Glue the splines into one side of all the pieces and then assemble the top, or build up the butcher block progressively by adding one component at a time.



Splines are visible on end grain (above). Cut the spline grooves on a table saw (right). Feather-board applies side pressure.



SPLINE-JOINT



4 Nail pins

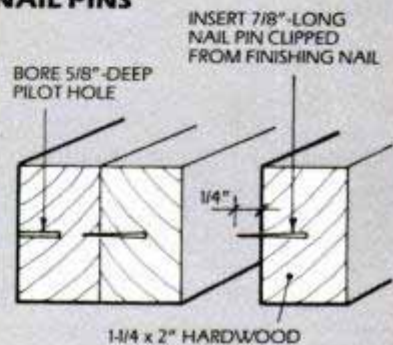
Short sections of finishing nails are used to align wood members and prevent slippage during gluing and clamping. This is the technique used to make the kitchen cart butcher block.

Bore a hole near each end on one side of every wood member. Then insert a nail pin, blunt end first, into each hole. Clamp the pieces together so that the pin points make indentation marks. Unclamp the assembly, apply glue and reclamp driving the pins in fully.



Use bar clamps to drive nail pins into adjacent pieces. Note board clamped across the top to keep butcher block flat.

NAIL PINS



5 Glue joint

This tight-fitting joint is made with a glue-joint cutter on a shaper or on a table saw with a glue-joint molding



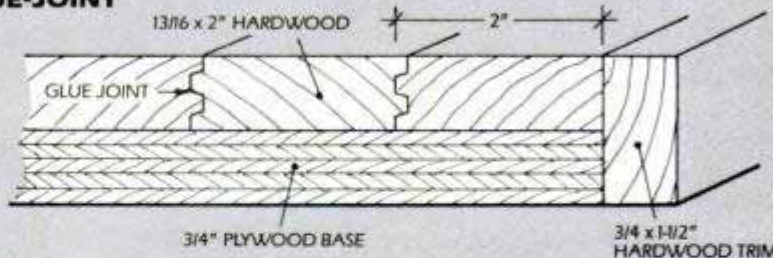
Cut the tight-fitting glue-joint on a shaper. Glue-joint molding cutter heads are also available for table saw use.

cutter head. Note that a 3/4-in. plywood base supports the butcher block.

Carefully adjust the cutter so that it's centered on the workpiece edge. Next, shape the edges of each board. Assem-

ble the butcher block onto the base with glue, then nail through the plywood and into the wood members. Add 1 1/2-in.-wide trim around the butcher block to conceal the plywood edge.

GLUE-JOINT



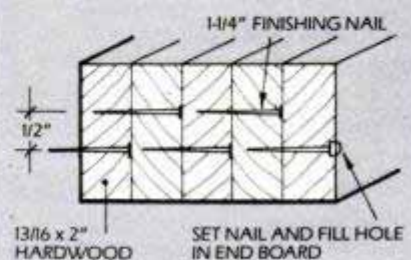
6 Direct nailing

The direct-nailing technique is used when making butcher blocks from boards that are less than 1-in.-thick. Bore pilot holes in each board about 6-in. apart. Then glue and nail one board to the next using 1 1/4-in. finishing nails. Be sure to stagger the nails so you don't strike a nail in the preceding board. Finally, clamp the assembled butcher block until the glue dries.



Direct-nailing technique is a quick and easy way to make a butcher block. Be certain to bore nail pilot holes first.

DIRECT NAILING

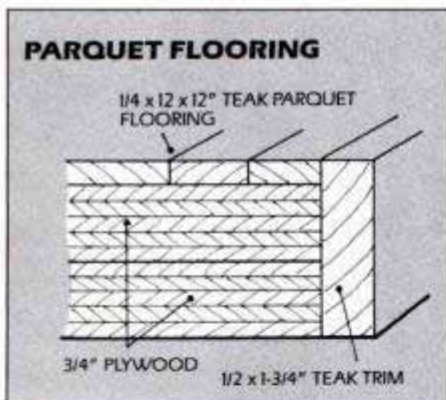


7 Parquet flooring

Hardwood parquet flooring is available in a wide variety of patterns and wood species which make attractive butcher blocks. Since most parquet flooring is only $\frac{1}{4}$ or $\frac{3}{8}$ in. thick, a base is needed to support the butcher block. Make the base from two pieces of $\frac{3}{4}$ -in. plywood. Glue the parquet to the plywood base with flooring adhesive. If teak parquet is used, as shown here, be sure to use an adhesive formulated specifically for teak, which is very oily. Complete the top by nailing on $\frac{1}{2} \times 1\frac{3}{4}$ -in.-wide hardwood trim to conceal the plywood edge. **PM**



Glue parquet flooring to a plywood base using the appropriate adhesive. Add a second plywood base for additional support.



HOME INSULATION

(Continued from page 127)

energy-efficient homes have radically reduced air infiltration rates, sometimes as low as 3 ACH.

The Colorado Research Institute has studied this situation closely and has reached a few conclusions. First, houses that have more than one ACH seem safe. But in tighter structures, people should consider installing air-to-air heat exchangers and should seal foundation cracks and pores with exterior latex enamel which can reduce the infiltration by as much as 73 percent.

