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home costs
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you can build and
enjoy this summer

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PM drives Olds & Rabbit

WAR IN SPACE:
Killer satellites
in orbit?

RADIO: 4 best
shortwave sets
and 3 scanners

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The ultimate RV!



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Ford's
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On the cover

What might look like some strange prehistoric monster is actually a 112-foot-long dirigible built by Brian and Kathy Boland, a husband-and wife team of do-it-yourselfers who took two years to construct the craft in—believe it or not—their living room. Like the Bolands, many other amateur homebuilders are helping to bring back an exciting new era in airships. —Painting by Ed Valigursky.



JULY 1977

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Carol Zweifel,
Police Officer



"I selected Firestones and I'm very happy with them. Do yourself a favor. If you've got to drive, drive on Firestones."

Hausmann DePass,
Inhalation Therapist



"What can you say about anything in life—it's the way you feel. I can't say anything more about a tire like Firestone except I'm comfortable with it."

Cliff Williamson,
Insurance Agent



"We have steel belted radial tires. Firestones. Based on what we've just experienced, I would buy Firestone again."

Ruth Metcalf,
Director of Christian Education



"I would recommend Firestone tires to anyone. A young fellow that works for me is going to put a set on. He told me if they don't last he's going to make me pay for them. I told him 'okay'."

Virgil Guess,
Meat Cutter

Friends like ours bring out the best in us...

Announcing the finest radial tire we've ever built:

FIRESTONE 721 STEEL BELTED RADIAL

5 million test miles now bring you the experienced radial.

At the Firestone Developmental Proving Ground at Fort Stockton, Texas, Firestone endlessly works at improving its steel belted radials. And it is here that the new Firestone 721 has become what it is. The *experienced radial*.



Our new 721 steel cord. Much stronger and why.

Before we tell you some of the things we do at Fort Stockton, we thought you'd like to know at least a few of the ways that our Radial 721 has become our finest steel belted radial tire as a result of torture testing.

Our tire gets its name from a steel cord we put together a different way than we ever did before, with each cord wound in a seven-strand-plus-two-strand-plus-one-strand method. In addition to the way it's wound, we now use ten strands of steel per cord where five were before. The result is a stronger cord for tire durability.



Be glad you're not a tire.

The life of a Firestone tire is not very pleasant at Fort Stockton, Texas. We do things in our development testing you'll probably never do in a lifetime of driving, and we urge you never to try.

We drive cars at 90 miles an hour day after day until a tire fails.

We corner on different surfaces, as fast and furiously as a driver can, plow cars through a road of water, overload station wagons with heavy sandbags, even *purposely* create blowouts by running tires over knives.



The part of a tire you never look at, we do.

But development testing isn't worth anything unless you use the results. At Firestone we not only torture a tire like our new Steel Belted Radial 721, we analyze the effects on every part of its anatomy. The tread, the sidewall, the belts, the beads.

Torture makes for peace of mind.

How can you have more peace of mind and take advantage of what we learn at Fort Stockton? By remembering that the safety of any tire depends on a lot of factors—on wear, load, inflation and driving conditions.

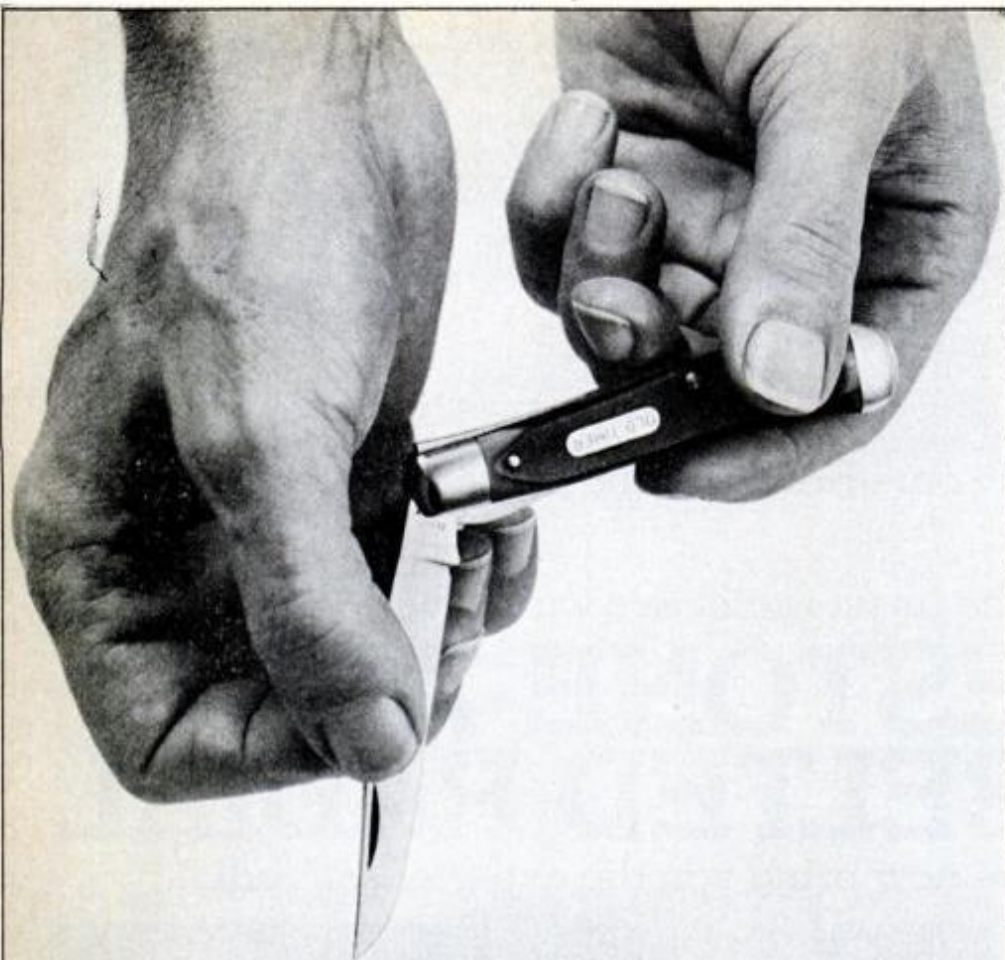
Our peace of mind comes from knowing we've done and are constantly doing our part, torturing tires in every important way we can think of to make them work hard and long and well for you.



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JOHN A. REGINA

Advertising Production Manager

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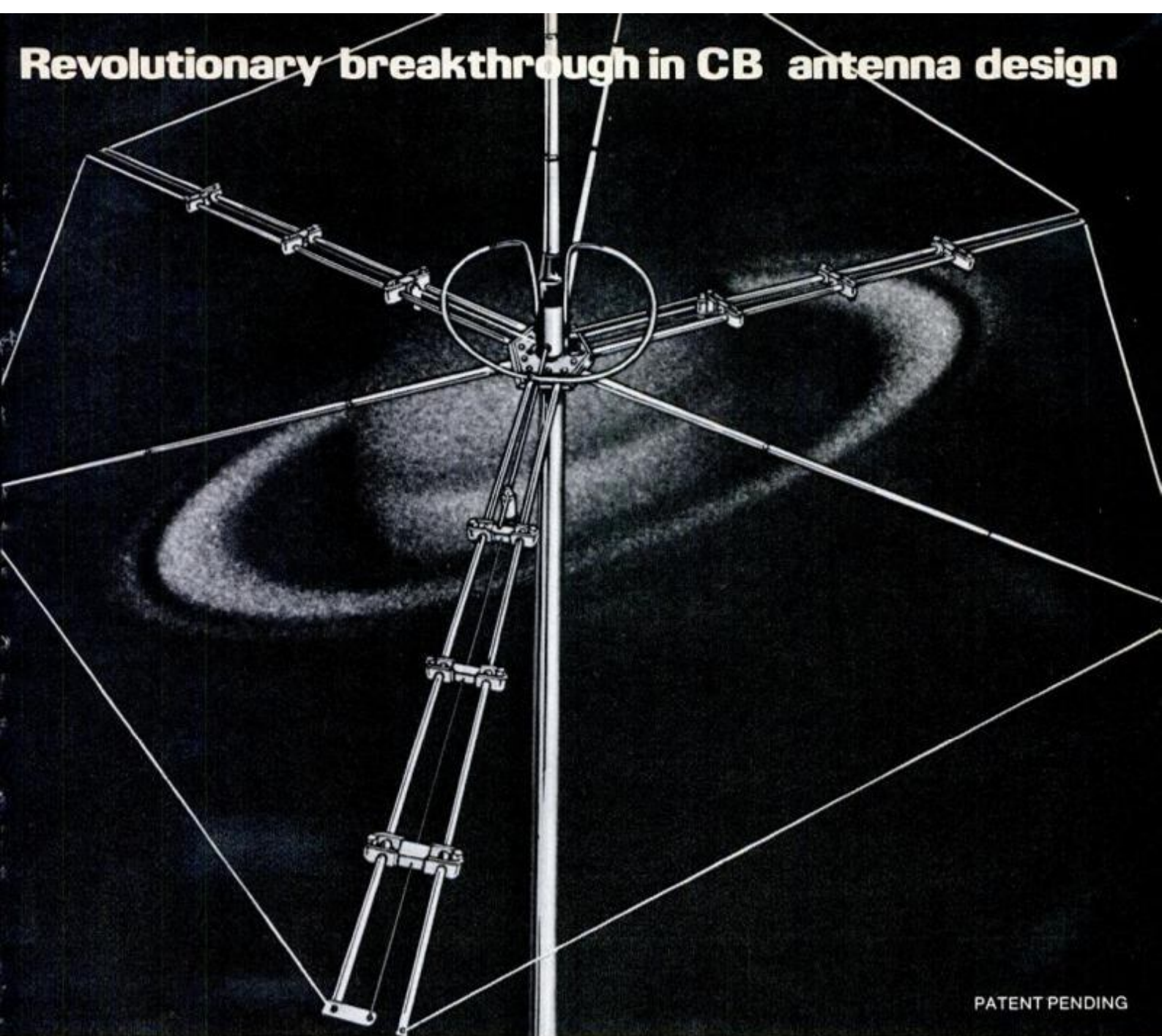
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Revolutionary breakthrough in CB antenna design



PATENT PENDING

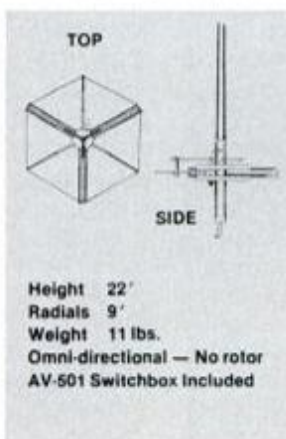
Photo courtesy of Edmund Scientific Co.

AVANTI Invents the Saturn™ Base

The reason the "Saturn" is so revolutionary is that it is absolutely the only **combination vertical and horizontal omni-directional antenna**. That's right, it needs no rotor! You can pick up mobiles (which are vertical) or horizontal and vertical beams.

The "Saturn", invented after years of research by Avanti engineers, is the latest development using AVANTI's unique CO-INDUCTIVE principle to give you the performance of two antennas combined into one.

The "Saturn" not only works on both polarities, but pounds out signals like an air hammer and picks them up like a magnet. Both polarities offer high gain figures.



Those of you who are worried about sun spots and "skip" can relax too. This antenna really helps. When the sun spots cause a signal shift, you can often change polarity (just like our P.D.L. or Moonraker) and still pick up the desired channel with no loss of transmission.

The P.D.L. and Moonraker made dual polarity famous as the only antennas to have during the last sun spot cycle, and this time around any serious C.B.'er will want to have the "Saturn."

In fact, having a "Saturn" and a "P.D.L." or "Moonraker" will put you in the elite group of C.B.'ers who "always seem to get out better."

Avanti makes a complete line of high performance base and mobile CB antennas from \$11.95 to \$404.00. Write for free Avanti catalog.

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LETTERS TO THE EDITOR

Re-orienting the express

In *Murder of the Orient Express* (page 71, April '77), Hans Fantel's observation that the famous train did not actually reach the Orient must make readers wonder why the train was so named. To the European, Turkey already lies in the Orient and what we distinguish as Near East or Far East was, when the great train began service in 1883, simply labeled Orient, or East, in contrast to Occident, or West. Apart from this, the article was a fine obituary.

RICHARD J. RUNDLELL
ASST. PROFESSOR OF GERMAN
NEW MEXICO STATE UNIVERSITY
LAS CRUCES, N.M.

Being, like King Boris of Bulgaria, a railroad buff, I found your story on the Orient Express a delight. And being that kind of fan, I'd like to point out the following: First, double-trucks (British bogies) were not first seen on the Orient Express, but had been in use years before. Second, in 1883 few locomotives used hemp packing on their pistons. If it was used, it was an ancient holdover or a one-time emergency application. Third, the track adhesion mentioned in connection with the trucks is solely for locomotives. Adhesion is hardly wanted in cars that are pulled.

TEMPLE NIETER
EVANSTON, ILL.

Hand-crankers go way back

I read with some interest a letter in your April '77 issue (*Historic Wipers*, page 6) stating nearly all cars in 1923 were hand-cranked and had magneto ignition. I owned a 1916 Haynes that had a battery, starter generator and coil ignition, and in 1917 or '18 a Ford could be had with a starter. It was standard equipment shortly thereafter. It's true that the "T" model continued with magneto ignition as long as it was built, but any hand-crankers in 1923 were old-model cars.

H. D. STRAUGHN
BETHANY, OKLA.

Don't sand antiques

Your article on furniture refinishing (page 115, Feb. '77) mentioned sanding in several places. Yes, on unfinished, raw wood furniture, but never on previously

finished surfaces. Old furniture, especially antiques, has a "patina" caused by years of use and the action of light and air on the wood. It takes years for a piece to acquire patina, but only a few minutes to obliterate it with sandpaper.

LARRY W. STORM
LEXINGTON, KY.

A steam-powered inspiration

I am enclosing a picture of the steam tractor that I built from your plans (page 94, Feb. '71). The only real change I made was to mount the idler gears on a separate pivoted arm so I could disengage the running gear while operating on compressed air. Also the re-



Steam-powered tractor now a showpiece.

movable cover was made from sheet tin rather than wood.

The tractor has been shown in numerous displays and has always been a center of attraction.

Such articles for a metalworker like me, as well as other "inspirations," are what keep an old duck like myself (64) in high gear.

J. W. HENRICKS
ATLANTA, GA.

Plans for the tractor are \$10. Send check or money order to *Popular Mechanics*, Box 1014, Radio City Station, New York, N. Y. 10019.

Boonie Bug transformed

When I saw plans were available for a "go-anywhere camper" (page 94, March '74), I immediately sent for them. Sixteen months later, July '75, I licensed my version of your "Boonie Bug." I call mine a Sun Buggy. Modifications included leaving the chassis full length (so I can stretch out when camping), using a split windshield assembly (less expensive) and an enclosed rear engine area to help brave the long, cold Pennsylvania winters.

Maiden voyage was from State

College, Pa. to New York City on my honeymoon. The bug performed great and has continued to for approximately 7500 miles since then. It cost about \$1500 to build and I have about 1000 hours in the project from junkyard to street-legal.

In my opinion, the project requires extensive mechanical aptitude, and above average ability in electrical systems, fiberglassing, bodywork and patience as well as humility. A simple multiweekend project, it is not. But Sun Buggy is a good little go-anywhere camper with a thrifty VW engine. And you can make it from PM plans if you



Sun Buggy built from Boonie Bug plans.

have the guts, the time, the tools, an obsession, high mechanical aptitude, about \$1500 and a good psychiatrist.

DAVID A. PROVAN
STATE COLLEGE, PA.

Detailed plans for PM's "Boonie Bug" come with complete instructions at \$14.95. Send check or money order to *Popular Mechanics*, Dept. 77, Box 1014, New York, N.Y. 10019.

Gasohol mileage confusion

Many thanks for the fine article about our Nebraska Gasohol program (page 46, April '77). The treatment of a rather complex subject was well handled. I should call your attention to one typographical error in the article. Those cars operating on Gasohol fuel in our Two Million Mile Road Test Program have been registering about five-percent better gas mileage than the control vehicles running on unleaded gasoline and not the five to eight miles per gallon stated.

Since the article was written, a group of Nebraska businessmen have incorporated a firm to build a grain alcohol plant in Nebraska. We hope that this will be another major step forward for our Gasohol program. DR. WILLIAM A. SCHELLER, CHAIRMAN
DEPT. OF CHEMICAL ENGINEERING
UNIVERSITY OF NEBRASKA-LINCOLN

Make Money In Your SPARE TIME

With A Service Business of Your Own



Millions of Lawn Mowers Need Yearly Repair

Every lawn mower in use today needs periodic repairs. In communities of every size there are enough lawn mowers to make a lawn mower service business very profitable. Lawn Mowers are used by golf courses, city and park maintenance departments, businesses... and most homeowners. The Market is Big! You can cash-in on the big money to be made... right from your own home.



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Soon after receiving the material you can begin making big money. Within a few hours you'll be able to professionally tune-up lawn mower engines. Soon you will be able to offer a variety of services to your customers that will mean more money for you.

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work. Working evenings and on weekends you can easily earn from \$12 to \$18 an hour. Working fulltime, your money-making potential is almost limitless!

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With experience you'll be able to service small engines similar to Lawn Mowers, such as Snow Blowers, Generators, Mini-bikes, Go-carts, Tillers and many Snowmobiles, Chain Saws, Paint Sprayers and others. All mean extra money in your pocket!

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Please rush me more information about Foley's NEW Lawn Mower Repair Program.

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ALL OUTDOORS

RV-CB

Citizens band is fine for the highway, but it's even better for mobile outdoorsmen getting away from it all. An emergency in the boondocks with no one around can be a lot more serious than alongside a road where help may come any time.

Unfortunately a lot of recreational vehicles—and that includes motorcycles, bikes, boats, golf carts and snowmobiles as well as motor homes—don't come supplied with metal roofs. For efficient operation, a CB antenna usually needs a "ground plane" to help bounce out a signal. Most antennas for mobile use count on the metal top of your car to provide that ground plane.

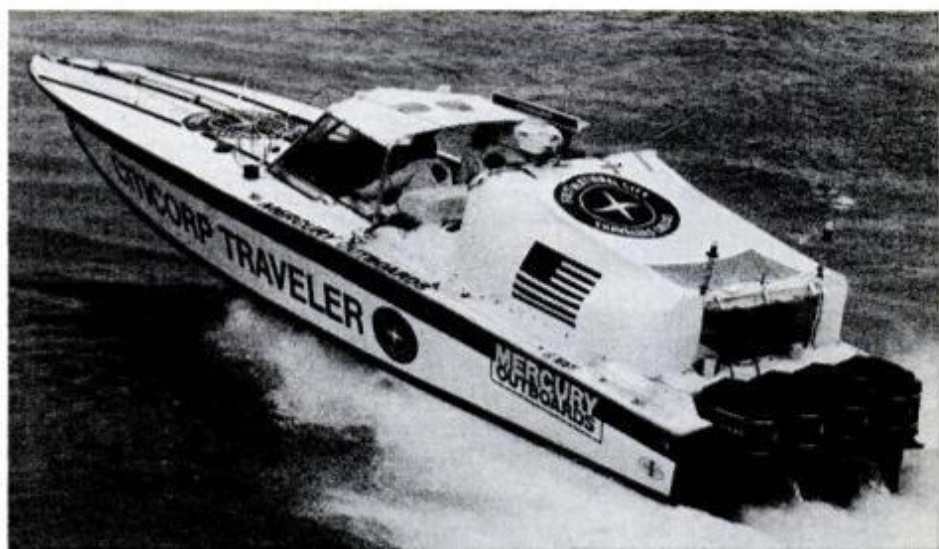
The answer is a special new antenna type that doesn't need a metal trampoline to bounce out the signal. Dealers handling units from Antenna Specialists of Cleveland can get you a brochure describing models especially designed for RVs. For boats, motorcycles, snowmobiles and fiberglass-topped RVs, there is a four-foot Antenna Specialists M-306 model that needs no ground plane, while for bicycles the same company makes a six-foot wand with a safety pennant at the top numbered M-307—good numbers to use with the other "good numbers."

On-the-go aids

Richard Dunlop, who did our fine study of backpacks (page 110, March '76), has just authored *Rand McNally Backpacking & Outdoor Guide*, \$5.95 at bookstores and camp-gear suppliers. There are few better or more pleasant ways to conserve our dwindling and expensive supplies of fossil-fuel energy than to use muscle power, and Dunlop tells how and where to do it.

Going far beyond the basics of which pack to pick and how to pack it, Dunlop provides chapters covering camping, trail riding, hiking, orienteering, bike travel, rock hounding, canoeing and rafting, boat camping, sport diving, conservation and wildlife. More than half the book details where these activities can be found in the United States and Canada. With or without a pack, it makes an excellent action guide for outdoorsmen.

Also from Rand McNally for campers going farther afield are a newly revised *European Campgrounds and Trailer Parks* guide,



Fastest Atlantic crossing, to break power records held by S.S. United States for steamships and Jim Wynne for outboards, is goal of Miami's Bob Magoon in a 36-foot Cigarette. His four 200-hp Mercury motors may preview 1978's top-line Mercs.

\$6.95, and a \$3.95 *Road Atlas of Europe*. It's no secret that campers can do the Grand Tour abroad on a very modest budget. A good estimate can be made of how much you'll need to spend by studying these guides in advance. They can be ordered by mail from the Rand McNally Map Store, 39 South LaSalle St., Chicago, Ill. 60603.

For bargains nearer home, Pilot Books, 347 Fifth Ave., New York, N.Y. 10016, mails postpaid for \$2.50 a 1977 *National Directory of Free Tourist Attractions*, listing over 700 free historical sites, restored villages, ships, museums, gardens, parks, zoos and other points of interest. For overnighting without overpaying, there is its \$2.95 *National Directory of Budget Motels*.

New needs

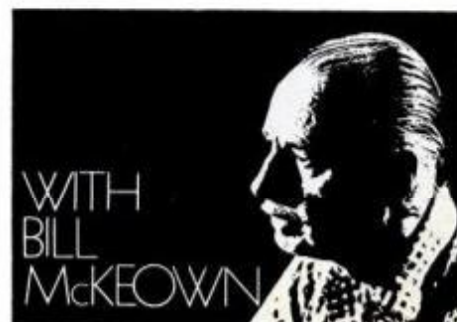
Why doesn't some manufacturer make a hybrid screen house that can turn into a tent, or a tent with roll-up sides and roll-down screening? Touring campgrounds recently, I've seen any number of screen houses set up as add-on rooms for motor homes and travel trailers or as dining and partying accommodations for tenters. They're fine for keeping the bugs out, but when a slanting sun or rain squall angles in, it's necessary to rig up some kind of inner wall to keep out the intrusion. I've seen sheets clothes-pinned up, newspapers rigged, pieces of cardboard positioned. Ingenious campers can always come up with some makeshift answer, but a manufacturer ought to tackle

the problem as well. Even one extra canvas wall that could be hung along the up-sun or upwind side would help.

Life preservers need more color

While I was testing boats and motors at Mercury Marine's impressive MerCabo engineering center in Florida, director Gene Wagner pointed with pride to the America's Cup life preservers his test drivers wear for hours during exhaustive saltwater endurance runs on equipment. The vests, bottom vented and hinged, prove particularly comfortable for extended wear, and have roomy front pockets for gear.

But the vests are made, Wagner noted, in a fashionable blue denim color that would make a driver blend in with the water immediately if he were flipped overboard. Why isn't this ideal life jacket design made in a bright high-visibility international orange color, Wagner wanted to know. Good question. America's Cup suggests wearing its racing models of the same design—a racing stripe on international orange—but no pockets. ★★★



New Sinclair Cambridge Programmable.

An astonishing \$29.95!

Pocket calculators grew up

A couple of years ago, calculators took a forward. Programmability transformed the slide-rule calculator into an advanced scientific machine.

Sadly, it also transformed a cheap little calculating aid into a piece of capital investment.

Now the all-new Sinclair Cambridge Programmable puts programmability where it belongs: in the palm of your hand, for less than \$30.

Features of the Sinclair Cambridge Programmable

The Cambridge Programmable is really pocketable. A mere 4 1/2" x 2", it weighs about 2oz.

Yet there is absolutely no compromise in the package of functions it offers.

Because the Cambridge Programmable is a scientific calculator with memory, basic logic and brackets (which means you can calculate exactly as you write it), and a programmable calculator which offers a flexible through-the-keyboard program and operation.

The Cambridge Programmable has a deep program memory, and features optional and unconditional branch actions (go to and go if negative).

There is also a step facility, which allows you to step through the program to check that it has been entered correctly. If there is any programming error, the learn key allows you to correct single steps without destroying any of the remainder of the program.

To achieve this, each program key-stroke has an identifying code, or 'check symbol'. The symbols for the digit keys are the digits themselves, while the symbols for the operator keys are letters printed beside the keys.)

The check symbol for \square , for example, is F. As you step through the program, the display shows

it means that \square is programmed as step 26. If step 26 should have been \square , all you have to do is press



It's as simple as that!

Use the 294-program library to tailor the machine to your own speciality

Like a full-size computer – and unlike far more expensive specialist calculators – the Sinclair Cambridge Programmable can be programmed to handle calculations concerned with any speciality.

It can even be given to an operator who doesn't understand the program!

To save you time, and to help inexperienced programmers, Sinclair have produced a library of 294 programs ready to be entered straight into the calculator.

Using these standard programs, the Cambridge Programmable solves problems from quadratic equations (where the program gives both real and imaginary roots) to twin-T filter design, and from linear regression to bond yields.

(The calculator is supplied with 12 sample programs, and full instructions for entering your own program. The four books in the program library are available at \$4 each, or \$10 for the complete set.)

A home computer – great education, and great fun!

The Programmable is a true computer in miniature.

An hour or two spent with it gives more insight than any plodding text book into the way computers work.

Great for children – and children find it easy to understand. What's more, the library shows you how to have fun with your computer. There's a 'matchstick' game (where you can win) and a real lunar landing program to run. (Right decisions – soft landing. Wrong decisions – disaster!)

The approach is so simple, and so immediate, that writing your own programs becomes an absorbing addiction. (New programs written by owners reach us all the time – send us yours, and we'll publish them.)

Why the Cambridge Programmable costs so little

The Sinclair Cambridge Programmable uses the Sinclair talent for miniaturisation to the full – as you'd expect from the company that pioneered the truly pocketable pocket calculator, and recently introduced the world's first pocket TV.

Chip and circuitry design are unique to Sinclair, and the Cambridge Programmable is assembled by Sinclair's own staff at their headquarters plant.

The result is a pocket programmable calculator of advanced design, sold by the manufacturer with the manufacturer's own 1-year comprehensive guarantee, at a price unmatched by any comparable calculator.

10-day no-obligation offer

There's a lot more to this remarkable calculator than a brief written description can cover.

You need to see it and handle it... to program it yourself in a few seconds to save you hours... to check its performance against tables and graphs... to test the full range of programs available.

So we're offering a 10-day trial. Send your check or money order with the order form below, and you'll receive a calculator direct. Use it for 10 days, and if you don't feel it's the finest \$29.95 you've ever invested, send it back. We'll refund your money without question.

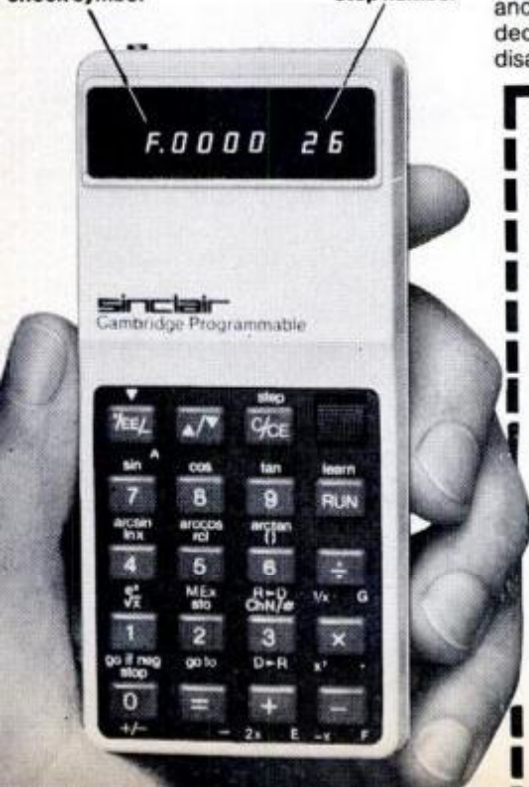
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check symbol step number



To: Sinclair Radionics Inc., Galleria, 115 East 57th Street, New York, N.Y. 10022, USA.

Please send me _____ (qty) Sinclair Cambridge Programmable(s) at \$29.95 each, including full instructions, and sample programs. \$ _____

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(PLEASE PRINT)

I understand that you will refund purchase price in full if I return calculator(s) and accessories in saleable condition within 10 days of receipt.

Signature _____

PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Fireworks safety

A timely reminder from the National Fire Protection Assn., received just as PM was going to press, notes that many—but not all—states have adopted the NFPA's Model State Fireworks Law. The law permits fireworks only in outdoor public displays put on by pyrotechnic specialists.

The word from NFPA's president, Charles Morgan, is that impairment or loss of eyesight, deafness and loss of fingers lead the list of major injuries caused by fireworks. Best advice is to warn youngsters repeatedly *never* to pick up a firecracker—and never to accept one that is offered. They should also be cautioned against sparklers. Because these can reach temperatures near 2000° F., they account for almost 600 accidents (including blindness) each Fourth of July.

Make your Fourth a safe one.

House framing teaching aid

As a woodworking teacher, I can vouch for the fact that it is difficult to teach house framing in a classroom. Teaching aids, offered by Identical Construction Co., 9002



A-frame and two-bedroom home kits.

Rosanna, Garden Grove, Calif. 92641, change that picture. Authentic scale models help you learn, teach or read floor plans, cut lumber to length, figure hip-rafter cuts and more. Considering all that's offered, the value is good: \$35 for a room-addition kit; \$49.50 for an A-frame, and \$49.50 for a ranch.

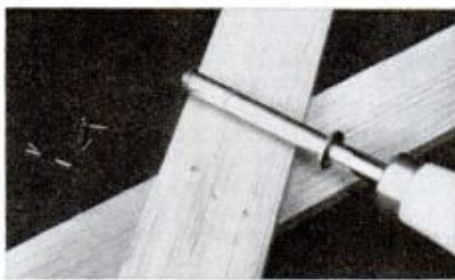
Better brad pushing

Most visitors to my workshop have never seen—or used—a brad pusher until they discovered mine. Thus I think it's time to flag PM readers to a remarkable, inexpensive tool.

The pusher makes it easy to pick



Comfortable-to-hold pusher has magnetized tip for easy pickup of small brads.



up $\frac{3}{8}$, $\frac{1}{2}$ and $\frac{3}{4}$ -in. brads. By simply retracting its sleeve with thumb and forefinger, the exposed magnetized tip can be touched to a brad head. When the sleeve is released, the brad is ready for driving. The total tool also countersinks nails (see bottom photo, above). At hardware stores, \$5. Hyde Manufacturing Co., 54 Eastford Rd., Southbridge, Mass. 01550.

News about this and that

Since conservation of energy has as much bearing on home cooling as home heating, it makes sense to give attention to airconditioner maintenance this season. To stretch your energy dollars, a strong, steady flow of air is a must for an airconditioner to cool efficiently. Take time to check all the filters cleaning those that you can, replacing those that you can't. If a filter needs replacing, try to buy a washable, aluminum-mesh type at a hardware or department store.

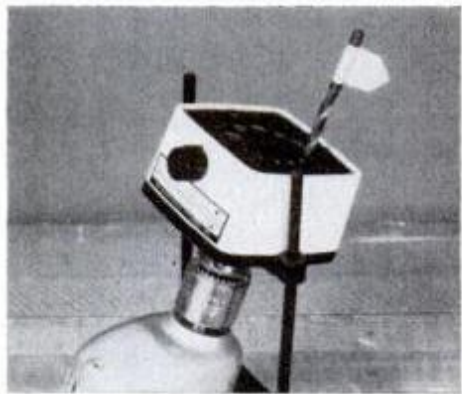
Two interesting books crossed my desk recently. *Build it Better Yourself*, Rodale Press, Emmaus, Pa. (\$17), is a collection of how-to projects aimed, primarily, at rural readers. A softcover book, *Firesafety in the Home*, from the National Fire Protection Assn., 470 Atlantic Ave., Boston, Mass. 02210, tells the complete story of home fires and why and how they happen. Order SPP-40, \$6.95 ppd.

Better bit sharpening

The latest twist-bit sharpener from Black & Decker fits most $\frac{1}{4}$ and $\frac{3}{8}$ -in. portable drills with speeds up to 3000 rpm. Not for $\frac{1}{2}$ -in. drills, it accepts 11 bit sizes— $\frac{1}{8}$, $\frac{9}{64}$, $\frac{3}{32}$, $\frac{1}{16}$, $\frac{7}{32}$, $\frac{1}{4}$, $\frac{9}{32}$, $\frac{5}{16}$, $\frac{11}{32}$



Tape flag indicated bit position: It's rotated 180° to sharpen second edge.



and $\frac{3}{8}$ in. The tool quickly sharpens carbon and high-speed twist bits, but is not designed for carbide-tipped bits. To use the sharpener, simply insert a bit in the proper hole until the cutting edge is seated, then turn on the drill a few seconds. Repeat for the second cutting edge. Model 79-800 sharpener with stand (shown) is \$15 at hardware and department stores.—*Harry Wicks, Home and Shop Editor*

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

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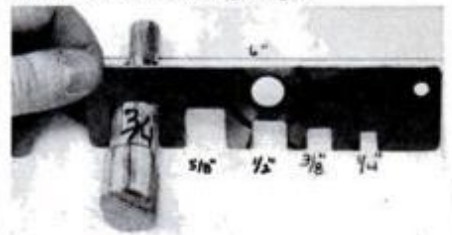
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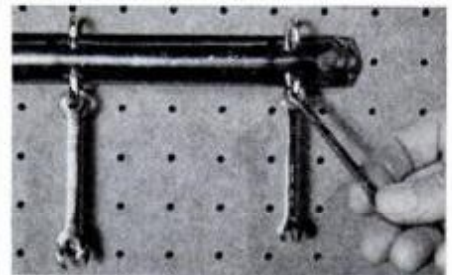
HINTS FROM READERS

Lathe diameter gauge



This handy lathe tool was cut from an old saw blade using a steel-cutting blade. The cutouts were made with a Dremel 409 cutting wheel.—*F.B. Palmer*

Binder rings hold tools



Screw the metal ring binder from an old notebook to the shop wall. The rings can hold a complete set of ignition wrenches or other small tools.—*Ken Patterson*

Stocking collects lint



To stop lint piles at a dryer vent discharge, attach a bottomless can and old stocking to the wall cap as shown.—*Bud Hawkins*

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1 3/4 1/2 3/8 No. 6 x 32 1 3/4 1/2 3/8 No. 8 x 32 1 3/4 1/2 3/8 No. 10 x 32	5/16 - 18 1/4 - 20 10 - 32 8 - 32 6 - 32	1/16 x 3/4 1/8 x 1 1/8 x 1-1/2 1/8 x 2

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J.D. Russell, Cicero, Illinois

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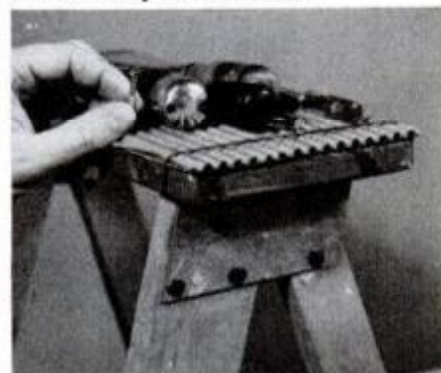
HINTS FROM READERS

Hacksaw cuts curves



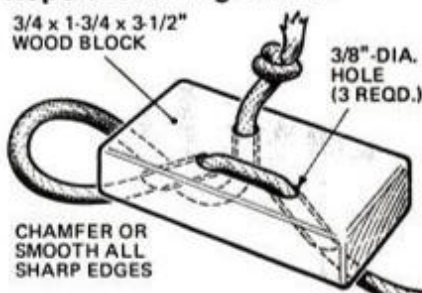
A standard hacksaw blade can cut curves if you reduce the blade width on a bench grinder. Also reduce blade tension by adjusting the blade fastener.—Ken Wells

Ladder top holds tools

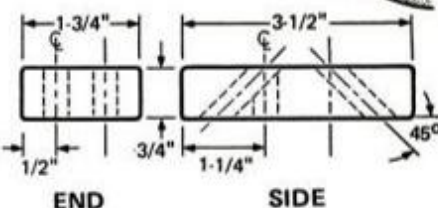


Corrugated cardboard attached to the top of a stepladder with rubber bands keeps tools from rolling off.—Ken Patterson

Rope shortening device



CHAMFER OR SMOOTH ALL SHARP EDGES



Make a simple device for shortening or lengthening clothesline or other rope. Drill three holes as shown in a block of wood; smooth the edges.—Alexander Hess

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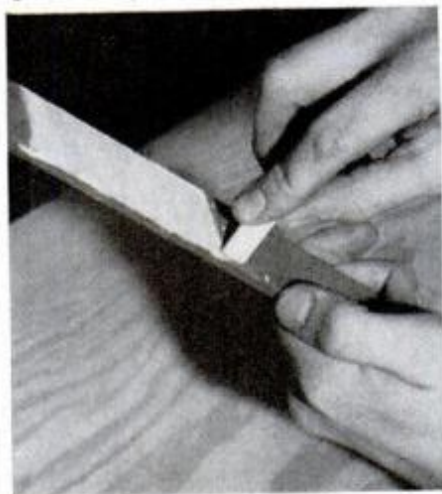
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HINTS FROM READERS

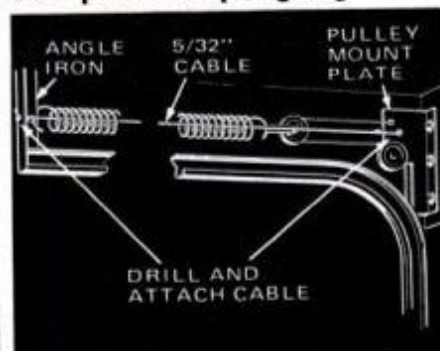
Chalk cleans file



To clean grit from a file, rub hard chalk parallel to the cutting teeth.

—Ken Patterson

Wire prevents spring sag



To prevent overhead garage door springs from sagging, run heavy wire through them, drill anchor holes and attach the wire as shown.—S. Clark

Disposable paintbrush



Make a disposable paintbrush for small jobs. Staple scrap foam to cardboard.—R.B. Brelsford



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SCIENCE WORLDWIDE

Deep-sea 'bone death'

Deep-sea divers are subject to many hazards including the bends, high-pressure disorders involving vomiting, brain dysfunction and something called osteonecrosis, or bone death. The last is caused by clumping of blood components when pressure bubbles form in the bloodstream. These block circulation in bone tissue, which dies, often crippling the victim.

Recently, 24 Canadian divers from Toronto's Seneca College made simulated dives in the Duke University Medical Center hyperbaric chamber to test two drugs— aspirin and dipyridamole. Duke's Dr. Peter Bennett hopes they'll prevent clogging. If so, divers may be saved bone death. The work also may help find a preventive for coronary thrombosis—a cause of heart attacks.

Ultra-mini computer brain

Less than one-tenth the size of a postage stamp, a new mini-computer

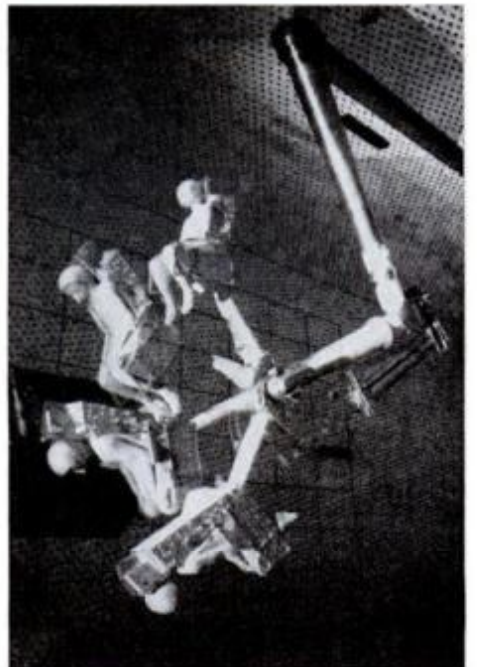
processor brain fits easily between a pair of wire office staples (above, right). The subminiature unit was developed by Bell Laboratories for a wide range of uses in switching systems.

Fleas, lice and security

Rat studies prove that in crowded conditions, rats kill other rats for no reason. But rats don't crowd up by choice. So now John Hoogland, a graduate student at the University of Michigan, is studying prairie dogs, who love to live bunched up despite fighting for mates and proliferation of lice and fleas.

What's in it for them? It's not group hunting, Hoogland found; they're vegetarians. It's not sparse habitat. Almost any diggable soil is prairie dog habitat. Protection from enemies? Hoogland tugged a stuffed badger on a line through prairie dog town. Squeals went up on all sides and the animals van-

chute deploys. To make sure the system works, engineers at the Air Force Systems Command Arnold Engineering Center in Tennessee rigged one seat on a rotating arm in

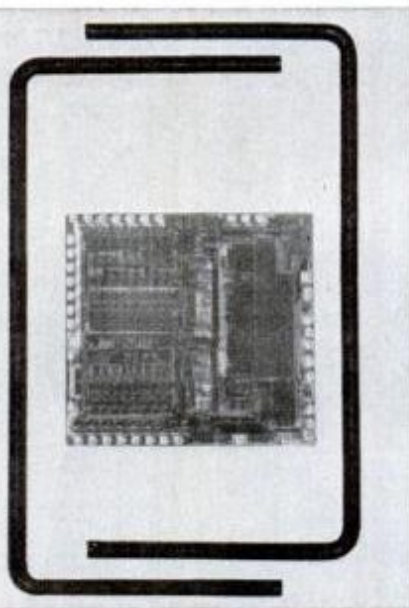


Self-righting ejection seat under test.

the center's transonic wind tunnel where a dummy "crewman" was hit with simulated catapult and rocket thrusts.

Painless metric

With the metric system creeping up, what's really needed is a whole new outlook. Forget there ever was an "inch" or a "quart." Beauty of metrics is that everyone else uses it, too. So why try to compare it with old standards? Learn how long a centimeter looks and how much a liter holds. But if you *must* compare miles with kilometers, there's a book called *Metric in a Nutshell*, which has all the rules of thumb and everything you'll ever want to know about conversion tricks. It's \$5.45 postpaid from Polymetric, Box 847, Tarzana, Calif. 91356. ★★



Mini-brain is dwarfed by staples (right), does same job as circuit boards at left.

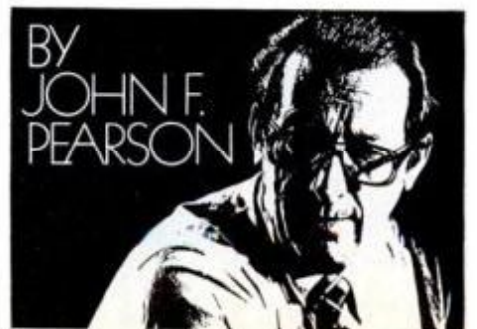
processor brain fits easily between a pair of wire office staples (above, right). The subminiature unit was developed by Bell Laboratories for a wide range of uses in switching systems.

The unit can also serve in electronic sensing—such as counting coin deposits in slot machines. Called MAC-8, the device does the job of two circuit boards like those at left, above. It responds to 400 different electronic instructions

ished. So, reasons Hoogland, colony living is security from predators. For prairie dogs, that is.

Ejection-seat spinner

When the first production model of the B-1 bomber takes off, each member of the four-man crew will be sitting on his own individual ejection seat, designed to catapult him clear of the huge aircraft, then stabilize the seat in space with vernier rocket motors until the para-



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KZ400 Special



KZ400 Standard



KZ400 Deluxe

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We know why you ride.

*Manufacturer's suggested list price, 1977 KZ400S, excluding freight, dealer prep, title, state and local taxes, at participating Kawasaki dealers.

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DETROIT LISTENING POST

Update on alternate engines

At least half the mail this page receives from readers asks the same question: "What's Detroit doing to come up with a new engine or an alternate to the gas engine?" Here's a rundown on three projects:

Alternate engine No. 1

Ford reveals it has built almost a hundred copies of its dual displacement engine and is testing the DD in vans and trucks. The company hasn't put any numbers on fuel savings achieved with the engine, but sources involved in the project say the results surpass anything Ford anticipated.

According to one report, a DD installed in a full-size car has improved fuel economy 30 to 40 percent over mileage attained with a conventional engine. Ford expects to use the DD in some '78 model trucks, maybe in cars later. The DD automatically deactivates two, three or four cylinders, depending on the load on the engine. Reducing the number of cylinders in use saves fuel.

Alternate engine No. 2

The Oldsmobile diesel coming in September could have a lot of company a year or two from now (See [drive test, page 84](#)). GM is planning already to extend the engine to a second car line—Buick or Chev—if the Olds is a success. Chrysler has reportedly pulled a VW diesel out of a Rabbit and will install it in an experimental version of its new front-drive subcompact. American Motors is also interested in the VW diesel for a new car coming in 1979. The Chrysler and American Motors diesel programs are tentative and the companies could back out at any time. If the projects go forward, this would leave Ford as the only U.S. company not offering a diesel. But don't count Ford out of the picture because Ford makes a light truck diesel in England that could be modified for use in a passenger car. Ford also has lines out in Japan to explore the possibility of importing a diesel.

Alternate engine No. 3

American Motors has signed an agreement to supply vehicles and

technical expertise for a gas turbine engine being developed by Williams Research Corp. You might not recognize the name Williams Research, because the company isn't widely known outside the Detroit area. I've had contact with Williams off and on over a number of years and from what I know of the company it is a solid, knowledgeable outfit. Williams has been working on a turbine for at least 20 years and I drove one of their turbine cars a few years ago (page 100, June '71). In addition to the deal with AMC, Williams has done experimental work on turbines for GM and Volkswagen.

Both companies—Williams and American Motors—decline to put out any specifics on what they are up to. Cruse Moss, head of AM General Corp., a subsidiary of American Motors, says AMC "sees a potential for early practical application of gas turbine engines to special purpose vehicles." The way I translate that is that American Motors will put a turbine in a bus or utility vehicle—that's what AM General makes—and if it works out, the company will then try a turbine in a passenger car.

Buick's 'new' V6

Buick also has a "new" engine. New in quotes because the engine is actually a reworked and improved version of the V6 Buick brought out in 1962. The engine was a good economical performer before it was reworked, but it tended to be noisy and run rough. Where the old version was odd-firing, the new version has even-firing timing (every 120°). The result is a quieter, smoother-running engine—like a V8—without loss of fuel economy. Buick is using the "Slick Six" in LeSabres and Skyhawks now and will make it the standard Six on '78 cars.

27-inch spread for GM cars

The difference in wheelbase between GM's biggest cars and smallest cars will be exactly 27 inches by 1980, assuming no change in plans during the next three years. The biggest cars will have a wheelbase of 114 inches, the smallest—a successor to Chevette—will have a wheelbase of 87 inches. GM is already at the 114-inch mark with Cadillac's Seville. If the numbers change, it's

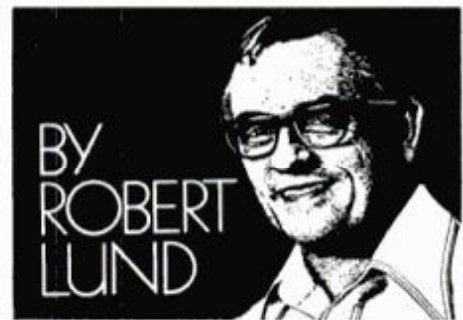
more likely to be on the high side, with a slight increase in wheelbase of the big cars, rather than a downsizing of the smallest car.

And the winner is . . .

There's a hot contest shaping up between GM, Ford and Chrysler to see which company will score the biggest gain in gas mileage on the '78 cars over the '77s. The figures won't be available until after the cars come out and even then you will need a pocket calculator to sort out the various claims and counter claims. There are umpteen ways of stating mileage to make one car look good and a rival car look bad. The only figure that really counts is the one for the particular car you want.

The front-runner at the moment appears to be Chrysler. The company is shooting for an average of 19 miles to the gallon for all its cars. That compares with 16.5 at the beginning of the '77 model year. GM will easily top that with an estimated 22 mpg for its new line of intermediates. But that's for only one line of cars, not for the whole fleet as in the case of Chrysler.

Ford is still a question mark and the company's standing will depend on how Ford fares with its new compacts, Fairmont and Zephyr. Ford is worried that it isn't selling more small cars. Government mileage ratings are determined in part by taking all cars a manufacturer turns out in a model year and averaging them out. Ford desperately needs more small-car sales to bring up its mileage rating. So there will be a major push behind Fairmont/Zephyr in '78 in the hope of increasing Ford's mpg rating. If the push is successful—increased sales of small cars accompanied by a corresponding decline in sales of big cars—Ford will show a sensational improvement in gas mileage over this year. ★★★



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But if you think you've got lots of time to get around to it, you're only kidding yourself.

The longer you knock around in dead-end jobs, the more you think that's all you're good for. You get used to being treated like a nobody. And you're so busy trying to take care of a wife and a kid and a mountain of bills, you never think about the hole you're digging for yourself.

Then one morning you wake up and realize you're over 35. Half your life is over and you're still going nowhere. With no real skill. No training. And nothing to look forward to but 30 more years of a job you hate.

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1. Buy a set of four Radial-Matics before July 31. And if you are not totally satisfied, call this toll-free number—(800) 521-6755—within sixty days of purchase.



We put shocks on a stagecoach to prove everything rides better on Radial-Matic. See our stagecoach commercial on national television programs.

2. Monroe will then arrange to replace the Radial-Matics at no charge with any comparably priced shock you want. It's just that simple. But you must act now, because the offer expires July 31, and is void in Alaska and Hawaii. In

those states, see your Monroe dealer for his special ride satisfaction offer.

Of course, after the 60-day ride satisfaction offer, Radial-Matic is still backed by the famous Monroe warranty.

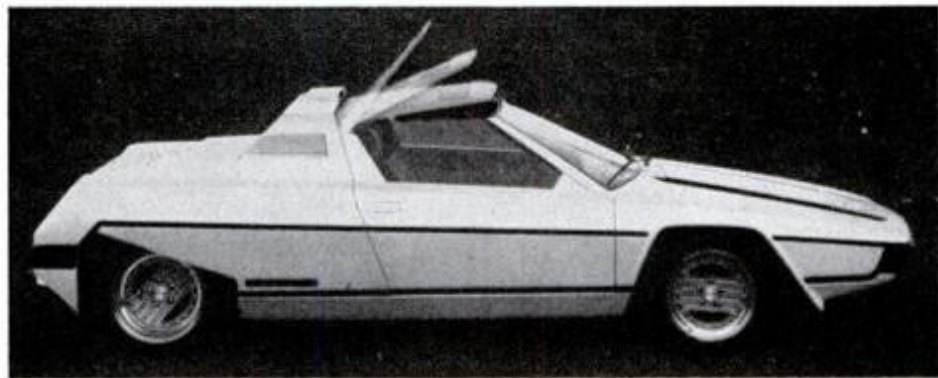
No one else makes a ride offer like this. But then no one else makes a shock like Radial-Matic. And we think that a shock this great deserves a great offer to go along with it.

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IMPORTS & MOTORSPORTS



Rainbow's pivoted roof disappears when in vertical position behind the seats.

Ferrari Rainbow

It's the slickest convertible design I've seen, and the credit goes to Italian designer Bertone. First shown at Auto Expo in New York, the Ferrari Rainbow has a roof that pivots back into a vertical position behind the seats. It would block vision to the rear if it didn't have a smoked-glass panel inset in it. When the roof is up, this transparent panel serves as a sunroof.

Even the name of the car makes sense: What do you see when the weather switches from rain to sun? A rainbow, of course. The Rainbow is built around Ferrari's Dino 308 GT4, but in appearance it more closely resembles the Fiat XI/9 which Bertone also designed. You won't find this car at your Ferrari dealer, or at the end of your rainbow. It's not scheduled for production. You'll have to settle for that pot of gold.

Slick six pack

Another fascinating design exercise, not meant for production, is this compact six-seater from Triplex Safety Glass Co. in England.

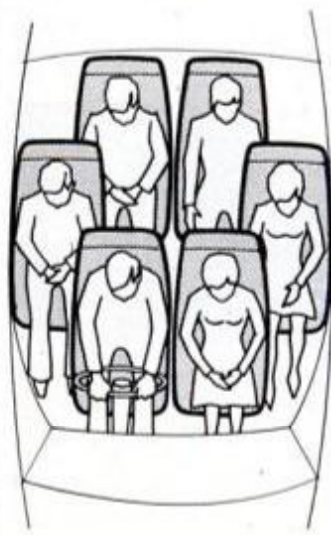
It's built around the Alfa Romeo Alfasud and features a unique seating arrangement that allows full legroom ahead of all six seats. The staggered seating layout is what catches your eye about the Triplex, but it was actually banged out to demonstrate advances in glass technology.

Goodies and gaskets

If you've ever owned an imported car, you know that Haan has the goodies and Sears has the gaskets. The Vilem B. Haan storehouse of international motoring accessories includes some needed hardware, but most items are for fine-tuning your driving. A new line of competition steering wheels is an example. Designed by Emerson Fittipaldi and distributed here exclusively by Haan, the Fitti E-3 is made with anatomic handgrips at 3 o'clock and 9 o'clock. The wheel fits



Fitti E-3 wheel.



Staggered seating arrangement of the Triplex design is shown at left. Each passenger gets full legroom with this layout. View above shows large glass area and removable Targa-style roof of bronze glass.

any car and prices start at \$95. Haan's neat catalog is still free: Write the company at 11401 W. Pico Blvd., West Los Angeles, Calif. 90064.

Sears 1977 Imported Cars Sears catalog.

