

4 WONDERFUL WEEKEND/VACATION HOMES

SPECIAL!
Illustrated, step-by-step

Popular Mechanics

MAY 1974
60 CENTS

Car Care Guide

'Swinging' beach house rotates for a view in any direction

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Pedal cars: no gas worries

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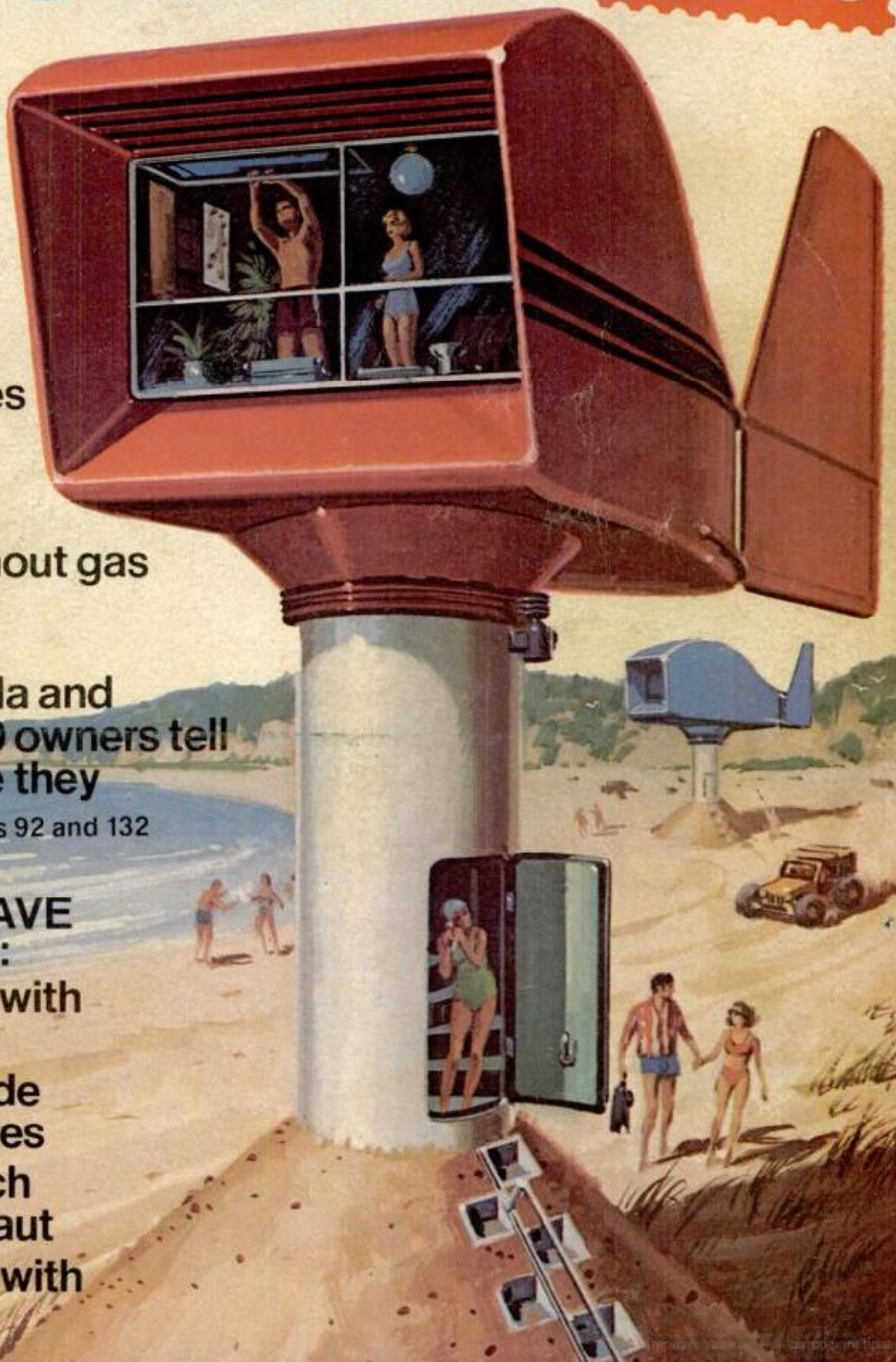
10 ways to vacation without gas

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Toyota Corolla and Datsun B-210 owners tell what mileage they really get

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CLIP-AND-SAVE KNOW-HOW:
How to work with plasterboard
16 ways to hide plywood edges
How to stretch screen wire taut
How to paint with spray cans



DODGE ANNOUNCES RAMCHARGER.



RAMCHARGER ANNOUNCES:



FULL-TIME FOUR-WHEEL DRIVE

Ramcharger was built especially for people who like to get off the beaten track. It has a frisky four-wheel drive that'll keep you going when the going gets rough—in rain, snow, or mud. And "full time" means you don't have to shift in and out of four-wheel drive or get out to lock or unlock the front wheel hubs. Front disc brakes are also standard.



REMOVABLE STEEL ROOF

Ramcharger's optional steel roof seals out wind-noise and rain. And because it's double-wall steel instead of fiber glass, it gives you even greater protection. (A soft canvas top is also available.)

CONSOLE ICE CHEST

If you opt for Ramcharger's deluxe interior with plush bucket seats, you get an insulated cooler right in the console. Just pack it with ice and a few cans of your favorite beverage. It's an exclusive.



SHORT TURNING DIAMETER

With a turning diameter of 35.4 feet, Ramcharger gives you the kind of maneuverability you need—especially on those back country roads that are Ramcharger's natural element.



AND MORE The options go on and on: An easy-to-operate lift gate. (It comes with the optional steel roof.) Two towing packages. An outside spare tire mount. A 35-gallon fuel tank. Heavy-duty springs. Air conditioning. Automatic transmission. Automatic speed control. Power steering. Roll bar. Skid plates. Tires ranging up to 10.00-15/B. And a choice of four different engines from the 318 V8 to the powerful 440 V8—all with standard Electronic Ignition.

EXTRA CARE IN ENGINEERING
MAKES A DIFFERENCE IN DODGE
... DEPEND ON IT.



When a rifle's as good as the Model 700, why improve it?

Great performance. Great looks. They've made the Remington Model 700 America's best-selling bolt action center fire rifle.

It's why so many experienced hunters would not rely on anything else.

And now we've improved the Model 700 five important ways. Introducing our new stock. First and foremost, you'll really be proud of the 700 BDL with its deep, sharp checkering, cut 20 lines to the inch. And it wraps all the way around the fuller, deeper fore-end to fit your palm better.

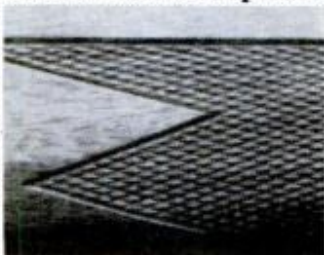
And a redesigned anti-bind bolt that prevents drag or hesitation when you push it home. We moved the bolt handle forward, too, just enough to make it miss your forefinger on recoil.

A new rear sight. Easier to adjust for elevation and windage. Easier to read because of the highly visible graduated markings. Easier to detach when you're ready to mount a scope.

We've put more grip in the pistol grip by making it slimmer at the wrist and fuller at the grip cap. To give you greater comfort and control.

Followed by a brand-new follower. This one's tough stainless steel. It's a more expensive process, but it pays off in strong, smooth operation.

Other new features: the butt plate (it now has four screws to eliminate any chance of warping), in magnum calibers a new presentation-type recoil pad and a



checked grip cap now make the 700 BDL a better than ever gun to buy.

And don't overlook the existing features which helped make the Model 700 America's best-selling bolt action center fire rifle.

The strength of its bolt action is unsurpassed. The famous three rings of steel action remain the heart of this great gun. When loaded, the cartridge head is completely surrounded by three rings of solid steel—the bolt head, the barrel and the receiver. There are no extractor cuts to weaken this critical area.

The 700 is so accurate its design was used as the basis for the Remington

40-XB Bench Rest competition rifle.

The choice is yours...the handsomely crafted 700 BDL Custom Deluxe or the 700 ADL Deluxe. The BDL, with its precision-contoured Monte Carlo stock protected by Du Pont's tough RK-W finish, black fore-end tip and white line spacers, hinged floor plate, jeweled bolt and sling strap with quick-release swivels starts at \$189.95*. The ADL, with Monte Carlo stock, skip-line checkering, and DuPont RK-W wood finish, is priced from \$164.95*.

Caliber selection for the Model 700 is almost unlimited...a caliber for every kind of hunting, from varmints to elephants.

To get the best performance from your Model 700, it makes sense to use the ammunition that was made for it. Remington "Core-Lokt" or "Power-Lokt" cartridges pack the stopping power you need when one shot makes the difference.

For more information on the complete line of Remington products, write for our free 1974 full-color catalog. Send a postcard to: Remington Arms Company, Inc., Dept. 566, Bridgeport, Conn. 06602.

MODEL 700 CALIBERS

CALIBERS	700 ADL	700 "VARMINT SPECIAL"
22-250 Rem.	X	X
222 Rem.	X	X
223 Rem.		X
25-06 Rem.	X	X
6mm Rem.	X	X
243 Win.	X	X
270 Win.	X	X†
30-06	X	X†
308 Win.	X	X
7mm Rem. Mag.	X	X†
264 Win. Mag.		X
300 Win. Mag.		X
375 H&H Mag.		X



This One



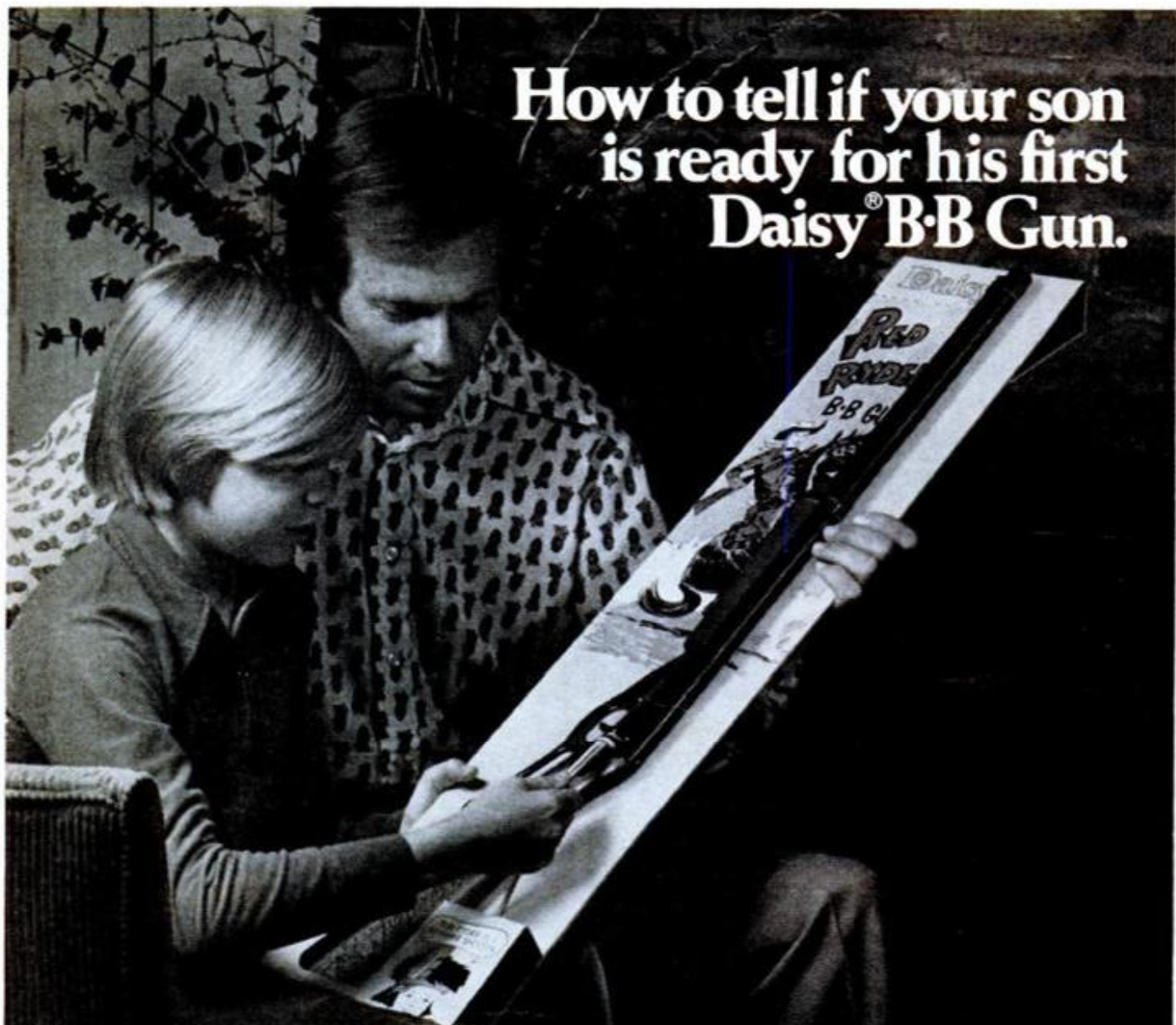
3FDB-PYU-641L

Remington

Great guns deserve great ammunition. W

*Suggested retail prices, subject to change without notice. "Remington," "Power-Lokt" and "Core-Lokt" are trademarks registered in the U. S. Patent Office.

How to tell if your son is ready for his first Daisy® B·B Gun.



It's in this free book.

If your son is eight years old, he should be ready for his first Daisy B·B Gun. Our free book, "The Air Rifle Marksman by Daisy," will help you decide for yourself.

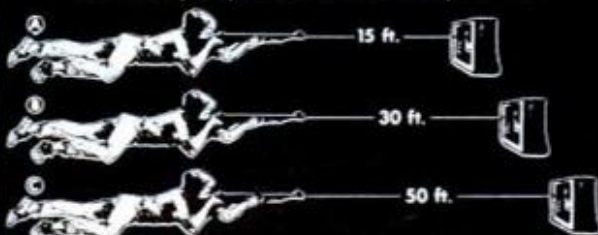
This book tells you everything you need to know about B·B Guns. Including the rules of proper gun handling and good sportsmanship. How to set up indoor and outdoor shooting ranges. Where your son can be enrolled in shooting education programs. It shows you 33 great Daisy models. Four models especially made for 8-10 year olds. Sixteen models for 10-15 year olds. And for more experienced marksmen, there's a section on Power Line™ adult air rifles for shooters 16 and older.

Pick up your free copy of "The Air Rifle Marksman" at participating Daisy dealers. Or write and we'll send you one. You can give your son a unique sense of responsibility and accomplishment with his first Daisy B·B Gun. And now is a good time to start.



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How little space you need to shoot a Daisy B·B Gun?



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SINCE 1886

Division Victor Comptometer Corporation
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in your free Daisy book.



Worn-out spark plug.

Deposits—and electrode wear—indicate that this spark plug has been used beyond the manufacturer's mileage recommendation. Must be replaced, as part of a tune-up, or it can start robbing you of gasoline mileage.



Carbon fouling.

Dry, fluffy black carbon deposits may result from such out-of-tune conditions as over-rich carburetion, a faulty automatic choke, a clogged air cleaner or spark plugs too cold for your driving conditions.



Lead fouling.

A coating in shades of grey, brown or yellow on the insulator tips and electrodes of your spark plugs indicates lead fouling. This can be caused by using a fuel with an improper octane rating. Spark plugs with a shiny, glazed coating must be replaced.

Nobody needs gas robbers these days

Pictured above are some of the gas thieves that eat into good gas mileage: spark plugs that show your engine's not in tune.

Tune up with AC Fire-Ring Spark Plugs. There's a correct AC Spark Plug for your car and your kind of driving. Even if your kind of driving has changed. That's why a tune-up with AC can help you get improved gas mileage, right now, when you need it most.

But, remember, even with AC Spark Plugs, always check with your owner's manual before any installation. Just to be sure.



Tune-up America

WITH...



AC SPARK PLUG DIVISION
OF GENERAL MOTORS CORPORATION

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Worth writing for S86

ON THE COVER: 'Swinging' beach house that rotates for a view in any direction.
Illustration: Ed Valigursky

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says Jerry Baker, "America's Master Gardener."



New! Hudson Cordless Electric Sprayer!

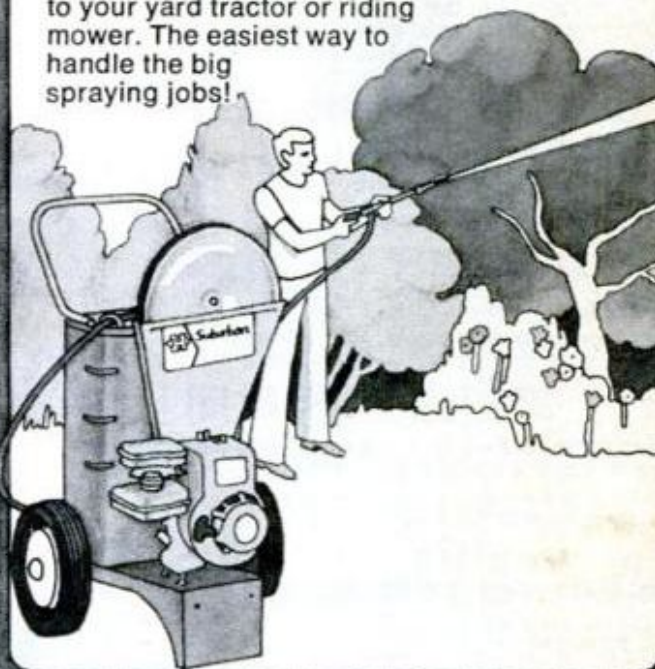
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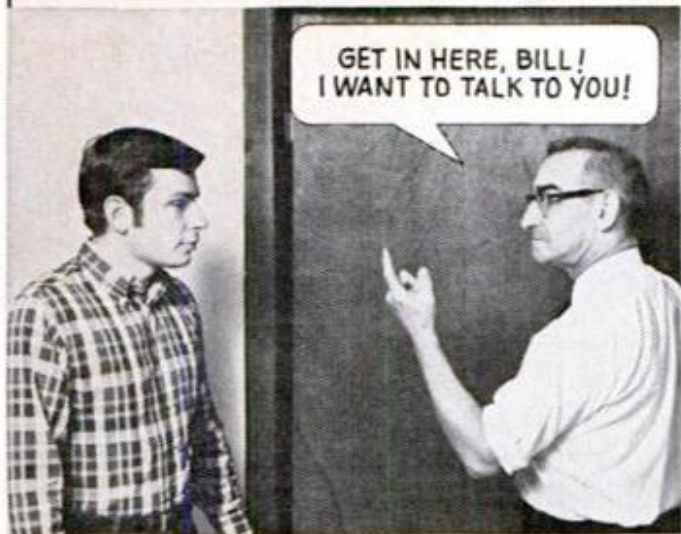
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The day Bill told off his boss



GET IN HERE, BILL!
I WANT TO TALK TO YOU!



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MINUTES LATE, I'M DOCKING
YOU AN HOUR'S PAY, AND
IT BETTER NOT HAPPEN
AGAIN... OR ELSE!



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THE MONEY!



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TO PAY YOU
THAT MUCH!

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OF GOOD JOBS!



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LETTERS

TO THE EDITOR

How d'you build the Bug's body?

Before I spend nearly \$15 on plans, I would like to ask a few questions about the *Boonie Bug* (page 94, March *PM*). How or where are the fiberglass panels that make up the body and doors obtained or made? Do you make them yourself or do you have a fiberglass shop make them?

MOUNTLAKE TERRACE, WASH. DON PETERSON

Complete instructions for laying up and fiberglassing the body panels are included in the manual and plans, so you can do it yourself. However, there's no reason you couldn't have it done by a professional.



The body panels are formed from standard insulation sheet material with cloth fiberglassing applied to the interior and exterior surfaces. The resulting body is completely watertight, weatherproof and extremely warm and noiseproof because of the use of thick insulation panels in the core.

For large, detailed plans and complete instructions for building the "Boonie Bug" camper on a Volkswagen bus chassis, send \$14.95 to Popular Mechanics, Dept. BBL, Box 1014, Radio City, New York, N.Y. 10019. Request plan No. B1307.

Better to stay in bed?

The approach S.S. Miner makes to a comparison of various means of travel (*Letters*, page 8, March *PM*) is so ludicrous in its attempt to uphold my grandfather's kind of

(Please turn to page 11)

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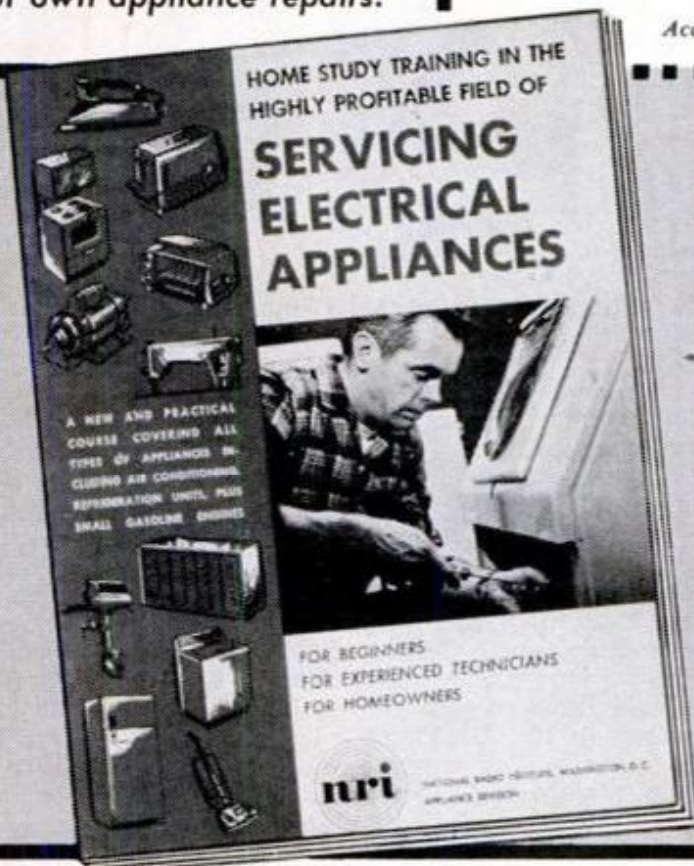
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to make \$5 to \$7 an hour fixing appliances for friends and neighbors.

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These are very special people.

Many heads turned when Charles Tripp, "Armless Wonder," and his friend Eli Bowen, "Legless Wonder," rode their bicycle built for two.



"Jacques" was the name Jean Libbera gave to the miniature twin that grew out of his body.

These are just a few of the many "mistakes of Nature" included in Frederick Drimmer's fascinating new book, **VERY SPECIAL PEOPLE**. What makes them very special is that they were all born "curiosities" and they all lived unusual lives. Like Chang and Eng, the original Siamese twins, who were joined at the chest for life. They married sisters, set up separate homes, and fathered 22 children between them!

Then there was Grace McDaniels, who was billed as the ugliest woman who ever lived (and her photo proves it). Believe it or not, Grace received several proposals of marriage before she accepted one from a handsome young man. They had a perfectly normal son, who grew up to be his mother's manager!

John Merrick, the grossly deformed "Elephant Man," was deserted by his heartless manager. Befriended by a kindly doctor, Merrick became quite famous and was frequently visited by Royalty.

All the stories in this book are true, and we have over 65 rare photographs to prove it. Never has one book been so complete. There are chapters on giants, dwarfs, fat people, armless and legless wonders, hermaphrodites (half man, half woman), bearded ladies, and numerous other human oddities.

This is not just a picture book of "freaks." The author treats these people with insight, compassion and the dignity one earns by being born different from everyone else.

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Julia Pastrana (1832-1860) was to ugliness what Marilyn Monroe was to loveliness.

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LETTERS

(Continued from page 8)

prejudice against the airplane that I must not pass it up. (Grandfather died in 1931 at the age of 94.)

Mr. Miner would make the comparison on a time-spent basis rather than the distance traveled, ignoring the purpose of travel is to go from one place to the other.

I would like to suggest to Mr. Miner's approach that a comparison with walking would get a much more favorable result. Then, if the danger of an accidentally sprained ankle is detrimental, we could go to the crawl. One step further—more people die in bed than elsewhere, but then on a comparison of time spent as compared to elsewhere, the statistics are much more favorable. But then, on the other hand, we aren't getting anywhere lying in bed.

YUMA, ARIZ.

WALT WILLIAMS

Squares should be larger

In *Classic Chandelier You Can Make for Less Than \$45* (page 158, Feb. PM) you

stated that the template was for $\frac{3}{4}$ -inch squares. I was just wondering if the squares should indeed be $\frac{3}{4}$ inch—or should they be 1 inch?

SANTA ANA, CALIF.

GEORGE H. MOFFETT

Yes, anyone who makes the chandelier should rule off his grid drawing 1-inch squares.

Useful light reading

Thanks for the useful article, *Safer Fluorescent Lighting* (page 134, March PM). I've been wondering if my home's light fixtures were safe. I've now called an electrician to change them.

KINGSPORT, TENN.

H. S. YOUNG

Leave a little sawdust, please

The workshop article, *A Great Shop That's Neat, Noiseproof and Productive* (page 69, March PM), certainly shows an enviable

[\(Please turn to page 12\)](#)

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LETTERS

(Continued from page 11)

layout, but, like many such presentations, the antiseptic conditions would do credit to a hospital operating room.

Couldn't you just leave a little sawdust, assorted shavings or a bit of plain dirt around to make us run-of-the-mill shop owners a little more comfortable?

HOUSATONIC, MASS. ROBERT E. ELLIOTT

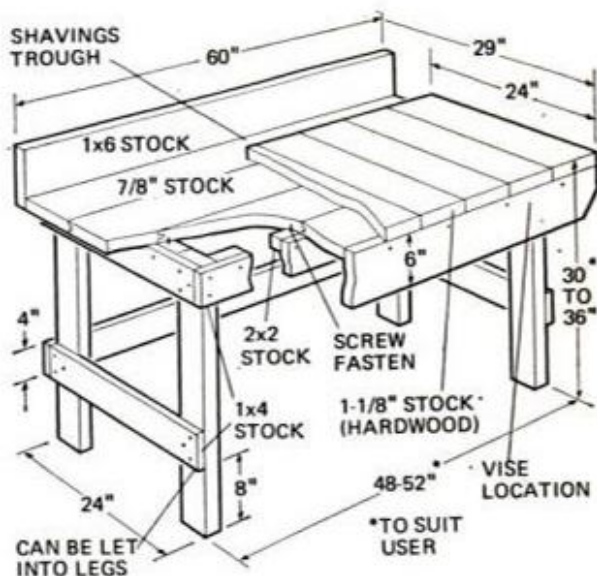
Instead of "Great Workshops," we ought to do a series of "Unexpected Visits to Editors' Workshops." There'd be enough sawdust, shavings and debris to make everyone happy.

Tips on workbench building

I am in the process of building my own workbench, but I don't quite know how to start. I have read several articles on building a bench, but for one reason or another I didn't like them. My biggest hang-up is the top of the bench.

CUYAHOGA FALLS, OHIO L. E. WILSON

Workshop Editor Harry Wicks advises: "Most workshopppers customize their workbenches to suit individual requirements. The main point to keep in mind when you're building one is that the bench must be solid and wobblefree."



"This sketch shows a basic method of constructing a solid workbench. This bench has a 60-inch-long top, and "out-to-out" dimensions of the legs can be from 48 to 52 inches. The bench can be built as long as

(Please turn to page 14)

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LETTERS

(Continued from page 12)

desired; just be sure there's not more than 52 inches between legs.

"Once the bench is finished, you can custom-build cabinets, shelves, drawers and the like to fit below. Have at least one woodworker's vise at either right or left end of the apron. If you plan to do a lot of woodworking, install another vise at one end of the bench, along with holes drilled in the benchtop for bench stops so you can work with long boards."

Fast curing weakens concrete

As an architect, I would like your readers to know that there are very serious side effects resulting from CO₂ in contact with curing concrete (*Science Worldwide*, page 52, Feb. PM).

Two major results of the consequent weakening of the surface of concrete are:

1. Excessive dusting which means the surface wears off quickly with the result that the floor is always dusty.

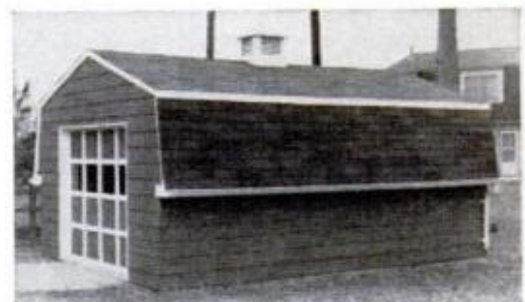
2. Vinyl tile will not permanently adhere to the surface since it is really in contact with a potential layer of dust instead of solid concrete.

HALIFAX, N.S.

HARVEY FREEMAN

Now those skills are known

I found your *Dutch Mini Barn* plans (page 64, Aug. '72 PM) quite useful for the basic framing and cupola of my garage. I enlarged it to 14 by 20 feet and used lap siding and roofing shingles to match my home. The interior is completely insulated,



wired, paneled and the ceiling finished. Total cost excluding concrete slab was \$960 and construction time was 10 weeks. Not bad for a practicing surgeon with no known carpentry skills.

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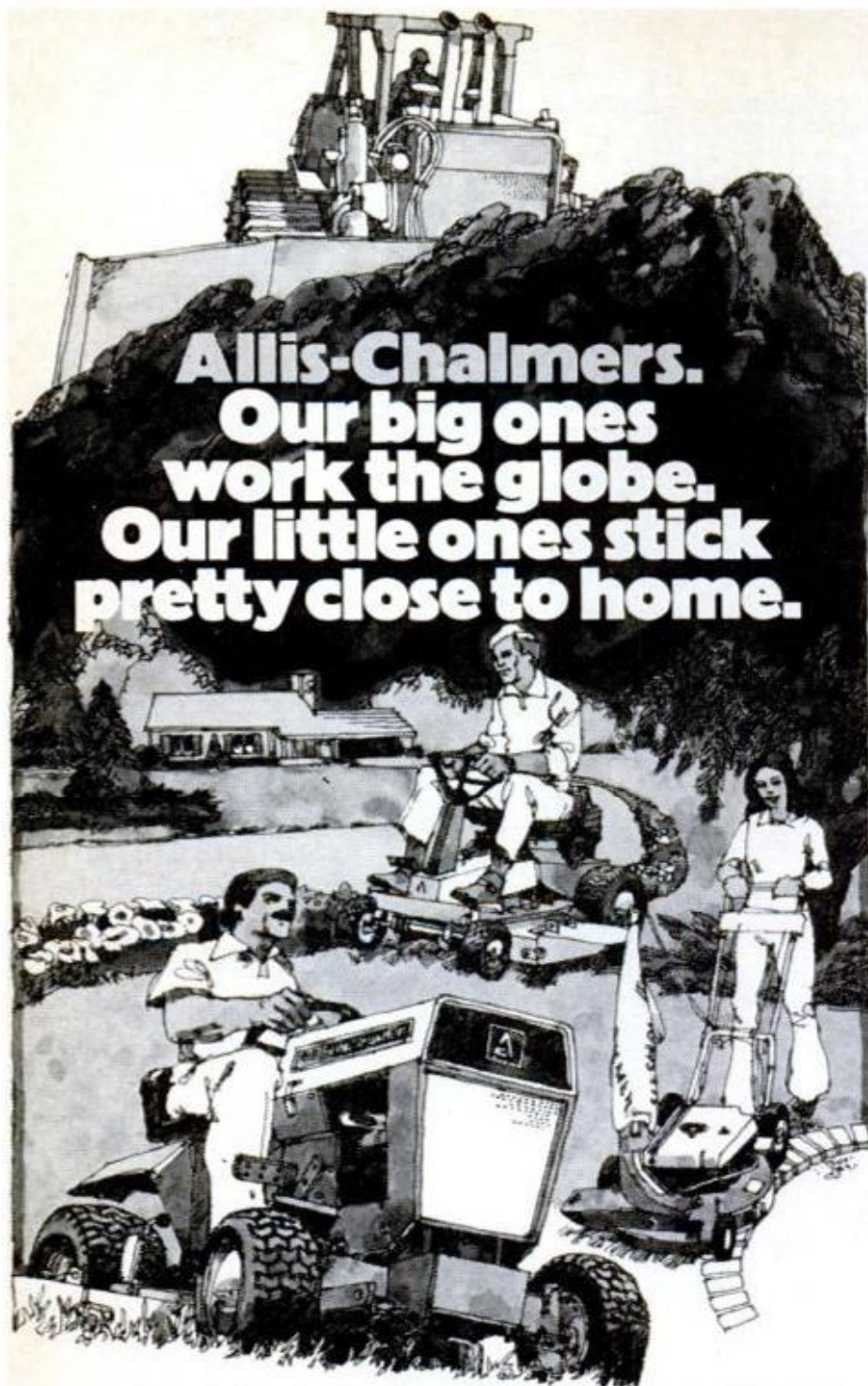
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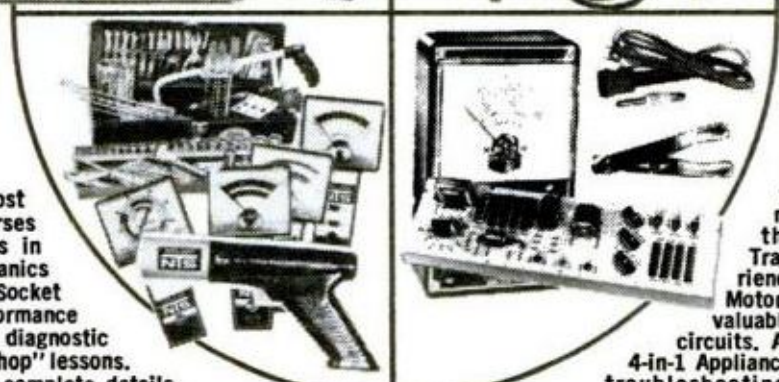
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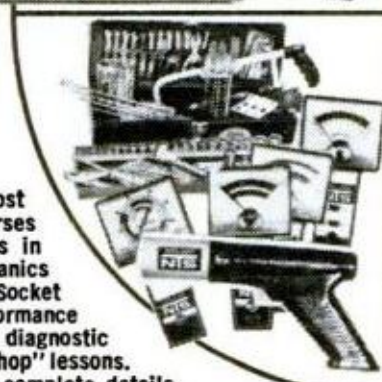
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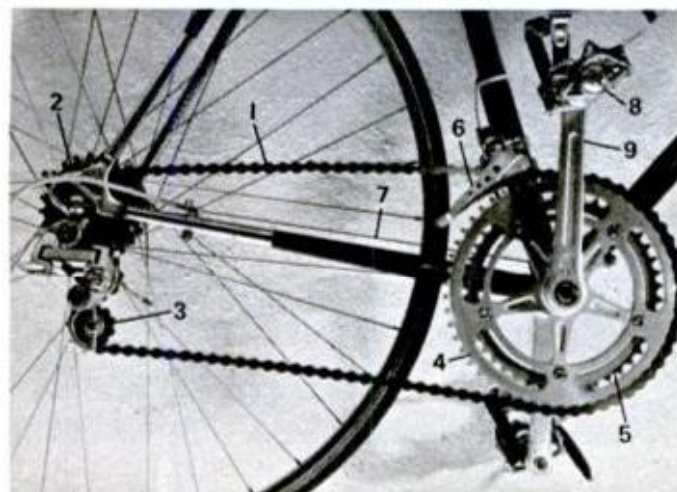
THE BICYCLE SHOP

BY EUGENE A. SLOANE

Fine, expensive bicycles are things of beauty, but they are almost never designed for the American bicyclist who uses his bicycle primarily for touring or for long day trips through hilly country. These European bicycles are really designed for the racing cyclist, and as such they have close ratio gears suited to him. Unless you are also a topnotch athlete in peak condition, you will need wider ratio gears that will make it easier for you to pedal up steep hills. Besides, you don't tour without baggage, and that's a real reason for the extra gears, if you don't want to admit that you aren't up to the energy output of a trained athlete. When you lug 15 to 30 pounds of gear (tent, sleeping bag, extra clothing, etc.) uphill, you will soon find there's a world of difference between cycling that loaded bike uphill, and the same bike with only you on it.

I have cycled through the Austrian Alps, the Green Mountains of Vermont, the French Alps, and I was not ashamed to use my ultrawide ratio gears to make some of those 15° grades, which from the bottom looked like a cliff. Sure, a few kids sweated by me on lower ratio gears, but most cyclists were walking up the hill. Even geared down so you're pedaling about 70 crank rpm,

Basic elements of typical 10-speed bicycle transmission are: chain (1), five-speed gear cluster freewheel (2), wide-range derailleur (3), outer chainwheel (4), inner chainwheel (5), front derailleur (6), rear derailleur cable (7), pedal (8), and crank (9).



and going little faster than a slow walk, cycling is a whale of a lot easier than walking and shoving the loaded bike uphill.

Why gears?

A lot of people ask me why all the gears, and particularly why 15 gears, which I have on my own touring bike. First, take a look at a typical transmission system (below, left). You will see the rear and front derailleurs, the rear and front gear clusters and the chain and cranks. This is the 10-speed transmission system. A 15-speed simply has one additional chainwheel up front, which gives you a higher gear ratio, or lets you step down gears in finer steps than with a 10-speed and still have a wide gear range.

But, still you ask, why the gears in the first place? Okay, take an automobile engine. Most cars have three or four forward speeds or gears. That's because an automobile engine has a wide energy range output compared to a human body, which has a very narrow range energy output. You can climb a steep hill or fight a 50-mph headwind and change gears only once in a car, or not all. In a bike under the same conditions you would have to shift gears five or six times to cope with an increasingly steep hill or varying headwinds. You don't always have the same amount of energy available every day, either. Some days you wake up feeling just great and ready to do 100 miles on the bike; other days you just know this is going to be a loaf-along trip with maybe 50 miles as a goal. (Sure, I said 50 miles; I'm 57 and a lot older than most of you and I can do it.) So on down days you don't pedal as hard, gear down sooner, take it easy. After all, cycling is supposed to be fun, not hard work.

Wide vs. narrow ratio gearing

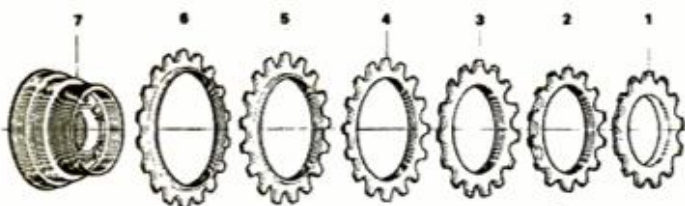
I define narrow ratio gears as a rear gear cluster with five or six cogs, with 13, 14, 15, 16, 17 and 18 teeth respectively, used with a front dual plateau chainwheel with 44

(Please turn to page 22)

THE BICYCLE SHOP

(Continued from page 21)

and 52 teeth or close to that. The drawing shows a six-speed Shimano close-ratio rear gear cluster freewheel. Nos. 1 through 6 are, respectively, 13, 14, 15, 16, 17 and 18 teeth



This six-speed rear freewheel gear cluster is a very narrow gear ratio unit, with gears of 13, 14, 15, 16, 17 and 18 teeth (Nos. 1 to 6 respectively). No. 7 is freewheel body onto which gears are threaded.

cogs. No. 7 is the freewheel body onto which cogs are threaded.

Medium-range gearing is a rear gear cluster of 13 to 24 teeth with a dual plateau chainwheel of 44 to 52 teeth. Wide-range gearing is, at the upper range, a freewheel with teeth from 14 to 34 teeth (photo) and a chainwheel of 44 to 52 teeth. I still don't believe this latter range is high enough for comfortable touring where steep hills and a load of around 20 to 30 pounds is involved. I used a 14 to 34-tooth rear five-speed cluster

This ultrawide-range freewheel gear cluster has 14, 17, 22, 28 and 34 teeth. Made by Shimano, this unit has every other tooth missing on 28 and 34-tooth gears, which makes it easier to shift down to them.



rear with a 32-40-51-tooth triple plateau (three) chainwheel up front in France recently, and still had trouble with 10° to 15° grades, of which there were too many. I did sweat up them, but I sure could have used a lower gear.

While I was in France I attended the 1973 International Bicycle Show in Paris and ordered a tailor-made bicycle with

really low gears of 30-40-45 front on which I will put my 14 to 34-tooth five-speed cluster on the rear wheel. With this gear I expect either to be able to make every hill I come to, or take a lot closer look at my own physical conditioning program. I know a lot of you younger people will have a good laugh at this wide gear range, but just you wait, your day is coming. Meanwhile there are millions of us over-30 bike tourists who do need these gears and this article is to help them install comfortable ratios.

We will discuss how to change over to wide-range gears in the June issue, with specifics as to changing freewheel clusters, wider-range derailleurs, longer chains, selecting correct chain length, and how to install wider range chainwheels. In this issue we will discuss gear selection.

Today bicyclists use a strange concept to describe the gear they use. It's strange because it's based on the diameter of the old-fashioned high-wheeler, which was pedaled at the front wheel and so had a one-to-one gear ratio. That is, for every turn of the pedal, the wheel would make one turn. This resulted in "gears" designated as so many inches of the front wheel. Obviously, the bigger the wheel the faster the bicycle would go, if the rider could supply the muscle power and had long enough legs. As the original two-wheeler progressed, its front wheel became larger until it reached the tallest and strongest man's limits of strength and inseam measurement. Because high-wheeler speed was related to front-wheel diameter, bicyclists today use this inch measurement, but have to make an awkward computation to do so. A gear chart is used, the formula for which is:

$$\frac{\text{Front gear teeth}}{\text{Rear gear teeth}} \times \text{wheel diameter.}$$

For example, my new bike's low gear is 34 teeth, the low front gear is 30 teeth and my wheel diameter is 27 inches.

Thus my "gear" would be $\frac{30}{34} \times 27$ which gives me a "gear" of 23.8. With this gear combination, a better measurement would be gear "ratio" which is simply the front gear divided by the rear gear or, $\frac{30}{34}$ —a gear ratio of .88 which means that

for every pedal revolution, I have a rear wheel revolution of .88 times. My high gear is a rear of 14 and a front of 45 which according to the formula gives me

(Please turn to page 24)

This spring, Homelite is picking up the tab for picking up the grass.



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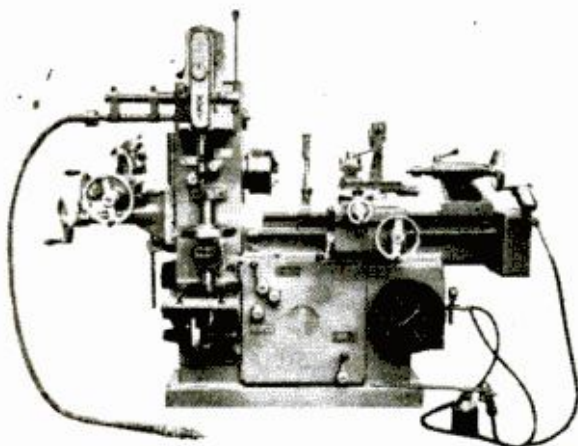
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THE BICYCLE SHOP

(Continued from page 22)

$(\frac{45}{14} \times 27)$ a "gear" of 86.8 and a gear ratio $(\frac{45}{14})$ of 3.2, so the rear wheel turns 3.2 times for every pedal revolution.

We do not have room to give you a complete "gear" table, but you can make up your own and even go one step further and, once you have figured your "gear," compute how fast you will travel in each gear at a particular pedal rpm. For instance, it's vital you learn to twiddle the pedals fast, and use a gear that lets you do this comfortably. If you use a big gear and strain at the pedals, turning them slowly, you work a lot harder than you need to. Try to keep a steady pedal cadence of at least 70 crank rpm.

To figure out how fast you go in any gear at any pedal rpm, use this formula:

$$\frac{\text{Pi} \times \text{"gear"} \times \text{crank rpm} \times 60}{63,360}$$

At my lowest gear, using this formula,
 $\frac{3.1416 \times 23.8 \times 70 (\text{crank rpm}) \times 60}{63,360}$

I will travel at the breathtaking speed of 4.95 mph. That's still a lot better than walking up those hills. At my highest gear, $\frac{3.1416 \times 86.8 \times 70 \times 60}{63,360}$ I will

be traveling at 18.1 mph, which is a pretty good clip. Don't count on doing it unless you are in prime condition and under 30. Again, let me stress that you should not think of bike gears as you do car gears. A lot of people ask me, "How fast can you go?" which is a nonsensical question. My answer is downhill, uphill, on the flats, with a 20-mph tail or headwind? Give me the conditions and I know how fast I can go in the gear required for these constantly changing variables of road grade, wind velocity and my own condition of the moment. You should be able to average 12 mph, say, on a day trip of 50 to 80 miles or so.

You should make up your own set of gear and speed tables. Here are two abbreviated tables for my own bike, and if you use the same gears you can use this table. For a complete set of gear tables please see the chapter on Gearing in my book *The Complete Book of Bicycling* (\$9.95, Trident Press, 342 pp).

As noted earlier, next month we will discuss in detail how to convert to a wider

(Please turn to page 28)

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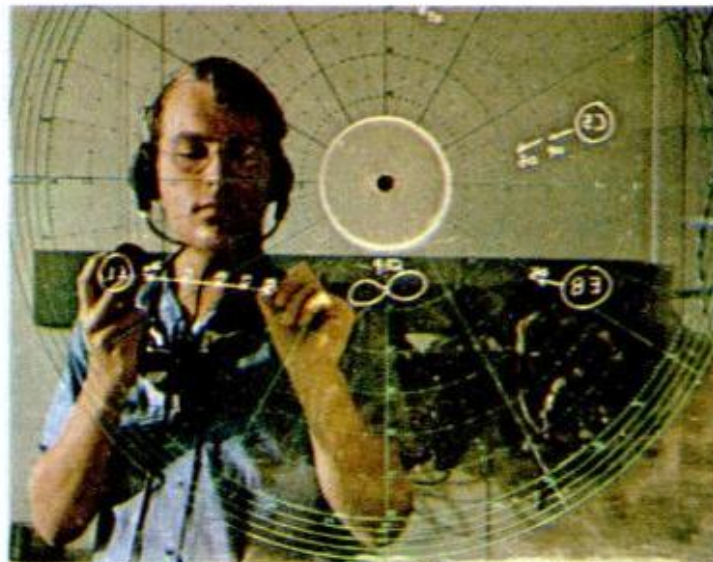
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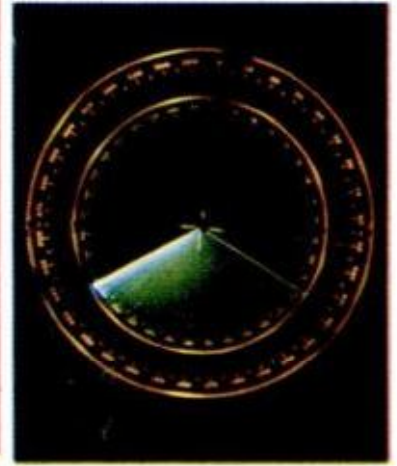
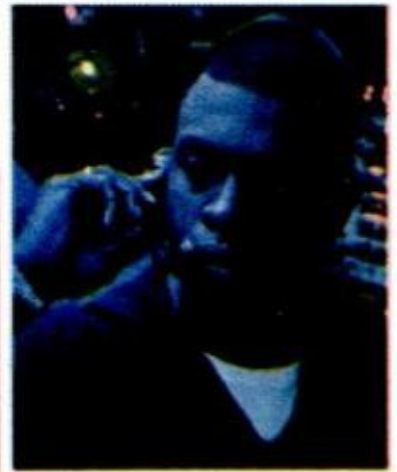
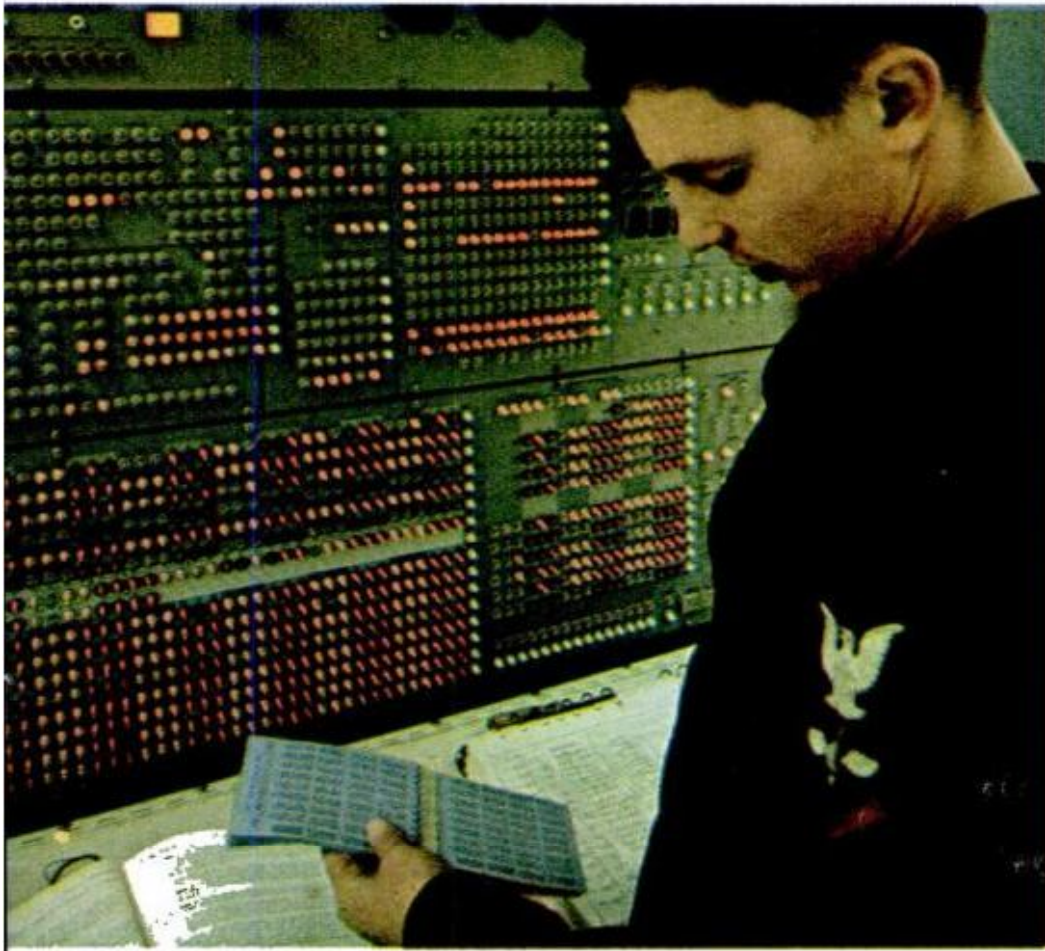
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THE BICYCLE SHOP

(Continued from page 24)

gear ratio more suitable for cycle touring in hilly country, without breaking your back and with fun. Meanwhile, have fun yourself with Tables One and Two and learn how to use them and make up your own tables. ★★ ★

Gear table

No. of teeth
in freewheel

14
17
22
28
34

Table 1

No. of teeth in chainwheel

30 40 45

57.9	77.1	86.8
47.6	63.5	71.5
36.8	49.1	55.2
28.9	38.6	43.4
23.8	31.8	35.7

To find the "gear" relating to the number of teeth in rear and front cogs, first find the number of teeth in the rear gear (left column), then the number of teeth in the front gear (top row) and underneath that number find the "gear" of that combination. For example you have a 14-tooth rear gear and a 40-tooth front gear. Where these lines meet you find 77.1, which is the "gear" you're looking for. This is a very abbreviated table which will probably not contain the gears you have. Compute your own combination with the formula:

$$\frac{\text{Front gear}}{\text{Rear gear}} \times \text{wheel diameter}$$

If you have a 44 front and a 14 rear combination with 27-inch wheel, the calculation is:

$$\frac{44}{14} \times 27 = 84.857141$$

Rounded off to two decimal places, your gear is 84.86.