Keep in mind that this problem is not directly related to insulation levels in your home. It's a question of air infiltration. **PM**

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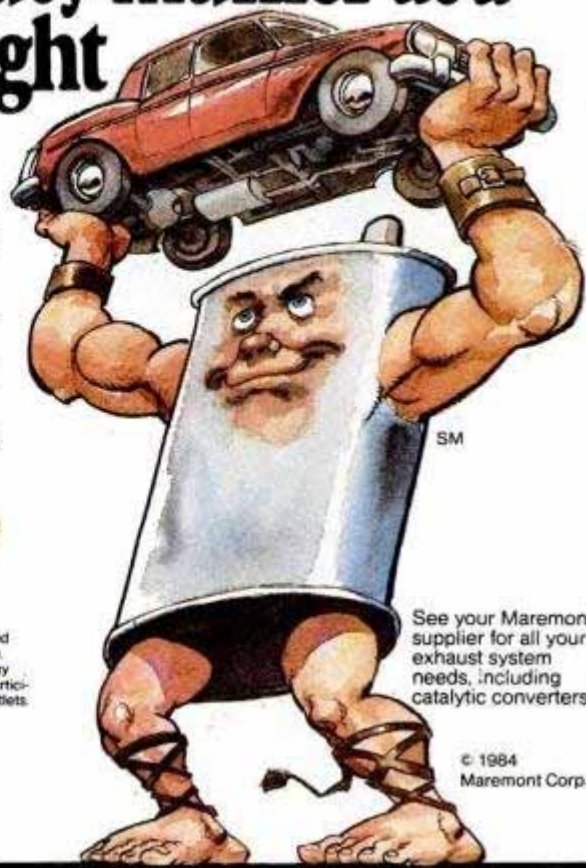
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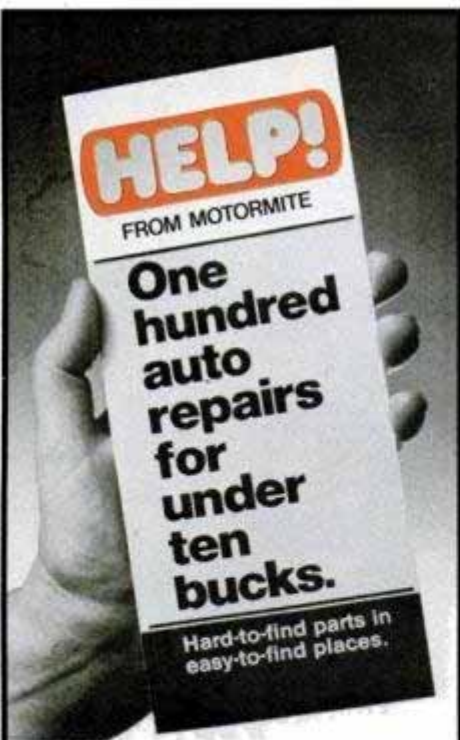
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HOME ENERGY WASTERS

(Continued from page 85)

seals the joint made by a glass or plastic panel and its frame in a door or window. Sealing these joints also reduces air infiltration.

ATTIC CHECKPOINTS



Areas often overlooked when applying insulation are the walls of an enclosed stairwell leading to the attic. Patches indicate that insulation has been blown in place.



Check the amount of insulation in the attic floor. If the floor is boarded, you can remove a board. Loose-fill insulation was blown under these floorboards.



The joint made by the chimney and attic floor should be sealed. When the crack is wider than $\frac{1}{4}$ in., you should stuff fiberglass insulation into the crack.

Checking doors and windows

Windows are often improperly sealed. Storm windows can protect against drafts, but before investing in storm windows, inspect and make needed repairs on your primary windows.

Besides seeing that windows are properly sealed with putty, caulk and weatherstrip, replace broken panes of glass. Other problems that result in heat leaks are: excess paint build-up that create gaps in the sealing system and broken sash locks.

In some cases, you may have to remove the sashes of conventional double-hung windows to make repairs. If they are badly damaged or deteriorated, you might consider replacing the sashes.

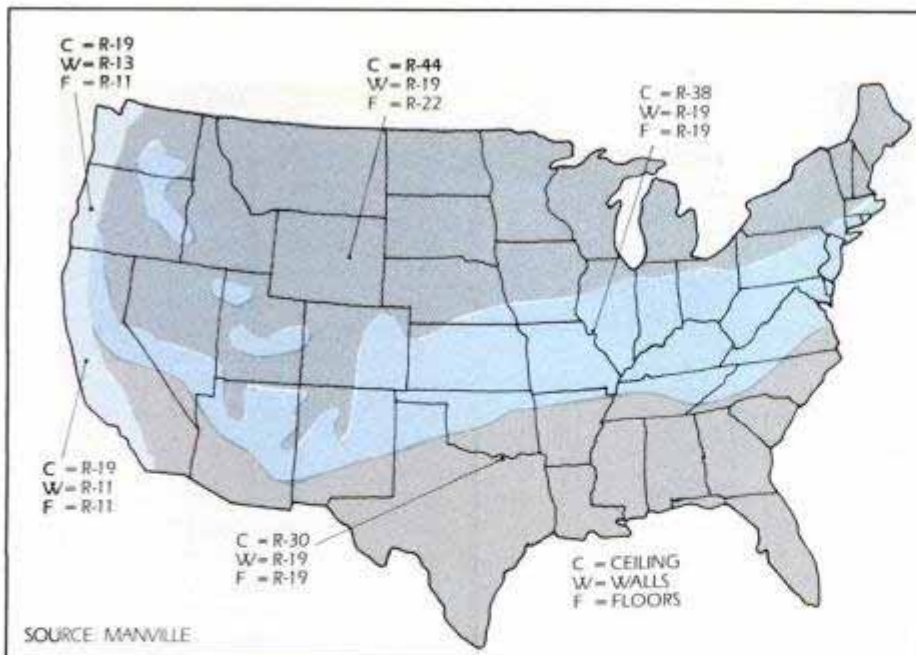
There are two broad categories of storm windows: Triple-track units are a combination of storm window and screen permanently installed on the exterior. Single-pane units of glass, rigid plastic or flexible plastic storm windows are usually installed during cold weather only and are inoperable.