Catalog of Replacement Parts and Accessories isn't as much fun, but it's got what you need to stay on the road. With the cost of using the U.S. Postal Service these days, it's no wonder Sears won't mail the catalogs. You'll have to pick one up at a Sears store.



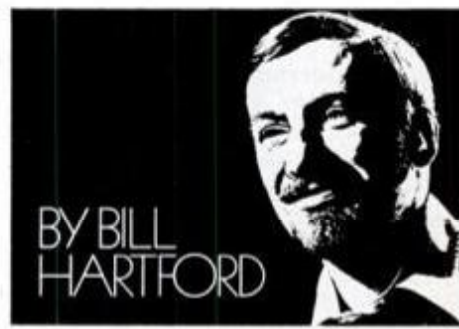
Battle of the belts

Maybe the battle to save life and limb on the nation's highways will have a victory by the time you read this. Brock Adams, Secretary of Transportation, may decide that with the airbag a few model years away at best, seat-belt use should be mandatory—to save lives now.

Belt laws are already saving lives in 18 countries. Indeed, the United States is just about the only motorized society in the world that does not require passengers to protect themselves with belts.

Full-time use of belts (only one in five wear them now) could prevent 89,000 traffic deaths and 3,220,000 injuries over the next 10 years, according to the U.S. Department of Transportation.

My pet peeve is reading about car accidents, deaths, and injuries in my local press with no mention made about whether the victims were belted. Chances are four to one they weren't. If the fact that the "unbelted victim went through the windshield" was reported, maybe usage would go up. How about asking your local police department and newspapers to include this in their reports. It's worth a try. ★ ★ ★



THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS BY THE EDITORS

Shock of a lifetime

It's hard to beat the deal you get now at big auto service centers. J.C. Penney auto centers, for example, now 450 strong, offer good service at reasonable cost. Moreover, the quality of auto products offered keeps improving. The latest replacement part to come out of JCP's product design department

HOLLOW PISTON ROD



TAPERED METERING PIN

Lifetime shocks for your wheels.

is a shock absorber with a unique feature: a tapered metering pin. Amazingly simple, the pin rides through a special valve in the piston and, depending on load and road conditions, allows more or less hydraulic fluid to pass through the valve. The design promises to offer a balance of comfort with heavy-duty control. Now becoming available nationwide, shock sells for \$14.99 and is warranted as long as you own your car—a boon to the owner who plans to keep his car for years. If that's you, buy only replacement parts guaranteed for the longest time or highest mileage. J.C. Penney Co., 1301 Ave. of the Americas, New York, N.Y. 10019.—B.H.

Mileage log

If you're of a record-keeping nature, or if you have to log car expenses for business reasons, there's a handy booklet.

Its main section records service intervals and is broken down into 1000-mile increments. So each time your odometer rolls over to three zeros, you know it's time to check or do something.

The *Kay 100,000 Mile Auto Maintenance Record* also has sections for recording expenses, gas mileage, travel records and repairs. It contains fuel-mileage tips and insurance data.

No car should be without a log of this type. But note that this particular booklet happens to be fairly large (4.3 x 11.0 inches), so it doesn't fit all gloveboxes. Price is \$2.95 plus 40 cents postage, from Kay Publications, 3003 N. Monticello Ave., Chicago, Ill. 60618.—M.L.

Buggy sitter

One way to keep an "eye" on your wheels, if they're within a range of 1200 feet, is with the electronic Page Alert system. The receiver (shown) is worn on your belt or kept nearby. The transmitter (not



Antitheft unit.

shown), installed in your car, sends a signal if your car is broken into. It's great if you're normally nearby: Car theft can occur right in your driveway! A continuous beep gives an audible alert. The Page Alert 100 costs \$180, but is certainly worth it if your buggy is usually parked in a high-crime area. In some parts of the country the average life expectancy of auto CB radios is less than two days! Page Alert Systems, Inc., Box 1013, Torrance, Calif. 90505.—B.H.

Clean thoughts

Any time is right to think about flushing and checking your cooling system. Some call it a spring job; others do it in the fall. I prefer summer, when my work uniform is a bathing suit. I reverse-flushed the last time but have never given

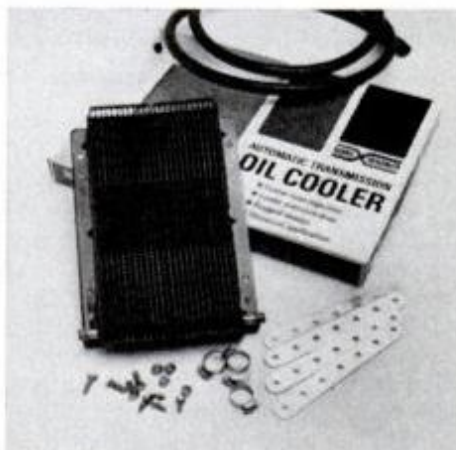


Peak cleaner.

my cooling system a real purging as it will get this year when I use Peak, a professional cleaner in \$5 16-ounce do-it-yourself cans. It dissolves rust and other deposits easily and is biodegradable. Northern Petrochemical Co., 2350 East Devon Ave., Des Plaines, Ill.—B.H.

A must for towing

You need an oil cooler for your automatic transmission if you tow a trailer, camper, boat, whatever. Borg-Warner has a do-it-yourself design that comes in three sizes de-



Automatic transmission oil cooler.

pending on your transmission's capacity. An unusual type of construction uses plates instead of tubes for faster heat transfer and for lower pressure drop. The kits are \$50 to \$70 and come with all needed hardware and instructions. Borg-Warner Corp., Automotive Parts Div., 11045 Gage Ave., Franklin Park, Ill. 60131.—B.H.

Trick clamp

If you like gadgets, you'll love these molded nylon hose clamps. You spread them apart, slip 'em over the hose or tube and squeeze. Unique ratcheting action of the Snap-It clamp locks tight. Clamps are easily removed by twisting and are completely reusable. They come

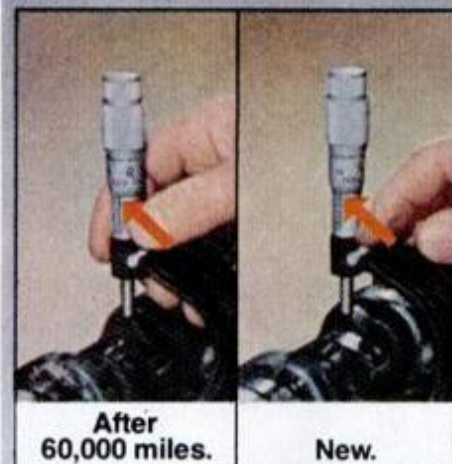


Molded nylon clamps squeeze-tighten.

in 10 standard sizes from 1/2 to 2 3/16-in. dia., can be used under the hood and for many other applications. KGL Co., 100 East Irving Park Rd., Roselle, Ill. 60172.—B.H.

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New STP Motor Oil was specially formulated to protect your car's engine against wear, sludge, varnish, rust and corrosion without an oil change for 15,000 miles, or one year whichever comes first, under normal driving conditions.



We know it will provide engine protection for 15,000 miles because we proved it in a 60,000 mile test.

After 60,000 miles on new STP Motor Oil the camshafts were compared to brand new cams.

We ran new STP Motor Oil in cars on



computer controlled test equipment which simulated highway driving and tough stop and go traffic. We ran it for 15,000 miles between changes for a total of 60,000 miles.

After the test, the engines were torn down and inspected. We found exceptionally clean parts and insignificant wear. As you can see in pictures on the left, the hard working camshafts from the test cars were compared

with a brand new camshaft. The average wear of the test car cams was so low, it fell within the manufacturer's tolerance specified for brand new cams. And that was after 60,000 miles.

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Filter Kings, 16 mg. "tar," 1.1 mg. nicotine; Longs, 18 mg. "tar," 1.3 mg. nicotine, av. per cigarette, FTC Report Dec. '76



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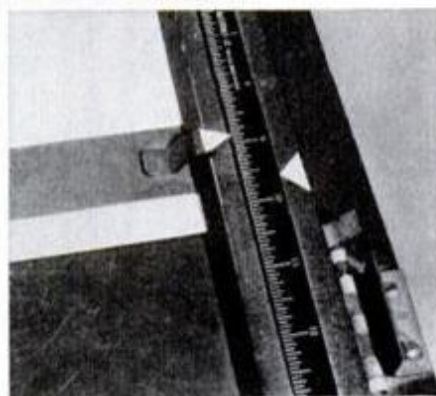
**PHOTO
HINTS
FROM READERS**

Switching accessories



Don't overlook other manufacturers' accessories. Nikon AF-1 gelatin filter holders, for instance, and adjustable hood fit my Minolta lens with adapter. The hood is sectional, saving on purchases of separate hoods. The holder allows use of cheaper, lighter, optically thinner filters, mounted on Calumet filter frames which provide easy handling and special filter construction.—*Stephen Peterson*

Print-border saver



If you use an adjustable enlarging easel, mount a triangle of white or reflecting stick-on tape at the end of the print border slide strips, and on the calibrated easel border just inside the limits of the enlarging paper size you usually use. Readily visible under the usual darkroom safelighting, the triangle will keep you from accidentally setting the border strips beyond the paper, thus "losing" the border. It's also wise to lacquer the black border slide strips red so they'll be visible under safelight where they cross dark areas of the projection.

—*George Daniels*

Only NRI gives you this 25" DIAGONAL designed- for-learning Color TV...plus complete Quadraphonic Audio Center!



Two home training schools give you a hobby-kit Color TV to assemble. Two others give you a commercial set right off the shelf. Neither was designed to teach you how to repair Color TV's. Only NRI invested the time and money to design equipment with learning in mind!

No other home training school gives you both a solid state Color TV and SQ™ Quadraphonic Receiver complete with four speakers...all in one course. In fact, to even match this kind of thorough training at another school, you'd have to take an

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NRI passes the savings on to you

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More know-how per dollar

It all boils down to the quality of training you get for your money. In our 62-year history, more than a million students have come to NRI and we're fully approved for career training under the G.I. Bill. We know the right way to make home training pay dividends for you.

Some of those "right" things are bite-size lessons to ease understanding and speed learning... personal consultation, and prompt grading of all tests...a full-time staff of engineer/instructors to help if you need it...the right kind of kits and experiments to give you hands-on training...and fully professional programs oriented to full or part-time career needs.

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Clarion CB Master Modulator Sweepstakes & Contest



\$75,000
in Prizes

200,000 Free CB Fact Books 6,662 Winners. Two Ways to Win

The new Clarion Mike System™ CB is the most advanced and exciting CB system available today. We want everyone who is even a little bit interested in CB to know about it. So we're offering a hefty bundle of valuable gifts and prizes as an incentive for you to visit our dealers. While the supply lasts, everyone who visits a participating Clarion or Datsun dealer can get a highly informative CB Fact Book and Language Dictionary.

200,000 Free CB Fact Books. (Retail value, \$1.95 each)

We're giving away a 128-page CB Fact Book and Language Dictionary with all the useful information every CB'er needs. It's got two CB language dictionaries, complete FCC rules, licensing information, features you should look for when buying a CB, and much, much more. It also includes full details about our Master Modulator Sweepstakes and Contest. Rules, prizes, and entry blanks are all in the book.



The Unique Mike System CB

The Mike System CB features an anti-theft remote transceiver that installs out of sight in your trunk, on the firewall, or under your seat. All the controls are on the mike, which easily disconnects for storage when you leave the car. As a result, there is virtually no chance of theft.

Our power mike action and full modulation give you maximum talk power, too. The Mike System CB is the first to work with the radio or tape system already in your car, utilizing your higher performance car radio speakers. You get bright sound, and clean sound too because our voice processing and noise blanking circuits deliver outstanding voice quality plus greatly reduced static. And, because you may not want to stay on CB all the time, we've built in a stand-by feature that lets you listen to your radio or tape player between CB breaks.

SWEEPSTAKES

6,612 Sweepstakes Winners

Just fill out the entry form in your free Fact Book, drop it in the mail and you may win one of these 6,612 prizes.

GRAND PRIZE... 810 Datsun Station Wagon. Fully equipped including a Clarion Hi-Way Fidelity sound system and a Clarion Mike System CB.

1st RUNNER-UP... A Kawasaki KZ 1000, the king of all grand touring motorcycles and a legend in its own time, plus a Clarion Mike System CB.

10 SEMI-FINALISTS... Daiwa Rods & Reels. The choice of fishermen who want the finest equipment money can buy.

100 QUARTER FINALISTS... The Popular Mechanics "Guide To Basic Auto Repair and Maintenance." Over 600 pages of useful and easy to read information on the care and maintenance of your car.

ADDITIONAL WINNERS...

- 500 Memberships in the Good Sam Club — The world's largest recreational vehicle club.
- 1000 Official Master Modulator T-shirts.
- 5000 Official Master Modulator emblems.

CONTEST

50 Contest Winners

If you are a good communicator, your skills could qualify you to win Clarion's Master Modulator Contest. We are going to pick the best modulator in each state, find a national champion, and add some fun for the good talkers everywhere. Get all the rules and entry information in your free CB Fact Book at participating Clarion and Datsun dealers. Qualified judges will first name 50 state champions, who will move on to a semi-final round of competition. Then we will select 6 finalists who will fly, at our expense, to New York City for a Talk-Off Round. As you can see by this prize list all 50 State Champions, finalists, and our Master Modulator will be very well-rewarded.



GRAND MASTER MODULATOR

- Datsun 280Z fully equipped including a Clarion Hi-Fidelity car sound system and a Mike System CB.
- \$5,000 personal appearance and TV contract. All expense paid 10-day vacation for two to London, England.

1st RUNNER-UP

- Datsun King Cab truck fully equipped including a Clarion Hi-Fidelity sound system and a Mike System CB.

2nd RUNNER-UP

- A rugged on/off road Kawasaki KE 125 plus a Clarion Hi-Fidelity sound system and a Mike System CB.

3rd RUNNER-UP

- Kawasaki KE 125 plus a Clarion Mike System CB.

4th & 5th RUNNERS-UP

- \$500 cash and a Clarion Mike System CB.

The six finalists will each receive an all expense paid weekend holiday for two in New York at the Waldorf Astoria Hotel where the Master Modulator Talk Off-finals will be held.

50 State Champions

- Clarion Mike System CB.
- Complete Outdoors Encyclopedia. Everything you need to know to be an active outdoorsman.
- Membership in the Good Sam Club.
- Official Master Modulator T-shirt.

One Last Note.

We believe in our Mike System CB, and we know once you see it and compare it with others you're going to want to ride with it. You don't have to purchase anything to win the Sweepstakes or the Contest. Sweepstakes and Contest entries must be received no later than September 1, 1977. You can enter one or both and win! Good luck.

Sweepstakes void in Missouri, Maryland and Wisconsin and wherever prohibited by law. Residents of Ohio only may write Clarion Corporation of America, 5500 Rosecrans Ave., Lawndale, CA 90260 for official entry blank and rules. Sweepstakes and contest start June 25, 1977.

For the name of a Clarion dealer near you
Call 1-800-821-7700 Extension 807
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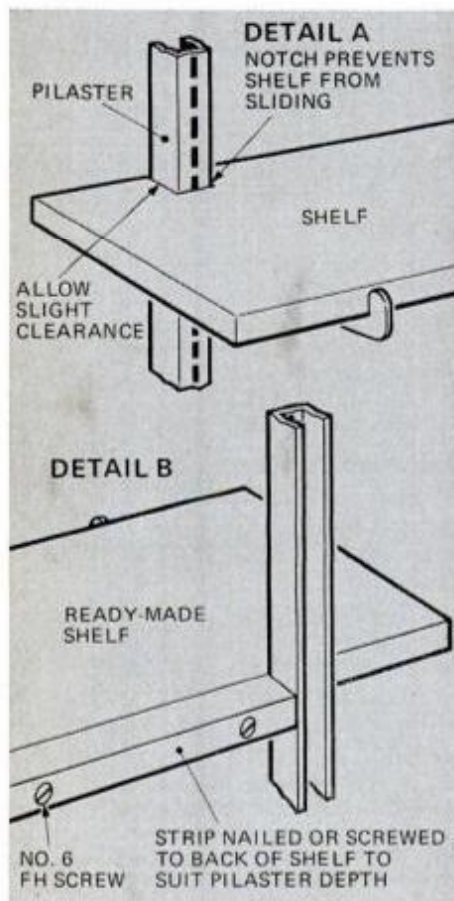
HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Unruly shelving

Can you suggest a simple method of preventing shelving that's on metal brackets from sliding sideways and from tipping when some heavy object is placed near one end? I need something that will not be difficult to make or unsightly.—Robert Page, Pittsburgh, Pa.

If you make the shelving yourself, cut the shelves slightly wider and notch the back edges as in detail A so that each shelf fits snugly between the vertical tracks when in place. Or, if you use ready-cut shelving, tack or screw a narrow



strip to the back edges as in detail B. The projection at the back edge will be unobtrusive when objects are placed on the shelves.

Long 'n wide veneers

I've contacted several sources for the wide veneers from 18 to 36 in. in lengths of 8 ft. that you suggested in a recent article, but I've failed to locate them. Can you tell me where they're available?—John S. Williams, Fort Worth, Tex.

The veneers you refer to in the widths and lengths given are avail-

able from Craftsman Wood Service Co., 2727 South Mary St., Chicago, Ill. 60608. These veneers are very thin, are flexible, can be installed on flat and curved surfaces and are available in all the common cabinet woods, including two kinds of oak.

Mildew and mold problems

Our concrete-block house built on a concrete slab has mildew and mold problems. The walls are furred and lined with plasterboard. What can we do to prevent mildew forming?—Leo W. Irwin, Grayling, Mich.

You do not say so I am assuming that mildew forms on the walls and possibly on window sashes. The formation is caused by excess moisture in the room air. You can reduce relative humidity by limiting teakettle boiling and installing properly sized ventilating fans in the bathroom, laundry rooms and kitchen. Take care to prevent release of undue moisture while cooking food and to reduce the release of moisture from a furnace humidifier if you have one. You might also look for and repair any leaks that permit outside moisture to enter your house. Owners of homes like yours often operate an automatic dehumidifier with good results (see *Dehumidifiers: The Low-Cost Way to Take the Sweat Out of Summer*, page 114, June '77).

Making new wood look old

To make a picture frame, I ripped strips from old, weatherbeaten wood. Now I have the problem of making the ripped edges match the color of the old wood on the surface of the strips. Can you suggest a procedure?—Norman Menning, Doon, Iowa

Were I confronted with this problem I would use artist's pigmented oil colors, or, next best, painter's tinting colors ground in oil. Mix these colors as you apply them. Use your finger or a matchstick to get the right color. Allow the color to

dry a minimum of 72 hours—a week is better—before joining the mitered parts. To add some texture to the edges, try using a punch-type can opener. Don't overdo it, though.

Is my basement really dry?

The concrete-block walls of my basement are tar-coated on the outside and waterproof-painted on the inside. I operate a dehumidifier during the summer. Yet anything we put in the basement mildews. Basement is dry. I give up. Any suggestions?—Etsil D. Nelson, Mansfield, Ohio

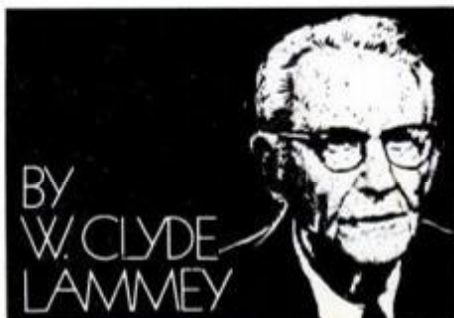
Obviously, your basement is not really dry. I think one of two essentials is lacking—air circulation or a dehumidifier of adequate capacity to maintain moisture in the air at a low level. If you correct one or the other—or both—you will at least minimize the trouble and perhaps eliminate it altogether. Yours is a common problem and as a rule these suggestions provide a cure.

Patching the kitchen sink

I have a cast-iron kitchen sink with a chipped spot roughly 1 in. in diameter in the side but below the normal water level. Can this be repaired? If so, how and what can I use to fix it?—David H. Eadline, Lafayette Hill, Pa.

You can make a fairly durable repair with an epoxy putty (not epoxy glue). Take time to do a thorough job of cleaning the depression; remove all residue. Press the putty firmly into the recess; allow it to dry for at least a week without getting any water on it. Even this repair cannot be expected to be as durable as the original finish. If epoxy putty is not available locally, contact Brookstone Company, 125 Vose Farm Rd., Peterborough, N.H. 03458.

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



New Ford F-250. For '77, our toughest 4x4 by far.

Ford's F-250 is new and it's tough. In fact, it's the toughest four-wheeler we build.

The F-250 is called a ¾-ton pickup, but it's rated to carry a maximum payload of almost two tons (3,665 lbs., to be exact). Its strong new frame delivers a whopping 8400-lb. maximum GVWR.

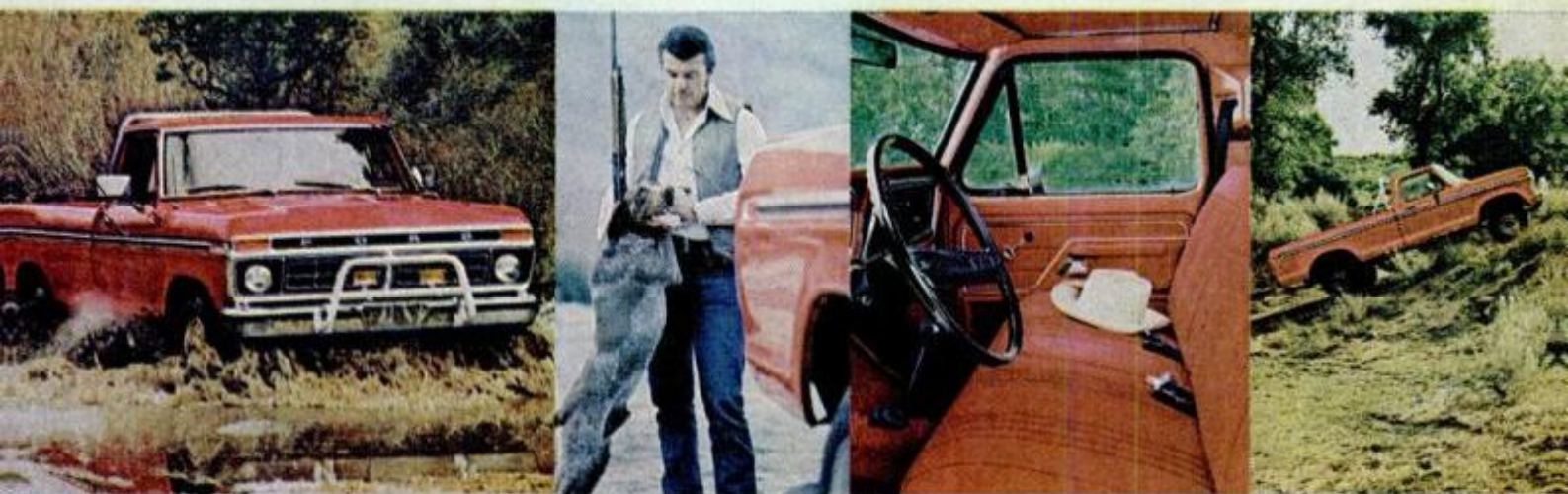
But the new F-250 is more than just tough. It has more than a dozen important new features in all. Like standard integral power steering. A turning radius that's been reduced by 12%. A new easier entrance

height. And more transfer case clearance than before.

And like all Ford 4x4s, the new F-250 (shown with and without owner-added roll bar, fog lamps and brush guard) has important features like:

- The choice of either part-time or full-time four-wheel drive with V-8 automatic.
- Two new optional big-cube V-8's—a 351 and 400.
- A full lineup of engines that run on any kind of gas.

Ford's new F-250 4x4. Off-road tough, with the muscle to get you there and back.



**Built
Ford
Tough**

93 out of 100 of all Ford Trucks registered over the last 12 years are still on the job.

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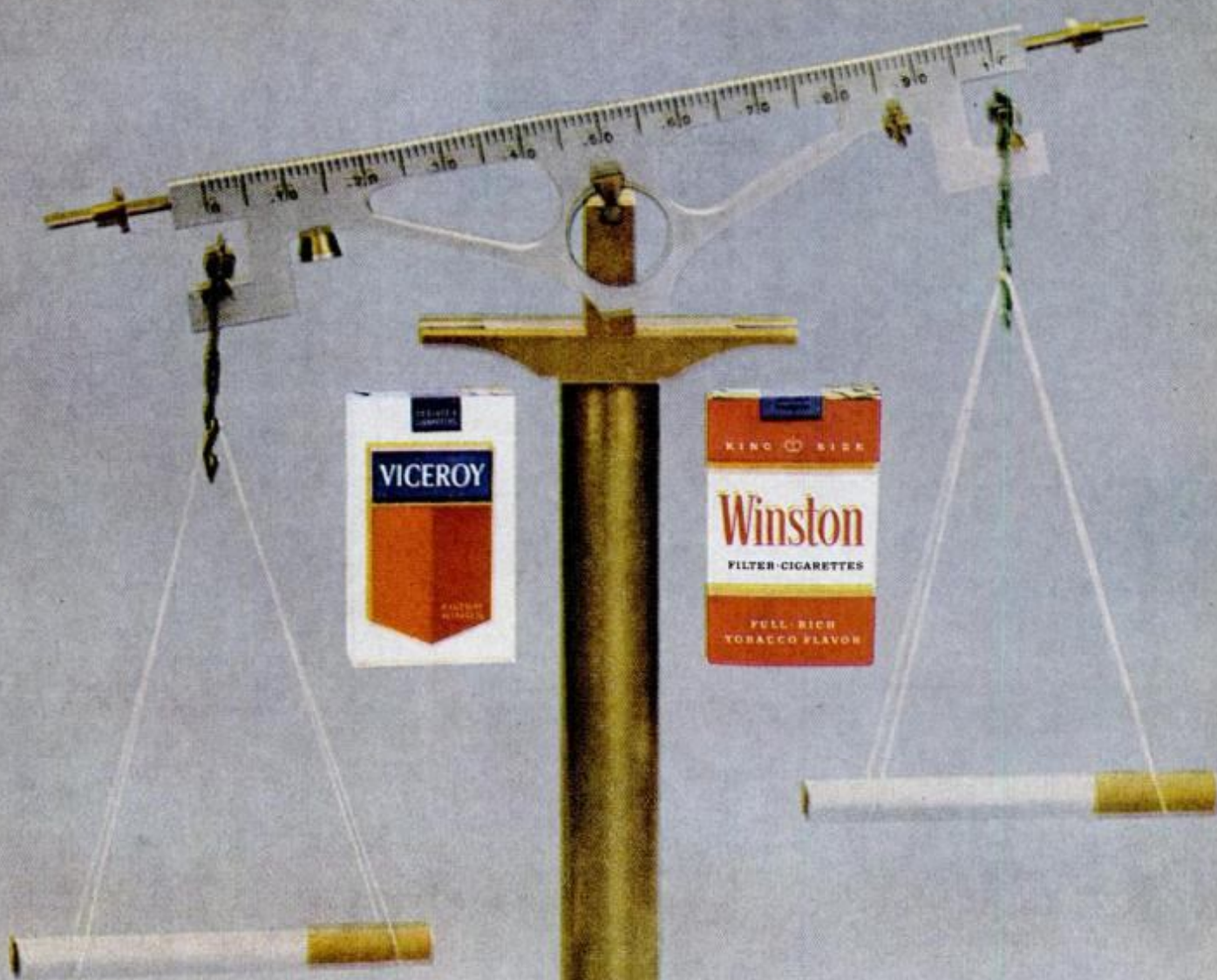
FORD DIVISION





Viceroy

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



More Tobacco
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Winston or Marlboro.

Instead of using stronger tobacco, Viceroy uses *more*¹ tobacco & a *lower*² 'tar' blend than Winston or Marlboro.

The result is a mild, fully packed cigarette with an extra satisfying taste.

And yes, lower 'tar' than Winston or Marlboro.

1. DURING 1976, VICEROY KINGS HAD, BY WEIGHT, 22-35 MGS MORE TOBACCO THAN WINSTON KINGS AND 40-52 MGS MORE TOBACCO THAN MARLBORO KINGS (AVERAGE PER CIGARETTE).
2. VICEROY HAS A UNIQUE, AGED-BLEND OF NATURALLY LOW 'TAR' TOBACCOS AND A SPECIAL PROCESS THAT ALLOWS THE USE OF MORE PARTS OF THE TOBACCO LEAF THAT ARE LOW IN 'TAR'. (VICEROY 16 MGS. 'TAR', WINSTON 19 MGS. 'TAR', MARLBORO 18 MGS. 'TAR' AVERAGE PER CIGARETTE, FTC REPORT, DECEMBER, 1976)

APPLIANCE CLINIC

QUESTIONS ANSWERED

Flubbed hub

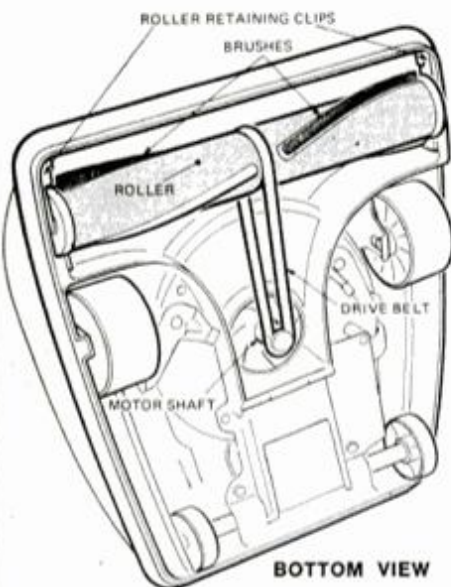
I own a General Electric automatic washing machine that has a weird agitator. During the wash and rinse cycles, it no longer agitates equally in both directions, but instead turns primarily in a clockwise movement. By putting hand pressure on the filter basket, which is positioned on top of the agitator, I can get the agitator to move more or less properly. What is my problem?—Charles M. O'Donnell, Brooklyn, N.Y.

The hub in the agitator is slipping. Has undue pressure ever been placed on the agitator assembly? Homeowners who overload machines often find themselves with this problem. The hub incurs damage, resulting in more movement in one direction than in the other. I think you will have to replace the agitator.

Deferred purchase

We have an old Hoover upright vacuum cleaner that no longer does a good job of picking up dirt. Is there any alternative to buying a new machine?—Michael Karl, St. Paul, Minn.

Lucky you. There is. The part of your machine that does the job of gathering dirt is a roller that has a line of thick bristle brushes. The



BOTTOM VIEW

Retainer clips hold the roller in place.

roller is driven by a belt which is connected to the motor shaft. If you turn the machine over and remove the bottom cover, you will see the setup. The illustration here shows it as well.

What happens in time to prevent your vacuum from effectively picking up dirt is usually one of two things: (1) The belt breaks, or wears and slips and the roller can't turn; (2) brushes wear and aren't able to scoop in dirt. The repair is very easy. Replace the belt and/or replace the roller. You can do both tasks yourself by pulling the belt off the motor shaft and releasing clips holding the roller.

Bad track record

The sanding belt of my belt sander won't track. No matter how fine I make the adjustment, or which belt I use, the belt either rubs the housing, or one-quarter of it runs off the rollers. Any suggestions?—Merlin Kindel, Milford, N.J.

Let's start with the easiest problem to correct. Are the sanding belts fresh? If not, they could be stretched, giving you trouble. Get new ones.

A bit more serious, but still not drastic, is the possibility that the rubber drive on the pulley (if your sander is made this way) is slick. Roughing up the pulley to provide more drag for the belt may solve your problem easily and inexpensively.

On a far more serious note, requiring that parts be replaced, are the following causes for sanding belts not tracking properly: a worn rear pulley that is not providing sufficient tension; insufficient tension by the front pulley because of a worn spring; flattened-out (worn) pads on the bottom of the pulleys which are preventing the pulleys from taking up the slack; and a bent front housing.

Person to person

May I add to your answer concerning the Magic Chef oven burner in the February Appliance Clinic?

Until recently I was a Magic Chef technician and many times encountered the same problem of a partial burner burning. You're right, the ports at the front or nose of the burner might be clogged, but with units that have pressed-steel burners, the condition is somewhat different. This type of burner consists of two pressed formed halves that are put together. Where cast-iron burners utilize ports, the pressed-steel burners have a thin

horizontal slit between the two halves that carry the flame around.

The slit is barely as wide as a safety razor blade is thick. A problem arises when the burner gets hot. Expansion of metal causes the slit to close enough so gas can't get through to carry the flame around. The following has worked for me:

Using a thin-bladed knife, spread the two halves of the burner just enough to insert small pieces of wire into the slit. Four pieces spaced evenly around the nose will be enough. You can use four average-size sewing needles instead of wire. The wire or needles will hold the two halves of the burner apart just enough to allow gas to escape through the slit.

To do this job, the bottom of the oven has to be removed and the nose of the burner lifted out. Take care not to spread the slit too far apart. A larger flame than necessary would develop at the nose. Thanks much.

—Ronald M. Heigert, Staunton, Ill.

Thanks much to you, too, Ron.

Broken arm

My Sears Kenmore portable dishwasher was purchased in October, 1969. The lower spray arm is not working. Dishes placed on the lower rack come out dirtier than at the start. What's the solution?—Mrs. Harry C. Prewitt, Salida, Colo.

Here it is in three parts:

1. Has the spray arm ever been removed? If so, it's possible that the center nut wasn't replaced properly. This nut has a bearing and flat side. If the flat side was accidentally placed downward, the spray arm could be locked in place. The nut's flat part must be up.

2. Remove the spray arm. There you will find a black hub that may have become coated with crud that may be impeding the spray arm. Clean out the area.

3. Finally, the spray arm itself may be worn in the center, which would cause the water to weigh down the arm more on one side than the other. This would prevent spray-arm rotation. The solution is to replace the spray arm. ★ ★ ★

If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 24 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.

CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY
MORT SCHULTZ



A finishing touch

I found your article, How to Stop Hesitation (page 102, Feb. '77), very interesting and helpful, but it left me with two questions. First, you say not to test an electronic ignition system by grounding out a sparkplug lead. This is an approved method for testing conventional ignition, so why not electronic? Second, you say special equipment is needed to check electronic ignition. Can you expand on this?—H.R. Stenberg, Brookline, Mass.

Of course. I caution against grounding out a sparkplug lead because of a safety factor. If you unknowingly or accidentally put your hand where you shouldn't, the jolt from electronic ignition will be sufficient to knock you on your rump. Not so when grounding out a secondary wire of conventional ignition. In comparison to electronic ignition, the amount of current is less and any shock would be just a tingle.

Even professional mechanics are warned about the consequences. For example, in service manuals published since the advent of electronic ignition, Cadillac has been cautioning service personnel not to remove sparkplug wires with the engine running.

"The higher secondary voltage... could cause electric shock," the company states.

A voltmeter can be used to get a general evaluation of overall electronic ignition system performance. However, for 100-percent-accurate testing and evaluating of individual components, such as amplifier modules and GM's HEI ignition coil, you need special testing instruments called for by the respective automobile manufacturers.

Stopping starting noise

I would surely appreciate any help you can give me on this one. I own a 1976 Chrysler New Yorker. On occasion, when I turn on the ignition to start the engine, the starter makes a terrible noise like the noise

that comes when your car is already running and you try starting it. The service department at the dealership where I bought the car has worked on this three times. Now, I'm told that unless they hear the noise, they can't do anything to fix it. Fat chance that the noise will be this accommodating. What can I do about it?—A.F. Vial, Menlo Park, Calif.

Easy. Direct the service department's attention to service bulletin 08-07-77. There has been a problem with Chrysler's new 1.8-hp starter motor. Sometimes, the starter will run but won't engage properly with the ring gear. The engine may not crank and/or a racket will be created.

A new starter pinion and clutch (part No. 4094174) has been issued to dealers. It should solve your problem.

Tu/be or not tu/be

I have a 1971 Toyota Corolla 1600. Clear water appears in the air cleaner after 50 miles of driving. There is frequently enough of a buildup so water enters the carburetor throat and causes rough engine operation and stalling. What can cause this?—Larry Poulin, West Warwick, R.I.

You know that choke on your carburetor, Larry? Well, it gets its heat through a tube that comes off the manifold. If that tube has a hole in it, the cool air entering the tube and mixing with hot air will cause moisture to develop. Look to the tube, Larry; look to the tube.

All in the family

My 1977 Mercury Bobcat is a joy to drive, but for one thing: It hesitates when the engine is cold—so badly at times that it almost stalls. Help, please.—Bob Miller, Columbia, S.C.

Hear, hear—owners of '77 Pintos and Mustangs. This applies to you, too.

The problem has been recognized, and the trouble diagnosed as an

electric-assist choke that is causing the choke plate to open too early. The result is a reduction in fuel enrichment needed for smooth cold-engine drive-away.

I might as well tell you that this isn't the only drivability problem which has arisen with these models. Engine stumble on wide-open throttle acceleration because of too much fuel being pumped by the accelerator pump is another.

Whatever, there are adjustments to be made. They have been approved by the EPA and are as follows:

■ The electric-assist-choke wire should be disconnected at the thermostatic choke cap and taped to the wiring harness.

■ The accelerator pump actuating rod should be moved from the No. 3 position of the accelerator pump overtravel lever to the No. 2 position. There are four holes in the lever: No. 4 position is topmost and the No. 1 position is on the bottom.

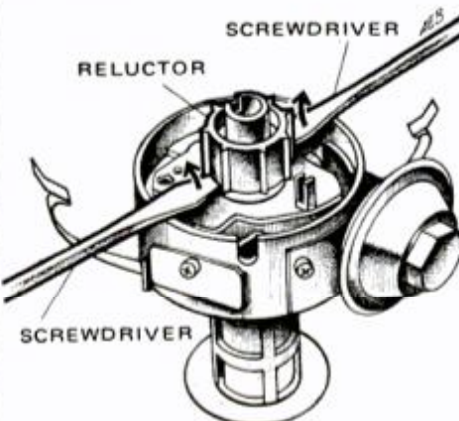
■ The accelerator-pump actuating rod should be moved from its in-board spot on the accelerator-pump

(Please turn to page 42)

Don't be reluctant— just cautious



Most producers use a pickup coil and reluctor as the basis for their electronic ignition systems. There may come a time when one or both may have to be replaced, such as when wear is excessive and the gap can no longer be maintained. This would cause a starting problem. Anyway, you must exercise caution in removing the reluctor from the distributor shaft since you could bend the shaft. Even a slight bend will prevent you from attaining the very close tolerance required between the reluctor and pickup coil. To remove the reluctor safely, slip two small screwdrivers held opposite to each other under the part and pry upward with steady, even pressure (see illustration).



Old Spice Stick Deodorant works up to XX hours.

Our lawyers will only let us tell you that Old Spice® Stick Deodorant works up to 24 hours.

In fact, on some people, Old Spice Stick Deodorant actually works up to XX hours.

Since we can't say how many hours XX hours is, we'll just have to content ourselves with telling you this:

Old Spice Stick Deodorant gives you fresh, clean Old Spice fragrance and protection up to 24 hours.

Give or take an XX or two.

SHULTON



CAR CLINIC

(Continued from page 40)

operating lever to the outboard position.

■ The thermostatic choke cap should be set to the center index from the 2-notch-rich mark. In other words, align the mark on the cap with the raised index boss on the choke housing.

If your car is still within warranty, have a Ford or Mercury shop perform the work. It's authorized by service bulletin 129.

Proper diet

Since I bought my 1970 Buick LeSabre in 1972, I have put in four starter motors. The last one went bad within the 90-day warranty period. The car has a 350-cu.-in. engine with a four-barrel carburetor and it has been driven only 55,000 miles. Why is it eating up starters?—Tom Medders, Fort Lauderdale, Fla.

Probably because you haven't fed it what it needs—shimming. The starter is more than likely being run too tightly into the flywheel gear, which is putting excessive load on the bearings or gear. It sounds to me as if you're doing

this work yourself, Tom, so you probably aren't aware of the fact that there should be 20 thousandths of an inch between the bottom of the flywheel gear and the starter pinion. You get this measurement by shimming the starter in or out.

Pointing a finger

I recently had a mechanic put new brakes into my 1966 Chevrolet Caprice. Since then, every time I have to stop fast the car pulls left or right and the steering wheel can't be turned until I let up on the brake pedal. This doesn't happen at a slow speed. The mechanic has done the job over, switching drums, changing brake fluid and bleeding the system. The car has new shocks, ball joints and idler arm and has had the front end aligned. Now the mechanic tells me to live with the problem, because he can't find anything wrong. Hope you can help me.—Mrs. Norman Guhl, Ewing Township, N.J.

I hope I can, too, because your mechanic doesn't seem to want to. Live with the problem? Baloney. The car didn't act this way before. It shouldn't act this way now.

There are numerous reasons for such pulling, but the most probable

ones in your case are the following:

- The wrong linings were installed.
- Linings were accidentally contaminated.
- Shoe return springs were improperly installed or accidentally damaged.
- Brake drums need turning.
- New linings and drums weren't matched, and new linings weren't ground to remove high spots so they mate fully with drums.
- Wheel bearings aren't correctly adjusted.
- Brake backing plates are loose or damaged.
- Wheel cylinders are seizing or aren't matched (wrong size).
- If your car possesses power brakes, maybe the valve rod linkage is binding.

Give this list to your mechanic and let him chew on it awhile.

Normal pulse

I service my 1974 Dodge Dart with 225-cu.-in. engine and power steering by putting the car on jack stands. I've noticed when I turn the front wheels from side to side with the engine off that power-steering fluid overflows from the spout of the steering unit. Is this normal, or do I have a sick car,



STAR PERFORMERS IN SPORTS

by Joe Garagiola

The great Bobby Jones took his first swing at a golf ball at age five, won his first tournament at age nine and the Georgia State Amateur Championship at 14. Between 1922 and 1930 he won 13 major golf crowns including the U.S. Amateur 5 times and the British Open 3 times. He was only 28 when he retired from competitive golf in 1930.



"WHEN YOUR CAR NEEDS SERVICE, GIVE IT THE STAR TREATMENT WITH MOPAR STAR PERFORMER PARTS."

Keep your car a Star Performer and ask for MOPAR renewal parts at service time. It's one of the surest ways to help keep your car in good driving condition. That's because MOPAR parts meet or exceed the original factory specifications of the vehicle for which they're intended—whether it's a Ford, GM, AMC, Chrysler, Dodge, Plymouth, import or light truck. So depend on MOPAR parts to help put back new-car performance and for all the high-quality parts your car will ever need. Remember, the best-kept cars are part MOPAR.



Doc?—Marvin Blumenfeld, Matawan, N.J.

It's normal. The moving piston in the power-steering gear is displacing fluid. Don't worry about it.

Tipping our hat

In the April 1977 Car Clinic, Gordon K. Thompson of El Paso, Tex., wrote asking about his pickup truck's "weird appetite" for coolant. You suspected the head gasket or an internal crack as causes, and rightly so. However, let me tell you my case with a 1976 Toyota Corolla with the same problem. I, too, thought it was being caused by a bad gasket or engine crack, but to my relief it was neither. We spotted a loose bolt on the manifold, which was tightened back up. I haven't lost a drop of coolant since. I hope this proves true in Gordon's case.—Glenn Foster, Brewer, Me.

We who overlooked the obvious thank you.

SERVICE TIPS

■ Here's a bit of good news for those of you who have been asking how to get service bulletins from Chrysler Corp. Technical service bulletins for 1975 or 1976 Chrysler Corp. cars may be ob-

tained by sending a check for \$7.25 to Chrysler Corp., Service and Parts Sales Div., Box 02807, Detroit, Mich. 48202. Let me clarify that. It will cost you \$7.25 if you want service bulletins for '75 or '76—\$14.50 if you want bulletins for both years.

■ Cadillac has issued a warning that applies to every make of car with automatic transmission. During predelivery operations, some service people are overfilling the transmission. This can result in fluid foaming and the transmission slipping. A word to the wise: When you take delivery of a new car, double check all fluid levels. Don't leave anything to chance.

■ A warning by the Automobile Assn. of America says that use of a CB radio while you're gassing up just might set off an explosion. Sparks can be created because of a loose connection. There is acute danger when a transmitter is mounted in the trunk near the gas tank and filler. So don't take chances. Cut the gas while gassing up. That's a 10-4 or, as they say it at the seminary, that's an amen, good buddy. ★★★

GOT A PROBLEM WITH YOUR CAR?

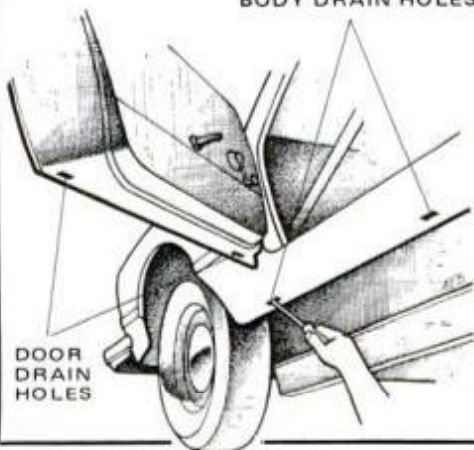
Just ask Mort about it. Send your question to the Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. While letters cannot be answered individually, problems that are of general interest will be published in the column.

Stopping body cancer

How many owners realize that a major reason for car body rot is that water gets trapped in doors, rocker panels and quarter panels, and a major reason for this happening is that drain holes get plugged? Every car I've ever seen has drain holes in doors and at body points (see illustration). They should be cleared out periodically with a small screwdriver to assure that the flow of water out of the body is unobstructed.



BODY DRAIN HOLES



MOPAR HAS A STAR-STUDDED PARTS LINE TO HELP RENEW THE PERFORMANCE OF PRACTICALLY EVERY CAR AND TRUCK ON AMERICA'S HIGHWAYS.



MOPAR Star Performer Parts are available at auto parts stores, many service stations, and independent garages.

STAR PERFORMANCE CHECKLIST

Put your car through this checklist:

- Brakes. Does pedal go more than halfway to floor? Is it spongy? Does it continue to sink under pressure?
- Motor oil level.
- Power steering fluid level.
- Belt condition and tension.
- Battery fluid level.
- Battery cable condition.
- Coolant level in radiator.
- Radiator and heater hoses.
- Tire wear. Are wear indicators showing? Is wear uneven?
- Shock absorber action.
- Stains from leaking fluids.



Mopar



STAR PERFORMERS



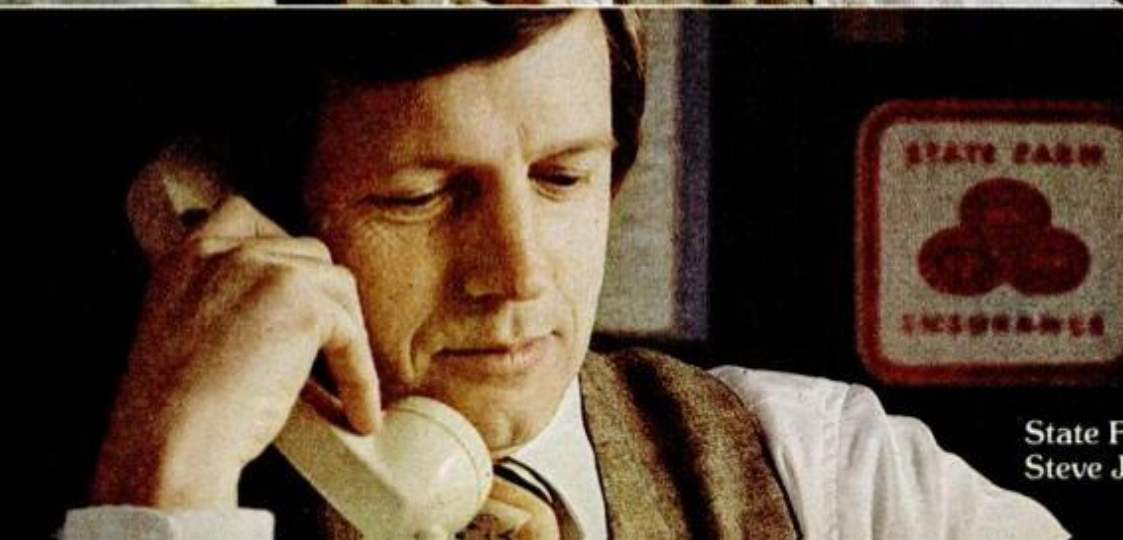
State Farm Life Agent
Steve Johnson



State Farm Health Agent
Steve Johnson



State Farm Homeowners Agent
Steve Johnson



State Farm Auto Agent
Steve Johnson

When it comes to family insurance, Steve Johnson is one of a kind.

Jeanne and Bob Beals of Chesapeake, Virginia, are extremely happy with their life insurance agent.

They're very pleased with their health insurance agent.

They're completely satisfied with their homeowners agent.

"And we know our car insurance man is the best around," Bob says. "We feel fortunate to have him so close by."

Of course, whatever the Beals think about one agent, they're bound to think about the others.

Because all of them are State Farm agent, Steve Johnson. As a family insurance specialist, Steve can provide knowledgeable advice and person-to-



person service on all the policies they're ever likely to need.

"If we have any question about our coverages, or a claim, we don't have to wonder who to call," says Jeanne. "We just

call Steve. It's a real advantage having one agent nearby who can help us with everything."

Having a State Farm family insurance man can be a real advantage for you.

He's the one agent who's backed by America's largest homeowners and auto insurer, and one of the largest life insurance companies, too.

And there's probably one like Steve Johnson in your neighborhood. Check your Yellow Pages.



Like a good neighbor, State Farm is there.

STATE FARM INSURANCE COMPANIES Home Offices: Bloomington, Illinois

A man wearing a white cowboy hat and a dark leather vest over a dark shirt is riding a brown horse with a white blaze on its face. He is looking to the right and has a lit cigarette in his mouth. Two packs of Marlboro cigarettes are overlaid on the right side of the image: a red pack of Marlboro 100's and a gold pack of Marlboro 100's. The red pack is in the foreground, and the gold pack is behind it. The background is a plain, light-colored wall.

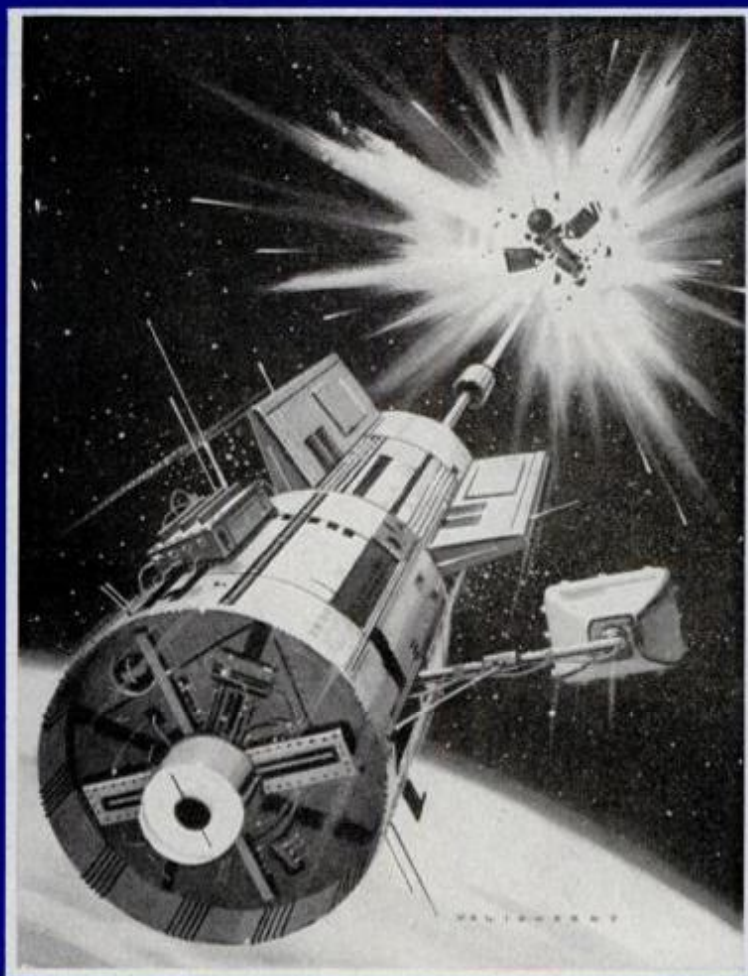
Come to where the flavor is.



**Marlboro Red
or Longhorn 100's—
you get a lot to like.**

18 mg. "tar," 1.1 mg. nicotine av. per cigarette, FTC Report Dec. '76

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



Will the next war be fought in space?

by Edward Hymoff

A hunter-killer satellite silently stalks another satellite in space. Slowly closing on its prey, it blasts it out of orbit. An early-warning satellite is "blinded" by the brilliant flash of a laser beam. Unable to "see," it fails to detect the oncoming barrage of ballistic missiles—in an instant its country is destroyed. A space Shuttle suddenly appears from nowhere, grabs an enemy satellite in its mechanical claws and pulls it into its cavernous cargo bay—like a giant man-eating insect. Trapped,

space war



EARLY WARNING
SATELLITE IS
"BLINDED" BY
LASER BEAM FROM
EARTH OR OTHER
SATELLITE

"MINE-LAYER"
SATELLITE
SOWS PATH OF
ONCOMING ENEMY
SATELLITE WITH
EXPLOSIVES

ENEMY SATELLITE
FLIES INTO
MINE FIELD,
IS DESTROYED

SELF-DESTRUCT
"SACRIFICIAL"
SATELLITE RAMS
ENEMY SATELLITE,
BLOWS UP BOTH

the enemy satellite is a doomed "prisoner" captured far out in space, no longer able to detect or attack opposing spacecraft. And so the satellite "dogfight" continues—one zaps another, then it, in turn, is itself zapped out of the sky, a molten mass of blazing wreckage spinning crazily out of orbit to a fiery death in the atmosphere above us.

Science fiction? No, these are not scenes from a Buck Rogers or Flash Gordon comic strip. They are just a

few of the many very real and possible techniques that could be used in a future global war—a weird and eerie conflict fought thousands of miles out in space. The technology exists today; the capability is not far away.

