

MAY 1977 75 CENTS

Popular Mechanics

HONDA ACCORD & PACER WAGON:
Owners' ratings after
3 million miles

50 years later:
Secrets of
Lindy's flight

THIS MONTH:
Indy's first
200-mph
lap!

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5 wilderness
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STATE FARM INSURANCE COMPANIES Home Offices: Bloomington, Illinois

This One



P516-DTC-3ZBG

Ⓛ Heads not strong enough - use color or rules

Popular Mechanics®

On the cover
Rugby's the game for the couple on the cover, but the name of the game when it comes to owning a car is Keep Down Your Costs. One way to do that is to keep your car 10 years or more. That's what Bill MacNaughton has done: That's his shiny red 1964 Ford Mustang convertible. Say you used to have one just like it? Eat your heart out!
—Photo by Jerry Abramowitz.



MAY 1977

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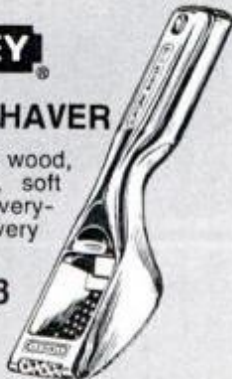


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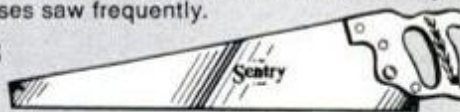


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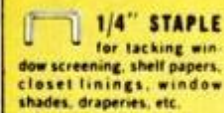





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LETTERS TO THE EDITOR

Sandlot stock cars

Hot Dogging It in the Bullring (page 78, Feb. '77) has let the world in on our secret in Southport, Conn. Larry Ross is not only a race-car driver and topnotch mechanic; he is also a man who cares about the people in his community. Many of us will not forget the cold, late hours he has come to our rescue when our "car" just wouldn't go. Thanks for the article. It is long overdue.

KEVIN M. CORCORAN
SOUTHPORT, CONN.

Cutler's rivets

Your article on kitchen knives (page 108, Feb. '77) was good (as are most of your DIY articles). However, I've found that by buying blade blanks it's possible to make really super knives. The supplier of my blanks also has cutler's rivets in small quantities. The address is Indian Ridge Traders, Box 20039, Ferndale, Mich. 48220. They have a catalog for half a buck that lists everything you may need.

RICHARD BEIRNE
GALESVILLE, WIS.

Don't junk spoke protectors

Eugene Sloane's recommendation that spoke protectors are extra weight and should be thrown away (page 60, Oct. '76) gives me the impression that he disregards safety. These devices obviously serve a purpose. If the chain ever *did* jump off of the low gear without a spoke protector, it could break spokes and bend them around the hub, jamming the rear wheel. After seeing a twig get caught in someone's derailleur and produce the result I just described, I would advise careful consideration of the type of riding that will be done before removing the protectors.

RANDY SHERRY
PITTSBURGH, PA.

PM's 8-tube superhet

Enclosed is a photograph of a radio receiver I acquired at an auction. It is a "Popular Mechanics 8-tube super-heterodyne." Apparently your magazine published the schematics and pertinent information regarding this "jewel of the past," probably in 1922-1924.

The radio is absolutely *mint* con-



dition! It has a sheet copper-lined walnut cabinet with the words "Popular Mechanics 8 tube Super Heterodyne" engraved on the front panel.

Can you provide me with *any* information or schematics for this little gem? Or can you tell me the month and year this receiver appeared in *Popular Mechanics*? I am a serious collector of old radios.

RONALD A SCRANTON
HOOPESTON, ILL.

Instructions for building the set were presented quite fully in the February and March 1925 issues of the magazine. Copies of the articles and plans are available from the Popular Mechanics Bureau of Information, 224 W. 57 St., New York, N.Y. for \$3.50 postpaid.

Screwy helix

I enjoyed your article covering the significant inventions, discoveries, and events of the past 75 years (page 66, Jan. '77). It was educational as well as interesting. However, I would like to point out a mistake you made in the diagram of the double helix structure of DNA. It shows the sugar-phosphate backbones running in the same direction (indicated by the arrows), and the purine and pyrimidine bases are paired in a like-with-like structure. This is the incorrect structure James D. Watson thought of before he and Francis Crick discovered the correct one.

MARK G. WILLS
ARIZONA STATE UNIVERSITY

A number of letters from readers pointed out this error. Our diagram, taken from early sources, was in-

tended to be more symbolic than an accurate depiction.

Dusting for earprints

Alfred V. Iannarelli's identification of people by their ears (page 58, Dec. '76) is not an original one.

In the late '20s or early '30s the magazine section of the Sunday *New York American* ran a series of stories on the French detective Bertillon who preferred to use ears for identification because, he said, you could not go to a person and ask to see his fingerprints.

E. MCKENZIE
BROOKLYN, N.Y.

'Hot line' not so hot

In your *Appliance Clinic* item relating to "Hot line for fixers" (page 16, Feb. '77) you advise readers with a problem to call a White-Westinghouse toll-free number. Your caption indicates the line is for technical information. It is not for that purpose. Your prompt retraction will be appreciated.

S.R. MILLER
MANAGER FIELD SERVICE
WHITE-WESTINGHOUSE

A White-Westinghouse "Electric Range Owner's Guide" booklet advises product owners to first read the checklist supplied with the appliance "to avoid a charge for an unnecessary service call"—whether or not the item is still under warranty. "Second," says the booklet, "if you have followed the steps on the checklist, call your nearest White-Westinghouse Service Center. If service cannot be obtained, call the toll-free Sure Line 800/245-0600." The purpose of the number is thus to provide information about service facilities, not direct service advice itself.

Swan song

In your article *Shooting Wildlife With a Camera* by James Tallon (page 74, Feb. '77), the "geese" that are pictured migrating—are not geese. They are swans. Love your magazine anyway.

SYLVIA RING
GROSSE ILE, MICH.

No. 4 shot bottle cleaner

Your item on *Treasured Bottles That Glitter* (page 56, Oct. '76) advises using "water and clear, sharp sand" to clean out old dirt and residue. Sharp sand will scratch. Shot for shotgun shells will clean the inside of bottles without scoring them. My mother used medium or coarse shot

(Please turn to page 8)

SHOULD BE 1172



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LETTERS

(Continued from page 7)

to clean milk bottles us kids drank from. No. 4 shot will do a good job. I am one of the oldies (75).

LUTHER W. DERK
SHAMOKIN, PA.

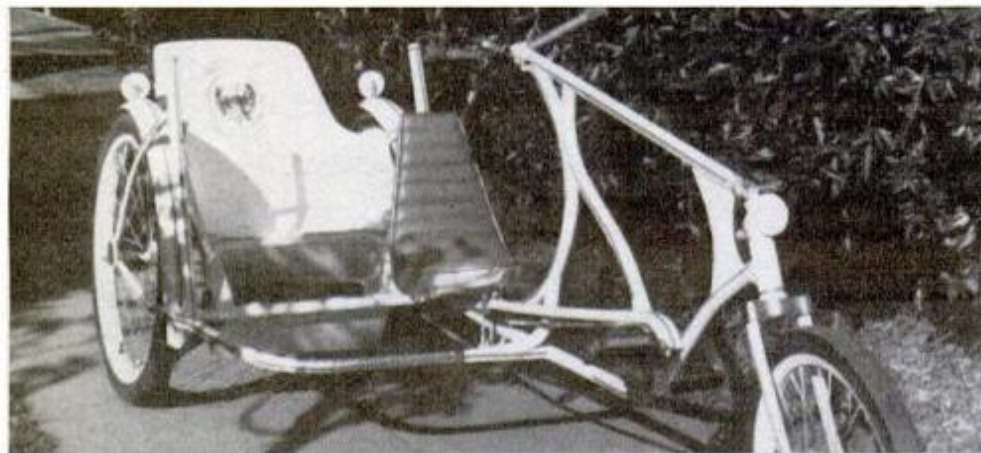
Thank heaven for girls

My father has been getting *Popular Mechanics* for years now, but I read your magazine for the first time just a few days ago. Since then, I have read two issues out of sheer interest. I am a girl and I just seemed to think of *Popular Mechanics* as a man's magazine. I especially liked Eugene A. Sloane's articles on bicycling. Again I would like to compliment your magazine. I love it.

LAURA MICKS
WAYNE, N.J.

Side-pocket ground-hugger

You published plans for a ground-hugger bike (page 192, April '69). I built one and had a hard time to balance it, so I put on a sidecar, and now anyone can ride, and carry a passenger or packages. Also it has a tool box under the seat. I am 78 years old and have read your maga-



zine since I was old enough to get to the library.

LLOYD F. OSMUNDSON
SAN DIEGO, CALIF.

Hope you bought some copies, too.

Which almanac do you read?

Some earthquake casualty figures that appeared in your December 1976 issue may be inaccurate.

According to the Weston Observatory, Weston, Mass., and the National Earthquake Information Service (NEIS), Golden, Colo., the Tokyo quake in 1703 killed 5230 people, not 200,000, as reported in *Popular Mechanics*. Also, according to the same sources, the Yokohama quake in 1923 killed 99,330 people, not 143,000.

Interestingly, the *World Almanac* (1974) also records the 1923 Yoko-

hama quake as having killed 143,000.

JOHN WHITMAN
CONCORD, MASS.

Both figures used came from the Reader's Digest Almanac. Since the Digest checks things with a fine-toothed comb, we relied on them.

"Published sources", including ours, involving head counts 275 years ago would be suspect in any case. The 1923 discrepancy, from the same source, is more puzzling. Evidently the figures depend on whom you read.

Underground living

Saw a cave house on the evening TV news built by a Mr. Andy Davis of Armington, Ill.

Cost him \$15,000 to build and a couple of dollars to heat all winter. That was for gas for his chainsaw to cut wood for heat.

The house was covered by earth except for one end which was for entrance. Can't find any info as to how to build this house. Seems like it could be an answer to the high cost of housing and the energy crisis.

Could you run an article on it?

L.A. FREEBORN
JEFFERSON TOWN, KY.

See the March issue, page 78.

Variable-control preamp

In your article *Better CB* (page 89, Jan. '77) you expressed a desire for a preamp with a three-position switch for off, amplify and attenuate. A number of REACT stations in Texas have been using a preamp that does better than that. The RPA-60 "US ContraBand" is a continuously variable control unit ranging from 25 dB of attenuation to 35 dB of gain. This unit is made by Contra-Band Electronics of 4705 S.E. 48th St., Oklahoma City, Okla. 73135.

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THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS BY THE EDITORS

Fantastic scraper



I used to snap a lot of plastic ice scrapers in half every winter. The plastic-edged types don't scrape that well, so you wind up pressing harder until—"snap!"—another one goes. Last winter (will you ever forget it?) I stumbled on a metal-edged scraper in my local appliance parts store—of all places. It was a snowy day so I bought it. I wound up using it all winter and will probably use it for many more seasons.

The Fantastic scraper, as it's called, uses a metal alloy (Wundaloy, as the manufacturer calls it) that doesn't scratch glass, and the handle is really tough. I paid \$1.29 for the scraper; maybe you'll find it for less. Krause Industries, Wattsburg, Pa. —B.H.

Battery care tools

Last winter also drove home for a lot of people the need for good battery care. I'm continually amazed at the number of car owners I talk to who don't own a hydrometer—and many of them are car enthusiasts.

I spent \$2.50 for a new one last winter and used it regularly to keep tabs on the condition of my three-year-old battery. Knowing your battery's specific gravity is the best way to tell whether or not you're going to start on cold winter days when battery efficiency plummets. It's easy to read state-of-charge right on the float in red, yellow or green, if you don't want to memorize the specific gravity numbers. For older batteries you'll want a



load tester, but with young batteries you can test them with the hydrometer whenever you pull the caps to check electrolyte level.

Adding water to your battery is easy, but most people do it inefficiently. For \$1.25 you can buy a rubber-bulb filler that won't spill water all over.

A third battery-care tool I invested in last winter was a battery carrying strap. Batteries seem to weigh more as you get older, so drop \$2 for a carrier before you drop a bundle on a bad back. Teeth on the type shown chew up the posts a bit, but you probably won't use it too often. All are from Sears, but wherever you go, the \$5 to \$6 is well spent.—B.H.



Rear-view mirror adhesive



Sooner or later, if you have a car with the rear-view mirror cemented to the inside of the windshield glass, the mirror is going to fall into your lap. That's when, after some appropriate remarks—%\$*&!—you'll need a good adhesive. Loctite has an adhesive kit that'll do the job for \$2 a shot. You get just enough adhesive and primer for one remounting. The primer is smeared all over the bracket as shown at left above. When the primer is dry, spread on

the adhesive as shown at right. Then press bracket to the glass and hold for one minute. Wait another five minutes before reattaching the mirror to the bracket. The kit, part No. 11067, is made by Permatex/Loctite, 18731 Cranwood Pky., Cleveland, Ohio 44128.—B.H.

Eight-plug cleaner

The latest thing in sparkplug cleaning is mass production. This new product takes eight plugs and cleans them all at once. The Elco-8 uses a



unique recirculation technique for the abrasive, which can be almost any type on the market. The abrasive, continually recirculated through a high-speed impeller, is blasted at the tips to clean them of deposits. A 12-volt d.c. motor drives the impeller. Clip the leads to your battery for power. The time-saver is \$20. Elco International, Ltd., Box 280, River Forest, Ill. 60305. —M.L.

Woodgrain, pinstripe peeler

No longer do you need a heat gun to peel the chalky woodgrain off your station wagon or the faded pinstripes off your Rally Sport.

The 3M Co. now markets a spray that makes removal a breeze. Called Woodgrain and Stripe Remover, it comes in a 24-oz. aerosol can. You spray it on, leave it for 15 to 20 minutes until the surface becomes white and crinkly then strip off the vinyl with a plastic scraper. The spray can be used only on acrylic enamel paint jobs. After the first remover, you'll need 3M's Adhesive Remover. Each is \$5.71. —M.L.



Raise the roof tonight in a Dodge Charger.

If you can't wait to see that evening sun go down, the '77 Charger is your special car. Made for people who come out to play after dark. And now you can make a night of it in a Charger that welcomes the night inside.

Just remove the transparent panels of the optional T-bar roof, and you're cruising in a Charger that's almost a convertible. Come alive in the invigorating breeze as you settle into the high-back bucket seats. For certain, you



and your Charger were born for the night.

A standard 318 V8 teams up with TorqueFlite automatic transmission to give Charger a response that's anything but everyday.

When the day starts to fade and you're ready to shift into high gear, you need the car that can light up the night—Charger.

Why let another sun go down without driving one? You can buy or lease an exciting new '77 Charger from your nearby Dodge Dealer today.



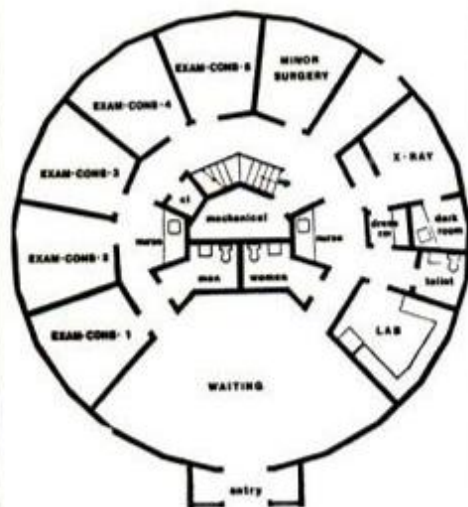
THE NIGHT BELONGS TO CHARGER.

SCIENCE WORLDWIDE

Health care under domes

Health-care centers housed under geodesic domes may soon add bulges to the landscape. The first "Medidome" went up in about four days in Clewiston, Fla., to serve migrant farm workers in a 50-mile area, under a Rural Improvement Council program funded by the Department of Health, Education and Welfare.

The 60-foot dome, with 2800 square feet of ground-floor space, provides a unique circular layout that handles 250 patients a day in



five examining rooms, a surgery, X-ray center, laboratory, nurse stations and an administration area. The units, made by Dome East in Hicksville, N.Y., range from 30 to 75 feet in diameter and provide from 700 to 4400 square feet. Frames of extruded aluminum—to which laminated panels are attached—can stand 100-mph winds.

Don't lie to an ape

You can't fool an ape, says Tim Gill, a doctoral student at Emory University's Yerkes Primate Research Center. He found out from Lana, a Yerkes chimp who—since she can't vocalize words, even

though she understands them—talks to him and other researchers via computer in a computer language known locally as "Yerkish." Lana presses keys representing words on the computer keyboard, and the computer rewards her with monkey chow when she has the right answers or statements.

Recently, Gill substituted cabbage for monkey chow—a much less desirable "reward" food. When it slid from the machine, Lana was baffled, and punched out a question to Gill via computer:

"?Chow in machine."

"Yes," lied Gill in Yerkish.

"No chow in machine," Lana shot back, then . . . "Cabbage."

"Yes, cabbage," Tim admitted.

"?You move cabbage out."

"Yes," Gill agreed, and made the switch. Lana then addressed the computer—not Tim Gill.

"Please machine give chow," she punched out, and continued until the supply was exhausted—thus proving, says Gill, Lana knows a Yerkish lie when she sees one.

Brakes for buildings

They're putting giant friction brakes on a hospital in Panama to see if they can keep it from sliding around in earthquakes. The system, developed at Lehigh University's Fritz Engineering Laboratory, involves installation of carbon steel plates—which slip at a specified load—in pylonlike flying buttresses at opposite sides of the building. These restrict lateral movement of the structure during violent tremors. It's important the brakes slip at a load that won't damage the building, but will hold long enough to arrest shifting. The new hospital will help determine the amount and direction of slip needed to stabilize a large building in a big quake.

Desert solar powerplant

Some 12 miles south of Barstow, Calif., in the Mojave Desert, the country's first solar electric powerplant is expected to be producing 10,000 kilowatts of electricity—enough to power a city of 10,000 people—in about three years. Thousands of mirrors will focus sunlight on a boiler atop a tower to produce high-pressure steam for generators. The complex will cover 130 acres of land, and is sponsored

by a consortium of California companies and ERDA.

Another wet galaxy

Water molecules have been detected, with the help of the 108-foot Effelsberg radio telescope, on the edge of another galaxy—nebula IC 133—some 2.2 million light years away. This means that the existence of other solar systems with conditions similar to ours is distinctly possible. And that would indicate a similar propensity for life as we know it elsewhere in the far reaches of space. The significant thing is that the water molecules had a density of one for every 10 cubic centimeters—very close to that found in the Milky Way. Scientists now will look for more vapor in more galaxies.

Future Navy V/STOLs?

Two new vertical and short takeoff and landing aircraft (V/STOL) are being developed by the Navy. The craft shown in the photo below, a joint NASA-Navy effort, is well into the design stage. Recently, a large scale model was tested in the 40-by-80-foot wind tunnel at



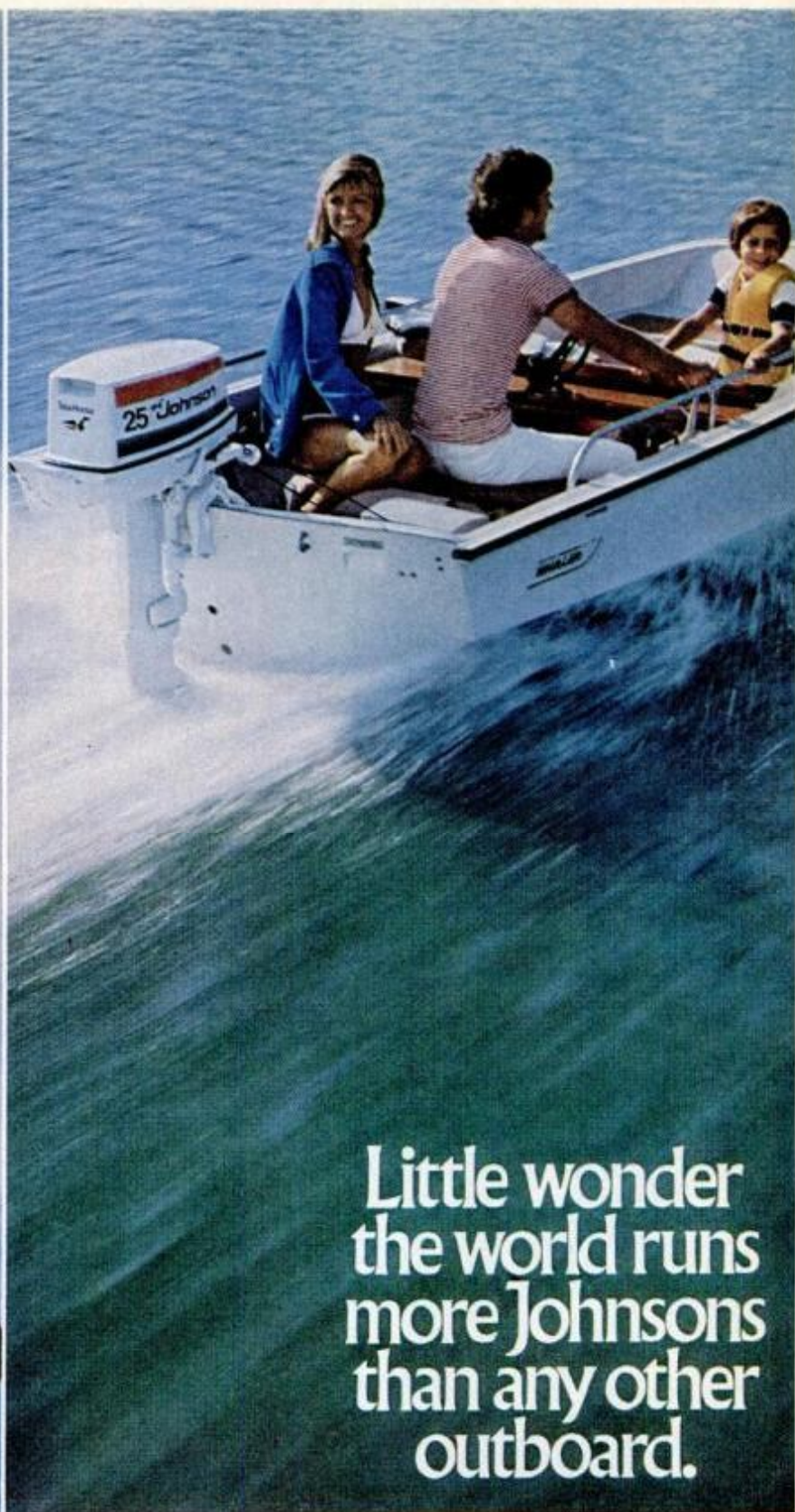
NASA-Ames Research Center. The aircraft under test has three fans. One, in the forward end of the fuselage, will blow air downward in the lift mode. Two on top of the

(Please turn to page 16)



BY
JOHN F.
PEARSON

You liked our
35 so well
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"kid brother."



Little wonder
the world runs
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We had a "best seller" with our 1976 Sea-Horse® 35 hp outboard, an all-new compact specifically designed for economical, all-purpose boating power. It has all the features of a good fishing motor, plus the power and fuel economy for family cruising and water skiing on small, easily trailered runabouts.

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See our new 35 and 25 at your Johnson dealer in manual or electric start models. Or write for free catalog. Johnson Outboards, Division Outboard Marine Corporation, 5732 Sea-Horse Drive, Waukegan, IL 60085.



First in Dependability
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OUTBOARDS

SCIENCE WORLDWIDE

(Continued from page 14)

wing will be used during lift as well as in conventional cruise flight. Deflectors in the forward lift fan are brought into use during the cruise mode. The photo shows the unique new craft mounted in the big wind tunnel.

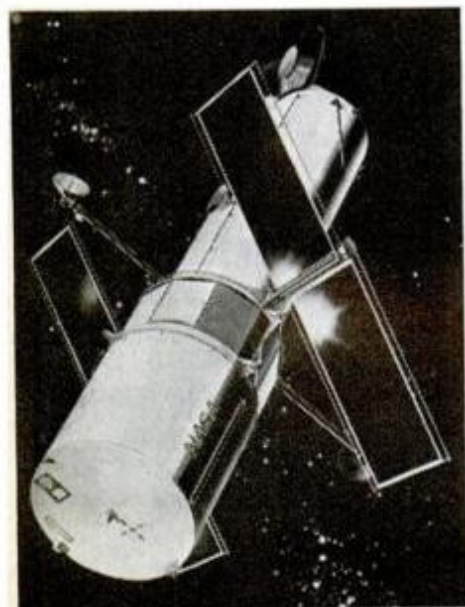
Within 20 years, another craft may be doing yeoman work for the Navy. That prediction comes from the Grumman Aerospace Corp., Bethpage, N.Y., developer of the plane at right that could be another candidate for the Navy.

As the photo sequence of a model shows, the pilot can put the plane in forward or vertical flight by tilting the engine nacelles, which provide thrust and control over a 90° range. The twin-jet would be able to operate from ships smaller than aircraft carriers and would have a variety of missions: antisubmarine warfare, delivering cargo to fleet vessels and transporting assault troops.

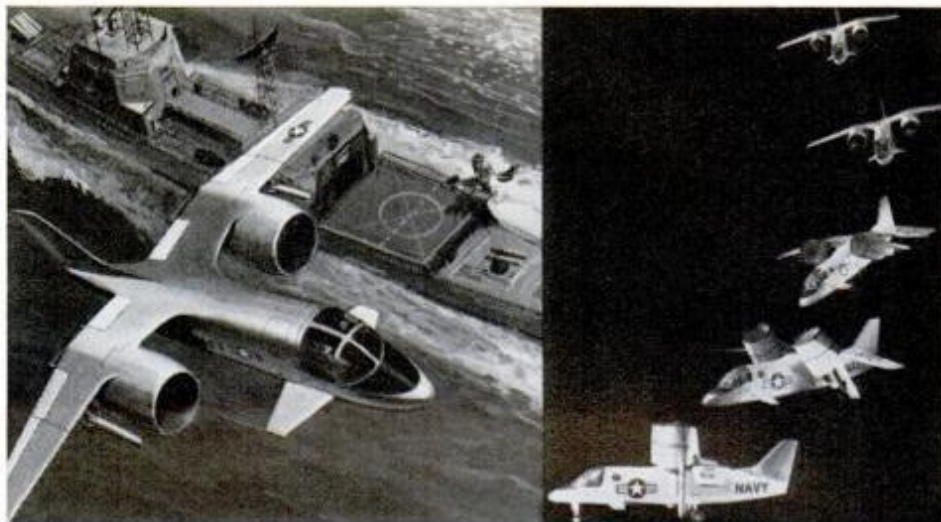
Using radio-controlled models, Grumman has demonstrated the practical application of its design. Ground-testing of a near full-scale engine and nacelle assembly is now underway.

To probe the fringes of space

A new orbiting telescope will enable scientists to peer seven times deeper



into space than is now possible. That capability was spelled out in NASA's recent announcement of the new telescope, scheduled to be placed in Earth orbit in 1983. The launch will be handled by the Space Shuttle, now being developed to become operational in 1980. Called the Space Telescope—shown here in an artist's concept—the instrument will have an



aperture of eight feet and will use two solar panels to provide electric power.

A support module containing power, control, environment and all necessary communications systems will be mounted in a collar-like configuration around the outside of the telescope housing.

Good news for avid surfers

Though it may look mighty risky, riding a surfboard is a relatively safe sport, according to a recent report in the *Journal of the American Medical Association*. Written by Honolulu doctors, the report states that the probability of a surfer sustaining an injury requiring hospitalization is about 1 in 17,500 surfing days. In contrast, according to the physicians, skiing (on snow, not water) is far more dangerous. We wonder what doctors in New England and Colorado have to say about that.

Trees can be nasty, too

When it comes to resorting to chemical warfare, plants and trees have been at it a lot longer than man. So say scientists now studying the processes by which chemicals naturally exuded from certain forest species serve to inhibit the growth of competing plant life that try their best to thrive nearby.

Carl Tubbs, a U.S. Forest Service researcher, has demonstrated in the laboratory and under field conditions that there is a definite chemical interchange between sugar maple and yellow birch that has led to a sharp decline in the number of yellow birches in areas populated by maples. Tubbs maintains that an exudate released from the maple's roots has a detrimental effect on jack pine, white and black spruce and other species found in forests of northern states. Similar chemical incompatibilities may also help to explain why certain

weeds and grasses do not grow around sunflower plants.

Eventually, says Tubbs, it may be possible for chemists to isolate the toxic substances exuded from trees and use them as a natural form of plant control.

Scientists spot space cavity

A gigantic "cavity" in interstellar space has been discovered by University of Wisconsin scientists who think it was created about a million years ago by the blast of a supernova, an exploding star. The cavity, which resembles a huge bubble in the sea of galactic gas that normally occupies most of the space between stars, is about 800 light-years across and appears to be increasing in size at a rate of 90,000 miles every hour.

The "outer shell" of the gas bubble appears on photographs and has been known for 20 years. But what it was remained a mystery until the Wisconsin scientists were able to examine it with a special spectrometer, which revealed the hollow, bubble-like structure.

Artificial hailstones

Machine-made ice balls—to simulate hail—are being used to test the strength of solar reflector panels at Sandia Laboratories, the huge research facility that is located at Albuquerque, N.M.

The balls—up to 1½ inches in diameter—are dropped on the panels from a 185-foot-high tower to see if the panels dent or crack. Solar reflectors, exposed to the weather, must be hail-proof as well as resistant to other storm conditions.

So far, fiberglass has been found to stand up well, but is expensive and requires scarce petroleum products. Sandia, conducting the tests for ERDA, is experimenting with lower-cost, non-petroleum-based substitutes such as plywood and high-strength honeycomb paper. ★★★

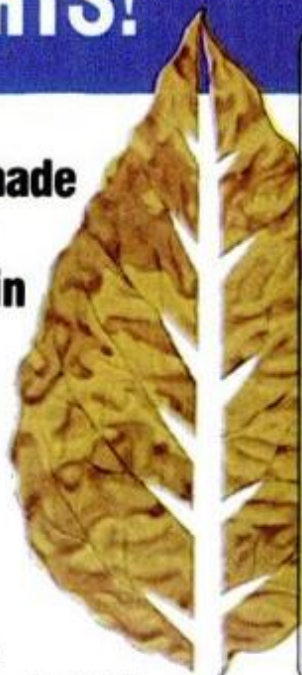
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According to a publication of the U.S. Office of Education, "You no longer need four years of college to start out on a scientific or technical career.

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But the key word is *skilled*. And that's where we come in. We're ICS, International Correspondence Schools. While we can't guarantee you a job, for over 80 years we've taken *men* and turned them into *skilled men*. And we can do the same for you.

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Careers	Average annual job openings, 1972-85†	% increase new job openings, 1972-85†
Auto Mechanics	22,300	18.4%
Air Conditioning Refrigeration and Heating Mechanics	13,100	96.3%
TV and Radio Service Technicians	4,400	18.1%
Electricians (Construction and Maintenance)	20,900	30.0%
Engineering and Science Technicians	39,600	48.9%

*Source: U.S. Office of Education publication, "25 technical careers you can learn in 2 years or less."

†Source: 1974 U.S. Dept. of Labor Occupational Manpower and Training Needs

tion to grant the Associate in Specialized Business degree in Accounting and Business Management, and the Associate in Specialized Technology degree in Civil, Mechanical, Electrical, and Chemical Engineering Technologies.

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If you already have some college education, you may be able to receive advanced standing toward your degree. With a degree from ICS, you'll be able to apply with pride for jobs that call for career training.

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No one can promise success, but if you *want* more—more money, more security, more day-to-day satisfaction and more future—our free Career Booklet and free Demonstration Lesson can help you get started in the right direction.

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ALL OUTDOORS

Speedboat specialist

Angelo Molinari, the Italian boat designer who has been called the father of the tunnel hull, received the Ole Evinrude Award as boatman of the year this spring during the Miami Boat Show. Named after the Wisconsin engineer who created the first successful outboard motor, the Evinrude award was fittingly presented by Ole's son, Ralph, to the designer who has raceboats that can go faster with outboard power



Ole Evinrude Award winner Angelo Molinari with PM's Bill McKeown (left), Ralph Evinrude, Renato Molinari.

than ever before. Immediately after the presentation, Signor Molinari explained through his interpreter that he was familiar with *Popular Mechanics* and agreed to give PM readers predictions about speedcraft of the future.

While there will be continuing advances in fast-boat design, Molinari feels the basics of the tunnel hull and its combination of hydrodynamic and aerodynamic lift should be important to racing for a number of years to come. Changes will be made to accommodate motors of greater horsepower that are sure to arrive.

Will there be a trend to mount more motors on one hull?

Molinari thinks not. One engine, he points out, can be faster than two or more; their advantage is in greater acceleration.

What will tunnel hulls of the future be made of?

Wood, he believes, for racing hulls. It allows easier modifications. Fiberglass and similar materials are better for mass-produced craft.

Will tunnel hulls become part of America's pleasure-boat market?

Fiberglass Molinari runabouts, now being sold in Europe, may be imported soon into the States.

Right now all Molinari racing imports go to the Outboard Marine

Evinrude and Johnson factory teams, but someday you may swing your Guccis out of your Ferrari and into your Molinari.

Outdoor power

One manufacturer likes to compare his new battery to a distance runner. To start your car, he points out, you need a sprinter battery that can push out a lot of instant power. But for an electric outboard trolling motor on your bass boat, or a source of current for lights and so forth in your travel trailer, boat or camper, you want a battery that can be discharged all the way down and then recharged a great number of times.

The name for a battery designed for just these uses is "deep cycle," a term that's not very well known. Most fishermen put an extra car battery in their boat to run their electric motor and then consider it bad luck when the battery takes less charge each night and finally conks out. Gould, Inc., maker of three deep cycle models called Action Pack that are sold through J.C. Penney, have tested deep cycle versus car SLI (starter, lights, ignition) batteries and find the automotive model may lose half its strength after 25 to 50 complete recharges, while a deep cycle can take 250 to 300 complete cycles with little loss in original capacity. "Marine" batteries, they find, are frequently car batteries with a different label.

Gould models are available in 34, 80 and 105-ampere-hour ratings, and at about \$50 for the 80, are priced about the same as car batteries. Deep cycle may become a new word in the bass fishing and recreational vehicle vocabularies.

Great guns?

When you write to me, or anyone else, and want to know how much a rifle you found in the attic is now worth, the answer unfortunately is, "We don't know." Too much depends on its condition, rarity, value to collectors and many other variables. But the best guide we've seen to give you a first estimate costs \$7.95 postpaid from DBI Books, 540 North Frontage Rd., Northfield, Ill. 60093. It's called *The Gun Digest Book of Modern Gun Values* and covers handguns, rifles, shotguns and commemora-

tives produced during the 50 years from 1925 to 1974. Formulas show how to guess buying and selling prices (which differ a lot) and the meanings of various grades of condition. It's worth having.

Pointers on which way to go

Going fast, slow, or away from it all, there are a number of new guides that point the way. If you already know the back lanes where you live and where you're headed, Rand McNally's *1977 Interstate Road Atlas* can show the best way in between. Magazine-sized and with just the main highways recorded, it outlines at a glance what the shortest route will be. For its purpose, it's a glovebox bargain at \$1.95, but for shun-pike travel to the back country the outdoorsman prefers, rely on the big \$3.95 Rand McNally *1977 Road Atlas: United States, Canada, Mexico* that's been a standard since 1924. Since last year, over 20,000 revisions were made to bring it up to date.

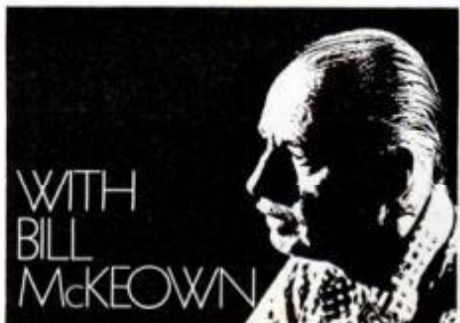
And once you've reached back country, two new directories from Adventure Guides, 37 East 57th St., New York, N.Y., 10022, tell where to find the action—or get away from it. *Country Vacations U.S.A.* lists ranches, farms and rural inns where a family can spend a quiet interlude. Pick *Adventure Travel U.S.A.* for a guide to backpacking, river running, climbing, canoeing, diving, cycling excursions, and the outfitters available. Either book is \$4.25.

Peeled projectile

Remington Arms calls it the "Accelerator" cartridge, and apparently the remarkable shell can turn your 30-06 rifle into a flat-shooting varmint and small-game .22 with the highest velocity ever produced in a factory-loaded round.

Inside a 30-caliber sabot casing is a 55-grain soft point .224 bullet.

(Please turn to page 25)





If your family is a crowd, you have four choices. You can jam them into a sedan, pay the price of a station wagon, bounce them around in a van, or...

Take the Bus.



The new VW Bus just might be the most practical family transportation ever. And maybe the most fun, too. Nothing else combines so much room, economy, visibility, versatility and comfort. And at the same time is such a pleasure to drive.

Take space. Not only do you get lots more than in a sedan, the VW Bus even gives you almost 70 percent more room inside than a full-size domestic station wagon! Accommodates a family of seven in style, with plenty of room left over for luggage.

Versatile, too. The big sliding

door lets you load even big bulky objects. And the rear seat folds down to give you extra cargo space. How does it compare to a van? About as roomy, but a lot nicer. In fact, the interior of your VW Bus is beautifully finished. Comfort to us is not an option.

And talk about economy. Your Bus has a peppy fuel-injected 2-litre engine, yet it still delivers an esti-

**Introducing
the '77  Bus.**

mated 28 mpg on the highway, 20 in the city with standard transmission in the 1977 EPA tests. (Of course, your actual mileage may vary depending on where and how you drive, your Bus' condition and whether you choose optional equipment, such as an automatic transmission.) And the '77 VW Bus comes with four-wheel independent suspension and radial tires for a smooth ride.

So if you'd like to own what AUTOWEEK says "might be the *real* best all-around car in the world," take the Bus!

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Putting the accent on comfort made Volaré America's best selling wagon.



The proof is in the putting. And we put more value into Volaré than any wagon lover could ever rightfully expect. Put one through its paces. Discover for yourself the best-selling combination of size, comfort and economy that leaves Volaré virtually without competition.

Volaré offers more cargo space than other small American wagons. Other small American wagons in Volaré's class just aren't. Comparisons don't exist. Better you should compare Volaré to big station wagons (83% as much space as a Chevrolet Impala wagon); or mid-size wagons (more passenger space than a Chevelle wagon). Pinto? Pacer? C'mon.

The liftgate is gas assisted for ease of operation. At various times there have been 1-way tailgates, 2-way tailgates, 3-way tailgates, even vanishing tailgates. Everybody tries to design their own tricky way to get into the cargo area. But the test of a good tailgate is simply this: It should work. It should get out of the way in a hurry, yet close easily and efficiently. (Volaré's does.) What it shouldn't do is pad out the price with rattle-prone gadgetry. (Volaré's doesn't.)



on 6-cylinder 2-barrel engine and manual transmission. Your mileage could differ depending on how and where you drive and your car's optional equipment, and will be lower in California and certain other areas. But considering Volaré's huge cargo capacity, 24 and 17 are nothing short of fantastic, sensational and terrific.

24 mpg/
17 mpg.

Volaré puts out some pretty impressive EPA estimates for highway and city driving, based on 6-cylinder 2-barrel engine and manual transmission. Your mileage could differ depending on how and where you drive and your car's optional equipment, and will be lower in California and certain other areas. But considering Volaré's huge cargo capacity, 24 and 17 are nothing short of fantastic, sensational and terrific. To put it mildly,

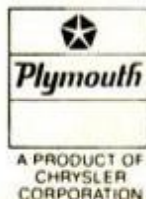
Volaré's isolated transverse suspension. Underneath the comforts of room, size and price is a ride that compares favorably to big wagons. It results from isolating, bending and mounting torsion bars in transverse fashion. Given time, other wagon makers may someday duplicate Volaré's isolated transverse torsion bar suspension. Maybe. Someday.

Hidden spare tire and lockable storage compartment. The difference between Volaré and other small wagons is that it doesn't just pretend to be a wagon. Like big wagons, the spare tire is under the cargo floor, out of sight. And, like big wagons, there's a hidden storage compartment on Premier models to keep that "out-of-sight" camera out of sight.



Even the price is comforting. It all comes down to price. And it's our contention, nobody has more features coming down on a lower price than Volaré. Just \$3941* for the base Volaré Wagon to your left. The Premier model shown above is, of course, more expensive. Putting the accent on comfort paid off. It has more people putting their money on Volaré than any other wagon in America.

*Manufacturer's Suggested Retail Price excluding: taxes, license, destination charges, whitewalls (\$39.25) and deluxe wheel covers (\$32.00). Prices higher in California.

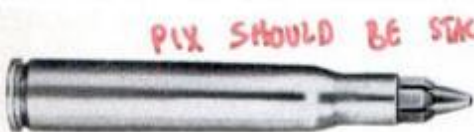


Volaré. The small wagon with the accent on comfort.

ALL OUTDOORS

(Continued from page 22)

Muzzle velocity from a 24-inch barrel is 4080 feet per second. Muzzle energy is 2033 foot-pounds, highest ever developed for a .22-cal. bullet and, out to 200 yards, superior to



PIX SHOULD BE STAGED

cal. cartridges packed in boxes with special old-style printing and "W.F.&Co." in the head stamp of the nickel-plated cases. Of course, to go with them, you can also get a limited-edition 30-30 commemorative carbine with a coach-and-six and "1852-1977" engraved on the hand-



Accelerator 30-06 cartridge, left, separates projectile into .22 caliber high velocity bullet and sabot which drops off as soon as the bullet leaves the barrel.

heavier cartridges such as the 30-30 Winchester, 35 Remington and the 45-70.

As the Accelerator cartridge's sabot-encased bullet leaves the muzzle, air resistance peels open the sabot and it drops off the bullet without disturbing accuracy or trajectory, it's reported. So, by switching ammo, the owner of a bolt or pump-action 30-06 can now own a tight-grouping, long-range small-game gun. Remington Accelerator cartridges do not operate the action of autoloading rifles, but can be used as a single-shot shell.

Teaming up

Often the easiest way for boat owners to get a better launching ramp, a dredged channel, dock space or an access road to the shore is to gang up. Group action swings a lot more weight and, once organized, a club can provide instruction, tournaments, regattas and much more fun for members.

There's a new free handbook for getting started—called *How to Organize Clubs for Fishing, Cruising, Racing, Skiing*. It's now available from the Evinrude Motors Public Relations Department, Box 663P, Milwaukee, Wis. 53201.

Commemorative cartridges

Reissue of old-time guns has created popular collectors' items for some time. But this year, to celebrate the 125th anniversary of Wells Fargo Company and the part its stagecoaches played in opening the West, Winchester-Western is producing a special limited run of 30-30-

some lever-action receiver.

Tire talk

Which tire for your recreational vehicle? Your local dealer may not be an expert on RV tires, but there are pamphlets available so you can be. Goodyear, for example, has excellent brochures: *Tires for Boat, Camper and Utility Trailers; Light Truck Tires; Specifications for Recreational Vehicle Tires*; plus information sheets on their Glas-Guard tires, Custom Xtra Grip Hi-Miler, Glas-Guard XG mud and snow tires, Tracker A-T for 4WDs, Cushion-Miler, Hi-Miler Wide Tread, Custom Flexsteel LT and Terra-Tire floatation tire. You can get the booklets from the Public Relations Department of Goodyear Tire & Rubber, Akron, Ohio 44316. Pick the proper tire, and even if you have a golf cart, lawn tractor, all-terrain vehicle, beach buggy or 46-tire missile mover, your dealer can order it.

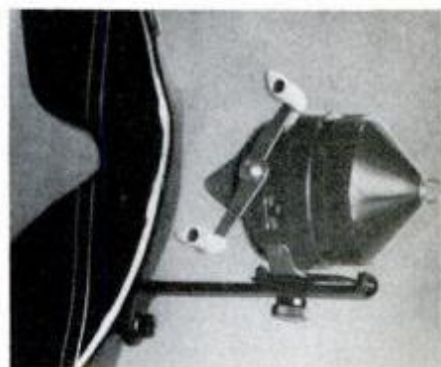
RV improvements

Titles are getting simpler and regulations more sensible in the booming recreational-vehicle field. The name for tent campers with canvas sides and camping trailers with fabric or solid walls has been standardized as "fold-down camping trailer." That should take care of all types of this popular model. And in a landmark Supreme Court case that will probably be known as the Euclid, Ohio, Decision, the court has ruled that a municipality cannot single out an RV owner and prohibit him from parking his RV on his own property. RVs are here to stay. ★★★

New Outdoors



One-club golf, from driving iron to putter, with Superstick 17-clubs-in-one from Highlander Products, 470 E. Thornton St., Akron, Ohio. No bag, no caddy.



Archers become fishermen after installing adapter to any bow with a stabilizer hole. Then add reel, 20-lb. line. From Saunders, Columbus, Neb.

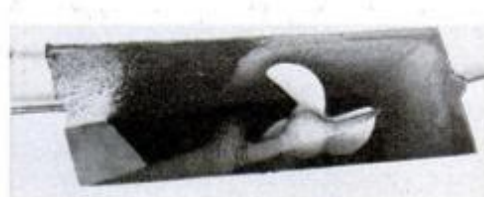


Functional fixed-blade model, the Ballard hunting knife uses a rust-resistant blade of 440 high-carbon steel that is one piece. New knife weighs 8 oz. with sheath, is made by Ballard Cutlery, Golf, Illinois 60029.

Get four horses, or a brace of motorbikes or snowmobiles, and you can tote them, plus a party of four, in the new 38-foot fully equipped horse and travel trailer from American Trailer Specialists, Fort Wayne, Ind.



Canoe with a hole in its hull



New maneuverability, plus extra stability and safety, is reported for an inboard well for mounting outboards in fiberglass canoes. Skipper can sit amidships for better balance than if the motor were aft and clamped to an outside bracket. View above shows bottom of hull with motor tipped up. Tilting up (also at left) allows beaching or running over snags without damage to the propeller or lower unit in this new design from Mekco Fiberglass canoes.

Outboard wells have proven successful for fishing skiffs. Why not one in the center of that ideal shallow-water fishing craft, the canoe? Then a boatman can maneuver without the instability of a motor mounted aft or out on one side. No need to sit in the back when canoeing alone, or to lean out to steer.

Ernie Hanson of Mekco Fiberglass, 1057 West Washington Ave., Cleveland, Wis., has modified a line of 16-foot canoes built by the company in order to mount a 2 or 4-hp outboard. The well is designed so the motor can be tipped up for beaching or running the shallows. Maneuvering is easy, even in narrow streams, since the motor may be reversed or pivoted and the canoe's bow becomes its stern. The well is found to take up only a little of the stowage space aboard the beamy Explorer model.

Tests indicate the modification doesn't impair performance. Better handling, stability and safety are benefits of this change to the Indians' classic craft.—*John Tuzee*

SNAPPER FAST.

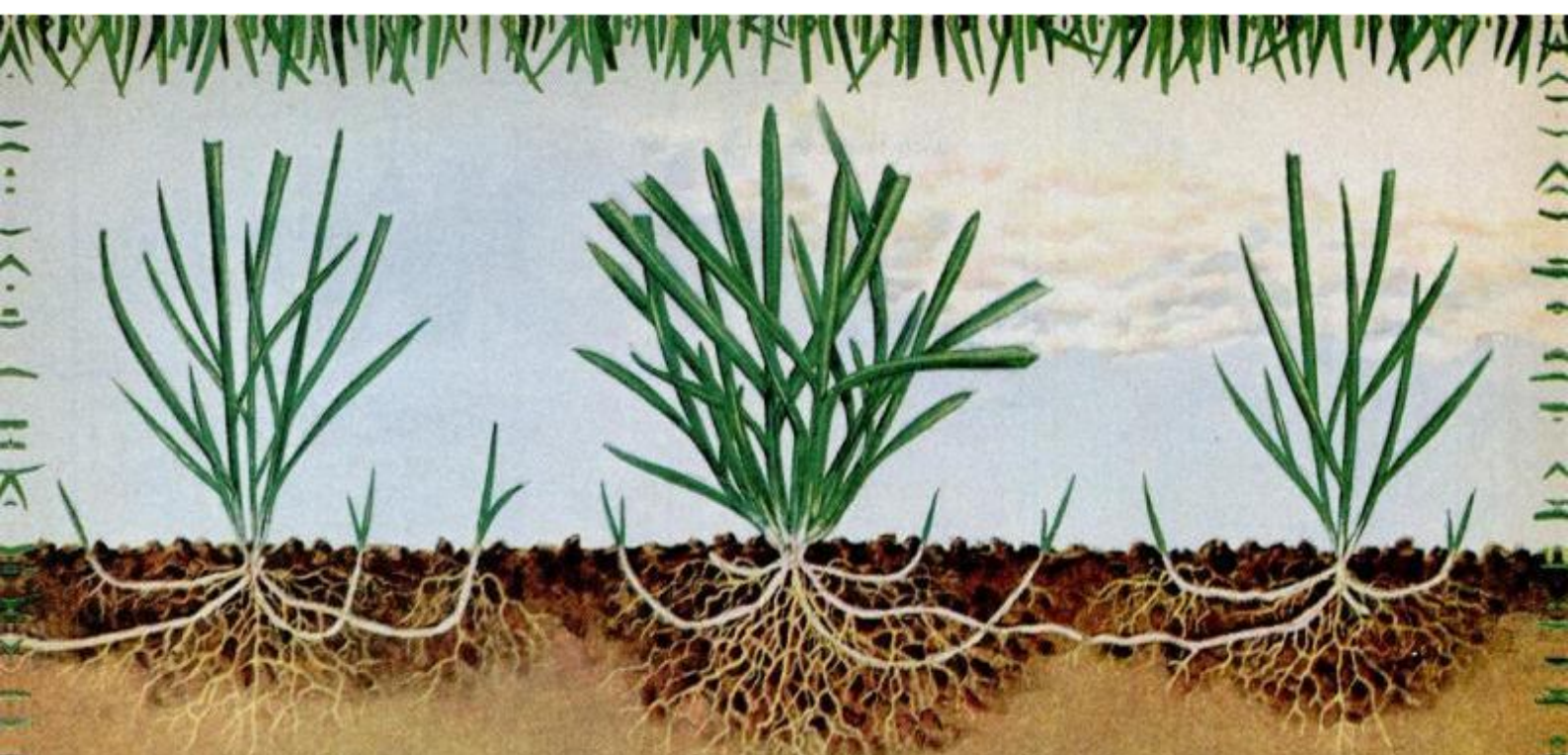


There's only one way to finish your lawn Snapper fast. And that's with a Snapper mower. You can choose one of our V-Series mowers. Or the famous Snapper Comet. Or the new "High Vacuum" Riding Mower with the

optional Bag-N-Wagon that holds 30 bushels. All of them are designed to help you finish your lawn Snapper fast. So that you can spend more time doing what you want to do.

SNAPPER

McDonough Power Equipment, Inc., Dept. PM-71, McDonough, Georgia 30253. A Fuqua Industry. See your Yellow Pages or write for a free brochure. All Snapper mowers meet A.N.S.I. safety specifications.



Every Spring almost as soon as the days get a little warmer, you'll see the color coming back into your lawn and it will probably look nicer than it really is.

Your grass is now producing chlorophyll, which is where that color comes from. And this is when your soil needs all the help it can get — not just to make your grass greener, but to help thicken up your lawn with lots of new grass while the weather's fine for growing.

All this is hard work for a lawn.

How Turf Builder helps thicken your lawn with thousands of new grass plants.

Grass plants start new grasses growing around them by sending out tillers, rhizomes, or stolons which form new "branch" plants that send down roots of their own. It takes a lot of energy on your lawn's part and your soil alone just can't come up with enough nourishment to do the job right.

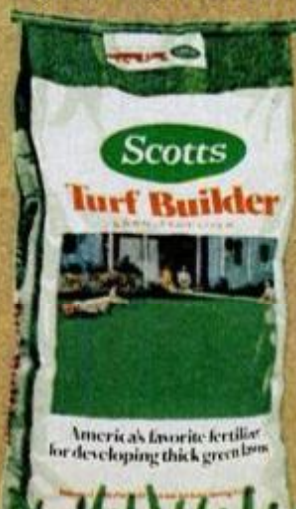
But about thirty minutes with your spreader and some Scotts® Turf Builder® will give your lawn the nourishment it

needs. In fact, one feeding will help grow thousands of new grass plants in a few weeks. We've done it ourselves on different grasses (from bermuda to St. Augustine to bluegrass) on our grass research farms around the country.

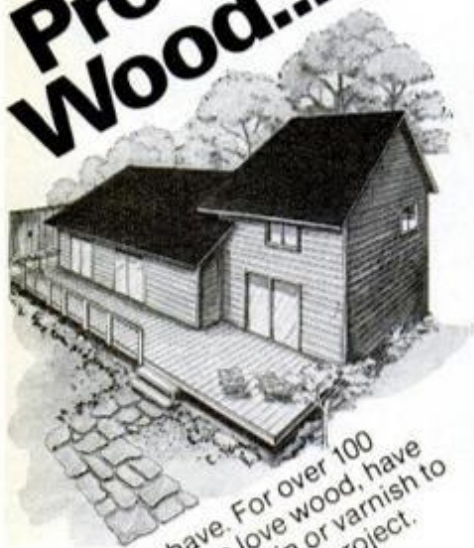
Turf Builder gives grass a prolonged feeding because it holds some of its nitrogen back for later. We worked out a kind of timing process that releases this food slowly, so that it will work on those thin spots for up to two months.

And you might also like to know that this same slow feeding action also keeps Turf Builder from burning your lawn. All you have to do is follow the directions on the label. In fact you could accidentally put on four times too much this Spring and it still won't burn.

We put out a quarterly booklet called Lawn Care® that's filled with tips for lawns. It's free and you can get it just by writing us here in Marysville, Ohio 43040. You don't need a street address. We're the Scotts people and everybody in town knows where we are.



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We always have. For over 100 years, people, who love wood, have found a McCloskey stain or varnish to inside or outside.

And maintaining the natural beauty and texture of wood outdoors is something McCloskey products do best. We have perfected the and stains that withstand the weathering effects of moisture, sun and temperature changes to give lasting protection to any exterior wood surface. All go on easily.

For a free booklet on wood finishing tips, write McCloskey Varnish Co., Dept. F, 7600 State Road, Philadelphia, PA. 19136.



McCloskey Stains & Varnishes

For the love of wood.

IT'S NEW NOW



On a bicycle built for . . . 35 to be exact

It took a total of 78 old bikes, 70 sprocket wheels and about 165 feet of chain to produce this king-size tricycle in Hadsund, Denmark. The massive frame of steel is about 20 feet long, and all 35 passengers do the pedaling to keep the monster moving. A Jutland mechanic, Tage Krogehave, put it together in his spare time.



Kite flies like a plane

Using principles of bird flight and aircraft design, an RAF squadron leader has produced a kite that flies like an airplane. Made of fabric on a wood frame, it can be used for hang gliding.



Portable artificial lung

Shoulderstrap device that can provide oxygen to damaged lungs is a new spinoff from the space program. The compact unit is highly portable and is the forerunner of an even more effective device with which developers hope to bypass lungs, delivering oxygen directly to the bloodstream.

Cruise control

Spring-loaded gas pedal damper needs double pressure to exceed 55 mph to keep you legal. Kit is \$8. Ohio Metrics, Box 22, Warren, Ohio 44482.



6 MONTHS FROM NOW... You can be the boss of your own locksmith shop!

We show you how...
furnish professional tools, too

**SEND CARD OR COUPON FOR FREE DETAILS
BY MAIL. NO SALESMAN WILL EVER CALL**

Train at home, using the professional tools of the trade, with the original, accredited LOCKSMITHING INSTITUTE. Be ready in as little as 6 months' time to take care of the demand in your community for professional locksmiths... a demand that is growing rapidly with the increased threats of domestic crime.

Earn while learning, too!

In just a few weeks, you have the know-how and the tools to make extra money changing locks, making keys, doing simple installations. And a few of these jobs each week can add up to several hundred dollars... for some students, even more than they've paid for the course.

Learn by doing

Locksmithing Institute's tested and proved method of home study makes it easy for you to learn... easy to do. Each lesson is fully illustrated and diagrammed and, as you follow the instructions, you work with the tools and materials that have been sent to you with the course. These are not just inexpensive gadgets, but real professional equipment... the tools, supplies, cylinders, tweezers, door handles, gauges, pins, springs, picks, extractors, wrenches, locks and keys... even an electric key machine... equipment that you will be using when you go into business with your own lock shop.

Cash in on the growing need for locksmiths

As an ethical school, we cannot guarantee employment or income for our students, but we do promise to help you develop skill in a profession for which there is a real need. The nationwide need for qualified locksmiths puts you in the driver's seat when it comes to a business that can really pay off for you. And, with your Locksmithing Institute Diploma as a skilled Master Locksmith, you'll be all set to go.

Widespread demand

You'll find locksmithing work to do all around you... in homes, offices, stores, factories, apartment buildings, hotels, hospitals, schools, public buildings, laundromats, vending machines... just about any place you look where a lock and key are used. Automobiles, new construction sites, banks, government locations... all need and use locksmithing services, and pay well for your work.

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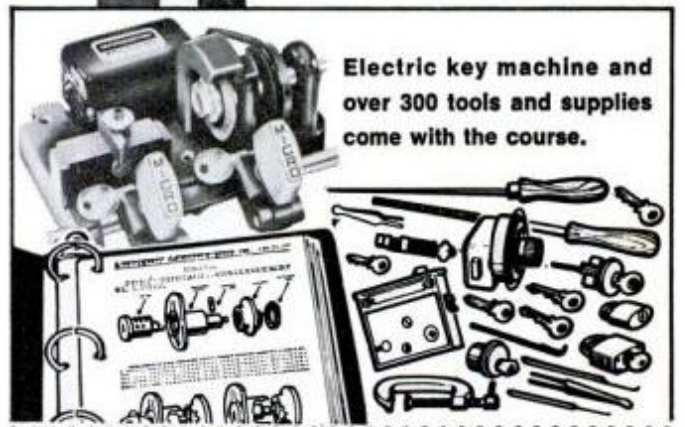
"Highly recommend the course to anyone interested in locksmithing. I've set up a mobile locksmith shop I work out of for spare time earnings. Earned extra money while training."

Jack W. Gray, Mantua, N.J.



"Was able to start my own locksmith service and earned almost \$500 before I'd actually completed the course. Now earn on an average of \$70 a week in my spare time."

Richard Kennedy, Philadelphia, Pa.



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PLEASE RUSH BY MAIL all facts and your FREE booklet, "Your Opportunities in Locksmithing." I am under no obligation, and no salesman will call.

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Convert to a cruiser with canvas

Put a top and curtains on any boat, and you've added a cabin—the best season stretcher around.

by Jim Martenhoff

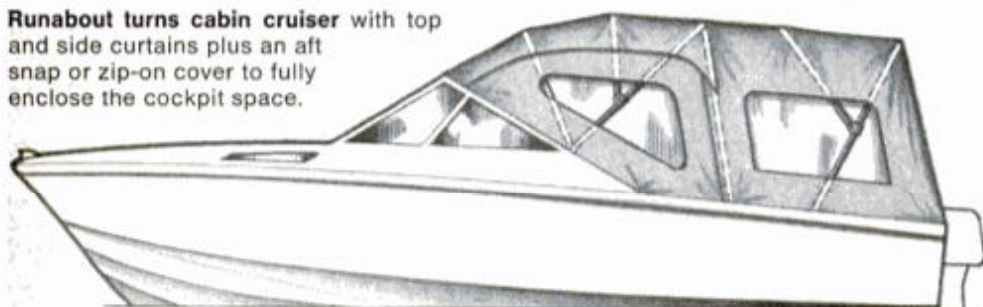
Check any waterfront lineup and you'll find a fine variety of ways to stay out of the sun and rain. Not every boat is suitable for adding a sail, but any craft can use canvas to become a convertible and change an open cockpit into a shelter. Even a sailing surfboard skipper can drape a sail over the boom and create a tent of sorts for overnighting on a beach.

You'll see runabouts with fold-back tops, sun shelters above flying bridges, covers on open skiffs and sailboat cockpits, pop-tops, Bimini Tops and Navy tops. The trade refers to all this as "canvas," even though the material may be vinyl, plain or cloth-backed, a canvas-like synthetic such as Acrilan, or even—and it is still useful—genuine canvas duck. Buy a new boat and you'll be offered a list of "canvas" options.

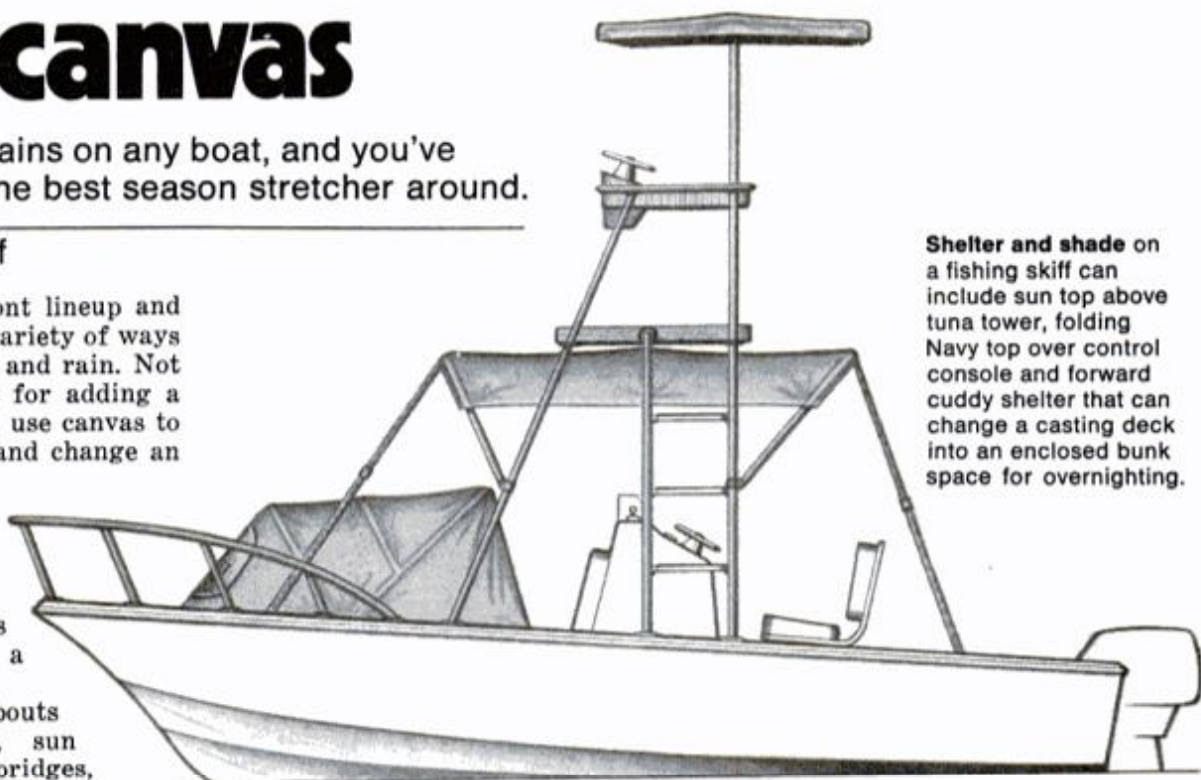
Individual tops may seem to vary greatly in style and design, but essentially they boil down to a basic pair. There's the convertible top that fastens to a windshield and is loosely known as a "Navy" top, though it has no official standing. And there are the tops that rest on their own framing and have come to be called "Bimini Tops," actually a copyrighted term originated by Ben LaPointe of American Marine Coverings, Miami.

When Ben added marine cover designs to his awning business in the

Runabout turns cabin cruiser with top and side curtains plus an aft snap or zip-on cover to fully enclose the cockpit space.



Runabout cruiser-camper



Offshore fishing skiff

Shelter and shade on a fishing skiff can include sun top above tuna tower, folding Navy top over control console and forward cuddy shelter that can change a casting deck into an enclosed bunk space for overnighting.

early 1950s, he borrowed the name of a nearby island in the Bahamas that was favored by cruising fishermen. But in time Ben's name for his boat coverings acquired a definition as a freestanding top that does not attach to a windshield, such as a flybridge top.

While studying snap-on improvements that can update your boat, consider the camper cover. This is canvas that fastens usually to your convertible top to completely enclose the cockpit and is sometimes braced to allow standing headroom. A few snaps and zips and it can convert a runabout into a cozy cabin cruiser. Real canvas is a sensible choice here since it "breathes." Ordinary vinyl with no cloth backing underneath may sweat during the night and drip condensation onto berths and a sleeper's face.

PM art: Walken Graphics

Despite the synthetics available today, canvas can still be useful but, though cheaper, it is less durable. A better alternative is cloth-backed vinyl or Acrilan, an amazing synthetic that wears like iron and, when colored, does not fade easily.

You'll see smart fishermen put on a "mooring" cover before leaving a boat tied up for the night. A small open craft that is not self-bailing can swamp overnight during a hard rain. The water runs aft to accumulate at the heavier stern. If the boat is an outboard, it may go down far enough for water outside to flow in over the motor cutout in the transom.

It's curtains for spray and rain

Other excellent protective coverings are available, too. Side curtains can keep out slanting spray and rain. Cockpit awnings provide shade aboard moored cruisers and sailboats. And you may see a "windsail" on a sailboat at anchor, although powerboats can use them, too. It's a canvas funnel that fits over the bow hatch and can direct a healthy breeze below on a warm night.

On craft with guard rails you may see "dodgers," a term that means spray dodger. It is laced to the life lines and, in theory, you can dodge behind it to avoid spray. It does, at least, lend a distinctive

(Please turn to page 37)



PEOPLE WHO KNOW OMC STERN DRIVE KNOW THE DIFFERENCE.

They know that OMC Stern Drive's Tru-Course™ Steering* and 90° turning give a boat the maneuverability needed in crowded harbors and tight slips.

They know that trailering, launching and beaching are easier with OMC Stern Drive's 75° Hi-Tilt™.

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Drive's Uni-Mount™ is designed for low levels of noise and vibration. They also know that SelecTrim™* "fine-tunes" the ride.

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*Other options available.



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GRAB YOURSELF A MOUNTAIN IN A NEW FOUR- WHEELIN' FORD.

The new Four-Wheelin' Fords are so tough they can tackle just about any mountain.

And this year, only Ford offers you this combination of important features:

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

And now Ford introduces the new F-250, with loads of features like an all-new frame, integral power steering, new easier entrance height and more transfer case clearance than before.

Take a look at all the Ford Four-Wheelers. Then go grab yourself a mountain.



New F-250. It's been redesigned to be tough all over—and under. Here it's shown with owner-added roll bar, brush guard and fog lamps.

**Built
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Tough**



Heavy-duty half-ton. Ford's F-150 Styleside works hard all week, plays hard all weekend. And now you can order it with your choice of Ford's optional bed covers.

Ford's Shorty. Our Four-Wheelin' F-150 Flareside is made to get good looks wherever it goes. It's shown here with owner-added roll bar, fog lamps and brush guard.

FORD

FORD DIVISION



Starcraft Introduces The Travel Stars

The quality you expect from Starcraft for \$1,000 less than you'd expect to pay

Our newest travel trailers are built with the quality that you expect from Starcraft—but the price is up to \$1,000 less than you might expect to pay.

Our new 25-foot Travel Star sells for under \$5,000* Our 21 for less than \$4,500.*

How do we do it? Not by cutting back on the essentials. We refuse to cut corners on the things that make our trailers strong—and that help to keep you safe.

Strong on the essentials.

Take our trailer chassis. No skimping here. It's a solid grid of four-inch steel box girders. Most other builders make do with less. But at Starcraft we know a chassis has to stand up to rugged use.

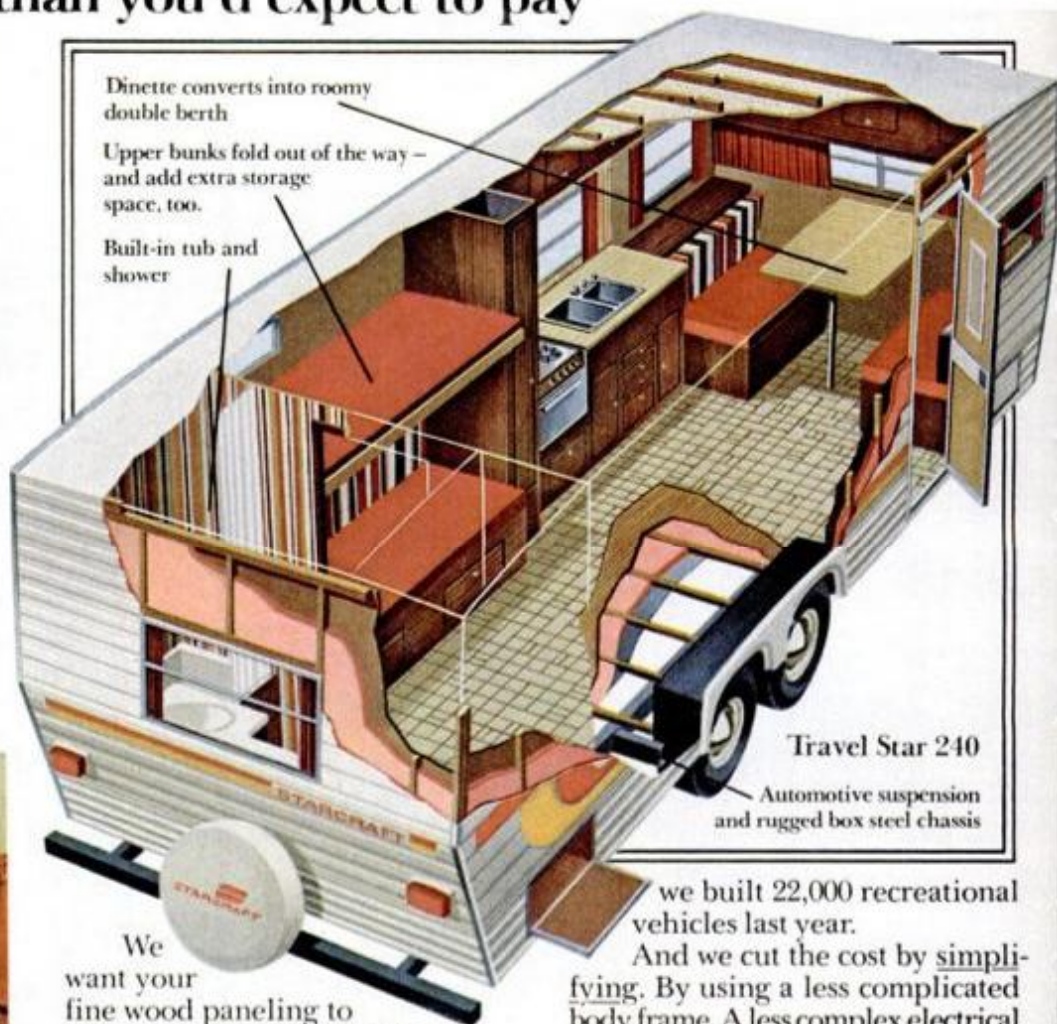


Fully equipped kitchen

We won't skimp on important little things either. Because we know they can be vital for your comfort.

Every Travel Star has a handy built-in clothes hamper.

Every kitchen drawer rides on a nylon roller.



We want your fine wood paneling to last—so we specify a thicker grade than other builders use.

On every Travel Star you'll find a big gas/electric refrigerator. A four-burner stove with oven. A heater. Pressure water. A full bath with a tub and shower.

So how do we save you money? For one thing, we buy in volume—

we built 22,000 recreational vehicles last year.

And we cut the cost by simplifying. By using a less complicated body frame. A less complex electrical system. Simpler switches and plumbing fixtures. They're not things you will notice—even after years of use—but they help us save you money.

Your choice of thirteen different travel trailers

There are five economical Travel Stars for you to choose from. And that is only part of Starcraft's travel trailer line. You can also take your pick of our eight luxurious Wander Star Models.

But whether you buy for economy or luxury, there's one thing you should remember: At Starcraft the first consideration is always quality.

*Subject to local dealer freight & handling charges.

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The Travel Star 240's sturdy suspension lets you take it practically anywhere.

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100 North 17 & 92
Casselbury, FL (834-8244)
The Outing Center
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Lantana, FL (582-4477)
Wooten Trailer Sales
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Fruitland Park, FL (787-4655)

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H & K Camper Sales, R.R. 2
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1108 E. Central
Wichita, KS (265-7807)
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Leavenworth, KS (682-2255)
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Liberal, KS (624-2323)

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Etowah, NC (891-7515)
Craig Lawing Enterprises, Inc.
5521 Belhaven Blvd.
Charlotte, NC (399-6372)
Bannister Enterprises
DBA Motor Mart, Hwy. 70
East P.O. Box 385
Garner, NC (772-4276)
American Camping &
Travel Trailer Ctr., Inc.
R.R. 5, Box 689
Gastonia, NC (824-9597)

OKLAHOMA

Bean's Travel Trailer Sales
10880 East 11th
Tulsa, OK (437-7480)

TEXAS

Starcraft Travel Trailers of
Dallas, 10330 Harry Hines
Dallas, TX (350-2662)
Outdoor Travel Unlimited
8937 Gulf Freeway
Houston, TX (941-4306)

VIRGINIA

Brookville Camper Sales
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Lynchburg, VA (239-1086)
Mt. Ford Sales, Inc.
P.O. Box 160
Clintwood, VA (929-4619)

CANVAS CRUISERS

(Continued from page 32)

look to both sail and powerboats.

And last, but not least, don't be surprised if you spot a big umbrella mounted on a boat. A common beach umbrella. It may look ridiculous, but it is eminently practical: It is cheap, handy, available anywhere, stows easily, sets up quickly with the shaft slipped through pipe straps mounted on a bulkhead, and can offer a pleasant spot of shade.

Custom canvas

If you are buying a new boat, you can usually order the factory options at the same time. Most people do, and these covers are perfectly satisfactory if you don't need individual designs to suit your personal needs. But if you want to add canvas later on, consider having it made to order. While you could do the work your-



Bimini Top over the flying bridge and a plastic windshield give sun and spray protection; canvas below encloses cabin.

self, you'd need some skill in patternmaking and a special sewing machine that can easily handle heavy-duty material. Sewing by hand is possible with a sailmaker's palm and needles, but could be very time-consuming.

You'll pay a little extra for local custom-made tops and curtains, but not all that much more than factory canvas. Your waterfront man doesn't have to add on middleman and dealer profits. From him you can get custom-fitted creations to match any far-out fantasy, and the chance to have any necessary alterations made right on the spot.

Where do you go? Try to find a marine covering specialist first. If you own a trailer boat, you may be within easy driving distance of an expert shop. You may also find good workmanship at a local camping-gear and tent-repair shop. Lately, even automobile convertible shops are getting into the marine covering business since the passing of the Detroit-made ragtop. Some sailmakers can handle such chores and, finally, mail-order catalogs and marine discount houses offer ready-to-fit coverings a handyman can install himself.

Strong framing important

One word of advice, however: Try to find a marine specialist first. Many smaller shops do not have complex bending equipment to produce heavy-duty metal frames. This expensive and sophisticated gear can cost a shop owner \$20,000. The smaller shops can't cope with complicated bending assignments.

The framing is important and is the one point slighted by canvas buyers who want to shave a few dollars from the costs. A runabout top may have been priced \$50 back in the 1950s. Today it can run \$400 because boat speeds have gone higher and it takes a sturdy frame to stand up to mile-a-minute winds. A marine shop is also better-equipped to install tracks and similar items which allow you to fold a top down and then slide it forward or aft so it stows in a boot neatly and out of the way. Bolting fittings to a fiberglass deck requires special care.

Installation, maintenance

Modern fiberglass boats require little maintenance, but the canvas work on them can create problems. Even factory installations can be faulty. Leakage is a common problem where the top of the windshield joins with a Navy top. Often there are large gaps between the snaps that aren't obvious but will allow a Niagara of water to flow up over the windshield, through the gaps and into your lap. A convertible top must have a tightly fitting overlap, one reason a custom-made model can be worth extra expense; too many factory option tops leak like sieves.

Less often, leaks may occur along the side curtains because of inadequate "underlap" and too few snaps. Look for tops with a deep drop on the side to cover the seam.

Sweating, as mentioned before, is especially likely under vinyl covers. Cloth-backed vinyl will be damp but won't drip. Canvas, as noted, will not normally sweat. Ordinary house-

(Please turn to page 38)

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CANVAS CRUISERS

(Continued from page 37)

hold cleaners or soap are usually satisfactory for cleaning a top, but don't use detergent, especially on canvas where it can destroy the waterproofing. Household bleaches also should not be used to fight the common problem of mildew. An old standby, instead, is plain lemon juice and salt. And every time you think of it, apply a dab of petroleum jelly to the glove snaps. The stud is not as important as the cap part with its tiny spring that can corrode or freeze up. Use zipper lubricant as well.

When unsnapping canvas, try to work the snap straight up, rather than prying at an angle—that might rip the material. But snaps shouldn't stick and freeze if you keep them properly lubricated.

Good marine coverings that pro-



Even sailors like some shelter, and a sailboat can add an extra cabin by mounting top and curtains over cockpit.

common flies and mosquitoes, but the mesh is far too large to stop that plague of boatmen, the tiny biter. It will be the gnat, or no-see-um, or sandfly, depending on where you are, and it can ruin a cruise. Some larger craft have airconditioners installed just to lock out bugs.

Fine netting vital

You need a very tiny mesh, something like a Bobbinette—which campers use on tents. If your boating region is afflicted with the tiny type of bug, make certain you have this type of screening. It is the only thing that will stop them.

The best way to screen a boat is with Velcro, that fancy tape with the multitude of tiny hooks. You cut a paper pattern to fit the door or hatch, cut the fine-mesh screening to match, sew Velcro around the edges and then glue down the mating Velcro tape around the opening. It takes but a few hours to make up a screen yourself from a kit or the raw materials. It is not especially complex; if you lack a sewing machine at home that can handle fairly heavy work, take your pinned assembly to a canvas shop—a tent and top repair place can handle it. For a dollar or two they'll sew it together on a heavy machine. You'll find Velcro screening kits offered in marine stores and through mail-order outlets. Just make sure the mosquito-netting mesh is small enough.

A hull too small to mount much canvas can still be rolled over ashore at night to support a lean-to shelter tent. With a pontoon boat, a regular tent can be pitched right on the deck. And for fishing skiffs, runabouts and anything larger, a top, side curtains and screening can turn your boat into a season-stretching camping cruiser. While other craft stay tied up or ashore on a trailer during chill weather or blazing sultry days, your shaded and sheltered boat can be enlarging the definition of good boating weather. ★★★



Pitch a high-topped cover over a fishing craft and it may look ungainly but offers a standing-headroom small-boat cabin.

vide protection from burning sun, waves, spray and driving rain are not just sheltering you. They will also protect your boat, and it is conceivable that the price you pay for good canvas is returned to you in a higher trade-in or resale value.

Bug ban

But protection from the elements is not enough, especially in some warmer climates. During hot summers you may need protection from insects when you moor overnight.

Factory options or even standard equipment may include some screening over cuddy hatch forward. But rarely do you find screening for companionway doors which may be louvered for ventilation and therefore open to every flying creature small enough to enter.

The same specialist who produces your canvas tops, however, can make up bug screens as well, and you may want to replace the factory screen over the bow hatch while you're at it. Standard screening will keep out

Build a drafting table that folds for easy storage

A unique pyramid design solidly supports the adjustable tabletop.

by Lane C. Sander

Folding tables are inherently unstable—but not this one! Its base incorporates a pyramid form, a very strong construction as Egypt's 4600-year-old monuments attest.

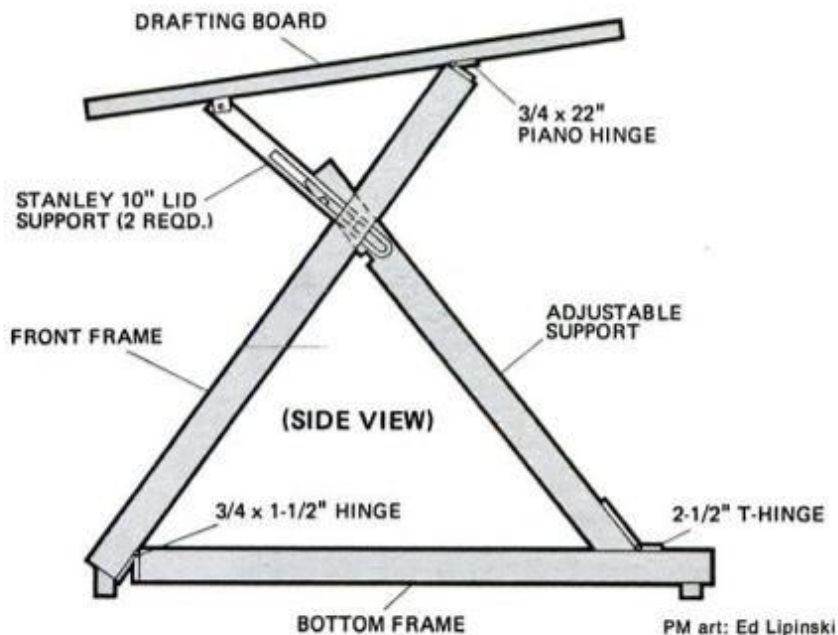
The drafting table won't rock or wiggle since it rests on three legs and has a lattice framework. And it's strong—the frame alone easily supports 175 lbs.

The top of the 2x3-ft. table is adjustable in height and angle, making it an ideal work surface for hobbyists. Though it's primarily intended for drafting and drawing, you'll find lots of other uses for the table.

When not in use it can be neatly folded and stored, occupying only slightly more space than a collapsible card table. But unlike card tables, this one has no tendency to collapse of its own accord.

You can build it in a few hours using 2x2s and a commercial drawing board; materials cost about \$30. In the prototype, I laminated two 3/4-in. clear fir boards together instead of using 2x2s. This is unnecessary if you can find good-quality 2x2s (which actually measure 1 1/2 x 1 1/2 in.).

Hardwood lumber-core plywood can be substituted for an art store's drafting board, but avoid fir plywood—its wild grain is too bumpy and fir plywood can warp very easily. But to prevent indentations that may occur in the veneer surface, cover plywood with Borco; available



PM art: Ed Lipinski



Connect the 2x3-ft. drafting board to the front frame with a 3/4x22-in. piano hinge. Position the lid supports so that the drafting board lies flat when the brackets are extended. When table is folded up, the corner of the bottom frame should be flush with the crosspiece of the front frame. If it isn't, remove the hinges from the bottom frame and trim until it is flush. Fold and mark frames for a friction catch.

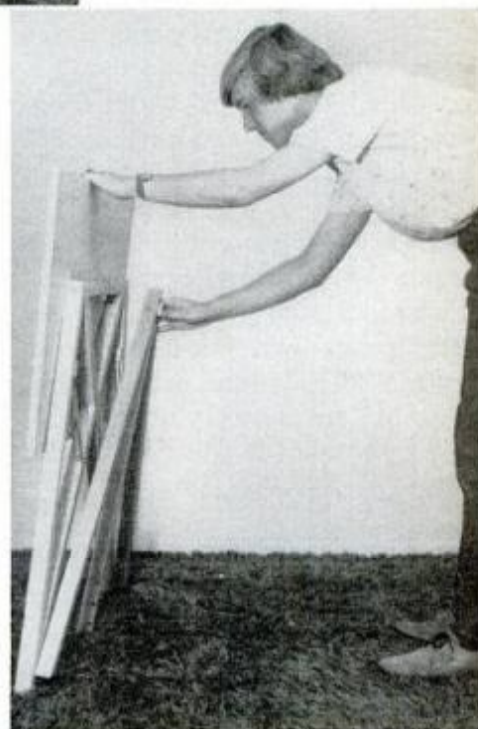
at many of your local art stores.

Begin with the front frame by cutting two 2x2s to 44 1/2 in. Measure off 14 1/2 in. and mark the center of each board. Drive a brad through one board and into the other, being sure to keep the marks aligned. Using the brad as a pivot, spread the 2x2s until the bottoms of the long ends are 40 in. apart. With the 2x2s in this position mark and cut the lap joint.

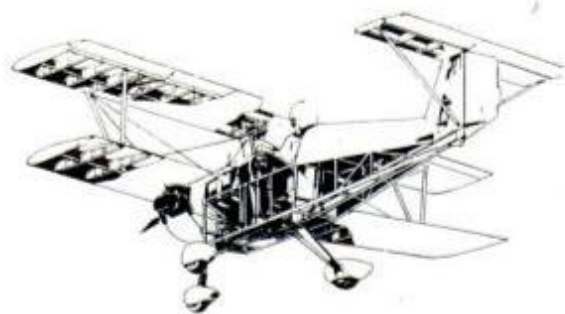
Next, cut the top cross-piece and attach it to the two legs with glue and dowels or screws.

Drill and counterbore holes in the legs for a 5/16 x 8-in. stove bolt, making sure that it's about 3 1/2 in. above the center of the lap joint, then attach the bolt. Complete the frame by cutting and attaching two small blocks with glue and 1/4 x 2-in. hanger bolts. Attach the bottom

(Please turn to page 42)

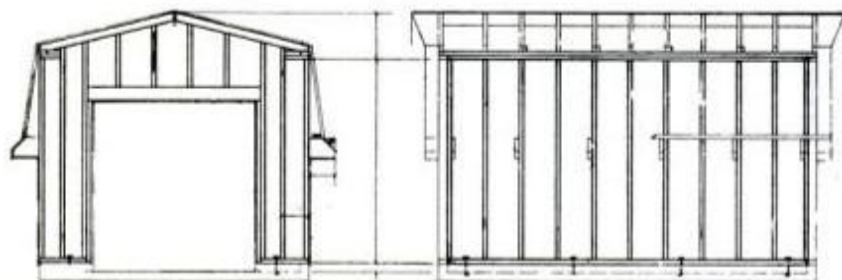
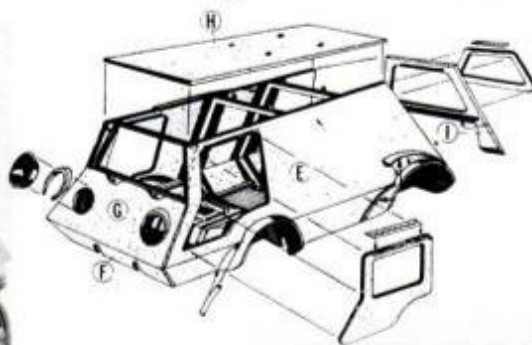


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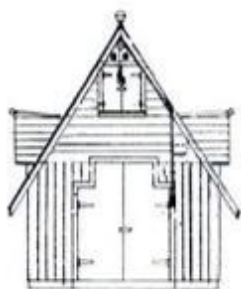
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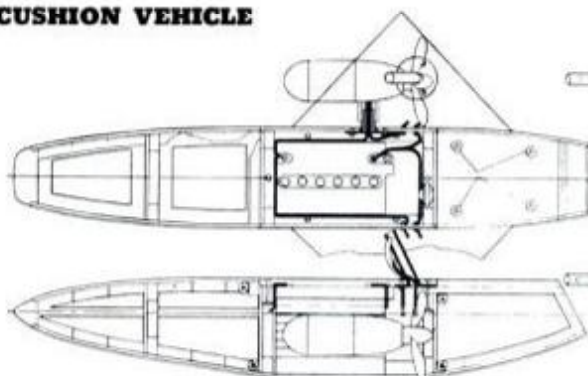
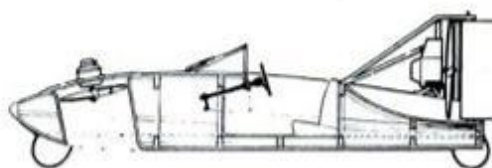
AND UNDER THE SEA



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doors in the back lead to a special tool-storage room walled off from the playrooms. You can hang a lot of garden tools inside and still provide plenty of play space. An extra set of plans is included for a building permit. **\$5.49**

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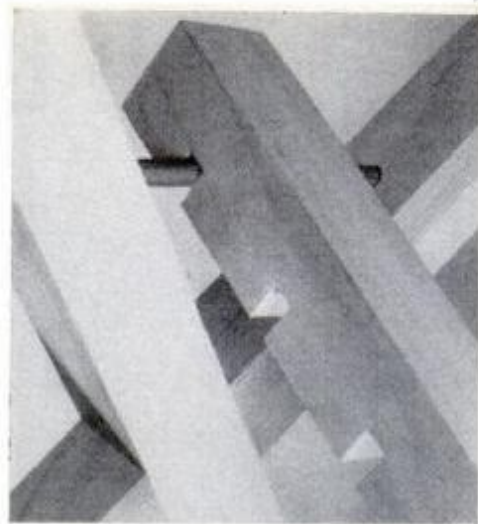
DRAFTING TABLE

(Continued from page 39)

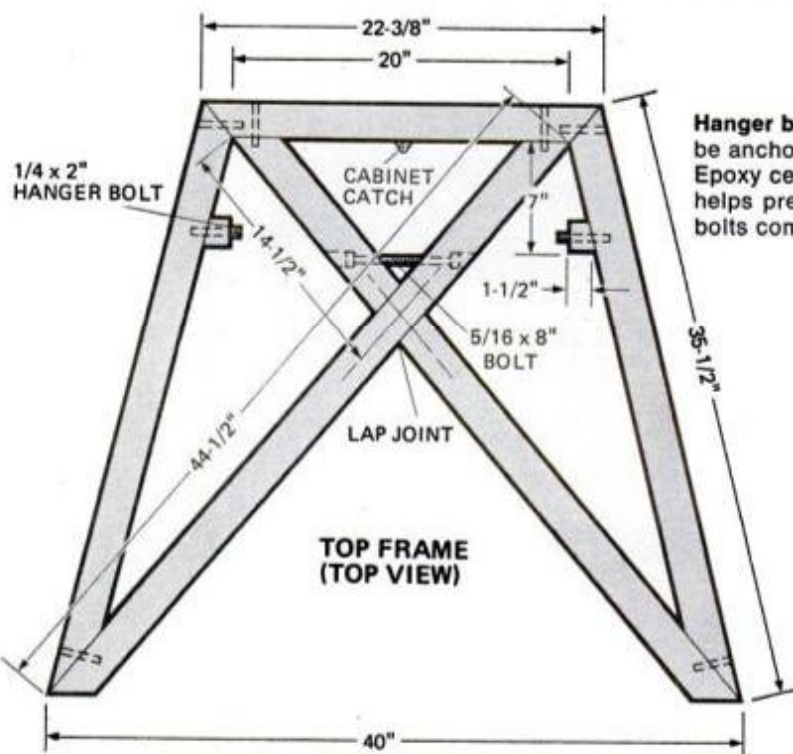
frame to the front frame with two $\frac{3}{4}$ x $1\frac{1}{2}$ -in. hinges.

The drafting board should be about 24 x 36 in. Connect it to the front frame with a $\frac{3}{4}$ x 22-in. piano hinge. Two Stanley 10-in. lid supports (your hardware store can order them if they are not available in stock) and wingnuts hold the tabletop in position.

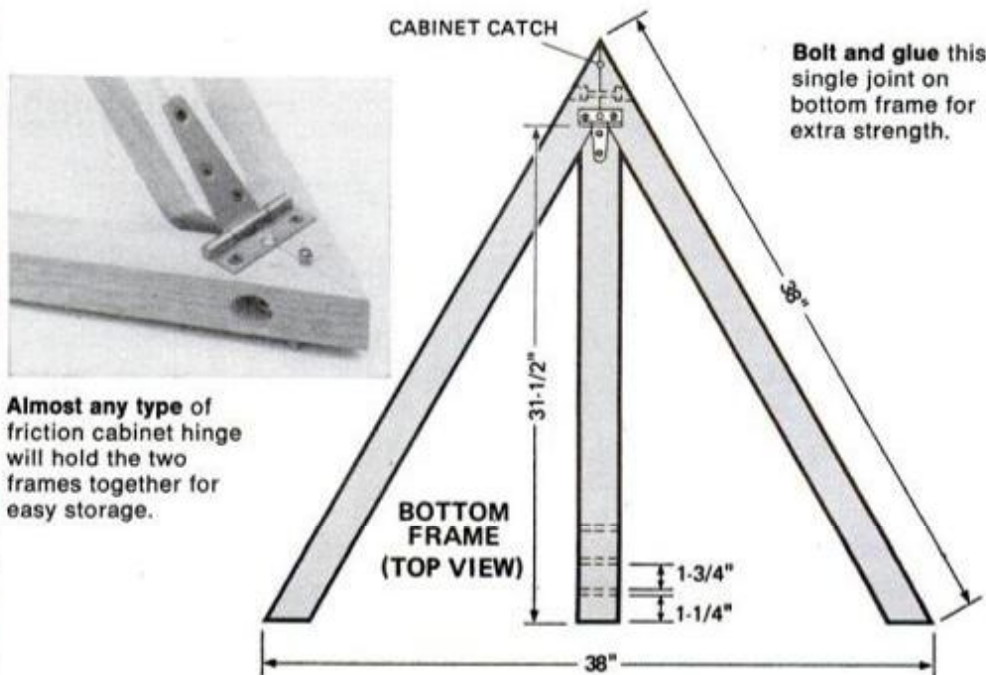
Now, attach the legs—small blocks of wood capped with nonskid furniture glides. You can finish the base with polyurethane varnish, but don't varnish the drafting board itself or you may pebble the surface. ★★★



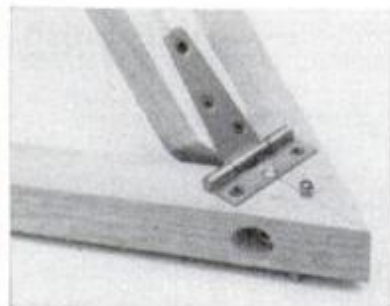
Notch $\frac{1}{2}$ -in deep and just wide enough so stove bolt slips easily.



Hanger bolts should be anchored securely. Epoxy cement helps prevent bolts coming loose.



Bolt and glue this single joint on bottom frame for extra strength.



Almost any type of friction cabinet hinge will hold the two frames together for easy storage.

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FIRSTHAND REPORT

by Michael Lamm
WEST COAST EDITOR



Diplomat and LeBaron both come in two body styles: 4-door sedan (Diplomat above) and 2-door coupe.

Going one step further, Chrysler adds two luxury compacts in its already successful Volare-Aspen size class.

Chrysler has taken their Aspen/Volare F body and turned it into what they call their M body. The new M-bodied cars—the Chrysler LeBaron and Dodge Diplomat—become luxury extensions of the F-bodied sedan, with a new coupe added that borrows the F sedan's chassis platform.

The sedans

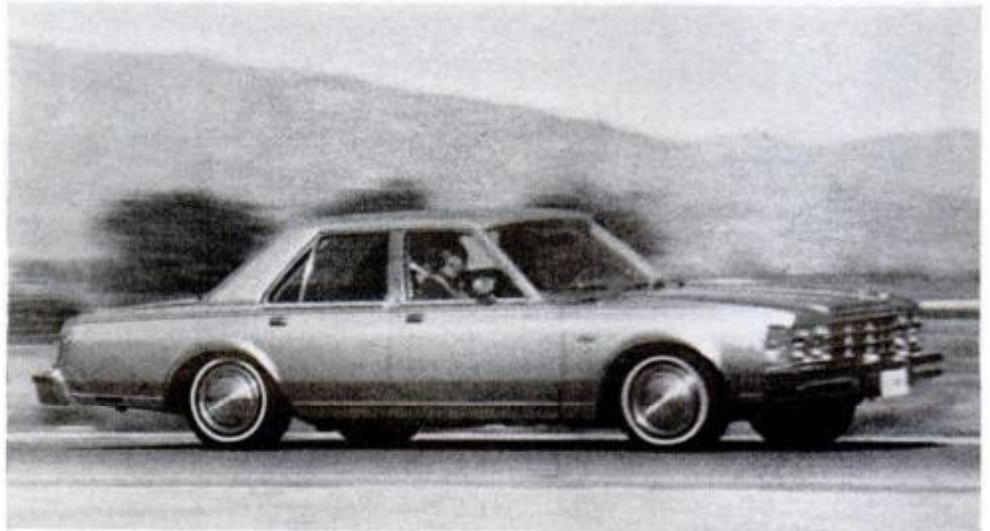
All LeBarons and Diplomats use the F sedan's wheelbase: 112.7 inches. Stampings brought over from F to M sedans include roofs, doors, front fenders and rear quarter panels. On M sedans, the rear quarters are cut off, then a longer

LeBaron Medallion coupe at right is fitted with optional Landau roof.

At the wheel of the Diplomat (below), you're aware of greater body insulation and suspension isolation than with lower-priced Dodge Aspen and Plymouth Volare.



Driving the Dodge Diplomat and Chrysler LeBaron



LeBaron Medallion sedan is 206.1 inches overall, on a wheel base of 112.7 inches. Standard engine for both LeBaron and Diplomat is Chrysler's 318 cu.-in V-8.

end cap is added, with different taillights. The longer end cap gives 4.6 inches more overall length. Rear bumpers are the same for F and M cars (except for backup lamps).

Up front, of course, new grilles and facial expressions distinguish the new LeBarons and Diplomats. Hoods, decklids and lower deck panels are

also entirely different from one another, and further distinguish the two cars which should please dealers.

The M coupes are almost totally unique. The only items they share with the F body—aside from the basic unitized sedan platform—are their doors, front fenders and rear

(Please turn to page 46)





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DRIVING DIPLOMAT AND LeBARON

(Continued from page 44)

bumpers. The M coupe, by the way, actually has more seating space inside than the M and F sedans (and the F coupe, on a 108.5-inch wheelbase, has much less rear legroom than any other M or F car).

In many ways, the LeBaron and Diplomat Medallion coupes qualify as slightly shorter editions of the Chrysler Cordoba and Dodge Charger.

The engines

Engines and running gear are again shared in all LeBarons, Diplomats, Aspens and Volares. The newer cars come with Chrysler's time-tested, two-barrel, 318-c.i.d. V8 and three-speed Torqueflite automatic. Whether the LeBaron and Diplomat will get the Aspen/Volare four-speed manual overdrive gearbox and 360-c.i.d. optional V8 remains to be seen, but the 318 does have Chrysler's Lean Burn emissions system.

The suspension

The new M bodies' suspensions are the same as the F body's, namely transverse torsion bars up front and leaf springs in the rear. All bodies are unitized, with isolated front-suspension subassemblies.

If you're wondering exactly why Chrysler decided to create these new M-bodied cars, the answer is simple. They want a more luxurious contender in the broad price range that spans such rivals as the Cutlass S, Granada Ghia, Thunderbird, top-line Skylarks, Chevelles and so forth. Even buyers eyeing Seviles and Versailles can comfortably settle for the Chrysler LeBaron Medallion at many thousands of dollars less and yet



Trunk space with space-saver tire is 16.3 cu. ft. for the coupes and 16.6 cu. ft. for the four-door sedans.



Interiors are available with a wide range of seats and coverings: 60/40 split bench (above) is standard on Medallions.

drive away happy. It's that sort of car.

Driving them

We drove the Diplomat and LeBaron and found both very quiet, smooth, comfortable automobiles. They show considerably greater body insulation and suspension isolation than the Aspen and Volare, although basically they're all the same.

On paved surfaces, you feel almost no road irregularities at all. You'd swear you're in a full-sized car, and in the Medallion series the added insulation gives the feeling of a full-sized luxury car. I took the Diplomat over some unpaved stretches, too, and found that while the ride became fairly jiggly, the suspension doesn't allow wheel hop, so the car stayed under easy control. I'd rather have that slight harshness than tires that float up in the air more than they're on the ground.

In hard cornering, the M body rolls very little, and even that comes on gradually instead of in sudden snaps as in some larger Chrysler cars.

Straight-line performance is ade-

quate, but the LeBaron and Diplomat aren't meant to be rocket sleds. Fuel economy with the 2.76 axle ought to be good.

Creature comforts

Power steering, power disc brakes and automatic come as standard equipment, as do a dozen unexpected bonuses like electric rear-window defroster, reading lamps in the windshield header of coupes, carpeted trunk, semi-padded coupe roof, and rear-seat center armrest. The top-line Medallion series in both the LeBaron and Diplomat include about 110 pounds of additional insulation, 60/40 recliner front seats, more luxurious upholstery and trim, plus distinctive exterior touches. And the Diplomat/LeBaron option list includes nearly every accessory known to Detroit.

The 1976 Aspen and Volare came as replacements for Chrysler's count-on-me compacts, the Dart and Valiant. And the Diplomat and LeBaron become the corporation's luxury compacts for owners who want more style and prestige. ★★★

Specifications—1977½ Chrysler LeBaron and Dodge Diplomat

Dimensions and capacities:

	SEDANS	COUPES
Wheelbase	112.7 in.	112.7 in.
Overall length	206.1 in.	204.0 in.
Overall width	72.8 in.	73.5 in.
Overall height	55.3 in.	53.3 in.
Track, front	60.0 in.	60.0 in.
Track, rear	58.5 in.	58.5 in.
Trunk capacity	16.6 cu. ft.	16.3 cu. ft.
Gas-tank capacity	19.5 gal.	19.5 gal.
Weight, approx.	3600 lbs.	3575 lbs.

Engine:

Type	Ohv V8, cast-iron block and heads, water-cooled, 5 mains.
Bore and stroke	3.91 x 3.31 in.
Displacement	318 cu. in.

Bhp @ rpm	145 @ 4000
Torque @rpm	245 @ 1600
Compression ratio	8.5:1
Emission controls	Air injection, exhaust gas recirculation, electronic leanburn, catalytic converter.

Type of fuel required. Unleaded regular.

Drive train:

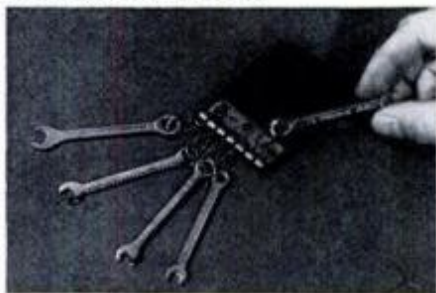
Transmission	Automatic torque converter with planetary gears (Torqueflite 3-speed).
Transmission ratios	2.45:1, 1.45:1, 1.00:1, 2.22:1.
Standard axle ratio	2.76:1.
Tire size	FR78-15, Load Range B

Suspension, steering, brakes:

Front suspension	Independent, unequal A-arms with transverse torsion bars, tubular shocks, link stabilizer.
Rear suspension	Hotchkiss drive, longitudinal semielliptic leaf springs, tubular shocks, link stabilizer.
Steering	Integral power steering, recirculating ball type, 18.7:1 overall ratio, turn circle 40.7 ft.
Brakes	4-wheel hydraulic, power assist, front discs, rear drums, 355.24 sq. in. total swept area.

HINTS FROM READERS

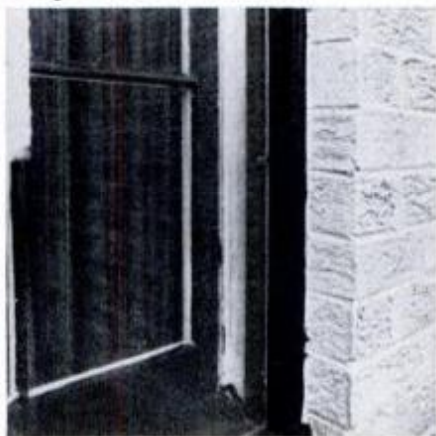
Mini wrench holder



The insert from an old key case makes a good holder for several small automotive wrenches. For convenience, keep it stored in the glove compartment.

—Ken Patterson

Acrylic storm windows



Make your own storm window by cutting a 1/4-in. sheet of clear acrylic plastic to fit the window. Drill three holes in each side and fasten the panel to the rabbets in the window frame with brass screws.—Mathieu Manning

Rain gutter extender



Prevent erosion by extending downspouts with an old motorcycle innertube. Cut the tube to slip it on spout.—H. C. Ward



March 26, 3:00 P.M.



March 26, 3:20 P.M.

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Power Front Disc Brakes	No charge
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Remote Control Mirror	14
Color-keyed Belts	18

TOTAL \$5,434

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FORD DIVISION



CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Synthetic oil symposium

Car Clinic has received many letters recently about synthetic motor oil and whether claims about extended oil-change intervals can be taken literally. A recent advisory from Chrysler Corp. sums up quite nicely, I believe, the present position of all U.S. carmakers:

"The term 'synthetic' has not been well defined at this time, and is being used to encompass a wide variety of lubricants with greatly differing characteristics. We are aware of the advertising claims regarding extended oil drain intervals, and in some instances implied elimination of oil drains through use of these products. Chrysler is currently conducting laboratory and vehicle tests making use of synthetic oil. There is insufficient information developed at this time to provide you with a policy relative to the oil manufacturers' and marketers' claims.

"Our present position regarding the use of synthetic engine oils, therefore, is the same as for petroleum oil products. Only oils which meet the API requirements 'For Service SE' quality are recommended . . . Engine oil and filter should be changed at the recommended mileage or time intervals outlined in the Required Maintenance and Emission Control booklet furnished with the Operators Manual in each vehicle."

Oversize and overactive

What effect on a car's speedometer would the installing of oversize tires have?—Ethel Murray, Worcester, Mass.

If tires having outside diameters in excess of standard tires are installed, the speedometer variance is equally relative in percentages. For example, if a tire's outside diameter is 10 percent greater than a standard-size tire, the speedometer will read 10 percent less than the correct, or actual, speed. A car with 10 percent oversize tires whose

speedometer reads 40 mph will actually be going 44 mph.

Take a specific example. A Firestone steel-belted radial 500 GR 78-15 tire has an outside diameter of 27.32 inches. If a car's four GR 78-15 tires are changed for oversize tires measuring 32.50 inches outside diameter, the increase in the outside diameter is 5.18 inches, which is 19 percent greater. The speedometer will therefore be off 19 percent. When it reads 55 mph, say, the car will actually be traveling at a speed of 65.5 mph.

Pinging Pinto

My 1976 Ford Pinto with a 2.3-liter, four-cylinder engine has had a bad ping almost from day one. I've had it back to the dealer on several occasions, but no one has been able to correct the problem. The dealer has adjusted and readjusted the timing and replaced the thermostat control in the air cleaner as the company recommended in service bulletin 119. Any suggestions would be appreciated.—Jay A. Lundell, Staten Island, N.Y.

Your engine probably has a back-pressure transducer connected to an adapter between the EGR valve and intake manifold. The transducer modulates EGR flow by varying the EGR valve vacuum signal according to exhaust back pressure. When a bad pinging problem doesn't respond to "normal" solutions, the back-pressure transducer should be considered. It may be leaking or not working. The probe (tube) attached to the exhaust manifold and the transducer housing assembly should be inspected for a broken connection and a vacuum leak. If there is a broken connection or a leak, replace the transducer and adapter assembly.

Rotary replacement

After 93,000 miles, my 1972 Mazda RX2 rotary engine has given up the ghost. The engine overheated and ruptured a side seal, allowing wa-

ter to enter the front rotor. A Mazda dealer tells me that a complete overhaul is required to the tune of \$1200. I hesitate to spend this much money on a car having limited resale value, so I'm considering picking up a piston engine with manual transmission from a wrecking outfit. Will my idea work?—Don Seaton, Oookala, Hawaii

You can make anything work, Don, but you are asking for more headaches than you now have. Axle ratios are going to be a problem as will linkages and motor-mount adaptation. In other words, you will be able to find an engine and transmission that will adapt to the Mazda. However, once you have made the modification a satisfactory performance will be questionable.

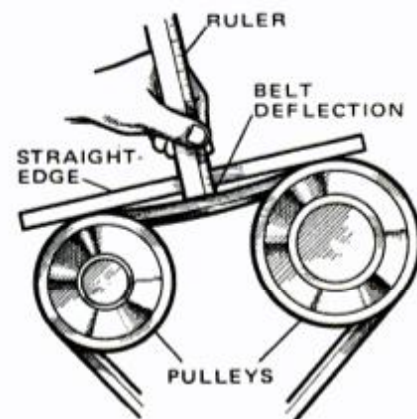
I think a better bet is to contact the Mazda distributor in Honolulu. He may agree to make an adjust-

(Please turn to page 50)

Are belts adjusted accurately?



Every car owner that's worth his salt (mechanically speaking, that is), knows an accurate drive-belt tension is important. Accurate drive-belt tension helps assure that vital components (water pump, alternator and others) are operating efficiently; it also lessens drive-belt noise and maximizes drive-belt life. But how can you determine if belts are adjusted accurately if you don't have a belt-tension gauge, which is a professional mechanic's tool? Some people press down on the belt and guess at its deflection. This "Kentucky windage" approach is about as accurate as a "Wrong Way" Corrigan flight. The accurate way to check belt tension without a belt-tension gauge is by (1) placing a straightedge along the belt from pulley to pulley; (2) depressing the belt at the midpoint between the pulleys; (3) measuring the distance of belt deflection. Belt deflection of between 1/4 and 1/2 inch is considered acceptable.



CAR CLINIC

(Continued from page 49)

ment that will allow you to either overhaul or replace your rotary engine at more reasonable cost. The cost of overhauling a rotary engine in such cities as New York, St. Louis and Los Angeles is \$700 to \$800, which is a far cry from \$1200.