Cadence chart

Table 2

Gear (From Table 1)	Crank (pedal) rpm			
	60	70	80	90
23.8	4.24 mph	4.96 mph	5.66 mph	6.37 mph
28.9	5.15	6.02	6.89	7.74
31.8	5.67	6.62	7.57	8.51
35.7	6.37	7.43	8.50	9.56
36.8	6.57	7.66	8.76	9.85
38.6	6.80	8.04	9.20	10.34
43.4	7.75	9.04	10.33	11.62
47.6	8.50	9.91	11.33	12.75
49.1	8.76	10.23	11.69	13.15
55.2	9.85	11.50	13.14	14.78
57.9	10.34	12.06	13.78	15.50
63.5	11.33	13.20	15.11	17.00
71.5	12.76	14.89	17.01	19.14
77.1	13.76	16.06	18.35	20.64
86.8	15.50	18.08	20.66	23.24

Find out how fast you are going by starting with your "gear" (first table) in the gear combination you are using at the pedal rpm you are pedaling. From this table, with a "gear" of 23.8 at 70 crank rpm you would be traveling 4.96 mph. Chances are this table will not cover your gears, so compute your own with this formula: Mph = 3.1416 x gear x pedal rpm x 60 ÷ 63,360. If your "gear" is 26 and you're pedaling at 70 crank rpm, your mph will be 5.41:

$$\frac{3.1416 \times 26 \times 70 \times 60}{63,360} = 5.41$$



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HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Inefficient fireplace

Even though I keep a good high fire, my fireplace doesn't put out much heat. What alteration must I make to get more return from the wood consumed?—Stephen Droscheck, Eagle, Colo.

What kind of wood do you burn? It could make the difference. The hardwoods such as oak are best; they are hottest and slowest burning because of their density. The lighter soft woods burn brightly and quickly, but with a relatively low heat output (and more soot accumulation in the chimney). Manufactured "logs" made from paper are usually better "heaters" than the soft woods and even some hardwoods, such as birch.

You may have your damper open farther than necessary. This can rob you of heat. Once the fire is going well, close the damper as far as you can without getting smoke in the room. If your fireplace is of average size and you burn hardwood and use the damper properly, and heat output still seems low, you may wish to have a contractor examine the fireplace.

Cracks in flooring

I live in an old house with wide floorboards. The cracks between the boards being about 1/8 in. wide. I've tried various fillers. No good; these break up. What can I use to fill the cracks permanently?—John Stanlow, Reading, Pa.

Slight movement of adjacent boards will tend to break up ordinary fillers or caulking. Assuming the boards are butted—not tongued and grooved—I know of a case where cracks were filled just below flush with the artificial rush used in caning chair seats. Then the cracks were filled flush with white lead paste colored to match the boards. Ample drying time before use must be allowed. Another method is ripping thin wedge-shaped strips from matching wood and tapping these into the cracks edgewise. Then the floor is sanded and refinished.

Quandary over clippings

With the mowing season here, I want to know whether I should remove clippings with the catcher on my power mower or leave them on the ground instead. Some advisers tell me one thing, some say the other. Who's right?—H. Adams, Lansing, Mich.

It isn't entirely a question of right or wrong, yes or no. There's a rule of thumb that has gained wide acceptance: If the clippings are bunched, or visible, after drying 24 hours or so on the ground, they should be removed. Otherwise, short clippings resulting from frequent mowings may be left as a mulch, particularly when the end of the mowing season nears.

Objectionable house odor

Recently I bought an old home of 11 rooms, and I've done as complete a renovating job as I know how to do. But still, objectionable odors are permeating the whole place. Do you have any suggestion?—John Rusman, Palisades Park, N.J.

If this house has been closed, unlive-in and unventilated for a relatively long time, the conditions that develop over such a period of time were ideally favorable for the growth of mildew, whence comes the persistent musty odor. Perhaps the only practical further step is to scrub everything scrubbable with a strong solution of trisodium phosphate (*caution*: wear rubber gloves and eye protection), then paint everything paintable—walls, ceilings and woodwork—with aluminum paint, followed by a primer and a finish coat. If the carpeting is old, discard it and lay new material. ★★★

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. While letters cannot be answered individually, problems of wide interest will be discussed in this column.

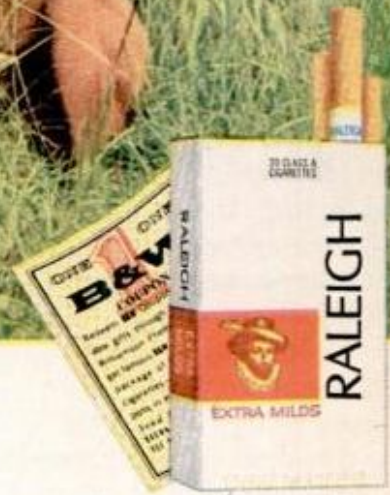


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ALL OUTDOORS

Saving energy outdoors

This month let's take time for a look at some excellent new aids for stretching energy outdoors. Leading suppliers are losing no time turning the engineering and ingenuity that created great gear into ways, now, to make it even more efficient. Industries that developed engines you can carry in one hand, boats requiring practically no maintenance, campers with living room/bedroom *and* kitchen sink, plus off-road rigs that make like mountain goats are figuring how we can get along on less fuel and money.

Recently they've been putting it on the line in pamphlets, booklets and instruction sheets now available at local dealers and directly from the companies. Economy methods range from useful basic hints we know and have forgotten—to intricate fuel-metering machines that might cost more than the money saved. Any tip today is worth considering, however. Here is a roundup of some of the suggestions. See your dealer, or write some of the manufacturers mentioned for more helpful data.

Obvious first step for any kind of economical performance is cleaning up and tuning up. Replacing tired sparkplugs, inflating tires to proper pressure, rechecking lube and alignment, scrubbing the bottoms and drying the bilges of boats are examples of normal maintenance we should be doing already. Then, in addition:

Engines. While it's no secret that cutting back on speed will reduce gasoline consumption, a number of manufacturers are now providing performance curves showing when, and just how much. Apache camping trailers, for example, have provided their dealers with figures from the Detroit Testing Lab showing that a Ford Pinto towing the Apache Eagle 4 model burned only 1.96 extra gallons of gas on a 200-mile trip and under five gallons for 500 miles. Five additional makes were tested as well. Checks by other companies also show that a small car pulling a heavy trailer burns more gas than a larger model using less rpm for the same speed, and that buying a larger car for towing may be more economical. For the



Hints in print are becoming available from many manufacturers and their dealers. This set includes: Onan, Evinrude, Glastron, Johnson, Coleman and Goldberg's.

average driver, a fuel-flow meter and tachometer can pay off.

Marine engines usually need to be measured in relation to the hulls on which they are mounted, although OMC stern drives have come up with some efficiency curve figures available in their booklet. (A cut of 1000 rpm could lower speed 36 percent, gas burned 71 percent.) Aquasport has run performance tests showing, for instance, that backing off from 4400 rpm to 3000 with a 140-hp MerCruiser in its 19-footer cuts fuel consumption just about in half.

Pamphlets available from Johnson and Evinrude outboards point out that backing off 20 percent from full throttle can save up to 40 percent in fuel, and that a big engine at cruise throttle can burn less gas than a smaller model wide open at the same speed. A larger model may be a better buy, in some cases, because of the speed and power it has in reserve. Proper trim and propeller selection are outlined in the book-

(Please turn to page 34)

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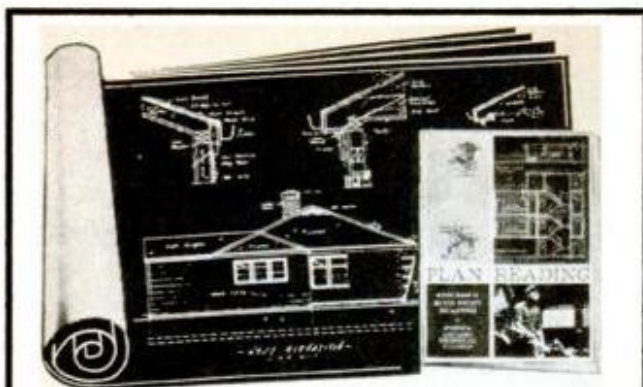
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ALL OUTDOORS

(Continued from page 32)

lets, and Evinrude provides an order blank for its \$4 service manual.

Eska notes that a fisherman can make notable savings. Its five-hp model uses a third of a gallon per hour at trolling speeds, and Eska electric outboards, like all other makes, burn no gas at all.

Fuel economy is being engineered into motors as well. Evinrude and Johnson snowmobiles have announced for 1975 an accelerator pump carburetor that is claimed to improve gas mileage up to 58 percent.

Boats. Many factors influence the fuel supply a boat will need—from hull design to wave conditions—and the sources mentioned, plus booklets at Glastron dealers and from Goldberg's Marine in Philadelphia and others outline a number of these factors. Though every boat differs, any pleasure craft plowing along and making waves uses much more fuel than it might if traveling faster on plane or slower with less wake.

The Boating Information Council reports there should be no unfair cuts in marine fuel allocations this summer, but setting up any boat and trimming it for better performance makes sense, saves money.

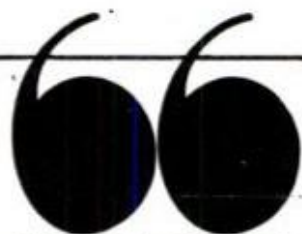
Bass Anglers Sportsman Society reports that it will require all boats taking part in tournaments to use only motors of the power specified on each craft's capacity plate.

Vehicles. Recreational and off-road vehicle owners can cut fuel consumption with the help of tips from the Automotive Information Council and the Recreation Vehicle Institute provided through car and RV dealers and garages. Tune-ups, plug changes, minimizing of wind-resistance and careful driving will improve mileage, they estimate, by at least 10 percent.

Summer camps and homes. Electric, LP-gas and generator fuel, as well as the two-cycle mixes for pumps, chain saws and power tools, can all be conserved with proper planning. Onan has a new standby power system that can be plugged into power lines of a house; improved electric sanitation systems for sewerless camps are in the works.

How to find out about all the energy and economy shortcuts available indoors, outdoors and afloat? Glastron, OMC, Chrysler, Bertram, Thermos, Johnson, Evinrude, Coleman, Goldberg's, Onan, Boating Information Council are some sources with hints and tips for the outdoorsman. ★ ★ ★

READ WHAT THE EXPERTS SAY ABOUT THE NEW HEATHKIT DIGITAL COLOR TV



other production color TV being sold in the U.S.:

"On-screen electronic digital channel read-out...numbers appear each time you switch channels or touch the RECALL button... On-screen electronic digital clock...an optional low cost feature...will display in 12- or 24-hour format... Silent all-electronic tuning. It's done with uhf and vhf varactor diode tuners... Touch-to-tune, reprogrammable, digital channel selection...up to 16 channels, uhf or vhf ...in whatever order you wish...there's no need to ever tune to an unused channel. LC IF amplifier with fixed ten-section LC IF band-pass filter in the IF strip...eliminates the need for critically adjusted traps for eliminating adjacent-channel and in-channel carrier beats. No IF alignment is needed ever. Touch volume control...when the remote control is used...touch switches raise or lower the volume in small steps."

POPULAR ELECTRONICS took a look at the 25-in. (diagonal) picture and said it "can only be described as superb. The Black (Negative) Matrix CRT, the tuner and IF strip, and the video amplifier provide a picture equal to that of many studio monitors..."

Furthermore, the Heathkit GR-2000 is an easier kit-form TV to build. POPULAR ELECTRONICS pointed out that "Each semiconductor has its own socket and there are 12 factory-fabricated interconnecting cables... The complete color adjustments can be performed in less than an hour."

And here's what RADIO-TV REPAIR said about service: "...virtually every function of

the TV receiver has been broken down to a miniature plug-in circuit assembly...if trouble develops you simply pop out the correct board and check it yourself...Heath provides free technical consultation, and if you do need factory service, as we said, the costs are low, well below that for (conventional color TV) insurance protection."

To sum up, POPULAR ELECTRONICS concluded its study by stating, "In our view, the color TV of the future is here—and Heath's GR-2000 is it!"

Why not see what the experts have seen? The Heathkit Digital Color TV—without question the most remarkable TV available today.

Mail order price for chassis and tube, \$649.95. Remote Control, \$79.95 mail order. Clock, \$29.95 mail order. Cabinets start at \$139.95.



Send for your FREE '74 Heathkit Catalog—world's largest selection of electronic kits. If post-paid card has been removed, write: Heath Company, Dept. 17-5, Benton Harbor, Mich. 49022.

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That Cigarette Smoking Is Dangerous to Your Health.

CAR CLINIC

BY MORT SCHULTZ

Do-it-yourself filter

My 1973 Vega has an 85-hp engine and two-barrel carburetor. Because I drive a lot on dirt roads, I replace the disposable air cleaner assembly far oftener than the 50,000 miles recommended by Chevrolet. This may not sound drastic to those driving cars having "normal" air cleaners, but with the Vega the filter element is locked inside the cover so the whole assembly has to be replaced—not just the element. This is a \$10 part, and I'm wondering if there's a company that makes an assembly which permits replacement of the less expensive filter only.
—Ray Fritzky, Jersey City, N.J.

If there is, Ray, it has escaped my search. But why not try to make your own "replaceable assembly"? Neatly cut the top off an old unit and remove the filter. Find one of the same size and shape at an auto parts store. Put it in the can, place the cutoff lid on top and secure with the holding bolts that have been provided by Chevrolet to hold the assembly.

good shape. If you get any bear down on the car's suspension, you may want to install a set of equalizer shocks, but no other "trailer-ering" equipment will be necessary.

Simple solution

My 1971 Dodge Swinger with 225-cu.-in. engine starts, runs briefly and stalls. However, if I remove the oil filler cap, it starts and idles normally. I've replaced the carburetor, sparkplugs, distributor breaker points, condenser, carburetor air filter, gas filter and PCV valve. I also cleaned out the inside of the rocker arm cover. I have spent a lot of money for nothing. Please help.
—Bruce B. Duff, Winthrop, N.Y.

I'm sorry that your pocketbook has taken a beating, Bruce, especially since the probable cure for your problem costs a few cents. The trouble, I believe, is a clogged crankcase inlet air cleaner. The crankcase inlet air cleaner is part of the car's crankcase ventilation system. It is that large cap-like device on the right rear of the engine which accommodates two hoses: one coming from the carburetor air cleaner and another which is the evaporation control system vent line.

Many owners of Chrysler Corp. cars overlook the fact that this part should be cleaned every 12 months. If it gets clogged, idling will be disrupted.

Disconnect the hoses and examine them. If they are damaged, replace them. If they're okay, let them soak in combustion chamber conditioner (Chrysler part No. 2933500) for no more than one-half hour. Then you can dry them with compressed air or let them air-dry.

Wash the crankcase inlet air cleaner thoroughly in kerosene. When it has been cleaned, invert the part and fill it with SAE 30 engine oil. Turn the air cleaner so excess oil drains through the 5/8-in. diameter vent nipple on top of the part. This is the nipple

(Please turn to page 40)

To tow or not to tow

I can't get a consistent answer to this question: Can I tow a 2500-pound camper trailer with my 1974 Volvo 145E station wagon? If so, what trailering equipment will I need?
—Don Mosley, Pearl City, Hawaii

Maybe you can't get a "consistent" answer because your question falls into a gray area. Volvo of America says that the maximum trailering weight for your car is 2000 pounds. The European trailering specification for the car is 2640. Personally, I think you can tow your 2500-pound load without sweat, but you had better check one thing first: Hawaii's law, if any, setting down what weight class trailer you can tow with your weight of car. Consult the department of motor vehicles.

As for trailering equipment, as long as you can get an equalizer hitch that will fit and handle the tongue load, you're in

CAR CLINIC

(Continued from page 39)

that accommodates the hose from the carburetor air cleaner.

Left holding the wheel

My 1972 Ford Pinto ran a smooth 30,000 miles on its original 6.00x13 conventional nonbelted tires. Then I switched to Michelin 175-13 steel-belted radials and got shimmy that was traced to a slightly bent front wheel. The tire company denies responsibility, arguing that the wheel was probably bent before and that the more sensitive radials amplified an existing condition. This sounds like a cop-out. Do you agree?—Eric Plow, Carrboro, N.C.

They may have bent the wheel, but then again they may not have. There's no way to tell, because the explanation they offered is valid. Radials contact the road differently than conventional tires and are more sensitive to road feel than conventionals. For example, radials are very flexible, while

conventional tires are "stiff" in cornering situations. This fact could have hidden the effects of the bent wheel.

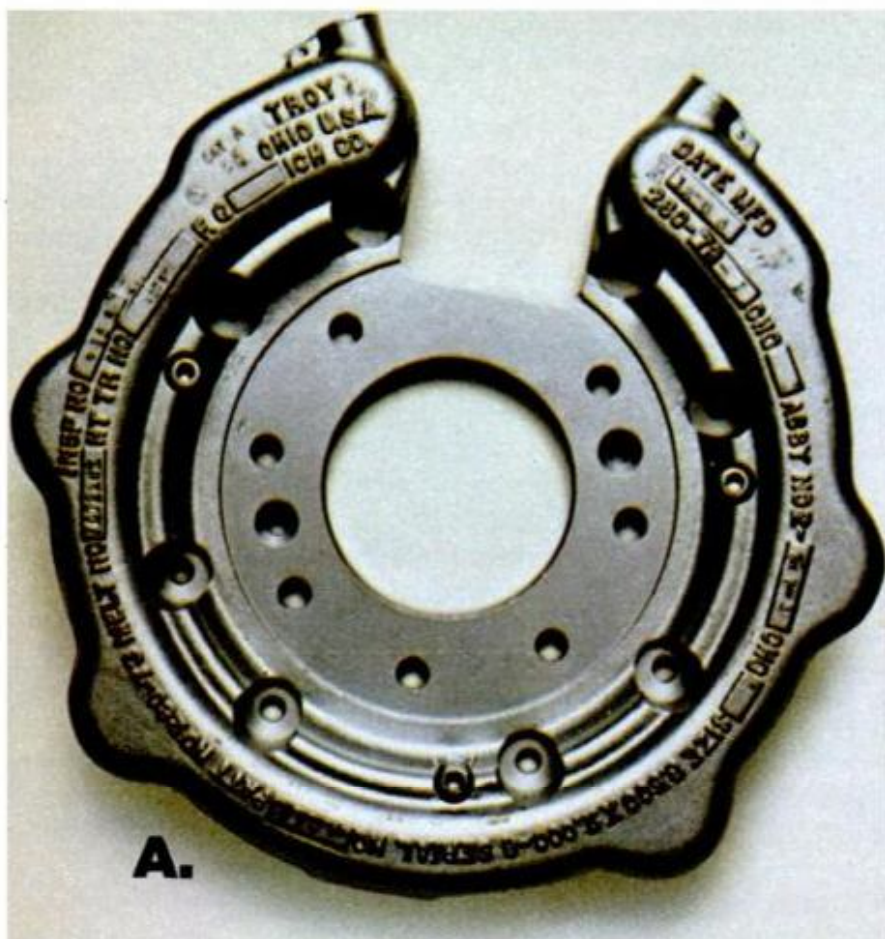
All you can do now is replace the bad wheel and forget about it.

Corvette fret

In the last month, my 1969 Corvette has burned up the internal transistor regulator of three new alternators. The car has been checked, but the cause of the burnouts hasn't been uncovered. Both my auto electric shop and I implore you to help.—Dan Madrid, El Paso, Tex.

The only reasons I see for this are a bad ground or erroneous hookup of one of the grounds. There are two grounds: one at the battery and one from the alternator to the frame. Double check the battery ground cable. It should be in good condition and should be attached tightly to *clean* connections.

The ground I would worry about with the Vette, though, is the strap from the alternator. Make sure that it's *there*. Make sure



it is not attached to the car's body, since this is fiberglass and would not provide a ground! Make sure that the strap is in good shape and is connected to clean spots at both ends.

Slowest man wins

Reducing driving speed is supposed to save gas. I don't see how. Wouldn't we save more gas by driving at higher speeds to reach our destinations faster so we can turn off our engines sooner?—Steven Best, Trenton, N.J.

If you think you can go farther on a gallon of gas by doing it quickly rather than more slowly, try it. If your car gets, say, 15 mpg at 50 mph, there's no way you'll get 15 mpg at 70 mph. Increased wind resistance would be only one factor acting to cut mileage. But try it with one gallon in your tank. Bet you have a nice fast trip for about the first 12 miles. But you'll walk the last three.

SERVICE TIPS

□ **1974 Barracuda or Challenger owners:** If your car doesn't steer smoothly, it is probably the fault of a component called the steering-column pot coupling that lies just above the steering gear. The thing is probably out of adjustment, so draw your Plymouth dealer's attention to service bulletin 19-02-74C or your Dodge dealer's attention to service bulletin 19-02-74D. They give him authority to make the adjustment.

□ **1974 Pinto owners:** The metallic ringing sound that you're getting from the transmission gear can be stopped if you will have your dealer install a cardboard-lined drive shaft (part No. D1FZ-4602-B). The "fix" is discussed in service bulletin 58.

□ **1973 and '74 Chevrolet owners:** Watch out how you pry against the air injector reactor (AIR) pump. Prying against the housing to adjust the belts has resulted in destruction of many pumps. That housing is made of easily deformed cast aluminum. If you must use a pry bar to get proper belt tension, be sure that you pry against the cast iron end cover only. ★ ★ ★

GOT A PROBLEM WITH YOUR CAR? Ask Mort about it. Send your question to Car Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Letters cannot be answered individually, but problems of general interest will be published in the column.

If you can tell us what these parts do, we have a job for you. If you can't, we'll teach you.

Their names pretty much describe their functions. If you spotted "A" as being an aircraft wheel brake piston housing, you were right. If you knew "B" is a hydraulic aileron actuator, part of a flight control system, give yourself 100%. In fact, if you even came close, you're probably a natural for the Air Force. If you qualify, we can use your talents. And you can, too—to get ahead quickly.

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IMPORTS AND MOTORSPORTS

Sit-down sidehacking

It's not quite a legitimate sidecar like those featured last month (*Sidecars are back!*, page 77, April '74 PM), but it will carry a passenger in a sitting position. The advantage of the mini-hack sidecar is that it will fit small and medium bikes of any make and it's easily attached. The sidecar is priced under \$200.

For more information, write to Speedway Products, Inc., at 160 East Longview Ave., Mansfield, Ohio 44905.



Fresh from the future

There's no limit to what you can wrap in aluminum foil. This mid-engine sports coupe has an aluminum-sheet body that was built to prove it could meet all the beaming and torsional resistance limits required of steel car bodies. The "X2036-T4" (actually, that's the designation of the aluminum alloy used) was built by Reynolds Aluminum with the help of Chevrolet as a Corvette study vehicle. It was built to prove that lightweight aluminum can be used for car bodies that are 40 to 50 percent lighter than a comparable steel body. Less weight means less gas consumption, of course.

The 2036 alloy was selected because of its high yield strength and elongation, good spot weldability and corrosion resistance. It also lends itself to forming on production tools the same way as steel. The more complex shapes were formed on the presses with



the metal hot. An added advantage of a single alloy is easier recycling than possible with a mixture of alloys.

The body is integral with the chassis (monocoque) and spot welding with epoxy filler was used for most joining. Hang-on parts like hood, doors, and so on, were mechanically fastened with aluminum weld nuts with steel inserts. A primer paint was used on the aluminum and then the car was given several coats of conventional lacquer spray.

Policing the peninsula

Saab 99s have long been used by the police in Sweden and Finland, but the first 99 to be used in full-time police service in the United States is shown below. The police department of Belvedere, Calif. (near San Francisco) selected the Saab after considering its advantages of size, economy and

(Please turn to page 44)





Nova the thirteenth.

The thirteenth Nova and the first Nova. A 1974 Hatchback Coupe and, behind it, a 1962 Chevy II Nova Sedan.

Nova was a sensible car when first introduced, and it's a sensible car today.

Each year we try to make it better.

This year, for example, along with some new colors and new fabrics we made some meaningful mechanical changes, like a new, improved hydraulic bumper system.

The Nova Six is a particularly suitable car for these times.

While you can reap the economy of a six-cylinder engine you can also enjoy the ride, the comfort, and enough space for five or six adults.

You can even order the extra con-



venience of the wagon-like Nova Hatchback if you like.

Maybe it's time you considered the newest Nova.

The 1974 Nova. Nova XIII.



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IMPORTS AND MOTORSPORTS

(Continued from page 42)

performance. The four-door, fuel-injected, automatic transmission model was fitted with airconditioning and special police equipment before going into service.

Motorsports '74

The 1974 racing season has started with a bang—and a whimper. Attendance is strong, race cancellations have been few and the new cars are exciting. Race lengths and practice time have been trimmed, however, saving even more fuel than requested by the Federal Energy Office. But drivers and teams do miss all those practice laps they used to have to sort out their cars.

The Indy 500, set for May 26 with its 58th annual running, is usually preceded by a full month of testing. This year, though, qualifying days have been cut from four to two, practice days from 19 to 11 and practice hours per day from nine to seven. There'll also be a fuel cut of 70 gallons per car on race day. Remember, that's methanol, not gasoline, they're burning. The 500 won't be the only event this year: an Indy 5 will be held after carburetion tests. A two-lap invitational for drivers and celebrities, running—bicycles!

Among the Formula 1 Grand Prix cars this year, Colin Chapman's Lotus will especially stand out: biplane style wings replace



the usual single wing to provide downforce over the rear wheels. The JPS/9 replaces the Type 72 Lotus, last year's winning car. Drivers Ronnie Peterson and Jacky Ickx will each have a John Player Special. ★★

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top pay job, or a business of your own. In NRI's TV-Radio Servicing Course you build NRI's exclusive New 25" diagonal, solid state, color TV set. NRI's Free Electronics Catalog explains the 14 training programs in TV-Radio Servicing Computerized Industrial Electronics, and NRI's New Solid State CB Communications program.



2 AUTOMOTIVE SERVICING

Save dollars servicing your own car, or prepare for a top-paying mechanic's job. You learn step-by-step with bite-size texts combining practical service work with top quality professional equipment that you

keep. NRI's Master Automotive Technician Course includes — at no extra cost—your own analyzer scope (an NRI exclusive) and 9 other servicing items. NRI's Tune-Up and Electrical Systems program offers 8 servicing items. Both courses give you "hands-on" experience and the chance to earn spare time money.



3 AIR CONDITIONING, REFRIGERATION, AND HEATING

The "boom" industry of the '70s, where tens of thousands of technicians are needed. NRI courses were developed with the technical assistance of the York Division of the Borg-Warner, a world leader in air condi-

tioning. Training units include a *Circuit Demonstrator* for circuit studies; a *Control Simulator* for learning electric controls. The Master Course has a window air conditioner for troubleshooting and your own personal use. Resident training at *York Institute* is optional at no extra charge.



"Hands-On" Training Pays Off... NRI pioneered custom-designed kits with bite-sized texts to make learning at home fun and profitable. You get professional test instruments to perform experiments and keep for use in servicing. Tens of thousands of NRI graduates are proof it's practical.

Earn \$5 to \$7 an Hour, Starting Soon... Keep your present job while preparing for a top-paying job, or your own business. With NRI's professional equipment (provided at no extra cost) you can make good money doing repairs for friends.

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*Suggested retail price for MC-1M (model shown slightly higher). FOB West Coast POE. State, local taxes, dealer prep, options extra.

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APPLIANCE CLINIC

BY PAUL MANN

Difficult adjustment

We have a GE automatic coffee percolator—I don't have the model number, but the catalog number is 94P15. It was a gift that we didn't use until the warranty expired. Now we find that it perks the coffee okay, but shuts off before the coffee gets hot enough. How can I fix this?—Lucas J. Gabrovic, Tigerton, Wis.

You don't, and here's why. This particular percolator is an immersible unit. In order to get it to make coffee hot enough, you have to adjust the thermostat. To adjust the thermostat, you have to turn the adjusting screw. But to reach the adjusting screw, you have to remove the base. Once the base comes off, getting it back on properly—so that the immersible integrity of the percolator is retained—is, as one GE service manager told me, "one hell of a job."

In fact, he says, GE service centers generally won't even try it. Naturally, if the base isn't reinstalled properly and the unit is immersed, a short can result.

I have been advised to tell you to return the percolator to your nearest authorized GE service center and explain the problem to the people there. Chances are in your favor that they will exchange the unit for you free of charge.

Out of the past

Turn back to the Dec. '73 Appliance Clinic for a minute, Paul. What you suggested to E. J. Bussey on diagnosing his electric range problem (page 24) might have included one more step: checking the circuit breaker. I had a similar experience with an electric oven. After much head scratching, I found that the double circuit breaker used for the 230-v. input was to blame. Apparently because of wear, just one of the two contacts was latching, so that only 115 v. reached the oven. This was enough to operate indicator lights and so forth, but only warmed up the heating units. A neighbor of mine found the same cause for the clothes-

dryer problem he was having, so it doesn't sound too uncommon.—S. Black, Akron, Ohio

Indeed it isn't. Thanks much for adding this important point.

Beneath the surface

One surface unit of our Hotpoint RF 35-C electric range is not working. The pushbutton controls function, but the unit doesn't get hot. The other units operate perfectly. What's wrong?—Edward Kasinakas, Bethany, Conn.

One of three things: The surface unit itself has gone bad, a wire to the surface unit has worked loose or has gone bad, or the switch has gone bad. Have the unit checked with a continuity tester.

Flapper flap

Our Lady Kenmore automatic clothes washer will occasionally waste a good deal of hot water. It fills properly, but as the wash cycle starts, the water drains out, which causes more hot water to flow in as the machine tries to maintain proper water level. What's wrong?—Harvey G. Hill, New Berlin, Wis.

The key word in your letter, I think, is "occasionally." The pumps of many Lady Kenmore machines possess a flapper valve. When the washing cycle is completed, the pump-out phase begins. The timer switch controlling the circuit in the agitation solenoid opens to stop agitation. This mechanically moves a cam bar to disengage the agitator gear, and, through a mechanical linkage, to also open the pump flapper valve. The wash water is then pumped out.

If water is draining prematurely on occasion only, I have a hunch that some small foreign object introduced with a load of wash has worked its way into the pump. On occasion, this object is getting lodged under the flapper, allowing water to drain. The

(Please turn to page 50)

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APPLIANCE CLINIC

(Continued from page 49)

solution, I think, is to dismantle the pump and see what's going on inside.

Saving the hard way

Because of the energy situation, I'd like to bypass the frost-free cycle of my Westinghouse self-defrosting refrigerator. Should I?—Andrew P. Stirnweiss, South Kent, Conn.

Not if you want to keep your refrigerator working properly, you shouldn't. It takes no more than two days before the evaporator coils build up enough frost to affect cooling efficiency inside the compartment. In a self-defrosting refrigerator, you see, evaporator coils are closed in. Self-defrost takes place every 24 hours to keep frost from building up. In a non-self-defrosting refrigerator, evaporator coils are larger and are exposed. Although frost builds up, it takes a much longer time before manual defrosting has to be done to maintain cooling efficiency.

There is one way for you to bypass the self-defrosting capability of your unit, but I don't think you'll want to use it: Defrost the unit manually *every day*.

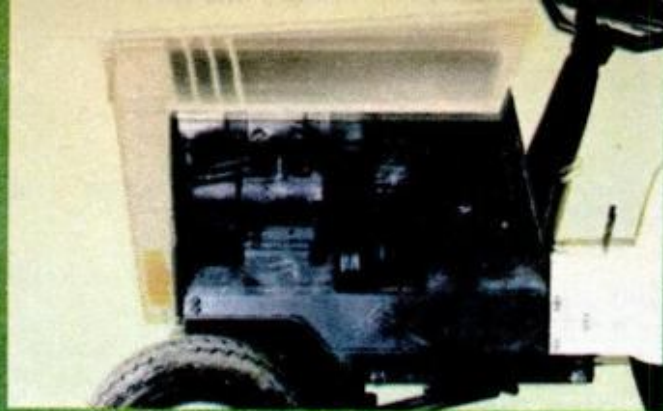
Lowdown leak

Our Hotpoint model MW9 food waste disposer has developed a leak from below after six years of excellent service. Can the unit be repaired?—J. Weisman, Philadelphia.

Yes, it can be repaired. But the real question is: *Should* it be repaired? The cause of the problem is probably a defective seal between the impeller and rotor. Replacing the seal is relatively easy—drop the lower flange assembly and take off the flywheel, revealing the seal.

But if the leak has continued for some time, the motor windings may be saturated, and the motor might soon burn out. Replacing a motor is almost as expensive as replacing the entire unit, so examine motor components carefully first. ★★★

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 answered in this column.



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These rugged new 16 hp Bolens tractors are quiet. And then some. Because they're not just over-muffled. But re-engineered from the inside out. To cut noise and vibration. And give you sophisticated new power for every yard and garden chore. With effortless operator controls. Like Bolens hydrostatic drive that gives you full forward to zero to full reverse with one pedal control. 4-position hydraulic attachment lifts. Dual rear wheel brakes. And Bolens exclusive power locking collar that clicks attachments in line with just fingertip pressure.

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DETROIT LISTENING POST

Pontiac naming new compact

Pontiac is sorting through a list of names for its version of the Chevrolet Vega, a sure sign the car is ready to roll. Pontiac produces a Vega spin-off in Canada under the name Astre. But GM practice is to use different names in Canada than in the United States, so the Astre name won't be carried over to the American counterpart.

Engineers told to think small

The message Volkswagen has preached for years—that bigger, heavier, more complicated, more expensive do not necessarily add up to better—has really penetrated Detroit this time. For years, engineers working on the low-price cars have looked to the high-price cars for ideas and inspiration. As soon as Cadillac, Lincoln, Imperial et al came up with something new or different—never mind if the innovation was better—the guys working on the low-price Chevys, Fords and Plymouths tried to copy it, to come up with a poor-man's version of the same device or development. It was the drift-down approach to engineering.

Now, with the energy and fuel shortages, the trend to smaller cars and all the other fact-of-life dilemmas confronting Detroit,

the worm has turned, the pyramid has been up-ended and is standing on its peak. The engineers assigned to the big cars are looking at the less expensive cars to find ways of building them smaller and better, to save weight, save money and to simplify.

AMC may get VW Wankel

There may be a deal brewing between American Motors and Volkswagen. Here's the story: AMC was planning to put a Wankel in its new small car the second year after the car was introduced. That would be the '76 model. The car would carry a conventional engine the first year and the customer would be given a choice of a conventional six-cylinder or a rotary the second year. AMC had a deal locked up to buy the rotary from GM. But the optional rotary had to be shelved when GM announced it would not start production of the Wankel until its gas mileage could be improved.

Enter VW. VW says it expects to market a luxury car equipped with a Wankel in the United States in 1976. It's talking a fairly expensive car, while AMC is talking a medium-price car, so the two vehicles will

(Please turn to page 54)



Future Firebird? This one-of-a-kind car was developed from the Firebird chassis by Pontiac stylists and engineers to serve as a test vehicle for evaluating future concepts of safety and design. It is equipped with features that are not available on any production cars—indeed, some of them are illegal according to the current motor vehicle laws. The rectangular quartz halogen headlights are one example and the fact that they are covered is still another. The glass area is large, and the side windows are fixed and flush with the sheet metal to assure better aerodynamics and a reduction in wind noise. The small "toll window" is electrically operated.

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Let Harrison Air Conditioning make you a cool camper!

Turn on "The Wacky World of Jonathan Winters" on local television.

DETROIT LISTENING POST

(Continued from page 52)

not compete with each other. The two companies have discussed working together in the past, but without giving up any autonomy. What would be more natural than for AMC to buy a rotary engine from VW, or perhaps even a joint engine-manufacturing operation?

Chrysler working on new Sixes

Chrysler has two different versions of a new six-cylinder engine in the works, and a four-cylinder aluminum powerplant as well. The Sixes should be out next year for use in Chrysler's mid-size cars. The Four won't be ready for another two years at least, and will be used in the company's 1976 compact. At GM and Ford, engines for the '75 cars are expected to carry about the same c.i.d. numbers as this year, but horsepower ratings will show subtle changes. Power will decrease, fuel economy increase.

Back to the box shape in styling

In line with the austerity movement under way in Detroit, will the auto companies go back to the box-on-wheels look in styling?

The designers reply, "Never!" But suppliers who have seen revisions GM and Ford have ordered on in-the-works cars since the energy panic hit last November say cars coming after 1976 will have fewer rounded surfaces and more angular lines.

Like what? "The one car I know about first-hand," says a source working with Ford, "looks a lot like the Audi Fox. Thin side metal and a squarish front and rear."

Better mileage coming

Detroit engineers say the mileage standards being considered by the Environmental Protection Agency for 1977 and beyond cars are attainable, providing the government doesn't come up with other legislation that will take priority over the mileage goal. EPA would like all cars to give a minimum of 14 mpg by 1977, 17 mpg by 1980 and 21 mpg by 1985. With that kind of lead time, the auto-makers are optimistic about achieving the numbers called for by EPA. ★★★

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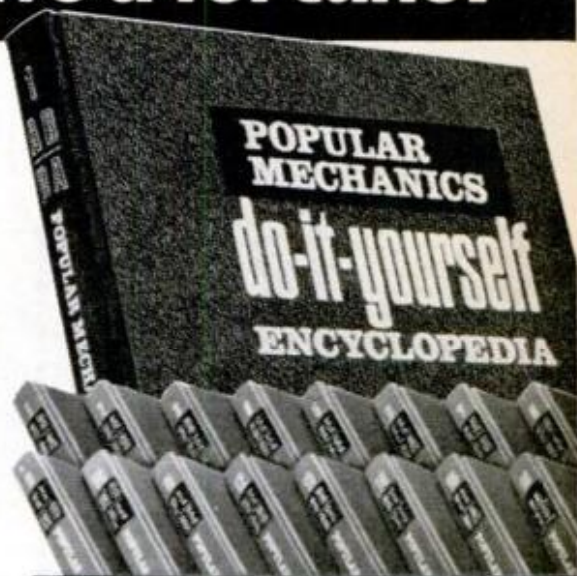
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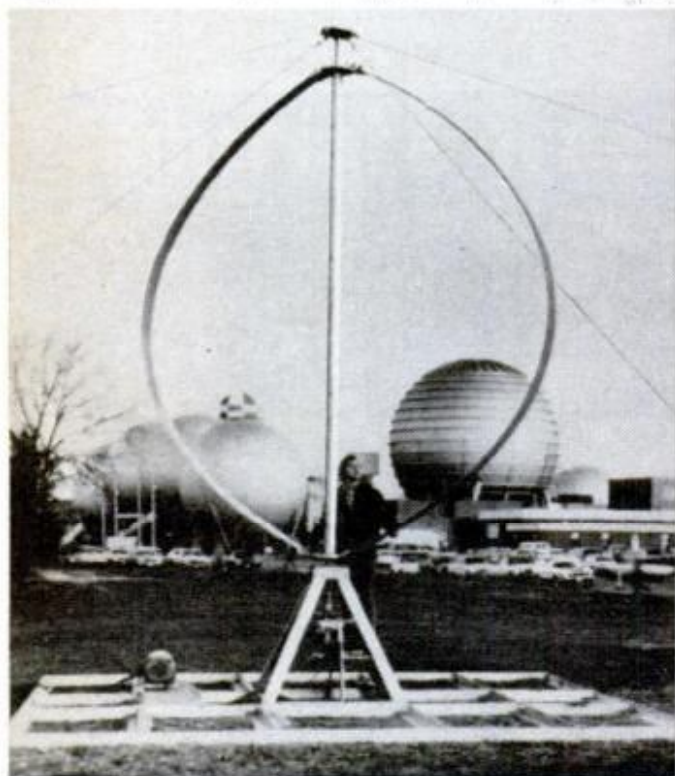
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SCIENCE WORLDWIDE



New windmill based on old patent

Development of a windmill system designed to provide energy for the individual home is under study at NASA's Langley Research Center, Hampton, Va. Called a vertical axis windmill, the device is based on a principle first patented in 1927. Two curved blades made of balsa wood and covered with fiberglass are attached at top and bottom of a 15-foot vertical aluminum shaft. A system of gears connects the shaft to an electric generator. The device is said to be more efficient than a conventional windmill with a horizontal axis requiring a complicated system of gears to transfer mechanical energy to a generator. The established power output for a 15-foot vertical mill is 1.3 hp at 15-mph wind velocity.

Robot diver has 'eye' for fish

RUFAS II—a second generation robot diver that can inspect the seafloor at great depths

—is expected to provide significant aid in locating commercially important stocks of fish and other undersea resources. Developed by two Department of Commerce agencies, RUFAS II (Remote Underwater Fisheries Assessment System) is towed behind a research ship and dives on command to look at selected underwater features. The 12-foot-long, 1000-pound sledlike device provides the mother ship with a TV view of the seabottom and can, on command, record images on 35-mm film. It is also equipped with sonar. In recent tests, RUFAS II performed well at depths to 2400 feet.



From scenic wonder to tap water?

A future shortage of fresh water threatens many areas, including Austria. But that central European country has some 600 glaciers—slowly moving rivers of ice—that heretofore have been regarded only as tourist attractions. Now UN experts and Austrian scientists are studying the possibility of melting the glaciers and piping water

(Please turn to page 60)

Back-yard storage with dual purpose utility



Left: A little beauty for tools and kids. Looks more like a storybook cottage. 10 ft. square with 6 ft. porch.

B1300 Single set \$3.95
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Right: Delightful A-frame. Outside stairway to attic crawl space. 8 ft. by 12 ft. and almost 13 ft. high.

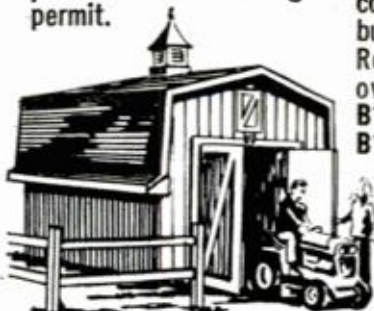
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Left: Playhouse and storage with covered walkway. Two-story house 8 ft. wide by 12 ft. long. 2nd floor 2 ft. 4 in. wider.

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These appealing back-yard houses can also serve as playhouses or place for a guest. Extra plans are for obtaining permit.



Left: Dutch mini-barn with country charm. Looks small but is 10 ft. by 13½ ft. Roof design gives 8 ft. overhead.

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Right: Featuring a pillared porch with a dutch door. Shake roof topped with a birdhouse-cupola. 8 ft. wide by 8 ft. deep.

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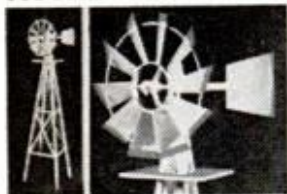
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SCIENCE WORLDWIDE

(Continued from page 58)

all over Europe. The glacier shown, high in the Alps, is one of Austria's largest and the "lab" where scientists have set up technical and ecological studies.



New type of studded tire?

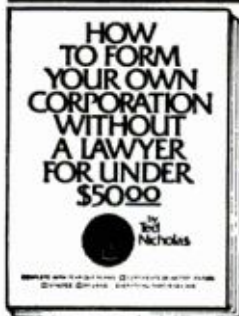
One of the best uses for old tires is as building blocks for artificial reefs, according to the Goodyear Tire & Rubber Co. As part of an effort to find useful applications for scrap tires, Goodyear built artificial reefs off Fort Lauderdale and Marco Island, Fla. The structures proved popular with barnacles, as shown above, as a haven for fish and a spawning ground for many kinds of aquatic life. New reefs are now planned at other Florida sites. Tires are weighted and bundled before they're dropped into the sea.

Good medicine via satellite

An experimental satellite communications system has dramatically improved health care in 14 remote Alaskan villages, according to findings of Stanford University researchers. The NASA ATS-1, "parked" 22,300 miles above the equator, provides communication between minimally trained health aides in villages and doctors in a field hospital. Formerly, aides had to rely on high-frequency radio, which proved highly unreliable because of interference from storms, atmospheric disturbances and mountain ranges. The satellite communications system—from ground to satellite to ground—bypasses most interference. ★★

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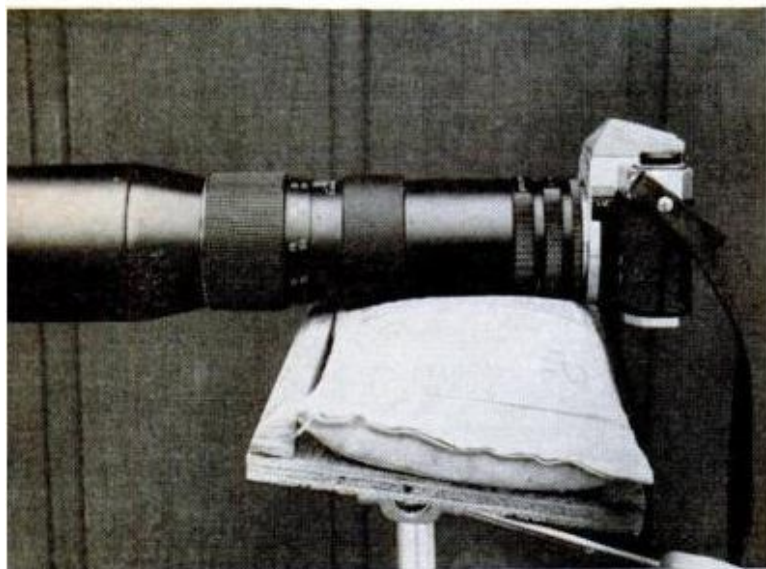
FROM READERS

Sandbag steadies tele lens

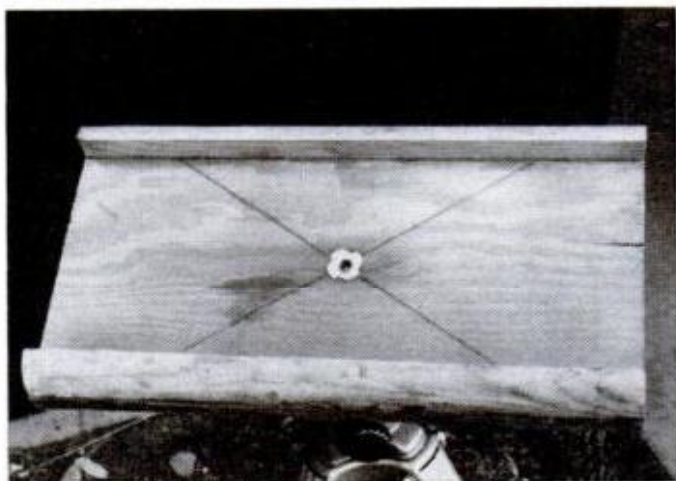
Even with a tripod, holding long telephoto lenses motionless isn't easy. But add an inert, unmoving sandbag to the tripod, and it gets much easier. In addition to holding the lens steady, the bag helps absorb camera vibrations from your release of the shutter, or from the camera's mirror, and its weight helps hold the tripod steadier. Yet it also gives your lens more freedom of movement (over a small range) than a tripod head.