Why should anyone want to shoot down satellites? Because, quite simply, they are our "eyes" in the sky. In today's modern sophisticated art of warfare, highly sensitive early-warning satellites have become our first line of defense—just as our now

largely obsolete DEW line used to be. Especially for the superpower nations that rely on them, satellites form a vital part of long-range detection, communication, navigation and missile-guidance systems that would be useless without them.

Eventually, "armed" satellites could be used as attack weapons as well as defensive aids. Any nation able to knock out another nation's satellites could, in effect, cripple all its enemy's forces in minutes with-

ICBM IS
"SHOT DOWN"
BY LASER
BEAM FROM
EARTH

HUNTER-KILLER
SATELLITE
DETECTS ICBM,
KNOCKS IT
OUT WITH LASER

BALLISTIC
SATELLITE
DEORBITS
TO BECOME
ITSELF A
HUGE BOMB

GOTCHA! SPACE
SHUTTLE CAPTURES
ENEMY SATELLITE
WITH MECHANICAL
CLAWS, PULLS IT
INTO CARGO BAY

out shooting down a single plane or sinking a single ship. The war could be over before it even began.

The Russians realized this years ago and since 1967 have conducted a series of 16 experiments designed to develop a special breed of hunter-killer satellite whose sole purpose is to blast unwanted foreign satellites into oblivion. This intriguing—and frightening—prospect took on a new and even more compelling importance when the mainland Chinese started

launching experimental spy satellites of their own in February 1976. The Soviet spy-in-the-sky developments stepped up in pace dramatically.

Last December, radar observers with the North American Defense Command (NORAD) watched spell-

bound as two Russian satellites went through a hunter-killer exercise as they orbited the Earth. One satellite acted as the "victim" while the hunter first circled it, as if inspecting it, then used a camera to "shoot" it, experts believe. The implication was grimly clear: If you can maneuver one satellite close enough to another to take its picture, you can also maneuver close enough to blow it up.

It is well known that most satellites already carry self-destruct ex-

plosive charges that can be triggered by radio command from Earth. So far, this capability has been used only to get rid of unwanted satellites that have strayed from orbit, gone dead or otherwise outlived their usefulness. But if you can explode a satellite on command, you can also make it a controllable bomb. Just sneak it up next to an enemy spacecraft, press a button and—pow!—no more enemy satellite.

Last fall word leaked out about a satellite attack that was neither an experimental exercise nor a war game between two Soviet spacecraft. This time the victims were two U.S. satellites, an early-warning surveillance satellite and a companion message relay satellite. The surveillance satellite had been blinded and its companion totally crippled. What really happened is still being debated. The official explanation is that the bright glare of fires burning off nat-

lights and sharper television systems to show Earth watchers what the attackers look like, and they carry extra fuel and rocket power to get out of the killer's way.

In addition, these are backed up by a small fleet of decoy satellites that also give off an alarm when they spot an intruder and, if necessary, will suicidally eliminate the hunter-killer by rushing up to it and exploding.

As another backup precaution last March we launched the first two of a new series of "dark" satellites. Built with special exteriors to make them invisible to conventional radar, these will be set out in deep space where they will wait silently to be called into action to substitute for destroyed satellites.

To implement its own seek-and-

the unmolested territory, the sanctuary that it is today."

What could change this "sanctuary" into a real battlefield, according to many experts, is the development of some kind of "death ray"—a weapon that needs only one shot to destroy its target and that has no effect on the vehicle used to fire it.

Regular weapons no good

Except for sacrificial satellites that deliberately blow themselves up, conventional weapons are of little use in the vacuum and weightlessness of space. Trying to fire a small 20-mm cannon from a satellite would have the same effect as igniting a propulsion rocket on the craft—the reactive force of the gun's recoil would blast the satellite out of orbit in the opposite direction, rendering it useless.

What's needed is something that's fast, deadly—and recoil-less. Right now, the prime candidate to fill that spot in our space arsenal is—you guessed it—a weapon using Light Amplification by Stimulated Emission of Radiation, better known as the laser. In theory, the laser is the perfect space weapon. It's fast—literally traveling at the speed of light—has no more kickback than a flashlight beam, and actually would be even more efficient in space than on Earth.

The reason is the laser is a beam of light so concentrated it can bore through the densest of materials. On a cloudy or foggy day on Earth this concentration tends to get broken up, but out in airless space this is no problem. Equipped with a high-intensity laser gun, a soldier satellite

If you can explode a satellite on command, you can make it a bomb. Just sneak it up to an enemy spacecraft and—pow!—no more enemy satellite.

ural gas on a Soviet pipeline caused the blindness, but skeptical critics say it would have taken a fire 10 to 10,000 times brighter to cause that kind of damage. Some speculate that the spacecraft were knocked out by an experimental high-powered laser beam from Earth.

Of course the Pentagon has not been unaware of this renewed Soviet interest in satellite warfare and has a few defensive and offensive tricks of its own. Back in the early 1960s it briefly toyed with the idea of a one-on-one Satellite Inspection Technique (called SAINT) by which we would launch satellites to check out every one put up by the Russians. However, the idea was scrapped after it was realized they were putting up far too many for us to look over one at a time.

Attack alarms

Among the ideas that did make it is the special equipment added to new models of our SAMOS (Satellite and Missile Observatory Systems) and MIDAS (Missile Defense Alarm System) satellites, part of our fleet of "Big Bird" surveillance/reconnaissance network 50,000 miles out in space. They are now equipped with special alarm systems to alert Earth if they come under attack by hunter-killers. They have high-powered

destroy strategy against hostile spacecraft, the Pentagon is considering such sneaky tactics as using "mine layer" satellites to sprinkle clusters of explosives in the orbital paths of unwanted satellites or even using the Space Shuttle with its large cargo bay to kidnap enemy satellites, snatching them literally out of space.

The subject of arming satellites for open warfare with one another is a very touchy one, both militarily and diplomatically. The reasons are the 1967 Outer Space Treaty by which both Moscow and Washington agreed to ban weapons from space, and the 1972 antiballistic missile treaty in which both agreed to leave each other's spy satellites alone.

In fact, it was the 1972 treaty which banned another satellite weapon, the Russians' Fractional Orbital Bombardment System. Essentially this was a bomb in the form of a satellite which hugged the planet in a close Earth orbit. On command, it could break its orbit and plunge to strike an Earth target and detonate.

In spite of these treaties, no one is so optimistic as to think that all will remain quiet on the outer-space front forever. As Dr. Malcolm R. Currie, director of Defense Research and Engineering for the Pentagon, remarked: "Over the next 10 to 15 years space is not going to remain



THE RUSSIANS PLAYED SPACE WAR

could cripple an enemy satellite or an Intercontinental Ballistic Missile (ICBM) as it arched above the atmosphere on its destructive run.

One problem, however, is that a light beam of weapon-strength intensity takes a tremendous amount of energy. For example, one arms specialist says we could build a long-range laser cannon with our present know-how. The only trouble is it would be a huge piece of apparatus and would need most of the electricity generated in the northeastern United States to make a single shot. "It's great protection," he says, "if you don't mind living by candlelight."

In spite of the obstacles, both powers have been pushing ahead. As long

ago as 1964, Nikita Krushchev, then Russia's Premier, was bragging to a visiting American industrialist that "our Soviet scientists are superior to yours." As proof he picked up a steel ruler sitting on his desk and pointed to a series of different-sized holes drilled in it.

"You see these holes?" he asked his visitor. "They were drilled by rays of light that our scientists created!"

Here in the United States our own laser weapon research is done at Kirkland Air Force Base in Albuquerque, N.M., under the code name "Eighth Card." Working under the direction of the Defense Advanced Research Projects Agency (DARPA), scientists have already come up with a small arsenal of laser weapons.



Not quite a "death ray" yet, but this laser-aimed bazooka-like rocket launcher is getting close to the ultimate deadly weapon. Laser beam spots target, then rocket "rides" beam to score hit. The portable field piece is designed to let foot soldiers knock out enemy tanks and low-flying planes at great distances. Similar system could be adapted for space-war use.

In lab tests, as shown at left on facing page, laser beams of highly concentrated light have burned holes in steel and "fried" other materials. There's no doubt that a short-range "killer" ray is feasible; main problem is the tremendous power needed to produce laser beams with enough range to be combat-practical.

Experimental laser-guidance equipment is installed in the nose of military aircraft at right. Lasers are used both for precise aerial navigation and pinpoint fire-control systems that help to direct air-to-air missiles to unseen targets miles away. They can also guide missiles to enemy ground targets.

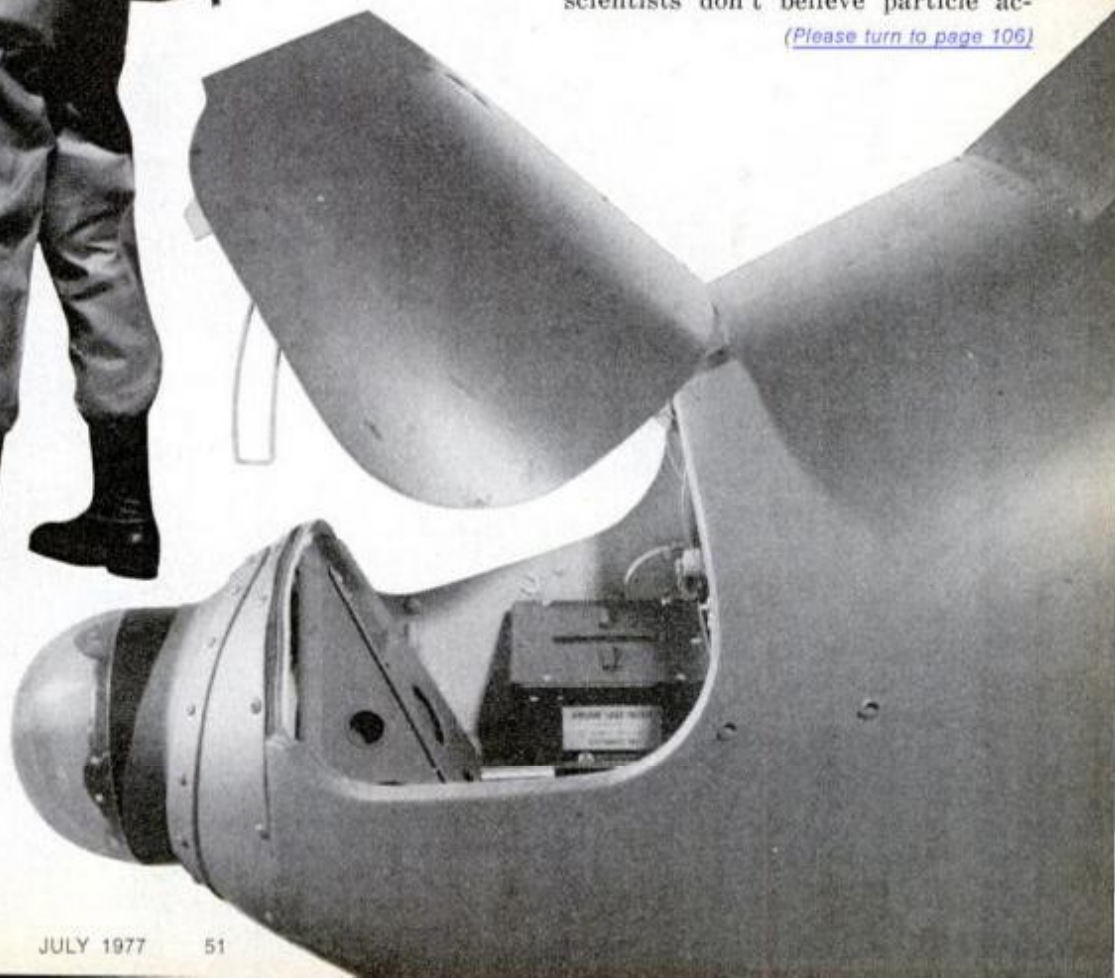
The Army has developed a rifle-like ranging laser for its tanks and artillery as well as a tank-mounted laser cannon. The Air Force has another laser powerful enough to knock an airborne target out of the sky. And in a report to Congress this past February, DARPA director Dr. George H. Heilmeyer admitted his agency is also working on satellite armaments using lasers. In fact, some experts believe the United States will have its first laser weapon in space by the 1980s.

Next: particle beams

Another version of the death ray getting special attention from the Russians is the particle-beam weapon that accelerates charged atomic particles, such as protons and electrons, and uses large electromagnets to aim the stream of particles. According to military intelligence, the Russians have had a huge research commitment to this weapon for the past 20 years. The word is they may have an experimental model ready for testing some time this year, and plan to have it fully operational by the 1980s. In May, the highly regarded industry magazine *Aviation Week and Space Technology* reported ominously that such a breakthrough "may soon provide a directed-energy beam weapon capable of neutralizing the entire United States ballistic missile force."

U.S. research in this area has not been so intense largely because our scientists don't believe particle ac-

(Please turn to page 106)



NEW STYLES FOR STAYING AFLOAT

The throwable \$10 buoyant cushion is safe only when worn across the chest (as shown by Cypress Gardens, Fla., water skier) to float swimmer in face-up position.



Latest life-preserver laws require these special types on every boat.

by Bill McKeown
BOATING EDITOR



Two giant steps have been taken recently to keep us alive on the water.

One is a new law making it illegal to go out on any kind of boat without a life preserver along.

The second development improves the looks and fit of preservers so much that a boatman is tempted to wear one instead of stowing it out of reach and sight.

Any boat—and that now means rafts, rowboats, canoes, kayaks, sailboats, skiffs, anything you can paddle or power or sail away from land—must carry the right preserver for each person aboard if the waterway is under Coast Guard jurisdiction. You don't even have to be aboard; if you're out on water skis, a preserver for you must be carried aboard the towboat. The rules apply just about anywhere you might go boating. State laws have been passed to cover waters that don't come under Federal regulations, and sometimes are more strict than the Coast Guard requirements.

During 1971, a Federal Boat Safety Act was passed to update a num-

ber of recreational watercraft laws, and since then additional changes have been made. For a while, exceptions were allowed for canoeists who claimed they needed to wear more flexible nonapproved vests in order to paddle easily. Now, however, light loosely fitting vests have received Coast Guard okay and all boatmen must follow the rules.

Latest requirements are quite straightforward. Life preservers are called Personal Flotation Devices (PFDs), and must be labeled "Coast Guard Approved Equipment" which shows they have been examined and comply with CG specifications as to materials used, construction and performance. Some preservers, such as ski belts and Mae West types that are inflated by CO₂ cartridge or mouth are not approved because they might not keep a wearer upright or do not inflate automatically if he is unconscious. They are useful to have along, but will not count as legal equipment if you are stopped

(Please turn to page 122)



Colorful, practical and all Coast Guard approved, these new life preserver PFDs are (from left) Grumman canoe model, \$26; Cypress Gardens Ski-Pro, \$33; Stearns Sans-Souci Sportsvest, \$35; Cypress Gardens vinyl jacket, \$35; Stearns Pee Wee Sans-Souci, \$20; Cypress Gardens Tech-1, \$37, and Stearns Windjammer Jacket, \$68. Black Tech-1 comes with matching water skis and ski case.

At last, an 'American' mini-car that can hold a candle to the competition.



At the wheel of the Fiesta, as shown below, you experience what big-on-the-inside, small-on-the-outside means to a driver. Sun roof adds to spacious feeling, of course, as does the open, shelf-like, right-side dash. Note that front vent windows are back! As evident above, hatch door opening extends to bumper. Front end is indistinctive.

Driving the



FIRSTHAND REPORT

by Michael Lamm
WEST COAST EDITOR



European Fiestas differ slightly from the U.S. versions. Overseas Fiestas come in six levels of trim as against four here.

The U.S. Fiesta uses the 1600-cc Kent engine while European versions carry 957-cc and 1117-cc powerplants — all identical except for dimensions. Minor body details like headlamps and upholstery also differ for different sides of the Atlantic.

The Fiesta represents Ford's answer to GM's world car—the GM T-Car, which we know in the United States

What's it like to drive?

I picked up a Fiesta Sport at Bill Stroppe's garage in Long Beach and, together with photographer David Gooley, put a quick, enjoyable 132 miles on the car. We took ourselves on a pleasant tour of the immediate Southern California area.

Gas mileage came to 32.9 mpg in what probably didn't amount to a fair test. The car was nowhere near broken in, and it's pretty unscientific to base a mileage figure on just one refill. Even at that, 33 mpg isn't half bad considering our trip included highway, mountain and considerable stop-and-go driving.

The Fiesta's engine impressed me as being agreeably strong and flexible. I could throttle down to 10 mph in fourth and hold it there, then shift to second and take off like a flicked fly. The pushrod Four likes to go, thank goodness, and while it's a little noisy accelerating, there's no buzz nor hum at freeway speeds.

The four-speed transmission shifts with remarkable ease—it's smooth, positive and well-ratioed. Reverse takes a shove downward on the gear-shift lever, like the VW Beetle, and involves a bit of practice.

The Fiesta handles extremely well, with excellent roadholding and fine directional stability in crosswinds. I feel some credit for this has to go to the Michelin radials, standard on all Fiestas.

I found no particularly noticeable torque steer under normal acceleration, but when making fast J-turns under full throttle, the rack-and-pinion steering doesn't want to recenter itself automatically. It requires physically turning the steering wheel back to the straight-ahead position under those rare conditions.

Considering its very positive cornering ability, the Fiesta rides well, without the jiggliness of so many short-wheelbase cars. Front suspension comes via conventional Mac-Pherson struts (invented at Ford and now practically universal among smaller cars), but the rear axle is a five-link, coil-suspended, steel tube beam with a track bar, antiroll bar, and freestanding tubular shocks. The entire suspension system is heavily isolated by rubber bushings, helping to make the Fiesta admirably quiet on the road.

Inside the Fiesta

Instrument layout on this Sport model includes a tach, temp gauge,

Ford Fiesta

Ford's "world car," the Fiesta, has come to America. It's a huge international undertaking—engineered mostly in Germany, available on the Continent since September 1976, launched in England early this year, here this summer, and slated for South America, Africa and Australia in the near future.

Where exactly is the Fiesta built? All over. Everywhere. Cylinder blocks and crankshafts are cast in Dagenham, England, but European Fiesta engines are assembled in Valencia, Spain. Versions destined for American shores, however, have their engines built in Kent, England.

Carburetors come from Belfast. Transmissions and axles are made in Bordeaux, France, and some gears and aluminum castings come from Cologne, which also supplies a number of the Fiesta's body stampings. Wheels? Genk, Belgium. Gas tanks? Saarlouis, Germany. Sparkplugs? Enfield, England. Radiators? Basildon, England.

And the cars themselves finally come together, all miraculously whole and similar, in three huge assembly plants; one in Saarlouis, one in Valencia and the third in Dagenham.

Ford's 'World Car' ideas

Only an organization as huge as Ford of Europe could oversee such a complex logistical arrangement. Even at that, it takes a fleet of aircraft, ships, rail cars, trucks and Ford's incredible communications network to get the many parts where they're needed.

as the Chevette, in Europe under Opel and Vauxhall nameplates, and in Japan as the Isuzu Gemini.

And I should mention, too, that Chrysler's international division is readying its own world car, currently coded 1307-1308. Like the Fiesta, Mopar's mini uses a transverse Four and front-wheel drive. Chrysler plans to begin production soon in France and hopes to bring this car into the United States the first months of 1978.

You can see, then, that Ford has quite a lot riding on the Fiesta—a tremendous investment in the present and future. There's talk of the Fiesta being another Model T—an everyman's car. And perhaps it is.

Car design convergence

Sociologists theorize that all world cultures are tending to blend together, and eventually there'll be only one World Culture.

Cars are likewise dovetailing into what amounts to two basic designs. Big cars follow the pattern exemplified by Mercedes—the "3-box" school of squared-off styling: hood, greenhouse, trunk.

The minis are heading, it seems, in a different and much more radical direction, namely to crosswise engines, FWD and unit bodies—all pioneered by the BMC Minis, introduced in 1960.

Today, the Fiesta is only the latest representative of an automotive design convergence that includes, worldwide, the VW Rabbit, Honda Accord and Civic, Fiat 128, Lancia, BLM Minis, Datsun F-10 (Cherry) and Peugeot 104.



Easy service features include translucent reservoirs to quick check fluid levels.

trip odo, speedo and a raft of warning lights, all handsomely packaged and very readable. Switches stand in stalks on the steering column.

There's a broad parcel shelf with a cavernous (and I mean *cavernous*) glovebox on the passenger side. Door bins and map pockets on front seat-backs are nice unexpected touches in Sport and Ghia versions.

Supercomfortable seats recline and adjust about every which way, so you can find a comfortable driving position, no matter how tall or short you are. Rear-seat legroom is ample, but there's not an overabundance of headroom in back.

For cargo, the rear hatch lifts to expose a double-floored trunk. The rear seat folds flat for more volume, and another bin is under the bottom floor next to the recessed spare. In Ghia versions, this bin is plastic-lined and lockable.

What about serviceability?

Ford engineers went to great lengths to make the Fiesta easy to work on. Word came down from on

high to "simplify wherever possible."

Early in the Fiesta development program, electrical engineers scrutinized the car's wiring harnesses and got rid of 40 percent of the proposed electrical connections.

Researchers studied the 100 most common repair problems of FWD subcompacts and found ways to cut repair times in the Fiesta. Front disc-brake rotors, for example, can be checked and changed without removing hubs or bleeding the system.

Suspension components are set up for quick replacement. The exhaust plumbing uses quick-release hangers. Major engine, clutch and transaxle work can be done without taking out the engine. The heater

have been carefully thought through to avoid pockets and traps that might catch road salt and mud. So in theory, at least, the Fiesta comes as a backyard mechanic's delight.



Cast-aluminum-alloy wheels, optional of course, were designed for the Fiesta.



Flip-up sunroof option tilts up at rear edge or it can be removed completely.

Levels and options

The Fiesta comes in four basic trim levels: Standard, Decor, Sport and Ghia. We guess that base price will be around \$3500.

The Decor group gets you plusher seats that recline, rear-window defroster, more insulation and pepped-up accessories. Sport adds a tach, heavy-duty suspension, fancier wheels and interior appointments, more sound deadening and "S" decals. The Ghia option mounts wider Michelin radials, plusher interior appointments, distinctive body moldings, brightwork and more insulation.

More options include an interchangeable flip-open sun/moon roof, front vent windows, power brakes and an AM/FM stereo radio (the last ready in September). There's talk of an automatic transmission coming soon.

So if you want a small, well-built car to travel in and work on, here's a front runner with pleasant surprises and a real "fiesta" to drive. ★★

core slides in and out like a slice of toast. The clutch cable and ball joints are set up for quick replacement.

In the body, big access panels unbolt for getting at hidden places. Doors have bolt-on hinges for easy adjustment or removal. Bumpers and grille come off and go on quickly.

Many joints are lubed for life. Wheelhouses use plastic liners to prevent rust. Body welds and joints

HOW FORD'S NEW FIESTA COMPARES WITH OTHER SMALL ECONOMY CARS WITH FRONT-WHEEL DRIVE

SPECIFICATIONS	FORD FIESTA	HONDA CIVIC CVCC	FIAT 128	HONDA ACCORD	DATSUN F-10, WAGON	VW RABBIT	VW RABBIT DIESEL	RENAULT R5TL	SUBARU STD
Wheelbase (in.)	90.0	86.6	87.5	93.7	94.3	94.5	94.5	95.8	96.7
Overall length (in.)	147.1	150.0	156.4	162.8	157.3	155.3	155.3	141.5	164.0
Max. cargo cap. (cu. ft.)	29.0	10.5 ²	33.5	N.a.	55.6	38.9	38.9	31.5	59.2 (wag.)
Turn circle (ft.)	30.2	30.9	32.0	32.9	34.2	31.2	31.2	32.0	31.6
Engine direction	Crosswise	Crosswise	Crosswise	Crosswise	Crosswise	Crosswise	Crosswise	Longitudinal	Longitudinal
Displ. (c.c./c.i.d.)	1600/47.6	1488/90.8	1290/78.7	1600/97.6	1397/85.2	1588/97.0	1469/89.7	1289/78.7	1595/97.0
Bhp @ rpm	66 @ 5000 ¹	60 @ 5000	62 @ 6000	68 @ 5000	70 @ 6000	78 @ 5500	48 @ 5000	60 @ 6000	67 @ 5200
Torque, ft.-lb. @ rpm	88 @ 3200 ¹	76.7 @ 3000	67 @ 4000	85.4 @ 3500	75 @ 3600	82.7 @ 3000	58 @ 2500	70 @ 3500	81 @ 2400
Carburetion	2-barrel	3-barrel	2-barrel	3-barrel	2-barrel	f.i. ³	f.i.	2-barrel	2-barrel
Compression ratio	8.5:1	8.0:1	8.5:1	8.0:1	8.5:1	8.2:1	23.5:1	9.5:1	8.5:1
Avail. transmissions	4-spd.	5-spd., auto.	4-spd.	5-spd., auto.	4-spd. (wag.) 5-spd. (cpe.)	4-spd., Auto.	4-spd.	4-spd.	4-spd., 5-spd., auto.
Steering type	R & P ⁴	R & P	R & P	R & P	R & P	R & P	R & P	R & P	R & P
Suspension type	MacPherson Ind. coil	MacPherson Ind. coil	MacPherson Ind. leaf	MacPherson Ind. coil	Ind. coil Ind. coil	MacPherson Ind. coil	MacPherson Ind. coil	Ind. torsion Ind. torsion	MacPherson Ind. torsion
Fuel capacity (gal.)	10.0	11.0	12.5	13.0	10.6	10.9	10.9	10.0	13.2
EPA mpg. hwy./city/avg.	43/28/33 ²	52/40/44	35/23/27	48/38/42	41/29/34	43/29/34	52/39/44	41/25/30	41/28/32
Curb weight (lbs.)	1775	1801	1995	2018	1960	1860	1893	1819	1985
Base price	\$3500 ²	\$2999	\$2998	\$4145	\$3499	\$3599	\$4249	\$3345	\$3043

FOOTNOTES: ¹prototypes, ²estimate, ³seat up—figure not available with seat down, ⁴rack and pinion, ⁵fuel injection

FIRSTHAND REPORT

by Bill Hartford
AUTO EDITOR



This is not the first time that Volvo has beaten all the world's automakers—big and small—to the punch. The Swedish manufacturer began designing its cars for safety before our government asked for safe cars. Now the company has taken the lead in applying the latest clean-air technology to its passenger cars—and surpassing the toughest government emissions regulations easily.

Volvo is the first to apply the Lambda Sond, or oxygen sensor approach to emissions control, to a production vehicle. Lambda Sond is actually a Bosch development, but, still it's Volvo who's using it first—on the four-cylinder, fuel-injected engines in its 240 Series of passenger cars.

Designed for California

The Lambda Sond system easily meets the strict California emissions standards, and is on all West Coast 1977 four-cylinder Volvos. Saab, the other innovative Swedish automaker, is using Lambda now, and even more manufacturers will put the system on some or all of their California cars for 1978. Volvo may put Lambda on all its U.S. cars soon.

That Volvo received an award for excellence in air-pollution control from the National Environmental Industries Council impresses the environmentalist in me, but the driver in me is ecstatic that this has been done with no sacrifice in drivability. The Lambda approach eliminates those air pumps, EGR systems and other add-ons that murder performance.

This is an emissions control system you don't have to mess with: Performance of the fuel-injected Four with Lambda is silky-smooth and strong, and that goes whether it's hot or cold, whether you're down in Death Valley or up in the Donner Pass.

Driving the Lambda Sond Volvo

It's a clean machine—viewed from the tailpipe or any other angle.



The 1977 245DL, Volvo's four-cylinder station wagon, loads a tremendous 77.6 cu. ft.

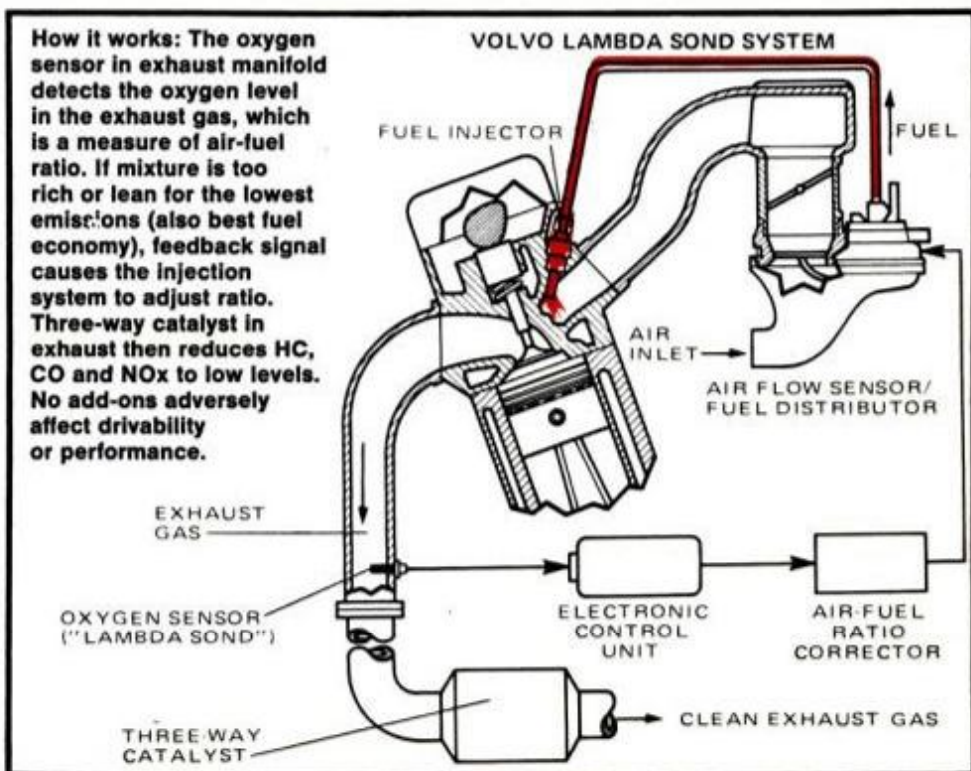
Translating from the Greek

When I picked up the 245DL wagon to test last February, I noticed that Volvo was actually using the Greek letter, Lambda, on the grille badge (in addition to "Volvo" on another badge. Volvo in Latin means, "I roll."). Now, if we can throw in a reference to German we'll be all set: "Sonde" in German means sensor, and in mathematical equations, Lambda is used to represent air/fuel ratio. (So that's why Volvo says its cars are "for people who think.") With the language lesson out of the way, I can get back

to the system itself which is quite simple.

The feedback circuit

As shown below, there is a feedback circuit from the oxygen sensor to the CIS, or continuous-injection system (CIS was described in PM's fuel-injection story on page 97, Nov. '75) and a three-way catalyst in the exhaust system. The feedback system keeps the combustion process working within a very tight tolerance of air/fuel ratio—not a sloppy 14 to 1 or 15 to 1, but in a narrow working area only .02 air/fuel



Most owners bought their Chargers on the basis of styling: nearly 60 percent.

"As a Realtor," comments an upstate New Yorker, "I want a car I'm proud to chauffeur my clients around in, and the Charger looks fantastic."

"Good styling," agrees an Illinois college instructor; "less boxy than GM and Ford products."

Charger vs. Cordoba

"I traded a 1976 Cordoba in on my Charger," affirms a Saratoga Springs insurance salesman.

"Really a good-looking automobile," says a Miami management consultant, and a Michigan technician echoes: "Beautiful—that's why I bought it."

Yet 5.6 percent of the owners we queried said they'd like the Charger even better if it looked less like its cousin, the Chrysler Cordoba. "I wish they'd go back to the 'classic' Charger body style, because now it's too much like the Cordoba."

Brand loyalty

Styling, of course, isn't the only reason that people buy Chargers. Past experience came in No. 2, a Texas manufacturer's rep noting,



"I had 126,000 trouble-free miles on my 1971 Charger, with no major repairs, so I have a lot of respect for the reliability of Chrysler products."

"We have been a Dodge family for the 10 years we've been married," states an Illinois pharmacist and his substitute-teacher wife. "Our 1967 Polara still runs like a champ."

Buyers also do appreciate the Charger's price. Observes a self-employed Californian: "We chose the Charger because it was cheaper than a Cordoba but basically the same car."

Styling again topped the list of best-liked Charger qualities, and

right behind that came handling, ride, comfort and economy. We asked owners to list their specific likes, and here are representative replies:

"Very responsive with good acceleration. It rides very smoothly and quietly, handles easily, and I just feel good driving it."—Kentucky telephone serviceman.

A Michigan machine operator: "I have nothing but praise for any of the four Chargers we have owned. However, this present Charger is by far more outstanding than the previous ones."

"I appreciate the car's handling



Distinctive paint scheme and roof colors identify Daytona series.

characteristics, its performance, and the way it looks," says a District of Columbia domestic worker.

BY MICHAEL LAMM WEST COAST EDITOR

Classic styling sells the Charger, but owners bemoan fuel mileage

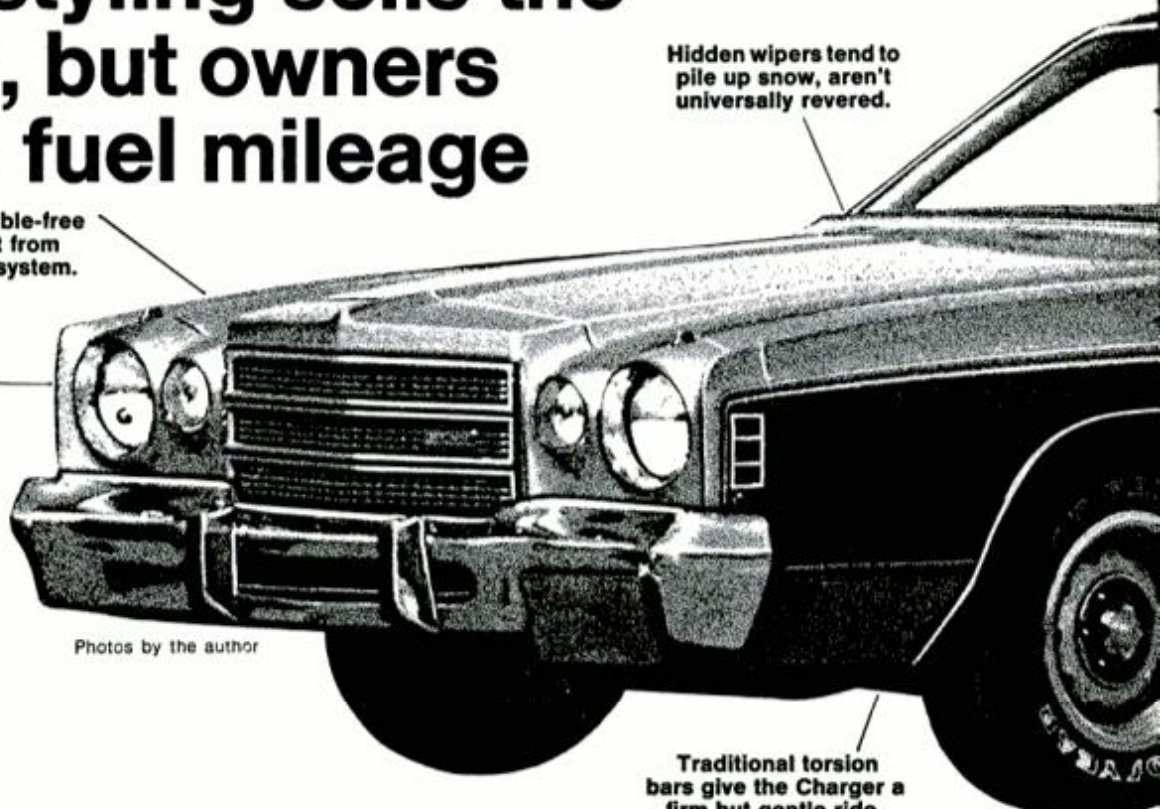
Cold starts and stumble-free acceleration result from MoPar's Lean Burn system.

Owners say they like classic round headlights better than "faddish" square ones.

Photos by the author

Hidden wipers tend to pile up snow, aren't universally revered.

Traditional torsion bars give the Charger a firm but gentle ride.



Lean burn and fuel mileage

A Michigan housewife: "The lean-burn engine makes this the easiest-starting car I've ever owned. It handles like a dream,



Charger offers buckets or 60/40 velour bench with reclining backs.

has snappy acceleration and good comfort."

And a New York retiree: "This is the best car we have had in the past six years so far as workmanship is concerned."

As to the least-liked features, the one mentioned most often was lower-than-expected fuel mileage. All cars we've sampled within the last two years have fallen below EPA estimates (the EPA averages better gas mileage than the owners we survey). In the case of the

Charger, though, EPA and owner figures came nearer matching than for most cars. (see the data chart on page 117).

As to other general gripes received from Charger owners, here's a cross section:

"Squeaky brakes," says a Michigan materials handler, "and my car was put together the week

(Please turn to page 116)

"Less plastic," cry a few owners, and many want more rear legroom.



For the record . . .

The American specialty-coupe market took its inspiration from the four-place Thunderbird of 1958 and has expanded tremendously since then. Buick's medium-priced Riviera challenged the T-Bird in 1963, and today's specialty coupes span a wide price range. They include the Charger, Cordoba, Monte Carlo, Grand Prix, Riviera, Eldorado, Toronado, Matador, Thunderbird and Continental Mark V.

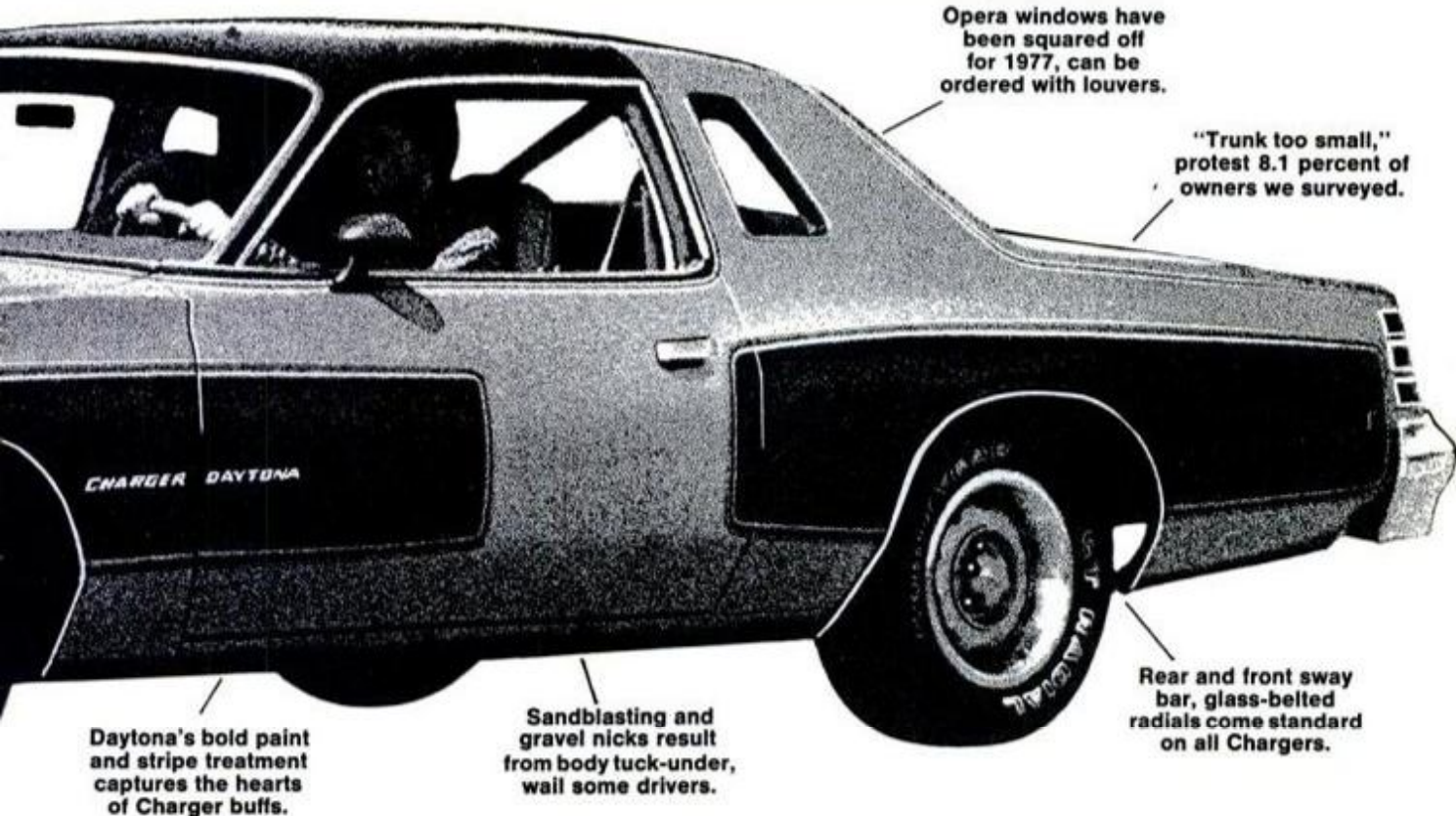
The Dodge Charger made its first public appearance in 1966, between halves at the Rose Bowl game. It began as a fastback on Dodge's intermediate (Coronet) body shell and 117-inch wheelbase.

The Charger's first restyling came for 1968, and that year the R/T made its debut. The R/T could be ordered with either the 440 Magnum or 426 hemi V8.

In 1971, Dodge shrank the Charger's wheelbase to 115 inches and gave it a swoopy and entirely new body style, which design it shared with the Plymouth Satellite.

For 1976, soon after Chrysler's highly successful Cordoba appeared, Dodge announced the new Charger—nearly identical to the Cordoba but costing \$629 less. Today's Charger comes in three trim levels: Special Edition (SE), Daytona Charger, and Midnight Charger.

A NATIONWIDE SURVEY BASED ON 951,617 OWNER-DRIVEN MILES



Opera windows have been squared off for 1977, can be ordered with louvers.

"Trunk too small," protest 8.1 percent of owners we surveyed.

Daytona's bold paint and stripe treatment captures the hearts of Charger buffs.

Sandblasting and gravel nicks result from body tuck-under, wail some drivers.

Rear and front sway bar, glass-belted radials come standard on all Chargers.

IT'S NEW
NOW

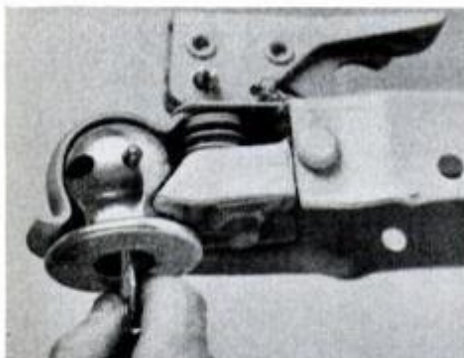
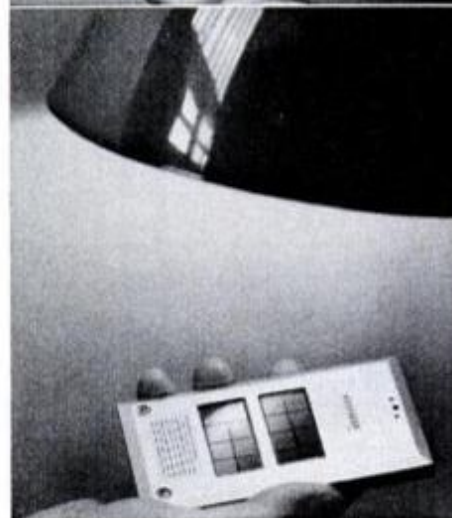


Pushbutton handyman

If you need help around the house and can't find anyone to do the work, build yourself a domestic. That's what Ben Skora of Palos Hills, Ill., did. His robot, named "Arok," is programmed to act as butler, waiter, dog walker (left), refuse dumper (right). Under pushbutton control, he'll hold a soldering iron or other tools.

Skinny solar sums

Newest solar-battery-powered Sun Man calculator is so slim it slips in a pocket. Its battery takes two hours of window light to recharge. Six functions include percentage and square root. About \$99.95. Sharp Electronics, 10 Keystone Pl., Paramus, N.J. 07652.



Trailer ball-coupler lock

Trailer-home thieves who make a business of backing up to parked empties, hooking on and driving them away can't hitch up if the coupler socket is equipped with a Sentry Ball Lock. The dummy ball blocks the socket and is held in place by hardened-steel pins that slip into holes in the coupler when extended by turning a key. Rounded pin ends prevent driving or drilling out. \$17 to \$20. Recreation Creations, 210 West Oldfield, Lancaster, Calif. 93534.

Pressure washer on wheels

Two pistons drive a ¾-hp pump to provide a pressure of 500 lbs. per square inch for a high-efficiency power washer. The 75-pound unit mixes water and detergent and sprays it at two gallons a minute from turret-head nozzles on a 30-foot gun hose. It will scrub a walk, wash windows upstairs or down, clean a house wall, unclog gutters and downspouts or clean the car. Model 250, \$372. International Harvester, 401 North Michigan Ave., Chicago, Ill. 60611.



New inexpensive shortwave receivers open up a world of excitement when you tune in from your own home listening post.

by Carmine W. Prestia Jr., WB3ADI

Eavesdrop on the world with these hot new receivers

Exotic music from the Orient, precise news from London, ham radio operators helping out in an earthquake, even CBers talking across your home town. Now you can eavesdrop on radio signals, secret as well as public, more easily than ever before.

There's a new breed of general-coverage radio receiver being used by shortwave listeners (SWLs) around the world. The new sets, costing \$150-\$350, are as sensitive and well-built as the \$2500 rigs of the '60s. Names like Yaesu, Drake, Radio Shack and Heathkit have a familiar ring in SWL listening posts



Spy stations, foreign broadcasters, ham operators and countless other shortwave signals are tuned easily with the Yaesu FRG-7 general-coverage radio receiver.

PM photo: Benn Mitchell



Frequency-synthesized Drake SSR-1 shortwave receiver is styled for the family room. Signals from the farthest corners of Earth are heard easily on this new breed of radio.

where sets by these manufacturers can pick up weaker signals, can separate interfering stations, and have more features than many of yesterday's more expensive receivers.

Supersensitive sets

These new radios go beyond \$25 multiband portables which can hear only the giants of international shortwave broadcasting. In fact, it takes little more than a wet noodle to pick up the millions of watts transmitted by Radio Moscow, Voice of America, or the British Broadcasting Corp. (BBC). The new batch of professional communications receivers offered to hobby listeners are far more sensitive, selective and convenient to use. More sensitive means that they can hear Afghanistan, Peking, or the 50 African nations now transmitting music, news, comment, sports and other excitement on shortwave. More selective means you can tune in weak signals buried on the dial between

Radio Cairo, All India Radio, Radio Japan or the Voice of Vietnam.

The new sets are more convenient with more controls up front, finer tuning knobs and well-marked front panels. Radio Shack, Drake and Yaesu receivers can be tuned continuously from 550 kilohertz (kHz) to 30 megahertz (MHz) in the radio spectrum. The Radio Shack set also tunes 150-400 kHz. (See *How to Eavesdrop on Cloak-and-Dagger Radio*, page 72, Aug. '76.)

All you need to make these new sets work is a simple antenna. That could be a wire out your window to the nearest tree, or even a small-diameter hidden wire stretched under your living room rug.

We listened to hams chat with each other, propoganda from Albania and radioteletype carrying news stories to tickers in far corners of the Earth on four topnotch sets. We tested Model FRG-7 from Yaesu Electronics Corp., Box 498, Paramount, Calif. 90723 (\$299);

Model SSR-1 from R.L. Drake Co., 540 Richard St., Miamisburg, Ohio 45342 (\$350); Model DX-160 available at 5000 Radio Shack stores in North America (\$159); and Model HR-1680 by Heath Co., Benton Harbor, Mich. 49022 (\$199). The excellent Yaesu FRG-7 is available from Sears, Roebuck and Co. (catalog No. 61A3638C) as well as hobby shops.

Frequency synthesizer

The Drake and Yaesu rigs use an ultramodern synthesizer circuit to determine what frequency the receivers are tuned to. Radio Shack uses conventional tuning capacitors but adds dial markings so you can tune quickly to an international broadcasting portion of the radio spectrum or to a ham band, making it easier for an SWL newcomer to find signals of interest.

Both Radio Shack and Yaesu have noise limiters to dampen static and car-ignition interference. And the Radio Shack has an automatic volume control (AVC) switch so you can select the steadiest signal.

Yaesu and Drake provide attenuator switches to cut down signal strength from overpowering local stations. These are useful when local AM broadcasters overdrive the receiver or when your CB neighbor transmits on the channel next to yours. Radio Shack uses an RF gain control, rather than an attenuator, giving you a greater range of control.

Monitor CB channels

You can tune smoothly and continuously from 26.960 to 27.400 MHz (CB channels 1-40), hearing signals between channels. You might operate your CB set on one channel while using the shortwave receiver to monitor emergency Channel 9.

All three receivers have dual pow-

Scan these shortwave frequencies for exotic signals

Here are frequencies in the shortwave portion of the radio spectrum where international broadcasters, amateur radio operators and other transmitters can be heard:

International broadcasting to SWLs

120-meter band	2.300-2.500 MHz
90-meter band	3.200-3.400 MHz
75-meter band	3.900-4.000 MHz
60-meter band	4.750-5.060 MHz
49-meter band	5.950-6.200 MHz
41-meter band	7.100-7.300 MHz
31-meter band	9.500-9.725 MHz
25-meter band	11.700-11.975 MHz
19-meter band	15.100-15.450 MHz
16-meter band	17.700-17.900 MHz

13-meter band	21.450-21.750 MHz
11-meter band	25.600-26.100 MHz

The *World Radio TV Handbook* by Jens Frost of Denmark, distributed by Billboard Books, 1515 Broadway, New York, N.Y. 10036 (\$10.95), is a popular guide to the international broadcasting stations and their frequencies.

U.S. amateur radio 'ham' bands

160-meter band	1.800-2.000 MHz
80-meter band	3.500-4.000 MHz
40-meter band	7.000-7.300 MHz
20-meter band	14.000-14.350 MHz
15-meter band	21.000-21.450 MHz
10-meter band	28.000-29.700 MHz

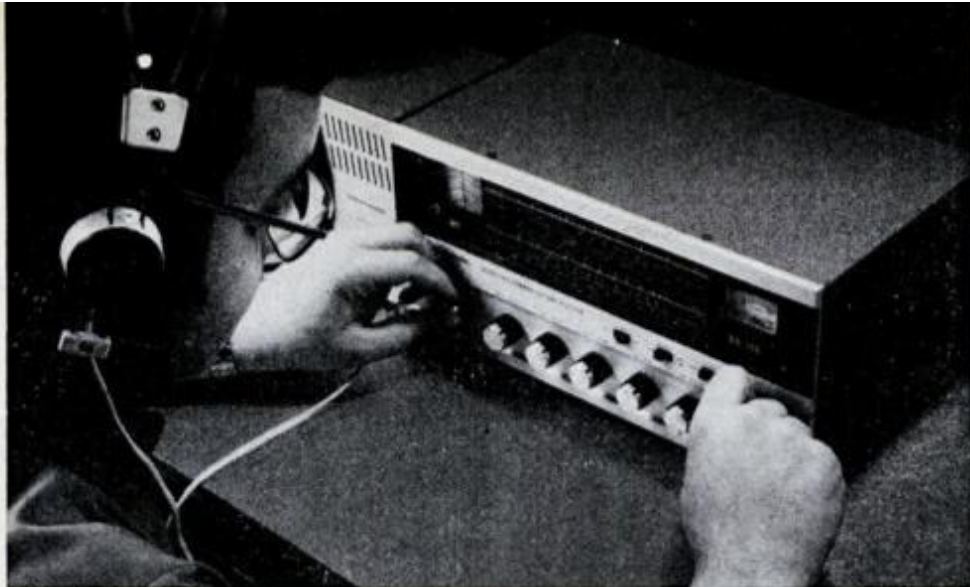
U.S. Amateurs have additional frequencies in the VHF and UHF parts of the radio spectrum.

U.S. 'CB' citizens band

Channels 1-40	26.965-27.405 MHz
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Time signals

BVP, Shanghai, China, 9.368 MHz.
 CHU, Canada, 3.330 MHz; 7.335 MHz.
 JJY, Japan, 10.000 MHz.
 RAT, Moscow, USSR, 5.000 MHz.
 WWV, Colorado, and WWVH, Hawaii, 2.5, 5.0, 10.0 and 15.0 MHz.



Earphones help you concentrate on shortwave listening without disturbing others while you tune rare DX (distant) stations on the Realistic DX-160 receiver from Radio Shack.

er supplies built in, permitting operation from 117-volt house current or a 12-volt automobile, boat or other battery. Yaesu and Drake left space inside their cabinets for packs of D batteries. Batteries are left inside the Yaesu and Drake and, if house electricity fails, the sets automatically operate on internal batteries.

How do they look? Radio Shack has a classic communications receiver kind of styling that comes with a very informative manual which makes it excellent for a beginner. Drake, however, has made the SSR-1 in a different design that might tuck away easily in some family rooms. The Yaesu looks like a professional rig that would sit well beside your favorite chair or in any ham shack. ★★★

Ham-only receiver gives more for less

You get a more sensitive, more selective receiver for your shortwave dollars when you buy a set peaked for maximum performance on selected bands. The HR-1680 by Heath Co., Benton Harbor, Mich. (\$199), does a spectacular job of covering five shortwave ham bands. It is targeted on the 80, 40, 20, 15 and 10-meter amateur bands only, unlike the general receivers which leave no gaps in coverage. Constructing the Heathkit was easy. It took 20 hours and no extra test gear was needed.

Operation is a breeze with seven fast controls up front. The radio

receives single sideband (SSB), International Morse code (CW), radioteletype (RTTY), slow-scan television (SSTV) and other exotic two-way amateur communications.

Sensitivity of the 1680 is very hot. And selectivity permitted tuning between stations clashing on adjacent frequencies. We even copied radioteletype using a Model ST-6000 TU (terminal unit) by HAL Communications Corp., 807 East Green St., Urbana, Ill. 61801. The HAL converted audio from the receiver into drive for a Model 19 Teletype.