The man to see in Honolulu is Anthony Shelly of Shelly Motors, Inc., 744 Ala Moana Blvd., Honolulu 96818 (Tel. 521-3853 or 521-6921).

Leaning to

Ever since we purchased our 1976 Buick Estate wagon, the body has leaned to the right side. At first, the lean was approximately 1½ inches. The dealer replaced front and rear springs, installed a spacer on the front spring and replaced a damaged right rear shock absorber. The body of the car still leans ¾ inch. I have requested that all four springs be replaced, but this suggestion hasn't received much attention. I have now been told that the area service representative for Buick has no solution to the problem. Can you help?—R.G. Gratton, Wausau, Wis.

I will assume that exact measure-

ments of body-to-ground clearance were made by the dealer according to shop manual instructions to establish that the body of your wagon is truly tilting. Measurements should be made from the frame and axles only as specified in the shop manual when the car is on level ground. This will eliminate the possibility of a misalignment condition giving you a false reading which could have happened if measurements were taken at the bumpers, say. Bumpers aren't always straight.

Now if the car is truly tilting, you should shim the rear spring. This is the only thing left that hasn't been done. Of course, a body mount could have been left off during manufacture, but I doubt it. If such were the case, you would be getting quite a racket.

What a memory!

My car is a 1976 Pinto with automatic transmission, bought new. From the first, there has been a severe scraping kind of noise from beneath the car, but only when I accelerate rapidly. Investigations have lead nowhere. Any ideas?—Larry Stalker, Syracuse, N.Y.

Noise problems are difficult to

diagnose by mail, Larry, but yours struck a responsive note because of an advisory I remembered that was issued by Ford about a year ago. It is likely that the right-hand through bolt on the No. 3 cross member is too long and is contacting the flange on the transmission oil pan. The condition also may affect some 1975 Pintos and 1975-76 Mercury Bobcats.

The solution is to remove and reverse the bolt that attaches the No. 3 cross member to the front side rails so the bolthead is facing the front of the car. Install a new locknut and torque to 20-30 ft.-lb. The advisory is labeled 27.116-40-674 Nm.

Keeping things in perspective

I've been a front-end man for years, and have been able to correct various ailments on many cars, but this one really has me stumped. It concerns my 1968 Plymouth Fury III with 318-cu.-in. engine and Midland Ross power brake. The only problem with this car is that it has 70 percent brakes up front and 30 percent in the rear, which produces a far from gentle stop if one is not careful how he hits the brake pedal. I have installed a new dual master

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here's another bonus: Those tiny mulched particles go to work for you. They decompose, returning precious nitrogen to the soil. So every time you cut your lawn, you feed it. And save a little more work.

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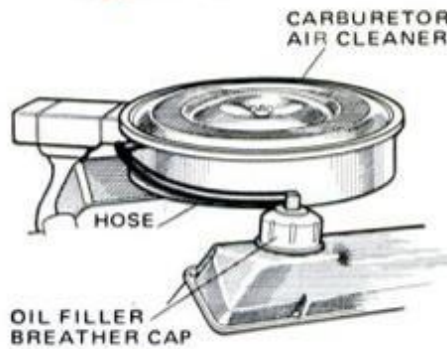
FMC Consumer Products

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Give it life— give it breath



Seldom given thought and therefore seldom serviced, the oil-filter breather cap in millions of cars—maybe yours—can start giving owners a really tough-to-find rough-idling and/or stalling problem. When the cap's filter gets clogged, as it likely will following some 12,000 miles of use, the efficient circulation flow through the PCV system is curtailed. The cap should be washed thoroughly in mineral spirits periodically to avert the trouble. In some cases—Chrysler Corp. cars in particular—the filter has to be lubricated. Generally, AMC, Chrysler and Ford cars do require service of the oil-filler breather cap. GM does not. To find out whether the cap in your car requires this service, simply examine it. If it has a hose attached to it, it needs care.



SERVICE TIPS

■ Those who service a 1975-77 Honda Civic or Civic CVCC after working on other makes should remember that one step in the ignition timing procedure is much different. When checking the timing of other cars, the vacuum hose is disconnected from the vacuum advance and plugged. When checking Honda, the vacuum hoses stay in place.

■ A new riveted brake-lining assembly (part No. 4094101) has been issued by Chrysler Corp. to relieve severe disc-brake squealing in 1976-1977 Volare and Aspen, Also 1973-76 Dart and Valiant. Installation procedure in service bulletin 05-02-77 must be followed.

■ Ford tells us that spark knock (pinging) in its line of 1977 car and light truck engines is usually corrected or minimized by retarding the initial engine timing up to 6° from specification in 2° increments. If the vehicle is still under warranty, the Ford dealer will do it for you free of charge as spelled out in service bulletin 126. ★ ★ ★

cylinder and rear hoses. All cylinders have been honed and rebuilt, drums turned, and new linings installed. Front shoes were reversed and that helped some. Everything seems in order. Should I convert to a manual braking system by doing away with the power booster?—Lawrence J. Penney, Auburn, Mass.

I can't advise that. You're heading for a difficult modification, which is unnecessary. For example, you will have to increase rear-

cylinder bore size to prevent brake-system lockup. There's an easier way to get more subtle stops.

Actually, a 70:30 front-to-rear brake distribution isn't bad, but if you can't live with it a Chrysler dealer can provide improved Mopar brake linings (the only ones you should use) and a Midland Ross modification kit that reduces pressure to the brakes. This kit was originally meant for 1971-72 Valiants and Darts, but will work effectively in your case.

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.

"New Elmer's Cabinetmaker's Contact Cement has the permanence and strength of acrylics and it works great."

Dick Carey, Professional Cabinetmaker

"When I heard about the accelerated aging test Elmer's® developed for their new Contact Cement, I was convinced Cabinetmaker's would be as tough and durable and permanent as anything I had ever used.



They put two laminates in a 220° F. test oven for four days. The laminate they'd glued down with Cabinetmaker's stayed down. It's a real acrylic.

Of course, since new Cabinetmaker's goes on with a brush or a roller, and dries crystal clear to

let me know when it's ready to bond, it's also easier to use.

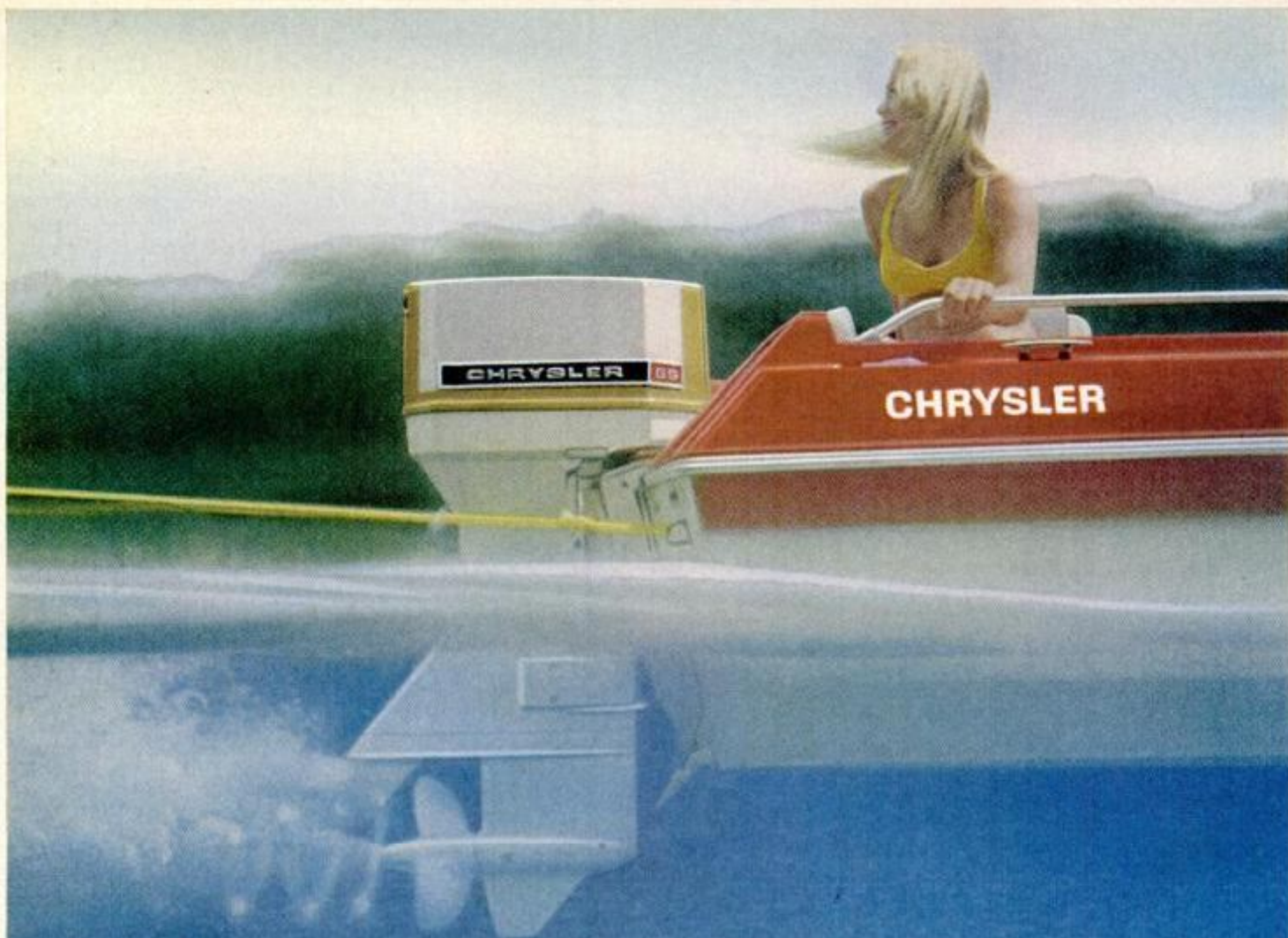
And it cleans up with plain warm water, which is pretty easy.

Oh. Another thing. New Cabinetmaker's goes up to twice as far as conventional solvent-based contact cement and has no harmful fumes so you don't have to worry about fires.



Elmer's. When results count.

It's no wonder things are so much easier for me now."



The new Chrysler 65. Sleek underwater design that moves you. Fast.

Meet the new Chrysler 65! Engineered to be high-performance all the way with the new Chrysler high-speed "Power-Flow" underwater drive unit.

Simply stated, "Power-Flow" design gives you more speed. Significantly more speed without having to increase engine horsepower—on some hulls, the equivalent of up to 10 extra horsepower, at speeds over 40 mph.

"Power-Flow" design was developed and perfected in the



unique computer-controlled water tunnel at Berlin University in Germany. It's now incorporated into every 65, 105, 120 and 135-hp. engine Chrysler builds.

The Chrysler 65 has the same displacement as competitive 3-cylinder models with the simplicity, economy and light weight of 2-cylinder design. Making the Chrysler 65 the most powerful 2-cylinder on water! Plus, the 65 features the new

Chrysler corrosion-protection process.

Check the Yellow Pages today for your nearest Chrysler outboard dealer.

Chrysler manufactures an entire family of pacesetting marine power: inboard, outboard, jet and stern drive; plus, a complete fleet of powerboats, sailboats and accessories.

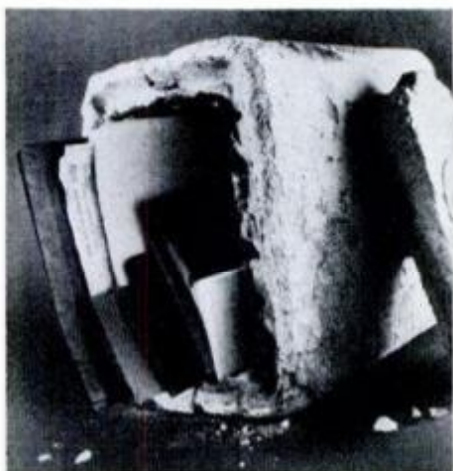


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For the time of your life.**

PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Fire-safe safe



Most families accumulate papers that they can't afford to lose. The Sentry Survivor is built to protect your important papers from theft and fire. It's about \$50 from John D. Brush & Co., Rochester, N.Y. 14625.

The 35-pound unit measures about 8x13x17 in., has a key lock and will keep papers intact inside during a one-hour fire at 1700°F. Although the safe is portable, you can build it into a closet wall and even add a fake front panel.

Pyronox concrete insulation fills the 2-in.-thick walls that are coated inside and out with layers of plastic. Even a direct flame from a torch won't cause significant damage. Fire resistance is claimed to be equal to that of a 2-ft.-thick concrete wall.

Pipe problem-solver

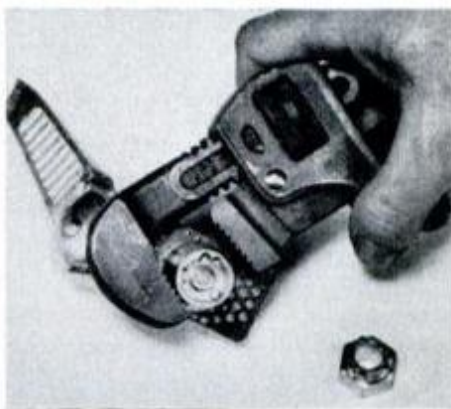
We get a lot of letters about problem pipes. That means dripping from condensation in the summer and leaks from freeze-ups in winter. Pipes that are exposed to severely low temperatures have to be protected with a heat cable.

For most in-the-house locations, an insulated pipe wrap will do. Mortell Co., Kankakee, Ill. 60901, makes wraps in different sizes to fit most jobs. Material is a closed-cell vinyl foam covered with foil that cuts easily and molds to irregular shapes. It's ½-in.-thick, 6 in. wide and comes in a 30-ft. roll for \$3.59.



Theftproof bolt

This ingenious item is going to frustrate a lot of burglars. Superwinch, Inc., Putnam, Conn. 06260, makes the case-hardened bolt with a smooth, circular, conical nut. How do you tighten it? A nut "key" with a standard surface fits into the locknut. Turn it with any wrench to tighten, then remove it. No matter what tool we used, we couldn't get a grip on the locknut to loosen it so don't lose the key nut. A ¾-in.-dia. bolt is \$5.95.



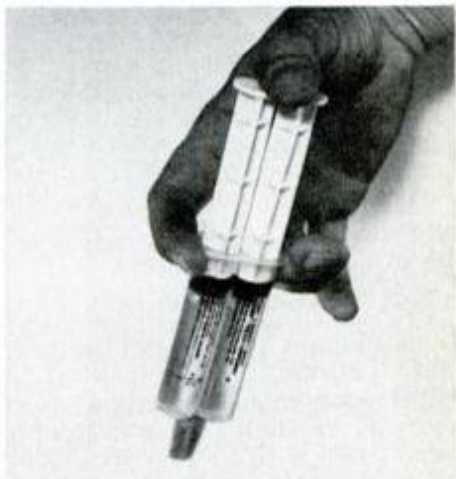
Plexiglas edger

When you work with plastics and sheet acrylics, glued seams have to be flat, square and scraped in order to create tight, durable joints. Rohm & Haas, Independence Mall West, Philadelphia, Pa. 19105,



now offers an L-shaped edging tool (\$5.49) that's easy to hold (1 x 1¾ x 4½-in.) and glides along without scratching. Cutters can be adjusted at each end.

Epoxy dispenser



A neat dispenser that eliminates measuring with epoxy glue—as well as the possibility of misplacing one of the tubes—has been developed by the Devcon Corp., Danvers, Mass. 01923. Resin and hardener are both included in the dispenser.

Just press down on the plunger and they emerge in exactly the right proportions to mix and apply to the job. Both Devcon's Clear 2-Ton and 5-Minute epoxies are available in the dispensers.

For first-time use you have to snip the ends of the tubes; when you're done, a small two-pronged plug is inserted and the unit is stored upside down. The epoxies provide high-strength bonds for wood, aluminum, ceramics, glass and metals. The Dev-Tube sells with your choice of either type of epoxy for about \$2.—M.M.

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IT'S NEW NOW



High rise blooms on a stem

Faced with a subsurface network of utility tubes and subway tunnels, an enterprising Boston contractor erected a 16-story office building by cantilevering it out over a slim central pedestal of steel framing (below). The new Fiduciary Trust tower sits on eight caissons from which the steel extends about 20 feet above street. Trusses up to 158 feet long reach out to support six exterior walls 39 to 124 feet long. Finished structure will have 225,000 square feet of floor space. Cost: about \$16 million.

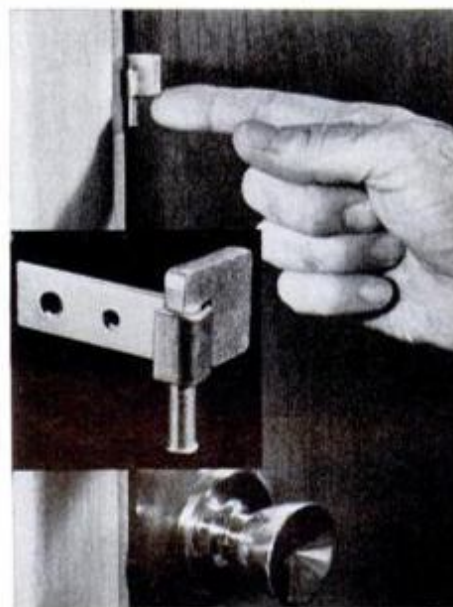


Junior Formula Six

Scaled-down Formula Six for 8-year-old does 40 mph, can be upped to 100. The British boy was driving at 4. His dad, a Birmingham mechanic, built it.

Luxury front-engine rider

Soft, padded contour seat, car-type controls, wide footrests and synchro-balanced engine for smooth ride appear on Toro's new 8 and 10-hp riders. Estate-size rear bag optional. At Toro outlets.



Tamperproof door lock

Easily installed "flip" lock for use on exterior or interior doors (bath, basement, closets, cupboards and the like) fits in the door jamb at any desired height. A brad is nailed flush in the fastener plate, which then is secured by a screw that's included in the installation kit. The Payne Safe-T-Lock Co., Box 7074, Phoenix, Ariz. 85011, makes the unusual lock.

Air Force Announces The Golden Opportunity Program



Now You Can Earn A Good Salary and a College Degree

Today, more than ever, look to the Air Force for the wide range of educational opportunities you need to succeed.

The Community College of the Air Force now has the authority to grant 2-year Associate Degrees.

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Backed by 40 years of four-wheel-drive experience, today's Power Wagon gives you four-by-four performance full time. It's the latest—full-time four-wheel drive. Designed for deep biting traction to pull you through mud, snow, or up a towering hillside. And you never have to get out of your truck to lock or unlock wheel hubs when going on or off the highway.

When you want four-wheel drive, you want it tough. You want a truck you can count on to carry the load over country that would

whip an ordinary pickup. You want a truck that can take a beating and come out of it looking good. You want a Dodge Power Wagon.

Dodge builds a full line of Power Wagons for 1977, including Club Cab and six-passenger Crew Cab models. Whether you're buying or leasing, whether it's one truck or a fleet, you can count on Dodge four-wheel-drive Power Wagons. Special tires shown not available as factory equipment.

**Price comparisons based on manufacturers' suggested retail prices, not including destination charge, taxes and options.*

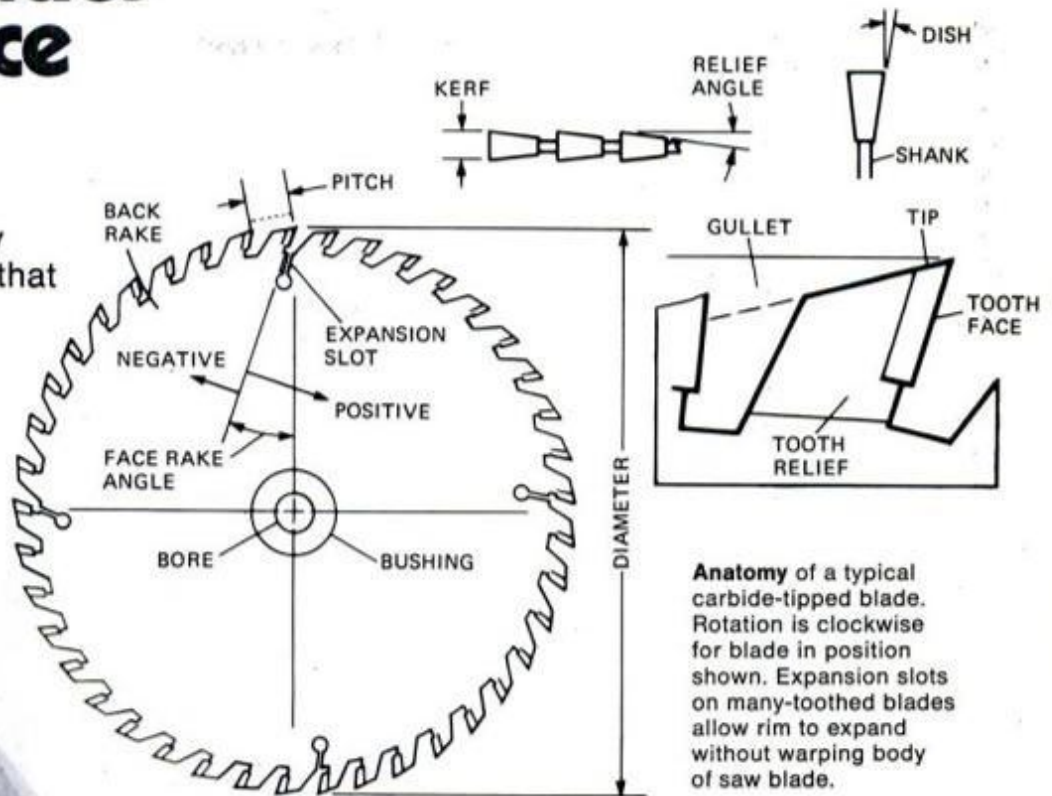


Dodge trucks have got it where it counts.

96 out of every 100 Dodge trucks registered in the last ten years are still in use.
(Source: R. L. Polk & Company, *Trucks in Operation*, 1975)

Carbide blades - performance at a price

Tungsten-carbide-tipped saw blades offer versatility and long-lasting sharpness that can justify their extra cost.



Anatomy of a typical carbide-tipped blade. Rotation is clockwise for blade in position shown. Expansion slots on many-toothed blades allow rim to expand without warping body of saw blade.



You may not need tungsten-carbide-tipped blades for your circular saw. If yours is a light-production workshop, if you rarely work with tough or exotic materials or if you sharpen your own blades regularly, the premium prices of carbide blades probably aren't justifiable.

But if your shop really hums with activity, if you want exceptionally smooth cuts in materials like expensive veneer plywood, or if you've figured the cost of having steel blades sharpened as often as they should be, carbide blades can start to look like a bargain.

They can hustle through materials that mean instant dullness for ordinary steel blades—hardboards, high-pressure laminates and laminated panels, asbestos and soft (nonferrous) metals such as brass and aluminum. A carbide-tipped blade will stand up to high-volume hardwood cutting better than steel, create less edge splintering than a combination blade and make smoothest-possible cuts in plywood.

Some can take in stride the occasional nails encountered in major home renovations or in cutting recycled wood.

Best of all, they'll stay sharp 10 times longer, on the average, than steel blades will in the same applications. The reason is that tungsten carbide, a manmade substance, is extremely hard—three times harder than the hardened steel used for files.

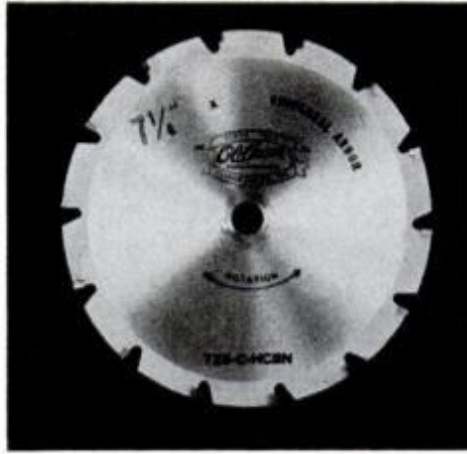
Not every carbide-tipped blade is right for every use, of course, and they do suffer from two major disadvantages. The first is high initial cost: Carbide blades commonly cost four or more times as much as the nearest steel equivalents. You can pay more than \$40 apiece for some carbide blades—and never get your money's worth if you use them only rarely.

The second disadvantage is sharpening—it's costly, too; usually several times as much as commercial sharpening of a comparable steel blade. Don't think you can do it yourself, either—it requires a diamond wheel. If you take a green silicon-carbide wheel to a carbide

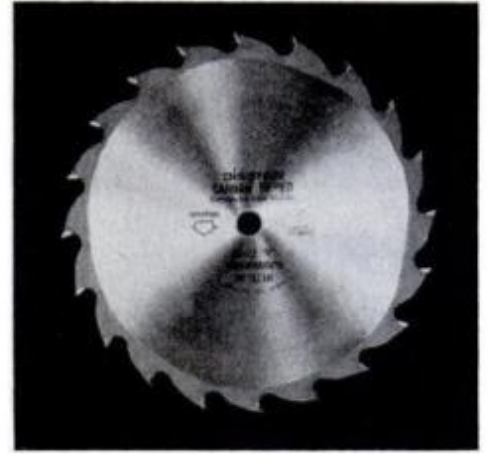
(Please turn to page 60)



Eight-tip blade for portable saws does rough carpentry, handles tough materials.



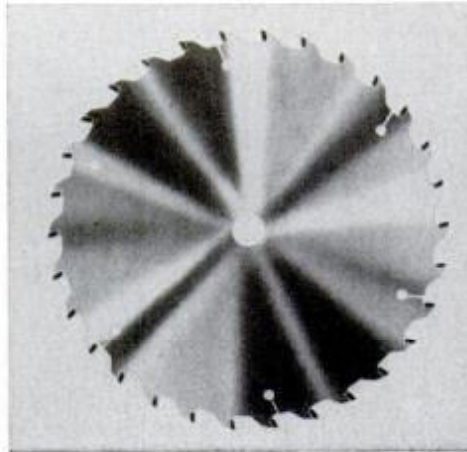
Nail-cutting blade sold by Brookstone has a negative face-rake angle.



Combination blade having 20 alternately beveled tips both rips and crosscuts.



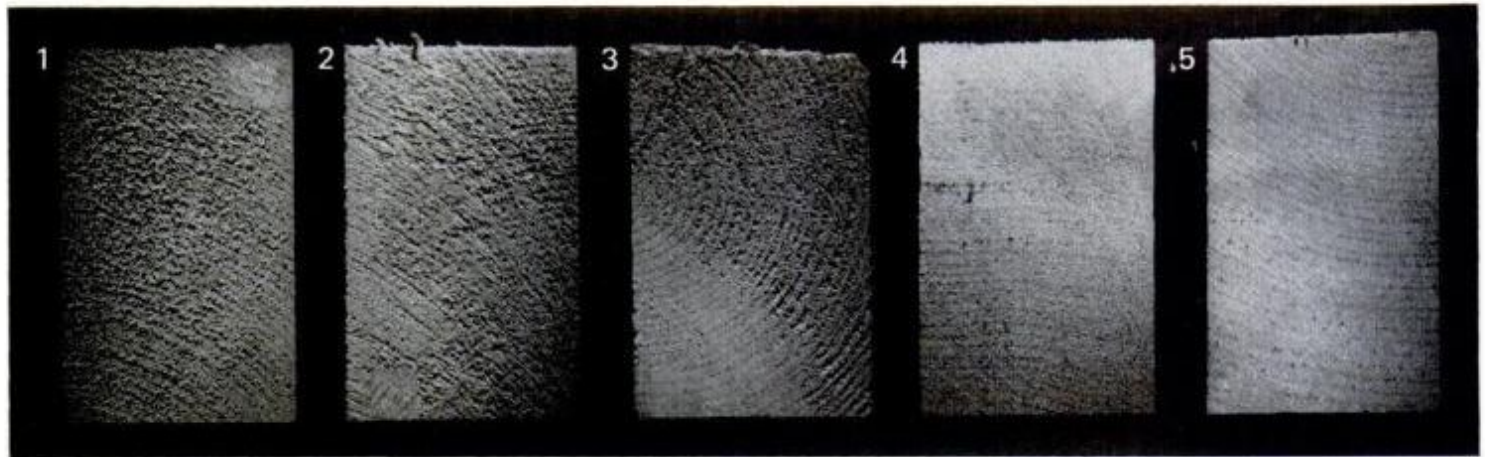
Square-grind blade made by Foley is for ripping and rough crosscutting.



Luxite blade is designed for radial-arm saws; 12-in., 30-tip model is shown.



For advanced woodworking, 10-in.-dia., 60-tip blade cuts silky smooth.



Comparison cuts in 8/4-in. soft pine were made with 10-in. steel combination blade (1) and four carbide blades: 7-in., 8-tip (2); 10-in., 12-tip (3); 10-in., 24-tip (4), and 10-in., 60-tip (5). Only the last two cut smoother than steel blade.

CARBIDE BLADES

(Continued from page 59)

blade, you're almost certain to wreck the geometry of the tips. Some small, independent sharpeners are properly equipped for the job—but check before you hand over your blades.

You'll have to work out the cost equation for your own situation.

(Please turn to page 272)

LIFETIME COST—STEEL BLADE VS. CARBIDE-TIPPED BLADE			
10-in.-dia. steel combination blade (64 teeth in 16 sections)		10-in.-dia. carbide combination blade (24 tips)	
Initial cost	\$ 7.00	Initial cost	\$25.00
Ten sharpenings (\$2 each)	20.00	One sharpening	8.50
	Total 27.00		Total 33.50
Ten sharpenings	20.00	One sharpening	8.50
	Total 47.00		Total 42.00
40 more sharpenings	80.00	Four more sharpenings	34.00
	Total \$127.00		Total \$76.00



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The same people who built these Novas for the police build three Nova models for you. And when you get right down to it, a lot of the things the police look for in a car are the same things you look for in the car you drive. This year, we'd like *you* to test a new Chevy Nova. Once you've experienced it, you'll know why Nova won its star.



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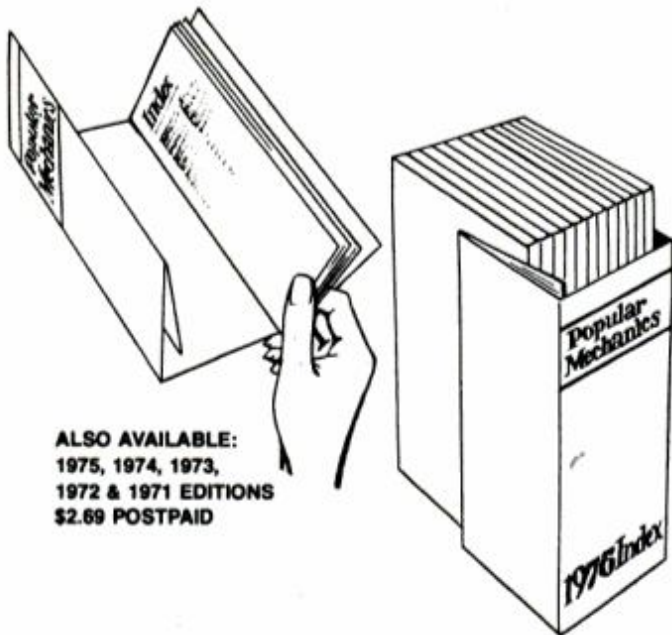
Your copies of Popular Mechanics are crammed with this type of information. Sometimes, though, it can be frustrating to find an exact article that you recall appeared several months ago.

The Popular Mechanics 1976 *Index and Shelf Wrapper* solves that problem. Each of those thousands of items that appears in PM throughout the year is not only referenced, but thoroughly cross-referenced as well. You can find *any* article you want in seconds! Or you can find *all* the articles on broad categories such as auto repairs, boats, drills, photography, woodworking and other subjects at a glance!

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APPLIANCE CLINIC

BY PAUL MANN



Various variables

Our seven-year-old Sears Kenmore washing machine intermittently (about 20 percent of the time) leaves two to three inches of water in the tub. What could be the reason?—A. T. Birkemeier, Delphos, Ohio

There are three possible reasons why this machine retains water: (1) weak side-check valve; (2) loose drive belt; (3) weak pump. One of these, coupled with an occasional overloading of the machine with heavy clothes, may account for the intermittent retention of water.

The side-check valve opens to allow water to be pumped from the machine. You can inspect it by opening the lid as water is being pumped out. Look into the machine at about the 10 or 11 o'clock position, which is where the valve is located. If you see water falling back into the tub, the side-check valve is sticking and should be replaced.

The belt should then be inspected for damage and correct tension. If neither the side-check valve nor belt proves to be damaged, and care has been taken not to overload the unit, but the trouble is still occurring, disassemble the pump for inspection. It is probably the culprit.

Good timing

My undercounter dishwasher fails to fill. I overhauled it, and still no water goes in. I have a hunch the timer is bad. Am I right?—Ed Naravas, Winchester, Va.

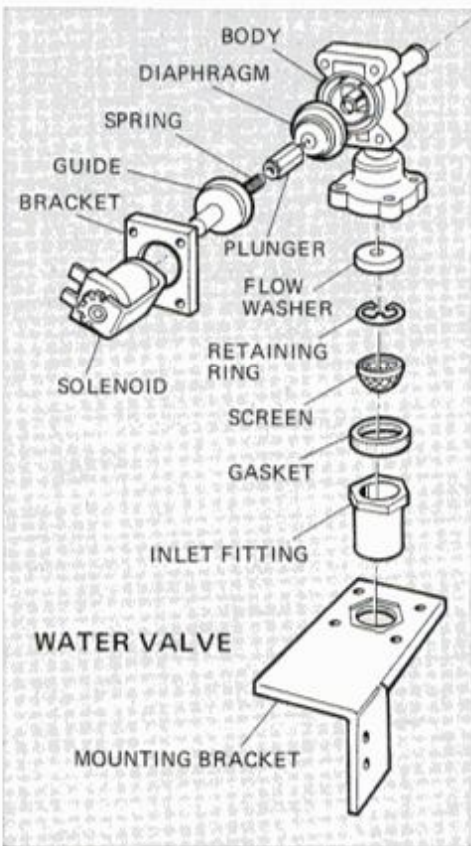
You could be, but unless you have checked these other possibilities, you may replace the timer unnecessarily:

1. Defective water inlet valve solenoid. Locate the solenoid. Turn the timer to FILL and check voltage at the solenoid terminals with a 115-volt test light or voltmeter. No voltage indicates a problem in the wiring. Presence of voltage with the water valve remaining closed points to a defective solenoid or valve. In some units, solenoid and valve are integral and have to be replaced together. In others, replace the solenoid first. If this fails to correct the problem, replace the valve.

2. Dirty water valve. Valves generally are fitted with inlet filter screens. If this screen becomes badly

clogged, water intake will be impeded. The valve should be disassembled and cleaned. Refer to the drawing of a typical valve for guidance.

3. Defective float switch. Some machines have this part. Check for a loose wire to the switch. Lift up



the float arm and let it drop. You should hear a "click." If not, replace the float assembly.

Now, if nothing has helped, tackle the timer. Your hunch may prove correct. The timer might, as you suspect, need replacing or adjusting.

Frost-free not free

We are going to buy a new refrigerator-freezer. My wife prefers a frost-free model, but I've been told it would be more expensive to operate. My question: how much more expensive?—P. Zimmerman, Denver, Colo.

The figures quoted here have been provided by the Florida Power and Light Co. of Fort Lauderdale. Taking 14-cubic-foot frost-free and conventional models as examples, FPL estimates that the former would use

150-180 kwh per month while the nonfrost-free model would use about 100 kwh. At current prices charged by FPL, it would cost about \$2 a month more to operate the frost-free model.

Foreign exchange

While living overseas, we purchased several expensive appliances, including a sewing machine and mixer. They operate on 220/240 volts as compared to 110/120 volts in the United States. I know converters are sold that permit those traveling overseas from the U.S. to use their appliances, but where can I get a converter which allows me to use appliances here that were purchased overseas?—Mary Lee Rubrecht, Loco, Okla.

Radio Shack sells 220/240-110/120 step-down converters. Two kinds are made. One is a converter for small non-motorized heating appliances; the other is a converter for small motorized heating appliances consuming a maximum of 50 watts.

The latter converter could probably be used with the mixer and small appliances such as electric shavers, toothbrushes and radios. However, your sewing machine is a borderline case. Most consume 65 to 85 watts. If I were you, I would write directly to the company and ask specifically if the converter can be used with your particular machine. Include technical data contained on the machine's specification plate. The address you want is Radio Shack Merchandising Dept., Tandy Corp., 2617 West 7th St., Fort Worth, Tex. 76107.

If a converter for your sewing machine is not available, your only other course of action is to have the motor replaced. If the machine's manufacturer has an American affiliate, take the unit there. Maybe they can help or suggest another alternative so you can use the machine.

★★★

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

DETROIT LISTENING POST

Update on Chrysler mini

If you happened to be snowmobiling in Ontario, Canada, a couple months ago, around Wawa, Thunder Bay and Kenora, you might have seen a VW Rabbit and a Rabbit look-alike car. The look-alike was Chrysler's new sub-compact. A Chrysler crew took the cars to Canada for a winter shakedown and to compare the Chrysler mini versus VW. Beats me why they had to go to Canada to do the cold test, unless it was for security reasons. Michigan had its coldest winter in a hundred years and there were days when the temperature at Chrysler's Chelsea, Mich., proving grounds was below the temperature in Anchorage, Alaska.

Some car details from the report compiled after the Canadian run:

Chrysler's small car will have the best brakes and suspension system of any lightweight automobile sold in the U.S. Better than Rabbit, Chevette, Fiesta, Fiat, better than Simca, the "mother" car from which the new car was derived. The car runs quietly—qualifier: for a small car—with little wind noise or chassis noise entering the passenger compartment.

Chrysler has done a neat job of designing and packaging under-the-hood stuff to make the car easy to service. Accessory lines have been positioned so a mechanic can work on the car from the top. It does not have to be put on a hoist and no special tools are required.

The car will debut as a four-door sedan this fall. Not a five-door, as some reports have it. A two-door is planned for 1979.

New engines for GM Xs

Basic engine for the smaller- yet X-body compacts (Nova, Ventura, Omega and Skylark) coming from GM in 1979—calendar year, not the model year—will be a reworked version of Pontiac's four-cylinder job. There will also be an optional V6, a new engine, not a rework of the Buick Six. The X cars will not offer an eight-cylinder engine.

Outwitting the car crooks

The guys who think up ways of protecting cars from thieves predict most if not all automobiles will

eventually have an inside hood release. They see the engine compartment becoming a bigger target for ripper-offers. If a thief breaks in your car today, he will go for the tape player, CB radio, spare tire or the whole car. But he isn't likely to steal anything out of the engine compartment. Too much trouble and not enough of a market for gear he can get his hands on in a hurry.

But there are expensive electronics coming in the next few years that will make prime pickings for rip-and-grabbers. These will be pull-and-replace units. That means if something goes wrong with the device, the mechanic is supposed to pull the unit, replace it with a new control and return the pulled part to the factory to be remanufactured. This equipment has to be mounted so it's easy to get at, easy to remove: Thus you'll see more hood releases inside cars.

GM promises better service

Nearly everybody who owns a car can tell you about a bad experience they've had trying to get it fixed. Detroit puts out a great line of palaver about its devotion to improving service, but that's all it amounts to—rhetorical razzle-dazzle. The auto companies are primarily concerned with selling cars and they look on service as a pain in the neck. GM says it is going to change that.

The company has named a v.p. in charge of customer relations and service. That's a bigger deal than it sounds like on the surface. GM has never had a corporate v.p. for service before this. GM v.p.'s have a lot of clout and assuming the new guy is given the authority that usually goes with the title, buyers of GM cars should get a better break when they have a problem.

Cougar to get sun top

Lincoln-Mercury dealers complained of being left out when rival Ford Division got to offer a sliding panel sun roof as an option on Mustang this year while Cougar was passed up. So Cougar will get a hatch roof for '78.

Parts buying made easier

If you're undecided between brands X, Y and Z next time you buy a tire, battery, shocks—anything over \$15

—there's a new law that makes the sorting out a lot easier. The law says you are entitled to see the warranty on an item before you pay your money. That's assuming the item carries a warranty. If it doesn't, beware.

It used to be that you didn't get to see the warranty until after you bought a part and had it installed on the car. Most places that sell parts and accessories carry a minimum of three or four lines, different grades or brands. In the case of tires, the list can run to 20 or 30 choices. This makes for confusion if you try to base a decision on what the salesman tells you.

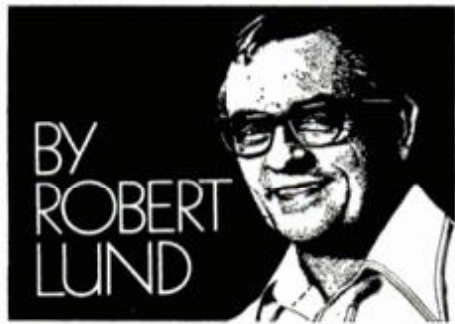
I checked around the Detroit area to see how dealers and replacement shops are handling this. The places I contacted have put together warranty books. These are three-ring binders with the warranty information sandwiched between plastic sheets. The customer is welcome to sit down and take as much time as he wants to read the info. A word of advice if you do this: Take notes on what the procedure is to get a refund or adjustment if the product doesn't live up to the guarantee.

Automatic headlight dimmer

Lucas Industries, a big manufacturer of automobile parts in England and also a supplier to United States car factories and the replacement market, is working on a sensing device for headlights that automatically dims the intensity of the lights depending on ambient lighting—street lights or other lights that illuminate the road.

Interesting angle on the sensing device is that it is able to distinguish between the headlights of other vehicles and lights from stationary sources as it responds only to lights deriving power from al-

(Please turn to page 66)



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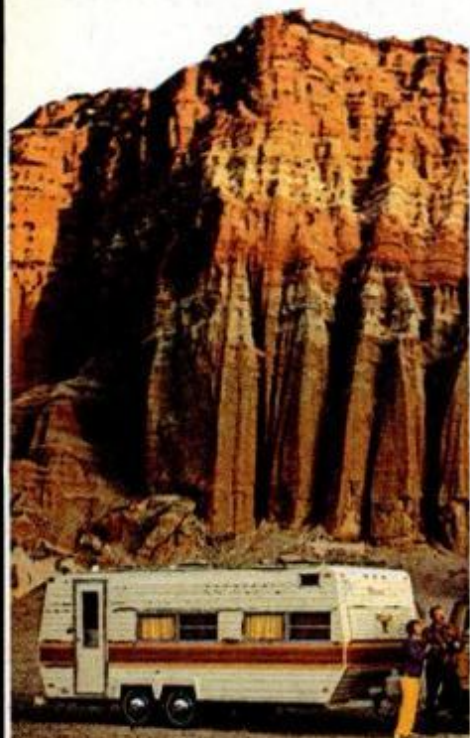
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Filter Kings, 16 mg. "tar," 1.1 mg. nicotine; Longs, 18 mg. "tar," 1.3 mg. nicotine, av. per cigarette, FTC Report Dec. '76

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BERNZOMATIC

DETROIT LISTENING POST

(Continued from page 64)

ternating current. So if you're driving in the boondocks your headlights won't dim when the lights from an oncoming car hit your car.

Three freebies

If you're trying to squeeze the most miles out of a gallon of gas, there are several booklets on the subject that are worth checking out. No charge for any of them.

Chrysler has published a new edition of its *Guide to Fuel Economy*. Send your request to Chrysler Corp., Box 7749, Detroit, Mich. 48207.

The Environmental Protection Agency has a pamphlet on *Factors Affecting Fuel Economy*. Write Public Information Center (PM-215), EPA, Washington, D.C. 20460.

The government also has two versions of its *Gas Mileage Guide* for 1977 cars. There's a 49-state version and a California-only edition. You can pick these up from car dealers or by writing Fuel Economy, Pueblo, Colo. 81009.

How to find a good mechanic

Four years ago when it looked like Congress might pass a law requiring mechanics to be licensed, various groups in the auto industry got together and formed an outfit called the National Institute for Automotive Service Excellence (NIASE). The idea behind this was that the Institute would set up standards and tests to determine the competency of mechanics. If a guy knows his stuff, he can take a test to prove it. If he passes the test, he receives a certificate saying he is qualified to do such-and-so.

This is not a diploma mill. The tests are conducted to guard against cheaters and NIASE runs a clean, up-and-up operation. GM thinks enough of the organization that it will include an endorsement of NIASE in all owner's manuals for its '78 model cars.

The group has certified more than 100,000 mechanics thus far. You can get a directory of shops where the mechanics are employed by sending \$1.95 to NIASE, 1825 K St. N.W., Washington, D.C. 20006. Good item to have in the glove compartment if you have to have your car repaired when you can't get to your regular mechanic.

If you don't want the national directory, NIASE will send you a list of shops employing certified repairmen in your state free for the asking. You have to supply a stamped, self-addressed envelope. ★★★

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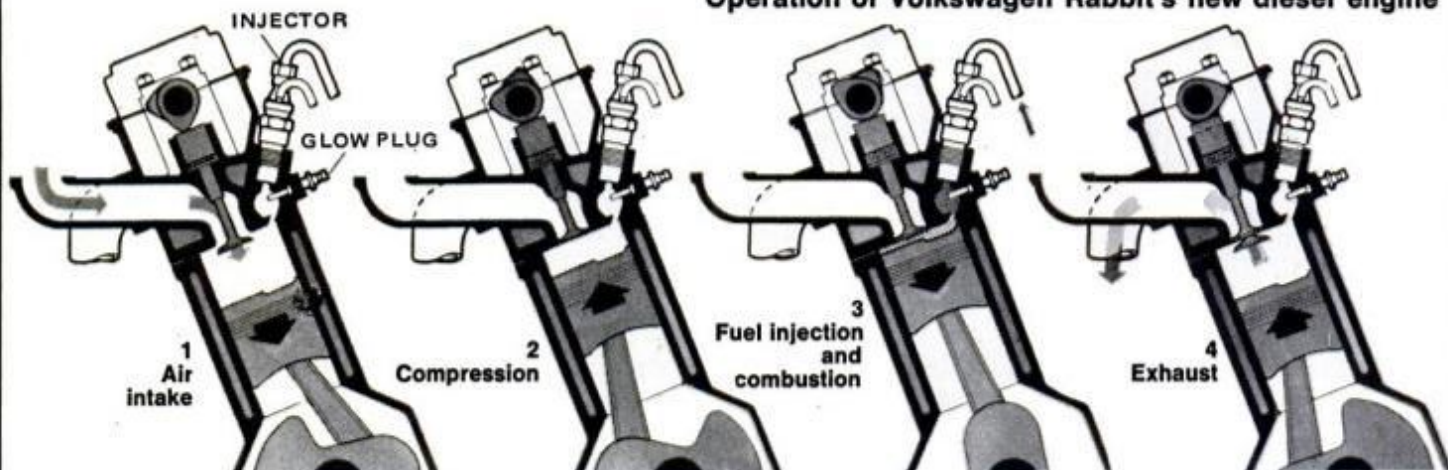


Mercury Marine, Fond du Lac, Wisconsin
Canada/Australia/Belgium



IMPORTS & MOTORSPORTS

Operation of Volkswagen Rabbit's new diesel engine



Reasonable diesel

Volkswagen's diesel-powered Rabbit is now in dealer showrooms, and PM is putting some miles on one for a report that will appear soon. The diesel-engine version of the Rabbit, rated by the EPA at 52 mpg highway and 39 city, offers for the first time, a diesel-engine option in a mid-priced passenger car. Until now, the advantages of diesel power were only available in the high-priced and luxurious Mercedes-Benz and Peugeot models. The other diesel option, in the International Scout, is available if you're ready and willing to pay the almost \$2000 premium.

The breakthrough of diesel power for only \$170 over the gas-engine Rabbit price was accomplished by VW's foresight. The 1500-cc four-cylinder diesel uses the same block, flywheel, bearings and crankshaft as the Rabbit's original gas engine. It works because the original Four was engineered, I'm sure, with an eye to this future diesel application. The conversion, therefore, is just a matter of strengthened connecting-rod wrist pins, and strong but light pistons and cylinder head.

Horsepower of the engine is 48 at a high-revving (for a diesel) 5000 rpm, and torque is 58 lb.-ft. at 2500 rpm. Like other diesel designs, VW's uses a pre-chamber, in this case spherical, where the incoming air/fuel mixture is swirled. Combustion begins in this swirl chamber and spreads to the cylinder. This design promotes complete combustion and also reduces peak load or shock that the force of combustion would otherwise lay on the pistons, rods, bearings and crankshaft.

Here's how it all works. As shown

above, a glowplug protrudes into the swirl chamber. It preheats the cylinders so the engine can be started easily (preheating takes 15 to 60 seconds depending on the outside temperature). 1. Piston moves down and air is drawn into the cylinder. 2. Piston moves up; both intake and exhaust valves are closed. The air is compressed by a factor of 23.5 to 1 (the compression ratio) and, as a result of this compression, reaches 1650° F.—way above the flash point for diesel No. 2. 3. When the piston reaches top dead center, the injector sprays in a mist of fuel, which ignites spontaneously. The expanding gases drive the piston downward, turning the crankshaft. 4. Exhaust gases are forced out of the cylinder.

Beetle-Benz



It looks like a beauty of a 1929 Mercedes-Benz roadster, but that's only skin deep. The fiberglass body sits on a VW Beetle chassis and engine. The Baron SS is a \$3000 kit from Classic Conversions, Inc., 11318 Highway 55, Minneapolis, Minn. 55441.

Automatic TR7

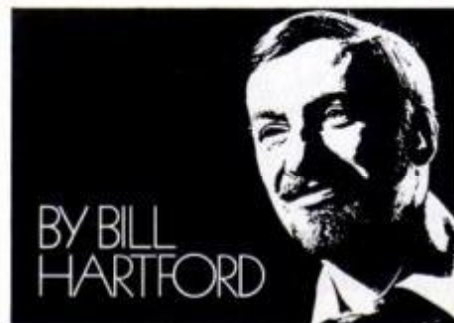
"No shifting, please—we're American" is how the folks at British Leyland Motors joke about our one-foot driving style. Even though BLM provides us with all those

nice rag-top sports cars, which we eagerly consume, they also know that in the United States you've got to offer the nonsporty option of an automatic transmission. So, as promised, the Triumph TR7 now has an automatic as a \$300 option.



It's a Borg-Warner Type 65 three-speed unit. The selector lever is visible above in what is one of the coziest cockpits you'll find on the road today.

On the really sporty side of things, BLM has just announced that it will campaign a couple of TR7s in rally events this season. John Buffum will drive April 23-24 in the North American Rally



BY BILL
HARTFORD



Assn.'s (NARA) Olympus Rally in Tacoma, Wash., and May 7-8 in the Rim of the World Rally in Palmdale, Calif. No, he won't use the new automatic transmission; he won't even use the standard two-liter engine: His 240 hp will be cranked out by the 16-valve Triumph Dolomite Sprint competition engine. This rally TR7 is shown in action in the photo above.

Fold-up moped



This 78-pound Pack-A-Way is a 49-cc moped from Italjet USA, 7471 Greenbush Ave., North Hollywood, Calif. 91605. A slick, compact design, the bike can be kept folded in your footlocker, ready to open up and ride away at a moment's notice. It's nice, but a bit stiff at a suggested list of \$579.

Old motorcycles

The American Motorcyclist Assn. (AMA) wants to set up a Motorcyclist Hall of Fame and Motorcycle Museum and would like to hear from owners of antique (up to 1930) and classic (1931 to 1953) motorcycles. Write the AMA Hall of Fame/Museum Committee at Box 141, Westerville, Ohio 43081. There should be a place to see the marvelous old bikes. You'll be able to see them in PM soon when we'll have a feature on the fine art of motorcycle restoration. ★ ★ ★



Anything else is mock turtle.

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There's a fogged window with a railroad scene on it, in the style of an etching. There's an engineer's bell hanging in the rear of the car. And a conductor's clock with the rich look of brass.

Outside, there's special striping. And a distinctive Sunflyer Limited insignia.

Of course, we back the Sunflyer Limited as we do all other Itascas. And that means you also get our 3-Year/36,000-Mile Owner Protection

Plan. It covers the inside, the outside, the underside—anything operational, except normal replacement items, like spark plugs and oil filters. For 3 years or 36,000 miles, no repair job resulting from a mechanical malfunction will ever cost you more than \$25. And for the first year or 12,000 miles—Itasca's Limited Warranty period—it won't even cost you a penny.

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HOMEOWNERS' CLINIC

A brassy solution

What kind or type of finish will prevent a brass bedstead from tarnishing? Several procedures have been recommended to me so I am puzzled about which one to use. Which is the most effective?—Mrs. E. Zamft, South Salem, N.Y.

You may not like my brassy answer: Polish the bed and forget the lacquer. Nothing that's short of an expensive oven-baked lacquer finish can keep your brass bed shining. Even a professional polish and lacquer job—which costs about \$150—will tarnish in time.

The biggest problem is that the brass will discolor unevenly under a lacquer finish—so if you do decide to apply the lacquer, be just as even-handed with the aerosol spray as possible.

A tip about tarnish: After polishing, make sure that no one touches the bed because skin oils accelerate the tarnishing process.

Clean and clamp

I have a small oval picture frame and it's joined on opposite sides with unusual V-cut joints. These joints have come loose and need regluing. But how?—Russell Emerich, Shreveport, La.

First off, I'd suggest that you separate the joints and clean off any glue residue and dirt on joint surfaces. With old frames, this preparation must be done with care so that the joints aren't damaged. For a clamp, use a heavy rubber band—scrap rubber such as a bicycle's inertube, knotted or doubled, works well. Apply white glue to the joints,

covering the meeting surfaces with a thin film. Press the parts together and snap the rubber band around the frame. Wipe off the excess glue with a damp cloth and check the joints. If the latter tend to open, close them tightly using small C-clamps. Avoid marring the frame's finish by using cardboard strips positioned under the clamp pads.



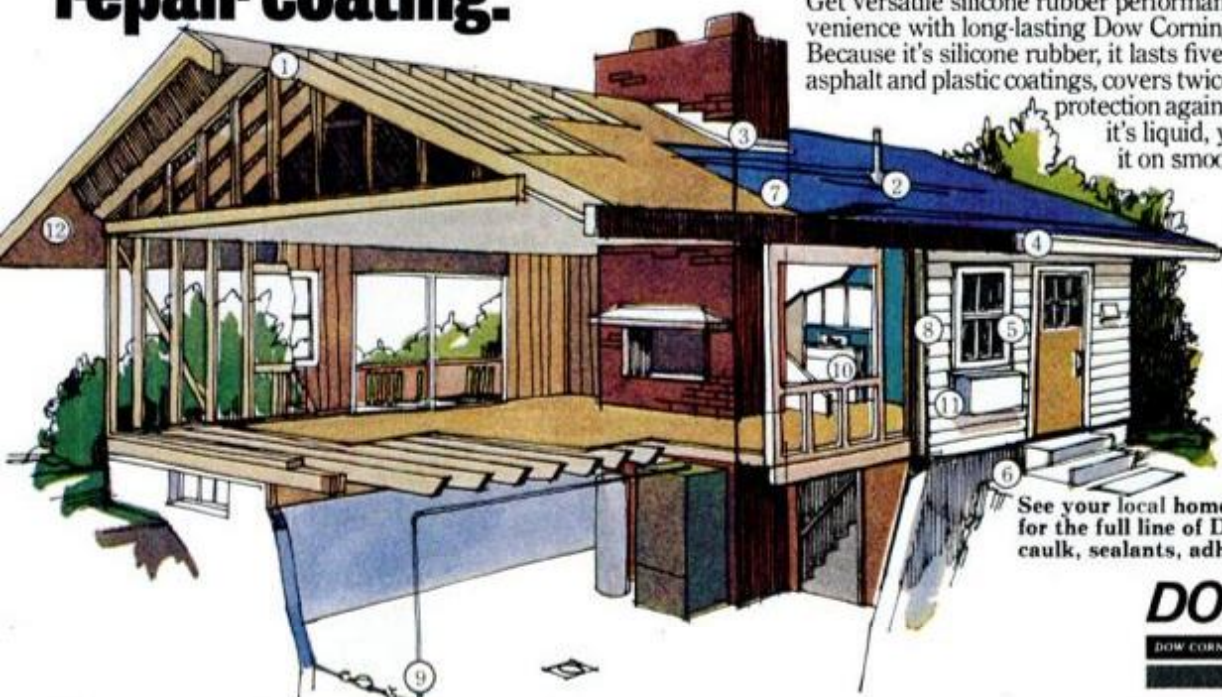
Forever dull

The Formica top on my coffee table is old and has several dull, dingy spots. Is there any way to renew the

(Please turn to page 72)

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8. Patches and repairs wood and aluminum siding.

9. Rustproofs drains, plumbing joints.
10. Rustproofs underside of sinks, dishwashers.
11. Weatherproofs air conditioner covers.
12. Rotproofs wood.

HOMEOWNERS' CLINIC

(Continued from page 71)

original finish?—Mrs. James R. Rice, Bishopville, Md.

Once the protective "melamine" surface has worn out, there is little hope of bringing back former luster. A good paste wax will restore some shine so your coffee table will have a slight luster.

Heat away rust

I need to remove several rusty screws without damaging the screw slots or the adjacent wood. I can't get them out. Do you have any suggestions?—Dan Holmes, Sacramento, Calif.

Nothing is fail-proof, but a soldering iron has helped me out on occasion. Use a small-tipped iron to heat the screw heads as illustrated. This will expand the metal and then contract it when it cools. Expansion and contraction should "break" rust on the screws.



Mold and mildew

We have a problem with the concrete floor in our family room, which is on

ground level. Moisture seeps through the floor and forms mold under the rug and a musty smell permeates the house. We have a vinyl tile floor over the concrete, but is there anything else we could do to seal the floor?—Ed Compaan, Lynden, Wash.

Your best bet would be simply to remove the rug and its pad, which absorb moisture instead of allowing it to evaporate. You might also consider buying a dehumidifier if the problem isn't severe.

But if you want to keep the rug, you'll have to lay a whole new floor. Take your choice of plywood or concrete—either will solve the problem and accommodate a wide range of finish flooring.

No matter which you choose, first cover the floor with a continuous layer of 4-mil polyethylene film to serve as a moisture barrier. Cut the film to fit in one piece, or overlap the seams by at least 4 in. and seal with tape.

For a wood floor, lay 2 x 4 "sleepers" on the flat and cover with plywood.

For concrete, pour a 2-in. slab over the film. Doors will then have to be cut shorter to clear either raised floor. Another alternative is to hinge the doors to open outward.

Dark spots on the siding

My husband and I recently painted our home. About a month later, we noticed dark spots appearing around the nailheads in the siding. We've been told it's mildew. What can we do about it?—Mrs. J. Frascatore, Schenectady, N.Y.

No, I don't think it's mildew—more likely, your problem is rust. Aluminum or noncorrosive nails should be used with exterior siding as steel nails rust and destroy the painted surface. This is more likely to occur when a water-soluble paint is used. The only good news I can offer you is that the discoloration will stop after all of the nails have been oxidized with rust. Wash the siding surface with a cleanser that contains oxalic acid. Sand the surface lightly if it is slick and re-touch it with an oil-base house paint. ★★★

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

The Winner II

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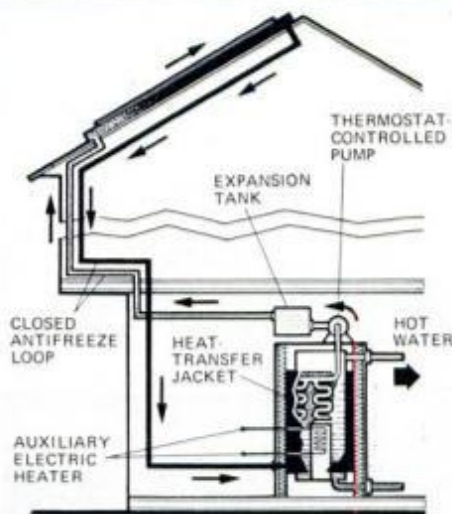
Split suede over choice of nylon or vinyl. Padded tongue and collar for comfort. Full cushioned insole for support. Sawtooth-tread rubber sole for traction.

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IT'S NEW NOW

Go pedal your handlebars

If you're tired of pedaling your bike with foot pedals, try hand pedals. Inventor of the system says it's better exercise for arms and chest. If you're not up to hills with your biceps, foot pedals still function—along with back-pedal brakes, foot and hand brakes. Developer is Antonio Spagnuolo, Via Spartaco 11, 20135 Milano, Italy.

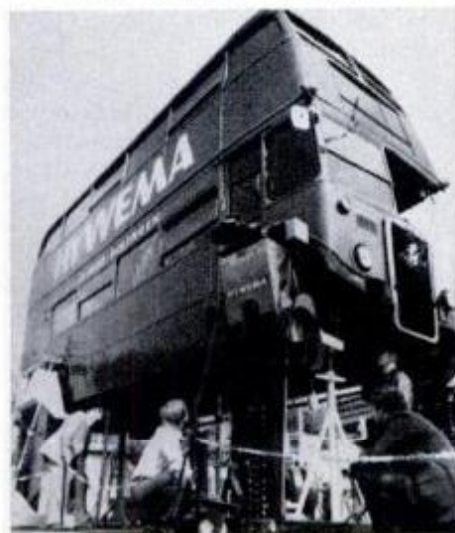


High-efficiency solar collectors

Special tempered double glass, impervious to ultraviolet, forms the surface of Libbey-Owens-Ford's new 3x7-foot solar panels, designed to handle temperatures up to 400° F. Units use copper tubing on copper absorber plate, with three inches of insulation beneath to provide hot water and heat for homes or commercial buildings.

Super bus jack

For people who need to look under buses, a "bus lifter" is just the thing. The new device, shown at Frankfurt's "Automechanica" spare-parts fair, has four jacks that raise or lower each corner of the bus according to preprogrammed instructions. Just push the right buttons.



Snip the garden soil

Rotating "scissors" on a new hand cultivator called Garden Weasel stir up soil without shifting it around. Three pairs of 5¾-inch spiked wheels roll crosswise to pulverize soil and lift weeds. Units are adjustable for large areas or window boxes. Garden Weasel, 1001 West 8th St., Kansas City, Mo. 64101.



Hear-through headphones

Most headphones *prevent* conversation. Now Pioneer's Model SE-4 with super-thin polyester drivers for stereo, has a hear-through design on the ear pads so adjacent voices come through. Pioneer Electronics, 75 Oxford Dr., Moonachie, N.J. 07074.

New big boats you take in tow

With maximum beam width of 8 feet or less, a brand-new fleet of trailerables is available.

by Bill McKeown BOATING EDITOR

Trailerling may be the secret today to owning more boat for less cost. Once you buy the rig, your back yard can be your boatyard. You'll need no dockage or moorage payments, and maintenance expenses can go just for the chores that you don't feel like doing yourself.

In our latest PM survey, we found a variety of new boats that fit this category. Many craft that are too heavy to carry or cartop can rate as trailer boats. Basic highway limitation, however, is a width of 8 feet or less. Beamier hulls can be towed, but special "wide load" permits must be obtained. States differ on rules for turnpikes and hours of travel, lights and flags, and warning cars



Versatile trail boats range from offshore speedsters like Wellcraft's 70-mph 30-foot Scarab to Cruisers' cabin model (top) for overnight camping on wheels ashore.

ahead and behind. For a cross-country trip with an oversize load, write for instructions from the motor vehicle bureau of each state you will pass through.

Trail-hull types

Power or sailboats to be trailered start at about 12 feet and range up 30 feet or more. Big 35-foot unlimited hydroplane raceboats with their broad sponsons use trailers with hydraulic jacks that tilt them up sideways to the necessary 8-foot width. Catamaran and trimaran sailboats provide ingenious folding, unbolting or telescoping crossmembers to shorten up a broad beam. Pontoon deckboats and houseboats sometimes mount side decks that can be hinged up to narrow them down into 8-footers.

How much hull can you pack between these side-to-side limits? Fixed-keel sailboats carry so much ballast weight that a heavy-duty trailer is necessary to support the load plus a hull high above the road. Swing-keel and centerboard windjammers ride lower and are easier to launch without a hoist and slings. Multihulls, of course, don't need keels for stability and are usually light enough for easy handling.

Powerboats, from rowboats and runabouts up through offshore skiffs and cabin cruisers, can now be spotted at the launching ramps.

With your compact car, you should be able to tow light hulls up to 18 feet. Most big standards and station wagons with beefed-up suspension can manage as much as 25 feet of boat. Pick a van or pickup to pull the big end of the trailer fleet—hefty houseboats, offshore machines and cabin cruisers that can reach 30 feet overall. Largest models will sleep eight, mount dual inboard or sterndrive engines and handle offshore waters.

Pick of pull-alongs

In addition to the Chrysler, Cruisers, Wellcraft, Glastron and Silverline trailerables shown here, some of the new models we find of special interest for taking in tow include:

■ **AMF Crestliner's Cruiser line:** From 19 to 25 feet in length, they offer fiberglass or aluminum deep-V hulls with an especially smooth ride, sleeping accommodations for two or four, and enough fuel capacity for a good cruising range.

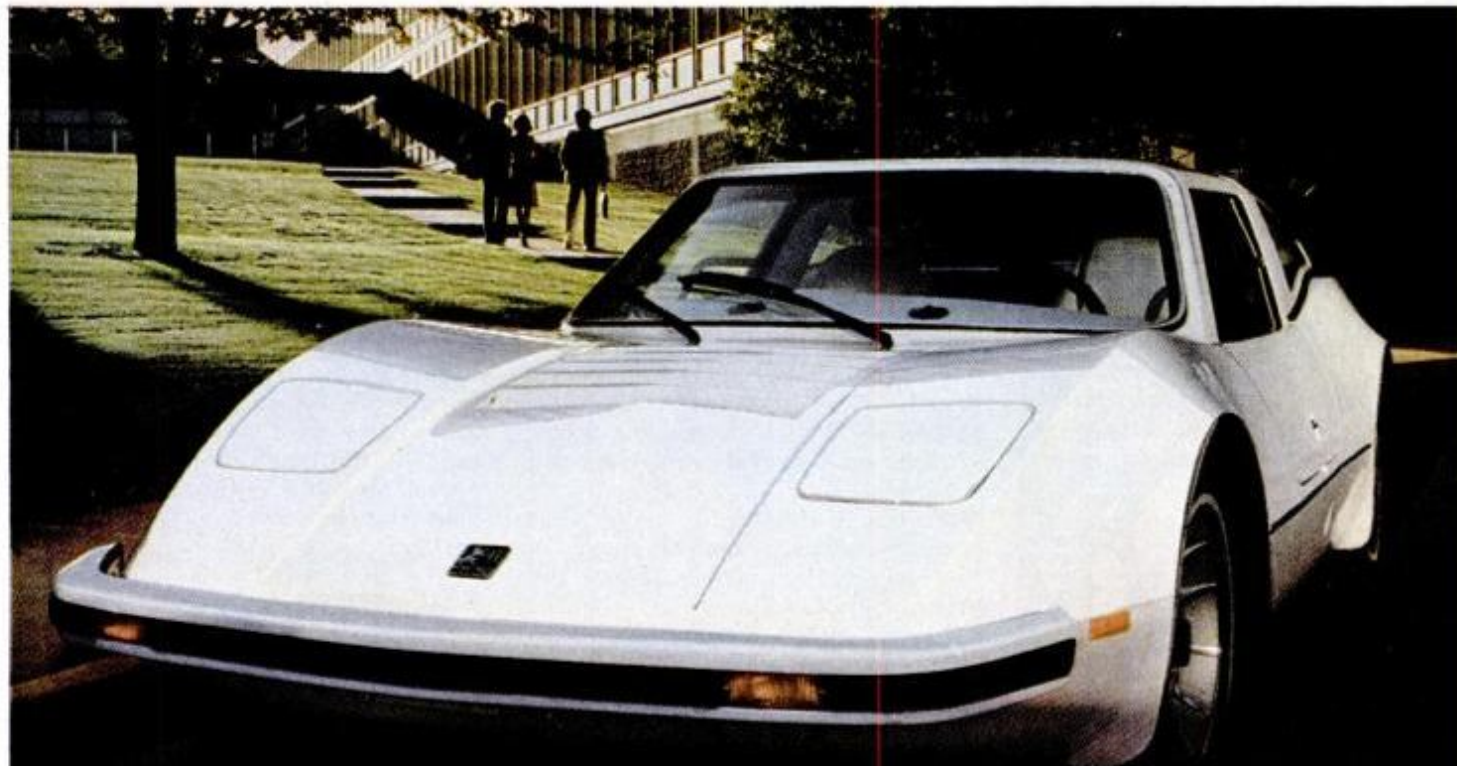
■ **Banana Boats**, in Providence, R.I., uses a race-proven offshore hull for a 55-mph cruiser that can be custom-outfitted and powered with outboards or sterndrive engines.

■ **Bayliner**, of Seattle, has a new 25-foot 2550 Saratoga Sun Bridge with V-berths forward and aft, under the cockpit, and a stateroom

(Please turn to page 76)



Chrysler's new 26-foot sloop, big enough to sleep six and small enough to trailer, has stern double berth, 6-foot headroom.



Introducing an exciting new concept in autodynamics.

The Bradley GT II.

Nothing in the motoring world so dramatically combines the style and performance of the finest European sportscars with the economy and dependability of a VW. Each component of the GT II car kit is custom-designed for precision fit and easy assembly on a Volkswagen chassis. The totally-engineered, finely-crafted finished product is a reflection of your own good taste and individuality. A product with unique autodynamic properties that provide significantly improved performance. And with styling so reminis-

cent of the most expensive and lavish European sportscars.

Its many amenities include fiberglass gull-wing doors and hatchback rear door. A steel reinforced roof and fiberglass body. Tinted safety glass windows. European-styled instrument cluster. Electrically-powered pop-up headlamps. And so much more.

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NEW BIG BOATS YOU TAKE IN TOW

(Continued from page 74)

with queen-sized bed in an unusual and clever arrangement. Bayliner's 2750 Victoria is a big 27-footer that sleeps six.

■ Cigarette 28 and 28-SS models are open-cockpit and decked-in truly high-performance duplicates of offshore racing machines that have topped 80 mph.

■ For the sailing home-builder, the Glen-L 7.9 is a 26-foot centerboard or keel sloop that will sleep a family of five and provide over six-foot headroom.

■ MFG's Morrison-25 sleeps four, or more under a camper canvas in the cockpit. Penn Yan's 24-foot Flybridge Sports Fisherman provides a tunnel hull for propeller performance and protection.

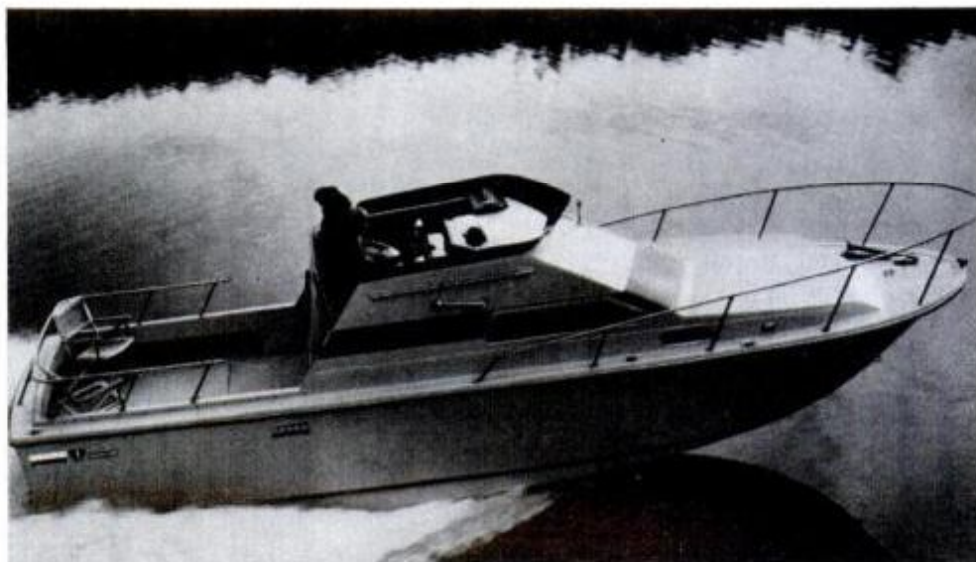
■ One of several trailerable Reinell cabin cruisers, the 8 Meter features a midship stateroom in the 26-foot

hull. Starcraft offers the choice of a 25-foot Chieftan Mark IV aluminum cabin cruiser, or the American 25 that can sleep six in the fiberglass hull. Steury has three 25-footers that sleep five—the S2500 Express Cruiser, the Fly-Bridge and the Sport-A-Bout. For a 24-footer that tops 35 mph, Winner has a stern-drive-powered Express Flybridge.

And for our pick of probably the largest cruiser that it's practical to tow, there is the 30-foot Cutter from Cargile Boats in Nashville, Tenn. Claimed to have topped 40 mph and capable of handling offshore passages, this big eight-sleeper has a price tag that starts at \$30,000 with trailer.

Best wheels

Unfortunately, too often after you've bought a bigger boat than you really want to lay out cash for, the dealer then mentions the trailer—and you're ready to cancel the deal. To



Skipjack, a Wellcraft 28-footer of popular West Coast design, has a modified-V hull, V-berths forward and a small stateroom aft, flying bridge and a large open cockpit.

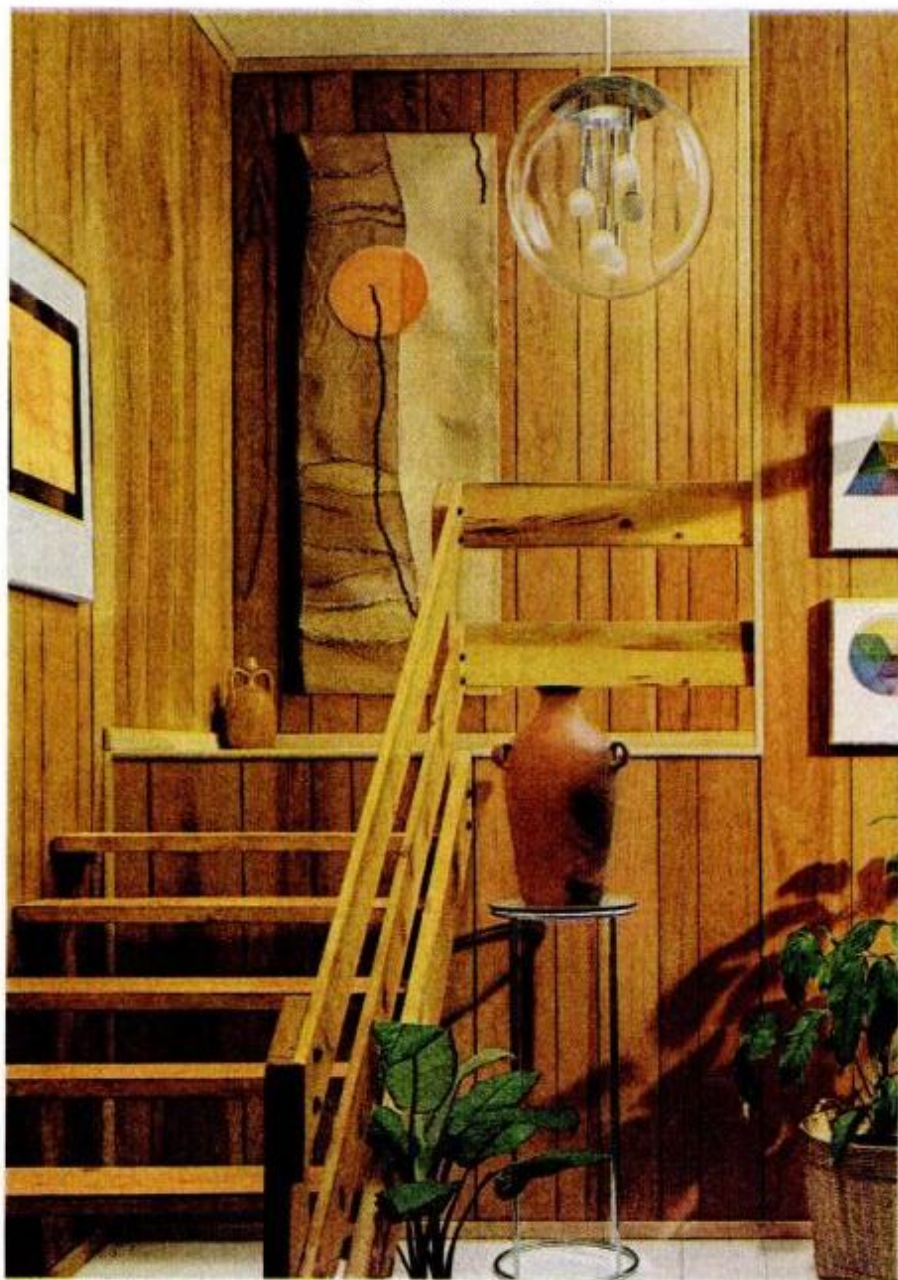


Standing headroom inside the cabin and a large open cockpit aft are features of Cruisers' 26-foot Bar Harbor. Power options include single and twin sterndrives.

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And if you'd like to know more about the paneling, send for our full-color booklet, "All About Wall Paneling." It's filled with decorating hints, and it's yours when you send your name, address and 50¢ to Champion Building Products, Box 61, N.Y., N.Y. 10016.



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NEW BIG BOATS YOU TAKE IN TOW

(Continued from page 76)

save a sale, the dealer may suggest the cheapest two-wheeler around, so close to capacity that you may overload it by adding water to your battery.

Rather than a flimsy, potentially dangerous trailer, rent or borrow one if you need it only spring and

fall to launch and haul. Remember that on trips you may add extra outboards, batteries, ice chests, and the weight of luggage for six weeks. Be sure the trailer supports your hull properly—a Sears, Roebuck test station test showed a hull could endure more stresses on a trailer trip than in the water. Again, as in all things afloat and ashore, quality counts. ★★★



Glastron's brand-new SeaFury line of 20-foot trailerables has V-208 offshore sportsman rated for 220 hp (above), plus 202 open fisherman and 209 sterndrive with cabin.



Nantucket 26-V with Wynne hull converts the dinette into a double berth and has twin V-bunks forward. Lifting rings, hydraulic trim tabs are also Silverline features.



Gran Bateau, 25-foot trailerable by Cruisers, can add to the cabin berths with runabout-type sunlounger bunks in the cockpit. A flush-deck model is for fishermen.

There'll never be a better time to buy an RV!

Have you seen the latest line-up of RVs for 1977? If you haven't, you're missing out on a whole new world of traveling fun! You can have all the comforts of home...away from home. The 77's are better than ever and there's a style and model to fit everyone! The earlier you buy, the more time you'll have to enjoy summer. Find out more about the fascinating world of RVing by visiting your nearest dealer today!

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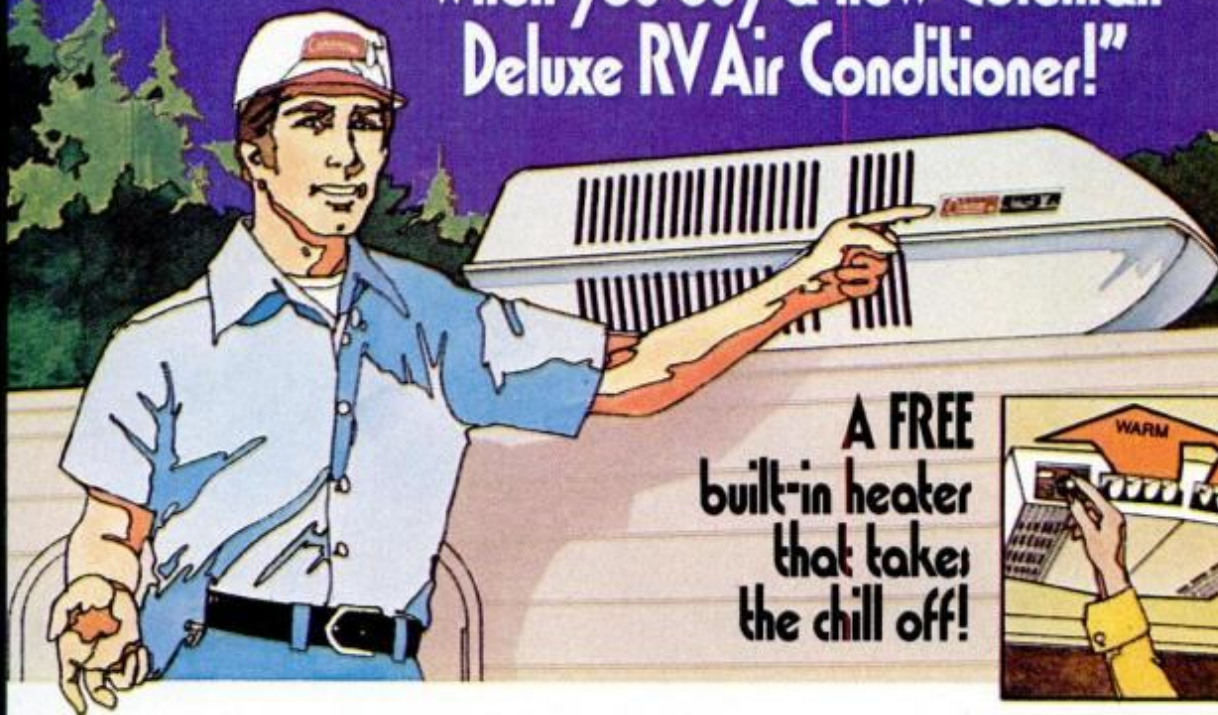
Enter the Sweepstakes each time you visit your participating Coleman Sweepstakes dealer on an official entry blank. Winners will be determined by a random drawing. Sweepstakes is open to all United States residents who are 18 years of age or older. Offer void in Missouri and wherever else prohibited or restricted by law. No purchase is necessary to win, and all prizes listed will be awarded. Contest begins April 1, 1977 and ends June 30, 1977. Entries must be postmarked prior to closing date. See official entry blank for complete details of Sweepstakes conditions.

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It's ideal for those mornings & evenings that are just cool enough to make you uncomfortable, but not cold enough to fire-up your LP furnace.

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fantastic offer right now! And Coleman quality air conditioners deliver unequaled efficiency, with super-quiet performance to give you cool, quiet comfort. Compare! Exclusive Dial-A-Comfort control lets you "fine-tune" your own personal comfort setting. All this plus a **FREE** built-in heater that takes the chill off without wasting precious LP gas. This limited-time offer is good on Deluxe ("A" Model) air conditioners purchased between April 1, 1977 and June 30, 1977 from participating RV dealers.

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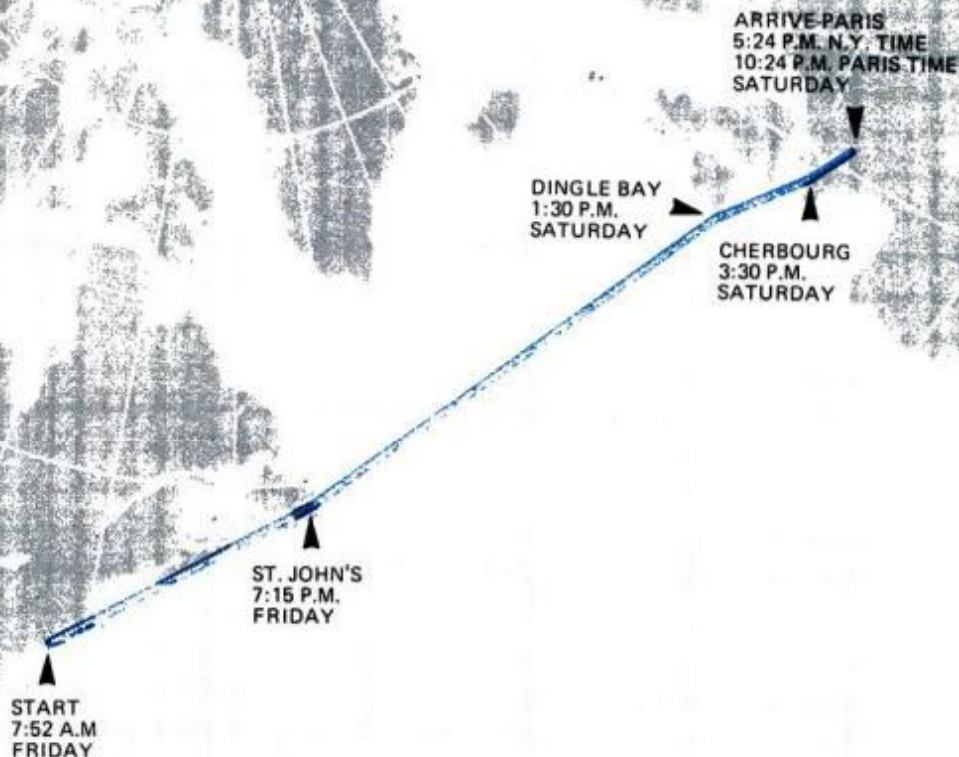
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A flight to remember

'Here was an airplane constructed
for one purpose: to fly the ocean.'

by Richard F. Dempewolff

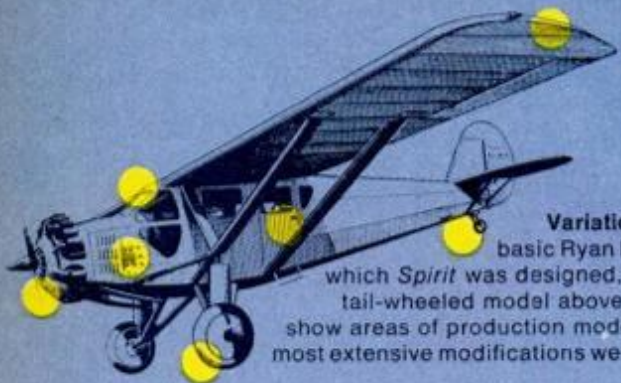
Fifty years ago the skies buzzed with barnstormers and wing-walkers flying over county fairs in World War I Jennies, spidery triplanes, biplanes and a few newfangled monoplanes. Mail and small parcels already were winging between large cities. But for eight years, an offer of \$25,000 posted by a wealthy French hotel owner, Raymond Orteig, for the first plane to fly nonstop from New York to Paris had gone begging.

Then, early in 1927, front pages proclaimed a flood of contenders. The race to be first was on.

Floyd Bennett and Cmdr. Richard E. Byrd, with a crew of two, were said to be preparing a Fokker trimotor for the trip. The American Legion was funding two Navy pilots, Lt. Cmdr. Noel Davis and Lt. Stanton Wooster, in a retrofitted three-engined Keystone bomber. A rich New York junk dealer named Charles Levine had just bought a Bellanca monoplane and the word was out that he'd hire Bert Acosta, Clarence Chamberlin "or someone" to pilot him over to collect the prize. In Paris, two famous French aviators, Charles Nungesser and Francois Coli, were



Lanky "Lone Eagle" Lindbergh, a boyish 25, poses beside the *Spirit* during flight tests. The plane still lacks a prop hub.



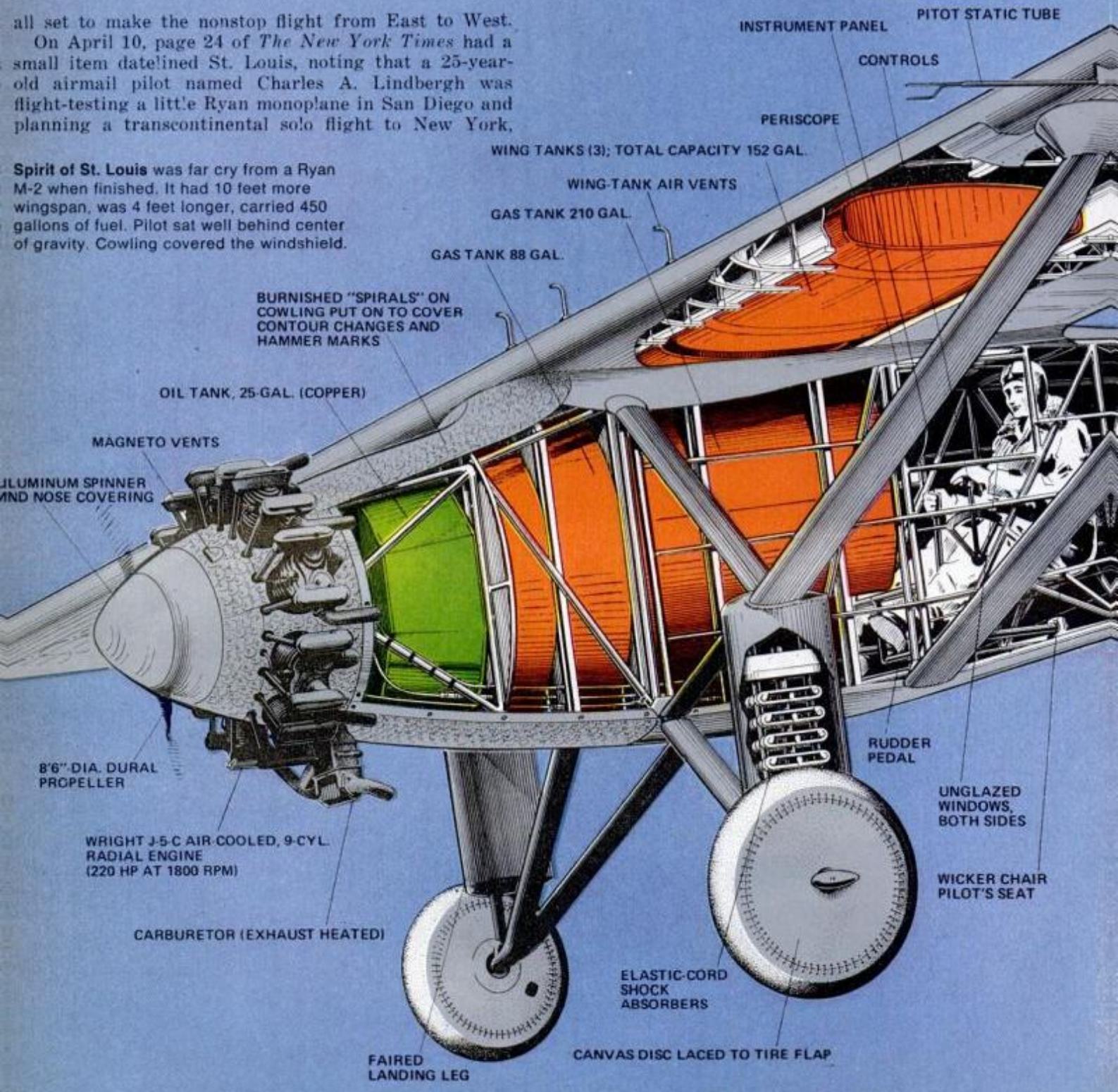
Variation of the basic Ryan M-2 from which Spirit was designed, was the tail-wheeled model above. Circles show areas of production model where most extensive modifications were made.

followed by a solo nonstop from New York to Paris. The brief note drew little serious attention. A copilot or navigator was vital, the old pros insisted. A lone pilot couldn't stay alert—or even awake—on the 32-hour drone. The single-engine concept was considered an absurd risk, and one snide "expert" kissed off the entire idea as a Hollywood promotion stunt for a coming movie. Then, in quick succession, several tragic events occurred. On April 16, at Teterboro, N.J., the Byrd-Bennett Fokker—now dubbed *America*—nosed over on its first landing and was out of it until repaired. On the 28th, Davis and Wooster crashed on their final full-load test at Langley Field in Virginia. Both were killed. On May 8, Nungesser and Gali took off from Paris and were

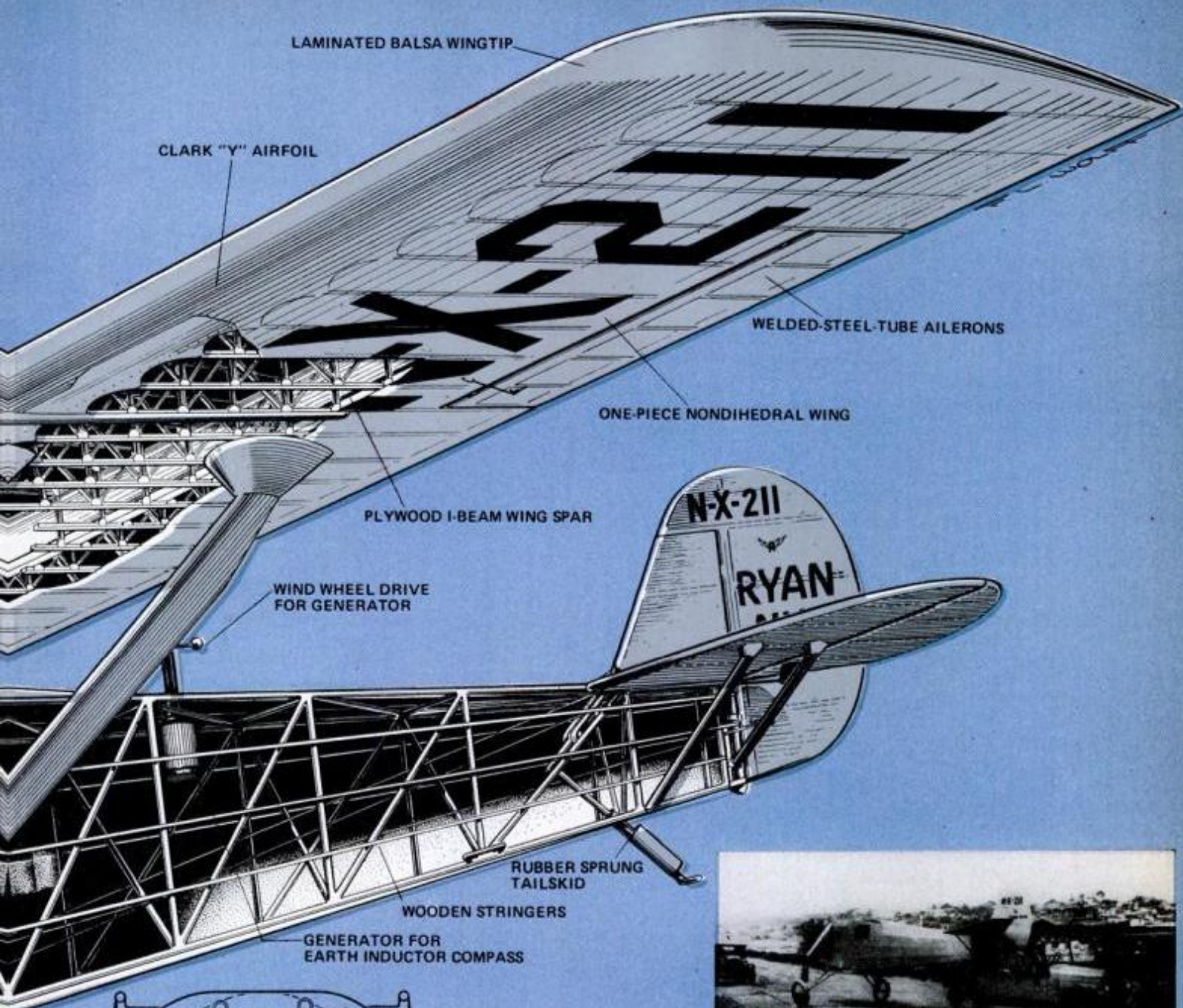
(Please turn to page 235)

all set to make the nonstop flight from East to West. On April 10, page 24 of *The New York Times* had a small item datelined St. Louis, noting that a 25-year-old airmail pilot named Charles A. Lindbergh was flight-testing a little Ryan monoplane in San Diego and planning a transcontinental solo flight to New York,

Spirit of St. Louis was far cry from a Ryan M-2 when finished. It had 10 feet more wingspan, was 4 feet longer, carried 450 gallons of fuel. Pilot sat well behind center of gravity. Cowling covered the windshield.



PM art: Fred L. Wolff



LAMINATED Balsa WINGTIP

CLARK "Y" AIRFOIL

WELDED-STEEL-TUBE AILERONS

ONE-PIECE NONDIHEDRAL WING

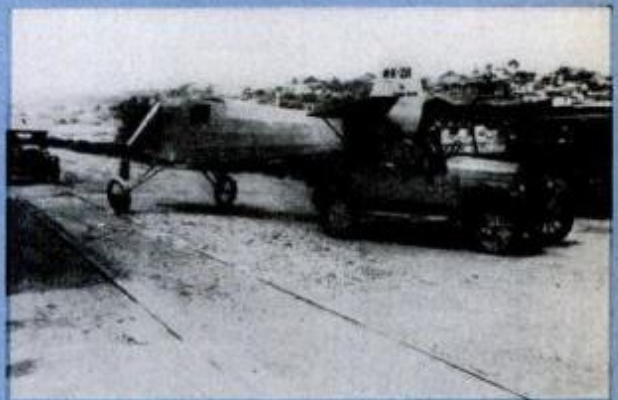
PLYWOOD I-BEAM WING SPAR

WIND WHEEL DRIVE FOR GENERATOR

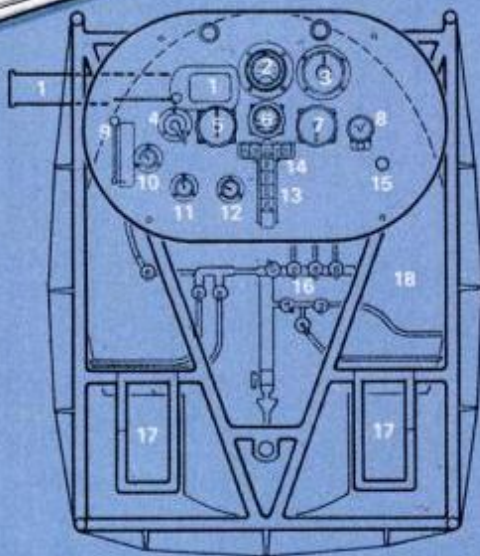
RUBBER SPRUNG TAILSKID

WOODEN STRINGERS

GENERATOR FOR EARTH INDUCTOR COMPASS



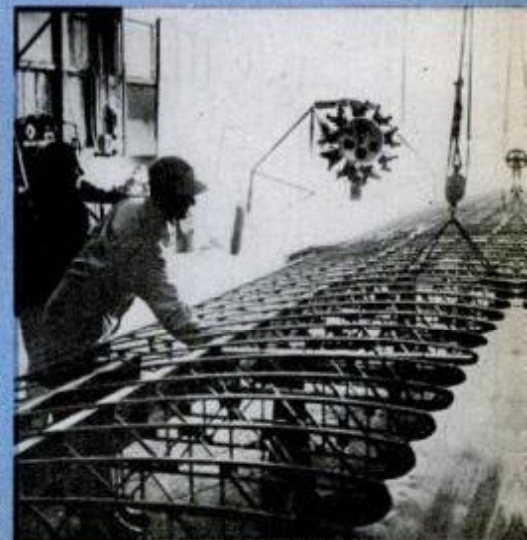
Completed fuselage of *Spirit* was towed from Ryan factory by private roadster of Claude Ryan along a public highway to the company's flying field for final assembly (right).



1. Periscope. 2. Earth inductor compass.
3. Altimeter. 4. Magneto switch. 5. Tachometer.
6. Turn and bank. 7. Air speed. 8. Clock.
9. Gas mixer. 10. Oil pressure. 11. Oil temperature.
12. Air pressure. 13. Fore-and-aft level. 14. Transverse level.
15. Primer. 16. Fuel cocks. 17. Rudder pedals.
18. Aft fuel tank (210-gal.).



Oversize wing for the *Spirit* was built on top floor of Ryan factory (above). To get it out, workers slid it out to the roof of a freight car on the siding, then hoisted it to a flat-bed truck. At right, craftsmen assemble ribs 11 inches apart to insure airfoil contour integrity.





RANGER 1750 FISH-'N-PLAY



BASS MASTERS CLASSIC RIG



B.A.S.S. ALUMINUM CHAMP

With a little effort, an open pocketbook, a liking for fancy electronics and a taste for candy-apple metal-flake finish, a fisherman today can spend well over \$10,000 for his bass boat rig.

But now the price pendulum is taking a happy swing the other way. With a little compromise in performance, this year's angler can get many features of that big-ticket rig for a third of that cost. The angler may hum out to his favorite fishing hole at 30 mph rather than 50 (and save some gas along the way), but he should catch just about as many fish without any sacrifice in safety and little in comfort. While some swank will be missing, an owner can always trade up later as many other boatmen do.

Evolution

The slick '77 machine bearing the bass boat name has come a long way from the skiff-and-cane-pole days. Sparking much of this development has been Ray Scott, creator of Bass Anglers Sportsman Society in Montgomery, Ala. For eight years, his tournaments have brought together the country's best professional fishermen and they naturally compared notes on rigs that worked best for them.

Today's result of the bass boat growth is a specialized hull that can get up and plane out smoothly on its center keel-pad strip with moderate power or handle more muscle from the motor if the angler insists on high horsepower. The ride must be comfortable and safe in modest chop and so stable at anchor or trolling speed that fisherman can stand up and move about to cast or boat a fish. It's a sheltered-water boat with low freeboard, and the gunwales have a minimum of cleats, chocks and fittings that might foul a line. Built-in storage compartments are customary, and a true bass boat will have at least one live well that is often arranged for aerated circulating water to allow live storage of catch or live bait.

Seats are upholstered for long hours of pleasant casting—a large improvement over slats and bait-bucket seats. Seats often swivel, provide armrests and height adjustment—some feature built-in shock-absorber systems. Instrumentation is optional, but most bass experts know the advantages of depth-and-fish finders, electric temperature gauges, trolling motors and other improvements.

Controversy

Some bass boat improvements are a result of harsh criticism. Bass

tournaments have become so popular they are an easy target for critics unfamiliar with them. "Fish are being needlessly slaughtered" is one false complaint. In tournaments sponsored by the BASS organization, all boats must have wells to keep the fish alive for weigh-in and the fish are then returned alive to the water to grow and get caught another day. Winning points are deducted for any fish not weighed-in alive, and after the 1976 BASS Masters Tournament in Guntersville, Ala., over 90 percent of all fish were returned. The others become food fish donated to charity.

Excessive speed, however, has been a valid bass boat complaint as fishermen clamped the biggest engines they could buy onto their little rigs. Tournament rules now being enforced outlaw all entries exceeding the maximum power notation installed by the manufacturer in every boat.

Even if not overpowered, a boat in a sharp turn can still flip a driver overboard, so emergency kill switches that turn off the ignition if the driver leaves the helm are now required.

Bass boats are not race boats and a concerted effort is being made to prevent reckless driving and accidents. Some areas already have rules that no passenger can ride up on a forward or rear pedestal seat at any speed faster than trolling.

While a Ranger bass boat, like the 17-footers with 115-hp Johnson outboard power that are the official BASS Classic rigs, can top 50 mph, the new lighter aluminum models with only a 35-hp motor can turn out a very reasonable and worthwhile 35 mph.

Revolution

There's a good chance that the new aluminums will start an impressive new trend toward less expensive models. The B.A.S.S. Champ, called a \$4378 value with its live well, sonar fish finder, motor, trailer and modest refinements, is expected to sell for about \$3595. A dozen other aluminum boat manufacturers are also eyeing the field.

Not all "bargains" are likely to be worth the money, and the careful and frugal fisherman shopper should find out if his choice is made of a good heavy-gauge aluminum alloy designed to stand up to marine conditions. Metal boats have a reputation for being noisy as wavelets drum on the outside and a rattling tackle box spooks fish for miles. See if your selection is well carpeted inside to deaden noise and give better

(Please turn to page 240)

Best new boats for bass

Choices run from posh to bargain-practical for the latest in fishing craft.

by Bill McKeown
OUTDOORS EDITOR

Performance hull of 17-foot Ranger has high-styled cockpit and deck. Designed-builder Forrest Wood readies personal model for fishing.

Classic rig developed for the BASS tournaments is an outboard-powered package worth over \$8500 when fitted with all its accessories.

Stripped-down B.A.S.S. Champ still includes basic fishing accessories, can be bought for about \$4600 with trailer, thanks to economies.

by Eugene A. Sloane

The great displacement race

KZ1000

KA

DOHC

SAKI

The race is on. BMW's newest superbike is now 1000 cc. Kawasaki's speedy entry is at the same number. Even Moto Guzzi, the exotic, totally automatic entry from Italy, is hitting the scales at a magic 1000 cc—a new high for that marque. Why the big displacement race? Well, for one thing, big-bore machines are safer. They have the horses, they get up and go, to pass a long trailer truck and get back into a safe lane quickly. Even loaded with two-up riders and 30 or 40 pounds of camping gear, the big machines will cruise all day at a comfortable 55 mph and whip up to 80 in seconds if you need the speed. Most important, the bigger bikes are far more comfortable to ride long distances. You can travel 400 miles or so a day without undue fatigue, and that's a

YAMAHA XS750



MOTO GUZZI V-1000



SUZUKI GS750



HONDA GL-1000



HARLEY-DAVIDSON FLH-1200



BMW R100RS



BIG-DISPLACEMENT MOTORCYCLES—SPECIFICATIONS

MAKE AND MODEL	ENGINE TYPE	BORE AND STROKE (in.)	CC DISP.	COMPR. RATIO	CARBS.	RED LINE	FUEL CAP. (gal.)	MPG (Aver.)	WHEEL BASE (in.)	CURB WT. (lbs.)	SEAT HEIGHT (in.)	GROUND CLEARANCE (in.)	TIRES		PRIMARY	SECONDARY	DRIVE TRAIN RATIOS					APPROX. PRICE
													FRONT	REAR			1	2	3	4	5	
Kawasaki KZ-1000	DOHC 4-stroke, 4-cylinder	2.76 x 2.60	1015	8.7:1	Mikuni VM26SS (4)	9000	4.4	47.5	59	554	32	6.75	3.25 x 19	4 x 18	Helical gear	No. 630 double-row chain	12.06	8.33	6.35	5.25	4.64	\$2600
Honda GL-1000	OHC 4-stroke, 4-cylinder, liquid-cooled	2.83 x 2.42	999	9.2:1	32-mm Keihin (4)	8550	5	40	60.8	595	31.9	5.9	3.5H x 19	4.5H x 17A	Helical gear	Shaft drive, spiral gear	2.5	1.78	1.333	1.097	.939	\$2600
Harley-Davidson FLH-1200	OHV V-twin, 4-stroke	3.437 x 3.968	1200	8:1	38-mm Dell'Orto	5000	5	37.4	61.5	775	33	6	5.1 x 16	5.1 x 16	Double-row chain	Single chain	10.74	6.5	4.39	3.57	—	\$3900
Motor-Guzzi V-1000	V-twin, 4-stroke	3.85 x 3.07	949	9.2:1	30-mm Dell'Orto	7400	6.4	46	58.5	560	31.5	5.5	4.1 x 18	4.1 x 18	Double-row chain	Torque converter with cooling radiator in oil circuit; two-speed automatic transmission	13.2	8.58	6.21	5.01	4.5	\$4000
BMW R100RS	opposed-twin, 4-stroke, OHV	3.70 x 2.78	980	9.5:1	40-mm Bing V94 (2)	7300	6.3	44	57.5	535	32.5	6.5	3.25H x 19	4 x 18	Helical gear	Shaft drive, spiral gear	13.2	8.58	6.21	5.01	4.5	\$4600
Suzuki GS750	DOHC 4-stroke, 4-cylinder	2.56 x 2.22	748	8.7:1	Mikuni 2M26SS (4)	9000	4.8	41.5	58.7	492	31.5	5.9	3.25 x H19	4H x 18	Double-row chain	Single chain	2.71	1.777	1.39	1.625	.9	\$2200
Yamaha XS750	DOHC triple 4-stroke	2.68 x 2.7	747	8.5:1	Mikuni BSS4 (3)	7500	4.5	40	57.9	511	31.9	5.5	3.25 x 19	4 x 18	Hy-Vo gear	Shaft drive, bevel gear	13.38	8.63	7.07	5.96	5.19	\$2250

NA—not available



Displacement leader among big, touring bikes is Harley-Davidson FLH-1200 (right).

safety feature in itself. Finally, the superbikes handle rock-steady on the road, virtually immune to side winds and the vortex of air from trucks and cars ahead that blows smaller bikes around and makes them harder, more tiresome to handle.

Now let's get down to the seven big displacement motorcycles that are available coast to coast. We tested each of these machines, and here are our findings, along with comparative specifications.

Kawasaki KZ-1000

I nominate the KZ-1000 as the king of the superfast bikes. It sure is the fastest of the seven big bikes I road-tested for PM. I mounted this big bike at the Kawasaki headquarters near Los Angeles and headed out over the San Bernardino mountains for the desert where I could open it up. The KZ-1000 handled easily even at low speeds in traffic and more than held its own in high-speed freeway traffic. Even over the rain grooves at 60+ mph, this bike stayed steady with very little wobble so common to other bikes in this situation.

First thing I noticed when climbing the mountains at high speed was how smoothly this machine ran. The mirror, tip-off of any vibration, was practically rock-steady. The front rear disc brakes, unusual for a motorcycle at this price, were great—a good thing, too, I might add, considering how fast this baby goes. You can get her up to 80 or 90 mph so fast it leaves your front teeth back there somewhere. There's more than enough torque and horsepower for anybody to handle, and perhaps more than enough.

Just how fast *would* the KZ-1000 go? I bent down, head over the bars, throttle easing open. Soon the white line in the middle of the road seemed

(Please turn to page 266)



Fastest Indy ever!

by Glenn Howell

2 "LOOKS LOUSY"
A new track surface, new tires and allowable boost in manifold pressure all add up to the likelihood of a 200-mph lap!