My bag (which originally held 25 pounds of lead shot) is about 14x6 inches and is loosely filled with dry sand. The platform that holds it to the tripod is a piece of $\frac{3}{8}$ -inch plywood, 12x6 $\frac{1}{2}$ inches, with a $\frac{1}{4}$ -20 T-nut (which accepts the standard U.S. tripod screw) at its center. Rails of quarter-round molding along the long sides hold the sandbag in place. My platform took me less than an hour to build of scrap lumber, and materials cost less than a dollar.

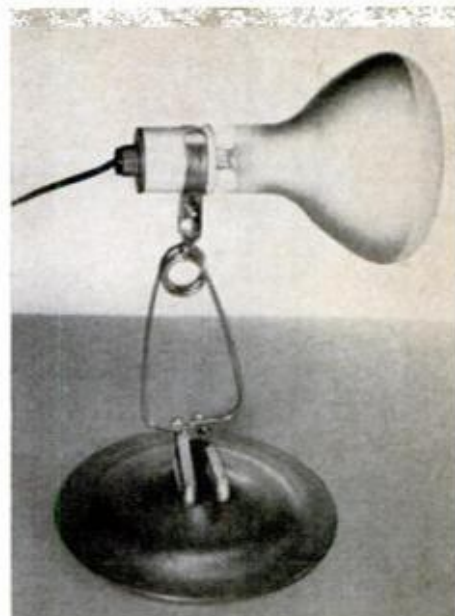
—*E.V. Reyner, Salinas, Calif.*



Bag rests loosely on plywood platform which mounts on tripod with $\frac{1}{4}$ -20 T-nut. Rails at side of platform keep bag from flopping off. Bag damps camera motions but allows free aim. It can also be removed from the platform to rest on your car, boulders and the like.



Two ways to make low light stands



Here are two ways to make low floodlight stands that you can set on the floor for low-angle lighting, or set on tables and other furniture for more usual lighting effects. C.E. Banister of Pomona, Calif., suggests saving the stand bases from discarded electric heaters or fans (above, left) and attaching lengths of $\frac{3}{8}$ -inch rod to turn them into photo stands. Lower ends of the

rods used on the left and right stands were flattened and drilled to take the locking screws; center stand (with camera mounted using standard light-stand accessories) has rod clamped into existing fixture.

Phil Tempo, of Verdugo City, Calif., suggests using an ordinary pot lid as a base for clamp-type floods (above, right); just clamp the light to the lid's knob. ★ ★ ★

Minolta helps you bag the one that got away.



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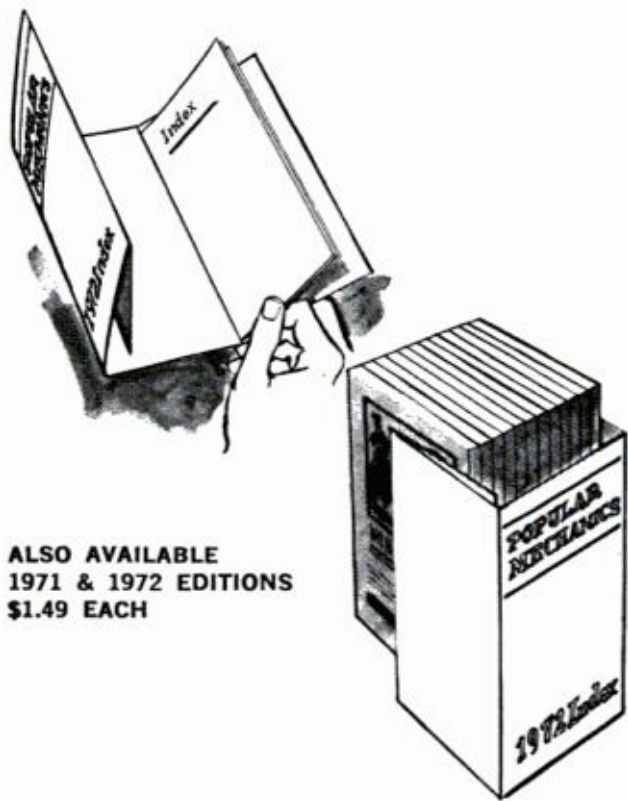
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Here's a great idea that will multiply the value of your back issues of PM. Reserve your copy now!

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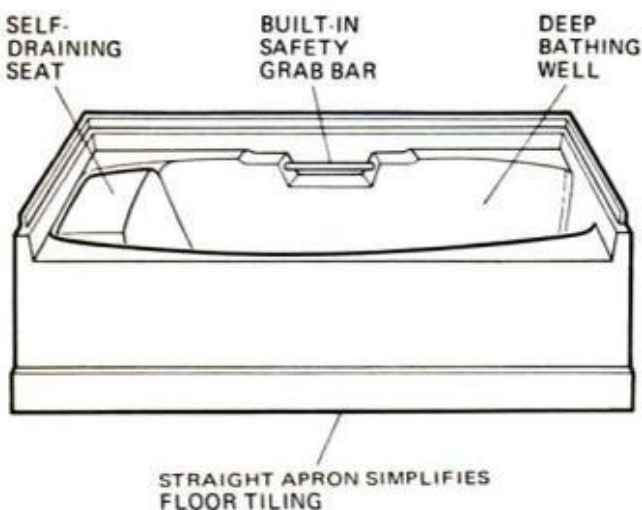
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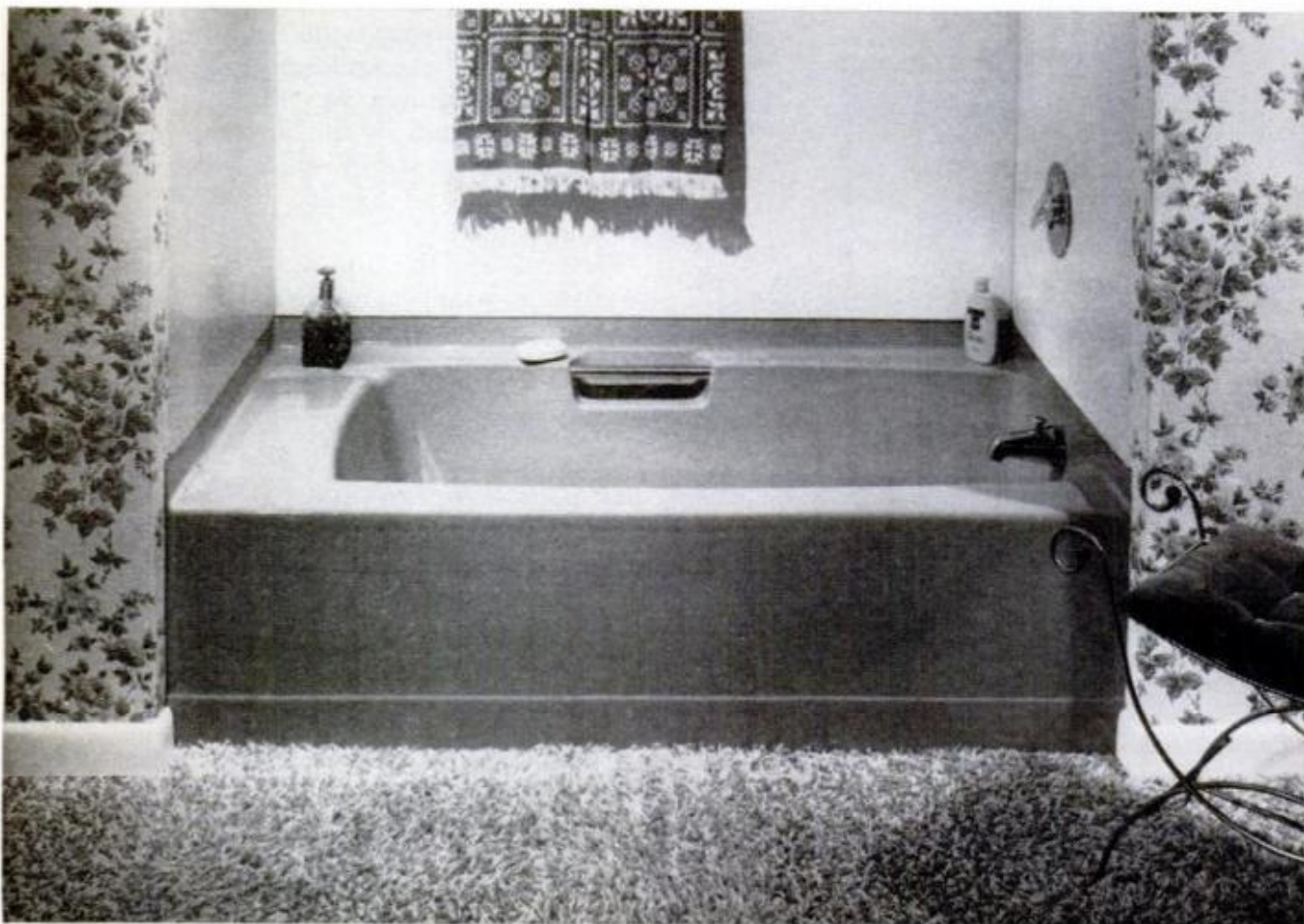
An end to tub-rim caulking

by Wayne C. Leckey
HOME AND SHOP EDITOR



If you are thinking of remodeling your bathroom *yourself*, you should take a good look at a new fiberglass tub introduced recently at the Home Builders Show in Houston. It weighs a mere 70 pounds, which is a strong point in its favor if you have ever tried carrying a steel or porcelain tub to a second-floor bathroom. In addition, it's designed so you will never have to caulk a crack that invariably develops where wall meets tub. The reason is simple: There is no joint. The tub features a 3-in. water-retention flange around three sides allowing the tile walls to overlap the sides of the tub rather than sit on top. Shower water cascades off

(Please turn to page 70)



Fabulous FOLBOT HOLIDAYS

Weary of crowded Camping or burdensome Back-Packing???

NOW Go carefree **FLOAT-PACKING**
the superior **FOLBOT WAY!**

Let sturdy Folbot carry the load while you cheerfully float-cruise along INTIMATE waterways with selective camping in untrampled surroundings amid spectacular scenery. You explore nature, observe wild life or fish and hunt undisturbed or sail gracefully ... as you positively celebrate the ultimate of GENUINE Recreation.

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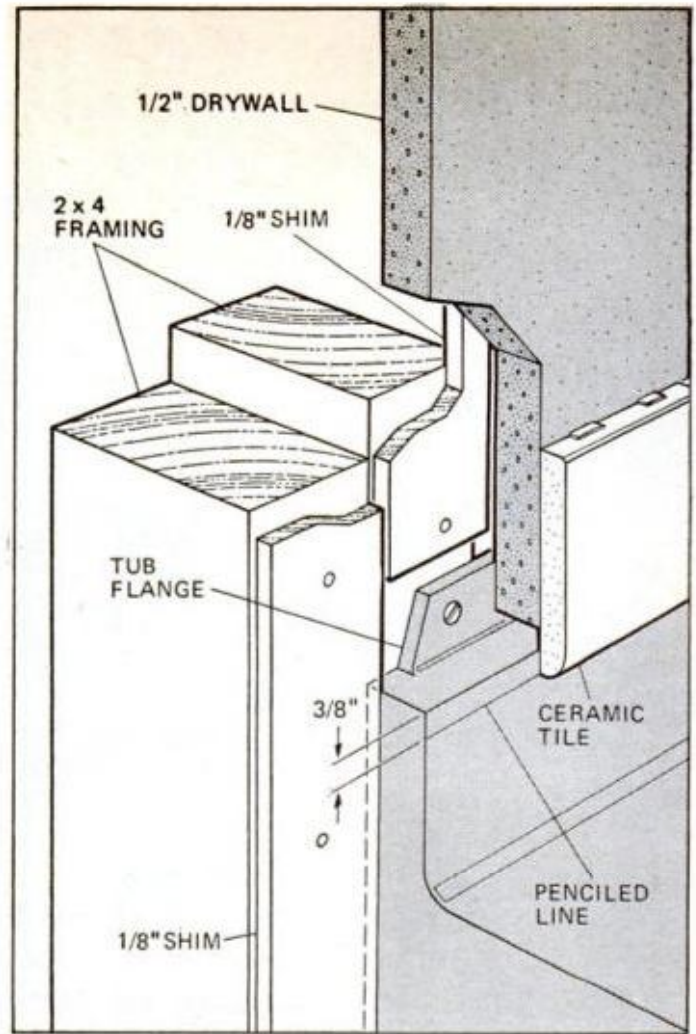
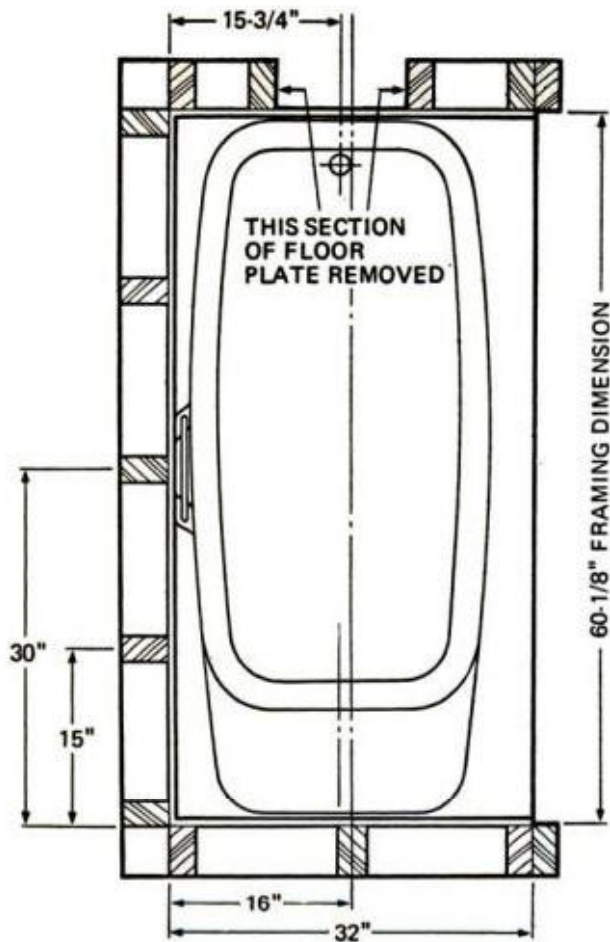
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END TO TUB-RIM CAULKING

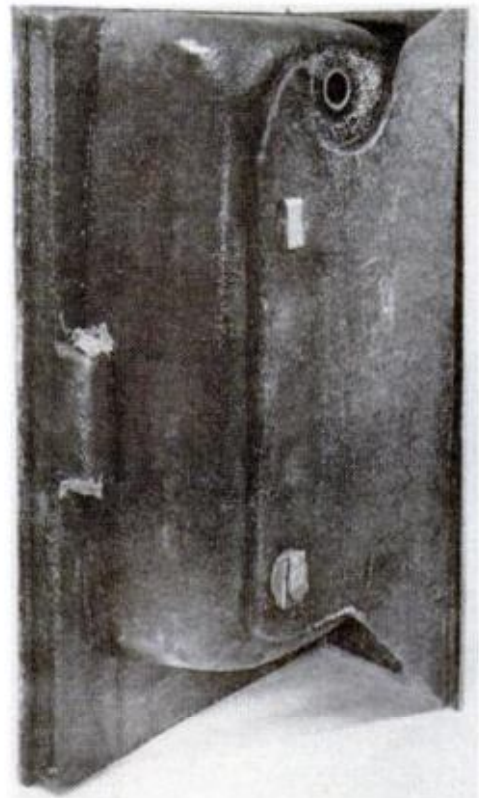
(Continued from page 68)

the overhanging walls and falls directly into the tub, not over a joint.

Called Comfortub, it offers several other unique innovations. It has a built-in self-draining seat at one end and a built-in, stainless-steel grab bar. It features integral self-draining soap dishes, extra-wide armrests and a roomy contoured bathing area 15 in. deep and 22½ in. wide.

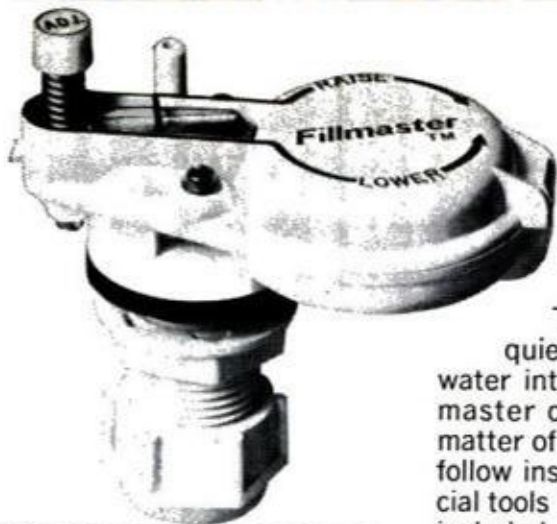
This 5-ft. tub is molded of Miracril, a deluxe fiberglass bonded acrylic, which has a gleaming slip-resistant finish that wipes clean with mild detergent and water, and being of fiberglass, it stays "warm" to the touch. It comes predrilled for standard waste and overflow fittings, and has a straight front apron which makes for less work when tiling the floor.

You have a choice of right or left-hand models, as well as five colors—avocado, golden harvest, Lucerne blue, tawny beige and natural white. The tub is a product of Borg-Warner Plumbing Products, 201 East Fifth St., Mansfield, Ohio 44902, and sells for about \$100, less fittings. ★★★



Judging from rough underside, it's hard to believe tub could have lustrous finish topside. Manufacturer warns about smoking while soaking—a burning cigaret will leave a lasting mark on the mirror finish.

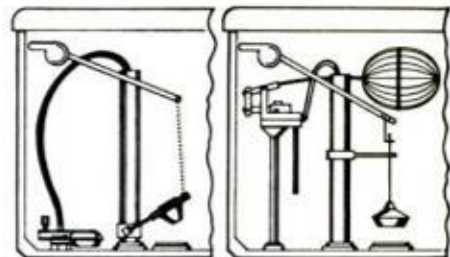
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senses water level from the **bottom**, right where the water enters.

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THIS

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With the revolutionary new Fillmaster Toilet Tank Fill Valve... the only modern way to replace old-fashioned noisy, leaky ballcocks.

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Components in our insulated, 5-3/4" walls interlock for weather-tight fit; floor and roof beams are reinforced with *steel*; decking is 2" thick! All that, plus the natural warmth and beauty of kiln-dried cedar, inside and out.



With a Lindal, *what you get* is even more impressive than what you save.

For more proof (73 plans, prices), send \$1 for our 44-page Planbook.

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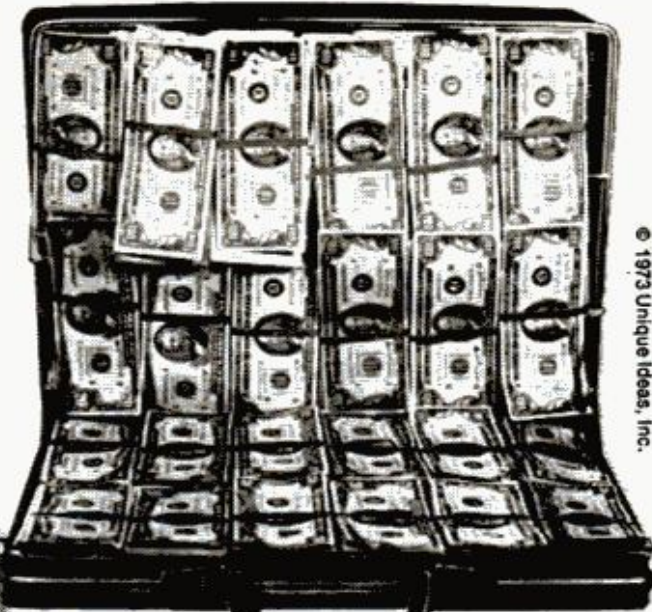
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AT HOME IN BED WITH THE FLU"**

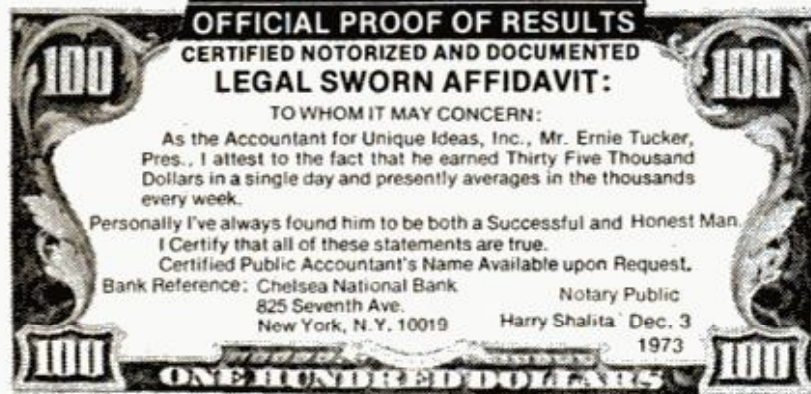
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in action I'm making thousands of dollars
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CERTIFIED NOTORIZED AND DOCUMENTED
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TO WHOM IT MAY CONCERN:

As the Accountant for Unique Ideas, Inc., Mr. Ernie Tucker, Pres., I attest to the fact that he earned Thirty Five Thousand Dollars in a single day and presently averages in the thousands every week.

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TO MAKE MONEY**

Obviously you were not born rich so what? 85% of the men and women who are rich today started with very little money and had only average education, so why not be honest with yourself and stop using lame excuses, stand up and face the fact that the only real difference between you and thousands of rich Americans is that they discovered the right moves to make and you did not!

**YOU GET RICH MAKING
"THE RIGHT MOVES"**

I've proven this to be true despite the fact that I was born poor and barely squeaked through high school. I still made a fortune in just a short period by making the right moves and I'll show you exactly how I did it.

But why am I so anxious to reveal to you my secret money making method? Surely there's more to it than because I enjoy helping others share in the rich good life as I have but frankly I expect to profit at least two hundred thousand dollars, maybe more, from the publishing of these ads in nationally famous magazines and newspapers.

STOP WASTING PRECIOUS YEARS

I should know, I wasted more good years than I care to remember, before I finally discovered the secret of making money, I stayed up to my neck in debt, bounced around from one eight hour dead end job to another. Just working, waiting and wishing for a great fortune to fall in my lap. I got married, became a proud father at a young age. I worked in a toy factory for a short time and peddled cosmetics from door to door, but everything I tried my hands at failed because I didn't know the right moves to make. This only happened to me twelve years ago. No doubt there are millions who are suffering this agonizing torment now.

**REVEALING: THE RICH MAN'S
SECRET MONEY MAKING METHOD**

It's true that most rich persons keep

their money making secrets to themselves, seldom sharing it with others, but fortunately I met several unusually fair minded rich men who were so impressed with my ambition to get rich that they agreed to teach me the secret money making techniques that their many years of making millions had taught them, providing I would virtually work for them at least one year. I eagerly jumped at the opportunity to gain this valuable knowledge and said yes to their generous proposition. So for one year I listened and watched very closely, until I learned from A to Z how these financial wizards made thousands of dollars every single day. I'll always be most grateful to these men for teaching me their fast and easy money making secrets. It didn't even matter that I was practically penniless when I first put these methods into action.

**SUDDENLY IT STARTED
MAKING MONEY FOR ME**

At first it was unbelievable... I paid off all my bills and my wealth continued to multiply. Huge sums of cash poured in so fast that I was forced to employ a full time bookkeeper and retain a corporation attorney, accountant and tax expert to help manage my prosperous financial affairs.

We had investments, property, stocks, money in the bank and can afford most anything we want. My family and I enjoyed our wealth and success. We were very proud of our accomplishments and it was our secret of making the right easy moves that made it all happen.

**THIS IS YOUR CHANCE
DON'T BLOW IT**

It's a better chance than I had. If you're really serious I'm willing to share my secret. Surely I can afford to give it to you free of charge, but I won't, why should I give you something for nothing? Instead I'm going to ask you to send me ten dollars for sharing my secret. What's more, I want you to know that I intend to make a fair profit

from the information I mail you, why not? If I can show you how to make more money than you ever made in your life why should you care if I make a profit? Remember what I'm giving you for only ten dollars cost me 12 years to master. Even more important you get certified and documented proof beyond the slightest doubt that my method can make a fortune, this is why I can offer you the strongest legally binding guarantee possible!! A guarantee so incredible that you'll probably think it sounds too good to be true.

**UNUSUAL \$1000
GUARANTEE**

This is a legal and binding guarantee from me to you - The information I'll send you can actually put thousands of dollars in your pocket. But this is my pledge to you, after just 10 days if you don't agree my secret method is worth at least \$1000.00 in cash to you (one hundred times the ten dollars you pay) send it back and I'll rush a full refund, including your 10¢ postage. You take absolutely no-risk -not even the price of a stamp.

GET READY TO GET RICH

Every single day my method can bring you more cash. You'll never again need to borrow, budget or ask anyone for credit. You'll be proudly independent. You can enjoy those luxuries you've always dreamed about, but never could afford. Sound impossible? But it's not, you only need a serious belief in my proven method, very small capital and enough ambition to give it a try. Remember "nothing ventured nothing gained" and there's absolutely no way you can lose.

**JOIN THOUSANDS WHO ENJOY
THE RICH GOOD LIFE:**

Ed K. says: "I never earned over one hundred dollars a week in my life until I

made 2 thousand dollars the first month using your money making method. I'm glad I took a chance." Sincerely, Ed K., N.Y. You can easily learn what I taught him and now his money worries are over, so why not take advantage of this rewarding opportunity. Any news of good fortune travels fast, already thousands of just average men and women have benefited from my concept, you will too. But I will not promise you'll make as much money as fast as I have, yet, it's possible you'll make a lot more even faster.

**YOU CAN LIVE HIGH ON THE HOG
AND DO LESS WORK...**

I'll show you how to stop breaking your back to make ends meet and start using your head to get easy riches. If you're seriously fed up with being treated like a hard working stiff while others enjoy the rich good life, then don't pass up this opportunity—you risk absolutely nothing—not even the price of a stamp.

MAKE THE RIGHT MOVE NOW

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Yes count me in on your \$1000 guarantee offer. I enclose \$10. Rush your proven easy money method. I understand that it has been officially certified, notorized and documented. If I don't agree it can actually put \$1000 or more in my pocket within 10 days I can return it for a full refund, including my 10¢ postage. There is no risk on my part.

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Get into the big, year-round
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that's EASY to learn—EASY to
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You Can Make Up to \$10 an Hour—even while learning!
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You're "in business" ready to earn \$5 to \$10 an hour a few days after you begin Belsaw's shortcut training. Take advantage of today's unprecedented opportunities in Locksmithing for year-round EXTRA INCOME in spare-time—or fulltime in a high-profit business of your own. Hundreds we've trained have done it. So can YOU! All tools plus professional Key Machine given you with course. These plus practice materials and equipment,

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YOURS TO KEEP—**

can add \$25 to \$40 a week to your income . . . and it won't cost you a cent with your training.



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Tells how to make money in Locksmithing almost from the start!

**ALL TOOLS, MATERIALS AND PRACTICE
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"War injuries left me badly handicapped, but now I'm a financial success as a Locksmith, thanks to your training. Besides, the work is fascinating. If I can do it anybody can." — Glen Johnson, Larned, Kan.



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BEST AND
BIGGEST
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the master's complete course of KUNG-FU

**... CONSIDERED BY MANY TO BE THE
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Now is your chance to learn the famous, deadly secrets of Kung-Fu — certainly the most effective form of attack and defense ever devised! Kung-Fu has been handed down from father to son — cloaked in secrecy until now! In less than half an hour a day (depending upon the personal goals you set) you can learn and master techniques that could defeat a Karate expert!

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**MONEY-BACK
GUARANTEE**

We think that Kung-Fu is so effective that 30 days on our system will give you more self-defense power than if you used any other system daily for a solid year! If you don't agree — if you feel that this course isn't the greatest, the most effective, the most powerful self-defense and attack system ever devised — then simply return the course within 30 days for a full instant refund! What could be fairer?

**KUNG-FU CAN MAKE YOU A GIANT
IN BOTH MIND AND BODY!**

Easy to learn, this Kung-Fu course shows you dozens of ways to counter-attack any man, regardless of his size. With Kung-Fu your body becomes an instant arsenal of power. Our course takes you step-by-step into the fascinating world of Kung-Fu — we show you in plain, simple language how to use the techniques of Kung-Fu so that you can handle yourself in any difficult situation. This course requires no professional equipment and you can learn easily by yourself or with a friend. Shortly, you'll be amazed at your new powers!

**ORIGINALLY SOLD NATIONWIDE FOR \$7.00, YOU PAY
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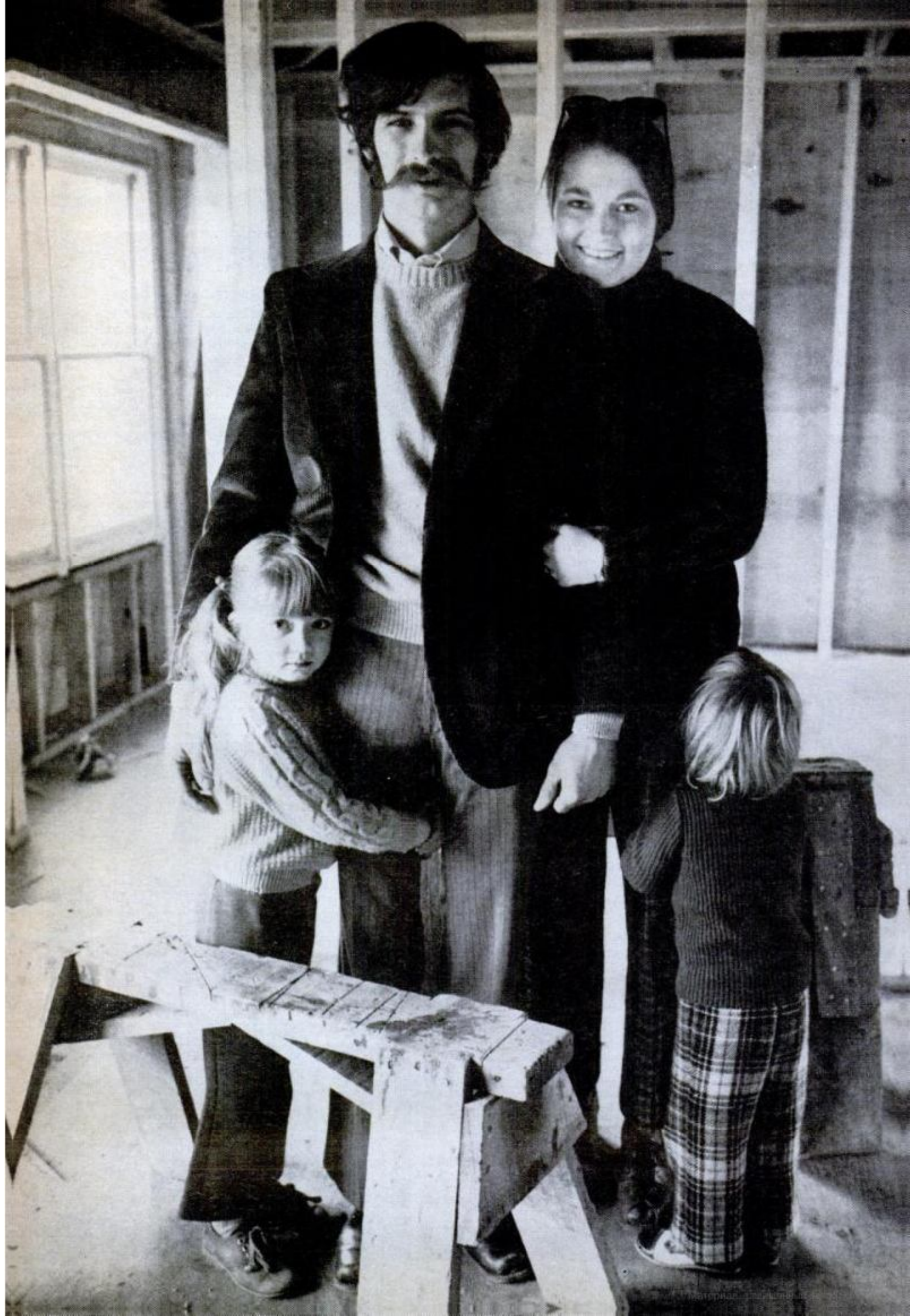
DEAR KUNG-FU INTERNATIONAL:

Send me your complete Kung-Fu course!
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How to start making it early in life.

(A TRUE STORY)

Since he got out of the Navy, John Muirhead of Gales Ferry, Conn. has provided well for his family.

Two cars. A new house going up alongside a wooded lake. Even a handsome Great Dane named Sherman.

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The right combination for success

John has the right combination for success. He's in a growing field. And he has good training for it. You could, too.

Especially if you're interested in one

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We'll show you a better way to earn a living.

Soon, a new home built on a wooded lake site will give John and Cheryl Muirhead lots of room for their growing family. (Photo: Frank Cowan)

A cowboy on a horse is herding a large group of horses through a shallow river. The scene is set in a lush, green landscape with dense trees in the background. The water is shallow and reflects the surrounding greenery. The overall tone is natural and serene.

Come to
Marlboro

Kings: 18 mg. tar, 1.2 mg. nicotine—
100's: 18 mg. tar, 1.3 mg. nicotine av. per cigarette, FTC Report Sept. '73

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



Country.

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

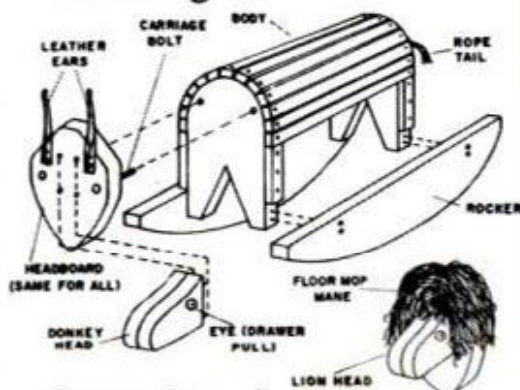


Surform tool shaves, planes easier. Free plans prove it.

Now and then a woodworking project can turn you off. Especially if it calls for a lot of planing, filing and smoothing

grater" blade can't clog either; shavings pass right through.

All of this you can prove for yourself. Our free plan set to make these animal rocking toys calls for a good amount of planing, forming and smoothing



down edges. A Stanley Surform plane or file or even pocket-size model makes it a pleasure. And — by the way — Surform tools aren't just for woodworking; they also take on soft metals, plastics, material like autobody filler. Another thing — if a Surform blade wears out, you just snap on a new one.

So go take a look at

those Stanley Surform tools. Almost any store with a good tool department sells Stanley Surform tools and replacement blades. To get the free plans to make the rocking donkey and lion, just send your name and address to Stanley Tools, Dept. A1, New Britain, Conn. 06050

— which sometimes can be tricky work.

It's no problem with Stanley Surform tools. They let you trim away material fast, easy, without goofing. Really make you look like a pro. Surform's "cheese-



STANLEY
helps you do
things
right



Four wonderful weekend / vacation homes

by Ralph C. Rittenour

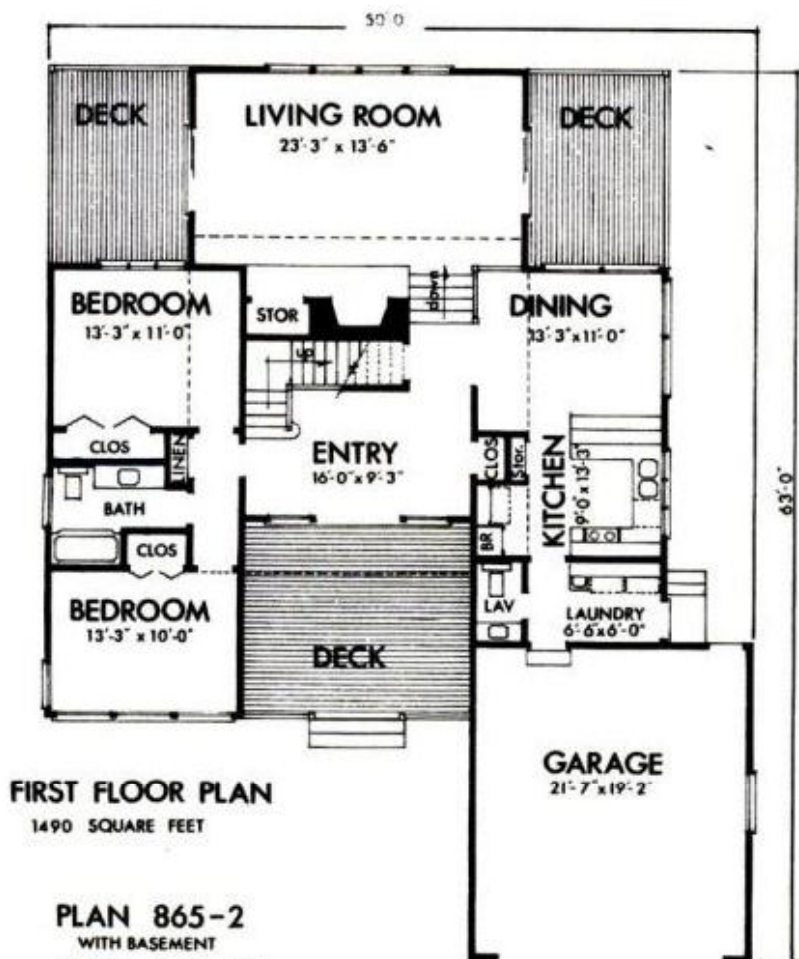
Plan 865—2 & 2A

Whether you plan to build a second home strictly for summer vacationing or as a regular weekend hideaway for family relaxation, you're making a wise investment. A second home not only serves a present purpose, it can also prove to be a pleasant way to plan for the future and your retirement years.

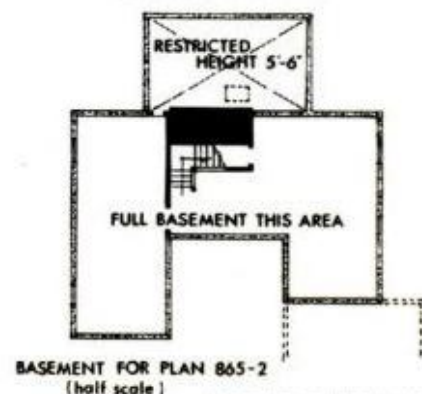
To help you find the home you'd like to build, PM presents on this and following pages plans you can order of new designs that are contemporary, yet will retain their charm in any setting.



Clerestory windows in gable end of bedroom and over the laundry add privacy and light. Attached two-car garage extends to the front.

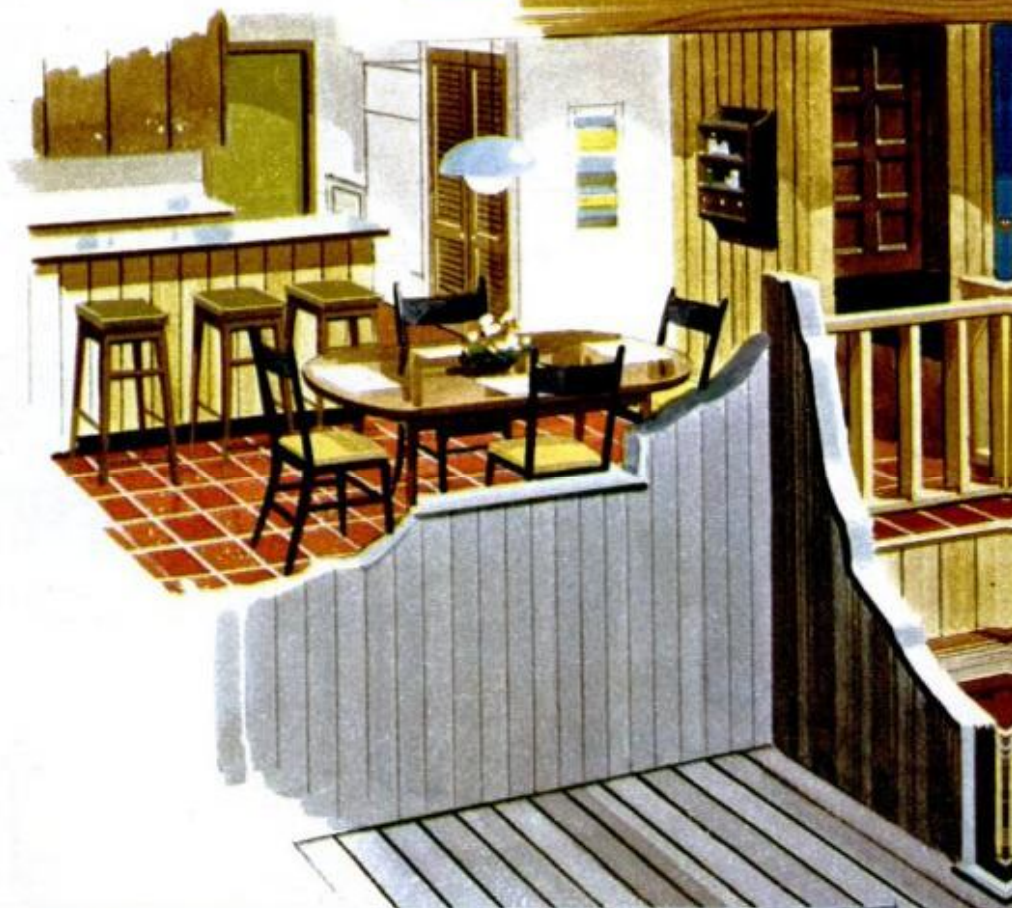


PLAN 865-2
WITH BASEMENT
PLAN 865-2A
WITHOUT BASEMENT



Dramatic balconied living room

The contemporary architecture of this elegant home combines with a rustic country styling. A spacious entry connects with all portions of the main level and to the second floor by an open staircase. At the rear of the home, a short flight of steps leads to a recessed living room. The soaring height of



Outside decks that flank both sides of the living room are accessible through sliding glass doors. These decks are also viewed from the windows of the dining room and from one of the rooms of the bedroom wing. Although the home is comfortably sized, plans also allow for a partial basement.

Plan 865-2 & 2A





Plan 865—2 & 2A

the room is accentuated by a vaulted beam ceiling. A wood-deck ceiling slopes from the support over the balcony to the outside wall where large windows offer a skyline and treetop view of the outdoors.

A massive fireplace is the focal point of the living room. This interesting room may be viewed from the dining area through the open balustrade of the hallway railing. Note the raised masonry hearth and the louvered doors that cover the storage shelves.

How to order plans

You can buy complete plans for any home featured in this article for \$35 for one set, or \$50 for four sets of the same plan. Add \$5 for a materials list. Four sets are needed for permits, estimates, financing and construction. A plumbing diagram and a wiring diagram, helpful if you intend to do the work yourself, are available for \$5 each. Send orders to Home Building Plan Service, Dept. PM., 2234 N.E. Sandy Blvd., Portland, Ore. 97232. Specify the plan number and the number of sets you want.



Plan 886-1 & 1A

Both of the plans illustrated on this page have identical main and second-floor plans. The difference is in the arrangement of the basement. Plan 886-1 has a standard basement below grade. Plan 886-2 has a daylight basement and includes a garage under the building. Only plan 886-1A is available without basement.



Plan 886—2

Modified A-frame preserves wall space and headroom

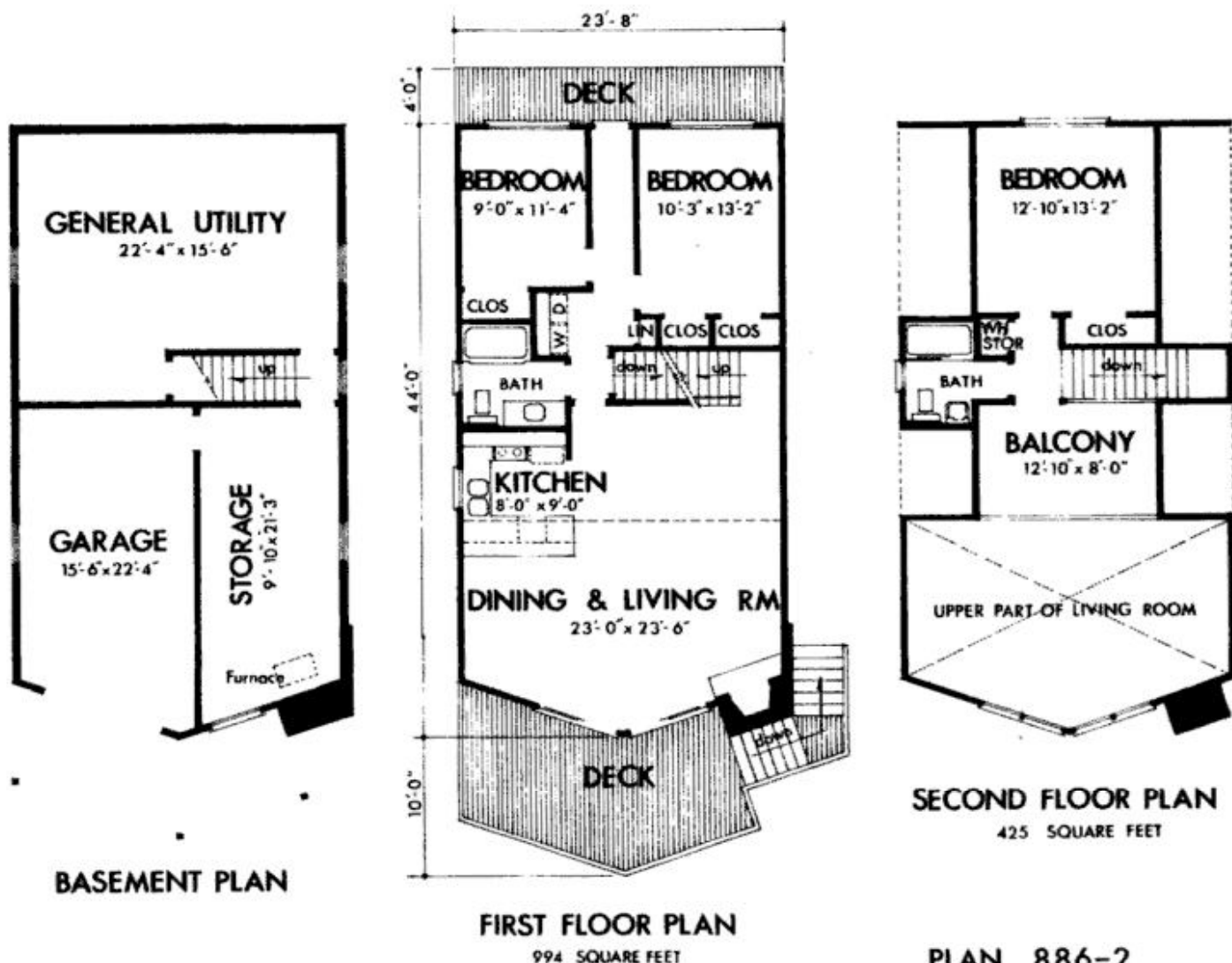
Close examination of these two designs will reveal how the roof does not extend to the ground level as in a conventional A-frame, but rests on perimeter walls that are adequate for providing comfortable headroom. This design feature also permits the installation of windows that otherwise might be impossible in an A-frame.

Take note also how the roof has been broken midway down the slope of the gable and extended over the front porch. This latter projection provides valuable cover for the large prow-shaped fenestration of the front-gable wall, giving added protection from sun and snow. A clearly defined separation of the living and sleeping areas insures both privacy and quiet.

The living room rises a soaring two stories and is finished in natural-wood decor. Other features of this plan that will appeal to the recreation-home builder include three bedrooms, plus an overflow balcony sleeping loft. A complete bathroom is

located on each floor, and a laundry wall flanks the central hallway of the first floor. It includes both washer and dryer. The U-shape kitchen opens onto the living-dining area to minimize wasted steps in serving the dining table. A massive oversized fireplace is placed in the corner of the living room, enabling the owner to enjoy both the view of the outdoors and the fireplace hearth at the same time. Another important feature is the access to the rear deck through a central hall as well as to the front deck through sliding glass doors.

Outside, there is a large deck at front which is ideal for sunbathing, evening relaxation in cool breezes, and for outdoor entertaining. If Plan 886-1—standard basement, first-floor on grade—is used, the guard rail is optional. If, however, you decide to go with Plan 886-2 below, which puts the daylight basement on grade and first floor above, the deck is enclosed with a clean-looking, contemporary railing.