The 1680 makes an ideal begin-

ner's set. Comparable ham rigs start at \$400. It's a great way to get code-copying practice since amateurs are on the air 24 hours a day. Tune in W1AW, flagship station of the American Radio Relay League, or any ham transmitting CW, and get all the practice copy you'll need!

Radioteletype signals are intercepted easily with Heathkit HR-1680 receiver and HAL Communications Model ST-6000. Audio from receiver (below top) is converted in HAL (below bottom) to drive Teletype Model 19 printer (right).



Sporting traditional wicker gondola, the homemade *Albatross* (also shown below and on cover) is hot-air balloon powered by 40-hp air-boat engine. Note the shrouded prop mounted on rear of gondola at right. The shroud provides both protection from the blades and a ducted-fan effect to improve airflow efficiency.



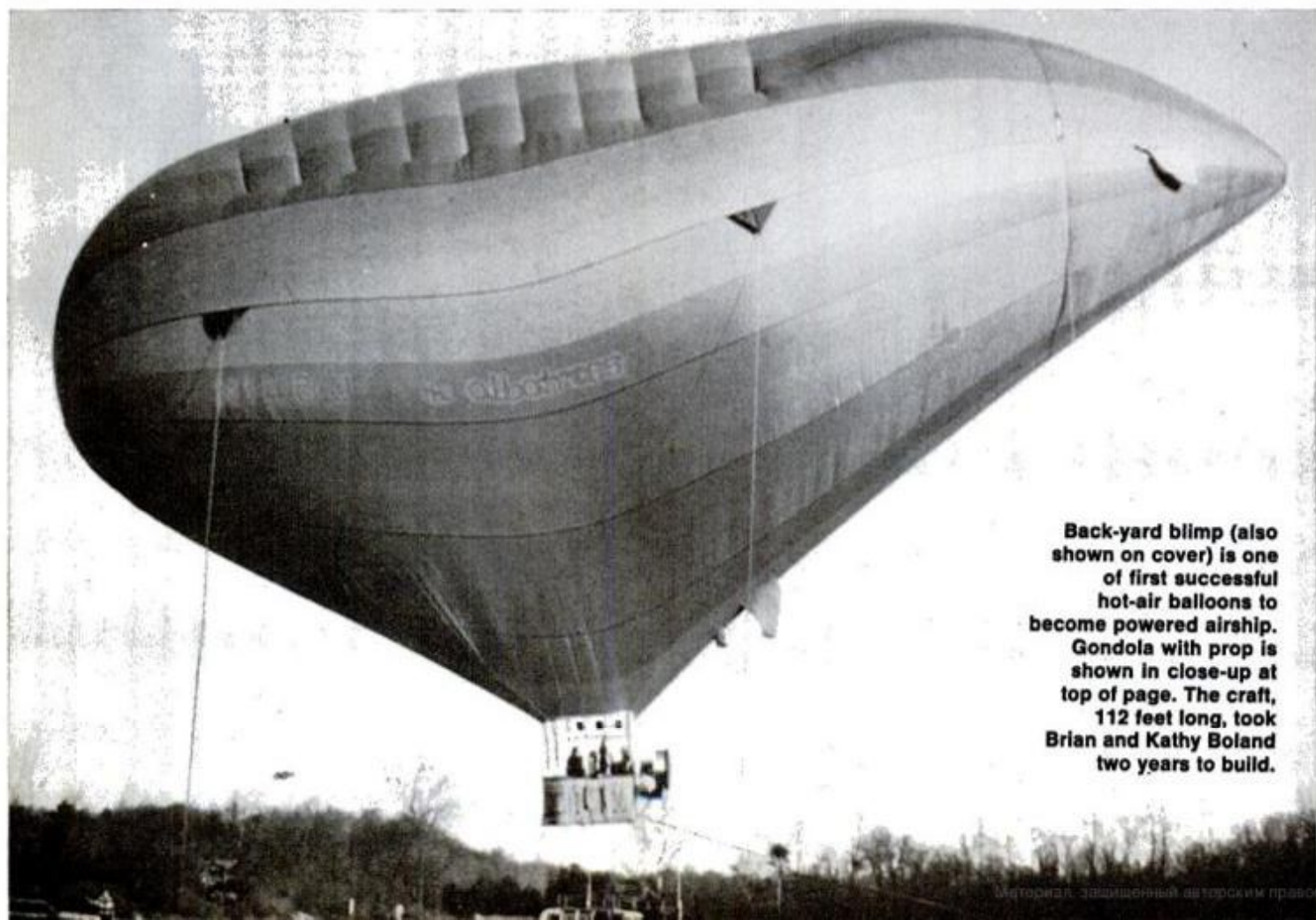
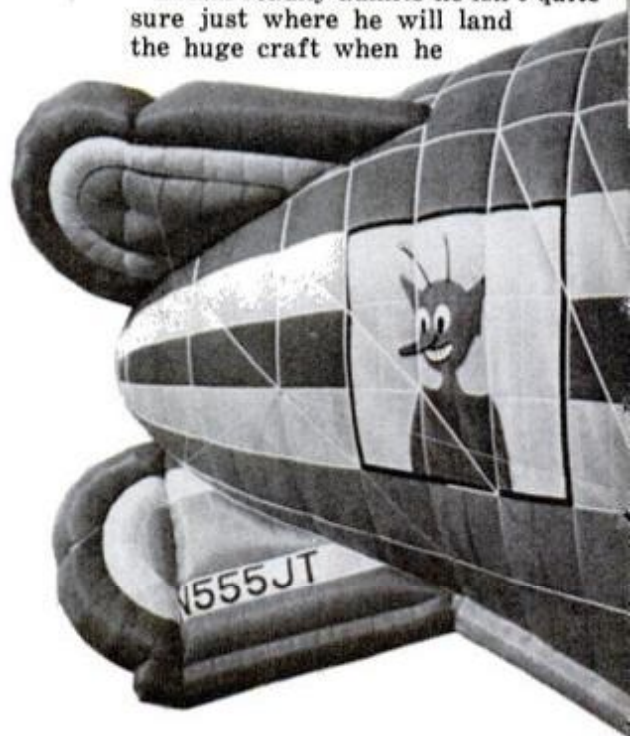
Big boom in gas bags

There's such a mad scramble to bring back the airship that even do-it-yourselfers are building them in their back yards—and they might just help to usher in a new age in practical dirigibles.

by Bill Allen

Brian and Kathy Boland want to fly from their home in Burlington, Conn., to visit relatives in Huntington, Long Island, a relatively short hop down the New England coast to New York. Seems simple enough—people do it every day. The thing that makes the Bolands' trip a little different is that they plan to do it in a 112-foot-long homemade dirigible put together between their living room and back yard.

Brian readily admits he isn't quite sure just where he will land the huge craft when he



Back-yard blimp (also shown on cover) is one of first successful hot-air balloons to become powered airship. Gondola with prop is shown in close-up at top of page. The craft, 112 feet long, took Brian and Kathy Boland two years to build.

reaches his folks' place, or how the FAA will view the venture, but he wants to try it anyway to, as he says, "surprise" his family—an objective there seems little doubt about his accomplishing.

Actually, the Bolands' dream ship—which took two years to build and involved the sewing of 3324 feet of seams in ripstop nylon—is no idle

fancy. It represents one of the many serious, scientific efforts on the part of small, private experimenters that are helping to revive new interest in the airship as a safe, practical means of transportation. All over the country—working literally in back yards, abandoned aircraft hangars and other makeshift facilities—home-builders are coming up with fresh, new concepts in airship design that may find their way into commercial and recreational applications.

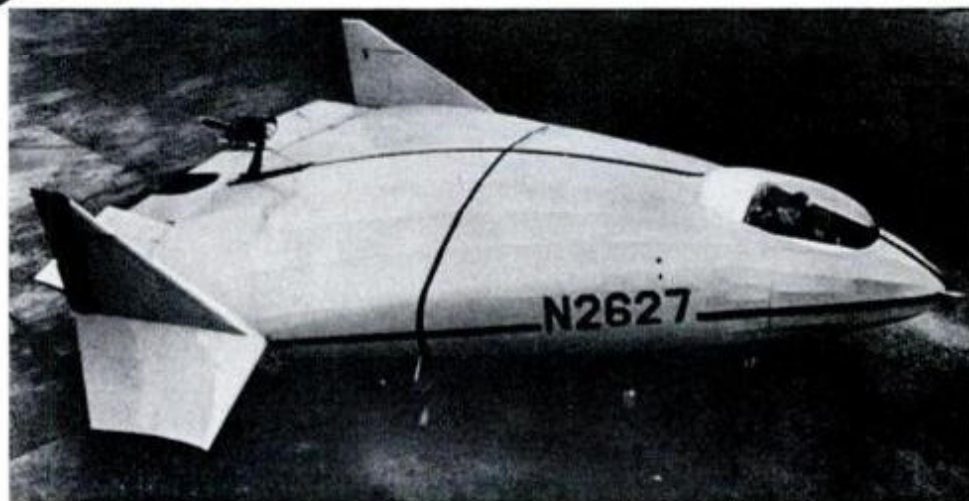
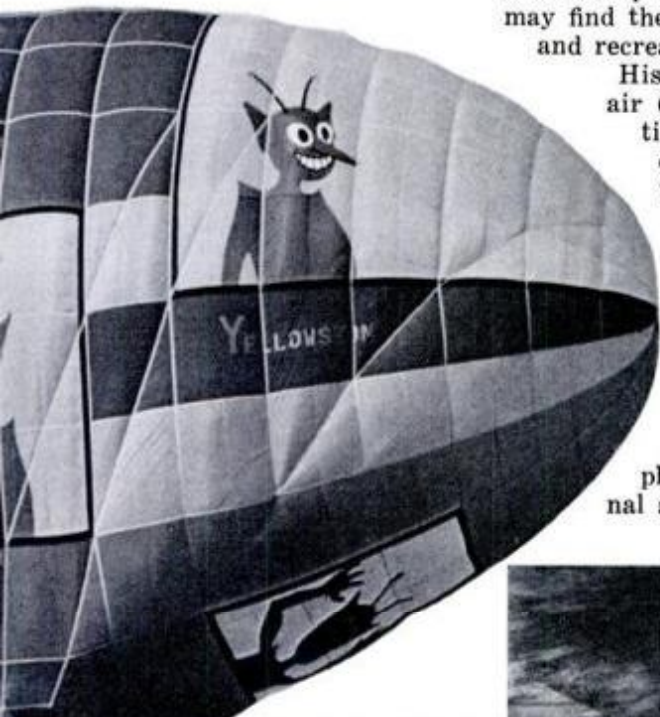
Historically, lighter-than-air (LTA) airship construction has fallen into one of three basic classifications: nonrigid, a gas bag (envelope) with no internal supporting structure, like a blimp; semirigid, a gas bag with a bottom "keel" for extra bracing but no other framing; and rigid, a dirigible with a complete and complex internal structure such as Good-

year's sister ships *Akron* and *Macon*, flown by the U.S. Navy in the 1930s, the great *Graf Zeppelin*, and the famous *Hindenburg* whose fiery crash in 1937 did much to sound the death knell of the rigid airship.

Today, there are emerging exciting new hybrid designs that combine the best of several operating principles. There are airships with pivoting rotors that can point straight up for added vertical lift, then tilt down to the horizontal for fast forward flight. There are dirigibles with wings that are half airplane, half airship. There are gas bags shaped like wings that, too, use aerodynamic lift to supplement the buoyancy of helium cells inside. There even are airships helped aloft by helicopters.

Though none of these hybrids have been built, all are aimed at achieving greater lifting power, greater speed, greater control, greater operating range, greater safety, greater comfort, greater economic efficiency—the very things that might just bring the airship back.

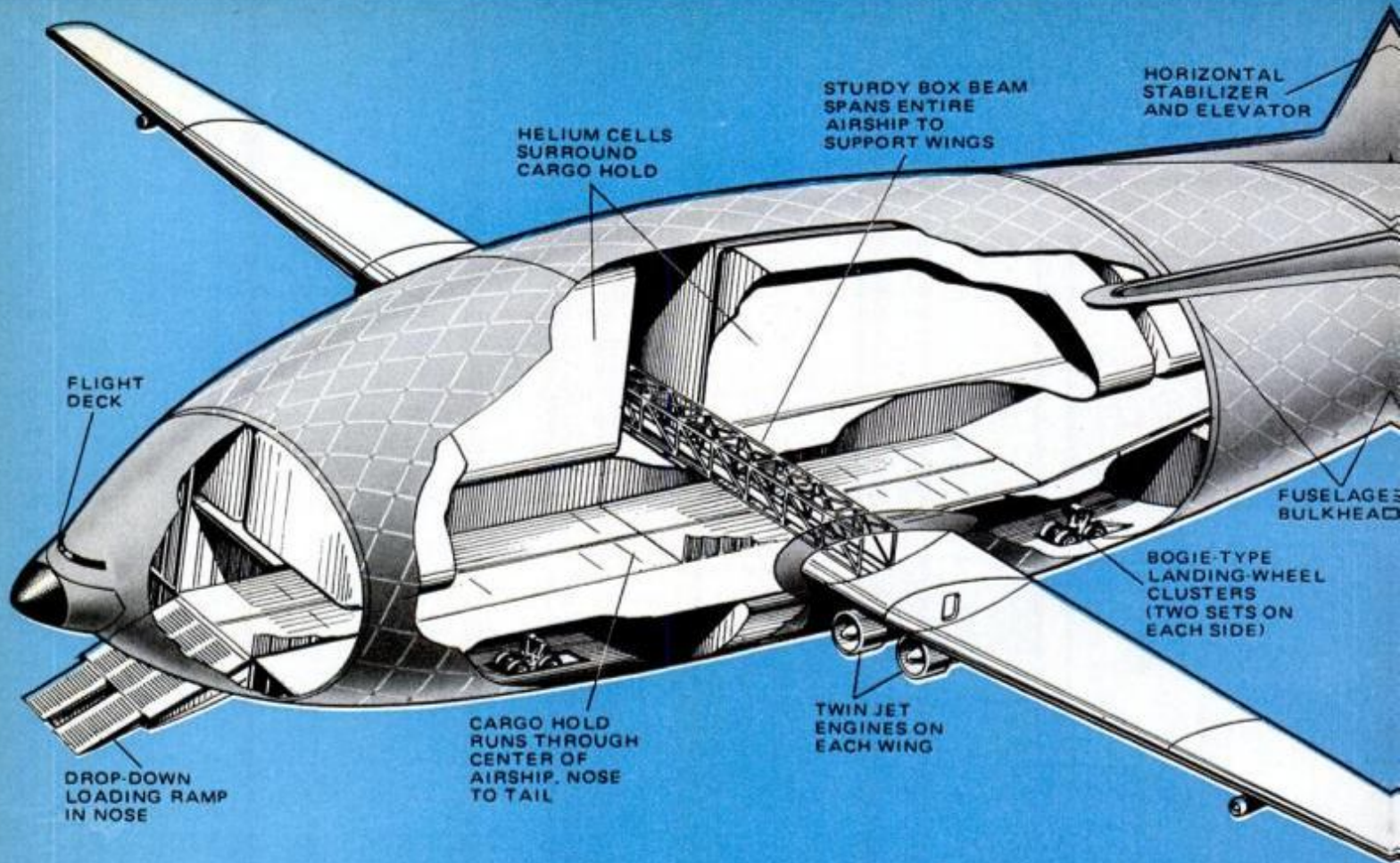
The Bolands' creation, called the



Whimsically painted Cameron D-96 above, a British import, is a hot-air balloon also prop-powered like the *Albatross* at left and *Raven* below. The big scoop hanging down behind the gondola directs ram air into the bag to help maintain nonrigid envelope shape. Craft accommodates two, is 95 feet long, has a speed of about 11 mph. You can pick one up, delivered in the United States, for \$39,500—less tax and dealer prep.

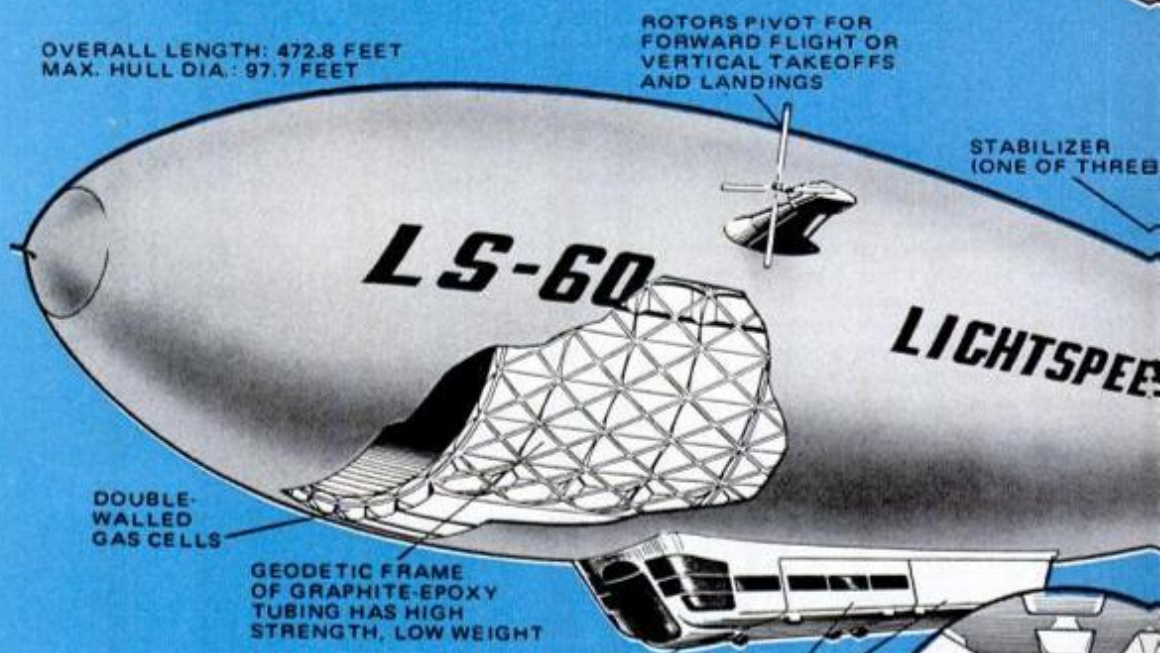


Delta-shaped "flying wing" at top is one-man prototype of much larger *Dynairship* shown on following page. Ship has actually flown, indicating combination of gas and wing lift could work. At left is *Raven's* two-man, 120-foot hot-air "sport" craft powered by 65-hp VW engine with steerable prop mounted behind gondola (above).

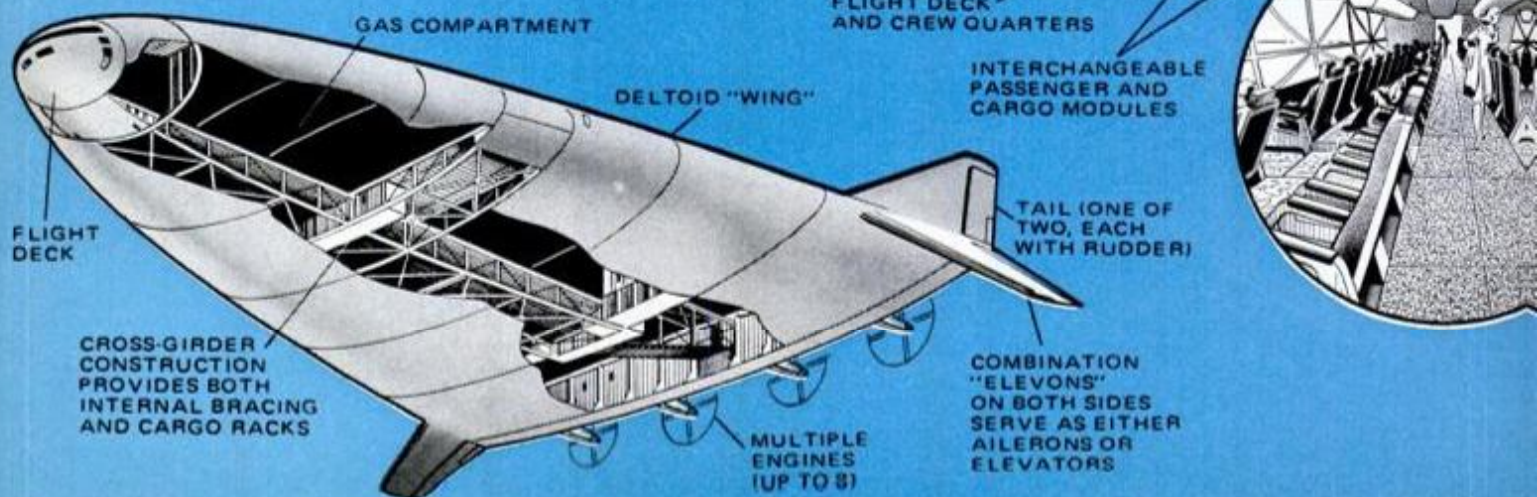


One of the biggest and most unusual hybrid airships proposed is *Megalifter* above. Half airplane and half dirigible, it would be 650 feet long with a wingspan of 530 feet. It would rely on helium for heavy-lift capacity and jet engines for high-speed cargo delivery.

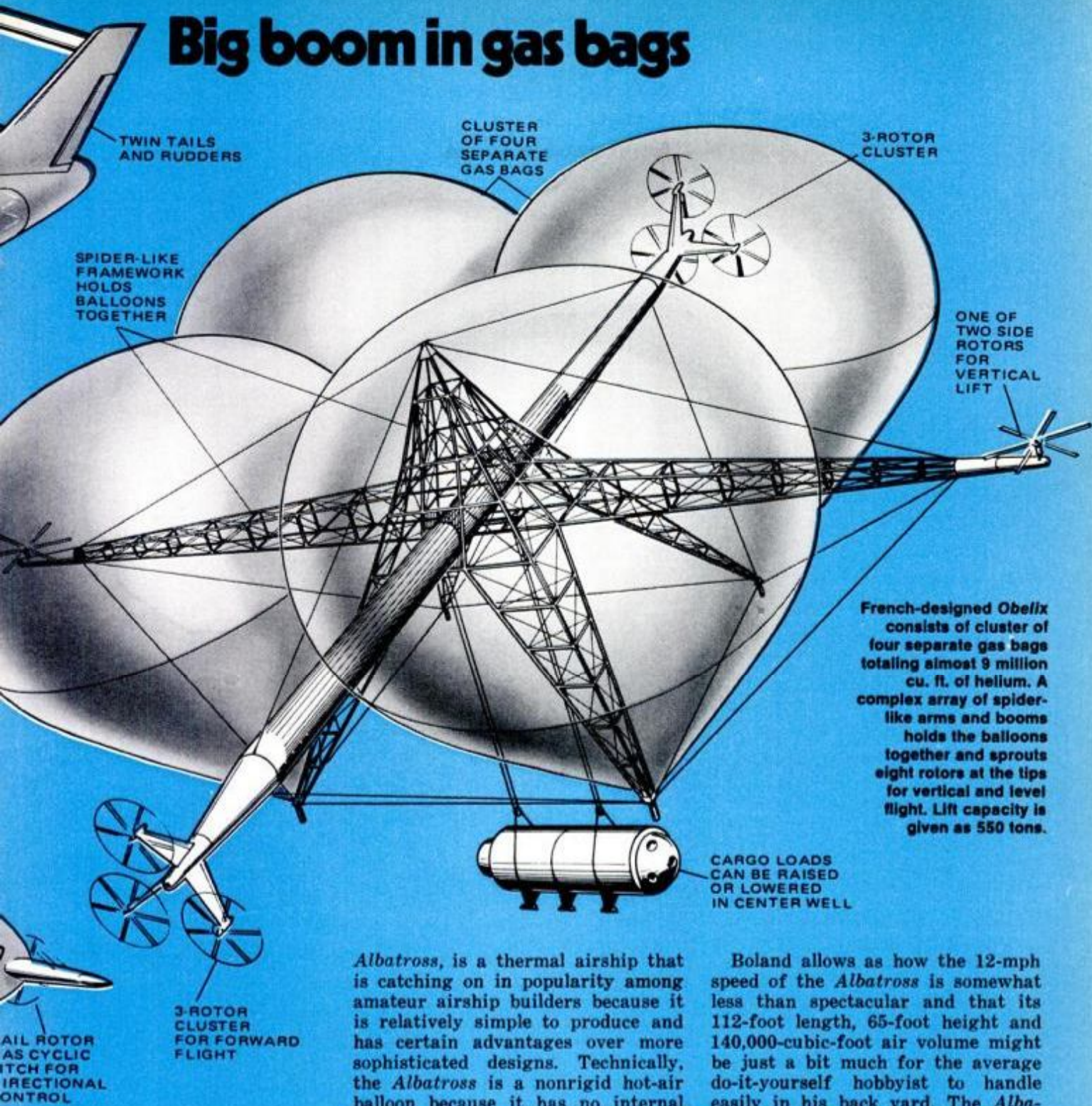
OVERALL LENGTH: 472.8 FEET
MAX. HULL DIA.: 97.7 FEET



Wing-shaped *Dynairship*, like *Megalifter* above, combines gas lift with aerodynamic lift for both speed and range. Ship is powered by pusher props along rear end. Navy is considering design for long-range surveillance of enemy submarines.



Big boom in gas bags



French-designed *Obelix* consists of cluster of four separate gas bags totaling almost 9 million cu. ft. of helium. A complex array of spider-like arms and booms holds the balloons together and sprouts eight rotors at the tips for vertical and level flight. Lift capacity is given as 550 tons.

CARGO LOADS CAN BE RAISED OR LOWERED IN CENTER WELL

Albatross, is a thermal airship that is catching on in popularity among amateur airship builders because it is relatively simple to produce and has certain advantages over more sophisticated designs. Technically, the *Albatross* is a nonrigid hot-air balloon because it has no internal framing and uses hot air for lift, not a gas like helium. It relies on propane burners to supply the heat.

Power makes the difference

What makes the *Albatross* an airship—aside from its elongated streamlined teardrop shape—is that it is *powered*. Mounted on the rear of the quaintly traditional wicker gondola is a modern 40-hp, shrouded-prop Rockwell powerplant originally made for propeller-driven swamp boats. With it Brian can make up to 12 mph headway in more or less the direction he wants to go, instead of drifting along at the mercy of prevailing winds as unpowered free balloons must do.

Boland allows as how the 12-mph speed of the *Albatross* is somewhat less than spectacular and that its 112-foot length, 65-foot height and 140,000-cubic-foot air volume might be just a bit much for the average do-it-yourself hobbyist to handle easily in his back yard. The *Albatross* is primarily a test bed for experimentation, however, and many modifications are planned.

First, Brian is going to try more power—a 95-hp Subaru engine from which he expects to get 25 mph, or double his present speed. Next year, he plans to scale down the *Albatross* to roughly half its current size, which he says will be much more manageable—the present version requires about eight ground crewmen and carries four; the new half-scale ship will be launched and piloted by two—Brian and his wife, Kathy. Its gondola will be designed to fit a car-top carrier and hold the folded-up gas bag, flight gear and camping

(Please turn to page 130)

Rigid-framed dirigible at left on facing page is conventional in appearance, but has unusual new features. Side rotors pivot up or down for vertical or forward flight. In addition, a tail rotor with helicopter-like cyclic pitch helps to provide directional control. Designed by Lightspeed USA, Inc., LS-60 would be 473 feet long—twice that of 747 jumbo jet. Circular inset shows how passengers sit sideways to enjoy scenic views through large cabin windows.

Computerized scanners

A new breed of public-service radio scanners channel-hop among police, fire, ambulance, ship-to-shore and ham broadcasts, searching for exciting new signals to listen in on.

Remember when you had to ask the man in your local radio store what frequency the cops talked on? And you dropped \$5 on a crystal to hear that one channel in your scanner? No more! Now scanners search through thousands of channels, looking for new and different signals to excite your listening. And they do it without your buying any crystals.

At the touch of one finger, you can fire off your own private signal seeker in search of secret police transmissions, downed-aircraft hunts, newsmen gabbing with their home offices about what really happened behind the lines, or harbor pilots chatting with friends. You can program your receiver to scan your favorite frequencies tonight and change the program tomorrow.

A revolution in public-service-band radio listening is underway. Manufacturers are adapting the latest digital electronics technology to set design:

- **Digital synthesizers** replace crystals for frequency determination.
- **Digital readouts** reveal actual frequencies of mystery signals being received from unknown stations.
- **Digital memories** store and recall frequencies heard.
- **Digital keyboards** give you full command of all receiver operations at the tip of a finger.
- **Digital microprocessors** control the whole works.

You save \$40-\$100 in single sets of rocks for these crystal-less scanners. It would cost \$75,000 if you had to buy crystals for the 15,357 channels scanned by Regency's radio. And you won't have to keep lists of frequencies for which you have cristaled your radio. Large red light-emitting diodes (LEDs) spell out exact frequencies of signals received. Memories store that frequency information so you can get back there fast when action breaks.

You don't need a code book, either. The first generation of digitally synthesized scanners merely replaced crystals with electronic circuits. You had to look up a frequency you wanted to hear and key special numbers into your scanner. This second generation of synthesized machines permits direct entry of specific frequencies. If you want to listen to an amateur radio repeater on 146.94 MHz, you punch in 146.94 on the radio's keyboard.

Here's a rundown on some of the best of the new sets:

Bearcat 210

Electra Co., Cumberland, Ind., one of the best-known manufacturers of scanners, gives coverage of a wide chunk of the VHF and UHF radio spectrum in its Bearcat 210. The rig can be programmed to search any frequency from 32-50 megahertz (MHz); 146-174 MHz and 416-512 MHz.

You can load 10 favorite frequencies into the 210 and it will scan those. Or you can set it off on a search of any one of the three bands for whatever it can find to hear. It rapidly tunes across the bands at a rate of

Mystery signals are uncovered by Bearcat 210 (right). Search-and-find sequence is controlled by fingertip keyboard. Exact frequencies are displayed as digital numbers in front-panel window.



Action at your fingertips

by Anthony R. Curtis
RADIO EDITOR



Digital synthesized scanners seek uncharted radio signals in public-service bands.

20 channels per second. And it is very sensitive to weak signals, even when used with its built-in telescoping whip antenna.

Regency Electronics, Inc., Indianapolis, Ind., has the most versatile of the new sets in a model called The Touch. Along with the search and scan capabilities, The Touch has a priority receiver which sits back and listens to a channel you have specified as top priority. When a signal comes in on that frequency, The Touch automatically switches there. You'll never miss a call on your favorite frequency.

The Touch also stands by on the National Weather Service frequency in your area and sounds an alert when NWS transmits a special tone indicating severe weather warning.

The Touch covers 30 to 50 MHz, 146 to 174 MHz and 440 to 512 MHz. It scans 12 channels per second.

Both Bearcat 210 and The Touch have a feature long needed by public-service-band listeners: a filter to

WHERE TO LISTEN

Police, fire, ambulances, rescue services, weather reports, marine ship-to-shore, ham radio operators, CIA, FBI, forest rangers, railroad trainmen, even plumbers, all can be heard in the portions of the radio spectrum known as VHF-low band, VHF-high band and UHF.

In the VHF-low band, 30 to 50 megahertz (MHz), you can tune in police calls from 45 to 46 MHz and fire trucks from 33 to 34 MHz.

In the VHF-high band, 146 to 174 MHz, eavesdrop on telephone calls from private cars at 152 to 153 MHz; newsmen calling in stories at 173 to 174 MHz; and ham radio operators chatting from 146 to 148 MHz.

In UHF, 416 to 512 MHz, peek into the world of taxicabs at 472 to 473 MHz; police and fire at 460 to 461 MHz; or the little-known CB band at 462 and 467 MHz. If you live where one or more of TV channels 14 to 20 are used, listen for sound-only TV signals from 470 to 512 MHz.

Many areas have police, fire, taxis, school buses, telephone calls, and other signals in all three bands.

Remember, it's against the law to repeat to anybody anything you overhear in these bands. You can't make personal gain from use of information learned while eavesdropping. So don't talk about what you hear!

screen out idle tones used on mobile telephones. The scanners keep right on searching when they come to a channel tied up by a tone. However, if any other audio is on that frequency, the scanners lock up and let you listen in.

These new searchers are in the \$300 price range, have built-in loudspeakers and are powered by 110-volt a.c. house current. The Touch and Bearcat 210 also work on 12-volt d.c. car, boat or battery power.

Tennelec MCP-1

The microcomputer built into Tennelec's MCP-1 can look in 16 memory channels for your favorites or go off in search of the unknown. It sifts through 10 channels per second in three frequency ranges: 31.180 to 51.655 MHz, 151.180 to 171.655 MHz and 451.180 to 471.655 MHz. The VHF-low band spread is wide enough to cover nearly 2 MHz of the 6-meter ham band from 50 to 54 MHz. But the set doesn't include the 2-meter amateur radio band which hums with excitement from 146 to 148 MHz. Nor does it cover the 420 to 450 MHz UHF ham band.

Here's how they work. The receivers have front-panel keyboards through which you enter frequencies, start searches or program normal scanning. Suppose you want the Bearcat 210 to search the frequency range of 152 to 153 MHz for unknown mobile telephone calls. You key in 152.000 and press a key labeled "lower." Then punch in 153.000 and press "upper." Now press "start" and the automatic search begins. To stop the search or stay on a frequency after the machine has stopped, depress "hold."

Scanning your favorite 10 channels in the Bearcat 210 is accomplished by programming your selection of frequencies into the 10 available memory locations. For instance, if your local police operate on 154.655 MHz, you punch in 154.655 and the "E" key to place the police frequency numbers into the radio's memory. Press "scan" and the rig starts looking over the 10 channels you like. Push "manual" to stop the action or to step forward one channel at a time.

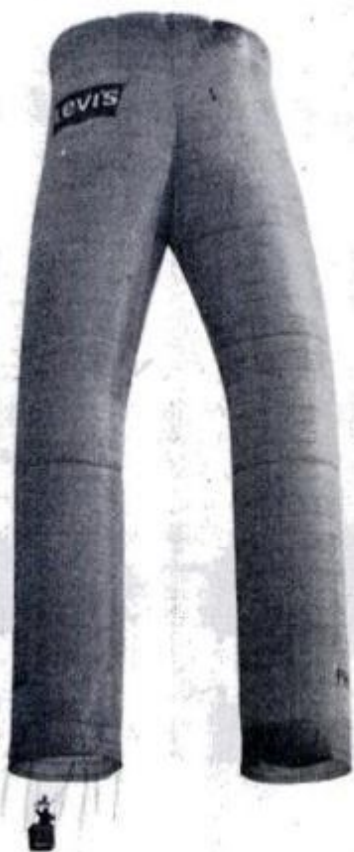
You can hold onto a channel for a couple of seconds after a signal disappears by programming "delay" into the memory. Or you can "lock out" a channel, causing the receiver to overlook it.

There's a world of unusual and exciting radio signals waiting to be heard. You'll be surprised at just what you can hear once you have one of these computerized scanners on the job hunting down secret transmissions. ★★★



The Touch, a new-signal-searching VHF-UHF scanning monitor by Regency (above), silently listens to 15,357 radio channels. It will alert you automatically if the National Weather Service sends a severe weather warning. Tennelec MCP-1 (top) also searches out uncharted signals, plays them for you, stores them in memory, recalls on command. These new digital synthesized receivers need no code book or crystals.

IT'S NEW NOW



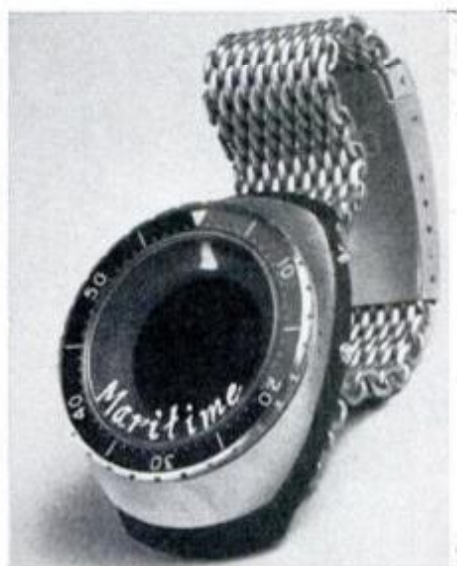
Hot-air pants

Flying jeans soared over the Netherlands recently when a pair measuring 1160 inches at the waist, with an inseam of 1198 inches, levitated over a blowtorch flame that filled them with hot air. The pants were made by Cameron Balloons, Ltd. of Bristol, England, to promote the Levi's jeans produced by a Dutch firm. The advertisers had to get a certificate of airworthiness before they could launch their unique hot-air balloon pants. The pilot hangs under the left leg, while the right leg is sealed.



Double-ender car can go in either direction

Real "double-header" at recent Frankfurt auto show was Citroen's attention-getting "2 CV" which can go "full speed in both directions"—one at a time, we hope.



Skin-diver digital

For the first time, skin divers can time dives with an underwater digital Maritime watch. Bright-red LEDs for visibility; good to 600 feet. \$250. Intertime, 17782 Sky Park, Irvine, Calif. 92714.

Combo calculator for races

It's the CQ-1 computerized quartz calculator, clock, stopwatch and alarm—all in one, especially well adapted to fast figuring at races. Besides four math functions, it computes time up to 10 hours, dates from 1901 to 2099, elapsed time to 10 hours in tenths of a second. Alarm sounds four times a day. Doremus, 120 Broadway, New York, N.Y. 10005.



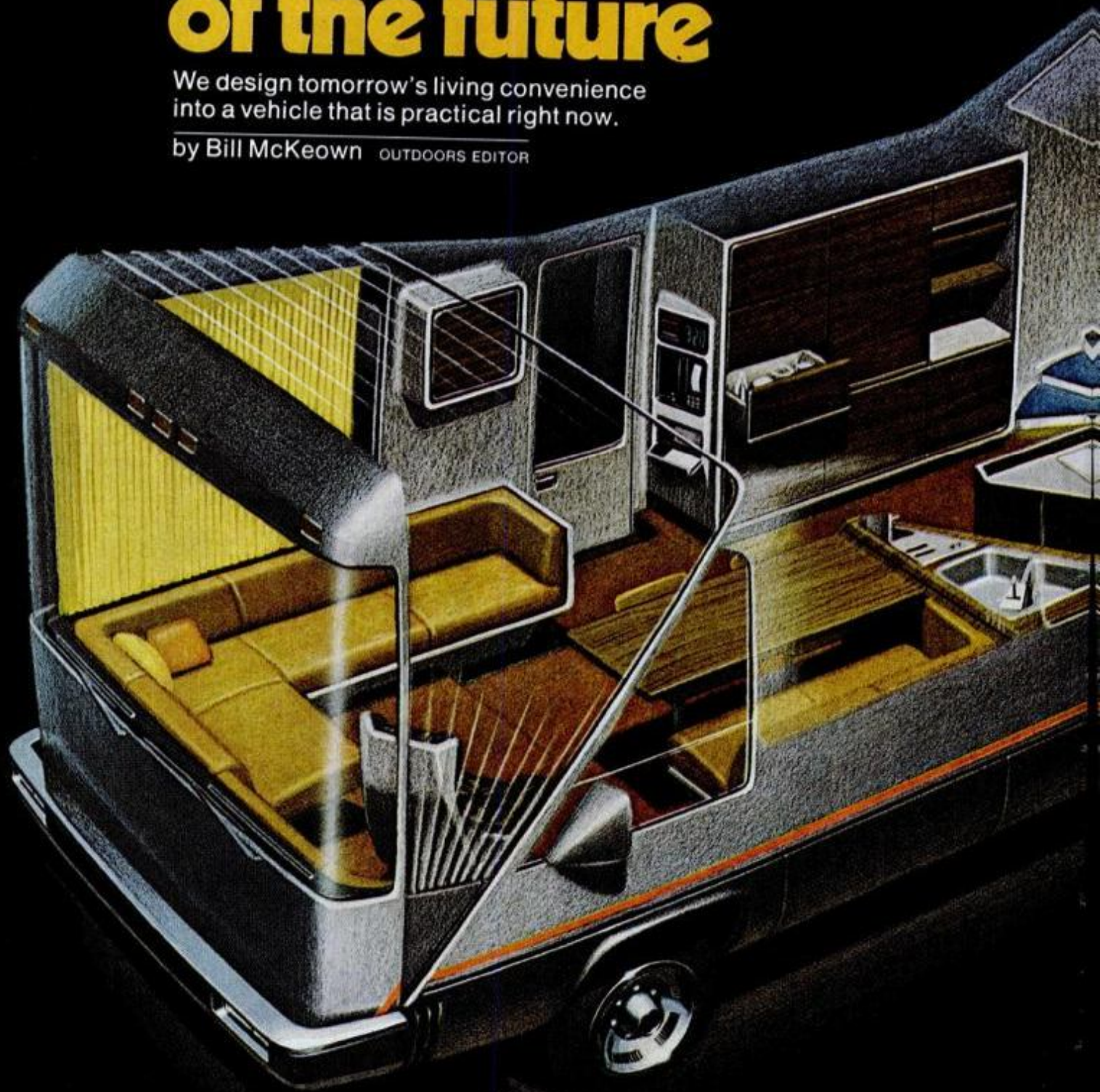
Drive-in boat wash

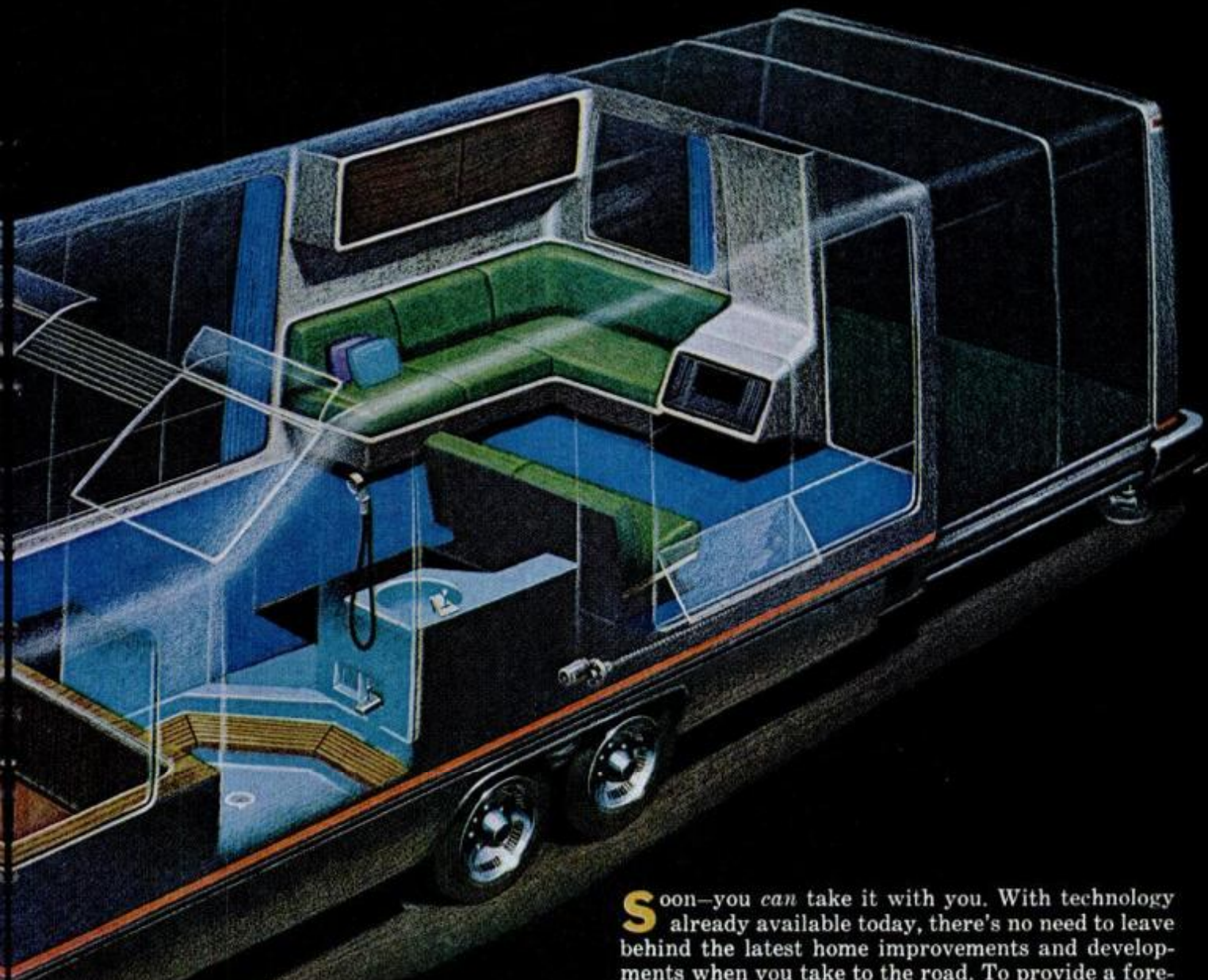
Some boat owners won't need to go over the side with scrub-brush to clean stained hulls anymore. Their marinas sport a Vanguard Boat Wash with 6-foot-diameter polypropylene rotating brushes and automatic detergent-water feed, driven by 15-hp hydraulic pump. Boat rides forklift or sling.

PM's motor home of the future

We design tomorrow's living convenience into a vehicle that is practical right now.

by Bill McKeown OUTDOORS EDITOR





Soon—you can take it with you. With technology already available today, there's no need to leave behind the latest home improvements and developments when you take to the road. To provide a forecast of things to come, *Popular Mechanics* worked with some of the top transportation designers to fit these predictions into a practical package on wheels.

More than the comforts of many a home are presented here in PM's prototype vehicle. It incorporates ideas by industrial designer Ed Westcott and Richard Lee Kessler of Westcott Associates, Westport, Conn., and illustrator Dale Gustafson. Westcott was formerly a designer for Ford and Chrysler, and helped create the Metroliner and airport people-movers. Gustafson spent years in Detroit working on automotive designs for General Motors. The clean aerodynamic lines and light strong materials of aircraft construction used here won't cut the cost of our RV, but will add to safety, durability and fuel economy. Complementing the sleek exterior, and equally important, is the roomy interior arrangement with maximum use of all available space, plus creation of some to spare.

Pull into a campsite of the future and you first expand the front lounge by pivoting forward the streamlined nose. This provides full headroom and, with the front in vertical position, the driving con-



Gone with the wind-resisting frontal area is the shoebox look. Clean aerodynamic lines and strong, light construction aid appearance and fuel economy when front pivots back for driving.

PM's motor home of the future

trols and instrument panel can be swung down out of sight, driver's seat reversed and slid forward, and the padded dash hinged down to form a couch that can later become a bed. Instead of individual dials on the dash, digital readouts can give information selected by pushbuttons. A few years from now, speed signs along the road may emit rays that activate a vehicle sensor to display speed limits ahead on a dash panel.

Though PM's travel home is planned for continuous touring and does not have the tilt-out room extenders that are already available in some large park-model travel trailers which stay at one campground for months at a time, it can stretch out quickly in back as well as forward. The split-level layout with raised lounge and bedroom aft makes possible the storage of a patio floor underneath. Actuate the screw-drive mechanism shown and the back of the RV extends to accordion-out a 6-foot back porch. Lower the supporting legs, set up deck chairs, open the back of the lounge fireplace, and get ready for a barbecue as the sun goes down.

Because a traveler often follows the sun to regions of balmy weather, the travel home's roof has a number of flush-mounted solar energy panels to generate power for charging batteries, running communications equipment and heating water as an occasional option in place of generated or plug-in power. Sunlight also floods in through skylights over the sauna and the steps to the upper level, as well as in the large picture windows on both sides of the vehicle. The raised rear section allows storage of airconditioners and the heating unit, a clean roof line results and, without top-mounted conditioners, clearance height is less than that of many motor homes today.

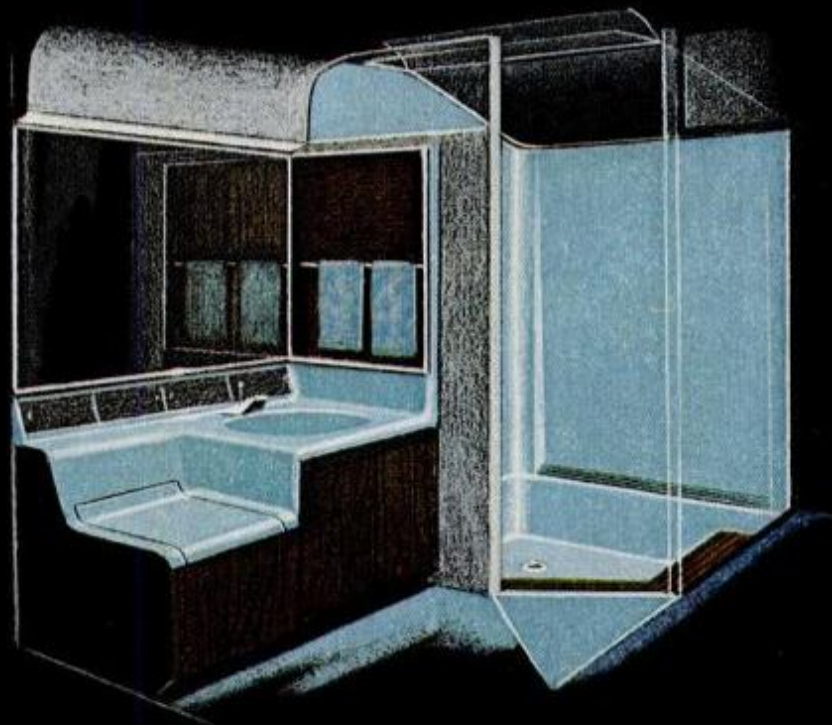
While water and fuel tanks under the raised flooring allow an increased range of action and camping away from hookups, minimum space is required for gray water and sewage holding tanks since the incinerator systems now being introduced are fully utilized.

Center of action for entertaining, our kitchen is offered with a bar-height island stove and counter, U-shaped arrangement option or wall-counter with built-in standard and microwave ovens. The shallow spill-proof drawers of the refrigerator wall and tambour-enclosed shelves are handy space-savers.

Builders of large motor homes like Apollo, Landau, Executive, Barth and Bluebird are already offering microwave ovens, bars with built-in TV and other niceties. Here we go beyond to what the future can hold for travel homes away from home. ★ ★ ★



Command console for driver seats him behind a picture-window windshield and facing a control panel where digital readouts display miles an hour, distance remaining to campsite, miles per gallon, time and distance run, estimated time of arrival, engine temperatures and pressures on demand, gas tank levels and programmed route numbers. Pushbuttons adjust climate control, lights. Control handles can replace steering wheel.



Bathing in luxury can be a pleasing way to start and end a day of driving or camping. Single or dual-privacy compartmented bath has an adjoining sunken sauna with skylight. Split-level arrangement with raised area bedroom-lounge in the aft section of the vehicle allows generous hot and cold water supplies, and holding tanks under the rear flooring.

When you are parked for the night at a pleasant campsite, the motor home front accords out into a vertical position, driver's controls and instrument readout panel pivot down out of the way, front cushioned dash unfolds down into a couch that can later pull out to become a bed. Panel above driver's seat gives rear-viewing TV monitor picture of vehicles behind while motor home is on highway.



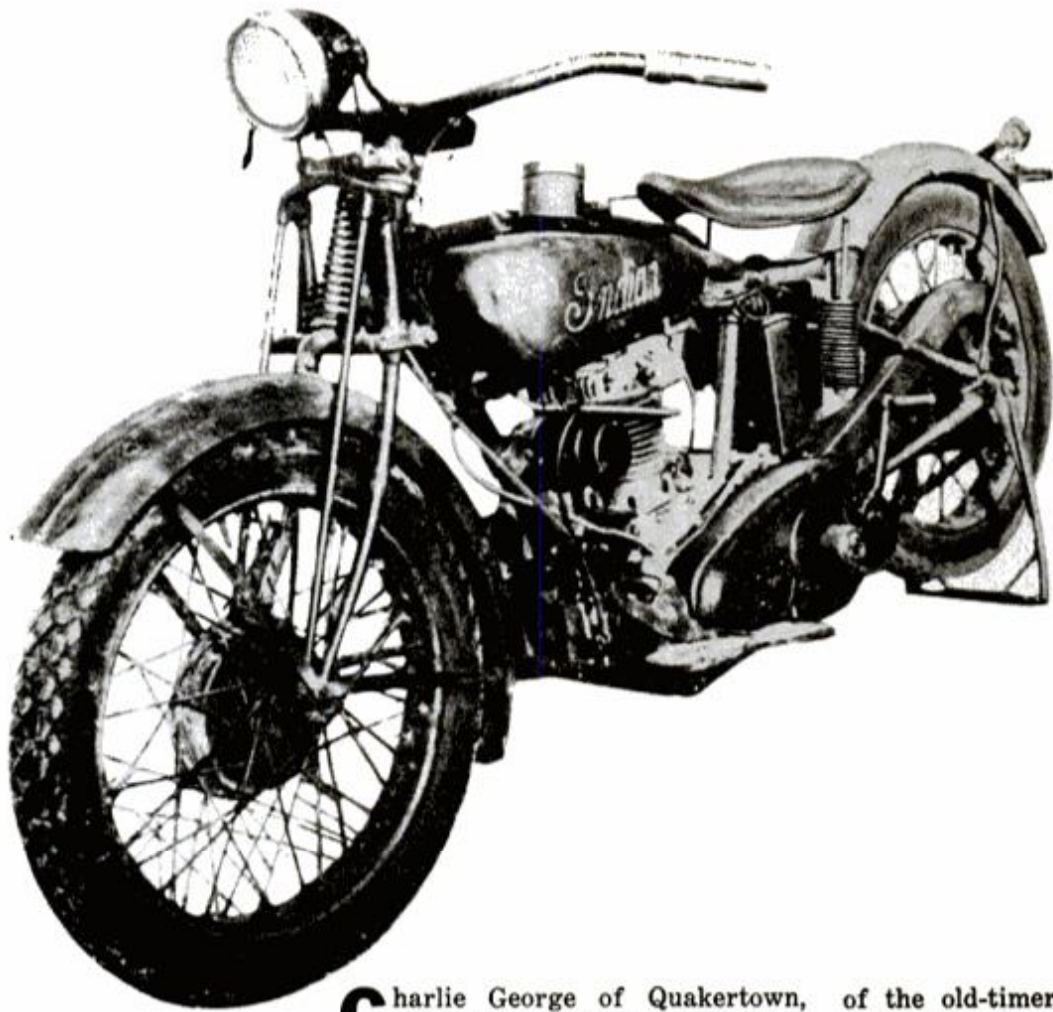
Rainy day and evening entertainment is easy in forward lounge-bedroom with TV or cassette movies projected from overhead closed-circuit center. For driving in fog and rain, infrared sensor might be used, aimed ahead and behind, to indicate heat-type images of other vehicles.