Even in an era of space travel and supersonic passenger planes, 200 mph on the ground is plenty fast. It's even more incredible at a racetrack that first opened in 1911 and was once paved with bricks!

Several changes have occurred that should make the 1977 event the fastest Indy 500 to date: There has been a small—but tremendously important—change in the rules, and the speedway has been totally repaved since last year.

Those factors taken together with ever-advancing technology and the constant search for more power from the engines means, quite simply, that one or more drivers could average over 200 mph for a single lap at the "brickyard." One driver, Johnny Rutherford, almost did the trick back in 1973. He steered his McLaren around the course in 45.21 seconds for a single lap of 199.07 mph.

The pop-off valve

The rule change this year involves a little gizmo known in racing as the "pop-off" valve. Basically, it acts like the relief valve on a pressure cooker or steam radiator—when the pressure (measured in pounds per square inch, or p.s.i.) builds up to 80 p.s.i., the valve releases the excess pressure into the atmosphere.

Last year all cars running at Indy had to have the pop-off valve for qualifying *and* the race. This year it is mandatory for qualifying only. That means cars have an unlimited amount of boost available to them, the limits determined only by the fuel available and the amount of boost the engine can withstand.

The tires

Additionally, the new surface at the Speedway means that Goodyear has had to develop entirely new tires for the '77 race.

"When the rules change, as they have for 1977, we must respond," says Leo Mehl, Goodyear's director of racing. "The tires we ran last year will not do the job this year. Beyond the fact that cars change, and the fact that there will be numerous new cars at Indy, the most basic ingredient in tire performance has changed

LATE NOTE: In March, before competition began, Gordon Johncock ran an unofficial 200.401-mph lap during tire tests.

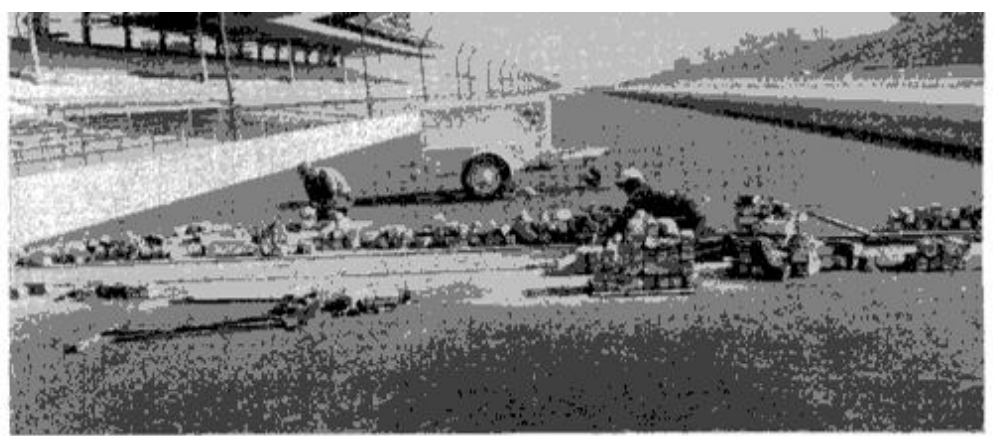
and that's the surface of the race-track."

Goodyear currently supplies all the tires used in the Indy 500 and has wasted no time in preparing for this year's race. "We tested there immediately following the repaving. They repaved it in June (1976) and we were there in July. And we've been back there two times since," adds Mehl.

"If you took last year's tire to Indianapolis and put it on a new car," Mehl points out, "you would blister the thing very quickly; it would fail from heat."

The cars

Not only will there be all-new tires



Repaving of speedway began right after last year's race. New surface will be big factor in this year's speeds. At 61st running on May 29, cars will speed over 3 feet of traditional brick, shown being relaid flush with new surface at start/finish line.

at the race; there will be more all-new cars in 1977 than there have been in many years. Possibly as

many as 18 new cars are expected, and most of them will be in the hands of drivers who have an excellent

SPEEDS AT INDY — 1911 TO 1977

Year*	Winner	Car	Average Speed	Fastest Qualifier†
1911	Ray Harroun	Marmon	74.590	No Times Available
1912	Joe Dawson	National	78.720	David Bruce Brown
1913	Jules Goux	Peugeot	75.930	Jack Tower
1914	Rene Thomas	Delage	82.470	George Boillot
1915	Ralph DePalma	Mercedes	89.840	Howdy Wilcox
1916	Dario Resta	Peugeot	84.000	Johnny Aitkin
1917	Howdy Wilcox	Peugeot	88.050	Rene Thomas
1920	Gaston Chevrolet	Monroe	88.620	Ralph DePalma
1921	Thomas Milton	Frontenac	89.620	Ralph DePalma
1922	Jimmy Murphy	Murphy	94.480	Jimmy Murphy
1923	Tommy Milton	H.C.S.	90.950	Tommy Milton
1924	L. L. Corum and Joe Boyer	Duesenberg	98.230	Jimmy Murphy
1925	Peter DePaolo	Duesenberg	101.130	Leon Duray
1926	Frank Lockhart	Miller	95.904	Earl Cooper
1927	George Souders	Duesenberg	97.545	Frank Lockhart
1928	Louis Meyer	Miller	99.482	Leon Duray
1929	Ray Keech	Simplex Piston Ring	97.585	Cliff Woodbury
1930	Billy Arnold	Miller Hartz	100.448	Billy Arnold
1931	Louis Schneider	Bowes Seal Fast	96.629	Billy Arnold
1932	Fred Fame	Miller Hartz	104.144	Lou Moore
1933	Louis Meyer	Tydol	104.162	Bill Cummings
1934	Bill Cummings	Boyle Products	104.863	Kelly Petillo
1935	Kelly Petillo	Gilmore Speedway	106.240	Rex Mays
1936	Louis Meyer	Ring Free	109.069	Rex Mays
1937	Wilbur Shaw	Shaw Gilmore	113.580	Jimmy Snyder
1938	Floyd Roberts	Burd Piston Ring	117.200	Ronney Householder
1939	Wilbur Shaw	Boyle	115.035	Jimmy Snyder
1940	Wilbur Shaw	Boyle	114.277	Rex Mays
1941	Floyd Davis and Mauri Rose	Noc-Out Hose Clamp	115.117	Mauri Rose
1946	George Robson	Thorne Engineering	114.820	Ralph Hepburn
1947	Mauri Rose	Blue Crown Spark Plug	116.338	Bill Holland
1948	Mauri Rose	Blue Crown Spark Plug	119.814	Duke Nalon
1949	Bill Holland	Blue Crown Spark Plug	121.327	Duke Nalon
1950	Johnnie Parsons	Wynn's Friction Proofing	124.002	Walt Faulkner
1951	Lee Wallard	Belanger Motors	126.244	Walt Faulkner
1952	Troy Ruttman	Agajanian	128.922	Chet Miller
1953	Bill Vukovich	Fuel Injection	128.740	Bill Vukovich
1954	Bill Vukovich	Fuel Injection	130.840	Jim McGrath
1955	Bob Sweikart	John Zink	128.209	Jack McGrath
1956	Pat Flaherty	John Zink	128.490	Pat Flaherty
1957	Sam Hanks	Belond Exhaust	135.601	Paul Russo
1958	Jimmy Bryan	Belond A-P	133.791	Dick Rathmann
1959	Rodger Ward	Leader Card 500 Roadster	135.857	Johnny Thomson
1960	Jim Rathmann	Ken-Paul	138.767	Jim Hurtubise
1961	A. J. Foyt	Bowes Seal Fast	139.130	Eddie Sachs
1962	Rodger Ward	Leader Card 500 Roadster	140.293	Parnelli Jones
1963	Parnelli Jones	Agajanian Willard Battery	143.137	Parnelli Jones
1964	A. J. Foyt	Sheraton Thompson	147.350	Jim Clark
1965	Jimmy Clark	Lotus Powered by Ford	150.686	A. J. Foyt
1966	Graham Hill	American Red Ball	144.317	Mario Andretti
1967	A. J. Foyt	Sheraton Thompson	151.207	Mario Andretti
1968	Bobby Unser	Rislone	152.882	Joe Leonard
1969	Mario Andretti	STP Oil Treatment	156.867	A. J. Foyt
1970	Al Unser	Johnny Lightning 500	155.749	Al Unser
1971	Al Unser	Johnny Lightning 500	157.735	Peter Revson
1972	Mark Donohue	Sunoco McLaren	162.962	Bobby Unser
1973	Gordon Johncock	STP Double Oil Filter	159.036	Johnny Rutherford
1974	Johnny Rutherford	McLaren	158.589	A. J. Foyt
1975	Bobby Unser	Jorgensen Eagle	149.213	A. J. Foyt
1976	Johnny Rutherford	McLaren	148.725	Mario Andretti
1977	?	?	?	?

*No races the war years of 1917-1918 and 1942-1945.

†Not necessarily the pole position winner.

‡Cummings' over 125 mph lap made before Snyders'.

chance of winning a first, second, third, or—in the case of A.J. Foyt—a fourth Indianapolis 500.

Early odds-on favorite to set the fastest time and, conditions being right, break the 200-mph barrier in the process, is the new McLaren M24-Cosworth. The new McLaren is a close relative of the McLaren M23 which carried James Hunt to the world driving championship last year. In fact, one of the M23s was left in the United States last fall after the U.S. Grand Prix to serve as a test bed for the new Indy car.

Powering the M24 will be another close relative. It's a turbocharged (exhaust-driven supercharger) version of the Cosworth V8, an engine

by Britishers Mike Costin and Keith Duckworth and funded by Ford of England in the mid-'60s. It's the most popular engine in Grand Prix racing and was used in Hunt's championship McLaren last year.

Team McLaren will have First National City Travelers Checks as the sponsor for defending winner Johnny Rutherford. Additionally, two other M24-Cosworths will be in the hands of racing impresario Roger Penske for Tom Sneva (the Norton Spirit) and Mario Andretti (CAM2 Special).






Andretti dazzled the troops last year by setting the fastest time of all, but started toward the back because an overseas Grand Prix race

caused him to miss the first weekend of time trials when the pole is awarded.

Tyler Alexander, Team McLaren's Boston-born team manager, hedges a bit when he considers a 200-mph lap: "It really depends on what kind of a day it is. There's a possibility we might break the record, yes. If for some reason it's really hot and it has rained and the track is lousy, then I don't see it happening. But if it's cool and there's no wind..." he says, his voice trailing off into contemplation of his team being on the pole with a new record and heading for a third win. After all, they started first and they finished first in the

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Speed Milestones

Qualifying Speed (mph)	Year	Driver	Car	MPH
88.45 88.23 99.86 96.90 96.69 104.76	1919	Rene Thomas	Ballot 	LAP OVER 100: 104.78
99.15 100.75 100.50 108.17 108.037 113.196 111.735 120.100 122.391 120.599 113.268 116.080 117.363 118.530 119.329 120.736 119.644 125.267	1937	Bill Cummings†	Boyle Products Special/Offy 	LAP OVER 125: 125.139
125.769 130.138 127.850 128.691 133.944 128.755 131.603 132.939 134.343 136.872 139.034 138.392 141.033 142.580 145.596 144.817 145.974 145.908 149.056 147.481 150.370	1962	Parnelli Jones	Franklin-Walker Special/Offy 	LAP OVER 150: 150.25
151.153 158.828 161.233 165.899 168.982 171.559 170.568 170.221 178.571	1971	Peter Revson	McLaren/Offy 	LAP OVER 175: 170.354
195.940 198.413 191.632 193.976 189.404	1971	Johnny Rutherford	Gulf McLaren/Offy 	LAP OVER 175: 198.871
?	1977	?	?	OVER 200?

†Still stands as a race record.

REALLY
LOOKS
GOOD

PM OWNERS REPORT: AMC PACER STATION WAGON

No one feels wishy-washy about AMC's eye-catchingest wagon

A nationwide survey based on 908,301 owner-driven miles

by Michael Lamm WEST COAST EDITOR

Some people consider the Pacer unusual-looking, especially the wagon version. Others think it's "cute," "futuristic," "adorable," "striking," "handsome," "original."

Whatever you think of the Pacer's styling, AMC certainly can't be accused of copying anyone. As American Motors' design vice president Dick Teague noted at the Pacer wagon's preview: "At least we're not bringing out another button-down Mercedes."

The significance of the Pacer's styling is, indeed, evident: More purchasers bought the wagon on the basis of its looks than for any other single reason. Of the 1000 Pacer wagon owners we surveyed, 41.2 percent listed "styling" as their primary buying incentive.

We'd like to let a number of individual owners have their say. The following responses to our questionnaires are representative.

First, a self-employed California product designer, aged 40: "I wanted an auto that showed some original industrial design, was large enough for comfort, and offered some promise of gas savings. I'm 6-4, 320 pounds, have driven the Pacer wagon up to 500 miles a day and am surprised by the comfort. What I like most are performance and comfort, especially when driving in the high Sierra and on secondary gravel roads; also visibility, handling, steering, suspension, good brakes and the optional reclining seats. My complaints are shoddy materials and workmanship in the interior; also difficulty in getting parts and proper repairs. For example, I've had the car in the shop for a total of eight days

Forty-eight cubic feet of cargo capacity with the rear seat folded flat.

Size and roominess tied for second, but styling brought buyers into the showroom.

AMC dropped its overdrive option this year, but a four-speed is available.

for little things—nothing major—and the gas gauge still doesn't work."

Now a 45-year-old North Carolinian who's the branch manager for a vacuum cleaner company: "I need a car with plenty of interior room plus economy. I've found the Pacer wagon excellent in every way—hasn't needed a bit of servicing in 5000 miles; dealer's sales policies excellent; excellent body work except for some loose carpeting around the pedals. I especially like the big, fat bucket seats, the big-car ride, the wide doors and the Pacer's handling on the road. The only problems I can see are that the outside mirror should be about six inches forward of its present location, the steering wheel seems too large, and the dimmer switch is too far from my foot."

A Michigan factory worker, aged 47: "I was attracted by the looks and body styling. I had been driving Oldsmobiles and Pontiacs, but because of gas prices, I decided to try a smaller car. Workmanship is pretty good, with only minor defects like a cracked door panel and some misalignments. Dealer didn't pressure me to buy; salesman polite, helpful, efficient. No problems yet so can't comment on dealer's service department. Rides better than the average small car, especially over rough roads. I particularly appreciate the handling ease, roadability, roominess, body styling and dependability."

A Kansas rubber worker, aged 57: "I bought Fords every two or three years for 20 years, have driven nearly every make of

(Please turn to page 243)

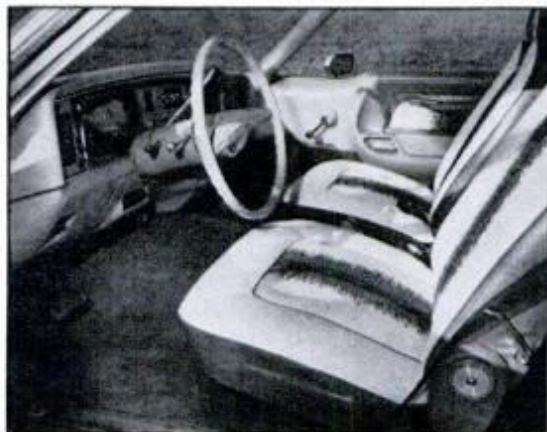
Summary of 1977 Pacer Wagon Owners Reports*

Total miles driven	908,301	Specific dislikes:	Comfort opinion (rear seat):	Good	33.8
Average miles per gallon		Gas mileage lower than expected	Excellent	Average	14.4
232-cu.-in. Six		Poor-quality materials	Very good	Fair	6.8
In town (EPA, 18 manual)	15.5	Lack of power	Good	Poor	11.7
Long trips (EPA, 23 manual)	19.0	Initial cost too high	Fair		
258-cu.-in. Six			Poor		
In town (EPA, 17 manual)	15.4	What changes would you like to see?	Had any mechanical trouble?	Number of vehicles owned:	
Long trips (EPA, 24 manual)	19.1	Better gas mileage	No	Pacer only	45.0%
Engine choices:		Standard rear wiper	Yes	Two cars	45.0%
232-cu.-in. Six	15.5%	Bigger glovebox		Three cars	6.9
258-cu.-in. Six	84.5	More powerful engine		Four cars	2.7
Why did you choose the Pacer wagon?		Bigger-quality materials	What type of trouble?	Five or more cars	0.4
Styling	41.2%	Workmanship opinion:	Carburetor	Makes of other cars owned:	
Size	26.3	Excellent	Electrical	Chevrolet	18.9%
Roominess	22.4	Good	Transmission	Volkswagen	16.8
Economy	20.0	Average	Oil leaks	Ford	13.3
Handling	14.9	Fair		Oldsmobile	7.7
Specific likes:		Poor	Did you fix it yourself?	Buick	7.0
Handling	54.4%	Comfort opinion (front seat):	No	Age distribution of owners:	
Comfort	32.9	Excellent	Yes	15-29 years	19.2%
Styling	31.3	Very good		30-49 years	46.4%
Roominess	28.6	Good	Dealer repairs satisfactory?	50-plus	34.4
Good vision	26.6	Fair	Yes	Would you buy another Pacer wagon?	
		Poor	No	Yes	82.3%
				No	17.7
			Dealer service opinion:		
			Excellent		

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




Although only 4 inches longer than the Pacer sedan, wagon version provides 48 cubic feet of cargo capacity on a flat, carpeted, chrome-ribbed floor. Rear venti-panes open, and rear riders report ample leg room. Wide doors make for easy entry and exit.



Wagon weighs a mere 76 pounds more than sedan, uses two versions of AMC's in-line Six. Vertical taillamps allow long lift-gate for lower loading still. Unitized body has isolated suspension plus rack-and-pinion steering. Reclining seats, special interior, fancy wheels come in D/L luxury package.





The best weapon for a winning game may not be that costly model you've wanted.

If you haven't been through the racket section of a tennis pro shop or large sporting goods store recently, it may surprise you to find an array suggesting that NASA scientists are trying to reconstruct a medieval armory. The tennis boom is being invaded by technology, with the current focal point being the ultimate "weapon" of the game, the racket.

Only five years ago, you chose between a wood or metal racket and paid about \$35 for a top-line, professionally endorsed model. Today, you can walk into a tennis specialty store and easily pay as much as \$200 for a racket that may not only fail to give any significant lift to your game, but could actually increase your chances for a serious case of a painful affliction known as tennis elbow. The entry of some 30 million Americans into tennis in the past

Can an exotic new racket improve your game?

by Robin Nelson

PM photo: Bob Golden

Материал, защищенный авторским правом

five years (for a current total of perhaps 40 million players) is partly responsible for the atmosphere of technological innovation, both dubious and legitimate. But a good deal of the cause lies in the nature of the game itself.

Good tennis is an exacting, painstaking and time-consuming pursuit, for which better-than-average physical condition and athletic ability are prerequisites. Yet few average players, or "intermediates" as tennis players style themselves, spend much time just practicing the game. Public courts are jammed, playing time limited, and fees for private and club courts are going through the roof. Having paid \$20 or more for an hour of court time indoors in most major cities, few players are going to spend it smoothing out the rough spots in their strokes.

Teaching professionals and coaches rail against this syndrome, but to little avail. A more powerful influence is the often evident American tendency to look for any available technological shortcut—better equipment, better shoes, a better racket. At least partly in response to this approach to the game, there are now some three dozen different tennis rackets on the market, at retail prices of from \$65 to \$200, which aren't made of wood or metal, but are of composite construction.

To manufacture them, dissimilar—often exotic and expensive—ma-

terials are bonded or molded together. Elements of wood, steel, aluminum, glass fibers, epoxies and plastics are all being used in these racket frames, but the glamour elements of composite matrix construction are graphite and boron fibers. These space-age fibers are manufactured molecule by molecule in super-hot furnaces and then woven into tapes or mats which can be built up and bonded with epoxy resins to form a structural unit—a racket frame—with an amazing strength-to-weight ratio.

Tennis rackets made this way are undoubtedly stronger than those made of wood, fiberglass or metal. Yet even more is being claimed for composite rackets, which are often promoted with statements that fall just short of guaranteeing a remedy for every flaw in the average hacker's technique. I've pored over a lot of racket brochures and ads recently, and while high-school physics is only a dim memory to me, it seemed that a number of these amazing pieces of equipment had escaped from Newtonian reality.

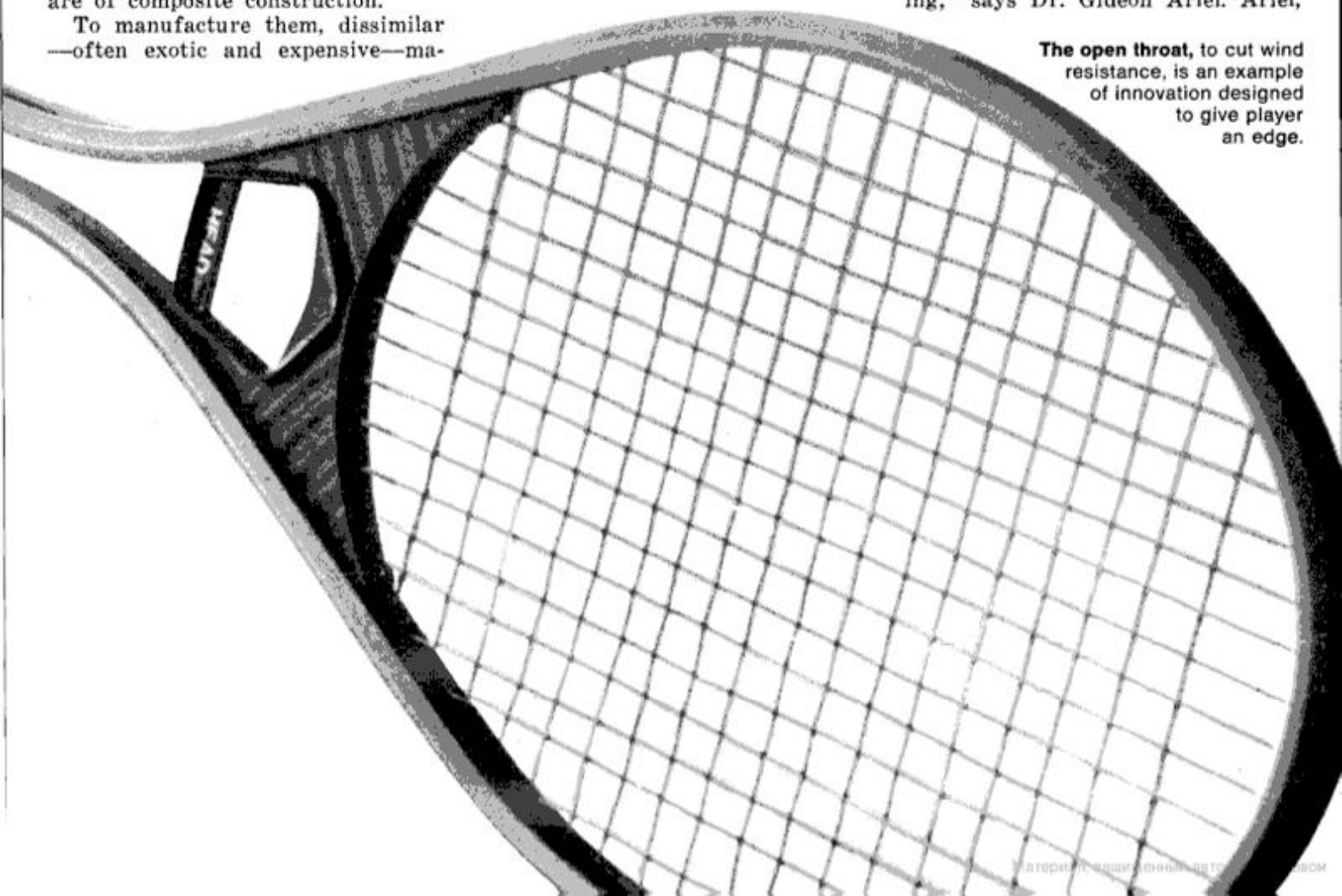
I read, for instance, that a new graphite racket from a major maker "does 70 percent of the work." As intriguing as that may sound, "work" is a formal definition in physics—a

measure of force moving through distance. I phoned the manufacturer and was referred to another company that supplies the graphite racket frames. Their project engineer, however, could offer no guess as to how the statement originated. This was a surprise, since I had anticipated the claim to be a distortion of a 70-percent coefficient of restitution (the proportion of the ball's original velocity at which it rebounds from a given position on the racket's face), which would be a good one as rackets go, but would by no stretch constitute "work."

"There's a very low level of sophistication in research and development among tennis racket manufacturers," another engineer told me. A former corporate R&D director in a high technology industry, he had been appalled when during a visit to one of the top-brand racket companies he had asked to see their lab facilities. "The most complicated piece of equipment they showed me," he recalls, "was nothing more than a machine that automatically throws tennis balls at a racket to see how long it holds up."

Could it be that a lot of expensive and highly touted tennis rackets are the product of guesswork? "According to our studies, the manufacturers must be doing a lot of guessing," says Dr. Gideon Ariel. Ariel,

The open throat, to cut wind resistance, is an example of innovation designed to give player an edge.



a formal Israeli Olympic discus thrower, heads a Massachusetts firm called Computerized Biomechanical Analysis. By computerizing the images from high-speed motion-picture film of various athletic activities, Ariel can analyze performance and utilize computer simulation to predict the results from adjustments or improvements in both technique and equipment. He helped Spalding design a new tennis ball, and those studies have prompted him to look more closely at tennis rackets.

Besides talking to Ariel and other researchers, I also consulted such tennis experts as Vic Braden, the psychologist-tennis pro who runs a California complex known as the Tennis University and has become one of the country's best-known teaching theorists, and Roy Emerson, the Australian champion who has won more major tournament singles and doubles titles than any other male player and now spends much of his time teaching. As a result, I reached one primary conclusion concerning tennis rackets: Their importance to the average player's game is entirely overstated. What follows is a rundown of the most common misleading impressions.

■ **My selection of a tennis racket is critical to my game.** In the words of Vic Braden, "the selection of a racket is way overplayed. Everything is already over-engineered, and by that I mean there isn't a player on the face of the earth who can play up to the potential of any good, modern racket—wood, metal, what have you."

■ **My racket doesn't give me enough power.** Any 10-year-old with a reasonably well-coordinated swing can hit a tennis ball from one end of the court to the other with good pace (speed) on it. Whippy metal rackets offer a trampoline effect that can add speed to a shot, compared to a stiff wooden racket, but is it relevant? "The average player's overwhelming problem," says Vic Braden, "is not generating more power but controlling the power he or she already has. Racket designers talk about increments on the order of four miles an hour now—it's meaningless."

■ **Then maybe I just need a heavier racket.** Probably not. You remember the formula for kinetic energy—mass times velocity squared over two. You gain a lot more power by increasing velocity rather than weight. That "macho" type at the tennis club with the heavy racket has forgotten that Mickey Mantle swung one of the lightest bats on the whole Yankee team.

■ **Okay, how about a new racket**

with less wind resistance? Ads for rackets with a divided throat or a "slimmer profile" make much of lowered wind resistance and are a classic case of those minuscule increments Braden talks about. They never go into exact figures or factors. Besides, swinging a racket with any upward or downward component to add spin to a shot changes the angle of attack to the resisting air away from 90° and further dissipates the infinitesimal advantage—it could

even result in a divided-throat racket having more "wind resistance."

■ **Forget power, then. I want one of the new rackets that will give me more "touch," more "feel."** Good luck. Gideon Ariel's studies at CBA showed that a tennis ball makes actual contact with any conventionally strung racket, under normal playing conditions, for only 3.7 to 4.2 milliseconds. It takes a nerve impulse approximately 50 milliseconds or more to get from your fingers to the cortex of your brain. In other words, the ball is long gone before you "feel" it, and as far as your being able to "control" the ball while it's on the racket, that's pure fantasy.

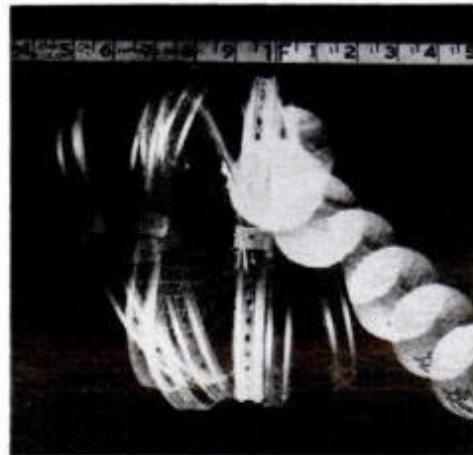
■ **I'll change my strings, or loosen them, for more control.** More mythology. Ariel's tests also showed that even when loosely strung rackets were involved, the composition of the racket frame more often determined differences in how long the ball resides on the racket face—and on some of them it was *less* time than with tighter stringing. Bernard Kaminstein, who developed a unique stringing pattern for the Pancho Segura Sweetspot racket, used a computer to analyze the behavior of strings very closely. He claims extensions of residence time by as much as a factor of 10 on his string pattern (remember, we're still talking milliseconds and the ball is still gone before you can react to it).

In his work, Kaminstein also coincidentally exploded one of the most widely held misapprehensions in tennis: Gut strings are more resilient than nylon. "Gut and nylon have nearly identical coefficients of elasticity," says Kaminstein, "and elongation under strain is also the same. If there is a difference that could affect play, it's only in the surface of gut strings which are rough, on a microscopic level, and keep the strings from moving as much as nylon, and therefore dissipating energy through friction." A substantial difference? "Not at all," says Kaminstein.

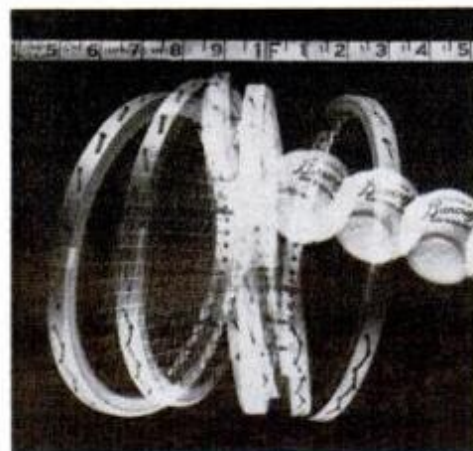
■ **Graphite and composite rackets resist torque from offcenter shots. That'll help my game.** A stiffer racket, whether reinforced by fiberglass, boron or graphite fibers, will give less twist when the ball strikes away from the dead center of the strings. However, more of the initial shock of that twisting force will be transmitted to your elbow, and doctors who have studied the problem say torque is a major factor in the tendon and muscle inflammation we call tennis elbow. Tennis professionals, who play most frequently, have not rushed in great numbers to

(Please turn to page 242)

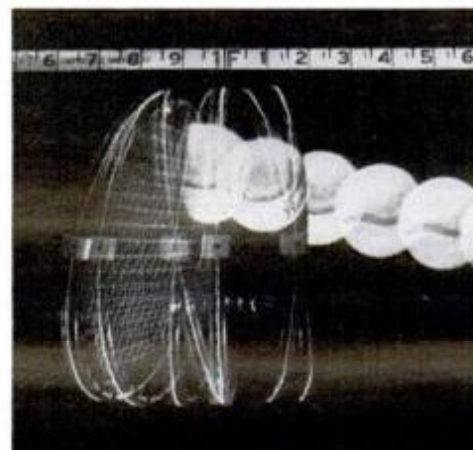
Photos: ProGroup, Inc.



Metal racket, struck offcenter by an 85-mph ball, shows flex in MIT photos.



Laminated wood racket showed the largest flex in tests for Tony Trabert Division.



Graphite, in ProGroup's Tony Trabert C-6 model, appeared strongest with least flex.

Test bed for the Shuttle

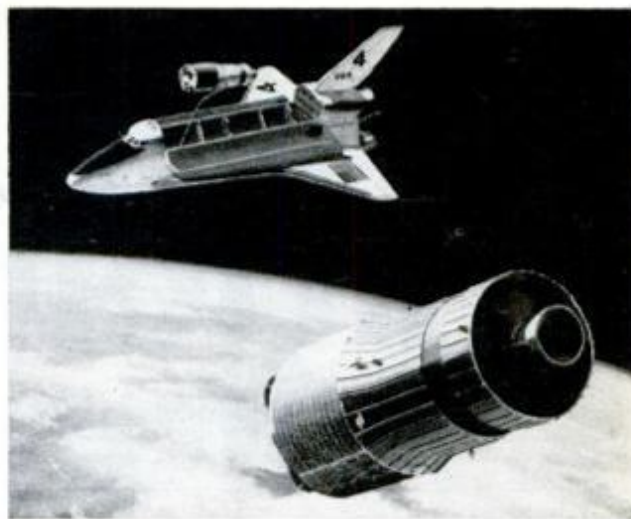
Anyone wandering unsuspectingly into the cavernous maw of Building 9-A at Johnson Space Center, Houston, Tex., may come away wondering about his mental balance.

Out on the gleaming "air bearing" floor, space-suited astronauts wearing shoes with suction cups walk across vertical walls like giant flies. On one side of the hangar-like space, a triple-jointed metal robot "arm" with a 50-foot reach lifts and lowers a 32,000-pound arrangement of gadgetry, or gently manipulates a bulky cylindrical air bag 60 feet long in and out of a canvas cradle.

In the distance, a huge, far-out craft is acrawl with space-suited men who act as though they were getting ready to leave this world. They are!

The sprawling complex is a test bed for all the systems and equipment destined for use in the Space

At right, Interim Upper Stage (IUS) solid-fuel systems for boosting future craft to higher orbit or planetary trajectory, float free of Shuttle Orbiter for stockpiling in space. Boeing envisions use of Shuttle to ferry such freight.

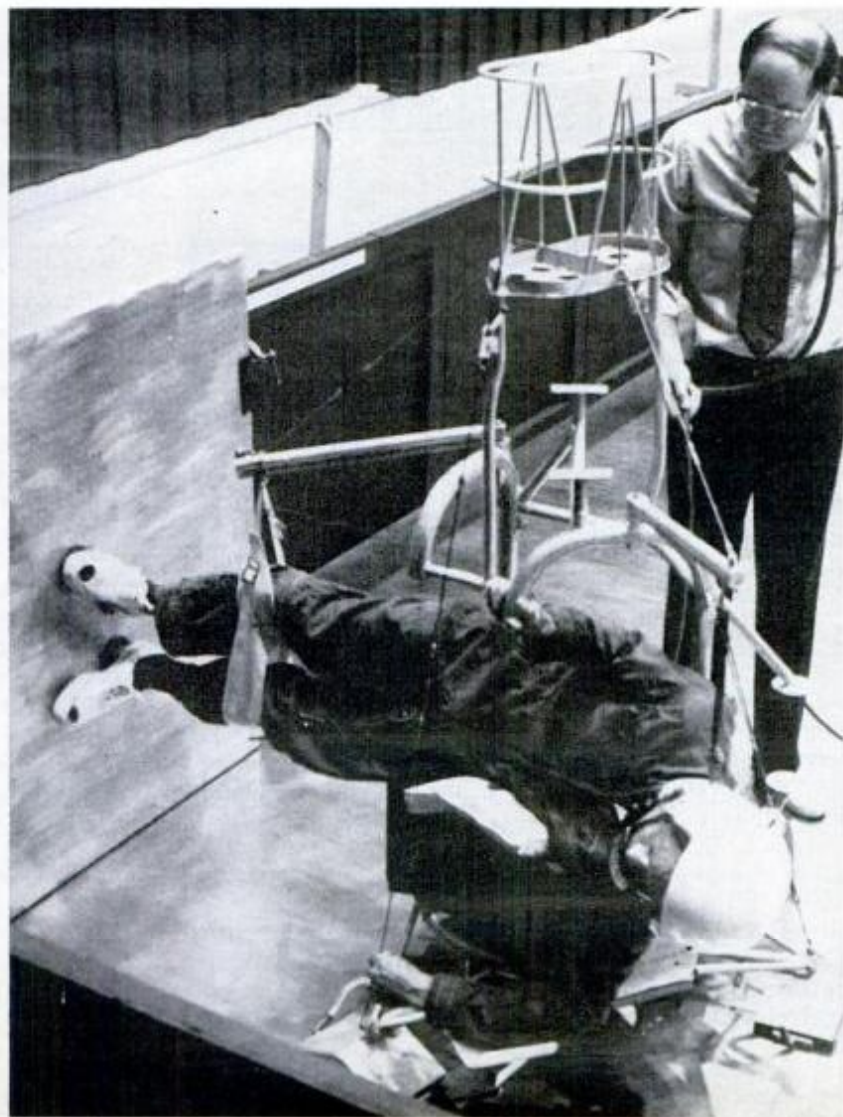


Shuttle when it heads for orbit in 1980. The wall-walkers are evaluating "foot restraints" that may have to be used by crews on the Shuttle Orbiter. The rubber cups on their soles, adapted from suction tabs used by glaziers to carry panels of plate glass, will help them cling to surfaces when orbiting in weightless space.

That gawky crane is a prototype of the 50-foot manipulator arm that will be mounted on the Shuttle Orbiter to launch and retrieve payloads "deposited" in space from

Shuttle cargo bays. The big air bag simulates something called an Interim Upper Stage (IUS)—a solid-fuel rocket system that will be stockpiled in orbit by Shuttles and used to propel future space vehicles toward other planets.

And that huge spaceship is a mockup of the Shuttle itself, instrumented for computer-simulated flights in and out of Earth's atmosphere, so that crews-in-training can adjust to the details of getting the ship (and themselves) out there and back safely. ★ ★ ★



Test subject (left) in "side mode" checks suction-cup shoes (above) for wall-walking in Houston. Shoes may help him cling to surfaces in space.

Inside Building 9-A at Houston, scientists use a 60-foot inflatable bag (below) to simulate a payload in order to check operation of a prototype manipulator that will be mounted on Shuttle.



706

Keep in touch from anywhere

You're never more than a hearty beep away from a phone call to or from the highways and byways of the world.

by Hans Fantel

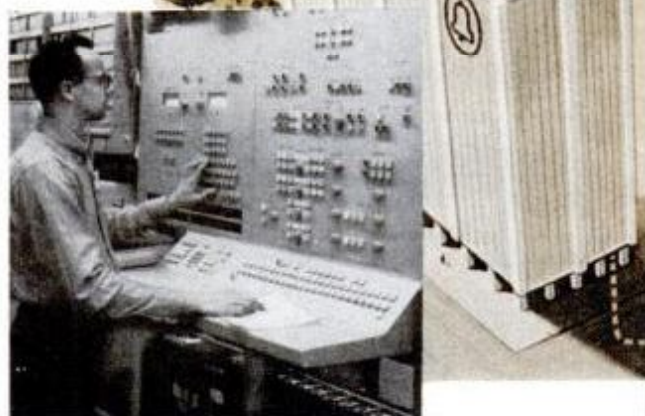
On Mondays, when I have to go into New York I often get a ride with Bob Gorsky, who has a house near ours and works on Wall Street. I do the driving so Bob can get in some early work. One day recently a steady drizzle slowed up traffic, and the bridges into Manhattan were jammed. I knew we'd be late. But none of this bothered Bob. His secretary was already reading his mail to him over the car telephone.

"Hold it," Bob said suddenly into the phone. "I've got to check this out." He hung up and looked at his watch. It was 9:46. The New York Stock Exchange would not open for another 14 minutes.

He had just received information concerning a company in which one of his clients owned 6000 shares. He lifted the receiver again, waited a moment until the amber light on his phone told him that he had a free channel, then dialed a Washington number and talked briefly with somebody at the Commerce Department—something about a copper shortage that might raise costs and trim profits for his client's company. Then he made still another call, first dialing the international code for Switzerland. Within seconds, as I swung the car onto New York's East River Drive, he had contact with Zurich via satellite.

Thanks to the time difference, the Zurich Stock Exchange had already been open for hours. In fluent German, Bob told the Swiss branch office of his firm to sell his client's 6000

Out of touch? Not if you don't want to be. You can phone to and from your car or be signaled when someone has a message for you only. Heart of such communications is computer switching center (right) through which calls are routed. Range of car calls is being extended by "cell" system (shown) with receivers spotted at distant intervals; sound then travels via underground wires to computer.



shares on the Zurich Exchange. Then he looked at his watch again: 9:58—two minutes before Wall Street could react to the news about the copper shortage. Meanwhile, Bob had gotten his client out of a shaky situation, saving him thousands of dollars.

He patted the phone. "This gadget really paid off today."

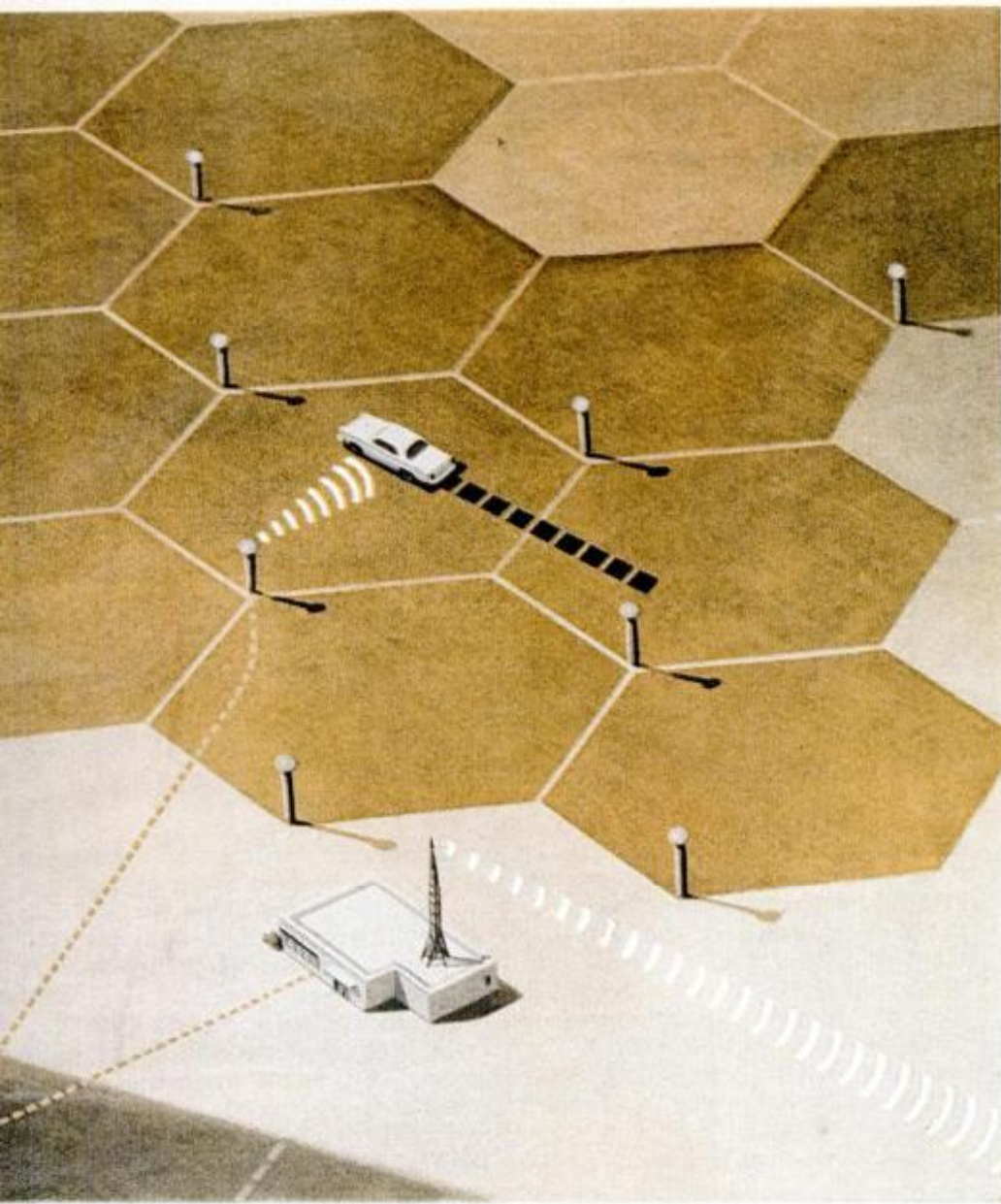
It's not CB

Unlike CB, car telephones can call, or be called from any other phone anywhere in the world. They are radio extensions of the regular telephone system. Again unlike CB, they offer privacy. Other cars can't listen in while you talk. They just get a busy signal on your channel. (However, listeners with public service radio band monitors could eavesdrop.)

Bob sometimes lets me use his car phone when I ride with him, though my calls are less dramatic than his. Usually, I just ask my wife to hold off dinner when we're late. But in

my own line of work, I often have benefited from another type of mobile communications device now experiencing a great upsurge: the "beeper," a tiny radio receiver that fits into your shirt pocket and lets you know when someone is trying to phone you. As a reporter, I do a lot of running around. At the same time, I must be reachable for my editors and information sources. The beeper solves that problem. Anywhere within about 70 miles from my home base in New York City, it whistles in my pocket whenever somebody dials my number. I then head for the nearest phone and call my answering service to get the message.

Both the beeper and the car phone have lately undergone some radical technical updating. Together, they now form the frontier of the rapidly growing field of on-the-go personal communications. In New York alone, more than 40,000 people are now "on the beeper." I asked David Kass of New York's Mobilphone Corp. what



Out of sight but never out of touch. She can call for help or while away a long cross-town drive chatting with a friend with this ultra-modern push-button telephone in her car. She even can have a radio paging firm send a message to someone special. To do that she would make a normal mobile telephone call to message service personnel. They, in turn, would transmit a coded signal to alert the person for whom the message is intended. His paging receiver would beep for his attention.

Any phone in the world will connect you with personnel who send beeping radio signal to receiver wearer. Chirping tones alert him that a message awaits his return call. Beeper receiver (above) can be clipped to belt or hidden inside pocket, easily silenced with touch.

KEEP IN TOUCH FROM ANYWHERE



Hearty beep of Motorola pocket receiver can be heard many feet away or when muffled inside breast pocket of winter coat. Beeper (above) is a tiny FM radio receiver which listens silently for special VHF signals aimed at it. When correct code is heard, it chirps an electronic tone. Complete beeper receiver, including built-inside antenna, is clipped on belt or inside shirt or coat pocket. Dial telephone (left) is standard in-car mobile two-way radio for phone calls to and from anywhere.

accounts for the rapid upswing in the number of subscribers.

Not just doctors

"People want to keep in touch," he said. "It's no longer just doctors and emergency services using this kind of radio paging. More and more, it's just people who want to keep within reach, no matter where they are. After all, the beeper is the only way to get hold of someone when he's away from the phone. You don't even have to know where he is to contact him. The signal will seek him out."

Kass, a stocky bearded man bustling with energy, was showing me the base station of his beeper service. Lights were blinking along racks of electronic gear. "Looks like a computer," I said.

"Basically it is," Kass explained. "Suppose you want to get to me while I'm out walking or at the movies. You just go to any phone and call my number—each beeper has its own phone number. This computer here takes the call and immediately codes it into a short tone-burst consisting of five notes. Then it sends out the tone-burst simultaneously over several linked transmitters spotted around the area to cover a region of about 75 miles in radius. All beepers in this area will hear the signal. But only my personal beeper will respond. The five-tone pattern acts like a key to a lock when it hits the decoder in my beeper. Only when the decoder recognizes its particular tone-burst will it close the solid-state switch that activates the sound gen-

erator." Most units work this way.

Despite the large number of calls relayed by the computer, there is no delay. The computer can rattle off more than 300 tone-bursts per minute, each representing a completed message to one particular person. "The average waiting time for an incoming call to get on the transmitter," Kass says proudly, "is about 0.002 second."

This new computer-based technology of radio paging makes available channels far more efficient. Some years ago, radio pagers were simply receivers tuned to a base station at a telephone answering service. The operator would keep reading off numbers into a microphone. Every so often, you just turned on your receiver to check if your number was being called—an awkward, time-wasting procedure. Besides, the receiver weighed about 1½ pounds and was rough on batteries. Today's miniaturized pagers weigh just four ounces, fit unobtrusively into a shirt pocket, and will run a whole month on a single AA battery, assuming a daily on-time of about 10 hours.

Better than two-way radio

These improvements account for the beeper's fast-growing popularity. Many service industries now use them in preference to two-way radio to keep tabs on their personnel in the field. "Two-way radio didn't work nearly as well for us," says the manager of a building maintenance firm. "It's good only if the guy is in the car." His plumbers, electricians and

refrigerator and heating repairmen now carry beepers to tell them when to call the home office for updated instructions on their daily rounds. "We find that four men with beepers can do as much work as five without," the manager reports. "Besides, you need no base station of your own. Any phone becomes a base station."

Everyman's beeper

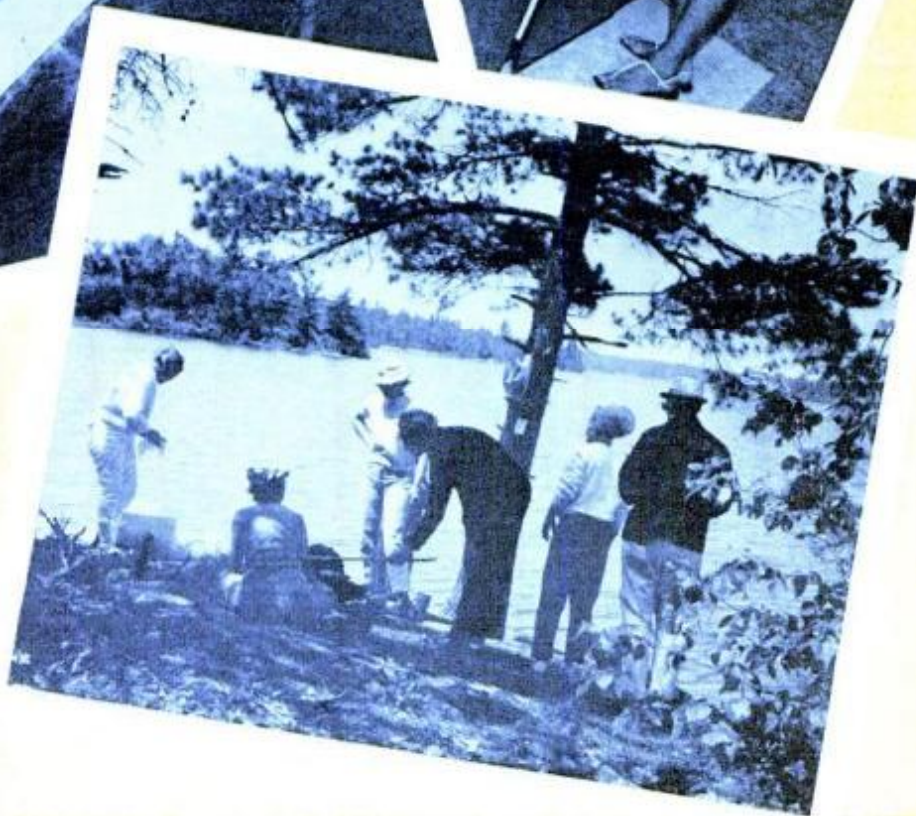
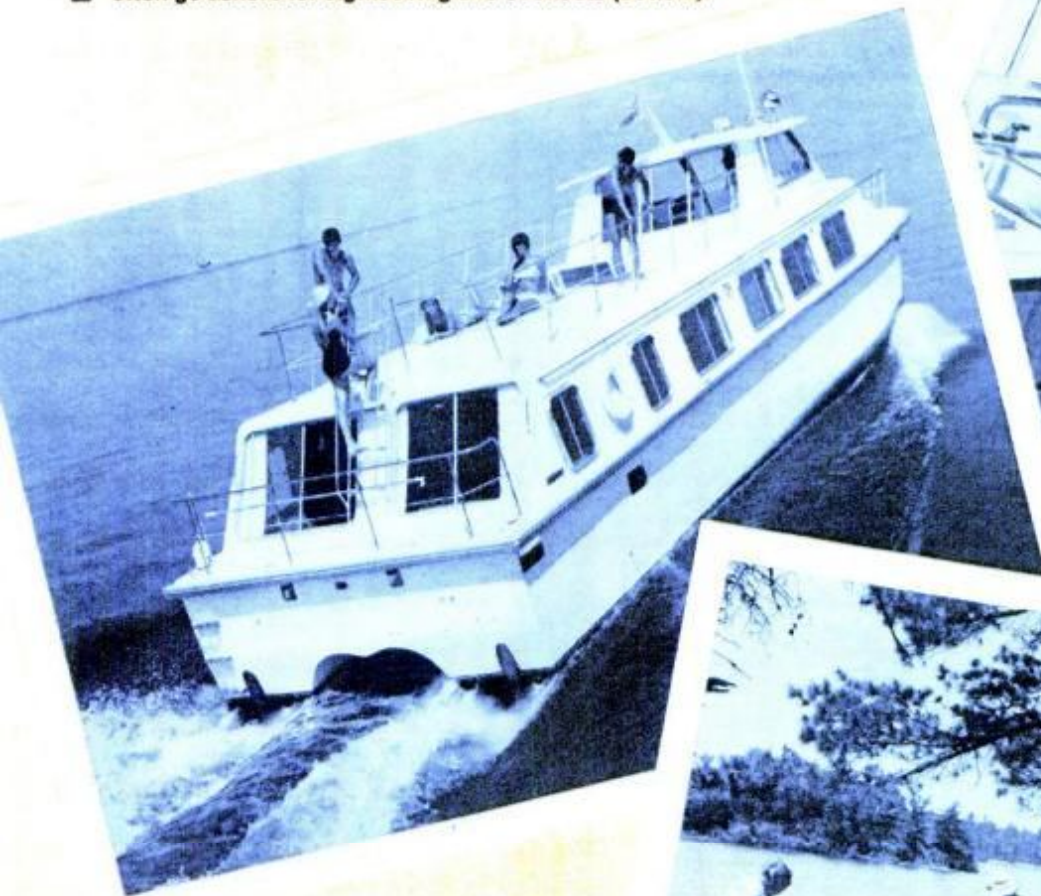
But the most surprising trend, says Kass, is the current spread from business and professional use to private individuals. "One of my customers uses it so her baby-sitter can reach her any time anywhere. Another gave a beeper to his girl friend, who is a horse trainer. Before, he was never able to get through to her when she was out on the track." Now, presumably, he can reach his filly even when she's on a horse.

For some people, the beeper has become a status symbol—something to bolster their ego. To them it means, "I am important enough to be wanted and needed. I must be reachable." That may be the reason why beepers are now the rage among gadabout socialites who even wear them at the beach on a necklace.

The strangest of all beeper clients also wears her around the neck. She is the lead cow of a herd belonging to a farmer in Wisconsin who trained her to head for the stable when she hears the beep. He phones her at milking time, and the rest of the cows follow her home.

(Please turn to page 244.)

1 Rental houseboats (below) average 38 to 48 ft. long, have modern galleys (right) and sleep six. Housboatmen often go ashore for sightseeing and cookouts (bottom).



Echoing through the outdoors this summer will be sounds of a growing stampede. Americans in incredible numbers are taking to the woods and waters on do-it-yourself vacations. Vacationers are finding that participation in every aspect of outdoor life is fun. And such vacations are less expensive than luxury trips where you do nothing. Available to you today is an amazing variety of exciting do-it-yourself outdoor adventures. What I have done is select five samples to give you a general idea of what is entailed in taking a do-it-yourself vacation.

(For some extra d-i-y ideas, PM went to *Adventure Travel U.S.A.* which lists more than 1000 outfitters for river runs, pack trips by horse, mountaineering, covered wagon treks, cycling tours, cattle drives, windjammer cruising, four-wheel-drive trips, boat cruises, float trips, scuba trips, soaring and the like. The book is available for \$4.25 or \$5 via first-class mail from Farm, Ranch & Adventure Guides, 36 E. 57th St., New York, N.Y. 10022.)

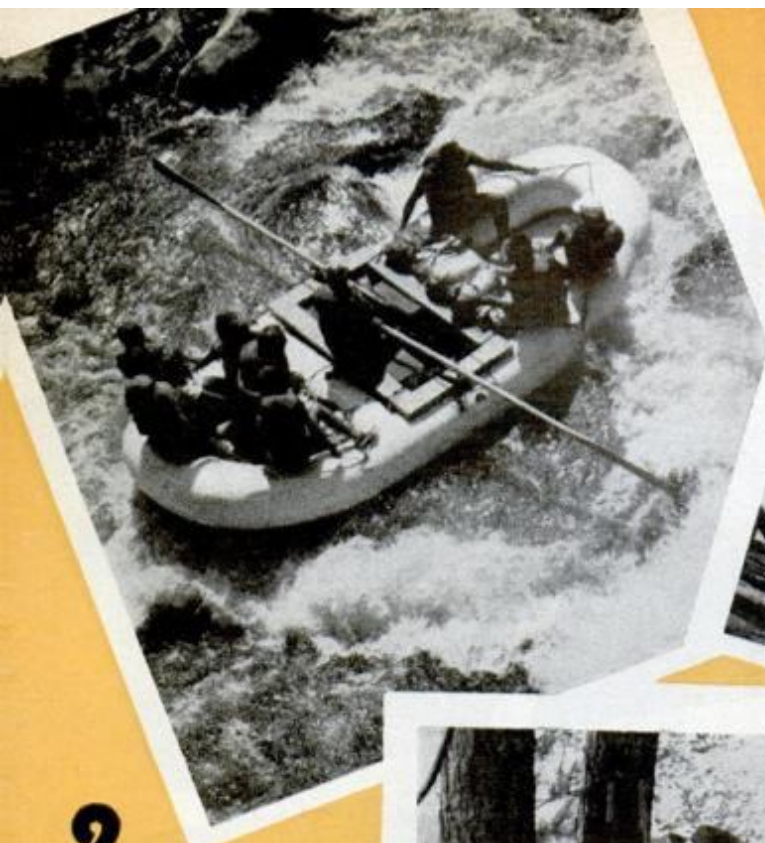
WILD RIVER RAFT TRIP

Whitewater rafting is still in its infancy, but the growing popularity of this activity attests to the quality of this type of vacation experience. Such trips are exciting enough to hold anyone's interest. Yet, they're still safe enough for participation by the entire family. Days are spent drifting down

5 great do-it-yourself vacations

Pick one of these getaway trips and lend a hand for an unusual summer adventure.

by E. L. (Buck) Rogers



2

Wild river rafting is exciting, but not as dangerous as it looks. Neoprene rafts are unsinkable, and skilled boatmen know how to maneuver through the wildest rapids. Most of the trip is lazy drifting with frequent stops along the way. Shooting the rapids (above) is all fun.

3

Fly-in fishing means a lot of action and large fish taken from little-fished lakes (above) deep in the wilderness. Small aircraft equipped with floats are the key to these fishing trips that are available in the Canadian northwoods. Remember, a do-it-yourself fishing trip requires you to do some cooking and camp chores, even if it is during a shore lunch of golden brown filets (left).

scenic canyons with alternating stretches of exciting rapids and stretches of quiet water, with frequent stops for shore excursions, a refreshing swim, or to fish feeder streams which empty into the river.

These float trips are conducted on a number of western rivers, with the favored being the Green-Colorado river systems located in the scenic badlands region along the eastern Utah border. The two trips I've made included a boatman guide to handle the raft and supervise the cooking and camp chores. But all members of the party still pitched in to do the things that had to be done. This type of float, which includes food, all equipment, beer and soft drinks, even dinner wine, is priced at \$285 per person for a five-day trip.

Outlaw Trails, which operates out of Green River, Utah, also offers a complete do-it-yourself package for those who wish to drift down a more tranquil river completely on their

own. This package includes a completely equipped raft, life jackets, cooking and camping gear, ice chests, first-aid kit, a river guide book, and ground transportation to and from the river at both put-in and take-out sites. For an extra \$12 per person per day this outfitter also furnishes food and ice. Including the latter, the tab for a five-day raft trip on one of these rivers is a reasonable \$155 per person.

So take your pick. You can rush through fast rapids with all the thrills of fast-water excitement, or you can wander the leisurely route of the relaxed drifter.

Rafts are unsinkable, and the rivers used for this type of trip do not have any dangerous rapids. For more information contact: Outlaw Trails, Inc., Box 336, Green River, Utah 84525; Wyoming Travel Commission, I-25 at Etchepare Circle, Cheyenne, Wyo. 82002; Idaho Outfitters and Guide Board, 1365 N. Orchard, Rm.

308, Boise, Idaho 83704; Montana Travel Promotion Unit, Dept. of Highways, Helena, Mont. 59601.

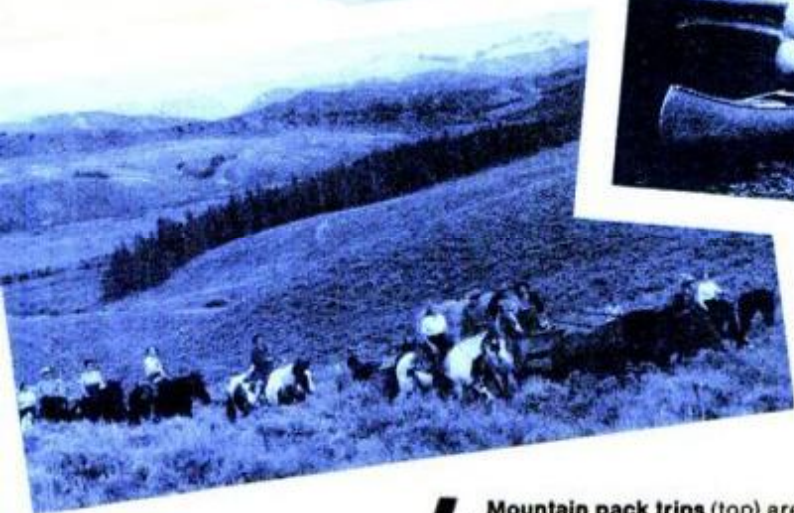
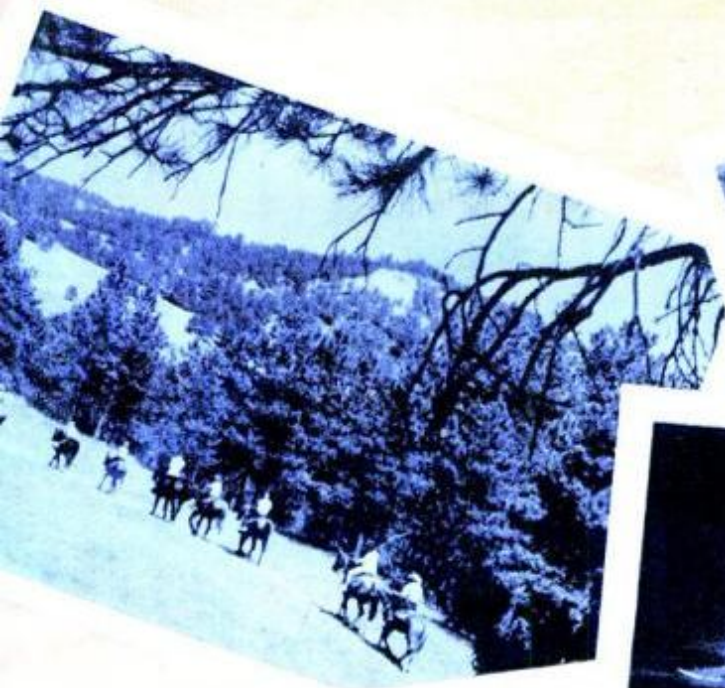
An extra do-it-yourself vacation idea

Windjammer cruises

Raise the anchor, hoist the main and take the helm and you'll be going to sea under sail. Windjammer cruises are available out of ports in Maine, Rhode Island, the U.S. Virgin Islands and Massachusetts. Charges run about \$200 week. The largest number of windjammers ply the waters of Maine. Many are located in Camden like: Yankee Schooner Cruises, P.O. Box 696, Camden, Me. 04843; Maine Windjammer Cruises, P.O. Box 617, Camden, Me. 04843.

MOUNTAIN PACK TRIP

Most of our posteriors are oriented to living room sofas and automobile bucket seats, and mine is no excep-



4 Mountain pack trips (top) are safe for families because horses are trail-wise and gentle. Grand scenery (above) is always there.

5 Canoe trips down float streams like those in Ozarks (top) do not require previous experience, though knowledge of canoe handling is recommended. Dousing the fire (above) signals day's start.

tion. So it was a little saddle-weary when we broke out of the stand of black timber and began to wind our way across the alpine meadow to the shore of a little lake on the other side.

Here we made camp. The horses and pack animals were unsaddled and turned out to graze on the lush grasses. Several of the group started pitching camp, and those of us more concerned with the rises on the lake's surface unlimbered our fishing rods and sought to creel a few trout for dinner that evening.

That night we would sleep under the stars, with a crackling camp fire for company.

Pack trips of this sort are the ultimate in do-it-yourself adventures and are available throughout the Rocky Mountains states with dozens of outfitters and dude ranches. Trips range in cost and variety from expensive do-nothing styles to inexpensive do-everything. Recommended for the average group is a compromise ar-

rangement, with a guide in attendance, to keep trip members from getting lost, and to supervise wrangling activities and camp operations. On this type of trip there are still plenty of chores to satisfy the most ardent do-it-yourselfer, but not to the extent that the outing becomes more work than pleasure.

Such pack trips are priced from \$25 to \$50 per day per person, with longer trips costing less and with additional discounts for larger parties. Considering all of the variables involved, a week's pack trip for a group of 10 people should cost less than \$200 each. Included in these package deals is a mount for each party member, sufficient pack animals to carry all the gear, all food, cooking and camping equipment, and one or more competent guides. These outfitters are fully licensed, know their country like you do your own neighborhood, and have many years of experience in packing greenhorns in

and out of their high-country wilderness areas. For more information contact: Colorado Dude and Guest Ranch Associates, Box 6448, Denver, Colo. 80206. See also listings under

(Please turn to page 246)

An extra-do-it-yourself vacation idea Cattle and horse drives

Although there are no longer 1000-mile drives along rugged trails, there are some drives that move herds from winter to summer ranges. A knack for riding horses is necessary. Rates run from \$12 to \$45 per day. For more information contact: Rock Creek Pack Station, Box 248, Bishop, Calif. 93514; Canyon Ranch, Rt. 1, Box 61A, Olathe, Colo. 81425; 711 Ranch, Box A, Parlin, Colo. 81239; Sylvan Dale Guest Ranch, 2939 No. Co. Rd. 31D, Loveland, Colo. 80537; Dakota Roundup Western Travel Merchants, P.O. Box 1570-BB, Cody, Wyo. 82414; Box R Ranch, Cora, Wyo. 82925.

How to dress up your yard with brick

From walkway to patio, you can add a distinctive touch to your home with brick.

by Penelope Angell ASSISTANT HOME AND SHOP EDITOR

A Sunday drive through almost any attractive neighborhood will prove the point that brick enhances a home. Whether it's a row of small planters or some grand steps to the door, brickwork draws attention and gives a look of permanence.

The mellow tones of brick can be a complement to your outdoor greenery and good ground cover for a large shady area where grass won't grow. Some projects, such as making stepping stones or lawn edging, are easy to do and will reward you with a functional, long-lasting product.

When you plan an outdoor brick project, consider the type, color, size, shape and pattern you want to make. These factors add to the total effect. In most areas, Service Weather brick (SW grade) is best for outdoor use. Color choices include white, buff, gray, brown and, most popular, red. Brick comes in numerous sizes and shapes from rectangular to hexagonal.

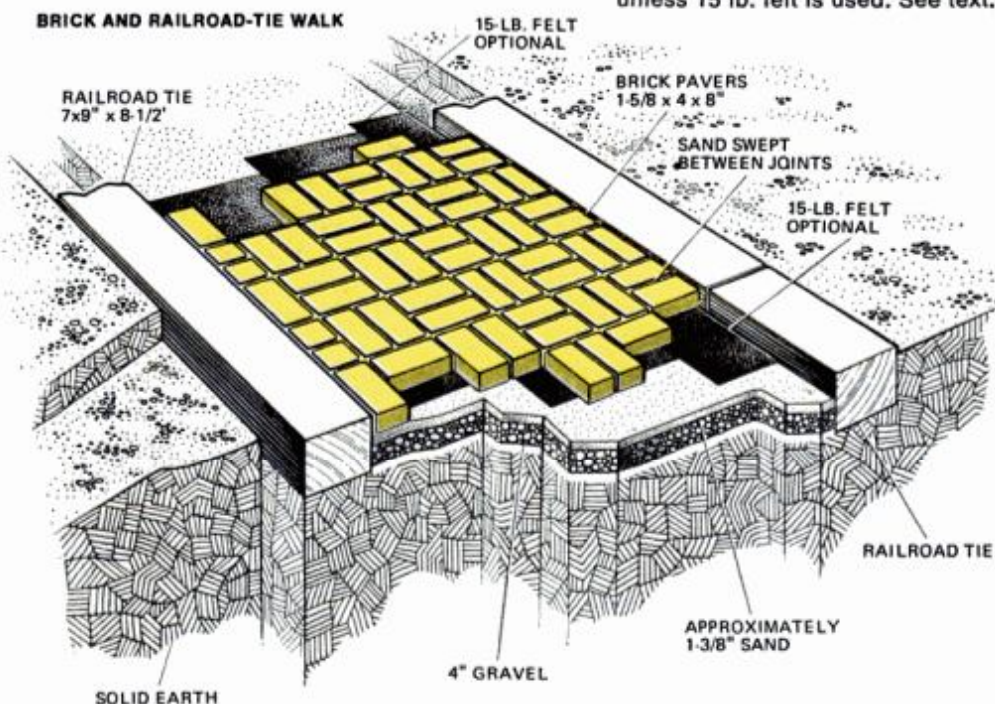
You can also experiment by creating your own brick patterns. Consider a herringbone or other traditional design, or lay brick in rings around trees, planters and other stationary forms.

To help you estimate the quantity of brick and other materials needed, contact a building supply dealer or send 10 cents to the Brick Institute of America, 1750 Meadow Rd., McLean, Va. 22101, for: *How to Buy Brick for Outdoor Projects*.

There are two basic ways to install brick—with mortar and without mortar. Mortarless brick has a natural look, is grouted with sand and can be placed over a gravel base. Mortared brick paving is usually laid over a concrete slab. It's more time-consuming, but it's also more permanent.

Brick and railroad-tie walk

Mortarless paving such as the brick and railroad-tie walk shown here is not only attractive; it's functional. You can apply the same techniques for making this walk to



other non-mortar projects, such as patios and driveways.

When you work without mortar you needn't lay mortarless brick all at one time. You can stretch the project over several weekends or when you have spare time.

You can substitute 2x4 staked redwood boards for the railroad ties. Or you can make an 8x8-in. concrete form around the paving perimeter and set the edge bricks in mortar.

Properly preparing and compacting the subgrade and base supporting the bricks will insure a paving that you can enjoy for a long time to come. If moisture accumulation might be a special problem, you can install 4-in. clay pipe drain tiles in the gravel base.

To make a brick and railroad-tie walk, first stake out the area to be paved using mason's line to define the shape. Place the railroad-ties in approximate position, then remove the topsoil beneath and set the ties.

Next add a gravel base. A 4-in. gravel layer topped by 1 or 2 in. of sand makes a good base for the brick. Add sand, rake level and tamp.

A screed board will help you con-

Railroad ties surround this mortarless brick walk. A gravel base under a sand cushion is added. Because water drains through, bricks can be set level unless 15 lb. felt is used. See text.

trol the depth of the sand. It can be made by cutting a 2½x6-in. notch in each end of a length of 2x4 that rides back and forth on guide boards. You can also make a wooden tamper from a 1-ft. length of 2x6 by nailing it to a 5 or 6-ft. length of 2x2 or 2x3. Use 10d common nails to join the boards.

If the ground where you plan to install the brick is shaded by trees causing damp conditions, laying 15-

PM photos: Al Nunes-Vais



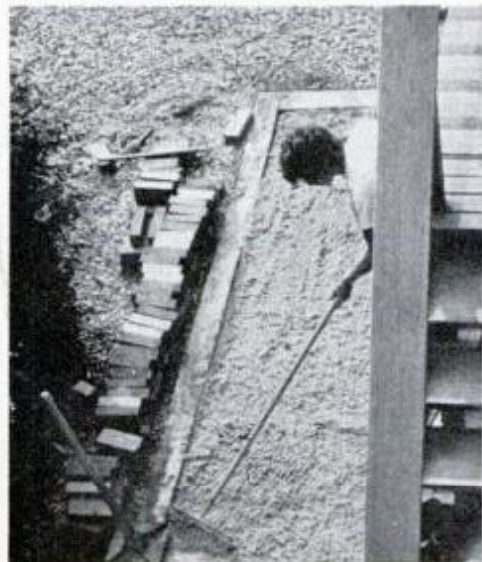
The ground is excavated and the railroad ties are then leveled in position along the perimeter of the excavated area.

Материал, защищенный авторским правом



Brick in soft muted tones gives warmth to this patio.

Photo: Brick Institute of America Region 9



Pour in layer of gravel, then mason's sand, tamp. Felt can help prevent weeds, but then patio must be pitched.



Lay the bricks close together and sweep sand between the joints. Then wet the sand down to compact it.



Brick and railroad-tie walk can give many years of use as well as be an attractive accent for your home.

lb. felt beneath the brick reduces the amount of subsurface ground water drawn into the brick. The brick will then be relatively free of algae. If felt is added, however, the paving *must* be pitched to provide positive water runoff.

Lay the brick close together in the pattern you want, then sweep sand over the surface and into the joints. A more permanent mixture of three parts sand to one part portland cement can be used in place of 100-percent sand. After sand or mixture is swept in cracks, use a fine water spray to compact it. Repeat the sweeping and spraying until all bricks are firmly locked in place. Once bricks are secure, the patio can be swept clean and used.

Creating a mortared brick wall

You can build a low wall to set off bricked paving, or make a bar-

becue grill or planter, once you know bricklaying basics.

Some brick should be laid completely dry and others should be dampened. The Brick Institute of America suggests this simple test to determine whether or not you should predampen the bricks.

Draw a 1-in.-diameter circle on a brick, then apply 20 drops of water from a medicine dropper inside the circle. Wait 1½ minutes. If the water is still visible, the brick should be laid dry. If the water is absorbed, it indicates that the brick needs to be dampened. Hose down the brick pile for about 15 minutes before construction. The brick should be damp, not wet, when laid.

You can rent a mixer if you plan a large project. Begin by mixing only the amount of mortar you expect to use up in an hour or two of work. From here on, you will mix

in two-hour batches. The mortar should have a consistency of soft mud. Keep it that way by adding a little water if it begins to stiffen.

Mortared joints between bricks on most projects should be about ⅜-in. thick. With a trowel, spread mortar on no more than three bricks of the preceding course, leaving a little more than the needed thickness. Texture the mortar surface by making a shallow furrow with the trowel point. A mason's line along the brick course can help check the thickness.

Next, butter one end of a brick with mortar and lay it into the mortar bed so the top of the brick is level with the mason's string. Butt the brick tightly against adjoining bricks to assure a lasting, watertight joint. Then scrape off the squeezed-out mortar and return it to the mortar tub.

After the brick has been mortared in place and the mortar has hardened slightly, use a mason's joint tool, or short length of ¾-in. pipe, to tool each horizontal joint, then the vertical ones, pressing each to make the mortar dense, watertight and concave.

If any bricks need to be cut at the end of the course, you can score them on two surfaces by tapping them with a broad-blade mason's chisel and a hammer. Then break the bricks by giving the chisel a sharp blow with the hammer. *Safety tips:* Be sure to wear safety goggles to protect your eyes and waterproof gloves to protect your hands from painful blisters.

Slab for mortared brick

The patio in the color photograph was made with bricks set in mortar. The regularity of mortared brick placement gives a more formal look than brick-in-sand.

Brick with mortar joints is best laid over a very stable base like a concrete slab. An existing concrete patio in good condition will do. If you pour the slab, premixed concrete is convenient, especially for small projects. As with all mortared brick paving, be sure you have about ¼-in. pitch per foot for positive water drainage.

Use 2x4s with stakes to make the form for the slab. Be sure the stakes are sturdy, at least ¾x2½x24-in., space them every 18 to 24 in. so the wet concrete won't push the form outward. Install the 2x4 formwork with the slope of the slab you want. You can determine the pitch using a 2 or, preferably, 4-ft. spirit level and straightedge.

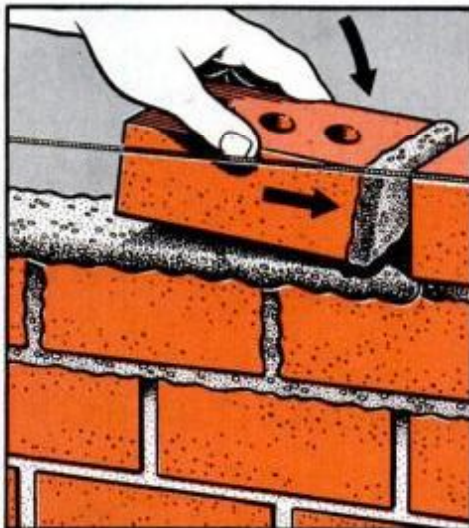
Concrete is easiest to transport in

(Please turn to page 279)

HOW TO LAY UP BRICK WALLS



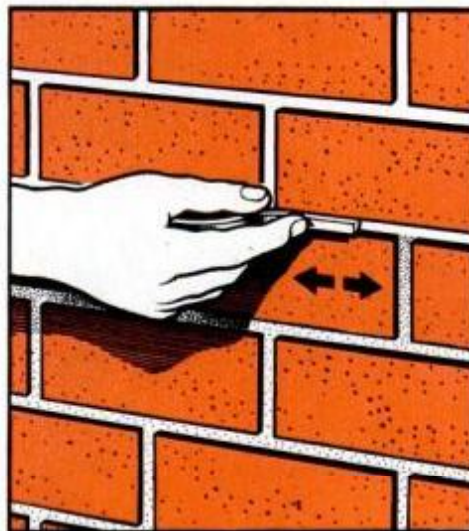
First, with a trowel, spread the mortar evenly, adding slightly more than needed. Use mason's line for accuracy.



Second, butter brick end with mortar, tap into mortar bed so it seats in line and is level in both horizontal planes.



Third, remove mortar squeeze-out with your trowel and return it to the mortar tub so you can use it again.



Fourth, after mortar sets slightly, use a joint tool (or bent ¾-in. pipe) to indent and compact the joints.

Build an add-on barbecue table

Here's a serving table to wrap around your barbecue.

by Rosario Capotosto

By adding this redwood barbecue table to your back-yard cook center, barbecues are certain to be happier times for both guests and chef. Designed so that PM readers can duplicate it using simple tools, the table costs about \$30 to build.

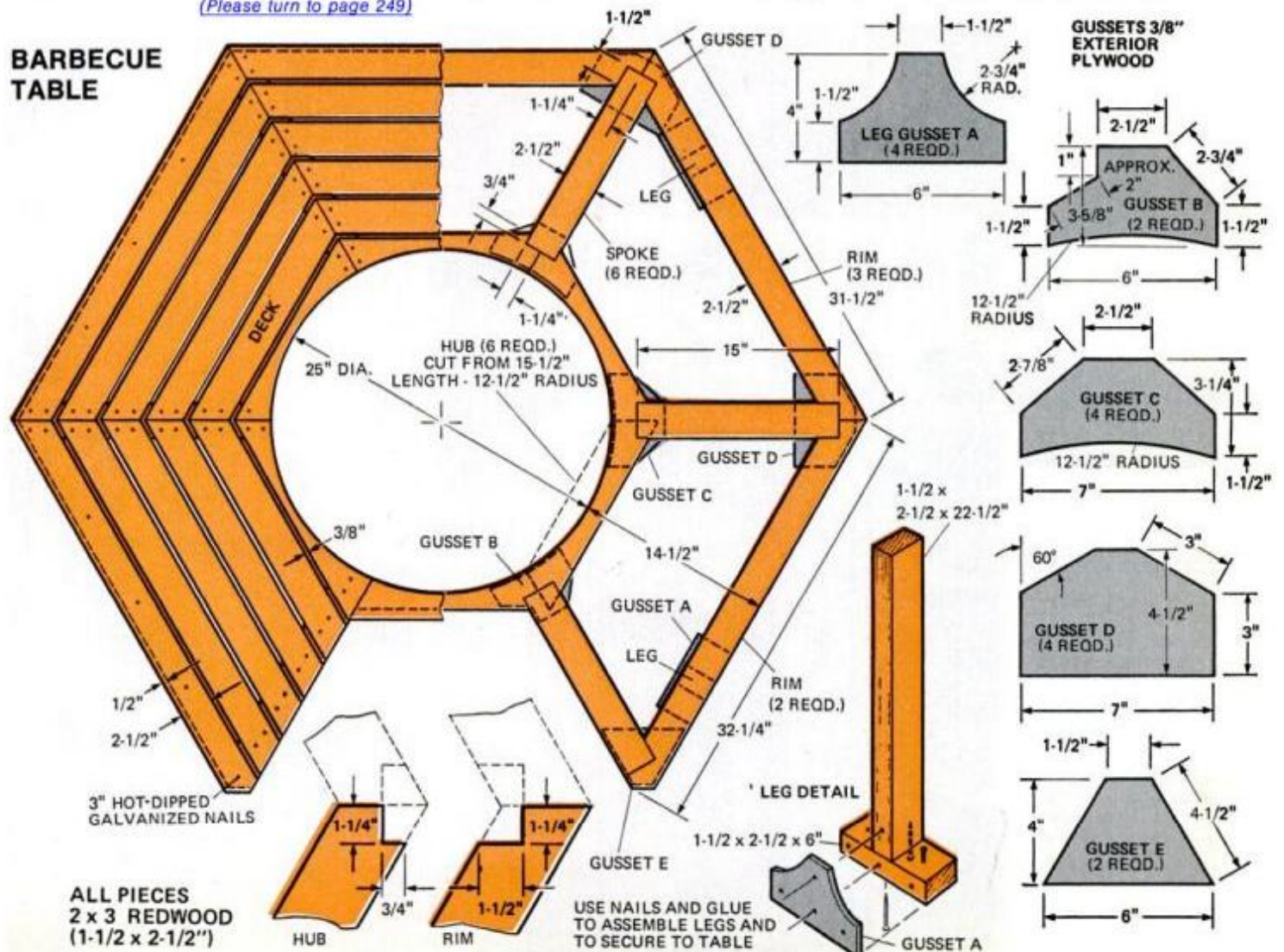
It wraps around a standard-size 23-in.-dia. kettle-shape brazier that's 29-in. high. Be sure to check the size of your brazier so you can alter the table's center opening and table height if necessary.

(Please turn to page 249)

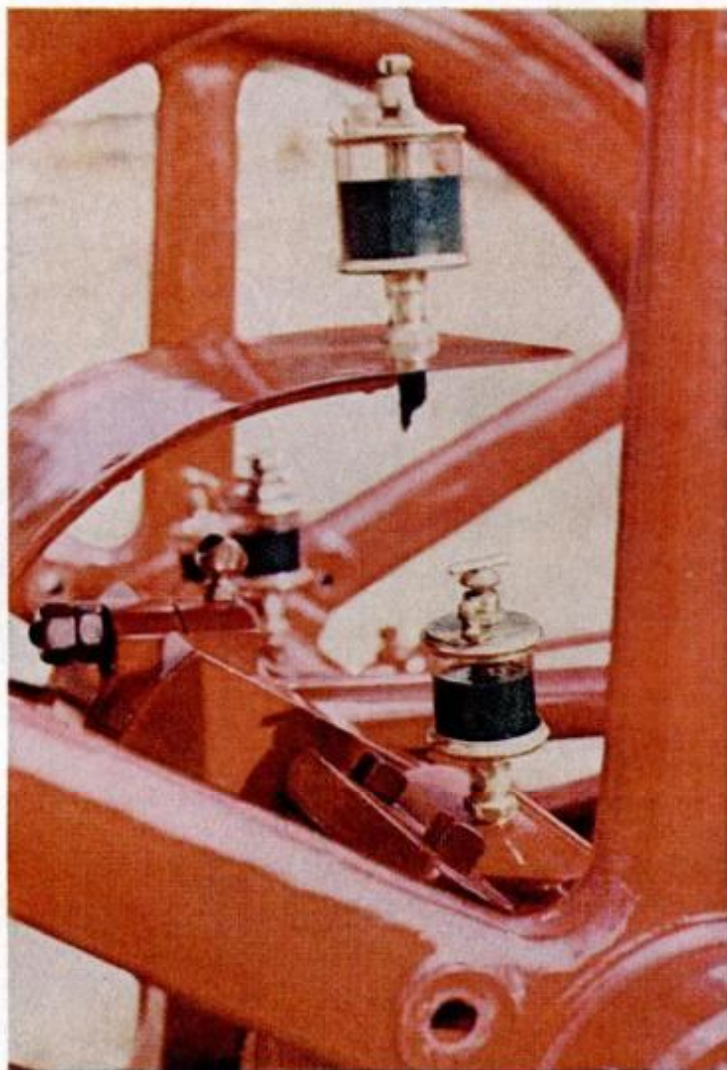


Add-on barbecue table comes in handy for holding cooking gear and food ready to put on the fire. It also makes serving food easier. Everything you need is in one spot so family and guests can help themselves. It's a good way to get organized, and one that will save you extra trips back to the kitchen for forgotten items. Serving 'em up is easy with this unusual, attractively shaped redwood table. Cleanup's a snap, too.

BARBECUE TABLE



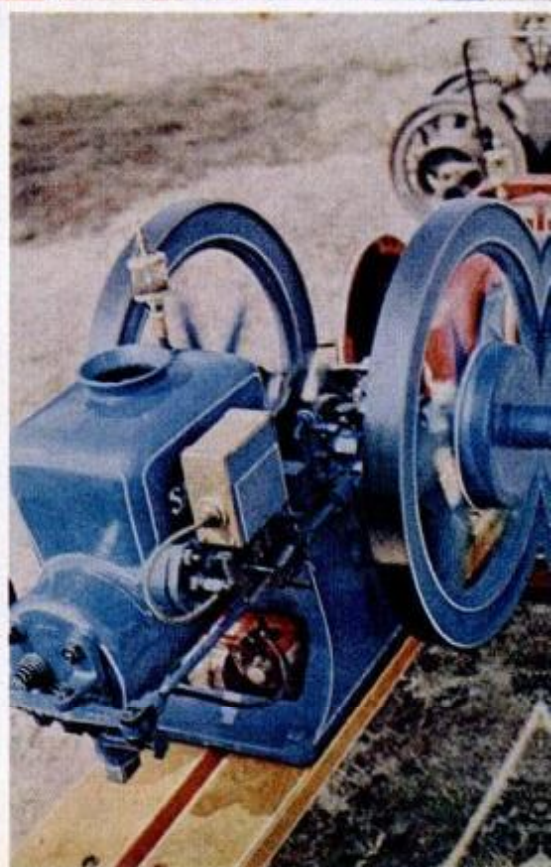
Fix 'em up and show 'em off



Used in oil fields with abundant natural gas, this 1895 Reid (far left) has hot-tube ignition. It's a two-cycle, single-cylinder with side cylinder for air compression. Close-up (center) shows 1900 6-hp Olds in metal-fill finish. Rotating connecting rod wiper center lube cup. Below are early 1900s engines with horizontal cylinders and water-hopper cooling.



An early International upright (above) has a vertical cylinder air-cooled by small fan. Owner's initial decorates engine. Marine engines (center) interest buyer. These two 1910 Fairbanks-Morse uprights are cooled by water stored in drum. Fly-ball governor keeps speed even on hit-and-miss Sears (lower right) equipped with an early magneto-sparkplug ignition. Note oil cup used for piston lube.



Restoring old engines is exploding into a big American hobby.

by Dan Fales MANAGING EDITOR

Set up in circles like wagons before an Indian attack, 100-year-old engines will cough, sputter, choke and sneeze all across the country this summer. It's part of a booming American hobby—fixin' up and showin' off old gasoline engines.

Early designs of these old hit-and-miss models are as varied as their uses. First came the horizontal cylinder with the hot-tube ignition. Then came the hot-shot battery ignition and simple carburetor. A water hopper was used to cool the cylinder. Soon the magneto and sparkplug appeared. Cylinders on some engines were raised to upright (vertical), which permitted air cooling. Marine engines were developed that pumped cooling water from external sources. Governors went from simple fly-ball systems to complex throttles.

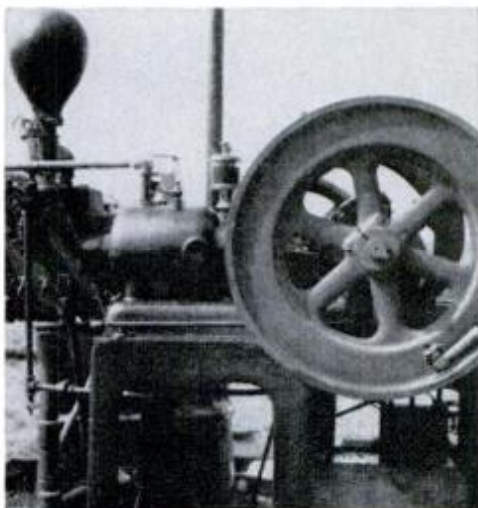
Engines had many uses

Belts ran from these low-compression, low-horsepower engines to drive everything from pumps and sawmills to looms and washing machines.

Early in the 1900s, there were

1500 engine makers in the country. You know many of the names—Olds, Sears, Roebuck & Co., Maytag, International. But as technology advanced the old designs were replaced by modern rigs and electric motors. Many old engines ended up unceremoniously in junk heaps.

And it was the scrap drives of World War II that really cut into the old-engine population. Today, locating an antique model in an ancient barn or a friend's old toolshed is like finding an unknown Rembrandt. Bargaining to buy or trade



Kewanee engine (above) of unknown horsepower was built about 1910. It weighs 800 pounds, has a 4-inch bore, 5-inch stroke and 20-inch flywheel. It was used as shallow-well pumping engine, thus the bulbous fixture on the left.

Old engines were used for many jobs. Here one is driving an apple grinder used to chop up whole apples just before they are spread out in an apple press. The press (far left) is used to squeeze out the apple juice which is poured into gallon jugs.



has become a high art form. Much of this art is practiced at weekend gatherings organized by local clubs.

The meeting of the Granite State Gas and Steam Engine Assn., photographed here, is typical. Its membership, headed by Carlton Ekdahl, meets yearly in a field near Dublin, N.H. The membership is as versatile as the engines displayed. Everyone dresses in old workclothes so you can't tell the plumbers from the legislators or the architects from the garage mechanics. A few members, like Mike Worcester, who restores automobiles professionally, own their own commercial garage operations, but most have staked out only a small area of their basements or garages to restore their engines.

Once restored, the old engines are proudly brought to the meet and displayed in the demonstrators' circles. As spectators crowd the field, owners stand about swapping fantastic tales of old-engine finds, while others swap real engines.

All this time, spectators wander among the wheezing, popping, banging engines—grandfathers who remember teach grandsons who learn. All seem to become hypnotized. The only hint that they aren't in a trance is the everpresent tapping foot that beats to the rhythmic pulse of a 1907 Schmidt's or a 1902 Sears Economy, beautifully restored.

Information needed

The mark of a good restoration is detail. The best restoration is the one that looks exactly like new. And looking-like-new means getting old engine spec sheets. Though some publications are available, most information is obtained from owners and old-timers who know. At a meeting of these weekend engineers, information flows like the beer that's consumed.

When asked why they enjoy these engines, most owners mention "the sound" somewhere in their answers.

"I like to listen to 'em," said one who started his hobby two years ago. Like this hobbyist, most listeners who get into engine restoration are amateurs. True, there are some pros, but most people follow the philosophy of this buff: "Heck, my brother and I have been fooling around with engines for years. It's strictly a hobby. I wouldn't spend more than \$80 for any engine." ★ ★ ★

Veneering: Enjoy beautiful wood on a budget

Thin sheets of exotic wood cover common woods for an uncommon look.

by Penelope Angell
ASSISTANT HOME AND SHOP EDITOR

You can build the intriguing markings and the meandering grain patterns of exotic hardwoods into your projects once you know the secrets of veneering. These wafers of wood offer an inexpensive way to give unfinished furniture and humble surfaces the rich look of hardwood. Veneers can also counteract warpage when they're applied to both sides of a panel.

Since you can select the veneer pieces that join together, you can create patterns in wood, for example, a book match design where two sides are mirror images from the center. You can also join four pieces of veneer so their grain forms a diamond shape. Veneers usually come in 1/28 to 1/36-in. thicknesses in sheets from 4 to 12-in. wide and 3 ft. or longer.

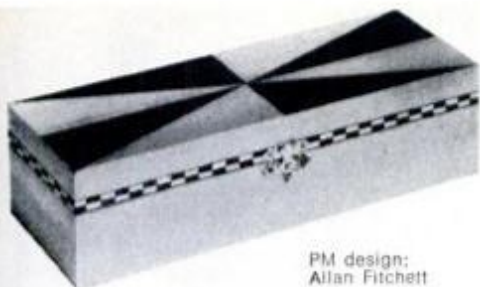
Two ways of applying veneer are explored here. The first way uses contact adhesive such as Constantine's Veneer Glue. It needs no

clamps but the veneer cannot be adjusted once it's laid. The second method uses a white glue such as Elmer's Glue-All or a yellow glue such as Titebond Glue.

These require presses or clamps, but the veneer can be adjusted after it's laid.



JEWELRY BOX



PM design;
Allan Fitchett

With a little effort and *not* much money you can turn an inexpensive basswood box from a craft shop into a unique and elegant box for jewelry or odds and ends by applying veneer. You can make the top design by cutting two light and two dark rectangles, halving them diagonally and joining the pieces together alternating wood types.

Materials include a box, light and dark veneer, fancy inlay border, hinges, lock, veneer tape, contact adhesive, No. 180 garnet paper and varnish or other finish. Begin by removing any hardware and tracing the box outline on paper—top, sides, front and back. Draw the design shown or one you've devised yourself. Cut the veneer sections for the top exactly to size with a model knife and tape them together.

Glue the assembled design (make sure joints are tight) to the box—taped side up—with contact adhesive. To assure proper veneer placement (you can't move it once it's down), put a sheet of brown wrapping paper or wax paper between the box top and the veneer, leaving a slight margin at the front. Align the front veneer and box edges, press the veneer in place, then gradually slip the sheet away. Then roll the veneer firmly and evenly.

Next mark and cut the veneer and border for the sides, lid and bottom, allowing an extra $\frac{1}{16}$ in. to overhang at each corner. Tape the veneer and inlay together and glue them to the box using the slip-sheet method

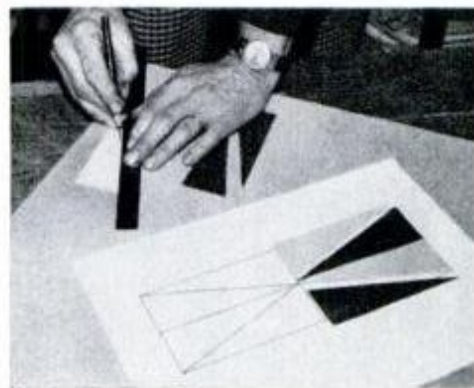
just described. Go over the veneer with a roller and trim the overhangs.

Mark, cut, tape and glue the front and back veneers in the same way, again allowing a $\frac{1}{16}$ -in. overhang that is trimmed off. To finish the box, first peel off your tape. A razor blade used carefully helps. Sand the surface smooth, then apply a finish.

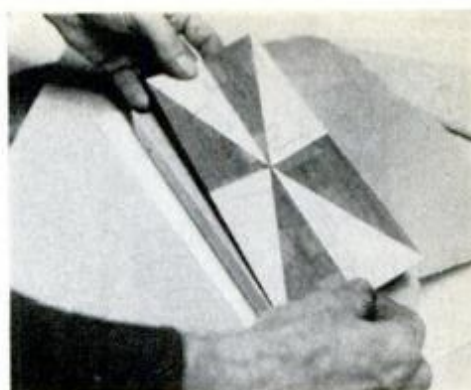
If you can't locate veneers or inlay borders in your area try Constantine, 2050 Eastchester Rd., Bronx, N.Y. 10461; or Craftsman Wood Service, 2727 South Mary St., Chicago, Ill. 60608.



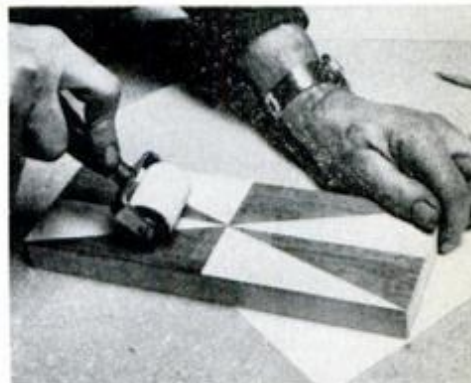
Tools you'll need include a model knife equipped with fine blades; steel rule to cut against; a square; veneer roller and a veneer saw.



Veneers for top design are cut to size with a model knife. The light veneer is aspen and the dark is mahogany. Pieces are placed on the pattern to check fit.



The top veneer is glued to the box with tape side up, using the slip-sheet method. Brown or wax paper between veneer and box is removed as veneer is positioned.

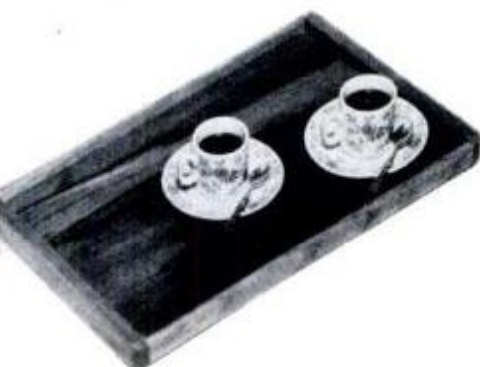


The top of the box is pressed down with a veneer roller immediately after the veneer has been cemented on to insure a secure bond over the entire glued area.



The overhanging veneer is cut off with a veneer saw. Later it's sanded smooth. The extra overhang is added at the corners to insure a smooth edge.

TRAY



PM design; Alex and Annellen Simpkins

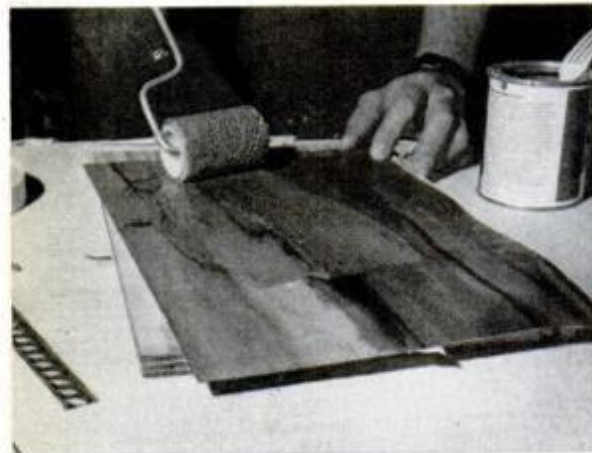
You can make a striking grain design as on this tray top by using two pieces of veneer taped together. Materials you'll need are a piece of $\frac{1}{2}$ -in. plywood good on both sides for the core of the tray (10x15 in. or whatever size you wish), veneer for the tray top (we used African Bubinga) and tray bottom (a less expensive plain mahogany is fine here), $\frac{1}{2}$ x $1\frac{1}{4}$ -in. cherry or other wood edging strips to size; veneer tape and tung oil.

Tools and equipment needed include a model knife, metal straight-edge, plastic resin or yellow glue, short-nap roller, file and sandpaper in grits from 60 to 400. Either glue requires a veneer press made by sandwiching the tray between wax paper, two sheets of plywood the same size as the tray and three 2x2s on either side. Six C-clamps hold the assembly together.

Begin by cutting the veneers for the tray top and bottom the same



Joining veneers together makes it possible to create patterns in the grain. Set up your patterns by joining veneer sections with short pieces of tape across the joint and add one long horizontal strip.

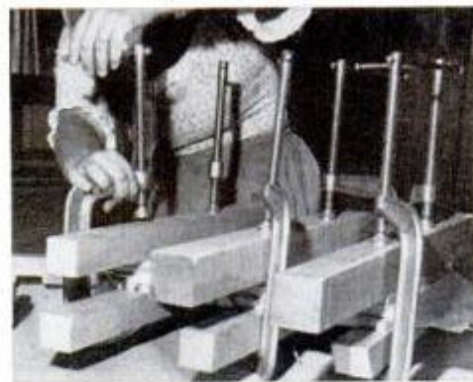


Apply plastic resin, such as Weldwood, with a thin-nap roller to be sure the glue is evenly applied over all the surface. Any area not covered may cause a bump in otherwise smooth surface. Work quickly after you apply the resin.



Top and bottom veneer edges all have been taped to the plywood (left) and the tray is now prepared to be sandwiched into the press.

To make the veneer press, use three hardwood 2x2s, birch plywood and a wax-paper sheet on each side of the tray. Hold assembly with C-clamps.



wax paper on each side and start applying pressure with the C-clamps, working from the middle out. After you've turned down all clamps part way, begin from the middle again and tighten them as much as possible. Wait about 12 hours; then remove the tray and peel off the tape. Align veneer and plywood edges.

Sand with the grain, clean, then rub on tung oil. Glue and press the long edging pieces to the tray with bar clamps. Then do the same to the short edgings, round the corners, sand and finish with tung oil.

size as the plywood piece. Cut the veneer so its grain is at right angles to the top layer of plywood to help prevent warping. Tape veneers together with short crosspieces, then with one long vertical strip.

Next apply plastic resin evenly to the back of the veneer that goes on the tray top, facing the tape side up. Now work quickly until the tray is in the press. Place the veneer on the plywood and tape the edges. Glue and tape the tray bottom veneer.

Place the tray in the press with

BACKGAMMON BOARD



This backgammon board is made with four wood veneers and inlay banding. Materials you'll need are four pieces of $\frac{1}{2}$ x 14 x 17-in. birch plywood good on two sides (two pieces each for the board and a press), wood strips to make the box and inner compartments, edging for plywood, two 3-in. butt hinges, a box catch, plastic resin or yellow glue, sandpaper from coarse to fine grit; masking tape and tung oil.

You need light and dark veneers for the playing triangles, another for the center of the board face and board back, a fourth for the inner compartments, plus inlay banding.

Tools needed are a plane, glue roller, table saw, sharp model knife, four bar clamps and a press. The veneer press, although larger, is used as it was in the preceding project. It's made of eight 2 x 2s, two plywood sheets, two layers of wax paper and eight C-clamps.

Cutting and taping veneer

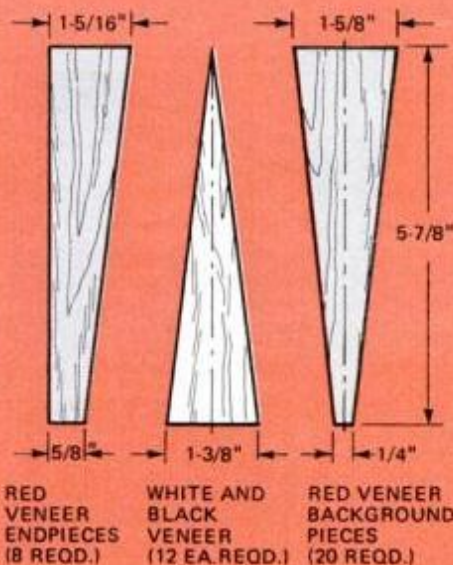
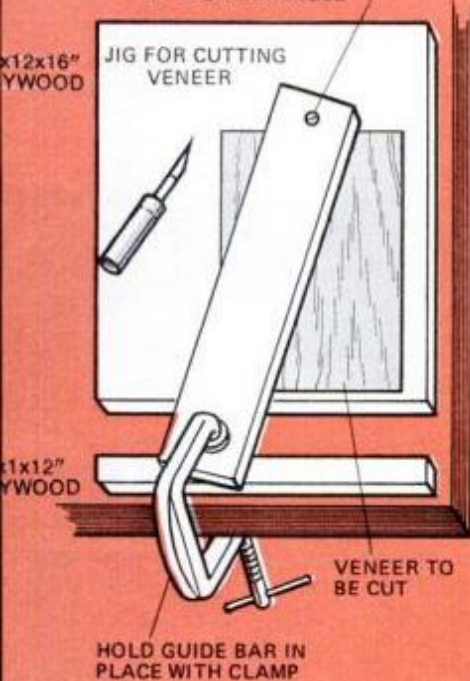
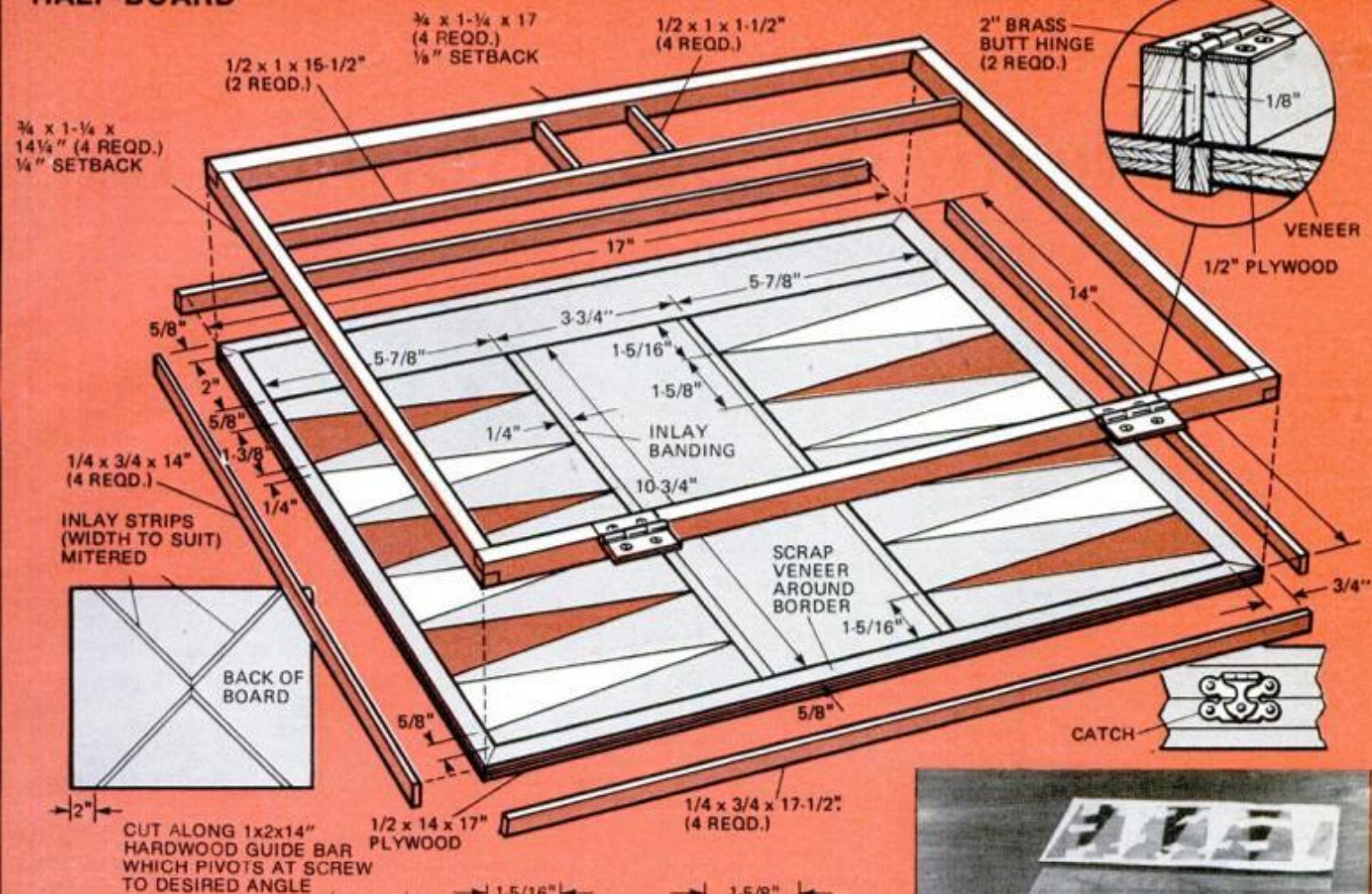
Mark the veneer layout for the face and back of the backgammon board on two pieces of plywood. Each side of the boards must be completely veneered to prevent warpage. *Be sure to set up a right and left-hand panel with alternating colored triangles.*

Make cardboard templates of the veneer triangles and draw outlines on the veneer. The latter may need trimming later, so make templates slightly larger than required. The jig shown can help you cut the veneer with a model knife. Use moderate pressure and make repeated passes over the veneer. To plane the veneer, brush it lightly with the grain across the plane's cutting edge.

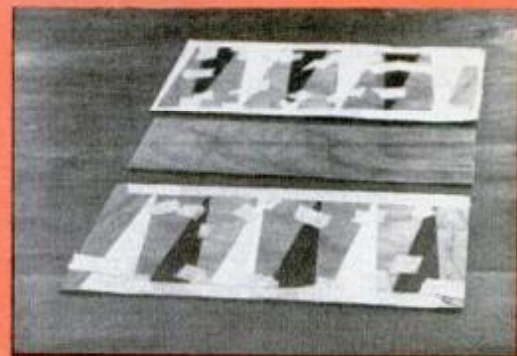
Cut all veneer pieces. Inlay bands can be cut and taped now or glued later in a space cut and chipped out of the veneer after it's pressed.