PLAN 886-2

Mini octagonal home starts a cluster

Build this unique starter home containing only 331 square feet and meet all requirements of the Uniform Building Code. Take note of the complete kitchen and dining area as well as the space for a fold-out sofa bed in the living quarters of the starter home. Full bath and lavatory are also provided in the original home. The octagonal unit measures 20x20 feet, and each wall of the home is spanned by two sheets of plywood. A low-pitched roof with wide overhang is covered with cedar shakes.

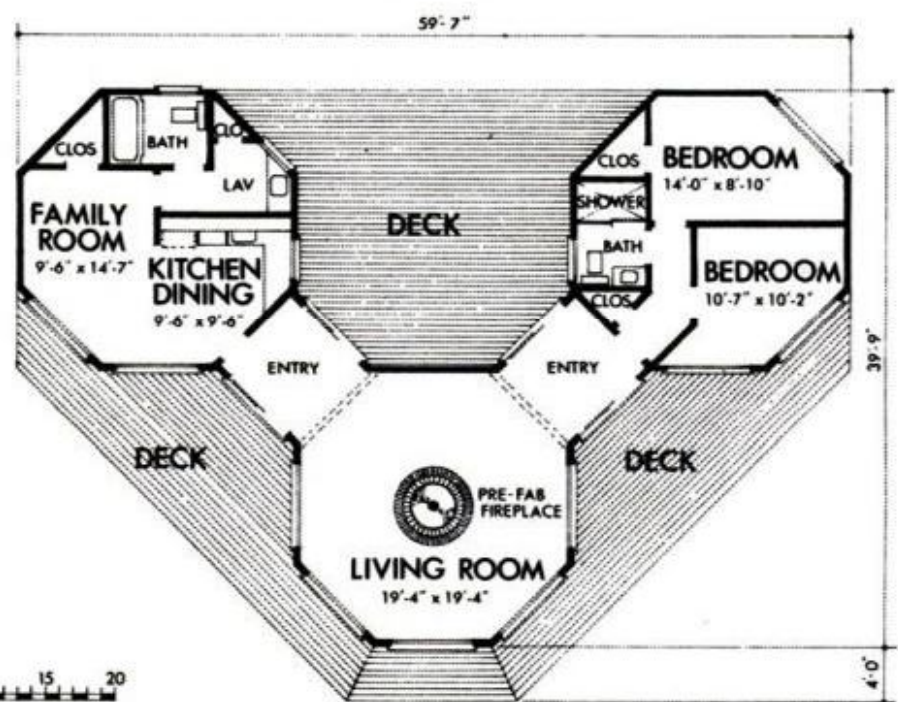
All interior walls of each unit are non-bearing, as eight exposed hip beams are supported at the center of the vaulted ceiling by a compression ring. The owner may move partitions in case he should like to make modifications in the design. Locate the dwelling so you can make the best use of your property. All three of the octagonal structural units in this expandable plan are identical. The only difference lies in the way the windows have been arranged and the partitions have been placed.

PLAN 880-S



STARTER PLAN
331 SQUARE FEET

PLAN 880-1A



FINISHED PLAN
1122 SQUARE FEET

0 5 10 15 20
USE THIS SCALE TO MEASURE IRREGULAR ROOMS

This versatile design may well be the answer to your recreation program. You may build this starter unit at your convenience and add on to it as your needs arise. It will not only serve you as an independent home to start with but also offer you the opportunity to expand in many different ways.



Plan 880-S



Plan 880-1A



Two levels and a covered deck

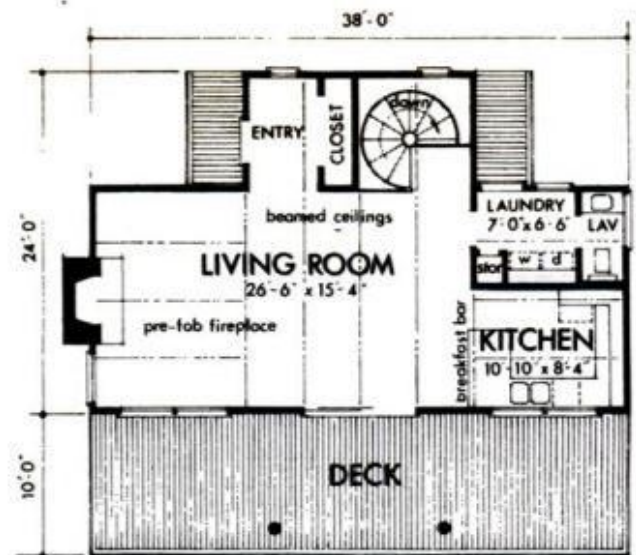
Here is a plan that emphasizes informality with the rooms arranged so that the whole scheme of living promotes family togetherness.

The generous-size entry reveals the open character of the home immediately upon arrival. Note the ample closets and the guest closet that's tucked into the alcove wall of the entry hall.

The living room is the center of a complex of connected living spaces with the dining area at one end and a huge log-sized fireplace at the opposite end. An intervening area of over 26 feet connects the two ends of the spacious room.

All along the rear wall of the living room a series of windows and sliding glass doors invite the occupants to a generous-sized deck where all sorts of pleasant outdoor activities may be enjoyed. The deck spans the width of the home. ★★★

Pole house on hill has panoramic view from two levels. Roof overhang shelters center portion of upper deck. Stained-glass windows light the entry and staircase.



UPPER LEVEL
739 SQUARE FEET



LOWER LEVEL
739 SQUARE FEET

Plan 885-1



New TV tubes lock in better color pictures

by Jim Lockett

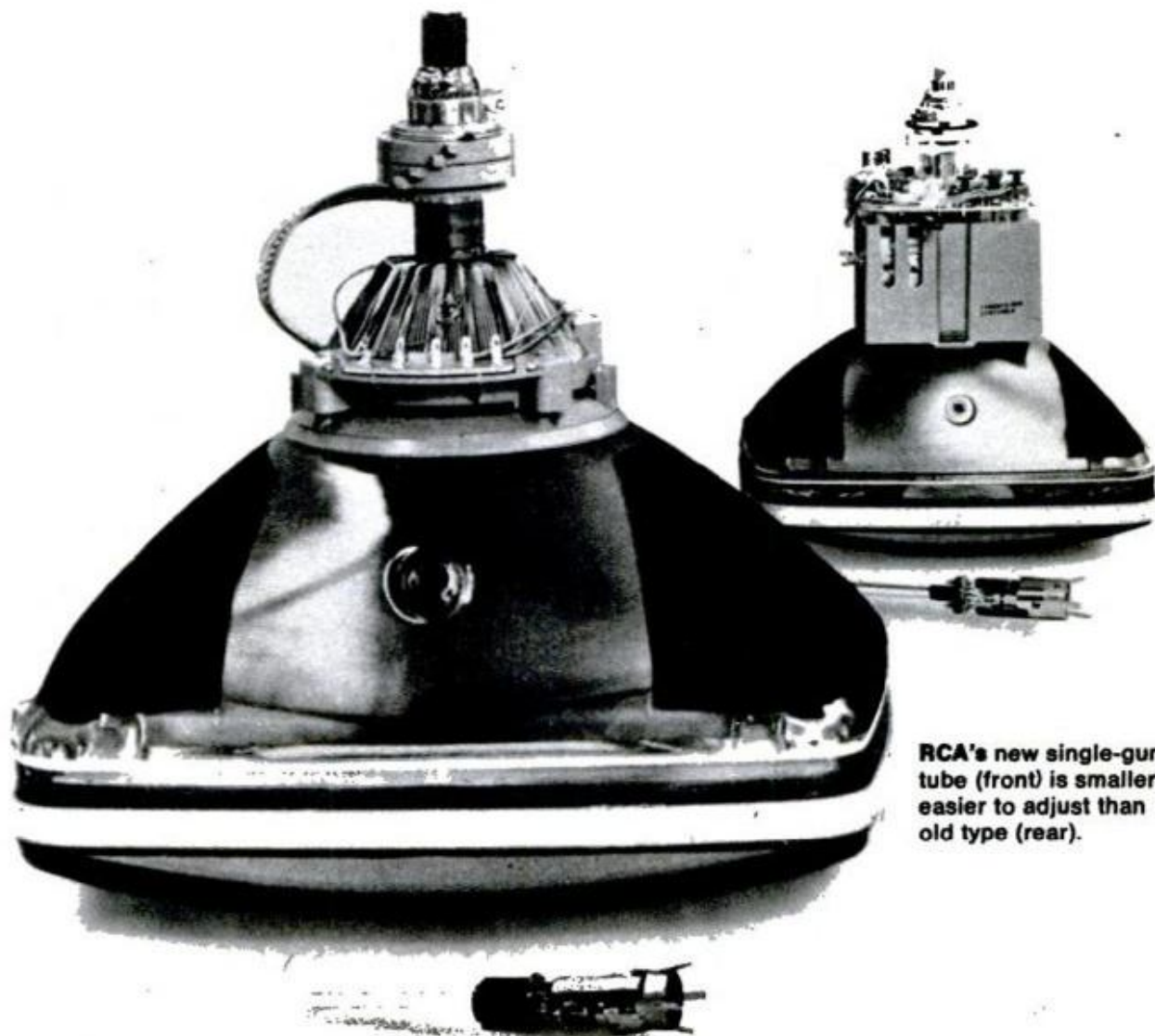
The old, familiar picture tube design that has dominated the color TV industry since mass-production color began in the mid-fifties appears to be on its way out. A new generation of tubes with radically different internal structures is sweeping the industry.

The new tubes won't bring dramatic improvements in picture quality—but they

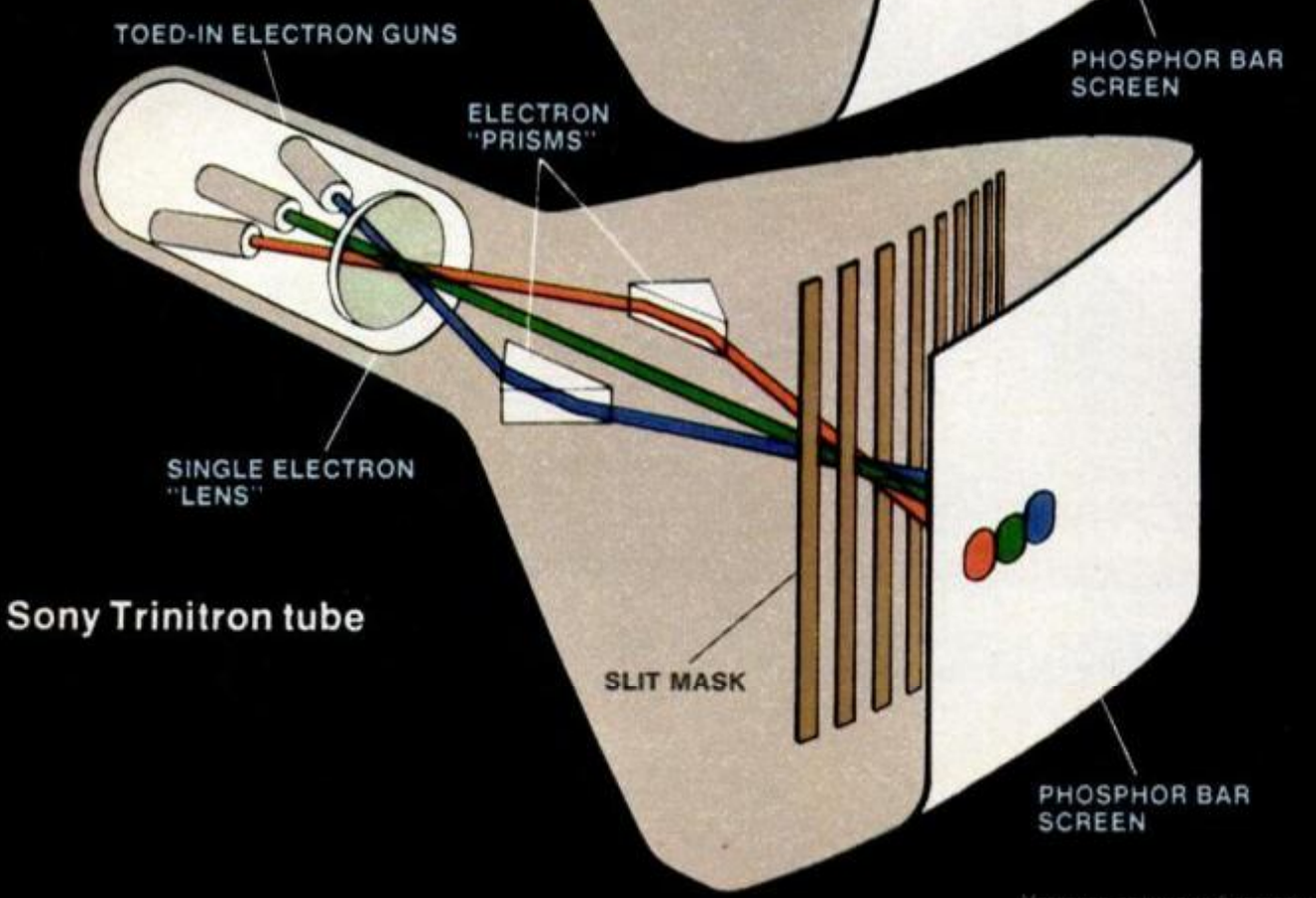
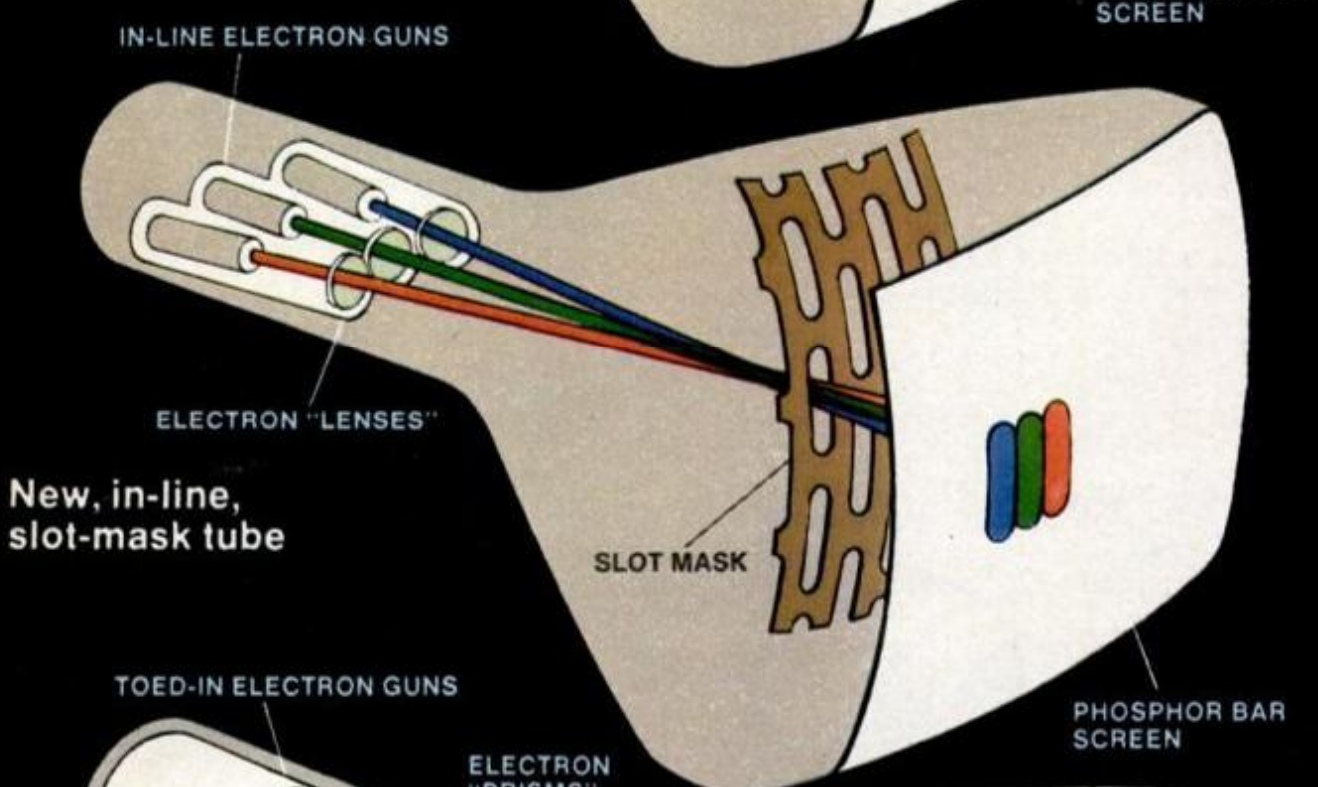
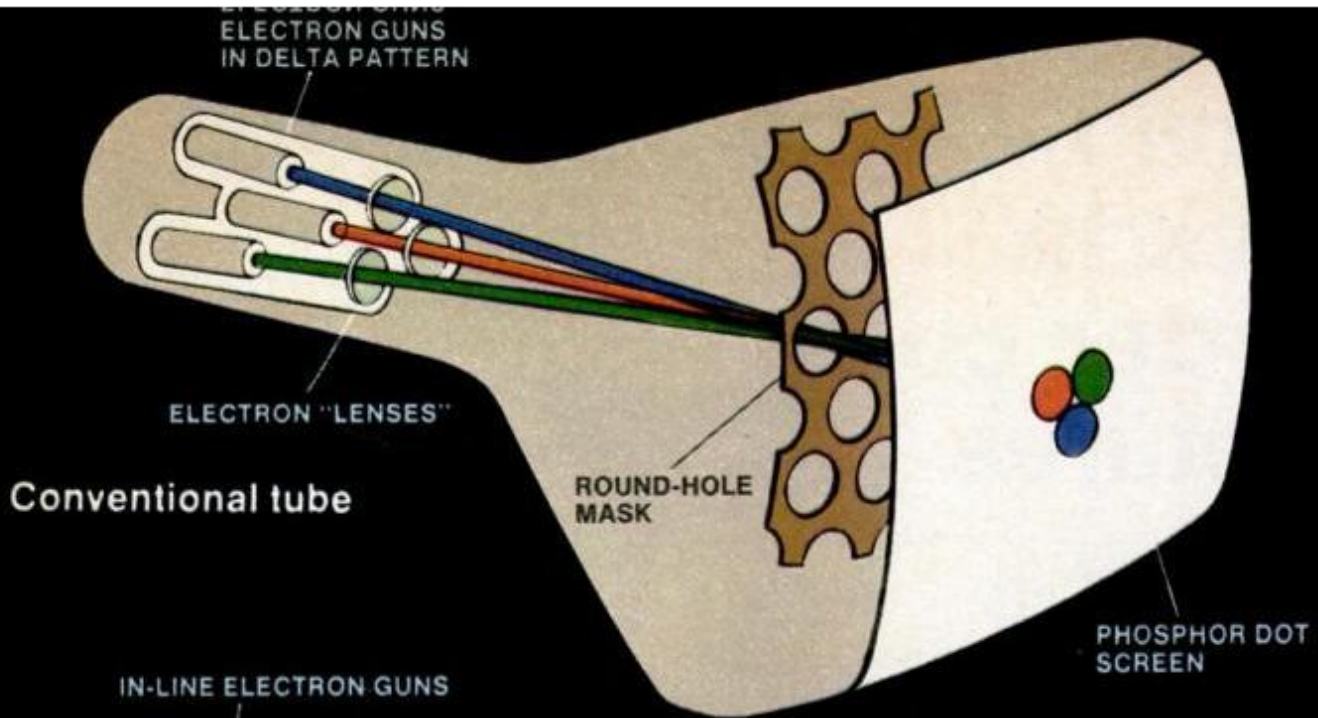
do match picture quality of the best conventional tubes and should be more reliable, needing fewer service calls. They may lower original set cost, too.

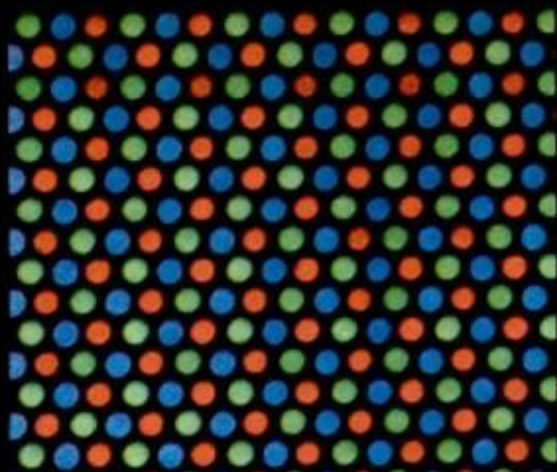
That's mainly due to their simplified convergence adjustments—the adjustments that insure that the electron beams from the tube's red, green and blue guns will converge closely on the tube face's phosphor screen. Properly converged, all three spots blend into single spots of white or other colors, rather than appearing as distinct primary-color spots, or adding color fringes to picture details.

But there are other benefits, too: The color purity of the new tubes' pictures is less affected by the earth's magnetic field. They're also a few pounds lighter and up to five inches shorter. And they save the manufacturer about \$5 in chassis parts and assembly costs—which could result in a saving of about \$15 to you, if set makers choose to pass that saving on. So far, the new tubes have not resulted in lower prices, but costs may come down as the tubes come into

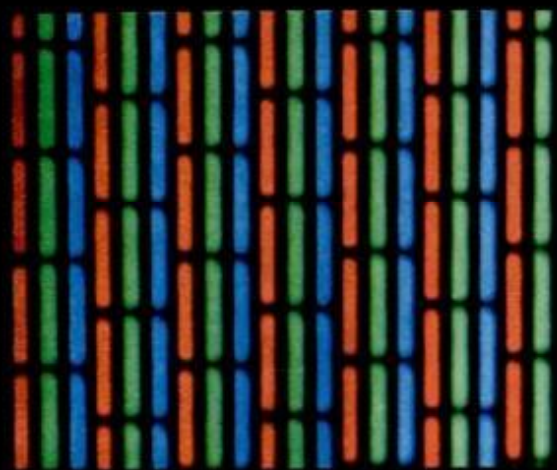


RCA's new single-gun tube (front) is smaller, easier to adjust than old type (rear).





Round phosphor dots mark conventional tube, with round mask holes, and guns usually in delta pattern. (This and other TV-screen photos are 10X life-size.)



Slot-mask tubes have continuous phosphor stripes (horizontal black shadows are cast by mask), guns in in-line pattern. RCA version has "unitized" gun (see text).



Sony Trinitron's phosphor stripes show no shadows since mask has only vertical strips. Tube face curves only in one plane, an antireflection plus, Sony says.

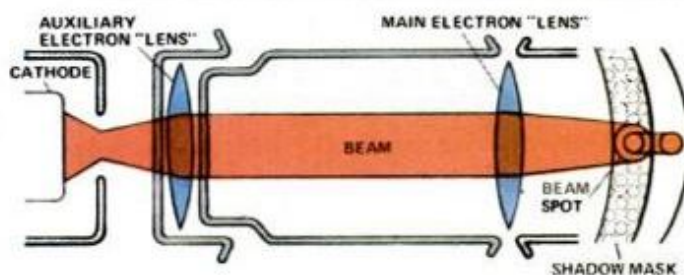
greater use and lose their novelty appeal.

The common denominator of the new picture tube designs is the rearrangement of their three electron guns (one each for blue, green and red) into a straight line, instead of the usual triangular "delta" pattern. With the electron guns in the same horizontal plane, it's easier to converge their beams into a single spot.

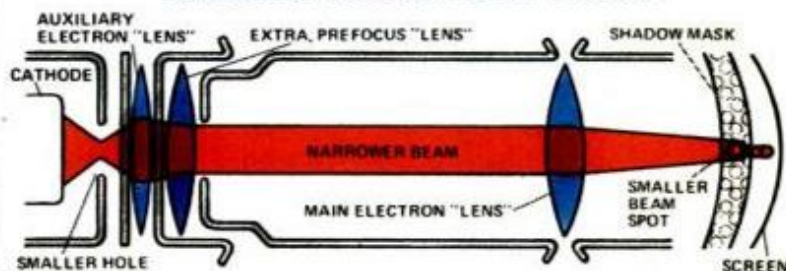
Conventional tubes have 15 convergence adjustments which must be carefully set on the assembly line and—in some instances—readjusted by a serviceman in your home. **But some of the new tubes (see table, page 89) have no convergence adjustments at all;** their guns are converged at the factory, then cemented into the tubes' narrow necks. Other new designs retain up to four adjustments; manufacturers claim this allows greater flexibility to correct convergence errors, and that the wider necks of these tubes allow larger electron-grid "lenses" which can focus the picture more sharply on the screen. (Narrow-neck advocates, on the other hand, claim improved convergence and registration and lower power requirements.)

Another key element in the design of the new tubes is their use of tiny vertical phosphor stripes instead of dots to "paint" the

CONVENTIONAL PICTURE TUBE BEAM PROFILE



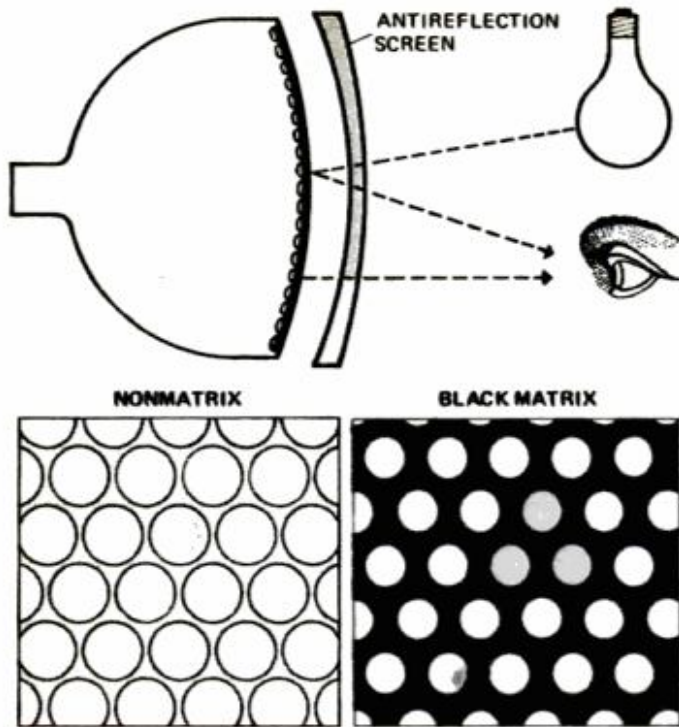
PANASONIC QUINTRIX BEAM PROFILE



Art: Adolph Brotman

Panasonic Quintrix is an unconventional round-dot tube. It uses an extra electronic "lens" to focus the electron beam more critically, resulting in a narrower beam and smaller image spots which Panasonic claims are sharper (and more perfectly round).

New TV tubes



Black-matrix screens, now almost universal among picture tubes, surround each dot or bar with nonreflective black. As a result, antireflection screens can be made lighter, allowing the picture to come through with greater brightness and purity.

color picture. On striped screens, electron beams deflected up or down by the earth's magnetic field will still strike the proper color phosphor, avoiding color impurity; on dotted screens, deflected beams tend to illuminate dots of the wrong color above and below the correct dot. Stripes are also claimed to yield greater "apparent resolution" because the eye supposedly can focus more easily on the vertical lines than on the dots used in conventional designs. Not much evidence has been presented to back this up, though, and the claim isn't being pressed very strongly.

To use a striped screen, the tubemaker must modify the shadow mask—the thin metal grid between the electron guns and the screen whose holes are positioned to insure that each beam strikes only one color of phosphor. In conventional dot-screen tubes, the holes in the shadow mask are round, with one such hole for every triad of color dots. In striped-screen tubes, the holes are either vertical slots—tall, thin rectangles—or slits running from the top to the bottom of the mask.

Theoretically, slotted and slit masks allow brighter pictures, by blocking off less of the electron beam's energy. In practice, the slotted mask (which, like the dot-mask

is curved both horizontally and vertically into a section of a sphere) loses much of this advantage because its bars must be thickened to reinforce it and hold its curve precisely; and the thicker the bars, the narrower the slots between them.

Sony, the only user of a slit mask, gets around the rigidity problem by curving its mask and screen only in the horizontal plane, shaping them like a section of a cylinder standing on end (a very rigid shape), instead of a spherical section. Sony claims this vertically flat shape also reflects less extraneous room light back at the viewer. The slit mask also casts no horizontal shadows on the phosphor stripes, which can be excited by an electron beam anywhere along their lengths. The horizontal members of slotted masks on the other hand, create a bricklike pattern on the screen, which is visible to the naked eye on very close inspection.

Another unique aspect of the Sony Trinitron is its single focusing lens system and the unique gun arrangement that goes with it. Most color tubes use separate grids to focus each of the three electron beams on the screen, just as lenses focus light beams; the guns are aimed to have their beams converge at the plane of the shadow mask. Sony uses a single, larger lens grid for all three beams, toeing them in sharply so they converge at the lens's center. This system, Sony claims, produces sharper images, since beams pass only through the lens's sharp center, never getting as close to the unsharp edges as they might with smaller lens designs. But since the beams converge at the lens, they diverge again between the lens and screen; convergence plates (which Sony compares to prisms) bend the beams back into correct alignment.

Panasonic has another new lens design in its Quintrix tube, an otherwise conventional round-dot black matrix type. The innovation, here, is an extra focusing grid, for a tighter beam and sharper image spot. The shadow-mask and black matrix guard bands are also produced by a new "direct-exposure" system, which Panasonic claims results in more sharp-edged, perfectly round dots and more accurate beam landing.

The purpose of those black-matrix guard bands (now nearly universal in the best conventional tubes and used in most of the new ones, too) is to improve picture contrast. Some sort of guard-band separation must be maintained between phosphor dots

or bars, so the wrong phosphors won't light up (causing color impurity) if the beams or phosphors are microscopically misaligned.

In early tubes, this separation was provided in part by making the phosphor dots larger than the electron beams (so that slight misalignments would still allow the beam to illuminate its original phosphor area) and in part by leaving part of the screen blank between dots. Between the unilluminated portions of the phosphor dots and the blanks between them about half the screen was free to reflect room light, and the glass on the tube face had to be darkly tinted to keep such reflections from washing out the picture. The glass did cut potential picture brightness by about 60 percent—but since reflected light had to pass through the glass both coming into and leaving the tube, its intensity was cut by about 85 percent.

By making the dots smaller, and filling the space between them with black, reflection-absorbing material—the black matrix—screen reflections are reduced enough to permit more transparent glass to be used on the face plate, allowing up to 85 percent of the light from the picture phosphors to be seen. This in turn means less beam current

is required for bright pictures, which allows sharper focus.

On the new phosphor-bar tubes, only the vertical spaces between the bars are blacked in; tubes that will black out the horizontal shadow bars as well are yet to come. And Sony Trinitrons, as well as the new RCA 15-inch, GE 10 and 16-inch and Sylvania 13-inch in-line models have no matrix.

All the in-line designs save an inch or two in the front-to-back measurement of the picture tube; but the really big reductions in color TV bulk come from the use of tubes—in-line or conventional—with wider deflection angles between the tube sides. So far, the widest is the 114° angle of Sony's 19-inch Trinitron and some of its 17-inch sets. All other in-lines have a 90° deflection angle, as do most conventional tubes. Tubes with 110° angles are used in a few otherwise conventional sets available from RCA, Sears and MGA, and both MGA and Zenith are reported to be working on 110° slotted-mask tubes. But wider sets are on the way: Toshiba has announced 118° sets for the Japanese market, and Sony says tubes in its labs have deflection angles up to 122°.

How good are the new tubes? To find out, I borrowed a selection of sets that repre-

(Please turn to page 169)

In-line gun picture tubes

Brand	Tube name	Tubemaker	Mask	Sizes	Convergence controls (No.)	Matrix
GE	Porta Color	GE	Round hole	10, 16	6	No
GE	Porta Color	GE	Slot	10	6	No
¹ GE		GE	Slot	13, 17	4	Yes
Magnavox		RCA	Slot	17, 19	None	Yes
RCA	AccuLine	RCA	Slot	15, 17, 19	None	17 and 19 only
Sears		Toshiba	Slot	13	4	Yes
Sears		RCA	Slot	17	None	Yes
Sharp	Linytron	Toshiba	Slot	9, 13, 19	4	13 and 19 only
Sony	Trinitron	Sony	Slit	5, 9, 12, 15, 17, 19	2	No
Sylvania	Chroma-Line	Sylvania	Slot	13	4	No
Teledyne		RCA	Slot	15, 17	None	17 only
Toshiba	Black Stripe	Toshiba	Slot	9, 13	4	Yes

¹Planned for introduction this year.

How to work with plasterboard

Gypsum-core plasterboard provides a low-cost interior-finish wall that is an ideal surface for both paint and wall coverings. When it is installed properly, your walls can have the smooth look of plaster. Plasterboard is available in fire-resistant grades that meet most building codes too: Most codes require this type on walls between house and attached garage.

Many of the techniques for repair of plas-

terboard surfaces are the same as for new installation, and professionals frequently use plasterboard to replace large areas of damaged plaster.

When joints, nailheads and corners in an installation are finished, allowed to dry thoroughly and sanded, the entire surface should receive a coat of vinyl or oil-base primer-sealer to assure uniform absorption of paint or wall-covering adhesive.

Estimating materials

NAILS

Wallboard thickness	Nail type	Per 1000 sq. ft. of wallboard
3/8", 1/2"	1 1/4" annular-threaded wallboard nail	6 lbs.
5/8"	1 3/8" annular-threaded wallboard nail	6 lbs.

Start by making a drawing of the surfaces to be covered with plasterboard and planning the arrangement of panels. Use the longest panels you can to reduce the number of end joints. Horizontal application to a wall is often preferred for this reason. Vertical application is desirable where the ceiling height of a wall is more than 8 ft. 2 in. or the wall space to be surfaced is 4 ft. wide or narrower. Where end joints cannot be avoided, they should be staggered.

The installation method that uses both an adhesive and nails is not only quicker, because there

PREMIXED JOINT COMPOUND AND TAPE

Plasterboard (sq. ft.)	Ready-mix joint compound (gals.)	Wallboard tape (rolls)
100-200	1	2/60'
300-400	2	3/60'
500-600	3	1/250'
700-800	4	1/250', 1/60'
900-1000	5	1/250', 2/60'

are fewer nails to drive and conceal, but also means a better-quality installation than nails alone. With this method, you will require about half as many nails as indicated in the chart at left above; for a professional-grade installation, you will need a quart tube of adhesive for every two 4x8 panels (64 sq. ft.).

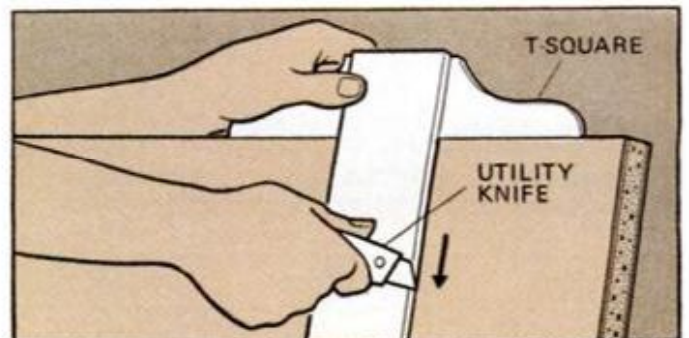
Use the chart above to estimate the quantities of wallboard tape and ready-mix joint compound (spackling compound) you will need. Joint compound is also available in dry powder form; allow 60 lbs. per 1000 sq. ft. of surface.

Tools required

1. Wallboard cutting knife or utility knife
2. Wallboard hammer or crown-head claw hammer
3. 4-ft. T-square or steel straightedge
4. Steel tape measure
5. Keyhole saw or sabre saw
6. Joint-finishing knives, 4- and 10-in. blades
7. Pan for joint compound (mortarboard)
8. Medium-grade sandpaper and block
9. Cartridge-type caulking gun (for adhesive)
10. Corner-taping tool (optional)

Cutting plasterboard

Using a T-square to get an aligned straightedge, hold a wallboard or utility knife perpendicular to the surface and score completely through the face paper. The board can then be snapped with a firm, even pressure. Folding back the snapped-off section, cut through back paper with the knife. Use sandpaper to smooth any rough edges. Use a keyhole saw or sabre saw to cut any needed openings in panel; be sure to measure them carefully.



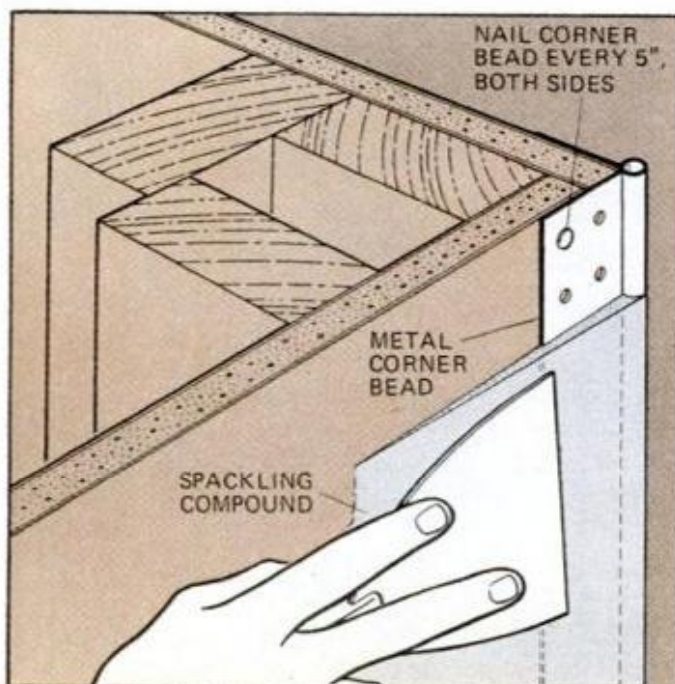
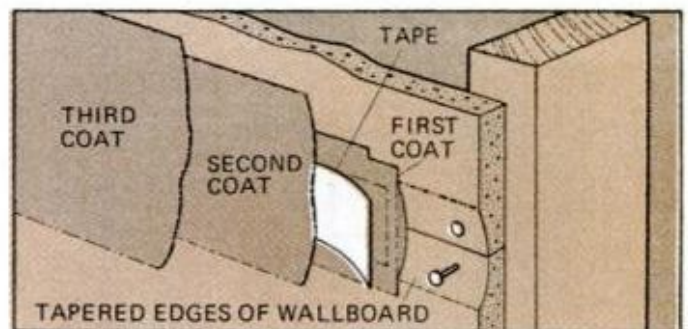
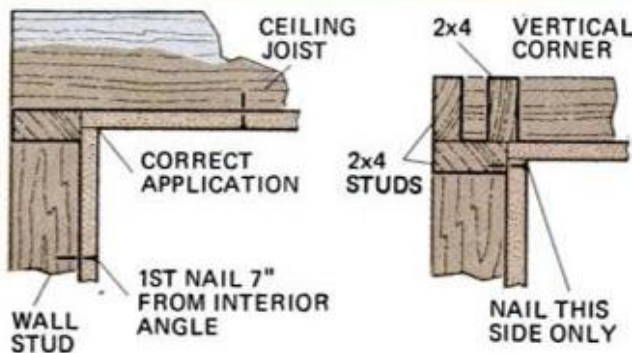


Ceiling installation

Ceilings should be covered before walls. Panels are held in place for nailing with support tees; make them about 1 in. longer than floor-to-ceiling height. Place nails 7 in. apart. If the adhesive-and-nails method is used, all edges should still be nailed, but only one nail per ceiling joist will be required in the "field" of the board. Drive nails to bring the panel tight to framing, then strike each nail one more time to "dimple" (set) the head, taking care not to break face paper.

Wall application and corners

In horizontal application, bottom panels are installed first; the second row can then be rested on the first. Nails are spaced 7 in. apart and dimpled. No nail in the top course should be less than 7 in. from the ceiling. If adhesive is used, no nails in the field are required unless a panel is bowed—then it may be nailed temporarily while adhesive sets. In a vertical corner, the panel edge that is lapped over need not be nailed.



Finishing joints

Joints are filled, reinforced and finished as shown. First coat of joint compound is applied with 4-in. joint knife and tape pressed into it with knife held at 45° angle. Allow at least 24 hours for each coat to dry. Second and third coats are sanded and third feathered-out with 10-in. joint knife to a total width of 12 to 14 in. Treat end and butt joints the same way, with final coat 14 to 18 in. wide. Nailheads get three sanded coats of compound, no tape unless paper is broken.

Finishing corners

Two coats of compound may do for an outside corner. Final coat should extend 7 to 9 in. back from nose of corner. Tape creased lengthwise is embedded in inside corners, topped with one or two feathered coats of compound. To halt cracking, use the least possible compound in crease line. ★★ ★

You can stretch a gallon, but not your legs!

A nationwide survey based on 1,200,000 owner-driven miles.

by Michael Lamm
WEST COAST EDITOR

Photos by the author

Toyota's Corolla surprised Detroit five years ago when the makers of big cars couldn't figure out why such a flea should sell so well. The Corolla became the first really successful subcompact brought into this country.

But Toyota had done its homework. In 1967, the firm began exporting Corollas to England—an 1100-cc version. The car did so well there that by 1969 U.S. Toyota dealers began selling Corollas, too—a 1200-cc on a 90.9-inch wheelbase. Over the years, as competition grew, Corollas have been progressively upgraded. A 1600-cc engine became an option, and in the summer of 1972 so did a five-speed manual gearbox, making the Corolla the first inexpensive mini so equipped.

This transmission shows typical Toyota foresight. The four-speed offered all along was actually the five-speed with fifth missing! The fifth-gear slot had always been there, but Toyota didn't install the extra



cog until it felt that the market was ready.

Over the years, the Corolla has grown only an inch in wheelbase but more than a foot in overall length (comparing 1969 and 1974 models). This extra foot shows up mostly in the federally mandated bumpers. Short on looks, it's actually longer than the VW Beetle, Dodge Colt and Datsun B-210. Relatively few owners that PM sampled bought the Corolla for its size—only 15.9 percent. Most were more interested in the car's price and economy.

Let's dive into our sampling and see how owners like their cars.

Says a Florida mother of three, aged 26 and employed as an insurance rater: "It's the easiest-shifting car I've ever driven [manual four-speed in this case]. Very good mileage and it's nice to handle. Convenient size and I like the reclining seats, standard toolkit and turn-signal dimmer switch. A tough little car; good for the money. Once I had to drive through water

that came halfway up the door. I had my three children with me and it was still raining. I hate to think what would have happened if we'd been stranded in that flood. The engine didn't die, though, and that really impressed me."

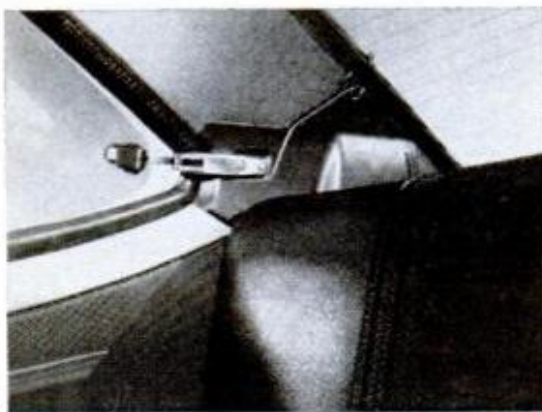
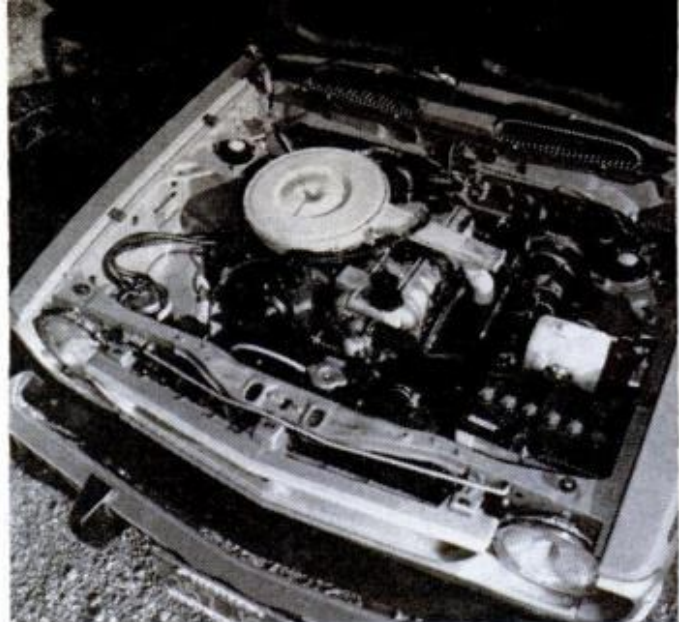
A 42-year-old California manufacturing manager who owns a five-speed SR-5 comments: "I bought it for economy, reliability and comfort on long commutes. I think the driver's seat should be moved back about two inches for the average American driver. The belt hangs up on its own label and the buckle can puncture the door panel (mine did). Workmanship is well above average and better than Detroit. Service seems slow and expensive—\$112.09 on routine maintenance in 12,000 miles."

Another Corolla SR-5 owner, a student in Georgia, writes: "With my budget, it gives me the most car for the money. I wanted a sporty car with a five-speed. It's as close as I could get to a Porsche 911-S. But



With radial tires, Corolla SR-5 sticks well and corners flat. The five-speed transmission makes acceleration snappy. Fifth is an overdrive ratio, which increases the already good gas mileage. Many owners praised rear-seat headroom and legroom, but a few felt they'd been short-changed on front legroom. Apparently, too, it's not possible to buy a locking gas cap. The SR-5 is becoming known as the poor man's Porsche.

Power disc brakes are standard behind nicely styled wheels (1). Gas cap's fluted design aids on/off (2), and five-speed stick (3) has short throws. Pushrod engine (4) delivers 65 and 88 bhp net in 1200-cc and 1600-cc versions. Trunk would benefit from fold-down rear seat in coupes (5). Sporty dash (6) shows taste and practicality. Rear panes push out (7) for flow-through ventilation; relatively thin pillars help in backing. Corolla's new 5-mph bumpers (8) have added almost a foot to the length of the car since it was introduced.



I would like to see them add a sunroof, fold-down rear seat, better looking wheels and improved rear suspension—it's weak and bottoms. Workmanship? Best buy for '74. My only complaint is that you can't get a locking gas cap."

A 35-year-old Alabama teacher had this to say: "I wanted an economical subcompact, researched the various models, boiled them down to three, found a 1200 two-door without extras, and bought it. Gas mileage is phenomenal. It's easy to park and seems more roomy inside than most subcompacts. But the rear window always fogs up. A defogger should be standard rather than optional. The rear-view mirror is too small, and the radio doesn't produce a clear tone. Front bucket seats are comfortable, but need to be a little taller. This car would be more pleasing if wires under the dash were not exposed."

A 21-year-old California sales clerk reports: "I like the looks, handling and size—and it's fun to drive. But with automatic, acceleration is sluggish. I wish they'd put a little more power in it." (Many owners with automatic asked for more horsepower).

A South Carolina accountant, aged 23, declares: "I bought it because it was the cheapest new car available. Workmanship is very good for the price. It's comfortable, and most passengers feel that even though the back seat is small, it's bigger than

most other small cars'. The thing I like least is that the engine keeps racing after I take my foot off the gas." (Lots of complaints on this last. It's caused by the no-die detent on the carburetor.)

A 35-year-old Alabama production scheduler: I drive 20 miles to work each day. My Corolla 1600 is fun to drive and great on gas. I wish, though, that they'd hide the mass of wires under the right dash panel. I bought it as a small car and am happy with the room inside, even with four people."

An Oregon market manager, aged 24, states: "Toyota even sent me forms to tell how I was treated. I got a high trade-in allowance on my Datsun. What I like most is the snappy acceleration in town with the five-speed, smoothness, economy and style. I've found no flaws in workmanship, but there's not enough headroom getting in and out."

And to wind up this report, a New Jersey cable TV technician, aged 48, comments: "I use this car a lot on rutted roads to reach our antenna site. I carry videotape recorders and camera equipment. Standard cars scrape bottom, but the Corolla wagon doesn't because of its short wheelbase. And the car handles great on the highway—just aim and it's there."