Flexible polyethylene plastic sheet can be installed in a frame or simply tacked to furring strips that are screwed in place. The latter storm window is inexpensive, but must be replaced more often than the other types. However, the windows all are effective in reducing heat flow.

Exterior doors must be maintained much like windows to guard against air infiltration. Look for gaps around the door on sides, top and bottom. Gaps under the door can be sealed by installing a door sweep. Other gaps can be sealed by weatherstripping. Storm doors are expensive and may not be economical. A less expensive alternative is to install a glass or acrylic panel

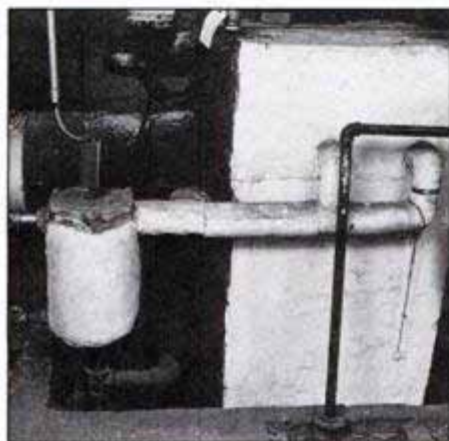


If gable vents are covered by insect cloth, keep it clean and unclogged. Always leave vents open. In winter this stops condensation, which limits insulation effectiveness.



For a broad idea of the insulation R-value needed in your home, use this map. For the exact recommendations, see a building supplier, public utility or your state energy office.

SOME CHECKPOINTS IN THE BASEMENT



Heating system should be cleaned and efficiency checked yearly. External hot water generator (left) needed boiler to operate in warm weather and was disconnected.



Don't judge the capacity of a water heater by tank size alone. Its recovery rate also is a factor. To conserve energy, insulate the hot water pipes and the tank.



Heat pipes should be insulated. However, these pipes have damaged asbestos insulation. Current recommendation is to leave material and repair with duct tape.

over the glazed area of the door during winter.

Checking home insulation

A final observation our energy auditor made on the exterior was to point out patched wall areas, which indicate blown-in insulation. If there were no visual clue, we would check for wall



The hole in the basement wall may indicate water damage and is a source of air infiltration. First, correct the water leak, then you should patch the hole.

insulation from inside of the house.

The next part of the audit took place in the attic, where we checked for insulation in the floor. You should spot-check the entire attic for insulation, as some homes have only partial coverage. A rule to follow to help you determine what areas should be insulated: All

(Please turn to page 132)

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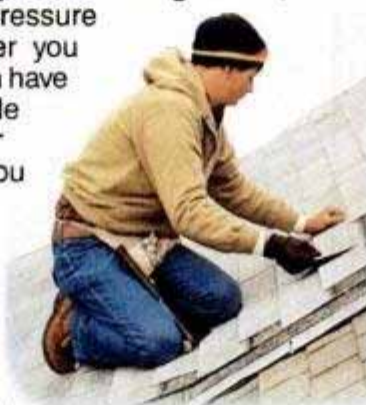
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HOME ENERGY WASTERS

(Continued from page 131)

heated areas of the house should be separated from unheated areas by insulation.

Insulation prevents the flow of heat out of or into the house. It is specified by R-value. The R stands for resistance to heat flow. The higher the R-value, the greater the insulating ability. For the approximate R-value needs of the attic, house walls and basement ceiling for your area, see the map on page 131. For R-values of various types and thicknesses of insulation see the chart on page 87.

Since heated air rises, the attic is the most cost-effective area to insulate in a home. In an attic with an unfinished floor, insulating involves placing batts parallel between the floor joists. If the insulation reaches the top of the joist, and more is desired, installing batts perpendicular to those already in position and over the joists reduces heat loss through the joist. A thorough installation without compressing the material and without leaving gaps is important.

If the floor is boarded over, you must remove some boards and use a stick to push batt insulation under the flooring. Or a contractor must blow-in insulation under the flooring.

Vapor barriers such as foil, plastic and impregnated kraft paper impede the flow of moisture, and will prevent or minimize condensation problems. The vapor barrier should face the heated area of the house, separating insulation from moisture leaving the house.

When you insulate an attic, it's important to provide adequate ventilation. Without it, moist, cold winter air may condense and introduce moisture problems. In summer, inadequate ventilation will cause additional heat in the attic. The standard ventilation needed for an attic with a vapor barrier is a minimum 1 sq. ft. of free ventilating area for each 300 sq. ft. of attic floor area. If there is no vapor barrier, you should have 1 sq. ft. of free venting area for every 150 sq. ft. of attic floor.

Vents should be provided by at least two vent openings, located so that air can flow in one opening and out the other. An effective methods for venting an attic is a combination of vents in the eaves and a continuous ridge vent.