You can begin taping the face

HALF-BOARD



Wood pieces that make the box are glued and clamped to the board (right). Bar clamps apply pressure sideways and C-clamps apply up-and-down pressure.



First step of taping process is shown above. More tape strips are added crosswise, then longer tape strips are placed lengthwise.



pieces together with short cross-pieces of tape pulled tightly. Then tape the joints lengthwise, covering the cross tapings. Tape the face veneers for both panels, then tape both back inlay and veneers.

Mix the plastic resin and smooth some on a plywood panel; then place the back veneer on the panel (tape side up) and tape edges. Place veneered side down in the press on wax paper; then glue and tape edges of the face veneer to top side of the

panel. Cover with wax paper, plywood and the top 2x2s evenly spaced; then apply pressure with C-clamps.

After the proper glue-setting time has elapsed, remove the panel and repeat the process for the second panel. Remove the tape, sand the panels with the grain and oil lightly.

Constructing the box

Cut the $\frac{3}{4} \times 1\frac{1}{4}$ -in. pieces and make lap joints. Glue them together; then clamp and glue them to faces

of the panels using bar clamps and eight C-clamps as in the photo. Use wax paper and scrap wood between the board and clamps.

Cut, glue and clamp the edging to the plywood panels, make the box compartments and hinge the box parts together. Sand, chip away any excess glue and lightly oil the box.

You can get a catalog of playing pieces like those shown from Backgammon Headquarters, 669 Madison Ave., New York, N.Y. 10021. ★★

Nearly perfect, so owners have

A nationwide survey based on 2,441,671 owner-driven miles.

by Michael Lamm WEST COAST EDITOR

Honda became the world's biggest motorcycle maker in 1960 and still holds that distinction. More amazing, though, is that Honda now ranks No. 3 in American imported auto sales—behind Toyota and Datsun.

In 1976 alone, Honda's car sales here shot up nearly 50 percent. In Canada, Honda held that No. 1 spot for a good part of the year.

One reason for Honda's terrific showing is that—like VW in the early 1950s—the new Accord sells by word of mouth more than by formal advertising and sales promotion. People tell other people about it, making Accord demand so high that now it's very hard to buy one at its \$4145 base price. Dealers don't have to discount Accords, and in some areas there's a waiting list. Contrast that with the rebates, discounts and incentives some other small-car dealers are offering.

We sent questionnaires to 1000 Accord owners to get their reaction to the car. One of our first questions was: Why did you choose the Accord—on what basis did you make your choice?

Economy and styling proved the principal reasons, but an unprecedented 23.4 percent listed "reports on it" as their main incentive. We've never had that particular reason listed often enough to tabulate.

A California schoolteacher's comments are typical: "What tipped it were stories about the car and owners' comments; also the car's comfort and handling balanced against initial price."

A Florida Air Force explosives expert: "I ordered the car sight unseen—had read articles about the car which praised it."

And a California medical-equipment salesman reports: "Honda's reputation and early press reports on the car swayed me. I found it an excellent value for the price. The competition couldn't compare. The Honda dealer had a long waiting list, and he answered any questions with, 'If you don't like it, bring the car back and we'll resell it for more than you paid.'"

Another unprecedented statistic came in answer to our question about workmanship. We asked owners for their opinions on the way Accords are put together, and a remarkable 70.6 percent answered "excellent." Even the Lincoln Continental Mark V's very high 41 percent rating is nowhere near that. Here are representative comments on the Accord's workmanship and overall quality:

A Texas military man: "Excellent—all fittings are even and smooth, no glue or welding runs." A Georgia journalist agrees: "Exceptionally well assembled for an economy

Dealers hold all the cards—it's one of the few small cars in great demand.

This doctor could well be right. Honda's motorcycle rise came overnight.

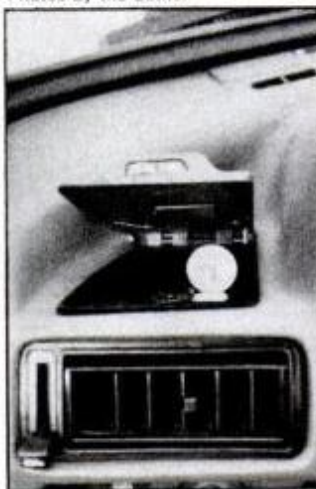
car." A California university professor: "Workmanship on the Accord is outstanding. Everything fits! I haven't had to return the car to the dealer to fix anything." And an Illinois inventory analyst: "Good materials and put together well. No irritating 'plastic look' inside; no visible screwheads and so on."

Comfort, both front and rear, again came in for great praise. A California physician remarked: "One of the reasons I bought the Accord was that I can fit in the rear seat. I've been waiting three years for American small cars to provide that feature. I'd rather buy American, but when will Detroit get the message? Small U.S. cars will soon find themselves in the position of Harley-Davidson when Honda motorcycles arrived."

Also on comfort, a Kentucky district manager observes, "Tremendous car for cross-

(Please turn to page 250)

Photos by the author



Accord's standard items include coin holder atop dashboard, tach, lighted diagram to warn of burned-out lamps and doors ajar, AM/FM radio, delay wipers.



Hatch lifts to reveal 15.9 cu. ft. over back deck. Optional tonneau hides cargo. Rear quarter windows flip outward; there's a rear-window wiper and defroster and tailgate release inside.

to nit pick!

Vinyl upholstery has nylon cloth inserts for less slipperiness. Owners cite comfort front and rear, with a good flow-through ventilation system. Rack-and-pinion steering feels responsive and positive, as do the brakes and five-speed manual transmission.



Honda's CVCC engine stands crosswise under hood. It's like the Civic's but with a 6.5-mm greater stroke, 110 cc more displacement. Like the Civic it has FWD, needs no catalytic converter, burns leaded regular. Our survey showed less than EPA mileage disappointing owners.



Styling grabbed most owners. Annoying some were vibrating hood and hard-to-seal windows. MacPherson struts up front and Chapman struts in the rear give a good combination of ride and handling, yet the rear tends to be noisy.





New gear that makes yard work easier

by Mort Schultz

The trend continues this year toward smaller, more compact lawn and garden power equipment. However, two recent developments are real standouts.

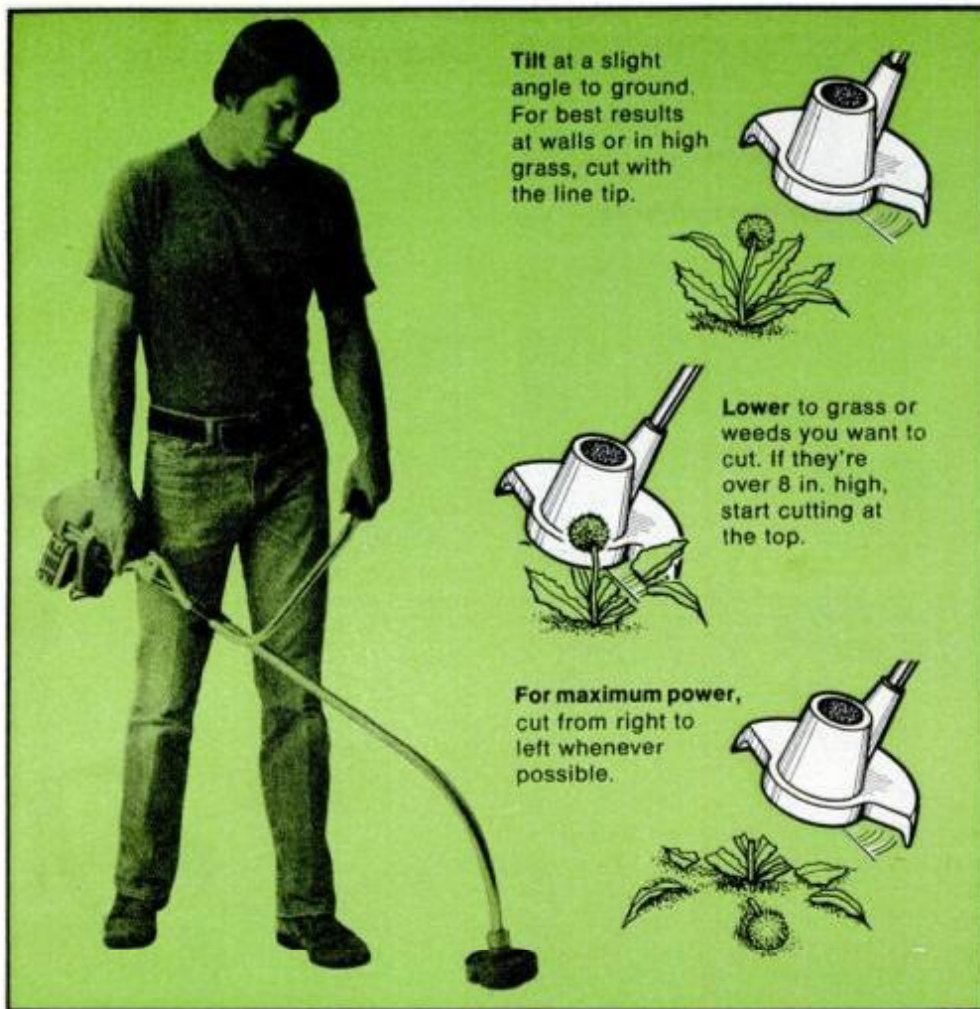
One is the appearance of new lightweight tillers for small gardens and for maintaining soil around shrubs, trees and in flower beds more easily than with larger models.

The other development is the increase in the number of new hand-held nylon-line grass and weed trimmers. The first one was introduced in 1975. Now four major companies offer versions.

Here is a summary of new equipment for '77 that PM rounded up to help you with your yard work. Addresses of manufacturers are given so you can get more information if you need it when deciding which machine to buy.

New garden tillers

Ariens has two new lightweight tillers: The 2-hp Gard-N-Yard (left) weighs 63 pounds. The 3-hp compact tiller (not shown) weighs 103 pounds. Both have Briggs and Stratton engines and are gear-driven, one-speed units. Ariens Co., 655 West Ryan St., Brillion, Wis. 54110.



Tilt at a slight angle to ground. For best results at walls or in high grass, cut with the line tip.



Lower to grass or weeds you want to cut. If they're over 8 in. high, start cutting at the top.



For maximum power, cut from right to left whenever possible.



Flexible-line lawn trimmer

The Mini-Weedy trimmer above, from Weed Eater, may look like a metal detector, but in fact it cuts grass and weeds with a whirling nylon-line "whip." Weed Eater, Inc., 5146 Richmond Ave., Houston, Tex. 77056, was the first to offer this type of trimmer. This latest addition is a gasoline-powered unit. Although it weighs only 12 pounds, the Mini-Weedy is designed for heavy-duty use. The unit has a 17-in. cutting path and can be used as a trimmer, edger, mower and sweeper.

An adjustable guide handle and fingertip throttle control help make it easy to manipulate. The shoulder harness distributes the weight of the unit to make it seem lighter. Cost of the Mini-Weedy, Model 607, is about \$230.

Heavy-duty tiller

The Roto-Hoe tiller Model 910 at right is a heavyweight with tines located in the rear. It's for use on farms and in large gardens.

The model 910, which carries a \$309 price tag and boasts a 5-hp Tecumseh power unit, has four forward speeds and one reverse. The speed is variable from $\frac{1}{2}$ to $2\frac{1}{2}$ mph.

The 13-in. nonadjustable tiller attachment sells for \$90, is chain-driven and clutch-controlled. The unit can also be outfitted with a number of other helpful attachments, which include a furrowing plow able to make 8-in.-wide by 6-in.-deep furrows, a turn shovel that can lay two parallel seedbeds, and 11-in.-diameter discs that break up clods in the



More whip trimmers

The Toro company offers two flexible-line trimmer units. The Whirl Trim Standard is powered by a 3.8-amp. motor and weighs six pounds. It sells for \$50.

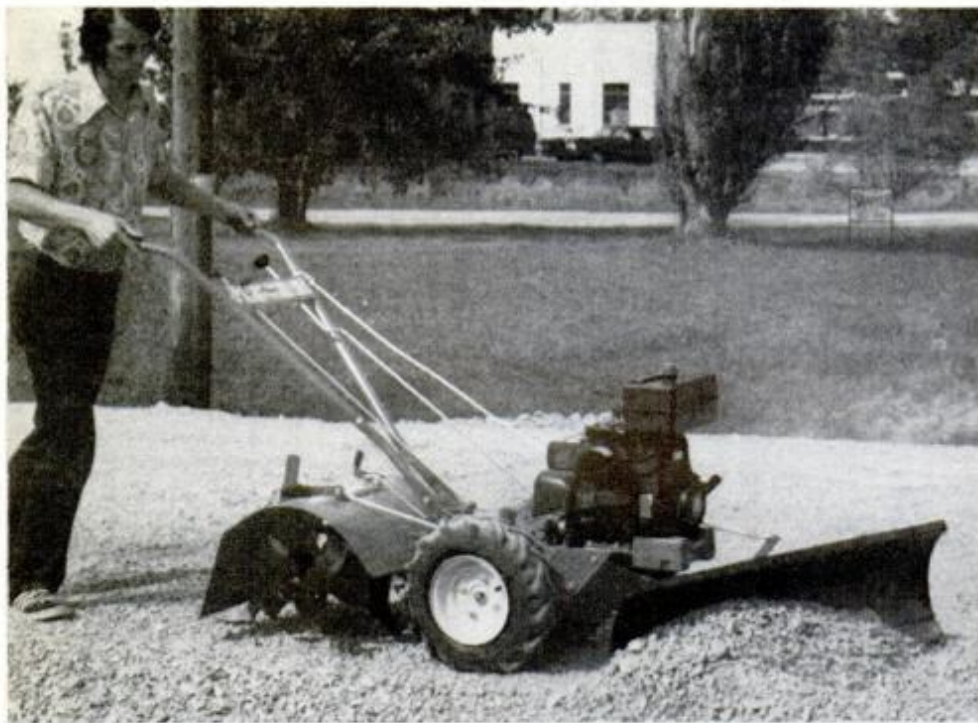
Toro's best is the Whirl Trim Heavy Duty unit. This flexible-line trimmer has a high-rise adjustable handle for balance and easy control. It has a 5-amp., 8500-rpm motor for use on heavy grass and weeds.

The power cord caddy at the base of the tubular handle stores up to 100 feet of cord for use in large areas. The pistol-grip handle where the control button is located is molded for comfort. The heavy cutting line stores on a spring-loaded reel and clears a 12-in. swath. The machine sells for \$70. From Toro, 8111 Lyndale Ave. S., Minneapolis, Minn. 55420.



preparations of good sized seedbeds.

Roto-hoe has another heavyweight machine, Model 990, and a Model 190 for light duty. The lightweight tiller is best where space is tight. Its power unit may be either a $3\frac{1}{2}$ or 5-hp Tecumseh engine, and the machine is then outfitted with a tiller attachment, cultivator-tiller attachment or shredder. The tiller adjusts from 12 to 24 in. The cultivator-tiller is a fixed 12-in. width. Roto-Hoe Co., Newbury, Ohio 44065.



Five-hp tiller

If you need a rugged tiller or plow for a large plot of ground, check this husky, new Ariens 5-hp gear-driven Rocket model above. It's modeled after the company's top-of-the-line, 7-hp unit. The 5-hp model isn't as elaborate as the latter though. It won't accept the electric starting option and has two forward speeds and one reverse speed, rather than two and two. Main features of the 5-hp model include 16 12-in.-diameter tines that work at speeds of 172 to 235 rpm, a tilling depth up to 7 in. and a width of 20 in., adjustable to 28 in. by the use of an extension kit. It weighs 360 pounds, is 70 in. long, 23 in. wide and 44 in. high, can take a dozer blade. Good for use on a large-size gardens and small farms where it can go to work and show its true worth. This tiller is for the homeowner who goes in for gardening in a big way. Ariens Co., 655 West Ryan St., Brillion, Wis. 54110.



Lightweight tiller

Another new lightweight one-speed compact cultivator (left) has just been introduced by Gilson Brothers Co. It weighs approximately 65 pounds and is equipped with a 2-hp Briggs and Stratton engine. Like the 2-hp Ariens unit, the Gilson 51104 is easily transported and stored by removing its handles. But there are differences between the two that you will want to consider:

The Gilson machine has chain-drive—rather than gear-drive. The chain is case-sealed and receives continuous lubrication. The thin, spring-steel tines of the Gilson 51104, which will be replaced free of charge should they break, are adjustable from 7 to 22 in. From Gilson Brothers Co., Box 152, Plymouth, Wis. 53073.

Chain-driven tillers

Two new products from MTD are on opposite ends of the tiller spectrum. One is a lightweight Till-It (below) similar to the Ariens Gard-N-Yard and Gilson 51104. The other is a 225-pound, 8-hp heavyweight built for professionals. MTD Products Inc., 5389 West 130th St., Cleveland, Ohio 44111.

The Till-It has a Briggs and Stratton 2-hp engine, one forward speed, folding handles and 16 tines with a 10-in. diameter.

It is chain-driven and has handle-mounted throttle controls to vary motor speed. Larger model is a chain-drive tiller with 4-speed transmission.



Lawn sprayer

The Broyhill Co., North Market Square, Dakota City, Neb. 68731, offers a new 5-gallon lawn and garden sprayer. The sprayer emits a uniform 3-foot spray as you push or tow it along.

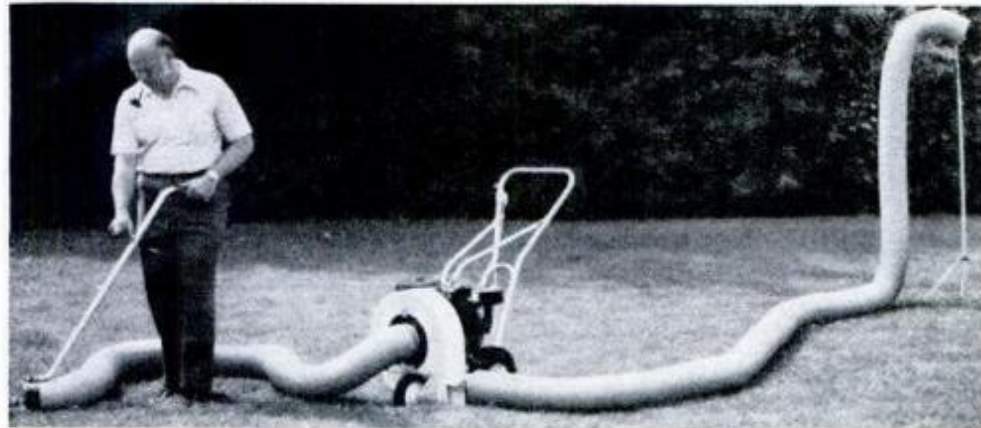
Here's how it works. Wheel-mounted squeeze pumps, driven by pressure against the ground, eject spray through four nozzles. The lawn or garden areas can be sprayed thoroughly with no patches left bare.

Blower collects debris

You can use this blower just like a broom or rake to clean patios and drives or even large areas like tennis courts. Made by Little Wonder, 1028 Street Rd., Southampton, Pa. 18966, it will also help you pick up debris after thatching a lawn.

A 10-ft.-long intake hose attaches to the front of the blower. A rear hose, 6 in. in diameter by 20 ft. long, discharges the trimmings, leaves or other debris into a cart or upward into a truck bed. The hose consists of a coiled wire covered in nylon with a vinyl wear strip over the nylon. The unit will also accept a discharge bag.

The blower is run by either a 5 or 8-hp motor. Cost of the 5-hp blower is \$273.95, plus loader hose and bagging attachments. The blower with 8-hp motor is \$329.95. Attachments are additional.

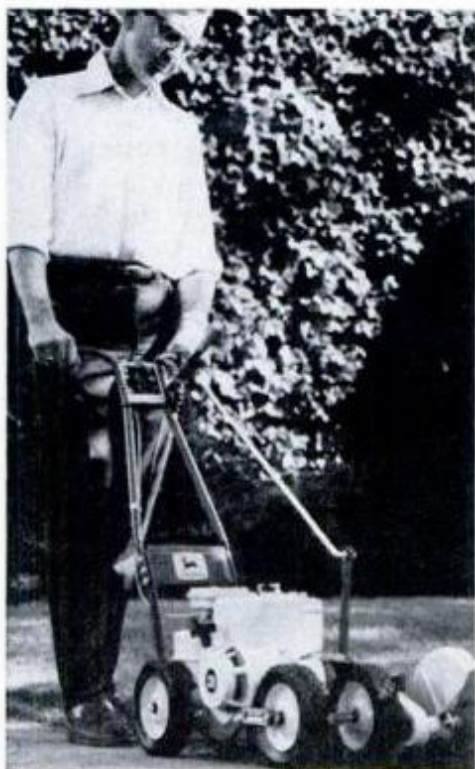


Tiller for small chores

The Mini-Tiller above, by Black and Decker, is in a class by itself. At 18 pounds, it is the lightest lightweight available, and it is run by an electric motor (8 amp.) rather than the standard gasoline engine.

It can be fitted with lawn thatching and digging accessories. Right-angle tines (top) are used for weeding and aerating soil. The lawn thatcher attachment promotes better lawn growth by bringing old grass clippings to the surface for easy removal.

The B&D Mini-Tiller is priced at \$130. Black and Decker Manufacturing Co., Towson, Md. 21204.



Walk-behind trimmer

A new walk-behind edger/trimmer that helps you keep your lawn looking good is this 3-hp machine (left) from John Deere. The engine is an air-cooled, four-cycle Briggs and Stratton with a recoil-type starter. You can adjust the depth control up to 2 in. by means of a nine-position control lever. The unit turns into a trimmer by repositioning the cutting head from vertical to horizontal. Four-wheel design gives better balance on slope, according to the maker. It's \$195 from John Deere & Co., Moline, Ill. 61265.



similar to the powerplant used on Honda's small motorbikes. Two forward speeds and one reverse are provided in the A2 model (the Model A1 is available without reverse), and tines are adjustable to a maximum 36-in. width.

Other features of the F-400 include an ignition cutoff switch on the handle, a handle that swings and can be adjusted both horizontally and vertically, and a lever-controlled clutch. Prices of the A1 and A2 models are \$363 and \$388 respectively. (They're slightly lower on the West Coast.) You can find them at Honda dealers. American Honda Co., 3435 Wilshire Blvd., Los Angeles, Calif. 90010.

Garden workhorse

If you thought that Honda only made bikes that go vroom and cars with mysterious initials (CVCC), be advised that this firm now produces a piece of machinery called the F-400 Earth Mover Tiller (right).

The unit is chain-driven and powered by Honda's 3.5-hp, four-stroke engine, which is

Looks good



Once again, Popular Mechanics and the Automotive Parts & Accessories Association are bringing you their special "May is Car Care Month" program. It's filled with valuable information and money-saving specials that will help you keep your car running smoothly. The APAA's involvement reflects its continuing dedication to provide you with safer, more reliable automotive parts and products. Thousands of retailers, manufacturers and newspapers will be helping to make this year's "Car Care Month" the most exciting yet.

Check the Directory on page 202 for your local "Car Care Month" Headquarters. These retailers will be able to supply you with many of the fine products from cooperating manufacturers that you'll see advertised in Popular Mechanics' Car Care Guide. You'll find a listing of the cooperating manufacturers on page And, be sure to look for the PM and APAA logos in advertisements and store displays in your area. Hundreds of newspapers from across the country will be featuring Special Car Care Month Sec-

Annual Popular Mechanics APAA May is Car Care Month

tions. You'll find the newspaper Directory on page 216 Watch your local newspaper for special moneysaving values and advertisements.

The POPULAR MECHANICS Car Care Guide is a "magazine within a magazine". It's filled with essential car repair information and loads of hints to help keep your car running smoothly. Just bend back the magazine and pull the Guide away. You've got an instant reference manual at your fingertips.

This year, the Environmental Protection Agency has announced a program that asks motorists to help conserve our dwindling fuel supply, reduce our dependence on foreign oil and cut air pollution. Backed by major government, industry and consumer groups, it offers a free, one-minute analysis of auto emissions from service outlets who have the necessary analyzer equipment and who display the GAS SAVER CHECK poster.



Cooperating motorists, who are asked to voluntarily submit their cars, will receive the "I'M A GAS SAVER" Decal shown. Being kicked off this month in some cities, it will be an on-going effort, with emphasis in high car population and car/air pollution areas.

Look for the stores and products that bear these symbols:



Popular Mechanics 1977

CAR CARE GUIDE

In this fifth annual special section, PM's Auto Editors tell you how to keep down the cost of owning and operating your car, and how to troubleshoot it when it won't run right or won't run at all!



You can fix dents, holes and scratches in your car's body. Everything you need is in the 11-piece kit. Follow the **FREE Auto Body Repair Manual**. You can't go wrong. And you'll save money! A lot of money! When you do it with **DURO**, you do it right.

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CAR CARE GUIDE

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HOW PM PREPARED THIS '77 CAR CARE GUIDE
CAR OWNERSHIP: HOW TO TAKE THE LOW-COST ROAD
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How do I start troubleshooting a starting problem?

Prepared by the editors of Popular Mechanics, with technical art by Peter Trojan, Low-Cost Road illustration by John Huehnergarth, Start Saving Here art by Dale Gustafson

Finally.
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that does what
it's supposed
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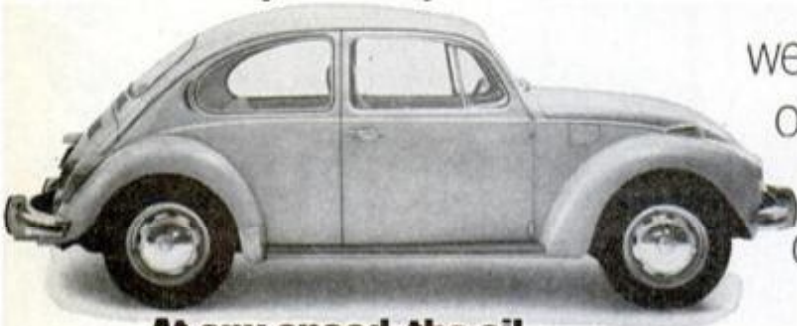
Offer expires October 31, 1977.

Mail check or Money Order to:

BLUE MAGIC CORPORATION
P.O. Box 3145 Long Beach, CA 90803

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.



At any speed, the oil in a small car is working twice as hard as in a big car.

Smaller cars with their 4- or 6-cylinder engines circulate their oil twice as fast as big sixes or eights. They run at 25 to 30% higher revs throughout their entire performance range. So there's more friction and heat in the engine.

And the design features that increase their fuel efficiency also happen to increase their operating temperatures.

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.

The heat in a small engine can drain the life out of an oil.

All this causes increased wear, tear and shear (thinning out) on your oil. Which can keep it from lubricating and cleaning properly.

It can also cause sludge and other kinds of deposits to form and clog passageways in the engine. 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 ever since then, Castrol has been specially formulated to withstand the tortures of small cars. Today's Castrol incorporates the costliest additives available anywhere. (Including



viscosity improvers, anti-wear agents, anti-oxidants, detergents and dispersants.) 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 up 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.)

And to satisfy ourselves even further, we test Castrol on two additional small car engines: a 1302cc VW and a 1798cc MGB.

So naturally, Castrol exceeds all U.S. and foreign car manufacturers' specifications.

And that goes for every single grade and multi-grade of our oil, no matter where in the country you buy it.

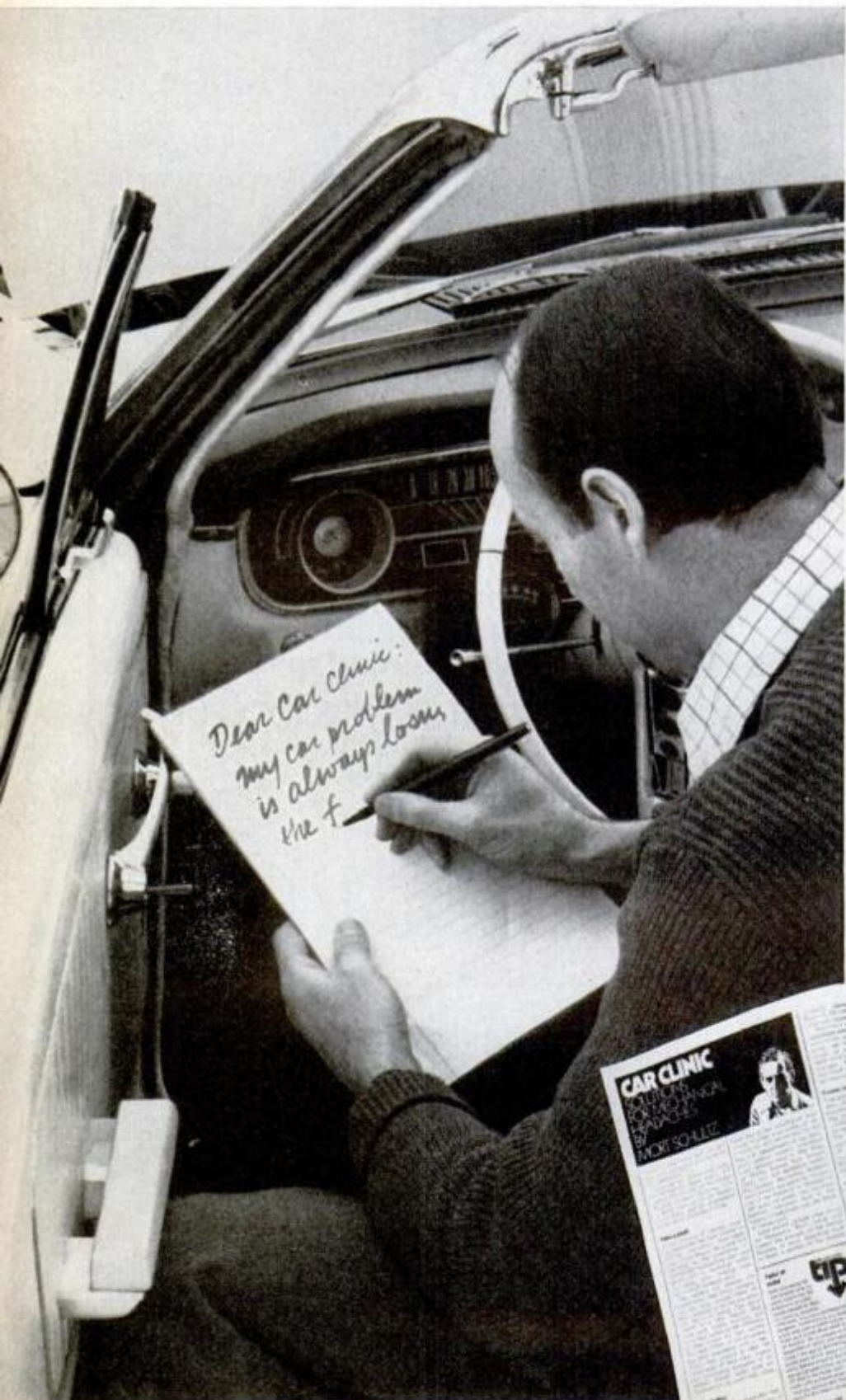
Now if you have a smaller car, you have some big reasons to change your oil.



Castrol
The first oil engineered for smaller cars.

*Organization of European car makers and oil manufacturers.
**Society of Automotive Engineers.

Get longer car life at lower cost with this '77 CAR CARE GUIDE



Popular Mechanics' *Car Clinic* column is a "Dear Abby" for car owners who may be on the verge of clobbering their carburetors with a wrench, kicking in their rusted rocker panels or even rolling the clunker off a cliff.

Every year thousands of car owners write to *Car Clinic* for answers to problems plaguing them. Every month we answer many of these letters in the column, but in this *Guide* we're able to give the information that will answer many, many more.

Here's a percentage breakdown of problems outlined in the letters we've received in the past year. Each problem area is treated in its own section in the *Car Care Guide*:

1. Carburetor-related problems	15.6%
2. Hard-starting problems	8.4
3. Drive train problems	8.2
4. Suspension and steering problems	7.8
5. Engine problems	6.8
6. Ignition and electrical problems	6.2
7. Oil-related problems	6.1
8. Cooling system and airconditioner problems	6.0
9. Body and finish problems	4.3
10. Brake problems	3.1
11. Exhaust system problems	2.6
12. Tire problems	2.4
13. Fuel-system problems	2.4

Section 14 in the *Car Care Guide* is devoted to sources and contacts for those readers who wrote to *Car Clinic* asking for information. These letters comprised a full 20.1 percent of the total.

Section 15 is a quick-reference section that outlines troubleshooting procedures.

Any do-it-yourselfer knows how much can be saved by doing his own car maintenance. But there are other ways, too, that you can keep down the high cost of owning and operating your car. Just turn the page for the right steer onto the low-cost road . . .

—The Editors



Autolite spark plugs are leakproof to assure full power and fuel economy longer.

Everybody expects spark plugs to spark. But **how much** and **how long** they spark depends on how well they **plug** against electrical and compression leakage. Here's the inside story on how Autolite plugs are sealed to deliver superior performance and gasoline mileage to you. No matter what you drive.

Terminal Post/ Center Electrode

Up to 50% thicker than top competitor. Sealed within the ceramic insulator. Autolite's conductor spine is virtually unbreakable. Try it yourself.

Copper/Glass Seal

Autolite uses an exclusive copper-glass seal which literally **bonds** the terminal post to the center electrode, assuring full voltage at the spark gap.

Shell Threads

Precision Rolled Threads conform perfectly to SAE and International Standards Organizations (ISO) standards - to assure easy, leak-proof installation, easier removal.

Center and Ground Electrodes

Nickel Chromium Alloy Electrodes resist gap growth. Maintain a precise spark gap longer.

Insulator

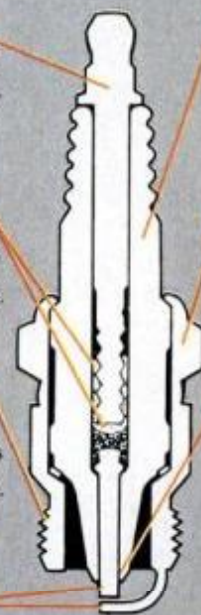
Resists wrench breakage. Autolite's diamond-hard ceramic insulator will actually cut glass. Provides maximum insulation, plus extraordinary ability to deliver precise heat ranges.

Shell

Hot Pressed Assembly assures a perfectly centered, unitized and leak proof assembly. To resist corrosion, Autolite shells are deep etched with black oxide in a 45 minute bath.

Power Tip

Self-Cleaning Power Tip, pioneered by Autolite, operates more efficiently over a wider heat range, and allows combustion deposits to burn away, thereby reducing misfiring and fouling.



Cutaway Diagram of Autolite Spark Plug



Fram and Autolite are Bendix Companies.
FRAM CORPORATION
Providence, Rhode Island 02916

50,000 miles of free driving. That's your bonus if you take this tip: Keep your car at least 10 years and maintain it yourself.

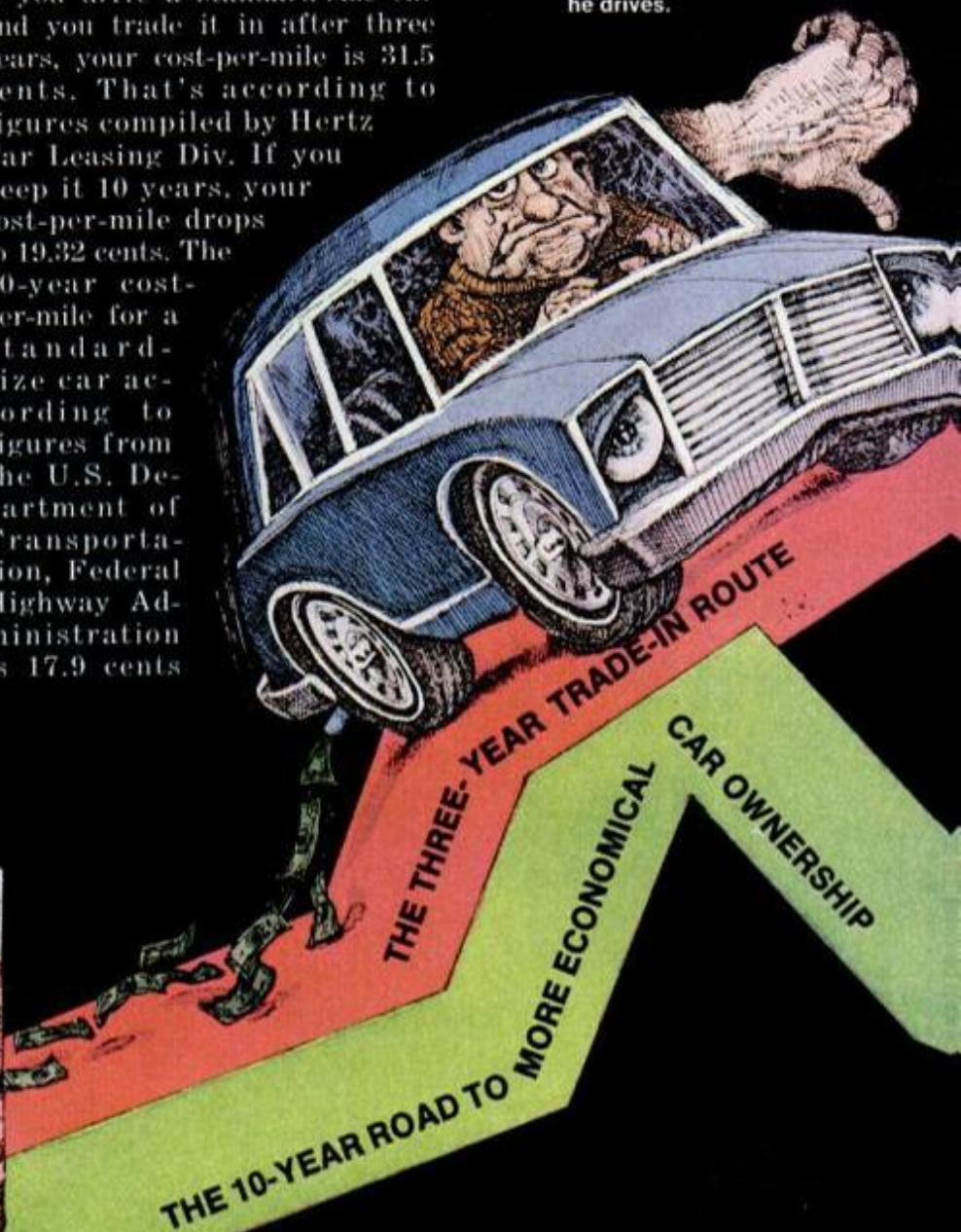
That's it. No tricks, just simple arithmetic. A lot of addition and division was done last year by car fleet owners, government agencies and other organizations to illustrate that 1976 was another record year in the number of dollars it takes to keep your car on the road. It doesn't take reams of professionally prepared charts and tables, however, to remind you that last year the price of a new car was more than ever before; that the price of gasoline went up; that the price of oil, lubricants and parts went up; that the price of replacement tires went up; that the price of insurance went up, up, up! All you have to do is look at your bank balance.

What the pros did for 1976, and what you did if you keep cost-per-mile records for your car, was add up all the dollars that were paid out to own and operate typical full-size, intermediate, compact

and sub-compact cars and then divide by miles driven (typically, 10,000 miles per year). The resulting figures were presented to show the cost-per-mile to the owner if he financed a car for three years and then traded it in, if he kept it for 10 years and so on.

For example, it was found that if you drive a standard-size car and you trade it in after three years, your cost-per-mile is 31.5 cents. That's according to figures compiled by Hertz Car Leasing Div. If you keep it 10 years, your cost-per-mile drops to 19.32 cents. The 10-year cost-per-mile for a standard-size car according to figures from the U.S. Department of Transportation, Federal Highway Administration is 17.9 cents

The all-thumbs, three-year trader pays a stiff rate for every mile he drives.



The total cost of owning and operating a car is the sum of many individual expenses. Ownership costs are those bills you have to pay whether or not you ever drive your car. Operating costs are those payments that are directly related to the amount of driving you do.

Some of these expenses are levied on you and there's not a thing you can do about them—your annual automobile registration fee,

for example. Other taxes, some of which are used for road maintenance, are extracted from you as part of the price you pay for a gallon of gas.

Here's a breakdown of the expenses you incur owning and operating your car. You can trim dollars off most of them. Some you can slash to nothing: Your own labor (tender loving care is a better way of expressing it) costs nothing

CAR OWNERSHIP: HOW TO TAKE THE LOW-COST ROAD

The do-it-yourself owner who has kept his car young for 10 years pays only pennies a mile.



PM art: John Huehnergarth

when you maintain and repair your car yourself.

- **Sticker price** of a new car is something you can dicker about.
- **Interest** or finance charges on a new-car loan will be less if you shop around.
- **Depreciation** of a new car during the first years of ownership is a nasty blow, but not for those who keep their automobiles for 10 years and longer!

- **Insurance premiums** have skyrocketed, but there are a few things you can do to keep the annual tab to a minimum.
- **Gasoline and lubricants** vary in price depending on where you buy them. Know how to stretch a gallon of gas.
- **Replacement parts**, tires and accessories can also go a long way in affecting the cost of maintenance. Buy wisely.

- **Garaging, parking and tolls** are not figured in the cents-per-mile costs cited in the text because they vary widely with individual needs and locations.
- **Repairs and maintenance** are where you make out in a big way: Do-it-yourself and laugh all the way to the bank. This *Car Care Guide* will get you started with what you need to know to take the low-cost road.

CAR OWNERSHIP: HOW TO TAKE THE LOW-COST ROAD

—a bit less than the Hertz figure.

An owner who does his own maintenance, and is savvy on keeping his insurance costs down and on getting the best mpg from his car, will lower his cost per mile to at least 15 cents.

That's what PM figures, and that's half what it costs the three-year trader per mile, or looked at in another way, it's 50,000 free miles in 100,000 over a 10-year ownership.

The formula that will allow you to operate your car for the lowest cost is not a secret:

- Start by selecting a car that meets your needs.
- Pay a rock-bottom price for it.
- Purchase only the insurance that you absolutely need from a company offering it at the lowest cost.
- Use oil recommended by the manufacturer, buying it in bulk from an auto-supply dealer, rather than a quart at a time from gas stations.
- Buy gasoline from a station that offers it at the cheapest price.
- Maintain the car like a fanatic.
- Buy parts only when you need them from reputable suppliers.
- Do all your own troubleshooting and repairs.
- Drive sensibly.
- Let's see—did we leave anything out? Oh, yes. Keep the car forever, if possible.

This formula is easier to expound than to practice. However, even if you are able to carry through only a part of it, you will be that much ahead of the game.

Buy right

The difference in price between new full-size and new subcompact cars is several hundred to several thousand dollars. The cost-conscious car buyer must therefore select his vehicle with care. Other than initial price, the economics of operating, maintaining, repairing, licensing and insuring one model in relation to another must be weighed.

(In our discussion of relative costs, car models are classified as full size, compacts and subcompacts. A full-size model weighs more than 4000 pounds. A compact weighs between 2700 and 3600 pounds. A subcompact weighs less than 2700 pounds. Weights are with the car empty. Intermediate-size cars, weighing 3600 to 4000 pounds, are not included. Neither are mini-size vehicles of the Chevette class.)

The size of your family, or the need for extra room to carry car-pool passengers or equipment, may demand that you buy a full-size model. However, consider carefully

if you really need a V8 engine and automatic transmission. These options add several hundred dollars to the purchase price.

There is a significant variation in the cost of operating full, compact and subcompact models. Just how much was estimated last year by the Highway Statistics Div. of the U.S. Department of Transportation. The organization conducted a cost-analysis study of suburban-based 1976 models that will acquire 100,000 miles over a 10-year period.

Costs considered were original price, depreciation, maintenance, accessories, parts, tires, gas and oil (excluding taxes), garage fees, parking charges, tolls, insurance, and state and federal taxes.

The cost of operating a full-size model came to 17.9 cents per mile, or \$17,900 for 10 years/100,000 miles. The same cost for a compact was 14.6 cents per mile, or \$14,600—\$3,300 less. And for a subcompact the cost dropped to 12.6 cents per mile, or \$12,600—\$2000 less than the 10-year operating cost of the compact and \$5300 less than that of the full-size model.

Put another way—if you purchased a subcompact this year, you would save enough in 10 years to be able to buy another new subcompact model. Assuming today's prices, you would even have cash left over.

In the cost for gasoline alone, the differences between the three classes of vehicles are impressive. It is estimated that the cost of gasoline for a full-size car will be 3.19 cents per mile, or \$3190 in 10 years/100,000 miles. Gasoline for a compact will cost you 2.28 cents per mile, or \$2280 in 10 years—\$910 less. Gas for a subcompact will be 1.65 cents per mile, or \$1650 in 10 years—\$630 less than the cost for a compact; \$1540 less than that for a full-size model.

Options really are optional

When selecting options for a new car, you can lower your initial cost if you don't let desire take precedence over practicality. In some cases, you have no choice, because what is an option in one model is standard equipment in another, and the cost has already been added to the car's list price.

Where choices are given, consider each option offered carefully. Ask the salesman to go over with you the extra equipment offered by the company and its price. Where a designation isn't defined, such as mirror group or light group, ask for clarification.

Don't forget also that generally included in a list of options are four-door, hatchback and station wagon. They are priced higher than basic two-door models.

Totaled, the cost of optional equipment can add \$2000 to \$3000 to a car's base price. You may be able to afford a new car by eliminating some of the frills.

Order or pick it

Consider whether to order or pick a new car from stock. All in all, if you find the model you need having the equipment you want in a dealer's showroom buying it is usually financially advantageous.

The dealer has money invested in a car he has on hand. He doesn't have any invested in a car you will order. He is therefore anxious to sell vehicles in stock and will usually do so for a smaller profit.

In discussing selling price with a salesman (never pay the price on the sticker), there is a rough rule-of-thumb to follow.

For full-size cars, the sticker price on the glass reflects dealer's cost plus an approximate 20 percent markup. For a compact the sticker price includes about a 15 percent profit. For subcompact models, the profit margin is about 10 percent.

Another distinct advantage in selecting a car from stock is that you don't have to wait. You can have the car within a day or two. Disadvantages in selecting a car from a dealer's stock include the fact that a vehicle may have more or less equipment than you want, and it might not be the color desired.

Used-car buying

You can often buy a good used car privately from a relative or acquaintance, or from a dealer who has been in business for a number of years and has a good reputation. Call the Better Business Bureau or Chamber of Commerce to determine whether a particular dealer has had any complaints lodged against his business.

You should take pains in judging the mechanical suitability of a used car. The law prohibits tampering with the actual mileage on the odometer and mandates a stiff penalty. However, there have been violations. In any case, use your eyes, hands, ears and nose to detect defects in mechanical performance and appearance.

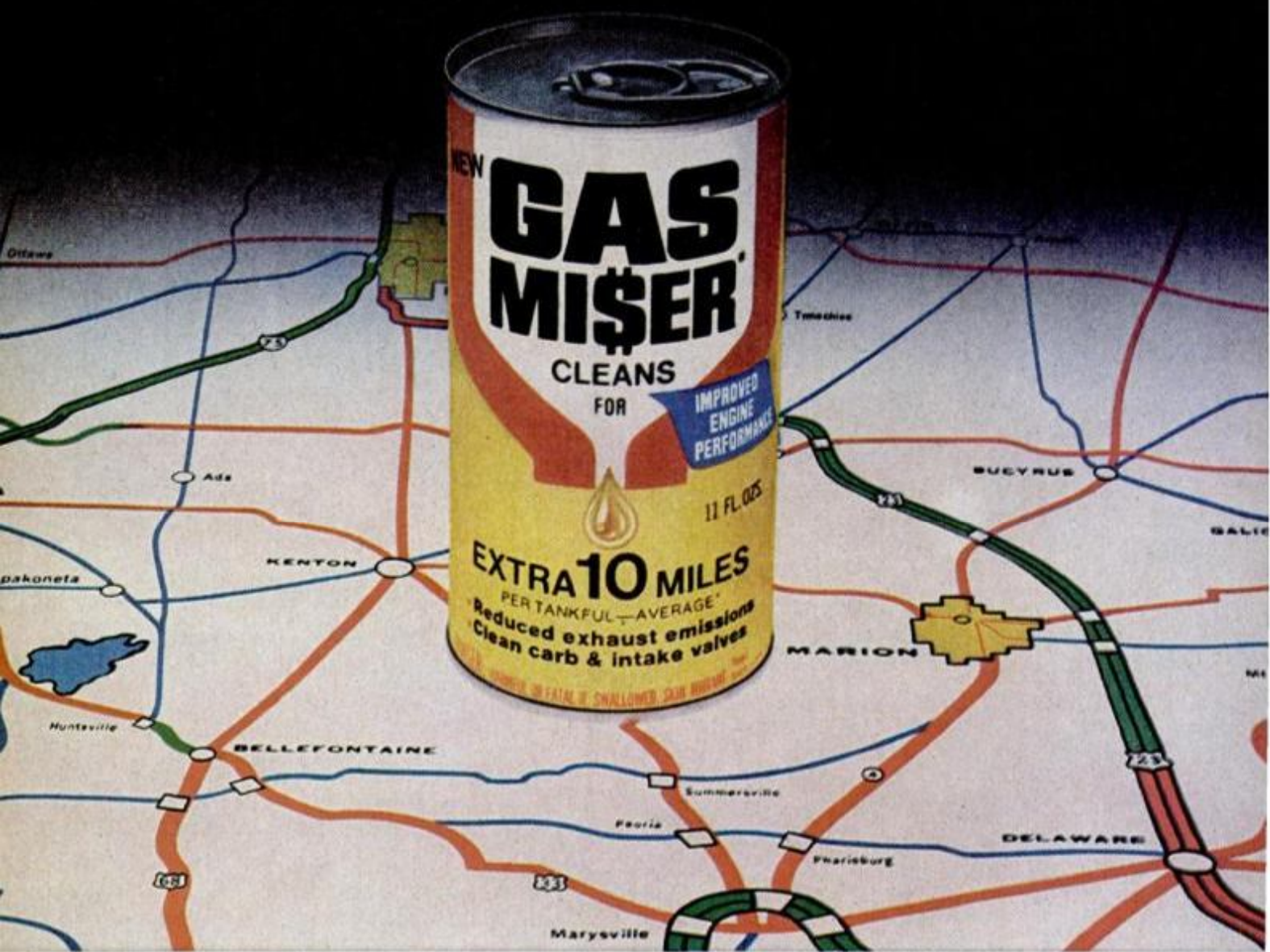
Following is a list of things to ask yourself about the car:

(Please turn to page 133)

**The ask-for motor oil.
Ever since America learned to drive.**



Pennzoil. It's worth asking for.



**Our new Gas Miser® gets you a cleaner carburetor
for fewer exhaust emissions.
And an average of 10 extra miles per tankful of gas.**

10 extra miles per tankful of gas. That's a lot of miles. But with new GAS MISER, it's only the beginning.

Formulated to improve performance

Because GAS MISER is a *detergent* formula. It keeps the vital parts of your fuel system clean. Your carburetor, PCV valve and intake valves.

And what it accomplishes is just as important as your increased mileage: it improves engine

performance. GAS MISER helps combat rough idling, stalling and sluggish response.

Cuts down auto exhaust emissions

It'll even reduce your car's exhaust emissions.

But exactly how well GAS MISER works depends, in part, on how you use it. For best results, use it regularly. One can for each ten gallons of gas added to your fuel tank.

GAS MISER is right for almost

every kind of vehicle you could own—car, pickup or truck. If it's powered by gasoline, it can be powered better with GAS MISER. From UNION CARBIDE.

50¢ refund

When you buy your GAS MISER, look for the refund offer on top of the can.

It'll have all the details you need to get a 50¢ refund on GAS MISER.



*Gas Miser® is a registered trade mark of Union Carbide Corporation, 270 Park Avenue, New York, N.Y. 10017.

CAR OWNERSHIP: HOW TO TAKE THE LOW-COST ROAD

(Continued from page 128)

- Is the car hard to start?
- Does it idle rough?
- Is the engine noisy?
- Does all equipment operate, including airconditioner, heater, defroster, lights, signals, windshield wipers and radio?
- Is the floorboard rusted (pull back carpeting)?
- Does the general, overall appearance give the impression that the car was cared for?
- Are there ripples in the body—a sign the car was in an accident?
- Are there signs of rusted-out areas (look very carefully under the car on the backside of the body, because tape or metal patches riveted to the body can hide holes)?
- Are tires in good condition and worn evenly?
- Have tires been replaced (they may have been worn unevenly), indicating a front-end problem?
- Does the car's exhaust look blue or blue-gray, indicating it is burning oil?
- Does the transmission shift properly?
- Are brakes and steering in safe condition?
- Are there any rattles when going over a rough road?

This list is not complete, but it is a start.

Trade or sell?

What you do with your present car bears on the initial cost of the one you are buying. You will get more money if you sell the car yourself rather than trade it. A way to determine the selling price to ask is to check newspapers and compare prices of cars comparable to yours. You could also look up average retail and wholesale prices in the NADA (National Automobile Dealers Assn.) *Used Car Guide* and the *Kelley Blue Book*, available at banks, insurance agencies and credit unions.

It usually does not pay to spend money for cosmetics to try and hide defects in a car if you are going to trade it in. The dealer is a professional. He knows whether the vehicle is a cream puff or dog.

Financing your new car

It pays to pay cash, if you can. The interest paid for your money by a savings bank will not offset the finance charges on money you borrow to pay for a car. If it did, lending institutions would rather put their money in the same bank than lend it to you.

Table I (above) compiled by the

Type of car	Loan amount	Finance charge (at 10.06%)	Cost per mile	SAVINGS WITHDRAWAL	
				Lost interest (at 5.13%)	Cost per mile
Full size	\$3266	\$533	1.4¢	\$296	0.8¢
Compact	2577	420	1.1¢	\$233	0.6¢
Subcompact	2163	339	0.9¢	188	0.5¢

Highway Statistics Div. assumes a 36-month financing period and demonstrates the costs of financing a car as opposed to interest lost by paying cash.

If you have to finance the car, remember that you'll pay the least by taking the shortest-term loan. For example, financing a full-size car for 60 months (five years) would cost you 2.3 cents per mile for that period, while a 36-month car loan would cost 1.4 cents per mile.

There are several ways to borrow money for less than is generally charged by banks and loan companies—such as from a credit union.

A passbook loan can be utilized when you have money in a savings account or certificates of deposit that you don't wish to withdraw. You can use the savings account or CD as collateral. The bank lends you the money, charging interest at a rate of at least 1 percent more than it pays into your savings. For example, if a certificate of deposit bears 7 percent interest annually, the bank will charge you at least 8 percent under the passbook-loan system.

If you use this method, your savings account will continue to earn interest, but assets are frozen up to the amount of money you owe. For instance, if you borrow \$3500 you must have \$3500 in savings to begin with, which cannot be withdrawn. If in six months you pay back \$1000, you must leave \$2500 as collateral. You can withdraw \$1000.

You can borrow on your life insurance. The interest rate is usually lower than that of other loans. However, if you should not pay off such a loan, (the insurance company doesn't pressure you to do so), interest will build up each year and

add to the outstanding balance. Interest is therefore charged on top of interest. This waters down the value of a life insurance policy.

To determine exactly how much it will cost to borrow money from sources available to you, ask each how much the *total* cost of the loan will be. Compare actual costs by filling out Table 2 (below).

The total you have to pay back is the monthly payment multiplied by the number of months. Thus, if the loan amount is \$3500 and your monthly payment is \$170.20 per month for 24 months, the *total* you pay back is \$4084.80. The cost of the loan would therefore be \$584.80.

Depreciation

Depreciation is the greatest single cost of owning and operating an automobile. It is a factor over which you have no control—if you trade cars frequently.

The greatest dollar depreciation of full-size cars occurs in the first few years. Depreciation of compacts and subcompacts is more evenly distributed over the years.

In its first year, a full-size car loses value estimated at 8.38 cents per mile. In the second year, depreciation amounts to 5.75 cents per mile; third year, 5.54 cents per mile; fourth, 4.66 cents per mile and fifth, 3.43 cents per mile.

After 10 years (100,000 miles), depreciation of a full-size car averages out at 4.86 cents per mile, or \$4860. The same depreciation average for a compact model is 3.83 cents per mile, or \$3830, and for a subcompact, 3.19 cents per mile, or \$3190.

The only way to beat depreciation

(Please turn to page 134)

Source of loan	Monthly payment	Total I must pay back	Cost of loan
1.	\$.....	\$.....	\$.....
2.
3.

CAR OWNERSHIP: HOW TO TAKE THE LOW-COST ROAD

(Continued from page 133)

is to maintain your car in excellent condition (hopefully doing-it-yourself to keep service costs down) and keeping the car until it begins to appreciate in value. People who bought and kept in good condition 1940 and 1950 models, for instance, can now get more than what they paid for their cars.

Insurance

Insurance is another weighty cost you can't do much about—it has spiraled upward in recent years. Your annual premium depends on the amount and type of coverage you buy, how you use your car and where you operate it.

Someone carrying \$100,000 and \$300,000 liability, \$50 collision deductible, full comprehensive fire and theft, medical benefits and uninsured motorist coverage, and who uses a car for business in New York City, will pay a whopping premium. But someone owning a car in rural Pennsylvania, carrying \$50,000 combined liability, \$250 collision deductible, etc. and driving only 5000 miles a year, will pay much less.

Judge your insurance needs and buy only what you need. To keep a premium respectable, you might assume some of the risks. You may decide to insure your car for major collision damage rather than for every dent it receives, and buy a \$250 deductible provision rather than \$50. You'll have to pay the first \$250 to repair damage (if any), but you'll save \$50 or \$60 a year in premium.

One more point: shop for insurance. Insurance companies still compete for business in many areas.

Taxes

State taxes for registration and titling usually depend on the size of the car. The tax is generally highest for full-size cars and lowest for sub-compacts.

Gasoline and state sales taxes on automotive parts are also fixed. However, if you use your car for business you can deduct from your federal income tax a certain portion of all taxes, also parking and toll fees, and maintenance and operating costs. The federal tax also allows some deduction for depreciation.

People who use cars strictly for personal use can also claim a certain percentage of deduction.

A worthwhile pamphlet explaining federal income tax deductions for car ownership is available from the American Automobile Assn. You can get a free copy of *Automobile In-*

come Tax Deduction from a local AAA office or by writing AAA, Public Relations Dept., 8111 Gatehouse Rd., Falls Church, Va. 22042.

Buying oil

Don't scrimp on the quality of oil. Use oil that meets API (American Petroleum Institute) service classification "SE" and meets or exceeds car manufacturer's requirements. The can label will state if the oil meets these qualifications.

To reduce vehicle-operation cost to rock bottom, you may be able to use a single-grade motor oil rather than multiviscosity. If so, you could save up to 30 cents a quart.

Generally, oil companies provide three types of high quality oil. One has a wide multigrade range, such as 10W-50, intended for use in temperatures of minus 10° to 110° F.

Another type is mid-range in price. It is multiviscosity, but of a more confined nature, such as 10W-40 for temperatures of minus 10° to 100° F.

The least expensive type of oil, is a single grade such as 10W, 20W-20, 30 and 40. If you use it, you have to tailor the grade to the consistent temperature in the area. If there is a wide swing between winter and summer, the oil will have to be changed as seasons change. SAE 30 oil, for example, is suited to temperatures between 30° and 100° F. A driver in Florida, say, would not usually change viscosities seasonally since the temperature seldom strays from this range. But a car owner in Michigan couldn't enjoy this freedom.

Don't forget that by using single weight instead of multiviscosity oil you usually trade convenience for savings. Either way, you'll save a great deal buying oil in bulk from an auto-parts supply dealer.

Buying gas

When it comes to buying gasoline, look for a station that sells fuel for the least amount. Self-service stations will usually save you 5 to 8 cents per gallon. Don't use a high-octane grade if your car doesn't need it. You will pay extra for nothing.

Your engine tells you if it requires additional octane by pinging. However, a ping could also signify the engine needs an adjustment, such as timing. It could also signify development of a serious problem that should be resolved promptly.

Buying parts

Shop for the best price on replacement parts, but remember it's not

wise to trade quality for a few cents in savings, so buy parts made by reputable, well-known manufacturers. Dealers often run seasonal sales, especially on such parts as tires, batteries and shock absorbers.

Maintenance and repairs

This is the area where you have an opportunity to save yourself a bundle of money and make headway in attaining the goal of 50,000 free miles. Professional repair shops today charge from \$13 to \$20 per hour for labor. They also charge full retail price for parts. Visualize the savings you can realize by buying parts yourself and doing your own work.

An ordinary tune-up, for example, that would cost you \$50 to \$75 to have done professionally would be about \$10 if you did it yourself.

Many shops operate on a so-called flat-rate basis. This means that if a particular job actually takes one hour for a mechanic to do, but the book says it should take him 1½ hours, you'll get a labor charge for 1½ hours.

When it comes to maintaining a car (such as changing oil, tune-ups, lube jobs) there isn't anything a reader of *Popular Mechanics* cannot do himself. As you know, PM is continually presenting feature stories to guide you in maintenance and repair operations.

When it comes to repairs, you are limited many times by a lack of special tools. But tools can be acquired as you need them.

Your personal troubleshooter

The big factor in repairing a car is to find the trouble. This year's *Car Care Guide* is devoted to just that.

The *Guide* is based on the hundreds of problems readers sent *Car Clinic* in 1976. We have pulled out the most common of these (and also some that aren't too widespread) for discussion. The purpose is to explain how to get at the root of a car problem so that the right thing can be fixed.

You will note that throughout the *Guide* we offer what are called "quick fixes." They are repairs you can do easily and quickly in an attempt to rectify trouble.

So without further ado, let's get into the *Car Care Guide* for 1977. The faster you get through it and begin practicing some of the skills it relates step by step, the faster you'll start working on your 50,000 free miles.

Stop boilovers.

Keep your cool this summer. Summer heat, traffic jams, and air conditioning can cause your engine to heat up. The result: boilover. That's why it's good to know about the protector, PEAK[®] antifreeze & coolant. No antifreeze & coolant has a higher boiling point than PEAK. So no antifreeze & coolant protects against boilover better than PEAK.

Get PEAK protection and you'll beat the heat this summer.

PEAK. The Protector.

PEAK[®]

antifreeze & coolant
guaranteed all year protection

WARNING: HARMFUL OR
FATAL IF SWALLOWED
SEE CAUTIONS ON BACK

NET 1 GAL.

 Northern
Petrochemical
Company



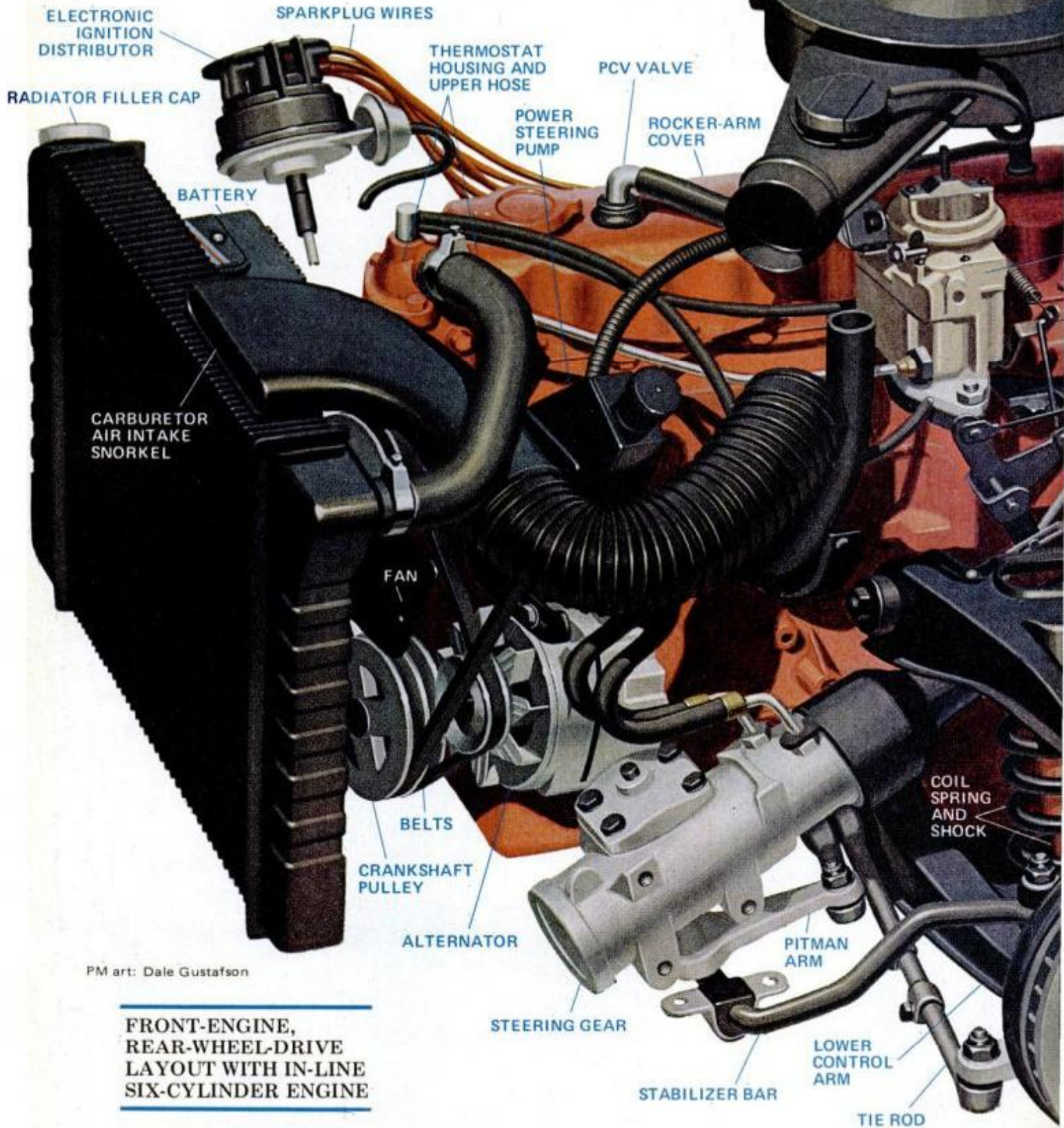
 Northern
Petrochemical
Company

2350 East Devon Avenue
Des Plaines, Illinois 60018

A subsidiary of  Shell International Chemical Company Limited

START SAVING HERE!

How much will your car cost you this year? There are some expenses you can't do much about. But when it comes to maintenance and repair, you can save a bundle. Here's a look under the skin to see what's where. Following, is the detailed information you need to service your car properly, to troubleshoot it when it's cranky and to repair the trouble spots.



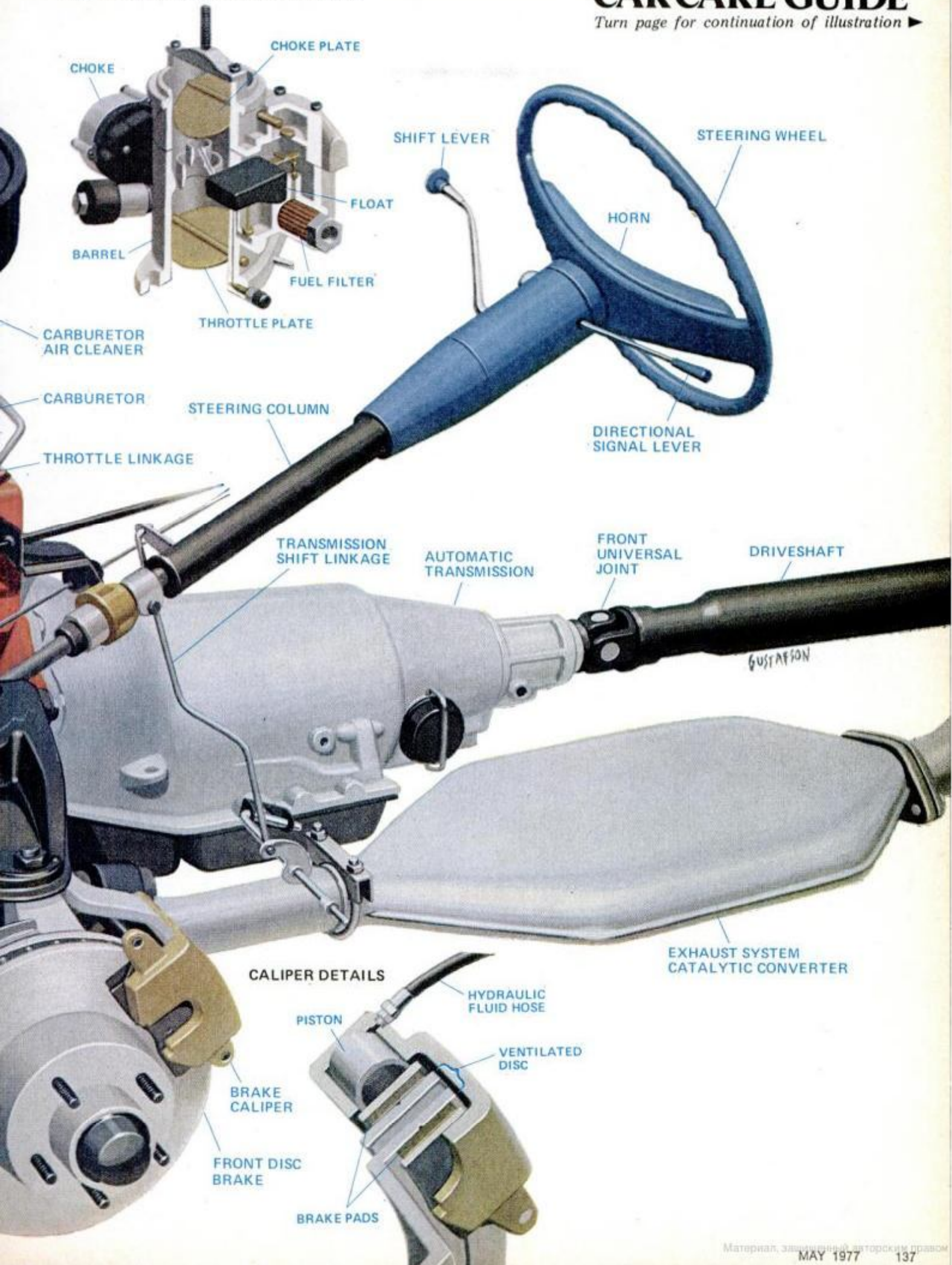
PM art: Dale Gustafson

**FRONT-ENGINE,
REAR-WHEEL-DRIVE
LAYOUT WITH IN-LINE
SIX-CYLINDER ENGINE**

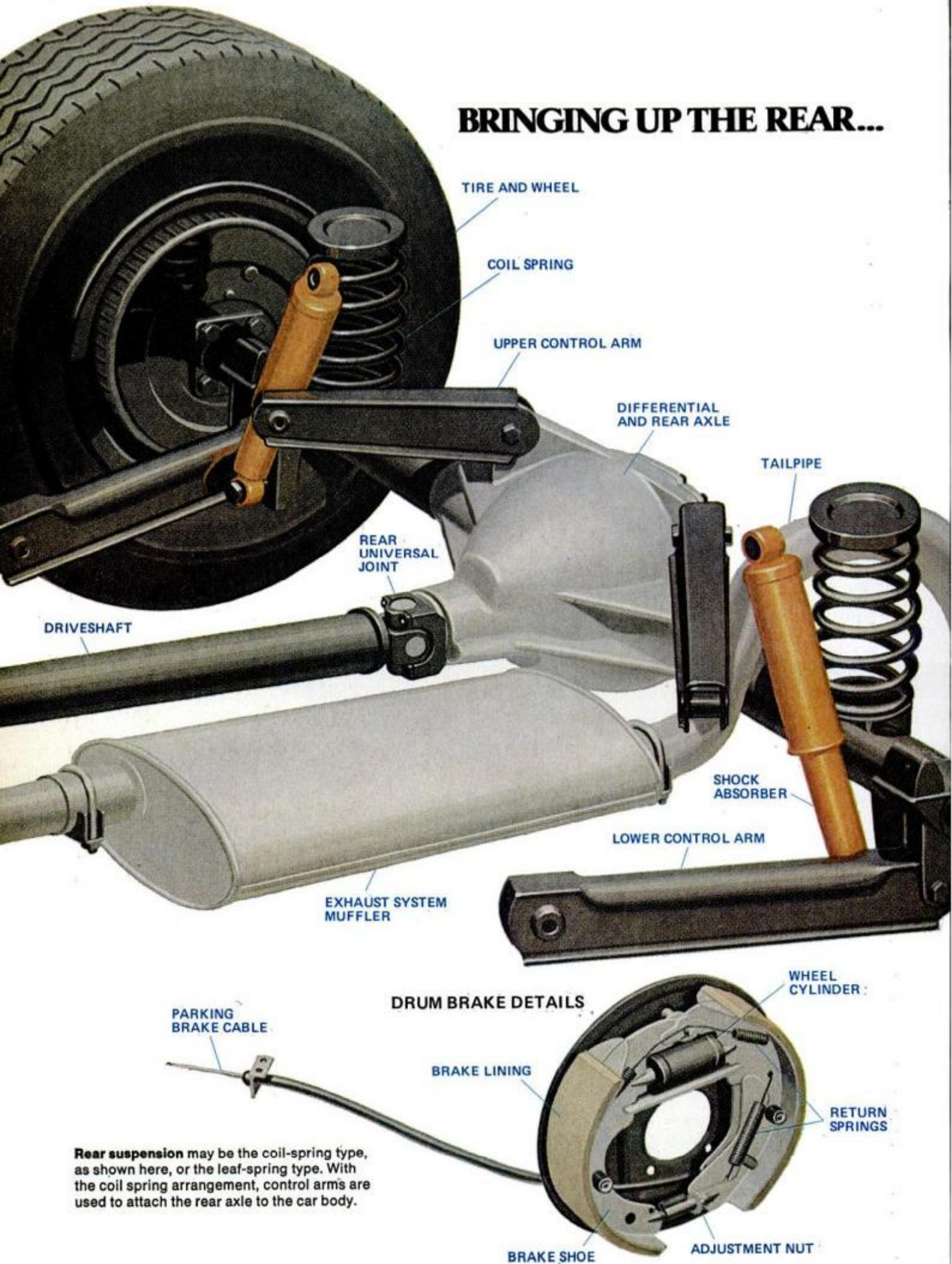
SINGLE-BARREL CARBURETOR DETAILS

CAR CARE GUIDE

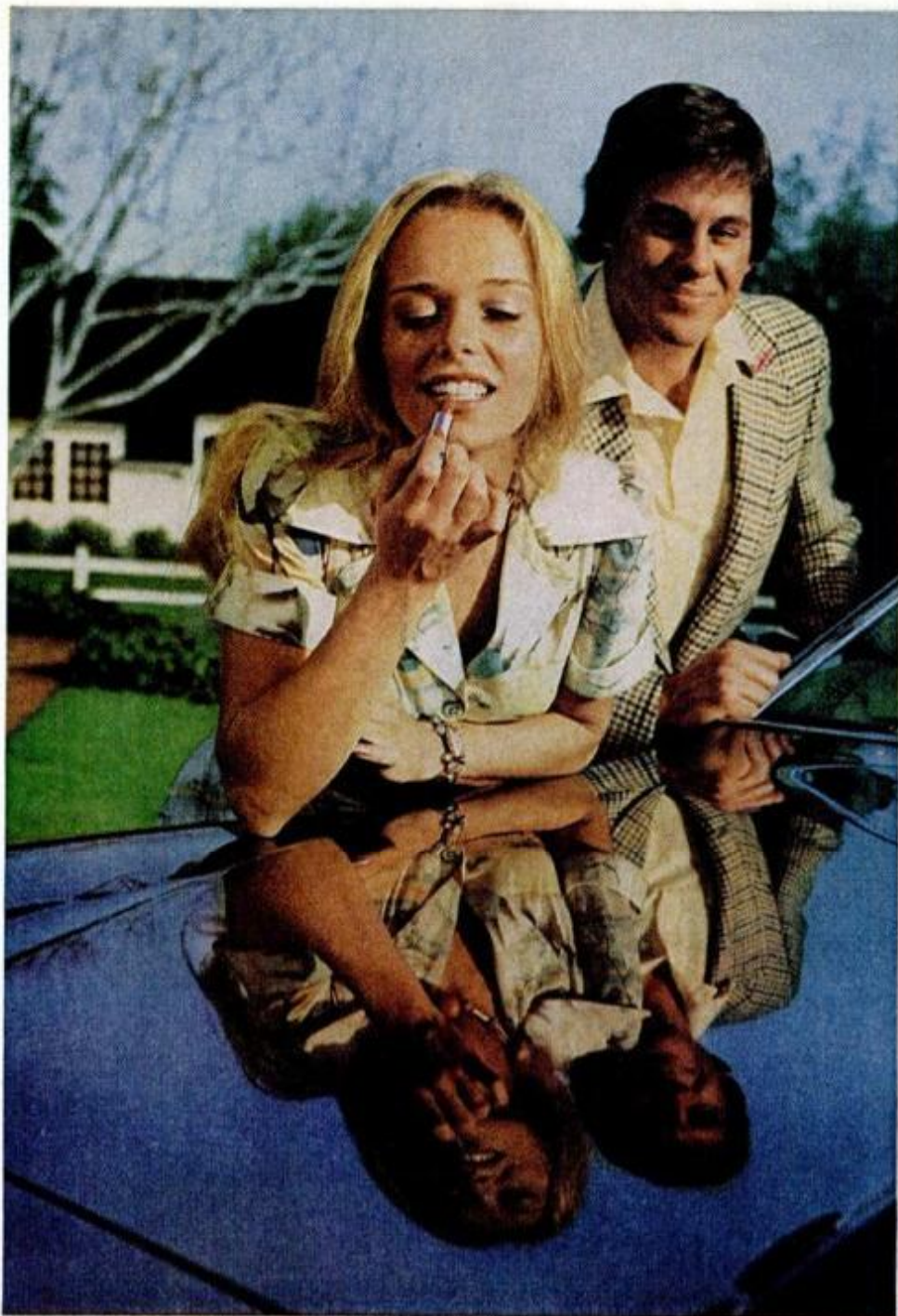
Turn page for continuation of illustration ▶



BRINGING UP THE REAR...



Rear suspension may be the coil-spring type, as shown here, or the leaf-spring type. With the coil spring arrangement, control arms are used to attach the rear axle to the car body.



Rally® shines deep because it cleans deep.

There's no glossing over dirt with 'Rally'. Its special cleaners remove even dull, dirty road film as you wax. 'Rally' has silicones and tough waxes to make it both easy to use—and durable. Get a deep, hard shine that people can't help noticing—mile after mile. Get Du Pont 'Rally'.



60¢

Get 60¢ back on Rally®

60¢

PM-77

Here's how to get your rebate on Du Pont Rally® Car Wax. (10, 14, or 18-oz. cream; 16-oz. liquid)
Just cut out the 'Rally' name from the overcap and send it along with this coupon. Also enclose the receipt or cash-register tape that shows you purchased Rally Car Wax. Please circle the price you paid. Send the 'Rally' name, this coupon and receipt (or tape) to: RALLY REBATE OFFER, P.O. BOX 8280, PHILADELPHIA, PA 19101
Note: 60¢ includes your postage refund. Only one rebate request per envelope or address will be honored.



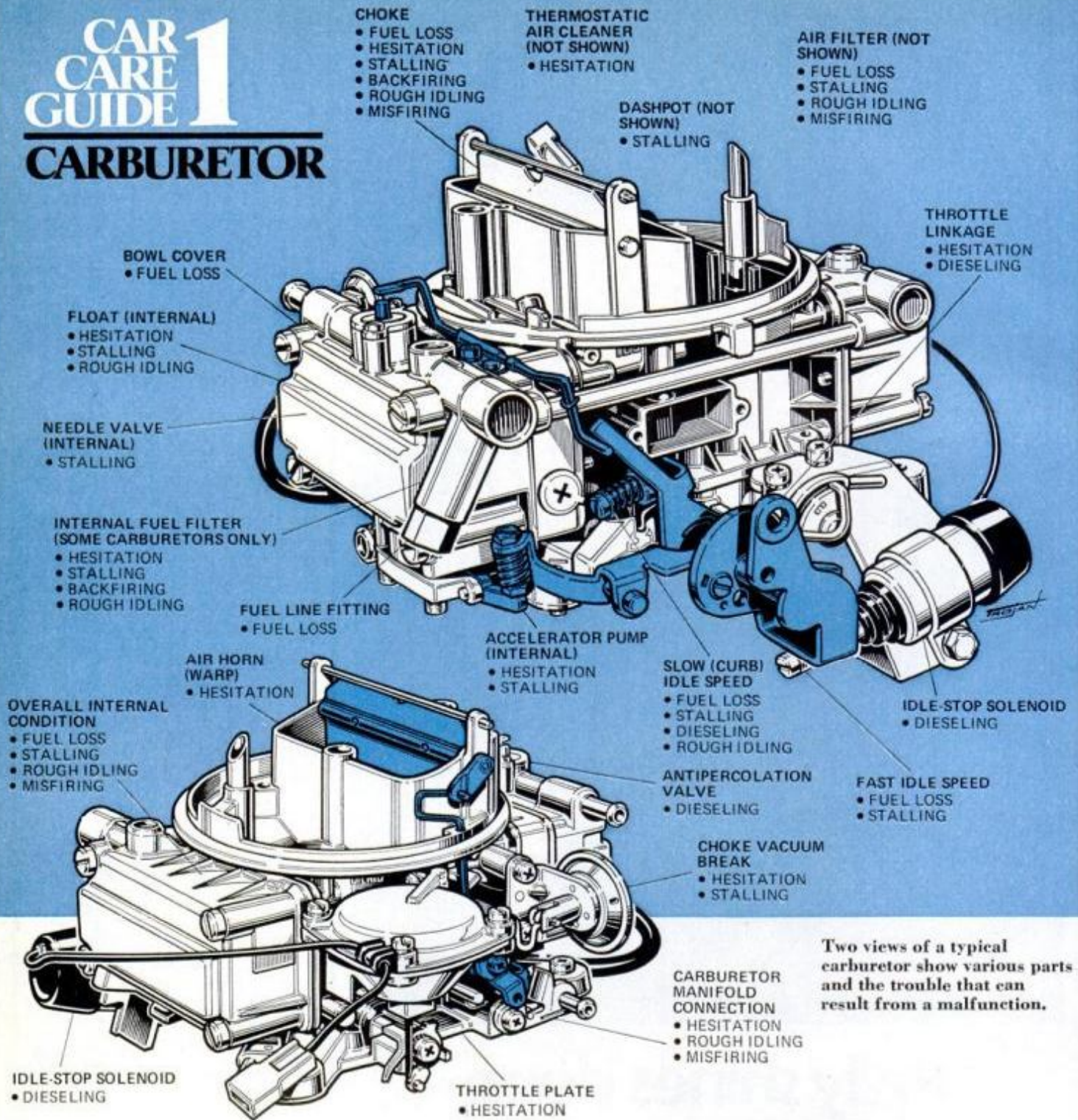
Name _____ (Please print plainly)
Address _____
City _____
State _____ ZIP _____

We can't promise delivery of refund without zip code. Allow four weeks for refund. This offer good only in the U.S.A. Not valid wherever offers of this kind are prohibited, restricted, licensed or taxed. This is not a store coupon. Offer expires July 15, 1977.

PM-77

CAR CARE 1

CARBURETOR



Two views of a typical carburetor show various parts and the trouble that can result from a malfunction.

Why do I get such poor mileage?

Of all the letters received at *Car Clinic* last year, 15.6 percent involved a carburetor-related condition. A breakdown of the problems you asked about appears in the adjoining table.

Most letters in the "general" category dealt with such things as refitting, parts procurement and disconnecting of emission controls. The "other related trouble" category comprises three major complaints: dieseling, rough idle and misfiring.

Note: While reading the discussion that follows, refer to the two drawings above to determine which parts are being described.

Problem	Percentage of letters
Gas mileage	4.3
Hesitation	3.7
Stalling	3.2
Backfiring	0.9
Other related trouble	1.5
Weather-related trouble	0.5
General	1.5
Total	15.6

Where's the gas going?

Letters sent to *Car Clinic* in 1976 show that more car owners are concerned

about getting better gas economy than any other carburetor-related problem. Check the following:

1. In the absence of a mechanical problem, your engine will consume a certain amount of gasoline. As long as you operate the car sensibly, you are getting the best mileage.

2. More than any other factor, thoughtless operation causes poor fuel economy. Excessive speed, prolonged warm-up, and jackrabbit stops and starts waste tons of gas in this country every day.

3. Gas mileage performance figures posted by new-car manufacturers are es-

(Please turn to page 142)



**To install Fram wipers,
you don't even need a pair of
pliers, just a pair of hands.**

You can put on a pair of Fram wiper blades in a matter of minutes, without any tools and without any special talents.

They adapt easily to both bayonet and the hidden type arms found on domestic cars. And complete, illustrated instructions are on the back of every box.

Made of strong, flexible, General Electric Lexan® Polycarbonate, the same stuff used in pro football helmets, Fram wiper blades can't rust, pit, or corrode. They resist ice buildup, are

not affected by heat or cold, and stay flexible for cleaner wipes throughout their long service life.

Furthermore, Fram rubber *refills* are the only ones that are fully interchangeable with factory original equipment. So if your holders are still in good shape, all you need are rubber refills.

Priced generally less than regular replacements, Fram wiper blades and refills are available at most leading automotive parts and accessories outlets.

So all you really need is a few bucks, a couple of hands, and a couple of minutes.



Fram Corporation
A Bendix Company
Providence, R. I. 02916

K-D Tools make weekend car repair jobs easy!

Want professional results when you "do it yourself"? Use the same K-D Tools professional mechanics use to speed and simplify the toughest repair jobs. Visit your auto parts jobber who features K-D Tools and check out these typical time and money savers:



K-D 2062 "Mini" Feeler Gauge Set— Gauge with 16 straight blades $\frac{1}{4}$ " wide by $1\frac{3}{4}$ " long. Ideal for working in close quarters. Blade sizes from .010" (.254 mm) to .035" (.889 mm). **Suggested retail \$2.25.**

K-D 2394 Oil Filter Wrench— Makes it a cinch to remove any disposable oil filter $3\frac{1}{8}$ " to $3\frac{3}{4}$ " in diameter. Can't puncture or crush filter even in closest quarters. **Suggested retail \$2.99.**



K-D 2397 Snap-Ring Pliers Set— Set includes internal and external snapping pliers with interchangeable points. Assures fast, easy removal and replacement of rings. **Suggested retail \$5.95.**

NO MAIL ORDERS FOR TOOLS.

Free Pocket Catalog

describes K-D automotive specialty hand tools. Mail coupon for your copy TODAY.



K-D TOOLS

make tough jobs easy

K-D Manufacturing Co.
Lancaster, Pa. 17604

Send me FREE K-D pocket catalog.

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Address _____

City _____ State _____ Zip _____

timates attained in the laboratory under fixed conditions. No allowance can be made for variations in driving technique, weather, road or mechanical conditions.

4. If a manufacturer finds a condition in a new car affecting fuel performance after the car is in the field, he issues technical service bulletins to correct the trouble. For example, if you own a 1975 Ford or Mercury with a 351-cu.-in. "M" engine and asked if there was a service bulletin issued to improve fuel economy, your service manager would uncover bulletin No. 107. Instructions state that certain 351-cu.-in. "M" engines would give better fuel performance if the initial ignition timing is advanced 4° more than the specification given on the engine's emission-control decal in the engine compartment.

TROUBLESHOOTING BAD MILEAGE

■ **Look for fuel leaks.** Tighten fittings and replace gaskets if necessary.

■ **Replace dirty air cleaner element.** A restricted filter blocks air, forcing the engine to run on an unnecessarily rich mixture.

■ **Adjust the carburetor's curb (slow) idling and fast idling speeds to specification using a tachometer.**

■ **Consider the fuel mixture.** Since 1968, idle mixture has been preset at the factory and external mixture adjustment screws have either been capped to limit travel or eliminated altogether. Mixture will normally stay constant until the carburetor gets dirty enough to need an overhaul. This condition can be determined by checking carbon monoxide output with a CO tester. If output exceeds manufacturer specifications and a regular engine tune-up fails to bring CO into line, the carburetor should be overhauled. This will improve fuel economy.

■ **A misadjusted or malfunctioning automatic choke** is another reason for excessive fuel consumption. Make sure the choke control is adjusted to manufacturer specification. Warm up the engine and remove the carburetor air cleaner. Is the choke plate wide open?

QUICK FIX: Clean linkage and butterfly valve pivots with choke or carburetor cleaner. Do not oil.

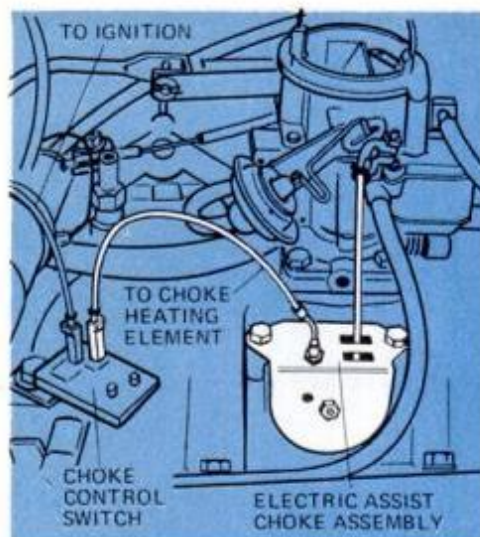
If cleaning fails to overcome choke plate sticking, the choke system needs work. With nonelectric-assisted stove-type chokes (the choke control mechanism is on the carburetor), replace the thermostatic spring, check the heat tube for damage and free up the choke piston.

With nonelectric well-type chokes (the choke control is in a well in the exhaust manifold), replace the entire control.

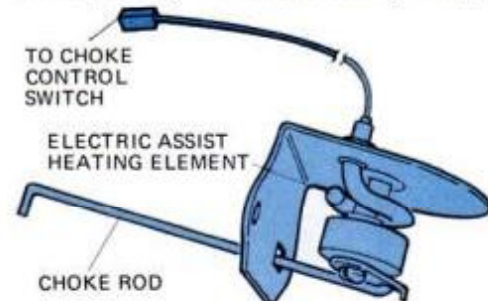
With electric-assist chokes, check wire connections. Then test the control switch and electric heating element (see illustrations above right).

The non-carburetor-related mechanical problems that produce low gas mileage are the following:

1. Underinflated tire.
2. Dragging brakes (see Section 10).



Installation of typical electric-assist choke (above) and detail view (below).



3. Restricted exhaust (mud in tailpipe or crushed pipe).

4. Inoperative manifold heat-control valve (see "Stalling," this section).

5. Worn, improperly gapped or wrong heat range sparkplugs (see Section 6).

6. Ignition system defect, including incorrect timing (see Section 6).

7. Sticking valves, camshaft out of time (see Section 5).

He who hesitates

PM received the following plea from a reader in Albertson, N.Y.:

Help, please! Could you tell me whether Chrysler has put out a service bulletin for the 1974 models regarding hesitation (stumble) on light acceleration?

The man was on the right track. It happens that Chrysler's bulletin 14-07-74 concerns stumble during light acceleration and/or choke sticking caused by carburetor air horn warpage. Information applies to 1972-74 cars and light trucks with 360 and 400-cu.-in. engines and Holley two-barrel carburetors.

The number of letters PM has been getting indicate that hesitation is a major current problem. One reason is the exhaust gas recirculation (EGR) system, which often disrupts smooth acceleration until an engine gets warm. The EGR cre-

CAR CARE GUIDE

ates an excessively lean fuel mixture to keep exhaust emissions at a low level.

This can't be helped. You may have to live with the condition. To find out if the EGR is disrupting smooth acceleration with the engine cold, clamp the hose going to the EGR valve and road-test the car.

If hesitation is eliminated, make sure the EGR valve is clean since a fouled valve may be accentuating the trouble. Tap the valve lightly with a hammer to free carbon and buff mounting surfaces with a wire brush. The valve has to be dismantled if this servicing is required. Inspect the EGR hose, too.

If hesitation prevails during the road test, something besides the EGR is causing the trouble. The reason for hesitation is usually carburetor-related.

TROUBLESHOOTING HESITATION

■ **Clean throttle linkage** and check it for binding.

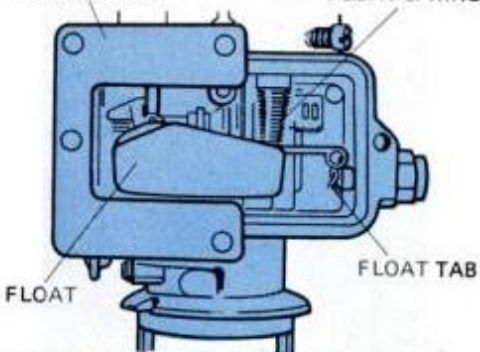
■ **Perhaps throttle plates are bent.** This is unlikely unless the carburetor has been recently overhauled and plates were accidentally damaged.

■ **With the choke plate open,** look into the carburetor throat as the accelerator pedal is rapidly depressed. A steady stream of gas should discharge into the venturi. If not, disassemble the carburetor and inspect the accelerator pump plunger (diaphragm) for deterioration. A faulty accelerator pump plunger is the main cause of engine hesitation on acceleration. Replace.

■ **The carburetor's high-speed** (main metering) circuit may be clogged. You can get a good idea by idling the engine at about 1000 rpm and partially covering the air horn with your hand. This should cause more fuel to be discharged from the high-speed circuit, causing an increase in engine speed. No increase? Carburetor cleaning is called for.

■ **Proper carburetor float level** position is important. If it's too low, the metering circuits won't be able to deliver sufficient fuel; if too high, flooding will occur.

FLOAT GAUGE FLOAT SPRING



Float level is adjusted by bending the tab. Carb is inverted here to show parts.

QUICK FIX: If a float springs a leak and takes in gas, the float level will be consistently low. Hold float to your ear and shake. Sloshing? Discard the float.

■ **A fuel filter** that's partially clogged

(Please turn to page 144)

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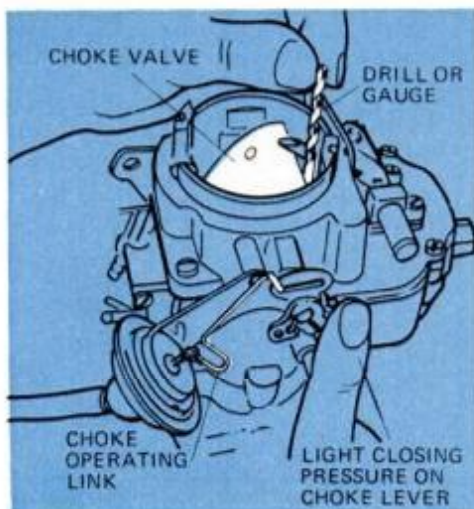
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causes hesitation. Remove an in-line filter from the fuel line. Remove an internal filter from the carburetor inlet.

■ **A malfunctioning choke** could cause hesitation as well as contribute to poor fuel economy (see earlier text).

■ **Chokes in some cars** are controlled by a vacuum break that opens the choke plate partially when a cold engine is started. This keeps the engine from loading up with gas. If the vacuum break is not properly adjusted, the choke plate may not open enough or may open too much. Hesitation will result. The vacuum break is adjusted by bending the vacuum break rod until a specific size gauge (see



Adjust choke vacuum break with a drill if you don't have a gauge.

manufacturer specs) fits snugly between the choke plate and carburetor throat.

■ **An air leak** into the intake manifold will lean out the fuel mixture and cause poor acceleration (also rough idling). Squirt a 50-50 mixture of SAE 10W motor oil and kerosene around the base of the carburetor and intake manifold with the engine running at idle. If the mixture is sucked inward and/or engine speed increases, tighten bolts. If this doesn't stop the problem, replace the gasket.

■ **Thermostatically controlled air cleaners** have been on most cars since 1968. A valve in the air cleaner snorkel is controlled by a temperature sensor to provide a leaner fuel mixture and thus lessen emissions. If the valve doesn't work, it may stay closed too long or may not close at all. Hesitation would result.

With the engine cold, look into the snorkel. The valve should be closed. Start the engine. The valve should start opening and be fully open when engine temperature reaches 100° to 110° F.

If the valve isn't working right, see that the hose to the snorkel is tightly attached and not torn. Then replace the temperature sensor.

Noncarburetor-related reasons for hesitation are the following:

1. Weak fuel pump (see Section 13).
2. Faulty distributor vacuum advance, bad sparkplugs, incorrect ignition timing, damaged distributor breaker points or weak spark (see Section 6).

Stall out at ground level

An engine can stall under varying circumstances, as follows:

1. Right after being started when cold.
2. Right after being restarted while hot following a long drive.
3. Starts but fails to keep running (cold or hot is immaterial).
4. After being started (cold) and while warming up.
5. As you accelerate from a standing stop.
6. Without warning and suddenly as you are driving.
7. In hot, cool or wet weather only (see "weather-related problems," this section).

Once you have classified your stalling condition, tracking down the cause is generally easy. In all but a few cases, the cause of the trouble is confined to a carburetor area, another part of the fuel system or the ignition system.

TROUBLESHOOTING STALLS

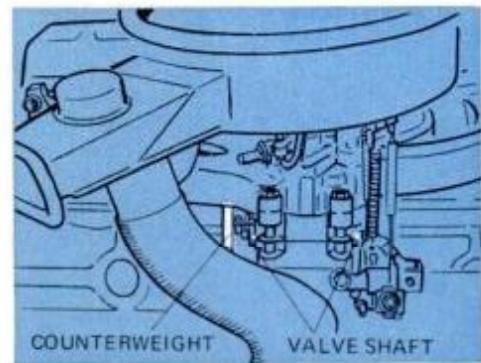
■ **Engine cold:**

1. **Automatic choke** (see "Where's the gas going?" page 140). If your choke system has a vacuum break, check its operation, too (see under "He who hesitates" page 142). A manually operated choke may also be the cause of a stalling condition. Check the plate for full travel (no binding) and the cable for free movement (no hang-ups).

2. **Fast-idle adjustment.** A fast-idle adjustment below specification is too low to feed an engine the fuel needed to keep running when started in cold weather.

QUICK FIX: With engine warm, hook up a tachometer. Release choke cam so the choke plate closes. Start the engine. Rotate the fast-idle cam so fast-idle screw rests on high step of cam. Engine speed should now be at specified fast-idle speed, about double the engine's specified slow (curb) idle speed.

3. **Manifold heat-control valve** (heat riser valve). One stuck open will prolong the time needed for an engine to warm up. This added time under rich fuel mixture conditions can contribute to stalling. Check by trying to move the counterweight, which is normally right beneath the exhaust manifold. *Caution:* The engine *must* be cold to avoid a nasty burn.



To find manifold heat-control valve, look for counterweight and two ends of shaft.

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QUICK FIX: If the valve is stuck, apply penetrating oil where the valve shaft goes through the manifold and tap (do not bang) the counterweight with a soft-nosed (plastic) hammer. To prevent any recurrence, keep valve shaft lubricated.

Engine hot:

1. Slow (curb)-idle speed. If a hot engine stalls as it idles, the carburetor slow idle speed adjustment may be set too low or the idle mixture may have gone awry, indicating that the carburetor needs cleaning and rebuilding.

2. Flooding. The engine may have flooded. You will usually smell gas, especially if you lift the hood. The problem may be caused by a number of conditions. Carburetor percolation is one (see "Weather-related trouble," this section). The choke plate may be stuck in a partially closed position. Also, the carburetor air-cleaner filter may be dirty (produces over-rich fuel condition); carburetor float may be set too high; carburetor needle valve may be stuck in open position; fuel pump pressure may be excessive.

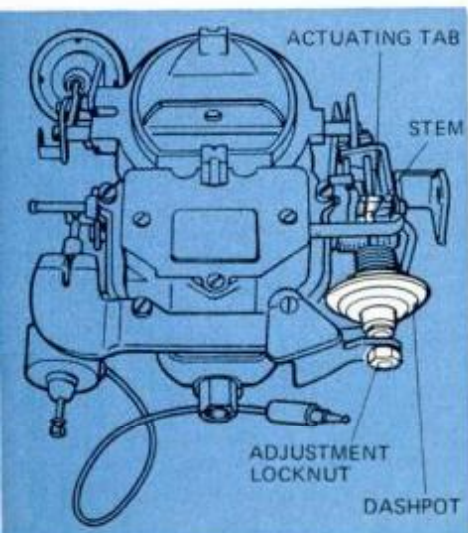
Added info: One big problem PM keeps getting mail about is an engine that starts smoothly when cold, but is hard starting when hot. The engine cranks sluggishly as if the battery or starter is faulty, which they aren't.

Be on the lookout for a buildup of carbon in the engine that gets hot and thereby increases compression, putting extra load on the starter. The problem affects older engines primarily. One way to find out if the trouble is occurring is to make a compression test with the engine hot to see if engine compression is higher than specifications.

Starts but fails to keep running:

1. Inadequate fuel supply: Slow-idle speed set too low, an imbalanced idle mixture because of a dirty carburetor air-filter element or dirty carburetor, defective choke operation, restricted fuel filter, improper carburetor float setting, defective fuel pump, carburetor icing (see "Weather-related trouble," this section).

(Please turn to page 146)



Throttle return check or dashpot, as it's called, keeps engine from stalling.

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CAR CARE GUIDE 1

er-related Trouble, "page 147) or defective fuel pump.

2. Carburetor dashpot. On some cars with automatic or manual transmission, the engine has a tendency to stall if the throttle is closed quickly. To prevent this, a dashpot (or throttle return check) is placed on the carburetor to retard the speed of throttle closing. This part consists of a piston or diaphragm and a spring closed check valve. If the dashpot is improperly adjusted or damaged, stalling may occur.

Dashpot stems, which intercept throttle shaft cams by linkage, are adjusted differently depending on the carburetor. If adjustment fails to solve a stalling problem and it is likely that the dashpot is faulty, the part has to be replaced. It cannot be serviced.

3. Ballast resistor or primary resistance wire is defective (see Section 6).

4. Restricted exhaust (see Section 11).

■ **On acceleration from a standing stop:** Look for the following carburetor-related conditions, which we have already discussed:

- Clogged fuel filter.
- Defective accelerator pump circuit.
- Low float lever.

Also check for:

- Worn, improperly gapped sparkplugs (see Section 6).
- Defective distributor vacuum advance (see Section 6).
- Grounded distributor primary wire (See Section 6).
- Inoperative thermostat (see Section 8). An inoperative thermostat could delay engine warm-up and possibly contribute to a stalling problem.
- Low engine compression (see Section 5).

■ **On the highway, no warning:**

The way an engine stalls generally pinpoints the trouble area. If the engine stutters and jerks, and then conks out, chances are the problem is a fuel system failure. If the engine just dies suddenly, the trouble area is most likely ignition.

If a fuel system failure is indicated, the problem could be:

- Out of gas.
- Clogged fuel filter.
- Vapor lock (see "Weather-related Trouble", page 147).
- Fuel pump failure (see Section 13).
- Dirt (or ice in winter) has wedged between needle valve and seat, causing the engine to flood.

QUICK FIX: You may be able to clear the obstruction without taking off the carburetor bowl cover by tapping the bowl with the handle of a screwdriver in the area of the needle valve.

If an ignition system failure is indicated, look for the problem to be one of the following (more information is provided in Section 6).

- Ignition system drown-out (wet weather only).
- Ignition wire has come loose.
- Poor vehicle ground.
- Loose electrical connection at dis-

tributor tower or coil, loose coil-to-distributor primary wire, or distributor primary wire has become bare and is grounding out against distributor housing.

- Bad coil.

BACKING DOWN BACKFIRE

Then there are the questions (0.9 percent of those relating to the carburetor) like D.O.'s of Sandston, Va.:

My car runs fine, but sporadically backfires through the carburetor like an old mule. What should I do?

Backfire is defined as a subdued explosion in the exhaust manifold.

From a carburetor standpoint, the thing to do is make sure the automatic choke isn't adjusted too lean and that the car isn't running on gas which is contaminated. Water in fuel leans out a mixture, causing backfiring.

QUICK CHECK: Disconnect the fuel line and allow some gas to fall into a receptacle. Rub some between the fingers, feeling for grit. Let some evaporate. If drops remain, that's water.

If a fuel system has taken on a load of contaminated gas, drain and flush the system. Install a new filter.

Other causes of backfire include intake valve trouble (see Section 5) and crossed sparkplug wires.

Although generally regarded as backfiring, a pattering sound from the tailpipe is technically called "afterburning." This condition is usually caused by leaking exhaust valves.

OTHER PROBLEMS

As mentioned before, the "other" carburetor-related problems most frequently asked about by those writing *Car Clinic* are dieseling, rough idle and misfiring. Here is a summary of what usually causes each:

1. Dieseling. This term describes an engine that continues to run after the ignition is shut off. Troubleshoot by checking the following:

- Idle-stop solenoid on many (not all) carburetors. Watch the solenoid plunger as someone starts the engine. It should rest against the throttle lever. Turn off the ignition. The plunger should retract at once. If not, replace the part.
- Dirty, binding throttle linkage.
- Improperly adjusted slow-idle speed.
- Manifold heat-control valve is stuck in the closed position.
- Improper distributor point gap and dwell, and ignition timing (see Section 6).
- Engine is running hot (see Section 8).
- Buildup of carbon in engine (see Section 5).

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2. Rough idling. Consider the following if your car reminds you of a ride on a New York subway train:

- Dirty carburetor air-cleaner element.
- Incorrect slow-idle adjustment.
- Improper idle mixture.
- Struck automatic choke.
- Improperly set float.
- Partially clogged fuel filter.
- Dirty carburetor.
- Stuck manifold heat-control valve.
- Engine vacuum leak.
- Faulty distributor breaker-point gap and dwell angle (see Section 6).
- Plugged positive crankcase ventilation valve.

QUICK CHECK: Remove the PCV valve from its seat and shake it. You should hear it click. If not, replace it. (For details about more thorough checking, see Section 10.)

3. Misfiring. The cause of misfire usually is to be found in the ignition system (see Section 6), yet sometimes a carburetor-related condition has a bearing.

Consider an improper fuel mixture, dirty carburetor air cleaner and closed choke. Other problems previously discussed (other than ignition) that cause misfiring are an air leak at the intake manifold, stuck manifold heat-control valve and PCV system restriction.

WEATHER-RELATED TROUBLE

A few *Car Clinic* correspondents had a problem with weather affecting carburetors. Two conditions prevail: percolation and carburetor icing.

1. Percolation refers to gasoline in the carburetor bowl boiling over into the intake manifold. Excessive heat bearing on the carburetor, usually after a long period of operation in hot weather, is the cause. Percolation is often called vapor lock, but the two conditions are different.

Vapor lock is the formation of vaporized fuel pockets (bubbles) in the fuel system caused by heat. Bubbles block the flow of fuel to the engine, causing the engine to stall. Vapor lock incidents in modern cars are rare.

Percolation also is no longer widespread because of the inclusion on many carburetors of relief valves. However, it can occur if the relief port plugs.

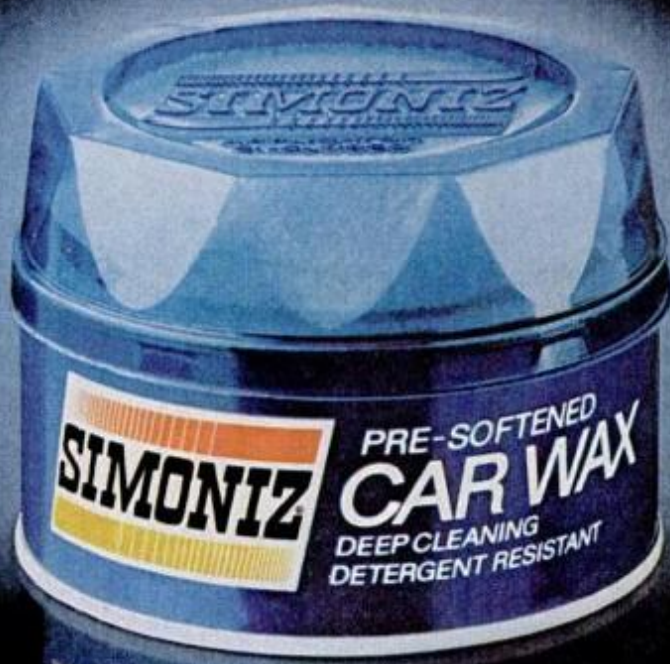
After a hot engine is shut off, percolation may develop. Attempts made to restart the engine result in hard starting. Allow the engine to cool a bit. Then, holding the accelerator to the floor so the throttle is wide open, crank the engine. It should start.

QUICK FIX: Check the antipercolation valve for clogging and to see that the valve cover isn't stuck.

2. Carburetor icing is the formation of ice in the carburetor that cuts off air and causes the engine to flood and stall. The condition generally occurs when the ambient temperature is between 30° and 50° F. and the relative humidity is 65 percent or more. If your carburetor is prone to icing, add a commercial anti-icing additive to the fuel.