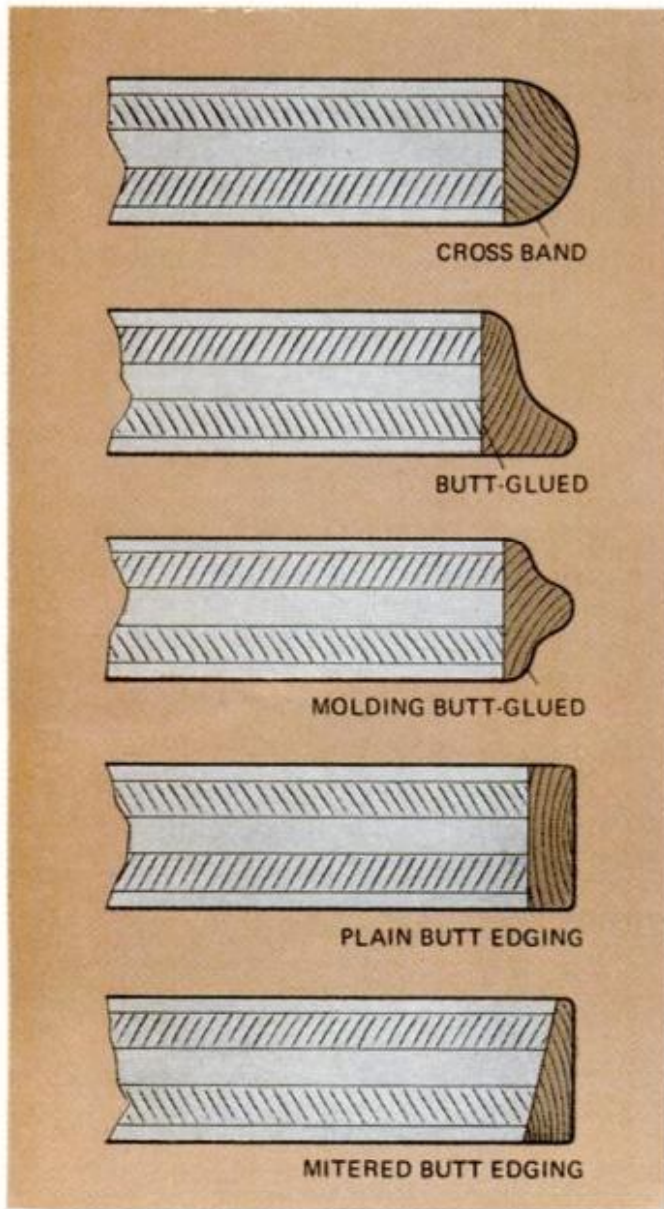
A very high 90.3 percent said they'd buy Corollas again—next time—strong testimony in the car's favor. ★★★

Summary of 1974 Toyota Corolla Owners Reports*

Total miles driven	1,282,551	Performance	14.2	Had any mechanical trouble?	
Average miles per gallon:		Size	11.8	No	70.6%
Local driving	24.8	Specific dislikes:		Yes	29.4
Long trips	28.9	Poor service	8.2%	What type of trouble?	
Series:		Lack of power	8.2	Electrical	16.1%
1200	57.7%	Rear defroster	5.4	Carburetor	9.2
1600	42.3	Cold starts	5.4	Defrost system	6.9
Body styles:		Poor materials	5.0	Gas pedal sticks	5.7
Two-door sedan	51.8%	Number of vehicles owned:		Seatbelt interlock	5.7
Two-door coupe	37.8	Corolla only	41.6%	Starter switch	5.7
Station wagon	6.0	Two cars	38.6	Transmission	5.7
Four-door sedan	4.3	Three cars	13.1	Did you repair it yourself?	
Transmissions:		Four cars	5.4	No	91.8%
Four-speed manual	72.2%	Five and more	1.3	Yes	8.2
Automatic	19.4	Other makes of vehicles owned:		Dealer repairs satisfactory?	
Five-speed manual	8.4	Chevrolet	31.0%	Yes	65.3%
Among five-speed Corollas:		Ford	21.8	No	34.7
S-5 coupe	70.6%	Oldsmobile	10.3	What changes would you like?	
SR-5 coupe	29.4	Toyota	10.3	More legroom front and rear	6.9%
Why the Corolla?		Plymouth	9.8	Change seatbelt interlock	6.1
Economy	67.8%	Comfort opinion:		Better materials	6.1
Price	23.1	Good to excellent	67.7%	Reshape seats	5.7
Styling	17.3	Average to poor	31.7	Improve rear defroster	4.9
Size	15.9	Workmanship opinion:		Age distribution of owners:	
Handling	6.4	Good to excellent	76.4%	15-29 years	56.9%
Specific likes:		Average to poor	23.7	30-49 years	32.5
Economy	80.6%	Dealer service opinion:		50-plus	10.7
Handling	56.3	Good to excellent	58.6%	Would you buy another Corolla?	
Styling	28.8	Average to poor	41.3	Yes	90.3%
Comfort	26.0			No	9.7

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

16 ways to 'hide' plywood edges



Edging held with splines

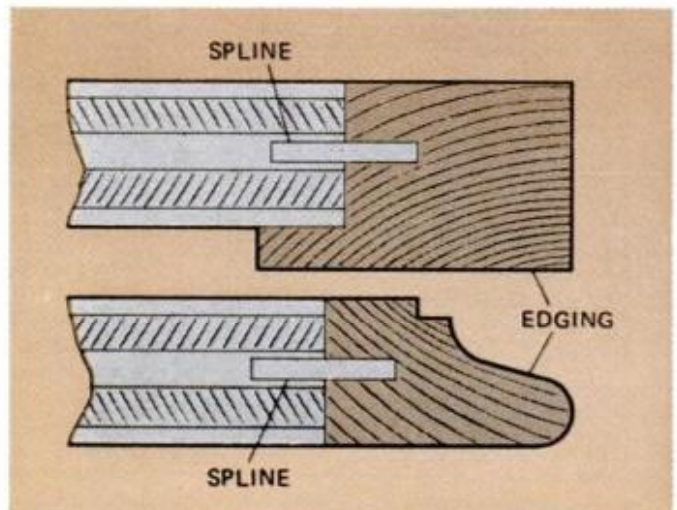
Where wide moldings are involved, such as those shown at the right, splines are often used to produce an exceptionally strong joint. Here saw kerfs are run in both plywood and molding on a table saw and thin wood members are ripped to fit the kerfs. If you have a means of shaping an edge, plain solid stock may be applied to the edges and the members shaped afterwards with a router or shaper. Where you wish the edge to be thicker than the plywood, such as shown in the lower detail, additional strength can be gained by a rabbet. This, plus the spline and glue, produces a joint that can take a lot of punishment.

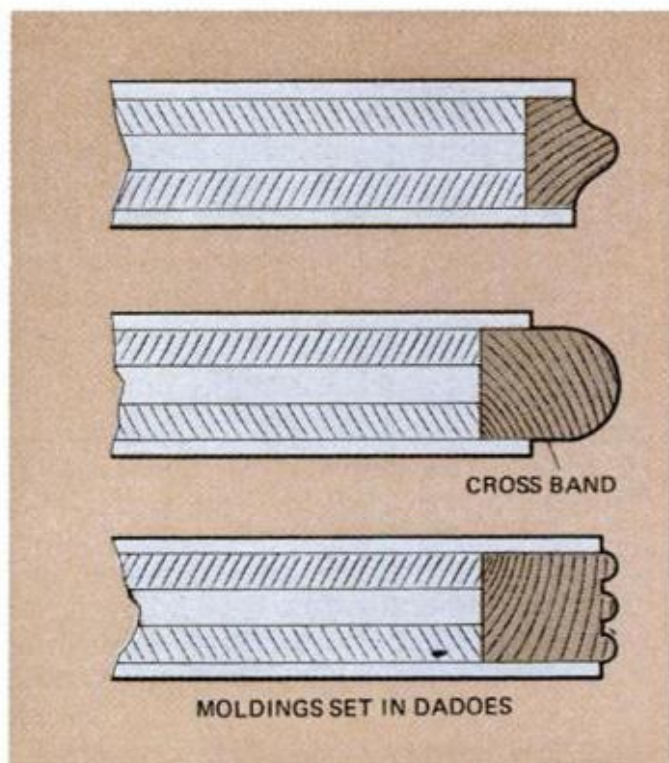
A problem from the beginning

The use of plywood in the home workshop has long presented the problem of what to do to hide the laminated edges of the material when they are exposed to view. Simplest way for the do-it-yourselfer to do it is to cover them with paper-thin wood tape which is sold in rolls in a choice of woods and merely glued on. This is okay for shelves in a bookcase and perhaps the square edges of a tabletop, but it's not too durable a treatment when the project is subject to considerable handling and wear. In being limited to plain square edges, wood tape is not the answer when you prefer that the edges of a piece of furniture be shaped. However, as shown here, there are many ways you can add eye appeal to plain plywood edges and hide the laminates in doing so. Some of the methods are comparatively simple while others are more involved.

Plain butt-glue treatment

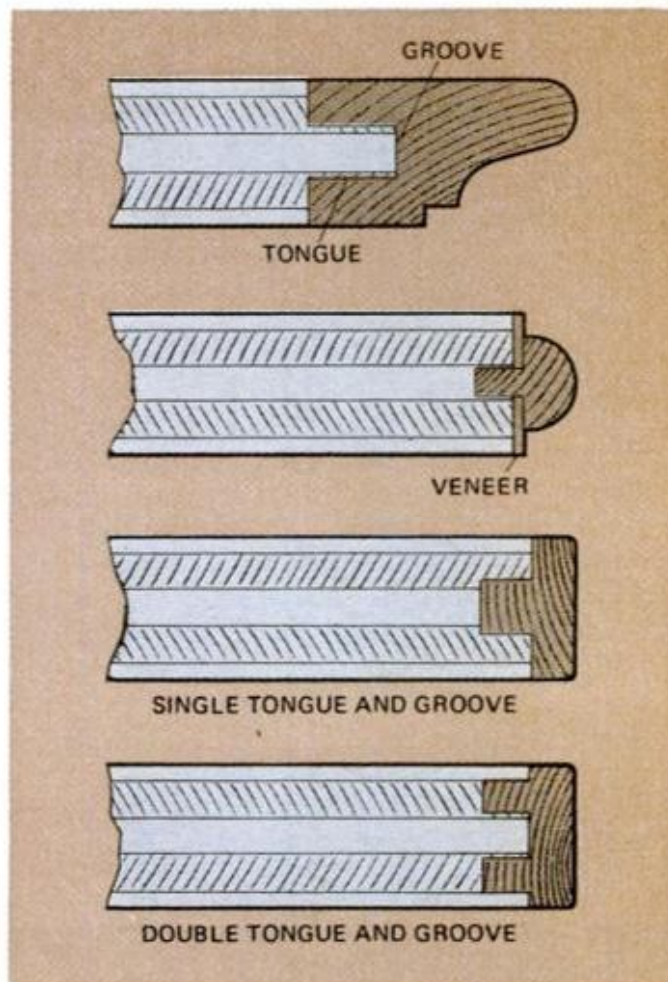
The drawings at the left show five ways you can conceal and treat straight plywood edges with a variety of moldings which are simply butt-glued. Here, of course, glue is not relied on alone; the moldings are also nailed with small finishing nails (brads in some cases) and the heads set and puttied over. A common trick for hiding nailheads is to first lift a chip of wood with a small gouge, drive the brad and then glue the chip back down. When sanded and finished, the chip is hard to detect. When the project is fairly small, rubber bands cut from a large size inner tube will prove handy in holding the moldings snugly to the edges while the glue dries.





Moldings can be inset in dados

The three examples above illustrate how the top and bottom surface veneers of the plywood itself can become part of the decorative edge. In each case, a dado (groove) is made in the core laminations to a depth to suit the molding. In two examples the outer veneers form shoulders; in the other the depth of the groove, plus the molding shape, creates an edge where the veneers are held flush. Pinch clamps hold top and bottom veneers snugly to the inset moldings when you glue.

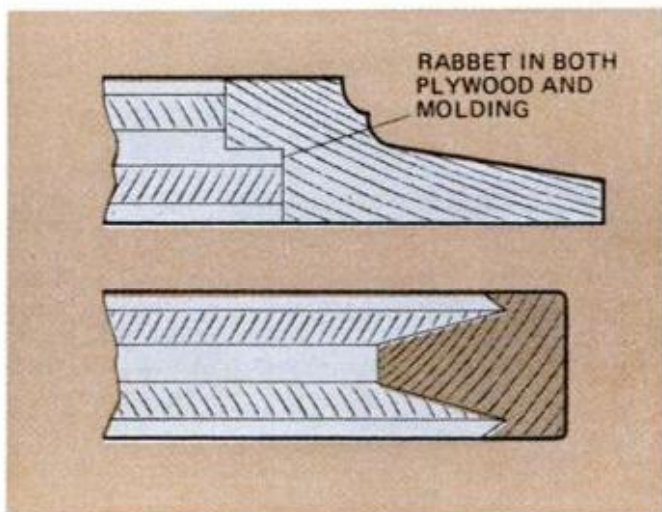


Tongue-and-groove joints are another way

Better than being just butt-glued, decorative edges applied with tongue-and-groove joints will not pull loose readily. The top and bottom examples differ from the others above in that tongues are cut in the plywood rather than the molding. The molding conceals the entire edge either by itself or by the addition of a veneer strip.

Examples of special treatments

The upper detail at the left is an example of how wide, fancy picture-frame molding can be used to treat plywood edges. As you see, a rabbet is made in the plywood edge. Later when the molding is glued in place, the top surface is sanded flush. The lower detail pictures a joint that perhaps is the strongest of all but requires special shaper cutters to form both groove and molding. In this particular treatment you have the option of leaving the molding as is or shaping it. ★★★



Pedal cars: The gasless way to go

by Sheldon M. Gallager

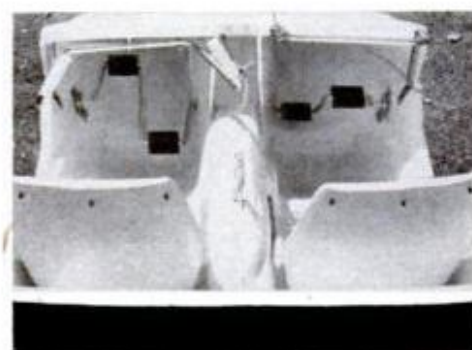
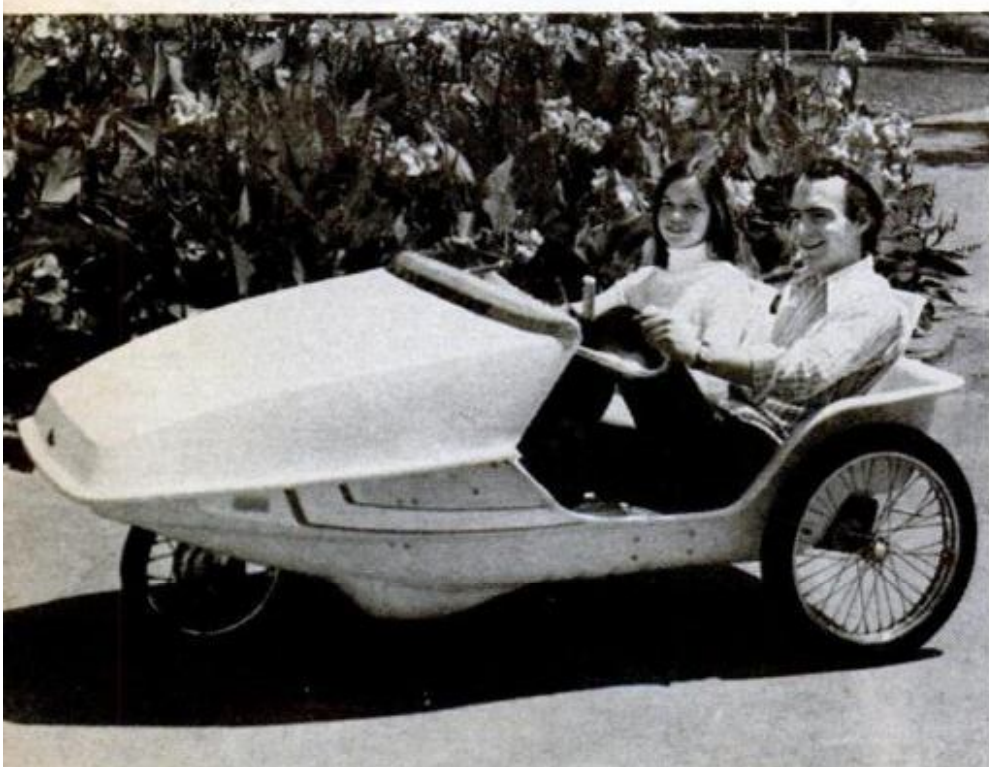
Can you really beat the fuel shortage? If you're willing to exchange leg power for long waits at the gas pump, you may be able to—at least to some extent. Your vehicle will have no engine, consume no fuel and never need a tune-up or oil change. It's the pedal car, a grownup version of the little toy midgets we used to pedal up and down the sidewalk as kids.

Ever since fuel cutbacks became critical, manufacturers have been rushing this new breed of personal transportation onto the market as a serious, fuel-saving substitute for the gas-gulping automobile. How serious it will prove to be is still unknown, but the idea is an intriguing, tempting one. Modern pedal cars are smartly styled, fun to drive and offer such adult conveniences as sit-down comfort in bucket seats, side-by-side accommodations for two, dual pedal drives so both passenger and driver can pump, multispeed transmissions, storage space for

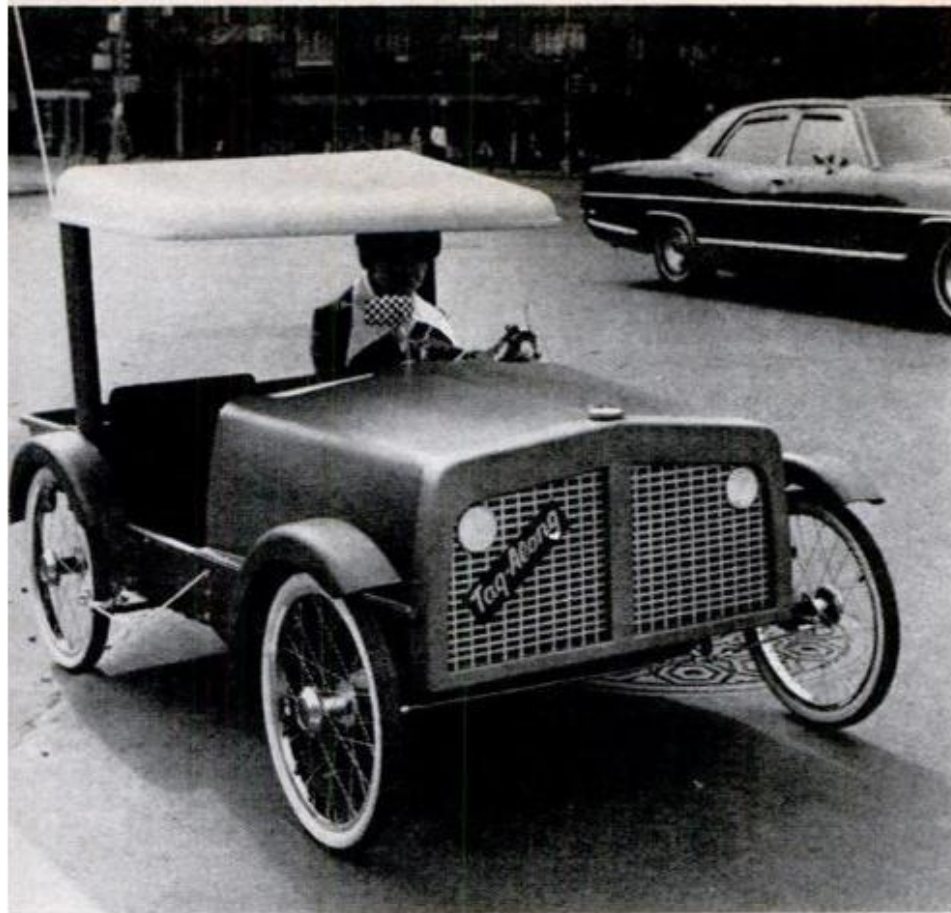
lugging home the groceries, and either built-in or add-on enclosures to keep out wind, rain and sun. In theory, they should be ideal for around-town shopping chores and short-run commuting trips; in practice, they may be a horse—or pedal car—of a different color.

Against them is their low speed and somewhat cumbersome handling compared to the lithe and agile action of a 10-speed sport bike. Their hill-climbing ability depends on how hard you're willing to pump, but, at best, is not going to equal the performance of a good cross-country two-wheeler. While manufacturers boast of speeds up to 25 mph, this is possible only for brief periods of all-out pedaling on level terrain. More realistic speeds average 8 to 15 mph, putting pedal cars at a severe disadvantage with their faster-moving motorized cousins.

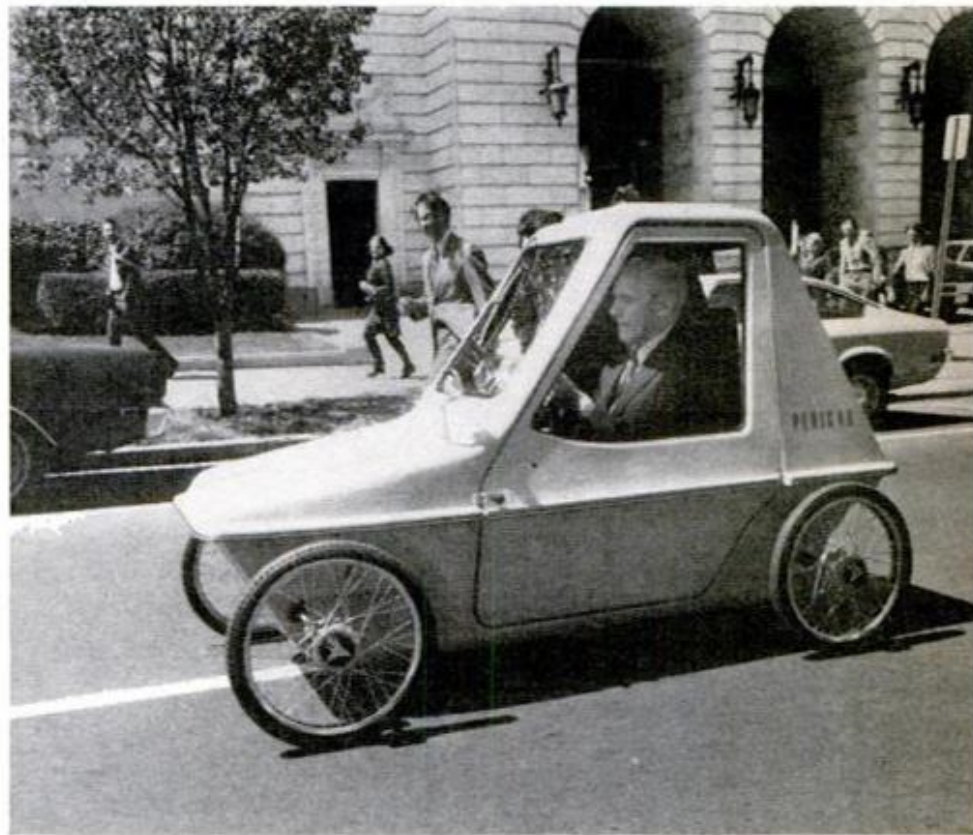
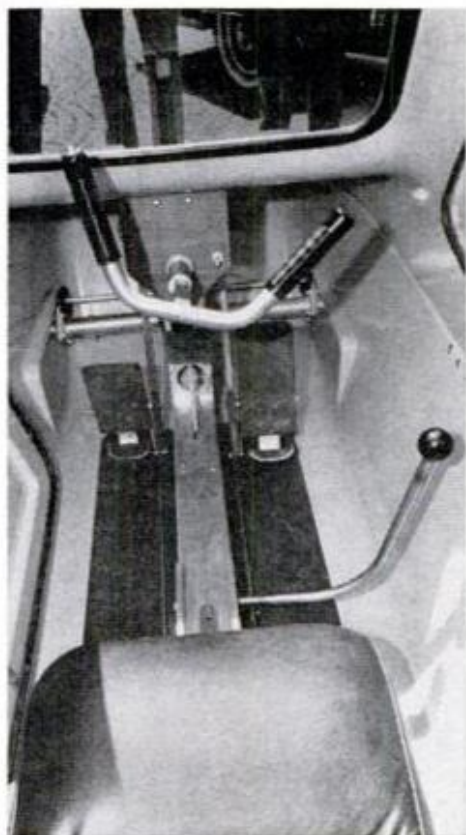
While bicycles can be ridden at the side of a road, pedal cars must vie for space in regular traffic lanes, creating both a hazard for themselves and a nuisance for motorists. Their relatively frail and light construction



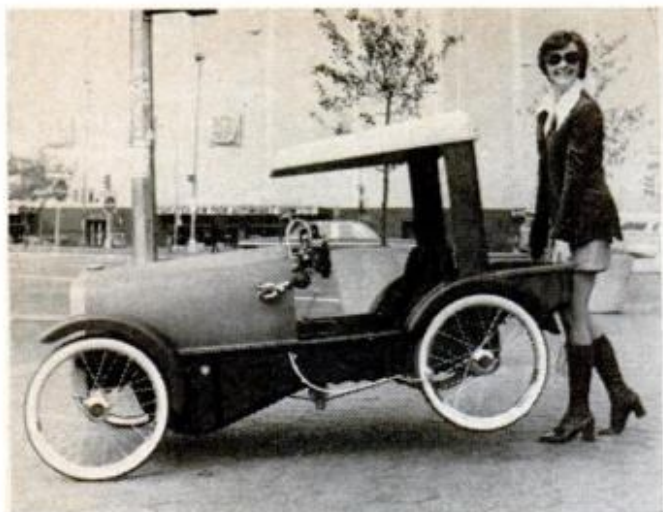
Sporty lines are key feature of this bullet-nosed, bucket-seated, two-passenger, three-wheel runabout, called PPV for People-Powered Vehicle. Dual pedal arrangement (above) allows both riders to pump for extra power while driver steers. Single-wheel brake lever is on handlebars, with three-speed stick shift on floor console. A sun roof and rain canopy are optional extras. Available in several colors, molded-plastic PPV is about \$380 from EVI, 6345 Product Drive, Sterling Heights, Mich. 48077.



Though boxy and a bit old-fashioned-looking, Tag-Along model has four-wheel stability and is one of few pedal cars to offer full four-wheel braking. Twin brake levers are mounted on T-bar steering control (below). Like the PPV, the semi-enclosed two-seater has dual pedal drive and three-speed transmission. Safety equipment includes horn and rear-view mirror, but "headlights" are dummy. Windshield is optional. Tag-Along sells for about \$300 from Pedal Power, Inc., 1545 Ocean Ave., Bohemia, N.Y. 11716.



Most sophisticated model is this fully enclosed Pedicar with straight-line pedal action, disc brakes and five forward speeds, plus neutral and reverse. Pedals (left, above) move forward and back, are said to be 50 percent more efficient than rotary drives. Shift lever is at right side. Other features: aircraft-type steering yoke, windshield wiper, headlight, rear-view mirror, parking brake, rear hatchback luggage door. About \$550, Environmental Trans-Sport Corp., Box 566, Windsor, Conn. 06095.



Reverseless Tag-Along can't back up, but is so light you just step out and swing it around when you want to go the other way. The 100-pound vehicle has good-sized 20-inch wheels, is 4 feet wide by 6 feet long.

—most weigh only about 100 pounds—is no match for a 3000-pound motor car; in any crunch between the two, the pedal car is sure to be much the worse for wear.

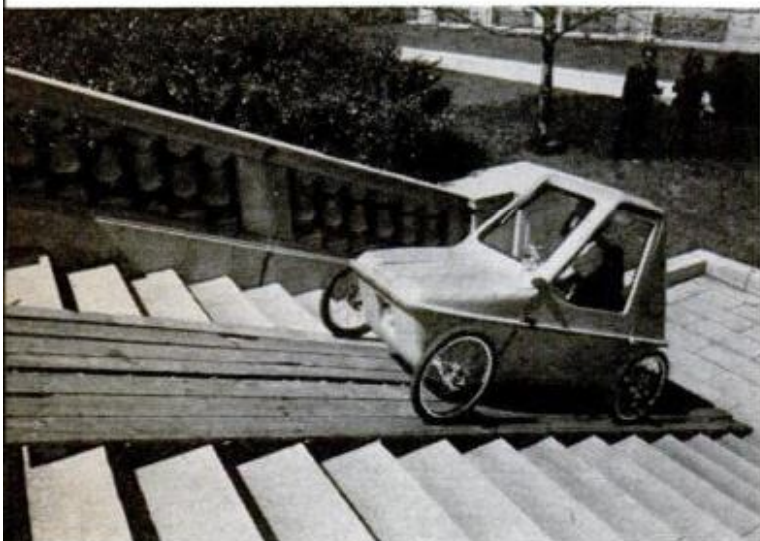
So far, most states permit the use of pedal cars on local roads, though not on highways. However, as the little pedal pushers grow in number, so will problems of traffic safety and congestion, causing some communities to have second thoughts.

Three-wheel pedal cars, a design liked for its trim, sporty appearance and simple steering geometry, have come in for some criticism because of questionable stability. Those who have tried them report that a sudden turn of the single front wheel can cause a nose-over, not possible with more sure-footed four-wheelers. Though manufacturers deny it, one well-known consumer testing organization judged the three-wheel design to be “not acceptable” for street use for this and other reasons. In addition to its tendency to tip on sharp turns, its single front-wheel brake was found to be inadequate on downgrades.

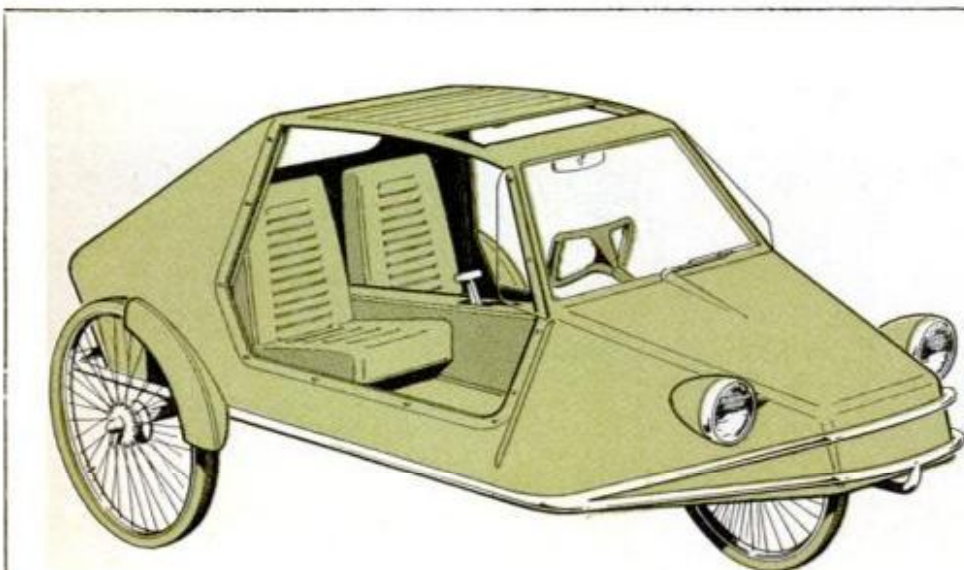
Another quirk to watch out for in pedal cars is the drive arrangement. Most models use a rotary pedal action similar to that in bicycles. If the vehicle moves backward, the pedals rotate backward with it. This can result in an unnerving experience if you're caught part way up a steep grade that the car won't quite make. If you start to roll back, it's possible to get your feet pinched under the backward-turning pedals—a situation that professional testers say they discovered “painfully.”

One notable exception is the Pedicar,

(Please turn to page 167)

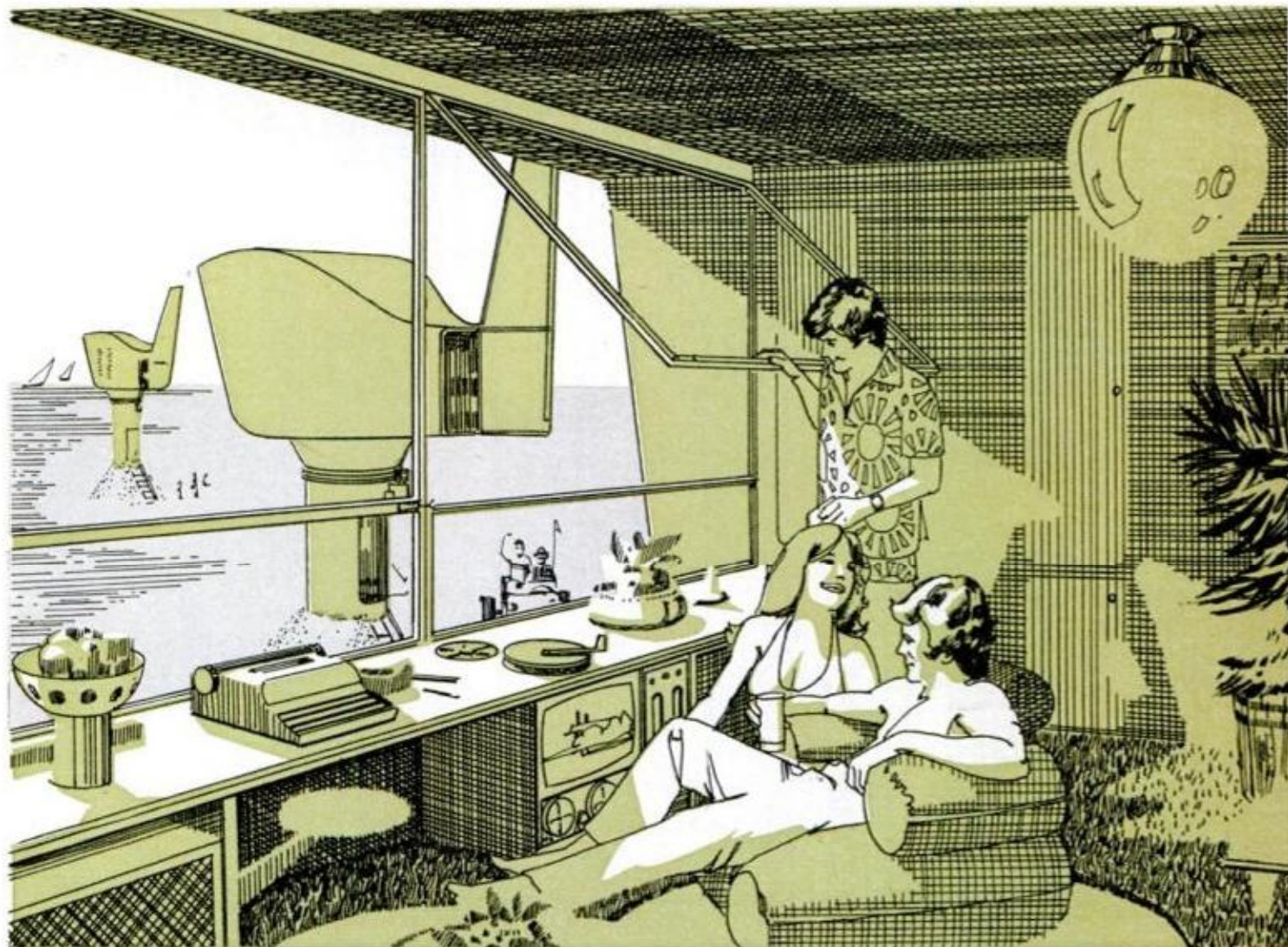


Proving it can climb grades, Pedicar negotiates 20° slopes, aided by powerful five-speed drive. All-weather cab makes it one of most practical designs. Main drawback: Its small size limits it to one occupant.



Canadian design, under study at Sir George Williams University in Montreal, is twin-seat three-wheeler with such luxury touches as sliding sun roof, front and rear baggage space and auto-type headlights. It will have multi-speed transmission and dual pedal drive.

Innovative second home:



Art: Roy Grinnell

The 'airplane' beach house

Designed to have minimum effect on the environment, this futuristic home rotates by wind or motor, or can be locked to face any view.

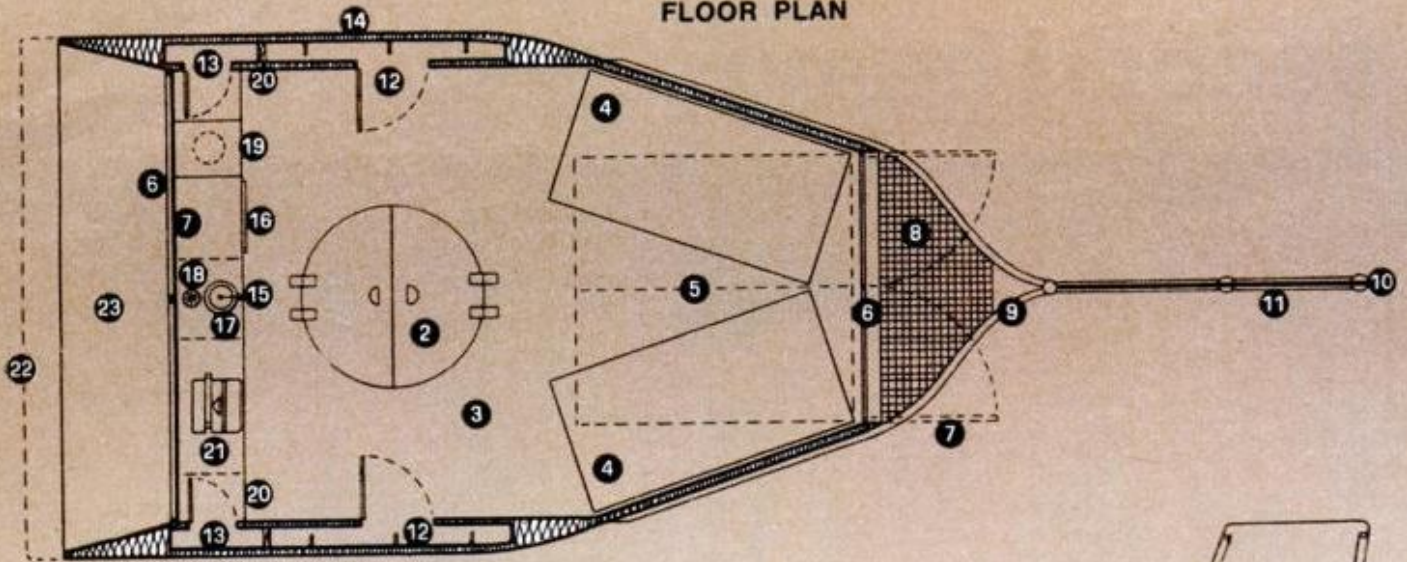
By Harry Wicks
WORKSHOP EDITOR

This cabana was designed to give its owners three new dimensions in living: 1. A beach-front weekend retreat that would let you enjoy cooling by nature's breezes—instead of by humming airconditioners; 2. For excitement, a cabin that would rotate like a weathervane nudged by the wind so occupants could enjoy a changing view; 3. A dwelling that would have the least possible impact on the environment in which it was nestled.

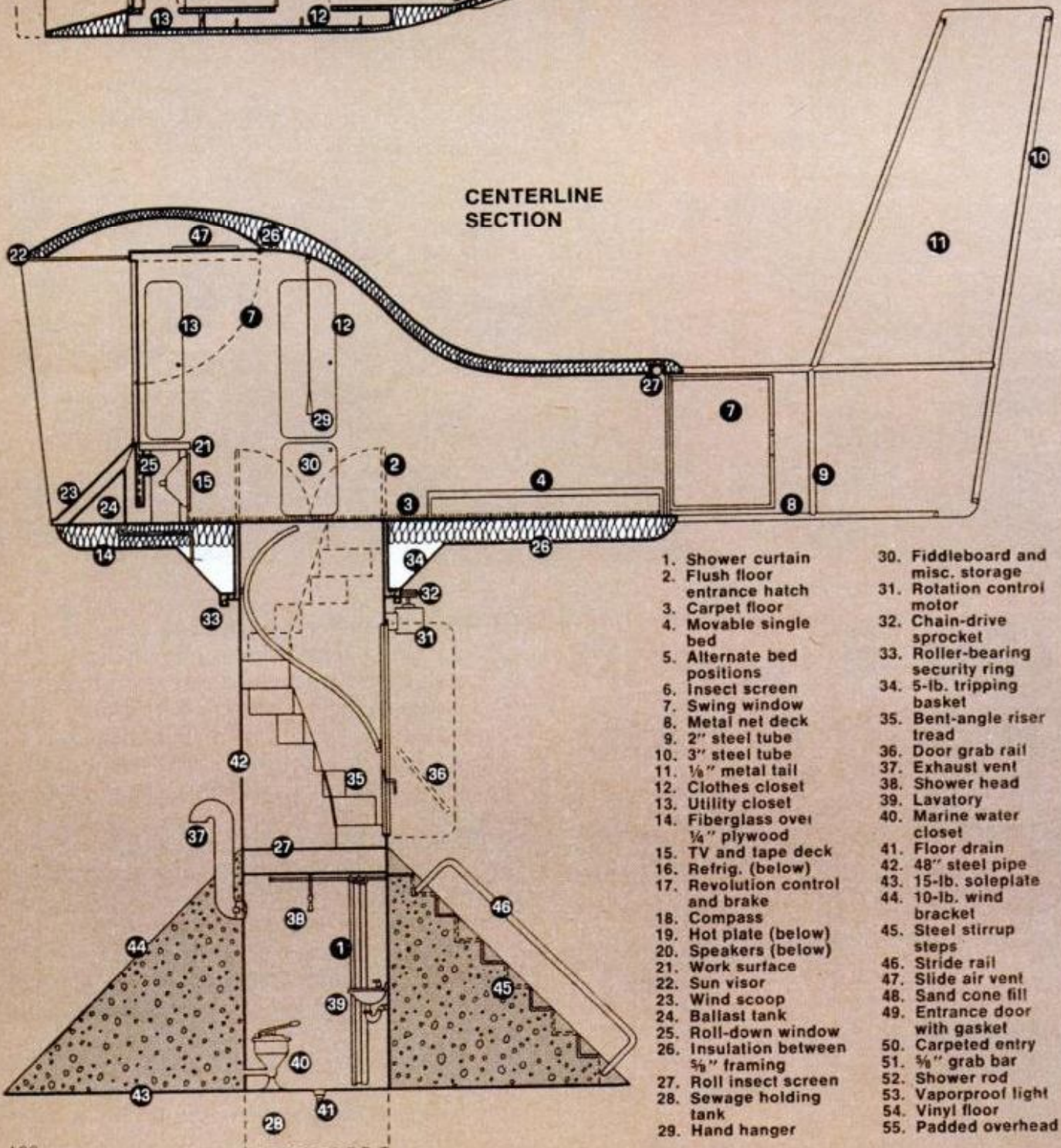
Such a house was the dream of New Orleans architect Charles Colbert. He wanted to create a "waterfront home for the adventurous" which would be self-sustaining and an "experience to spend some time in." Now that he has brought his dream to the working-drawing stages, plans are under way to erect 18 such structures on the west

Second home for the young at heart . . .

FLOOR PLAN



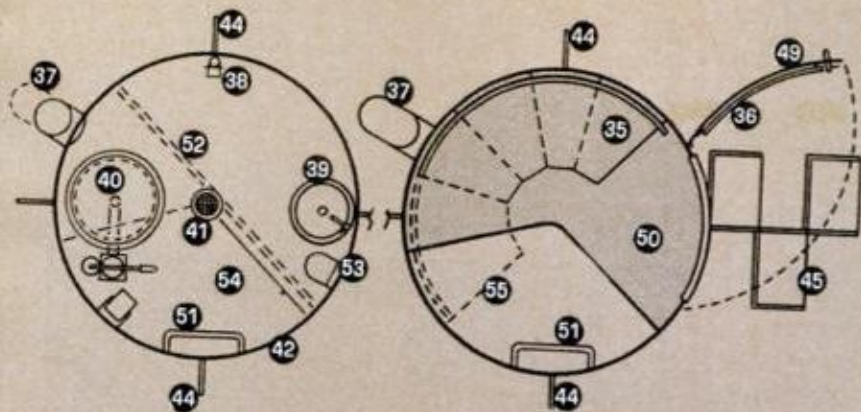
CENTERLINE SECTION



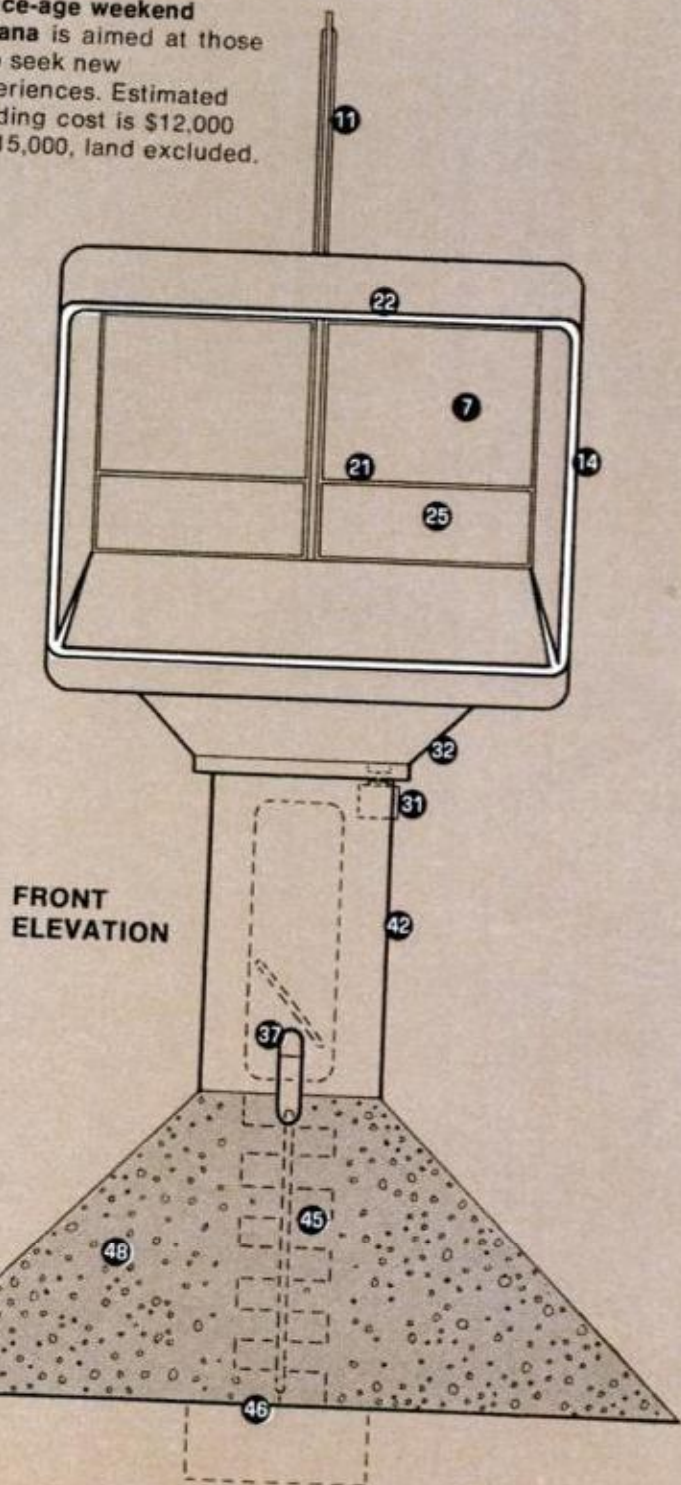
- | | |
|-------------------------------------|-----------------------------------|
| 1. Shower curtain | 30. Fiddleboard and misc. storage |
| 2. Flush floor entrance hatch | 31. Rotation control motor |
| 3. Carpet floor | 32. Chain-drive sprocket |
| 4. Movable single bed | 33. Roller-bearing security ring |
| 5. Alternate bed positions | 34. 5-lb. tripping basket |
| 6. Insect screen | 35. Bent-angle riser tread |
| 7. Swing window | 36. Door grab rail |
| 8. Metal net deck | 37. Exhaust vent |
| 9. 2" steel tube | 38. Shower head |
| 10. 3" steel tube | 39. Lavatory |
| 11. 1/8" metal tail | 40. Marine water closet |
| 12. Clothes closet | 41. Floor drain |
| 13. Utility closet | 42. 48" steel pipe |
| 14. Fiberglass over 1/4" plywood | 43. 15-lb. soleplate |
| 15. TV and tape deck | 44. 10-lb. wind bracket |
| 16. Refrig. (below) | 45. Steel stirrup steps |
| 17. Revolution control and brake | 46. Stride rail |
| 18. Compass | 47. Slide air vent |
| 19. Hot plate (below) | 48. Sand cone fill |
| 20. Speakers (below) | 49. Entrance door with gasket |
| 21. Work surface | 50. Carpeted entry |
| 22. Sun visor | 51. 3/8" grab bar |
| 23. Wind scoop | 52. Shower rod |
| 24. Ballast tank | 53. Vaporproof light |
| 25. Roll-down window | 54. Vinyl floor |
| 26. Insulation between 3/8" framing | 55. Padded overhead |
| 27. Roll insect screen | |
| 28. Sewage holding tank | |
| 29. Hand hanger | |

BATHROOM-LEVEL PLAN

ENTRANCE-LEVEL PLAN



Space-age weekend cabana is aimed at those who seek new experiences. Estimated building cost is \$12,000 to \$15,000, land excluded.



Charles Colbert, the beach-house designer, has won numerous awards from national magazines, as well as the American Institute of Architects. Formerly dean of architecture at Columbia University, he now practices in New Orleans. He is also visiting professor at Tulane, Louisiana State and Rice Universities.

coast of Florida. The prototype should be under construction at the time you are reading this.

The house, to a large degree, will be self-sustaining. Waste, for example, will be stored in a holding tank, as in a motor home, instead of being discharged to a septic tank or cesspool.