Central command and control center can show time, levels in all tanks, inside and outside temperatures, wind data, tape-trip monitor with projected strip map programmed to show present location. Radio and stereo include AM/FM and CB plus a TV antenna direction control, fire and intrusion alarms.



Kitchen arrangements, installed next to the dinette, can use bar or island counter stove (below) or wall counter (above) for cooking convenience en route or in camp. Both regular and microwave ovens are provided; food-preparation appliances are built in; drawer-type refrigerator and freezer pull-out shelves make selection of supplies easy and keep them secure in transit.



There's a
fine art to
restoring a
motorcycle.

by Robert Bahr

Charlie George of Quakertown, Pa., has a little good luck and a lot of common sense. A few months ago, he came across a 1925 Indian Chief motorcycle with a Princess sidecar. The bike was complete and original, but a beaten-up mess. So Charlie gave it a total restoration, then advertised it in *Hemmings Motor News* and sold it—to film star Steve McQueen, as it turned out. Another find of Charlie's was the 1928 one-cylinder Indian Prince shown above.

In nearby Boyertown, Bill Patt was driving past an apple orchard and spotted a 1929 Indian Scout, fenders-deep in mud. "It must have been there for 20 years—maybe 30," says Bill. "The tires were completely rotted."

The engine was missing, along with the gas tank and transmission, but Bill found them in the trunk of a dilapidated car nearby. He found the farmer, offered him \$25 for the whole heap and took it home. Today that cycle, nearly 50 years old, runs like a top, a mechanical wonder that wins trophies annually without fail as an unrestored antique.

Red-hot hobby

Antique motorcycle collecting is spreading so fast it has caught some

of the old-timers with their heads spinning. John Patt, Bill's brother and a former president of the Antique Motorcycle Club of America (AMCA), says that eight years ago the organization only had about 200 members. Today the number has almost doubled.

Collectors live all over the United States. In fact, the AMCA has one member in Arabia, one in Denmark, two in Australia, a couple in Finland and a half dozen in England. Not to mention John Larson of Wyoming. The largest representation is from California, Florida, Illinois, Indiana, Iowa, Missouri and the mid-Atlantic states.

Art Grigg of Garden Grove, Calif., has six BMWs, four Zundapps and two DKWs. A German Zundapp, the K750 with sidecar, is a half-ton monster, probably one of only three or four in the country.

Grigg's bikes are all worth money, but as one Ohio collector, Jake Sheetz, explains, "Scarceness in itself doesn't mean anything. Take cars, for instance. More '57 Chevys were made than '59 Dodges—but whom do you know who's looking for a '59 Dodge?"

The romance of certain models over others has a lot to do with the price, too. As Wes Stoll, a California

Photos: Wally Wyss

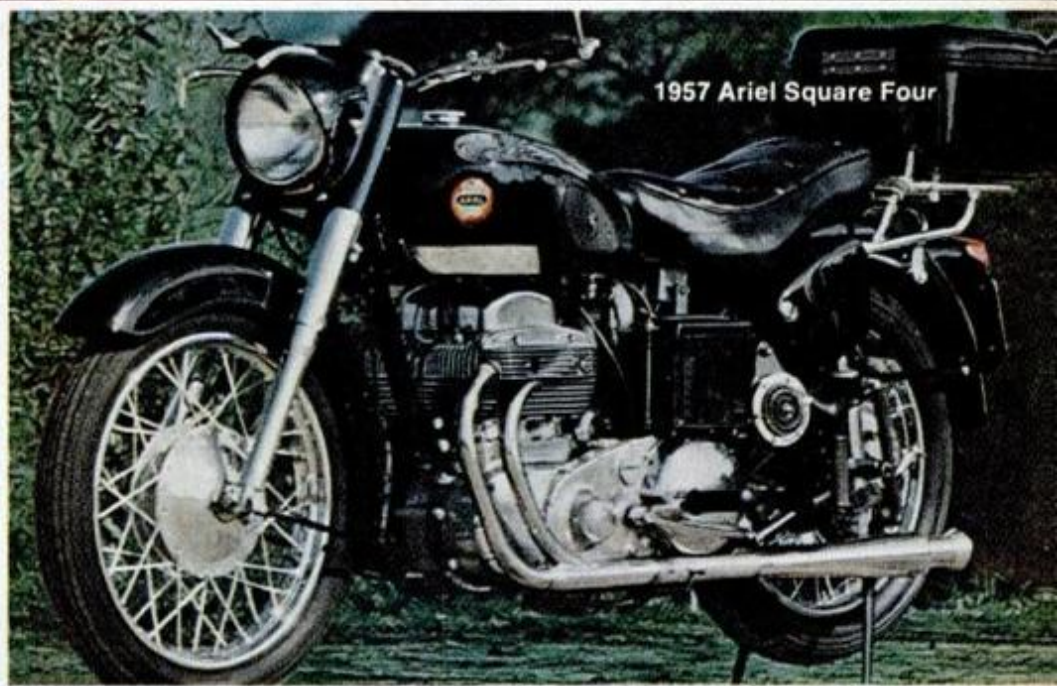
1939 Indian Four



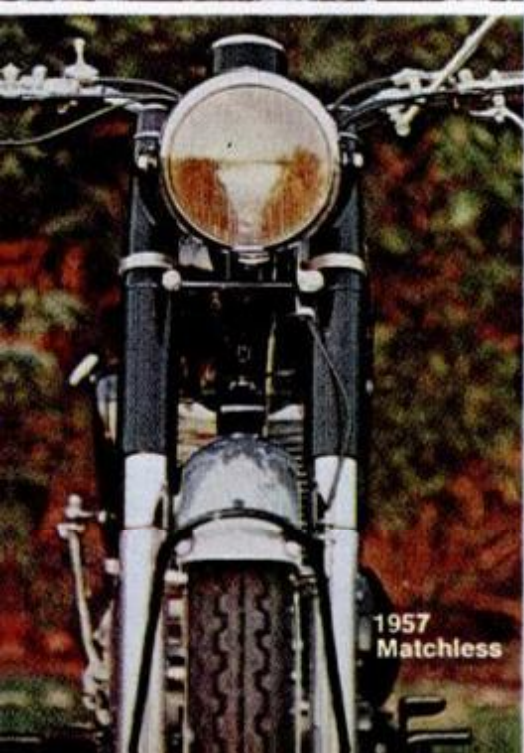
to chrome



1950 Vincent Comet



1957 Ariel Square Four



1957 Matchless



1951 Indian Chief "Eighty"

From crud to chrome

Continued

collector, commented: "When you're talking about a bike like the Matchless, a lot of collectors would rather have the big 500-cc single than one of the twins, even though the twins looked better. In British bikes, collectors seem to like the big singles."

Supply and demand

No one knows precisely how many different brands of motorcycles have been manufactured in the United States. An incomplete list, compiled by the AMCA last year, included 144 names. Some of those companies are still around—but you'd never connect them with motorcycles: Greyhound, Sears, Singer and such.

Pierce-Arrow motorcycles went the way of their fine automobile. Columbia and Schwinn Paramount are still going strong as ordinary bicycle manufacturers.

Many of these companies collapsed following World War II, when considerably less expensive imports from Britain, Germany and, most notably, Japan put all American motorcycle companies out of business—all but one—Harley-Davidson.

To be a surefire collector's item, a cycle should be a model that was popular when made and is still in demand. Probably the most sought-after motorcycles are the Indian Four-Cylinder, not built since 1952, and the Harley-Davidson. Also in demand are the Hendersons, Nortons, some Triumphs, Ariel Square Fours, Zundapps and BMWs.

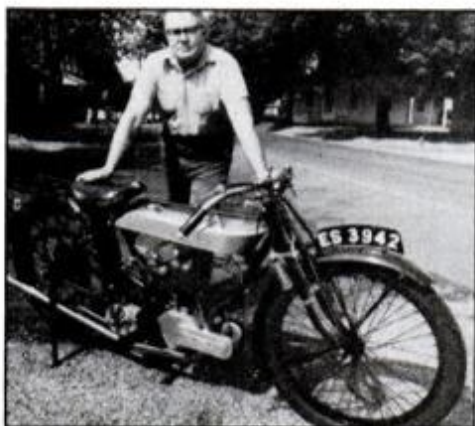
An unrestored, not-running Henderson in-line four-cylinder 1931 bike sold last year for \$2000. Also last year an Ohio collector offered \$5500 for a restored 1941 Indian Four—which, incidentally, cost \$485 new. And his offer was refused.

In 1975, at the first big classic motorcycle auction ever held in the United States—in plush La Jolla, near San Diego—Bill Harrah, owner of Harrah's Club in Reno and more than 1100 classic cars, paid \$11,000 for a four-cylinder Pierce—a record for a classic bike.

How to start collecting

While the machines are bought up rapidly, there's still room for a little guy in antique motorcycle collecting. "What I do," says Otto Link of Coopersburg, Pa., "is spread the word that I'm looking for an old cycle. Eventually, a friend of a friend knows somebody who has one lying around; I'll go up and see it, and maybe I'll buy it."

Today a rusted-out old junker, if



Good as new: The 1921 Norton (top left) belongs to Al Signman; the 1931 Henderson in-line Four (above left) is Leon Blackman's; the 1914 Pierce Arrow (top right) has a one-cylinder, four-cycle engine—with no gas tank, it stored fuel in hollow frame; 1912 Excelsior Auto Cycle (above right) is two-cylinder, four cycle, pedal-start.

it's a popular model, can go for \$200 to \$400—unless it's a classic like a Vincent Black Shadow or Ariel Square 4, and then it will go from \$800 to \$1000 even rusted, providing it's relatively complete.

Those are prices dealers charge collectors. But, advises John Patt, "Beginners would do well to put an ad in the local paper, talk to as many people as they can. Looking for these items gets to be an obsession. I hardly ever have dinner in a diner that I don't start talking about these old bikes."

For John, it has paid off. Among the dozen or so cycles he's collected over the years is a prize-winning 1928 Henderson Deluxe that resides permanently in his office.

That most of us can still afford an old motorcycle is one reason they're a better collector's item than antique cars. And you can work on it in your basement—or living room, if you have to.

Let's say you want to get an old motorcycle and restore it. First you must decide whether you want a genuine antique—and next, whose definition do you go by? The Antique Automobile Club of America applies the same standards as it does to au-

tos: anything 25 years old is an antique. The Antique Motorcycle Club of America is much more strict. Only cycles made before 1929 qualify as antiques. Those made from 1930 to 1942 are eligible for post-antique classification. Newer than that, they may be classics, but they're not antiques.

The Classic and Antique Motorcycle Assn. (CAMA) calls an antique anything built before 1941. If it's newer, but a low-production model like a Velocette, it could be a classic, depending on the brand. Some very recent bikes are considered classics because they are so rare, like the Benelli Six. "For a new bike to be a classic," explains Wes Stoll, a collector, "it has to be the automotive equivalent of a Lamborghini, not a Ferrari. Ferraris are too common."

The fine art of restoring

Once you bring home your cycle, the next step, virtually all collectors agree, is to get it in good operating condition if you ever want to enter it in an AMCA meet. More than that, veterans will tell you true love doesn't come until you have ridden

(Please turn to page 112)

by Carmine W. Prestia Jr.

The bug bit! I had to get a computer. Checking ads, I discovered a world of gear. The problem was sorting out what to get.

The heart of a home-hobby system is a *microprocessor* that sifts through and matches information with commands. Hooked to it are three links with the outside world: an *input* device so you can order the machine to do work; *output* gear so it can talk back to you; and *memory* in which it stores your orders and information.

Memory bytes

I built my \$2500 system around two microprocessors. One is the versatile Altair 680 by MITS, 2450 Alamo S.E., Albuquerque, N.M. 87106. I added 16,000 *bytes* of memory, enough storage for lots of data. For input-output, I use a Teletype similar to news machines in newspaper offices. I type in instructions and, when the computer completes its work, it sends messages to me on the same Teletype.

The other micro is the compact machine from HAL Communications Corp., Box 365, Urbana, Ill. 61801. I added keyboard input, TV-tube VDT (video-display terminal) output, and

the ability to control a cassette tape recorder. The computer stores information as audio tones on cassette tapes, giving it a huge, cheap capacity to save data and programs.

Talk to HAL

I talk to the HAL via a typewriter-style electronic keyboard mounted on top of the computer. It responds by displaying messages on the tube of an old black-and-white TV set I had.

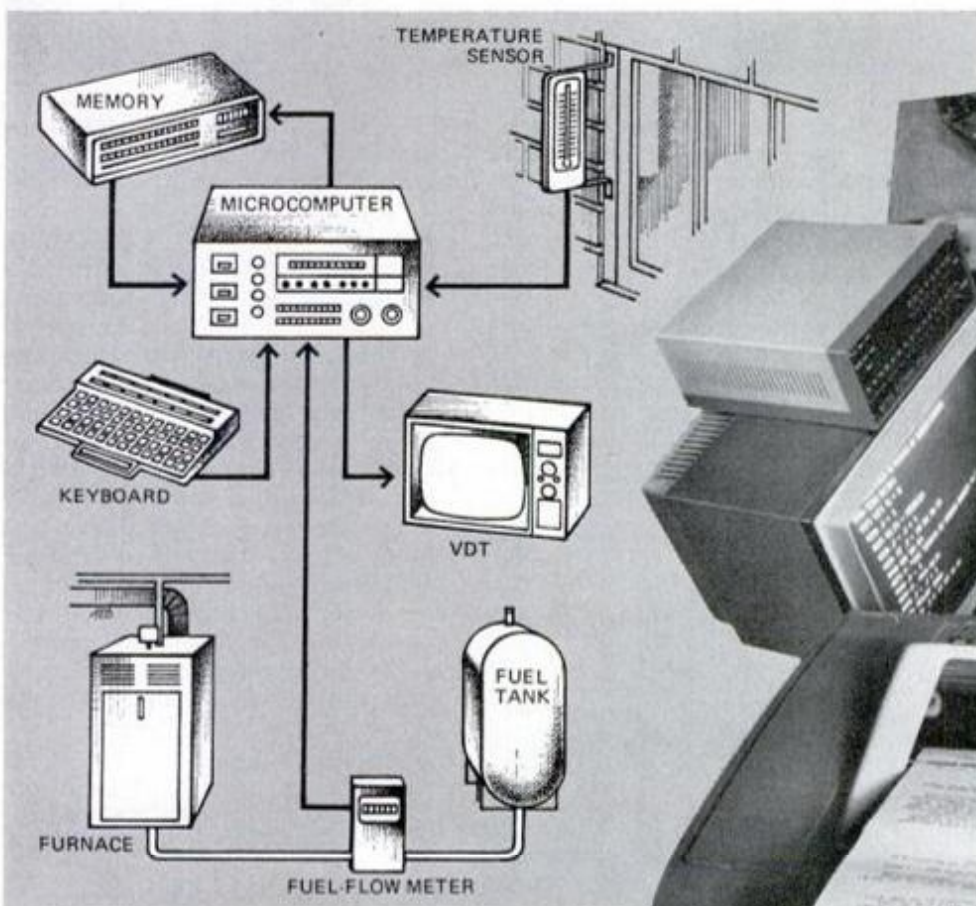
Typed or video-displayed messages are great for games, home budget-keeping and the like. But, increasingly, computer hobbyists want their machines to control things around the home such as furnace thermostats or lights. Computers can do these jobs when their outputs are converted into mechanical energy to do work.

I use my computer to watch over winter temperatures, calculate degree-days, and compare them with the flow of fuel into my furnace (see diagram below). The computer, at any time I ask, can predict when fuel may run low so that bad weather might put me in a home-heating bind.

With computer hobby stores springing up around the country, it's not hard to find some place where you can try out one of these exciting new home appliances. * * *

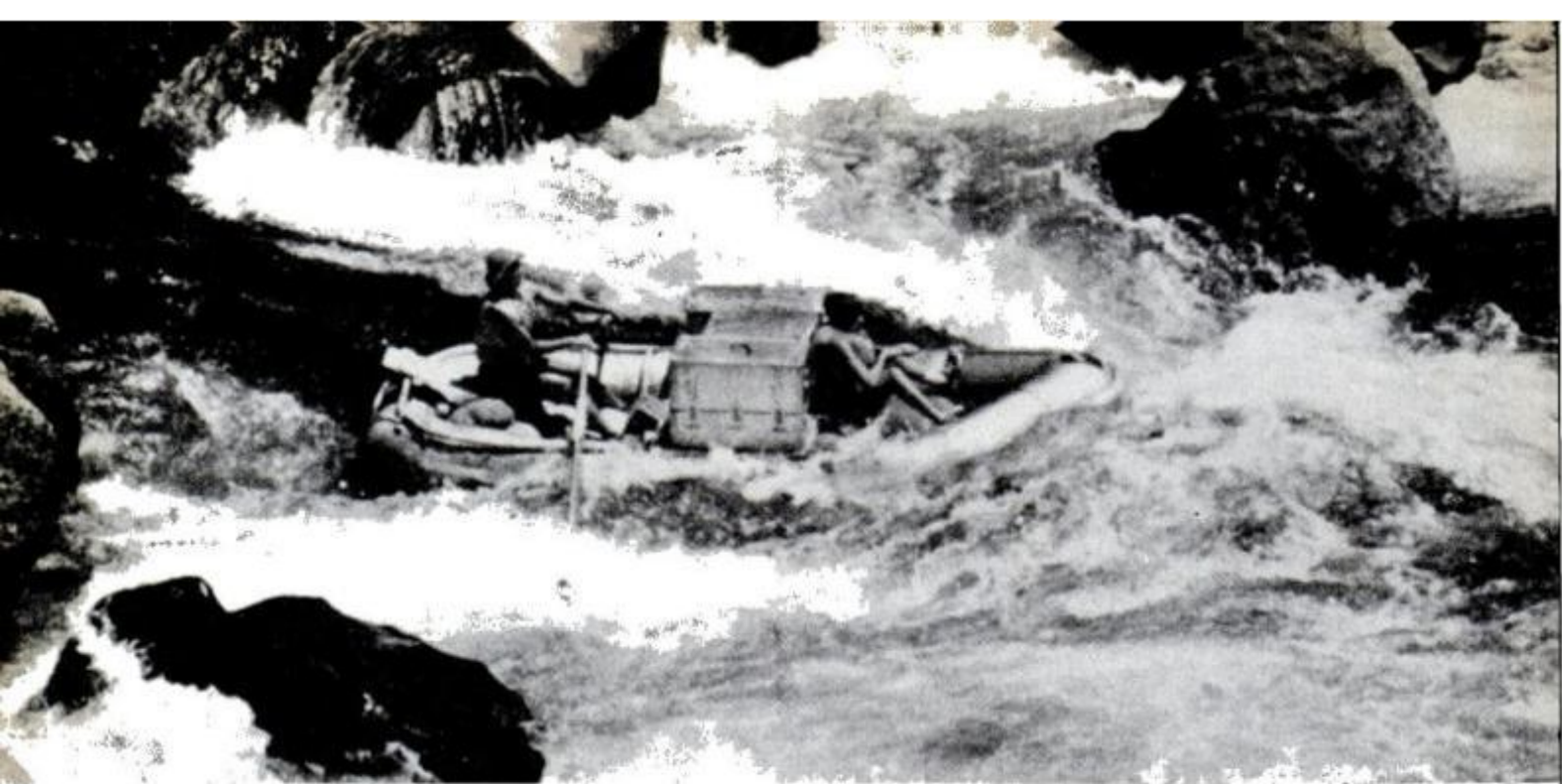
I built my own home computer system

A homeowner hobbyist programs his own basement computer to do household chores.



Temperature and fuel-use data are stored in memory, then compared in computer which is instructed via keyboard to display a warning on VDT screen of weather-related fuel problems.





With today's equipment you can be safe—without losing the thrill of high adventure.

by Doug Sturges

If you haven't been scared and wet—really wet—sliding down a swirling river recently, you're missing one of the best of outdoor adventures. New equipment and techniques make it possible to tackle rougher stretches, or you can pick gentle water and drift along for just about the best in relaxation.

There are three kinds of craft to float you down a fast stream—more like three and a half if you count inner tubes that are so popular for afternoon, not-too-turbulent runs. But for currents that get speedy and rough, your choice should be a modern raft, canoe or kayak.

Best introduction to wild water is available aboard a well-made inflatable raft. For a taste, or a faceful,

of white water, it is only necessary to sign up for a raft trip of a few hours or days—no techniques to learn, no river maps to memorize since an experienced outfitter-guide skippers the raft. Boat and equipment will be picked for maximum safety and a river can be an adventure for all the family.

Blow-up rafts can be strong

Modern rafts, steered by oars, paddles or motor, are not very maneuverable, but provide great abrasion resistance and reserve flotation. Though pioneer trappers and voyageurs managed wilderness rivers aboard logs and timbers lashed together, those rigid models would have pounded to splinters on the rocks. A present-day "rubber" blow-up can slide over without a scratch.

Proper equipment is essential once you decide to try the sport. Good inflatables are not cheap. A "four man" raft (suitable for two on a river run) rugged enough to bounce off boulders and branches could cost over

\$500; larger craft over \$1000. Light, thin-skinned models, fine for paddling or fishing, are considered swimming-pool toys by experienced river rats. Strong, neoprene-coated synthetic fabrics are more durable, and experiments are now being made with DuPont's Kevlar 49 aramid plastic filaments, superior strength-to-weight materials.

Big rafts used commercially for group river-runs may also be headed for legal shoals. Most are imported, making them "foreign-made vessels trafficking between U.S. ports," which the Coast Guard can't certify as safe until laws are passed to cut through the red tape.

Must learn some tricks and skills

No special training or permits are required on many rivers to run rafts on your own, but training and experience are highly advisable. Rafts can turn over, swamp, hang up on submerged trees, slam into underwater rocks, be trapped in suction-hole eddies or be spun out by the helical flow of a bend in the river. The white-water skipper must learn the hydraulics of river currents. He must study charts, learn how to read the water and know how to scout conditions ahead—sometimes it makes better sense to get out and walk while lowering the boat downstream by line.

Canoes

One step up in speed and difficulty for running rapids is the Indians'

Smaller boats provide a bigger challenge, but small size is necessary when you sluice down narrow cuts. Four-man boat is the right size for two in rapids.



PM photos: Warren Asa



New rides for white-water action

Rapids-running fliers flexible enough to form-fit the drop-offs and bounce off boulders, these big new inflatables (above and right) can carry cargo or passengers through wild water when aimed by experts who know river hydraulics.

double-ender. When water starts showing white patches, however, decking is necessary to keep the water out, and special skills required to keep the canoe upright. A 17-footer is a good average size for two paddlers with spray-skirt decking added and a shallow shoe keel to make maneuvering easier.

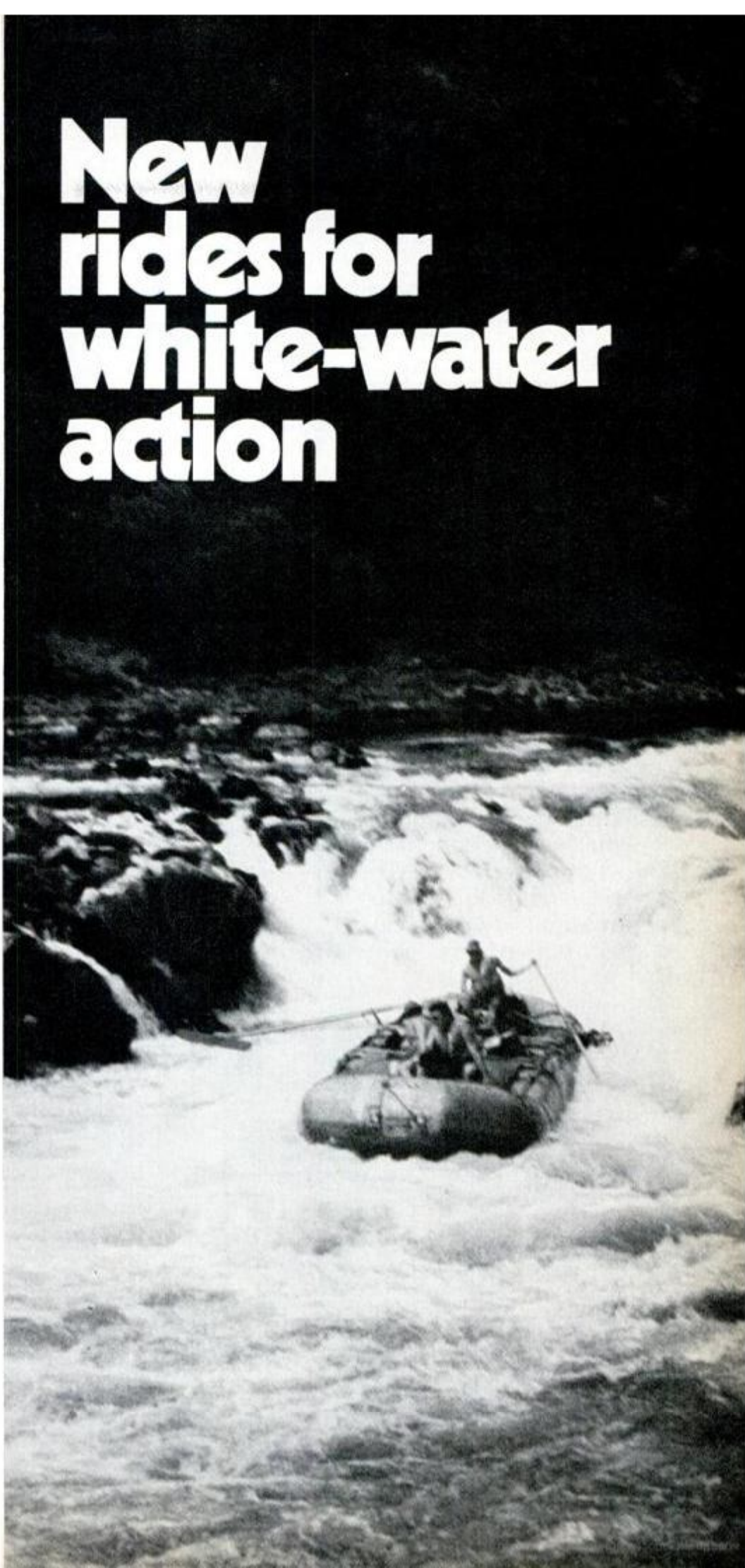
More specialized decked canoes are called C-1s and C-2s (for competition). The one-man C-1 slalom model is 13 feet long and weighs 40 pounds or less. The speedy C-1 down-river model is a foot longer. For two paddlers, the C-2 slalom and down-river models are about 16½ feet long and weigh 50 pounds.

Wilderness canoe campers can run into white water in an open-decked canoe without expecting it. Probably the best advice around for this sport is in *The Complete Wilderness Paddler* by Davidson and Ruge. It's considered the first and last word by many canoeists.

Kayaks

Fastest and most maneuverable of all, the Eskimo invention looks much like the new decked canoes. You will be paddling seated rather than kneeling, however, and you'll use a double rather than a single-bladed paddle. You'll have fewer paddle strokes to worry about, but will need to learn the Eskimo roll and get used to wearing a helmet so that if flipped in a suckhole you can roll back up with

[Please turn to page 104](#)



**SPECIAL
DIESEL
SECTION**

FIRSTHAND REPORT

by Michael Lamm
WEST COAST EDITOR



The diesel engine option on the VW Rabbit is \$170—an amount easily saved when you get 40 to 50 miles on a gallon. Whether you're patriotic or just practical, you'll want to ponder the plusses of diesel power. The six pages in this section are sure to diminish your desire for gasoline.

Driving the diesel

Volkswagen has done it. Broken the diesel barrier. Only \$170 more than the standard Rabbit. Before the Rabbit got dieselized, the least expensive diesel you could buy cost over \$8000. Now here's one for \$4249 base.

Better than that, VW's diesel *moves*. It's quicker from zero to 60 mph than either of the other two diesel imports currently available—the five-cylinder Mercedes 300D or the Peugeot 504D.

Starting it

Hard to start? No. In mild weather or with the engine already warm, it cranks right up. There's no waiting. If it's cold, though, there's a knob to the left of the steering column. You pull out this knob as you would a choke. Then turn the key one notch and a red dash light goes on, telling you to wait for the glow-plugs to heat up. The red light goes out in 15 to 60 seconds, you hit "start" and the engine fires.

Actually the "choke" knob isn't a choke at all (no carburetor). Instead, pulling out the knob advances the injectors to squirt 5° sooner. And even if you leave the knob pulled out while you drive, it can't hurt anything, because the injectors advance 5° above 1500 rpm anyway.

Stopping it

Nor do you need a "kill" button as in some diesels. An automatic solenoid cuts off the engine's fuel supply when you turn off the starter-switch key.

Noisy? I expected the usual diesel raspberry when starting and accelerating. But this is actually the quietest diesel I've ever driven, and that includes the luxurious Mercedes 300D.

Engine noise simply doesn't leak into the passenger compartment. When you drive past a high curb with the passenger's window open, though, you *can* hear the engine in echo. But in ordinary cruising and



Diesel Rabbit is identical to gas models . . . until you lift hood.

Under the hood of the diesel Rabbit beats a powerplant that's a breakthrough in diesel design. Lightweight and high-revving, the engine produces minimal noise and vibration. Transversely mounted and driving the front wheels, diesel gives the Rabbit an EPA rating of 52 mpg highway.

Rabbit

around-town driving, the diesel is only slightly noisier than the gasoline-engined Rabbit.

What's happened is that VW has added sound deadening in all the right places. It has also designed the combustion chambers and pistons to keep down clatter.

Working on it

One thing I really like about this car is the engine's simplicity. Unlike most 1977 cars, here's one that appears simple enough for the home mechanic to work on (see *Saturday Mechanic*, page 86). No carburetor, no ignition system, and no tune-ups to speak of. Everything's out in broad daylight, easy to get at. The Bosch fuel-injection system might be beyond the average do-it-yourselfer, but even that comes off in a flash. Once it's removed, you simply take it in to your dealer for repairs or recalibration.

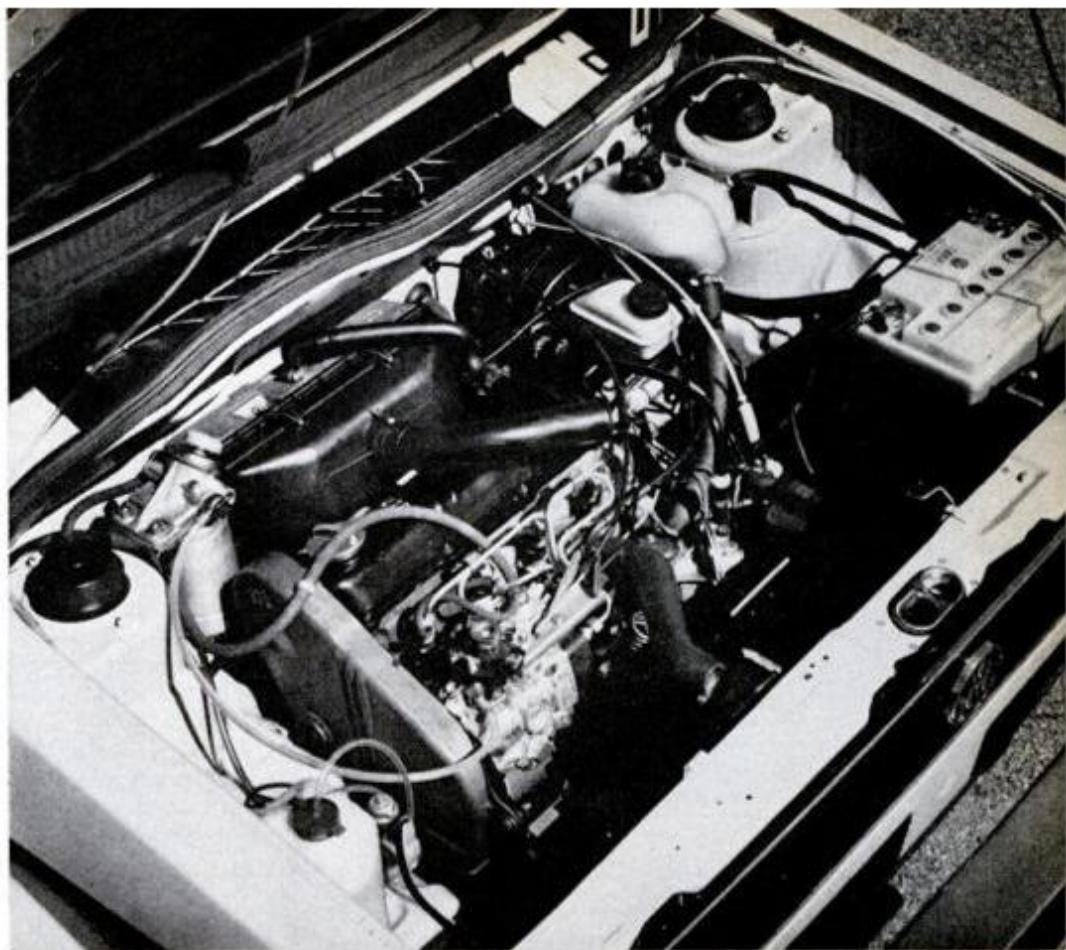
The Rabbit diesel meets EPA smog standards without a catalytic converter. Government mileage figures are 52 mpg highway and 39 mpg city.

One reason it does so well in town is that, during deceleration, the injectors shut off the fuel supply entirely, unlike carbureted engines which constantly dump some fuel through the partly open throttle butterfly.

Designing it

How can VW make a diesel so inexpensively? Simply by converting the standard Rabbit engine to run on diesel fuel—keeping as many original engine components as possible. The basic Rabbit block is the same, whether gasoline or diesel, and so are the rods, crankshaft, bearings and flywheel.

Wrist pins, pistons and head have been totally re-engineered, however. The head is aluminum, with a pre-chamber design. This spherical pre-chamber sets up a swirl in the fuel-air mixture for smoother, more complete burning. The combustion



process continues in the main combustion chamber.

The prechamber arrangement gives a number of advantages. It tucks the glowplugs into relatively small pockets so they can heat the chambers more quickly. It also reduces the peak combustion loads that normally put so much strain on a diesel's pistons, rods, crank and the like. It's this fact that allows VW to use so many components from the much more lightly stressed gasoline engine.

Weighing it

Actually the gasoline Rabbit engine is properly overengineered to take the diesel's 23.5:1 compression ratio and all the attendant diesel punishment. Diesels ordinarily need much heavier blocks and reciprocating parts, and weight has always been one of the diesel's great bugaboos. As it is, though, the Rabbit diesel—the entire car—weighs only 33 pounds more than the normal version. Both cars are, of course, identical in all other ways—bodies, suspension, drive train.

Like the Rabbit's conventional engine, the diesel uses a belt-driven overhead cam. Because of the diesel's different head and piston design, its displacement is 89.7 c.i.d. instead of the regular engine's 97.0 (1471 vs. 1588 cc). Horsepower rates 48 at 5000 rpm, and it really does rev that high. Most four-stroke diesels can't touch that, and that's why VW calls

this a high-speed, lightweight diesel. Maximum torque, by the way, is 58 foot-pounds at 2500 rpm.

Driving it

One thing I would have appreciated on the test Rabbit diesel is a tachometer. While acceleration in town felt strong, the engine's weakness showed up in hilly country at cruising speeds. Shifting to third kept the diesel Rabbit going uphill plenty fast enough, and third is good for about 70 mph. But a tach would help to hold rpm in the diesel's strongest torque range, which I'd say is between 2000 and 3000 rpm.

Volkswagen hopes to sell some 10,000 to 15,000 diesel Rabbits in this country this year. I'm sure that's a realistic figure, and I imagine that when word gets around on this car and engine, demand will be greater than supply, as in the Beetle's best days.

Next spring, VW hopes to include diesels in its new Pennsylvania assembly plant. Tolerances in diesel engines are higher than in gasoline powerplants, so quality control has to be better.

A couple of options Wolfsburg is currently working on include air-conditioning for the diesel Rabbit; also an automatic transmission.

Volkswagen has an awfully good car in the Rabbit to begin with. The diesel ought to remake VW's reputation as an economical, highly practical car. ★★★

SPECIAL
DIESEL
SECTION

FIRSTHAND REPORT

by Robert Lund
DETROIT AUTO EDITOR



General Motors' diesel V8 will be an option on 1978 Olds 88s and 98s, and that may be only the beginning of its application.

"Come on up and we'll let you drive a car with the diesel engine in it," the Oldsmobile public relations man offered on the phone.

That was surprise No. 1. General Motors has a fetish about not letting outsiders drive the new cars until the company is ready for the grand unveiling. I'd been bugging the Olds p.r. guy to drive the diesel, but I didn't expect him to go for it.

Surprise No. 2 was the car. Most of the negative things you've heard about the diesel aren't true. At least not to the extent that they would turn you off from buying a car with a diesel engine. GM hasn't conquered all the drawbacks of the diesel, but the Olds diesel is a highly acceptable car.

I think I figured out why GM lifted its ban against allowing outsiders to drive a new car before the official announcement. The company is worried about how the diesel will be received. Will the customers go for it? GM's last attempt at bringing out a new engine—the ill-fated Wankel—cost the firm something like \$500 million with nothing salable to show for it. GM doesn't want a repeat of that bungle, so the company is taking a different tack with the diesel. Show it off, let newsmen drive it and hope for favorable mentions in the magazines and newspapers before the car goes on sale.

If that's the way GM baited the trap, I fell for it. I couldn't find many faults with the car in a ride-and-drive on the streets and freeways of Lansing, Mich., where Olds has its headquarters.

The car I drove was a 1977 Delta 88 four-door. The diesel will be offered as an option on the 88 and 98 at the beginning of the 1978 model year. The cars will be out in late September. The 1978 versions of the 88s and 98s won't be much changed from the current car, so it would be fair to say the car I drove is essentially the same car you will see in September.

First difference

The first thing that's different about driving the Olds diesel versus driving a gasoline-engine car is the way you start the diesel. The engine is a hard starter in cold weather.

If the outside temperature is 75° to 80° F. or above, the engine starts immediately. Turn the key and you're ready to roll. But if the temperature is below 75°, you have to wait a few seconds for the engine to warm up. At 10° to 15° below zero, you might have to wait as long as a minute.

The temperature was in the 40s

the day I drove the car and I had to wait about 15 seconds before moving out. As I turned the starter key to the "On" position, a small panel on the dash, just to the right of the steering wheel, lit up with the word "Wait" in red. After about 15 seconds the red light went out and a green light flashed on the word "Start."

The car started smoothly, but not without some noise—what I'd describe as a soft knocking sound. I didn't find the noise objectionable. I attribute this to the fact I'm used to some start-up noise because my own three-year-old clunker sets up a racket when you turn it on. Although the knocking sound is subdued, Olds owners who are pickish and expect the engine to purr might find the start-up noise disconcerting.

What about freeways?

After a few blocks of city driving, I got on the freeway. The pickup seemed a little sluggish going down the entrance ramp, but it was about what I would expect of a big, heavy car. I'm used to a lighter car and I had the feel of driving a much heavier machine. But there was no problem merging into traffic going 55 to 60 mph. I didn't try the zero

GM diesel is installed in a '77 Delta 88 four-door which the author (left) drove and discussed with Olds engineer Jim Benner (right).



the diesel Oldsmobile



Diesel engine is being tested in '77 Delta 88.

to 60 test. Jim Benner, an Olds engineer, said he could do it in 16 seconds and I took his word for it. The same car with a gas engine can do zero to 60 in 12 seconds.

Once we got up to cruising speed, the car handled beautifully and even Benner's critical ear couldn't detect any engine noise. We were bucking a strong wind and even the wind noise wasn't discernible because of the way Olds has insulated the car.

Truck traffic is thick around Lansing and I kicked the car up to 65 a couple times to pass trucks. There was plenty of power to get by without flooring the pedal.

We pulled off the freeway after several miles and onto an unpaved road. I parked on the shoulder and killed the engine. I let the car sit for a few minutes and then turned the starter key on again. This time the "Wait" light did not go back on again. The car was warmed up, so the "Start" light flashed on as soon as I turned the key.

Tailing a diesel

Later in the day, after the car had been sitting a while, I got in a second (nondiesel) car and followed the diesel while another guy drove it. I wanted to see how much smoke came out of the tailpipe. The Olds diesel is a clean engine as diesels go and does not require a catalytic converter to meet government emissions standards. The only time the car smoked while I was following it was when the driver gunned it suddenly to make a light. Other than that there was no noticeable exhaust from the tailpipe.

Olds has several versions of the car for testing. The one I drove is the same car the company took to Washington to show to government officials. On that trip—Lansing to Washington to Detroit—the car averaged 27 miles to the gallon. The same car with a gas engine averages 18 to the gallon. Olds anticipates the government mileage rating on the diesel for 1978 will be around 22 to 24 miles to the gallon. The car is capable of doing better than 27 to the gallon if you drive it with a light foot and providing you don't get tangled up in a lot of stop-and-go.

Because diesel fuel isn't as widely available as gasoline, Olds has equipped the car with an oversize fuel tank. It will hold 27½ gallons, giving the car a cruising range of something over 600 miles between fill-ups.

There are some plus and minus trade-offs on the diesel from a service standpoint. The car does not have a carburetor, distributor or spark-plugs, so you don't have to change those things or make adjustments in timing. On the minus side, you have to change oil more frequently. Olds said it had not worked out a recommendation on how frequently oil should be changed, but it will be in the area of every 3000 to 5000 miles. On a gas-engine car, the company suggests an oil change at 7500 miles or six months.

Look-see under the hood

We lifted the hood of the car to see two batteries. The reason for having this is to compensate for the cold-starting problem. The batteries

CAN YOU USE HOME HEATING OIL?

What do you do if you run out of fuel with a diesel-engine car in an area where you can't find a diesel station?

No problem, just find a house that heats with fuel oil and tap the tank that feeds the furnace. That's cheating the government of its road taxes, of course, and Oldsmobile doesn't recommend that. However, the Olds diesel car will run on No. 1 diesel (for heating purposes), No. 2 (for cars and trucks) or aviation diesel.

Olds recommends use of No. 2 at temperatures down to zero. At temperatures below zero Olds suggests No. 1, because No. 2 has a tendency to skin over and form a waxy substance in extreme cold.

Olds even did some experimental fiddling around with a mixture of gasoline and diesel—25 percent gasoline, 75 percent diesel. The car will run on that combination, but the engine makes a terrible racket. There's no permanent damage to the engine using an occasional mixture of gasoline and diesel fuel, but Olds won't pick up the repair bill if you damage the engine.—R.L.

are tucked in the extreme front corners of the compartment, one on each side.

Olds declined to say what the car will cost, except that the diesel will carry a premium price over a gas engine.

Big, heavy cars are notorious gas-guzzlers and the government is talking about putting a penalty tax on the big jobs to discourage people from buying them. GM may have found a way around that with the Olds diesel. The driver can have his cake and eat it, too. He can keep his big car and still do his bit for fuel conservation. ★★

You can do it yourself

Here's a close look at what you can do to keep a diesel Rabbit running right.

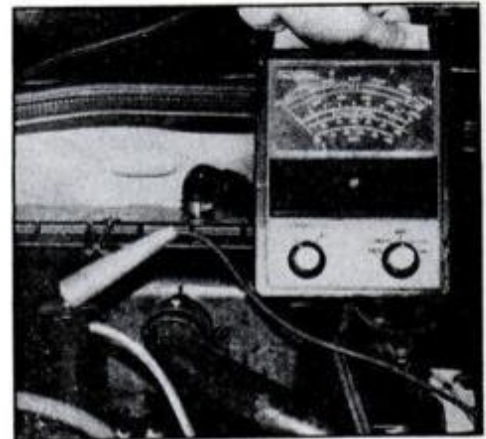
There may be a diesel engine in your automobile's future, and it will mean a number of new techniques for a Saturday Mechanic to learn, and new tools to obtain. You will, however, be able to build upon your experience with the gasoline engine to handle routine diesel service and troubleshooting.

The new Volkswagen Rabbit diesel is the first of the popularly-

priced versions, and should be typical of what is coming. The engine block, crankshaft, flywheel and main bearings are straight out of the gasoline version. The cylinder head bears a distinct resemblance to that used on the gasoline engine, but it is modified to accommodate fuel injection directly into the cylinders.

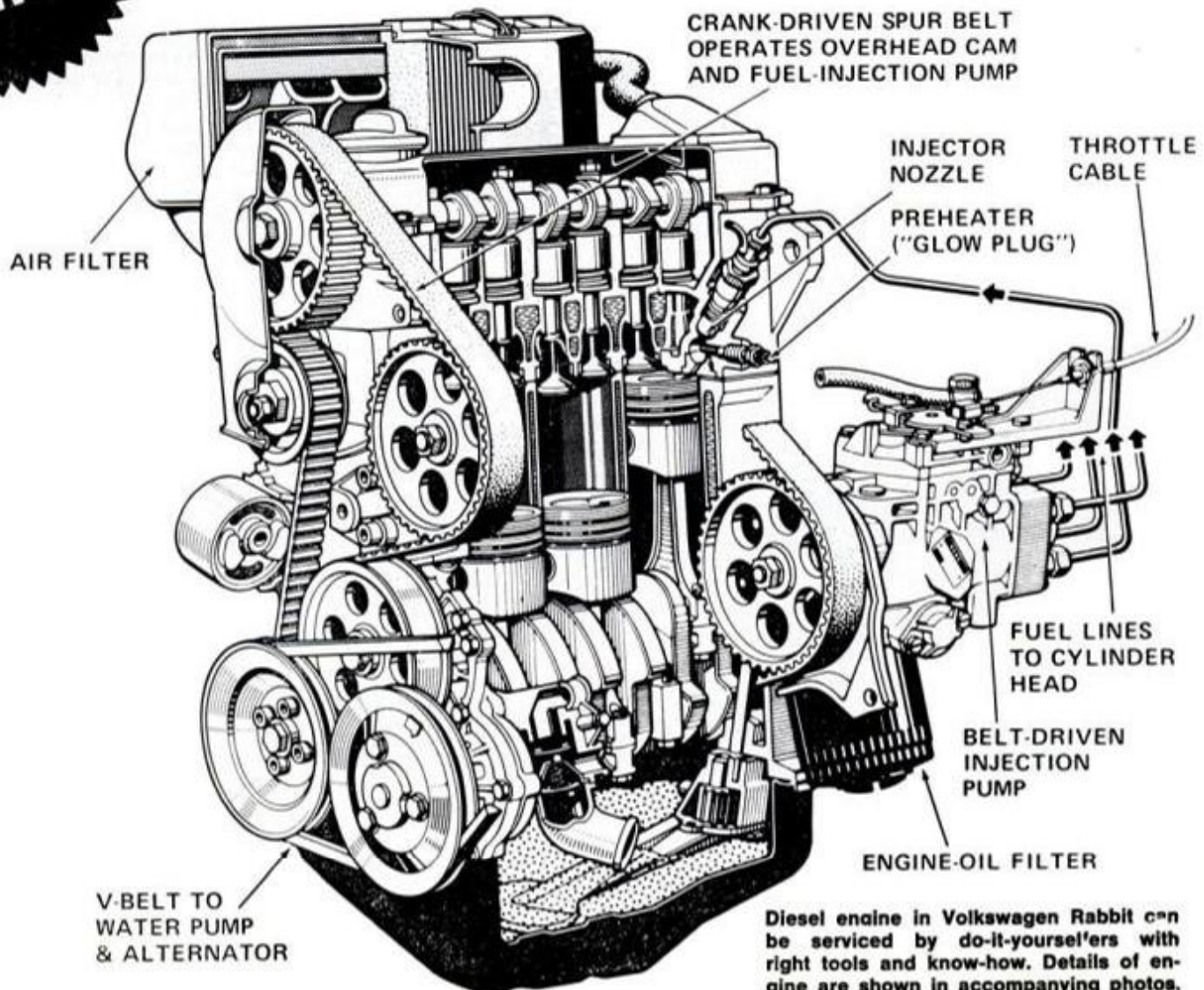
The fuel injection is the major external difference. It is a pulley-and-belt driven mechanical system, and its injectors thread into tiny precombustion chambers leading directly to the main combustion chambers at the tops of the cylinders.

There is no electrical ignition system. High compression (23.5-1



1 Engine rpm on diesel is measured using a special vibration sensor to which a standard tachometer is connected.

**SPECIAL
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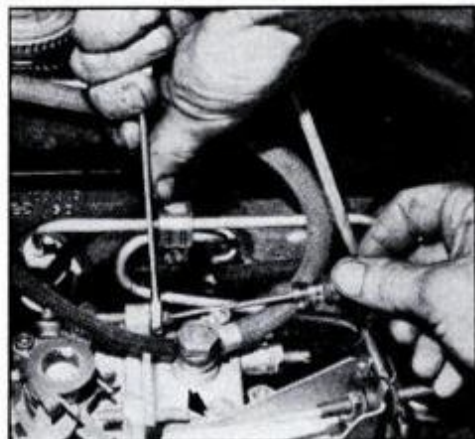


Diesel engine in Volkswagen Rabbit can be serviced by do-it-yourselfers with right tools and know-how. Details of engine are shown in accompanying photos.

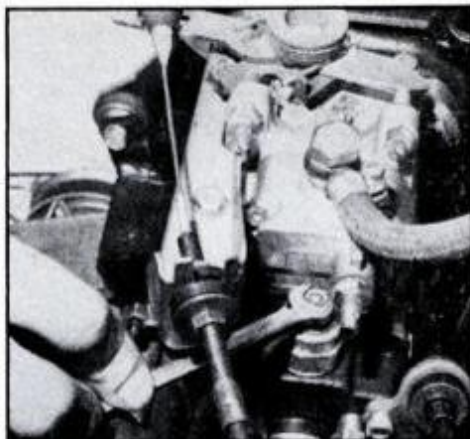
if you buy a diesel!

SATURDAY MECHANIC

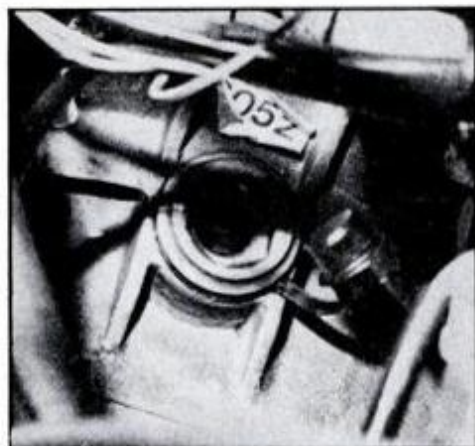
by Paul Weissler



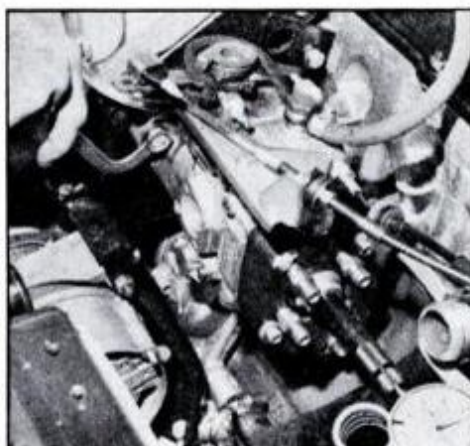
2 Engine idle is adjusted at the fuel injection pump. Slacken nut with wrench; turn screw for the desired engine speed.



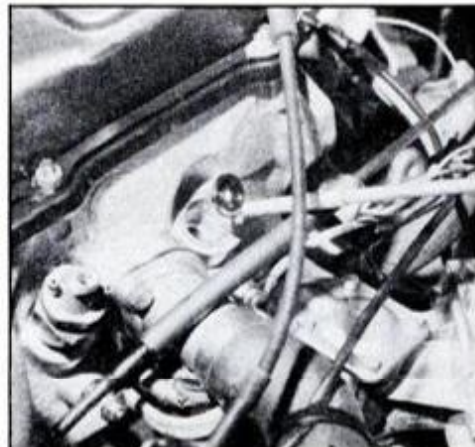
3 Fuel shutoff solenoid automatically cuts off fuel to engine. For service, first remove nut, then disconnect the wire.



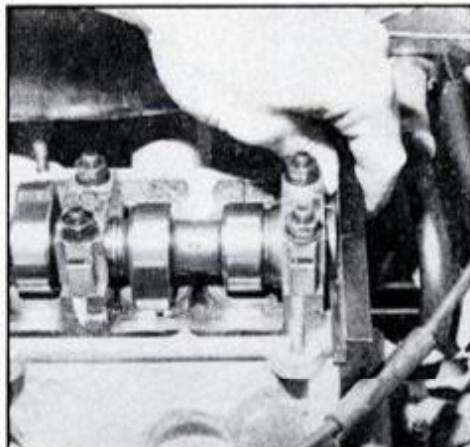
4 Timing mark opening is on bell housing. Mark on flywheel aligns with center of opening; indicates No. 1 piston is TDC.



5 Injection pump bolts are loosened with curved wrench; turn pump to adjust timing. Indicator checks plunger stroke.



6 After fuel injectors are removed, the heat shields are visible. Remove with a magnet. Install new shields as needed.



7 Drive belt replacement requires two simple tools. Here the camshaft is held from turning with an L-shaped steel bar.

ratio) heats the air sufficiently to ignite the fuel. In very cold weather, tiny electrical heaters called glow plugs, heat the pre-combustion chambers to assist starting.

Engine speed adjustments

The first new procedure you face is setting idle speed to specifications. This is new because there's no electrical ignition system for you to connect a tachometer. VW's solution offers a vibration sensor with a magnet in the base. Place it on the valve cover and connect its two lead wires to the car battery. The engine vibration and 12-volt battery current create an electrical pulse that will operate a standard tachometer (Fig. 1).