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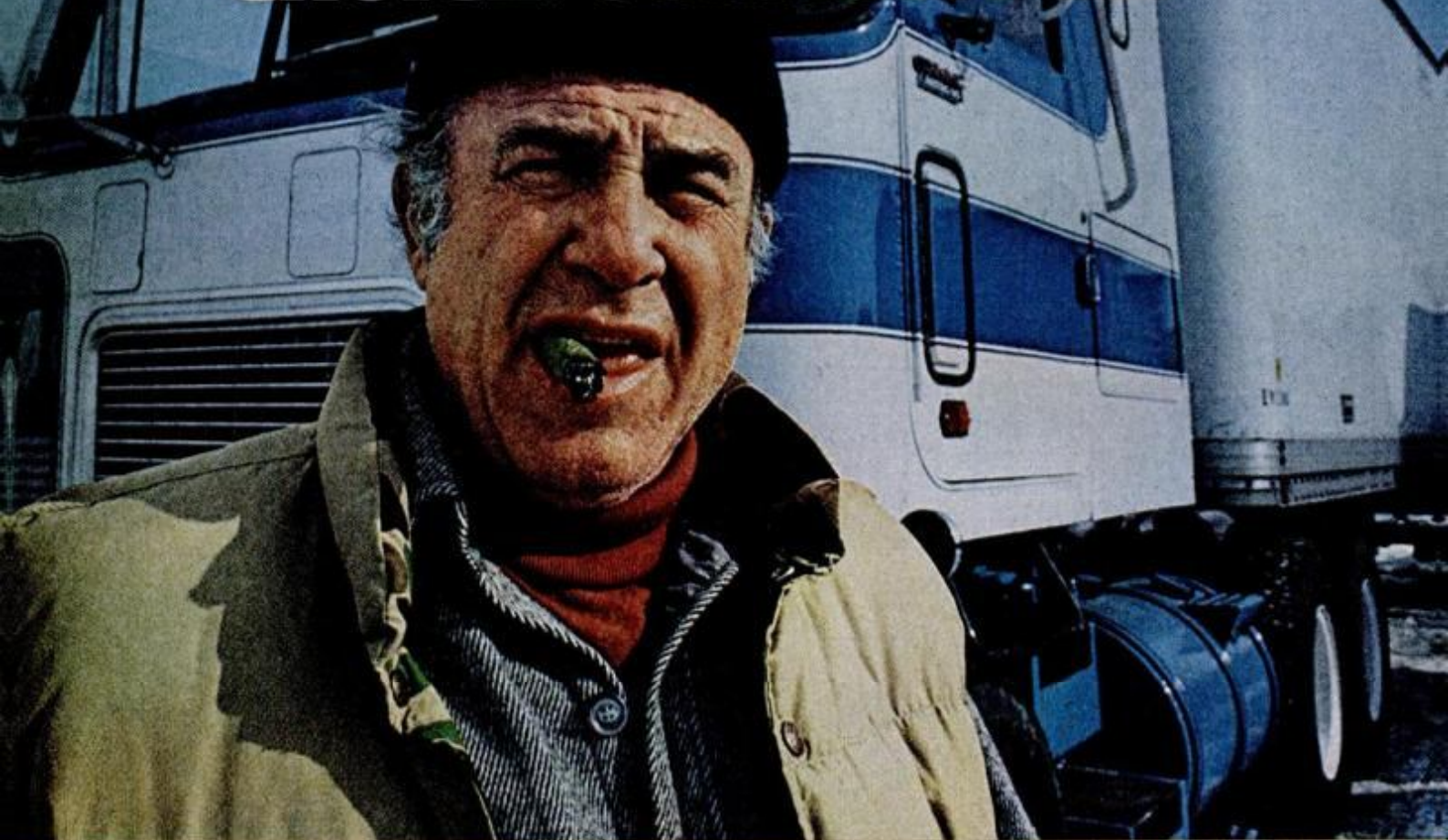
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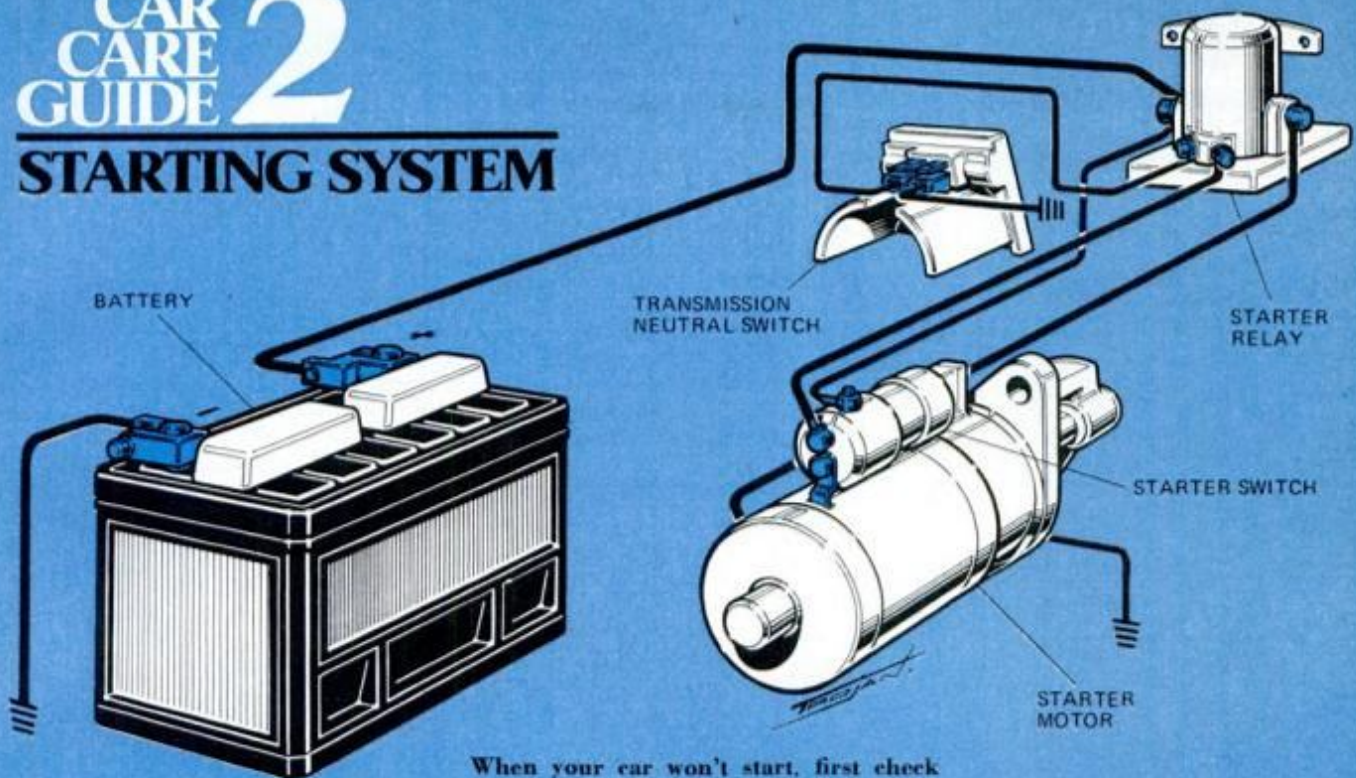


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CAR CARE GUIDE 2

STARTING SYSTEM



When your car won't start, first check battery state of charge and clean posts.

Why won't my car start?

Of all the letters received by *Car Clinic*, 8.4 percent involve starting problems. This is especially true in winter months.

The cause of hard-starting conditions can be blamed on one of the following:

- An erratic starting system (battery and/or starter motor).
- A malfunction in the fuel system.
- A malfunction in the ignition system.
- An internal engine problem.

In this section, we will concentrate on tracing the cause of hard starting in the starting system. Internal engine problems will be touched on.

Problems in the fuel and ignition systems that can make starting difficult will be listed. You should consult the appropriate section for details.

Ask questions

As with other automotive problems, hard starting may have as its reason a defect inherent in the particular car. You won't know unless you ask a service department of a dealer selling your make of vehicle. For example:

'My 1976 Pontiac Bonneville (V8 engine) experiences on-again, off-again starting. Can you tell me why?'

"Why any GM car with V8 engine would experience a starting failure or intermittent ignition has to do with a hookup at

the HEI (high-energy ignition) distributor cap. The battery ignition wire, which is pink, may not be installed properly. If the connector is not on the correct side of the cap's blade terminal, the ignition system will give trouble.

QUICK FIX: Push up on the connector with a finger. If it moves up and down $\frac{1}{16}$ inch, the connection is okay. If there's no upward movement and it seems tightly locked to the tab, lift the latch on the connector and remove it. Then re-install it so that the blade in the distributor cap is bent slightly outward, away from the center of the cap.

Zeroing in on trouble

When a starting problem arises for no inherent reason, answer the question: How doesn't the engine start? You'll be in one of the following groups:

1. The engine won't start, but growls weakly, or makes no sound, as if the battery were dead. This is a starting-system or engine problem.

2. The engine won't start, but cranks briskly. It will spark off or come to life only after prolonged revolutions—an ignition or fuel-system problem.

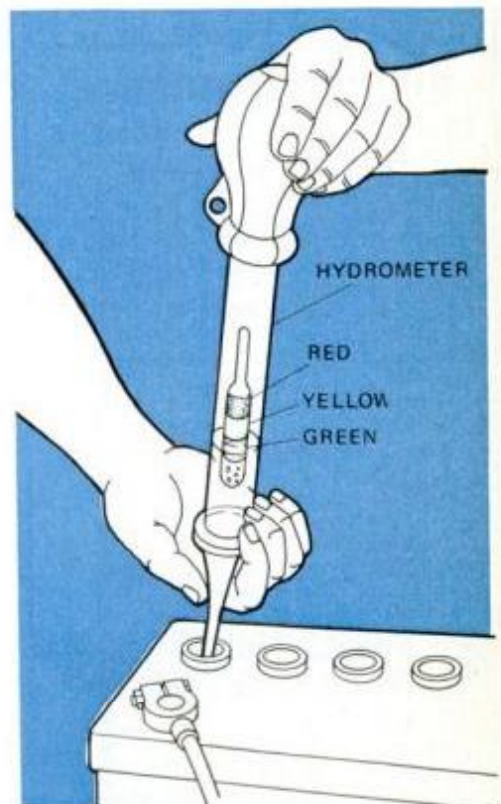
If in the first group, the failure is likely to be found in the starting circuit—anywhere from the battery ground-cable connection hookup on the engine block or frame to the starter.

Statistics tell us weak batteries cause two out of three starting failures, so you

should tackle this most obvious fault first.

QUICK CHECK: If you have a charged booster battery and jumper cable, hook it up and try to start the engine. If it

(Please turn to page 150)



Check charge by measuring specific gravity of electrolyte with hydrometer.

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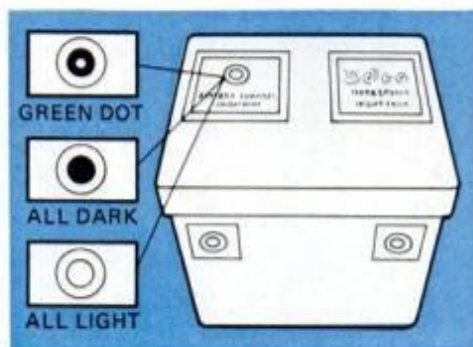
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starts, test battery and connections.

If the test shows that the battery is undercharged and all cells are within .050 points of each other, recharge the battery using a slow (trickle) charger. The overall specific gravity of a battery after recharging should be no less than 1.230 for the battery to be worthy of service.

Any battery having a cell with a specific gravity that is .050 or more points lower than its other cells should be replaced. The cell has shorted out, and the battery cannot be salvaged.

If your car is equipped with a sealed battery having no cell caps, you cannot measure specific gravity. The battery has



Sealed battery: Green dot, full charge; all dark, needs charge; all light, dead.

an "eye" that indicates condition. Follow instructions for charging or replacing provided with the battery if the indicator signifies the battery is undercharged or defective.

A battery may be amply charged, yet still have trouble meeting the demands of winter starting. The unit may be underpowered and thus fail to provide the energy required by the starter motor. This defect can be uncovered by performing a variable-load (high-rate discharge) test.

The test is done by making sure the battery is charged and connecting a variable-load tester. Adjust the instrument so its ammeter records three times the ampere-hour rating stamped on the battery case.

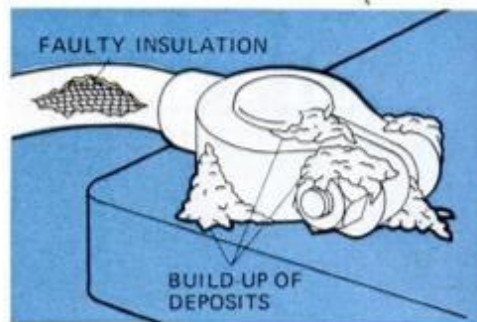
A variable-load tester measures battery output while imposing on the battery a load equal to starting load. The voltmeter part of the tester should show at least 9.5 volts (12-volt battery) for a period of 15 seconds.

CABLES—OVERLOOKED TROUBLEMAKERS

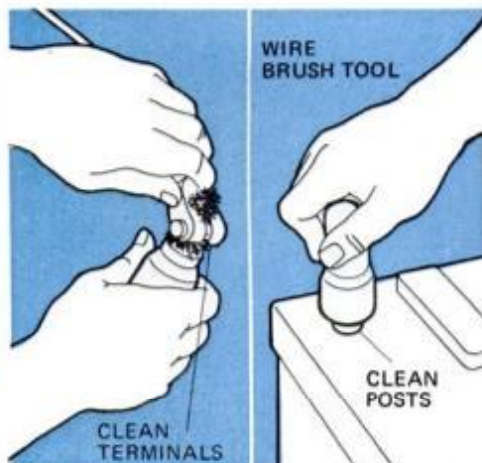
Before you test a battery, you should check cables and terminals. A battery and starter motor in perfect condition will fail to start an engine if current between them is interrupted by a bad cable or high resistance caused by corrosion.

QUICK FIXES: 1. Tighten cable connections at battery terminals. Try starting.

2. Remove cables at the battery. Clean terminals and battery posts with a battery cleaning tool (sold commercially) or plain sandpaper. Reconnect and tighten. Try starting.



Check cables and terminals for defects and keep them free of deposit buildup.



This two-in-one, male-female-type wire brush tool is best for cleaning connectors.

3. Are terminals badly eaten away by corrosion or are terminal nuts stripped so it isn't possible to tighten connections sufficiently? In an emergency, force the tip of a screwdriver between the terminal and battery post to complete the circuit and permit starting. Replace the cable as soon as you can.

4. Cables that are split (usually near terminals) so wires are bared, should be replaced.

FALSE START

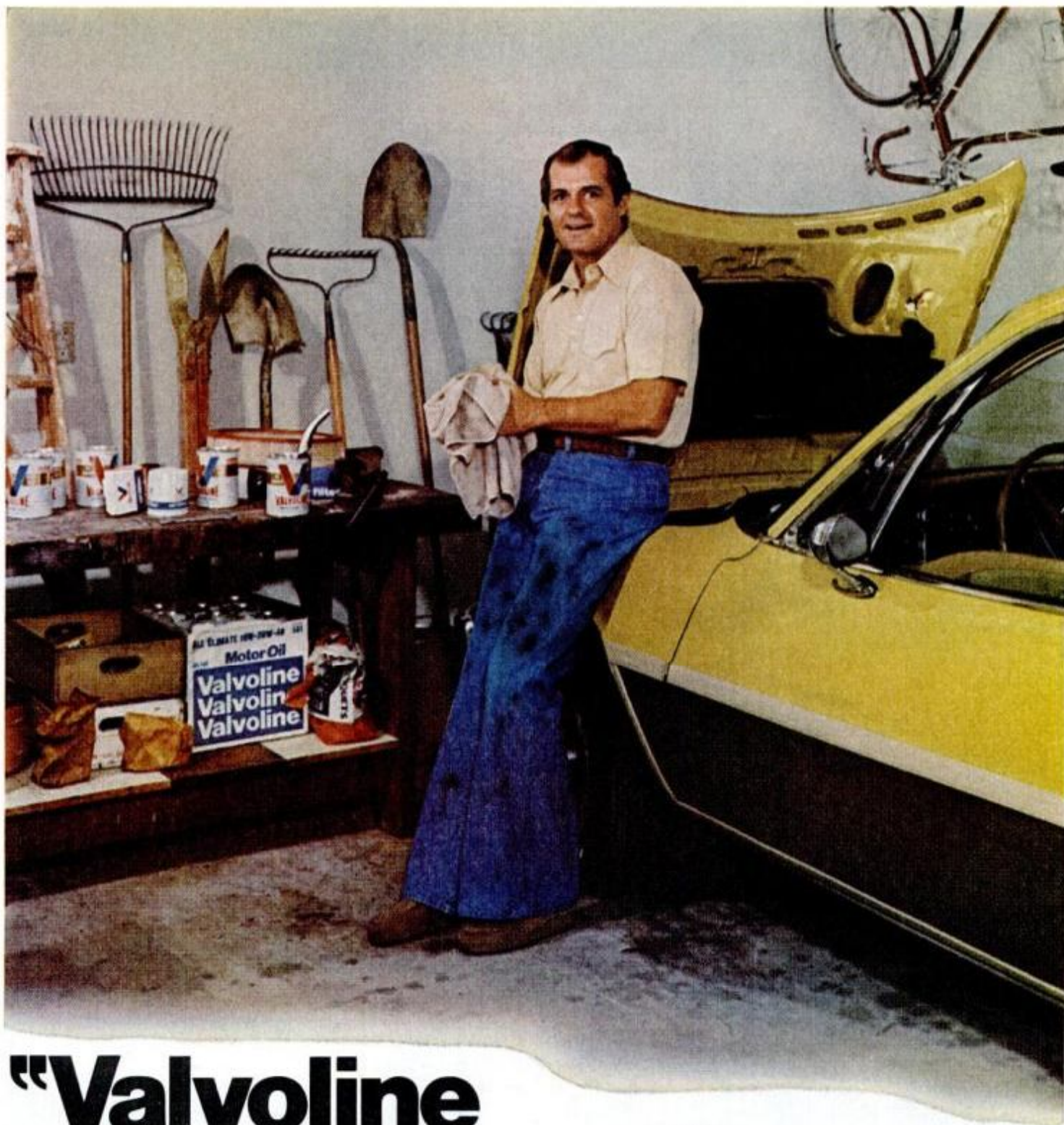
The next starting-system component that you should check out if the engine doesn't crank is the starter relay, if there is one. Trace the battery's positive cable until you come to the starter relay, which is normally located on the firewall.

The relay may be tested by disconnecting a cable from one side and touching its end to the other side of the relay, or by jumping cable terminals with a length of battery or No. 4 cable. If cranking speed now seems normal, it's a positive indication that the relay has gone bad. It is easily replaced.

The starter switch (solenoid) on the starter motor may be bad. Connect a jumper wire made of battery or No. 4 cable across the switch. If the engine now cranks, replace the switch.

At this point, there remain only a few other things that will cause an engine not to crank at all or to crank too slowly to start. These problems are:

(Please turn to page 152)



"Valvoline won me over!"

"I picked up a Valvoline booklet the other day that showed me how to change my own oil. And believe it or not, it was as easy as they said... I even saved myself some money!"

People were turning to Valvoline for lubrication and protection even before America had cars. In fact, Valvoline has been winning the world over since 1866.

With winning performances from the international racing circuits to the inter-

state highways, and everywhere in between. It's Valvoline. With unbeaten engine protection for whatever you drive, wherever you drive it. Millions of people prove it everyday. Valvoline® Motor Oil is winning them over. With quality.

Valvoline®

Winning the world over since 1866.



Valvoline Oil Company, Ashland, Ky.  Division of Ashland Oil, Inc.

Материал, защищенный авторским правом

- Bad neutral-start switch.
- Locked-up starter drive.
- Engine problem.
- Bad starter motor.

NOT SO NEUTRAL

If your car is equipped with an automatic transmission, it has a neutral-start switch which assures that the engine will start only when the transmission is in the



Neutral start switch prevents starting when automatic transmission is in gear.

Neutral or Park positions. Some cars with manual transmissions also have neutral-start switches, often found under the clutch pedal.

If the switch shifts or goes bad, the

engine will not start with the transmission in Neutral or Park. It may start while the transmission is in gear, or it may not start at all. If the engine should start while the transmission is in gear, replace the switch.

QUICK FIX: If the engine doesn't start at all, firmly shift the transmission selector lever throughout the full transmission quadrant two or three times. If the engine now starts, readjust the neutral-start switch.

LOCKED UP AND OUT

Put the transmission in high gear and try to push the car forward. If the car won't move forward, the starter drive gear may be locked.

QUICK FIX: Rock the car back and forth. Backward motion will frequently release the drive gear. If not, you will have to loosen the bolts holding the starter motor to the engine.

If the starter drive gear is not locked and the engine doesn't crank, your engine may be the victim of a frequently overlooked condition called "hydrostatic lock." Hydrostatic lock is caused when water is present in a cylinder. Since a liquid cannot be compressed, its presence will keep the piston from going all the

way to full travel on its compression stroke.

QUICK CHECK: Remove the sparkplugs and attempt to crank the engine. If the engine now cranks briskly, this is a good indication that water is leaking into the cylinders.

The cylinder head should be removed, and the gasket and head checked for cracks. The block, particularly around valve parts, should also be examined.

FINALLY, THE STARTER

If troubleshooting to this point has failed to uncover a sluggish or no-cranking condition, the trouble is almost certainly due to a defective starter motor. You can check this by conducting an amperage draw test, but you will need a carbon-pile rheostat voltmeter and heavy-duty ammeter, which is connected in series with the battery.

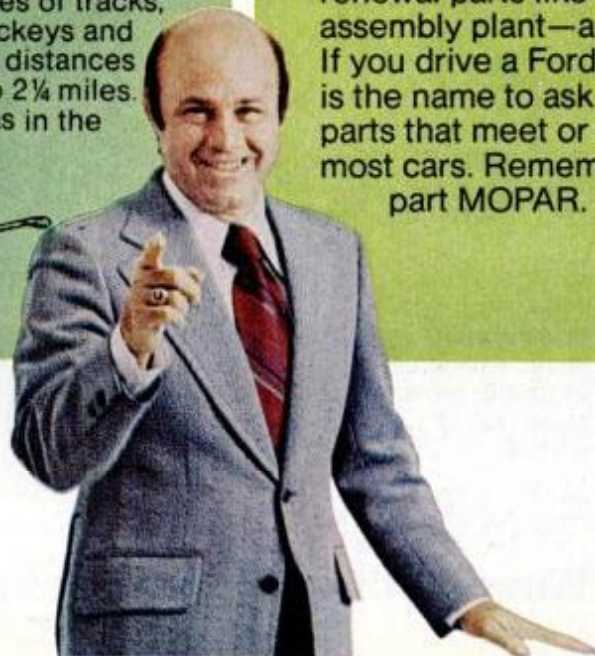
In the absence of such equipment, you will be able to find out if the starter motor is performing properly by removing the part from the car and connecting it to a fully charged battery. If the starter does not run, overhaul or replace it. However, if the starter does perform properly on the bench, it means that your starting problem is being caused by a seized engine, which should be disassembled.



STAR PERFORMERS IN SPORTS

by Joe Garagiola

The test of a star performer is doing the job under all conditions. For example, from 1917 to 1924 the great race horse Exterminator ran on different types of tracks, had a number of jockeys and trainers and won at distances from 5½ furlongs to 2¼ miles. In 100 starts, he was in the money 84 times.



"KEEP YOUR CHRYSLER-BUILT CAR A WINNER WITH MOPAR STAR PERFORMER PARTS"

When your Chrysler, Dodge or Plymouth car or Dodge truck needs service, be sure and ask for MOPAR Star Performer parts. Only MOPAR has genuine renewal parts like those installed on your car at the assembly plant—and every one is a Star Performer. If you drive a Ford, GM, AMC or import—MOPAR is the name to ask for, too. Because MOPAR has parts that meet or exceed factory specifications for most cars. Remember, the best-kept cars are part MOPAR.



CHRYSLER CORPORATION

There are three other sidelights regarding lack of starting that should be mentioned:

■ **Oil viscosity** could play an important role. If starting failure occurs, consider that the oil you have put into the engine may not be of the proper viscosity for the prevailing temperature.

■ **If the starter motor spins** (whirrs), but does not engage the flywheel gear, the motor should be removed. Clean or replace the starter drive, and look for a worn or damaged flywheel gear.

■ **If starting occurs properly** when the engine is cold, but is difficult when the engine is hot, remember what was said in Section 1—that there is probably a build-up of carbon in the engine which is creating excessive compression. Too much compression creates a resistance that the starter has trouble in overcoming as long as the engine is warm. To find out if this is the trouble, test for compression after the engine has been warmed to operating temperature.

Brisk, but unresponsive

An engine that cranks briskly, but fails to start is one that's plagued by a fault

in the ignition or fuel systems. If your car is equipped with a conventional breaker-type ignition, make the following test for spark intensity by:

1. Removing a high-tension lead from a sparkplug.

2. Inserting a screwdriver into the boot so it contacts the terminal and holding the screwdriver $\frac{1}{4}$ to $\frac{3}{16}$ inch from ground.

3. Cranking the engine. If the spark that jumps the gap is blue and strong, the trouble is more than likely being caused by the fuel system. But if the spark is yellow, weak or nonexistent, you'll find that the problem is located in the ignition system.

IGNITION-SYSTEM AREAS TO CHECK

Check out the following conditions if you should find that an ignition-system failure is indicated by the spark-intensity test (see Section 6 for additional details):

- **Open circuit** caused by loose or broken connections.
- **Defective resistor.**
- **Breaker points misaligned**, closed or worn.
- **Defective condenser.**
- **Bad coil.**

■ **Excessive primary resistance** caused either by a corroded or defective connection.

■ **Bad distributor cap, rotor or sparkplug cables.**

FUEL-SYSTEM AREAS TO CHECK

Examine the following possibilities if the spark-intensity test is satisfactory, which thus indicates a fuel-system condition (see Sections 1 and 13 for further details):

1. If flooding is a factor:
 - Sticking choke.
 - Improper unloader action.
 - High float level.
 - Leaking needle and seat.
 - High fuel pump pressure.
2. If fuel starvation is a factor:
 - Choke plate is sticking open.
 - Fuel filter is restricted.
 - Dirty carburetor.
 - Low fuel-pump pressure.

You can tell if flooding or starvation is a factor after cranking the engine and then removing a sparkplug. If you find that the tip of the plug is wet, the engine is being flooded. But if the tip of the plug is found to be dry, fuel is not getting to the cylinders.

WHEN MOPAR PARTS ARE READY FOR REPLACEMENT, IT MAKES SENSE TO INSTALL NEW MOPAR PARTS. THEY'RE LIKE THE PARTS INSTALLED AT THE FACTORY.



MOPAR Star Performer Parts are available at Chrysler-Plymouth and Dodge Dealers, auto parts stores, many service stations, and independent garages.



STAR PERFORMANCE TIP

Start your own safety and preventive maintenance program. Here are some easy checks you make yourself: windshield washer fluid; engine oil level; battery fluid level; automatic transmission fluid level; power steering fluid level; lights; tire pressure.



Mopar



STAR PERFORMERS

ONLY DATSUN

has the small pickup with room inside for long legs and large loads.

Like most small pickups, Datsun's exclusive King Cab™ has a 6-ft. bed for hauling stuff outside.

Unlike any other small pickup, it has room for hauling stuff inside. Up to 11.3 cu. ft. of storage space behind the seats.

And unlike any other small pickup truck around, it comes with reclining bucket seats. Plus such surprising features as more leg space than some full-size rigs. Full carpeting. And an extra-long wheelbase for smoother rides.

Not surprising, it's stingy on

gas. 32 MPG on the open road, 22 around town with manual transmission. Of course, those are EPA figures. So your mileage may differ depending on the condition of your truck and how you drive. California mileage slightly lower.

**Suddenly
it's going to dawn on you.**

DATSUN SAVES



One more strong point: King Cab utilizes the same all-steel body construction and rugged ladder-lattice frame as the Li'l Hustler that won the teeth-rattling Baja 500. So you know it can take a load of punishment.

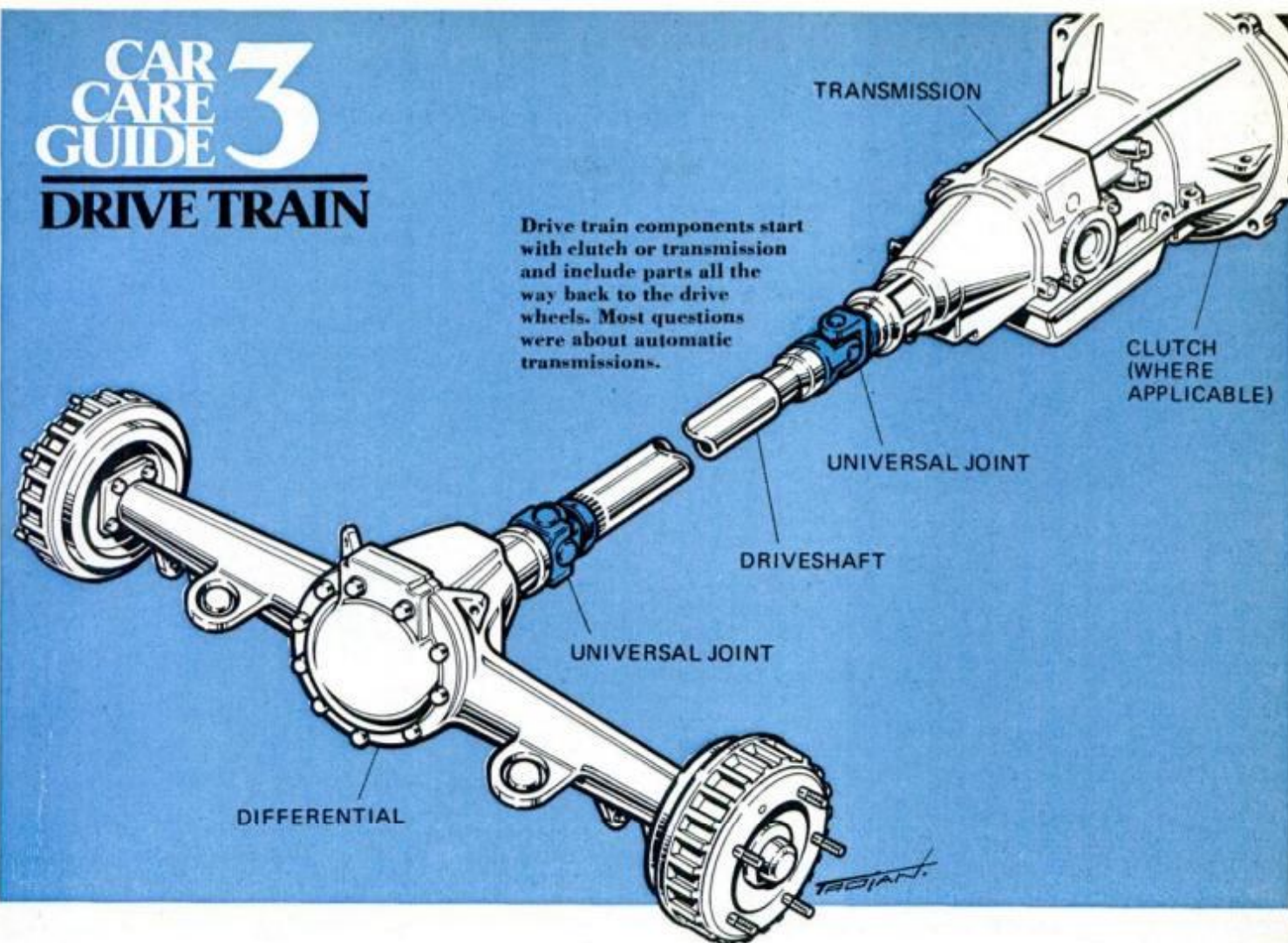
If by chance it ever does need service, you can count on some strong backing from over 4,000 Datsun service technicians.

Add it all up and it's pretty easy to see why Datsun is America's Number One Selling Small Pickup.



CAR CARE GUIDE 3

DRIVE TRAIN



Why is my transmission slipping?

For the purpose of this discussion, the drive train is defined as consisting of the transmission (manual or automatic), transmission linkage, clutch of a car equipped with manual transmission, driveshaft, universal joints and differential.

Among all the letters *Car Clinic* received in the first nine months of 1976, 8.2 percent related to the drive train. For a breakdown of the problem areas, see the table in the adjoining column.

The general category includes letters about retrofitting and acceleration problems, such as vibration that could be caused by failure of one of several systems, including a drive train component.

Limited action

Not long ago, J. P. of Jessup, Md., wrote us the following letter:

'Would you tell me how I, as a do-it-yourself mechanic, can troubleshoot the automatic transmission in my '76 Mercury? The unit, a C6, is slipping as I accelerate.'

Problem	Percentage of letters
Transmission	4.6
Shifting and clutch	1.7
Differential	1.3
General	0.6
Total	8.2

This question is selected to make a point. The Saturday mechanic is limited when it comes to pinpointing automatic-transmission trouble, particularly by a lack of troubleshooting tools, such as pressure gauges.

Even if tools are available, he would be limited by a lack of specific information unless he had access to service bulletins and service manuals. Consider J. P.'s problem with his C6.

Unless J. P. had available to him service bulletin 115, he would not know that the C6 was affected by a torn intermediate servopiston seal, which was allowing fluid to leak on clutches, causing erratic shifting. He would, therefore, be likely to tear apart his transmission and overhaul everything; thus creating major expenditures of time and money—all of them unnecessary.

The point is that even if you have tools and decide to tackle transmission troubleshooting and repair, you should check with a dealer to find out if there are pertinent service bulletins.

Furthermore, you should not proceed without the car's service manual. Each automatic transmission is different, and specific instructions about yours are needed to avoid getting yourself into a bind. Turn to Section 14 to find out where to write for a manual.

But what about those people who don't wish to make transmission tests and repairs themselves? Does erratic automatic transmission behavior signal a trip to the professional repair shop, which leads almost certainly to a significant outlay of money?

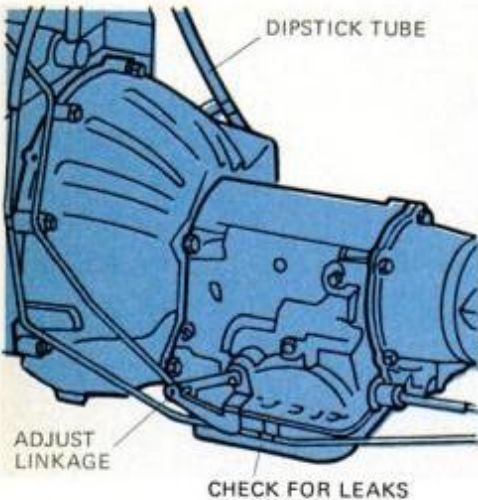
No, it doesn't. What a problem *should* signal is for you to undertake a sensible, but simple diagnosis procedure. In 9 cases out of 10, this procedure will lead to a solution, because seldom does an automatic transmission, which is one of the most reliable systems in a car, experience a serious internal breakdown.

TRANSMISSION DIAGNOSIS PROCEDURE

The diagnosis procedure we recommend when an automatic transmission malfunction occurs is the following:

- Check and correct the fluid level.
- Check for leaks, if fluid level repeatedly drops, check for leaks.
- Double check linkage adjustments.

(Please turn to page 156)

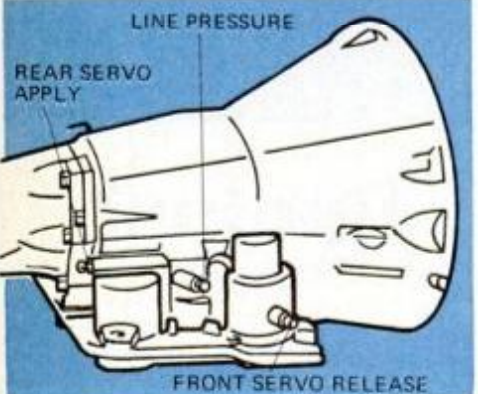


Automatic transmission diagnosis should start with the basics as shown above.

Generally, there are two: linkage to the shift lever and throttle-rod linkage.

Perform automatic transmission maintenance.

If the problem has not been resolved at this point, pressure checks should be made by tapping into transmission line-



Some points where pressure checks of transmission are made are shown here.

pressure fittings as the car is being road-tested. This will establish whether there is an internal malfunction.

Important: An engine which is not performing satisfactorily can result in erratic automatic transmission shifting, making it appear that the transmission needs major surgery even though it is in normal condition.

RUNDOWN ON THE PROCEDURE

Usually, fluid should be checked after the car has been driven, so the transmission will be hot. Consult the owner's or service manual for the exact recommendation, but if manufacturer's literature is lacking, make this fluid check:

- Park the car on a level surface.
- With the engine running, move the shift lever through each range.
- Place the shift lever in Park and draw the dipstick from transmission filler tube.

■ If the level is low, add enough fluid to bring it up to the FULL mark on the dipstick. You must use the type of fluid recommended by the manufacturer.

Caution: Do not overfill the transmission. This causes foaming and results in loss of fluid and erratic operation.

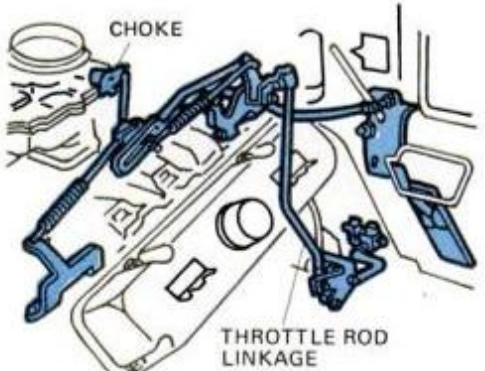
QUICK CHECK: Examine and smell the transmission fluid. If the fluid looks black or brown, and/or if it smells burned or like varnish, an internal problem, such as burning clutch, has developed. Drain the fluid immediately, clean the pan and replace the filter to try and reverse the damage (see below).

If the fluid level is consistently low from one check to another, there is a transmission leak. Some most likely areas where leaks occur are the following:

- Speedometer cable housing—replace O-ring seals.
- Oil-pan gasket—tighten oil pan and check again. Replace gasket if necessary.
- Fluid lines and fittings—if a leak cannot be stopped by tightening a fitting, replace the defective line.
- Rear extension—if fluid is leaking from the rear of the transmission, the rear extension seal or bore is damaged. Repairs are required.

The next step in trying to overcome erratic shifting is to make linkage adjustments. They are made differently for different cars, so you must refer to your shop manual. However, here's one example to show you the simplicity of the procedure. It refers to the throttle-rod linkage adjustment of a Chrysler Corp. model with V8 engine and Torqueflite transmission. (This procedure *cannot* be used for every Chrysler-built car with V8 engine and Torqueflite transmission. Check service data for your particular model.)

1. Warm up, then shut off the engine, and get beneath the car.
2. Loosen the adjustable swivel lock screw. See that the swivel slides freely along the throttle rod. If action is re-



Throttle rod linkage can cause erratic shifting; adjust as necessary.

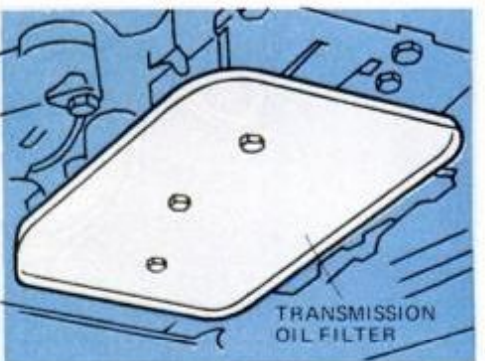
stricted, the swivel assembly should be disassembled for cleaning or repair.

3. See that the transmission shift lever in the car is firmly in Park and tighten the swivel lock screw to 125-in.lb. The adjustment is completed.

DRAINING PROCEDURE

If you are wise, you will observe this procedure *before* the transmission has trouble. Draining the transmission every 24,000 to 30,000 miles (more frequently if you use your car in dusty regions or to pull a trailer) will do more to prevent transmission failure than anything else.

1. Raise the car and remove the oil pan and gasket.
2. Discard the gasket.
3. Clean the pan in kerosene and let it dry thoroughly.
4. Remove and replace the filter and gasket, if there is one.
5. Carefully install a new oil-pan gas-



Oil filter should be checked and replaced following your car's service manual.

ket and replace the pan, tightening bolts to about 13 ft.-lbs. Do not overtighten. You will distort the pan.

6. Add about three pints of approved transmission fluid.
7. Start the engine, but do not race it. Shift the selector lever through each of the ranges.
8. Place the selector lever in Park and check the fluid level. Add fluid to raise the level to ¼ inch below the ADD mark on the dipstick. When the car has been driven and the transmission is hot, check the fluid level again and add more fluid if necessary.
9. Inspect the pan for leaks.

Stick-shift problems

When we get a letter like this one from A.M. of Florence, S.C., the answer is pretty much cut-and-dried:

'My '73 Camaro with manual transmission is difficult to shift. Why?'

Because the clutch linkage may need attention, the clutch may be damaged, the shift linkage may not be adjusted properly or may be damaged, or there may be internal transmission damage.

You shouldn't rip the clutch out of the

(Please turn to page 158)

"Hot weather is coming. When should I change my oil?"



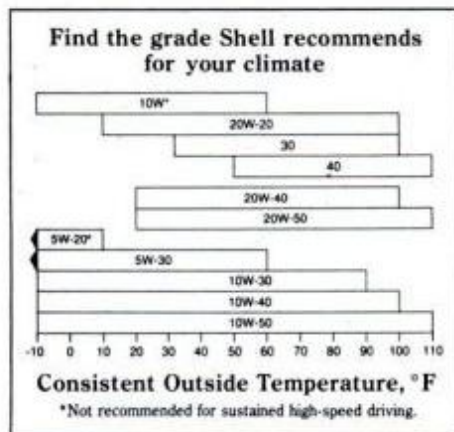
The Shell Answer Man helps you choose the right oil at the right time - winter or summer.

You don't have to change your oil just because the weather is warming up. Maybe the oil you've got will continue to do just fine.

The viscosity grade may tell the story

Numbers like SAE 10W, SAE 30 and so forth are viscosity grades. They tell how thick the oil is. And how well it protects at different outside temperatures.

Check your present oil on the chart. If it's okay for the kind of hot



weather you're expecting, leave it in there until your next regularly scheduled change.

But if you see that it won't protect

when the temperature goes up, switch to a grade that will.

Multigrades vs. single grades

While a high viscosity grade protects in a hot engine, and a low viscosity grade flows freely for quick starts, a multigrade oil gives you the advantages of both.

As the chart shows, multigrade oils will protect your engine in summer heat and winter cold.



Check the Shell line for the right motor oil for your car

Shell X-100® single grades motor oils are available in SAE 10W, 20W-20, 30, and 40. Each meets the warranty service requirements of every U.S. and most foreign cars.

Shell X-100 Multigrade is an SAE 10W-40 all season oil. It offers excellent high-temperature protection plus good low-temperature starting. Meets or exceeds warranty requirements for every U.S. and most foreign cars.

Shell Super X® motor oil earns the 10W-50 rating, the widest multigrade range you can buy. Helps protect today's hotter running engines. Recommended for use in extreme conditions such as towing. Exceeds warranty requirements for every U.S. and most foreign cars.

Owners' manuals and oil changing

The temperature outside isn't all you have to consider.

You should change oil when your

owner's manual says to. And most owners' manuals have three separate recommendations.

First, they recommend you change oil every so many miles. That's the number most owners remember.

Then a time interval is usually added to that. Something like "change oil every 5,000 miles or three months, whichever comes first."

That time limit is every bit as important as the mileage limit. Because if you reach the time limit first, it probably means that you're doing a lot of short trip driving.

That uses up your motor oil's protective additives. And since the oil doesn't get heated up on short trips, sludge and acids build up. So pay attention to time as well as mileage.

How severe is "severe"?

Finally, in addition to the regular time and mileage limits, your owner's manual probably tells you to change more often for "severe service."

That doesn't just mean driving in Baja torture tests. Stop and go driving in hot weather is tough on a car's engine. It's usually included under "severe." So are trailer towing and driving in dusty areas.

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They're 8-page, full-color booklets, packed with useful information about cars and driving. You'll get advice on automotive economics, guides for do-it-yourselfers, and facts to help make you a smarter buyer.

At present the series includes: *The Early Warning Book*, *The Breakdown Book*, *The Gasoline Mileage Book*, *The Car Buying and Selling Book*, *The 100,000 Mile Book*, *The Rush Hour Book*, *The Driving Emergency Book*.

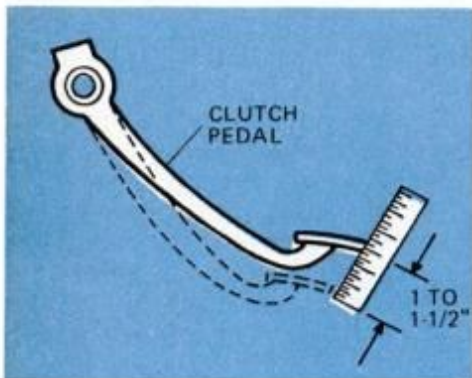
To get one or all, free, write Shell Answer Books, P.O. Box 61609, Houston, Texas, 77208



Come to Shell for answers

car or tear the transmission apart until you are dead certain that the clutch doesn't need adjusting. And the way to judge is first to make a simple test.

With the engine idling and brake set, hold the clutch pedal about ½ inch away from the floor and move the gearshift lever between first and reverse gears a number of times. If this can be done smoothly, the clutch is releasing fully. If the shift is not smooth, there is, hopefully, a clutch linkage problem. However, if gear clashing accompanies hard shifting, the trouble is probably located within the clutch itself, which should be removed, examined and repaired.



Clutch pedal free play should be checked as part of linkage maintenance.

If a clutch linkage malfunction is indicated, adjust the clutch. Adjustment is done differently in different cars, so a service manual will be needed. The following instructions, which apply to the Fiat 128, are provided to give you an idea of how the job is done:

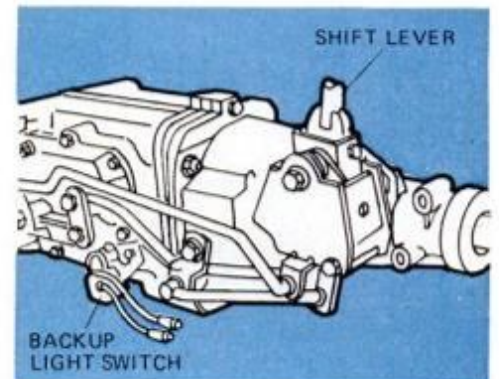
1. Place a ruler against the floor and in line with the clutch pedal as shown at left.
2. Note the measurement where the clutch pedal lines up with the ruler.
3. Depress the pedal until pressure is felt. Note the measurement.
4. Free play is the difference between the two measurements. For the Fiat 128, free play should be 1 to 1½ inches. If it is not, adjust the clutch.
5. Loosen the locknut on the clutch cable.
6. Tighten the large nut on the cable until the desired free play of the clutch pedal is attained.
7. Tighten the large nut—then the locknut.

TRANSMISSION TRAUMA

When clutch linkage and clutch have been discounted as the cause of hard shifting, you turn to the transmission shift linkage and finally to the transmission itself.

Incorrect shift-linkage adjustment will increase pressure when you're shifting, making shifting difficult. Similarly, if the linkage needs lubrication or is rusted or damaged at a pivot point, shifting would be difficult.

A service manual is needed for guidance. First, be sure that the lubrication points indicated are lubricated with chassis grease.

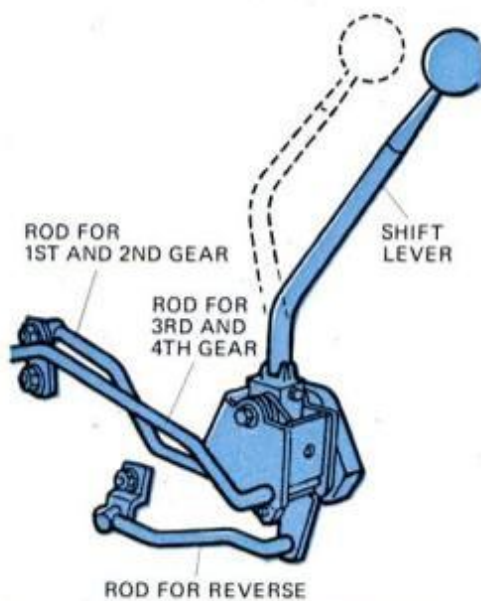


Shift linkage requires regular lubrication. Note backup-light switch location.

To make a shift-linkage adjustment, place the selector lever in Neutral and loosen the three swivel nuts. Insert a ¼-inch-diameter gauge pin into the bracket

It's easy to turn a heap into





Shift linkage, when it needs attention, can be difficult to reach and work on.

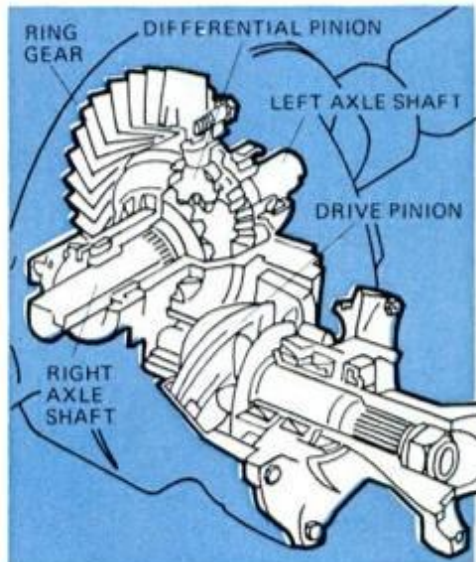
and holes in the control lever to align them. Tighten swivel nuts and remove the gauge pin. Check shifting.

Internal transmission trouble that will cause hard shifting includes a damaged shifter fork, damaged synchronizer, binding sliding gear or damaged sliding gear

teeth. The transmission must be disassembled to clear up the condition.

DECIPHERING DIFFERENTIAL PROBLEMS

Noise from the rear of your car may or may not signify a problem inside the differential. Some noise is acceptable.



Differentials are quite reliable. Test yours following instructions in text.

But if the noise is particularly annoying, here's a test to locate its origin:

Drive the car to warm up the differential. Shut off accessories. Try to isolate noise to a special area by considering:

1. If noise is continuous sound that varies with speed of car and changes pitch as car moves on varying roads, it is probably being induced by tires.

2. If changing the transmission lever from one speed range to another causes the noise to appear in one and not the other, it is coming from the transmission.

3. Note the road speed at which noise is loudest. With car still and transmission in Neutral, increase engine speed until it's at the speed at which the noise was heard. If noise is now present, it's coming from engine or exhaust.

4. As you drive, apply brakes lightly while holding car speed steady. If the noise varies in pitch, the problem likely is a wheel or axle shaft bearing. To verify, swerve the car sharply so body weight is shifted to one side and then the other. A defective bearing will howl louder when more pressure is applied.

5. If the noise tends to fade out below 30 mph, the differential is probably to blame. To verify this, drive steadily at the speed at which the noise is prominent and then coasting. If pitch changes, the noise comes from the differential.

a honey with a Kit shine.



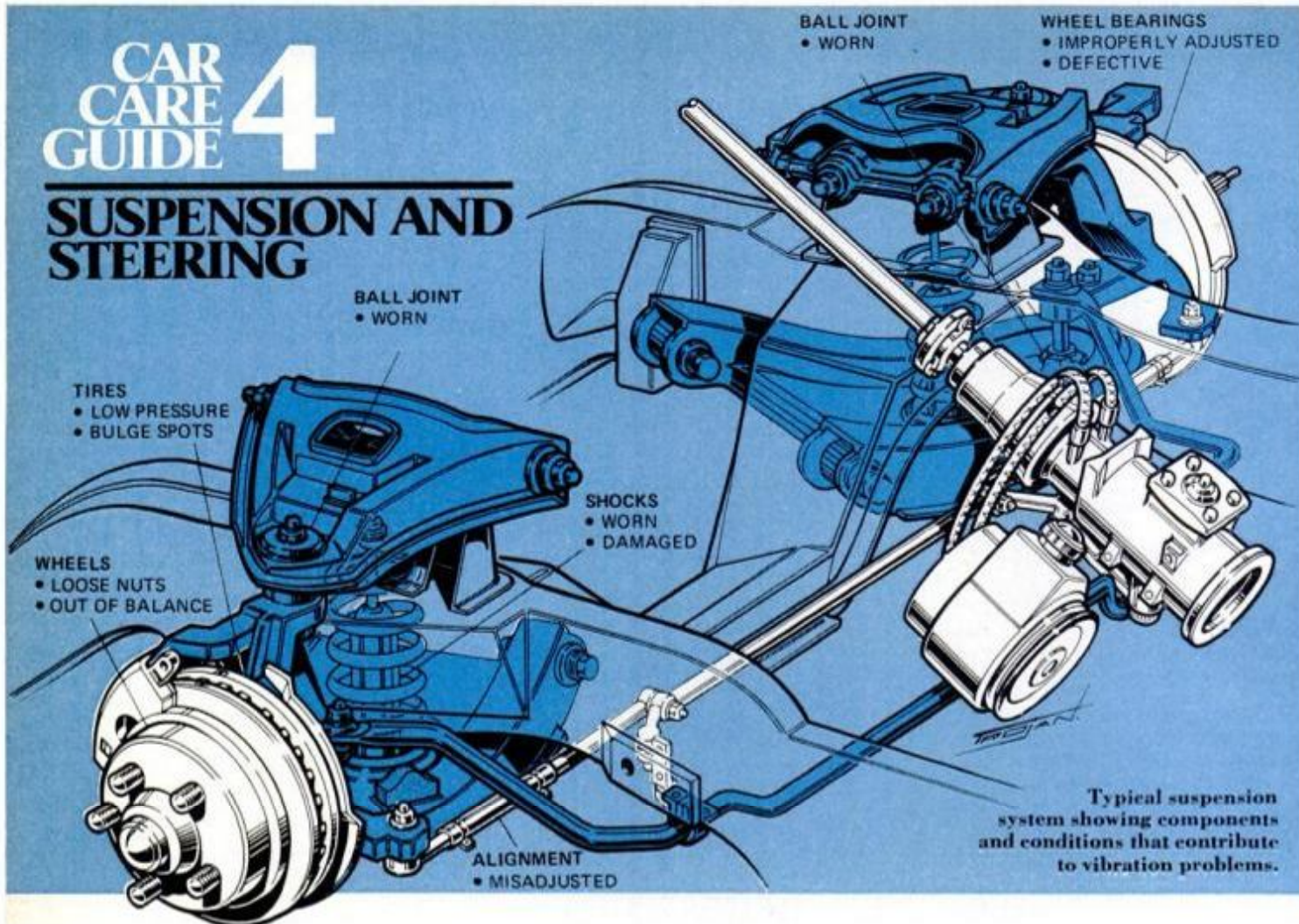
You don't have to knock yourself out to make your car look terrific. J/Wax Kit will make it easy for you. Kit's pre-softened — it liquifies as it hits the finish. Deep cleans. Wipes off easy. There's no easier, faster way to get a long-lasting paste wax shine than with J/Wax Kit.



No wonder it's #1.

CAR CARE GUIDE 4

SUSPENSION AND STEERING



Why isn't my car handling right?

Letters about suspension and steering systems sent *Car Clinic* during the first nine months of 1976 accounted for 7.8 percent of the total. An overwhelming 7.1 percent bemoaned "shimmy, vibration, poor steering, poor roadability, lousy handling" or similar faults.

An insignificant 0.7 percent was divided among subjects dealing with power steering and suspension modification.

Handling problems, therefore, get our entire attention in this section.

All in a name

The letter from M.K. of Wheeling, W. Va., went like this:

'I get this awful shimmy in the steering wheel between 55 and 60 mph. Please help.'

And the one from T.F. of Hallandale, Fla., said the following:

'My car begins to vibrate at a speed of about 60 mph when I travel I-95.'

The letter from S.S. of Shreveport, La., complained:

'I get a tramping sensation at between 20 to 25 mph.'

Each of these readers used three different words to describe two different conditions. Vibration and shimmy are the same. They have the same symptoms caused by the same mechanical failures.

Wheel tramp or thumping, on the other hand, is different. It is a cyclical sensation you feel in the steering wheel, seat or floor at between 20 and 30 mph.

In more cases than not, wheel tramp is caused by a tire problem, so refer to Section 12. However, if information in that section does not help, refer back to this section for data about shock absorbers and wheel assemblies, the other components that cause wheel tramp.

LOWDOWN ON VIBRATION

You know you have a vibration (shimmy) problem when you feel a continuous shaking in the steering wheel, seat or floor while traveling on a smooth road at a range of speed between about 50 to 70 mph. It may start, say, at 52 mph and continue until you exceed 56 mph.

The sensation persists as long as you remain in a particular speed range. It usually disappears at speeds below or above that particular range.

There's no secret concerning malfunctions that cause vibration. They are:

- Incorrect tire pressure.
- Tire bulge.
- Loose wheel nuts.
- Worn shock absorbers.
- Loose or damaged steering linkage component.
- Mud-coated or damaged driveshaft.
- Loose motor mount.
- Improperly adjusted or defective wheel bearings.
- Worn suspension ball joints.
- Out-of-balance wheel assemblies.
- Misaligned suspension.

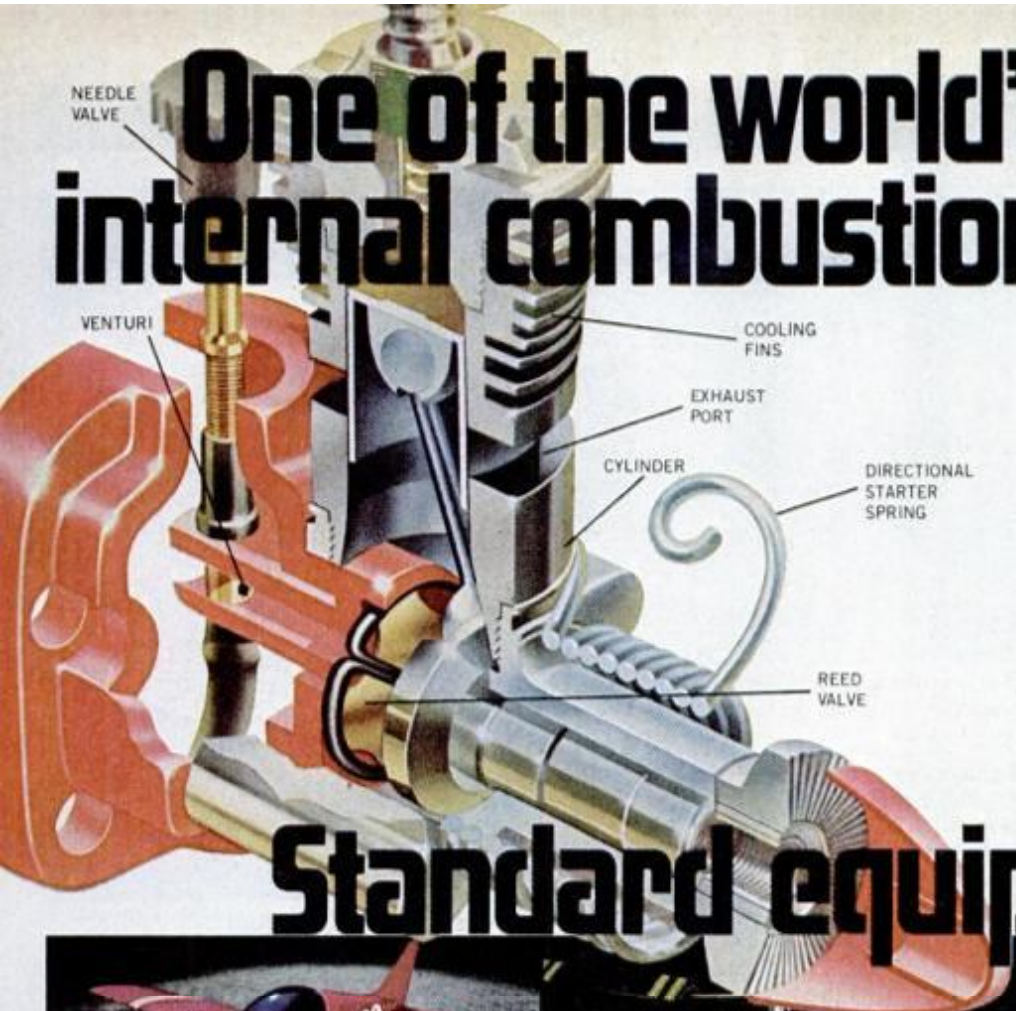
The order in which these are presented is important, because it is the way you should tackle troubleshooting. Why spend \$15, for instance, to have the front suspension aligned when the cause of your vibration problem may be low tire pressure, which costs nothing to rectify.

Tires top the list

How is tire pressure? Low or uneven pressure from tire to tire causes shimmy.

(Please turn to page 162)

One of the world's finest internal combustion engines.



An engine made from precision-machined steel, aluminum and platinum alloys... with a tolerance measure so inconceivable that even the finest auto engine bows with envy... and an RPM speed that could run circles around any real prop plane.

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Only Sure Flyers have Automatic Pilot. First-time flyers can switch it on while they're learning, off when they want full control. Pick up a refund certificate at your toy or hobby store when you buy any one of four Sure Flyer models or call the hot line for the participating store nearest you. Offer expires June 30, 1977.

The same dedication to quality goes into the design and construction of every plane housing the mighty Cox engine. In fact, our engineers are so proud of their work, they've got a toll-free hot line—800-854-3544*—so you can call the men who built your Cox plane and ask all the questions you like!

Check the planes shown here, then see all the others at your Cox dealer. Whichever you choose, you'll feel the thrill and excitement that go with flying the finest fuel-powered models in the world.

*In California, call collect: 714-540-5600.



QUICK FIX: Inflate tires to specs.

As you check tire pressure, look carefully at the tread and both sidewalls. A bulging tire is a primary cause of vibration and one of the greatest safety hazards. A bulge indicates separation of the tread or sidewall from the body; the tire could blow out any minute.

QUICK FIX: Replace a bulging tire.

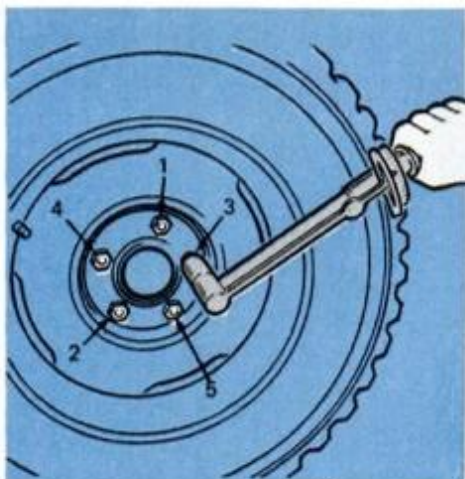
Important: Don't mistake the natural appearance of radial tires with the bulge that occurs when a tire is damaged. Radial tires have a natural squat appearance at their contact with the road, caused by a low vertical stiffness. Radials look "bulgy" even when properly inflated. (For more information about radials, their characteristics and care, see Section 12.)

While at the tires, remove wheel covers and *tighten wheel nuts*. If possible, use a torque wrench to tighten nuts to manufacturer's specification.

The proper way to tighten wheels and prevent trouble is as follows:

1. Tighten lugs in criss-cross fashion to *one-half* the specified torque. If a torque wrench is not available, use a lug wrench until each nut is snug. This equalizes pressure on the wheel, and seats the wheel properly.

2. Now, again, in criss-cross fashion,

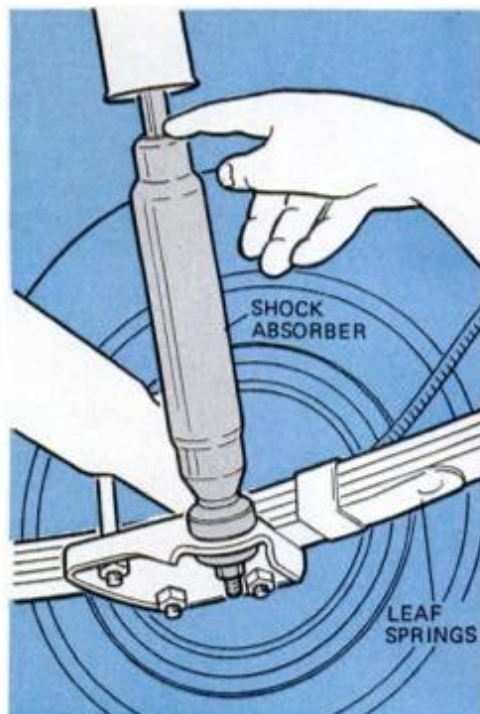


To avoid stressing wheel, tighten nuts in sequence shown using torque wrench.

tighten lugs to the *full torque* specified by the manufacturer. If no torque wrench is available, tighten lugs until excessive strength is required. Lugs should not be "as tight as possible."

Shocks, steering driveshaft

It is no big deal to determine if shock-absorber failure is causing your car to



Include a check for fluid leaks when you examine your shock absorbers.

shimmy. Get under the car and check each shock to see if hydraulic fluid is on the case. You may be able to see fluid

SCORE 2 WAYS WITH MARK TEN B AND...

You can add real zip to engine performance and eliminate the need for 3 out of 4 tune-ups with a Mark Ten B Capacitive Discharge Electronic Ignition. Over a million happy, satisfied users testify to the fact that the Mark Ten B really does:

- Eliminate 3 out of 4 tune-ups.
- Improve gasoline mileage—up to 20%.
- Give dramatic increases in acceleration and general performance.
- Extend spark plug life 3 to 10 times.
- Give instant all weather starts.

Put spark under the hood and score with *real* performance!

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The only carrier with truly innovative engineering, Delta's Mountain Man Carrier installs *without drilling a single hole*. A completely unique concept, it forms the basic unit of the first modular system ever devised to carry a variety of accessories. Look at these great features:

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*Patent Pending

- Fits all externally mounted 14", 15" and 16.5" tires.
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- Made of rugged 11 gauge steel for strength and durability.

Winner of PV4 Magazine's 1976 Product Of The Year Award, it will score on your 4WD, van, pickup, or mini, and it's a steal at only \$39.95 F.O.B.



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leaking from the bottom chamber. There is a shock at each corner of the car.

QUICK FIX: Replace defective shocks.

Important: If you must replace shock absorber on one end of the car (front or rear), replace the other one.

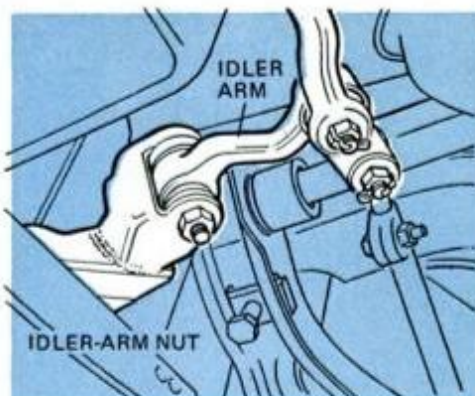
Now, at each corner of the car push up and down on the bumper until the corner is bouncing as vigorously as possible. Release the bumper at the bottom of a down push.

If the car comes up and stops bouncing, the shock absorber is okay. If the corner bounces more than one cycle (up, down and up again), the shock is weak.

Finally, the "feel" as you drive can confirm the presence of weak shock absorbers. At no time should the car bounce annoyingly, creating a shimmy, as the vehicle rolls over railroad tracks or cracks in the road.

After shock absorbers have been tested, you should turn your attention to the car's *steering linkage*.

With the car on a lift, grasp the front of each wheel and put pressure on wheels as if to push them away from each other. Then, apply pressure as if to pull wheels toward each other. Observe the ends of tie rods, idler arm and pitman arm for looseness. If any end has play in it, try to tighten the respective rod. If it won't, replace it.

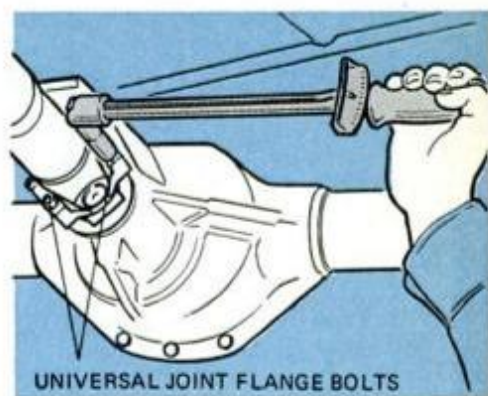


If steering system idler arm is loose, tighten idler-arm nut to specification.

Now, examine each rod to make sure it isn't bent. Also try shaking each to see if it has play. Replace a damaged component.

Hopefully, the car will be on a two-post lift so this next examination, checking the driveshaft, can be done easily. If not, lift rear of the car with a strong hydraulic jack and chock the front wheels.

Start the engine, shift the transmission into gear and watch the driveshaft. It should not look blurry as it revolves. On the contrary, it should appear to be motionless. Its edges should be sharply defined although the shaft is revolving.



Ball joints are easy to check on those cars having visual wear indicators.

If the driveshaft is out of alignment, try to solve the trouble by doing each of the following steps, performing the test just explained after each step:

1. Wash the shaft with kerosene. Mud or some other foreign substance, such as undercoating, may be caked on the shaft, affecting alignment.
2. Look for physical damage. Replace a bent or dented shaft.
3. Tighten universal joint flange bolts.
4. Check for a bad universal joint by rocking the shaft back and forth, first on

(Please turn to page 165)

Believe it or not, this is the same car.



The only difference is Star Brite.

The finish on Ditsy Garcia's 1965 Mustang looked like suede leather.

Oxidized by the sun, weathered and dulled by time, its original bright finish had turned to gloomy orange.

One application of Star Brite Car Polish turned it into a glittering jewel.

In minutes, under scorching summer sun, off came the dead, powdery

surface paint to reveal the original sparkling finish and color it had in the showroom.

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A second Star Brite application within 10 to 30 days after the first, will keep Ditsy's Mustang shielded from sun, oily airborne grime, bug acids, even road tar. After months,

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CAR CARE GUIDE

one end and then on the other end. You should not be able to move the shaft.

5. Check that rear of the car is level. A broken spring may cause the car to lean, throwing the shaft out of balance.

Wrapping up vibration

■ **Check motor mounts.** If your car has manual transmission, idle the engine, set the hand brake firmly, put transmission in gear and watch the engine while someone stalls it by letting out the clutch. If a motor mount is loose or bad, the engine will jerk sharply upward as it stalls.

If you have automatic transmission, put a jack under the oil pan and a 2x4 block of wood between jack and pan to avoid damage to the pan. Lift slowly; avoid too much force on the pan. If the mount is loose or bad, you'll see daylight between mount and engine block.

■ **Wheel bearings.** You can get a good indication if these are causing shimmy problems by raising the front of the car and rotating each wheel slowly. Notice any binding? Grab a wheel at top and bottom. Push it in and pull it out. If there is free play or binding, wheels should come off and bearings serviced.

■ **Worn suspension ball joints:** An accurate test using a micrometer-type gauge is specified by the maker of your particular suspension system. Some cars, especially those built recently by GM, have built-in ball-joint visual-wear indicators. If the indicator nipple (into



When you check driveshaft, make sure U-joint flange bolts are tightened to spec.

which the grease fitting is threaded) is flush with or below the surface of the socket cover, have ball joint replaced.

Important: When checking ball joints this way, the car must not be supported by the lower control arms. Lower ball joints only have wear indicators.

In cars without visual indicators, you can often tell if ball joints are causing vibration by noise. Be aware of crunching or squeaking from beneath the car when negotiating the curb-end of your driveway. Other signs: too much steering-wheel play, general instability on the road.

■ **Wheel balancing.** Have this done if vibration began right after you put on new tires or a wheel. An unbalanced wheel is probably causing vibration.

"You're Not going to Put Clean Oil into that Dirty Engine?"



5 Minute Motor Flush

...before every oil change!



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If all you do is change the oil, you've left the job undone.

Next time you're going to change the oil take an extra five minutes and put 5 Minute Motor Flush in the crankcase. It will clean out the sludge, varnish and other harmful deposits that dirty new oil—fast. And that means your new oil can do its job better. Protecting your car's engine.

Buy 5 Minute Motor Flush and other fine Gold Eagle products wherever automotive supplies are sold.

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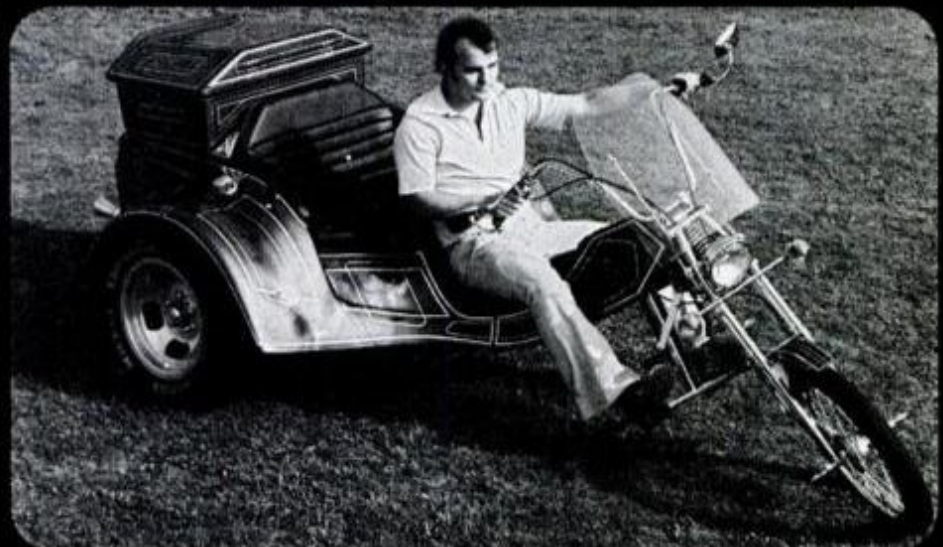
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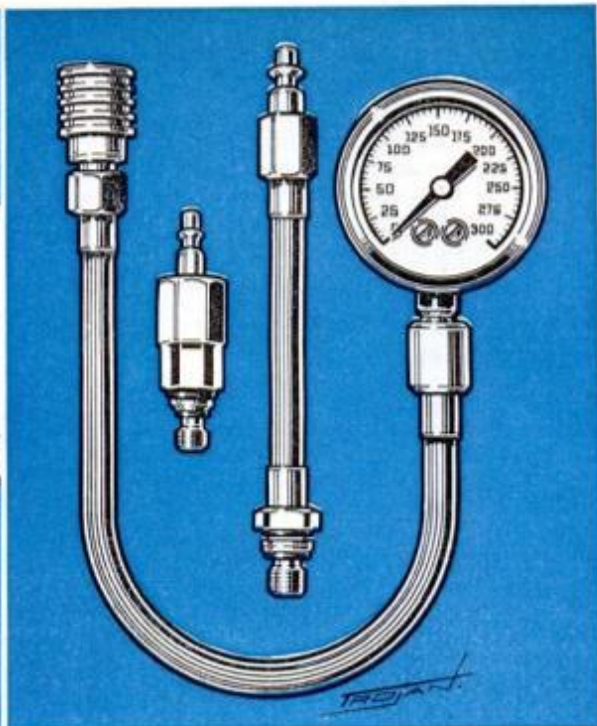
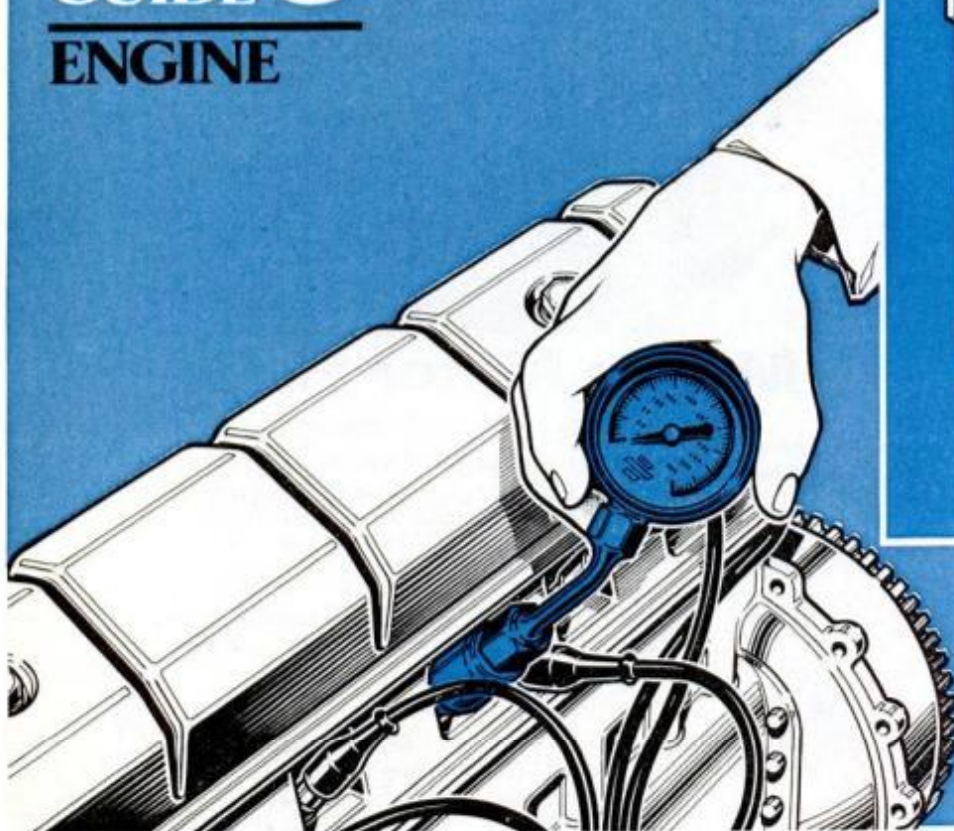
\$1 ENCLOSED FOR CATALOG

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Address _____

City _____

State _____ Zip _____



Engine condition can be tested using a compression gauge. Press-in type is shown at left: It must be held in sparkplug hole while engine is cranked. Gauge shown above is threaded type with adapters.

Why has my engine lost its pep?

Engine problems accounted for 6.7 percent of the total problems sent to us last year. These malfunctions can be broken down into the following categories: operational (lack of power, dieseling, missing), 3.3 percent; noise, 2.2 percent; engine timing, 0.8 percent and miscellaneous, 0.4 percent.

The miscellaneous category contains letters that are concerned with engine modifications or substitutions, subjects that are outside the scope of this *Car Care Guide*.

Problems, problems and more problems

'Mort, my car has no power.'

'My car runs on after I turn off the ignition!'

'My car could be used to give the President a 21-gun salute—it backfires so bad!'

'My car misses beats on a hard pull as regularly as a student drummer! Why?'

Well, "why" most frequently lies with a letdown in the fuel or ignition systems (see Sections 1 and 6). However, "why" could also have something to do with an internal engine malfunction, and the surest way to verify this possibility is by undertaking two simple tests: compression and vacuum.

All about compression testing

A compression test of each cylinder, if it's done properly, will disclose if a mechanical fault exists in the engine. The proper procedure to test compression is as follows:

1. Warm the engine up to normal operating temperature. This is done to assure that any valve which has a tendency to hang up when hot, but perform normally when cold, will reveal itself. Now cut the engine.

2. Remove all sparkplugs to provide a faster cranking speed and also to reduce drain on the battery.

3. Remove the carburetor air cleaner.

4. Open the throttle plate(s) to guarantee a full charge of air in the cylinders. This can be done by an assistant inside the car keeping the accelerator pedal pressed to the floor.

5. Place the compression-gauge intake

nozzle firmly into one cylinder. If you have not yet purchased a compression gauge, consider buying the type that screws into the cylinder. It provides a more effective seal than the type which is pushed in, thus limiting the loss of compression around the nozzle.

6. Crank the engine until the pointer on the gauge no longer rises. This normally takes six or seven compression strokes. However, when proceeding to test the other cylinders, you should keep in mind that the most accurate results are attained when you crank the engine the same number of revolutions for each cylinder.

7. Record the reading, remove the gauge from the cylinder and proceed to the next cylinder.

Once all cylinders have been tested and results have been recorded, an analysis is made. To make a sound judgment, you will need the compression specification for your engine (*not* the compression ratio). This specification is provided by the car's manufacturer.

ANALYZING COMPRESSION TEST READINGS

The following information will assist you in analyzing the compression-test readings:

■ If all of the readings are within 10 pounds of one another, an internal

engine problem is probably *not* affecting performance as long as the readings are within the minimum-maximum specification range. If only one compression specification is provided, the rule-of-thumb guide is that an overall reading of less than 100 p.s.i. means that the engine needs to be overhauled.

■ If compression in one or more cylinders of an older engine is 10 or more pounds above the maximum or normal specification, there is a buildup of carbon inside the engine.

QUICK FIX: You can try purging the carbon with a commercial penetrating agent that's sold by auto supply and accessory dealers. If this solvent doesn't work and engine starting is sluggish or difficult when the engine is hot, the head(s) can be removed and then carbon can be scraped from the head, valves and piston to rectify the condition.

■ The compression test may reveal the existence of uneven compression between two or more cylinders. Generally, compression of the lowest-reading cylinder(s) should not be more than 75 to 80 percent greater than that of the cylinder next in line.

For example, compression readings of 180, 175, 169, 171, 162, 165, 178, and 150 would be acceptable. Readings of 135, 140, 142, 148, 136, 101, 150 and 150 would not be acceptable.

QUICK CHECK: Inject motor oil into the cylinder through the sparkplug port of the low-reading cylinder. Then test compression again. If compression improves, the piston rings in that cylinder are probably worn. If compression does not improve or it improves only slightly, the valves are sticking, not seating properly or are burned.

■ If compression in two adjacent cylinders is low and the injection of motor oil into both improves the readings, then the head gasket between the two cylinders is probably defective.

All about vacuum testing

Vacuum testing and compression testing complement each other. Both should be done to verify findings or to reveal a malfunction that the other does not.

To perform the vacuum test properly, warm up the engine and remove the carburetor air cleaner. You will probably have to disconnect the positive-crankcase-ventilation system vacuum hose from the air cleaner. If you do, be sure to plug this hose. There should not be any leakage of vacuum as the vacuum test is being undertaken.

Connect the vacuum-gauge hose to a vacuum fitting. Suitable fittings will be found on the intake manifold or carburetor. However, as mentioned, if you disconnect any vacuum hose from a fitting so you can insert your vacuum gauge into it, be sure to plug up the hose.

Start the engine and take note of the vacuum reading. Refer to the accom-

panying chart for the meaning of readings that are not to the specification provided by the manufacturer in the service manual.

Analyzing noise

Engine noise is a subjective subject. This is why the kind of letter I got from A.D. of Portland, Me., always gets the same response from me.

A.D. wrote: "My engine makes a rapping sound. What is it?"

My response: "I don't know."

What A.D. describes as a rap, I may hear as a slap or thud. All three noises depict a different problem.

The right way to determine the cause of engine noise is with a visual spark-plug tester that connects to a sparkplug and flashes as the plug fires. How the noise occurs in respect to flashing in-

dicates generally what is causing the problem, as follows:











1. If the sound occurs twice for each flash, the source of the sound is some part driven by or driving the crankshaft. This would include pistons, rings, wrist pins or journals.

2. If the sound occurs once for each flash, the source of the sound is some part driven by the camshaft, such as a valve-train part, fuel pump, oil pump, distributor or camshaft gear.

3. If the sound occurs intermittently—that is, not at regular intervals with sparking—firing—some part may not be tied into the rotation of the crankshaft or camshaft. The noise likely is not inside the engine block, but is caused by the alternator, starter, power-steering pump or some such "add-on" assembly.

4. If the sound is a continuous whine or rubbing, it is being caused by a part that rotates, such as a timing gear, distributor drive or flywheel.

VACUUM GAUGE DIAGNOSIS

VACUUM GAUGE READING	PROBLEM	REMEDY AND COMMENTS
	Needle floats over range of four to five inches.	Faulty carburetor adjustment. Perform appropriate adjustment or repair (see Section 1).
	Needle steady, but below normal.	Faulty ignition timing. Perform appropriate adjustment or repair (see Section 6).
	Needle drops intermittently about four inches.	Valves are sticking. Check by injecting penetrating oil into the intake manifold. If intermittent vacuum drop stops temporarily, you can be sure the valves are sticking. Remove them for reconditioning.
	Needle drops back to constant low reading, returns to normal, drops, and so on.	Burned valve or insufficient valve tappet clearance causing leaky valve. Gauge needle drops back whenever the burned valve or the valve that isn't closing is in operation. Replace or adjust valve.
	Normal and steady reading at engine idle; vibrating reading at high speed.	Weak valve springs. Perform appropriate adjustment or repair.
	Needle vibrates excessively at idle, but steadies as engine speed is increased.	Worn valve guide stems. Perform appropriate adjustment or repair.
	Excessive needle vibration at all speeds.	Leaky head gasket. Perform appropriate adjustment or repair.
	Steady, but low reading.	Improper valve (camshaft) timing. Failure to obtain normal reading could also mean that ignition timing is off, but this possibility should be eliminated beforehand as indicated above. If necessary, adjust valve (camshaft) timing.
	Slow drop of needle to zero as engine speed is increased.	Restricted exhaust system. Perform appropriate adjustment or repair (see Section 1).
	Needle holds steady, but below normal.	Stuck throttle valve or leaky intake manifold or carburetor gasket. With key off, back out throttle stop screw to close valve; connect jump lead from distributor primary to ground; crank engine. If needle not normal check PROBLEMS. Squirt oil on joints. If needle normal, gasket bad.

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CAR CARE GUIDE 6

Charging system components must keep battery properly charged.

IGNITION AND ELECTRICAL

VOLTAGE REGULATOR
OVERCHARGING
UNDERCHARGING

LIGHT SWITCH
AND OTHER
ACCESSORIES

IGNITION SWITCH

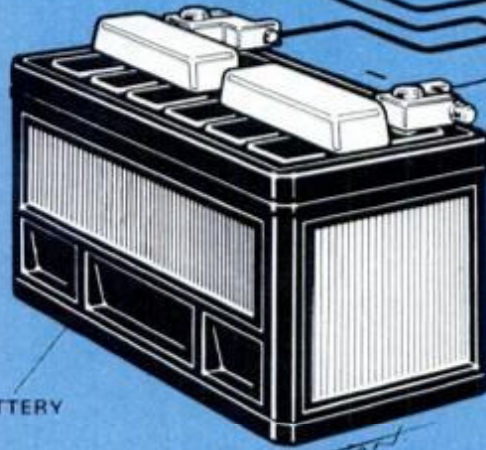
AMMETER

STARTER

TO LIGHTS

ALTERNATOR
UNDERCHARGING

BATTERY



Why won't my battery keep a charge?

In 1976, 6.2 percent of the people writing *Car Clinic* asked questions about the electrical and ignition systems.

Maintaining a just-right charge

Take a look at the schematic on this page that applies to the charging system. Notice that the starter and battery are shown, although we don't consider them part of the charging system. For our purposes, the starter and battery comprise the starting system (see Section 2).

Charging-system malfunctions that result in battery trouble lead to only two results:

1. The charging system doesn't put out enough current to keep battery charged.
2. The charging system puts out too much current, and high output causes the battery to overcharge.

Let's talk about the second indication first. It is easy to detect before it completely ruins the battery.

CHARGE, BUT NOT TOO MUCH

- If your car is equipped with an ammeter gauge, does the needle show continuous overcharging?
- Do lightbulbs burn out prematurely?
- Does the battery need refilling with water too often?

■ Do you get a sulphur odor, something like rotten eggs, when you remove the battery vent caps to check the level of the electrolyte?

Each of these conditions suggests a high charging rate. Without hesitating, you should have the voltage regulator tested. Invariably, a high output condition lies with regulator contacts that are stuck, an open regulator voltage winding or a regulator that has a loose or dirty ground.

Two types of regulators are currently in use. One is a solid-state unit inside the alternator. The other is a two-unit, double-contact regulator mounted externally on the firewall or fender.

If a test of the regulator shows that it is the cause of overcharging, don't indiscriminately replace it or the alternator. Some regulators built integral with the alternator can be replaced. Others cannot be replaced, and the entire unit must be discarded.

Many regulators can be adjusted—even some that are inside alternators. Investigate this possibility.

CHARGE, BUT NOT TOO LITTLE

Your first indication that a charging system is not supplying sufficient current is an ammeter gauge that shows no charge, especially when the engine is first started, or an ammeter indicator light

that glows bright red after the engine has been started.

Here is the procedure to follow, once a low charging rate is indicated.

1. Make sure the undercharged condition is not caused by leaving accessories turned on for extended periods.
2. Look for a damaged or loose alternator-drive belt. Examine it for grease or oil causing a belt to slip. Twist it to check for cracks, splits and glaze on inside.

QUICK FIX: A damaged belt should be replaced; a loose one tightened.

3. Clean and tighten the battery connections (see Section 2).
4. Inspect alternator wiring. See that all connections are clean and tight.
5. Perform the alternator current output test, using a voltmeter, ammeter and carbon-pile rheostat to determine whether the alternator can deliver its rated current output. If it can't, it has to come off the engine for testing of diode rectifiers, stator and rotor, and to check brushes and slip ring for wear.
6. Test the regulator.

IGNITION SURVEY MISLEADING?

We have to keep in mind that many engine problems discussed in Section 5

[\(Please turn to page 171\)](#)

We thought maybe you could live without constant engine tune-ups.



UniMag



UniMag

An idea that saves dollars and makes sense.

You don't need the hassle of constant adjustments to tell you that the fewer tune-ups, replacements and check-ups your car's engine requires, the more economically you drive.

That's the kind of thinking that gave birth to UniMag, Mallory's new breakerless electronic ignition. UniMag is an electronic conversion system for most four, six and eight cylinder cars, trucks and boats that eliminates points and condensers, and creates longer spark plug life, thus reducing the cost and number of engine tune-ups.

UniMag delivers tremendous spark energy, reducing spark plug fouling, misfire and stalling. It also delivers precise timing over the entire range of your engine. And you can install it yourself, easily, without special tools. In most cases, UniMag will even improve your gas mileage!

Ask your nearest Mallory dealer about UniMag.



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CAR CARE GUIDE

could have an ignition-system cause. These include missing, stalling, lack of power and dieseling.

Furthermore, if hard starting isn't caused by starting-system or fuel-system failure, then the cause is usually to be found in the ignition system.

Plugs fouling?

Here are some common firing-tip conditions and what they tell you:

■ **Wet, black deposits.** The engine may have an oil-sealing problem. Valves, valve guides, valve guide seals, piston rings, pistons and/or cylinders are usually to blame. However, the condition may be caused by the use of plugs too cold for engine operation. If all plugs get covered with oil, this is generally the case. If only one or two plugs foul, the trouble is usually inside the engine. If only two rear plugs in a V8 engine are oil-fouled, excessive sludge may have formed and plugged up the rear drain holes in the cylinder head, which would cause oil to draw in around the intake valve stems. This happens frequently when the engine is used only in heavy traffic or for light service, or if sensible drain intervals are exceeded.

QUICK FIX: Change oil and try a commercially available engine cleaner.

To avoid this, change oil frequently.

■ **Soft, fluffy, dry carbon.** Too much fuel is getting into the cylinder. Causes include running the engine at consistently low speeds (switch to a hotter plug), rich fuel mixture, prolonged idling and an inoperative automatic choke.

■ **Red, brown, yellow or white deposits.** Byproducts of combustion cause this—also excessively slow driving. Try changing your brand of fuel. The effect of deposits on engine performance is minimal, showing up as an intermittent miss under rapid acceleration or hill climbing until deposits harden. Unleaded fuel, in particular, leaves red deposits, but these seldom cause performance problems.

■ **White, blistered insulators.** Plugs are overheating. Check heat range. You may need a colder plug. If plugs in the rear of the engine assume this appearance, check the cooling system; it may not be circulating coolant properly. Early-stage preignition, which can seriously damage an engine if allowed to continue, may be a factor. If pinging noises are coming from the engine, check this out.

■ **Mangled electrodes.** Plugs are the wrong size. The reach is too long, and tips are being damaged by the piston.

■ **Brown or grayish-tan deposits** and some electrode wear. You're on the ball. Plug wear is normal.

Time for a change

When timing the ignition becomes a hassle, examine your procedure before looking for major problems. Ask yourself:

(Please turn to page 172)

Big Daddy Garlits says "NRI can train you at home to be a professional auto mechanic."

Don Garlits, America's All-time
Champion Top Fuel Dragster, and
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They give you all the training and equipment you need to get your career started in a hurry.

One thing I know for sure: in good years or bad, there's always jobs a plenty for good mechanics. Anytime I see a fellow who's good with his hands, I push him towards learning how to work on cars. And the best way I know to get that kind of training at home is through one of the NRI courses in Auto Mechanics.

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NRI's got two courses: a Basic Professional Repair Course, and a complete Master Automotive Technician's Course. Either one can get you started towards a real career, or some good part-time income.

NRI's 30 lesson **Basic Professional Repair Course** gives you the know-how to service auto electrical systems, carburetors and fuel systems, brakes, and cooling systems. You get eight important service items, including an Inductive Pick-Up DC Power Timing Light, Ignition and Electrical Systems Diagnostic Analysis and Tune-Up Instrument, tune-up tool kit, and more.

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If the coupon is missing, write: NRI Automotive Division; 3939 Wisconsin Avenue; Washington, D.C. 20016.

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946-057

1. Have I disconnected and plugged the distributor vacuum advance line? Only one maker we know of—Honda—requires that the vacuum line remain in place. Adjusting timing with the line connected gives an extremely retarded timing condition.

2. Am I aiming the timing light properly? Is the light tilted (as it should not be) or aimed straight at the marks?

3. Are timing marks visible or am I guessing?

QUICK FIX: With the engine off, clean timing marks with a cloth that has been dipped in kerosene, alcohol or some suitable cleaning solvent. Let this dry. Pick out the mark specified for your engine. Using a thin paintbrush from a child's paint set, apply a fine line of white or light-colored paint that will adhere to metal. Paint the timing pointer or index mark, too.

CAUTION: Don't use chalk. A chalkline can span several degrees, leading to inaccurate results.

4. Is the distributor housing tight? After making an adjustment by moving the distributor housing, be sure to tighten the distributor's lockbolt. You will need a distributor wrench made expressly for this purpose.

5. Is the vacuum advance working? Reconnect the vacuum advance hose and

aim your timing light at the timing marks while someone in the car accelerates the engine. The timing should show an advance of at least 3°.

Time for a break

1. **Point pitting.** This condition is characterized by a crater that has formed in one point with a corresponding buildup of metal on the other. This condition is almost always the result of using a condenser of the wrong capacity.

QUICK FIX: Replace points and condenser with a set contained in a sealed package specifically designated for your engine.

2. **Rapid point burning.** This is caused by high resistance in the condenser circuit due to a loose condenser mounting or lead, or by a defective condenser.

QUICK FIX: Replace the condenser and secure the lead.

Burned points will also result if the primary circuit resistor has failed. A warning that complete failure may result can be an engine that starts but fails to keep running.

QUICK CHECK: If possible, disconnect the ballast resistor from the primary circuit. If the engine now starts and continues to run, replace the resistor.

CAUTION: Do not allow the engine to operate for any extended period without a ballast resistor.

3. **Dirty points.** Almost always this condition is caused by use of a dirty feeler gauge to gap points. Furthermore, gapping dirty or rough points will result in inaccurate adjustment.

QUICK FIX: Pass an ignition-point file between points once slowly to try to remove dirt and lessen roughness. Use clean gauge. If points are very dirty or rough, replace them and the condenser.

IMPORTANT: Don't forget to adjust point dwell although you adjust point gap to specification. Improper dwell angle will cause poor acceleration and rough engine idle.

4. **Points have oil on them.** Points that get oil on them, because vapors work up into the distributor from the crankcase, will burn prematurely.

QUICK FIX: Replace the positive crankcase ventilation valve and make sure the PCV system is not clogged. Replace points and condenser.

5. **Point faces improperly aligned.** Each point face should touch the other squarely. If not, excessive heat will result and points will burn prematurely. Correct alignment may be obtained by bending the fixed contact-point arm.

DO YOUR OWN 60 SECOND AUTO LAMP INSPECTION.

Non-functioning lamps are one of the leading reasons for safety inspection failure. But it's easy to make your own safety check. Just turn on your headlamps and four-way flashers. Take a quick stroll around your car and check your headlamps, stoplights, tail, side-marker, parking and license plate lights for burnouts. It could prevent an accident or even save a life.

Your best replacement — General Electric Plus 25 headlamps.

If your headlamps are burned out, replace with General Electric Plus 25 headlamps. They generate 30% more light than our previous standard headlamps, which helps you see 25 feet further down the road. In fact, you should replace both headlamps with GE Plus 25's to get the full benefit of more light. The easy way to know if you have Plus 25's in your car is to check the number on the back of the light. If it's #4002 or #6012, it's our old model. If it's #4000 or #6014, it's a Plus 25. You can do-it-yourself, or have your service dealer install them. General Electric, Miniature Lamp Products Department #3382, Nela Park, Cleveland, Ohio 44112.

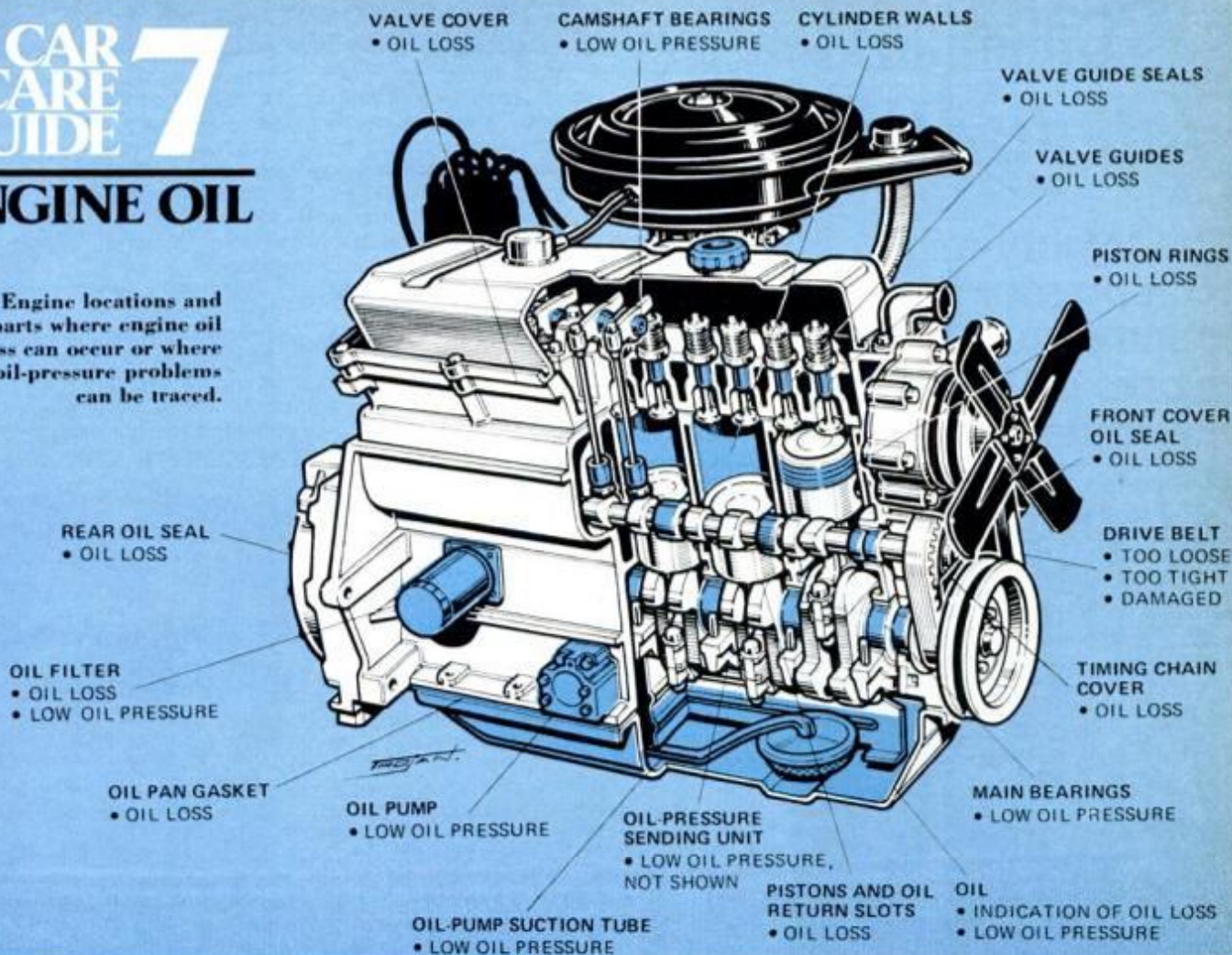


GENERAL ELECTRIC

CAR CARE GUIDE 7

ENGINE OIL

Engine locations and parts where engine oil loss can occur or where low-oil-pressure problems can be traced.



Why is my engine burning so much oil?

Representing 6.1 percent of the letters we received in 1976, oil-related problems don't seem widespread, but some nagging conditions prevail. The major one, showing up in 3.5 percent of the cases, is oil loss.

The next biggest problem is low oil pressure, followed by questions concerning synthetic motor oil.

What constitutes consumption?

The most asked question about oil consumption was summed up forcefully by V.L. of Cleveland, Ohio:

"My new car is losing a quart of oil in 800 miles. I don't consider this good oil consumption, but my dealer says it is normal. Please give me your opinion to reinforce me in my fight with the company. I'm desperate."

Opinions don't count. The point is: If your new car's engine uses oil in excess of the manufacturer's minimum, you have a warranty claim. If it doesn't, you don't have a claim.

As the years have passed, the manufacturer's "minimum" has shrunk. A while ago, using a quart of oil every 1500 miles was considered normal. Today, some manufacturers state that a new engine which uses a quart of oil every 700 miles is performing normally.

However, a certain number of new engines (and engines that have been overhauled) are oil consumers because of errors in production. An engine may get into the field with a defective front or rear oil seal, piston rings that have been improperly installed, or a defective oil-pan gasket. After verifying the loss of a significant amount of oil because of a defective product, no reputable manufacturer or shop will refuse to take steps that will rectify the situation.

DON'T BE TIMID

There is another reason for a new engine to demonstrate abnormal oil consumption. It has to do with the way some people "baby" a new car.

The cylinder walls in a new engine are smooth, and about 1000 miles of driving are needed before piston rings seat sufficiently to effectively prevent oil from seeping past.

However, if driving is too "cautious" during this period, piston rings may never seat. "Babying" the engine could cause glaze to build up between cylinder walls and rings, preventing effective sealing. If this happens, dismantling the engine, honing cylinder walls and replacing piston rings will be the only solution to solving the oil consumption problem.

When breaking in a new car, you should follow the instructions laid down in the owner's manual. For example, most 1977 models should be driven at a speed not to exceed 55 mph for the first 200 miles. Thereafter, all limits are off (except for the national speed law).

QUICK HINT: If your driving is confined to the city, drive your new car on the expressway at least 10 miles at the speed limit. Doing otherwise will make the engine a candidate for oil loss.

Older engines, obviously, can become oil consumers because of wear. Any one of a number of defects will result in loss

(Please turn to page 174)

Coleman™ Inflate-All 90™

the mighty mini-compressor that pumps up to 90 p.s.i.-works off a 12V auto cigarette lighter!



It's the one with Coleman quality. The Inflate-All 90 brings the average car tire from "flat" to inflated in about 8 minutes. Maintain proper inflation, perk-up spares in emergencies.



It also inflates truck, van and RV tires. Bicycle tires. Air mattresses. Footballs. Basketballs. Dozens of other uses.

The unique valve stem lets you measure pressure while you're pumping. Optional 15-foot extension cord, or handy clamp-on battery clips are available for extra versatility.



The Inflate-All 90 weighs just 4½ pounds. Hose, power cord, everything stores inside the case for easy carrying.

Look for the Coleman logo at leading automotive departments and specialty stores. Or write to Coleman.



THE COLEMAN COMPANY, INC. • WICHITA, KANSAS

CAR CARE GUIDE 7

including worn valve guides, damaged valve guide seals, worn piston rings, scored cylinder walls, worn piston-ring grooves, worn pistons and clogged oil-return slots that prevent oil from returning to the oil pan.

However, things other than an internal engine problem cause oil loss in both new and old engines, and it pays for you to make careful checks before deciding to tear the engine apart.

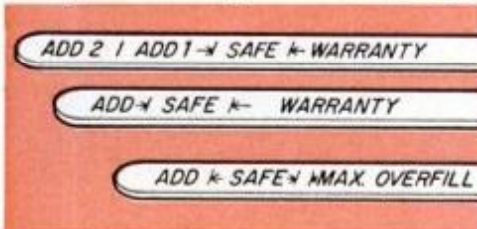
TROUBLESHOOTING THE PROBLEM

Here is how to proceed:

1. Start with the oil itself. Are you using oil designated by the car's manufacturer? Is the amount of oil in the engine to capacity? Does the car possess the right dipstick?

QUICK FIX: The dipstick is often overlooked in troubleshooting new cars. Occasionally, the wrong dipstick is put into an engine. To be sure this has not happened in your case, hold the dipstick next to one from the same model car, and make sure marks and length are the same.

2. Spread clean paper on the floor be-



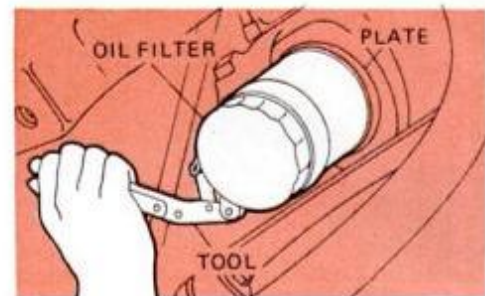
Manufacturers make many different dipsticks; make sure you have the right one.

neath the engine and transmission. Keep the engine at a speed equal to 20-25 mph (1000-1200 rpm), and continue running it for several minutes after it has reached normal operating temperature.

After the engine has warmed up, momentarily race it at wide-open throttle and let it come back to fast idle. Do this about five times.

Shut off the engine and examine the paper. Look for oil. Also check the underside of the engine for fresh oil.

If a leak is uncovered, find where it is coming from and fix it. Primary places include the oil filter connection, oil pan, front and rear oil seals, valve covers and the timing-chain cover.

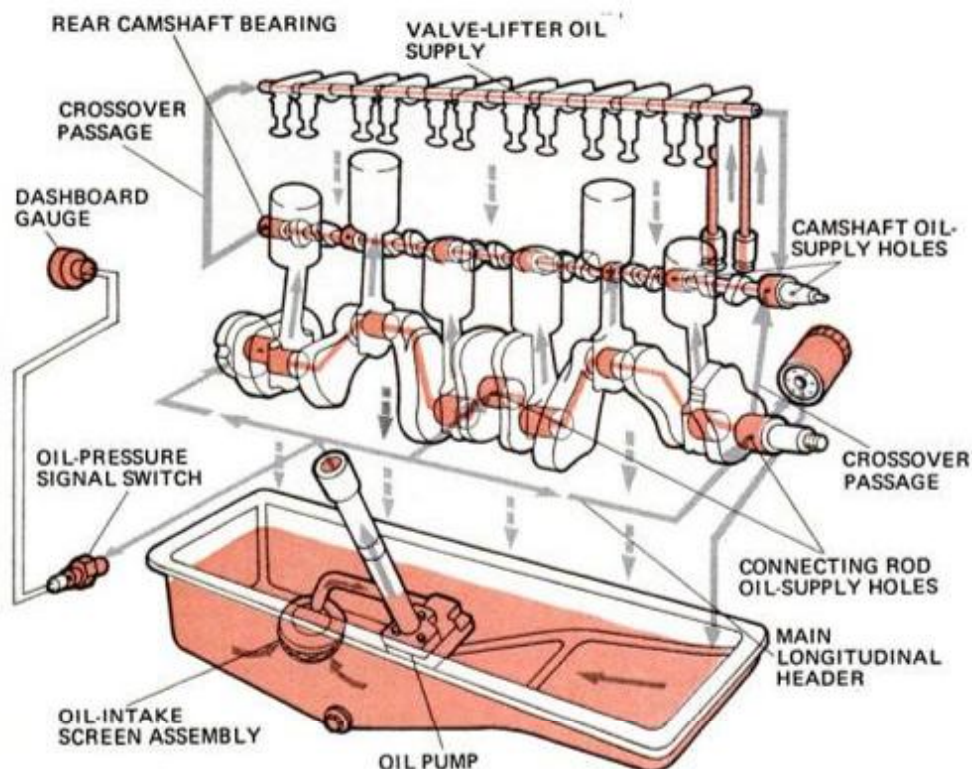


Use oil-filter tool only for loosening a tight filter. Install filter hand tight only.

3. As the car is being accelerated, check exhaust smoke. Excessive oil burning is often indicated by gray or blue-gray smoke—not black or white. Black smoke signifies burning of an overly rich fuel mixture—white smoke is condensation being expelled.

4. Replace the PCV valve which, if clogged or defective, can cause oil to be

(Please turn to page 176)



Typical engine lubrication system. Cause of low oil pressure can occur anywhere along the line.

Skimping on oil filters is like going over The Falls in a bargain barrel.



You can pay less for an oil filter than you might have to pay for a quality AC Oil Filter. That way you might save a few pennies.

But you could be risking a lot more than that.

There are powerful forces ready to attack your engine. The oil filter is your first line of defense. Choosing that filter carefully can save you a lot more than pennies.

"An engine saved is an engine saved."