Still to be completed are details for electricity. "Hopefully," says Colbert, "the day will come when the structure can be electrically self-sufficient." Until then, electricity will be brought into the house via conventional methods.

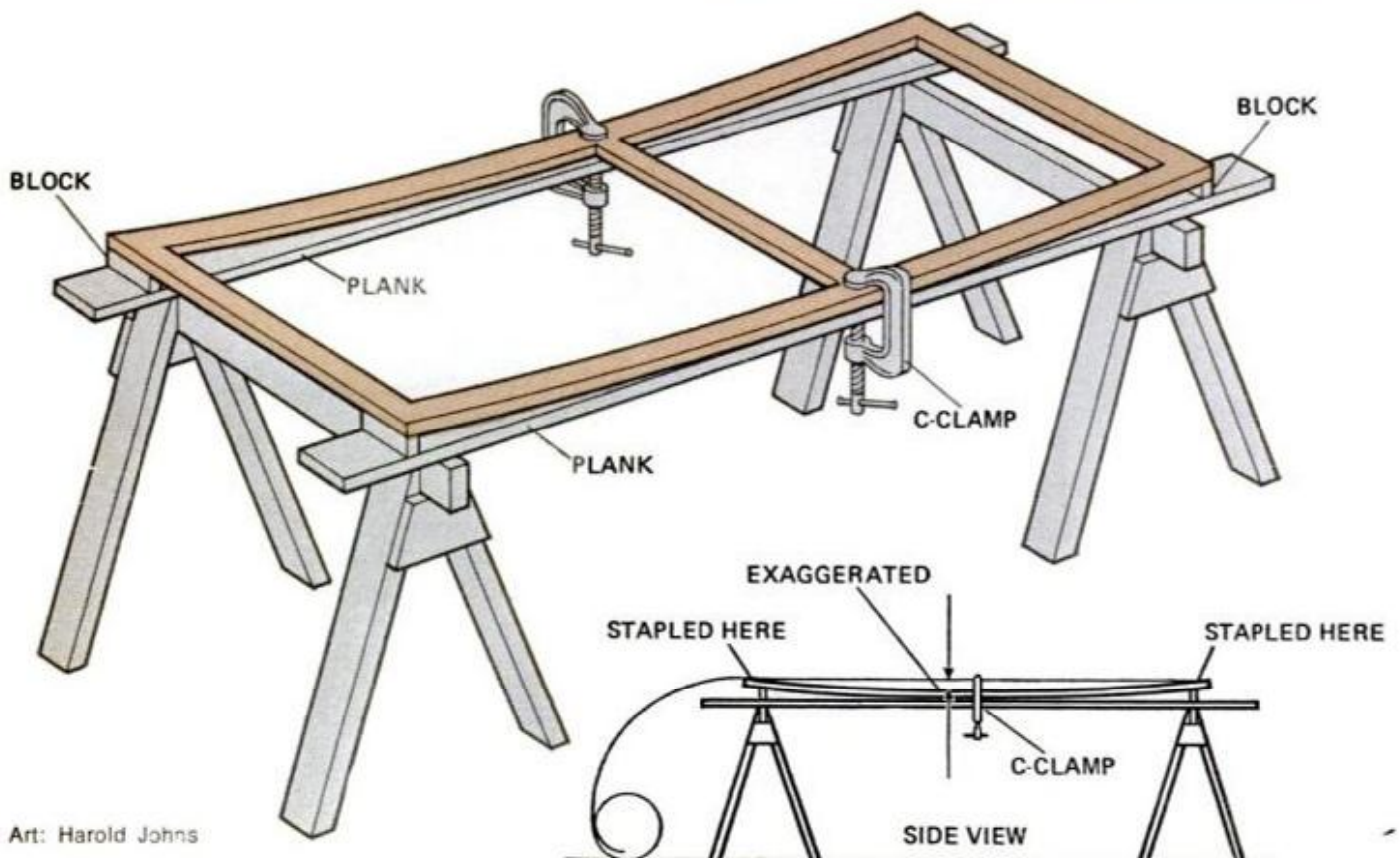
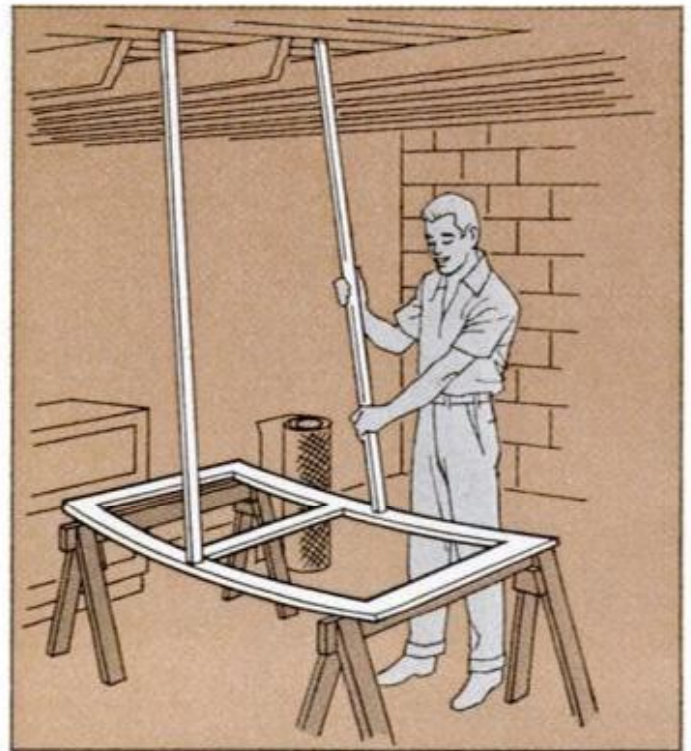
Basically, the house consists of a cone-shaped pedestal which is stabilized in order to adequately support the 48-in.-dia. column upon which the house is perched. To enter, you mount the stirrup steps while straddling a grab-rail. Once inside the column, you climb circular stairs to reach the entry hatch. Inside, there is room enough for two; the cabana contains a small refrigerator, hot plate, hi-fi and other features for a weekend of comfort. The excitement starts when the house is allowed to rotate. Whether moved by the wind or by motor, the house can be locked in any stop-position on the 360° circle.

How to stretch screen wire taut

Play it smart; let frame do stretching

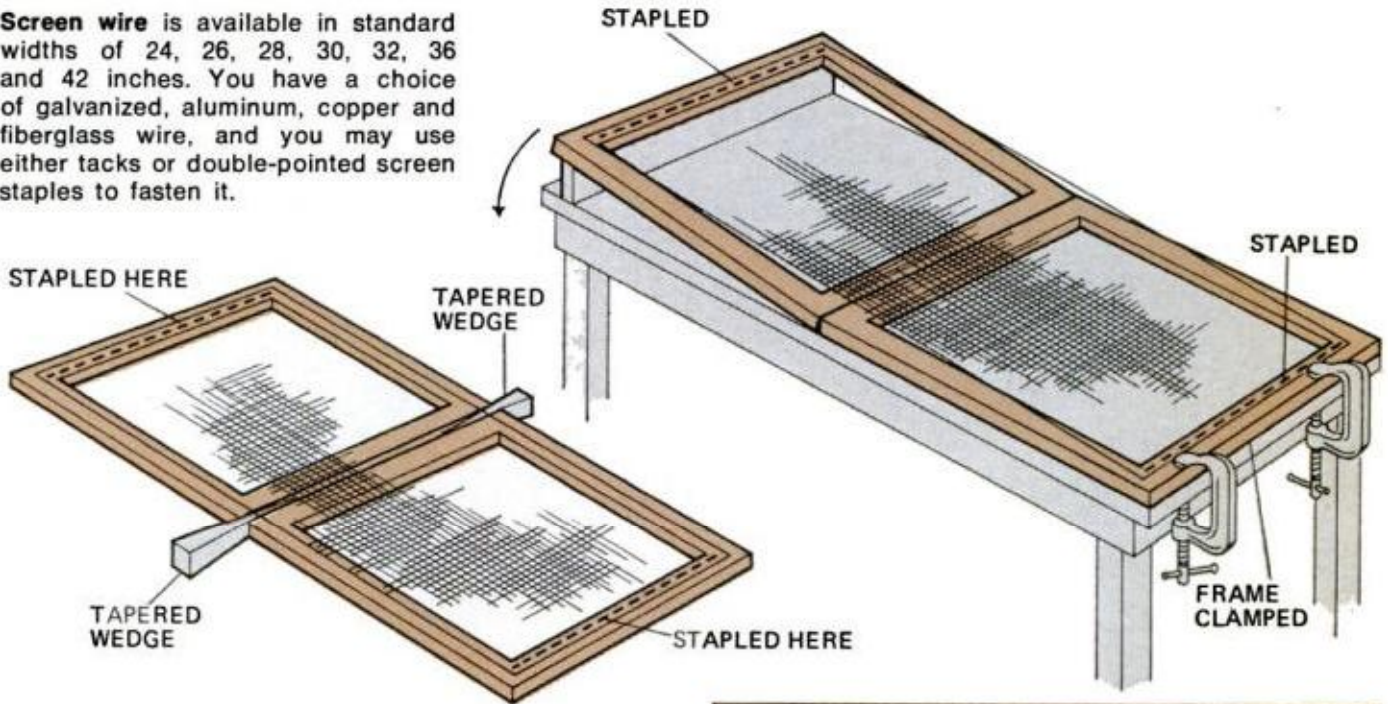
Ripping the old wire from wooden frames and stapling on the new is simple enough—it's the stretching that's the tricky part. Trying to get it smooth and taut by hand not only is hard on the fingers but invariably results in a belly in the wire, no matter how you tug and pull.

Actually, it's not that hard a job. If you play it smart, the frame itself can be used to do the stretching. Bowing the frame slightly is the most common method. This can be done with a couple of jack sticks, as at right, or with blocks and C-clamps, as shown below. After the wire is stapled to each end and the bow relieved, the frame will straighten out and stretch the wire as taut as a drumhead. The stapling is completed along each side while the frame is flat. This method works best on full-length frames, with the frame supported on a couple of sawhorses or wooden boxes. It doesn't take much of a bow; in fact, you should avoid bowing the frame too much as this could result in the wire pulling out the staples or tearing loose.



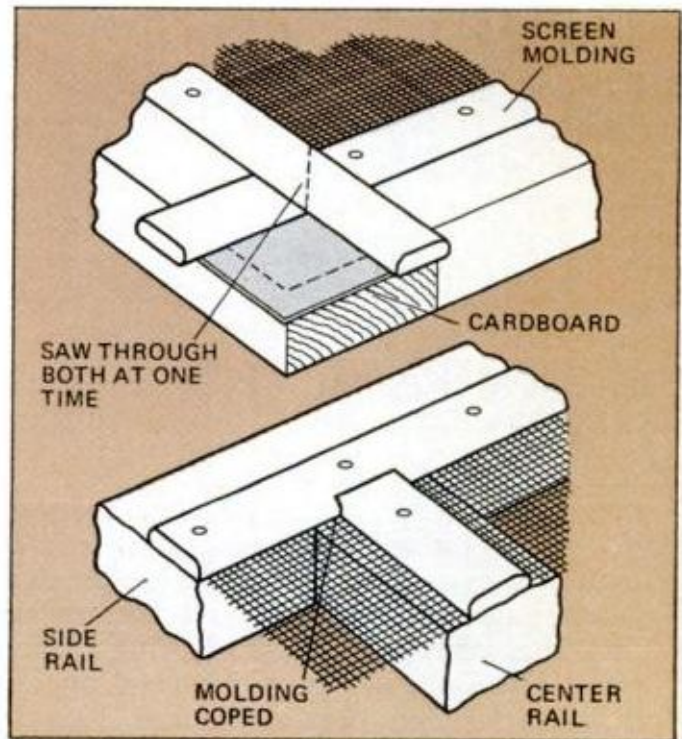
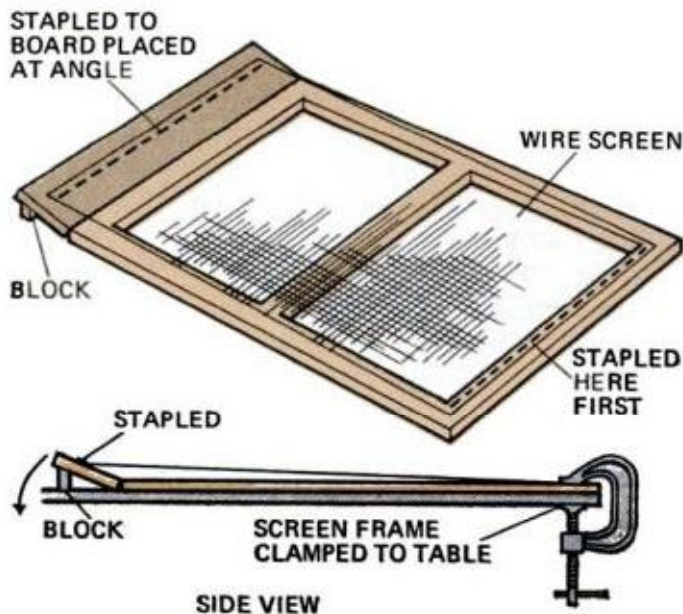
Art: Harold Johns

Screen wire is available in standard widths of 24, 26, 28, 30, 32, 36 and 42 inches. You have a choice of galvanized, aluminum, copper and fiberglass wire, and you may use either tacks or double-pointed screen staples to fasten it.



Small frames stretch each other

Small screens can be used to stretch the wire by covering two at a time (above). Frames are flat on a floor or table with one elevated a bit. In each case, they are butted and the wire stapled to the outer ends only. In method A, the wire is stretched by removing the block; in method B, it's done by forcing the frames apart with tapered wedges. Shown below is still another way for stretching wire on a full-length frame.



Slick molding trick

If you don't own a miterbox, you can do without one when mitering screen molding. Simply let one strip lap the other (above), then saw through both strips at a 45° angle at one time. Cardboard will protect frame from saw marks. Center-rail molding is coped to mate with side moldings. ★★ ★

10 ways to go without the gas



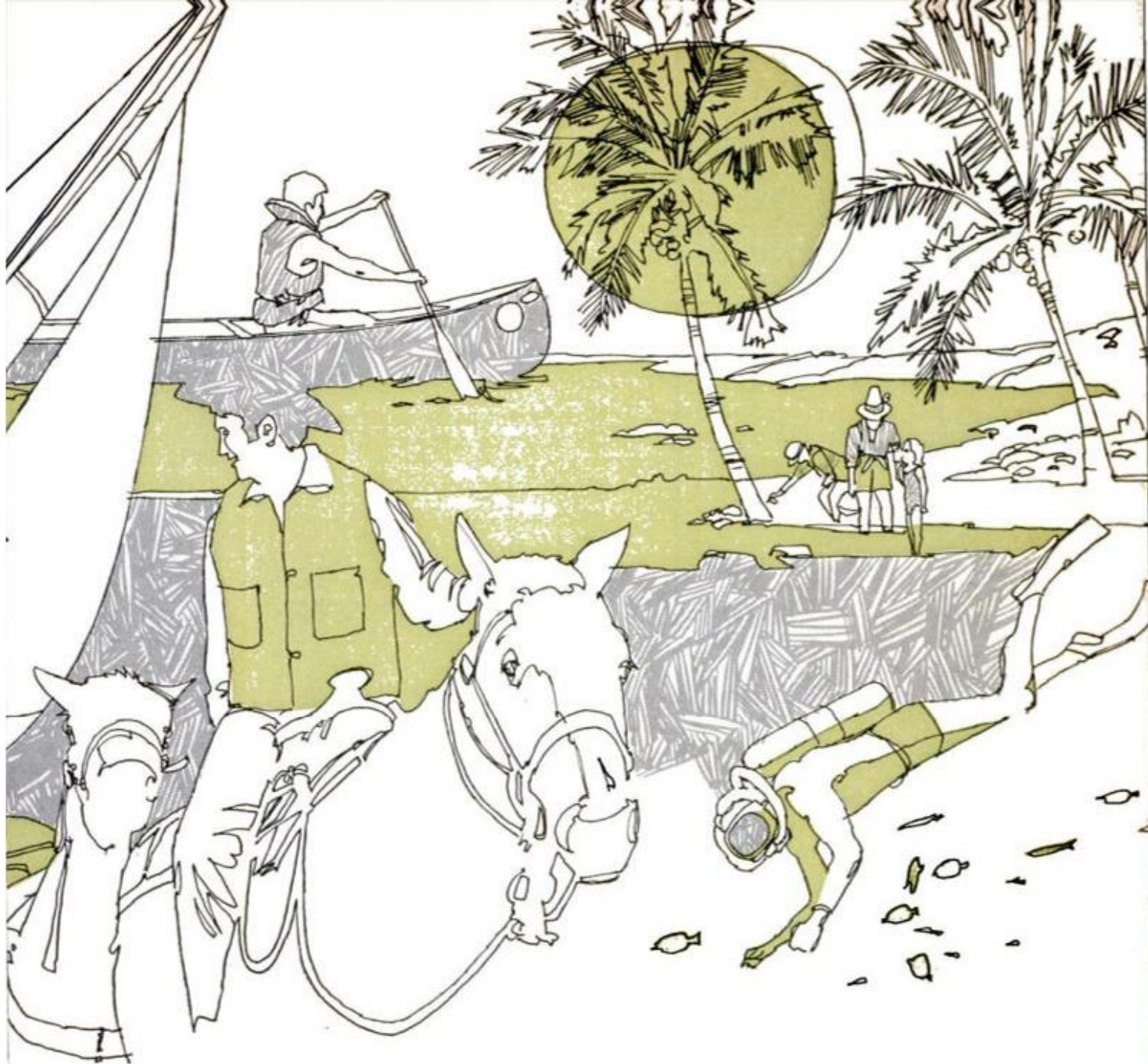
by Bill McKeown
OUTDOORS EDITOR

Considering the centuries when everyone got along without gasoline, there's no doubt we can figure ways to do the same this summer. In addition to activities and vacations that take less driving nearer home, there are plenty which need none at all and have often been overlooked. Then include trips that burn someone else's fuel—rail, ship, bus or airplane—and the choices of action available get mighty attractive.

Hiking is certainly the easiest, simplest, cheapest. Put a sandwich in your pocket and you're in business, or spend upwards from \$100 for the newest in lightweight backpack, tent, sleeping bag and gear.

Hikers in Europe frequently carry a knapsack without supporting frame, and overnight it at village inns or mountain huts. Their soft pack contains only rain gear, camera and spare clothes since tent, blankets and food are not required. Few American families are likely to hike between motels, but nearly all state and national parks have day trails, and the National Trail Systems Act of 1968 is encouraging more. The 2026-mile Appalachian Trail from Maine to Georgia and the 2404-mile Pacific Crest Trail are best known. Mountain climbing is the most spectacular form of leg-energy travel, but technical climbing requires practice, conditioning and training.

National and state parks can provide information and sometimes maps in advance. Hiking and outing clubs organize regular



trail hikes. Best source for backpacking plus boat, bike or off-road vehicle trail data is probably *Adventure Trip Guide* from Adventure Guides, Inc. (Or for a restful place to stay, they also have a *Farm, Ranch & Countryside Guide*.)

Bicycling began its recent boom before the energy shortage became apparent. Now multispeed models can be bought or rented and the 10 miles a day recommended for beginners can soon be stretched. Several states have marked cycling trails away from highway traffic; some airlines supply free cargo-cartons to take your bike safely to your destination. American Youth Hostels publishes a *North American Bicycle Atlas* giving U.S., Canadian and Mexican cycling routes. AYH also has organized group bike tours for Europe, Africa and Asia.

Horsepower can be harnessed for a trip with your animal ahead, underneath or behind you. Pack trips scheduled by many dude ranches range from easy rides for beginners to rugged weeks in the wilderness. Alaska, all western states and some eastern ones provide horseback treks. A letter to a state tourist bureau can usually get you names of ranches to contact. The National Wildlife Federation, Wilderness Society, AYH, Sierra Club, American Guides Assn., Matterhorn Sports Club and the Chalet Club are among groups that sponsor or can refer you to trips by horseback.

Not so sure of your riding ability? There are also covered wagon trips where you ride aboard with the horses doing the hauling up front. Or if you want to be really tall in the saddle, you can sign on for a cattle

drive and join in as a cowpuncher. The *Adventure Trip Guide* gives locations.

Packstocking puts your horse (burro or mule) behind you where he carries the camping gear and you both walk. This can lighten the burdens of a long hike, but unless you have a way with sometimes stubborn animals it's best to have a wrangler-guide along. On the other hand, you won't get saddle sore or worn down from a heavy backpack. Old-time prospectors found it a friendly way to travel far into the wilderness with adequate supplies.

Paddle power means canoe or kayak: Both can float you far into remote territory; light models and inflatables can be portaged between waterways. Though not primarily sailboats, some may be rigged for wind power when the breeze is right. Canoes, particularly, can now be rented with or without camping supplies in many areas. Grumman Boats has a *Group Camping* guide and *Rent-A-Canoe Directory* available through dealers. The *Makens' Guide to U.S. Canoe Trails* tells where to go. Florida and other states also have guides.

Sailing can mean travel with little work and skill, or a lot. Windjammer passages off New England or in the Caribbean may require helping sail the ship or simply sunning on deck. "Bareboat charter" is the term for renting a sailing yacht without captain or crew. It's cheaper but requires sail and seamanship experience. Small craft can become cruisers with a sleeping bag and a cockpit cover. Smart sailors, however, also stow a small outboard aboard for those times the wind fails and the current is running the wrong way.

Rafting and float trips usually depend entirely on the current but are well enough organized so that an average landlubber can now take a trip once reserved for the



Sources of Information

Adventure Trip Guide, \$4.50 postpaid first class or \$3.50 slower book rate, from Adventure Guides, Inc., 36 East 57th St., New York, N.Y. 10022.

American Youth Hostels, Inc., National Campus, Delaplane, Va. 22025.

Makens' Guide to U.S. Canoe Trails, \$4.95, LeVoyageur Publishing Co., 1319 Wentwood Dr., Irving, Tex. 75061.

National Parks & Landmarks, 75 cents, U.S. Government Printing Office, Washington D.C. 20402 (also write to the GPO, state and foreign-country tourist departments and airlines for information about specific areas and activities.)

most adventurous. The clubs and organizations already mentioned plan these passages every year here and abroad. Check with them if you want to try a run down the Colorado or the Snake, but don't forget there are also more placid rivers where you and friends could handle a rented houseboat.

Tenting is not a form of travel, but it has become a way to go on vacation with minimum use of energy and money. Stowed in a car, RV or backpack, the new strong lightweight shelters let a hiker or a family vacation on shore or mountaintop without need for extra energy. After renting or testing one near home, you're ready to stretch any travel plan or budget with a tent along.

Diving with scuba or snorkel, or simply beachcombing along the shore may be among the slowest forms of travel but also rate among the most pleasant. Waterway guides, libraries and travel information bureaus all have directories of places where rental equipment and instruction are available.

Planes, trains, buses and ships require no waiting lines for gas and can often reserve bargain transportation for you on arrival. Braniff International Airways organizes special sportsman's tours of South America. Swissair can schedule fly/drive/hiking trips in the Alps. Local travel agents and airline ticket agents will make reservations for almost any type trip or sport with good advice thrown in—all for free—while you save your energy for the action to come. ★ ★ ★



Photos: Howard Levy

The homebuilt you have to see to believe

Made from a surplus aircraft wingtip tank, this 65-hp midget costs only about \$1500 and handles like a dream.

by Sheldon M. Gallager
and Howard Levy

Homebuilt planes have been made out of many things, but few have had the distinction of coming from part of another airplane. This sporty little single-seater actually started life as a wingtip fuel tank for an old World War II fighter. Chief Master Sgt. Dick Killingsworth, an Air Force armament expert, spotted the tank as an ideal fuselage for the tiny sport plane he was designing, promptly purchased one and



"Before" and "after": You'd never believe an old wingtip fuel tank like the one shown in foreground above could become the sleek little single-seater sport plane standing behind it—but here's the proof it did.

began sticking on wings, tail and an engine.

The tank is the same 200-gallon type used in the construction of PM's *Two-Man Sub* (page 94, June '71 *PM*) and is still readily available through war-surplus outlets. Its use not only provides a sleek, streamlined body shape, but its ready-built construction vastly reduces overall cost and assembly time. Dick estimates his DSK-1 Hawk "Tip Tank Plane" can be built in six to eight



Short-field takeoffs and landings are major feature of featherweight Hawk, which can clear ground in 500 feet. Gross weight is 893 pounds; rate of climb, 1200 feet per minute.

months at a total outlay of \$1500, including its 65-hp Lycoming engine. The Hawk has attracted so much favorable interest at air shows that Dick has already received orders for more than 250 sets of plans.

The ship combines simple design with sophisticated engineering in a way that makes it both easy to build and exceptionally safe and easy to fly. The wings have a constant chord for uniform construction, but incorporate a built-in dihedral angle for good stability and drooped wingtips for increased lift. In addition to full-span flaps, the ailerons can also be lowered collectively to serve as extra flap area without interfering with their differential function as ailerons. The two together provide tremendous lift, giving the Hawk almost STOL-like characteristics. It can land at 45 mph in as little as 400 feet and take off at 60 mph in 500 feet. Top speed on its 65 horses is 146

mph; cruising speed, 131. Rate of climb is 1200 feet per minute, with a service ceiling of 10,000 feet.

Several thoughtful little design touches make the Hawk a tempting choice for the low-time pilot as well as beginning builder. The landing gear is of the modern tricycle type with both main-wheel braking and back-up braking on the nose wheel. The nose wheel is steerable, being linked to the rudder pedals, but automatically casters freely at speeds above 30 mph should you hit the pavement in a crosswind with the rudder not quite lined up with the runway—a handy safety precaution to keep you from nosing off into the ditch. Should the engine fail, the Hawk has a comforting power-off glide ratio of nearly 12 to 1—12 feet of forward flight for each foot of altitude loss. That approaches sailplane performance; you can reach an emergency landing



strip up to 10 miles away from 5000 feet.

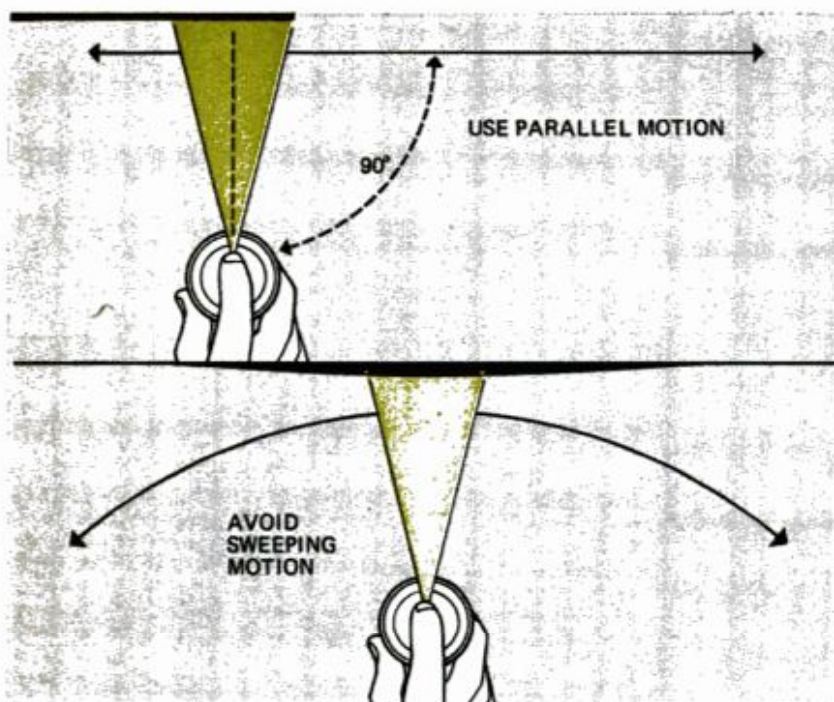
Construction is all metal with a minimum of welding and machining required. Most parts are assembled with simple Pop rivets and clamped two-by-fours serving as a home-made bending brake. Readily buildable and storable in a one-car garage, the Hawk has an overall length of just 15 feet. Wingspan is 20 feet, 4½ inches, but the wings are conveniently removable for stowing and trailering. Complete plans are \$50 from DSK Airmotive, 126 Georgia Pl., Fort Walton Beach, Fla. 32548. ★★★

Only 15 feet long, tiny single-seater Hawk stows easily in a one-car garage, has removable wings for trailering to nearby fields. Slide-back canopy can be opened in flight for wind-in-the-face flying if desired.

Cockpit view (lower left) shows bank-and-turn indicator, unusual for homebuilts, centered in lower row of instruments with compass immediately above. Lever at left side drops flaps in three steps from 10° to 30°.

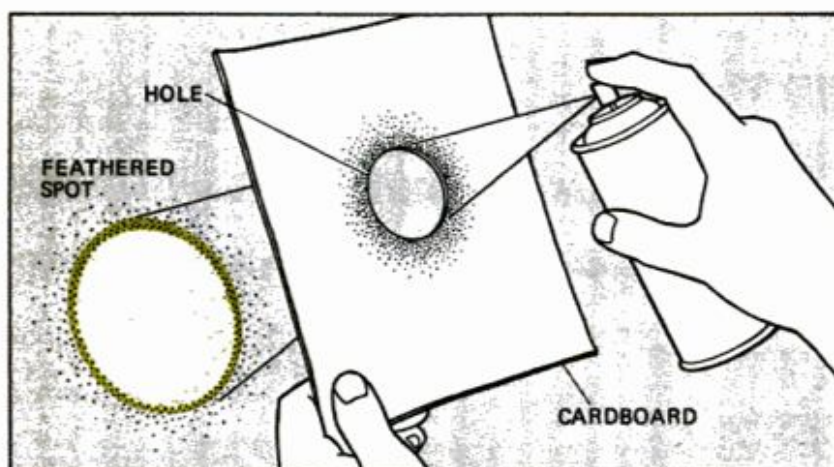
Drooping ailerons (lower right) combine with lowered flaps and drooping wingtips to give ship high lift for safe, short-run, low-speed landings and takeoffs. Ailerons operate both collectively and differentially.

How to paint with spray cans



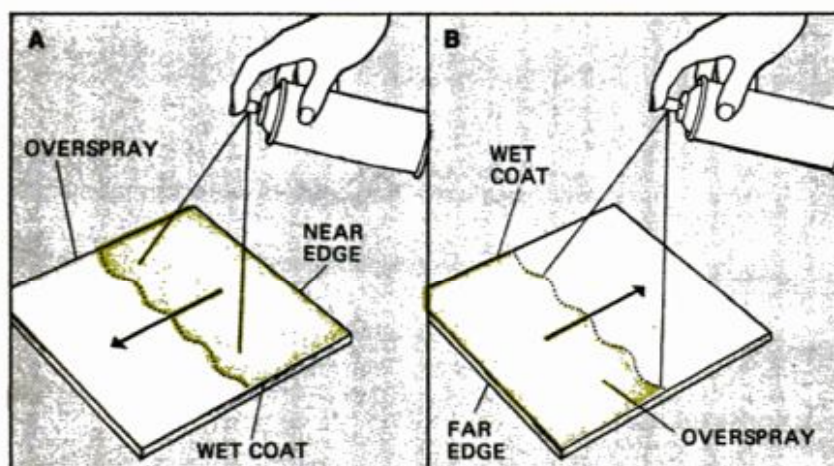
There's a knack to it

While the pressurized spray can has made painting a lot simpler than it used to be, there's a knack to handling these self-contained spray guns beyond just pressing the button. One of the secrets of a perfect paint job is to keep the can moving at all times. Another thing to remember is that the paint goes on in a uniform layer when the distance between the spray head and the surface is the same throughout a parallel sweep, as shown in the upper diagram at the left. When applied with a sweeping motion as shown in the lower diagram, the paint film is heavy at the center of the arc and thin at each end, producing a coating which is not uniform in thickness. Move your hand fairly swiftly; if you should move too slowly, the coating will run and sag.



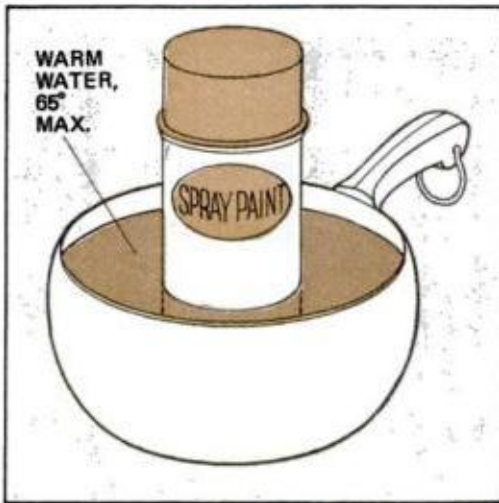
Feathering is a touch-up trick

A neat trick to remember when doing touch-up work, such as refinishing a fender scratch, is to aim the nozzle through a hole in a piece of cardboard held 10 in. or so from the surface. This feathers the edges of the spray so the paint will blend into the surrounding area rather than concentrate in a single spot.



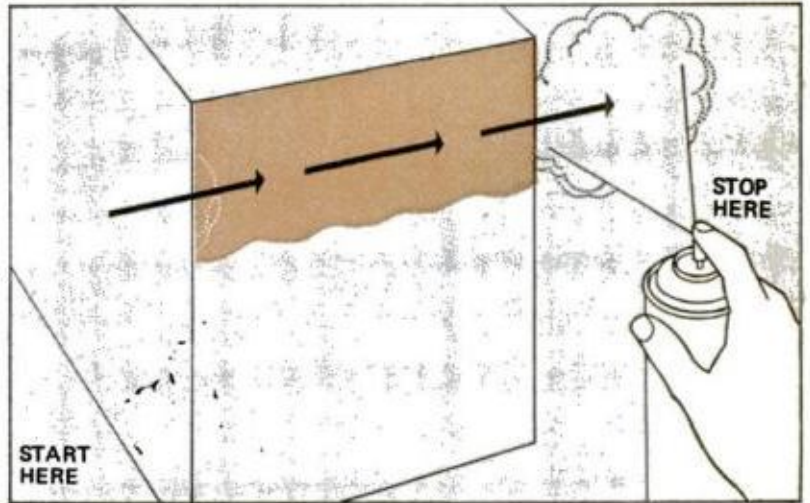
Always work from the near edge

When painting a horizontal surface such as the top of a table, start at the near edge and work away (A). This lets the overspray (mist) settle ahead of the full wet coat following. Working from the far edge (B) allows the mist to fall on top of the wet coat, producing a less smooth, "pitted" finish. Several thin coats will produce better coverage and hiding quality than one thick coat. Since aerosol paints are generally quick-drying, succeeding coats can be applied in as little as five minutes apart.



Wait until paint is warm

To dry properly, paint in aerosol cans should be at a temperature between 60° and 90° F. If cans are stored in garage or other unheated place during cold weather, the paint will be too cold to use immediately. To warm it, place can in a pan of lukewarm water (*not* over a fire) for a few minutes, or let contents warm up in the house.

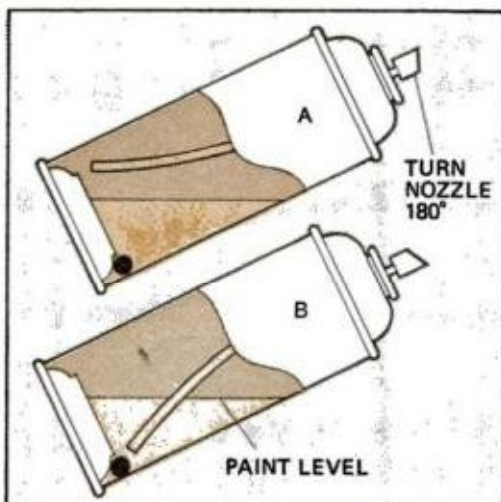


Start spraying before you paint

When spraying flat vertical surfaces, learn to trigger the spray so you start and stop the spray stroke off the work. This results in an even coating. Stay parallel to the surface and move back and forth across the full width of the work with each pass. Hold the spray head 10 to 12 in. from the surface and adopt a firmly rapid stroke. If applied too slowly, spray concentration becomes too great and paint will run and sag on vertical surfaces. Pause occasionally and shake the can to keep the paint well mixed.

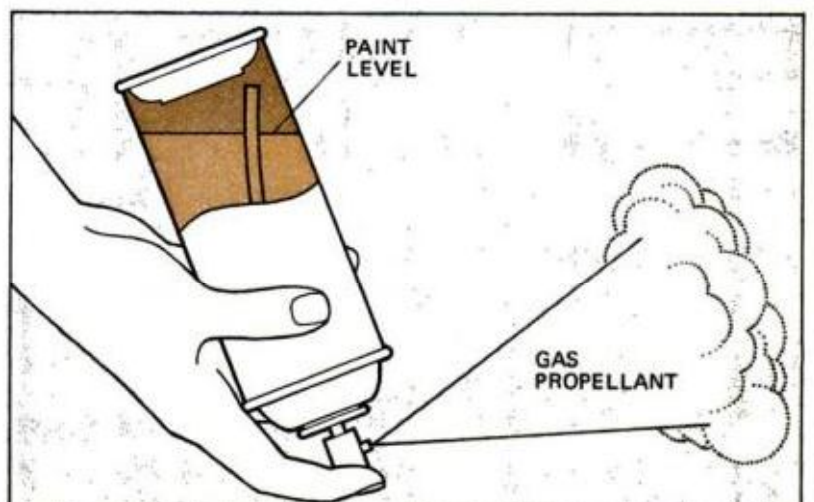
Good to the last drop

When a can is nearly empty and fails to spray when it's tilted, chances are that the siphon tube is above the paint level as shown in cutaway A. The remaining contents can be reached in most cases by turning the spray head 180° or until the siphon tube is in the lowest part of can and below the paint level as shown in cutaway B.



Keep it clean when job is done

After each job, be sure to clear the spray head of paint so it won't be clogged for the next use. To do so, turn the can upside down and give the spray a few bursts to blow out the pinhole orifice. Aim the nozzle at a dropcloth or newspaper as some remnants of paint will be forced out along with the gas. Even when emptied of paint, enough pressure is left to be a hazard. Before disposing of any aerosol can, hold down the spray head (release valve) until the remaining gas is completely exhausted. ★★★



IT'S NEW **NOW**



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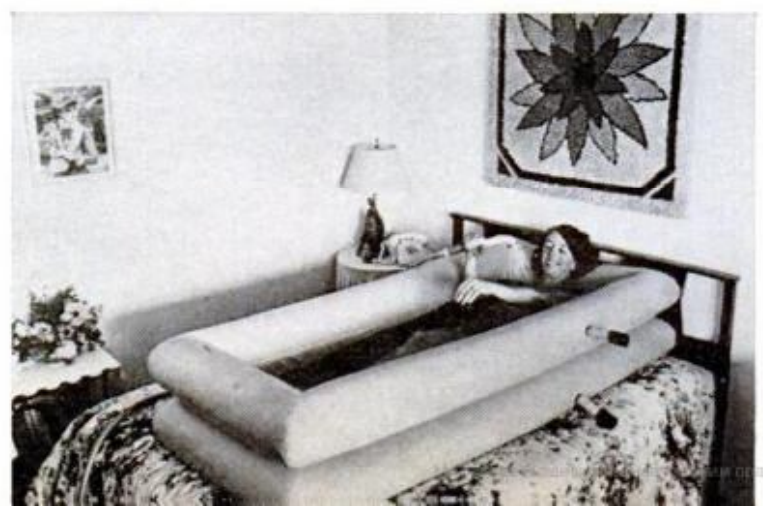


Freezer thermometer lets you leave the door shut

Freez-Gard, a new pushbutton freezer thermometer, gives accurate temperature readings while freezer door stays shut. It has color-coded dial for quick reading, requires no electrical connection or special installation; \$12.95 postpaid from Procon, Dept. 5094, 1304 Ethan Allen Ave., Winooski, Vt. 05404.

A water bed you lie in instead of on

You can take a bath without even getting out of bed with this inflatable plastic tub. Designed for use in hospitals and invalid homes, it's slipped under a patient flat, then the sides are pumped up and water fed in through a hose connection. After use, the water can be drained out the same filler hose and tub deflated for removal. Medical researchers at Stanford University in Stanford, Calif., developed the portable bathtub.





5 **You can sure count on the calculator makers to keep coming up with new ideas**

The hot competition for the ever-growing calculator market is keeping manufacturers on their toes. In the photos at left is a sampling of some of the new ideas they've come up with: Sharp's new Ultra-Mini Model EL-805 (Photo No. 1) uses a liquid crystal display that reflects light instead of glowing. As a result, the unit can run more than 100 hours on one penlight battery (other calculators require four pen-cells for about 20 hours)—and the brighter the surroundings, the easier the display is to read. It's \$110. Sinclair's checkbook-slim Executive (at left in Photo 2) is \$90; a new model with a memory is \$100. Bowmar's MX20 Brainchild, \$59, is a bit thicker, but has a protective flap to cover its display and keyboard. RCA's Model 3C1010 (3) has "Space Age" spherical styling with a swing-away dust cover. Powered by a.c., it sells for \$70. Palm-sized model from NS Electronics (4) has a big display; it's \$30 in the six-digit version shown, \$40 with nine digits and automatic shutoff. MIT's 941M (5) shifts when you press the triangle key to metric-inch conversions. It's \$130 in kit form; \$150 assembled. It does regular arithmetic, too, of course.



Metric nut drivers

Hex-nut drivers in 10 metric sizes from 4 to 11 mm feature solid-shaft, chrome-molybdenum steel sockets, unbreakable, shockproof handles. Set in convenient metal stand lists at \$13.75. For information, write Vaco Products Co., 510 North Dearborn St., Chicago, Ill. 60610.

Chair caddy keeps glass, ashtray handy

Lounging in your outdoor furniture is more pleasant when beverage and ashtray are close at hand. This chair caddy keeps them there and attaches to most tubular furniture at any angle. For furniture storage, caddy can be removed with clamp assembly left in place. Caddy sells for \$3.50 postpaid, including ashtray; from Creative Service, 125 West Fourth St., Los Angeles, Calif. 90013.



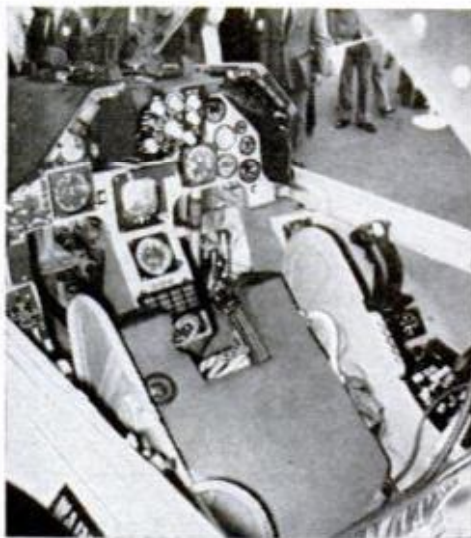


Trimaran folds for towing

Getting a wide-hulled trimaran to water and home is a problem unless you have this clever folding design by British boat builder Tony Smith. Two hinged outboard hulls swing down to bring the craft's normal 15-foot width to an easily towable 8 feet. About \$10,000, A.J.S. Sandwich Yacht Constructions, Sandwich, England.

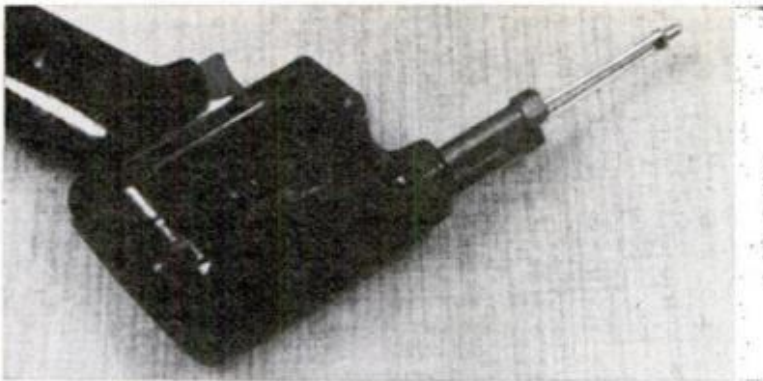
New 'low-cost' fighter

Newest Air Force fighter is this YF-16 developed by Convair. Said to have twice the range of current fighters at much less cost, the lightweight "simplified" jet has combined flaps and ailerons called "flaperons," side-mounted control stick and sharply back-tilted seat (near right) so pilots can better withstand heavy G forces in combat at speed of Mach 2.



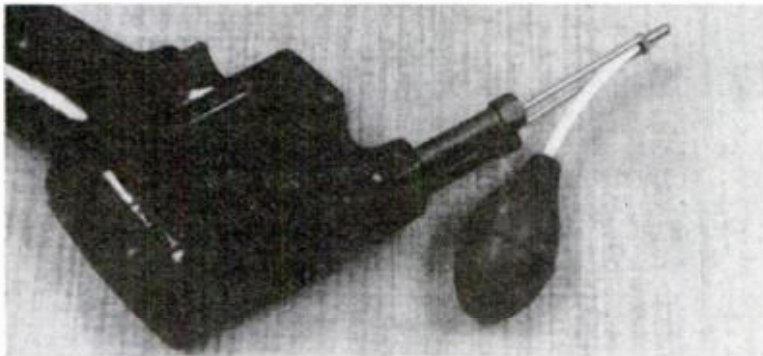
Coming: easy Army physicals?

Veterans and others may soon shed nostalgic tears for the long, drafty, naked lines of the good old military physical. With Computa-Lab, examinees will lounge comfortably while a computer takes their complete medical history and current symptoms. Then it checks heart and lung functions, hearing and vision, automatically analyzing the results and flagging abnormal data for a physician's attention. Only a few minutes of a physician's time are needed to complete the physical, says International Health Systems, Computa-Lab's developers.



Soldering-gun element for solid-state circuits desolders, too

High-wattage soldering guns, which reach high heats quickly, can often damage solid-state components. This new element, called Gunmaster, is designed to heat more slowly, giving the user extra control over heat buildup. The element, which mounts permanently in most popular soldering guns, accepts interchangeable tips in two styles: a solid "slug" for soldering, and a hollow-bore tip called a "dum-dum" for desoldering by capillary action. For heavier desoldering, a solder-sucking bulb accessory (lower left) may be attached to the back of the hollow-bore tip. For prices and information on the element, tips and sucker, write Gunmaster, Box 743, Kings Park, N. Y. 11754.



Mid-air pickup

Snatching Firebee drones out of the air is another job for the "Jolly Green Giant" helicopter, famous for its role in recovering downed pilots. The drone deploys a chute to slow it, then the chopper snags the chute with a hook and winches up the craft for the trip home. A second, smaller drag chute (right) keeps the drone stabilized during the flight. The Mid-Air Retrieval System (MARS) saves the valuable Firebees for reuse in recon and target missions.



Truck-cab-to-camper intercom adds safety convenience—and keeps the kids in line

Some kind of communication between a camper-truck's cab and passengers riding in the camper body is a safety must (and a legal one in California, which will require at least a signal light or buzzer by next year). This intercom can pass along route information, requests for rest stops and other family chatter. The two-way unit has a "monitor" position so the driver can keep an ear out for squabbling kids or other troubles. For entertainment, a switch sends the truck radio's output into the camper. Phillips Inter-Com is by BW, 721 North Webster, Kokomo, Ind.



NOW



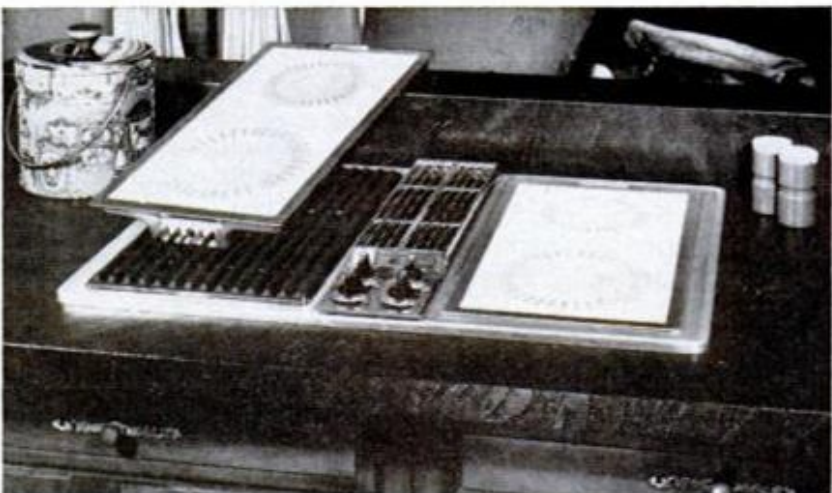
Multisize pencil sharpener

Six sizes of pencil are brought to a point of perfection by this handsome electric sharpener. The Whittler features a walnut case, adjustable point stop for sharp, medium or blunt points. It runs on house current and is \$34.95 post-paid from Mounteur Co., Box 443, Sturtevant, Wis. 53177.