One way to check for wall insulation from the indoor living area is to remove a switch plate on an exterior wall. Shine a flashlight around the switch box to see if there is insulation present. Better yet, make a small hole in an exterior wall (in a closet or other hidden location) and measure the insulation. Then patch the hole.

Adding insulation to the walls of an *(Please turn to page 136)*

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Yes, goes on to thrust itself so high, so fast that it actually towers over even a Japanese Red Maple, Cherry Tree or even the most graceful silky willow in such a ridiculously short time you will simply refuse to believe your eyes! Think of it!

GROWS MORE IN JUST ONE MONTH THAN MOST TREES GROW IN AN ENTIRE YEAR!

Because according to plant experts, Govt. scientists and Botanical Gardens who researched this wonder-hybrid... once established, you merely water it once-a-week, and be absolutely floored as, during its SUPER-SOARING growing season, it GROWS AS MUCH AS A FULL 1/2-FOOT WEEKLY AFTER EVERY TIME YOU WATER IT!

That's right! Grows higher than even a full grown Flowering Dogwood IN JUST ONE SINGLE SEASON! Grows higher than even a full-grown Star Magnolia IN JUST ONE SINGLE YEAR!

PLANT NOW—REACH OUT AND TOUCH ITS LUSH, THICK BRANCHES FROM YOUR SECOND STORY BEDROOM WINDOW BY THE NEXT SUMMER!

No doubt about it. There's just not another "instant" Shade Tree like it on this planet! Because thanks to this miracle of plant science, instead of spending a small fortune on a tree and then waiting half a lifetime for it to grow... get set for the garden-wonder of your life as this super-soaring hybrid rockets forth from a prize nursery-grown plant to a tower of roof-high beauty in less time than you ever dreamed possible.

GROWS IN VIRTUALLY ANY SOIL—REQUIRES NO SPECIAL CARE—SOARS INTO A MASTERPIECE OF BEAUTY IN JUST A MATTER OF MONTHS!

Best of all, unlike most trees that demand constant care, constant pampering... about the only thing you do after you plant this super-growing wonder-hybrid is water it and enjoy it! That's why leading botanical gardens... landscape artists... garden editors... can't stop raving about its indescribable beauty... its trouble-free care... its surging, towering growth.

Small wonder that leading experts hail it in the most glowing terms... recommended it again and again for homeowners who want a stunning display of beauty... both a wind and privacy screen and deep, cool shade... and with practically no more work than a thorough watering each week!

VITAL STATISTICS FROM LEADING EXPERTS

MATURE GROWTH SIZE: as much as 40 to 65 feet

MATURE SPREAD: as much as 30 to 35 feet

ZONE OF HARDINESS: Hardy from the deepest South to as far North as Vermont, Minn., Quebec, British Columbia. Winter Hardy in areas where temp. drops as low as 30 degrees below zero.

LIGHT NEEDS: Grows beautifully in Sunny location.

DECORATIVE MERITS: Highly recommended by landscape architects as beautiful decorative specimens for homes, parks, highways, etc., where exceptional fast growth and beauty are required. Perfect for fast screening and privacy.

RAPID RATE OF GROWTH: Experts report growth rates on specimen trees that measure up to 8 FEET THE VERY FIRST YEAR ALONE. That's more than most shade trees grow in 3... 4... 5... even 7 years! Yes, once established will grow ranch-house-roof high IN JUST ONE SINGLE YEAR, that's right!—The very next year after planting! Experts also report it soars an amazing 5 to 8 feet each year for YEARS thereafter. Naturally results are based on optimum growing conditions. Takes but 10 minutes to plant and normal care rewards you with a lifetime of beauty starting this very year.

CARE: Nothing special—just normal garden care. Water fully once weekly. Naturally resistant to most diseases, pests or insects.