There are other solutions, such as a photo-electric tachometer, which is self-powered and merely has to be aimed at the crankshaft pulley. It counts crankshaft revolutions, and so will work on any kind of engine. But it costs an unthrifty \$175 to \$200. For the actual idle-speed adjustment, loosen the locknut and turn the screw on the accelerator linkage at the fuel injection pump (Fig. 2).

There is no fast idle and no choke. For cold starts pull a dashboard knob, and linkage from the knob to the fuel injection pump operates an internal pump mechanism that advances the fuel injection by 5° on the crankshaft.

The diesel has a maximum speed—5450 rpm—controlled by a governor mechanism inside the pump. Check governed maximum speed by flooring the accelerator pedal. If necessary, adjust by slackening the locknut and turning the governor screw—it's next to the one for idle speed.

Fuel shutoff

To stop the diesel, the fuel supply must be shut off. Fuel flow is controlled by a solenoid valve on the pump; when the solenoid is energized, the fuel passes into the injection circuits; when the key is turned off, the solenoid de-energizes and fuel flow stops. Whenever you work

(Please turn to page 119)

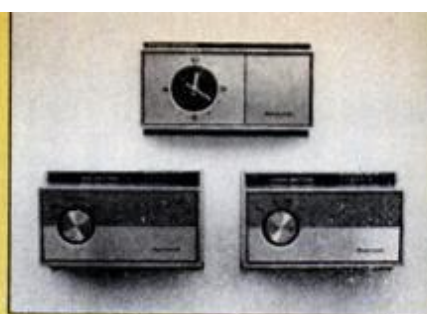


10. SHADING DEVICE
Patio roof rafter grid shades sliding glass bedroom doors.

12. LAUNDRY VENT
Dampened exhaust vents laundry when operating.



13. RIDGE VENT
Louvered metal ridge cap provides vent for attic heat.



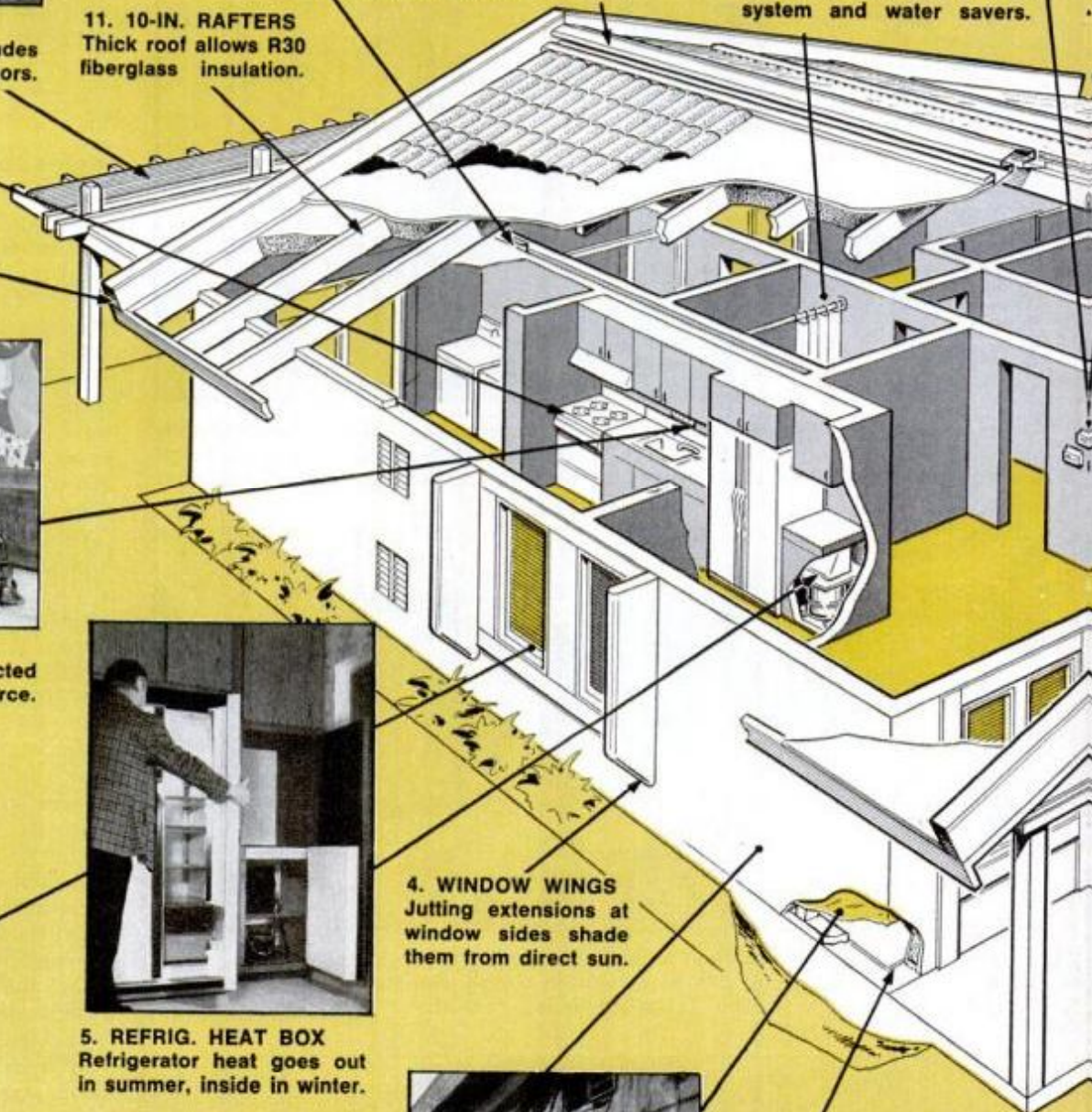
14. THERMO CLOCKS
Thermostat control has timers to heat and cool the air.

15. WATER MISER BATH
Unvented bath has a filter system and water savers.

9. LOW-ENERGY STOVE
Piezoelectric spark replaces pilot light on the stove.

8. WIDER OVERHANG
Three-foot roof overhang keeps high sun off walls.

11. 10-IN. RAFTERS
Thick roof allows R30 fiberglass insulation.



7. PREMIXED WATER
Water temperature is selected by button and mixed at source.



5. REFRIG. HEAT BOX
Refrigerator heat goes out in summer, inside in winter.



6. WINDOW LOUVERS
Adjustable mini-louvers between double-glass panes block heat of the summer sun.

4. WINDOW WINGS
Jutting extensions at window sides shade them from direct sun.



3. SIX-INCH STUDS
Thicker exterior walls allow use of R19 insulation to save heat.



2. VAPOR BARRIER
Heavy plastic sheet stops exterior moisture penetration.

1. SLAB INSULATION
Heat loss or slab infiltration is blocked by insulation.



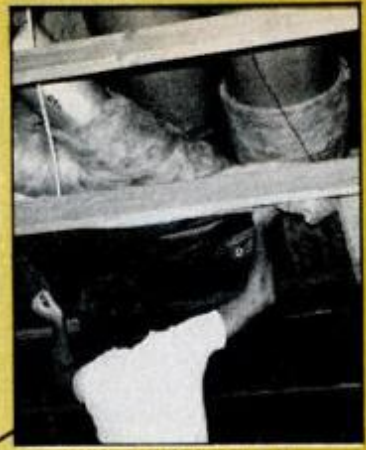
16. SHADED ENTRY
Covered entrance shades double-doored vestibule.

17. MAGNETIC DOOR
Insulated steel door has magnetic seal stop.



18. SOLAR ASSIST
Evacuated tubes collect sun energy to heat or cool house.

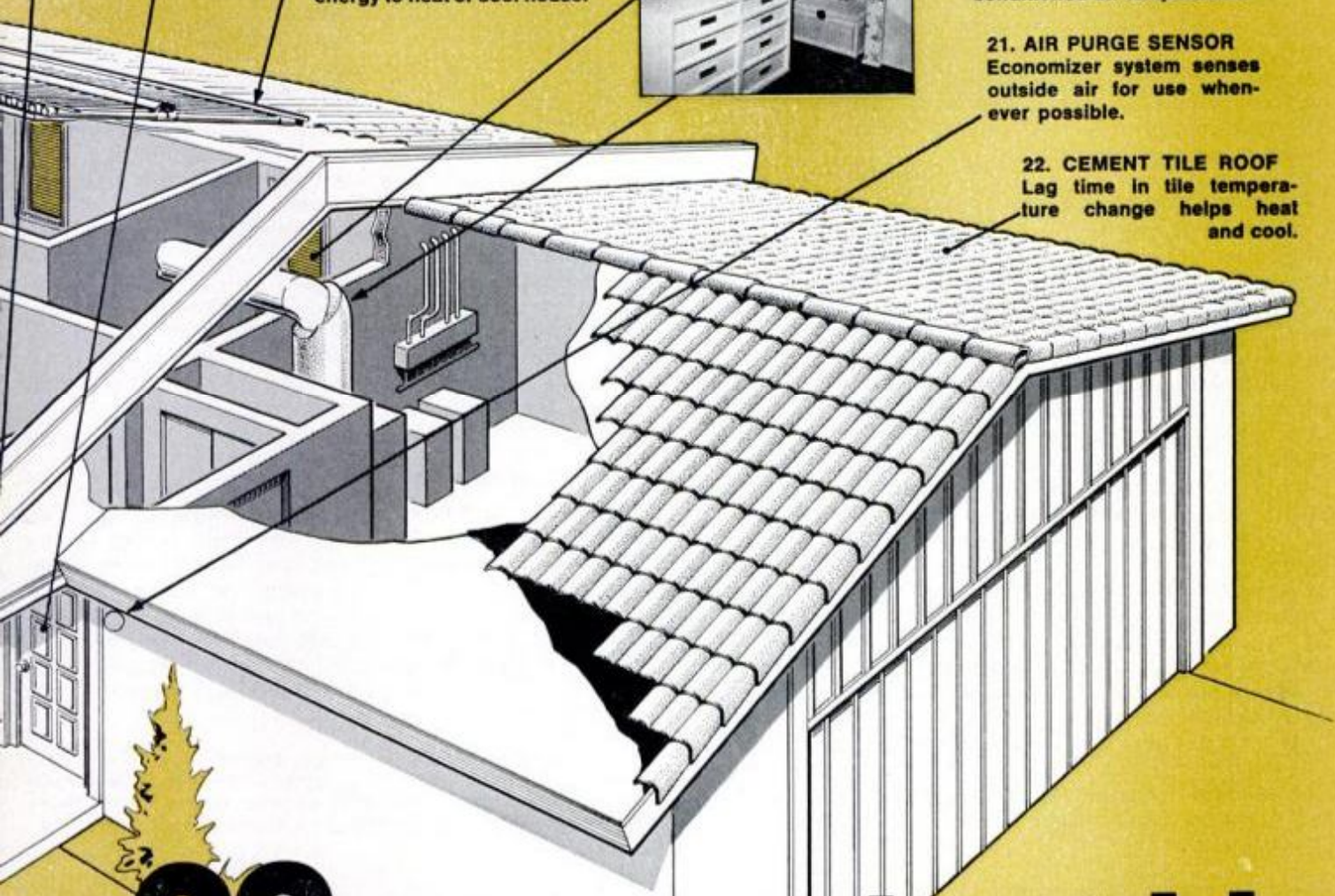
19. CORNER WINDOWS
Windows are small, but corner location bounces light.



20. DUCT INSULATION
Ducting is insulated to hold conditioned air temperature.

21. AIR PURGE SENSOR
Economizer system senses outside air for use whenever possible.

22. CEMENT TILE ROOF
Lag time in tile temperature change helps heat and cool.



22 energy-miser tricks that cut your living costs

Two new California houses are proving homes can be built and equipped to cut energy use in half without sacrificing comfort.

by Richard F. Dempewolff

When John and Dorothyann Sheehan want to turn on the water in their kitchen sink or bathroom shower, they don't flip faucets. They push buttons. Electronic signals flash back to an automatic switching system at the water heater, where hot and cold water are mixed according to which button was pushed. Water of specified temperature feeds through a single insulated pipe. There are no "hot" and "cold" lines.

You don't open windows willy-nilly in the Sheehan home. Sensors trigger a signal light when outside tem-

22 energy-miser tricks

perature and humidity are at the proper level so central heating and airconditioning controls won't be tripped. When the light's on, Dorothyann knows she can let outside air blow the curtains. Not that "airing out" is necessary. Filtered, temperature-controlled fresh air is renewed, even when all windows are closed, by the same "enthalpy" system that turns on the "economizer" signal light. In her kitchen, self-energizing starters light the burners on Dorothyann's pilotless gas stove and clothes dryer, and a fan-driven convection oven bakes and roasts in less than half the usual time.

These features and many more, including special construction techniques, have made this house one of the most energy-efficient anywhere. While final figures are not yet in, its first half year of operation indicates it may use some 70 percent less fossil fuel energy than identical—but unenhanced—homes of the same plan in the same development.

Test beds for future homes

What's it all about? The Sheehan house and an identically fitted-out demonstration model next to it are in Mission Viejo, Calif., a planned community nestled in eucalyptus, palm and citrus-cloaked hills some 50 miles south of Los Angeles. Both are test beds for a wide variety of energy-saving features.

The Sheehans—John, Dorothyann and their 4-year-old son Todd—were picked as a "typical young family" that might have chosen the standard Mission Viejo "Cordova" model—a 1150-square-foot, three-bedroom Spanish contemporary selling for about \$50,000. They are in-residence "human guinea pigs" who are testing the innovations by living a normal family life with them.

More than 100 delicate sensors in the two buildings are measuring everything from temperature and humidity outside, inside and *within* the exterior walls and slab, to the heat output of each appliance, and the consumption of gas, electricity, water and solar energy on a round-the-clock basis.

All this information is fed into a central computer, which will digest it and compare item by item—with similar data from identical homes that were built to the standard specifications of the builders in the same development.

Five-year research program

The test homes were built as part of a five-year "Minimum Energy Dwelling" (MED) research program of the federal Energy Research and Development Administration (ERDA). It is jointly conducted and financed by ERDA, the Southern California Gas Co., and Mission Viejo, a realty development company. Goal: to encourage home builders and developers to use the best of MED's energy-saving features in future residential construction.

ERDA scientists know that some 20 percent of all energy consumed in the United States is used in the home—half of it for heating and cooling. Of the remainder, 15 percent goes for water heating, the rest for appliances and lighting. If this consumption can be halved, the saving would amount to 300,000 barrels of oil per day by 1985.

"That," explains Dick Ashworth, research projects manager of Southern California Gas, "is what these houses are all about.

"The idea for them was hatched in 1975. We figured



that with funding help we could produce a practical minimum-energy, middle-income home using off-the-shelf products, and without sacrificing the comforts most Americans expect."

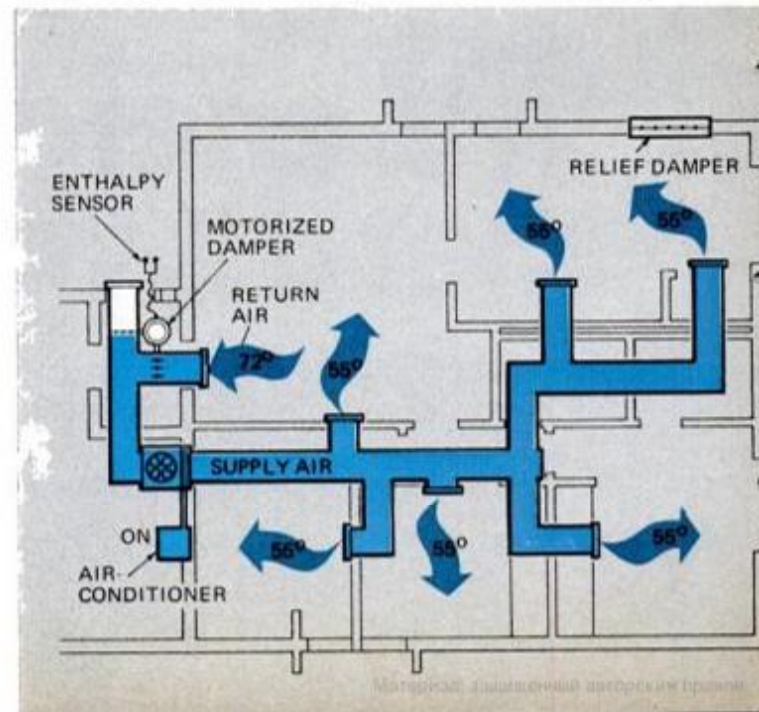
Gas company officials took their idea to ERDA, which offered to help. Mission Viejo Co. became the contributing building partner, and the \$600,000-plus project was born. Ashworth is quick to point out that the figure is *not* the cost of the houses, but represents total funding for the entire five-year project, including the expensive sensing and computer analysis program.

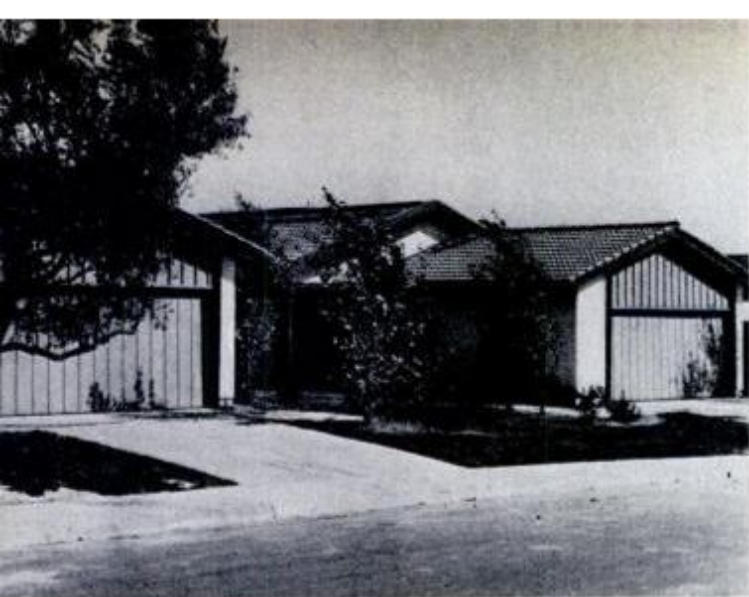
Economically practical

What *did* the houses cost? No one wants to say. They were built to demonstrate and test many energy-saving ideas, officials point out. Most, they insist, are economically practical. A few involve expensive items that could become reasonable with volume production.

Recently, I followed Dick Ashworth through the demonstration house to see how it was put together. Basic innovation is superstout construction, using ordinary

Airconditioning and heating airflow, controlled by clock thermostats, is introduced to duct system via the airconditioner or furnace, using the precooled or preheated air from inside the building and recirculating it for maximum efficiency.





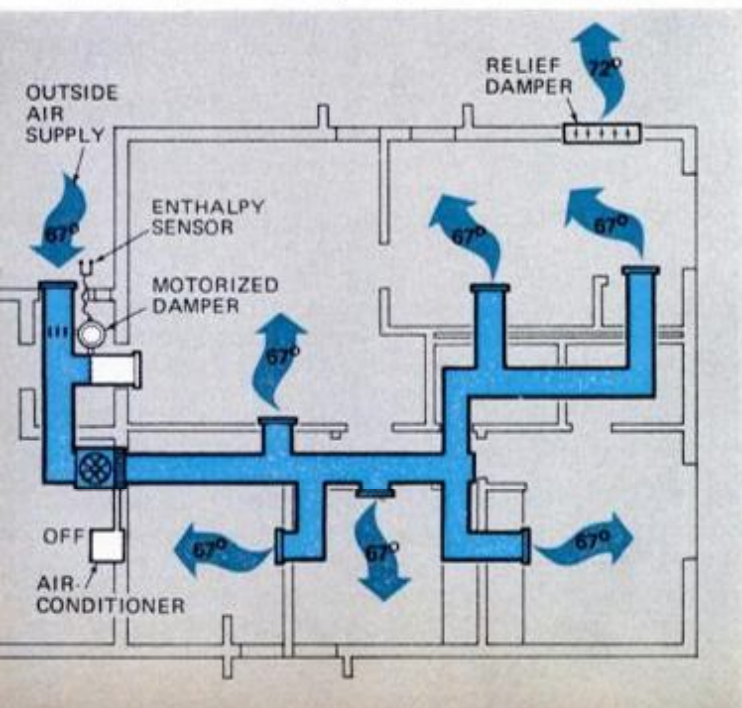
Computer terminal (opposite page) in demonstration house processes data from 100 sensors in both dwellings. Each has shaded or windowless walls and garage on south side (above) as a protection against the heat of the California afternoon sun.

materials, but carefully "over-building" in special ways. The object was to seal the shell against infiltration of outside air with its temperature differential, and escape of conditioned inside air except as determined by controls. Most important features:

■ **Slab and foundation insulation.** Concrete slabs are notorious thermal conductors to the outdoors and surrounding earth. To block this flow, MED builders lined the inside of the foundation wall and slab edge with two-inch foam insulation. Infrared photographs that reveal heat leaks in houses prove the method works.

■ **Six-inch studs for R19 batts.** Most homes today have sidewall framing of 2x4 studs on 16-inch centers. MED houses use 2x6s on 24-inch centers, which is the same amount of lumber by volume. But the walls accommodate extra-thick R19 insulation batts instead of the usual R10 type—almost twice the thermal "resistivity" (what that "R" stands for) or protection. Walls are caulked and insulated at corners; plates, outside door-sills and window framing are caulked against infiltration.

"Economizer" airflow is controlled by outdoor "enthalpy" sensor above front door. When outside air hits a predetermined temperature, air conditioner or furnace cuts out, fan draws in outdoor air and relief damper opens to exhaust overheated air.



Living room in the Mission Viejo MED demonstration home has a corner window shaded by the covered entry patio, as well as a louvered blind between the panes of double glass. Room is partly warmed in winter by heat from refrigerator in the kitchen.

■ **Ten-inch rafters for R30 batts.** The usual roof structure has 2x8 raftering on 16-inch centers. The MEDs have 2x10s on 24-inch centers to accommodate R30 instead of R19 insulation—this is 35 percent greater thermal protection (and it's all overhead where it counts most) for the same volume of lumber. (The higher the "R" number used, the greater the insulation value will be.)

■ **Vapor barrier.** To prevent moisture penetration, 8-mil plastic sheeting substitutes for the usual 15-pound felt to seal the exterior side of outside wall framing. Southern California builders don't normally use a sheathing substrate on residential structures.

■ **Window wings.** The real energy hog in Southern California is airconditioning—not so much winter heating. To minimize effects of hot summer sun, the MED houses are solar oriented, with few openings facing southwest. Windows on sidewalls are protected with side wings for shading.

■ **Extended roof overhang.** Protection for walls and windows against high sun angles is insured by 3-foot roof overhangs all around.

■ **Shading devices.** The garden patio is covered with a solid roof, plus slats on the outside edge, to shade sliding double-glass doors at the rear of the house. Even plantings are arranged to throw shade on the walls during hot periods.

■ **Shaded double entry.** The front door patio also is roofed to shade the doorway and front window. Protection against doorway infiltration is provided by a vestibule with an outer and inner door—like a submarine's airlock.

■ **Magnetic doorstop.** Exterior entry door is steel, permitting use of the same magnetic rubber gasket doorstop that keeps cold air from escaping from your refrigerator.

■ **Insulated door.** Since metal conducts heat and cold, the hollow-steel entry door has a foam-insulated core that gives it solidity, too.

■ **Louvered double glass.** All MED house windows are wood-framed with removable double glass inserts for insulation. Miniature Venetian-blind-type louvers fit between the panes and can be adjusted to prevent sunlight—direct or indirect—from "greenhousing" or overheating the interior.

■ **Cement tile roof.** To provide a six to seven-hour infiltration lag of heat or cold through the roof, red tiles are used instead of shingles. By the time the night

(Please turn to page 126)



Programmed watering—

by Rudolf F. Graf and
George J. Whalen

An automatic lawn-sprinkling system used to be considered a luxury. Today, with water shortages in many regions, it can be an important aid to conservation as well—an easy way to water properly but without waste. You get water only when and where you want it. With programmed controls, you can even water when you're away or asleep—they turn your sprinklers on and off at preset intervals.

The basic concept of an underground sprinkler is simple: Pipes buried below the lawn are fitted with sprinkler heads at strategic locations. The pipes have valves that are connected to the house water supply. The valves are activated by a controller that automatically directs the opening and closing of the valves. You program it, telling it when and how long to water. By using lightweight, easy-to-install plastic pipes and fittings, putting the system into the ground is a simple do-it-yourself project.

Planning the system

Begin by drawing an accurately scaled plan of your property. (A

photocopy of the survey is fine.) It should show the entire property plus the location of your house, lawn, patio, driveway, walks, garden, shrubs, trees, fences, water meter and water source. If the ground slopes significantly, note where this occurs.

You should also know the characteristics of the soil on your land. Its type and texture affect water intake rate and water-holding capacity. For example, a coarse, sandy soil can soak up as much as 4 in. of water per hour, but holds less than $\frac{1}{2}$ in. per foot. The agricultural extension service in your county can give you soil information. It's listed in your county telephone directory.

Measuring water availability

Call your local water company and ask them what the water pressure is at your location in the summer. A pressure of 45 lbs. is about optimum for most residential watering systems. If pressure is below 30 lbs., sprinkler performance will drop and some areas may not be watered. If pressure is above 70 lbs., there may be risk of burst joints.

If you supply your own water or want to confirm your information, you can borrow a pressure gauge from a dealer who handles under-

ground sprinklers. Look in your local classified directory under "Sprinklers—Garden and Lawn" or "Irrigation Systems and Equipment."

Also note the details of the type of water meter serving your home. You'll need to know its size, the size and type of the supply pipe and the size of the pipe that feeds the point where you will tap the supply. This information will help you determine maximum gallonage of your sprinkler system, the pressure loss along the line and what materials you will need.

Choosing materials

Although you can spend time studying the fine details of sprinklers and arrive at intelligent choices, a sound shortcut is to take your plan, water supply details and soil information to the local dealer where you'll be buying the parts.

He can give you good advice on sprinkler head type and location, piping layout and materials needed such as automatic controller, valves, pipe fittings, risers and adapters. Flexible polyethylene pipe is used in climates that have freezing temperatures. PVC pipe is often used in warmer climates, too. Your dealer can give you advice about local code requirements.



rials so you can take them with you. Residential underground sprinklers cost from \$600 to \$1200. The most expensive single item is the controller which costs from \$60 to \$250. Valves are about \$15 each. Heads run from \$2.50 to \$20 and polyethylene pipe is about \$20 per 100 ft.

Following your sketch, arrange the parts on your lawn, but don't start cutting. You can spot any materials shortages, or you may want to make a last-minute layout change. When satisfied, drive a marker stake at each sprinkler location.

Assembling the system

Starting from the supply valve, or valves if more than one water circuit is to be used, lay out the pipe according to plan. Cut it where necessary with a fine-toothed hacksaw to install the ells and tees. Remove any burrs, being careful not to damage the pipe. Fit clamps over the pipe at both sides of a joint then insert the ends of the fitting. Tighten clamps for a watertight seal.

Next install the riser pipes at each tee and screw on the sprinkler heads. At the end of each line, install a drain valve. The valves close when water pressure is applied, so sprinklers get full pressure. When the controller switches off, the drain valve opens so residual water in the line leaks out. This prevents freeze-ups in winter that could split the tubing.

Connect the pipe of each circuit to the main water supply through an automatic valve that can be operated by the controller. Control lines from the valves run back to the controller. Each watering circuit should also have a manual shutoff valve preceding the automatic valve. The main supply line should be able to be shut off by one master valve.

The connection to the water supply line should be at the point of entry or an accessible location in the basement or garage. An anti-siphon valve may be required to protect the water supply of your home against dirt and bacteria

(Please turn to page 114)

what a way to grow

You'll want to select sprinkler heads with discharge rates that give your land the exact amount of water it needs. Some typical heads are shown on page 114.

Plot a tentative layout on paper by drawing the spray patterns (circle, semicircle, horizontal stream, and the like) of each head and joining them with lines that represent pipes. Try to avoid sharp bends. They reduce line pressure. Keep each line as short as possible and indicate a drain valve at the end of each line. After making the layout, add the required flow of all the sprinklers in gallons per minute (gpm) to be sure the total flow will be available from your supply. Allow about 15 percent for friction losses in the pipes.

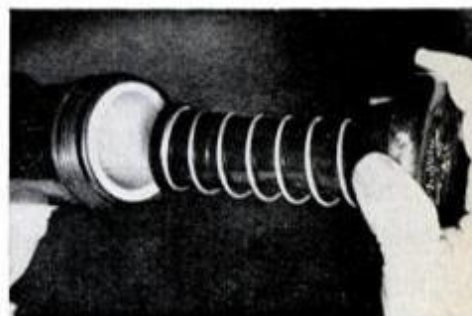
Your dealer can help you designate the most convenient locations for the valves. The controller that actuates the valves should be placed in a protected area—ideally in your garage. It usually comes with a transformer that is plugged into a wall outlet.

Go over the finished layout carefully. Note any areas receiving water that shouldn't. Also be sure you can manually operate the valves and controller without getting wet.

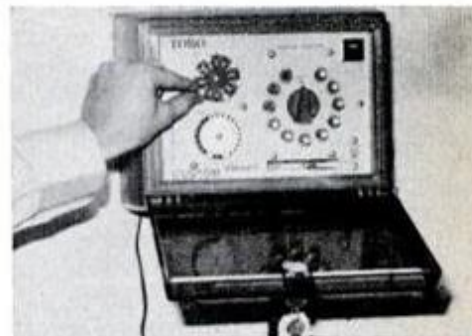
Your dealer can price the mate-



A tee fitting attaches to the flexible pipe with hose clamps. Next the riser pipe and the sprinkler head are installed.

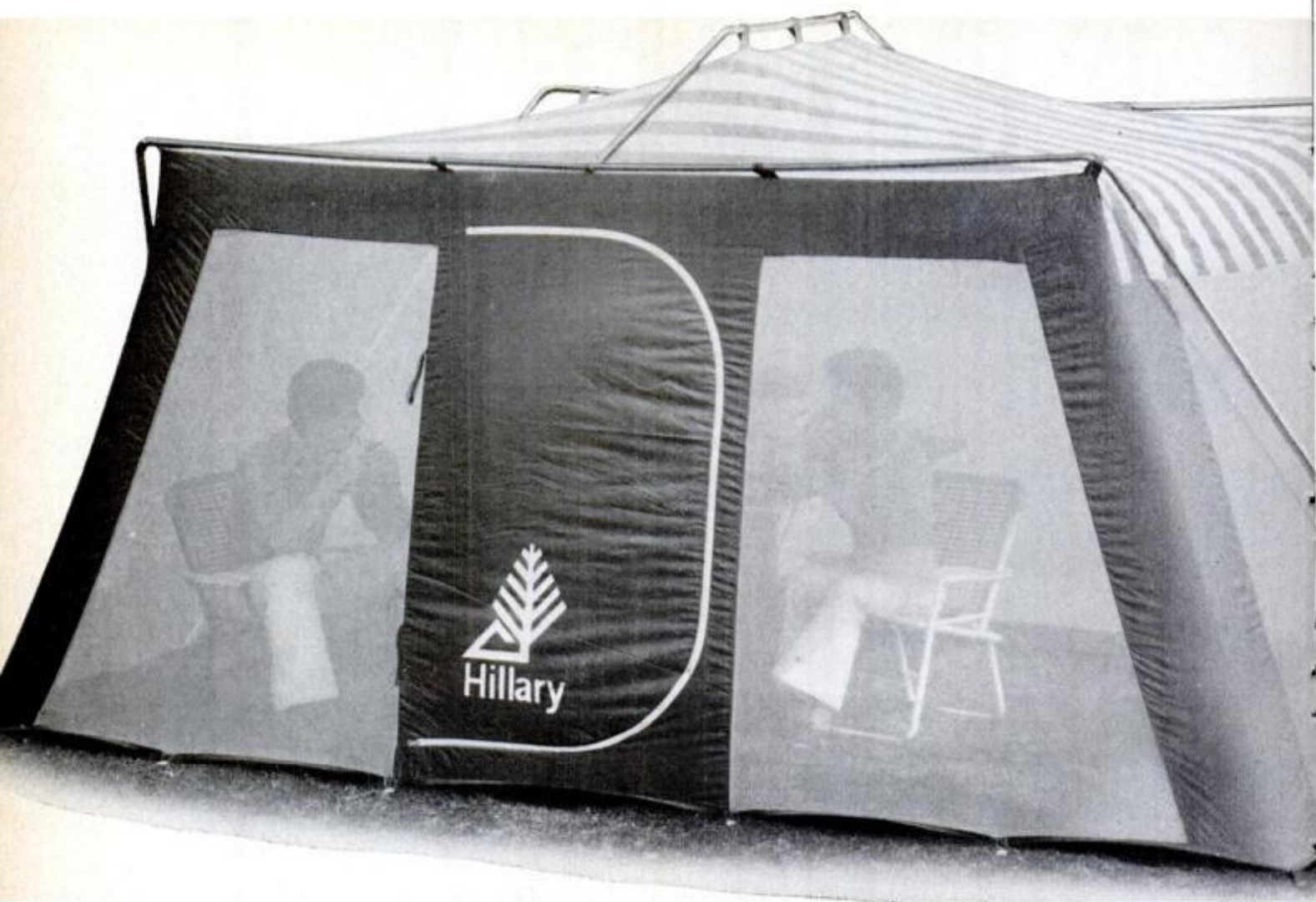


The filter in this pop-up head keeps dirt from entering. The spring returns head to ground level when water flow stops.



Removable pegs program the controller (above) to open actuator valves at desired times on selected days in a 14-day cycle.

Each of the actuator valves (left) serves a watering circuit. They are hydraulically run by water-filled tubing from the controller. Here the flow is checked manually.



Pitch a room outdoors

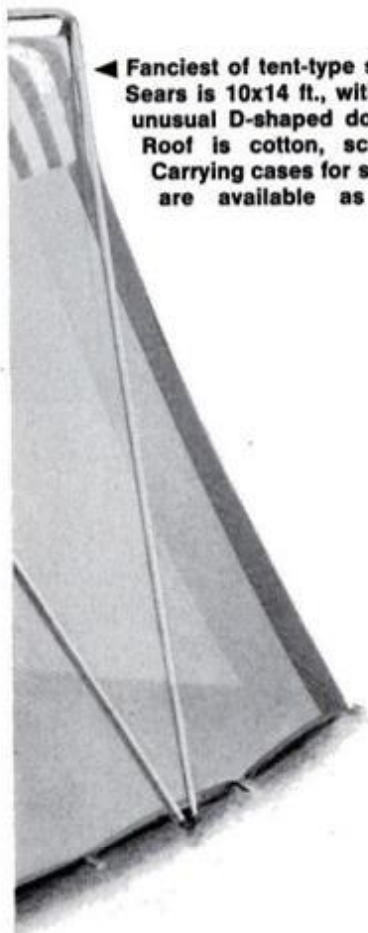
Back-yard screenhouses offer portability, protection from rain and insects and a touch of privacy, at low-to-moderate prices.

Outdoor living is great—but not when it includes flies and mosquitoes, showers or too much sun. A screenhouse can keep these facts of nature from forcing you indoors and give you more living space, either at a campsite or in your back yard. You can spend as little as \$50 or as much as \$500 for a screenhouse, basing your choice on looks, convenience and durability (in the tent type, more expensive natural fabrics may outlast synthetics). All but the 12x18-footer on the facing page can travel with you and set up quickly.—*Stephen Walton*

Steel frame supports canvas roof and fiberglass screening of this 12x12-ft., \$109 screenhouse with a 7-ft., 4-in. center height. Outdoor Venture Corp., Stearns, Ky. 42647, also makes a polypropylene-roofed model for \$70.



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◀ Fanciest of tent-type screenhouses from Sears is 10x14 ft., with aluminum frame, unusual D-shaped door; sells for \$200. Roof is cotton, screening is nylon. Carrying cases for screenhouse, frame are available as optional extras.

▶ Casita rigid screenhouse is cartop-portable; optional privacy panels allow cabana use. General Aluminum Products, Inc., Charlotte, Mich. 48813, makes \$375 11-panel model, others from \$250. Montgomery Ward, Sears and J.C. Penney sell similar units.

▶ Center is 8 ft. high in Penney 12x12-ft. screenhouse with polyester screening, woven polyethylene roof, priced at \$100. Others are offered from about \$50.

▶ Sears' largest model combines 12x12-ft. screenhouse with 6x12-ft. storage building for \$500 (floor not included). This one may require local building-department approval.

Two big picnic tables fit inside 10x14-ft. screenhouse; \$175, others from \$126. Eureka Tent, Inc., Binghamton, N.Y. 13902. ▼



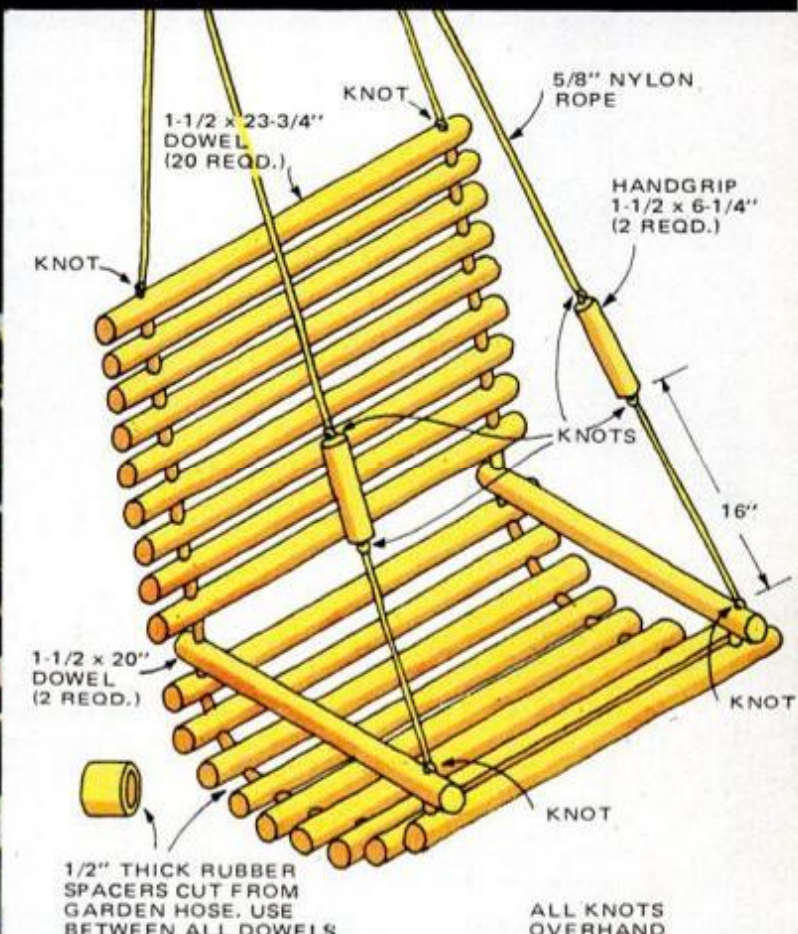
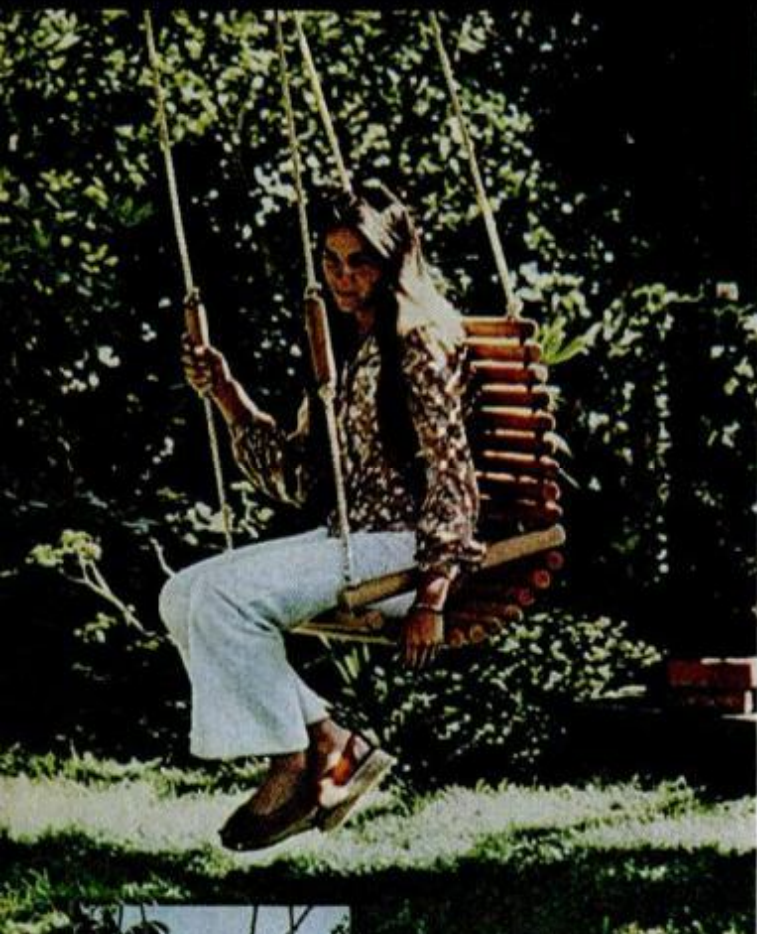
▶ For minimum shelter at minimum cost—about \$25—a dining canopy is the ticket. Maker, Sunshine Cover & Tarp, Inc., Chatsworth, Calif. 91311, also sells a line of four screenhouses.



6 wood projects you can build and enjoy this summer

A contemporary swing with a touch of nostalgia, hanging planter, screens and more.

by Harry Wicks
HOME AND SHOP EDITOR



DOWEL SWING

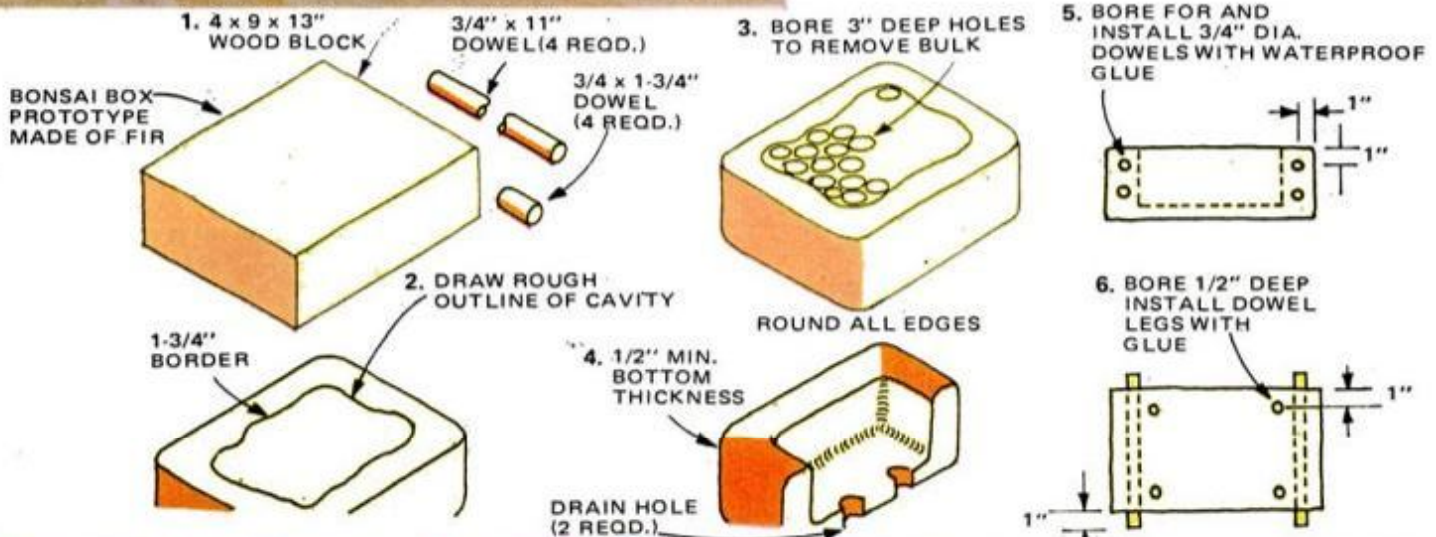


Wood furniture in either yard or garden setting is as natural as the plants themselves. Through careful use of material, life in our back-yard environs can be enhanced considerably— aesthetically and functionally. The dowel swing above is one of six projects we selected from the Ortho book *Wood Projects for the Garden* \$3.98 at most garden centers or directly from Chevron Chemical Co., 575 Market St., San Francisco, Calif. 94105. Drawings show how to build the swing and other projects.



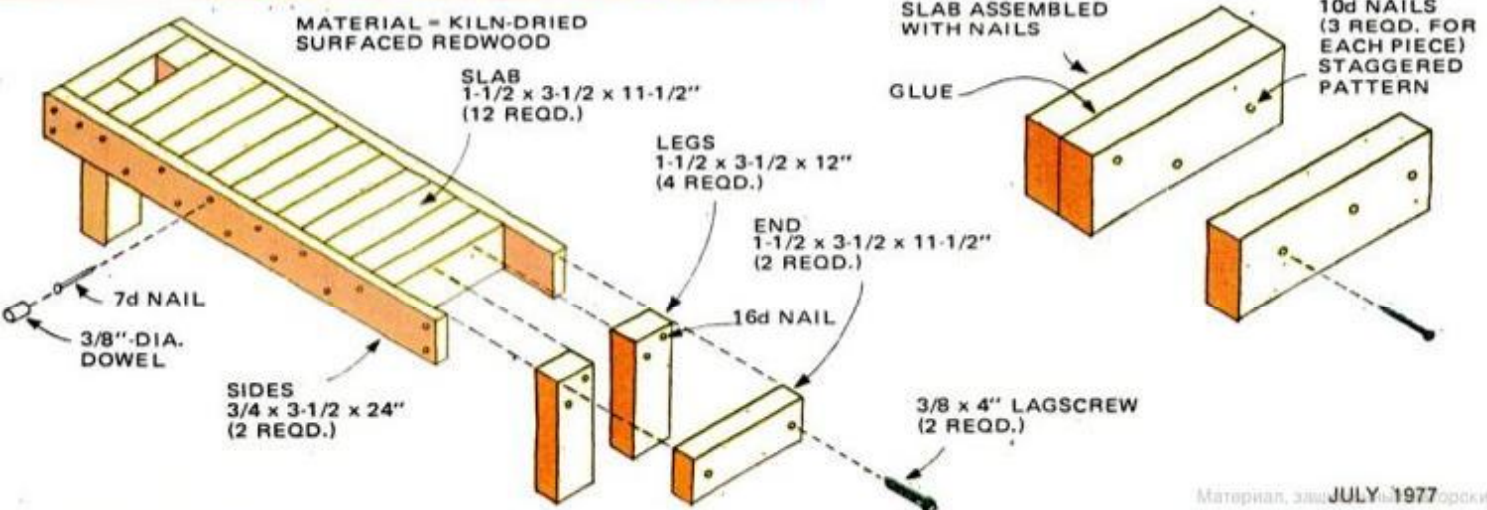
BONSAI BOX

This tabletop planter is a natural for those who are dedicated to the fascinating pastime of creating charming miniature Oriental gardens. The solid box is basically a mallet and chisel chore, but you can save a great deal of sculpting time by boring out a number of 3-in. holes to remove the majority of the waste stock. The holes for the through-dowels at both ends should be made by boring carefully from both sides to assure neat holes. Locate hole centers using ruler and pencil to assure accurately drilled holes.



LOW TABLE WITH BUTCHER-BLOCK TOP

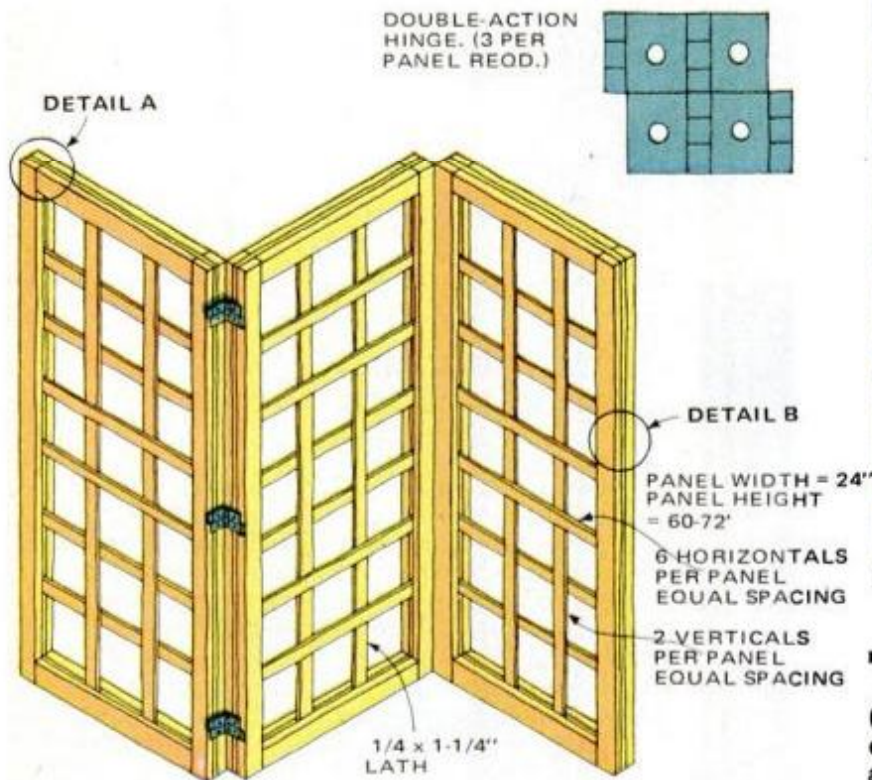
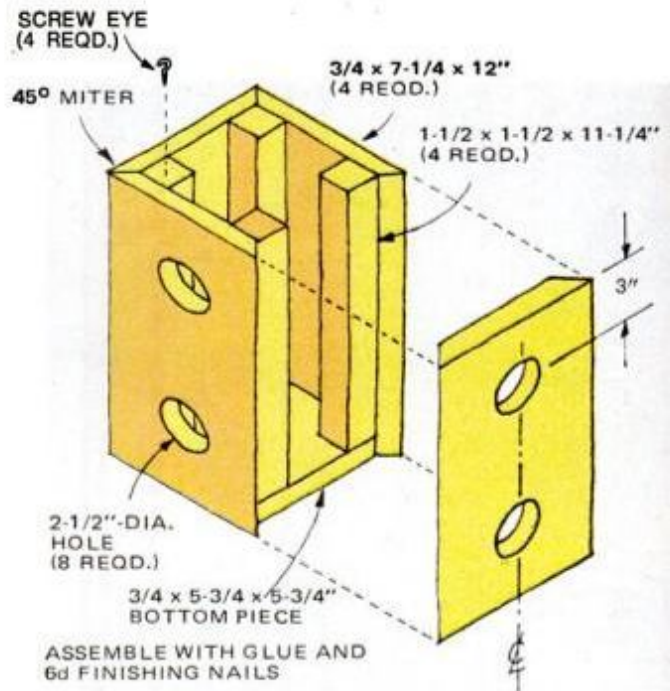
Just as a living room is enhanced by low end tables, patio living is upgraded when a table is conveniently placed for parking drinks, snacks and the like. This one was created using scrap 2x4s left over from other projects. If you own bar or pipe clamps, the table can be assembled with resorcinol glue only. If not, you can put the table together using the glue-and-nail method shown below. Set all exposed nailheads; finish with outdoor sealer.





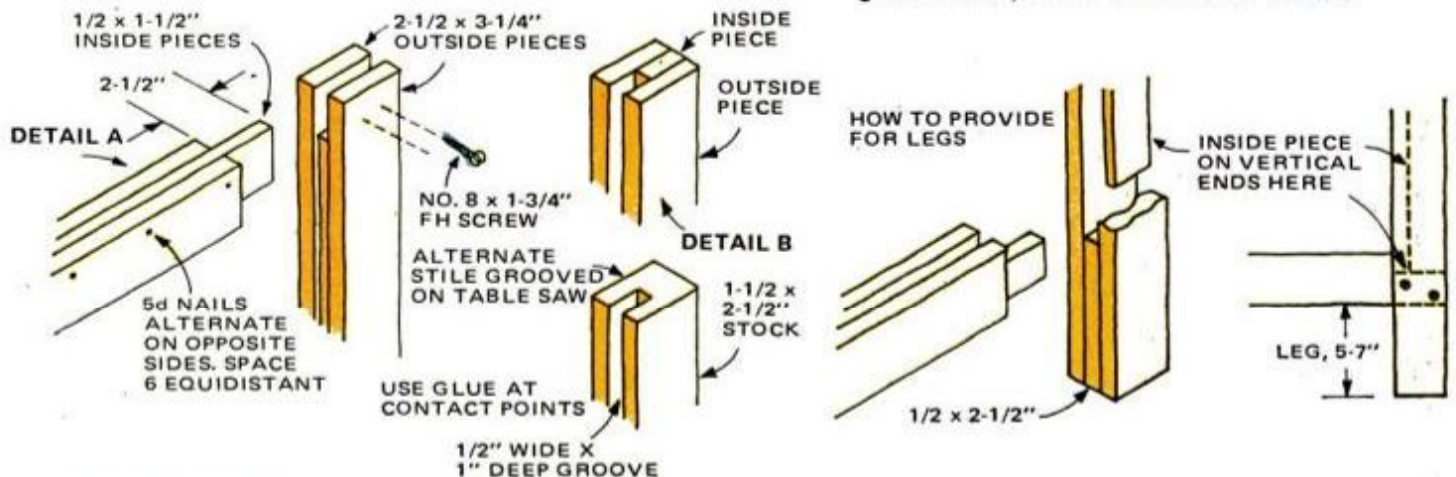
HANGING PLANTER

Rope and wood used with coleus will create a rustic hanging that will complement any patio. The box shown is made of clear all-heart redwood, assembled with waterproof glue and galvanized finishing nails. Start by cutting the four side pieces the same size, using 45° miters at the corners. For strong joints, assemble the box with corner cleats as shown. To hang it, use screw eyes in the box and a screw hook as the hanger. If box will hold a potted plant rather than one in soil, bore holes in bottom.