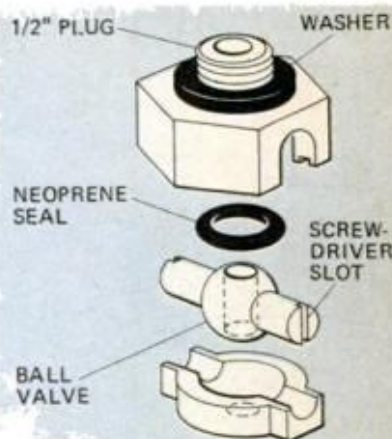
Animal-shape night lights

Cheerful nighttime companions for children, General Electric's Pet Parade nursery lights also provide enough illumination for parents' late-night checks. With replaceable long-life, low-wattage bulbs, nursery lights are available in supermarkets and department stores for a suggested retail price of \$1.49 each, fit any standard a.c. electrical outlet.



Plug-in cartridges for countertop cooking

Plug-in-element electric cooking tops with charcoal-flavor grill and surface ventilation are now offered for countertop installation. Basic model (top) has two permanently installed elements plus grill and griddle accessory; second pair of elements is optional. Model with both sides convertible (middle) allows double-grill use. Glass-ceramic elements are also available (bottom). Prices start at \$285. Jenn-Air Corp., 3035 Shadeland, Indianapolis, Ind. 46226.

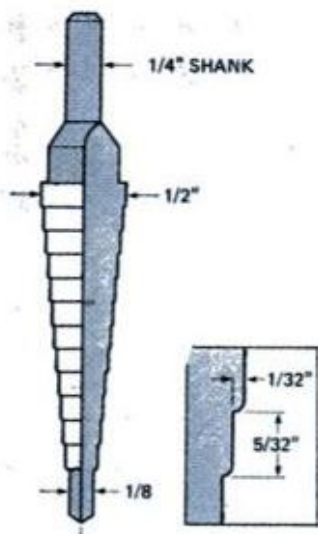
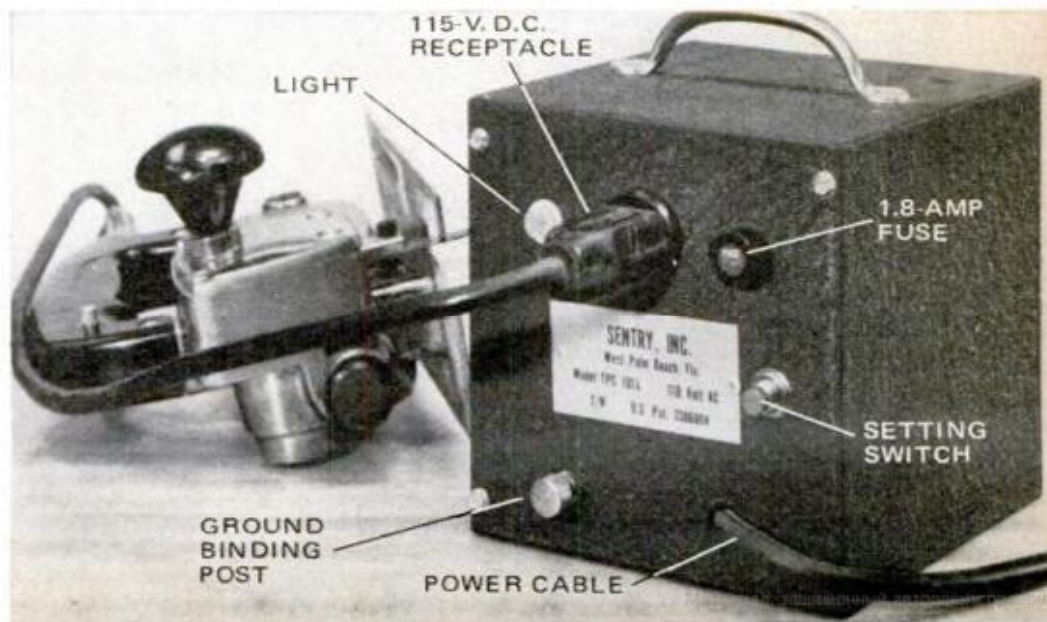


Permanent valve replaces crankcase plug for easy changes

Changing your car's oil without a rack becomes an easier job when you can drain the crankcase by simply opening a valve with a quarter-turn of a screwdriver. E-Z Drain Crankcase Valve replaces original drain plug of most domestic cars, can't leak or open, has positive stops in both closed and open positions; \$2.75 postpaid, including installation wrench, from C. B. Enterprises, 7701 Telegraph Rd., St. Louis, Mo. 63129. For pans with stripped threads, double oversize valve, with thread cutter, is \$3.75 postpaid.

Ground-fault protection plus for portable tools

Sentry offers ground-fault-interrupter protection when you work with portable electric power tools, and an added feature—it turns the tool off when its cutting edge contacts an electrically grounded object, such as embedded pipe or conduit. In addition, Sentry checks wiring polarity, shows whether tool's ground wire is intact. Manual reset model shown is \$75, automatic reset \$89.50, postpaid from Sentry, Inc., 1102 Clare Ave., West Palm Beach, Fla. 33401.



13-step drill bit

A single-flute, step drill doing the work of 13 twist-drill bits in thin material, Unibit fits any three-jaw 1/4-in. or larger chuck, has starting diameter of 1/8 in. with 1/32-in. steps to 1/2 in. Each step drills through material up to 1/8 in. thick. Edge automatically deburrs holes. Unibit sells for \$4.95 plus 25 cents postage and handling from Harry C. Oates, Box 131, Wyoming, N.Y. 14591.



Usable toolbox in 17th century style

Antique-style toolbox is a reproduction of a 1620 vintage Jamestown, Va., example found in an old print. Of distressed pine with simulated hand-rubbed finish, it's 24 inches long and has five compartments. It's practical for use in the shop as a working toolbox or as a garden-tool caddy or planter. Price is \$15 postpaid from Daniel I. Hadley, 105 North Colonial Ave., Wilmington, Del. 19805.

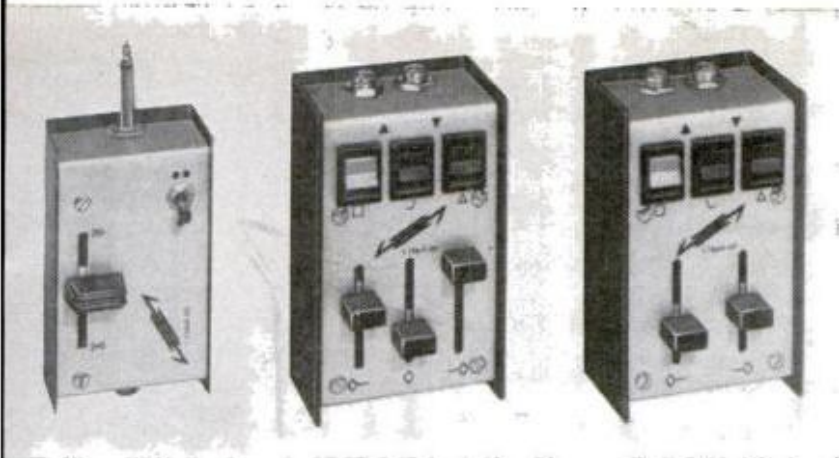
Look, Ma, no feet! The hands do the 'pedaling'

You pedal this bike with your hands instead of feet. The arrangement, devised by Antonio Spagnolo of Milan, Italy, is intended primarily for handicapped persons unable to use their feet, but is also said to provide a new kind of cycling fun as well. The crank drives the front wheel through a vertical chain, and the entire unit pivots for steering. Two rear wheels prevent tipping.



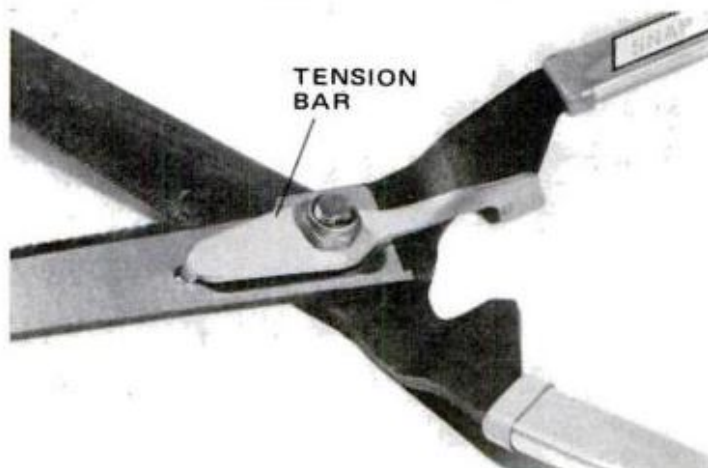
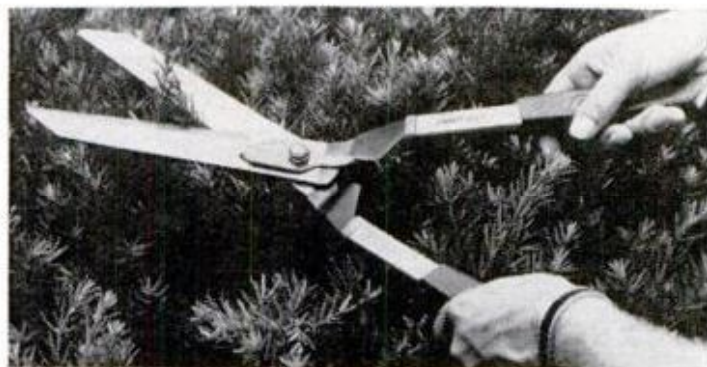
Modern bar clamp with some extras

The familiar bar clamp is updated as Jet Clamps, with spring-loaded jamming wedges that allow instantaneous adjustment, lock firmly when clamping force is applied. Knob on one arm tightens clamp. The unit is supplied with four sets of interchangeable pads for different kinds of work, including right-angle pads for clamping edges, and 12-in. bar ($\frac{1}{4}$ x $1\frac{1}{4}$ in. section, a stock size). The English-made clamp is \$19.95 ppd. from Seawood, Inc., 5100 Edina Industrial Blvd., Minneapolis, Minn. 55435.



Accessories add controls to guitar

Three new accessories from S. Hawk add new control capabilities to electric guitars. Left to right: Hawk I acts as a preamplifier for long cables and for power boost, doubles as a fuzz-box; Hawk II adds plug-in tone contouring over three frequency ranges; Hawk III, for a bass guitar, has separate boost controls for two bass ranges. Each attaches to guitar, strap or belt. S. Hawk, 65 Bank St., New York, N.Y.



Hedge shears have built-in shock absorber

For border trimming and edging as well as shaping hedges, these Snap-Cut hedge shears have a tension bar that automatically holds proper blade tension and also acts as a shock absorber to make trimming easier on wrists and arms. The precision-ground blades are notched for cutting large branches easily. The hedge shears have 9 in. blades, are available with metal or wood handles. Suggested retail prices start at \$7.70. Seymour Smith & Son, Inc., Oakville, Conn. 06779.

Wind power with a real wallop

If you doubt that windmills can produce useful electrical power, don't laugh. This 40-foot-tall experimental installation in Guerneville, Calif., is capable of generating up to 280 amps. of current, storing it in 60 batteries (top photo below) to provide a steady flow of cheap electricity.





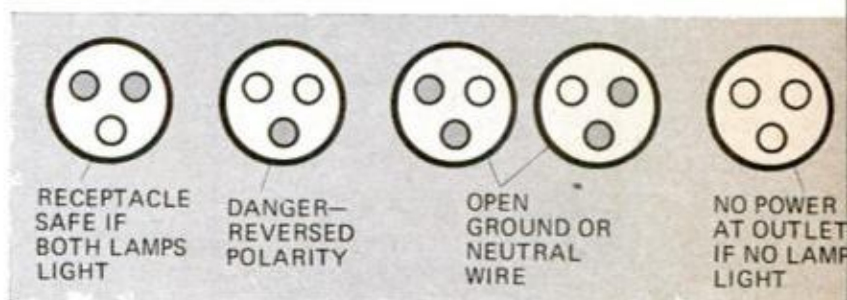
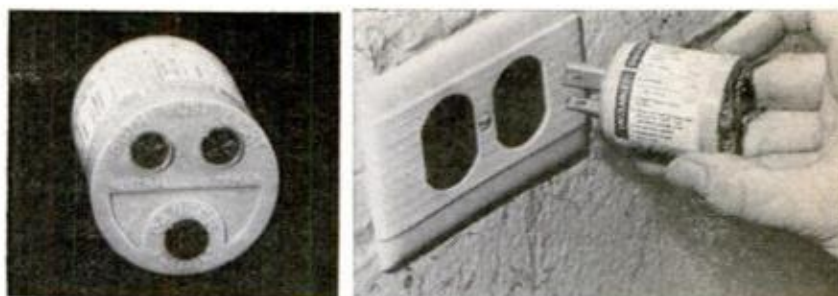
You don't see real people any more—just faces on TV screens

Television is turning up everywhere these days—in medical offices, conference rooms, even criminal courtrooms. At left, a patient punches out answers on a keyboard as a videotaped "doctor" asks preprogrammed questions. The system, used at Fulham Chest Clinic in London, saves doctors' time interviewing patients and puts patients more at ease by eliminating personal confrontations. Middle photos below show how TV is used in a courtroom developed by Pacific McGeorge School of Law in Sacramento, Calif. Evidence displayed on central pedestal is flashed to monitor screens around the room for jurors and lawyers to see more clearly. At bottom, London's Heathrow Hotel boasts conference room with 262 TV monitor screens so convention delegates get close-up views of important business proceedings.



The latest in footwear for horses—plastic 'horseshoes'

The age-old nailed-on steel horseshoe may soon become a thing of the past. For centuries, horsemen have been looking for a simpler substitute, and now a New Mexican inventor, Dr. Neel W. Glass, thinks he's come up with the answer. It's a tough urethane plastic clip-on bootie that requires no nailing, goes on and comes off in seconds, is lighter and longer-wearing than metal shoes and can't be "thrown" as a conventional one can. But if plastic boots come into style, how will we play horseshoes?



Quick tester for ground faults

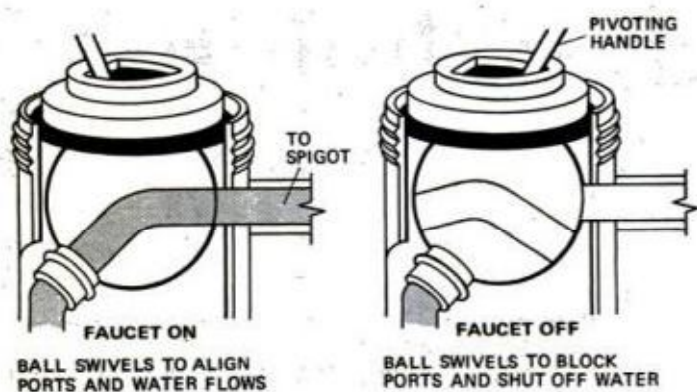
This pocket tester for grounded outlets lets you make quick checks for ground hazards safely. It simply plugs into a receptacle, and a pattern of lights tells the story immediately. Used with a "pigtail" adapter plug, it also checks the condition of two-wire receptacles. The GT-20 tester has attached instructions; \$6.95 from Alco Electronic Products, Inc., 1551 North Osgood St., North Andover, Mass. 01845.



Pocket movie camera has optional radio control

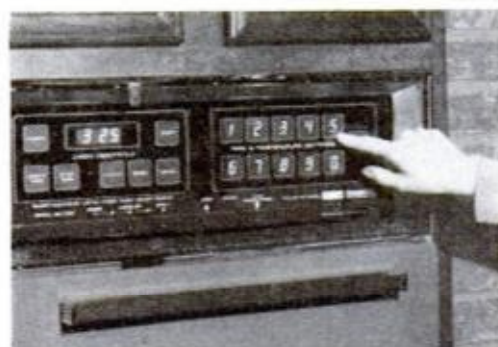
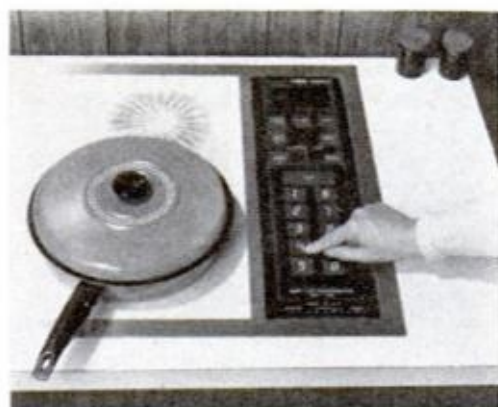
Newest of the pocket-sized movie cameras (see [Pocket Super-8s](#), page 130, Dec. '73 PM), this Yashica Electro-8 Macro has an f/1.9, 9-30-mm manual zoom lens with through-the-lens viewing and a minimum focus distance of 8½ inches. It will sell for about \$160. An optional Command Set (also \$160) has transmitter and receiver for remote radio control and time-lapse attachment for intervals of ½ to 60 seconds between frames.

NOW



Restyled joystick faucet

Delta Faucet Co. has restyled its washerless, single-handle faucet by making its ball-topped handle longer for greater convenience, improved appearance. In place of compression washer, faucet uses a rotating channeled ball to control pressure and hot water-cold water mix delivered to spigot. Faucets sell from \$23 suggested retail price, are available through plumbing-supply outlets. Delta Faucet Co., Box 31, Greensburg, Ind. 47240.



Fingertip control for cooking

Cooking controls styled like calculators are Frigidaire's new wrinkle in a drop-in ceramic cooking top and a wall oven. Operation of the solid-state controls is by pushbutton, with cooking function and temperatures selected—and the time of day, if desired—displayed in small windows. Both cooking top and oven boast programmed-cooking features, digital heat selection. Frigidaire Div., General Motors Corp., Dayton, Ohio 45401.

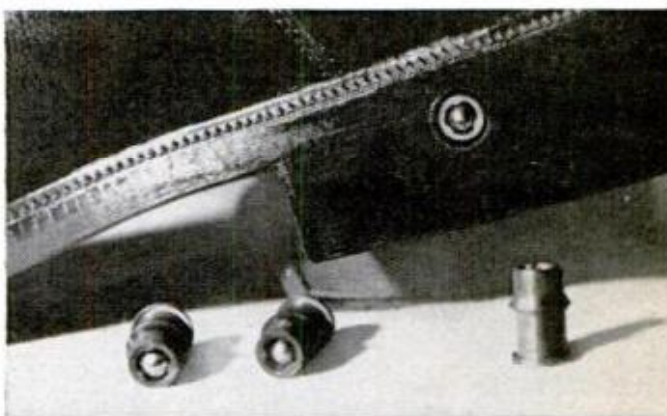
Portable power cultivator

Black & Decker's Multivator cultivates and pulverizes soil with 1750 strokes a minute. With accessories, it scrapes, sands, wire-brushes and does spade edging, too. Double-insulated tool has handles at front and rear for control, weighs 4¼ lbs. Portable cultivator retails for \$24.99; Multivator Assortment including all accessories retails for \$32.99. Black & Decker Manufacturing Co., Towson, Md. 21204.



Spray polish that stops tarnish

Since silver tarnishes faster than ever in today's polluted air, it's harder to keep it looking good enough to leave out on display. Spray polish makes the job easier—spray, then buff with a dry cloth to bring up a brilliant shine. Silversmiths' Tarnish Preventing Spray Polish also contains an ingredient that eliminates tarnish for weeks; 20-oz. can is \$5 at jewelry and department stores. W. J. Hagerty & Sons, Ltd., Inc., 3801 West Linden Ave., South Bend, Ind. 46624.

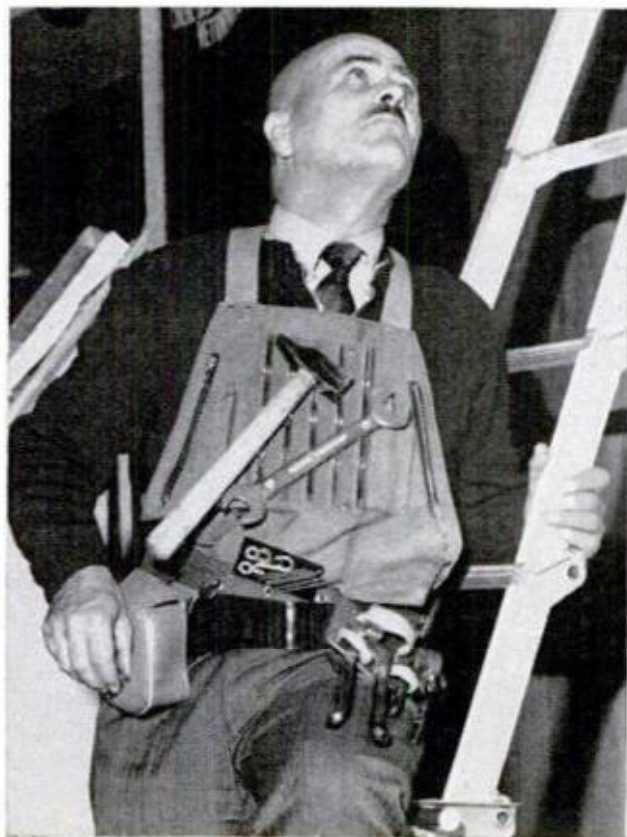


These are cool shoes, man!

These "airconditioned" shoes are said to keep your feet cool in hot weather and prevent perspiration buildup. Air enters through a one-way valve in the heel. As you walk, it's then "pumped" up small holes in the inner sole to circulate around the feet. The shoes are the invention of Giuseppe Pais, Chaussée de Chatelet 15, 6060 Gilly, Belgium. What isn't explained is how water is kept out while air is let in, so in wet weather you may also have watercooled feet.

He wears his 'toolbox' on his chest

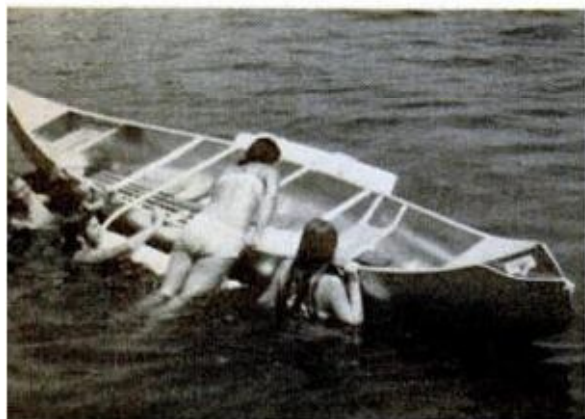
Tools are always within easy reach with this magnetic carpenter's vest. Seven magnetic bars attached to the front hold an assortment of tools weighing up to 55 pounds. The vest also includes pockets for nails, screws and other small supplies. A French invention, it's produced by Messrs. MACC, 36 Avenue du President Wilson, 86101 Chatelleraut, France.



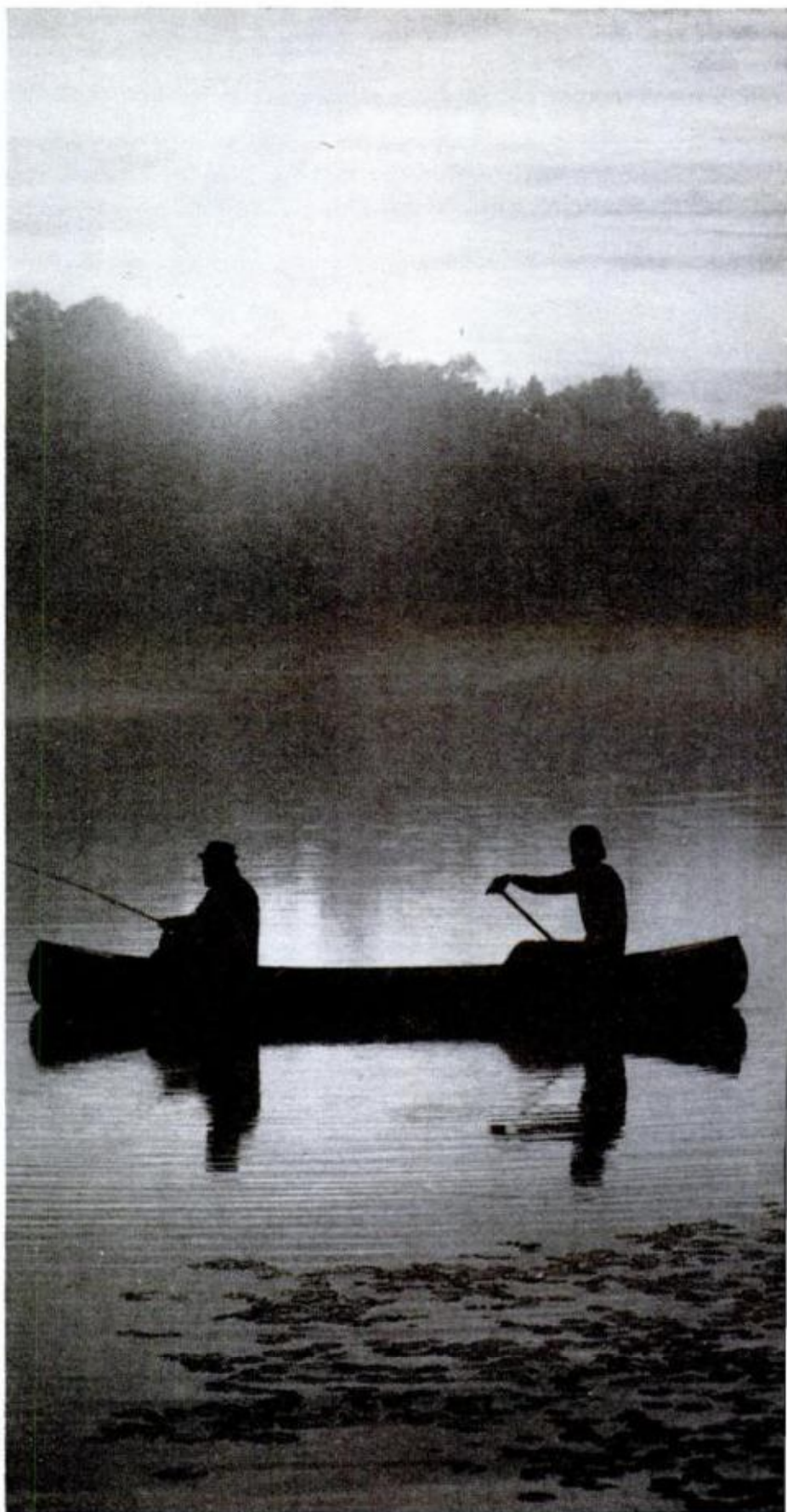
Canoes that take less paddle power

More white-water action or quiet boating, with minimum arm energy, are among advantages offered by the latest models of this Indian invention.

by Jerome Knap



Modern models are designed to handle rougher water, tip less easily, float if swamped or capsized. Foam pontoons (top) from Grumman Boats can be added for increased stability. Sawyer's Cruiser (above) offers both racing and cruising ability in a 17-foot 9-inch fiberglass hull of only 68 pounds.



Indians and voyageurs of 400 years ago would surely recognize today's canoes as close relatives of the craft they used to build. But construction and design developments of just the last few years have made these little double-enders much easier and safer to handle, while adding extra years to their life. No longer is the canoe considered a tippy cockleshell constructed of short-lived canvas and brittle wood. Now there are models made of fiberglass, marine aluminum, ABS plastic foam and polyethylene.

Basically, the craft is one of the most versatile afloat. It can be paddled, poled, sailed, powered with an outboard motor, and some are even rigged for rowing. Only a minimum water depth is necessary.

When choosing a canoe, selection is determined by design, features, size and construction material. Purposes for which it will be used indicate proper type and size. Material it is made of plus the workmanship is suggested by waters where it will be used, and personal preferences. A hull that will run rocky rapids and be hauled over cobbled beaches needs more strength than a model used for drift fishing through lily pads.

Today's standard canoe is pointed at both ends and has a flatter floor than canoes of yesteryear. The flatter floor makes a more stable craft with good load capacity, yet one that paddles and handles well. The ends do not curl up as high and are less likely to catch the wind.

One basic variation is a squared-off stern. Though a bracket can be clamped on a double-ender to mount an outboard motor at one side, the square stern is more convenient. A standard square-stern is more difficult to paddle in fast water than a double-ender, but the Y-stern which is pointed underwater and flares up, paddles easily and is a useful compromise for motors up to about three hp. Big freighter canoes with deep square sterns can handle as much as 20 hp.

Additional types include the racing canoe, a long lean model that may be up to 24 feet in length with a beam of only 26 inches. Quite different are stable, wide-



Rushton (above) from Old Town Canoes, is 18-pound fiberglass copy of old classic one-man pack model of only 10½-foot length. Grumman rental square-stern aluminum canoes (below), packed for camping, have Y-shaped transoms for mounting small outboards. Old Town 16-foot Wahoo (bottom) is shown rigged with sliding rowing seat; sails with leeboards or daggerboards may be added.



beamed canoes for hunters and fishermen that sometimes mount sponson flotation along each side. Difficult to paddle in fast water or high winds, they are also difficult to tip over and can even be rowed.

Among specialized narrow-beam models are some resembling kayaks. Though used for river touring, they have limited load capacity, are usually decked in, and are not as suitable for long camping trips as hulls with more space for duffel. One new ultralight miniature is made in fiberglass by Old Town Canoes as a Rushton replica. Pioneer canoe enthusiast Henry Rushton made his 10-foot original of cedar planking. Weighing only 15 pounds 9½ ounces, it was named Nessmuk—the pen name of early wilderness writer George Washington Sears.

Most canoes today have a keel running along the center of the bottom that helps stiffen the hull and fend off abrasion. For paddling lakes and slow rivers, the keel aids in keeping a straight course, but through fast white water, a keelless hull is more responsive and maneuverable.

The small canoes—up to 12 feet—are generally one-man models. They are easy to cartop and are popular with fishermen and hunters but, with the exception of the wide-beamed Sportspal, are often less stable and are best left to an expert.

Canoes of intermediate length—14 or 15 feet—are often chosen by a beginner who

believes that full-sized canoes are too long for him. For a long trip, however, they are too long for one man and too short for all the gear needed for two, since, loaded down, the canoe will generally ride too low for easy paddling. When in doubt, it is frequently wise to buy the next larger size. For a two-man canoe trip of several days up to several weeks, nothing under 16 feet is recommended and 17 feet is better.

Models larger than 18 feet are difficult to cartop and portage, although they have great stability. Giant square-stern Rupert House 24-footers are still used in Canada's far north by Indians for transportation.

Among canoeists, the big controversy comes when construction materials are discussed. Some consider wood canoes to be cooler in summer and warmer in winter than aluminum or fiberglass, easier to repair than aluminum and perhaps even easier than fiberglass. These might be important factors on a wilderness trip through rugged country. Old-time canoeists rate wood as quieter than aluminum and plastic as well. But a 16-foot model in wood can cost \$100 more than one of other material, and the wood has to be varnished and the canvas covering painted.

Aluminum canoes are rated almost maintenance-free and are particularly rugged, although they may dent. Considered slightly hotter and more noisy than other makes,

CANOE MANUFACTURERS

Among well-known canoe makers are the following:

American Fiber-Lite Inc., Box 67, Marion, Ill. 62959
Country Plastics Corp., 100 Verdi St., Farmingdale, N.Y. 11735

Delhi Mfg., Box 7, Delhi, La. 71232

Grumman Boats, Marathon, N.Y. 13803

Land & Lake Mfg., Box 223, Manchester, Mich. 48158

Michi-Craft Corp., 19995 19 Mile Rd., Big Rapids, Mich. 49307

Old Town Canoe Co., Old Town, Me. 04468

Ouachita Marine & Industrial, 721 Main St., Little Rock, Ark. 72201

Sawyer Canoe Co., 234 South State St., Oscoda, Mich. 48750

Sears, Roebuck and Co., Sears Tower, Chicago, Ill. 60684

Small Boat Shop, Box 808, Sandy Hook, Conn. 06482

Smoker-Craft, New Paris, Ind. 46553

Sportspal Inc., Emlenton, Pa. 16373

Trailcraft Inc., Box 606, Concordia, Kans. 66901

Trembly Canoes, 40 St. Paul St., St. Felicien, Que.

Tubbs of Vermont, Forest Dale, Vt. 05745

Voyageur Canoe Co., Millbrook, Ont.

Whitewater Marine Products, Box 355, Indianola, Iowa 50125

Whitmore Corp., 85 Willow St., New Haven, Conn. 06511

Sail, mast, rudder and leeboards convert 15-foot 3-inch Grumman Sportcanoe into sailboat. Beamy family boat can also take motor, oars or paddles.





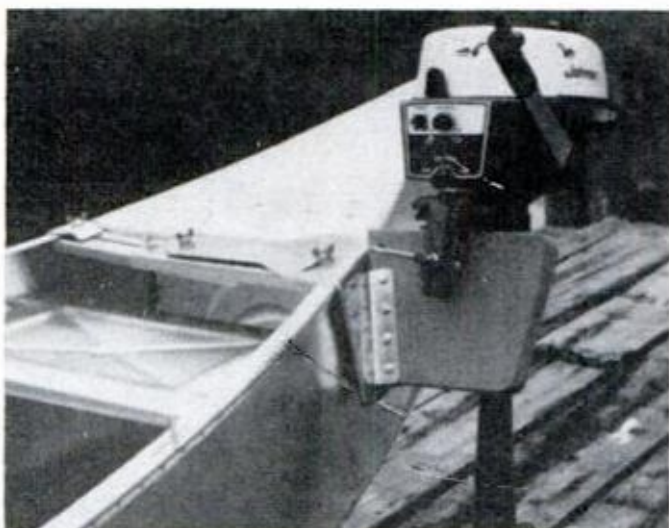
Flotation panels along sides of Sportspal aluminum canoes, cartoppers make them especially stable.

they are also lighter and this plus their good carrying capacity make them popular with canoe trippers.

Canoes built of fiberglass and plastic are classed as less noisy than metal and cooler in a hot summer sun. Like wooden models, they tend to be more elastic and may take a harder blow without puncturing. Some canoe buffs claim plastics are smoother and tend to slide off underwater rocks more easily than aluminum or fabric. Fiberglass is, of course, largely maintenance-free and reasonably easy to patch. A disadvantage is that such a canoe must usually be heavier than aluminum in order to be sturdy. ABS

plastic foam resists dents and chipping.

But practically all modern models require less push to paddle, have less windage to drift the hull off course and require minimum care. A beginner is wise to get advice and instruction from an expert when choosing the best model for local waters and then learning to paddle it properly plus the techniques of righting and reboarding from the water if it should tip over. He should remember that new laws require canoeists to carry—or, preferably, wear—life preservers. Once the basics are mastered, few forms of boating can give more quiet pleasure. ★★★



Accessories for canoeing include clamp-on outboard brackets (upper left) from Grumman and others. The 12 and 16-foot wood-and-canvas models above are assembled from Trailcraft kits, maker of fiberglass square and double-end canoe kits as well. At left, Old Town Potomac C-2, a white-water covered two-man model, is 15½-foot fiberglass slalom canoe. Canoeists kneel; kayak paddlers sit down.

New, lighter gear goes camping

Down substitutes and durability add to the cost—and comfort.

by Bill McKeown
OUTDOORS EDITOR



Flyweight plastic tube-tents can grow up into units like Palco's 8-foot Inflat-A-Tent with blow-up A-frame. Stag Giant Alpine (below) has headroom, sleeps four.



Sixteen ounces doesn't seem like much. Try adding a few one-pound items to your pack for a weekend hike, however, and a light weight turns into a load. Experienced woodsmen have been known to cut half the handle off a toothbrush or leave a razor at home just to save ounces.

Fortunately for the average camper, each ounce isn't that critical, but much new gear for this year is both lighter and stronger. Prices are up, but so are durability and quality. Some of the materials developed for outer space are now being incorporated into new camping equipment.

Keeping warm, dry, fed and rested—at a reasonable cost—are still the necessities. New gear we have previewed and tested shows no great changes but offers a number of improved answers to basic problems.

Even in midsummer it can get cold at night. Head north, camp at altitude, stretch outdoor action over 12 months—and staying warm becomes vital. Goose down is still considered best insulation in vests, jackets, parkas and sleeping bags to keep body heat in and cold out. But it's expensive, must be properly quilted so it doesn't shift, cannot be washed or cleaned easily and may become a soggy mass during days of rain. Look over the new equipment using Dacron II and Polar Guard, synthetics that cost less, wash, and approach down in insulation.



Some sleeping bags now combine materials. Jan Sport has one with down on one side, Polar Guard on the other to keep body weight from compacting the down and picking up cold and moisture from the ground. Reversed in wet weather, the Polar Guard goes on top. Stephenson's Warmlite bags have a built-in foam bottom. Theirs and others have multiple layers so you can pick your covers to match the temperature.

More tents will be available this year with a fly—an added roof over your tent that deflects sun and driving rain away from the porous tent fabric that “breathes” away inner moisture, prevents condensation. Alpine Designs offer an inner liner to prevent formation of frost in the winter. Warmlite has an insulating Filmgap tent liner that is claimed to make sleeping bags sometimes unnecessary. Jan Sport is using rip-stop Dacron in its tent tops because of its nonstretch properties and resistance to ultraviolet deterioration.

Little pack-in-a-pocket, plastic-tube tents are handy for emergency or use in rain, but must be properly vented to let out moisture and admit air. Campers in areas with considerable rain or snow should consider tents designed with a sheltered vestibule entry where backpack and supplies can be protected but left outside the sleeping space. Many now offer added vents for condensa-

tion control. The foam-coated fabric of Camp Trails' Chaparral backpacker tent is one successful answer. Visa-Therm has a Sleepertent with the sleeping bags built in.

For more space, some tents now zip together to form modular rooms. Others, like Coleman's Forest Home, divide into bedroom and screened-in room design popular in Europe.

Cooking out is simpler with new LP-gas stoves in models from backpack spider style up to several-burner size. Freeze-dried just-add-water foods come in even larger variety, are expensive, extend backpacker range.

For comfort, hiking shoes, knapsacks, compact first-aid accessories, shell parkas and windbreakers have been improved in design and durability. Frostline, Carikit and EMS supply sew-it-yourself kits for sleeping bags, clothes and packs. A number of backpack makers now offer models with slots for touring skis. Kelty has such a tour pack, plus a soft pack without frame but inner aluminum stays that are bent to the contours of your back for a custom fit.

And for an alternative to the layer theory of adding or taking off clothes to prevent sweating, Stephenson's Warmlite anti-breathability system to seal in warmth and moisture deserves consideration for cold conditions. It's another possibility this year for conserving energy outdoors. ★★ ★

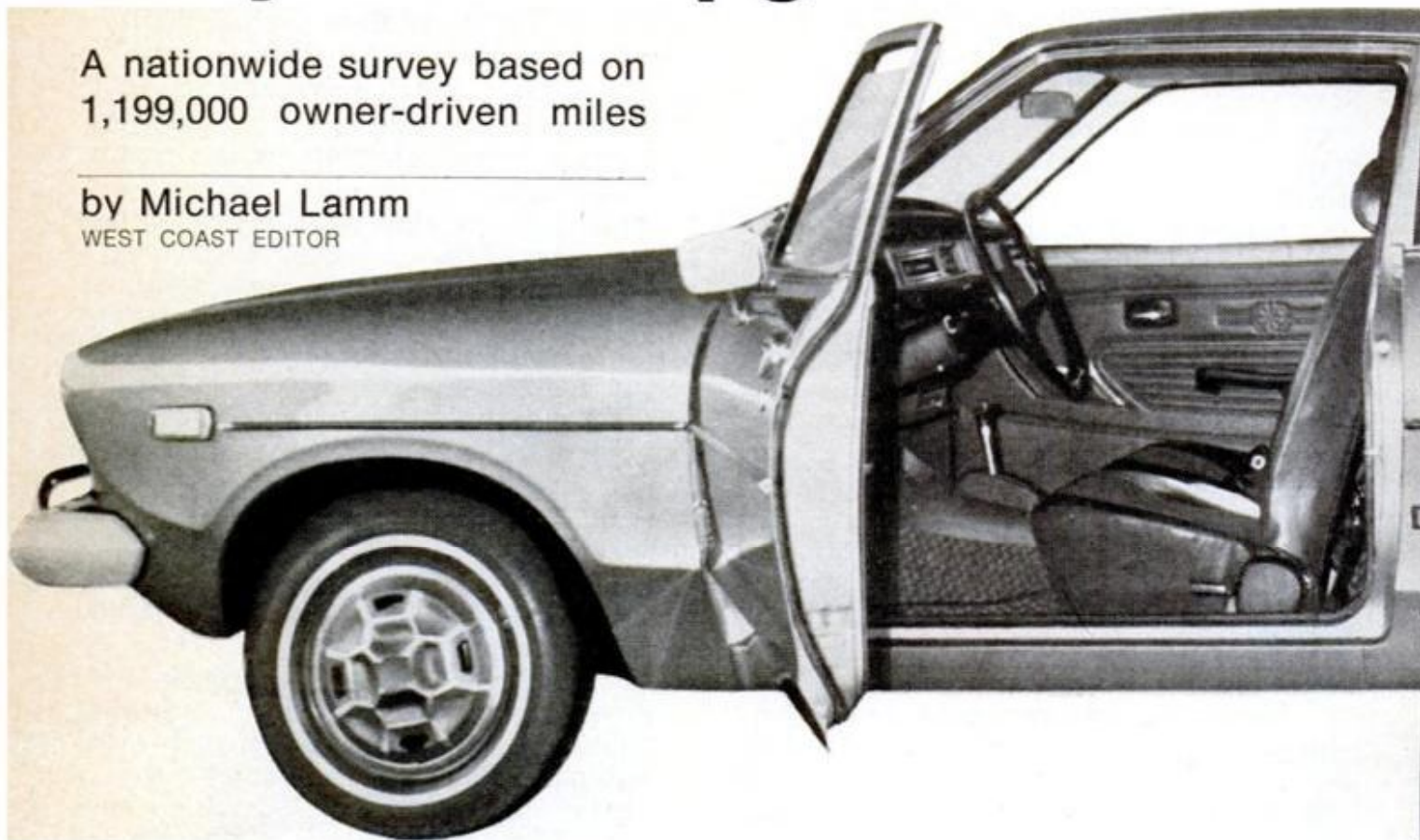


New backpack trend includes smaller internal-frame rucksacks like Universal Europa (far left) for short hikes; Loadmaster Expedition (left) for the distance. Stag Van Tent (above) is freestanding, attaches to RV with magnetic tape. \$132.

Long trips: 30.4 mpg! But 'only' 25.7 mpg about town

A nationwide survey based on 1,199,000 owner-driven miles

by Michael Lamm
WEST COAST EDITOR



When Datsun hatched the B-210 late in 1973, it became a logical successor to the thrifty and popular 1200 series.

The B-210 uses a totally new unitized body, with different styling, a 1½-inch longer wheelbase, plus four inches more length (most of this added length due to 1974's five-mph bumpers). The basic 1200 engine has grown about 100 cc and now has a stronger crank, heftier rods and a better valve train. Some B-210 components are shared with the larger Datsun 610 (or vice versa), notably the front disc brakes and steering.

The B-210 comes in three body styles: hatchback coupe plus two and four-door sedans. The four-door is new to Datsun's smallest line but is also the least popular. Most popular is the hatchback, with its hydraulic prop rods and easy access to a cargo area that's three times the size of the sedan's trunk.

The hatchback is also the sportiest of the

three body types and accounts for almost 4 out of 10 sales. Since over half of the B-210's owners are under 30, it's fair to conclude that this car appeals to the young on the basis of sporty looks and thrifty performance. Our survey showed average fuel mileage to be 28 mpg for all driving conditions.

Most Datsun owners surveyed were enthusiastic about giving us their opinions of the B-210.

A 26-year-old single Indianapolis secretary writes: "I think the B-210 has all other subcompacts beat hands down as far as body style is concerned. I'm very pleased that a manufacturer has finally realized that those of us who must drive economy cars appreciate styling as well as economy. I bought this car chiefly because it was the first subcompact I'd seen with style—very sporty but economical. Workmanship is good; slightly better than the three American-made subcompacts I checked. My only



Hatchback's sporty looks are enhanced by long rear quarter windows and chopped rear. Rear window defroster is standard.



Photos by the author

Datsun B-210 succeeds the previous 1200 series and has all-new sheet metal. Hatchback is most popular body style, although a four-door sedan is new this year. Hatch is supported on twin, spring-loaded hydraulic prop rods.



complaint is acceleration, which is rather slow from a dead stop. I should have ordered the manual four-speed instead of the automatic transmission."

A 52-year-old North Carolina physician reports: "I bought the car because I'd heard that Datsun's gas mileage was best. I would now rather have the four-door, and I could have had one except my wife didn't like the steel gray color. We now have the two-door sedan, and it's hectic with children getting in and out of the back. Also I don't like having to take parcels off the right front seat in order to start the engine. Workmanship is good, although the cigaret lighter rattles and a screw came

loose from the outside mirror. The best thing Datsun could do for this car would be to enlarge the gas tank from 11 to 18 gallons to permit weekend travel. But gas mileage is the best thing about this car, followed by a surprisingly good, smooth ride."

And this from a 31-year-old Oregon policeman: "Gas mileage and handling are excellent, and my optional radial tires probably have a lot to do with that. I like the car's looks, instrument panel arrangement, rear glass defroster. Workmanship is better than my Chevy Blazer. The B-210 has adequate front legroom for my six-foot frame, but the seats need more padding;

'... never failed to start, even at 10° below.'

also the ride feels a little choppy. My other gripe is that the fuse box is very flimsy. The fuses keep slipping out and sometimes touch one another."

A lawyer from Kansas writes, "We wanted an economical second car to replace an ancient VW. The B-210 gives good economy, I like its appearance, tremendous brakes, heater and rear defroster. Handling is great due to small size. It has never failed to start, even at 10° below. Workmanship is very good. At 60 mph, the engine starts getting noisy, and the car is very much affected by wind at higher speeds. I am six feet tall, 220 pounds, and find the car very comfortable, as do my wife and two children."

A foreman in a fiberglass boat factory who's 53 and lives in Arkansas complains that "I don't believe they told me the truth when I bought this car. The dealer said some B-210s were getting 39 mpg. I'm getting 26 to 30. I bought this car strictly to go to work and back. Workmanship is satisfactory. The one thing I'd like to see changed is price—lower. The car is comfortable, but passengers are a little crowded."

"I have no specific praises for this car, but my only real regret is that it comes

from Japan: American carmakers should have been in the small-car field sooner."

A Texas Army engineer, 39, had these comments: "This is my wife's car. We were planning to buy a BMW 2002, but recent price increases dissuaded us. She chose the B-210, likes the styling and compactness. The car has used four quarts of oil in the first 4400 miles. The mechanic, who's an absolute gem, says it's the chrome rings, which take longer to seat, and he also changed the PCV valve."

"As for the dealer, he gave very little discount on the car. There's a long waiting list. Workmanship is very good, but the plastic is thin and cheap, particularly on the dash. Other than that, power seems weak. The car could use an 1800-cc engine with automatic. I've disconnected the seat-belt interlock, although we use the belts faithfully."

And a 22-year-old Kentucky drapery cutter chimes in: "I bought this car for one reason only—I was getting 9.9 mpg with my 1972 Le Mans. Datsun was top-rated in the 1200-cc class. I find handling great, brakes good, gas mileage likewise, no troubles at all in 2000 miles. There's adequate trunk space in my four-door, and the re-



B-210 engine is ohv Four, displaces 1288 cc and nets 67 bhp. Torque works well with manual transmission, is weak for automatic. Spare tire and tools rest under floor of hatch compartment.





Reclining front buckets give plenty of legroom, but rear is tight. Hatchback roof is 1½ inches lower than sedan's. Included as standard: tinted glass, console, carpets, vacuum disc brakes.

clining bucket seats are comfortable. They might need a little padding, though. Workmanship is excellent, but there's a rattle under the dash, and my window trim is defective.

"Yes, I would definitely buy another B-210, and I guess I'm what you'd call a satisfied owner."