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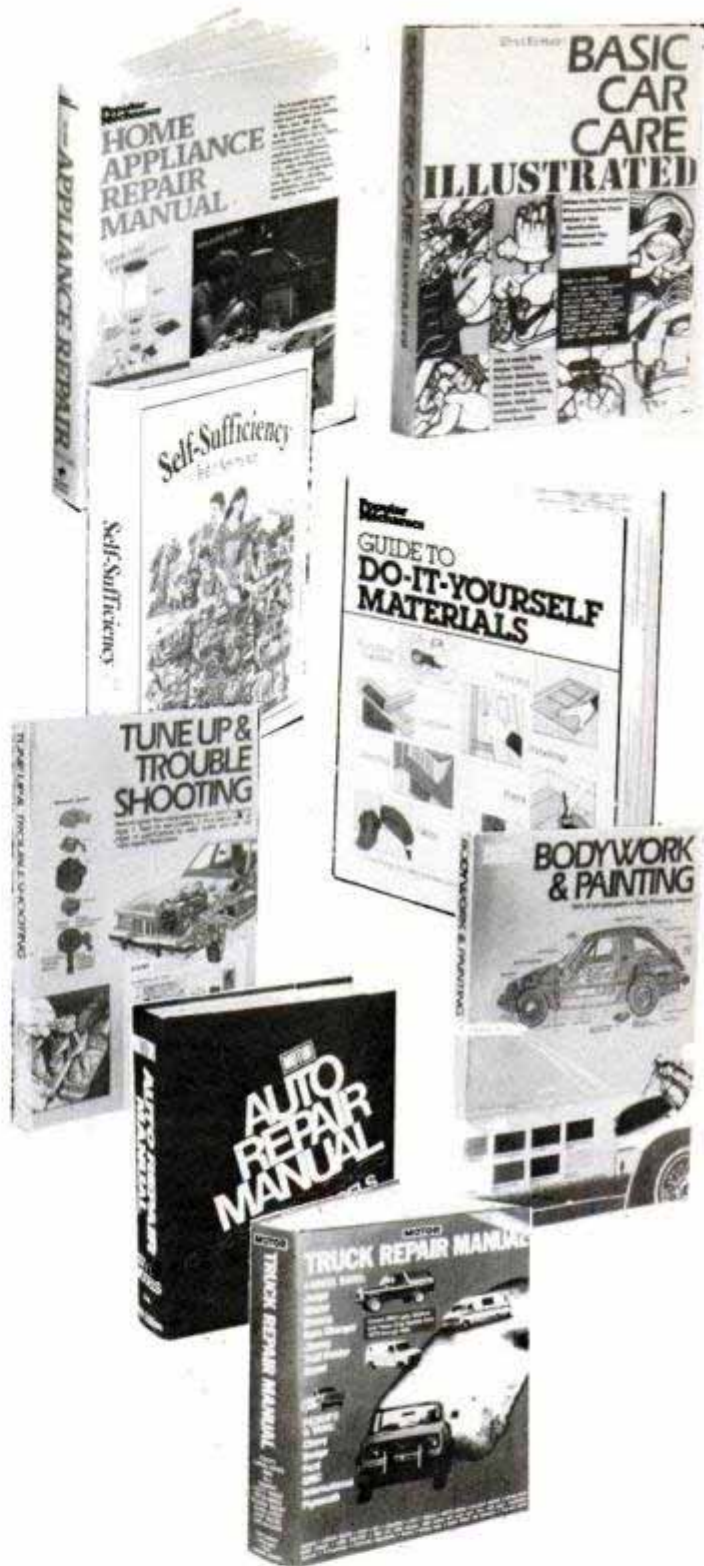
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HOME ENERGY WASTERS

(Continued from page 132)

existing home is costly and difficult to do thoroughly. A contractor uses special equipment to blow in insulation from holes bored in the walls. However, if you plan to re-side your house, installing rigid board insulation before applying siding is cost effective.

Insulation on the foundation of the house, whether you have a basement, crawl space or slab foundation, is often overlooked. Insulation applied on the house exterior to cover the exposed foundation and to extend 1 ft. below ground level is effective.

Other energy conservation measures for the foundation include caulking the sill plate where the sill meets the foundation blocks in a basement, and insulating the header above the sill plate.

If your basement is unheated, insulating the ceiling would make the floor of the first story much warmer, reduce heat loss and conserve fuel. If you do this, you must also insulate any heat or water pipes in the basement.

Maintaining heating systems

The energy efficiency of your home depends to a large extent on efficiently operating heating and cooling systems. In winter you should keep the thermostat at 68° F. during the day and 60° F. at night. However, the elderly, infants and people who are ill will require higher temperatures. A clock thermostat, which automatically lowers the heat after you're in bed and raises it prior to your rising in the morning, aids in your comfort and convenience. Check radiators or registers to see that they are free of dust and not obstructed.

If you have gas-fired heating equipment have the unit cleaned every two or three years by a service technician. From time to time you should check the burner plates to see if the unit is firing properly, because gas ports can become clogged with rust or dust. If you have a furnace, clean or replace the air filters once a month during heating season.

If you have oil-fired equipment you should have the equipment tuned-up and its efficiency checked annually. If the burner is not a flame retention head burner, consider replacing it. You should periodically inspect the burner for oil leaks.

Have your water heater—the second largest energy consumer in the home—drained periodically to remove built-up sediment. Insulate the hot water pipes and the water tank. On gas and oil water heaters, be sure to keep insulation away from the pilot light and controls. Repair faucet leaks as soon as they occur. Finally, consider installing flow restrictors in shower heads and faucets.

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SLICK SCOOTERS

(Continued from page 75)

For A New Kind Of Automatic Transmission, page 70, June '84).

The pulleys have weights and springs incorporated into them that change the effective pulley diameter when the speed changes. The drive pulley, up front, is at its smallest diameter when the engine is not running. When the engine is started, the crankshaft spins and the weights are thrown out from the center of the pulley. This squeezes the pulley halves together and the belt rides up, effectively increasing pulley diameter. Just the opposite occurs with the diameter of the belt on the driven pulley—it gets smaller. Pulley ratios are infinitely variable and the operation is as smooth as silk. Yamaha's V-belt, it should be noted, is still coupled to gears which are called primary and secondary reduction systems.

Broad luxury appeal

Both manufacturers have gone all out to convert more Americans to two-wheel transportation. So with the new scooters, they've gone the luxury route instead of trying to be spartan transportation for the emerging nations of the world. The Honda Elite, with its liquid-cooled 124-cc four-stroke engine, even

(Please turn to page 138)

The Great Scooter Trek

Sure, motor scooters might be great around-town transportation, but what about long-distance touring trips? "Out of the question," I thought, until Redwood City, Calif., scooter dealer Gordon Myers got me to try it for myself.