When considering the price of a quality AC Oil Filter, compare it to the important investment you have in your car. Because dirty oil in your engine can do a lot of dirty work on rings, cylinder walls and bearings.

Dirt can actually grind your engine down.



A bargain barrel

AC Oil Filters have a strong filtering material that helps trap the dirt in the oil. It's polyester-reinforced to help withstand high temperatures and pressures. And AC puts a special W-Fold in the material that allows more filtering in less area.

The tricky fold that helps trap dirt before it trips your engine.

It'll help your oil protect those precious engine parts. And it will help you protect your investment.

Don't get shortchanged on quality. Ask for AC.

Depend on a quality AC Oil Filter to do the job. After all, AC Oil Filters have been around a good long time. AC knows enough not to cut corners with your engine protection.



Go
with the names
you know.



AC-DELCO DIVISION OF GENERAL MOTORS CORPORATION

drawn into the air cleaner housing. Examine the carburetor air filter element. Oil on this is the tipoff.

5. Check sparkplug tips for oil, which indicates oil loss. Now, perform a compression test as described in Section 5, which should confirm that you have an internal problem.

Check low oil pressure smartly

Oil pressure that is consistently low or pressure that takes a long time to reach acceptable limits after an engine is started are problems that shouldn't be sloughed off. But neither should you panic over them.

Low oil pressure, especially when accompanied by a loss of oil, could mean that main or camshaft bearings are in poor shape. The engine may need overhaul. However, low oil pressure also has other several causes, which are less troublesome to eliminate. These are the ones to tackle first.

Important: Do not run the engine if low oil pressure is indicated. You could force the engine to freeze if a low oil pressure condition does in fact exist.

To get at the cause of low oil pressure proceed as follows:

1. Check the engine oil level. Is it low?
2. Is oil thin or diluted? Change the oil—check pressure.
3. The oil pressure light on my 1970 Dodge Dart started flashing. I was beside myself until someone told me to disconnect the wire from my oil pressure sending unit and wipe the terminal clean. No more problem.—A.K., Little Falls, N.J.
4. In line with A.K.'s experience, also make sure that the oil pressure sending unit itself is in good shape. Replacing the unit on a hunch costs a dollar or two. That's a lot less expensive than tearing the engine apart.
5. Replace the oil filter. Maybe it is clogged.
6. You have to go inside now. Start at the oil pump. Check the pump pressure. Parts of the pump may be worn or the relief valve may be stuck. Also look at the oil-pump suction tube, which may be cracked, bent or loose.
7. Next stop is internal engine work. Sorry about that.

Synthetic oil: What's the story?

The "story" is that at this point no automobile manufacturer has extended oil drain periods because of the use of synthetic oils. Manufacturers still say you should use only oil meeting API requirements for "Service SE" and you should change oil and oil filter at the recommended intervals given by the manufacturer—not the oil refiner.

As long as the car is under warranty you had better follow this advice. What you do after that is strictly between you and your engine.

**If You're The Kind
Who Demands
The Best...
We've Got
To Hand It To You**



This is the one with the smooth working, machined, undercut mating parts (1) that can't slip out.

This is the one with the reinforcing flange (2) that practically eliminates stress breakage.

This is the original. The first of its kind and still the best of its kind. CHANNEL-LOCK. Be sure you get the real thing. Look for the trademark on the handle.

CHANNELLOCK, INC., • Meadville, Pa. 16335

CHAN NEL LOCK

The ORIGINAL Tongue-'N'-Groover



Send For Our Free Catalog

Be sure to check the participating manufacturers listing on page 203 where you'll see many fine products to help keep your car running smoothly. These and other products are available at your Car Care Headquarters, listed on page 202.

CARS ARE MADE TO LAST. QUAKER STATE'S MADE TO HELP SEE THAT THEY DO.

The plain and simple fact of the matter is this: helping cars last is Quaker State Motor Oil's only job. And now, Quaker State filters can help, too.

For over 60 years, people have trusted Quaker State. And for very good reasons.

Quaker State DeLuxe, Super Blend and HD are made from Pennsylvania Grade Crude Oil. Then formulated and blended by lubrication specialists, dedicated to producing quality automotive oils for your car.

By the time Quaker State is poured into your car's crankcase, it's passed strict quality control standards. To

make sure your car gets the protection it needs.

The result? If you use Quaker State regularly, you can help avoid expensive engine repairs.

Quaker State didn't get to be the best-selling motor oil in America for nothing. Quaker State means quality and value. Quart after quart after quart.

Look for Quaker State Motor Oil and Filters wherever they care about cars. Because Quaker State helps cars last.

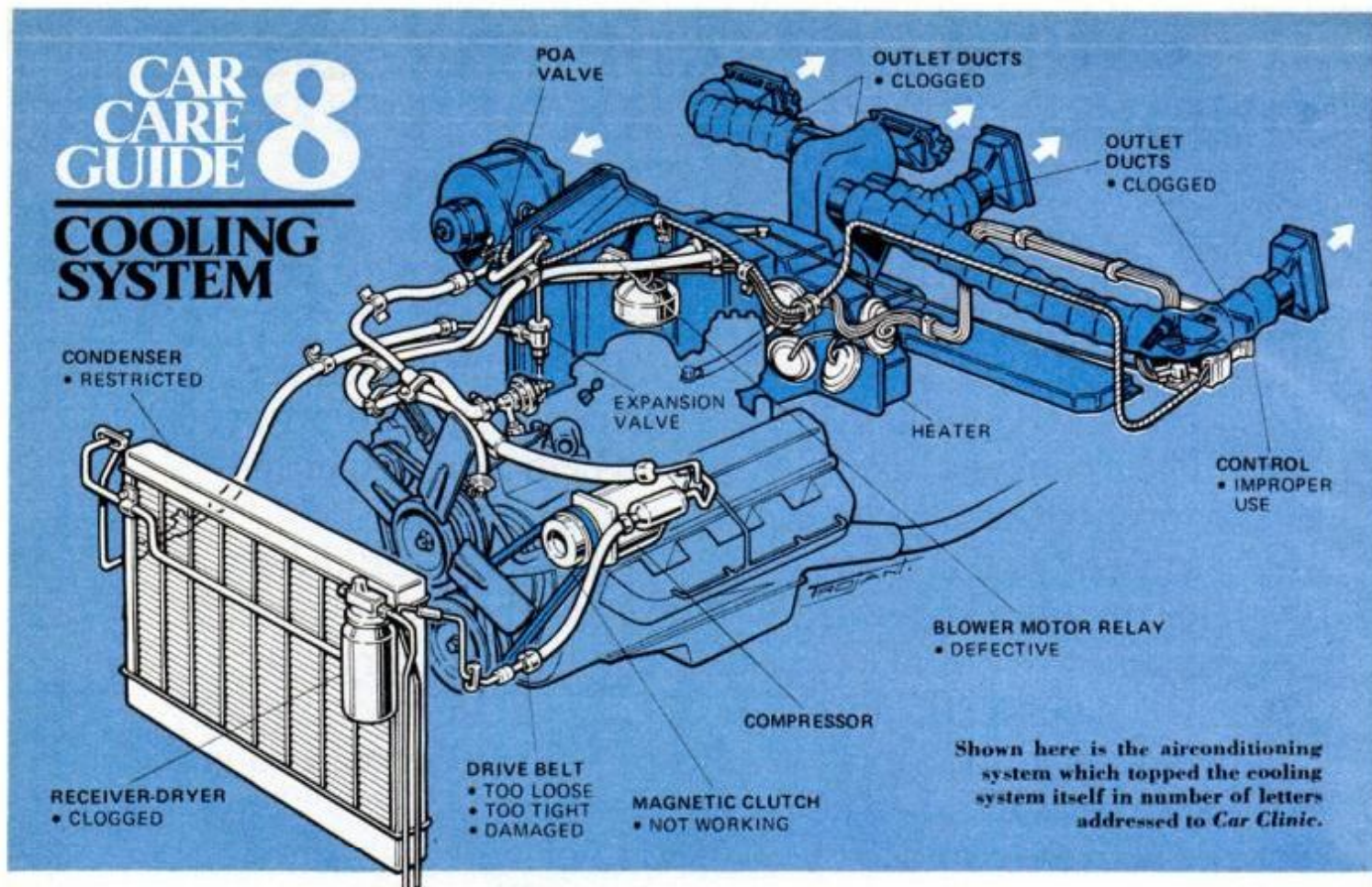
And to car owners these days, nothing's more important than that.

QUAKER STATE HELPS CARS LAST.



CAR CARE GUIDE 8

COOLING SYSTEM



Shown here is the airconditioning system which topped the cooling system itself in number of letters addressed to *Car Clinic*.

Why isn't the air conditioner keeping my car cool?

A major problem that our readers have is insufficient cooling from their air conditioners. Don't throw your hands up and hightail it to an air conditioner repair shop just yet. Although special equipment is needed if the refrigeration system does require service, the refrigeration system may *not* require that service. And if it doesn't your chances of correcting the trouble yourself are pretty good.

Getting cool—hopefully

Troubleshoot an airconditioning problem in the following way:

1. Are you manipulating controls properly? Consult the car owner's operation and maintenance manual.
2. Replace fuses. There may be one, two or more, and all of them should be discarded and new ones installed. Refer to the air conditioner wiring diagram in your service manual to find fuses. There is probably one in the main fuse block. The others are probably in the engine compartment on line with the compressor. If any one of these fails, the compressor won't run or will operate at diminished effectiveness.
3. Approach that drive belt with suspicion. Many airconditioning problems stem from a damaged or loose drive belt. However, very serious problems may oc-

cur if the drive belt is much too tight.

Chrysler Corp., with its Aspen and Volare, had trouble in the 1976 and 1977 models until the discovery was made that the "innocent" drive belt was the source of the problem.

According to a report we got, "airconditioning compressor crankshaft failures have been traced to overtensioning of the airconditioning clutch drive belt." To prevent the trouble, Chrysler said it is mandatory for the adjusting bolt to be tightened to absolute correct torque and that belt tension be checked with a belt-tension gauge.

4. Start the engine and switch the air conditioner control for maximum cooling. Look closely at the magnetic clutch, which you will find on the front of the compressor. Its purpose is to connect and disconnect the drive pulley from the compressor, allowing more or less pumping of refrigerant.

With the air conditioner set for maximum cooling, the magnetic clutch should be rotating. If it is difficult for you to see "rotation," have someone in the car turn off the air conditioner and then turn it back to the maximum cooling setting. If the clutch is not working, then compressor will have to be disassembled.

By the way, if the pulley is making noise when the compressor is *not* operating, but doesn't make any noise when the compressor is working, the pulley-bearing assembly is defective and should

be replaced as soon as possible.

5. The condenser core may be restricted with debris, such as leaves and dead bugs. This will reduce cooling.

QUICK FIX: Using a soft-bristle brush having a long handle, brush debris from the condenser.

Caution: You can use compressed air to clean the condenser, but this must be done carefully in order to avoid damaging the fins. Don't point any heavy blasts directly at the condenser. Shoot several short bursts at an angle.

6. Make sure the receiver-dryer, also called the receiver-dehydrator, is unclogged. The receiver-dryer is a container that holds liquid refrigerant. The unit also removes traces of moisture that may have been left in the system after it has been purged and evacuated. If the receiver-dryer is clogged, the flow of refrigerant will be restricted and cooling will be reduced.

QUICK CHECK: Operate the air conditioner at maximum cooling for five minutes; then run your hand over the receiver-dryer. If the outlet end should feel cold, the receiver-dryer should be replaced, which will require discharging and evacuation of the system.

7. Is the system short of refrigerant? Wipe off the sight glass of the receiver-dryer and observe if slow-moving bub-

(Please turn to page 180)



Snap!

This is Ford Motor Company's very own way for putting together many electrical connections. Anybody can put 'em together.



You can't put 'em together half way.

You can't put 'em together wrong.

And when you got it together (Snap!) no way should they come apart.

When you own a 1977 Ford, Mercury, or Lincoln car with snap connectors, you shouldn't have to worry about these electrical connections.



It's simple. Ford wants to be your car company.

bles, signs of vapor, are visible. A shortage of refrigerant might be indicated. However, keep in mind that continuous bubbles may appear in the sight glass in a perfect system if the ambient temperature is below 70° F.

If bubbles are apparent and you want a better indication of refrigerant charge, place a piece of cardboard or an old bedspread over half of the condenser. If the sight glass now clears, the charge is adequate.

8. Warm air leaking into the inside of the car will reduce the cooling effect of a properly functioning airconditioning system. All holes and crevices should be sealed with body sealer, commonly called

overheating. The reason for overheating can be found by following a set troubleshooting procedure.

1. Remove the radiator-pressure cap and look at the coolant. If it hasn't been drained and the cooling system hasn't been cleaned and flushed in more than two years, maybe you have found the trouble right off the bat. Mud-like coolant is enough to make any cooling system blow its top. The system should be drained and flushed thoroughly.

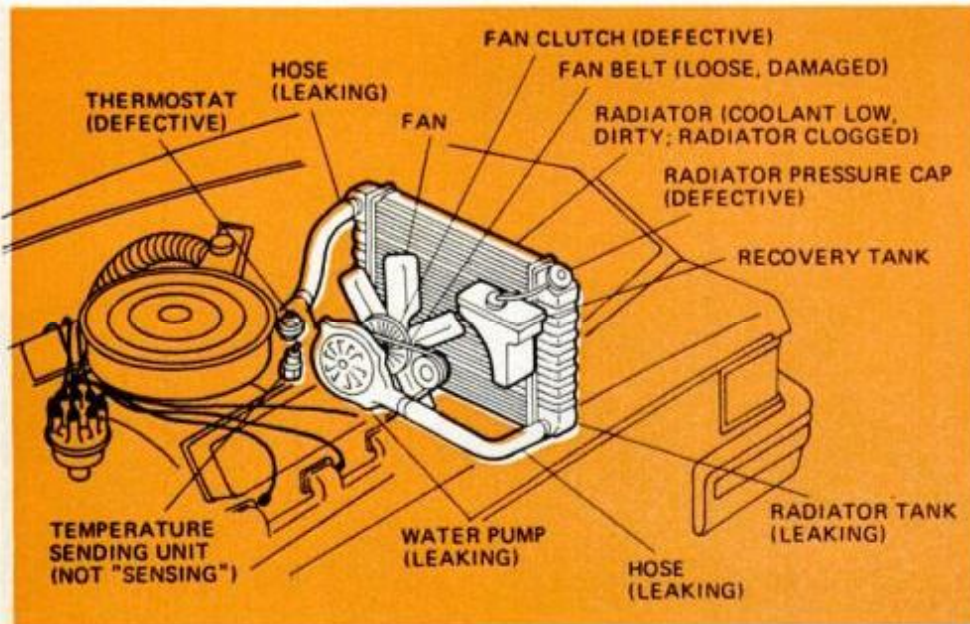
2. If coolant level is low and drops after you replenish it, there's a leak. Check the top and bottom radiator hoses, heater hoses, all hose connections, radiator tanks, heater and the water-pump

ture of the thermostat, which is printed in service manuals, squeeze the upper radiator hose. You should feel a surging of coolant. If not, replace the thermostat. It's defective.

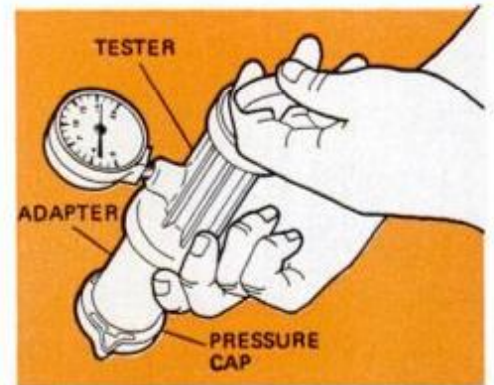


Newer cars use fans with clutches; test to make sure clutch is working properly.

7. Test the fan clutch while the engine is off. Grab a fan blade and spin the fan with a hard pull. If the fan should then



Components in the cooling system, and a number of problems that can lead to overheating are shown above.



Radiator cap must hold the pressure; tester shown will check condition of cap.

dum-dum, which is available at automotive parts supply outlets. Look for leaks in the car's firewall and on the underside of the vehicle.

If the procedure up to this point has failed to uncover the cause of insufficient cooling, the airconditioning system should be tested for leaks, discharged, repaired, vacuumed and recharged. This, of course, must be done by a professional shop unless you have the necessary equipment on hand and know how to use it.

There are two primary control valves in a typical airconditioning system—called the expansion valve and POA (pilot-operated absolute) valve—that can lose their preset adjustment. The ability of the valves to control pressure has to be tested with a gauge.

Engine overheating

That the cooling system is one of the most reliable areas of a car is proven by the fact that in 1976 we at *Car Clinic* received only a few letters related to

housing. A leak may be difficult to locate, which means you may have to put the cooling system under pressure with a cooling-system tester.

The tester is attached to the radiator filler neck and is pumped until the pressure on the dial equals the rated pressure of the system, which may be gotten from service data or off the radiator pressure cap. Pressure will reveal the area of leakage.

3. Check the drive belt for proper tension. A loose belt or belt that slips will curtail water-pump action.

4. Be sure the radiator fins are clear of debris.

5. Test the radiator pressure cap with the cooling-system tester. If the tester shows that the cap is not maintaining its rated pressure, get a new cap. A defective radiator pressure cap will reduce the boiling point of coolant.

6. Test the thermostat. With the engine cold and the radiator pressure cap removed, insert a high-reading thermometer (rated, at a minimum, above 200° F.) in the coolant. Start the engine. When the thermometer records the rated tempera-

spin five or more revolutions, it means the fan clutch is defective and should be replaced.

Heater hassle

The only complaint about heaters that we get is:

Help! No heat!

QUICK FIX: If you have recently worked on the cooling system and disconnected the heater hoses, you may have reversed the hoses. Switch these hoses and see what happens.

In 9½ cases out of 10, lack of heat from the heater is caused by a cooling-system thermostat that has become stuck in the open position. In the other half case, the heater is probably blocked by internal crud and should be removed for chemical cleaning. See the manufacturer's service manual for removal procedure.

SEARS ROADHANDLER.

15% better wet cornering traction than "The Tire That Beat The Baja."

HOW SEARS ROADHANDLER SET A NEW WET DRIVING RECORD FOR SEARS TIRES.

When it rains, the most important feature any tire can deliver is traction.

And RoadHandler delivers.

It's designed with many wet driving improvements over the original Sears Steel-Belted Radial.

For starters, five rows of grooves instead of four give water more outlets. So there's less possibility of *hydroplaning* — skidding on the thin film of water that builds up between the tire's surface and a rainy road.



Other wet driving improvements:

- RoadHandler has six rows of tread rather than five, 12.5% more rubber comes in firm contact with the road.
- RoadHandler has a deeper tread for 10% better tread life.
- RoadHandler has 15% better wet cornering traction as determined under carefully controlled laboratory conditions.

RAINY DAY DRIVING ISN'T THE ONLY WAY SEARS BEST STEEL-BELTED RADIAL PROVED ITSELF.

With 40,000 miles of relentless day and night driving already behind them, a set of four Sears RoadHandlers took on and tamed the rugged 2,000-mile route of the old Pony Express.

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Even when laboratory engineers subjected these Sears RoadHandlers

to thorough X-Ray examination, not a single tire failure of any kind.

Anywhere.

We don't call it the RoadHandler for nothing.



"Straight talk, good values and satisfaction."

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CAR CARE GUIDE 9

CAR BODY

PAINT DAMAGE

- MINOR SCRATCHES
- BLISTERING
- PITTING
- PLAIN DIRT

LEAKS

- AIR
- WATER

VINYL TRIM

- DIRTY
- TORN

METAL TRIM

- DIRTY

Keeping your car body in shape takes water, wax, elbow grease, lots of tender loving care.



WSW TIRES

- DIRTY
- MARRED FINISH

BODY DAMAGE

- RUST
- DENTS

How often should I wax my car?

In this category, which represents 4.3 percent of the total number of letters received by *Car Clinic* in 1976, we include questions about finish and body damage, water and air leaks, and interior glass haze.

Finish-and-body-damage problems were encountered by 1.6 percent of our readers, with the majority of letters asking us how to repair "typical" damage seen in the illustration above. However, this year a new "problem" made itself known. F.I. of Gary, Ind., told us about it in this letter:

'My car is red, but blue spots have started to appear here and there. I can't figure out why.'

Cars that suddenly develop "freckles," especially in heavy industrial areas, have probably been infected by chemicals in the air, specifically acid or alkali. A common airborne acid is sulfur dioxide, a byproduct of the burning of high-sulfur fuels.

Alkali damage may result from road-salt splash which isn't washed from the finish. It's also wise to wash road salt from beneath the car, especially in spring.

When acid or alkali on paint gets wet, it can change color pigment, like blue spots in red, dark blue spots in metallic green and bleached-out areas in yellow.

COSMETIC SURGERY

Hopefully, chemical damage will be spotted before it eats into the finish and extends below the surface. If so, it can

be removed using the method I describe here. If the damage has gone deep into the paint film and won't polish out, re-finishing will be required to get rid of further chemical injury.

Here is how to restore your car's complexion.

■ Wash the finish thoroughly with a good-quality commercial car-wash detergent, which you can obtain from an auto supply parts dealer. Let the finish dry.

■ Taking a small area at a time on the car's flat surfaces, apply a medium-grit polishing compound. Your auto parts dealer can advise you on which one to use if you explain the circumstances.

■ With a variable-speed drill equipped with a buffing pad, polish off spots. The drill should be operated at low to medium speed. Concentrate on spotted areas only. Repeat until spots are removed.

■ Over curved surfaces and near edges and metal trim, the procedure will have to be done by hand. Form a cotton cloth into a ball and rub the spots vigorously.

■ Wipe off excess compound with a clean, dry cloth and buff out the area with a clean, dry lamb's-wool pad to get rid of polishing marks and to bring up the gloss.

Dropping iron

There is another kind of fallout that's causing readers problems:

'Hey, what can I do about spots of rust that develop on my Camaro's white paint?'

If those dots feel rough to the touch and are hard to get off by simply washing the car, then the finish has been infected by iron-particle fallout. You must live near a foundry. To get rid of iron-particle damage, proceed as follows as soon as possible:

■ Wash the car thoroughly with a good-quality commercially available nonalkaline car-wash detergent.

■ Mix 6 to 8 ounces of dry powder oxalic acid (available in hardware stores) in one gallon of warm water. Add one or two tablespoons of car-wash detergent.

■ Using a large sponge, apply the solution freely to all affected areas. Keep the area wet and run your hand over the surface occasionally. When you no longer feel roughness, you can stop the treatment.

■ Rinse the area with clear water thoroughly. This must be done to prevent corrosion, which remaining traces of oxalic acid will cause.

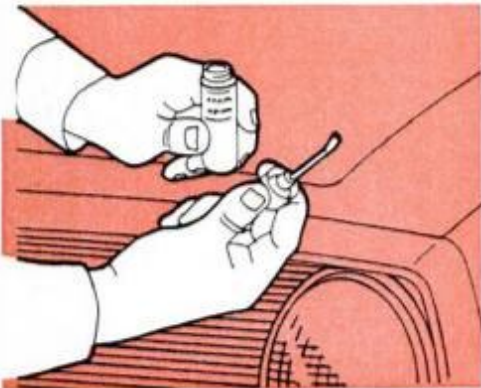
PREVENTION IS THE BEST CURE

If you think your car is going to be affected by industrial or chemical fallout, the best prevention is frequent washing with a good-quality nonalkaline car-wash detergent. A heavy coat of auto wax applied at least once every six months will help. Furthermore, if your car is left outdoors rather than garaged, you might want to consider covering it overnight with a heavy plastic dropcloth.

Also keep in mind that any chips in the paint should be touched up immediately in order to prevent damage from spreading. An auto-parts supply dealer has touch-up paints available to match your car's finish.

CAR CARE GUIDE

To get the right color, secure the body color code from the identification label affixed somewhere to your car. In all Ford



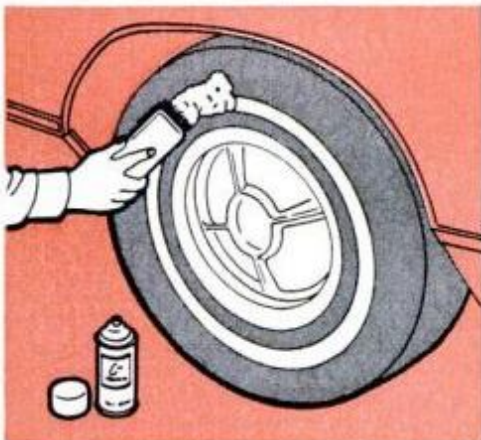
Touch up scratches before rust starts to form on the exposed sheet metal.

four-door models, for example, this label is on the rear face of the left front door. If you can't find the label, call a dealer's service department.

To touch up all minor flaws such as scratches, localized blisters, pitting and peel, apply baby oil to the flaw and very carefully sand the area with 600-grit wet sandpaper. Wash off the sanding sludge and wipe the area with a clean, soft cloth.

If the defect is removed before you get to bare metal, buff the area with a fine buffing compound. If you can't get rid of the flaw without removing paint to bare metal, touch up the spot with touch-up paint, let dry, then buff and polish.

There are shelves of other body and cleaning supplies at a local auto supply dealer to help you rectify tough conditions that ordinary products can't touch. For instance, you can try cleaning white sidewall tires with ordinary detergent and a stiff-bristle brush or soap pad, but this isn't always effective against hard-to-re-



A good white sidewall cleaner is a must to keep this type of tire free of dirt.

move scuff marks you've gotten by getting too close to the curb.

What you need is a commercially available white sidewall tire cleaner and your stiff-bristle brush or soap pad. Do not use

(Please turn to page 184)



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1. A \$2.00 Merchandise Certificate good in the store where you buy the Zerex.

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For a free booklet on cooling system care, write PPG Industries, One Gateway Center, 5NZ, Pittsburgh, Pa. 15222.





any makeshift cleaning substance containing any petroleum, such as gasoline or kerosene. Petroleum is harmful to rubber.

Suppose ordinary car-wash or laundry soap doesn't make your car's vinyl top sparkling clean. There are some really great vinyl-top cleaners and conditioners on the market. But as with all these products, use them as instructions require to get maximum results.

Whoosh-whoosh, gurgle-gurgle

Wind and water leaks in cars accounted for 1.2 percent of '76's mailbag. Repairing a defect that's causing you annoyance isn't all that tough, but finding the defect is something else.

Let's talk about wind first. J.T. of Tacoma, Wash., put his finger on the difficulty of finding the source of wind noise in his letter last September:

'I've followed instructions in PM's Complete Car Repair Manual to the letter (Chap. 19), but have failed to uncover the leak. What now?'

Start all over again. Get a friend and a length of vacuum hose. Close all windows, doors and vents tightly, turn off the radio and all blowers.

Instruct your friend to drive the car in a light traffic area and in different directions as you check for noise around all windows, doors and air inlet vents. If the noise appears inside the car, air is leak-



Wind noise, too, can be hard to pinpoint; use section of hose as an aid in the job.

ing out; if it seems outside, outside turbulence may be the reason. The two causes are treated differently.

To stop an air leak, proceed:

1. Check all weatherstripping for wear and damage. Auto-supply stores have roll-type auto-caulking compound you can place under a worn area to shim the weatherstripping and seal the leak. Replace torn weatherstripping.

2. Reattach loose weatherstripping with rubber cement.

3. If the leak is the result of a rust spot, patch the hole.

4. Examine door frames for solder lumps that are preventing weatherstripping from seating. Chip them off with a hammer and metal chisel.

Here's what to do to lessen the effects of turbulence:

- **Lower the radio antenna.** One whipping in the wind can create noise. That goes for CB antennas, too.

- **Cover one chrome molding strip** at a time with masking tape and road-test the car. If the noise is no longer apparent, remove the strip from the car and fill its hollow with caulking compound. Reattach.

- **If your car has vent windows,** examine weatherstripping around outside of the windows. Look for distorted rubber, called puckers. Soften a pucker with a propane torch and smooth it with a putty knife.

- **View roof rails suspiciously.** Tape one at a time and road-test the car to see if that rail is causing turbulent noise. If a roof rail has pulled away from the body or rusted, replace it if getting rid of the noise is important.

WET FEET, STREAKED GLASS

The best way to find the source of a water leak is to have someone inside the car as you pour a steady stream of water from a hose on all door perimeters, win-



Water leaks can be tough to find; best way is to use a garden hose to soak the car.

dow edges and trunk lid. Open the hood and give all seams and holes in the firewall similar treatment.

Hold the hose about three inches from the area you're dousing. Start at the bottom of a section and work up to the top. When your partner sees water or gets wet, the leak has been found. Repair it by repositioning weatherstripping, sealing holes or seams with auto caulking, or removing glass to reseal a windshield perimeter.

Interestingly, most who write *Car Clinic* about glass complain about a hazy film on inside surfaces. Haze results from tobacco smoke and vapors given off by vinyl and plastics. Use a glass cleaner containing ammonia. If that doesn't work, wash glass with a 50:50 solution of ammonia and warm water.

Now is the time to Road Test RISLONE

Engines get sluggish and noisy with miles and time. For 40 years RISLONE has been cleaning rings, valves and guides, oil screens and passages to make engines run better again.

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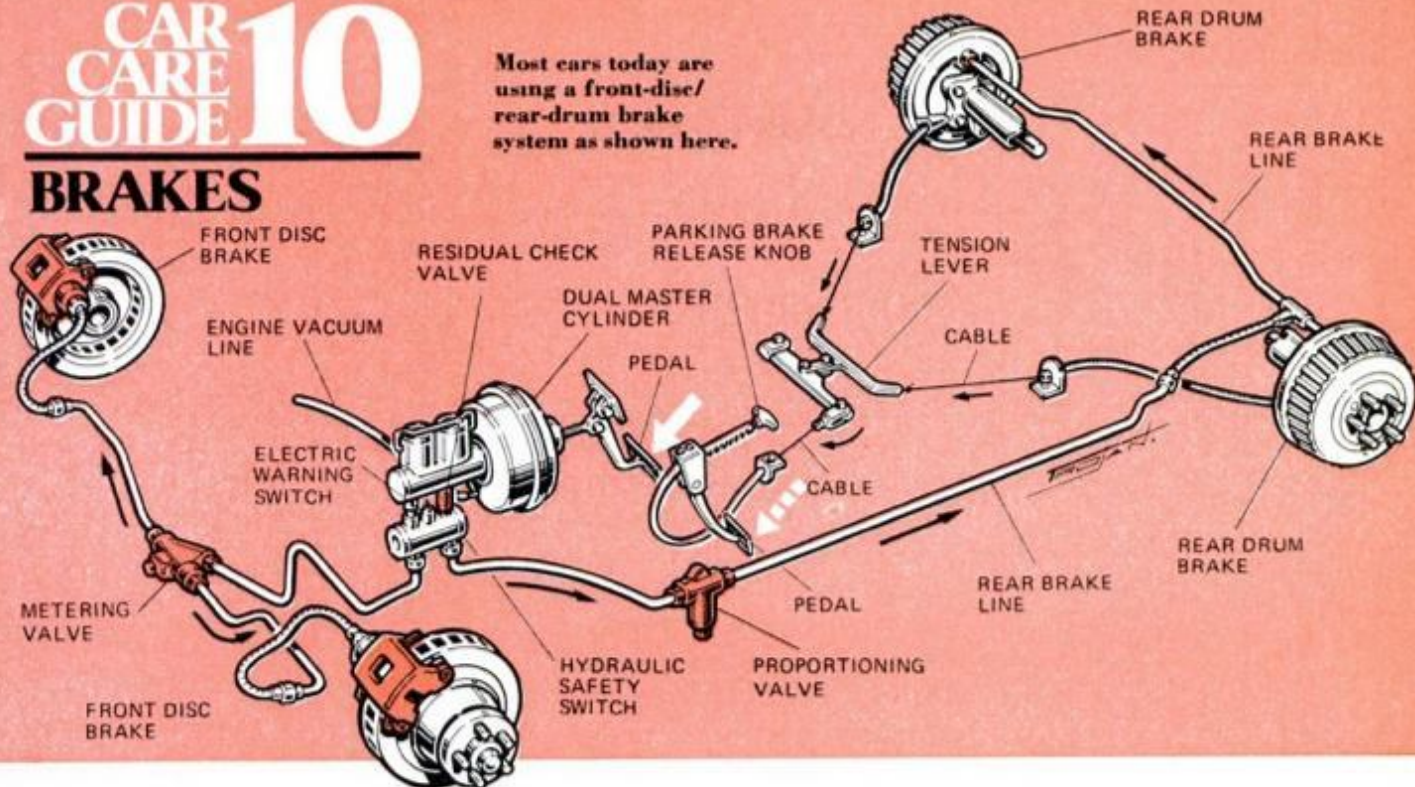
Waupun, Wisconsin 53963

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CAR CARE GUIDE 10

BRAKES

Most cars today are using a front-disc/rear-drum brake system as shown here.



Why can't I keep my brakes from squealing?

Brake problems represent only 3.6 percent of the total number of letters received at *Car Clinic* in 1976, which attests, probably, to the super performance of today's braking systems. On the other hand, though, a recent University of Indiana study shows that worn-out brakes are a factor in 40 percent of the automobile accidents involving a car malfunction caused by *owner neglect*.

This seems inconceivable. Automobile braking systems have had built into them for years the mechanisms that give drivers early-warning signals when maintenance, repair or adjustments are needed. One such device, adopted by General Motors and Volkswagen among others, is a built-in wear indicator (below) that

makes a warning sound when brake linings are worn.

How anyone could disregard this irritating noise, or a red signal light on a dashboard warning of brake failure, is hard to understand. Yet, the University of Indiana study shows this is exactly what some drivers are doing.

When is a 'problem' a problem?

Is it possible that drivers are failing to interpret warning noise? Could they be confusing it with the most common brake problem we get in *Car Clinic*—brake squeal?

is loudest when brakes have heated, as they are after prolonged driving in city traffic. Squeal may be loudest on humid days on some cars, while on others it may be more annoying on dry days.

Whatever, the noise in most cases is not unbearable, and it certainly is not signaling a problem. *Brake squeal of this kind has no effect whatsoever on brake operation.*

However, there have been cases, especially on light pedal operation, where squeal has been irritating enough to be uncomfortable. It is at this point that manufacturers have instituted remedies.

SOME CURES

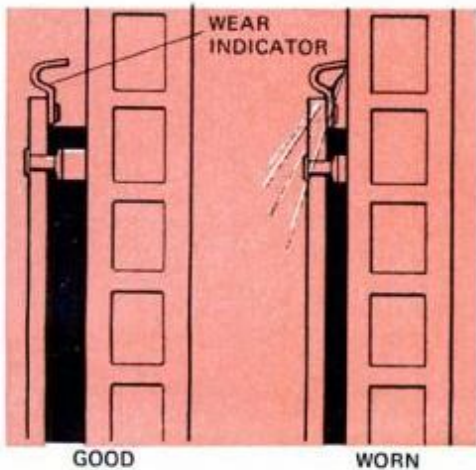
Consider the squeal on the '76 Capri. Early in 1976 Ford distributed new pads using a new material to help lessen squeal. They can be used on all 1971-76 Capris. You can order them using Ford parts No. D6RY-2001-B or D6RY-2001-A. Pads bearing the latter number are abrasive-coated to refinish rotor surfaces with minor irregularities.

Modified pads also have lessened disc brake squeal involving 1976-77 Dodge Aspens and Plymouth Volares and 1973-76 Darts and Valiants. The new squeal-less pad is part No. 4094101.

Volkswagen suggests that if squealing is excessive you have all drums cut and new Mintex brake linings installed. Linings are available at VW dealers.

QUICK FIX: If you find that there is no manufacturer's modification to solve your

[\(Please turn to page 186\)](#)



Built-in wear indicator gives audible warning when pads are worn.

'It's my 1976 Capri. The brakes make one devil of a squeal when I apply them. Please help.'

This noise and the kind made by built-in wear indicators are quite different. The noise described here occurs only when brakes are applied. The noise made by a wear indicator occurs intermittently when wheels are rolling and *disappears* when brakes are applied.

Every car with disc brakes is susceptible to brake squeal, which may occur at different times and under different conditions. Sometimes squeal appears only after the car has been parked for several hours or overnight. At other times, squeal

BALANCE & STABILIZE WHEELS PERMANENTLY



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**AUTOMATIC
WHEEL BALANCER
ADJUSTS FOR TIRE WEAR
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CAR CARE GUIDE 10

squealing brake problem, get brake-pad (lining) lubricant and spray some as directed on braking parts. This will provide relief, but it is only temporary in most cases.

A WRENCH ON LINE SAVES NINE

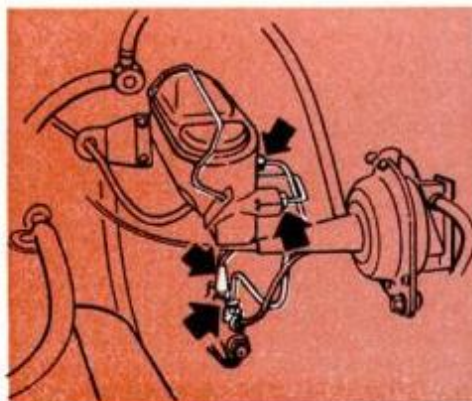
Here is a letter from one smart *Car Clinic* reader that emphasizes the wisdom of heeding warnings:

'When the brake pedal on my nine-passenger Ambassador station wagon felt as if it were fading beneath my foot, I smelled trouble. I found it in the form of a brake-line fitting that was letting brake fluid escape. The problem has been repaired.'

QUICK FIX: Tighten brake-line fittings at wheels, master cylinder and proportioning valve. Be aware that some models



Hydraulic-brake-fluid leak may be fixed by tightening brake line.



Master cylinder and proportioning valve with arrows where leaks may occur.

also use a T-device called a metering valve to split a main brake line into branches in addition to a proportioning valve. Fittings should be tightened here

as well. Fill the master cylinder with approved brake fluid. If the leak continues, replace the brake line.

Caution: If the brake pedal suddenly goes all the way to the floor as you are driving, the pedal linkage has become disconnected or the master cylinder has an internal leak. If you shift manually, move into second gear; if automatic, move selector level to S or L. Apply parking brake.

OTHER WARNING SIGNS

Other signs of a malfunctioning braking system emitted by your brake pedal:

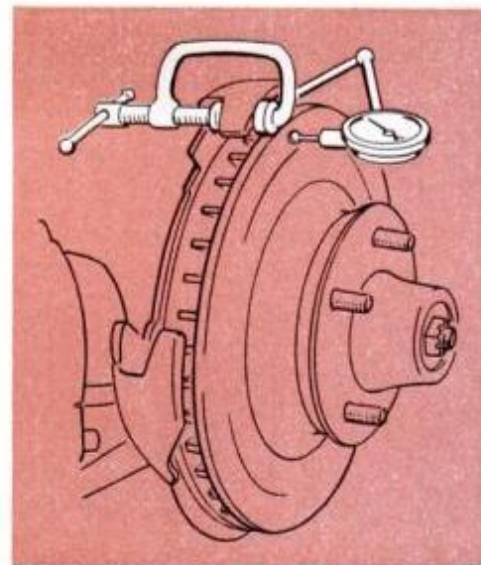
■ **Excessive pedal travel** is needed to stop the car or the pedal feels spongy. Check for leaks, add brake fluid and bleed the system. This could also indicate worn-out brake linings or brakes that need adjusting. All brake systems have self-adjusting mechanisms activated by moving the car forward and in reverse several times (check owners manual).

Important: It is advisable to inspect linings every 12,000 miles.

Another cause of excessive brake pedal travel is a brake hose swelling under hydraulic pressure. It should be replaced.

■ **A firm pedal** that gives little braking power (hard pedal), suggesting that pressure is not being transmitted to brakes. Look for an obstructed or kinked brake line, malfunctioning power booster unit (or low engine vacuum), pedal linkage that is binding, or brake linings that have developed surface glaze and are no longer gripping.

■ **A brake pedal that pulsates.** The major reason for a pulsating pedal, caused when linings fail to contact rotors or



Micrometer may be necessary to check disc for a lateral runout problem.

drums fully, is an uneven rotor or drum. Test rotors or drums for lateral runout. If the offending part can be cut on a lathe and evened without exceeding safe thickness standards, do so. If not, replace it.



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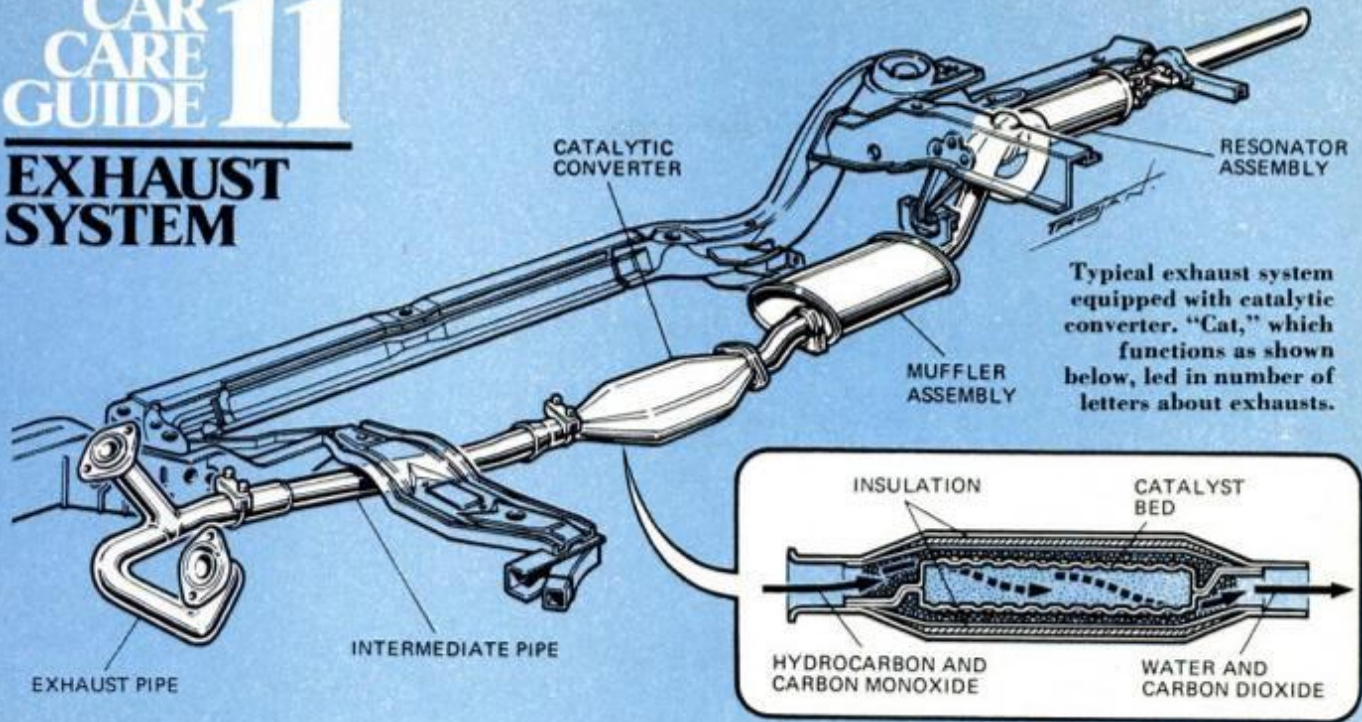
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PM-5/8

CAR CARE GUIDE 11

EXHAUST SYSTEM



Typical exhaust system equipped with catalytic converter. "Cat," which functions as shown below, led in number of letters about exhausts.

How do I know when my catalytic converter is shot?

Two questions stand out among those sent us about the exhaust system (2.6 percent of our readers):

1. Can I get rid of the catalytic converter?
2. What can I do about that embarrassing rotten-egg odor coming out of the exhaust?

Let's make short work of that first question once and for all. It is *your* car, and there is no law governing what you can or can't do to it. If you want to rip out the catalytic converters, go ahead. Unlike professional mechanics, you won't be subject to penalty.

(For those not familiar with it, the catalytic converter is a part of the exhaust system containing noble metals, such as platinum or palladium, which convert hydrocarbon and carbon monoxide emissions to unpolluting water vapor and carbon dioxide before expulsion into the atmosphere. Catalytic converters have been in wide use since 1975.)

However, *PM* is in favor of emissions control, and we therefore believe in catalytic converters until some better method of controlling pollution is developed.

Assuming you know how to disconnect a catalytic converters (or some other emissions control device), there is one caution you should be aware of before you proceed. Although the law can't dictate what you can do to your car, it can

dictate the amount of pollutants the engine may emit. Many states now have an emissions test as part of their inspection program, and more states are adopting one. What would you do if you disconnected a catalytic converter and your failed inspection—buy and install a new one for \$300?

EGGS FOR BREAKFAST

One condition catalytic converters have created is odor. Let's put it in perspective.

The exhaust odor given off by a car with a catalytic converter is different from the one given off by cars without catalytic converters. However, this odor is normal as long as it doesn't become exceedingly strong. In the strong stage, the odor resembles the stench of rotten eggs (it is hydrogen sulfide).

An objectional odor usually means the engine is running too rich at some operating mode—probably at idle and on deceleration. There are corrections.

When is odor objectionable and when isn't it? There's a quick test you can make to find out, but you need an infrared exhaust-gas analyzer. If you live in a state where emissions testing is part of inspection, you may be able to make free use of state equipment by taking the car to the inspection station.

To conduct the test, the car should be warmed to normal operating temperature and allowed to idle after being run at about 2500 rpm for 30 seconds in neutral. Insert the exhaust gas sample probe at least 6 inches into the tailpipe.

The carbon monoxide reading shown by the analyzer meter should be near zero and should not exceed the manufacturer's CO maximum standard. This standard is generally 0.3 percent. If the reading is greater, adjustments or repairs are needed to lessen emissions and make odor less objectionable.

QUICK FIX: How long has it been since you replaced the carburetor air filter? It is a primary cause of this problem, because it induces fuel-mixture richness, as well as increasingly worse fuel economy.

In practically all other cases where odor is not the result of a worn-out catalyst, adjusting the idle mixture to the specification in the service manual or on the vehicle's underhood emission label will neutralize the rotten eggs.

IMPORTANT POINTS ABOUT CC

Here are three important facts to keep in mind when you think about your catalytic converter:

1. The only maintenance it requires other than the continual use of unleaded fuel. An overdose of leaded gas will kill it.
2. When inspecting the exhaust system, make sure that hangers are tight so the minimum distance between the catalytic converter and the underside of the vehicle recommended by the manufacturer is maintained. If the converter is damaged, because it is banged to death, it will have to be replaced.
3. Most of the catalytic converters have

(Please turn to page 190)

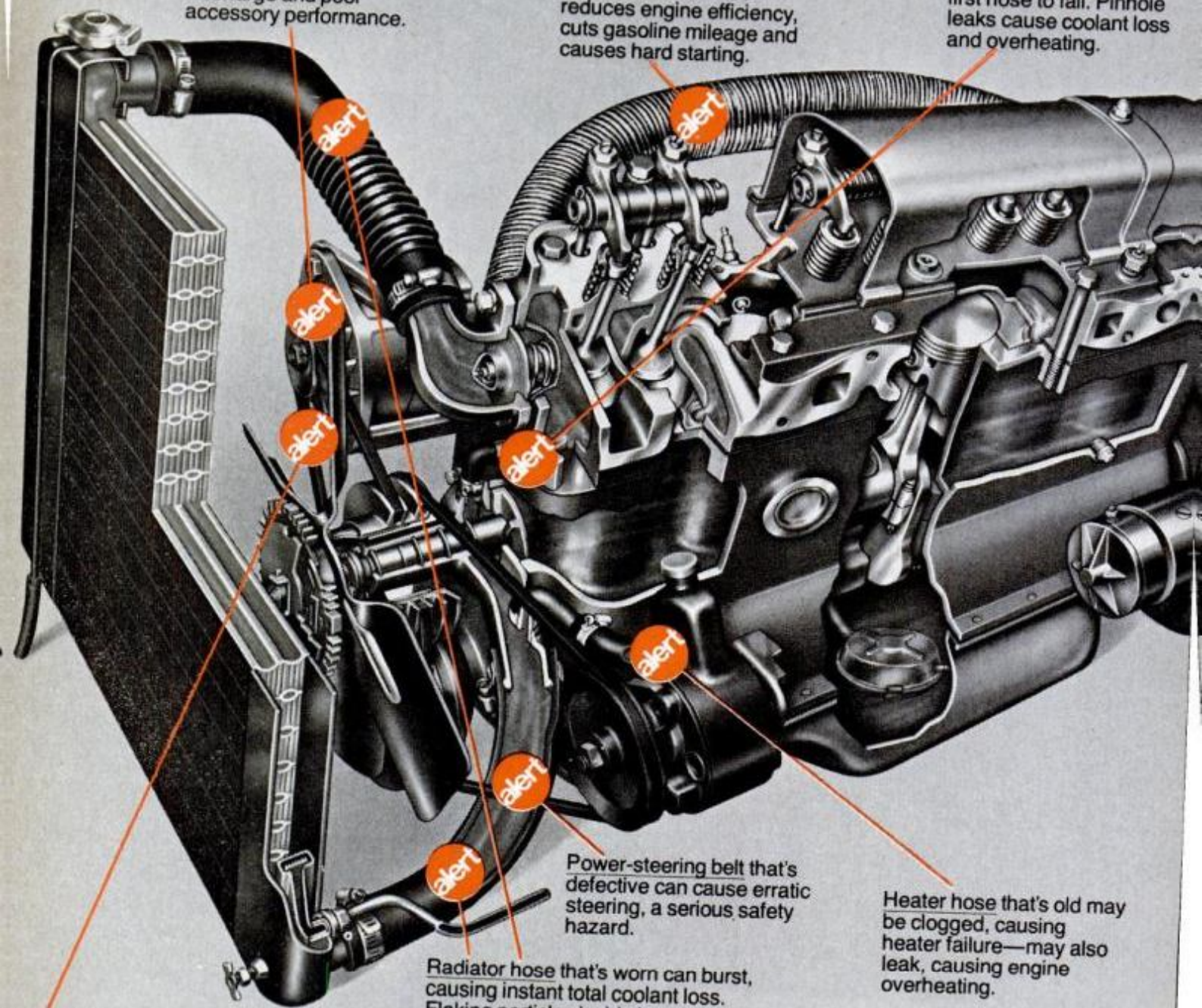
Be ALERT to these danger signs.

Avoid costly engine damage. Check and replace worn belts and hose and carry a spare for emergencies.

Alternator belt that's worn or loose can cause battery discharge and poor accessory performance.

Emission control duct hose that's torn or crushed reduces engine efficiency, cuts gasoline mileage and causes hard starting.

Bypass hose is usually the first hose to fail. Pinhole leaks cause coolant loss and overheating.



Fanbelt failures cause overheating, loss of coolant and costly engine damage.

Radiator hose that's worn can burst, causing instant total coolant loss. Flaking particles inside hose can clog cooling system. Hose becomes hard and brittle from age and heat and does not absorb engine vibration—causing hose to break, or radiator connections to fracture.

Power-steering belt that's defective can cause erratic steering, a serious safety hazard.

Heater hose that's old may be clogged, causing heater failure—may also leak, causing engine overheating.

Double check every belt and hose at least twice a year. If any resemble those shown here, replace them immediately with ALERT high performance belts and hoses—available at mass merchandisers, discount, chain and some drug and home center stores. Installation instructions on package.

Replace these belts.

Turn belts over and check for:



Cracks



Oil-soaked underside



Glazed surface



Worn cover



Separated belt layers

Replace these hoses

Tighten clamps and check for:



Oil softened exterior



Cracks



Hardened exterior



Flaking from interior tube



Torn or crushed cover on duct hose

Send today for Alert Quik-Test Belt Tension Gauge, a \$12.95 value, for only \$7.



Correct tension is vital to maximum belt life and performance. Alert Quik-Test Belt Tension Gauge makes accurate tensioning quick and easy. Quik-Test is made from heavy cast aluminum with stainless steel and nylon components. Satisfaction guaranteed. Operating instructions included. Allow four weeks for delivery.

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If more than one auto, send above information for each. No. C.O.D. orders, please. This offer ends November 1, 1977.

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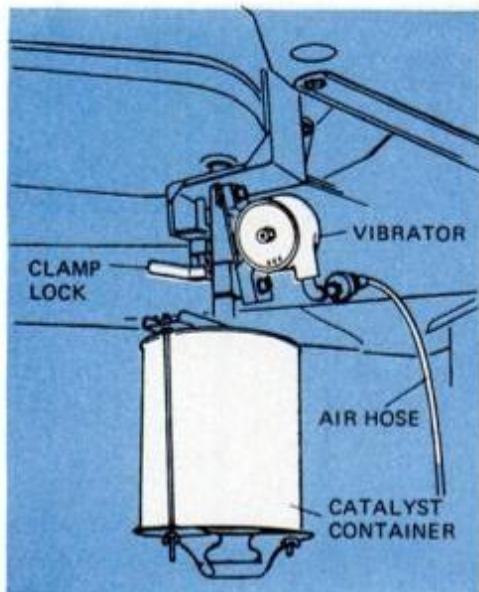


Catalytic converters get hotter than mufflers: position to spec.

to be replaced *in toto* when the catalyst loses effectiveness (usually about 50,000 miles). With some types, however, such as the converter used by GM, special tools are employed to remove worn-out catalyst pellets and the converter is re-filled.

CHECKING FOR RESTRICTED EXHAUST

A restricted exhaust will result in loss of power and popping back through the carburetor, as we mentioned earlier in *Car Care Guide*. If the fuel and ignition systems have been checked (see Sections 1 and 6), visually inspect the exhaust for blockage. If nothing is seen, at-



Emptying a catalytic converter for refilling requires professional equipment.

tach a vacuum gauge and tachometer. At idle, the vacuum gauge should read 16 to 21 inches.

Increase the engine speed rapidly to 2000 rpm. The vacuum will drop momentarily, but it should quickly return to normal. If the reading should settle below

16 inches, there is an exhaust-system restriction.

Disconnect the front pipe at the exhaust manifold and do the test over again. If vacuum stays below 16 inches, the restriction is in the exhaust manifold.

QUICK FIX: Free the manifold heat-control valve if it is stuck by tapping with a hammer and lubricating the shaft. If the vacuum does not respond by returning to normal when you repeat the test, the re-



Manifold heat-control valve is lubricated at valve shaft points shown here.

striction is inside the exhaust manifold, which should be removed from the car and inspected.

An exhaust manifold restriction, if it prevails, will show up immediately in a

Aircommand 40-channel CB..



From the people who bring you Marantz—the world's finest stereo systems—comes the Aircommand CB-640—the finest in 40-channel CB. With Aircommand you get over 25 years experience in outstanding 2-way communications products.

Full 6 Watts of audio power. Provides plenty of punch so your speaker cuts through freeway noise.

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4 big Watts of RF power. Aircommand delivers the maximum power legally allowable to let you belt out the big sound.

100% modulation capability. Even when you talk softly into the mike, your message cuts through loud and clear, thanks to one of the most advanced mike preamp and compressor designs in CB today. With Aircommand, you don't have to spend an extra \$30 to \$40 on a "power mike." You can't buy better modulation than Aircommand.

Specially tailored frequency response.

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8-LED (light emitting diode) meter display. Provides an easy-to-read display of SWR (standing wave ratio), modulation, and incoming or outgoing signal strength—instantly, accurately.

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Public address capability. The versatile Aircommand CB-640 public address package lets you (1.) Talk into the CB mike and out an exterior public address speaker. (2.) Attach a tape recorder to the auxiliary jack on the

car's early stages of life. This restriction is the direct result of a production phenomenon that's called casting flashing, which is an accidental extension of the casting.

You should *not* check for casting flashing by sight or by extending a length of wire into ports of the manifold. The port may appear free, but the restriction could be partial, a condition that would cause excessive back pressure at high rpm.

Get a length of chain that is about the same diameter as the manifold ports. Drop it into each port. If it is blocked from going into one port, you have found the restriction.

If the casting flashing is at the outer end of the port, it can usually be chipped out. If the flashing can't be removed, however, the exhaust manifold should be replaced.

Important: Don't forget that a V8 engine has two exhaust manifolds. Inspect both of them.

If the engine vacuum settles at 16 to 21 inches with the front pipe disconnected, the restriction is somewhere in the exhaust pipes, muffler or catalytic converter.

If your car is equipped with a catalytic converters, at this point you should make sure that the converter isn't restricted. Reconnect the front pipe at the

exhaust manifold and remove the muffler. Then conduct the vacuum test.

If the vacuum drop below 16 inches, the catalytic converter is blocked and should be replaced. If the vacuum is normal, the restriction may be in the tailpipe, which can be tested with a probe when the muffler is removed. The restriction could also be in the exhaust pipe or muffler.

Regarding the muffler, a baffle may have loosened, causing the blockage. You may be able to hear it by tapping or shaking the component.

QUICK TROUBLESHOOTING GUIDE TO OTHER PROBLEMS

- Check for exhaust-system leaks and repairs before CO knocks you for a loop. With the car raised and the engine running, you will be able to see a leaking area "puffing."

- Check that all brackets, hangers and clamps are in one piece and are securely tightened before major components knock themselves silly. However, do not tighten excessively or the exhaust pipes will be crushed.

- See that the exhaust pipe is securely tightened to the exhaust manifold. White deposits around the joint signify an exhaust leak at the joint, indicating the probable need for a new gasket. The two

parts will have to be separated to replace the gasket.

- If the muffler and pipes do not ring when tapped with a wrench, they are about to fail. You may want to replace them now. Do not tap a catalytic converter. You could damage it.

SAFETY CHECKLIST

To protect your passengers and yourself against the danger of breathing toxic exhaust, investigate the above conditions and also follow these precautions:

- Never run the engine in a closed garage or confined area longer than necessary to move your car in or out.

- If you must sit in a parked car with the engine running for more than a short period, adjust your heating or airconditioning system to force outside air into the car. Set the blower fan on high speed and the heater or airconditioner controls in any position except "off" or "maximum cool."

- Never drive with the trunk lid open if you can avoid it as this draws exhaust fumes into the car. If you can't avoid it, set the heater or airconditioner in a position described above.

- Station wagons deserve additional attention. That tailgate window should be closed when the car is moving or run at engine idle for an extended period.

..You never heard it so good!!!

CB-640 rear panel, and boom your tape out through the same external speaker. (3.) Mix your voice from the CB microphone with the program material on the tape recorder. Both voice and tape sound at the same time through the external speaker. (4.) Beam your **received signal** through the external speaker.

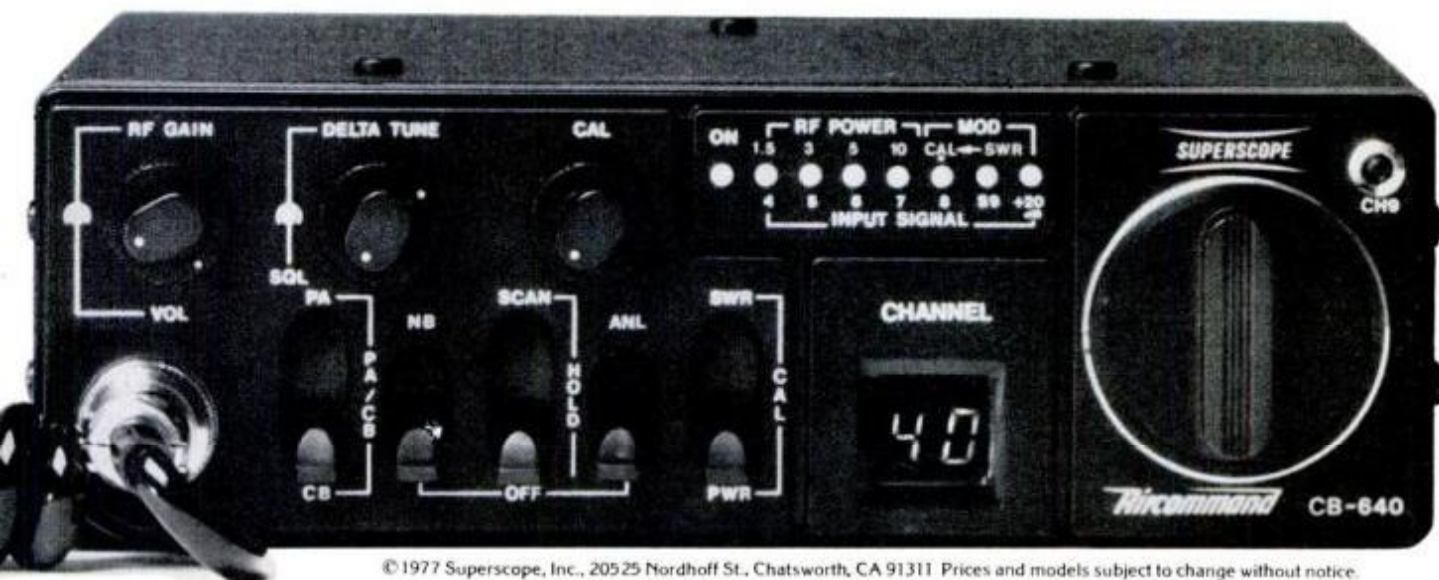
Built-in standing wave ratio circuitry. Measures the efficiency of the antenna system for optimum performance.

Other outstanding features include: Delta fine tuning control, digital synthesizer with phase-locked loop,

automatic noise limiting switch, noise blanking switch, squelch control, RF gain control.

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Aircommand by **SUPERSCOPE.**



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CAR CARE GUIDE 12

TIRES

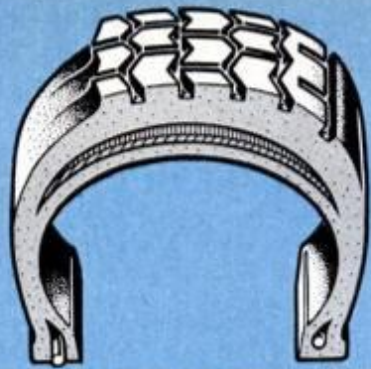
Tires will wear evenly on a properly maintained car, but will wear unevenly if not properly inflated or if front-end trouble exists.



UNDERINFLATION



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CUPPING—UNDERINFLATION AND/OR MECHANICAL IRREGULARITIES



OVERINFLATION



FEATHERING DUE TO MISALIGNMENT OR SEVERE CORNERING

Why are my tires wearing unevenly?

A smidgen of our readers—2.4 percent—expressed interest in tires. The most often asked question was about radials and the tendency of tires to sometimes cause shimmy.

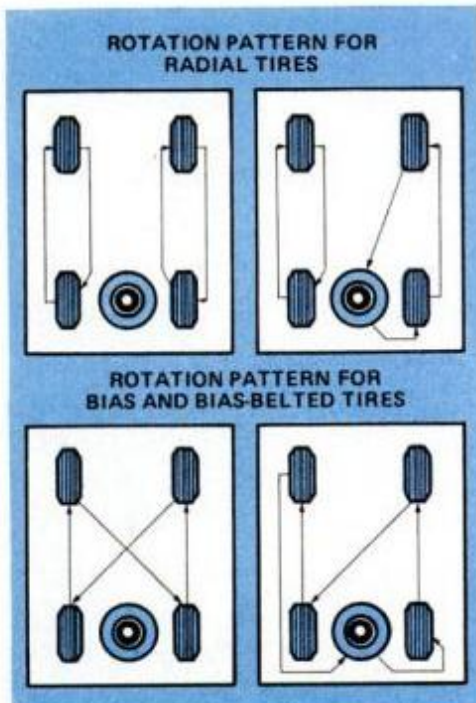
‘Shimmy in the steering wheel at 50 to 60 mph—that’s what I’m getting with my Pontiac ever since I rotated the tires. Can it (shimmy, that is) be eliminated?’

What method of rotation did you follow? The procedures for switching radials and bias-type tires are different.

Unequal inflation pressure between radial tires will also hamper vehicle stability. Keep your pressure gauge handy always. You may actually extend the useful life of radials beyond 40,000 miles, and the useful life of bias-type tires many thousands of miles, by checking pressure every day and making certain it is to the recommended level.

Radial tires will exhibit oscillations resulting in shimmy between 50 and 60 mph if tire-wheel assembly balance is the least bit off. The assemblies should be tested, but keep in mind that balancing radials with static-type balancing equipment will probably not improve or eliminate the condition.

In a radial situation, tire-wheel assemblies should be balanced dynamically.

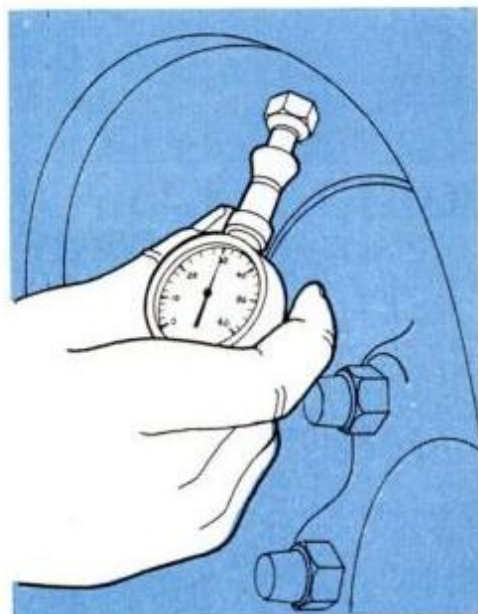


For longer tread life, rotate your tires following these rotation patterns.

The dynamic balancer may be off-the-car or on-the-car equipment. Both types are effective.

Before we explain the difference between static and dynamic balance, this important point must be made:

Many car owners believe that any equipment which tests balance on the



Accurate tire-pressure gauge should be used to check for proper inflation.

car is dynamic equipment. This is not the case. Static equipment consists of both the familiar off-the-car bubble balancer and on-the-car equipment that spins the assembly, but with insufficient force to cause oscillation if it is present.

STATIC DYNAMIC FORCES

When a wheel-tire assembly is statically out-of-balance, it means that a heavy

CAR CARE GUIDE

spot exists at a single point on the assembly. As the assembly rotates, the heavy spot is forced against the pavement with each revolution. This will create a significant vertical vibration—a bouncing effect.

If a tire and wheel assembly that is out-of-balance statically were balanced in midair on a shaft, the assembly would always revolve and come to rest with the unbalanced portion on the bottom, in dead center.

If you have a problem deciding whether the condition you feel as you drive is being caused by static or dynamic imbalance, remember that static imbalance creates a vibration at slow speeds. Dynamic imbalance shows up at 50 to 60 mph.

Dynamic imbalance refers to a wheel-tire assembly that has masses which are throwing equalization out of kilter at more than a single point. This creates an oscillating effect—a side-to-side movement. Not only will shimmy result, but if the situation is allowed to continue, the tire may develop flat spots. As the offending assembly oscillates, the tire is scuffed against the pavement.

Let's sum it up with two key points:

1. If you are getting a pronounced vibration in a car that's equipped with radial tires and inflation pressure is correct and equal, have the tire-wheel assemblies balanced with dynamic balancing equipment.

2. If the condition persists after balancing, switch tires front to rear.

Mugwumping down the road

Another adverse radial-tire condition reared its head in '76, explained here by C.R. of Baltimore, Md.:

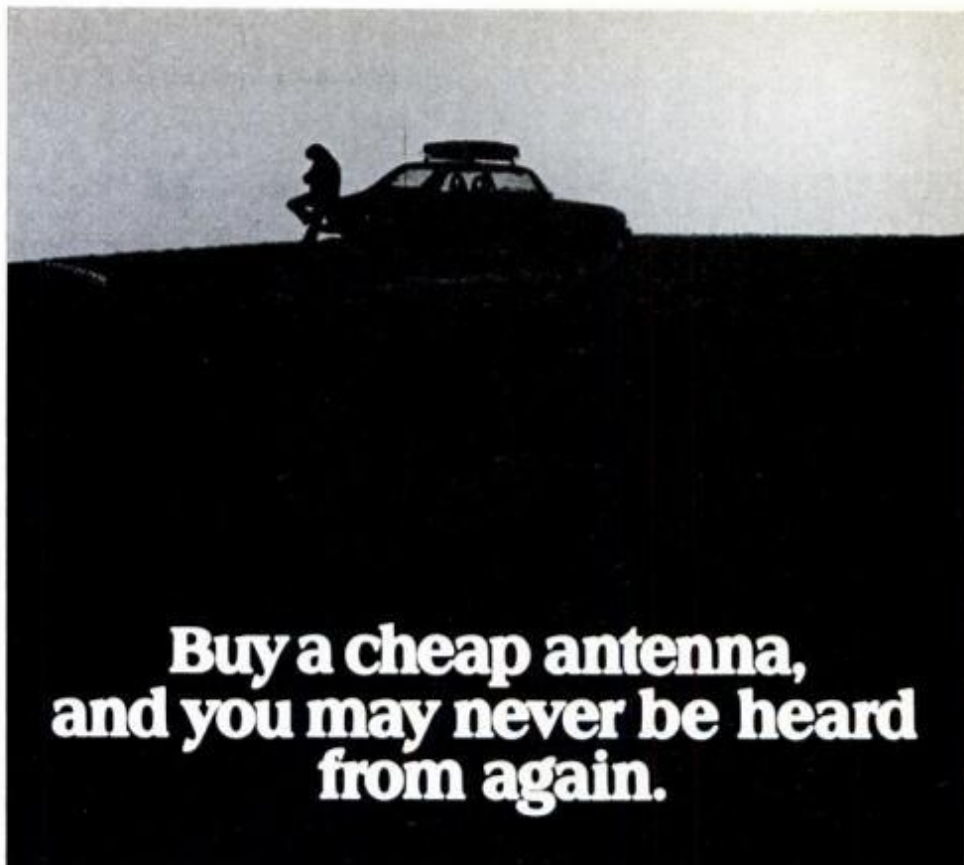
'My 1976 Cordoba shows instability toward one side of the road. The car doesn't lead straight and has to be oversteered. What can I do?'

The rigid belts in radials when coupled with natural road crown and crosswinds are the factor. Once correct tire pressure is confirmed and it has been established that the power steering gear valve is centered properly and isn't the cause, there is a definite procedure to follow that should eliminate or at least reduce substantially an overleading condition. Here it is:

Cross-switch the front tire and the wheel assemblies only. The car will now lead either in the opposite direction or in the same direction when it's road-tested. If the car should lead in the opposite direction, switch the tires as follows: LF to LR, LR to LF, RF to RR, RR to RF. Now:

1. If the car still leads, cross-switch

(Please turn to page 196)



Buy a cheap antenna, and you may never be heard from again.

When you're miles from help, you need a CB antenna that reaches for miles and miles. It could be your only link to safety. So saving a couple of dollars on a cut-rate brand could cost you.

But the price of an A/S antenna is worth the extra you might pay — just for the peace of mind. Every single A/S antenna is hand-tuned and tested for 23- and 40-channels. That's the kind of care and quality control that makes A/S the choice of

police departments, truckers and safety people everywhere. And that's why A/S has been the leader in antennas for 24 years.

So look for the red and black A/S stripes. You'll be heard when you have to be heard. We'll bet our A/S on it.



M-510 "Big Momma" Heavy Duty Antenna



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THE POPULAR MECHANICS CAR CARE GUIDE gives you information at a glance . . . why not put it in your glove compartment, where it will be ready whenever you need it?

Some people may think it's crazy to spend 3 or 4 times the regular price for a Mobil 1 oil change.

But maybe it's crazy not to.

In what you are about to read, every comparison made is between Mobil 1 and high-quality conventional motor oil typical of the oil that is used in most of the cars in this country.

We'd like to show you just what's in Mobil 1 that makes it worth every penny you spend for it. Why Mobil 1 is a super-slippery lubricant. Why it cuts engine wear. Why it does a better job of keeping your engine clean. Why it helps you start your car in bitter-cold weather. Why it doesn't thicken as much in summer heat inside a hardworking engine. Why there can be less oil consumption with Mobil 1.

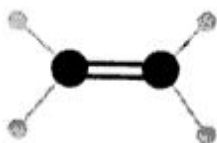
It's all due to the molecules that make up Mobil 1. Mobil 1 is a *synthetic* motor oil.

A short lesson in chemistry so you know what you're getting when you buy Mobil 1.

Take a look at one of the typical molecules in Mobil 1. It's a long chain of carbon atoms with one or two smaller chains hooked on near the middle. Right there you see the secret of Mobil 1's slipperiness: the long, snaky chains slither and slide across each other. That's the reason Mobil 1 lubricates so well.

How do we make molecules like

this? We start with short, two-carbon molecules called ethylene and keep knitting them together chemically step by step.



The ethylene molecule. We start with this.

Mobil 1 with regular lubricating oils. These are made up of thousands of different molecules that nature put into petroleum. They're of all lengths, all shapes. There are small and large ones. Rings and chains. Multiple rings and multiple chains. Rings with attached chains.

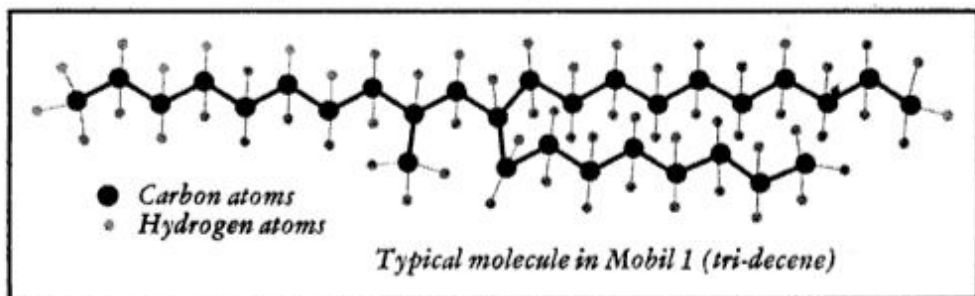
With a mixture like this, there are problems. Each kind of molecule reacts in its own way to the changing conditions in the engine. When the

temperature gets low, the large ones tend to become thick fluids or solids. When the temperature gets high, the lighter ones tend to boil off, and chemical changes can take place in the oil. Some molecules oxidize (burn) and turn into varnish-like products that can stick to engine parts.

Mobil 1 molecules are tailored to just the right length, just the right shape, so that they'll stay liquid under a wider range of conditions.

In cold weather, Mobil 1 remains fluid. In fact, your antifreeze will freeze before Mobil 1 will.

At high temperatures, Mobil 1 molecules are slow to vaporize, because they're neither too small nor too light, unlike regular oils whose lighter molecules boil off.



Finally, to give Mobil 1 a complete balance of lubricating properties, we've added other substances. For instance, chemicals called esters, which are very good lubricants. We've also included a set of special additives that help control oxidation, rust and deposits and minimize wear.

Mobil 1 is so different, so advanced, that it invites questions. Here are some common ones people ask:

Questions and Answers on Mobil 1

What's the best thing Mobil 1 will do for my car?

Since it does a better job of lubricating the engine—reducing wear of its operating surfaces and keeping them clean—it helps maintain the engine in top shape and prolong its life.

We've studied many, many engines run on Mobil 1, examined their parts and seen the proof of this. Mobil 1 will take abuse that will break down regular oils. It has tremendous reserve lubricating power, beyond the life of regular oils. It's a highly dispersant oil, so stuff that can make piston rings stick and change the clearances of moving parts stays suspended in the oil where it can't harm the engine.

Can Mobil 1 actually save gas?

Yes. Mobil 1 lubricates better. Its molecules cling to metal ("adsorb"—as scientists say) and where metal squeezes against metal, it resists being forced out. So friction is reduced inside your engine. Mobil 1 is also "thinner"—has lower viscosity. Your engine doesn't labor against the drag of thick lubricants. For these reasons, more of the power in your gasoline is delivered to the wheels instead of being wasted on turning over your engine. And that means you get more mileage from your gas

—up to ten miles more per tankful. You save money on gas by using Mobil 1.

Can Mobil 1 actually help me start my car better in cold weather?

Yes. Regular oils tend to thicken more in the cold. They generally contain waxes (long, straight-chain molecules), and in sub-zero weather these can turn solid in your engine. Imagine what a strain this puts on your battery and starter! Mobil 1 will circulate freely and lubricate your engine in very cold weather. It can help a well-maintained engine get started at 35 degrees below zero.

How low can it go? It will stay liquid at 65 degrees below zero—that's 97 degrees below the freezing point of water. Most regular oils jell at about minus 35.

Is Mobil 1 proven?

Yes. We've run it under extreme conditions in our test facilities. We've tested it in fleets of cars. In one test, Mobil 1 was run in a police car for 5,000 miles, then the used oil was run in a taxi for another 5,000 miles, then *that* used oil was run in a Cadillac for 5,000 more miles, topping it off only as needed. We found that after 15,000 miles, the used Mobil 1 could still do as good a job of protecting the engine as a brand new regular oil! Our testing goes on. We still haven't determined the practical limits of Mobil 1 before it needs changing.

Can I go longer between oil changes with Mobil 1?

That's a tough one to answer, because it involves more than just the oil. For instance, if your car is under warranty, you *should* change your oil according to your car manufacturer's instructions. That's generally at a lot fewer miles than Mobil 1 is good for. In this case, using Mobil 1

might be considered wasteful. But on the other hand, if you love your car...

After your warranty expires? Well, we're quite confident that Mobil 1 will protect your engine for 15,000 miles and more.

Is Mobil 1 compatible with regular oil left in my engine?

Yes. Completely.

Can I use Mobil 1 in an old car?

Yes, if the engine doesn't leak or burn oil. If it does, Mobil 1 will be used faster than a regular oil because it's thinner. Mobil 1 will do for an old engine what it will do for a new one, but what's worn will stay worn.

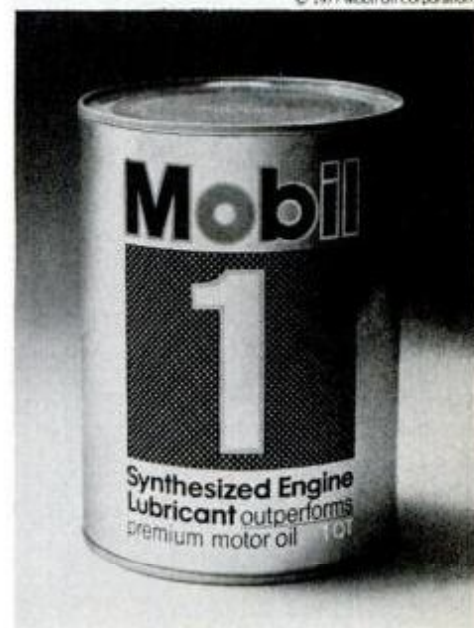
Is Mobil 1 really worth the extra cost?

Yes. You can get more mileage for your gas money. And it should be worth it to you to maintain your engine in top shape during the life of the car. You get faster sub-zero starting. You put less strain on your battery. You get excellent hot weather performance. And you can stretch the number of miles between oil changes.

We think that in the long run you won't just break even with Mobil 1.

You'll be miles ahead.

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"King of the Kustomizers" **George Barris**
says: AUI has the most complete and up-to-date customizing program I've ever seen!

George Barris, builder/designer of the world-famous BATMOBILE (pictured here) and other fabulous movie/TV cars
• Customizer to the stars/Eton, John, Sonny & Cher, Elvis, Sinatra, many more • 10-time Grand National Award Winner/Author of more books on auto customizing than any man alive!

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YOU'RE NEEDED NOW IN THIS EXCITING, HIGH-PAYING FIELD!

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NO NEED TO QUIT YOUR PRESENT JOB—earn while you learn at home in spare time. (Many report first earnings soon after starting with A.U.I.) if you can handle a screw-driver and a pair of shears, you can make it big in auto trim—and related fields like Vinyl Repair, Auto Glass and Landau Tops.

UPHOLSTER ANY VEHICLE . . . Auto, Van, Camper, boat or plane—start with your own car! It's a business so big, so fantastic that, usually, you need an appointment to take in a vehicle for reupholstering or customizing.

VAN CUSTOMIZING IS HOT! NOW is the time to cash in on this huge, growing market . . . where \$1,200 for a week's work is not unusual! Hard to believe? Not if you've priced a "Sultan's Den" lately—like the one shown. Jobs like this usually BEGIN at \$800—go all the way to \$3,000 or more.

LEARN HOW TO START, MANAGE AND DEVELOP YOUR OWN BUSINESS! A.U.I.'s proven step-by-step method is time-tested . . . includes the tools of the trade. And, right from the start you get fabrics, kits and supplies wholesale. So get the facts TODAY. No obligation—no salesman will call.

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Approved for Vets & Non-Vets

CAR CARE GUIDE 12

front tire only. Road-test it once more.

2. If the car still leads, replace the right front tire with the spare. Test again.

3. If the car still leads, the left front tire is to blame. Replace it.

If the car leads in the same direction, the probable cause of your trouble is front-end misalignment.

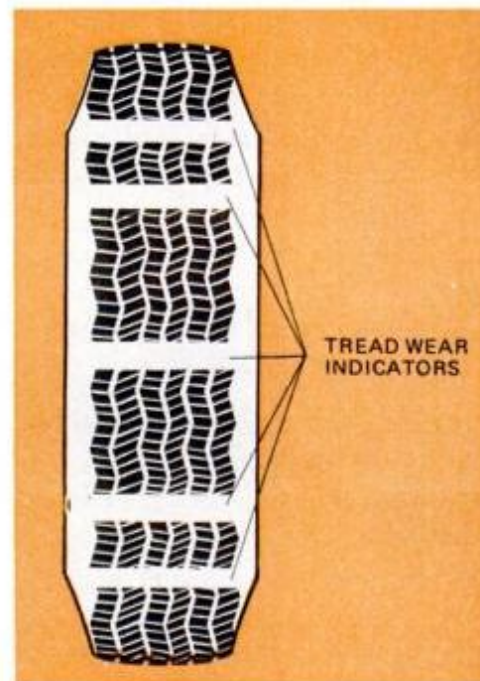
If the car still leads after adjusting the alignment to specification, increase the caster in the direction of lead $\frac{1}{2}^\circ$ at a time until the pull is eliminated. In other words, if the lead is to the left, increase the left caster—leave the right alone. If the lead is to the right, try increasing the right caster and leave the left one alone.

Two more facts about radials should be mentioned:

■ Never try to eliminate the bulge where the tire contacts the road. It's natural and inflating a radial until the bulge is eliminated will ruin the tire. Inflate to specification only.

■ Radial tires can be repaired if they are punctured. However, the puncture must not be more than $\frac{1}{4}$ inch in diameter, which gives you a lot of latitude, and it

often indicate that the driver is engaging in a lot of screeching stops and starts, is trying to negotiate corners and curves on



Tread-wear indicators built into new tires tell you when to replace a tire.

two wheels, and/or is hauling excessively heavy loads. Well, it's his money he's wasting—a set of new skins doesn't come cheap.

Give tramp the bum's rush

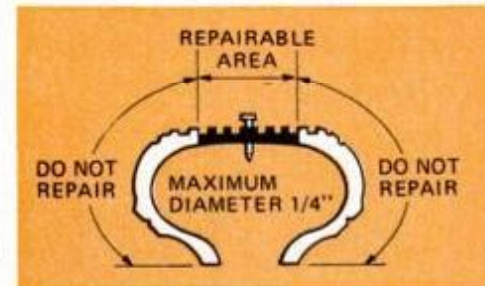
The only other significant tire problem that we haven't touched on, but one that shows up from time to time, is an out-of-round tire that creates a tramp or thump at 20 to 30 mph. There is a precise procedure you can follow to find the offending tire:

■ Inflate all tires to 50 pounds pressure and take the car for a test drive. If tramp has vanished, it confirms the presence of an eccentric tire.

■ Now reduce one of the tires to its normal pressure and test drive again. Tramp? If not, then this tire is not the guilty one.

■ Continue in this manner, reducing pressure in one tire at a time and test driving, until the reappearance of tramp uncovers the bad tire.

■ Return the tire to whomever you bought it from to receive an allowance on a new one.



Sidewall damage to radials shouldn't be repaired, nor punctures over $\frac{1}{4}$ in.

has to be confined to the major tread area, between the outer grooves. If the puncture doesn't meet these conditions, the tire should be replaced.

Tire wear tells story

Of the 2.4 percent of the people who wrote to *Car Clinic* with tire problems in '76, 1.1 percent of them asked about tire-wear patterns. As you can see by the illustrations on this page, abnormal tire wear can usually be traced to one of three things:

1. **Underinflation** (sometimes it can be overinflation). Having a tire ruined because of this situation is criminal. It only takes a minute a day or a week (or even a month, if the driver is that lazy) to prevent damage.

2. **Front-end problems.** Tires worn on one side usually indicate excessive camber to that side. If tread edges are feathered, adjust toe-in. Cupped spots are generally the result of tire-wheel assembly imbalance.

3. **Bad driving.** Tires that are cracked across the tread or that wear out rather quickly although inflation is maintained

If your car's appetite is getting bigger, try fresh Champion Spark Plugs.

Can spark plugs alone help mileage?

Most definitely. Of all the tune-up parts in your engine, spark plugs are the only ones that actually touch the gasoline and make it burn. If they do a good job, you'll get the best mileage your car and your driving can deliver. If they don't, your mileage will suffer. It's that simple.

What about a whole tune-up?

Many late model cars can go, say, 20,000 miles or more before they need a whole tune-up. But spark plugs start to lose their edge after 10,000 to 12,000 miles. So if you wait for a tune-up to change plugs, they could be costing you precious gasoline mileage. And give you starting trouble, too!

Why fill 'er up with Champions?

Champion makes a plug that's exactly right for your car.

How about another reason?

Champions have powered more race winners over the past years than any other plug made.

And a third?

Champion is the No. 1 selling spark plug in the world.

So if you get the feeling that your car is using more gas than it should, you could be very right.

Fill 'er up with Champions.

You'll probably come out miles ahead.



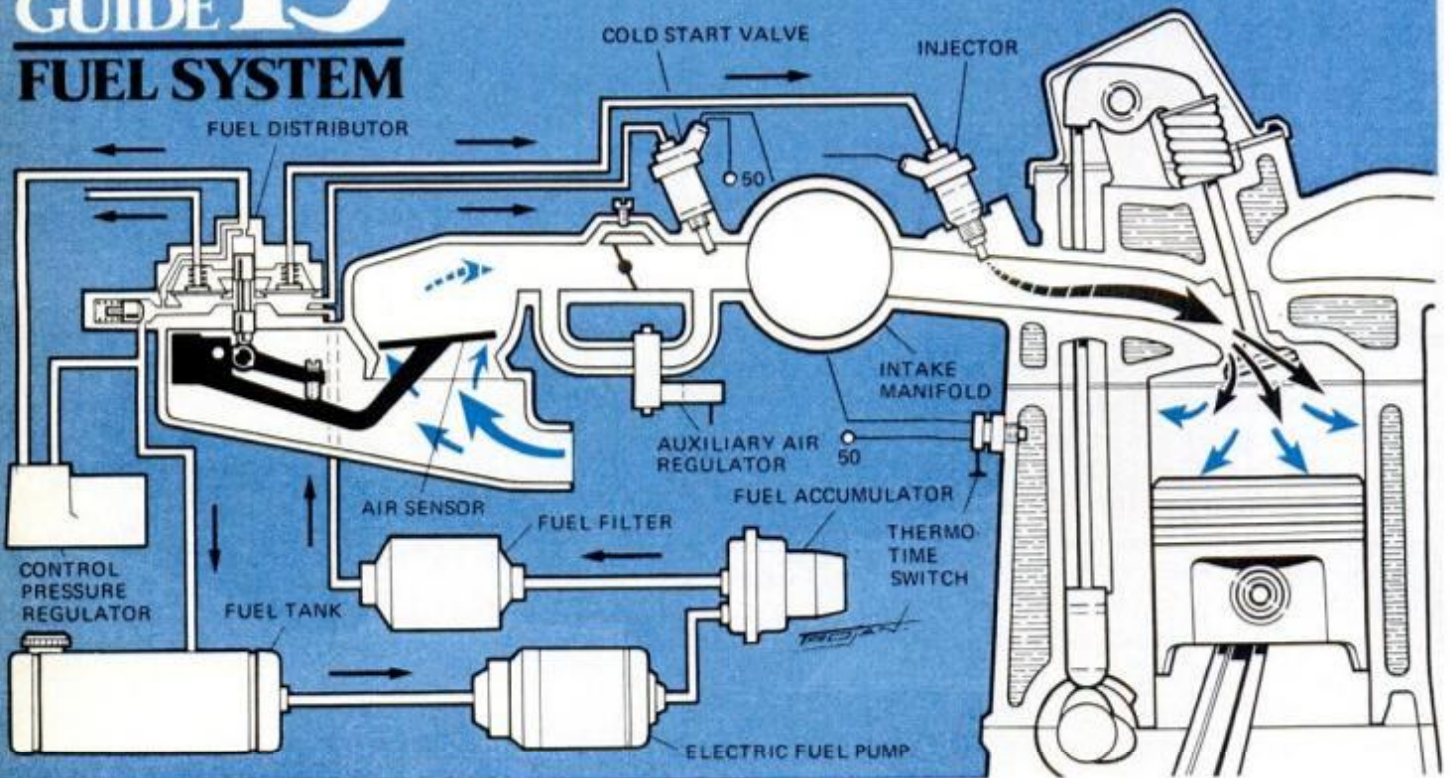
**Fill 'er up
with Champions.**



CAR CARE GUIDE 13

FUEL SYSTEM

Shown here is fuel flow from gas tank to cylinder in the continuous injection system (CIS) as used on Volkswagens.



Why isn't the gas getting to my carburetor?

This section contains various questions sent *Car Clinic* by 2.4 percent of the people. They questions are about the fuel system from the fuel tank to, but not including, the carburetor (see Section 1) and about gasoline.

We'll start with the most prevalent question in this category, asked by 1.0 percent of the people, and also the easiest to answer. K.G. of Danville, Va., was one of those asking:

'In an emergency when unleaded gas is not available, what do I feed my 1976 Buick, which has a catalytic converter?'

In an emergency you have no choice but to feed it leaded gasoline, but don't fill the tank. Pour in as little as possible to get you to a service station where unleaded fuel is available. Try to avoid many emergencies like this. Lead in gas, even in comparatively small quantities, can poison a catalytic converter.

Economic bind

And then there was the question sent us by T.E. of Odessa, Tex.:

'My '75 Gremlin doesn't have a catalytic converter. But it has a restricted fuel filler neck and an unleaded-fuel-only decal. Must I keep paying 8 cents per gallon more for unleaded gas, or what can I do so I can use leaded regular?'

From a mechanical point of view, people such as T.E. who own the later-model cars not equipped with catalytic converters do not have to use unleaded gasoline. However, they have to overcome two resistances:

1. The resistance of the fuel tank filler neck to permit penetration of a regular leaded gasoline pump's nozzle.

2. The resistance of service station attendants to sell them leaded gasoline, which they think they are prohibited by law from doing for 1975 and later models. But actually, the law applies only if the car is equipped with a catalytic converter.

Resistance No. 1 may be overcome by cutting or drilling out the restriction; resistance No. 2, by buying gasoline at a self-service station.

Filters and pump

The next biggest fuel-related problem readers faced deals with apparent fuel-starvation difficulties at high speed because of a malfunction aft of the carburetor.

'The engine didn't seem to take the gas and it stalled while I was traveling down the Interstate.'

That's how one reader summed it up. Well, except for a carburetor letdown, which we discussed in Section 1, the only other obvious trouble spots are the fuel filter and the fuel pump.

Most cars use one of only two types of fuel filters, called in-line and inlet (internal). A partially restricted fuel filter will cause fuel starvation at high speed.

The visible in-line filter is a chamber inserted in the fuel line between fuel pump and carburetor. After a problem such as this arises, the first thing to do is replace this filter, especially if it hasn't been replaced in 12,000 miles.

The inlet (internal) fuel filter lies in the [\(Please turn to page 200\)](#)



"I feel we can rely upon Firestone. They're fine. I don't even know they're there. And that's the kind of tires I like."

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

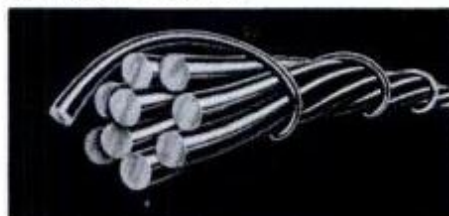
Friends like ours bring out the best in us...

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.

Ask a friend about

Firestone

...and ask your dealer about the new Firestone Steel Belted Radial 721™

*** PUT THE "IGNITION OF THE FUTURE" ON YOUR CAR TODAY!**

MODERNIZE and Bring Your Car "UP-TO-DATE" with the MOST EFFICIENT Ignition ever Invented!

*** End "Tune-Up" Problems FOREVER** caused by Points and Condenser



ALLISON XR-700

with the Exclusive... Solid-State Voltage Regulator.

The ONLY Ignition System that has COMPLETELY overcome the Problems that have baffled the Auto Industry for Years!

SO RELIABLE (99.9+%)... SO PERFECTED... that it will soon be STANDARD on most Future new Cars!

ALLISON Rated #1 by Official Testing Laboratory as the BEST "Fuel Saving" Ignition System of ALL the Different Ignition Systems Tested!

* The "XR-700" is a COMPLETELY NEW Ignition System employing the Most Advanced Technology, that replaces the inefficient Points and Condenser with an infrared Light Beam to Trigger the Latest type of Solid-State Power Components. Once installed... "XR-700" has NO moving Parts to wear out or adjust. It works without Friction or wear. Not affected by Dirt, Oil, Moisture, Vibration or extreme Engine Temperatures! **RUGGED and RELIABLE!**

* The "XR-700" is engineered to OUTLAST YOUR CAR!

* The "XR-700" produces the MAXIMUM "High Energy" Long Duration Spark... from your present car's Ignition Coil. This permits the Positive Firing of Spark Plugs, even under the most Adverse conditions. Also, Eliminates "Engine Misfire," resulting in more COMPLETE COMBUSTION! Thus you get IMPROVED Fuel Mileage, a HIGHER Performance Level... keeps Plugs FROM FOULING and gives LONGER Plug Life!

Customers Report:

*** "IT MORE THAN PAYS FOR ITSELF!"**

- ★ INCREASES Gas Mileage up to 30%!
- ★ SAVES Money on Costly "Tune-Ups"!
- ★ Gives Continuous PEAK Performance!
- ★ QUICKER Starting in Any Weather!
- ★ Smoother Running... Faster Acceleration!
- ★ Plugs Last Up to 4-Times LONGER!"

* Reliability PROVEN in Millions of Customer Miles to be so exceptionally GOOD... that every "XR-700" has a LIFETIME WARRANTY! FREE Repair or Replacement for as long as you OWN the Unit!... and even if you CHANGE Cars, Allison will supply you the necessary PARTS to fit ANY Point-Type Distributor... FREE! (Include \$2 for Postage & Handling).

* FITS ALL CARS, Domestic & Foreign, 4, 6 or 8-Cylinder.

*** DO-IT-YOURSELF... EASY INSTALLATION!**

The New "XR-700" is Completely Factory Assembled... Thoroughly TESTED! New Precision "Drop-in" Mounting Bracket, with color-coded, "Snap-Together" wire connections! No Distributor Removal necessary... Protected against "Incorrect Hook-up"!

Thousands sold at \$59.95 • ONLY \$39.95
 NOW! Allison's Production Technology offers you the same Premium Quality XR-700 at this SPECIAL LOW Price...
COMPLETE (Cal. Res. add Tax)
 THAT'S EVERYTHING... INCLUDING POSTAGE & INSURANCE

*** ORDER WITH CONFIDENCE...**

install the "XR-700", and prove to your own SATISFACTION that it is as advertised, or return it within 30 days for a FULL Refund of the Purchase Price

*** SAVE! ORDER FACTORY DIRECT.**

Send Check or M.O., State Car Make, Year, No. Cylinders

* MASTER CHARGE or BANKAMERICARD Card Holders: ORDER by TOLL-FREE PHONE. (800) 423-6525, Ext. 2 or Send us (1) Your Number, (2) Interbank No., (3) Exp. Date.

*** SEND for FREE BROCHURE and Comparison Sheet.**

"CB" USERS: The "XR-700" completely ELIMINATES the Major Cause of Primary (Ignition Noise) Interference.

* If you have already installed a "Capacitive Discharge" Ignition * Convert your "C-D" Unit to BREAKERLESS! INCREASE ITS EFFICIENCY with "XR-CD"... only \$29.95



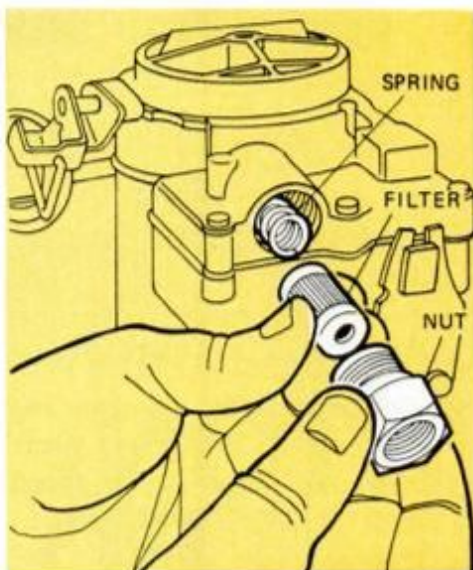
* America's Oldest and Largest Manufacturer of Opto-Electronic Ignition Systems. ©

ALLISON AUTOMOTIVE CO.

1267 - PM, East EDNA PL., COVINA, CAL. 91722

CAR CARE GUIDE 13

carburetor inlet. It, too, should be replaced when fuel starvation seems to be a problem. Getting this filter out of the inlet requires that you disconnect the fuel

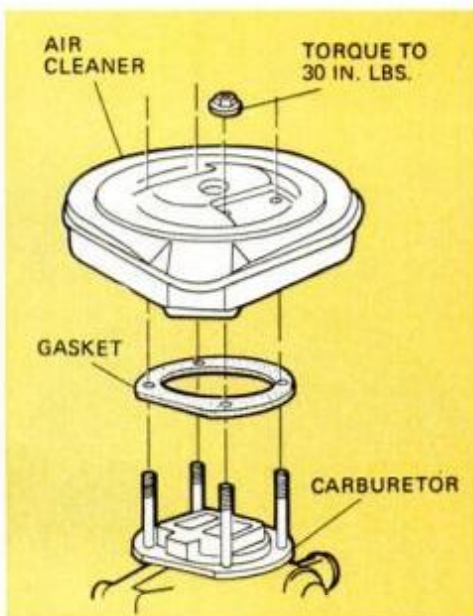


Fuel filters are either the in-line or internal type. The latter is shown here.

line and remove the inlet retaining nut. You will find a spring behind the filter. Retain it. However, if it looks damaged or is not "springy" when you squeeze it, replace it.

Caution: Remove an inlet filter when the engine is cold. Some gas will drip on the engine. A hot engine will pose a danger. Put a rag under the fuel-line fitting to catch and absorb this fuel.

Speaking about blockages, don't forget that overtightening the carburetor air cleaner could crush the air horn, caus-



Air-cleaner on carburetor should be replaced carefully; don't overtighten.

ing a restriction to air. This will result in the engine having to run on a rich fuel

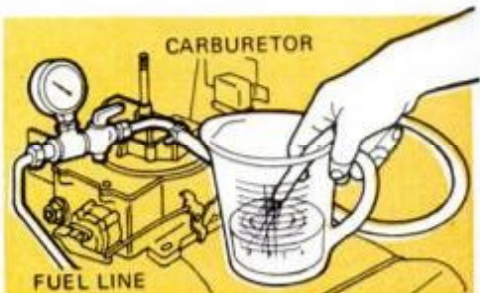
mixture. The damage could lead to flooding and fuel waste.

There are two ways to determine if a fuel pump is up to par. Check the ground beneath the pump after the engine has been sitting idle for a while. If there is gasoline present, it probably means the diaphragm in the pump is cracked. The pump should be replaced.

However, a surefire test you can make in your driveway without a lot of fancy equipment is a fuel-delivery test. All you need is a watch.

Disconnect the fuel line at the carburetor and to it attach a length of hose that fits tightly. Place the other end of the hose in a receptacle.

Start the engine and allow it to idle for about 30 seconds. The engine will run that long on the fuel retained in the carburetor bowl.



Thorough fuel-pump check-out may require the use of a pressure gauge.

At the end of 30 seconds, measure the amount of fuel in the receptacle. A properly performing fuel pump would have delivered about one pint in that time. If yours hasn't, you can now check the fuel-pump pressure with a gauge to see if it is up to the manufacturer's specification, if you wish, or you can simply replace the fuel pump.

PCV problems

Although it isn't a part of the fuel system, the PCV valve, which is one of the most overlooked and neglected parts of a car, contributes to as many fuel-related problems as, say, a fuel filter. Depending on the position of its piston when the piston gets stuck, a faulty PCV valve can cause an over-rich fuel mixture, thus affecting fuel economy. Or it could cause the engine to run on an overly lean fuel mixture, which will lead to rough idling. Or it may create a crankcase explosion.

The simple method of shaking the valve to see if it rattles, which allows you to assume that the valve is okay, is not valid. The piston may be partially clogged but still rattle, leading to one of the problems just mentioned. Replace the PCV valve as often as the manufacturer of your car suggests. That's the best insurance you can have.

FI—a wave of the future

You are going to hear more and more about fuel injection as time passes. Today, it represents only 0.2 percent of the letters we received at *Car Clinic* in 1976. However, all Volkswagens sold in the United States now have FI. As time passes, this trend toward FI and away from the carburetor seems certain.

Actually, fuel injection is not a new development. It has been around almost as long as the carburetor, but hasn't been adopted because of higher cost factors. Now, however, the state of the art has progressed, and cost is coming down.

In any event, the one problem we hear about concerns stalling during engine warmup, probably because of fuel starvation. For those who have the problem, there are two primary components of the FI system that can cause it: the cold-start valve and control-pressure regulator.

The control-pressure regulator should be tested with a FI pressure gauge. The cold-start valve may be tested by removing it and testing fuel delivery. We no doubt will have more to say about troubleshooting fuel-injection systems in the future.

OCTANE NUMBERS GAME

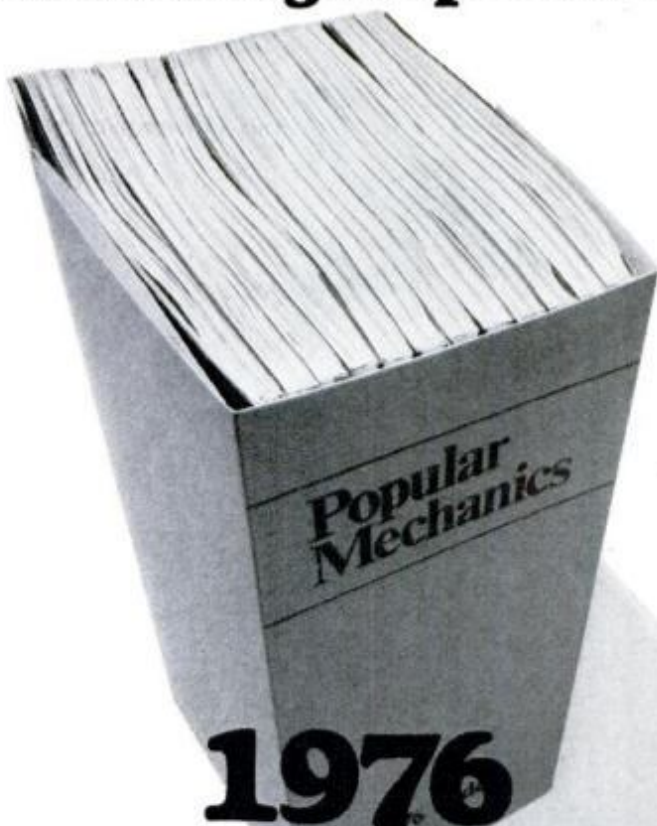
The octane numbers on gas pumps have me confused. My owner's manual tells me to use regular grades of gasoline having a 91-octane rating. Regular gasoline I've been using is posted at 90. If I want higher, I have to switch to premium. What gives?—Burt Mondale, Linden, N.J.

The posted octane number is the average of the octane rating derived by two methods: research and motor. The result is a number lower in value than the research octane number, which is the one that is commonly published in automobile owners manuals.

The research number defines the octane of gasoline according to laboratory test methods. The motor method defines octane rating by actual in-engine use and is lower numerically than the rating derived by the research method.

The posted octane rating is obtained by adding research and motor numbers and dividing by two. Hence, gasoline that has a research octane rating of 94 and a motor octane rating of 84 has a posted octane rating of 89 ($94+84=178 \div 2=89$).

As for those of us at *Car Clinic*, we'll use the "old-fashioned" way of determining whether the gas we use is suitable. If it causes the engine to ping, we switch—if not, we stick with it.



**1976
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Wrapper**

The 1976 Popular Mechanics *Index and Shelf Wrapper* actually converts your '76 PM issues into a formidable "reference library." That's right, over 5,000 entries have been indexed and cross referenced.

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Make checks payable to Popular Mechanics

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Address _____

City _____ State _____ Zip _____

These retailers from across the nation are your Car Care Month Head-

Your Car Care Month Headquarters

quarters. They'll be providing topnotch products to keep your car running smoothly. Many of these retailers will be offering money-saving specials on some of the excellent products featured throughout the

Guide. Remember to watch for the newspaper announcements and advertisements from your local Car Care Month Headquarters . . . and check the exciting "Car Care" sections in your newspaper.

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	CT, FL, NY, NJ
	NJ
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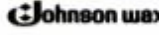


























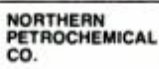

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"May is Car Care Month" Enters Its 5th Exciting Year

by: C.W. Higgins
President, Automotive Parts & Accessories Association

For the fifth consecutive year, the Automotive Parts & Accessories Association representing more than 50,000 retail outlets and manufacturers, and POPULAR MECHANICS, with over 6,000,000 readers, are working together to make driving safer, more economical and more fun for you.

This year's "Car Care Month" program is better than ever. There are more manufacturers with many more products. There are more retail outlets, too. And again this year, hundreds of local newspapers—they're listed on page 216—will be bringing you information-packed "May is Car Care Month" sections produced in cooperation with the Automotive Parts & Accessories Association and POPULAR MECHANICS. Check the listing for the quality manufacturers who are participating and be sure to look for your local retail "Car Care Month" Headquarters in the retailer listing.

 Airguide AUTOMOTIVE INSTRUMENTS	Airguide Auto Compass	 DUPLI-COLOR	Dupli-Color Auto-Panel	 BOND TITE	Auto Body Repair Kit Super Glass
 View-All ALONDRA INCORPORATED	Fill-O-Reg (fuel pressure control) AND View-All (gasoline filter)	 DU PONT	Rain Dance Waxes Rally Waxes	 Olin	Flares-2 pack Flares-3 pack
 ANES	Hi/Low Electronic Burglar Alarm	 Motorcraft TESTED TOUGH	Batteries Shock Absorbers Filters (Oil Filter in coupon book) Electrical Parts (feature tune-up kit) Wire & Cable (feature spark plug ignition wire set) AutoLite Spark Plugs	 Petersen INDUSTRIES INC	Auto Ramp
 ARMOR ALL PRODUCTS	Armor All	 Autolite	Oil Filters PVC Filters Air Filters Wiper Blades Refills Spark Plugs Gas Filters	 Big Book of Auto Repair	
 MSD IGNITIONS	MSD Ignition	 GEM MANUFACTURING CORPORATION	Hood Ornaments Bumper Guards	 Complete Test & Tune Kit Precision Master Test & Tune Kit DC Power Timing Light Maxi-Tune Ignition Analyzer Automotive Diagnostic Analyzer Digital Analyzer	
 B & M PERFORMANCE TRANSMISSION PRODUCTS	B & M Transpack Automatic Transmission Shift Kit	 GE	Headlight	 Johnson Wax	J. Wax Kit Sprint
 Berryman	Chemtool Crankcase Cleaner Chemtool Flo-Thru Carburetor Kit Chemtool Round Cone Top Pints Carburetor Cleaner Spray Chemseal Transmission Sealer Seal-R 8 oz. Tire Sealer	 Silicones	Black & Clear Auto Seal, Glass Seal, Hi-Temp Lastant Gasket	 SHALER	Rislone Engine Treatment
 BLUE MAGIC CORPORATION	Blue Magic Metal Polish Cream	 GOLD EAGLE	Gold Eagle 5 Minute Motor Flush	 VHT	Vinyl & Rubber Dressing
 BERNZOMATIC	Oxygen Cutting and Welding Torch	 GUMOUT	Gumout Carburetor Cleaner Gumout Jet-Spray	 Sta-lube	Cartridge Wheel Bearing Packer Gear Oil & Pump
 CHAMPION	Spark Plugs	 HUFFY	Huffy Spare Air Tire Pump	 Star brite	Star Brite Auto Polish Star Brite Car Wash in a Bottle Star Brite Vinyl Shampoo Vinyl Brite
 Chilton's	Chilton Basic Auto Maintenance Chilton's Auto Repair Manual	 HOLLYWOOD ACCESSORIES	Roller Seat	 Sun CONSUMER PRODUCTS	Timing Light Dwell/Tach
 CORDOMATIC	Handy-Lite Reel	 JET-X	Jet-X Deluxe Kit #151 (Pressure Washer)	 TOMCO, INC.	JET Carburetor Kits
 DL	DL Blue Label Hand Cleaner	 KAR CHECK	Advance Tune-Up Kit Master Tune-Up Kit	 turtle wax	The Grabber (promotional size kit)
 Dowgard summer / winter coolant / antifreeze	Dowgard Antifreeze Coolant XHD 450 Brake Fluid	 KENDALL MOTOR OILS	Motor Oil	 VALVLINE	All-Climate Motor Oil Oil Filter Tiffany Wax
		 MATEX OIL-O-CHANGER	Extender-Rak	 WD-40	WD-40
		 NORTHERN PETROCHEMICAL CO.	Peak Antifreeze & Coolant	 DURO	Super Glue 3

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**CAR
CARE
GUIDE 14**

INFORMATION WANTED

Where can I get a service manual for my car?