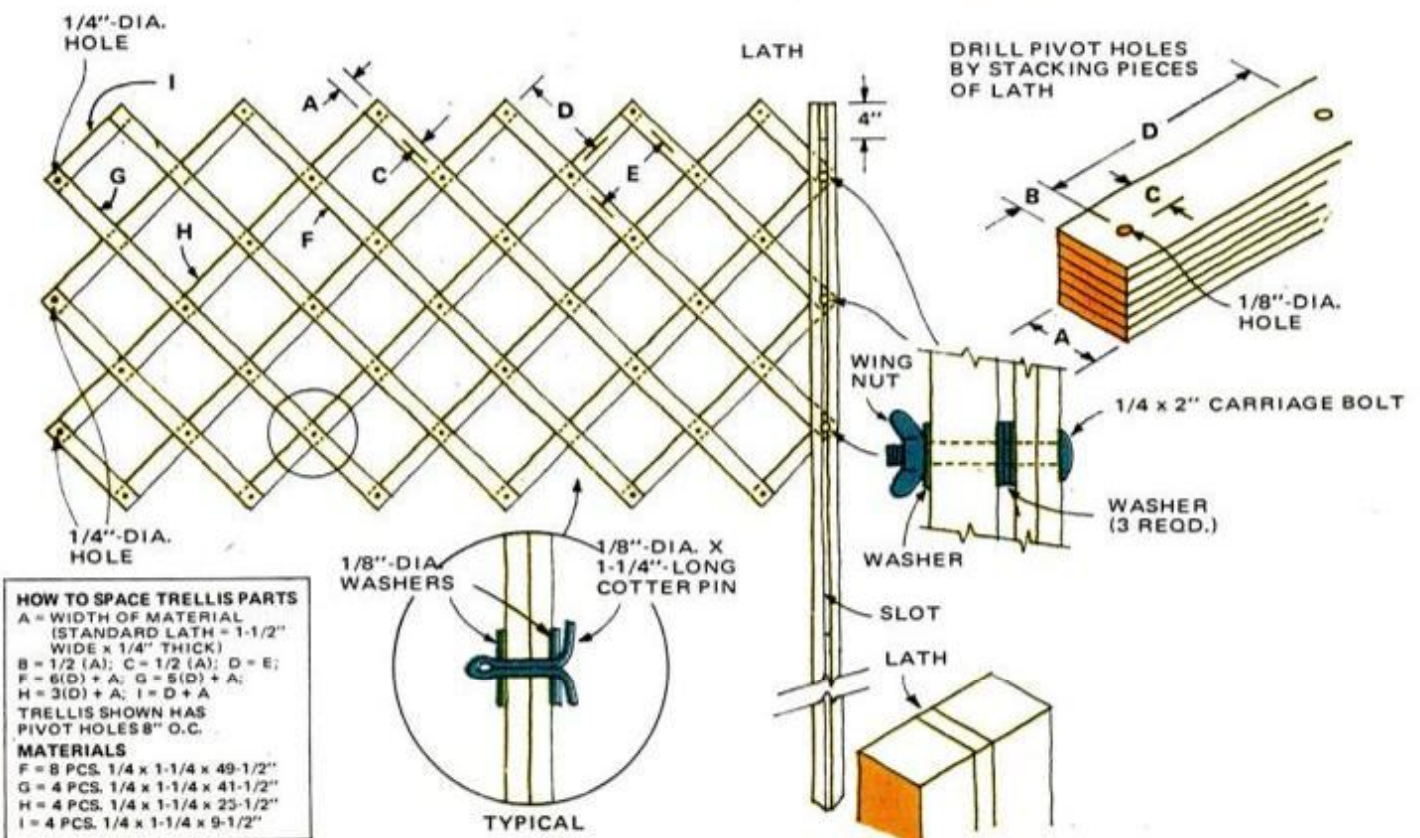
FREESTANDING SCREEN TRELLIS

This folding screen is ideal for use as a patio divider. Its double-action (folding-screen) hinges make it flexible enough so it can be arranged to surround a container or be used as a wind screen. Complete directions for building are given below; finish with a clear sealer.



FOLDING TRELLIS

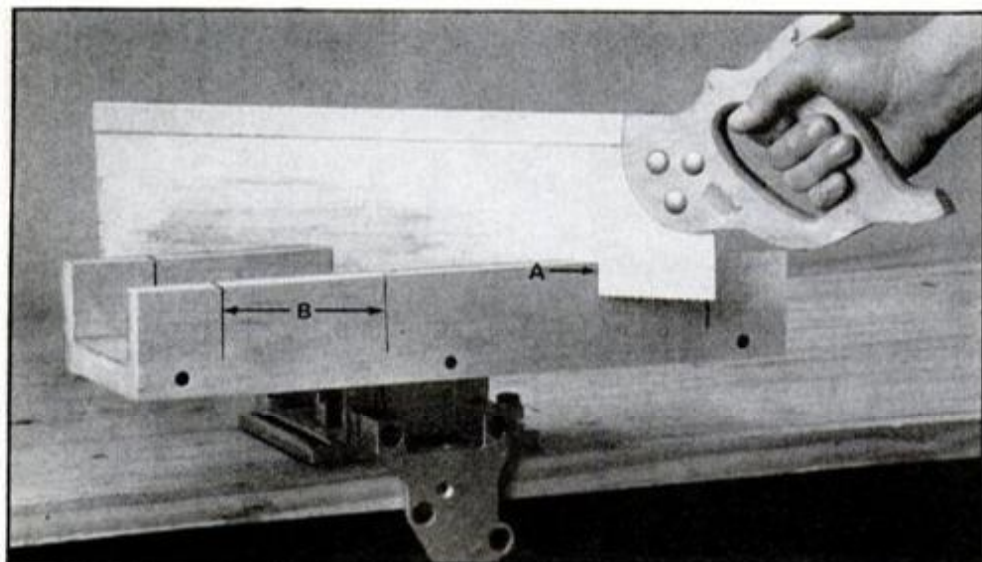
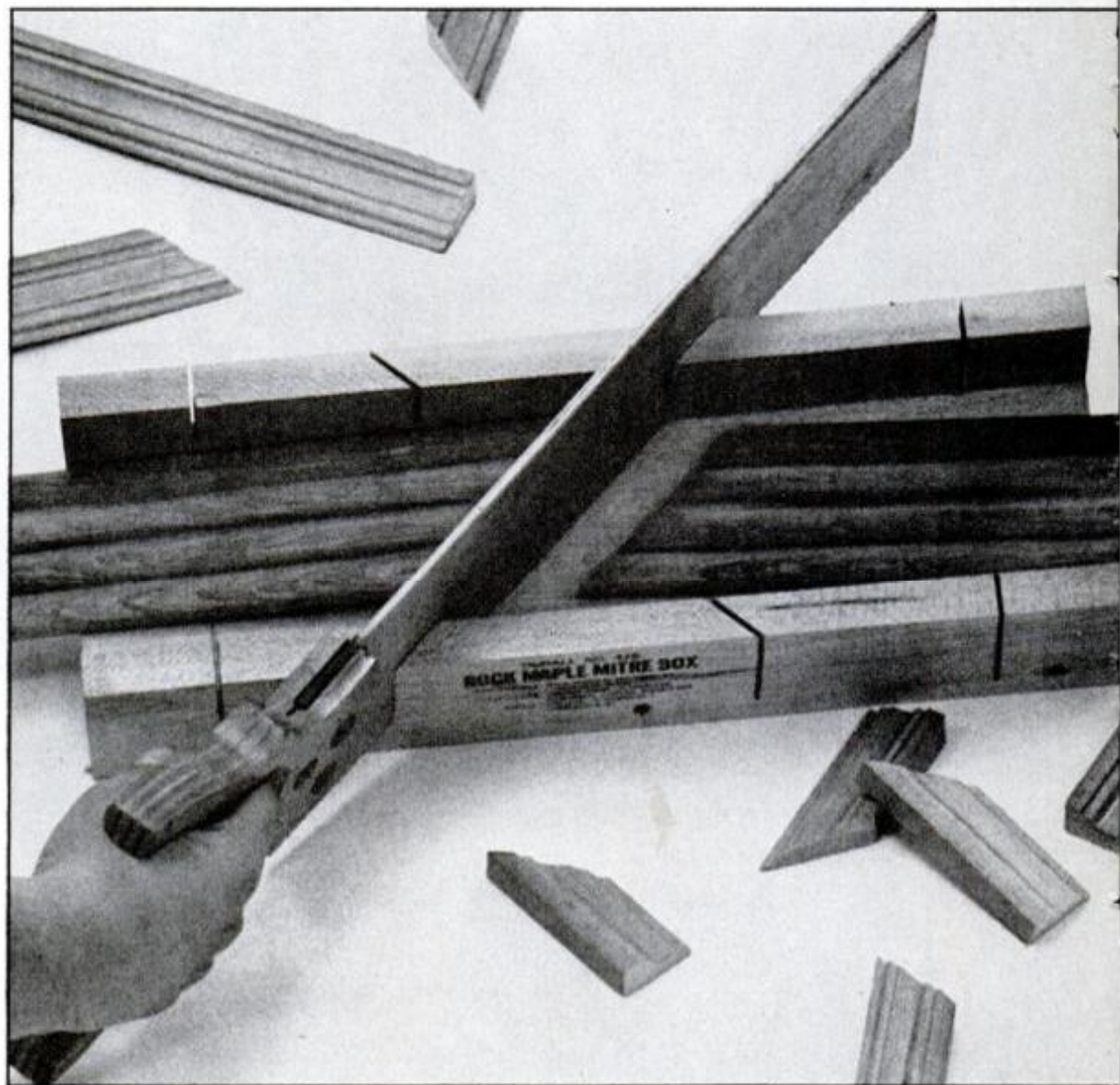
Reminiscent of safety gates for toddlers, this accordion-like trellis permits adjustment of both its height and width to suit a particular space. The critical dimension is the spacing of the pivot holes; in order for the trellis to work smoothly, these must be accurately located. The safest way to work is to carefully bore the pivot hole in the first piece and then use it as a template for the remaining pieces. The slot in the end posts is a must so the terminal points on the trellis can move freely when you make a size adjustment. You can use stock of a heftier dimension than the lattice shown, but be sure the cotter pins and bolts are long enough.



9 ways to miter by hand

You have a wealth of options when it comes to cutting miters—even without adding power.

by Ronald E. Thomas and Stephen Walton



Conventional hardwood miterbox comes with slots that are cut shallow for rigidity in shipping and storage. Slots must be deepened before use. Backsaw cuts slot A and corresponding slot on opposite side of miterbox down to base. Slots labeled B have already been deepened.

One of the satisfactions of woodworking is making a mitered joint that comes out perfectly square. It's not that difficult, if you work with care and use the right tools.

While the power miterbox is gaining in popularity among professional carpenters, it's not a reasonable purchase for most home craftsmen—not when there's a wide range of devices available to help make hand mitering fast, easy and accurate at much lower cost.

What you'll want to have will depend on how often you need to cut miters. For most do-it-yourselfers, a basic hardwood or plastic miterbox, backed up by the miter-cutting capability of a radial-arm or bench saw, will suffice. But if you're thinking of operating either a picture-framing or a custom-furniture business from your basement, you'll probably want to invest in a high-grade miterbox, a trimmer, or both. Either will give you good service for a long time.

Miter-cutting essentials

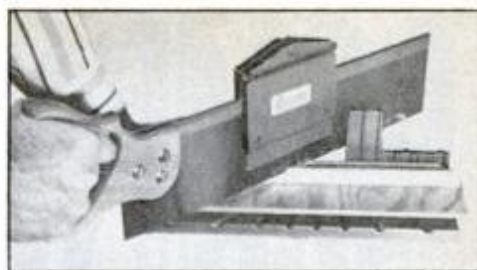
The essentials of cutting an accurate miter are precise measuring and marking, an accurate miterbox, a sharp saw and a firm hold on the workpiece. Your miterbox is a precision instrument and should be treated as such if you want to produce professional-looking joints.

Even if you've cut a miter well, the joint may still require adjustment for a perfect fit. Sanding is usually required (though not with a trimmer), but mitered ends may in-

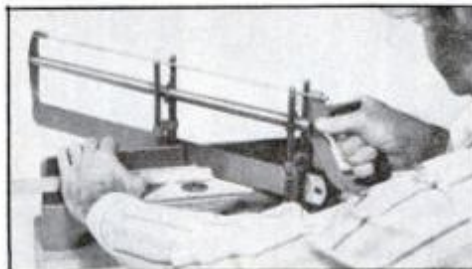
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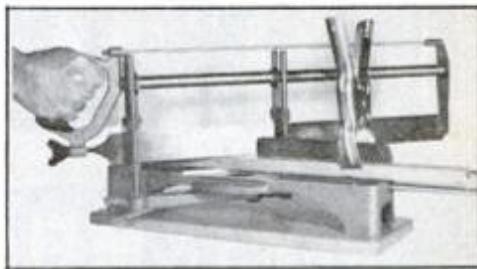
Inexpensive plastic miterbox gives 45° and 90° cuts with reasonable accuracy. For rigidity and best results, holes are provided for fastening box to workbench.



For about \$13, this miterbox offers a depth-of-cut adjustment and locking stops for commonly used angles. Hardwood strip under workpiece protects saw teeth.



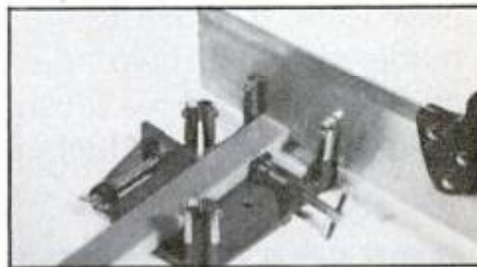
Miterbox with integral saw is a \$120 tool, but it is convenient and precise, and it lasts a lifetime. The saw blade is fully supported; deflection is minimized.



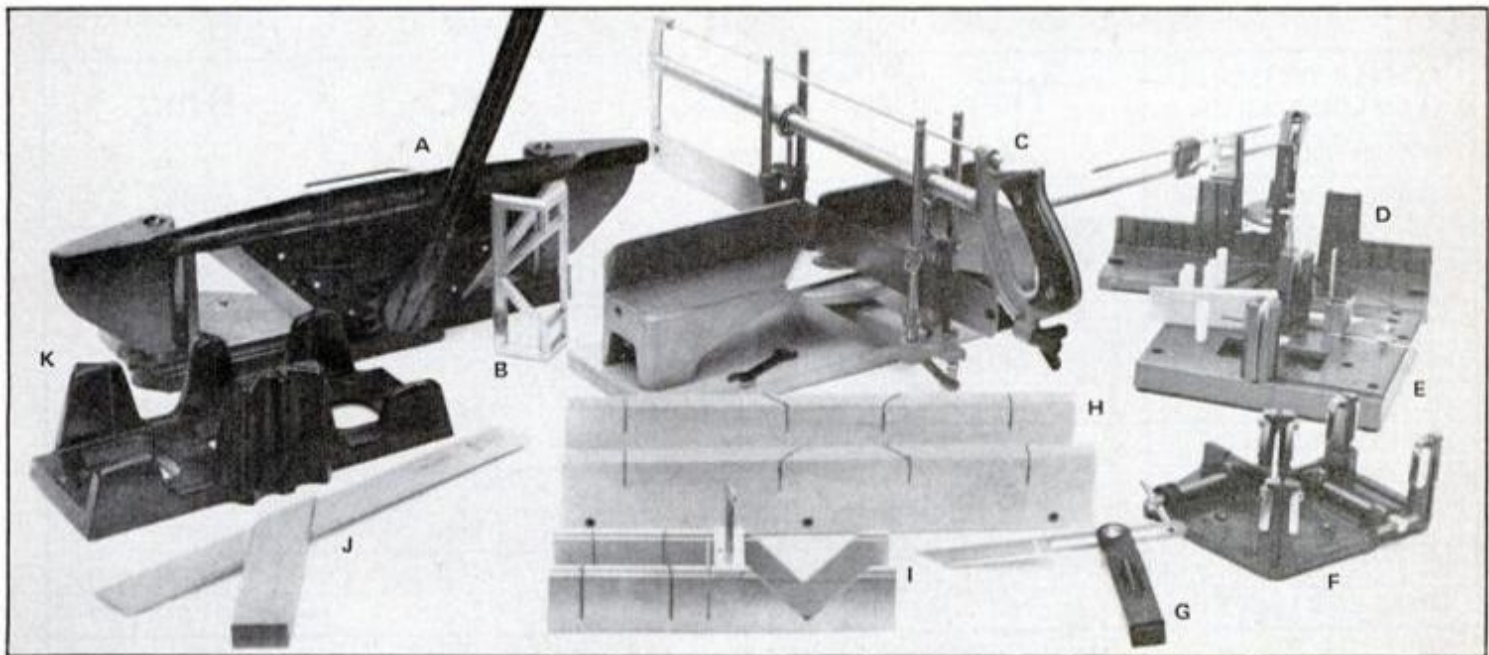
Narrow 10-point blade provided is kept stiff by tension adjustment. Clamping of the workpiece whenever possible helps to assure the most accurate cut.



Depth stops on a combination miterbox and clamp move up to contact the back-saw rib. Capacity of the \$24 unit ranges up to 2 in. wide and 1 3/4-in. deep.



Although limited as a miterbox to 45° and 90° cuts, a combination unit with right-angled jaws also can be used to clamp a mitered joint for gluing.



Aids for hand mitering include: (A) shearing trimmer; (B) marking template; (C) Ulmia miterbox with a built-in saw; (D) Stanley Handyman miterbox; (E) Jointmaster sawing jig; (F) combination miterbox and clamp; (G) sliding bevel used for laying out odd angles; (H) rock maple miterbox; (I) miterbox

used for cutting metal moldings; (J) 45° and 135° hardwood miter square; (K) Stanley plastic miterbox. Range of the devices shown here is not intended to be comprehensive; miterboxes are available from a variety of sources with prices from just over \$1 (for use with modelmakers' razor saws) and up.

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MARLBORO	NO	YES	YES	18 mg.
MARLBORO LIGHTS	NO	YES	YES	13 mg.
WINSTON	NO	NO	YES	19 mg.
WINSTON LIGHTS	NO	NO	YES	13 mg.
KENT	NO	NO	YES	17 mg.
KENT GOLDEN LIGHTS	NO	NO	YES	9 mg.
VICEROY	NO	YES	YES	16 mg.
VICEROY EXTRA MILDS	NO	YES	YES	14 mg.
VANTAGE	NO	NO	YES	10 mg.
MERIT	NO	YES	YES	8 mg.
DORAL	NO	NO	YES	13 mg.
BENSON & HEDGES	NO	YES	YES	17 mg.

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

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Flavor Lights; 8 mg. "tar", 0.7 mg. nicotine, av. per cigarette, by FTC Method.

Rod carrier for quick-draw fishing

by Sid Stall



Clamping blocks attached to rain gutter hold set-up rods securely but allow quick removal for instant fishing action.

Have you ever heard the sickening crunch of a \$60 fishing rod being crushed by a slammed car door? It's an unpleasant sound and a high price to pay for having a rod ready for the next roadside riffle.

Here's a carrier you can build for as little as \$2 that gives quick access to a pair of rods, yet holds them snugly at highway speeds. You will have to drill two holes in your car's rain gutter, but these are inconspicuous.

Two units are needed, each made of hardwood blocks sandwiched between two lengths of $\frac{1}{8}$ -in. steel bar stock. A bolt and wingnut clamp each sandwich together to hold the rods in the middle.

Begin by cutting an 8 or 10-in. length of ash, oak or other hardwood to about $1\frac{1}{8} \times 1\frac{5}{8}$ in. Mark off two $3\frac{1}{2}$ -in. lengths on the wider side and locate the centers of two rod-holding holes on each length.

My two fly rods needed a $\frac{3}{8}$ -in. and a 1-in. hole in each section, with centers spaced $1\frac{3}{4}$ in. apart. *Your requirements may differ—be sure to check these dimensions against your own equipment.*

Note that hole locations for the second assembly are the reverse of those in the drawing. After the four holes are drilled, halve the piece lengthwise by ripping it down the center of the $1\frac{5}{8}$ -in. side. Crosscut the two halves to make four blocks, each with two half-holes. Sand and finish the blocks with several coats of exterior paint or varnish.

Making the metal parts

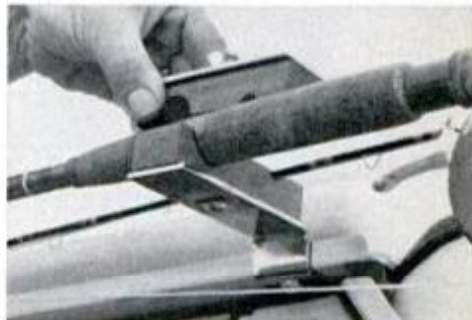
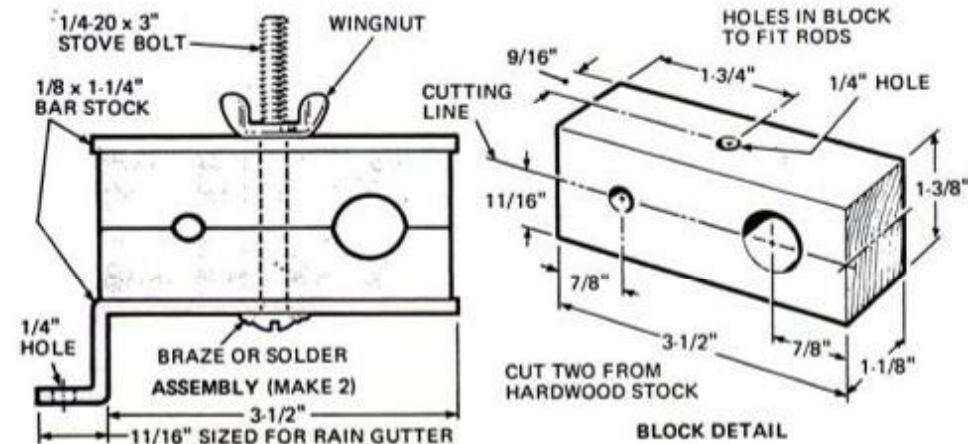
A 2-ft. length of $\frac{1}{8} \times 1\frac{1}{4}$ -in. steel bar stock will provide the metal parts of the sandwiches. Top pieces are just hacksawed to $3\frac{5}{8}$ -in. length; the bottom pieces with their doglegs are heated with a torch and bent. If you bend them cold, allow at least $\frac{3}{16}$

in. extra length for each bend or cut them to length after bending. As an alternative, let your local welding shop handle this step.

To make the $\frac{1}{4}$ -in. bolt holes, clamp the top and bottom metal pieces together and drill through both, then clamp the wood blocks between them, align them carefully and drill halfway through the wood from each side. Label parts to keep each set together.

Location of the carriers on your vehicle may be critical. Hold or clamp them in place and make sure swinging doors won't hit rods or reels, then drill the rain gutter and the doglegs.

For maximum convenience, solder or braze the head of each stovebolt in place and fasten the wood parts to the metal with contact cement. Suitable paint will protect the metal parts from rust. I went first class with chrome-plating that doubled the cost but tripled the eye appeal. ★ ★ ★



To mount or remove rods, loosen wingnut, lift the top block and twist a quarter turn. Single screw fastens carrier securely to vehicle's rain gutter.

More good reasons to use Bon Ami® Cleaning Powder and Cleaning Cake.

Every day we receive letters from Bon Ami users telling of new uses for Bon Ami Cake and Powder. We want to pass these along to you and tell you why Bon Ami is such an unusual and unique cleaning product.

FROM OUR LABORATORY:

Since 1886 Bon Ami's base mineral has been pure white feldspar. One unusual characteristic of feldspar is that, microscopically, it has far fewer jagged edges, a more rounded, smoother crystal. Other cleaners use silica as a base and this mineral retains jagged edges when crushed and has a greater tendency to scratch and mar many surfaces.

During the late 1800's and early 1900's feldspar was mixed by workers using large metal shovels. After awhile, these shovels looked nearly like silver from the constant mixing of the polishing feldspar mineral.

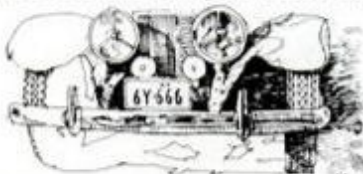


Unlike most products today Bon Ami Cake and Powder are still made with the same basic ingredients used in 1886. Bon Ami is a natural product that can clean many delicate hard surfaces like glass, stainless steel, porcelain, ceramic tile and chrome without scratching them.

FROM OUR CUSTOMERS:

1. A year ago we purchased a glass topped stove and since that time I have used Bon Ami bars to clean it. I have found this the

- fastest, safest and best way to clean the numerous spills and boil-overs that occur in my household. K. D., Oregon
- My husband is a photographer and uses Bon Ami Cake for cleaning chrome drums and equipment. A. Q., Michigan
- I live in a mobile home and find it quite difficult to keep the outside windows clean because dirty water runs off the roof. I know your product would do the trick. O. R. L., Washington
- It cleans road film from auto windows and rain spots from house windows. C. M. S., Arizona
- I find Bon Ami good for cleaning TV picture tubes and chromium. E. O., New Jersey
- I am an antique and classic car buff and own a 1955 Chevrolet and a 1937 Chev-



rolet Roadster, both vehicles have lots of chrome and polished aluminum and NOTHING will clean them like Bon Ami. D. W. L., Texas

- It is the one and only scouring powder that a person with any kind of respiratory condition should use. K. B., New York
- I found it to be very satisfactory for cleaning my white woodwork. J. L., Ohio

The original miracle cleaner.
Unchanged for 90 years,
because it couldn't be better.



Your hardware man knows how to help you solve your cleaning problems. Ask him. Nothing does as many cleaning jobs as well as Bon Ami. Look for Bon Ami in your True Value,® Sentry,® Pro,® Bluegrass,® Orgill Brothers,® Ace,® and other fine hardware stores.

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- Brochure describing increasing of fireplace efficiency through draft induction and draft control in conjunction with an air to air heat exchanger in an automatic system.
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RIDES FOR WHITE-WATER ACTION

(Continued from page 81)

your head intact. I found the roll difficult to learn until an experienced paddler taught me in a shallow pool; but the confidence it gave me was worthwhile when I rounded a bend into a chute one day, capsized coming out of a haystack and quickly rolled upright rather than having to bail out in the boil.

The most popular kayak today is the fiberglass slalom model—13 feet, 2 inches long by 23 inches wide and 20 to 35 pounds in weight. With it you'll want the double-bladed paddle, helmet, a quality life jacket, flotation bags for underdecks and probably a wet suit. You also need good instructions; river running clubs are often a good source. Ski resorts frequently switch to kayak lessons during the summer. Aspen, Colo., has several schools, as well as eight different outfits offering group river



You can convert from calm-water canoe to rough-water special with Grumman's nylon spray cover for its 17-footers. Decking has openings for three paddlers.

raft runs at about \$25 a day including lunch. The Aspen Chamber of Commerce can provide a list.

Where to go

Excellent new books, like *White-water!* by Strung, Curtis and Perry and *The All-Purpose Guide to Paddling* by Norman, tell of rivers, clubs, associations and waters where the action is rated from Class I, easy, through Class VI, too dangerous to be passable. With experience and courage you can work your way up. ★★★

Why a small car demands more of an oil than a big car.

Just because small cars are easy on gas, easy to handle and have smaller engines, don't assume they're easy on oil.



The heat in a small engine can drain the life out of an oil.

Smaller cars with their 4- or 6-cylinder engines circulate their oil twice as fast as big sixes or eights. And they run at 25 to 30% higher revs. So there's more friction and heat in the engine.

Then to add insult to injury, they have less engine surface and less room in the engine compartment to get rid of that extra heat.

All this causes increased wear, tear and shear (thinning out) on your oil. Which can keep it from lubricating and cleaning properly.

From there it's only a short step to preignition, power loss and premature engine wear.

To solve this oil crisis, you need Castrol.

Castrol started out in Europe where small cars started out. So naturally it was Castrol that first added the additives a

motor oil needs to protect those high-revving engines.

And today's Castrol incorporates the costliest additives available anywhere. That keeps Castrol from thinning out under intense heats and pressures. It keeps sludge from forming as the oil cools down. And it gives Castrol the strength to keep lubricating and cleaning the narrow passages in smaller engines.

Of the best selling oils, only Castrol has passed both U.S. and foreign car engine testing.

Since Castrol is designed to withstand the tortures of small car engines, we make sure it passes the engine tests for foreign cars set by the CCMC* (on a Fiat 124, Ford Cortina and Mercedes-Benz diesel) as well as the engine tests set up by the SAE,** (on a '67 Olds 425 cid V-8 and a Ford 302 cid V-8.)

Then to satisfy ourselves even further, we test Castrol on two additional small car engines: a 1302cc VW and a 1798cc MGB.

So naturally, all grades of Castrol exceed all U.S. and foreign car manufacturers' specifications.

Now if you have a smaller car, you have some big reasons to change your oil.



Castrol

The first oil engineered for smaller cars.

*Organization of European Car Makers, Engineers and Oil Manufacturers.
**Society of Automotive Engineers.

styling,
storage &
convenience

outdoor comfort was never like this before



The 1977 Wilderness travel trailer takes to the road with 11 new features designed for family pleasure and comfort. Starting with all new styling in all 15 of its trailers and 5th wheel models, Wilderness features include thoughtful expansion of storage capabilities and heating systems balanced to the trailer size. Some of the new features include -

In the 1977 Wilderness, the emphasis is also on choice. You can select a trailer from 17' to 31' in length or a 5th wheel from 20½' to 30½'. All are self-contained and equipped with full galley.

Easy access, lock-secure storage for 110V plug-in cord.



Positive catch hardware on all overhead cabinet and wardrobe doors.

1977
WILDERNESS

Fleetwood Enterprises, Inc., P. O. Box 7638, Riverside, CA 92503 PM-7
Please send me a free, full-color brochure on Wilderness Travel Trailers.

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NEXT WAR FOUGHT IN SPACE?

(Continued from page 51)

celerators would make very effective weapons. They share many of the same drawbacks of the laser weapon. They need huge amounts of power to operate and the impact of a weapon is diminished by the Earth's atmosphere which scatters and weakens the particle beam. Even in space its aim would be thrown off by the Earth's magnetic field.

If all these bugs were worked out, the particle accelerator would be a deadly antimissile weapon. Properly aimed, it could melt the plutonium in a missile's nuclear warhead and defuse it long before it ever hit its target.

No longer science fiction

The whole idea of satellites battling satellites or enemy missiles is long past the science-fiction stage and now at the point where it is openly discussed at presidential press conferences. This past winter President Carter admitted the possibility of satellite warfare is a very real one and told reporters, "I have already suggested to the Soviet Union that we forgo the opportunity to arm satellite bodies and also to forgo the opportunity to destroy observation satellites."

Still, if the Soviet Union doesn't take to these suggestions, most military experts believe that by the 1980s both superpowers will have the first few of their robot soldiers in orbit around the Earth. As a result, according to Dr. Charles S. Sheldon II, expert on Russian space activities, "the notion of the bloodless war fought by computer-controlled automatons . . . might become a part of the institution of war."

Space war a blessing?

Space warfare could take some strange twists. Some experts believe it might even be a blessing—that belligerent nations could settle their differences thousands of miles above us without ever firing a shot on Earth. Others see space armaments as the ultimate deterrent to war—that the very presence of such awesome might hanging over our heads would make nations think twice about pulling a trigger.

It almost certainly would be a war no one could win. There would be no victors—only the vanquished. Hopefully, most nations realize this—or will in time. But the chilling possibility that it *could* happen will be with us long after those pleasantly amusing fantasies of Buck Rogers and Flash Gordon have been forgotten. ★ ★ ★



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R. Davis, St. Louis, Mo.—"I cleared \$110 last Saturday."

Ed Boyle, Pittsburgh, Pa.—"My business going at top speed. I'm moving to bigger quarters."



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THIS DO-ALL PRO KEY MACHINE YOURS TO KEEP!



Can add \$25 to \$40 a week to your income . . . and doesn't cost you a penny extra!

HINTS FROM READERS

Coping saw cuts metal



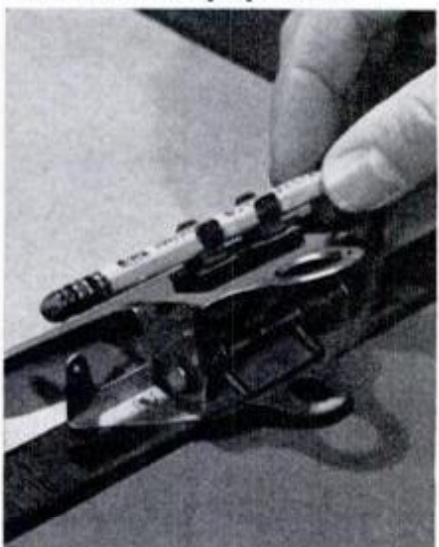
A coping saw cuts nonferrous metals (aluminum, copper, brass). Place the metal on a wood pad in a vise.—*Ken Wells*

V-belt drawer pulls



Make drawer handles from rubber V-belt sections. Bore holes at both ends for roundhead mounting screws.—*W.E. Burton*

Fuse holder clips pencils



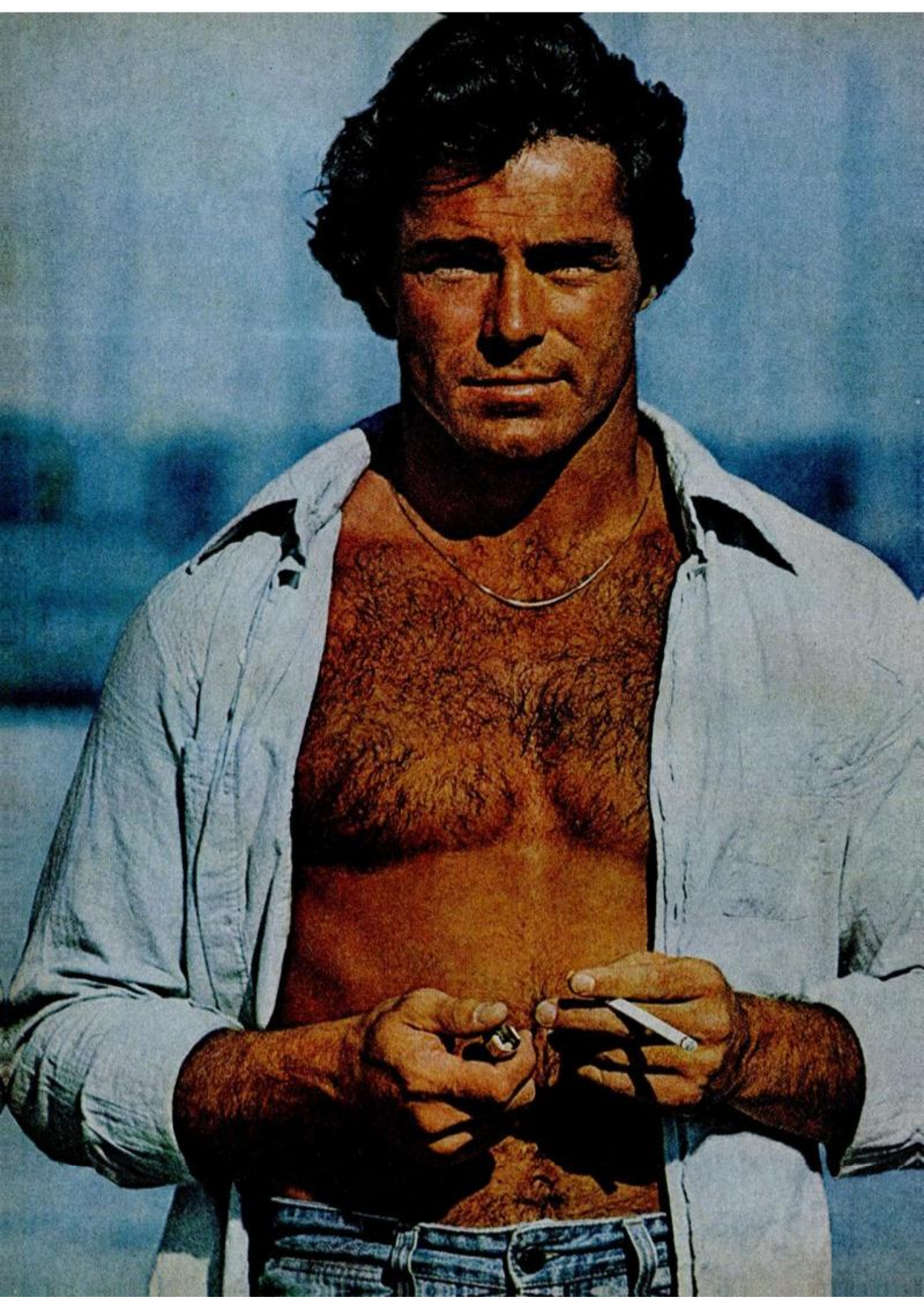
A small fuse holder fastened to a clipboard keeps pencils where they're needed.—*Ken Patterson*



Rally® shines deep because it cleans deep.

You'll be amazed how a car wax as easy to use as 'Rally' gives you a shine as deep and clean as 'Rally'. Its special cleaners remove even dull, dirty road film as you wax. 'Rally' also contains silicones and tough waxes to make that shine last. Get a deep, hard shine people can't help admiring. Get Du Pont 'Rally'.





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Winston King. Winston 100's.

KING, 100's: 19 mg. "tar", 1.2 mg. nicotine av. per cigarette, FTC Report DEC. '76.

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SEAL IT! USE GENUINE PLASTIC WOOD TO FILL IN AROUND WINDOWS AND PIPE HOLES TO KEEP OUT INSECTS, HEAT, DUST, RAIN, SNOW AND COLD AIR.



PLASTIC WOOD CAN HANDLE IT! FIX LOOSE HANDLES ON TOOLS, BRUSHES, MOPS, BROOMS, ETC. PARTIALLY FILL SOCKET HOLE WITH RUGGED PLASTIC WOOD. INSERT HANDLE AND LET DRY FOR A LONG-LASTING REPAIR!



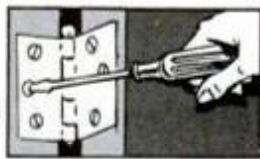
RELIABLE! YOU CAN COUNT ON RUGGED PLASTIC WOOD TO MAKE PERMANENT REPAIRS... EVEN ON FANCY SCROLL WORK. USE IT TO REBUILD DAMAGED AREAS ON ORNATE FURNITURE & PICTURE FRAMES.



PLIABLE! HOBBYISTS FIND VERSATILE PLASTIC WOOD'S PUTTY-LIKE CONSISTENCY IDEAL FOR MAKING WOODEN JEWELRY, COLLAGES AND WOOD SCULPTURES... BUILDING MODEL RAILROADS PLANES & SHIPS

DON'T FORGET THE ONE AND ONLY PLASTIC WOOD FOR EVERYDAY REPAIR OF CRACKS, HOLES & SPLINTERS

IN BASEBOARDS, HARDWOOD FLOORS, DOORS, SHELVES AND RAILINGS. IT'S GREAT FOR RESETTING LOOSE SCREWS, HINGES AND LATCHES, TOO. TRY IT!



IT'S NEW NOW



Highway igloos for tea and bandages

Collapsible igloos along West Germany's Wurzberg-Salzburg autobahn provide shelter and first-aid facilities for accident victims—along with hot tea for sleepy drivers. Red Cross motorcycle teams man the stations. There's a medical setup for each igloo, plus backpack kit with a tea canister for cyclists who answer road calls.

Tunnel-fan "jet"

Propulsion system for a sleek new plane designed by Italian engineer Luigi Collani for Hanno Fischer, German plane builder, incorporates a propeller inside the fuselage behind the cockpit, giving it "jet" characteristics. The two-seater is powered by a 150-hp Wankel engine, hits 150 mph and will cost \$32,000 when produced in 1978.



Foam squeeze play

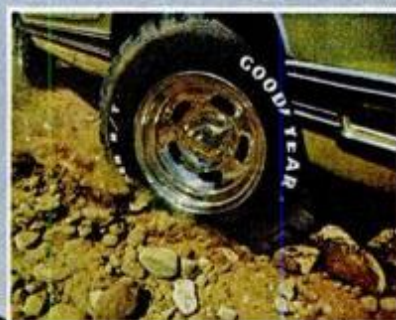
Transporting polyurethane foam is costly; it's all air and bulk. So a British firm built a truck with a hydraulic roof powered by a VW engine. Double load of foam blocks is loaded with roof raised. Then the lid is lowered, squeezing foam into the trailer's normal inside space. Foam takes day to unsqueeze after off-loading.

Cool bottle pipe

Two holes in a beer bottle accommodate fittings for a cool smoke. Tobacco goes in a bowl on the outside. Stem enters water through one hole; while the other hole regulates air pressure. Cost is \$3.95 from Rans-Pipien Enterprises, 100 Verdi St., Farmingdale, N.Y. 11735.



When the trail isn't there, Goodyear Wrangler R/T tires should be.



A tire has to do a lot of performing to get through terrain like this. Mostly, it has to keep a lot of rubber on the ground. And that's where the Wrangler R/T is in a class by itself.

The Wrangler R/T has "straight up and down design," so it has a wider footprint than any other tire

in its size ranges. That makes for a lot of traction, whether you're going through mud, snow or soft sand.

Add to that a strong, yet smooth-riding polyester cord body, long-wearing tread compounds, fiberglass cord belts (except load range A), a center riding rib for smooth highway performance, and

you get the kind of tire you can really depend on.

Those are just some of the reasons why more roads and trails get blazed on Goodyear's full line of tires than any other kind.

The Goodyear Wrangler R/T.

It's the tire to have if you don't have a trail. Or if you do.

GOODYEAR

How come food tastes so good on a Coleman™ Stove?

You get the taste of the outdoors . . . with adjustable cooking power, even when the woods are wet! And Coleman dependability keeps you cookin', trip after trip.



The Coleman Company, Inc. • Wichita, Kansas

FROM CRUD TO CHROME

(Continued from page 78)

it. According to CAMA rules, after the bike is judged in a Concours, you must start it in five kicks to get extra points. But in some classic-car Concours, a car will be disqualified if it won't start right off.

You'll start with the engine, doing necessary reboring and other machine work yourself or contacting a local shop that will do the work for you. You'll probably need to overhaul the transmission and replace the brakes and pipes. The gas tank may be rusted out. You'll need new tires. Generator and magneto may well need rebuilding. The carburetor will have to be boiled out. But keep at it. Get it running.

Says John Patt, "It's an act of love, that's all there is to it. I don't know how one could get fanatic about collecting stamps. But motorcycles? I love working on them."

Getting parts

Some years ago, Patt picked up a 1923 Douglas for \$25. It looked like a bargain, but Patt has been around long enough to know what he was getting into. It took eight years to find all the parts he needed for the machine.

"Stay away from a basket case unless you are totally familiar with that type of bike and are certain all the pieces are there," advises Wes Stoll, who has restored a dozen motorcycles. "You may think all the pieces are there and the owner may think they are, but there's really no way of knowing until you put it all together. So, I'd say, you're better off buying one that's all together and running. I know—I bought a bike missing only a gas tank, and that alone took two years to find."

For many antique bike buffs, that's the problem—getting parts. You can avoid that pain to a great extent by picking up an Indian or Harley-Davidson. They're so popular among collectors that some companies actually make replacement parts for them.

"This can even include a bolt-on detail like a tire. Wes Stoll runs new Dunlop K81 tires—a favorite of cafe racers—on his old Matchless but doesn't get marked off at CAMA Concours meets because the tires are British, from the right "country of origin." "It wouldn't do," says Stoll, "to have Japanese tires on a British bike."

Otherwise, do like the veterans do. Go to the motorcycle meets, browse through the flea markets there. Advertise in antique motorcycle magazines and bulletins. Get to know other collectors.

It is important to do your research first on the type of bike you want. For instance, many Vincent Twins have had their cases painted black so they will look like Black Shadows—the hottest model—instead of the lesser-powered model they are. Going to look at a bike armed with a parts book and serial numbers can save you from buying one that has been misrepresented or detuned.

"The parts are there," says Richard Little of Newark, N.J., who recently restored a 1927 Henderson. "You just have to shop around. Once you're certain you have all the parts, strip the sheet metal of paint, rust and dirt, knock out all the bumps, polish the parts that need polishing and repaint and refinish the frame."

While some restorers sandblast a frame before re-priming, others, like Wes Stoll, believe in hot-tanking it—a process that removes all grease, inside and out, but doesn't pit the surface like sandblasting.

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Built for more than a short slumber. Scroll stitching. Box corners. Materials you can count on, from the inside out. After all, we put our name on that bag!



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You might also have to get parts rechromed, or nickel or cadmium-plated. But a word of caution: One collector added \$800 worth of chrome to a snappy 1940 Indian Four Cylinder—and found himself out of the money in every antique meet he entered. His bike is a classic, no doubt. But as an antique it's a flop. If a bike is to place at the meets, it must be restored to every detail *authentic to the original*.

To chrome or not to chrome

So go easy on the chroming. Please yourself first in your restoration, but if you want to enter Concours competition, you must beware of the purist judge. Fortunately, in CAMA, things are fairly relaxed on this point, as illustrated by the club president's own Excelsior which has stock wheels but newly chromed (non-original finish) spokes. Wes Stoll, a CAMA member, comments: "Not all judges dislike chrome. Some might give you more points because your bike looks better that way."

Another example of how far some enthusiasts go in restoring their bikes to original condition is seen in the old Matchless dispatch bike owned by Los Angeles artist Merve Corning. It was painted Army olive drab again, but a *glossy*, flawless olive drab considerably above Uncle Sam's usual standards. To top it off, Corning had authentic leather dispatch cases handmade at a saddlemaker's to match the original British Army issue units that had almost rotted apart in 20 years since the war. But Corning poked tradition in the eye again by chrome-plating the spokes (yes, we know, purists, but they *do* look good).

After reassembling, the next step is to add the decals and striping of the original. With Indians and Harleys, as well as some more popular bikes, that's no problem. Bob Speck of Valparaiso, Ind., is probably the only man in the country who mass-produces decals for antique motorcycles. But if you've picked up a rare machine, you'll have to hire an artist to paint the decals and stripes or, if you have the time, patience and some skill, do it yourself.

Rely on the antique cycle clubs for details on what your bike should look like.

Joining a club

Clubs exist for virtually all popular antique bikes. Largest in the country is the Antique Motorcycle Club of America, Lake Ave., Harrisonville, N.J. 08039. The AMCA publishes a quarterly journal, *The Antique Motorcycle*, and holds six meets a year. The 1977 meets will be

in Orlando, Fla.; Fort Mott, N.J.; Schenectady, N.Y.; Boston, Mass.; Medina, Ohio; Davenport, Iowa, and La Mirada, Calif.

CAMA, the Classic and Antique Motorcycle Club, is now relocated at 13 El Cuenco, Carmel Valley, Calif. 93924, but it is an unusual club in that it only has one big meet (would you believe 500 classic bikes?) a year—late in April in California's San Joaquin Valley at Visalia. CAMA's rally packs the small town and includes one day of display and two tours of the surrounding foothills—a short tour for the pedalers

(some antique bikes have to be pedaled uphill) and one long one for the old war-horses like the Vincents and Indians that cruise at 100 mph.

Another popular club is the Springfield Indian Motorcycle Club, 2174 Winthrop Rd., Huntington Valley, Pa., 19006. There is also a club in Canada, the Canadian Vintage Motorcycle Group, 84 Cluford Rd., Toronto, Ont., M6M4J9.

The best introductory book on the machine is *The Classic Motorcycle (1896-1950)*, which is edited by Harry Lonis and Bob Currie (E.P. Dutton, 1976). ★★



March 26, 3:00 P.M.



March 26, 3:20 P.M.

**The Turtle brings
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Vinyl Top Cleaner.
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"Everyone needs a good wrench set for home and car," says Bignotti, "This set's it. Has sizes to cover almost any job." Reg. individual piece value \$25.91.

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FULL LIFETIME WARRANTY

SATISFACTION GUARANTEED. If you the consumer are not completely satisfied with any tool in any S-K set, simply notify your S-K jobber or dealer for a free exchange during the life of the tool.

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PROGRAMMED WATERING (Continued from page 93)



Shrub bubbler

Typical sprinkler heads

For flower beds, shrubs, ground cover. Water discharges in horizontal streams. Used near homes and borders. Adjusts from .9 gpm at 1 p.s.i. to 1.5 gpm at 10 p.s.i.

Stream radius 2.5-4.5 ft.



Adjustable precipitation spray head

Installed at ground level. Head pops up when water pressure is applied. Patterns available are: triangle, sector, semi-circle and full circle. Discharge rate is adjustable so that differing watering demands can be met in a circuit controlled by one valve. Useful in ground depressions. Delivers from .25 gpm at 25 p.s.i. to 5 gpm at 30 p.s.i.

Stream radius 11-15 ft.



Adjustable part-circle gear-driven head

Used for general watering. Large-radius sprinklers deliver moderate gallonage, can be adjusted to cover 45° to 315° areas. Full circles also available. Delivers from 1.1 gpm at 30 p.s.i. to 5.8 gpm at 50 p.s.i.

Stream radius 33-45 ft.



Stream spray shrub head

For slopes, beds, shrubs. Discharges spray at upward angle of 10°. Gentle spray minimizes runoff and puddling. Adjustable discharge rate. Types available deliver from .5 gpm at 15 p.s.i. to 2.1 gpm at 30 p.s.i.

Stream radius 13-16 ft.

Numerous head types are available. The total output (gpm) of heads on one line can't exceed the available water supply.

being sucked backward through the system.

The automatic controller

The automatic controller shown on page 93 is *electrically* powered for timekeeping functions but controls the automatic supply valves *hydraulically*. Thin tubing runs from each automatic valve to slip-on fittings on the controller. These are water-filled when installed. Winter draining isn't required.

Flushing out and testing

Before the sprinklers are connected, flush out and test this system. Open the supply valves of the first watering circuit, allowing water to push out any dirt in the pipes. Run it for several minutes and check each joint for leaks. When the circuits have been flushed, turn off the water supply and install sprinkler heads. Turn on the water again to see that each sprinkler throws water evenly over the area intended. It may be necessary to adjust some types of heads for the correct throw.

Burying the system

The finished system should be buried only 5 to 6 in. below ground—you don't have to worry about

freezing. Turn on the system, circuit by circuit, and let the water thoroughly soak and soften the ground. Then turn it off and cover each sprinkler with a plastic bag held by a rubber band to keep out dirt.

Using a flat spade, dig a V-trench under the pipe. The soaked sod should lift out in easily replaced wedges. When the trench is finished, ease the pipe and control lines into it. See that riser pipes leading to sprinkler heads are at proper level—so no one will trip over the head, or it won't be buried. Dig or fill the trench as needed; remove bags.

Using the system

Next you'll program the system so it turns the water on and keeps it on as long as needed. Authorities recommend a lawn be watered deeply (at least 1/2 to 1 in.) with intervals varying with the type of grass, soil and temperature. For more information write: Toro Irrigation, Box 489, Riverside, Calif. 92502. ★ ★ ★

Editor's note: Do-it-yourself sprinkler kits are also made by Mobile International, 16291 West 14 Mile Rd., Birmingham, Mich. 48009. The pipe attaches directly to a faucet. The system is operated manually. Kits are \$49.95 and \$66.95.

Материал, защищенный авторским правом

DRIVING LAMBDA SOND VOLVO

(Continued from page 57)



ratios wide—from 14.56 to 1 to 14.58 to 1, for example. Only within this tight band (or "operating window," as the researchers call it) can the catalyst do its job.

The three-way catalyst

When the exhaust gas, carefully controlled in its composition by the feedback system, reaches the catalytic converter, it is cleaned as exhaust gas has never been cleaned before. The standard platinum catalyst reduces hydrocarbon (HC) levels to .17 to .23 grams per mile and carbon monoxide (CO) levels to 2.7 to 3.4 gpm. A third catalyst, rhodium, reduces oxides of nitrogen (NOx) to previously unheard of low levels (.07 to .19 gpm). Compare



Under the hood in 240 Series Volvos is the 2.1-liter, ohc four-cylinder engine. Lambda SOND is a natural for in-line engines, but is difficult to apply to V-type configurations because the two banks are like two separate engines.

these with California's requirement of .41 HC, 9.0 CO and 1.5 NOx.

On the road

With the exception of Lambda SOND, the 1977 240 Series sedans and wagon are about the same as the 1976 models. That year there was a quantum leap forward in improvements (see *Driving the '76 Volvos*, page 89, March '76). The 245DL wagon is one of the most pleasing road vehicles—safe, economical, serviceable, good looking and, to my mind, the one car to own if you can't own more than one.

So, remember to change the Lambda SOND (now that you know what it is) every 15,000 miles (under \$20), and forget the technical lecture. The proof is in the driving. ★ ★ ★

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before Christmas. That's a poor week in any factory."

"Rear passengers complain about legroom."—Detroit structural steel detailer/designer.

A Chrysler plant worker in Michigan observes, "The company doesn't paint all the parts well enough, and some not at all. The underside of my car is already starting to rust, as are bumpers and some of the chrome."

"The airconditioner takes too long to cool the car down," avers a Tucson retiree, "and the body side molding is too low to ward off parking-lot nicks."

"Not as much room in the back

Chrysler's Lean Burn V8s get good marks on performance, drivability.



seat and trunk as I'd like," notes an Illinois farmer.

Good workmanship

Owners give workmanship a very high rating, with 71.6 percent of the respondents marking it *good* to *excellent*.

"My Charger was assembled in Canada," writes a Floridian, "and it's the best car I've bought yet."

"Workmanship is far better than other cars we looked at," states a California architect.

Even despite very good owner feelings toward workmanship, one statistic contradicts the euphoria. More owners report mechanical troubles with the Charger than usual in our surveys. In that respect, the Charger and the 1977 Plymouth Fury (page 90, June '77), came out about equal, with 62 percent of the owners of both cars reporting early mechanical problems.