Myers' flock of intrepid scooterists range from teen-agers to retired couples. These enthusiasts may travel light, but "Leave nothing at home" could be their motto. Some find room to haul cabin-sized tents, four-burner Coleman stoves and two dozen eggs on classic Vespas.

On summer weekends the Vespaphiles eagerly tackle mountain ranges you might be reluctant to challenge with a V8-powered truck. My three-day tour with them began with a windswept bridge crossing of San Francisco Bay. I was never so terrified. But, after Gordon coached me to relax my grip on the P200E's short handlebars, the wobbly tracking stopped.

Our group continued across California's board-flat San Joaquin Valley and into the High Sierra foothills where the real revelations came. The Vespa's willing two-stroke engine pulled easily up the mountain grades where speed was limited by lines of straining motor homes anyway. With no apparent loss of power from the altitude change, the scooters soldiered right up over the 9,624-foot Sonora Pass.

The next day we pointed our Vespas northward down the back slope of the



Motor scooters are perfect vehicles for slow-paced, long-distance tours.

Sierra Nevada. On this leg, where temperatures rose to well over 100° F., we heard no complaint from the scooters. But the riders took to dipping, fully clad, in the clear streams of Mother Lode country.

My opinion of long-distance scooter touring? Get yourself in a slow-lane frame of mind and enjoy the ride that's never possible in a car.—N.S.M.

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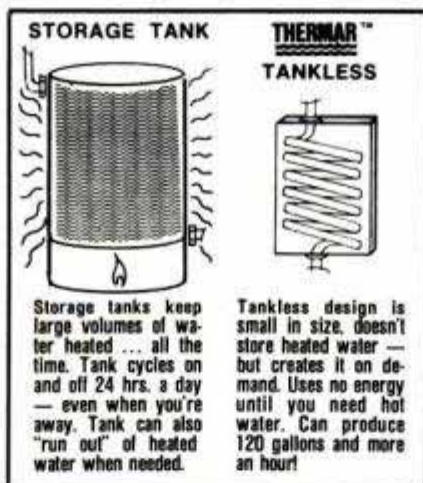
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SLICK SCOOTERS

(Continued from page 137)

boasts a heater to warm the rider's feet. Pegs for the passenger on this top-of-the-line model have been refined into fold-down floorboards. Add to this nice little touches such as a digital speedometer, a clock and pop-up headlight. The Riva 180 sports its own luxury touches, including an ignition keyhole that lights up with a press of the horn button.

Nothing is ever perfect, and these scooters do have their flaws. The top-of-the-line models from both manufacturers are heavy for their size. The Yamaha 180 is 253 pounds, the Honda Elite, 216 pounds—not as heavy as the old scooters but hefty enough to draw complaints from some women who rode them. Their weight is particularly noticeable when it comes time to put the scooters on their stands. Yamaha gets around this by providing an extra kickstand for around-town use.

The cowl in the front may seem like an excellent protective device. However, you can still feel the effects of



Honda Gyro trike has a frame jointed so front end leans in turns.

sudden blasts of wind despite this.

The new scooters are comparatively low-cost. Prices range from a low of \$398 for the Honda Spree to about \$1,400 for the Yamaha Riva 180. Both manufacturers offer full lines of accessories, including windscreens, front and rear baskets, mudflaps, trunks and body covers.

In England, there are scooter clubs and in Italy, they are raced for sport. In India and other areas of the Far East, people on scooters vie for road space with donkey carts and all manner of small automobiles. Here in the United States, motor scooters are scratching for a toehold and a fresh start—a sort of revival of an era past. But, with all the new technology, the good looks, ease of handling and low maintenance, they may eventually appeal to a bigger audience than even their manufacturers could have hoped for.

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

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

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

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

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

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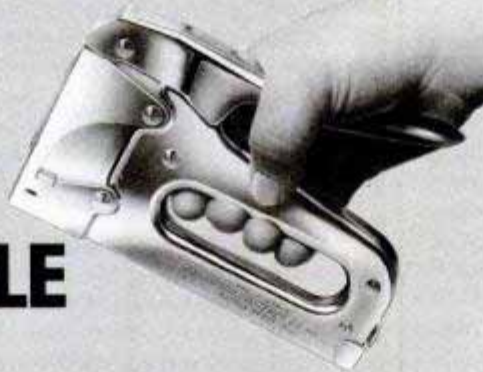
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CHRYSLER

(Continued from page 71)

p.s.i., resulting in steady-state output figures of 142 hp and 160 lb.-ft.

Peak power is available in short bursts for impressive acceleration, while the steady-state levels help to keep temperatures and pressures down for engine longevity. This kind of power gives the 2,600-pound four-door performance few other sedans can match.

For those who don't want or need to go so fast, the normally aspirated EFI 2.2 is the standard engine. Its 99 hp at 5,600 rpm, 121 lb.-ft. of torque at 3,200 rpm, and a base price under \$9,000 put



New options for T-van include three-seat front bench and Convert-a-Bed rear bench.

the car in a position where it can compete successfully against the Honda Accord, Mazda 626, Peugeot 505 and many sporty domestic four-doors. What Chrysler has created is a two-edged marketing weapon aimed at what it calls the "new middle" of the car-buying public—young-minded drivers who are looking for more than just basic transportation. The full-tilt sport versions should list at about \$14,000, or slightly less than a fully loaded Pontiac 6000 STE or Celebrity Eurosport.