As it was in previous years, this category had the largest number of letters—20.1 percent—received at *Car Clinic* in 1976. The following list should satisfy questions asked by readers concerning where to get information. The list is divided into sections giving general reference books, addresses of domestic and imported-car manufacturers, and addresses of government agencies and private organizations concerned with automobiles.

Note: Included under the list of domestic car manufacturers are names of printing companies which have contracts with auto manufacturers to supply technical manuals to the public. If you require a manual, write the printing company we mention. If no printing company is specified for your make car, write the manufacturer.

GENERAL REFERENCE BOOKS

The following books may be ordered from Popular Mechanics Books, Box 1575, Radio City Station, New York, N.Y. 10019. *Popular Mechanics Complete Car Repair Manual*. \$9.95.

PM's Guide to Basic Auto Repair and Maintenance. \$16.95

The books listed below may be ordered from Motor Books, Box 2316, New York, N.Y. 10022.

Motor's 1977 Auto Repair Manual (1971-1977 models). \$14.95

Motor's Auto Repair Manual—Early Model Edition (1964-1970 models). \$14.95

Motor's Truck Repair Manual (1966-1977 models). \$21.95

Foreign Car Repair Manual (1960-1973 models). \$18.95

Auto Engines and Electrical Systems. \$13.95

Automatic Transmission Manual. \$29

Automobile Emission Control I. \$27

Automobile Emission Control II. \$26

Automobile Troubleshooter. \$5.95

Airconditioning and Heating Manual. \$24

101 Shop Secrets of Master Mechanics. \$2.95

Official Used-Car Buyers Guide. \$2.95

High Performance Tuning Guide. \$2.95

Auto Problem Solver. \$2.95

DOMESTIC CAR MANUFACTURERS

American Motors Corp.

14250 Plymouth Rd.

Detroit, Mich. 48232

Buick Motor Division

General Motors Corp.

902 East Hamilton Ave.

Flint, Mich. 48550

Cadillac Motor Car Division

General Motors Corp.

2860 Clark Ave.

Detroit, Mich. 48232

Checker Motors Corp.

2016 North Pitcher St.

Kalamazoo, Mich. 49007

Chevrolet Motor Division

General Motors Corp.

General Motors Building

Detroit, Mich. 48202

Chrysler-Plymouth Division

Chrysler Motors Corp.

1200 Oakland Ave.

Highland Park, Mich. 48203

Drake Printing Co.

2000 West Eight Mile Rd.

Ferndale, Mich. 48220

(Pontiac)

Dodge Division

Chrysler Motors Corp.

Walter P. Chrysler Center

Detroit, Mich. 48231

Ford Division

Ford Motor Co.

Ford Marketing Corp.

Rotunda Drive at Southfield Rd.

Dearborn, Mich. 48121

GMC Truck and Coach Division

General Motors Corp.

660 South Boulevard West

Pontiac, Mich. 48053

Helm, Inc.

Box 07150

Detroit, Mich. 48207

(Chevrolet, Ford, Mercury and Lincoln)

International Harvester Co.

401 North Michigan Ave.

Chicago, Ill. 60611

Jeep Corp.

(See American Motors Corp.)

Lincoln-Mercury Division

Ford Motor Co.

3000 Schaefer Rd.

Dearborn, Mich. 78126

Oldsmobile Division

General Motors Corp.

920 Townsend St.

Lansing, Mich. 48921

Pontiac Motor Division

General Motors Corp.

1 Pontiac Plaza

Pontiac, Mich. 48053

Tuor Co.

Box 354

Flint, Mich. 48501

(Buick)

IMPORTED CAR MANUFACTURERS

Alfa-Romeo, Inc.

200 Sylvan Ave.

Englewood Cliffs, N. J. 07632

American Honda Motor Co., Inc.

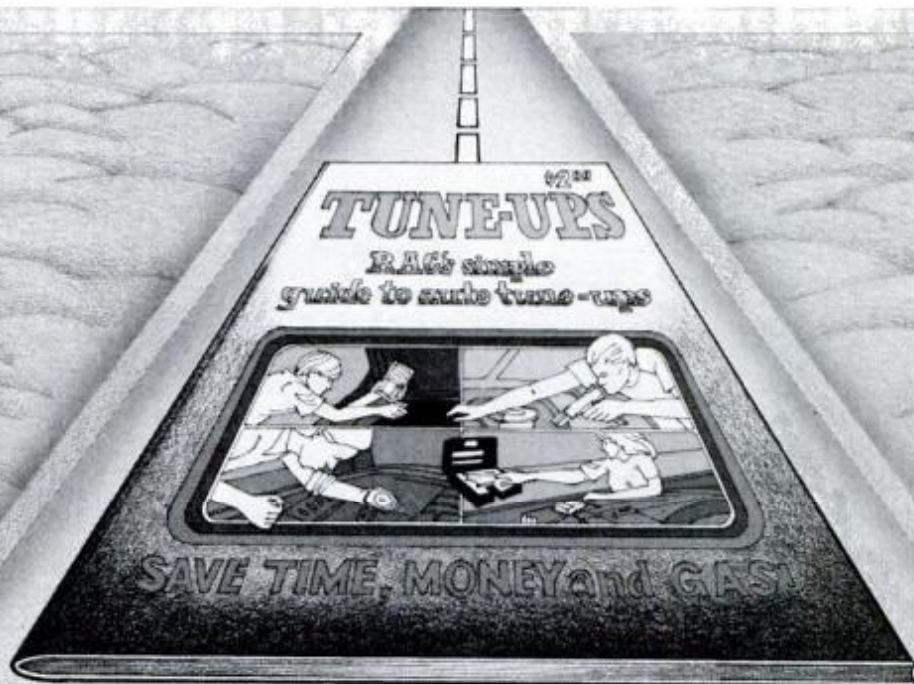
100 West Alondra Blvd.

Gardena, Calif. 90246

(Please turn to page 206)

Squeeze your wires

Another tune-up tip from the people who wrote the book.



Your spark plug wires are critical links in the energy system of your car. You can easily check their condition by squeezing each wire at both ends i.e. where it connects with the spark plug and with the distributor cap. Replace any wires that feel soft or spongy, which are signs of deterioration. You should also bend each wire all along its length and replace any that show cracks.

This tune-up tip from RAC demonstrates how easy and economical it is to care for your own car. You can tune your engine completely and keep it running smoothly by following the simple steps outlined in the original RAC "Tune-Ups" Book.

We're offering "Tune-Ups," (which retails for \$2.00) for One Dollar Off with the special coupon here. The next time you purchase one of our products at your neighborhood RAC dealers, tear off a "RAC" trademark from the box or package and send it to us with the coupon and \$1.00. We'll send you our "Tune-Ups" Book by return mail.

We're RAC, the nation's largest manufacturer of automotive test and tune-up equipment. Items like "Maxi-Tune" Ignition Analyzer, the Dwell-Tach Points Tester and the Dial Rotating Compression Tester pictured here, have been developed specifically for YOU . . . the home mechanic.



RAC
Rite Autotronics Corporation

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Thanks, RAC for making my life easier. Here's the "RAC" trademark from your product package and my dollar for your "Tune-Ups" Book.

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Address _____

City _____ State _____ Zip _____

Age _____ Sex _____ Make of Car _____ Year _____

Mail coupon to: Rite Autotronics Corporation, Dept. T.U., 3485 S. La Cienega Blvd., Los Angeles, Calif. 90016

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Address: _____
State: _____ Zip: _____
Phone: _____ PM

CAR CARE GUIDE

Arrow

(See Plymouth)

Aston Martin Lagonda, Inc.

650 Clark Ave.
King of Prussia, Pa. 19406

Audi

(See Volkswagen of America, Inc.)

Avanti Motor Corp.

765 South Lafayette
South Bend, Ind.

BMW of North America, Inc.

Montvale, N. J. 07645

British Leyland Motors, Inc.

(Austin, MG, Jaguar, Triumph)
600 Willow Tree Rd.
Leonia, N. J. 07605

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(See Lincoln-Mercury)

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(Please turn to page 208)

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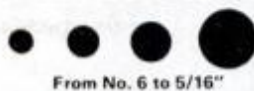
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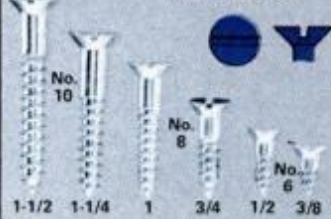
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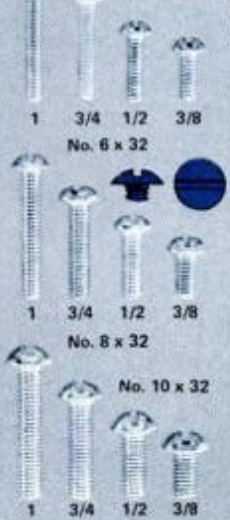
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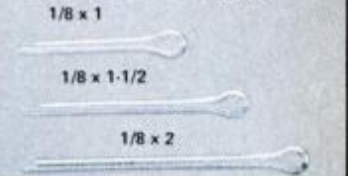
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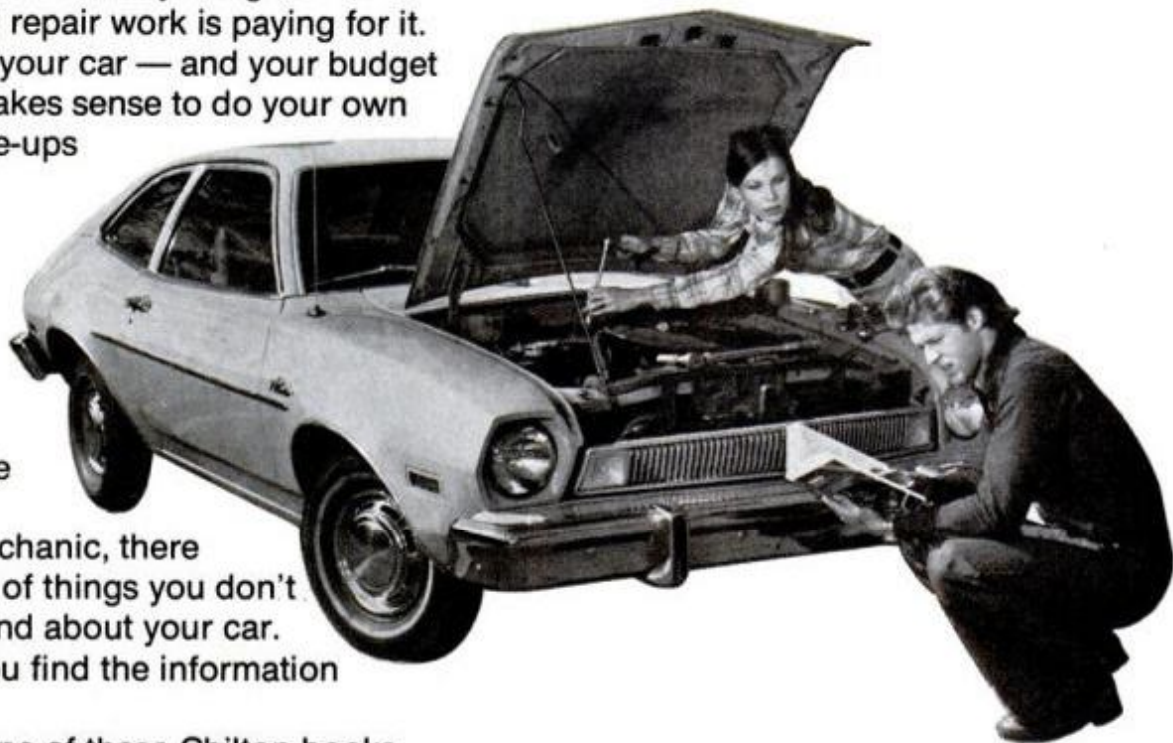
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CAR CARE GUIDE 15

TROUBLESHOOTING

How do I start troubleshooting a starting problem?

This section is devoted to troubleshooting a wide range of problems. It covers major complaints that readers of *Car Clinic* sent us in 1976. After each complaint, which is printed in boldface type, is a list of probable causes, followed by recommendations on how to approach repair. Where more than one recommendation is suggested, perform them in the order given. Try the first recommendation first. If this doesn't work, go on to the next.

A reminder before proceeding—remember that any problem you have with your car may have an inherent root cause. Consult a dealer's service department to establish if a service bulletin has been issued covering the malfunction. You may be able to get this information also by contacting a regional service office of your automobile's manufacturer. The locations of offices are often printed in the back of car owners manuals.

Engine won't crank

(Makes weak growls or no sound)

- Weak battery—test; recharge or replace.
- Corroded or loose battery connections—clean and tighten.
- Bad battery cable—test; replace.
- Wrong viscosity oil for temperature—drain and replace.
- Inoperative starter switch or solenoid test; replace.
- Corroded or loose starter cable—clean and tighten.
- Bad started cable—test; replace.
- Bad starter motor—test; overhaul.
- Faulty ignition switch—test; replace.

Engine won't start

(Crank normally)

- Improper starting procedure—be sure you're not flooding the engine or otherwise doing something wrong; follow recommended starting routine for your car.
- Moisture on ignition wires, distributor cap and sparkplugs—wipe parts clean and dry.
- Bad ignition wires—test; replace.
- Bad ignition coil—test; replace.
- Weak control unit (electronic ignition)—test; replace.
- Cracked distributor cap—replace.
- Damaged distributor rotor—replace.
- Corroded distributor contact points (conventional ignition)—clean if possible; replace if not.

- Fouled sparkplugs—clean if possible; replace if not.
- Improper sparkplug gap—set gap to specification.
- Incorrect ignition timing—set timing to specification.
- Sticking choke—clean; repair.
- Dirt or water in the fuel system—replace fuel filter; drain and clean system.
- Carburetor flooding—adjust carburetor or float level.
- Incorrect fuel level in carburetor bowl—reset float level to specification; check needle valve and seat for damage.
- Weak fuel pump—test; repair (pre-1968 models) or replace.
- Carburetor percolating—check float level; adjust anti-percolation vent on carburetor; check operation of manifold heat control valve.
- Inoperative Neutral-start safety switch—replace.

Engine idles rough

(Also stalls at idle)

- Idle speed set too low—adjust.
- Idle mixture too rich or too lean—adjust.
- Inoperative choke—repair.
- Incorrect fuel level in carburetor—reset float level to specification; check needle valve and seat for damage.
- Dirt or water in fuel system—replace fuel filter; drain and clean system.
- Dirty jets or plugged carburetor passages—clean and overhaul carburetor.
- Damp sparkplugs—dry.
- Moist, loose ignition wires and distributor cap—dry and reset.
- Improper sparkplug gap—set gap to specification.
- Weak coil—test; replace.
- Burned rotor—replace.
- Weak condenser (conventional ignition)—replace.
- Distributor points in bad shape or incorrectly set (conventional ignition)—replace or clean; set dwell.
- Worn distributor cam (conventional ignition)—overhaul distributor.
- Air leak into intake manifold—inspect; tighten bolts; replace gasket.
- Restricted exhaust—locate; repair or replace part.
- Incorrect valve lash or valve lifter clearance—reset valves to specification if possible; repair.
- Burned, warped or sticking valves—test; repair.
- Leaking EGR valve—test; replace.

(Please turn to page 212)

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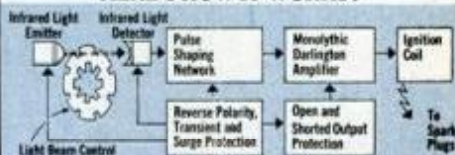
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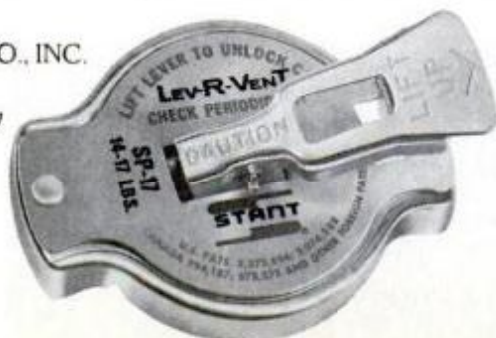
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CAR CARE GUIDE

- Low compression—test; overhaul.
- Worn timing chain or sprockets—overhaul.
- Worn camshaft lobes—overhaul.

Engine misses on acceleration

(Hesitation)

- Fouled sparkplugs—clean if possible; replace if not.
- Improper sparkplug gap—set to spec.
- Incorrect ignition timing—set to spec.
- Bad spark advance mechanism—test; replace.
- Inoperative carburetor accelerator pump—replace.
- Clogged accelerator circuit or carburetor jets—clean and overhaul carburetor.
- Weak ignition coil—test; replace.
- Burned, warped or pitted valves—test; overhaul.
- Defective EGR valve—test; replace.

Engine misses

(At high speed only)

- Fouled sparkplugs—clean if possible; replace if not.
- Improper sparkplug gap—set to spec.
- Incorrect ignition timing—set to spec.
- Worn or burned distributor rotor—replace.
- Distributor points in bad shape or incorrectly set (conventional ignition)—replace or clean; set dwell.
- Insufficient distributor point spring tension (conventional ignition)—test; replace.
- Distributor cam lobe worn or distributor shaft demonstrates excessive play—overhaul distributor.
- Weak ignition coil—test; replace.
- Weak condenser (conventional ignition)—test; replace.
- Dirt or water in fuel filter, gas line or carburetor—replace filter; clean.
- Fouled carburetor jets—clean and overhaul carburetor.
- Weak valve springs—test; overhaul.

Engine lacks power

- Incorrect ignition timing—set to spec.
- Worn or burned distributor rotor—replace.
- Excessive play in distributor shaft or worn distributor cam—overhaul distributor.
- Weak coil—test; replace.
- Insufficient point dwell (conventional ignition)—set to specification.
- Fouled sparkplugs—clean if possible; replace if not.
- Improper sparkplug gap—set to spec.
- Bad ignition cables—test; replace.
- Dirt or water in fuel filter, gas line or carburetor—clean lines and carburetor and clean or replace filter.
- Incorrect fuel level in carburetor bowl—reset float.
- Fuel mixture too rich or too lean—adjust.
- Weak fuel pump—test; replace.

(Please turn to page 215)



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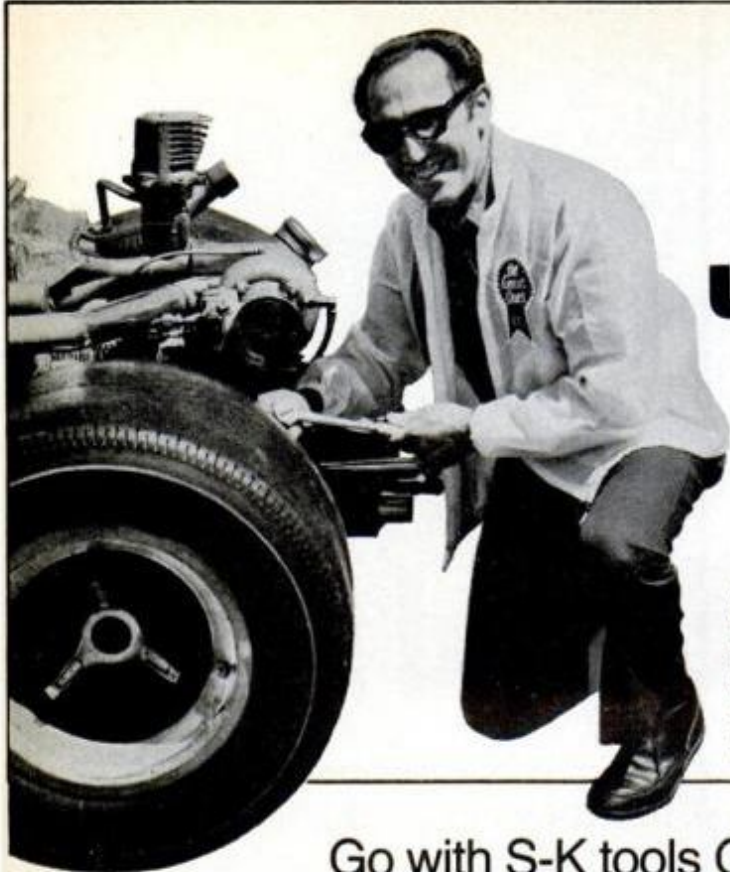
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- Weak valve spring; valve sticking when hot—test; overhaul.
- Restricted exhaust—locate; repair or replace part.
- EGR vacuum amplifier, if present, defective—test; replace.
- Clutch slipping—test; repair.
- Brakes dragging—repair.
- Automatic transmission regulator valve, if present, sticking—replace.

Engine overheats

- Drive belt loose, worn or broken—check and correct.
- Low coolant level—replenish.
- Using improper coolant—ethylene glycol is recommended.
- Clogged exhaust system—find and correct.
- Improper ignition timing—adjust to specification.
- Radiator core blocked with debris—clean.
- Faulty radiator pressure cap—test; replace.
- Faulty thermostat—test; replace.
- Clogged cooling system—drain and flush clean.
- Leaking cylinder head gasket causing aeration (bubbles)—verify; replace gasket.

Engine diesels

- Idle speed set too high—adjust.
- Incorrect ignition timing—set to specification.
- Inoperative idle stop solenoid, if present—test; replace.
- Engine overheating—check for cause, then repair.

External engine oil leak

- Oil level too high—be careful in future not to overfill.
- Improperly seated oil filter—reset.
- Ruptured oil filter gasket—replace filter.
- Loose valve (rocker arm) cover(s)—tighten.
- Ruptured valve (rocker arm) cover(s) gasket(s)—replace.
- Distorted valve (rocker arm) cover—replace.
- Improperly seated engine oil pan drain plug—reset.
- Distorted engine oil pan drain plug hole—repair; replace.
- Loose oil pan—tighten.
- Ruptured oil pan gasket—replace.
- Bent or distorted oil pan mounting surface—replace oil pan.
- Loose timing chain cover—tighten.
- Ruptured timing chain cover gasket—replace.
- Worn timing chain cover oil seal—replace.

(Please turn to page 218)

The leading car stereos in the leading car stereo country.

Japan is generally acknowledged to be the leading car stereo country in the world. Both in terms of technological excellence and manufacturing output.

And in the country where more car stereos are made than any other, more Clarions are sold than any other. The reason is simple. Clarion offers outstanding features for the money.

We're able to do this because we're one of the few companies who actually design and make virtually all the major elements that go into every one of our products. Everything from winding the coils to fabricating the solid metal cases. Surprisingly, many of the best known brands in this country don't even manufacture their own products. They only distribute what other people make. Still other popular brands merely assemble and sell other people's components. So obviously, none of these brands have the same quality or design control as we do. And you can see and hear the difference.

For instance, the two models pictured are our Model PE618A combination 8-track/AM/FM stereo radio and our Model PE666A com-



bination cassette AM/FM stereo radio. Both models have outstanding features such as no foul tape mechanisms with extra long life motors, automatic gain control to pull in long dis-

tance signals and keep nearby signals sharp, and front/rear fader controls. They also have internally adjustable side to side balance controls, precise phase-lock-loop integrated circuits to detect multiplex, automatic stereo/mono switches and illuminated, easy to read tape slots. Exclusive to the PE 618A 8-track is vertical head tracking for better tape reproduction, while the PE 666A cassette features automatic reverse which operates at both normal speeds and at locking fast forward/fast rewind.

The result is that both models offer the kind of clear, clean sound that you usually only get from a home high fidelity system.

Which probably explains why about 15 million Clarion radios have been sold already, all over the world.

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News for Car Care Month

Here are the newspapers in your area in which you'll find a section devoted to Car Care Month. These sections come to you through the cooperation of Popular Mechanics and the Automotive Parts & Accessories Association . . . and you'll find them to be a welcome addition to your Car Care Guide. Car Care Month sections will provide you with even more automotive ideas and many special offers from your local "Car Care Month" retail headquarters. Watch for it.

CALIFORNIA

Argus-Courier
The Sacramento Bee
Glendale News-Press
Burbank Daily Review
San Bernardino Sun-Telegram
Piedmont Oakland Bulletin
The Piedmonter
The Sparks
Newspapers:
The Daily Review
The Argus
Tri-Valley Herald
Tri-Valley News
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GEORGIA

Savannah News-Press
The Times
Gwinnett Daily News
The Marietta Daily Journal
Newspapers:
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The Vinings Neighbor
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The Tucker Neighbor
The Stone Mountain Neighbor
The Kennesaw Neighbor
The Acworth Neighbor

The Woodstock Neighbor
News Suns
Publications:
Clayton/Henry Sun
Decatur Dekalb News
Dekalb News/Sun
Southside/Fayette Sun

IDAHO

Lewiston Morning Tribune

ILLINOIS

Tazewell Publishing Co.
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Courier
South Taz-Wood
North Taz-Wood
Tazewell Shopper
Quincy Herald/Whig
Daily Pantagraph
The Beacon-News
Freeport Journal Standard
The Post
The Leader
Pickwick Newspapers
Park Ridge Advocate
Citizen
Des Plaines Highlander
Skokie
Morton Grove Niles
Franklin Park Schiller Park
River Grove
Olney Daily Mail
Barrington Courier-Review
Countryside
Newspapers:
Palatine
Countryside
Lakes Countryside
Fox Valley
Countryside North
Fox Valley
Countryside South
Reminder News
O'Fallon Progress
Command Post

INDIANA

Daily Herald
Telephone
The Elkhart Truth
East Side Suburban
Newspapers:
East Side Herald
Northeast Reporter
Muncie Newspapers Inc.
The Morning Star
The Evening Press
The Sunday Star
The Crusader
Newport News
The Hancock Advertiser
The Indy East
The Carmel News Journal
Randolph Southern Voice Press

IOWA

West Lyon Herald
The Monroe County News
Gazette
Tribune
West Lyon Herald
Grinnell Herald-Register
Quad-City Times
Fort Dodge Messenger
West Lyon Herald

KANSAS

Clifton News-Tribune
Chronicle Shopper
The Hutchinson News
Wichita Eagle
Wichita Beacon
Garnett Review
Anderson Countian
Squire Publications:
The Town Squire
Overland Squire
Village Squire
County Squire
Leawood Squire
Mission Hills Squire

Topeka Capital-Journal
The Daily Union

KENTUCKY

Inside the Turret
The Courier-Journal
The Louisville Pines

LOUISIANA

The Zachary Plainsman-News
Lake Charles American Press

MARYLAND

Baltimore News-American

MASSACHUSETTS

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The Sunday Sun
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The Allen Parker
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MINNESOTA

Mankato Free Press
Minnesota Daily Sentinel
White Bear Press
Free Press
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Minneapolis Star
Minneapolis Tribune

MISSOURI

The Mountain Echo
The Iron County Booster
Florissant Valley Reporter
St. Louis Suburban Newspaper, Inc.:
West County Journal
South County Journal
Neighborhood News
Meramec Community Press
Courier News
Jefferson County Journal
South Side Journal
Tri-County Journal

Press Journal
Fenton Journal
The Jackson County Pictorial News
The Oak Grove Banner
The Examiner
The Blue Springs Examiner
The Lawson Review

MONTANA

The Missoulian (Missoula, MT)

NEBRASKA

The Norfolk Daily News
Maverick Media, Inc.
The Syracuse Journal-Democrat
The Louisville Messenger
The Johnson County Courier
The Peru Challenge
The Talmage Topics
Thursday
The Southeast Nebraska Agribusiness Bulletin
The Penny Press
Omaha World Herald

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The Post-Standard
Herald American
Mayville Sentinel
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NORTH DAKOTA

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OHIO

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OKLAHOMA

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Indian Valley Echo

RHODE ISLAND

The Westerly Sun

TENNESSEE

Herald-Citizen

TEXAS

The Houston Chronicle
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News
The Houston Post
San Antonio Light
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Huntington-Zavalla Herald

VIRGINIA

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Times Herald

WASHINGTON

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The Spokesman-Review
Spokane Daily Chronicle

WEST VIRGINIA

Daily News Tribune

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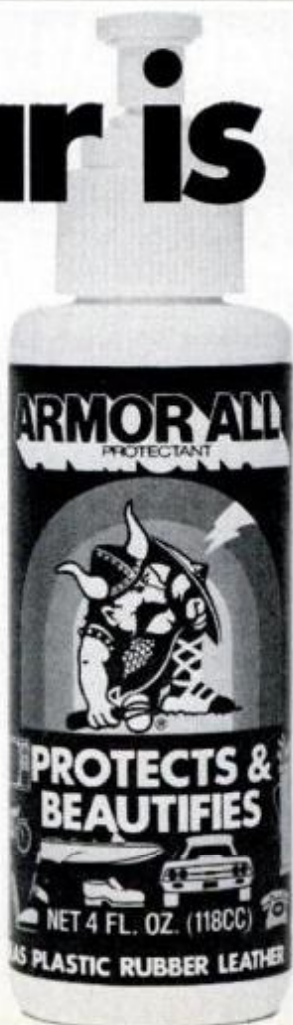
From the day your pride and joy first hit the road, it's been going downhill.

Every vulnerable surface — tire side-walls, vinyl top, interior, weather stripping, under-the-hood hoses, wires, cables — has been under attack by rotten elements that cause rotten things like deterioration, cracking and discoloring.

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PM2

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CAR CARE GUIDE

- Loose fuel pump—tighten.
- Ruptured fuel pump gasket—replace.
- Improperly seated or worn rear main bearing oil seal—repair.

Excessive oil consumption

(Mainly due to internal problem)

- Oil level too high—careful there.
- Oil too thin—drain and replace with correct viscosity oil.
- Defective intake valve seals—replace.
- Worn valve stems—replace valves.
- Worn valve guides—ream or replace.
- Plugged cylinder head drain holes—overhaul.
- Excessive main or connecting rod bearing clearance—verify; overhaul.
- Damaged, incorrect, improperly installed or worn piston rings—verify; overhaul.
- Ring grooves or oil return slots clogged—verify; overhaul.
- Ring grooves worn excessively—verify; replace piston.
- Worn or scored cylinder walls—verify; hone, reline and/or install oversize pistons.

No oil pressure

(While idling)

- Fouled oil gauge sending unit terminal—clean.
- Faulty oil gauge sending unit or oil gauge—test; replace.
- Defective oil pump or oil pump circuit—test; repair or replace.
- Worn main or connecting-rod bearings—verify; overhaul.
- Loose or worn camshaft bearings—verify; overhaul.
- Internal oil passage leak—verify; repair if possible; replace engine if not.

No oil pressure

(Or distinct oil-pressure drop while accelerating or cruising)

- Low on oil—Fill crankcase to proper level.
- Fouled oil gauge sending unit—clean.
- Faulty oil gauge sending unit or oil gauge—test; replace.
- Clogged oil filter—replace.
- Use of thin or diluted oil—drain and use correct oil.
- Worn oil pump or oil pump circuit—verify; overhaul or replace.
- Internal oil passage leak—verify; repair if possible; replace engine if not.

Noisy valves

Important: An exhaust gas leak can cause spitting or ticking sounds that can be mistaken for valve or valve lifter noise. When investigating this kind of noise, you should first test for an exhaust gas leak in one of six areas (whichever are applicable) as follows before doing expensive mechanical work:

(Please turn to page 220)

Stop spending money needlessly for new Spark plugs. Here's the answer! Satisfaction guaranteed or money back.

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Sludge and built-up carbon deposits can cost you plenty in plug replacement.

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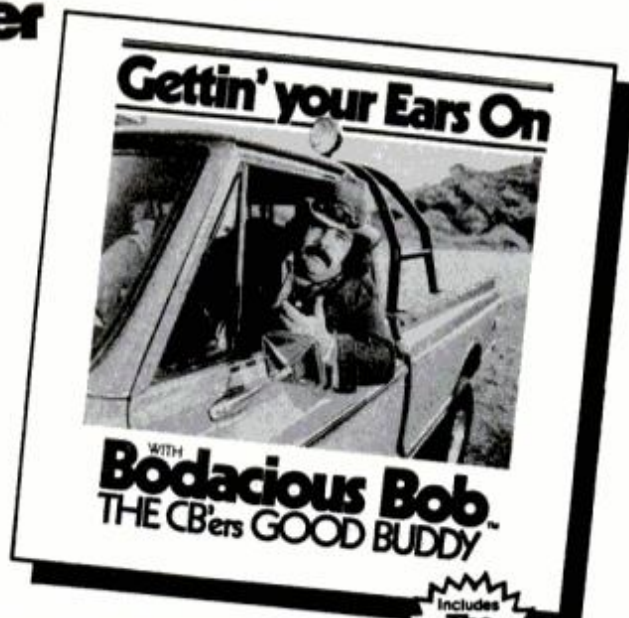


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ICS provides solid information all year
round to help you keep your car in top
shape.

CAR CARE GUIDE

1. EGR valve gasket—replace.
2. EGR back pressure transducer—test; replace.
3. EGR back pressure transducer gasket—replace.
4. Choke stove gasket—replace.
5. Intake manifold gasket—replace.
6. Exhaust manifold gasket—replace.

The following malfunctions apply to valve noise:

- Incorrect oil level—check level and be sure it's correct.
- Thin or diluted oil—drain and replace with the correct oil.
- Low oil pressure—see preceding sections on oil pressure.
- Dirt in tappets—clean.
- Bent push rods—replace.
- Worn rocker arms—check oil supply to rockers; if okay, overhaul.
- Worn tappets—replace.
- Worn valve guides—replace or ream out and install new valves having over-size stems.
- Excessive runout of valve seats or valve faces—grind valves and valve seats.
- Incorrect valve tappet lash—adjust to specification.
- Worn or leaking valve lifter—find the guilty party or parties and recondition.

**Tire wearing
unevenly**

- Tires aren't inflated properly—inflate to specs.
- Driver taking turns too fast—slow down on curves in future.
- Excessive wheel-tire runout—check wheels for wobble (damaged?) and proper mounting.
- Incorrect toe-in—set toe-in to spec.
- Uneven camber—set camber to spec.
- Incorrect toe-out on turns—steering linkage is bent; find and replace damaged part.
- Control arm or steering knuckle is bent—find and replace.

Tires cupping

- Tires aren't inflated properly—check and correct.
- Tires aren't being rotated—follow manufacturer's recommendations.
- Incorrectly adjusted or worn wheel bearings—adjust to specification; replace bad parts.
- Uneven camber—set to specification.
- Incorrect toe-in—set to specification.
- Tires out of balance—balance wheel-tire assembly.

**Front-wheel shimmy
(At high speeds)**

- Low or uneven tire pressure—check and correct.
- Bulge in tire—replace at once.
- Poorly adjusted or worn wheel bearings—adjust to spec., replace worn parts.
- Tire-wheel assembly out of balance—balance.

(Please turn to page 222)



Kiss your mechanic goodbye.

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PM-5

CAR CARE GUIDE

- Worn shock absorbers—test; replace.
- Worn tie-rod ends—test, replace.
- Incorrect caster—adjust to specification.
- Loose or worn ball joints—test; replace faulty part.

Hard steering

- Low, uneven pressure; check, correct.
- Loose or defective steering pump belt—check.
- Insufficient power steering fluid—check.
- Lubrication is needed—check lubricant in steering gear and lubricate steering linkage.
- Steering gear not properly adjusted—correct.
- Incorrect caster—adjust to spec.
- Front end part damaged—look for bent control arm or steering knuckle in particular.

Front end noise

- Loose or worn front wheel bearings—adjust; replace bad parts.
- Loose shock absorber—tighten; replace.
- Loose or worn ball joints—test; replace.
- Loose front end part hitting—look especially for loose control arm, worn bushings, loose steering gear; repair.

Apparent rear end noise

1. Noise is the same when coasting and cruising:
 - Road noise (should disappear or vary on different pavement).
 - Tire noise (should change for different pavement or car speed).
 - Front wheel bearings.
 - Driveline angle incorrect.
2. Noise is apparent with car standing in gear and driving:
 - Engine noise.
 - Transmission noise.
 - Driveline angle incorrect.
3. Vibration:
 - Tire-wheel imbalance.
 - Unbalanced or damaged drive-shaft.
 - Driveline angle incorrect.
 - Worn universal joint.
 - Rough rear wheel bearing.
4. Knock or click approximately every two revolutions of the rear wheels:
 - Rear wheel bearing.
5. Noise is more pronounced on turns:
 - Differential side gear and pinion.
6. Noise is a continuous low pitch whir or scrape starting at relatively low speed:
 - Pinion bearing.
7. Noise is a clunk on deceleration and acceleration:
 - Worn differential pinion shaft.
 - Worn side gear hub counterbore.
8. Noise is a groan in Forward or Reverse:
 - Wrong lubricant in differential.



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Cobra Fiesta Mini Home



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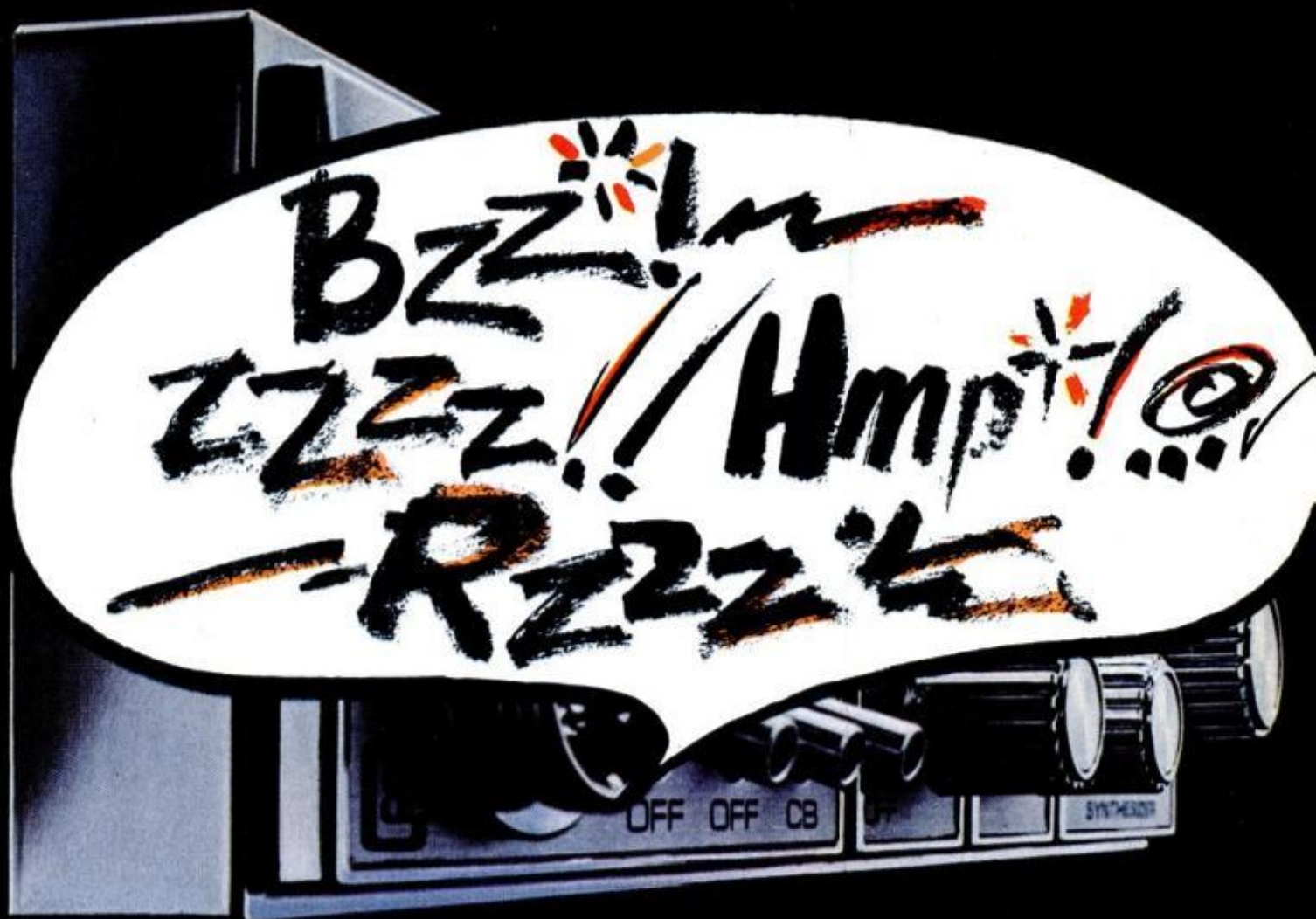
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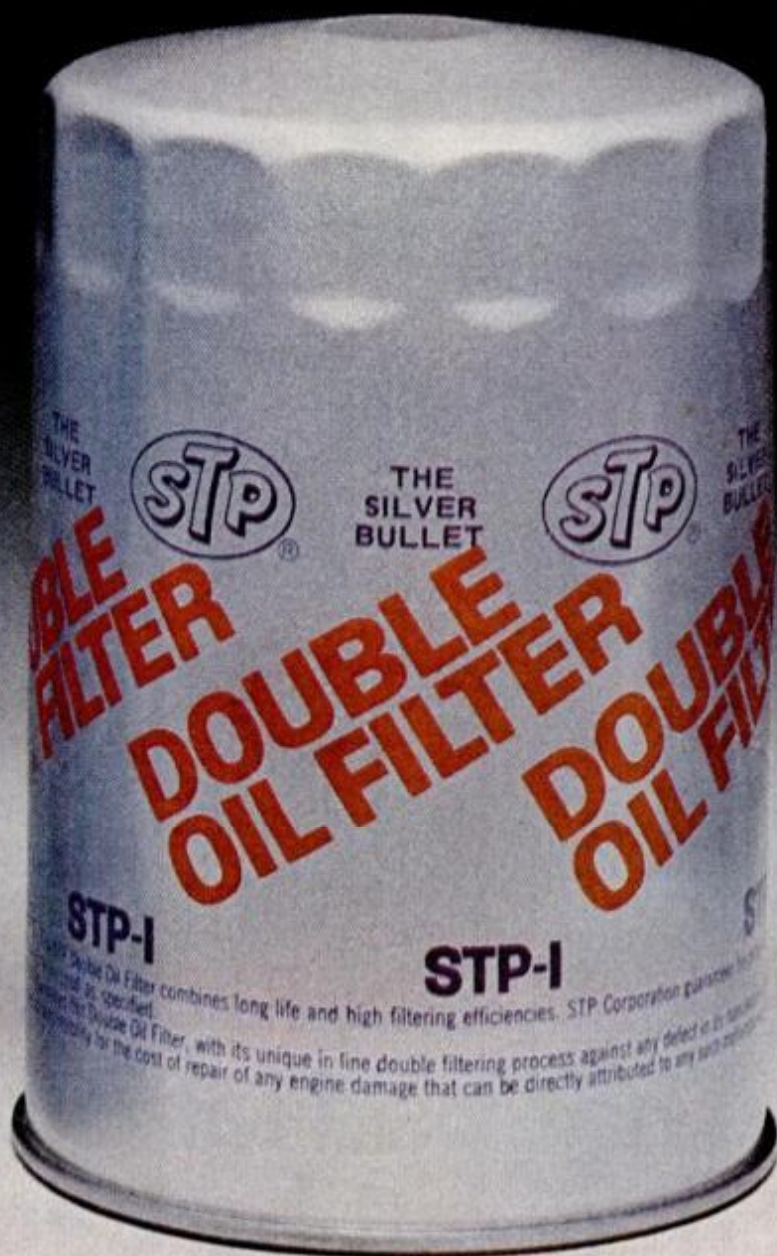


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PM art: Sandy Kossin

New action food for campers

Scientific diets and foods add muscle to outdoor menus.

by Jack Galub

Squeezing a last burst of effort from spent muscles while you reach for a crest can be the agony of rock climbing. On the trail, your last iota of energy can be wiped out and legs turned to rubber when lashing rain hits unexpectedly. Many of today's outdoorsmen claim that special diets before and during extended exertion seem to supply extra energy. And the new light freeze-dried foods make it possible to carry well-balanced meals without overloading a pack.

Recently I saw how this new approach to trail energy seems to work. Bill and I had hiked along a Berkshire ridge about three miles from our van. With about a half mile to go, driving rain and wind hit us head on. Suddenly my legs felt as if the plug had been pulled. Bill seemed as fit as when we first started out.

A week later, we watched Bill Jr. run a marathon. He matched strides with another runner for the first 20 miles of the 26-mile, 385-yard run. Then his partner ran out of steam and hit what marathoners call "the wall." Young Bill kept moving without breaking stride.

The difference wasn't conditioning. The advantage Bill and his son had going for them seemed to be a new high-stamina, glycogen-overload diet they had been following. Developed for long-distance runners and cross-country skiers, it recently is being tested by backpackers, hunters and climbers who want higher levels of endurance to keep them moving easily while others hit the wall.

The search for the secrets of muscle endurance and what causes them to give out when needed most has been challenging researchers for thousands of years. The best the ancients could offer—and it's still good advice—is not to overindulge in sweets. Avoid flab, they reasoned, and muscles will work more efficiently.

The myth of meat

In the early 1900s, athletic training tables were loaded with heaping platters of rare-cooked steak. Muscle is protein—therefore the more meat, the greater the strength and endurance, coaches reasoned. They were wrong. Protein is important to total health but not critical, it appears, to stamina.

Laboratory research at the time delved into why muscles tire instead of how to keep them energized. Lactic acid accumulation, sugar depletion, dehydration, changes in the balance of sodium, potassium and

FREEZE-DRIED—BUT FANCY

Mealtime no longer requires roughing it. Camp stores now stock such dehydrated specials as banana chips, omelets, turkey supreme, chop suey, eggs and bacon, strawberries, ice cream, chocolate pudding, pineapple, sausage patties, chicken tetrazzini, chili, lasagna, beef stroganoff, bacon bar and energy cookies.

other electrolytes, heat overload and their effects on muscle performance—all these were studied in detail. Each reduced muscle performance, but none seemed to hold the answers athletes needed.

A breakthrough came with two discoveries by Swedish researchers. First, endurance appears to be directly related to the amount of glycogen in a muscle. Glycogen is a starch produced by the conversion of carbohydrates within the body. Second, a diet could be developed that would increase muscles' glycogen by as much as 100 percent above normal. This should give us that extra energy needed on the trail or in competition.

Glycogen overload was worked out first by internationally acclaimed Swedish physiologist Per-Olof Astrand. His formula, which has since been modified by some disciples, is simple. He advised marathoners to run to exhaustion about one week before a major race. This would burn off the glycogen already in their muscles. Afterward they should follow a low carbohydrate diet for three days, switching them to high carbohydrate until the race. The deliberate depletion followed by a high carbohydrate intake would trigger the body into overloading the muscles with glycogen.

This promise of improved stamina and better running times has attracted distance runners around the world. A recent study by Dr. Paul Slovic of Decision Research in Eugene, Ore., revealed that 50 percent of male marathoners finishing in three hours or less followed the diet. In general, those who followed Professor Astrand's diet fully did better than partial dieters, and both groups outran nondieters.

Important meal after work

Continuing research by Dr. David Costill, director of the Human Performance Laboratory, Ball State University at Muncie, Ind., suggests that muscles are most responsive to glycogen storage during the first 10 hours after heavy exercise. It seems

(Please turn to page 230)

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NEW ACTION FOOD FOR CAMPERS

(Continued from page 229)

logical, therefore, that the first meal after a hard run or strenuous hike or climb should contain 80 to 90 percent carbohydrates. "There is considerable similarity between the endurance problem of the hiker or mountain climber and the marathoner," Dr. Costill asserts. "Over a period of time they will have the same caloric demands, as well, although the intensity at which they work differs."

Dr. Costill believes the average diet contains too much protein and fat and he leans toward steady use of higher carbohydrate if you work out regularly. But unless you hike, backpack, run or swim long distances three or four times a week, Dr. William Gualtiere of Cardio-Metrics Institute in New York City suggests you revert to a more balanced diet. While your body's glycogen will be burned up by arduous long-distance hiking or climbing, your muscles can be kept stoked by high-carbohydrate foods you pack along. If you do not eat enough carbohydrates, your body will eventually switch to burning free fatty acids found in the bloodstream. This is a slow process and for the average outdoorsman, the switchover may not come fast enough.

Should everyone try diet?

Does glycogen overload suit everyone? The answer seems to be a qualified yes. Though some find that the original diet recommended by Prof. Astrand upsets their system, others report that a modified diet of carbohydrates during the preceding week and while afield gives them the energy they need. In any case, you should discuss the diet with your doctor and test it several weeks before any extended trip.

Today it's easier than ever before to pack along the edibles that will give your muscles the fuel they need. Freeze-dried, compressed foods are one of the Army's gifts to the outdoorsman traveling light. Developed at the Army Natick Research & Development Command, freeze-drying does away with water in foods, reducing weight 70 to 90 percent. Reduction in volume varies with individual items. Peas, for example, can be compressed to one-fourth their original size, cherries to one-eighth, green beans to one-sixteenth.

Most camping outfitters stock a variety of prepacked and freeze-dried foods from such major manufacturers as Mountain House, Rich-moor Foods, Seidels, Tea Kettle and Wilson. Their packages offer convenience, but if you are willing to settle for a less extensive menu, you can supplement their products by packaging much less expensive supermarket foods yourself. Select dehydrated potatoes, pancake mixes, hard cheeses, fruit cake and other easily backpacked foods. Save as well by mixing ordinary dry cereals with nuts, sesame seeds, sunflower seeds and raisins. See-through plastic sandwich bags are fine for carrying these mixes as well as powdered milk, instant coffee and tea. Seal the bags with masking tape rather than the transparent kind; the masking tape can be easily lifted and reused while the transparent must be slit open.

Special food containers help

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(Please turn to page 233)

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I used to be an ordinary 9 to 5 wage slave. I wasted my leisure time watching T.V., playing games, and attending useless social functions. By chance I also read magazines. I answered many advertisements which promised a better way of life, but none of them did me any good, until one day a letter arrived which mentioned the huge amounts of money that could be made in a certain home-operated business. In fact, a U.S. government report stated that some one-man home-operated businesses made \$50,000.00 per year or more. Being a novice, of course I failed in my first attempts. Yet I knew it could be done, so I persisted until I learned a certain inside secret that assures success to anyone who uses it. I learned this from an "old-timer" whom I happened to meet in my quest for a lucrative spare-time business. Later I found that other successful men also used this same secret. I used it myself, and the money began to pour in — thousands of dollars a day. It was a dream come true. People began calling me to ask for advice. Then, I taught several friends this secret, and now they are all doing well. One does even better than I do, but he works harder. He is only 24 years old, and some days he takes in more than \$10,000.00 a day, and rarely less than \$5,000.00 a day. All this in less than one year! In 1975, when I met him, he was practically flat broke. Can I teach you to do the same? I'll do even better than that! I will literally "take you by the hand" if necessary and show you how to operate your own "leisure business" exactly as my successful friends and I do. What's more, I will give you the rights to use the exact programs that I use for a profitable operation. On top of that, I will even show you how to develop your own programs. It doesn't require education. I'm a high school graduate and so are the others. It doesn't require capital. I started out with less than a hundred dollars. It doesn't require luck. I was lucky enough to read about this opportunity and so are you. It doesn't require talent, just intelligence enough to know what to do, and I will tell you that. What does it require? Only one thing — ACTION. And that's what I am looking for in you. I'm not looking for the little fellow who's in big trouble if he doesn't get a paycheck by Friday — perhaps the kids'll go hungry or the wife can't get that operation. Much as I'd like to help, this guy really can't be helped because he's too desperate. He has to make money fast, and to him, fast means (you guessed it) by next Friday.

No matter how good a course or system I offer, he can't make it because he hasn't the intelligence to follow through. Sometimes intestinal fortitude is lacking, but usually he just cannot follow simple instructions.

If you don't have at least \$50.00, I want to avoid wasting your time and mine. I'm looking for the lazy guy who has some money and **wants to make more**, or the working man who is too busy with his own project to start another, yet would like a chance to get into the really **big time**.

If you're my man — here's my plan . . . I have found a system that makes money for anyone who uses it. You wouldn't believe the amounts of money I make with this certain kind of information, but I'll give you a hint: during this past year I regularly took in around \$5,000.00 a day whether I was there or not. I went away to one of the Caribbean Islands for a week, and when I returned there was about \$40,000.00 waiting for me in my mail box.

I know these figures sound unbelievable; I still don't believe it myself. But don't worry, I will send you notarized proof of this and every statement I have made. I don't expect you to take my word for anything. But think about it. Maybe you could live better with \$5,000.00 or more a week.

Okay, I know what your next question is — if the plan works so well, why don't I just work the plan myself? I do, but I'm only one man and I can only do just so much. The market is so vast that I cannot handle it by myself. To keep up with this incredible demand would require my expanding the office and enlarging my staff. Even then I would never penetrate

the market as effectively as I do with independent dealers like yourself. There are other reasons like simple arithmetic — it is better to sell 20 of something at \$10.00 than 3 things at \$30.00. By establishing independent dealers, the sales volume is increased and everybody involved makes money. And by setting you up as an associate I can do just that, if I set you up in a business that makes you over \$5,000.00 per week, or more.

If you want to work harder — and eventually take it over yourself, good. I don't want to run your business; I start you off. Then you run it yourself. In effect I'll make the money for you. After you see the money rolling in — hundreds and hundreds of letters crammed with checks, money orders, cash and cashiers' checks — then you will know it works perfectly. Then you can take the reins, I step out of the picture, and you go on to get rich.

I want you to succeed. I want you to get rich. I intend for you to make it big, because even after I step out of the picture, you will still be making money for me. Sure, I make money on this deal. I'm not in this game for the fun of it. If I told you I was, you'd know I was lying and your faith in me would be destroyed. So, I'm telling you up front I do make money — big money. If you are intelligent, you know it's okay for me to make money as long as you make yours — and you will. How does this plan work? I will send you the complete story. I'll give you names, addresses and telephone numbers so you can verify everything; all notarized facts — how I did it, how my friends and associates did it, and how you will do it. (The complete story, program, samples and examples are actually worth one week's gross, or at least \$5,000.00. I would like to give these to you free also.) But in order to keep out "freebie seekers," I must request a \$10.00 good faith deposit which will be fully credited and refundable towards your investment in our program's promotions. In effect you are getting everything as mentioned absolutely free. But you must prove to me that you are serious, and I have found that the only way that I can know this for sure is if I receive the \$10.00 good faith deposit. I will answer **no one else**. Show me that you have \$10.00 worth of belief in yourself. If this is beyond your means, then I don't want you to waste your time and effort either — because once you read this complete explanatory package, you will want to invest an additional \$50.00 to use my proven sales letters, ads and programs. This fee also includes consultation privileges and other bonuses.

I have no doubt that once you receive this incredible money-making program, it will be crystal clear to you that it would be a bargain at \$5,000.00. And you will know that you would be a fool not to invest the \$50.00 to become my associate and work with me. I know you may want to do this now. But I must

2 FREE GIFTS

For years people like yourself are leading happier lives, making more money, and have become more intelligent because of the valuable publications I have been fortunate to create and distribute through my million-dollar corporations. Now I want to reward you by giving you my innermost secrets of successful living. Your first free bonus gift, the new "HOW TO MAKE MONEY WITHOUT WORKING — AND LIKE IT," shows you a very enjoyable and easy way to make money, the regular price of this report is \$10.00. Your second gift, I'll send you a replica of "Good Fortune Talisman". If it were genuine, it would be worth \$116,500.00. It has to be the most amazing thing you have ever seen. (Since you will want more of these to sell or give as gifts — everyone who sees one wants one — I'll include low wholesale prices.)

make 100% sure I want you. So please only send me the \$10.00 good faith deposit, which is fully credited and refundable, fill out the Request Form and tell me briefly what you expect from your life. If you're a action man, I'll help you.

God Bless You,

Mike DiBiano

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P.S. I want you to know, I truly regret having to insist on even a \$10.00 good faith deposit. But I must make sure this valuable material gets into the hands of deserving people who will use it. Believe me, if you are a person of action, you will benefit enormously. Please do not let the fact that I am giving you two unbelievably valuable free gifts, plus an incredible money-making program that should be priced at \$5,000.00 for a \$10.00 good faith deposit, fool you into thinking that these are not the most valuable things you may ever own. I am giving them away because you probably couldn't afford to pay their actual value anyway, and I want to do you a favor. I fully expect almost everyone to send for this, if he has sense enough to recognize a good thing when he sees it. You are among the unfortunate few who do not, I'm truly sorry I can't help you.

REQUEST FORM

Michael DiBiano
P. O. Box 686 Dept. PM-5
Montclair, New Jersey 07042

Yes, I'll accept the two free bonus gifts you will send to me: (1) "HOW TO MAKE MONEY WITHOUT WORKING — AND LIKE IT" it is my first bonus gift; (2) My second bonus gift is a replica of your "Good Fortune Talisman". If it were genuine, it would be worth an incredible \$116,500.00

I understand both these precious gifts will be sent to me with your latest report, "How I Turn Leisure Hours into Thousands of Dollars", which has a true value of over \$5,000.00. But it is mine just for the good faith deposit of only \$10.00. Enclosed

Name _____

Address _____

City _____

State _____

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NEW ACTION FOOD FOR CAMPERS

(Continued from page 230)

Special plastic boxes have also been designed for packing eggs along.

For group hikes, try packaging complete meals into a set of bags taped together. For breakfast, for example, a powdered fruit drink, instant cereal mix and powdered coffee can be packed as a unit, ready for quick preparation. Bulk buying can also lower freeze-dry costs.

The major drawback of freeze-dried or dehydrated foods is their need for water. If you may have to tap streams or springs, carry a supply of Halazone, germicidal tablets or crystalline iodine and know how to use them to treat cooking water. (If you decide on iodine, be certain you are not overly sensitive to it.)

You are likely to need at least 3400 calories a day while out hiking so menus should be figured and prepared accordingly in advance. Planning to "live off the land" is seldom practical; some days there is no game around, the fish aren't biting and edible vegetation is missing. Well-packed meals are a better bet, supplemented if necessary with vitamin tablets.

To drink or not to drink

Liquor, doctors note, can have a place in packs during the cold months, but like all good things should be used carefully. Three examples explain why:

■ A U.S. Army officer on duty with an Italian Alpine unit was turning into a icicle when one carabinieri noticed his condition and pulled out a standard-issue plastic envelope filled with liqueur. The American drank it and his chill disappeared. This and the following incident illustrate the benefits of moderate use.

■ A camper's van broke down in front of a French farmhouse one bitterly cold day. The farmer brought out a jug of homebrew calvados. Warmed inwardly, the camper quickly completed repairs.

■ On the other hand, two hunters decided to ward off the chill before going out to their blinds and took a number of stiff shots in advance. What they forgot is the open-pore effect of alcohol and the chilling results of evaporation. They nearly froze to death.

Used with care, liquor can have beneficial effects, but if overused it can dull reflexes and make you careless and accident-prone in the field.

What food intake will you personally need to keep you going? Keep track during short trips first and you'll soon have a good idea of your requirements. ★★

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A FLIGHT TO REMEMBER

(Continued from page 83)

observed heading West over Ireland. No one ever heard from them again. Levine's Bellanca was grounded in litigation over disagreements with an airmail pilot he'd hired. Toward mid-May, however, release of the plane became imminent. Chamberlin was to be the pilot. Roosevelt Field hummed with takeoff rumors.

On May 12, Byrd's rebuilt *America* was to be ferried from Teterboro to Roosevelt Field for new test flights and last-minute preparations. Due to wet weather, a heavy roller had just finished compacting the dirt runway to accommodate the huge craft. Crowds that had gathered to watch the much-publicized plane land that afternoon were puzzled by a tiny silver monoplane that circled the field several times and, at 5:30 p.m., let down for a tidy landing. Painted on its bare metal cowl was the name *Spirit of St. Louis*. Beneath a Ryan label, the rudder bore the telltale letters NYP, for New York-Paris.

Byrd gives up airstrip

While people gawked, a lanky, serious-faced young pilot unfolded his 6-foot, 4-inch frame from the cabin door. His whole demeanor changed a lot of minds in a hurry.

Within an hour of the unheralded arrival, Byrd had offered to forgo test hops to release the strip for this young man's transatlantic take-off. Casey Jones, a famed aeronaut of the time, offered to hangar the craft at adjacent Curtiss Field and put crews at Lindbergh's disposal. Critics vanished back into the woodwork. Knowledgeable aviation people at Roosevelt and Curtiss fields realized that this was no neophyte kid or Hollywood publicity stunt.

"Here was an airplane constructed for one purpose: to fly the ocean," wrote Lauren D. Lyman, then a *New York Times* reporter who got an early look inside.

Decided only six months before

Indeed it was. Capt. Charles Lindbergh had decided only six months earlier that his years of barnstorming and piloting mail planes through storms (on four occasions he'd had to "abandon ship" and take to a parachute) would make an ocean hop seem like a breeze in the proper craft. In St. Louis, where he headquartered, he found half a dozen public-spirited businessmen willing to back him.

In December 1926, he registered with the National Aeronautic Assn. for the Orteig prize and went on a research tour scouting for the latest

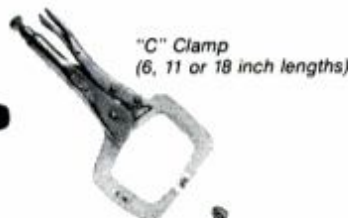
(Please turn to page 236)

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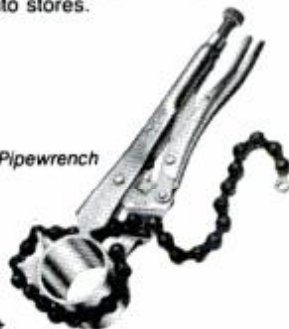
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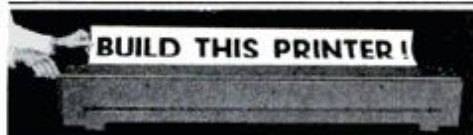
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A FLIGHT TO REMEMBER

(Continued from page 235)

in planes, motors, instruments and the like. By the end of February he knew what he wanted. He flew to San Diego and ordered from Ryan Airlines a special plane "equipped with a Wright Whirlwind J5C 200-hp radial air-cooled motor and Pioneer navigating instruments, including the earth inductor compass." He virtually lived in the plant through the construction period.

He wanted a monoplane, he said, because the absence of airstream interference between wings (a problem with biplanes) would allow it to carry a greater load per square foot of wing surface at higher speeds.

Single engine a must

Wasn't he taking a long chance flying solo? No. There was little likelihood he'd drowse off, he said. He'd be far too busy working his dead-reckoning navigation for a course change every 100 miles—about once an hour—to compensate for wind drift and magnetic deviation in order to maintain a straight-line great circle course. "Besides," he confessed, "I decided to replace the weight of a navigator with extra fuel for 300 miles more range."

Why a single engine? Multiengine craft had that many more chances of engine failure, he pointed out. If it happened early, it would mean dumping fuel and returning for another start. Further, a single-engine craft has less head resistance. His faith in the reliability of the new air-cooled radial engines was boundless. He insisted that chance of motor failure was far outweighed by much better cruising range and "ability to reach the objective in the face of unfavorable conditions."

Unbelievable loads

With Lindbergh on hand daily to answer questions, Ryan crews soon caught the excitement of the project. Working day and night seven days a week, they modified their basic three-place production Model M-2 high-wing monoplane to accommodate unheard-of load and lift requirements. Wingspan was stretched from 36 to 46 feet. To maintain lateral stability, the tail had to be extended back two feet, which threw off the center of gravity, requiring the engine to be moved forward 18 inches. This meant the M-2 fuselage had to be forgotten. They custom-designed and built a new one. The extra weight meant heavier landing gear with high wheel rise to absorb shock.

So it went. Yet, only 60 days after the order was placed, Lindbergh took

his plane on its first test flight. The *Spirit* was airborne in about six seconds within 165 feet, with 400 pounds of extra gear. It hit a top speed of 130 mph—performances well above design specs.

A few days later, flying over mesquite near old Camp Kearney, the pilot's clipboard with pages of vital flight data flipped out the window in a gust of wind. Circling, he watched it flutter into the scrub. Noting a small clearing nearby, he landed at Kearney and called Ryan for a special plane, which he flew in to the clearing. Though visible from the air, the board was hidden on the ground by the thick bush. He tossed a coat atop the mesquite near where the board *should* have been and took off again. It was 20 feet from the coat. But when he went back in the mesquite, it was still hidden. Two flights later, he finally recovered the board with its irreplaceable data.

Wicker chair for a seat

The craft Lindbergh flew to Roosevelt Field on May 12, 1927, was—as he put it—"a plane unlike any built before it." Old-time aviators at Curtiss and Roosevelt agreed. The standard Ryan M-2 had a 50-gallon fuel capacity. This one carried 450 gallons in an array of tanks filling the front end of the plane. The seat—Lindbergh replaced the leather one with an ordinary wicker porch chair to save weight—was almost four feet aft of the normal position. A tunnel was built under the main fuselage tank so his feet could reach the rudder pedals.

There was no windshield—the forward fuel tank filled that area. So the pilot could see ahead, Ryan mechanics installed a periscope through the left side of the plane with a viewing lens extending from the instrument panel. Lindbergh, however, simply stuck his head out the window during landings and takeoffs.

Strange shapes

To shield the gas tanks, Ryan workers cobbled up a cowling, hand-hammered and shaped from bits and pieces of sheet metal. It looked awful until someone got the bright idea of spinning a carborundum disc over the surface to make a shiny pattern of "whirlies" on the surface, which hid laps and rivets.

Beneath the instrument panel were rows of valves and pump handles for hand-pumping fuel from one tank to another. Should an engine fuel pump fail, gas could be wobble-pumped by hand from fuselage tanks to a wing tank, where it would flow to the engine by gravity. Besides, if

the fuel in the nose tank were used first, the plane's center of gravity (CG) would move aft, with serious loss of longitudinal stability. So the pilot was able to move fuel around to compensate. Lindbergh later admitted that he sacrificed stability and let the CG move aft to reduce chances of nosing over in case of a forced landing.

Other innovations in the *Spirit* included her unique (for those days) streamlining. Despite its crudity, the cowling was faired into the fuselage to provide a smooth slipstream. The formed-plywood leading edge of the wing, closely spaced ribs and shaped balsa wingtips insured accuracy of airfoil contour. All external struts were covered by streamlined aluminum fairing to decrease resistance. Even the wire wheels were streamlined with doped fabric crudely laced to the tires along the tread edge. Under identical load, the *Spirit* achieved a top speed 10 mph higher than the Ryan M-2 with the same engine. Minimum speed was 8 mph lower than the M-2, improving stall characteristics.

Bad Atlantic storms

For a week after Lindbergh's arrival at Roosevelt Field the rain never let up and the North Atlantic was black with storms. May 20 arrived dripping, but forecasts were better. The pilot, who'd spent the night checking his course data, was out long before dawn to supervise last-minute installation of a barograph in the *Spirit* at the Curtiss hangar and towing of the plane across to Roosevelt. By 7:40 it was fueled and at 7:52 a mechanic spun the propeller, while more than 1000 people watched from the fences. The engine caught, and he revved it to check the instruments. Two men pushed against the wing struts to help move the overloaded craft on the soft ground. It wobbled precariously through a couple of puddles and slowly, painfully gathered speed while everyone but "Lindy" held his breath. Halfway down the runway he was still on the ground. "It was apparent then I'd clear the obstructions at the end," he said easily later. No one else was that sure. He cleared the parked steamroller by about 10 feet, according to Lauren Lyman, who was hiding behind it (Lindbergh said 15), and telephone wires by less (he said 20). But he was off.

Skimming the earth

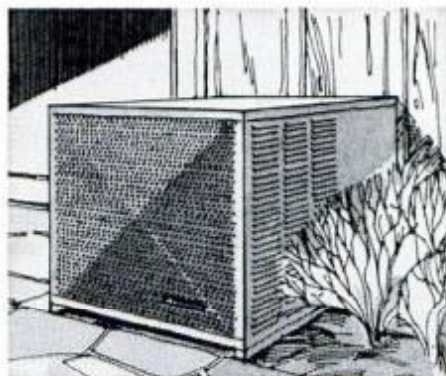
Along the New England and Newfoundland coasts he flew as low as 10 feet above waves and treetops to

(Please turn to page 238)

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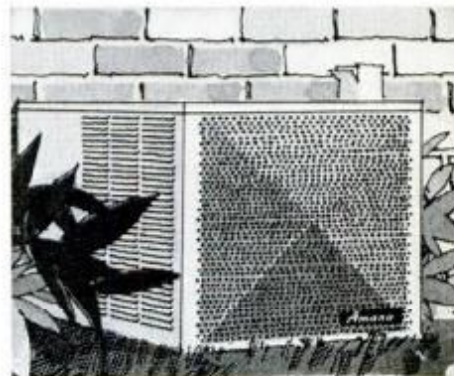
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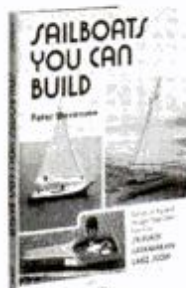
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A FLIGHT TO REMEMBER

(Continued from page 237)

avoid wing and carburetor icing. He was reported over St. John's, Newfoundland, late in the afternoon. When that was announced at Yankee Stadium that evening, 40,000 fans watching a Sharkey-Mahoney fight stood up, bared their heads and prayed for his safe arrival in Paris.

Lindbergh's total cargo for the trip consisted of a box lunch (he ate half a sandwich during the flight), and emergency equipment including:

- 1 rubber raft, pump and repair kit.
- 1 gallon canteen of water.
- 1 Armbrust cup (to condense moisture from human breath into potable water).
- 5 cans of Army emergency rations.
- 1 hunting knife.
- 1 ball of cord.
- 1 ball of string.
- 1 large needle.
- 1 flashlight.
- 4 red flares in sealed tubes.
- 1 match container with matches.
- 1 hacksaw blade.

None of these were ever used.

It's 3610 miles to France

Lindbergh's course was as carefully plotted as everything else. Total distance from Roosevelt to Le Bourget was 3610 miles, but from Newfoundland to Ireland was only 1850. A lot of that distance he flew 10 feet above the whitecaps so he could observe the spray force and direction to figure his drift accurately. With reasonable navigation, he pointed out, he could reach the coast of Europe 300 miles off course and still have enough fuel to reach Paris. He'd studied the coastal terrain so he'd know where he was: Ireland is rugged; England hilly on the coast, France low on the coast and Spain mountainous. Once sure of the country, he could pinpoint himself by rivers, towns and railroads.

Actually, he came in right on the nose. Off a rugged coast (Ireland) he circled fishing boats, his wingtip skimming wavetops, and yelled out the window: "Which way is Ireland?" The fishermen shook their heads in uncomprehending amazement at this madman. He gave up and followed the coastlines.

At 10 p.m. Paris time Lindbergh circled Le Bourget, landed and started taxiing back to the aerodrome. He never made it. The plane was confronted by thousands of people racing toward it. He quickly cut the switch so the prop wouldn't massacre them and got out to draw their attention from the plane. His feet didn't touch the ground for an hour.

(An earlier nonstop transatlantic

flight was successful, but Lindbergh was the first to make a solo crossing and first to fly from New York to Paris. In 1919, Capt. John William Alcock and Lt. Arthur Whitten Brown made it from St. John's, Newfoundland, to Galway, Ireland, in a twin-engine Vickers. An even earlier crossing was made by a U.S. Navy crew in a Curtiss flying boat, but this was not a nonstop flight.)

There's a new Spirit

This month Lindbergh's historic accomplishment will be uniquely celebrated. A replica of the *Spirit* has been built from original blueprints by the Experimental Aircraft Assn. (EAA), a society of aeronautical engineers and enthusiasts. EAA members Paul and Tom Poberezny, famed for their engineering skill with unusual planes, are overseeing the project to insure authenticity. Engineer Mike Heuer is in charge of the construction.

Some variations from the original are needed to conform with modern FAA regulations. Landing wheel brakes and tail wheel have been added. Plexiglas replaces the cowling for visibility but, says Heuer, "this will be replaced by 'whirled' metal when the plane is on display." Radio and VHF navigation equipment have been installed, along with a single 130-gallon wing tank. "This will enable the pilot to sit up front; there will be a seat behind for a passenger," explains Mike Heuer.

St. Louis celebration

The new *Spirit* will take part in a 50th anniversary celebration of the Lindbergh flight, featuring an air show, banquet and presentation of the first "Spirit of St. Louis Aviation Award" to "a person whose life and career have made a significant contribution to the advancement of flight." All of it will happen during the weekend of May 20-22, sponsored by a group of St. Louis civic leaders. Then the new *Spirit* will be flown on a duplicate of Lindbergh's July-to-November national tour following his return from Paris. Lindy's tour was designed to demonstrate the viability of a fledgling aviation industry. The new tour, funded by the St. Louis group sponsoring the celebrations, not only will put an exclamation point to that concept, but will emphasize how far aviation has come since Lindbergh's spectacular transocean flight in 1927.

Meantime, anyone interested can see the original *Spirit*, still intact. It's hanging just inside the entrance of the Smithsonian Institution's new Air and Space Museum, on the Mall in Washington, D.C. ★★

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BEST NEW BOATS FOR BASS

(Continued from page 85)



B.A.S.S. Champ afloat shows aluminum hull with modified-V design that allows soft, safe but fast ride with only 35 outboard horsepower pushing the light rig to 35 mph.



Newest from Grumman, the 3.8 (meter) model meets the latest level flotation requirements and takes a 10-hp motor. The aluminum hull has V-form with strakes.



Glastron rates all-new 17-foot, high-performance HP-171 at up to 140 outboard power. Built-ins include two live-bait wells, foam-insulated ice chest, foam flotation.

footing. Note if it has foam installed out of sight for sufficient upright flotation as well.

Even a low-priced model should offer a control console with wheel steering; for adequate safe control, no outboard of over about 20 hp should be tiller-steered in a small boat. The console should also have space to mount a fish finder, and the foredeck will need space to mount an electric outboard.

Converted johnboats with added swivel seats and a name change are not the answer. So flat-bottomed that they're likely to pound in even a gentle chop, the johns and simple skiffs are fine for their drift and troll-speed duties but are less satisfactory for chasing largemouth lunkers in comfort when it's necessary

to cover a lot of lake miles to find the likely holes.

Newcomers

But this new trend to lesser cost and power will let a lot of new fishermen join the bass-chaser ranks and there is no reason that the money saved cannot be invested in popular new gear like meters to read the vital oxygen percentage in the water, underwater scanners and recording printout depth finders, CB radio or even VHF marine models, selective 12 or 24-volt electric trollers, electric anchor winches, fancy built-in cabinets, Navy tops and the rest.

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FASTEST INDY EVER!

(Continued from page 91)

rain-shortened event of last year.

Penske's prediction

Roger Penske, on the other hand, walks right out to the edge of the limb with: "Conditions being favorable, I'm sure there'll be people over 200 mph. In fact, I think the front row will all be over 200 mph!"

Ironically, the new McLarens will look something like last year's Eagles, a design which builder Dan Gurney is abandoning for 1977. Gurney's new Jorgensen Eagle for Pancho Carter will be a slimmer car with radiators moved back into the nose (see *Imports and Motorsports*, page 16, April '77). "It looks like it's going to be fast in the corners as well as on the straight," confided Gurney after early testing at Ontario. "Our intention is to be able to be the fastest of the new crop of cars."

Certainly one of the most famous names in Speedway history is Parnelli Jones who as a young man was the first to break the 150-mph barrier 15 years ago. Now appearing as an entrant instead of a driver, Jones will be fielding cars that are updated versions of last year's Parnelli-Cosworth.

It was Jones's team that conceived the idea of running a turbo-Cosworth on the United States Auto Club trail, a series of races that includes the Indy 500. Like the McLaren M24, the Parnelli was influenced heavily by a Grand Prix car, in this case it was the Parnelli driven by Mario Andretti during the 1975 Grand Prix season.

Two-time winner Al Unser scored two victories with the Parnelli-Cosworth last year including a 500-mile event at Pocono.

Does the man who first went 150 mph at Indy think someone can go 200 mph? "It depends on a lot of things," says Jones, "but I don't think it can be done. Well, let's say this," he adds, "I don't think it can be done legally."

A major contender

Always a contender, the irascible A.J. Foyt will be driving a car with an engine carrying his own name. The Foyt engine, like the Cosworth, is a V8 that was designed with Ford money several years ago. His cars, called Coyotes and sponsored by Jim Gilmore's broadcasting empire, seem to be struggling to keep up with everyone one year, then simply fly away from competition the next.

Will A.J. bring a new Coyote-

(Please turn to page 242)

Here's How Herman Builds a Better Boot

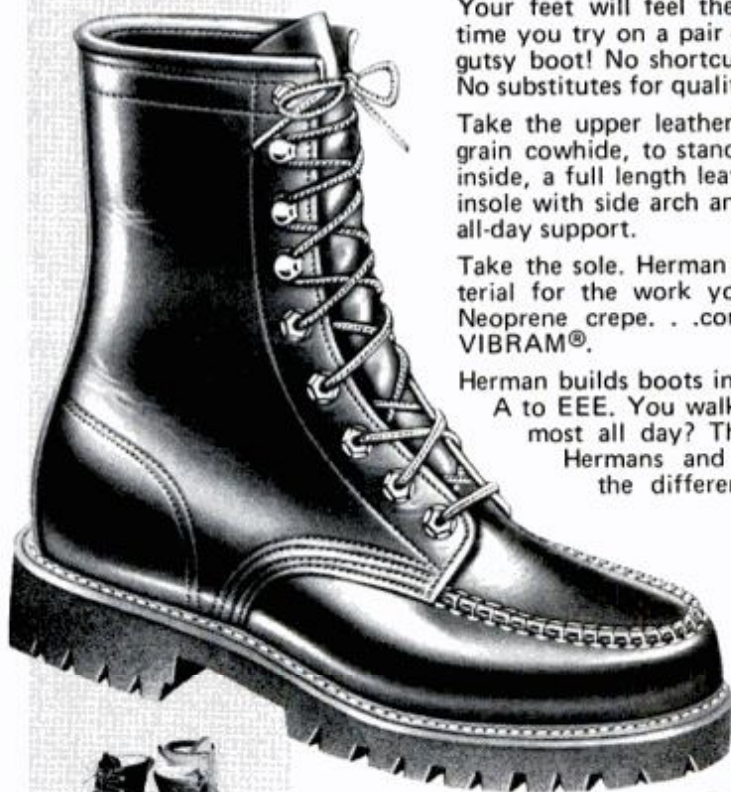
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FASTEST INDY EVER!

(Continued from page 241)

Foyt to Indy this year? Well, no one's entirely sure, but everyone knows that A.J.'s got the stuff to be either the first man to go over 200 mph at Indy or the first man to win a fourth Indy 500. Or both.

Janet Guthrie's car

Lest it be thought that the famous four-cylinder Offenhauser engine is dead, consider the fact that Roger McCluskey eased his Lightning-Offy up to 198.7 mph in tire tests at Indy last summer. That car, by the way, has been sold to Rolla Voldstedt for Janet Guthrie to drive. This could be the year that Tony Hulman has to abandon that famous and dramatic line, "Gentlemen, start your engines!"

McCluskey will be at the helm of a brand-new Lightning, as will two-time winner Bobby Unser. The new Lightning cars were designed by Roman Slobodinskyj who did the current crop of Eagles for Dan Gurney (but not the new one), and there could be as many as seven of them at the track this year.

The Wildcats

Not to be left out are George Bignotti's creations. They're called Wildcats and will be driven by Wally Dallenbach and 1976 USAC National Champion Gordon Johncock. Gordo, Indy winner in 1973 in a Bignotti-prepared Eagle, had the Sinmast-sponsored car in the middle of the front row last year so it's a proven fast car.

"They're going to go 200 mph at Indy, but it won't be during May," says Bignotti. "I think it'll be during the off-season when the weather's cool. Unless it's a very cool day, I don't think we'll see 200 mph."

More blown engines

Most everybody agrees that the removal of the pop-off valve during the race is going to mean more blown engines and less car-to-car dicing because a driver can dial up a little more boost to whiz away from somebody who's closing. But at the same time, he risks overstressing his engine.

And 200 mph? Well, it could happen. But it's going to take an optimum day—cool, no wind—and a perfect lap to do it.

But the driver who does it will carve a special place for himself in the record books. And there are going to be at least a dozen drivers at Indy this year shooting for that record. ★★

TENNIS RACKETS

(Continued from page 96)

graphite or composite rackets.

■ **But pros always hit the ball with the center of their racket strings.** Tennis racket manufacturers seem to think so, but the pros themselves often disagree. "Hardly anybody, amateur or top tournament professional, can consistently hit a ball with the center of the strings," says Vic Braden. "It's so unusual that I remember years ago when Pancho Gonzalez and I walked into the Chapultepec Tennis Club one day both of us stopped in our tracks because Rafael Osuna, the great Mexican player, was practicing and he was catching the ball dead center time after time. That's very rare."

■ **Then I should play with the racket my favorite pro uses.** There's no telling, but it's certainly not critical. Your favorite pro could probably play and win with any of a dozen rackets. Some do, almost; Swedish star Bjorn Borg uses a Bancroft racket when he plays in the U.S., a Donnay model in his European appearances and a Slazenger in Australian tournaments, because he gets paid hard cash for it. In addition, professionals often string their rackets very tightly; the same racket more loosely strung for an average player's game is a different animal.

■ **Graphite rackets "damp" vibrations.** Their manufacturers make that claim, but it's relative and perhaps, depending on the particular racket, even false. One of the problems is that manufacturers bench-test rackets that are firmly gripped by a vise-like support, and the reaction to shock is entirely different than it might be in actual play.

"In play," notes Gideon Ariel, "the racket and the player's arm rotate as a unit from the shoulder, and among other things this establishes the racket's center of percussion at somewhere down on the shaft, near the throat, *not* in the center of the strings, on the so-called 'sweet spot.' So, because the ball strikes any racket at a point other than the center of percussion, vibration pattern resonances result, and the behavior of the racket is often unpredictable. In our computer simulations showing vibrations transmitted to the racket grip, some of the graphite rackets were *worse* than other kinds."

Right now, there is so much disagreement on the role of vibration in tennis elbow, and investigation is in such a preliminary stage, that the player pretty much has to experiment for himself if he is prone to the condition.

The medical profession tends to recommend a flexible (metal) racket to absorb initial shock; researchers like Ariel say what happens to the racket after the initial shock, after the ball has left it, may be more of a factor in causing tennis elbow than the impact itself. When it comes to vibrations, "similar" materials—metals—are least effective in damping and actually amplify vibration, while "dissimilar" materials tend to damp them. Few are more effective than that natural composite of cellulose and resin we call wood.

■ **But wood rackets get worn out, mushy, after a while.** Maybe so, but it takes a lot of hitting tennis balls before that will happen. Roy Emerson tells participants in his tennis clinics a favorite story about the great Aussie player of 30 years ago, John Bromwich. "Bromwich played with a beat-up old wood racket strung like a fishnet," says Emerson, "and won with it, much to the dismay of his sponsors, the Slazenger people."

"One day, after running through an opponent, 6-0, in the first set, he broke a string on the old bat and they rushed a new one out to him. Bromwich easily closed out the second set, 6-1, but when he lost that one game you could see his expression change. Barely maintaining control of himself, he finished the match, stormed off the court cursing his 'bloody new racket' and then immediately threw it away."

For most of us "intermediate" (or struggling to be) tennis players, the point should be clear. Of the several courses open leading to improvement in our play, buying a new racket seems to offer the lowest percentage. Hitting the ball, even perfectly, is after all only part of the game. And while more research into tennis elbow and related afflictions is sorely needed, all authorities agree that poor stroking technique—not faulty rackets—is the leading cause among amateur players.

"In our studies among hundreds of students of the game," says Vic Braden, "I've found only one occasion where a significant improvement in play can be related to equipment. That's when you break your racket and have to borrow one. Quite often there's an immediate lift to your level of play; we attribute it to relaxation—the pressure's off, you can't be expected to perform well with a racket you're not used to, and so forth. We also find this lift lasts about as long as it takes you to go out and buy a racket just like the one you borrowed, then you're back to your old game again."

In tennis, it seems, technology is no panacea. ★★

AMC'S WAGON

(Continued from page 92)

car, but this Pacer wagon tops them all. It's the ultimate in design—utilizes every inch of interior space. I think it could have a little more powerful engine, but I'm getting 15 to 19 mpg, which is pretty good. The car is well put together—hood, doors, hatch fit almost perfectly. The paint job could be better, though. The design width, short wheelbase, visibility, riding comfort, utility—I don't see how they can improve on it."

A New Hampshire machine designer adds, "I wanted a small wagon for a change and consider the Pacer the best-built, roomiest and most comfortable. It's extremely well designed, with good, rugged construction when compared with other small cars. I'm comfortable in it (I weigh 250), appreciate the rack-and-pinion steering, get good mileage compared to my Impala, and although it's a little light in the rear it performs well in snow. About the only thing they can do to make it a better car would be to raise the brake pedal one or two inches. I keep getting my foot jammed under it."

And an Ann Arbor art professor opines: "It's fun to drive, sporty enough to appeal to our teen-agers, has excellent vision, and starts perfectly in below-zero weather. I've always liked AMC products—drove a Pacer as a loaner and thought it was excellent. I'm very pleased with the car."

From an Arizona retiree: "The Pacer is in

◀ This is about average. Some 28 percent said they'd expected better.

Wide doors surely help, and you don't get all tangled up in harnesses.

◀ Dealer service and sales departments got high marks generally.

◀ Even backing out of driveways, you don't have to worry about not seeing low obstructions.

a class by itself. Its styling is so different that a person either likes it or hates it at first glance. All other American cars are 'me-toos,' and for \$5000 we wanted a different-looking, good, basic car, not just a different paint job. Overall quality is excellent. It needs bumpers, though, that aren't paper-thin and weak, so we can mount a hitch to them. Very easy to get in and out, easy to unload; quiet engine at any speed."

A California engineering design manager: "I enjoy the Pacer's handling and looks, and I think that, being Number Four, AMC tries harder to please the public. Workmanship is good, but the carpeting on the rear liftgate ought to be stapled on better. Comfort rates excellent front and rear. My greatest complaint is with the dealer, who seems to do more harm than good, especially on warranty problems. My rear U-joint clanks going into reverse. The dealer tells me he'll fix it, but when he fixes one thing he damages another due to carelessness—scratches the paint, etc. I rate the car's general engineering good, but the local dealer has a way to go."

A 27-year-old full-time student in Houston, Tex.: "The futuristic design really got me—no other car looks like a Pacer. The power steering went out soon after I got the car. The dealer replaced the whole unit—a one-day job—and I was given a loaner. I'd rate the dealer about the best in town. And the car has lots of room inside, gets good gas mileage, handles great, rides like a big car. I have no complaints—I like the Pacer." ★★★

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KEEP IN TOUCH FROM ANYWHERE

(Continued from page 100)

Unlike almost anything else, the cost of this service has been getting cheaper. In New York City, you can now get on the beeper for \$9 per month if you own the equipment, or \$25 if you rent it. With nearly 600 radio paging companies now in the United States, and with more than one company often serving the same area, competition is likely to keep costs low despite rising demand. Only the price of the paging receiver, at about \$250, remains stiff. But even that figure may soon come down as major manufacturers, such as Motorola, gear up for mass-production in response to recent surveys projecting an enormous beeper boom. Now there are about half a million beepers in the country, a figure expected to triple by 1980.

Tomorrow's message

Even today's advanced paging technology seems dated to engineers already designing tomorrow's equipment. The next step will be a paging receiver capable of sounding different signals to convey different messages. One kind of sound pattern may mean "call the office." Another, "call home," and so forth. To code the pre-arranged message into the signal, the caller will hit an extra digit on the touch pad after punching in the call number. Another item now on the planning board is a pager that displays the calling number in an LED read-out, like a pocket calculator. Finally, paging companies may arrange networks of linked transmitters to form a nationwide paging service capable of locating any subscriber anywhere.

Technology is also changing fast for car telephones—the chief form of radio-extended phone service. For one thing, all car phones are fully "duplexed" now, meaning that you can listen and talk at the same time without using a "push-to-talk" button. Another recent improvement is a scanning system known as IMTS. Before that, you had to keep pushing channel-selector buttons to find an empty channel. With IMTS, your equipment constantly scans all channels operating in your area, so when you lift the handset to make a call, you automatically get on the next channel coming free. The same kind of scanning is used at the base station for sending out calls to moving cars, assuring optimum use of channels. "All the phones I install nowadays," says Thomas R. Morgan, president of New York's Car Telephone Corp. "are equipped for IMTS."

Traffic jam

Even so, in the larger cities, traffic is so heavy on available channels (six on VHF, six on UHF) that you have to wait for months to get a number assigned for your car phone. A total of about 25,000 people, nationwide, are on the waiting list. That is because most car-phone companies limit the number of phones to about 70 per channel, so you don't constantly get busy signals. Some companies, however, notably in California, put no limit on the number of phones per channel. The result is heavy channel congestion and long waits for getting car calls through.

To break this bottleneck, the Bell System is now testing a new kind of radio link with car telephones. Instead of beaming signals to cars over a wide area from a powerful central transmitter with a high antenna, Bell is spotting low-power transmitters with low, directional antennas all over the service region. The signals from each of these are confined to a small area called a "cell," ranging from one to eight miles in radius, depending on local conditions. Nearby cells can therefore use the same channel for different calls without mutual inter-

ference, thus multiplying the capacity of each channel.

As a car travels from cell to cell, a locator signal sent out by all cell transmitters triggers a transmitter in the car. The car-emitted signal hits strongest on the nearest cell receiver, telling the computer at the base station the best signal routing for calls to the car. Calls from the car automatically establish the signal path via the nearest base receiver, which selects the strongest incoming signal. Thanks to the "capture effect" of an FM receiver, the car phone locks on the strongest nearby base station and blocks out weaker signals on the same channel operating in other cells. As the car moves to another cell area, the base computer automatically switches the call to a free channel there. The caller will never know the difference.

With the present large frequency allocations (a radio spectrum space of 40 MHz) for this service, Bell expects to have 666 voice channels. With a total capacity for several hundred thousand cars, Bell hopes to wipe out the waiting lists as soon as cellular service goes into operation. Within five years, Bell expects to have the cell system working in the 25 largest cities, where demand for car telephones is heaviest. Bell hopes to interconnect this service in such a way as to permit direct dialing to and from car phones on a nationwide basis.

One-hand pushbutton

Car sets themselves have lately become more sophisticated. For example, Motorola's latest model, the Pulsar II, features one-hand operation with pushbutton dialing. It also has a built-in memory that "remembers" the dialed number, seeks a free channel, and automatically puts your call through when it finds that channel. You don't even have to dial the complete number. You can program the phone to pulse out frequently called numbers by just pushing a two-digit code. The current cost of car telephones—about \$2000 to buy one or \$80 per month to rent—is also expected to drop with increasing sales volume.

The development of the cell system with its high call capacity already has telephone engineers talking about portable personal phones, much smaller and lighter than the unwieldy 24-pound briefcase telephones introduced a few years back. Though it hasn't yet been produced, recent advances in microcircuits make the personal pocketphone a strong possibility. That will be the ultimate keep-in-touch device.

Hams are ahead

Amateur radio operators, who have pioneered radio developments for 75 years, already have tiny hand-held battery-portable two-way radios which permit telephone calls even while walking in a woods, on the seashore or wherever hams want to talk.

Many hams have equipped their portables, as well as car two-way radios, with tone telephone dials. They have built systems into their VHF and UHF repeater stations which automatically can switch a ham's signals into a regular public telephone line so the amateur can call another ham or make any other nonbusiness telephone call. Most of the 2000 ham repeaters have such "autopatch" devices.

Of course, such ham calls are not private and can be heard by anybody with a receiver capable of tuning the two-meter ham band. Since repeaters are built and maintained by local ham clubs and individuals, long-distance toll calls usually are electronically locked out by controlling operators.

Motorola is testing similar gear which would be rented for walk-around phoning, but, as of now, telephone use away from fixed-base locations by the public is limited to in-car installations. ★★★

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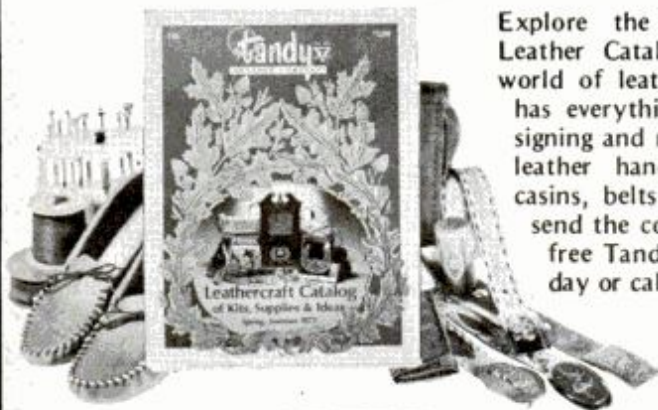
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GREAT VACATIONS

(Continued from page 103)

float trips for Montana, Idaho and Wyoming outfitters.

OZARK FLOAT TRIP

Floating a scenic Ozark river in a canoe or jon boat is one of the most relaxing and rewarding outdoor experiences that I know of. Missouri streams, such as the Current, Jacks Fork and the Eleven Point, are clear, fast-moving waterways which wind their way through green hills, beneath tall limestone bluffs, and are refreshed throughout their course by hundreds of sizable springs.

Outdoor skills are not necessary on expeditions of this sort. With a little practice, almost anyone can learn to guide a canoe through the shallow rapids of these Ozark streams. Someone in the party should know a little something about camping, preparing camp meals and selecting a suitable campsite.

Required equipment is minimal. You'll need a grub box for food and cooking equipment, and one or more ice chests to store perishables. Some floaters tote along tents, but a plastic tarp strung overhead keeps off the dew just as efficiently. Each person should also have a sleeping bag, an air mattress or two-inch foam mattress, and a few items of clothing and personal effects. The latter should be stored in plastic bags or other containers capable of keeping out water in case of an occasional dunking.

Gear Distribution

All of this gear should be disbursed among the canoes in the party and stored so it will float free in case of an overturn. One canoe, designated as the commissary craft, should carry the grub box and coolers and be piloted by the best canoeist in the group. Other required equipment is furnished by the outfitter—aluminum canoes or flat-bottomed jon boats, paddles, and the trucks to haul you and your gear back to your access point.

The floating season in the Ozarks commences in May and continues until late autumn. Greater care should be taken in the selection of campsites at this season because river rises can submerge low-lying island or gravel bar sites. Summer means warmer days and mild nights and more canoe traffic. If possible, plan your float in the middle of the week at this season. Autumn, with its colorful fall foliage, tranquil stream-flow, and good fishing conditions is perhaps the best season of all.

Last, but not least, is the fact that an Ozark float trip is one of the best

vacation bargains I know of. For instance, the average outfitter rents canoes for around \$8 per day, and charges \$12 to \$20 to pick up the first canoe and a greatly reduced rate for other canoes in the party. Hence, a party of six can take a three-day float trip utilizing rental equipment of this sort for less than \$20 per person. Even after adding food costs, travel, and the cost of a few miscellaneous items of equipment, this type of do-it-yourself vacation is still unbelievably low in cost. For more information contact: Missouri Tourism Division, Box 1055, 308 E. High St., Jefferson City, Mo. 65101. For canoeing in wilderness areas in other parts of the country contact: Maine Wilderness Canoe Basin, Box F, Springfield, Me. 04487; Gunflint Wilderness Outfitters Assoc., Box A-100, Grand Marais, Minn. 55604; Ely Chamber of Commerce, 30 S. First Ave. East, Ely, Minn. 55731.

FLY-IN FISHING TRIP

Most serious anglers who fish Canadian waters know that the fly-in locations usually produce more action and larger fish than the places which can be reached by road. There's no mystery about this fact. A trophy-sized pike in the 20-pound category takes a decade to reach these proportions, and it doesn't take much fishing activity to eliminate these lunker-sized specimens. So it pays to get off the beaten path in Canada for best fishing results.

Canada has a number of fine fly-in fishing camps which offer good fishing, comfortable accommodations, and trained guides, but there's a "catch" to these fishing hotspots just the same. The going rate at these better fishing camps is \$100 per day per person, and that doesn't include the fly-in charter flight, tips for the guide, and other miscellaneous expenses. With these expenses added, the tab for a week of this type of fishing is usually no less than \$1000 per person.

But, there's a way to beat this high cost of Canadian fishing.

White River Air Services is one of several dozen small float plane operations servicing northern Canada, and most of them are now offering excellent fishing for a fraction of the previously mentioned rate. This outfitter for instance, offers a week package which includes fly-in transportation, comfortable housekeeping accommodations, a boat or canoe for each two persons, outboard motors complete with fuel, and the other miscellaneous equipment needed to live in the north woods. The price for this package ranges from \$159.50 with tent

(Please turn to page 248)

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GREAT VACATIONS

(Continued from page 247)

accommodations to \$199.50 for a comfortable housekeeping cabin located on the shore of a remote wilderness lake. All the angler has to do is provide his own food (which is flown in for him), tackle, and other personal items. Of course, he's got to clean his own fish, stoke the stove with firewood, and do a little cooking, but these are the types of chores that make a wilderness expedition of this sort more rewarding.

The season in this part of the world commences shortly after "ice-out" in May and lasts through September. Early fishing is usually excellent because the pike, walleye, lakers, and speckled trout are usually ravenous after their long winter fast. But so are the black flies. These pesky biting insects are most plentiful during the early Canadian spring, and can make life a mite unpleasant in some areas.

Fishing is fair to good in mid-summer, depending on weather conditions, and is usually excellent again when the nights grow chilly enough to put a skim of ice on the water bucket. For more information contact: White River Air Services, Ltd., Box 220-B, White River, Ontario, Canada; North Ontario Tourist Outfitters Assoc., Box 200, Alban, Ont., Canada POMIAO; Jack's Air Service, Box 584, Greenville, Me. 04441; Northern Wilderness Outfitters, P.O. Box 98, Ranier, Minn. 56668.

HOUSEBOAT HOLIDAY

For the ultimate in a leisurely, care-free vacation, this is the way to

go. A houseboat holiday is particularly suited for a family of four or six, but is equally attractive for two or three young couples who share craft rental and food costs. Under such circumstances, the cost for a week's vacation is less than \$150 per

An extra-do-it-yourself vacation idea

Covered wagon trips

For those with the pioneer spirit, there are trips in prairie schooners over prairie sod and mountain trails in Montana, South Dakota, Utah and Kansas. You sleep under canvas on the wagons or under the stars on the ground in sleeping bags. Prices range from \$25 to \$90 per day depending on trip length. For more information contact: Wagons Ho, Box 74, Main St., Quinter, Kans. 67752; Buckhorn Ranch, Box-84-B, Eureka, Mont. 59917; Dakota Wagon Train, Western Travel Merchants, P.O. Box 1570-BB, Cody, Wyo. 82414; L.D. Frome's; Box G, Afton, Wyo. 83110.

person in a party of six and this is a bargain by any standard these days.

These floating vacation homes are available from California to Florida, where facilities are located on lakes or waterways with plenty of cruising room. In Florida, for instance, you can cruise the Intracoastal Waterway, with its posh marinas and fine waterside restaurants. You can poke around in Lake Okeechobee, which offers excellent bass fishing as well as serene wilderness surroundings. Or you can explore the Florida Keys, a great snorkeling and fishing area.

Houseboating is big in Kentucky and Tennessee. In New York you can spend a leisurely week cruising among the Thousand Islands. Several marinas in Minnesota and Missouri offer houseboats for rent, and out in Arizona you can rent a houseboat and cruise through the awesome painted canyons of Lake Powell. These are just a few examples.

The average rental houseboat is 32 to 40 feet long and sleeps six to eight persons in comfortable bunk beds. There is a convenient galley for food preparation, a marine toilet, hot water, refrigerator—virtually all the comforts of home. Usually, propane gas is used for cooking, to operate the refrigerator, and in some cases for lighting as well. Most rental houseboats also have both a 12-volt and 110-volt electrical system.

Houseboats are almost as easy to operate as the rental outfitters say they are. Most offer instructions and a short shake-down cruise to familiarize everyone with the controls and equipment operation.

Houseboats, depending on their size and the outfitter, rent from \$300 to \$450 per week and include everything except fuel and food. Discounts are usually offered for the second week and during off-season periods. Considering the fact that these craft sleep six to eight persons, and that youngsters can sleep two-to-a-bunk or in sleeping bags on the front deck, a vacation of this sort is economical on a per-person basis. For more information contact: Lake of the Ozarks Assn., Lake Ozark, Mo. 65049. Worldwide Yacht Charter and Boat Rental Guide, 18226 Mack Ave., Grosse Pt., Mich. 48236.

Some people really dig Britain

Young American archaeological buffs are discovering that for every dig in America there are hundreds in Great Britain. Foreign diggers are welcomed to sites in Britain, and an American can help unearth the Bronze Age ring ditches at Roxton, Bedfordshire; muck about on a Roman site at Mucking, Essex; explore the ruins of Gorey Castle on Jersey in the Channel Islands; or assist in excavating neolithic chambered tombs on Scotland's Orkney Islands. Some digs provide housing or camping arrangements. Some pay subsistence wages, but it is scarcely financial reward that the diggers are after.

No experience needed

The digs are almost as popular with girls as they are with boys, and those in their middle years try their hand with trowel and brush as well.

by Richard Dunlop

In order to be covered by British insurance, the diggers from America must be at least 18 years old.

A volunteer digger need not have any experience in archaeology, but he must have a serious interest in the scientific purpose of the dig.

The working day at a British dig lasts from seven to eight hours with time off for lunch and two short tea-breaks, mid-morning and mid-afternoon. At some sites, particularly in more remote places, the diggers camp, but usually hostel accommodations are provided. In most places bed-and-breakfast guest houses are available for those who want more comfort and have the means to pay for it. Generally there is no pay provided, because the digs are all financed in different ways. However, some diggers can earn about \$30 a week to cover basic expenses. Expe-

rienced diggers can command a bit more money.

If a digger plans to camp, he is usually expected to provide his own sleeping bag, knife-fork-and-spoon set, mess kit and other personal equipment. In any case, he is urged to bring along old clothes, warm and waterproof garments both for use on and off duty.

Take your pick of sites

There are so many digs going on in Britain that a volunteer digger can virtually take his pick of sites. To know what is going on at a given time it is necessary to write to the Council for British Archaeology, 8 St. Andrew's Place, London, N.W. 1, England.

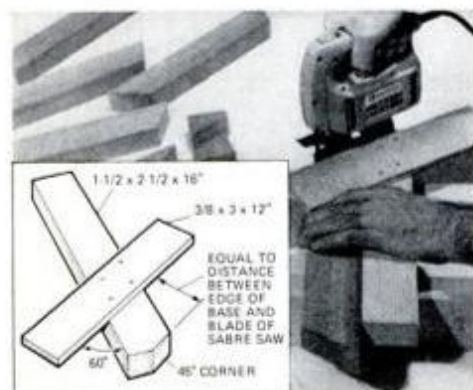
A digger stays on a site at least three weeks, though one month is an average stay. ★★★

ADD-ON BARBECUE TABLE

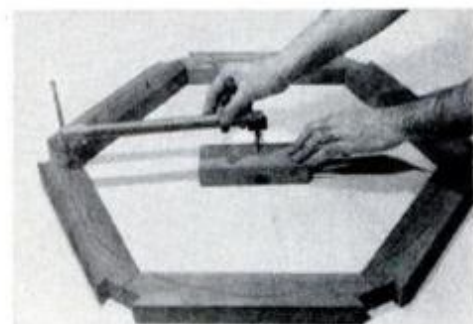
(Continued from page 107)

You'll need about 98 ft. of 2x3-in. construction heart redwood. The lumberyard can rip 2x6s if needed; you can lower the wood cost 40 percent by using western red cedar, also good for outdoor use. Other materials used are $\frac{3}{8}$ -in. exterior-grade plywood for gussets, epoxy or resorcinol waterproof glue, 3-in. hot-dipped galvanized finishing nails, 3-in. and $1\frac{1}{4}$ -in. galvanized common nails and wax paper.

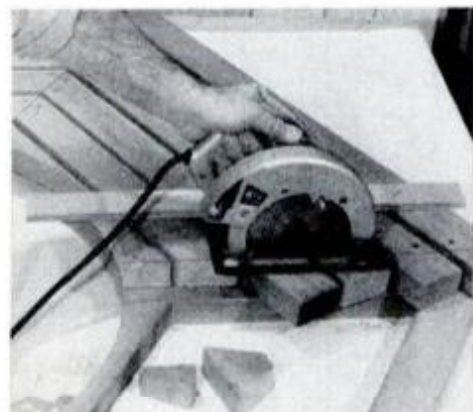
The only tools you need are a sabre saw, circular saw, drill, hammer, beam compass, sliding T-bevel, $30^\circ/60^\circ$ triangle and a rule. A simple jig



Use a jig to cut the mitered ends. Two 2x4s on edge make a good work surface. Set-tooth blade helps assure straight cuts.



A beam compass set at $12\frac{1}{2}$ in. pivots at the center-marked block, marks curve that's to be cut to accommodate brazier.



Circular saw shoe rides against tacked-on guide strip to cut diagonal joints. Set blade so that it won't cut frame below.

(below) helps miter the boards.

Begin by using the triangle to sketch the full-size pattern of half the frame section. The sketch will help you align the hub and spoke parts of the frame accurately, later.

Cut mitered ends for the six hub pieces using the jig and sabre saw. Use this jig to make left and right-hand miters by turning the stock over as required. Also use it to make $\frac{3}{4}$ -in. partial cuts parallel to the miter cut. Make the $1\frac{1}{4}$ -in. middle cut freehand to cut off waste.

Joining the hub

A fast-setting epoxy such as Devcon 5-minute Epoxy is good for joining the hexagonal hub together. Just position two alternate pieces and tack-nail them onto the worktable. Insert wax paper under the joints so the pieces won't stick to the table, then apply epoxy and push the middle piece in place. Leave this first half of the hub tacked to the table to use it as a guide for assembling the second half, but don't glue the halves together as yet. Position the halves together. Then place a scrap block in the center and locate the center mark of the hub by intersecting each joint with a straightedge.

Use a beam compass set at $12\frac{1}{2}$ -in. to draw a center circle cutout where the brazier will be placed. Cut along the curve with a sabre saw, then epoxy the two hub halves together.

Cut spoke pieces to length and use two 3-in. finishing nails to join each to the hub. Cut five rim sections with notched ends, bore small pilot holes and nail rims to the spokes.

A simple way to add the decking is by cutting only one set with both ends mitered and installing it on the rear center section. Use 3-in. common nails, two at each end, and bore pilot holes to avoid splitting the wood. Then cut one mitered end for the next six-piece section of decking and butt it against the first section. Nail it in place, leaving the free end overlapping the next spoke slightly. Repeat this for the remaining four pieces in that section. Tack-nail a straight strip of wood to serve as a guide and use a circular saw to cut off the waste ends.

Repeat the process for the remaining deck sections.

Adding gussets

Turn the table over and make the reinforcing gussets from $\frac{3}{8}$ -in. exterior plywood. Cut leg parts and assemble with glue and nails to form a T. Then glue and nail the top of the T to the table frame. Now the table can fit your brazier. ★★



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country travel—very easy to cover 700 miles in a day." An Oregon teacher says, "I am 6-2 and my son is 6-0. We both have plenty of room in the front or back seat of the car."

We asked owners to list specific likes about their Accords now that they've had a chance to live with them. From an Illinois pension actuary: "It's fun to drive; all those standard features, including the no-cost AM/FM radio, rear wiper and so on; good gas mileage; its lack of a catalytic converter; front-wheel drive; four-wheel independent suspension."

Most owners like front-wheel drive, but a few noticed torque steer on hard acceleration.

Combine this with superb workmanship and you'll see why Accord owners rave.

A Nebraska housewife: "Easy handling in traffic and parking; good mileage; front-wheel-drive roadability and traction in snow; comfort; appearance."

An Air Force officer stationed in England: "I like the automatic maintenance reminders for oil, filter and tires—a small item but one example of Honda's attention to detail. Also the door and brake-warning-light diagram is nice."

A California airline pilot: "I appreciate the engineering sophistication, the quality of execution, economy of operation, roadability, performance, handling and brakes."