Good dealer service, for the most part, compensated for those problems. Just over 60 percent of our owner-respondents rate



Smallish trunk isn't helped much by space-saver spare tire.

their dealers' service departments as *good* to *excellent*—about five percentage points higher than for the Fury.

Quite a number of Charger owners mentioned the space-saver spare tire, mostly negatively. Many expressed fear that it wouldn't inflate when needed, that it costs more than a full-sized radial spare tire but lasts an average of only 2000 miles on the road as against 40,000 for the radial. A Texas disc jockey mentioned that he wanted to swap his dealer the space-saver spare for a conventional tire, but the dealer wouldn't do it.

Decisions...decisions... Make your decision

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Pall Mall 100's 19 mg. "tar" 1.4 mg. nicotine av. per cigarette, FTC Report Dec. '76.
Pall Mall Filter King . . . 18 mg. "tar" 1.2 mg. nicotine av. per cigarette, FTC Report Dec. '76.
Pall Mall Extra Mild . . . 7 mg. "tar" 0.6 mg. nicotine av. per cigarette by FTC method.

The bottom line

On the whole, Charger owners like their cars just fine. A mechanic from Illinois confides, "I work hard for my money and would not spend it on just any car. The Charger SE's standard equipment is far superior to its competition.

The car is a joy to drive and gives me the confidence to handle any situation. I consider it the best buy in its class, with by far the most comfort and luxury at the most reasonable price."

A New York Amtrak repairman agrees: "It's a very beautiful car,

with sensible, sleek lines. The interior is well arranged, with good front and rear vision. Seats are comfortable, heater and air conditioner work well; the sound system is excellent. Chrysler products are reliable mechanically. So what more could a person want? ★ ★ ★

SUMMARY OF 1977 DODGE CHARGER OWNERS REPORTS*

Total miles driven951,617

Average miles per gallon

318-cu.-in. V8
In town (EPA autom. 13) ..13.3
Long trips (EPA autom. 18) 17.0

360-cu.-in. V8
In town (EPA autom. 14) ..13.2
Long trips (EPA autom. 20) 17.5

400-cu.-in. V8
In town (EPA autom. 11) ..12.2
Long trips (EPA 19)16.5

Engine choices:

318-cu.-in. V816.1%
360-cu.-in. V856.1%
400-cu.-in. V827.8

Why did you choose the Dodge Charger?

Styling59.5%
Owned one before23.7%
Good price10.2%
Performance9.3

Specific likes:

Styling68.6%
Handling43.6%
Ride33.3%
Comfort32.4%
Economy15.2

Specific dislikes:

Poor gas mileage13.6%
Disappointing workmanship 8.5
Squealing brakes8.5
Poor dealer service7.5

What changes would you like?

Better gas mileage8.6%
More trunk space8.1%
Better quality materials7.1%
Different (unique) styling5.6%
More rear-seat legroom5.6

Workmanship opinion:

Excellent34.4%
Good37.2%
Average14.7%
Fair7.3%
Poor6.4

Comfort opinion (front seat):

Excellent61.3%
Very good30.4%
Good6.0%
Poor1.4

Comfort opinion (rear seat)

Excellent22.6%
Very good32.2%
Good23.1%
Poor8.5

Had any mechanical trouble?

Yes62.8%
No37.2

What type of trouble?

Carburetor18.2%
Transmission12.4%
Brakes12.4%
Rear defroster8.8

Dealer repairs satisfactory?

Yes65.4%
No34.6

Dealer service opinion:

Excellent29.6%
Good31.0%
Average15.8%
Fair6.9%
Poor16.7

Number of vehicles owned:

Charger only47.2%
Two cars41.3%
Three cars7.8%
Four cars1.8%
Five or more cars1.9

Makes of other cars owned

Dodge31.6%
Chevrolet20.2%
Plymouth12.3

Age distribution of owners:

15-29 years37.5%
30-49 years36.6%
50-plus25.9

Would you buy another Charger?

Yes79.4%
No20.6

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



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Again this year, The Wagonmaster—Ford—gives you more of what you buy a wagon for. Ford offers the standard features and popular options you would expect from the Wagonmaster. Including Ford's exclusive optional dual facing rear seats (left).

Compared with Chevrolet, the 1977 Ford LTD Wagon

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- more hip and shoulder room to carry 6 adults in comfort.
- an optional extra 1,000 pounds rated towing capacity.

* With optional heavy-duty trailer towing package, Ford LTD is rated to haul more than Chevy. Yet based on sticker price comparisons of comparably equipped vehicles, Ford LTD is priced about the same.

If your family is growing bigger, you need all the wagon you can get.

More than ever, Ford LTD Wagon gives you more of what you buy a wagon for.

FORD

When America needs a better idea, Ford puts it on wheels.

DIESEL MAINTENANCE

(Continued from page 87)

on the engine, particularly if it is to be turned, it's standard procedure to disconnect the wire from the solenoid (Fig. 3).

The solenoid is a potential trouble point. If it fails to energize, the engine won't start. If it doesn't disengage, the engine won't stop. To check it, place your fingers on its body and feel for a click when the key is turned on.

Injection pump timing

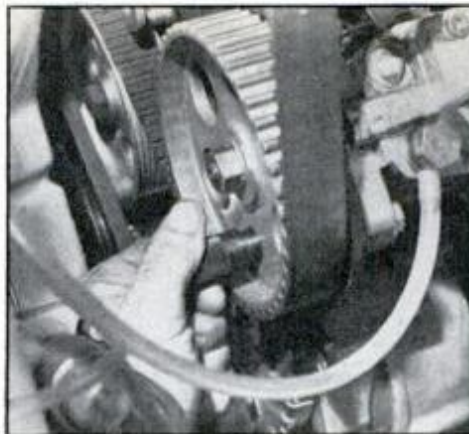
The fuel injection pump must time its fuel delivery to the injectors as precisely as ignition is timed on the gasoline engine. As engine speed increases, the injection system must spray fuel earlier. The advance system is built into the pump, just as spark advance is automatic in the distributor, but the basic pump timing must be correct.

Checking the basic setting is done with a dial indicator inserted into the pump. First you turn the crankshaft pulley with a wrench, until the flywheel top dead center mark is lined up at the bell-housing opening (same setup used for ignition timing on the gas engine. See Fig. 4). Next insert the dial indicator until its rod causes the dial needle to move a few millimeters. The rod is bearing against the pump injection plunger, the part that pushes fuel under pressure up to the injectors.

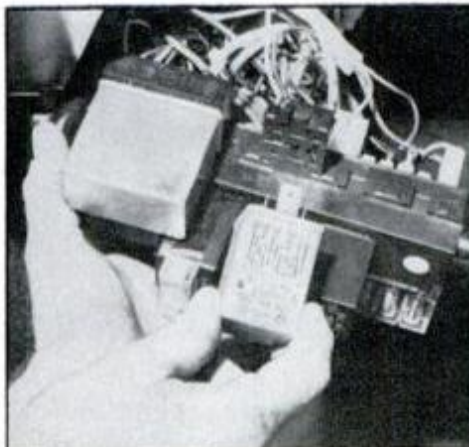
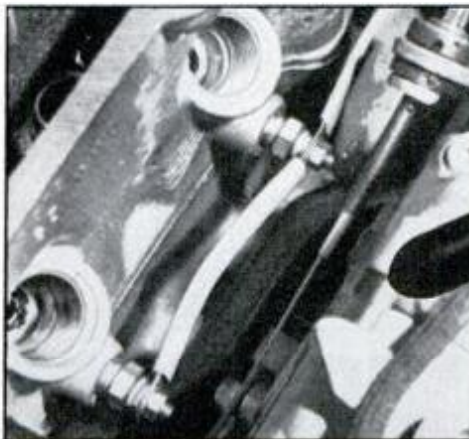
Turn the crank backward until the dial needle stops moving, set the dial to zero and turn the crank forward until the top dead center mark lines up again. The dial needle should have moved forward a specified distance, which is equal to the pump plunger stroke (0.83 mm on the VW). If the reading is too great or too little, slacken the four mounting bolts on the pump and turn the pump one way or the other to get the exact reading on the dial (Fig. 5). The bolts pass through elongated holes to permit adjustment.

This adjustment, plus engine speed and replacement of a defective shutoff solenoid are the only jobs that can be done on the pump. If the pump fails, it must be replaced. (A factory rebuilt costs \$200, plus exchange of your bad one.)

To help extend pump life, use No. 2 diesel fuel, which has better lubricating qualities than the lighter No. 1. Fuel is the pump's only source of lubrication, so this is important. A quality No. 2 is seasonally blended for cold weather, so startability should be tolerable. Only in extremely cold weather, with no other choice,



8 To change the drive belt, the injection pump pulley must also be kept from turning by a simple locking plug.



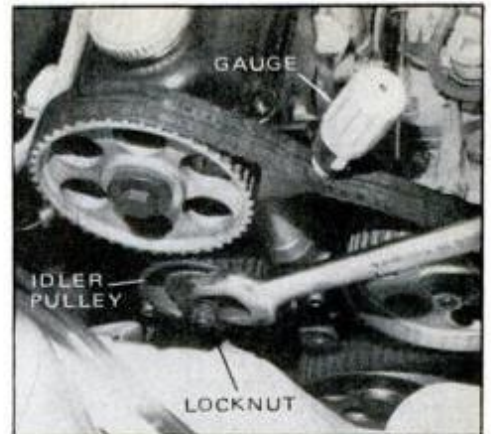
11 A glow plug relay is a plug-in unit on fuse box under left side of dash. It can be removed and replaced easily.

should No. 1 be used to ease starting.

The diesel develops a lot more compression pressure than a gas engine. The typical gas engine will run satisfactorily with cranking compression pressures as low as 90-100 p.s.i. The VW diesel should produce pressures in the 400 to 500 p.s.i. range in order to raise the air temperatures to above the flashpoint for diesel fuel.

Compression testing

A conventional compression gauge, with its 250 to 300 p.s.i. limit, obviously won't do. VW supplies a



9 Gauge measures belt tension. To adjust, slacken locknut and turn large hex nut on idler pulley with a wrench.



10 Glow plugs preheat cylinders before a diesel can be started. A typical glow plug (above) has heating-element tip; wire-brush it clean as necessary. View of engine block (left) shows bus bar connecting plugs in a single circuit.

model that not only reads to 600 p.s.i. but includes a roll of paper and automatic marking pen (in place of the standard indicator needle) to provide a permanent record. This type is widely used in truck fleets, but you should soon be able to get something more like a conventional gauge, which is less expensive.

There is no sparkplug hole on the diesel, so the compression gauge is threaded into the fuel-injector hole. To get the VW injectors out, remove the fuel lines at the pump and at the injectors, then take out the injectors with a ratchet and deep socket (when reinstalling, tighten to specs with a torque wrench).

Next, withdraw the heat shields, which look like plug gaskets and sit over the injector hole, narrow side down (Fig. 6). The old shields must be replaced when reinstalling injectors, but they temporarily can be used to help seal the compression gauge for a test. Install the shield onto the gauge hose fitting (narrow side down), thread the hose fitting into the injector hole and tighten with a wrench. Now you're set to crank the engine and take readings.

Drive belt

The rubber drive belt on the VW diesel is steel-wire reinforced for

(Please turn to page 120)

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(Continued from page 119)

long life. If it breaks, serious engine damage can result. Reason: There is very little clearance between the top of the piston and the closed valves when the piston is at the top of its stroke. If the belt snaps, the overhead camshaft stops and some valves are left open. The crank continues to rotate and when it brings the pistons up, they crash into the valves. A similar result could occur if the belt were loose and jumped a number of teeth on the pulley.

VW has no recommended replacement interval for the belt, but it is obviously a good idea to pull the guard and check it periodically. If the belt is frayed or if it has stretched quite a bit in use, consider installing a replacement. Yes, the belt can be retensioned, and the \$15 to \$20 price tag for a new one is not pennies, but compared with a replacement engine, it's cheap.

To change a drive belt, you need inexpensive tools. One holds the camshaft (Fig. 7), another locks the injection pump pulley (Fig. 8). Line up the flywheel timing marks so both tools can be inserted to prevent accidental turning of either pulley. Loosen the idler pulley locknut, replace the belt and tighten it.

To measure tension accurately, a special gauge is used. The gauge, which measures belt deflection to the millimeter, is hooked onto the belt, the specified deflection is dialed in, and the idler pulley is tensioned with the wrench as shown (Fig. 9).

Valve adjustment

The Rabbit engine—gas or diesel—has a shim-type valve clearance adjustment. The cam follower and valve must be pushed down to extract the old shim and install a replacement.

Although this is normally a job for the dealer (who has a stock of replacement shims), note one problem area if you decide to do the job yourself: On the diesel, the limited clearance between valve and top of piston means you can't push down the valve when the piston is at top dead center. Measure the clearance at this point, then rotate the crank 90° to bring the piston down. Now you can depress the cam follower and valve to replace the shim.

Glow plugs

The glow plugs are heated by battery current supplied via a key switch and a relay. The relay also turns on a dashboard indicator light when preheating is complete and the engine can be started. This second

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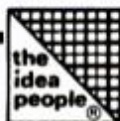
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function is time-controlled according to engine temperature—the light may take anywhere from seconds to more than a minute to go on.

Failure of the glow plug circuit is a common cause of hard starting in cold weather. A simple check for the entire system begins with disconnecting the wire from relay to the bus bar, which is the current supply bar connected to all the glow plugs (Fig. 10). Then attach a test lamp to the wire and to ground and have a helper hold the key in the "glow" position. The lamp should light. If not, listen for a click at the relay, which is a simple plug-in to the fuse box. No click? The relay probably is bad (Fig. 11).

Individual glow plugs can be tested by removing the bus bar, attaching a test lamp to the battery starter terminal and touching the probe to each glow plug terminal. If the lamp lights, the plug probably is good. If the car has high mileage, remove each glow plug and inspect the heating element for carbon deposits. Wire-brush clean if needed.

Injectors

As long as the diesel fuel is clean, injectors normally last indefinitely. The manual calls for injector testing at 60,000-mile intervals or if the engine is misfiring and compression is normal. It takes a \$150 pressure tester-pump device to pump fuel into the injector at operating pressure (1700-1850 p.s.i.) so you might give this job to a specialist. Since an injector is only \$32 list, checking a suspect injector by substituting a spare injector may be a cheaper way.

Routine maintenance

The VW diesel has a king-size spin-on fuel filter (about \$18) to protect injectors and pump. It should be changed every 15,000 miles, with the oil filter. To replace, take the filter and mounting adapter off the bracket, loosen the filter with a wrench at the base, then spin it off. Lube the new filter gasket with clean diesel fuel, then spin on hand-tight and refit to the bracket.

Engine oil, which must be Service CC, should be changed at 7500-mile intervals. A good quality gas-engine oil also may qualify for CC, so check can markings. Diesel oil blackens very quickly, sometimes in a few miles. Don't panic.

The truck industry's experience with the diesel is almost all good. Fuel mileage is superb, much routine maintenance (such as ignition) is eliminated and, while parts aren't cheap, their longevity is impressive. Service procedures are different, but not complex. ★ ★ ★

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NEW STYLES FOR STAYING AFLOAT *(Continued from page 53)*



Specialty jackets offer worthwhile extras for added cost. Stearns Windjammer at \$68 (above, left) has good looks plus warmth to fight submersion chill. Skyjacket, Simpson Marine, Torrance, Calif., (above, right) uses attached parachute with ripcord. It's worth more than \$352 price when it saves a racer's life. Vests (right) from Cypress Gardens Skis (left and right) and Stearns provide action, style.



by a Coast Guard or state mobile boarding team.

PFDs are now classified by type. The length of your boat plus the number of passengers determines the number and type of PFDs needed. Here are the latest regulations:

■ **Type 1.** This is a large bulky vest intended for use aboard commercial vessels, but is also legal for pleasure craft use.

■ **Type 2.** These buoyant vests, in various models, have a "Positive Righting Moment" intended to turn you face up in the water. For children who weigh less than 30 pounds, only this type (in a suitable size) is acceptable.

■ **Type 3.** Buoyant devices in this category are designed for active water sport without restricting the wearer. While they won't necessarily turn you face up in the water, they are designed to support you in a stable upright position, also to be comfortable and good-looking, and are worth wearing all the time you are afloat. Some look like attractive fishing vests with lots of pockets and are made in many colors; others are full-

sleeved jackets that can help ward off that other overboard danger—hypothermia—death from water-chill. Type 3 PFDs are legal for any size recreational boat.

■ **Type 4.** This "throwable device" category includes the old familiar buoyant cushion and ring life buoy. If worn, the cushion must be across the chest (it's better to put it on in the water) with opposite arm and leg or head and leg through the grab loops. It can lose buoyancy after being used as a makeshift fender or cushion, but it's still legal.

■ **Type 5.** These are special-purpose PFDs where no other type is suitable. A model with extra buoyancy for white-water rafting is an example.

What you'll need

There you have the five basic pre-server categories. To be legal, each must have a USCG Approval label, be in good condition, be the right size to fit the person who might wear it and be readily available.

On recreational boats less than 16 feet long, you can get by with one

Type 4 boat cushion for each person aboard, although a Type 1, 2 or 3 wearable PFD would be better. Boats 16 feet or longer must now have a suitable Type 1, 2 or 3 for each person *plus* at least one throwable Type 4 aboard.

Canoes and kayaks, of any length, can also count Type 4 cushions (or rings) as well as Types 1, 2, and 3 as the required device for each person. Any smart paddler, however, would wear one of the new light Type 3 canoe vests especially designed for active boating.

Nonapproved, but useful, too

Once you are fully equipped with legal PFDs, don't overlook the supplemental nonapproved flotation devices available. Vests that inflate by mouth or CO₂ cartridge can often fit compactly under a windbreaker, foul-weather jacket or even a snowmobile suit and give added protection. In-



Though nonapproved, multipurpose inflatable-type PFDs like Stearns's Angler's Vest (upper left) and Boater's Jacket (lower right) take little space. Stearns Kindergäard (upper right) is approved for children under 30 pounds. Camouflaged pants match several hunting vest PFDs.

flatables may be harder to maintain in good condition and won't blow up if you are unconscious (hence no Coast Guard approval). But they can still keep you afloat until help comes. Simple water-ski belts are useful if you take a spill and get knocked breathless, although tournament skiers and jumpers usually wear the new approved free-action models.

So which PFD will be the best for you? Each person has a different buoyancy requirement, and it's best to borrow several used models and test them in shallow water. Then pick a type you find comfortable and good-looking—one you're likely to wear all the time afloat! ★★★

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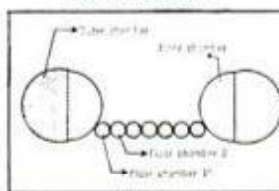
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9 WAYS TO MITER BY HAND

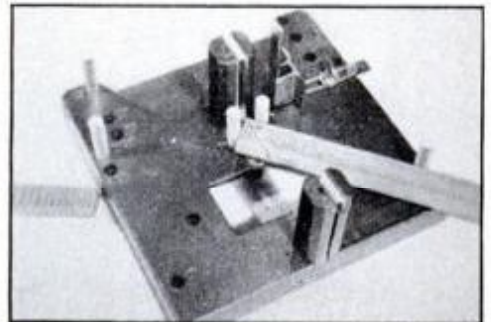
(Continued from page 101)

stead be planed smooth—with a length allowance for the stock removed. No matter how careful you've been to make an accurate miter, wood-putty filling may be necessary for a smooth-looking joint, but it will show if the work is stained rather than painted.

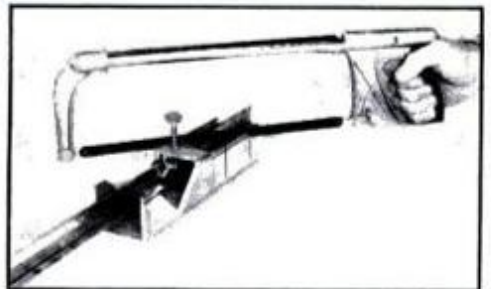
Carpenters' trick

There's a trick finish carpenters use on trim that you may find helpful—undercutting (back-cutting) the mitered surface slightly with a plane iron. When you do it this way, only two edges have to line up, not two faces.

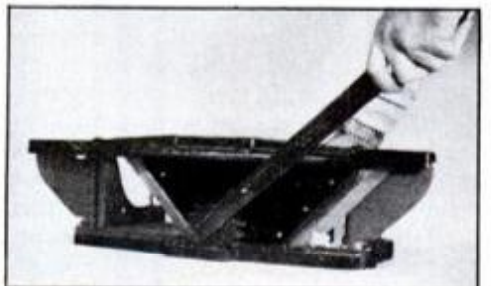
The weakest but best-looking way to fasten a miter joint is to glue and clamp. It's fine when the glued-up pieces are attached to a backup board—decorative moldings on a



Mitering jig called Jointmaster uses movable nylon pegs to hold the work in position for cutting. This setup allows neat end mitering of small workpieces.



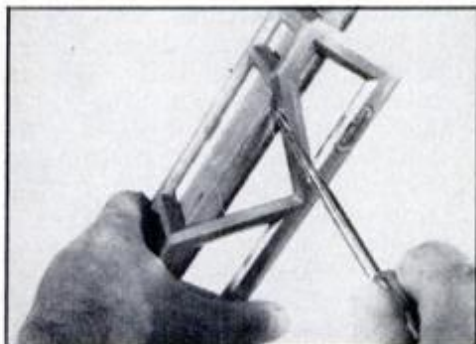
Intended for mitering metal moldings, this simple box for use with hacksaw has a built-in clamp that slides along beads formed in the sides of the box.



Miter trimmer uses a shearing (knife) action to make an extra-smooth finish cut. The work must first be cut to within 1/8 to 1/4 in. of the desired size.



Freehand cut can be accurate if laid out precisely with a miter square like this or with a combination square. A sliding bevel also can be used, but must be set accurately. Cutting must follow the line.



The template is designed to allow marking of both 90° and 45° lines at once.

kitchen-cabinet door, for example. This joint can be strengthened with brads that are set, and the holes plugged with wood filler.

Joint fasteners

Corrugated nails will also beef up a joint; use them where the work is thick and they can be driven from the rear. One strong commercial fastener is the Scotch connector, which is also intended for use where it won't be seen.

A purist will probably prefer to reinforce a joint with wood: glued-in keys, spline or dowel pegs. Be advised that cutting accurately for a spline, or boring for dowels, does take skill, experience and some specialized equipment. ★ ★ ★

SOURCES OF MITER DEVICES (Letters refer to photo on page 101)

Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801: (A) Woodcraft Miter Trimmer, \$159.75; (B) miter template, \$7.55; (C) Ulmia miterbox, \$120.10 with 17½-in. table, \$180.85 with 24½-in. table; (E) Jointmaster Sawing Jig, \$19.80; (F) combination miterbox and clamp, \$23.60; (J) horn-beam miter square, \$4 (all prices postpaid).

The Stanley Works, 195 Lake St., New Britain, Conn. 06050: (D) H114A Handyman miterbox, \$12.90; (K) 85-112MB plastic miterbox, \$3.39; (not shown) 85-600 plastic miterbox with 14-in., 13-point back-saw, \$8.99 (all suggested retail prices).

Durall Tool Corp., 923 Old Nepperhan Ave., Yonkers, N.Y. 10703: (H) No. 116 rock maple miterbox, \$3.16 suggested retail price.

Beno J. Gundlach Co., Box 544, Belleville, Ill. 62222: (I) No. 601 Quick-Lock Miterbox, \$6.95.

Pootatuck Corp., RR 2, Box 18, Windsor, Vt. 05089; (not shown) Lion Miter Trimmer, \$175 list price.



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22 ENERGY-MISER TRICKS

(Continued from page 91)

air has chilled them through, the sun is warming up and they help counteract it. After baking in the sun all day, they help offset the evening chill.

■ **Ridge vent.** A unique weather-proof metal ridge cap insures that heat infiltrating the roof is vented through a double row of louvers. The void beneath it also acts as a heat dump for some appliances.

■ **Refrigerator heat rejector.** The heat dissipator of any refrigerator or freezer dumps a lot of warmth into every home. In the MED house, these units have been removed and installed in an adjacent foam-insulated cabinet. Sealable louvered vents direct the waste heat into the living room in winter—or dump it outdoors in warm weather to reduce the airconditioning load.

■ **Low-energy stove.** Energy conserving appliances include a pilotless gas range and laundry dryer, with piezoelectric burner lighters. The act of turning the dial energizes the igniter. A convection fan in the oven cuts roasting time by more than half—"as much as two thirds," says Dorothyann Sheehan.

■ **Laundry air control.** To avoid using cooled inside air in summer, the dryer pulls in warm air from outdoors, using much less energy to bring it to drying temperature. In addition, washer and dryer are behind airtight doors, sealed from the house by the same magnetic gasket material used on the entry door.

■ **Premixed water.** The pushbutton water system, explained earlier, supplies kitchen and bath through one pipe to each outlet. Hot and cold are blended in a manifold at the water heater, preselected on a row of buttons at each fixture, saving wasted heat in long runs of separate hot-water pipes.

■ **No-vent filtered bath.** To prevent infiltration or heat loss via bathroom window or vent, air is circulated through a chemical filter.

■ **Water-conserving showers, toilet.** The showerhead is designed to use only six gallons for a good shower, as opposed to the usual nine, and the toilet flush tank uses little more than half the water usually dumped away for that job in most homes.

■ **Light-bounce walls.** To maintain infiltration-free integrity, the MED houses have relatively small windows. To compensate, the windows are located in the corners of white-walled rooms, where the light they admit is reflected for maximum effect.

■ **Duct insulation.** All ducting for

the central airconditioning and heating system is wrapped with insulation, insuring nearly 100-percent-efficient delivery of conditioned air, without loss en route.

■ **Thermo-clock controls.** A night setback clock and two thermostats are set to vary inside temperatures according to requirements at specific times of day or night. Honeywell units are tied into the enthalpy and "comfort control" systems.

■ **Solar system.** Both MED houses are heated and cooled by solar energy. The hot-water supply also is preheated by the system and delivered to a "heat pipe" water heater.

According to Ashworth, the solar system alone has been more than adequate, though a backup gas furnace will kick in if needed. Roof panels contain evacuated-tube collectors—320 square feet of them—resembling organ pipes. They are efficient but expensive. The sun heats water coursing through blackened copper pipes in the collector tubes. The water then goes to a 500-gallon storage tank—enough heat to carry through a sunless day or two—under the garage floor.

If house heat is required, water is drawn from storage through a "single coil air handler" where it heats forced air blown over it and through the ducts to room registers. If cool air is called for, 195° F. water from the solar collectors "fires" an absorption chiller that sends chilled water through the air-handler coil, which now cools air for distribution. The unique setup produces three tons of cooling—far more than needed for the little MED homes. Actually, the houses are so tight and well-built that, says Ashworth, "we may not need the air-conditioning system at all."

■ **Air purge system.** In summer, when outside air is cool enough, and in winter when it's warm enough outdoors, "enthalpy" sensors alert the system and it brings in outside air, flushing the house through a pressure vent and using Nature's conditioned air for "comfort control." The house systems automatically shut down.

Living in the house

What is it like to live in a MED? I spent an hour or so with the Sheehans one morning to get their reactions. According to John, since it all began last September the solar plant hasn't had to contribute much energy at all—most of the heat it collects has to be dumped. "The most significant energy-saving factor is the way this place is built—tight and solid," he says. "With

(Please turn to page 128)

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22 ENERGY-MISER TRICKS

(Continued from page 126)

everything closed, we hear almost no outside noises at all. Even graders in the next lot were almost soundless here.

"An unexpected spinoff," he adds, "is the acoustical effect inside. People in adjacent rooms can't be heard. The place is soundproof."

According to both Sheehans, the solar plant is completely unobtrusive. When it's on, the water-circulating motors and automatic-valve switch controls—all tidily packaged in a back corner of the garage—are nearly soundless. "If it's a quiet night," says John, "you're subliminally aware of the system changing function. There's a faint pulsating hum—like inside a submarine."

Dorothyann's reactions to the changes in lifestyle from a 40-year-old California farmhouse she grew up in to a "home of tomorrow" are ambivalent. She's highly enthusiastic about most of her advanced kitchen appliances—especially the high-speed oven. The enthalpy system that circulates filtered air through the house also has advantages. She dusts once in two months and that, she admits, is pretty ac-

ademic. But the system took some getting used to.

Some disadvantages

"The idea of not being allowed to open a window for fresh air until some computer lit a light and gave the orders was pretty hard to take at first," she reveals.

What about disadvantages?

Biggest complaint involves the water delivery system. "I don't like it," Dorothyann confesses. "Since it mixes at the other end and moves through a reduced-size line to save pumping and heating energy, John can't take a shower while I'm doing the dishes. Whoever starts first gets the hot water."

Another beef is that the small windows make for less daylight. "The living room," Dorothyann notes, "is especially dark." And to help keep down emergency consumption, the designers skimped on footage for the three bedrooms which, the Sheehans both feel, are too small.

Aside from all that, the matter of "living in a fishbowl" has provided some curious episodes. "People actually come to the windows and peer in at us," John says. "They even rattle the doorknob to see if

it's open. After we'd been here a week," he recalls with a wince, "Dorothyann heard someone prowling outside one night. I went to the front door, opened it, and found myself face-to-face with a .38. Somebody'd forgotten to tell the sheriff that we'd moved in. He was just checking, but it was pretty unnerving."

Despite mishaps, they like it

Has everything worked as expected? Well, almost. One night, son Todd was having a bath when suddenly there was, as Dorothyann put it, "a loud concussion noise in the garage." She rushed to investigate and found a torrent of water pouring across the floor. "The bottom of the water heater had fallen out," she said wryly. "We had to shut everything down for a while, which was inconvenient but no disaster."

All considered, the Sheehans wholeheartedly favor the entire MED project. Even 4-year-old Todd has a distinct awareness of what's going on. Recently, after watching lights flick on at the solar function panel, he turned to his father, saucer-eyed, and said excitedly: "Look, Daddy, the sun is working!" In Mission Viejo, indeed it is. ★★ ★

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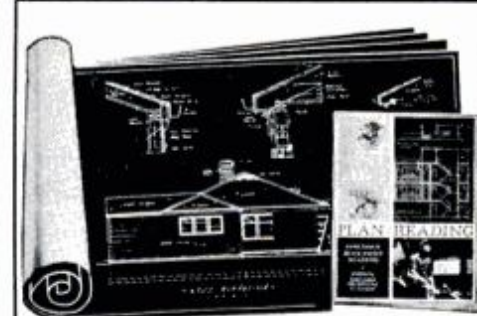
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BIG BOOM IN GAS BAGS

(Continued from page 67)

supplies so the young couple can head for the hills on vacation weekends, park, and unload and launch their mini-dirigible for breathtaking air views of wilderness scenery. Brian is convinced this type of small, fast, maneuverable balloon will eventually become the "sports car" of airships.

Advantages of hot air

The chief advantage of hot-air or so-called "thermal" airships is that you can deflate them any time you want, fold and store them in a closet—without wasting hundreds of thousands of cubic feet of highly expensive, hard-to-get helium—the only inert, nonflammable lighter-than-air gas considered safe for use in airships today (hydrogen is much cheaper and more readily available, but is explosive; helium, on the other hand, actually tends to put out fires.)

Other advantages of hot-air craft are that they are easier and simpler to manage. You don't need big hangars, special mooring masts or large ground crews.

Not all agree, however—there are disadvantages to the hot-air ap-

proach, too. Volume for volume, hot air provides only about 29 percent as much lifting force as the equivalent amount of helium. This means that, as increased lift is needed, the size of a hot-air ship would have to go up drastically in proportion to that of a comparable helium-filled craft to the point where it would ultimately become simply impractical—too ungainly, unmanageable and uneconomical. Helium is also stable, provides constant lift, and uses virtually no energy.

By contrast, thermal airships gobble up two to four gallons of propane an hour to supply heat and could be seriously affected by suddenly falling temperatures such as caused by a malfunction of the propane burners, which could result in loss of lift. Still, the hot-air concept—though probably not destined to see long-haul, heavy-lift applications—may well open the way for lightweight, short-run uses as in sport craft, flying billboards for advertising, amusement-park fun rides and the like.

Big companies are in it, too

Meanwhile, not all airship experimentation is being done in back yards. Many world governments and large aerospace corporations, cau-

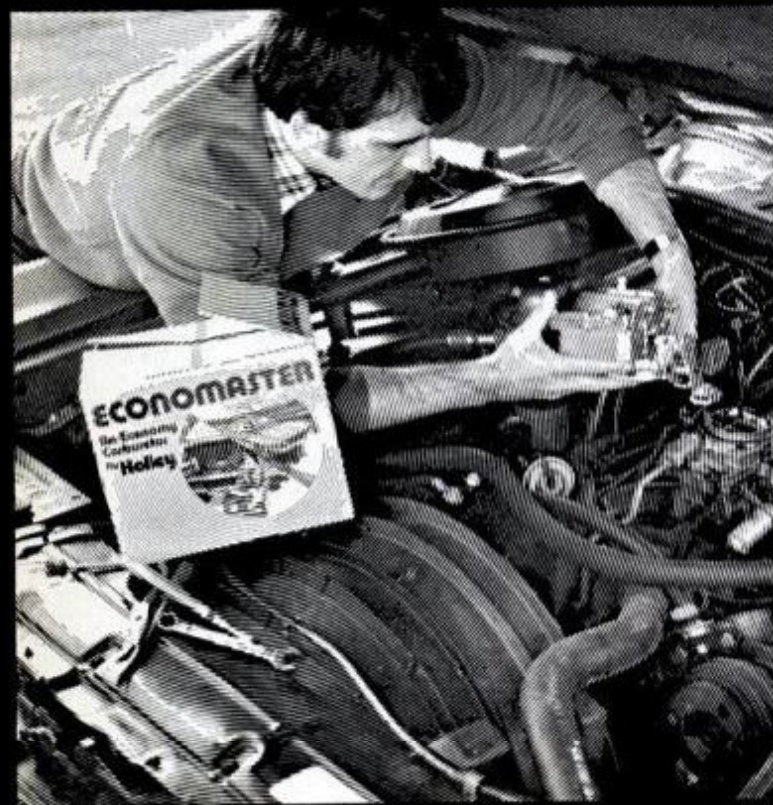
tiously watching on the sidelines, are seriously considering new ways to bring back the airship to do exciting and unusual new jobs. Shell International has reportedly put more than \$1 million into studying the use of airships to find and ship natural gas.

Could fill a gap

The airship—faster than ocean vessels, farther-ranging than limited-fueled aircraft, and with a heavier lift capacity than any current helicopter—is being looked upon as the possible ideal "gap filler" to be used in conjunction with conventional air and sea craft. Goodyear—long a proponent of airship use—is currently involved in at least three major proposals for new and practical applications. One is for a blimp-like "airport shuttle"—a flying limousine that could carry airline passengers from congested midtown city points to outlying jetports quickly, efficiently and in greater numbers and comfort than in conveyances now used.

Another Goodyear proposal suggests the use of small, fast airships to help patrol the immensely enlarged coastal waters that must be policed by the Coast Guard under the new 200-mile fishing limit put into effect last March. Such recon-

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naissance airships would "fill the gap" between slow-moving surface vessels and fast but short-range aircraft. They could remain at sea for days or weeks at a time, if necessary, tracking suspected violators and reporting position fixes until a Coast Guard cutter could get there.

Airship plus helicopters

Perhaps one of the most intriguing and ambitious projects now on Goodyear drawing boards is a heavy-lift airship that sprouts four powerful helicopters on outrigger arms along the sides. The combined lifting force of the four Sikorsky CH-54B copters and the 342-foot-long gas bag containing 2½ million cu. ft. of helium would be enough to pick up 75-ton payloads and whisk them along at nearly 70 mph.

Such a super lifter could pluck the heaviest battle tank off a landing barge and move it quickly into attack position, could load and unload ships far at sea without waiting for them to come ashore, could transport entire prefab buildings and other giant structures from factory to site—the list of possible military and industrial uses is almost endless. Research and construction on the mammoth craft will be conducted at Lakehurst, N.J.—ironically the site

of the *Hindenburg* disaster where the grim ending of one airship era may see the bright, new beginning of another.

The Army, Navy, Air Force, Coast Guard, U.S. Forest Service and NASA are all interested in the feasibility of new LTA applications. A key agency involved in research is the Navy LTA Project Office formed in 1975.

Dirigibles go way back

Turn-of-the-century America had a brief fascination with small "dirigibles"—steerable balloons. L. Guy Mecklem "rowed" one at 4 mph around a 1905 Los Angeles amusement park. Teenager Cromwell Dixon pedaled his across the Mississippi in 1907. Between 1907 and 1910, Walter Wellman made two unsuccessful attempts in a dirigible to locate the North Pole and to cross the Atlantic. There even were dirigible races. But this activity soon lost most of its aviators an public interest to a more glamorous gadget—the airplane. Sixty years later we find history starting to repeat itself.

Australian Tony Norton recently used one-mil metalized Mylar for the envelope of a one-man-powered airship. Forty feet in length, 500 cu. ft. in volume, it reportedly can do

9 mph. Norton is working on a two-man, nonrigid, 84-foot, 21,120-cu.-ft. craft using two 45-hp engines to achieve a predicted 48 mph.

In Los Angeles, Curt Tucker is nearing the completion of a 91-foot, 20,500-cu.-ft. semirigid started in 1973. The TX-1 *Silverhawk* will carry two people at an estimated 55 mph with a single 90-hp engine. The plastic envelope was home-sewn and the wood superstructure built in a friend's garage.

Hollywood stunt pilot Dean Engelhardt (*Baa Baa Black Sheep*) modified an existing utility balloon, adding control surfaces, cockpit, engine and other paraphernalia. The result is a 108-foot, 46,000-cu.-ft. nonrigid design about half the size of a Goodyear blimp. The only problem is that the craft, if operated regularly, would require a staff of four, \$4000 a month in hangar fees and \$3700 worth of helium each time it was inflated (at the going rate of \$8 per 100 cu. ft.).

Anthony Smith, one of ballooning's great adventurers, has been operating his 76-foot, 33,000-cu.-ft. nonrigid blimp, *Santos-Dumont*, in England. The father-son team of C. W. and Darwin Conrad in Arizona plans a rigid internal frame-

(Please turn to page 132)

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BIG BOOM IN GAS BAGS

(Continued from page 131)

work for its 120-foot "sportster." Though still on the drawing board, the helium-filled craft is believed to be a practical project for amateur homebuilders.

A 'flying saucer' airship?

The Conrads are also working on a saucer-shaped rigid airship 80 feet in diameter with a helium capacity of 70,000 cu. ft. It will be powered by three engines driving props fore, aft and in a center duct, enabling it to carry two crewmen and six passengers up to 75 mph. One possible use seen for the "flying saucer" would be in aerial police work where its greater range, increased airborne time and lower vulnerability to gunfire attack could give it advantages over currently used police helicopters.

As an example of just how sophisticated airship technology has become, the Canadian Airship Development Corp. cut the envelope fabric for its 120-foot, 91,000-cu.-ft. CAD-1 dirigible from computer-generated patterns—with help from research at two prominent Canadian engineering schools, McMaster University and the University of Toronto.

Cameron Balloons in England demonstrated the first successful thermal airship in 1973. Today four Cameron 95-foot, 96,000-cu.-ft. D-96s are flying in Europe and one in America. They are priced at \$39,500 in the United States. Two people are carried at some 11 mph by a 46-hp VW engine modified for propane. Envelope shape is aided by ram air pressure from an enormous scoop above the gondola. A 140,000-cu.-ft. model, D-140, costs \$73,000.

In 1974, America's largest sport balloon manufacturer, Raven Industries of South Dakota, flew its *Enterprise*. This two-man, 120-foot, 140,000-cu.-ft. design with a 65-hp VW engine, has fan pressurization to help maintain an envelope shape like that of Cameron's ram-air scoop. Top speed claimed is 26 mph.

In England, the firm of Thunder Balloons is working on a thermal airship similar in dimensions to Cameron's D-140. It will be pressurized and carry four people. Anticipated U.S.-delivered price is about \$70,000. Transatlantic balloonist Bob Sparks (page 70, June '75; page 103, Nov. '75) has a thermal airship projected.

Navy considering airship use

Because airships can be more fuel-efficient than other craft and

(Please turn to page 134)

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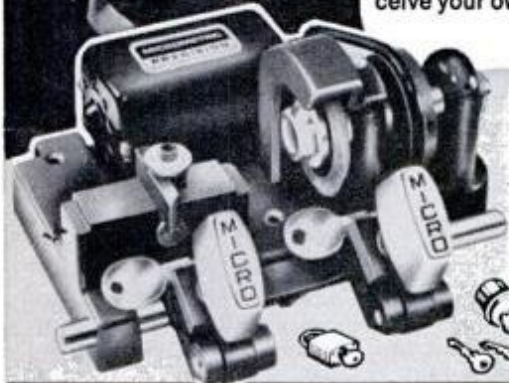
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BIG BOOM IN GAS BAGS

(Continued from page 132)

also more silent running, the Navy is again looking at blimps and even aircraft-carrying rigids as large as 11 million cu. ft. for extended tracking of enemy submarines and other sea duties. Another possibility for ocean patrol is a hybrid pioneered by Aereon Corp. of Princeton, N. J. Delta-shaped, the *Dynairship* would use both aerodynamic (wing) lift and buoyant gas lift.

For heavy lifting, All-American Engineering of Wilmington, Del., is working on spherical balloons with a rigid internal structure to support four helicopter-like blades around the sides (page 38, Nov. '75). Called the *Aerocrane*, the vehicle rotates at 10 rpm except for the crew and hoist suspended in a gondola. Blade thrust directed up or down eliminates the airship problem of compensating for gain or loss of cargo weight. At 50 mph, an *Aerocrane* could carry huge military or industrial loads far beyond the capacity of today's most powerful heavy-lift helicopters.

The French government's *Obelix* idea would use four large balloons totaling 8.82 million cu. ft. to move loads up to 550 tons with eight helicopter engine/rotor units for propulsion and control. The British have been considering numerous airship designs. Currently Aerospace Developments has contracts for testing or producing conventional small blimps for the Royal Navy and a Venezuelan group.

WDL of Mülheim, West Germany, has made blimps of the Goodyear type. Last year one was sent to Africa to determine its feasibility for cargo transportation in developing nations.

Lightspeed, a European firm, has relocated in America at 17 East Hibiscus Blvd., Melbourne (Cape Kennedy), Fla. 32901. Its object is to try to organize an airship consortium with U.S. aerospace companies. It plans to start with a 278-foot, 427,500-cu.-ft. LS-12, an unusual design with interchangeable gondola modules for passenger, cargo, heavy-lift and other missions. An even larger LS-60 version will be 473 feet long and have a helium volume of more than 2 million cu. ft. It will lift 50 tons.

Thinking big

An unusual current concept is a hybrid proposed by a group of California airship designers. Called the *Megalifter*, it is literally half dirigible and half airplane—a huge cigar-shaped gas bag with wings, twin

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tails and an elevator stuck on. Helium cells provide some lift; the wings add more. To top it off, the gargantuan craft—roughly the size of four or five 747 jumbo jets put together—would be powered by four jet engines, two on each side.

The combination could presumably carry staggering amounts of military and industrial supplies at airliner speeds—if the ship's sheer size doesn't raise questions of practicality. Cost figures, exact dimensions and performance capabilities are not yet available, but you must admit the promoters are thinking big.

Back to thinking small: How practical is building an airship in your back yard? Yankee ingenuity at scratch building and scrounging parts can't fully replace money, of which plenty is needed. Your patience must be surpassed only by your wife's. Joining the Assn. of Balloon and Airship Constructors (ABAC) helps. The Conrads reportedly spent only \$1000 on their 75-foot rigid, but many materials were on hand and the engine loaned. Boland says the *Albatross* cost \$4000. I've been told that builders should expect to spend roughly \$1 to \$2 per cu. ft. of volume.

Licensing requirements

Pilot requirements for airship operation are currently in a state of flux, partly because of the sudden appearance of so many home-made, back-yard designs. Presently, Federal Aviation Administration pilot-rating requirements are aimed mainly at operators of large, commercially used Goodyear-type blimps.

In time, these requirements will need overhauling for application to small designs. Currently, such small craft are defined as "motorized balloons." If you contemplate the construction of any kind of airship—even just hanging an engine on a standard hot-air balloon—check your nearest FAA field office to see how it will be classified and what you must have to fly it. ★★

Organizations and publications

- Assn. of Balloon & Airship Constructors, Box 7, Rosemead, Calif. 91770; annual fee of \$10 includes two quarterly publications.
- Balloon Federation of America, 806 15th St. N.W., No. 610, Washington, D.C. 20005; \$5 a year for quarterly magazine.
- Lighter Than Air Society, 1800 Triplett Blvd., Akron, Ohio 44306; \$2 a year for bimonthly newsletter.
- Inside the Control Car, 910 Sherwood Lake Dr., No. 3-B, Schererville, Ind. 46375; \$6.50 a year for bimonthly newsletter.

Airship manufacturers

- Cameron Balloons U.S., 3600 Elizabeth Rd., Ann Arbor, Mich 48103.
- Thunder Balloon Loft, Ltd., Box 9, Lookout Mountain, Tenn. 37350.
- Conrad Airship Co., 1614 East Second Ave., Mesa, Ariz. 85204; \$5.95 for information kit.

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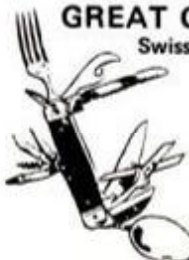
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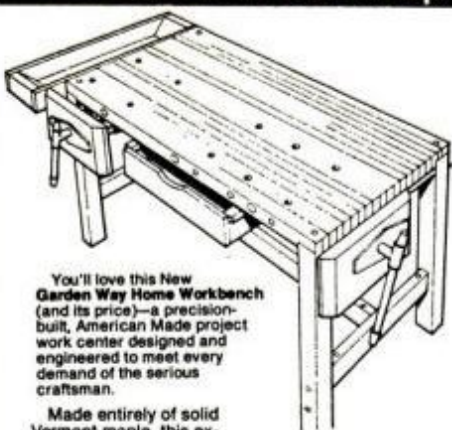
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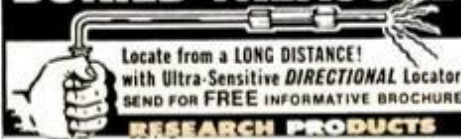
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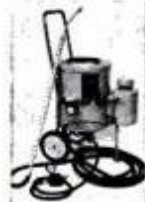


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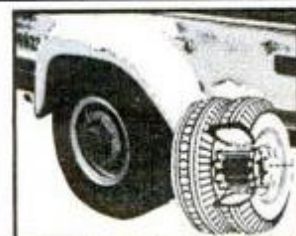
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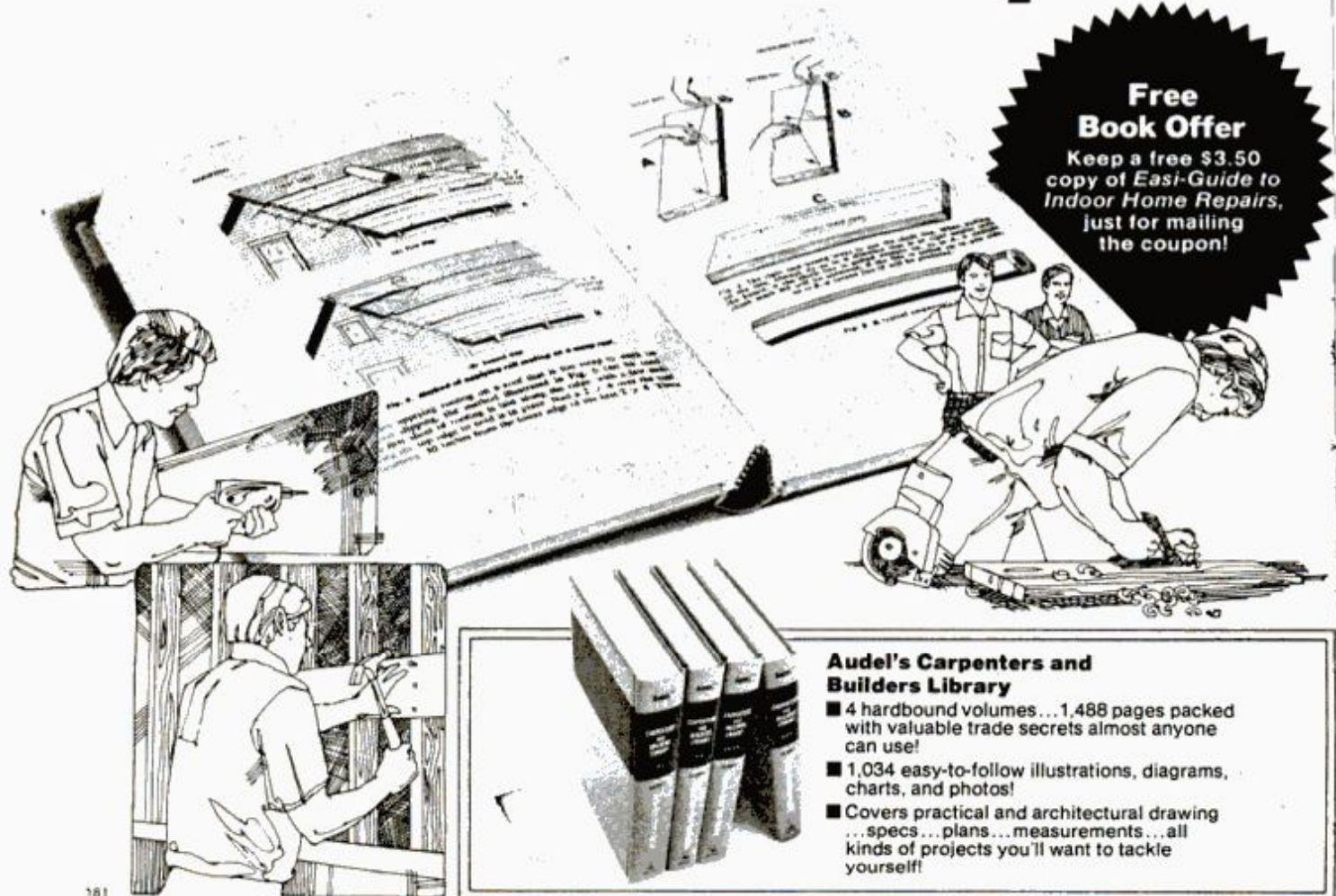
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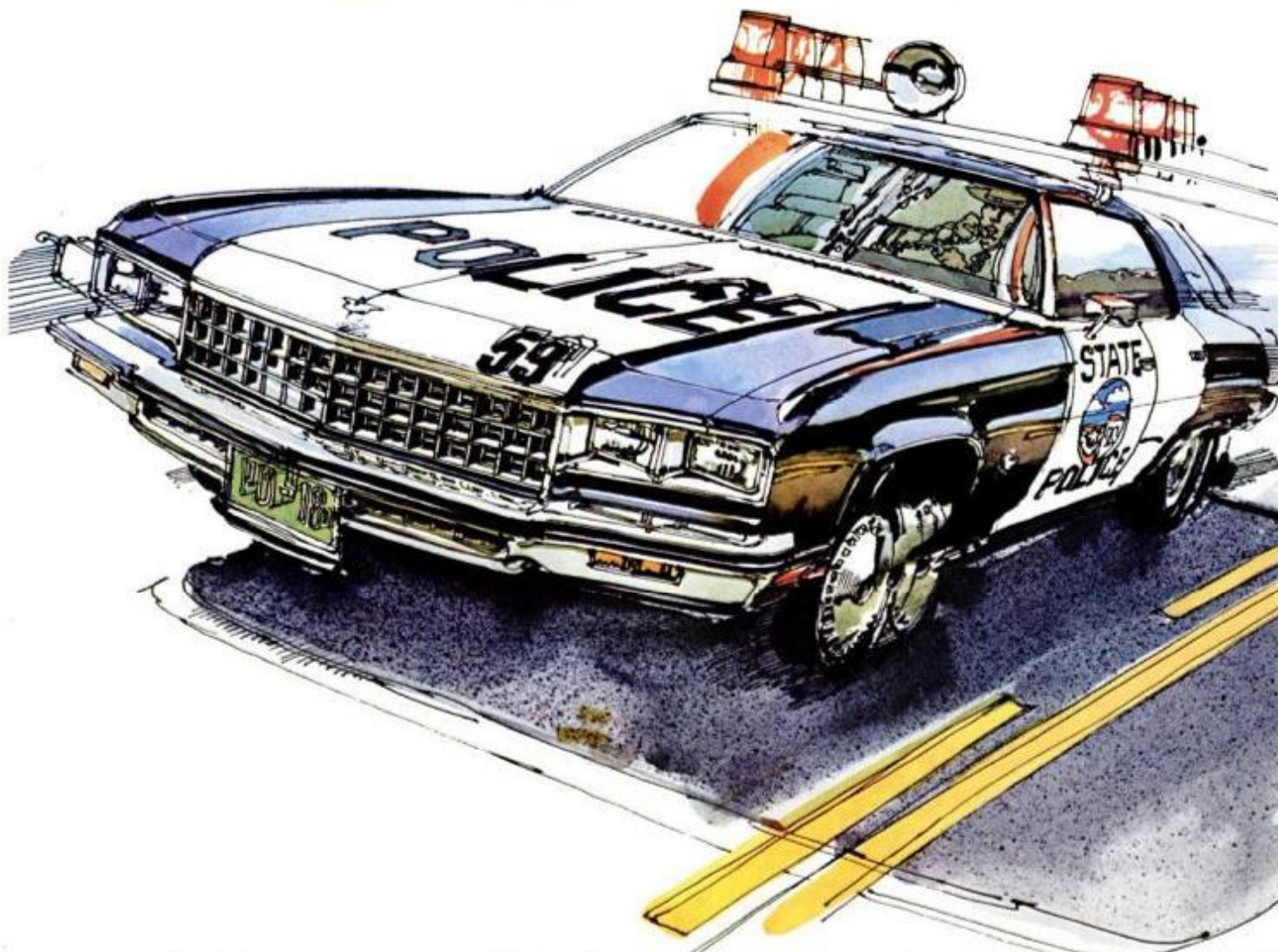
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