Standard transmission is a five-speed manual with a long-legged 0.72:1 over-drive ratio on FIFTH. A three-speed automatic transaxle is optional and, although it will probably be the best-selling transmission, it adds more than 1 second to the five-speed's 0-to-60 time of 8 seconds. The cars are only 1/2 second apart at the end of the 1/4 mile (mid- vs. high-16s), but the five-speed definitely feels faster.

Three different suspension setups are available—the standard Road Touring setup, an optional Sport Handling package and a Sport Handling II option. All three have MacPherson struts in front and a beam axle with coil springs, located by trailing arms, at the rear. Gas-pressurized front struts and rear shocks, front and rear anti-sway bars and quick-ratio (14:1) power-assisted rack-and-pinion steering are used with all three suspensions.

The Sport Handling package consists of P195/70-R14 Goodyear Eagle GT
(Please turn to page 144)

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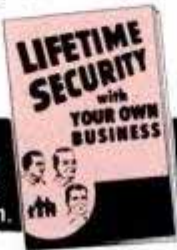
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CHRYSLER

(Continued from page 140)

tires (in place of all-weather P185 Vectors or Michelin X4As), plus tighter shock and spring rates.

The Sport Handling II package includes 15-in. Shelby aluminum wheels with low-profile P205/60R15 Eagle GTs. In order to fit these fat tires, rear suspension jounce was cut to 27 mm and turning lock reduced, resulting in a slightly choppier ride and increasing turning radius from 35½ to 41½ ft.

All three setups are relatively firm, providing precise control and confidence-inspiring maneuverability. They give the driver a good feel for the road without being punishing, but even the Road Touring base level, "tuned to in-city use," does not have the numb, cushy ride of traditional American sedans. These are cars you can fling around with brio and still not get into serious trouble (unless you are really foolhardy).

There are plenty of detail changes and improvements elsewhere in the Chrysler lineup. The K-cars (Plymouth Reliant and Dodge Aries) have been subtly restyled with new, more rounded fenders, deck lids, hoods, bumpers, taillights and grilles. This results in slightly less drag (0.42Cd) and better looks than the original, square-rigged K-cars. Gas-pressurized shocks on the optional HD suspension result in better handling without a harsher ride. A counterbalanced (coil-spring) hood eliminates the pesky hood prop.



Latest entry in Chrysler's Mercedes look-alike contest is restyled Dodge Aries K-car.

Since their introduction in 1981, the K-cars have been regularly but quietly improved, with a 17 percent increase in power, 10 percent in torque and 20 percent in fuel economy. Of the hundreds of changes made, only a few can be seen—like the tethered fuel cap, headlight flasher, revised instrument panel, map pockets in the doors and a useful center console with holders for coins, cassettes or a coffee cup, plus a storage bin, ashtray, and a little cubby-

(Please turn to page 146)

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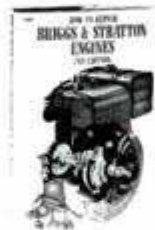
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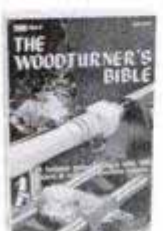
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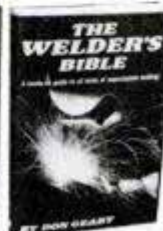
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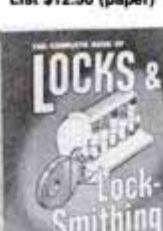
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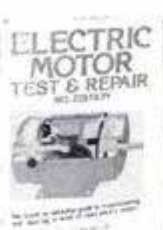
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CHRYSLER

(Continued from page 144)

hole with a door. Things you can't see include better motor mounts, a dual proportioning brake valve to reduce rear-brake lockup, and improved shift linkage on cars with manual transaxles.

The K-car has never been a glamorous model—it's reliable family transportation at a low price. The only six-seater on the American market that lists for under \$7,000, it comes with Chrysler's five-year/50,000-mile warranty. Scheduled maintenance for the first five years is said to add up to only \$165, and Chrysler has an outstanding quality record. While GM recalled 1.2 million cars last year, Ford 1.6 million, and the Japanese imports 1.2 million, Chrysler recalled only 7,000-odd cars!

The other new nameplate at Chrysler is the Plymouth Caravelle—actually last year's Chrysler E Class with a different, more appropriate name. No one believed it was a Chrysler, since it was identical to the Dodge 600.

New options on the popular Dodge Caravan/Plymouth Voyager should make these minivans even more popular. There is now a 40/60 split front bench seat that will accommodate three passengers. This eliminates the walk-through feature between the front buckets, but increases passenger capacity to eight. A Convert-a-Bed rear seat (see *How To Customize The New Minivans*, page 88, July '84) is a three-place bench that folds into a double bed. A clever overhead console has a compartment for sunglasses, another for a garage-door opener, plus two map lights. And the important rear wiper/washer is now standard.

Rippling performance

Performance engines and options are spreading throughout the whole Chrysler lineup. The 146-hp, 2.2-liter Turbo engine is available on the Shelby Charger, the Dodge Daytona, 600 and Lancer, the "new" Plymouth Caravelle SE, and on just about every Chrysler—LeBaron, LeBaron GTS, Laser, Town and Country, and New Yorker. Come January, it will even be offered as an option on the Dodge Omni GLH pocket rocket. Gas-pressurized performance shocks and struts are available on K-cars, Laser/Daytona, H-bodies, Shelby Charger, Dodge 600 and Chrysler LeBaron series.