(Please turn to page 254)

Summary of Honda Accord Owners Reports*

Total miles driven	2,441,671	What changes would you like?		Had any mechanical trouble?		Number of vehicles owned:	
Average miles per gallon:		Choke warning light	23.4%	No	57.3%	Accord only	34.7%
In town (EPA, 38 5-sp. man.)	27.3	Better radio/antenna	5.1	Yes	42.7	Two cars	52.0
Long trips (EPA, 48 5-sp. man.)	33.1	Different seat shape	5.1	What type of trouble?		Three cars	10.8
Why did you choose the Accord?		More powerful engine	4.4	Windshield wipers	23.7%	Four cars	2.3
Economy	47.6%	Workmanship opinion:		Electrical	8.9	Five or more cars	0.3
Styling	32.7	Excellent	70.6%	Carburetor	8.9	Makes of other cars owned:	
Reports on it	23.4	Good	26.6	Choke	7.1	Chevrolet	13.9%
Size	14.6	Average	2.0	Did you fix it yourself?		Honda	13.1
Price	13.9	Fair	0.5	No	90.4%	Volkswagen	12.3
Specific likes:		Poor	0.3	Yes	9.6	Oldsmobile	8.9
Economy	60.4%	Comfort opinion (front seats):		Dealer repairs satisfactory?		Ford	8.1
Handling	46.8	Excellent	61.5%	Yes	77.7%	Age distribution of owners:	
Styling	41.9	Very good	34.0	No	22.3	15-29 years	35.9%
Comfort	33.2	Good	4.0	Dealer service opinion:		30-49 years	46.1
Performance	14.6	Fair/poor	0.0	Excellent	30.1%	50-plus	18.0
Specific dislikes:		Comfort opinion (rear seats):		Good	35.7	Would you buy another Accord?	
Mileage lower than expected	12.4%	Excellent	26.7%	Average	17.0	Yes	91.2%
Cold starting	12.4	Very good	35.2	Fair	7.0	No	8.8
Underpowered	7.0	Good	29.4	Poor	10.2		
Rattles	6.7	Fair	8.2				
		Poor	0.5				

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

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Complete Owner's Manual*

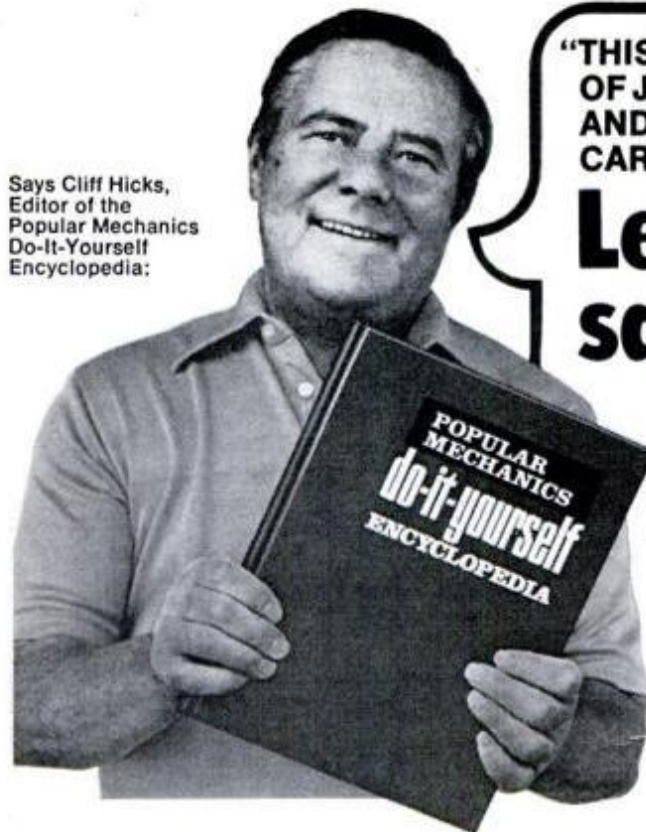
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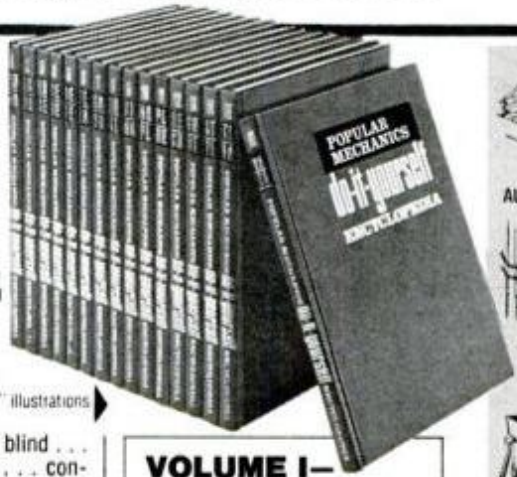
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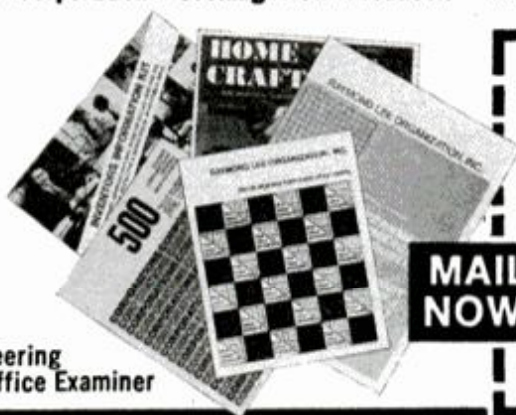
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HONDA ACCORD (Continued from page 250)

While it sounds as if the Accord might be the perfect car—some owners do consider it that—there are a few gripes. Several drivers complained about the Accord's long warmup period and cold-weather manners. A New York commuter sums it up thus: "The Accord starts just fine, even at zero, but regardless of outside temperature, the time between starting and moving takes too long. I commute by rail to and from Manhattan. In the evening, I'm first off the train and first to my car—I'm anxious to get home. But by the time I can think about driving, the parking lot is empty—I'm the only car still sitting there."

A Kansas band director: "Gas mileage is a lot lower than the EPA ratings. There's also a rattle in the driver's door, and the plastic squeaks a lot." An Indiana student: "I've noticed that the steering gets stiff when accelerating hard through sharp turns."

A number of owners noted that the Accord's rear Chapman struts make whumping noises on rough roads, a condition that different shock absorbers sometimes cures. Reception with the AM/FM radio isn't the best, either, some say, and the only 8-track that fits into the dash is the one marketed by Honda—the receptacle is too small for standard units.

We also asked owners to suggest improvements, and while 12.6 percent advocated no changes ("Leave a good car alone," said a

Our survey is of owners who registered their Accords during September 1976: Honda's added the warning light on its '77 models.

One common complaint centered on long warm-up times. Engine stumbles for 3 to 4 minutes after start-up.

These were in the minority, and no dealer can satisfy all customers.

It's standard equipment but not up to some listeners' standards. And if you want stereo, you have to buy the factory's.

New York attorney), fully 23.4 percent felt it would help to have a warning light to tell when the manual choke is on.

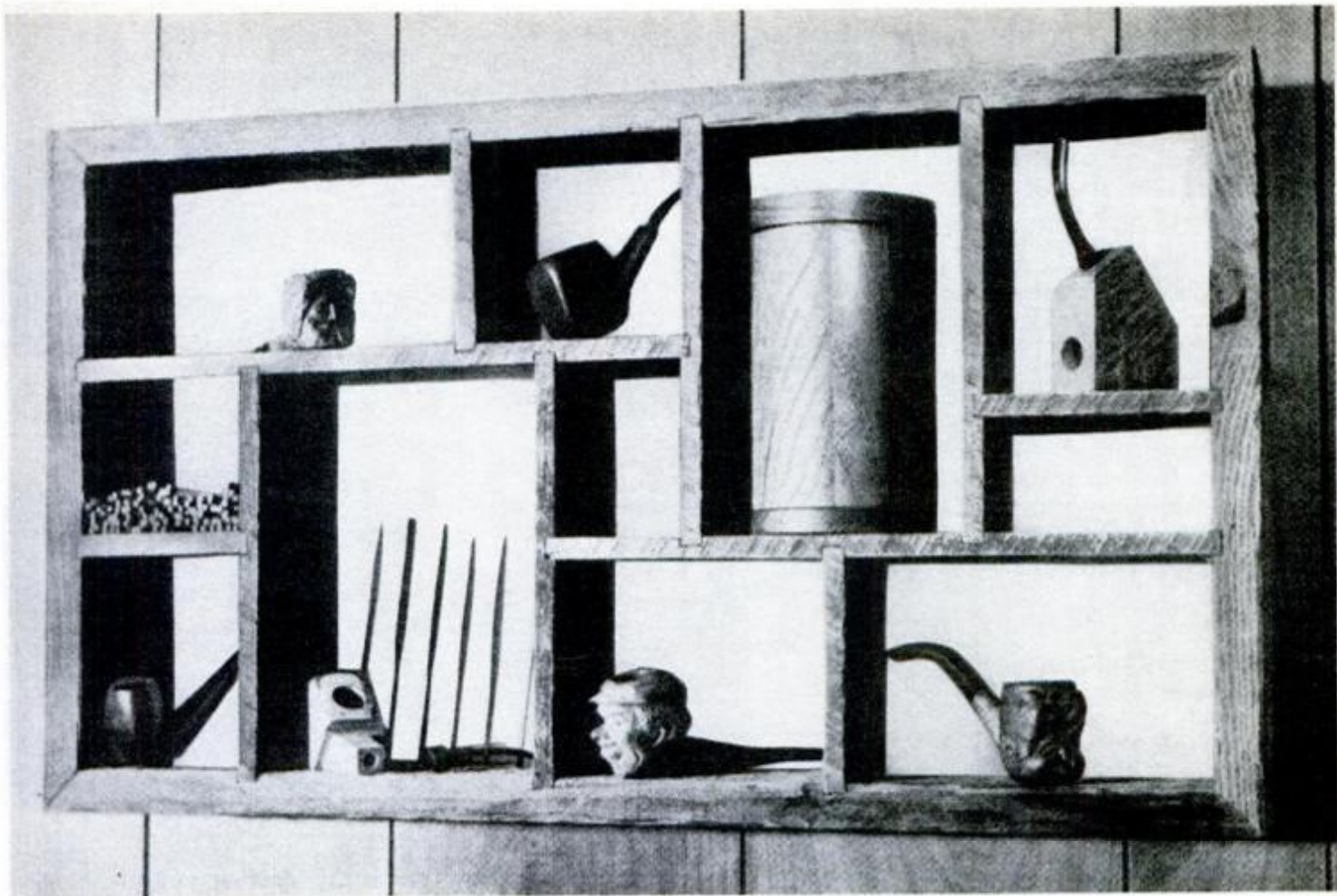
Other recommended changes included better tires, more engine power (especially with the two-speed automatic), better hood mountings so the panel doesn't vibrate, a change in the emission system to let engine rpm fall off in a normal manner between shifts (as it is now, the engine keeps revving even after you take your foot off the gas), front seats that don't obstruct rear vision, and adjustable lumbar firmness in seat backs.

Dealer sales and service got high marks, by and large, with 65.8 percent of our respondents rating it good to excellent. Those who'd had bad dealer experiences, though, really screamed, and we received a fair number of carbons of irate letters to dealers and American Honda. The factory points out that dealers act as independent businessmen, so complaints have to be settled at the local level.

The vast majority of Accord owners are very pleased. "It's truly uncommon," writes an Illinois contractor, "to find an absolute bargain and a company that delivers exactly what it claims. But Honda does."

And a NASA program analyst: "I have owned many sports cars and am very impressed with the solid feel and stability of the Accord, its agility and cornering power. Steering and shift linkage are very good."

Indeed, a whopping 91.2 percent of owners in our survey would buy another. ★★★



Pipe collection contains designs from Corsican Briar Carve-a-pipe blocks plus briar and meerschaum blocks ready to be worked.

Carve your own dream pipe

Here's how to shape
your own designs
from pre-cut blocks.

by Garth Graves

If you're a pipe smoker, you've probably dreamed of owning a beautiful one-of-a-kind handmade pipe. Instead of paying a stiff price to purchase one, you can make your own personalized pipe. All you need is a pre-shaped pipe block, a few tools and a little imagination. You can create a pipe that might cost \$70 and up if you bought it ready-made.

Briar and meerschaum pipe blocks with a shank, prebored bowl and smoke hole fitted with either a straight or curved stem are available at tobacconists. You can buy the blocks alone or in a kit with carving tools.

Briar is the most popular material used for carving pipes. It is hard and close-grained, yet easy to carve and shape. Heat doesn't easily affect it and it won't absorb tar residues from burned tobacco.

The other elegant alternative, meerschaum, is a soft, white mineral that's so light it floats on water. The wax used to finish these pipes turns them to a golden brown that deepens as the pipe is smoked.

Planning the pipe design

Pipe designs that have become classics over the years combine smoking comfort with a pleasing shape and balance. You may want to choose one

of the time-tested designs shown on the following page or create your own classic.

Whether you make an ornately carved pipe or a free-form shape, the design should be planned in proportion to the shape and size of the block.

When selecting the block, remember that curved stems tend to reduce the noticeable weight felt at the bit; straight stems accentuate the weight.

Tools for pipe shaping

Although the designs you carve can be complex, the tools you'll need are not. Use a hacksaw, bandsaw or coping saw to cut away the excess wood to rough-shape the pipe. You can use pipe cleaners to locate and identify the position of the air holes in your pre-drilled block, and to apply stain.

You'll need a white China marker or pencil, half-round rasp and rat-tail file. A small electric shaping tool will cut down on your carving time, but there's a lot of satisfaction in cutting your designs by hand.

Use sandpaper in 80, 120, 230 and 400 grits to smooth the pipe surface. A buffing wheel with Tripoli jeweler's rouge gives an ultra-smooth finish.

An alcohol-based stain such as
(Please turn to page 256)

CARVE YOUR OWN DREAM PIPE

(Continued from page 255)

Omega dye from Tandy Leather Co., 2727 W. 7th, Ft. Worth, Tex. 76107, gives coloring. If your pipe has a uniformly good grain that you'd like to highlight, simply finish it with a light coat of vegetable oil.

Marking the design

Remove the bit from the briar to keep it from being broken. Place a straight pipe cleaner in the precarved bowl and measure the bowl depth. Also note the approximate position of the air hole entering the bowl from the stem. Using your China marker, transfer these measurements to the outside of the block. Then trace the approximate shape of the bowl interior on one side of the block, using the bowl depth and air hole location as guide lines.

Place a straight pipe cleaner in the predrilled hole in the stem and use a straightedge to mark the location on the outside of the block.

Now you're ready to sketch the basic shape of your pipe. Within the limitations of your block shape there are endless possibilities. Whether you use a classic design or your own, it's a good idea to make a preliminary sketch on paper.

If you want to try some high-relief carving, make sure you leave enough stock to work with. Plan your design so that the bowl thickness is not less than $\frac{3}{8}$ in. in order to make a practical smoking pipe. The thicker the bowl, the cooler the smoke.

Rough-shaping the block

Trim the excess wood from the block, using a hacksaw, bandsaw or coping saw. It's better to leave too much wood than to risk trimming the pipe too thin.

During the wood-trimming process, you'll start to see the hidden grain on your pipe, the first evidence



This rough-cut block of briar comes with straight stem (as shown) or a bent one. Meerscham blocks are also available.

CLASSIC PIPE SHAPES



BENT



SLIM BILLIARD



TAPER BULLDOG



RHODESIAN



PANEL



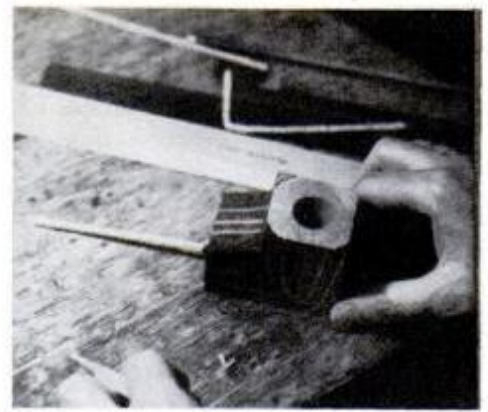
SLIM APPLE



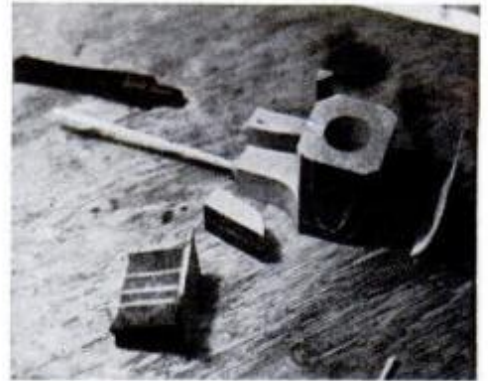
WOODSTOCK



LARGE POT BOWL



The basic pipe shape is outlined on top and bottom. Portions of the bowl top are also marked to be trimmed.



Excess wood is trimmed from the block with a hacksaw, bandsaw or coping saw. Be careful not to trim off too much wood.



As you begin to shape the pipe in the vise attach the stem. It should be in the pipe while fine finishing is done.

of its originality. In many cases, hidden flaws in the grain only add to your one-of-a-kind finished product. Large flaws can be filled with Plastic Wood.

Place the briar in a vise and, using the rasp, begin to rough-shape the bowl. Try to avoid getting too enthusiastic and trimming off too much.

Fine-shaping the pipe

Now that the pipe is beginning to take form, replace the bit. It will be an integral part of your design and should be attached when you're fine-shaping the bowl. Protect the block as you work on it in the vise by wrapping it in toweling and using a smooth file for final shaping.

Keep checking the bowl thickness to be sure you aren't shaping the bowl too thin. Shape the shank of the pipe to blend with the stem.

You can also use a sanding disc in an electric drill to fine-shape the pipe. Start with 80-grit paper. The best way to do this is to put the drill in a vise (being careful not to cover the ventilation openings) and move the pipe into the sander. The pipe must be kept moving constantly and lightly to avoid developing flat areas and deep swirl marks.

You can make ornate carvings on your pipe with regular wood carving chisels or those that come in your kit. Don't use thin model-knife blades—they'll break off in the briar. You may want to give your pipe a

smooth finish, particularly if it has areas of handsome grain.

Finishing the surface

Gradually work from coarse to fine grits of sandpaper to finish the pipe. Keep the bit in the pipe and sand it as well so its final finish will blend in with the overall pipe design.

Stain the pipe by brushing stain on with a pipe cleaner and allowing it to dry. The more coats you apply, the darker the finish your pipe will have. Use only alcohol-based dyes.

If you have an unusually attractive grain on your pipe, you may want to omit staining it and simply apply vegetable oil for the finish.

Whether stained or left with a natural vegetable oil finish, buffing will put the finishing touch on your pipe. The grain and texture of your pipe will now be brought out to their fullest beauty. Be sure to buff the top of the bowl and the bit. Use plenty of Tripoli on the buffing wheel.

If you finish with stain, you can brighten the pipe by applying some liquid carnauba wax to it and polishing with a soft cloth. Don't apply wax to a pipe finished with vegetable oil, as the wax won't adhere to the oiled wood surface.

Although the pre-cut pipe block costs under \$10, the finished pipe will give you many hours of priceless smoking pleasure.

Where to get pipe blocks

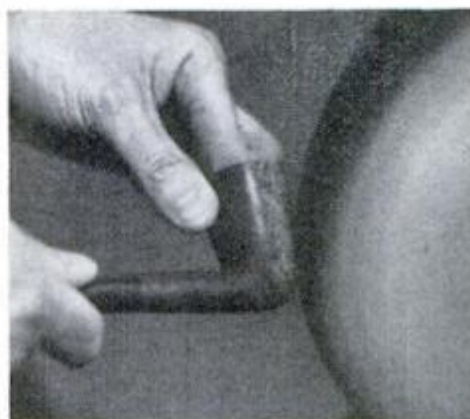
A well-stocked tobacconist should carry rough-cut briar and meerschaum pipe blocks and kits. If you have difficulty in locating pipe supplies in your area, write to A. Oppenheimer and Co., 435 North Midland Ave., Saddle Brook, N.J. 07662. They are pipe-kit distributors and can give you the name of a tobacconist in your area who carries the items.

You can also order a rough-cut briar block with a straight stem by sending \$8.50 to The Tinder Box International, at the address at right.

★★★



Sand the pipe beginning with coarse and continuing to finer grits of paper while the stem is in the pipe.



Buffing adds the finishing touch to your pipe. This brings out the grain and texture of the briar.

PIPE CARVERS' CONTEST

Now that your pipe is completed, why not show it to others? The Tinder Box Pipe Carving Contest is going on now through Aug. 15, 1977. Thousands of dollars in prizes will be awarded to craftsmen who make the best-carved and best-finished pipes. Your local Tinder Box store has complete information or write:

R.K. Pierce, V.P. Marketing
The Tinder Box Int'l., Ltd.
1723 Cloverfield Blvd.
Santa Monica, Calif. 90404



When you get the hang of carving, try making a pipe as unique as your imagination allows. These dream pipes are from left: a Sun figure, Swedish chap, a large Sun figure, Zeus, and the North Wind. The light pipes are meerschaum; the dark ones are briar.

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11 new add-ons for cycling fun

by Eugene A. Sloane

Bicycling gets better every year as improvements continue to appear in accessories, camping gear and tools. Here are 11 of the best new products to choose, to make your cycling easier, safer and more fun.



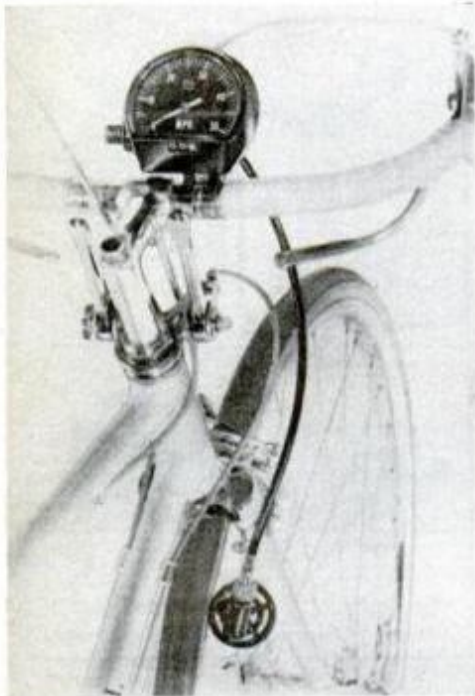
For a cool bottom

The Procover is a three-dimensional mesh cover that keeps your bottom cool, dry and well ventilated. Helps you cycle all day in comfort by circulating air between you and the seat, speeding evaporation, and cushioning without springback. The cover is \$9.95 at your bicycle shop. From Comfort Products, Aspen, Colo. 81611.



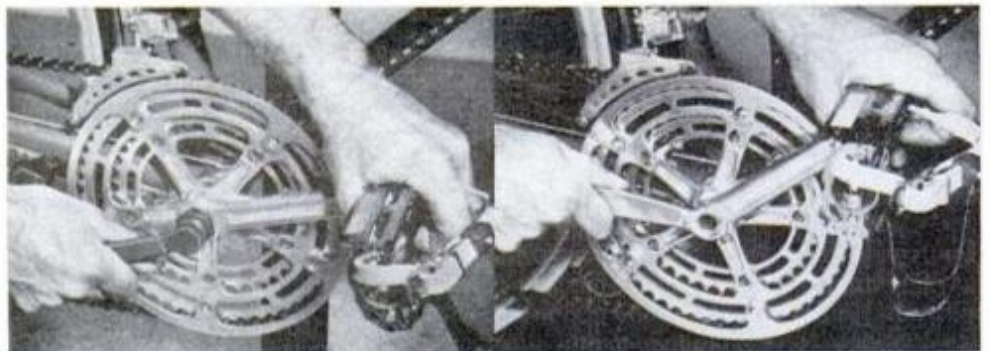
No more wet tents

If you've done a lot of bicycle camping, you have found out, the hard way, that the ordinary small nylon tent won't let body moisture out. On cold nights, body moisture condenses on the inside, and if you don't rinse the tent out before packing up for the day's ride, it will smell like a stable that night. A new tent just out is made of a special triple-layer fabric that breathes. It lets moisture escape even when zipped up tight for the night, yet keeps the most torrential rain out. I have tested this tent and can report that it does just that. The tent weighs only 3 lbs, 8 oz., has plenty of room for two with a height in inches of 39 front, 19 rear, and widths in inches of 40 front, 56 middle and 37 rear. Taking only minutes to erect the Light Dimension tent costs \$195, comes from Early Winters, Ltd., 300 Queen Anne Avenue N., Seattle, Wash. 98109.



How far—how fast?

For the answer, use a new speedometer with resettable trip odometer. The newest model has little friction because the drive part rubs on the tire. The entire unit weighs about 1/2 lb., is easy to install. Made by Stewart-Warner Corp., 1826 Diversey Parkway, Chicago, Ill. 60614.

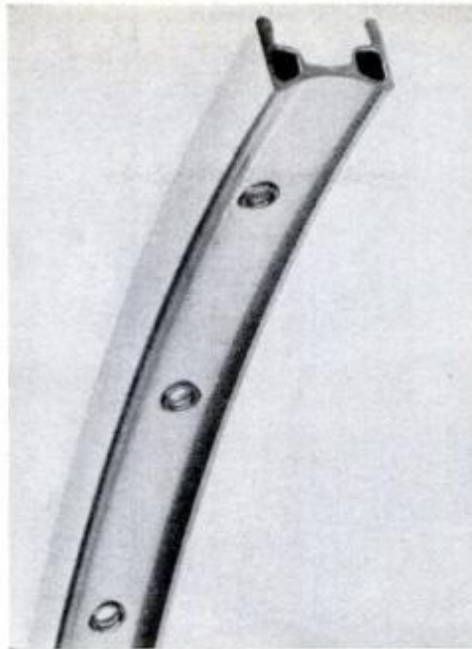


For cotterless cranks

With these two tools you can remove expensive cotterless cranks to service the bottom bracket spindle bearings. They fit any make crank-set. Best of all, they cost far less and are better made than foreign brands. Price for both is about \$10.50 at your bike store. Made by Park Tool Co., 2250 White Bear Ave., St. Paul, Minn. 55109. This company also makes a full line of very elegant and reasonably priced bike tools.

Tubular-to-wired-on conversion

Tired of spending upward of \$30 each for tubular tires? Now you can use your tubulars for around-town cycling and tour with sturdier wired-on tires that resist flats better and are easier to fix if they do go flat. Just use the new Weinmann 700 C rims spoked onto new hubs. Because the rims are the same size as tubular rims, you can interchange both without having to readjust caliper brake shoes, as is the case when you switch from tubulars to 27 x 1 1/4 rims. The Weinmann A124 is exceptionally strong, with nicked brass eyes, smooth sidewall for better braking, and aluminum construction for lightness. From Delaware Mercantile, Stamford, N.Y. 12167, or your bike shop. About \$30 a pair.



Ultralight pedals

Here is a pair of pedals that together weigh only 8 1/4 oz. Lightness comes from the titanium spindles and the aluminum-alloy rattrap-cage body. Bearings are sealed so maintenance is nil over thousands of miles. The spindle is threaded 9/16-20 to fit British cranks. Cost, \$79.95, less postage, from East Rochester Tool and Die Corp., 1841 Ridge Rd., East Rochester, N.Y. 14622.

Touring bags with room

Each side of these bicycle panniers has three pockets. The R.E.I. Pannier II set is tapered to allow for heel clearance. Each is 5 1/2 x 13 3/4 inches at the top, 5 1/2 x 7 1/2 at the bottom, and 18 high. Exterior pockets are 2 x 5 x 11 1/2 inches high. Panniers are of coated nylon, and have drawstring closure for side compartments, fiberboard inserts, strap-down overflaps and carrying handles. Price is \$29.95; weight, 2 3/4 lbs. Seat bag, shown, is 5 x 9 inches with 9-inch covered zipper, weighs 3/4 lb., costs \$5.50. Both from Recreational Equipment, Inc., Box 24827, Seattle, Wash. 98124.



(Please turn to page 260)

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APPLY IT! NEXT TIME YOU USE A SAW, WIPE 3-IN-ONE HOUSEHOLD OIL ON THE BLADE. YOU'LL BE AMAZED HOW IT MAKES SAWING EASIER, FASTER.



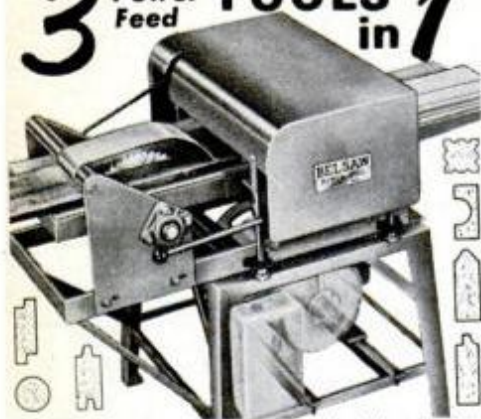
TRY IT! TRY PUTTING A DROP OF 3-IN-ONE HOUSEHOLD OIL ON SCREWS AND NAILS. THEY GO INTO WOOD A LOT EASIER.



BUY IT! GET A CAN FOR YOUR BICYCLE. 3-IN-ONE HOUSEHOLD OIL ON WHEEL AND PEDAL BEARINGS, SPROCKETS AND CHAIN MAKES PEDALING EASIER.

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YES Please send me complete facts about PLANER—MOLDER—SAW and details about 30-day trial offer.

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\$47.00



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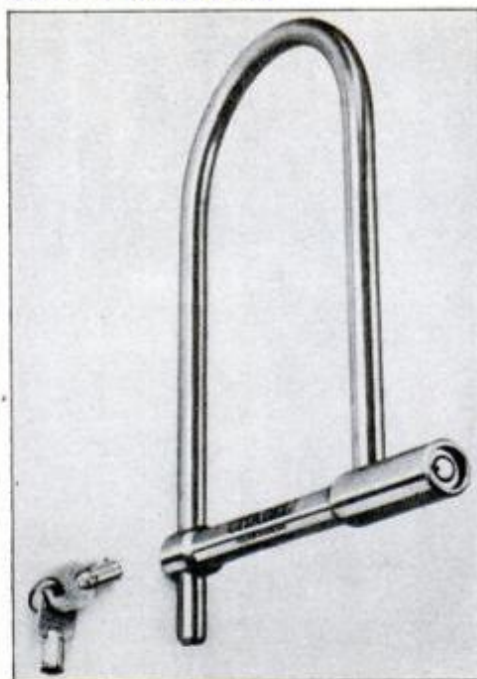
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 Please send free brochures, postpaid.
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CALIF. RES. ADD 6% SALES TAX

11 NEW BIKE ADD-ONS

(Continued from page 259)



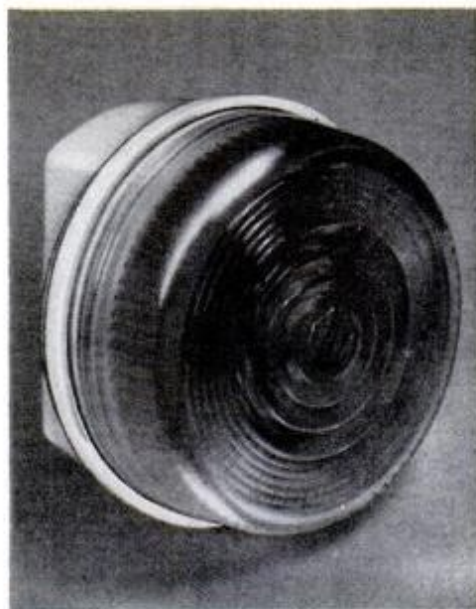
Anti-ripoff device

The makers of the Citadel lock are so sure of its theft-stopping power they guarantee for up to \$150 a bike locked with one against theft. The lock withstands 42-inch bolt cutters, sheer cutters, cable cutters, hacksaws, files, prybars, hammers and acids. It would resist rod saw attack for about 15 minutes. The lock uses a round key cylinder, has a hardened 1/2-inch-thick shackle and is made of tough alloy-steel. It fastens to the bike frame with a special carrier that comes with the lock. Cost is about \$24.95. From Acro-Fab Industries, Inc., 177 Tosca Dr., Stoughton, Mass 02072.



Measure a second

For those cyclists who want to time cadence and elapsed time, there's a new digital-readout electronic stopwatch that measures seconds in tenths, with hold and reset buttons. Price, \$49.95. From Siliconix, Box 4088 Agnew Sta., Santa Clara, Calif.



Flashing beacon lifesaver

A new transistorized, brightly flashing beacon light that can be strapped to the belt or to the bike makes you highly visible to motorists from both sides and the rear. Model 3B60 flashes 60 times a minute; Model 3B40 flashes 40 times a minute. I prefer the faster-flashing Model 3B60. With Mallory battery MN1604, life is around 500 flashing hours. 3B40 costs \$6.95; 3B60, \$8.95. From your bike store. Made by Ampec & Associates, Inc., Arcadia Sta., Box 15461, Phoenix, Ariz. 85060.



Air-cooled brake pads

The new contoured, bonded-in finned-aluminum brake blocks offer far more braking power than conventional brake blocks for bike caliper brakes, according to my tests. Particularly impressive was how cool brakes stayed under fast downhill runs. A hot rim can melt tubular tire glue so the tire slides off the rim, or heat wired-on tires to the bursting point. The brakes are far less susceptible to fade. And wet weather stopping power is definitely superior. They cost a bundle, \$15 per set, but worth it in terms of safety. The brake blocks are available from Scott Matthauer Corp., Box 1333, Sun Valley, Idaho 83353.

"I NEVER STOPPED EATING - YET I LOST 18 POUNDS IN 15 DAYS!"

FAT-BURNING SYSTEM - FOR THE BODY

POSITIVE PROOF THIS SYSTEM REALLY WORKS... AND FAST!!

My name is Brad Mitchell. For many years I have helped thousands of people lose weight. And I believe I can help you!

I realize that today, there are so many weight loss products and programs on the market, that you are probably thoroughly confused as to which one is truly effective.

Everyone, both young and old is striving for that slim, sleek, youthful and energetic figure. The problem is how to achieve such a shape without damage to your health and at the same time keep your energy level high in order to cope with the tensions and rapid pace of today's world.

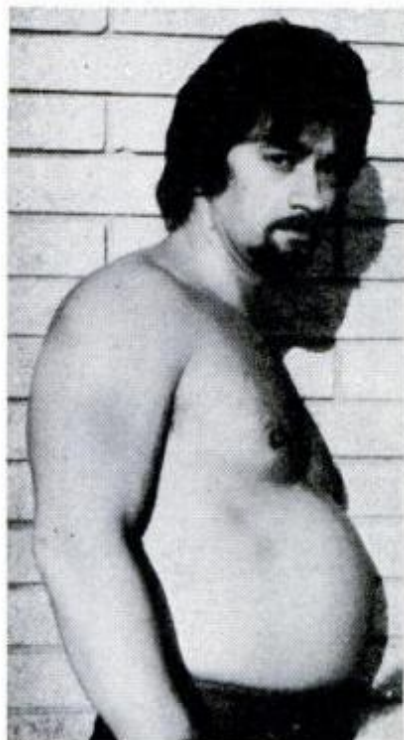
I have developed such a system!

I firmly believe that this Amazing Fat Burning system is the most effective system ever. I should know, just take a look at my before and after pictures. I lost 18 pounds of ugly fat, in only 15 days.

And, believe it or not, I kept my stomach full of food (no hunger pains).

And, my wife lost 40 pounds in only 30 days!

Since then, I have been continuously researching areas of nutrition, bodybuilding, and diet programs, in order to help thousands achieve that slim attractive shape desired by everyone. In fact everyone I put on this Amazing Fat Burning System, reported that they made fantastic weight losses--fast and easily!



almost any weight reduction you desire. And isn't that what you want?

This system is so unique and effective (because it really works)--so much so, that we have had the system copyrighted with the US Government, so that the secrets cannot be copied and stolen!

MAN OR WOMAN--YOUNG OR NOT SO YOUNG--THIS SYSTEM IS FOR YOU!

Everyone can use this system, regardless whether you're young or not so young. It doesn't matter whether you're 10 or 100 pounds overweight, or how many times you have tried to get into shape. With this new system you'll lose weight faster than ever before. In fact you'll have more energy, strength and endurance so that you will feel younger and enjoy a fuller more active life.

I HAVE A SUPER EXERCISE FOR YOU! MORE EFFECTIVE THAN JOGGING!

To help you loose that fat even faster, I've developed a program for a Fun exercise that is more effective than jogging (in the same amount of time), yet it can be done in the privacy of your own bedroom. It takes only several minutes, three times a week to perform this unique exercise! This exercise is done by top athletes and even astronauts. You won't believe how fast your energy level will rise (and how fast you'll get back into shape).

THIS AMAZING SYSTEM REQUIRES ONLY A MINIMAL AMOUNT OF YOUR TIME!

This system requires a small amount of your time (and some effort), but the results will be nothing short of miraculous! Our program offers you plenty of food to eat, plus supplements that will also help burn off the excess fat.

IF YOU REALLY WANT TO BE TRIM AND SLIM...AND WITHIN DAYS BEGIN TO SEE A REAL DIFFERENCE

IN YOUR APPEARANCE--THEN THIS SYSTEM IS FOR YOU!

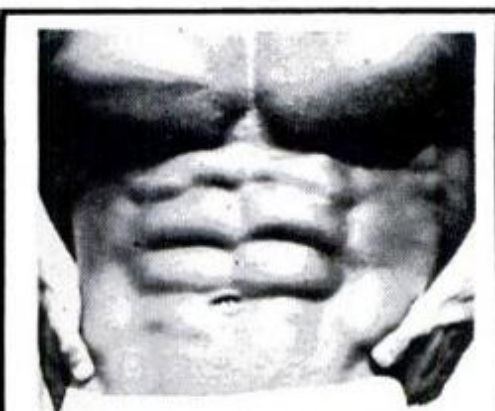
Remember, it doesn't matter how many times you have tried to lose weight, your time has finally come, with the Amazing Fat Burning System!

A healthy slim, trim and energetic figure is our goal--make it yours!

SEE DRAMATIC RESULTS IN JUST DAYS...OR RETURN EVERYTHING FOR A FULL REFUND!

You have nothing to loose except fat. Try the Amazing Fat Burning System for a couple of weeks--if you don't feel that the results are fantastic in every way, you can return the system to us, and you'll get a full refund. Just like that! No questions asked.

Give it a try today.



FREE WAIST COURSE!!

Order your Fat-Burning System today and we'll send you FREE our fantastic ABDOMINAL COURSE. This big book will show you how to have a trim, muscular waist in the fastest time possible! Get rid of that pot-belly and have a sexy, trim waist. You'll look and feel like a new man!

IS IT THE WORLDS FASTEST, MOST EFFECTIVE FAT BURNING SYSTEM EVER?

I sincerely think it is! Why? Because many of the principles and methods used are the same as those used by top physique champions to eliminate all excess fat.

In fact, many physique champions reduce their body fat to the extreme, so that the skin becomes almost paper thin. Certainly you don't want to become extremely thin. But, it's nice to know that the Fat Burning System can accomplish

Brad Mitchell
27313 Plymouth Rd., Dept ME-2
Detroit, Michigan 48239

Okay, Brad, I accept your offer! But I've got to feel that the Amazing Fat Burning System is the greatest and that the results will be nothing short of miraculous. Otherwise I'll send everything back for a full refund! I enclose \$9.95. (cash, check or money order)

Please charge Bank Americard
 Master Charge

Credit Card No. _____

Expiration Date _____ Interbank No. _____

NAME _____

ADDRESS _____

CITY _____ STATE _____

© 1977 Brad Mitchell ZIP _____

Maximize your CB firepower

Tune your antenna for lowest SWR and you'll put the most signal into the air.

by Anthony R. Curtis RADIO EDITOR

The quickest way to fire more radio energy into the air from your CB set is to tune up the antenna system for maximum efficiency. Send the most power forward into your antenna with the least reflected back from the antenna toward the transmitter and you'll get out best.

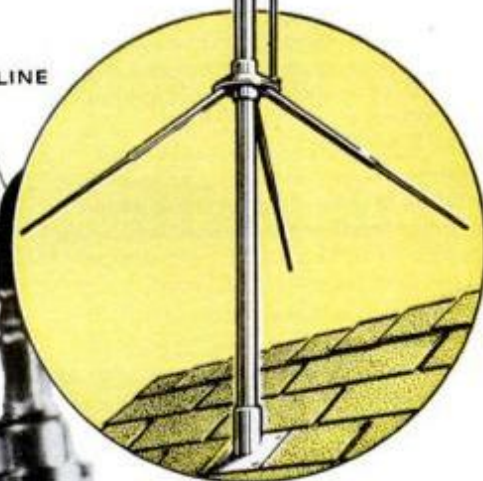
To tune your system you'll need an SWR bridge. Several are available from \$10 to \$200. For an installation, I chose a new Radio

Shack model (No. 21-521A) at \$17.95. It also included a switch permitting me to select from two different antennas.

SWR, by the way, means *standing wave ratio*, but all you need to remember is that it is a meter which shows roughly how much power you are transmitting out to your antenna and

ANTENNA ON ROOF OF HOUSE

ANTENNA LINE



DUMMY LOAD

INPUT

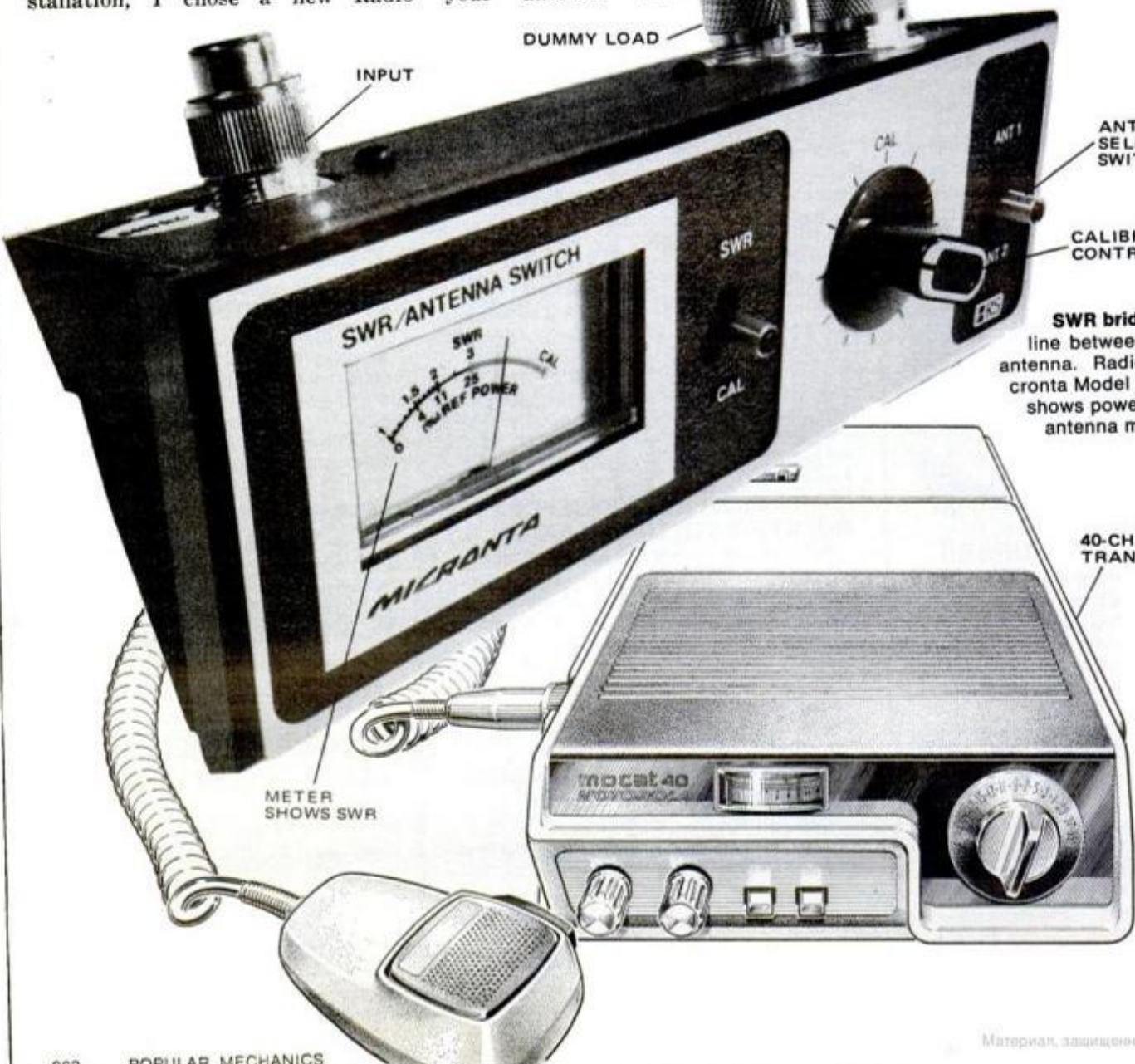
ANTENNA SELECTOR SWITCH

CALIBRATION CONTROL

SWR bridge plugs into line between CB rig and antenna. Radio Shack Microcra Model 21-521A (left) shows power output, how antenna matches radio.

40-CHANNEL CB TRANSCEIVER

METER SHOWS SWR



how much of that power is being reflected back from the antenna toward your transmitter. Best operation comes when maximum forward power is radiated by the antenna and minimum power is reflected back.

SWR is a ratio and usually is spoken of as "five to one" or "one point seven to one" or whatever your bridge tells you. The best tune-up results in an SWR near one to one (1:1).

Watts in a meter?

Transmitter power is measured in watts. Some SWR bridges have meter scales labeled 0-5 or 0-10. Don't think this is your power output in watts unless you purchased a more expensive device actually labeled "wattmeter." Wattmeters cost more because they have extra circuitry inside and have to be calibrated against a known standard of power. Most inexpensive SWR bridges, while working well for relative forward and reflected power readings, are not wattmeters and can't tell you the actual power output from your CB transmitter.

An SWR bridge has two connectors for hooking the instrument into the antenna line, an SWR/calibrate switch, a variable calibrate-control knob and a meter for reading forward and reflected power.

To install my bridge, I was very careful to note the in and out connectors on the unit. A two-foot length of RG-58U coaxial-cable patch cord (Radio Shack No. 278-968; \$3.49) was selected to connect from the antenna jack on the rear of the transmitter to the SWR bridge input connector. My antenna was connected to one of the two bridge output jacks. I screwed a five-watt dummy load (Radio Shack 21-628; \$1.95) into the other output connector in back of the SWR bridge.

I used the dummy load to check out the SWR bridge. I had screwed the dummy load into one antenna connector on the back panel of the SWR bridge. I turned the power on to my transmitter and pressed the push-to-talk button on the microphone. That caused a signal to be transmitted through the patch cord, into the SWR bridge, through the meter and out into the dummy load.

Switching the SWR/Cal toggle to calibrate, I adjusted the Cal knob control for a full-scale deflection of the meter in the SWR bridge. The manufacturer conveniently had labeled the right end of the meter scale as *set* so I adjusted the forward power indicated on the meter to that reading. I released the push-to-talk


button on the microphone, turning off the transmitter. The calibrate reading of forward power on the meter dropped off to the far left end of the scale where a zero is printed below the line, indicating no power was being transmitted forward toward the antenna.

Next I moved the SWR/Cal switch to SWR and started transmitting again by pressing the push-to-talk button on the microphone. I was careful *not* to change the position of the calibrate control knob. Since I was using a dummy load, simulating a perfect antenna, the reflected power measured with the toggle switch in SWR position read out as zero. The meter did not move from

its far left position. It had given full-scale, showing maximum forward power, on calibrate and no reading on SWR. That meant that the dummy antenna was giving a 1:1 SWR reading.

I flicked the antenna selector to the second antenna connector which removed the dummy load from the system and hooked in the outside antenna. I went back to the calibrate position on the SWR/Cal toggle and pushed in the microphone button to start transmitting. Such transmission, with your rig connected to a real antenna, should be kept as short as possible to cut down on interference to others using the channel

(Please turn to page 264)



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CASH

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In the last few years chain saws have become one of the most popular cutting tools in America. They're used by loggers, tree trimmers, park maintenance departments, fire and rescue departments and tool rental companies. And thousands of homeowners own chain saws for their own use. Every one of these chain saws need to be sharpened periodically. The demand for qualified professional chain saw sharpeners is very great. You can cash in on the profits to be made... right from your own home... in your sparetime.

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Please send more information about starting my own sparetime business

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Introducing Black 'N' Burley, the newest Mixture No. 79. Fine Kentucky tobaccos, cured to a surprisingly smooth-smoking ebony color. Then combined with gentle burley brights. Boldly aromatic, yet mild to the taste. A pleasantly savory blend.

Black 'N' Burley. You're bound to like it. After all, opposites attract.

Mixture No. 79

Regular Aromatic, Cherry Brandy Flavor, Cavendish, Black 'N' Burley.

CB FIREPOWER

(Continued from page 263)

on which you are making tests.

I quickly adjusted the calibrate control knob for full-scale deflection on the meter. I changed the SWR/Cal switch to SWR and, without touching the calibrate control knob, read SWR on my antenna. It was 2.5:1 which I called unacceptable.

Climbing out on my roof, I made minute changes in the length of the main vertical element on my antenna until the SWR reading dropped to below 1.5:1, which I liked very much.

Pick peak channel

I peaked my antenna on channel 13 which is the prime local frequency in my town. The antenna adjustments would have been different if I had tuned up the system for channel 1, 40 or some other frequency. CB transmitters are permitted by the government to operate in a small portion of the radio spectrum set aside for such personal communications. The Federal Communications Commission has set aside the frequency range of 26.965 MHz to 27.405 MHz for CB.

Radio antennas are cut to exact lengths for specific frequencies. A fudge factor allows you to use an antenna cut for channel 19 on, say, channel 1 or channel 40. CB antennas, both mobile and base, are adjustable so you can peak them on the channel you use most often. They will work on other channels but less efficiently with higher SWR. Even though adjustments to your antenna might change its length by an inch or less, they might make the difference between good and bad SWR readings.

Watch your watts

When you start out with four watts, at best, coming out of your CB transceiver, you have to conserve power where you can. As a rough rule of thumb, figure you have lost four percent of that power if you have a 1.5:1 SWR; 11 percent if you have a 2:1 SWR; 19 percent if you have a 2.5:1 SWR; and 25 percent of your power if you have an SWR of 3:1.

It's best to keep SWR below 2:1. Some CB sets will be damaged by heat generated when you transmit for more than a few seconds into an SWR above 2:1. Anything below 2:1 down to 1:1 is acceptable. In most base or mobile systems, you won't be able to tell the difference in how well you get out between an SWR of 1.5:1 and 1.1:1. ★★★

HINTS FROM READERS

Carver trims cushion foam



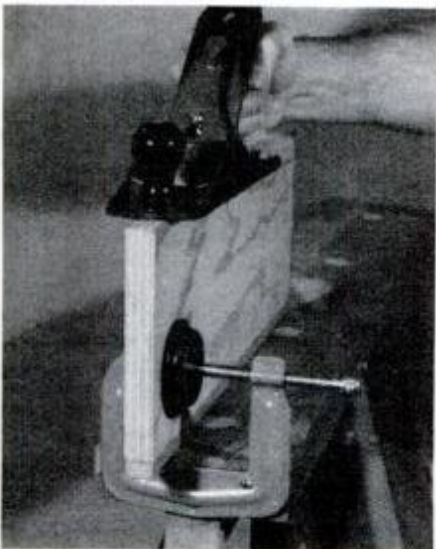
Accurate cuts on foam cushion material are usually difficult because the spongy foam yields to pressure. But an electric, two-bladed carving knife slices the foam with very little pressure to produce straight cuts.—*E.L. Griffin*

Magnetic picker-upper



A magnetic paper clamp on a yardstick retrieves nails and other small items. Use a magnetic door catch for greater lifting power.—*W.E. Burton*

Planing holder



A large C-clamp fastened to a sawhorse makes a good third hand when you're planing. A rubber furniture glide protects the planed piece.—*Ken Patterson*

Need More Money? Start Business Of Your Own Sharpening Saws & Tools in sparetime



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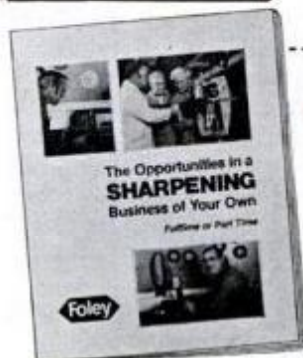
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to be coming out of my nose and the tumbleweed of the desert was just a blur. I sneaked a glance at the speedometer and was horrified to see it hanging at 136 mph. This bike wasn't supposed to be going that fast! I must have had a hefty tailwind and a slight downgrade, but even so that's more speed than this old boy wants to handle. It took about five miles to slow down c-a-r-e-f-u-l-l-y.

Quickly summing up the outstanding features of the KZ-1000 for 1977, the four-into-two muffler system gave the quietest ride of the seven bikes—at speed, the tires make more noise than the engine! The bike gave the best mileage of the four at 47.5 mpg, because the big-bore engine generates more hp and torque at low rpm. At \$2575 it's \$1293 less than the Harley-Davidson 1200 road monster at \$3868. Of the seven bikes tested, the Kawasaki KZ-1000 is by far the most bike for the money.

Honda GL-1000

The Honda Gold Wing GL-1000 highway eater is about as close as a motorcycle can come to an automobile. Water-cooled engine, high-speed road comfort and reliable components make this a super touring bike.

I found the Gold Wing to be very quiet, mostly, I suspect, because the water-cooled engine can be made to tighter machined tolerances than your normal air-cooled bike. On hills, the high low-speed torque required far less shift-down than any of the other bikes tested except the Harley-Davidson.

I checked owners of this machine who have racked up 25,000 to 50,000 miles, and they report excellent reliability of components, with little maintenance except normal tune-up. There were complaints about short plug life, however.

On long trips over smooth roads, the GL-1000's quiet, smooth ride reduces fatigue to a minimum. However, I found the front springs too stiff for comfort on rough pavement, and even on the highest setting the rear shocks would bottom out when the bike was loaded to its rated capacity of 360 pounds. So long as you stick to relatively smooth highways, the Gold Wing is indeed a deluxe touring machine. The dual disc front brake and the rear single disc, both of course hydraulic, provided more than ample braking surface to stop this fairly heavy machine at any speed I took it to. The GL-1000 is no cafe racer, the Kawasaki KZ-1000 will run rings around it. But you don't buy the Gold Wing for racing anyway, so why worry.

The GL-1000's cornering characteristics at high speeds on curvy mountain roads were a bit on the cumbersome side, but, again, this is not a cafe racer so you do not go zooming around roads like that at 90+ mph and expect this heavy a machine to corner like one.

At low speeds, particularly at under 5 mph, the Gold Wing requires a lot of muscle to keep upright, but once on the road it's a dream machine. The bar-to-seat configuration can be uncomfortable because the bars are too far forward for the average rider. Setbacks can solve this problem, though.

The drive train uses helical-cut gears and spiral shaft, eliminating the conventional motorcycle secondary and primary drive chains.

With this heavy a machine, the tire mileage reported by owners isn't too great—anywhere from 4000 to 5000 miles. That's anywhere from a \$50 to an \$80 tab every few months, if you ride a lot.

The stock saddle on the GL-1000 is a real butt buster, especially on long trips. Sure, you don't have the vibration of a smaller machine, or the engine noise, or the sensitivity to side winds. But you do need something soft to sit on all day, and that is not what comes with this machine. A custom saddle for around \$150 will solve this sore problem.

With better shocks, saddle and a few minor changes, though, the Honda Gold Wing GL-1000 is a first-class super road-touring motorcycle. If it has a major drawback, it is one shared by all motorcycles except the Harley-Davidson 1200, and that is limited carrying capacity. The GL-1000 is rated at 360 pounds maximum. Riding two-up, you will already be at around 300 pounds. With a 30-to-40-pound fairing, you're near the limit. Add crash bars and luggage and you go way over the limit, which is not conducive to longevity of you or the tires.

Harley-Davidson FLH-1200

"Road hog" . . . "King of the Road" . . . "Monster" are just a few of the appellations the H-D Electra-Glide FLH-1200 1200-cc big V-Twin is given. Over the past four or five years very few basic changes have been made in this biggest of all American-made stock motorcycles—still the undisputed most comfortable, stable and load-carrying bike of them all.

It's awfully easy to rev this big machine up well past the legal 55 mph. In fact, the first time I took it out on the freeway I was up to 80

mph and hardly knew it. Location of the speedometer is such that you have to take your eyes off the road ahead to see it, which is conducive to ignoring actual speed and just keeping up with the traffic.

The saddle is super comfortable, really great! But it's too short to ride two-up for a long trip. The big V-twin has lots of power and torque for stable handling, even at very low speed.

Perhaps the one feature that makes for comfort, the saddle and suspension system aside, is this heavy machine's weight and low center of gravity. It is positively the only bike I have ridden that is all but immune to the corkscrew turbulence produced by a huge trailer semi. During hundreds of high-speed miles on traffic-laden California freeways not once did I have to fight to hold this machine steady, yet trucks were all around me, and on the desert and mountains some pretty strong crosswinds were blowing other motorcycles all over the road.

While the manufacturer claims around 38 mpg, I did a lot better—about 40 to 42. The tank is a bit small, holds only five gallons, so you have to stop every 200 miles or so to refuel.

One of my major gripes with the FLH-1200, though, is the turn-signal system. It's vital you signal turns or changes of lane, especially at night. Yet, at night, with gloves on, I simply could not find the tiny lever that actuates these signals. With time, I suppose, you could learn to locate the switch, but it was a major frustration for me.

Most FLH-1200 riders report another problem with their bikes and that is a constant, annoying, moderately high-frequency vibration. This I also found on the machine the Harley people loaned me for test. However, the vibration was tolerable, even on a long trip.

The brakes were a surprise. I had been used to almost instant stopping power, but the first time I applied the brakes the bike kept going. In a microsecond I found that more pressure was required on the hand and foot-brake levers. That learned, I had good control all the way.

This big machine is no cafe racer. But for straight-up, long-distance, all-day touring, it can only be beat by a big car.

The H-D FLH-1200 has an automatic chain oiler that will gobble a quart of engine oil every 250 to 500 miles unless it's carefully adjusted. You need to decide on a happy medium between chain lubrication and oil

mileage, and once that is reached you should get much better mileage out of the oil supply.

I found the kickstand a bit difficult to reach, once off the bike. And of course a center stand is non-existent simply because this bike has a dry weight of 775 pounds and loaded with a fairing, bags, luggage, fuel and oil, it can zoom to nearly 1000 pounds. I dropped the bike on a mountain hill at low speed, for reasons I won't go into except that they were dumb, and it took two of us, me and a kindly pickup truck driver, to right the beast. H-D mechanics tell me they can easily lift the FLH-1200 back up. If you get a flat and you're alone, that's what you'll have to do, because the only way you're going to get a wheel off without a center stand is to lay the machine on its side.

The electrics, with a huge automobile-size battery and alternator to go with it, are the best of any bike on the road, in my judgment.

I had some qualms about slow-speed handling, but found they were unfounded, thanks to the low center of gravity. In fact, you could handle this beast easily at any speed even if you're a 97-pound weakling. The bike looks huge, but it handles like a baby.

Finally, as you might imagine, the FLH is no racer, so it corners badly at high speed. Don't fight it; just sit up straight, steer it carefully at reasonable speeds on narrow, hilly roads, and this bike will behave like the lady she is.

Moto Guzzi V-1000

You would have to be a complete dunce to do something wrong with the Moto Guzzi V-1000. Just about everything that can be made automatic has been done so with this machine.

The big transverse V-twin engine is hooked to the rear wheels through an automatic two-speed torque converter. The low speed is for—you guessed it—around-town driving. Second gear is for high-speed highway riding. In either, once you select the gear, everything else is automatic. On steep grades and curves I preferred the low gear for better control.

The foot brake is linked to the left of two front disc brakes so that when you use the foot pedal you get 100 percent of the rear and 30 percent of the left front brake. This makes, I discovered, for excellent and safe control, especially when rounding sharp curves. The combination braking effect keeps the bike in line and on course. For more braking power, the right front disc brake is

actuated by the brake lever on the bars. Both front discs and the rear brake can, of course, be used by applying foot pedal and bar lever together.

When the kickstand is down, the rear brake is locked, which solves the parking problem on hills and keeps the bike in place on the flats. The engine cannot be started with the kickstand down and unless both hands are resting on the handlebars because the clutch must be held disengaged by the left hand while the right hand punches the starter button.

There are 10 idiot lights in two neat vertical bars which warn you of just about everything but a nearby flying saucer. A flashing indicator tells you that you're trying to start the engine with the kickstand down. Both side flashers work when the emergency blinkers are on. There are lights to warn of low brake liquid and low fuel level. A courtesy light tells you when the key is in the ignition lock so you don't walk away with the key in the bike, ready for instant theft. And of course there's low oil pressure, high and low beam signals and turn indicator signals. The 10th light shows generator charge. The odometer is resettable.

The Moto Guzzi 1000 automatic gave me a bit more vibration than did the BMW R100RS, but not so much more that I found it objectionable. What did bother me was the need to practically tear the bike apart to do routine maintenance.

This is not a bike you may like right away. So many of the operations you are used to, such as shifting and braking, are largely done for you. Eventually you'll get used to the idea, and to the fact that it's just not going to be possible to take off like a banshee. The fluid coupling just isn't up to fast getaways. But the ride is smooth and the saddle, for once on a stock bike, is very comfortable.

True, the two rear bags which are standard equipment are not big enough to hold much more than an overnight bag would. So if you take a long trip you will have to scrap the stock bags and add bigger ones, or buy a bike trailer and drag it along. Certainly the big V-Twin engine has plenty of power to pull a trailer. The driver has comfortable footboards, but the passenger has to put up with somewhat inadequate foot pegs.

Oh, yes, one more safety feature. The twin carbs are fed by an electric fuel pump, so there's no fuel valve to forget to turn off. The big 6.4-gallon fuel tank will carry you

(Please turn to page 268)

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THE GREAT DISPLACEMENT RACE

(Continued from page 267)

around 300 miles unless you hit a lot of headwind. One more nit-pick. The torque converter does not permit the engine to help brake on downhill runs, so I used a lot more brake than I normally would. Otherwise this automatic machine is a great tourer.

BMW R100RS

In an obvious attempt to catch up with Japanese styling, the folks at the Bavarian Motor Works have come up with a sexed-up version of last year's R90s machine. Unless, of course, you're an old BMWer who may well say what a horrible thing to do to a Beemer.

If you like a beautiful motorcycle with lots and lots of torque, speed, comfort and outstanding durability, the newest Beemer R100RS is for you—if you want to spend \$4595. Aluminum-alloy wheels are extra.

So what makes this machine worth all that dough? As I said, it's super reliable. The twin horizontally opposed configuration has been tested and improved and tested and improved again and again over the years. Today there is, in my opinion, no stock bike that can touch the BMW for dependability. If I had to ride up the Alcan Highway, this is the machine I would do it with.

For the money, you get a shaft-drive machine with a twin, four-stroke, opposed-cylinder motor with a 9.5:1 compression ratio. As with all BMWs of this configuration, the cylinder heads stick out on either side for maximum wind-cooling efficiency that permits close tolerance design.

You get a decent-capacity electrical system (finally) with a 25-ampere-hour battery and an increased starter gear ratio, all of which helps the machine start in cold weather. BMWs are notoriously poor starters in any weather in which you can see your breath.

The R100RS comes with a factory-installed large touring-type fairing that does a good job of protecting the rider. Well, almost. The fairing, supposedly aerodynamically designed, sports a windscreen which creates bothersome turbulence at head height. And when it comes time for maintenance, you lose at least an hour removing sections of the seven-piece fairing to get at the engine. That's expensive shop time unless you do your own work.

The paint job is gorgeous, in a silver-blue with clear lacquer coating which gives the bike a luminous look. The swept-back design is high style, with a unique saddle that

gives little room for a passenger.

Fairing design calls for short, almost clip-on bars which won't appeal to all touring cyclists. The bars and seat location virtually demand a crouched-down European-style position which, when you get used to it, is comfortable.

Other features include an integrated switch (ignition, volt-meter and lock), speedometer, tachometer, warning lights, toolkit (a good one) and tire pump. There's a small compartment under the seat at the tail section which will hold wallet, toothbrush, and a few other small odds and ends.

The saddle, unlike older models, is comfortable. The familiar BMW soft suspension has been improved with a revalved, 7.87-in.-travel front fork for a more controlled ride. Rear shocks are the same 4.92-in. travel, three-way adjustables.

The gearbox is smoother, with less of the "clunk" which alarms new Beemer owners. The snazzy flush fuel cap is lockable and is vented so you can't spill gas with a full tank under the hot sun. The 6½-gallon tank will carry you 230 to 280 miles.

The brakes are excellent. The perforated dual front disc brakes and the single leading-shoe brake in the rear respond easily and precisely. There's a new horn with a piercing, double tone.

A lot of money, but worth it for the comfort, convenience, shaft-drive reliability and, if you like it, the zoot-suit appearance.

Suzuki GS750

I feel in love with Suzuki's 1977 four-stroke, four-banger on a ride from Santa Monica to San Jose. All the way up Route 1, with the blue Pacific on my left, past Santa Barbara, San Luis Obispo, the lovely cliffs of the Big Sur, this spirited 750-cc four-stroker behaved like the real thoroughbred it is. By the time I had 400+ miles on the bike I felt most reluctant to turn her back to the kind Suzuki folk who lent it to me.

I have ridden a lot of 750-cc machines, and I'll stack Suzuki's new four-stroke design up against any of them for quick, precise road-handling, responsiveness, acceleration, quietness and all-round comfort. This is the machine to use if you want to start out with a big bike as a new motorcyclist, or move up from a 350-cc or so.

At 31½ inches, the saddle height is closer to the ground than any of the seven big-displacement models I tested. If you're under 5 feet, 8

Материал, защищенный авторским правом

inches, you'll feel much more in control being this close to the ground when you come up to a stop light.

Get up and go is a blast; the closest machine to it is a Kawasaki Z900. Top speed is 115+, which is a lot more zing than I'll ever use. In town the Suzy handled like a lamb. For a combination of town and country machine, I'd opt for the Suzuki GS750. At \$2195, the price sure is right for all this comfort, speed and reliability.

The bike uses a heavy-duty, self-lubricating, rear-drive chain, which eliminates the daily chore of chain tension adjustment on tour. The cam chain is self-tensioning.

And this bike is really quiet, which seems to be a characteristic of the big-displacement machines these days. They are obviously meant to appeal to the gentleman tourist.

This machine is also unique in that it has a pollution-control system that brings emissions to EPA standards. Possibly this is one reason why mileage is a bit low for this size machine—around 40 mpg in normal driving or about 180 miles per tankful.

The Suzuki people have come up with a real winner with this four-stroke, four banger. As I said, after

a few hundred miles this is the kind of motorcycle you get attached to.

Yamaha XS750

I must confess that the Yamaha version of a shaft-driven motorcycle was a disappointment. I had expected something like BMW 750/7's comfort and freedom from vibration.

The vibration was a lot more than I would want to feel on any kind of extended trip. Otherwise, the XS750 is a beautiful hunk of machinery. Aluminum wheels are standard, with only seven easy-to-clean spokes.

Turn indicators are self-canceling, which is a feature I find helpful because of my own tendency to leave the turn signal on. I'm not alone there; other riders who, like myself, concentrate on driving and safety, tend to forget the turn signal is on. This is an unsafe habit, since motorists believe you, and if you turn the other way they'll run into you, or you into them.

The huge single muffler hanging on the right side is responsible for the low ground clearance of only 5½ inches, so on tight right turns you could drag something.

The bike weighs in at 511 pounds so you're toting a hefty 19 pounds more steel around than with the

Suzuki GS750. This would partly explain the slow pickup and low gas mileage of around 40 mpg. Tank capacity could be larger, too, since it holds only 4.5 gallons.

The Yamaha shaft-drive certainly is durable and should see you cross-country without mechanical failure. The designers have made it easy to service because all major top-side work can be done without removing the engine from the bike. Considering that this is a shaft-drive, this is an important moneysaver.

Under the seat there's a document holder and toolkit. With the seat up, you can also reach the battery, fuses and air filter, which makes maintenance easier for the owner.

While the shaft drive gives you more positive clutch/engine engagement, with none of the "play" in the drive train associated with chain drives, you still must be careful to follow manufacturer's instructions. You must check the oil level in the intermediate and final gear cases frequently. Should you run one of them dry, you will be in for a costly repair item. But that's true of the BMW and all other shaft drives, too. The Yamaha XS750 is the lowest-priced shaft-drive 750-cc machine on the road. ★ ★ ★

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Get started in ham radio the easy home study way

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by Anthony R. Curtis, K3RXX
ELECTRONICS EDITOR

Become a ham radio operator and talk to the world." This message from a bumper sticker rolls in your mind as you drift into a day-dream of radio dials, beam antennas and a Sunday afternoon's chat with a friend at sea or folks back in the Old Country. You join the chase to be first to make contact with a remote ham station in Antarctica. Then your CB chatters "breaker, breaker" in your ear, bringing you back to the reality of clogged, noisy channels.

Hundreds of thousands of CB operators today are discovering they can talk farther and longer, by stepping up to amateur radio. Along with this growing interest in ham radio has come an increase in the number of home-study courses to help those who want a ham license.

Ham radio is a two-way communications hobby for anyone who passes simple Federal Communications Commission exams about rules, operating procedures, International Morse code and elementary electronics. There are five classes of ham licenses: novice, technician, general, advanced and extra.

Dah-dit-dah-dit

Most beginners, whether they have been in CB radio or not, start with the *novice* license. That requires learning the alphabet in International Morse code and being able to receive the dots and dashes by ear at the rate of five words per minute. The exam consists of someone sending you five minutes of a message, which you copy on paper, and an easy quiz about the content of that message. You are graded on how well you comprehended the message, not on whether you got each word exactly right.

The written exam, following the code test, covers basic FCC rules and

regulations and a tiny bit of knowledge of electronics. With the novice license, you get the right to operate a code transmitter of up to 250 watts power on four shortwave bands capable of reaching all four corners of the Earth.

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If you want to transmit voice and use television, teletype and OSCAR space-satellite communication systems, you'll need the second-step *technician* license. The test requires *no* increase in code speed, but you will have to know slightly more electronic theory. With the tech license, you can use the network of 2000 amateur radio repeater stations across America. Through these, you'll chat from your tiny hand-held, battery-powered portable radio on clear channels with friends scores of miles away. I have relaxed in my living room with a portable in hand, talk-

ing with a friend 100 miles away.

The third-step *general* license brings access to all ham bands. You must be able to copy code at 13 words per minute and know more electronics. The *advanced* class fourth-step license adds some operating privileges at the same code speed as the general, but with more electronics. The *extra* requires that you understand a coded message sent at 20 words per minute.

Programmed instruction

If you're nervous about the code and want a guided tour through your radio, what you need is a ham radio home-study course. Several programmed instruction courses are available:

Heath Co., the kit manufacturer, offers the latest course, including an effective textbook plus two audio cassette tapes to reinforce the textbook and provide code practice.



All the comforts of home make completing an amateur radio license correspondence course easy. Programmed instruction leads to a ham radio license.

The course (ER-3701; \$24.95) is tailored for CBers, electronics hobbyists and experimenters, and others interested in moving up into the ranks of amateur radio. For \$29.95, Heath adds its HD-1416 code practice oscillator so you can perfect your sending via telegraph key.

You study FCC rules and regs, radio phenomena, operating procedures, electrical principles, practical circuits and antennas. It also has aids for operating on the air, a glossary of common abbreviations, definitions of the ham Q signal, instructions for making your own antenna, a list of call-letter prefixes from around the world, an International Morse Code alphabet, a time-zone chart, list of states to check off as you talk on the air with hams from each, and a call-sign map of the United States. Write Heath at Benton Harbor, Mich. 49022.

For \$7, on the other hand, try *Tune in the World With Ham Radio*. It's a 136-page easy-to-read text and includes a one-hour code tape and colorful wall map showing the call-sign areas of the states. *Tune in the World* is being used as a standard text in hundreds of ham-club classes across the country. The course is supplied by the American Radio Relay League, 225 Main St., Newington, Conn. 06111.

Going beyond novice

The Heath and ARRL courses are aimed at getting you a novice ticket. An excellent course to take you beyond novice and technician licenses to the general class is *From 5 Watts to 1,000 Watts* at Radio Shack stores (textbook 62-2056; \$2.95).

For a nearly perfect course, teaching you everything for all five ham license classes, NRI Schools gives you the works for \$220. The Cadillac of ham-radio home study, NRI's course will give you full knowledge of electronic theory and all operating procedures. Information is available from McGraw-Hill Continuing Education Center, 3939 Wisconsin Ave., Washington, D.C. 20016.

At the other end of the scale, *Ham Radio Horizons*, Greenville, N.H., 03048, offers a free novice packet including an FCC license application form and a list of recommended study materials.

No home-study course is more effective than your motivation. If you buy a course and don't crack the textbook, don't gripe at the publisher. On the other hand, if you complete a course but fail the FCC exam, you'll want to know about Heath's offer: It will refund your money for the course material—a very unusual guarantee. ★ ★ ★

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CARBIDE BLADES

(Continued from page 60)

The table on page 60 shows projected lifetime costs (based on recent New York-area prices and sharpening quotes) for two blades, both used for general woodworking. The 24-tip carbide combination blade used in the comparison is the logical first carbide buy for a woodworker who already has a good selection of steel blades.

After half a dozen or more sharpenings, a carbide blade may have lost its clearances (excess carbide that makes it possible to regrind a tip to the correct shape) and will be ready for replacement.

Retipping an entire blade is not economical—a recent quote was \$2.80 per tip. It's good to know that if you break one or two blade tips, they can be replaced, however.

In use, the tips of a carbide blade act as tiny chisels, each carrying a chip of material out of the workpiece. A blade's face-rake angle (also called hook angle) determines the angle at which each tip strikes the work. Most carbide blades for home-workshop use have positive rake angles, larger on rip blades and smaller on combination and cross-cutting blades. The nailcutting blade shown on page 60 is one of few with negative rake available for home use. (Fire departments use negative-rake blades to cut into burning houses without stopping for obstacles such as nails, wiring and ducts.)

The way tips are ground also helps to determine a blade's characteristics. Square grind is usually for

ripping; alternate top bevel (ATB) is for combination and crosscut blades. Grinds using two ATB tips to one square tip (2-1 or raker grind) and four ATB tips to one square tip are also found on combination and smooth-crosscutting blades. Triple-chip grind (TCG) may also be used on high-grade blades for the do-it-yourselfer, but is not common.

Like most hard materials, tungsten carbide is also brittle. Carbide blades require gentle handling to prevent tip breakage. Keep them in their original packages if possible; if they must be stacked, put cardboard spacers between blades.

It's always important that your saw run true, without play, and carbide-blade manufacturers are particularly insistent on this point. Check the saw's alignment as shown below, make adjustments if necessary. For true running with minimum wobble, blade makers recommend stabilizers, also called stiffeners. These are discs clamped on both sides of the blade; in most cases, they will not interfere with a blade's usable depth of cut.

Work should be held firmly, clamped when possible. Stop using a carbide blade at the first sign of dullness—tips are easier to break when dull.

Remember that there are materials that carbide blades can't handle—masonry, concrete, ceramic tile, iron and steel.

As a general rule, the more tips on the blade you choose, the smoother the cut will be—but the sharpening will cost more. ★★

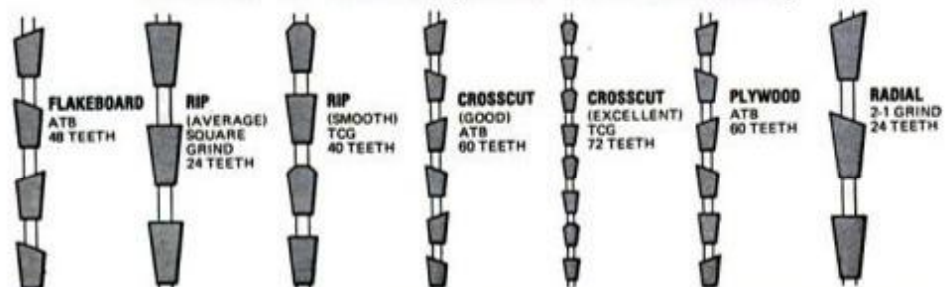


Check blade trueness with framing square; turn blade by hand with saw unplugged.



Check-rip-fence alignment to keep workpiece from binding between it and blade.

CARBIDE TIP GRINDS (10 and 12-in.-dia. blades)



Common grind patterns are alternate top bevel (ATB), square, 2-1 (raker) and 4. Triple-chip grind (TCG) is found on the higher-priced and industrial blades.

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Kiln-dry your lumber with solar heat



To beat the cost of small quantities of kiln-dried hardwoods, Curtis Johnson found a way to dry his own green wood using solar energy. The retired Forest Service employee has been using solar kilns for several years. His latest model, with an 800-board-foot capacity, is shown here.

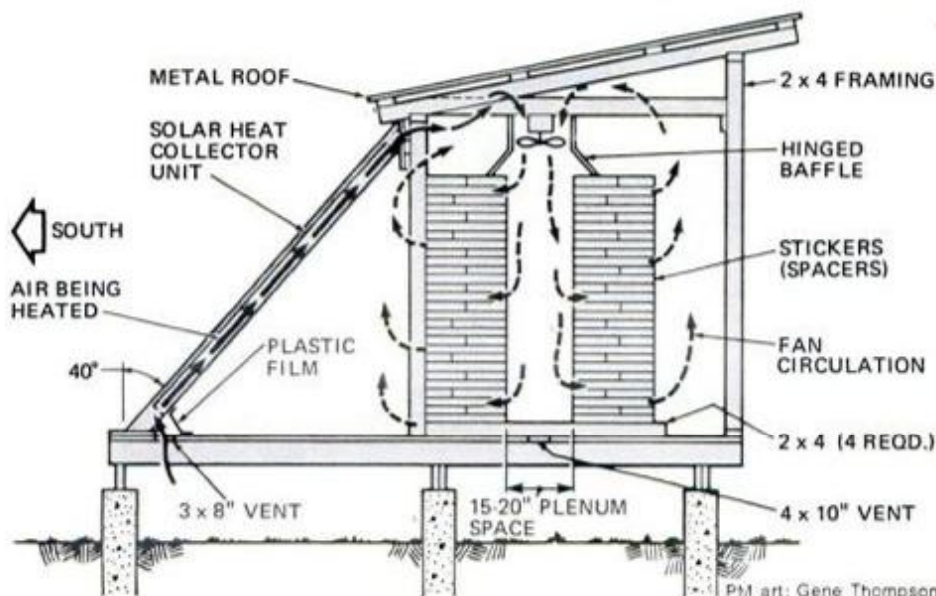
Collectors on this version have been rotated on their 40°-from-vertical axes to collect more early-morning and later-afternoon sun.

Operating in southern Wisconsin (43° north latitude), the kiln can dry a load of 1-in.-thick (4/4) walnut from 85-percent moisture to 8 percent (same as kiln-dried and right for interior use) in 50 summer days, with the interior temperature often reaching 130° F. Wintertime drying does take considerably

longer, but output can be upped by starting with air-dried wood.

Operation of this solar kiln is simple. Solar collectors fitted 1½ in. behind glazed sash are broad, flat ducts—black-painted sheet metal on the side facing the glass and ¼-in. hardboard on the other. Air enters the collectors through floor vents cut off from the interior by plastic film. Warmed air rises in the collectors, escapes out the tops, and is circulated through the stacked and spaced wood by two thermostatically governed fans (set to go on at 80° F.) Electricity for the fans is the only operating expense.

A free booklet on building and using the solar kiln is available from State and Private Forestry, United States Forest Service, Dept. PM, Box 5130, Madison, Wis. 53705. ★★



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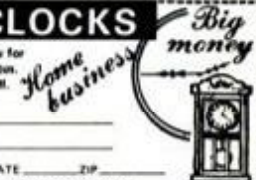
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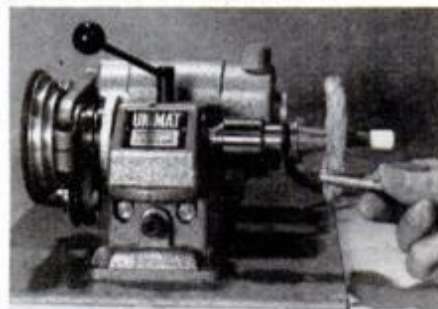
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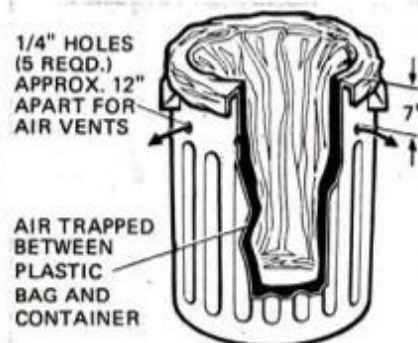
HINTS FROM READERS

Flexible polishing arbor



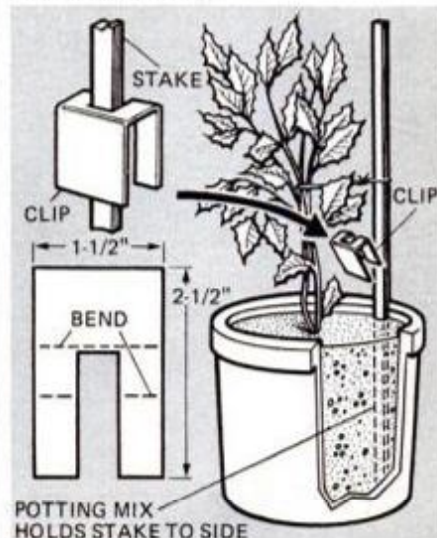
A tapered spring door stop can be used as a flexible arbor for holding a polishing disc in a small lathe. The door stop will bend when too much pressure is applied so as not to damage the surface being polished.—Ken Patterson

Air escape holes



Five 1/4-inch holes drilled around a trash container permit trapped air to escape when plastic liners are inserted.—S. Clark

Plant stake clip



Three cuts and two bends can turn a scrap of aluminum into a plant stake clip.—Charles Hardy

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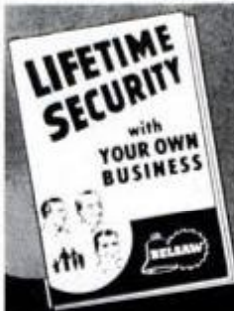
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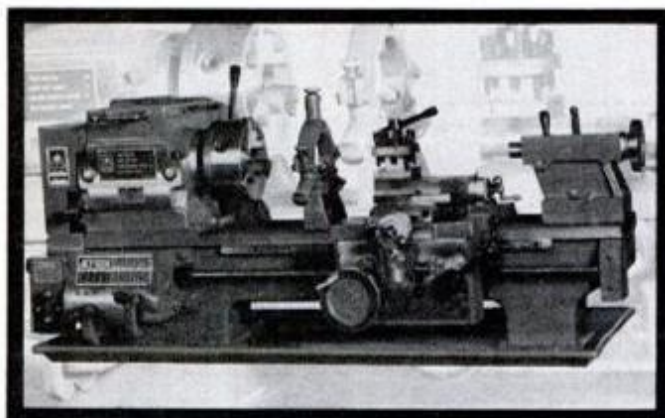
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Cut the top, bottom, ends and side pieces in pairs from 1/4-in.-thick walnut or cherry. Jigsaw two card slots in the top and bore a 1-in. hole in the center; bore a 5/8-in. hole in the bottom; assemble the parts. Note that 1/16-in.-deep rabbets are cut along all four edges of top and bottom pieces. The side and end pieces fit flush in the recesses formed by these rabbets. The dividers forming the card wells must be in place before



the rest of the parts are actually put together in the assembled form.

Turn the pedestal from a 3 1/4-in.-sq. block of solid stock and form a tenon 1/4 x 5/8-in. at the top.

The pedestal can be finished while it is still spinning in the lathe. Since it would be difficult to finish the score-pad rack after it's attached to the holder, finish it before assembly. Then cover the bottom with felt held on with white glue.—*Elmer E. Scott*

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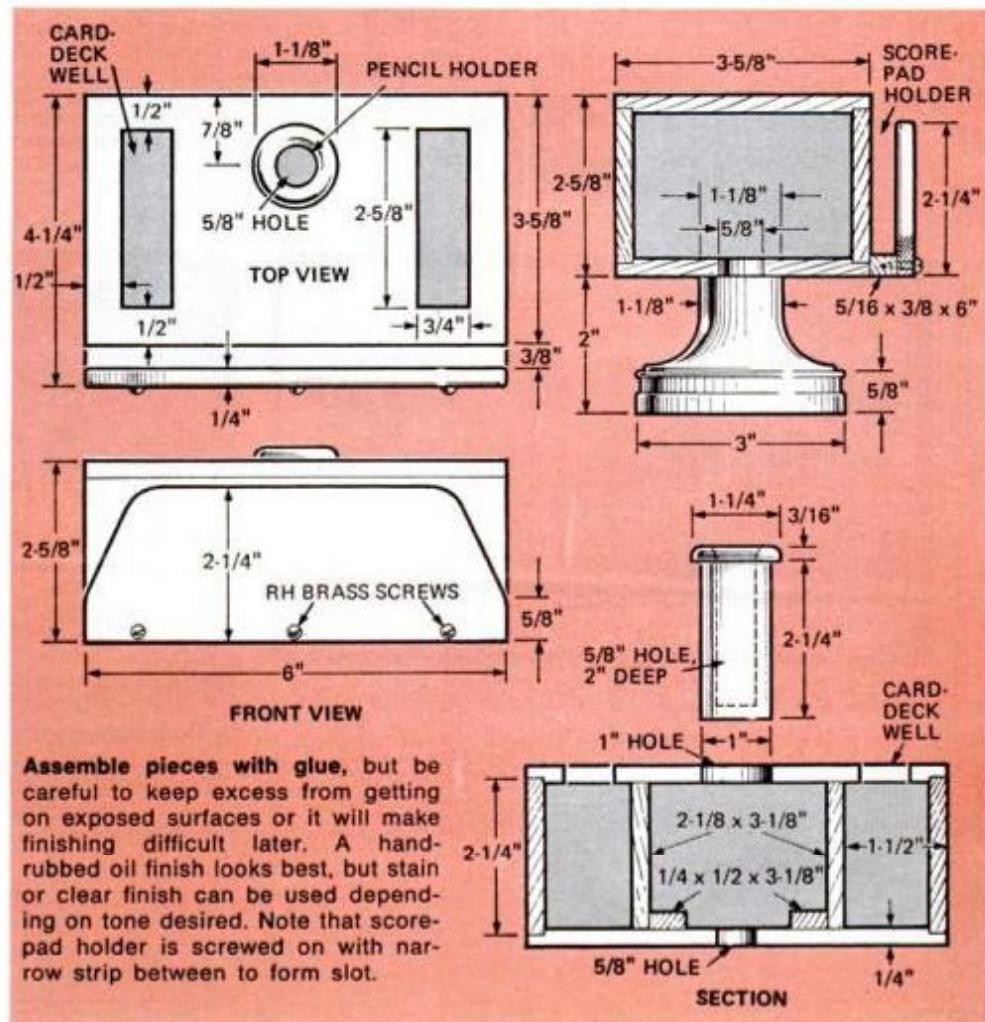
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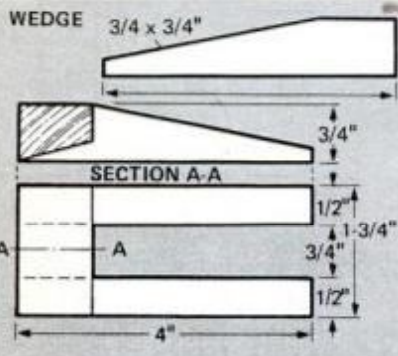
STRUCK KIT, Dept. PM577 Cedarburg, WI 53012



Assemble pieces with glue, but be careful to keep excess from getting on exposed surfaces or it will make finishing difficult later. A hand-rubbed oil finish looks best, but stain or clear finish can be used depending on tone desired. Note that score-pad holder is screwed on with narrow strip between to form slot.

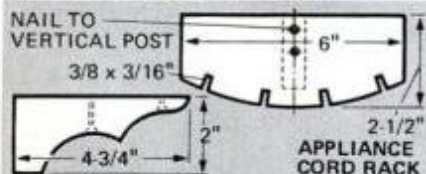
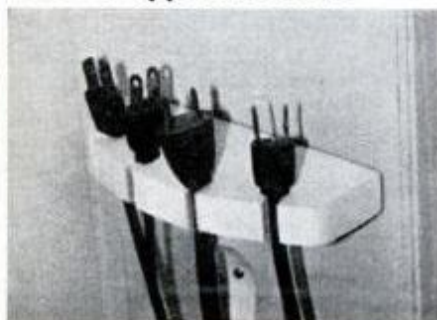
HINTS FROM READERS

Wedges tighten cord



This wedge set holds securing cords taut on boxes and items that have just been glued. The wedges are sloped in opposite directions and keep the cord centered. As they are squeezed together, their beveled surfaces force the cord outward and taut.—*W.E. Burton*

Rack for appliance cords



Appliance plugs are handy and ready for use when held in this simple rack. It's made from 3/4-in.-thick pine. The post is screwed to the wall. Slots are sawed to hold the cords.—*Ralph S. Wilkes*

HANDY IDEAS FROM BIG RED

T.M.

A handy man to have around the house.

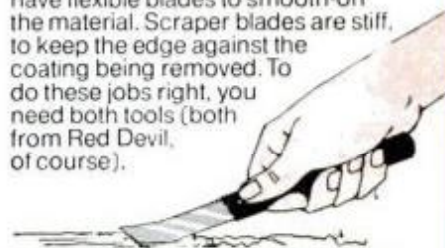


More home fix-up tips from the pro.

Fill the tub before you caulk. (Get in if you can, too.) Then, when the tub is empty, it'll rise slightly and squeeze the caulk. Even a good flexible caulk (like Red Devil's) will serve you longer when the filled weight is not stretching it between the tub and wall.



A putty knife is not a scraper. And vice versa. Putty knives (for spackling walls and putting windows) have flexible blades to smooth-on the material. Scraper blades are stiff, to keep the edge against the coating being removed. To do these jobs right, you need both tools (both from Red Devil, of course).



Caulk is caulk is caulk? Wrong!

Latex or acrylic latex caulk provide excellent durability (especially when painted) and easy clean-up for most uses, but you'll need butyl caulk for the water resistance required at or below ground level. Different caulks for different jobs, that's why Red Devil offers different kinds.



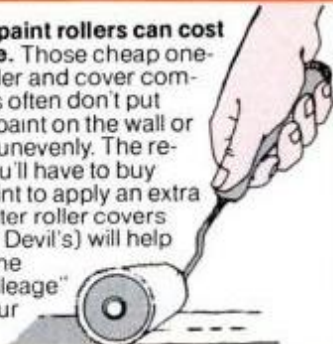
Bag your paint brush.

Don't throw away the plastic cover when you buy a new paintbrush. It'll keep the brush dust-free and in perfect shape between uses. Red Devil brushes come with re-sealable covers for just that reason.



Bargain paint rollers can cost you more.

Those cheap one-piece roller and cover combinations often don't put enough paint on the wall or put it on unevenly. The results? You'll have to buy more paint to apply an extra coat. Better roller covers (like Red Devil's) will help you get the most "mileage" out of your paint.



Stud finders are un-hole-y. When hanging pictures on a freshly painted or papered wall, don't fill it with holes before you find the wood behind it. Use a Red Devil Stud Finder. It points out where nails are—and where there are studs.



Red Devil has hundreds of things to make your home fix-up easier. Look for them wherever you shop for home-care products. And for best results, always follow directions on the package.

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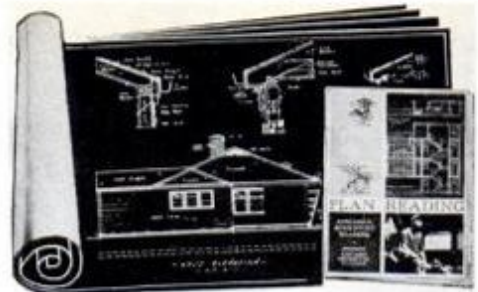


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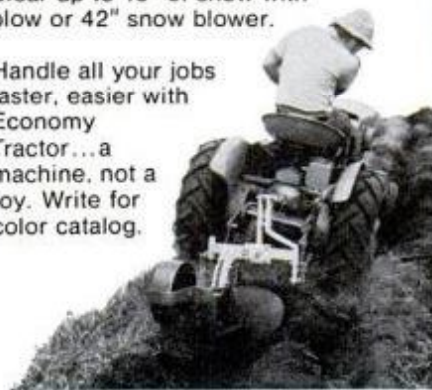
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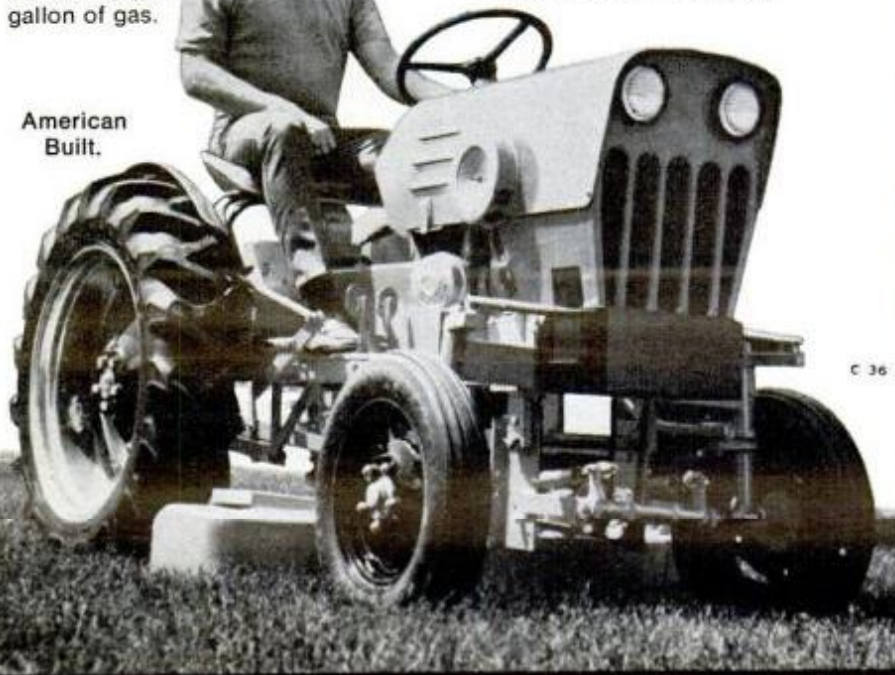
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DRESS UP YOUR YARD WITH BRICK

(Continued from page 106)

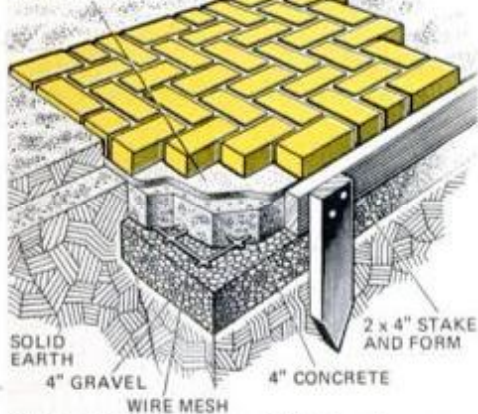
the type wheelbarrow used on construction sites—one with a deep tub and pneumatic tire. To pour a slab for outdoor use, you'll normally need about a 4-in. thickness over an equally deep gravel base. If you place 6x6-in. wire mesh over about 2-in.-thick, newly poured concrete, and then pour the remaining 2 in. of concrete, there will be less chance of cracking due to temperature changes and frost upheavals.

Smooth the concrete with a wood float that gives a coarse texture. The roughness assures a better bond between slab and following mortar bed.

Let the concrete cure for two weeks or more. For best results, cover it with burlap, canvas or salt

BRICK PAVING WITH MORTAR

1/2" MORTAR
LEVELING BED



It's best to lay mortared brick paving on a concrete slab cured with controlled hydration for 10 days to two weeks.

hay. Spray it with water, then dampen it daily to control hydration.

Laying mortared brick

Before you lay the brick, double-check the pitch of the concrete. Use a string and line level to establish slope with positive drainage.

Try a dry run of laying the bricks without mortar to get an idea of how many bricks you'll need per course. Be sure to consider the width of the mortar joints. If necessary, use a cut brick at the end of each course to equalize joint variation.

When you've dampened the brick (if needed) and mixed the mortar, begin by laying the brick in a 1/2-in. mortar bed. When the bricks are in place and the mortar has hardened slightly, press each joint with a pipe or mason's joint tool as when laying brick vertically.

After all brick is laid, sprinkle lightly with a garden hose, taking care not to disturb the joints. When dry, clean off mortar by sprinkling sand on it and sweeping. ★★★

HENRY MORGAN SAYS:

"Even if you don't know which end of a screwdriver you hold, you can learn to make money fixing appliances"

If you've seen this well-aged comic on television, you know I'm not in the business of fixing appliances. So what am I doing in an ad for an appliance repair course? It's simple: I got tired of laying out a sockfull of money every time something went wrong around the house. Then I came across an NRI ad and I thought, "Why not? I've spent a fortune on repairs . . . if I'm too stupid to fix a toaster, this is the way to find out."

So I took the course and now I can fix my own appliances and I can even make money out of it if I want to. As a matter of fact, there's enough money in fixing these things, I'm tempted to quit show business and go straight.

Think I'm kidding about the money? Just check out the receipts on your last repair bills. And then ask anybody if they know a good reliable repairman. You'll find they're scarcer than doctors who make house calls. If there ever was a field crying for good men, this is it. Opportunity is knocking louder than my car's engine, and it could be knocking for you.

If you've ever toyed with the idea of making it on your own, with your own repair business . . . NRI has a low-cost, home study plan that really makes sense. You can hang in there with your present job while you're learning, and you'll find NRI's course is quick, easy, and cheap.

Let's say you have trouble just plugging in your electric shaver. You'd better start with the basics . . . and the NRI course starts right there. First they tell you what electricity is, and you can't get any more basic than that. They take you by the hand, step by step, as fast or as slow as you want to go. If you get an attack of the stupids, there's always an NRI expert waiting to give you a hand. They do everything but turn the pages for you.

Like I say, I took the course and it turned out to be even better than they



said it would be. Sure they pay me for writing this ad, but it ain't much, believe me. I could make more in a month by fixing things for the neighbors . . . and I'm not kidding. It's just that I believe in seeing guys make it on their own. If you follow the simple texts and the big pictures, you can be a technician in no time. They even send you a professional appliance tester with the course.

You don't have to stop with toasters and irons. They'll even show you how to repair air conditioners, refrigeration units, commercial appliances, power tools, and small gas engines. That's where the big money is.

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Trail walk- commando course for archers

Around every corner a new field test is waiting for the bow-and-arrow sportsman.

by Gene Haman



Along a leafy woodland path you walk quietly, bow and arrows ready. Peering ahead, you study every shadow behind the trees and beneath overhanging branches as you watch for any sign of an animal shape. Suddenly you sight the outline of a big bird behind a bush. One step to the side shows the outline of a wild turkey about 20 yards away. You draw and quickly fire off an arrow. Just as can happen under actual hunting conditions, you fired too soon—and missed.

But this time you will have another chance because the turkey is a life-size cutout of cardboard. You shot from a stake that marked the proper aiming position. Your hits and misses are scored by club members who, across the country, are laying out field test ranges as carefully as golf courses to test an archer's ability with lifelike targets.

Formal field archery started about 40 years ago as off-season practice for bow hunters. Since then it has expanded into contests as a recreational game for many archers who never hunt at all but enjoy the challenges faced during trail-walk conditions over varying terrain and at distances of from 20 feet to 80 yards.

Two organizations have field programs, The National Field Archery Assn. (NFAA) and the National Archery Assn. (NAA). The NFAA is devoted solely to field archery and bow hunting, while the NAA is the official amateur archery group and affiliated with the U.S. Olympic Committee. Its major activity is target archery, but it also has an active field program.

Setting up a course

To set up a basic NFAA field course, five to 10 acres are needed for each unit of 14 targets; two units, or 28 targets, constitute a round. Primary rounds are Field, Hunter and Animal, with bull's-eye targets in various sizes and distances for the first two and animal silhouettes for the last.

Group One includes black bear, grizzly bear, deer, moose, elk and caribou targets at ranges of 40 to 60 yards. Group Two targets of small black bear, antelope, small deer, wolf and mountain lion are ranged at 30 to 45 yards. Group Three includes

Field archery club layout may include deer silhouette poised in the shadows (at top) and practice downhill shots of 50 to 80 yards (left); close practice from 20 to 45 feet (above); uphill, downhill and ravine angles; a 100-yard running deer range (far left above the clubhouse); and 100-yard practice range (bottom) in from parking lot for tune-up before a session.

coyote, raccoon, javelina, turkey, fox, goose, wildcat, and pheasant at 20 to 35 yards. Group Four has turtle, grouse, crow, skunk, woodchuck, jack-rabbit and rockchuck targets at 10 to 20 yards. Distances are often marked on stakes showing shooting position so that archers can learn to estimate range.

The NAA's field program is similar to the NFAA's, but all distances and targets are given in metric measurements and neither the compound bow nor release aids are allowed.

Individual clubs, however, often create their own inventive layouts and use life-size game animal paper outline targets or three-dimensional replicas. These can be made of Styrofoam or burlap/Styrofoam combinations and painted in the animal's natural coloration. Clubs can follow national rules or adapt their available space to other layouts.

Targets hide, move, disappear

Often a club will place targets along a trail-walk in deep shade to make target spotting and distance judging more difficult. Next you may come to a shooting position where you must bend, twist or stand on a log to get off a shot. Sometimes part of your target may be concealed so that you must shoot through branches or even climb a tree or construct an elevated shooting platform to simulate a tree stand. Moving targets of the running deer type can be constructed to pass rapidly through an opening or across a field and into the brush, where they reverse direction, then appear to run the other way.

Some leagues favor "instinctive" archery where no sights are allowed

to be attached to the bow, and arrow weight required for men and intermediate boys is 400 grains on a 28-inch arrow length, and 300 or 350 grain arrows for women, intermediate girls and cadets. They also generally require standard placement of the index finger over the arrow and the others under it. A regional club in Michigan, for example, might plan most shots at distances of under 40 yards to simulate local hunting conditions, while a Colorado club near wooded mountains and open parks would have more long-range shots.

What it costs

Getting outfitted to take part in trail-walk archery can cost about \$50, but many people are now paying \$150 to \$200 because of the increased interest in the compound bow with its system of cables and eccentric-mounted pulleys which lessen the peak draw weight required. Compound bows run \$75 to \$250, and archers using them favor aluminum arrows at \$25 to \$50 a dozen. Other necessary accessories—shooting tab or glove, arm guard and quiver—should total under \$10. Bow sights range from \$7 to \$50 or more. Begin with arrows of the proper stiffness (spine) for your bow's draw weight at your draw length. This is important.

Additional field archery information is available from the NFAA, Rt. Box 514, Redlands, Calif. 92373; and the NAA, 1951 Geraldson Drive, Lancaster, Pa. 17601. You can, of course, set up your own archery obstacle course if you have a very big back yard. But check first to see if local ordinances allow it. ★★

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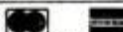
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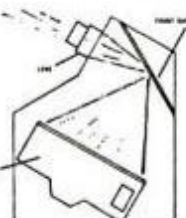
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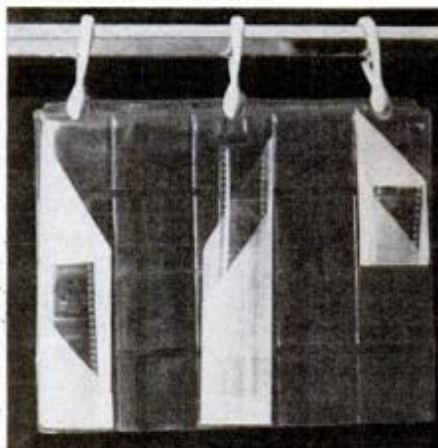


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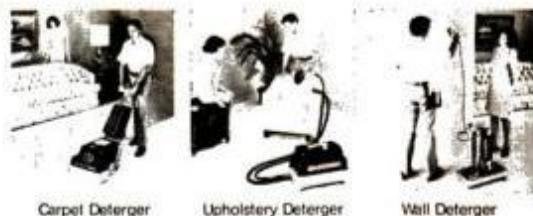
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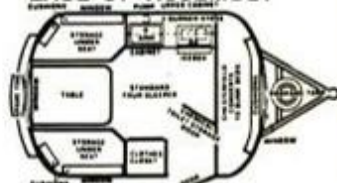
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(Continued from preceding page)

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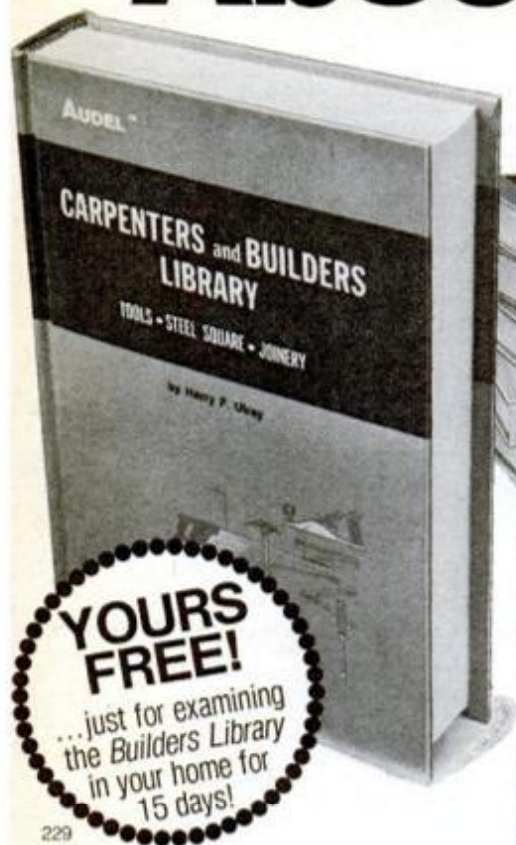
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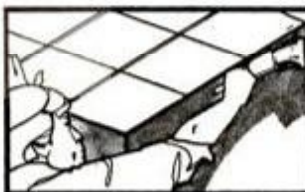
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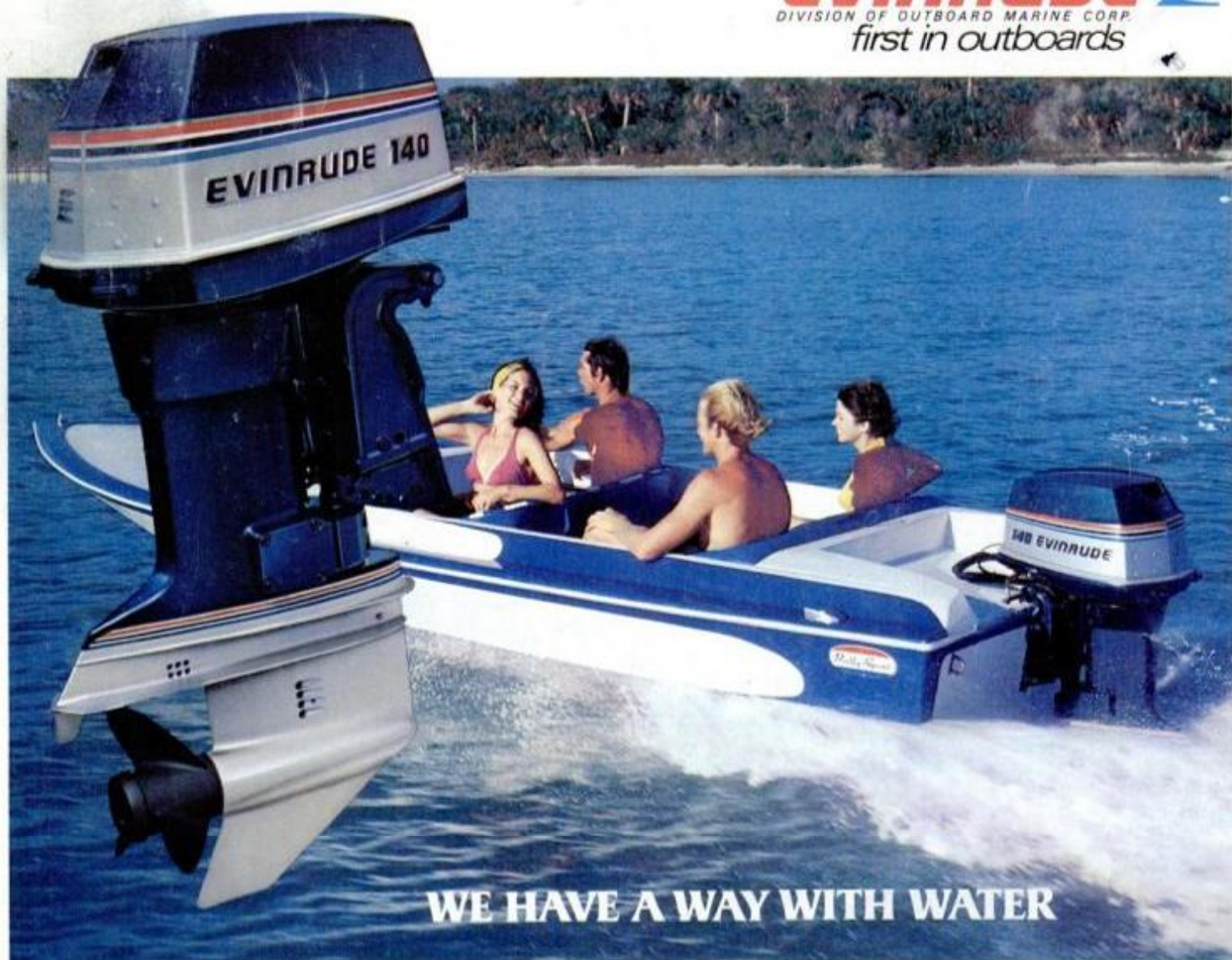
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