For those not interested in such things, nonperformance cars with manual transmissions get an upshift light (which Chrysler calls a Fuel Pacer).

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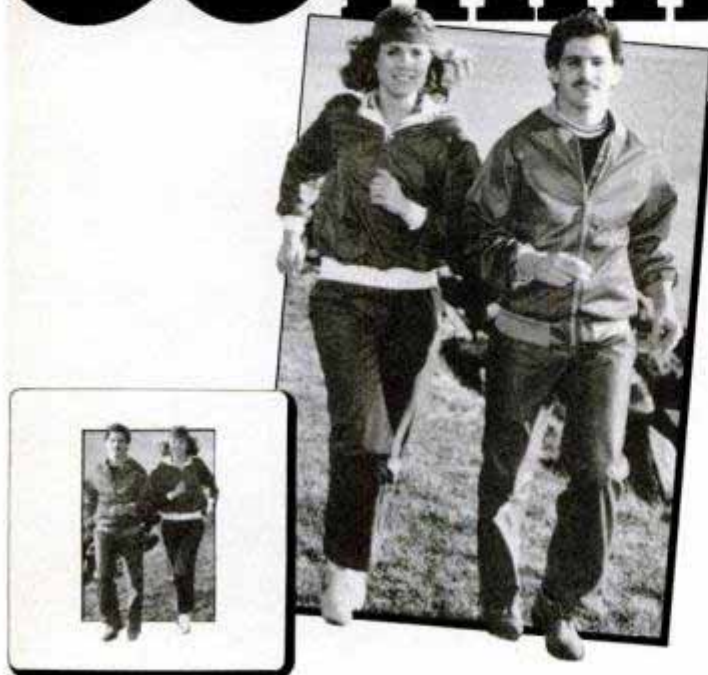
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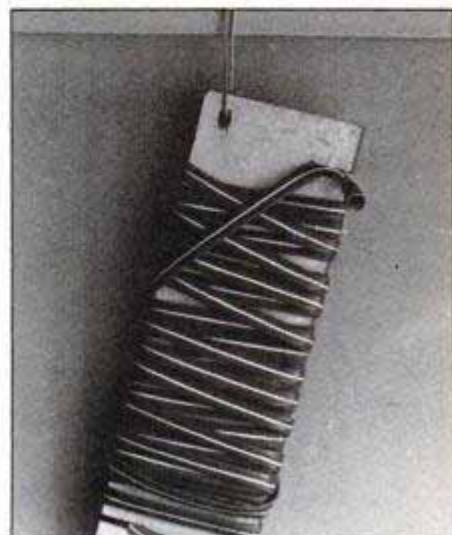
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Some switches that control space heaters, refrigerators and other appliances should be left in one position and not disturbed by house guests or family members. Taping these switches makes it inconvenient to flip them the few times it is necessary. Just install a U-shaped pipe clamp over the switch as a caution signal. Use the plate screws to hold the clamp.—*Fred Haitz*

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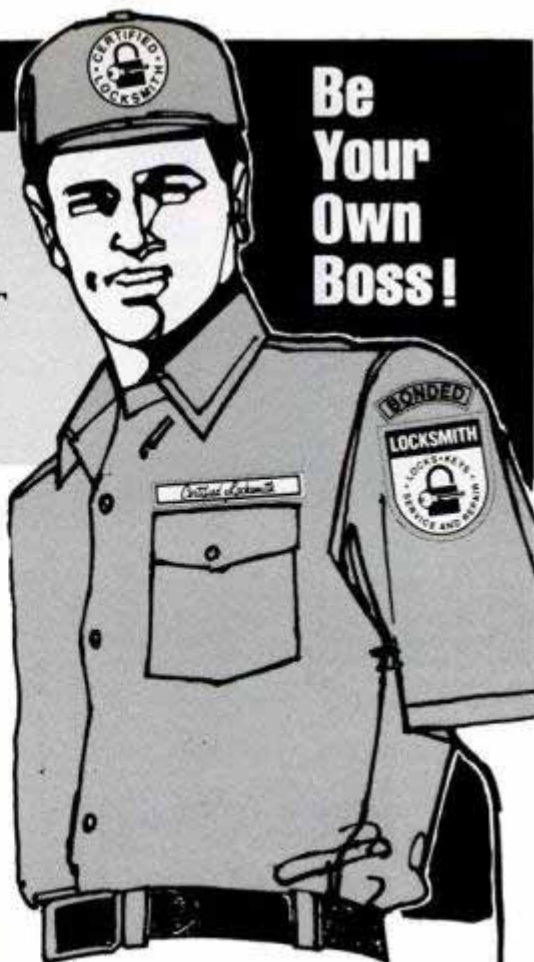


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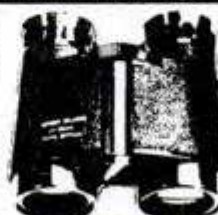
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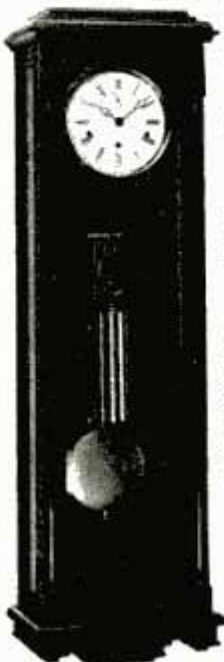
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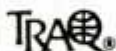
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