Most owners answering the questionnaire are, because an overwhelming 85.5 percent of them vowed they'd buy another Datsun B-210. That's an extremely high percentage, especially considering owner age and the fact that most owners know they'll most likely have larger families when the time comes to buy their next car. ★ ★ ★

Summary of 1974 Datsun B-210 Owners Reports*

Total miles driven1,199,269

Average miles per gallon:
Local driving 25.7
Long trips 30.4

Body styles:
Two-door sedan 35.9%
Four-door sedan 24.2
Two-door hatchback 39.9

Transmissions:
Four-speed manual 74.8%
Automatic 25.2

Why the Datsun B-210?
Economy 67.6%
Styling 31.4
Price 15.9
Size 12.8
Reputation 6.9

Specific likes:
Economy 80.4%
Handling 50.7
Styling 37.4
Comfort 17.1
Ride 8.4

Specific dislikes:
Dealer service 9.6%
Choppy ride 8.9
Lack of power 8.9
Cold starts 6.8

Number of vehicles owned:
Datsun B-210 only 42.3%
Two cars 45.4
Three cars 8.5
Four cars 2.7
Five and more 1.0

Other makes of vehicles owned:
Chevrolet 25.4%
Ford 15.4
Pontiac 14.2
Datsun 13.0
Plymouth 9.5

Comfort opinion:
Good to excellent 76.1%
Average to poor 21.9

Workmanship opinion:
Excellent to good 76.1%
Average to poor 23.8

Dealer service opinion:
Excellent to good 51.2%
Average to poor 48.9

Had any mechanical trouble?
No 62.7%
Yes 37.3

What type of trouble?
Electrical 23.4%
Carburetor and choke 19.6
Cold starting 8.4
Rear defroster faulty 8.4

Did you repair it yourself?
No 91.7%
Yes 8.3

Dealer repairs satisfactory?
Yes 58.4%
No 41.6

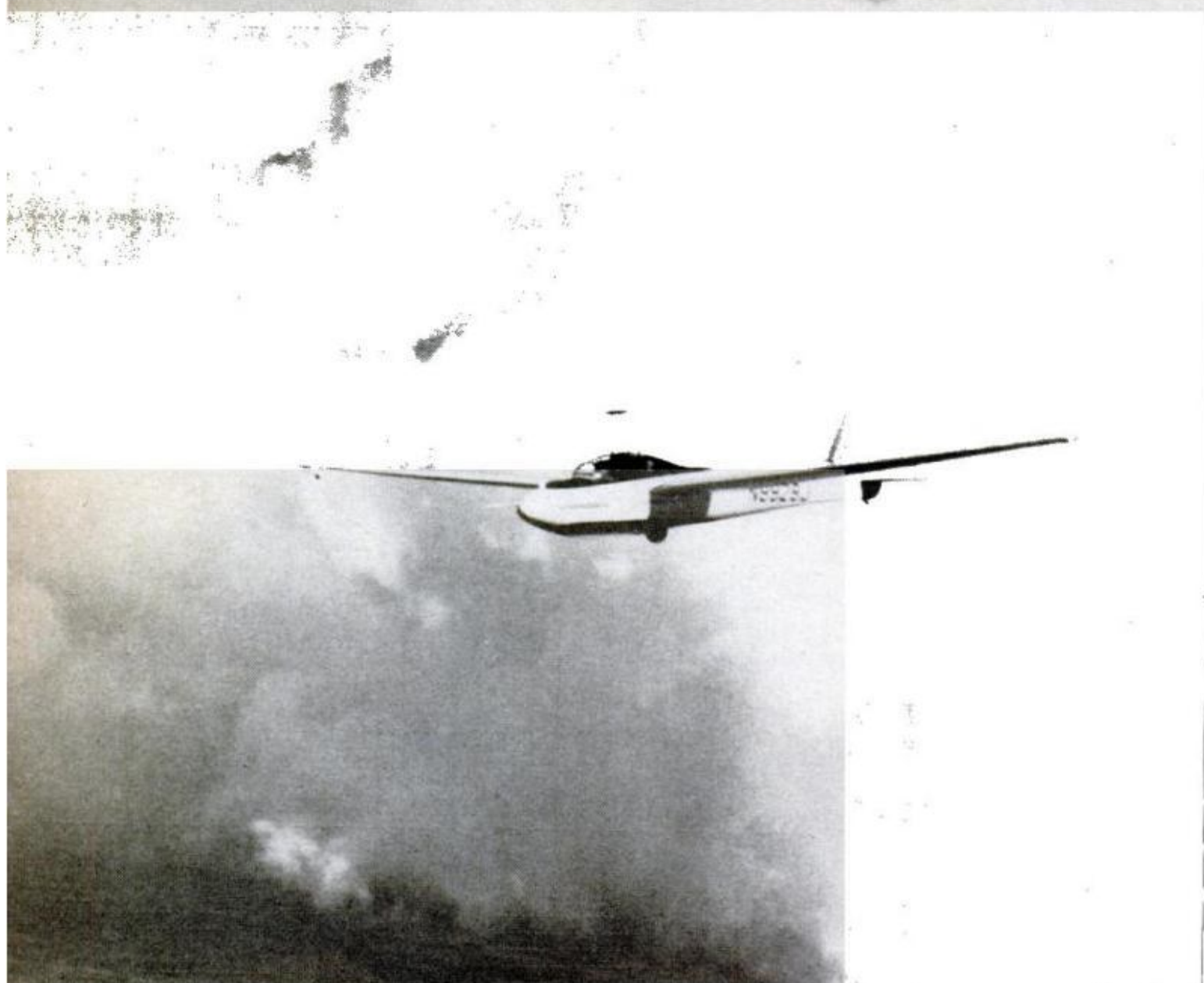
What changes would you like?
Remove seatbelt interlock 10.7%
More rear legroom 9.1
More headroom 9.1
Better tires 5.2

Age distribution of owners:
15-29 years 50.2%
30-49 years 31.7
50-plus 18.0

Would you buy another B-210?
Yes 85.5%
No 14.5

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

Schweizer sailplane is at home in thunderhead. The craft soars on updrafts to chart atmospheric motions and measure cloud particles.



They ride the hailstorms

Daring scientists and fliers take to the air when a thunderstorm threatens the Great Plains. Their object: to learn more about hail.

by Gene Smith

136 POPULAR MECHANICS

This summer, a transplanted Dutch physicist will climb into a sailplane and, over the eastern flank of the Rockies, head for the dirtiest weather he can find.

Lanky Wim Toutenhoofd is no mere thrill seeker. A research scientist as well as an experienced sailplane pilot, he is a member of the scientific staff of the National Hail Research Experiment—a five-year program that could result in an annual saving of \$500 million in property and crops.

Funded by the National Science Foundation at a level of about \$2.5 million an-

nually, NHRE commands an "army" of more than 200 scientists, tons of sophisticated ground equipment and a dozen aircraft ranging from Toutenhoofd's modified Schweizer to supersonic military jets. Men and machines are arrayed against a single enemy: hail.

One of the farmer's traditional problems is the weather. If it's not too dry, it's too wet. And if it's neither, hail may come along just at the peak of the growing season and hammer crops to the ground. Government estimates say hail losses cost American farmers more than \$400 million a year. Hail insurance among wheat, sugar beet and corn growers is almost a standard precaution, but high premiums can wipe out a good part of the profit on a crop.

Logan County, Colo., where a \$5 million seasonal crop loss is not considered unusual, lies in an area weather men call "Hail Alley." In addition to the northeast corner of Colorado, the Alley also includes chunks of adjoining states—Wyoming, Kansas, Nebraska. It is here that NHRE has instrumented a 600-square-mile test plot that straddles the Colorado-Nebraska line.

Man has been trying to tame the weather for thousands of years, with indifferent success. At least as early as 300 B.C., men tried to bring rain by beating on kettles set in their fields. Dr. William C. Swinbank, NHRE director, says the Egyptians, Greeks and Romans all experimented with various hail-suppressing ceremonies.

Swinbank, a much-traveled Englishman with an international reputation and shaggy eyebrows, says an Egyptian practice was to post four nude women, legs raised, in a field. He dismisses Greek and Roman practices as too erotic for comment.

What Swinbank calls "serious" attempts at weather modification date from about World War II, and commercial cloud seeding has been expanding slowly since.

At first, aircraft "seeded" likely looking clouds with dry ice, producing very severe cooling, which in turn caused the cloud's water droplets to freeze and form strong foci for accretion of more water. The idea was to cause rain, but today a very similar technique is used to suppress hail.

Now, metallic iodides have replaced dry ice. The most common is silver iodide, a substance far finer than face powder and one of the basic ingredients of photographic emulsions. Lead iodide also is used occasionally. Mostly, the iodides are seeded



Prior to cloud-seeding mission, Bill Carley (top) loads a silver iodide flare into rack in belly of a Piper Aztec. Flares are fired electrically by pilot, burn 30-45 seconds. Each discharges 3.5 ounces of silver iodide. Wim Toutenhoofd, shown with sailplane he regularly flies, was an ideal choice for a job with the National Hail Research Experiment. Not only is he a nuclear physicist, but also a skilled sailplane pilot. On typical flight, Toutenhoofd guides plane through a storm's lower levels, and a technician in the back seat photographs water droplets and collects graupel—soft hail. The sailplane is equipped with temperature and altitude sensors, air motion detectors and FM telemetry linking it with a mobile ground station and eliminating need for heavy recording devices aboard craft.

by aircraft burning special flares just below cloud base.

On the other side of the world, the Russians, who have more anti-aircraft guns than aircraft, have perfected a new twist on the tactics they used 30 years ago against Nazi bombers. Today, instead of protecting cities, they use batteries of guns and rockets to protect 10 million acres of agricultural land, largely in the Ukraine and the Caucasus. Originally, they claimed 90 percent success with these ground-to-cloud control techniques, but lately have scaled these claims to about 80 percent.

The 100-mm AA guns commonly used deliver about four ounces of silver iodide per shell, and typically fire 45 to 50 shells in an afternoon—200 to 300 rounds for a 60-square-mile area on a very stormy day.

To protect an important wine-growing area in southern Georgia, they use special plastic rockets, reports Dr. John Marwitz, a University of Wyoming scientist. Marwitz, one of the NHRE operations directors, spent much of one summer observing the Soviet program. He says the rockets can put around 100 pounds of lead iodide into a small-to-moderate thunderstorm in about 70 minutes.

Marwitz notes the Russians are "well experienced" in their techniques and conduct their program efficiently, but points out that "we have at least 10 times the aircraft density, and a lot of aircraft not under FAA control. I personally wouldn't like to try that kind of seeding operation in the U.S., particularly right here."

He offers no conclusions on the validity of Soviet success claims, but says he thinks their techniques work better on smaller storms. He reported they do little airborne cloud research and relate success data simply to "past records."

In contrast, a day at NHRE's elaborate research headquarters compound near the town of Grover, Colo., starts with a full staff briefing, including a detailed weather forecast and readiness reports on all equipment, aircraft and crews.

At some point in their life cycle, nine out of 10 thunderstorms contain some hail, but most of it melts on the way down and finally falls as rain. A half-inch hailstone, falling from 10,000 feet, will melt before it reaches the ground. A quarter-inch hailstone will do the same in a 2000 to 3000-foot fall.

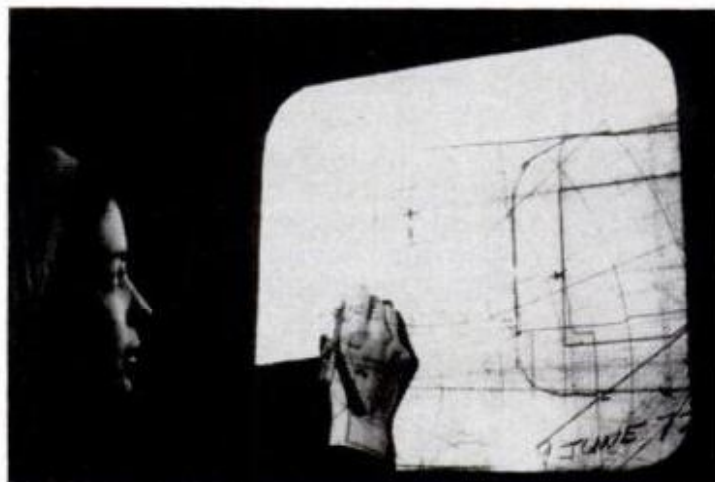
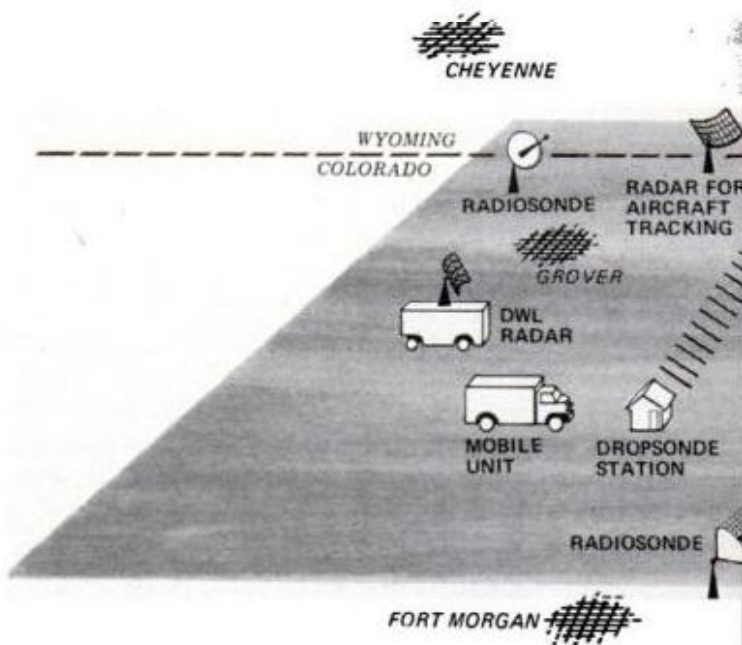
Sometimes conditions are different. Then

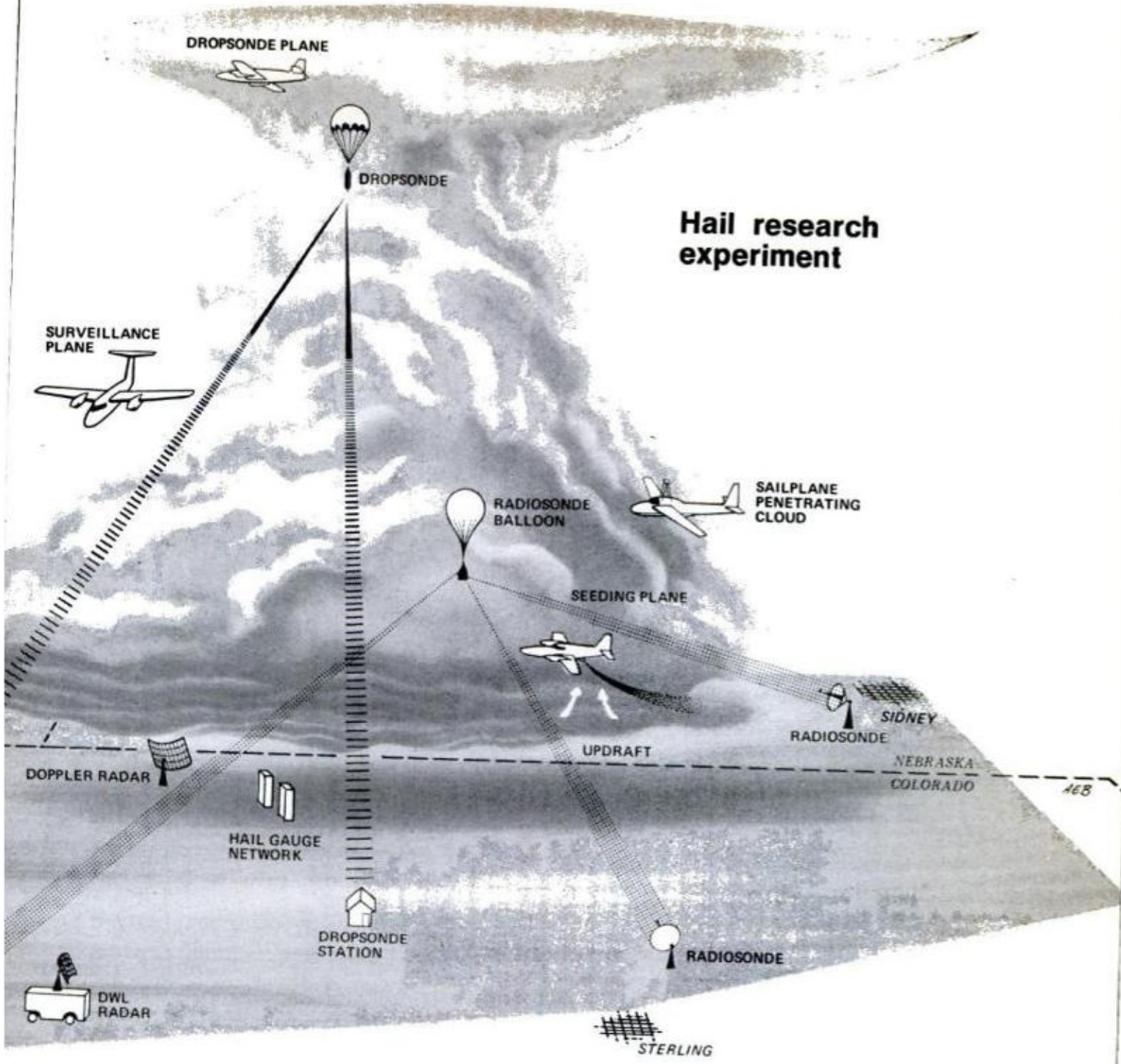
A 600-square-mile test area was laid out in "Hail Alley" by the weather scientists. As shown in drawing, radar is used to track planes and to follow motion of precipitation particles. Doppler radar is capable of measuring the apparent change in frequency of radar waves caused by particle motion. DWL (dual wavelength) radar measures size of water droplets.

Photo of radar scope image is projected onto map (photo below) to permit plotting of storm tracks for the daily staff briefing.

Amounts of rain and hail from storm can be calculated from accumulations in separator (opposite page), shown being serviced.

This installation (opposite page) near Fort Morgan, Colo., is one of two dual-wavelength radars specially designed for research program.





Hail research experiment



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hail can damage, destroy, even kill. The largest hailstone recorded in the United States was collected at Coffeyville, Kans., in September, 1970. It was 17½ inches around and weighed 1¾ pounds, and there were others nearly as big. They had hit at nearly 200 mph, plowing into the ground, punching holes in roofs, denting cars.

Hail size depends on the temperature, the amount of water vapor in a given cloud, and other factors. Any thunderstorm sucks in warm, moist air and discharges cool air, rain and (often) hail. If inflow velocities at the cloud core are very high, say 100-120 feet per second, and if internal temperatures are right, a hailstone might form and be held aloft for as long as 10 or 15 minutes before its weight finally overcomes

the uprushing column of air and it falls.

Silver iodide particles allow cloud droplets to freeze at much warmer temperatures than normal, increasing the competition for available supercooled water. The result is lots of little hailstones, which will ultimately fall as rain, rather than a few big ones, which won't.

But scientists still don't know enough about atmospheric thermodynamics to single out clouds likely to produce damaging hail.

There's a great shortage of reliable scientific data on both cloud physiology and the effectiveness of existing seeding methods. That's the kind of information that NHRE intends to provide.

Research scientists—men who have spent decades studying weather—were assigned to head the team and draft the program. Some of the world's most experienced cloud seeders were hired, and the best weather-research pilots available were assigned to probe both seeded and unseeded storms.

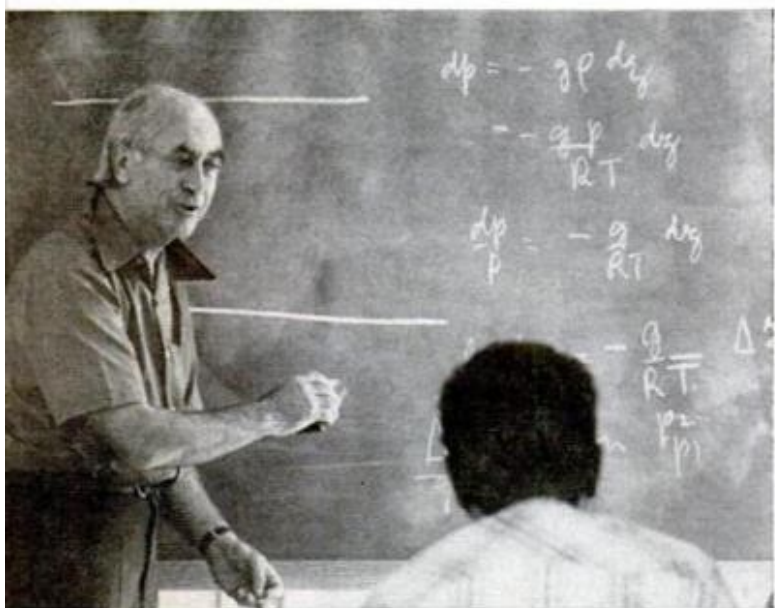
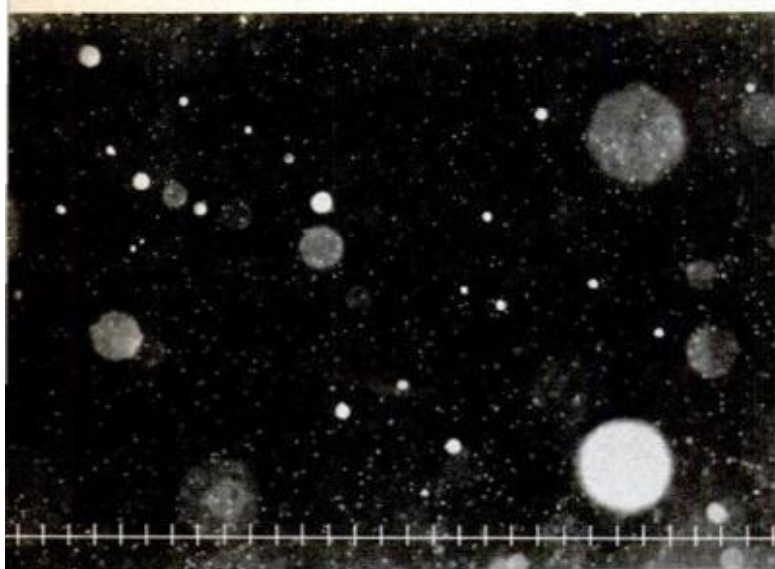
A computer was used to prepare an elaborate, randomized methodology to assure that, over the five-year test span, half the storms studied would be seeded, the other half would not.

The NHRE team was richly supplied with all the specialized equipment the world's most technically advanced society can provide, including custom-built radar, sophisticated computers, thousands of pounds of special sensors built into or designed to be dropped from airplanes, and an impressive squadron of aircraft.

The 90 days of peak thunderstorm intensity, based on Weather Bureau records, were picked for each summer's field research, and a 600-square-mile test plot set up in Hail Alley. The program got underway in 1972.

Radar can't detect whether a storm cell contains hail, but it can and does give readings on the storm's density. When the big NHRE radar at Grover reports one properly located and dense enough to meet program criteria, a hail day is declared and from one to five seeding aircraft are scrambled.

Research planes are already airborne. Most of them circle storm cells at comfortable distances, measuring temperature variations and airflow around the cell. Colorado State University's F-101 Voodoo may actually fly through the upper levels of the thunderhead, taking similar readings. A modi-



Cloud droplets and ice particles were photographed (top) inside a cumulus cloud. Scale superimposed on photo indicates millimeters. Ice crystals range from .1 to .7 mm in diameter, but the cloud droplets are much smaller. Other photo shows William Swinbank at blackboard during typical briefing session.

RVs that go easy on gas

Less wind resistance, fewer cylinders, smaller sizes, lighter weights all have new appeal for motorists stretching miles per gallon. A number of newly announced rigs are suitable for mounting on or towing behind compact lower horsepower cars. Others can be carried by the smaller import pickups. Predictions point to new popularity for camping tent trailers, plus growing—but more careful—use of all other RVs.—*Bill McKeown*

Pop-up penthouse Jiffy Camper fits compacts, is only 3 inches high when folded; \$225 from CarBak Camper, 1115 Twigs St., Tampa, Fla.

Minuteman in red, white and blue stripes from Coleman flips open from low-profile trailer into roomy, screened three-sleeper. About \$695.



Fifth wheelers don't have to be big. Ardon's 18-foot Caravelle adds 12 feet to half-ton pickup tow truck, has double or twin beds.

Mini-truck camper only 7½ feet, 750 pounds, fits Chevy, Ford, Toyota, Datsun pickups. Four-sleeper is about \$1195 from Rover Industries.



Handi-Van, multipurpose 18-footer under \$5000 from Champion Home Builders, has Ford or Chevy chassis, 15 miles per gallon, heavy-duty models.



New from Polaroid:

by Ivan Berger
PHOTOGRAPHY EDITOR

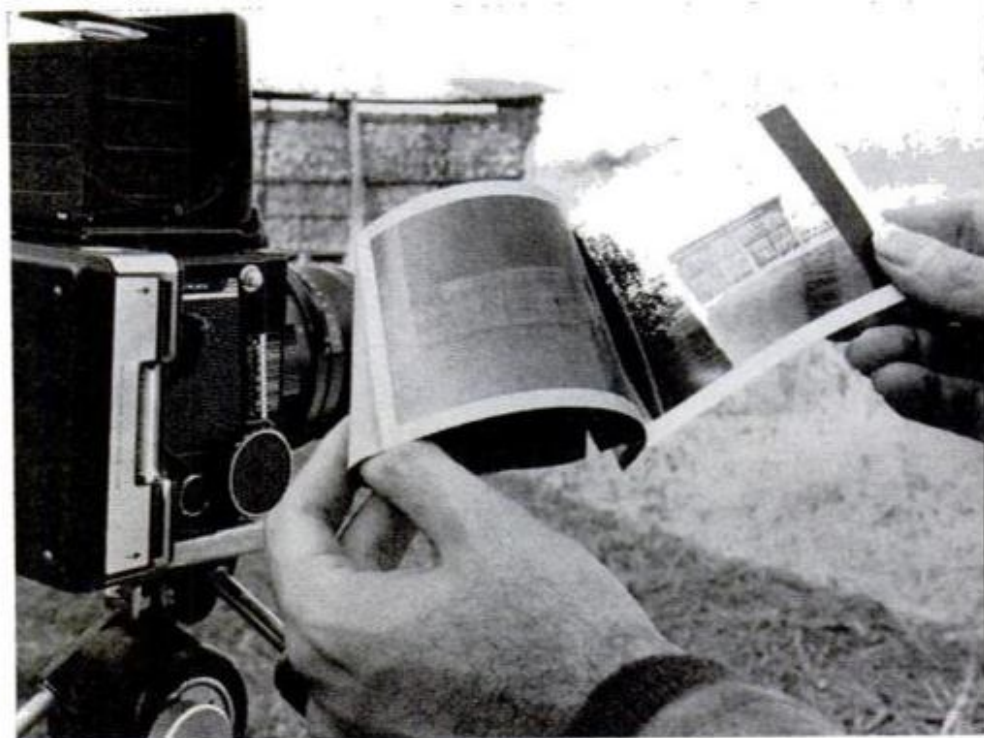
Polaroid cameras have always given you a picture in a minute—but just one picture. Now there's a Polaroid film pack that also gives you a negative you can use to make more prints: the new Type 105.

After exposing, developing and peeling the new film like normal Polaroid films, you soak the negative half in sodium sulfite to remove its opaque backing and developer goo, then wash it. Since the negative should be soaked within three minutes after developing, Polaroid makes a handy, portable



Polaroid's new Type 105 film packs give you an instant print (top center) and an almost-instant negative (top left) from which enlargements (above) can be made. (For 4X enlarged detail of above test shot, see next page).

New film fits Polaroid's regular amateur film-pack cameras, also interchangeable-back professional roll-film cameras like the Mamiya RB67 reflex (right). Between these extremes in cost and versatility is Polaroid's new "professional" Model 195 camera (below), with f/3.8 lens, 1/50-second shutter and a price tag of \$199.95.

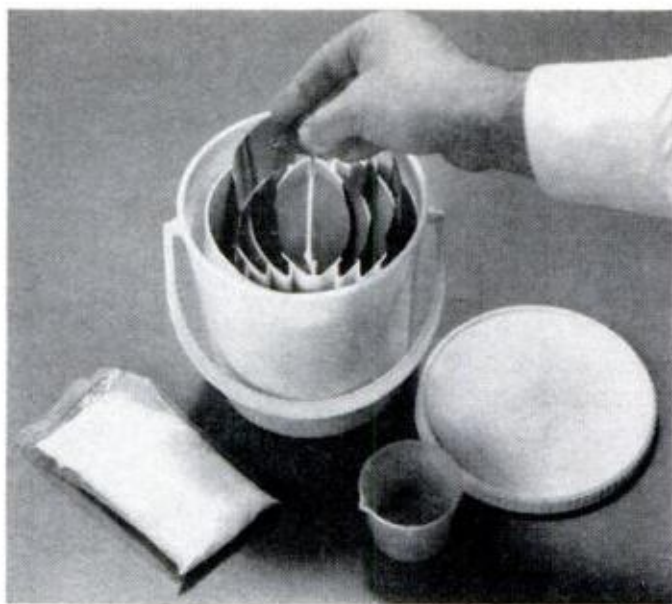


cleaning tank that holds negatives, and whose lid fits tightly, so you can carry it without spilling (the negatives can stay in the sulfite for a few days, if need be).

The film gives softer, less contrasty and grainier images than conventional films of roughly equal speed (ASA 75). But it also has unique advantages: instant confirmation that focus, framing and exposure are correct, and an instant print. These virtues will be invaluable to the pro—but they'll be valuable to amateurs, too. ★★★

instant negatives

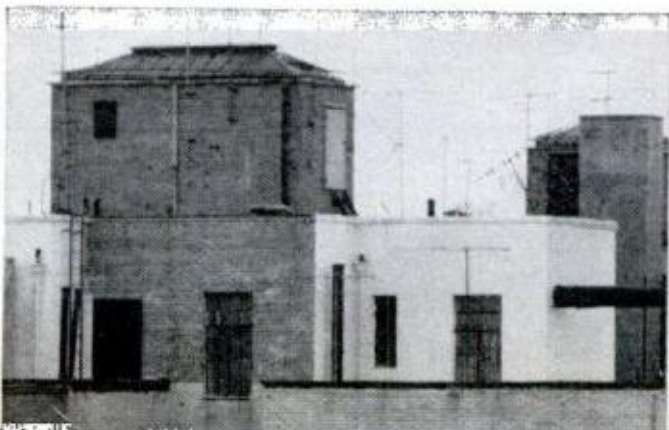
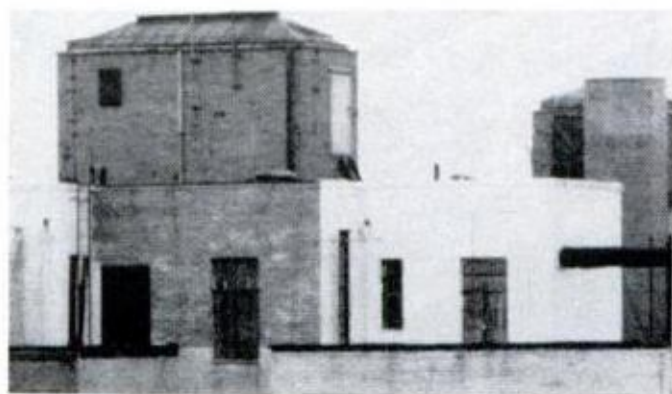
Photos: Peter Schneider



Negative clearing tank (above) holds six negatives in sodium sulfite solution, and comes with an initial sulfite supply and measuring cup. The agitating carrier basket speeds clearing. In the sulfite solution (above right), the black backing strips off to reveal the negative, which must then be washed. Tank costs \$4.95 (it's free if you buy three packs of 105 film) and has a watertight lid.

Negative quality is reasonably good, as shown at right (enlarged about 1.25 times). But when matched against conventional Plus-X 120 film (bottom), Type 105 (below) proves not quite as sharp, contrasty nor fine-grained as Plus-X.

Photo: William Buckley



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Four-wheel-drive get-away van!

You'll never get stuck in the outback when you put power to all four wheels and turn a run-of-the-mill Ford Econoline into a *QuadraVan*.

by Allen Girdler

Everyone stops to ask how a van got four-wheel drive and what it's like to drive. No Ford Econoline has four-wheel drive when it leaves the factory, that's for sure. But when it leaves the Pathfinder Equipment Co. it's a whole new vehicle that's renamed *QuadraVan*. It was created to combine the popularity of a van and the demand for an off-road vehicle that doesn't act like one when it's on the road.

Pathfinder is what's called an after-market manufacturer for Ford. It has been manufacturing *QuadraVans* for the last year and has the conversion job down to

Photos: David Gooley



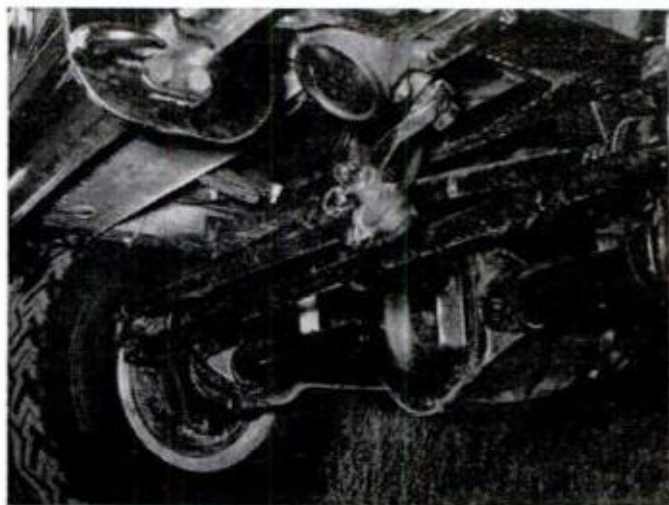


Quadravans start out as Ford Econoline vans. This one was further customized, however. Along with the mechanical transformation to four-wheel drive, the van got exotic paint, side exhaust, lots of lights.

assembly-line efficiency. It takes the Ford vans right from the factory and converts them to 4wd for any Ford dealer.

Your local Ford dealer may not know about Quadravans, however. That's because the 4wd conversion is not a Ford Motor Co. operation and therefore is not brought to the attention of dealers nationwide by Ford. Nevertheless, the procedure for ordering a Quadra van still must be done through a Ford dealer—anyone you pick. Have him contact Pathfinder at Box 86, Dept. PM, San Gabriel, Calif. 91776. He'll order the vehicle for you and it will be shipped to him where you take delivery. The new van is warranted by Ford Motor Co. and the components of the conversion to 4wd by Pathfinder.

Before you read how Pathfinder makes a Quadra van out of a standard Econoline, note that the Quadra van shown here isn't the final result. What you see here is not what you get! This Quadra van was beautifully customized by another California com-

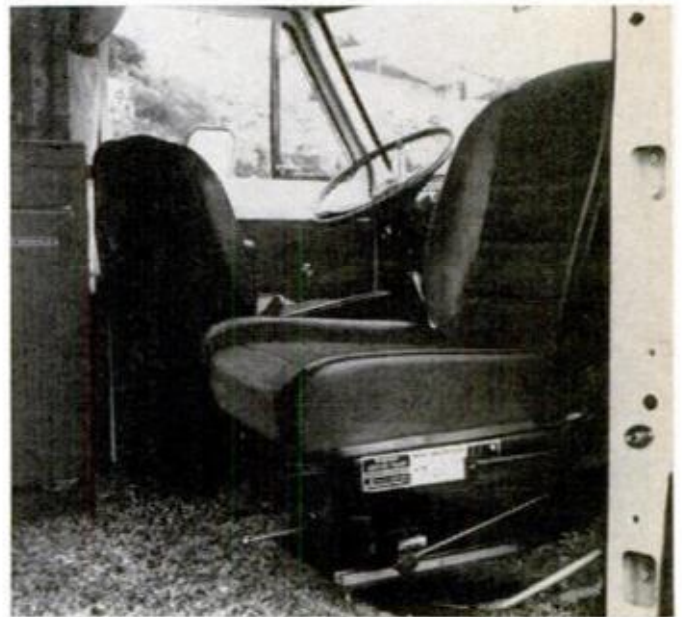


New front subframe in Quadravans replaces stock front suspension. Original Ford coil springs are retained, however, and axle is located with radius arms and patented system of tracking rods.

pany, Recreational Vans, Inc. That's what the "RVI" designation is that appears several places on the van in the pictures.

RVI fully developed only one of the many configurations that are possible. The interior could be laid out to satisfy a wide range of industrial or recreational requirements. The interior space is ample enough to allow a variety of floor plans—bare workhorse, mobile laboratory, business office or mini-motorhome.

A Quadra van is available on either the short (105-in.) wheelbase or long (123-in.) wheelbase. The first step in the manufacture is the removal of the stock front suspension. Pathfinder installs a new subframe



High-back, wrap-around bucket-type seats are in the customized Quadra van. They're adjustable up and down, swivel for ease of access and are mounted on adjustable shocks. You can also adjust bounce rate.

of 10-gauge steel that reinforces the original unibody construction. The new front axle is built by Dana Corp. to Pathfinder's specifications. It is a Model 44 heavy-duty drive axle.

Most four-wheel drive vehicles use leaf springs to locate and suspend the front axle. The Ford Quadra van was specifically designed for coil spring suspension and locates the axle with radius arms and a patented system of tracking bars. The bars provide tracking and cornering stability.

Maximum use is made of Ford stock parts. Behind the transmission goes an adapter housing and a Dana Model 20 two-speed transfer case. The transfer case has four positions: 4WD high, 2WD high,

neutral and 4WD low. The high range simply puts the power through the transfer case at a 1:1 ratio and the low range steps up the engine speed for slogging through soft terrain, up hills and the like.

On the road, the Quadravan does well. The ride is firm but not overly so. The stability is excellent. The van doesn't tend to wander as do some other 4wd vehicles. The



Living section of customized Quadravan is set up for great comfort for two people: there's two-burner gas range, refrigerator, sink with a 40-gallon tank, an electric pump and double bed/couch.



Interior of the customized van is completely insulated, fully carpeted and paneled. All the cabinetry drawers and pull-out bed are notched and slotted so everything stays in place when the going gets rough.



On the road, Quadravan's ride is firm but not too hard. Offroad tires aren't for sustained high-speed driving, but with recently imposed speed limits you can run them with no problem at all.

van will do 85 mph, but don't try it these days. Owners who have taken their Quadravans into the desert in company with four-wheel-drive trucks, Broncos, and other 4wd vehicles say that the Quadravan has never failed to climb a hill the others could climb.

If you get enthused about customizing a Quadravan, there are any number of configurations you can select from and lots of custom equipment designed for vans—you can even raise the roof! Long-wheelbase models will sleep four people and ride eight while still having enough space for a four-burner range, an oven, sink, refrigerator and all the other comforts to be found in motor homes.

RVI could have gone in a number of directions in customizing this Quadravan. They chose luxury for two. Driver and passenger ride in Bostrom seats, high-back, wrap-around bucket jobs. The seats go up and down, they swivel for ease of access and they have an air-spring suspension to absorb major bumps.

This last feature is tunable by the occupant. There's an AM/FM 8-track stereo player overhead and the engine cover has a little holder to keep your glass or cup from tipping over.

The living section has a two-burner gas range, a refrigerator, a sink with a 40-gallon water tank and an electric pump, a couch that folds into a double bed, and a lot of storage space and cabinetry plus "wall-to-wall" carpeting. ★★★

World's fastest bicycle

by Jake Grubb

Photos: H. Gallagher



Record-setting bike has vertical bumper just ahead of its handlebars. Bumper is same height as a horizontal bumper bar mounted on shock absorbers at the rear of the pace car. The system acts as buffer in case the two vehicles collide. In photo below, Abbott rides in partial vacuum created by boxlike rear of the pace car.

Traveling at times more than 140 mph, 29-year-old Allan Abbott set a new world bicycle speed record of 138.674 mph late last year on the Bonneville salt flats.

The record broken by Abbott was that of Frenchman Jose Meiffret, who in 1962 rode 127.243 mph behind a Mercedes 300 SL pace car on a German autobahn.

Abbott, a San Bernardino, Calif., physician, also used the paced method—that is, he pedaled close behind a shuttlecock-shaped car that “bored a hole in the air” through which he was able to develop the fantastic speed over the mile course.

Abbott designed and built both the record-setting bicycle and the pace car especially for the record attempt. Two drivers operate the car, one behind the wheel to steer and the other sitting in back facing the rear to operate the throttle. During the record attempt, Abbott's front wheel was partially inside the clear Lexan plastic-enclosed rear opening of the car.

The 35-pound bicycle is double-diamond design and follows the frame geometry of a Yamaha TD3 road-racing motorcycle,



including fork rake, wheelbase, overall length and ground clearance. All tubing is chrome moly. The 18-inch lightweight wheels are made by Akront. The Dunlop motorcycle racing tires are shaved of tread to reduce all possible friction.

The bicycle's huge primary-drive sprocket was made by a firm that closed down its regular production for one day to produce the 230-tooth special. Every other tooth was then machined away to reduce friction. The rear sprocket has 13 teeth, so that the rear wheel turns 17.5 times for every turn of the primary sprocket. At 140 mph, Abbott's legs would have been turning the primary sprocket 135 times a minute. ★★★

Kit-built auto tune-up instruments save you money

by Ivan Berger
ELECTRONICS EDITOR

Do your own tune-ups, and you'll save. All it takes is a little knowledge, time and the right instruments. And if you build those instruments yourself from kits, you can save even more.

Tune-up kits can't do everything, of course. Not too surprisingly, these electronic instruments are primarily useful for checking your car's electrical and ignition systems (though they can be of some help with such simple carburetor adjustments as idle speed). And you'll still need the appropriate wrenches, screwdrivers and such

spare parts as points, plugs and condensers (though once you're in a position to check them at will, you can replace them only as it becomes necessary—not on an arbitrary schedule).

Two basic instruments are required for a complete tune-up: a timing light and an ignition analyzer that incorporates dwell angle and tachometer functions. The three timing light kits we tried (the two Heathkits shown and a \$20 ArcherKit) seemed basically similar; the main practical difference was the Heath CI-1040's inductive

Car-care instruments available in kit form run gamut from \$130 oscilloscope (far left) to \$20 timing light.

For details on differences between meters shown, see the comparison table on page 150.

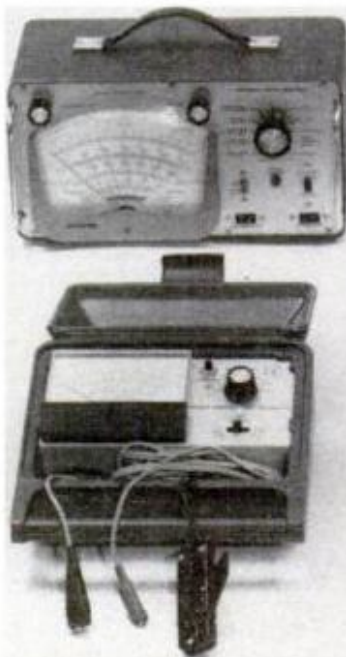
ARCHERKIT 28-3323, \$55

EICO 888, \$55

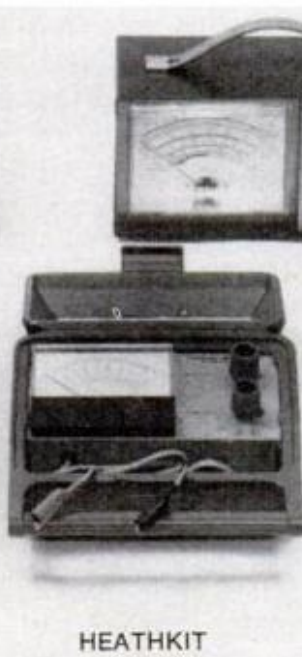
EMC 100K, \$26



HEATHKIT CO-1015
IGNITION
SCOPE, \$130



HEATHKIT CM-1045
SMALL-ENGINE
ANALYZER, \$40

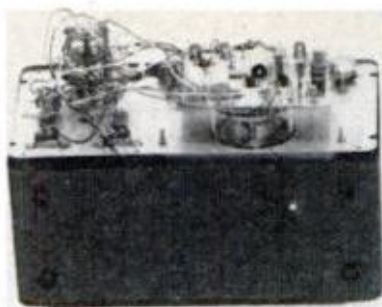


HEATHKIT
ID-29, \$30



HEATHKIT TIMING LIGHTS:
CENTER, CI-1020, \$20
FRONT, CI-1040 WITH
INDUCTIVE PICKUP, \$30

ARCHERKIT 28-3323



EICO 888



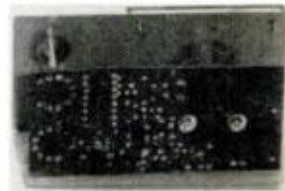
HEATHKIT CO-1015



HEATHKIT CM-1045



CASE FOR
HEATHKIT
CM-1045, ID-29



HEATHKIT ID-29

Inside views show degrees of complexity, but sizes can fool you: Heath scope took only 9 hours to build, while smaller ArcherKit meter took 10 hours. Heath ID-29 Auto Tune-Up meter took just 1¾ hours, but is less versatile. Plastic case in center fits both of Heath's small meters, the CM-1045 and ID-29.

Photos: Robert D. Borst

Heathkit CM-1050 has cord storage compartment (as does ArcherKit), well-recessed meter (as does Eico).

pickup (see photo on page 151), that snaps around a sparkplug lead so you don't have to disconnect the plug.

The analyzers ran a wider gamut of prices and capabilities, as shown in the table. All can check engine rpm and dwell angle, while the more elaborate ones add spark, diode, condenser, resistance, voltage and current ranges. The over-\$50 analyzers had larger meter faces (largest on the ArcherKit), which were a trifle easier to read, but which could be damaged if you carry them around in your car trunk. All three meters were about equally handy, though we'd rate the Heath a trifle higher for having both cord storage and protectively recessed meter, an inductive tachometer pickup and slightly greater versatility.

If you want to keep a tester in your trunk, we'd recommend one of Heath's smaller meters, whose tough plastic cases provide cord storage and a lot of protection (though they also make the meters a bit bulkier than they'd otherwise be). The "small engine" meter is the more versatile and expensive of the two, and though it's calibrated for engines of one to four cylinders (two-stroke or four-stroke), the only change needed to use it on Sixes or Eights is to halve the dwell readings from the three-cylinder or four-cylinder scales.

For the occasional user, we'd recommend Heath's ID-29, since it has no batteries to rot away if forgotten (a common complaint



HEATHKIT CM-1050, \$65



Stroboscopic timing light, flashing in sync with spark, "freezes" moving timing marks.



Multifunction meter kits aren't too complex. For inside look at this ArcherKit assembled, see page 148.

with analyzer owners), and its instructions are printed inside the case lid; it's also easy to build and inexpensive—but one of the two least versatile meters, too.

The most sophisticated tune-up tool is the oscilloscope. Heath's scope can't make many of the tests the meters can (voltage, current, continuity and diode tests, primarily), but it does give the most thorough readout of ignition ailments: once you've learned to read its traces, you can check directly for plug gapping and condition, dwell angle, cam wobble and the condition of your points, condenser, coil, distributor and wiring—and, if the trouble doesn't affect all cylinders, know which ones are suffering.

The scope's leads are also long enough to reach from the engine to the passenger seat, so with the optional inverter power supply that lets you run the scope from your lighter socket, and a passenger to watch the scope traces as you drive, you can check out your ignition under actual operating conditions, too.

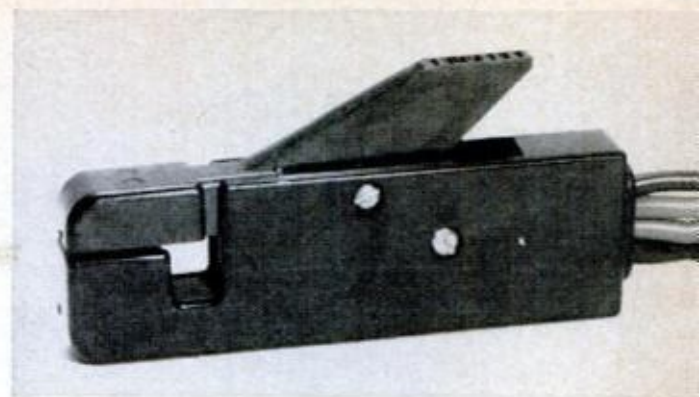
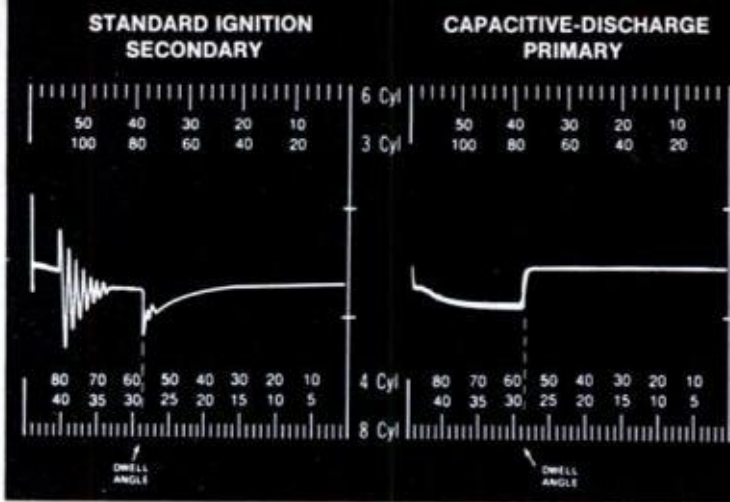
Proper use of any of these instruments requires some knowledge of your car (your dealer can show you such "landmarks" as the timing marks) and careful study of the instruments' instructions. Heath wisely puts its scope's operating instructions in a separate manual from its assembly instruction book, and prints it on greaseproof and waterproof paper. Otherwise, the "handy instructions" award goes to the ArcherKit, whose book folds easily into its test-lead compartment. ★★★

Auto test kits compared

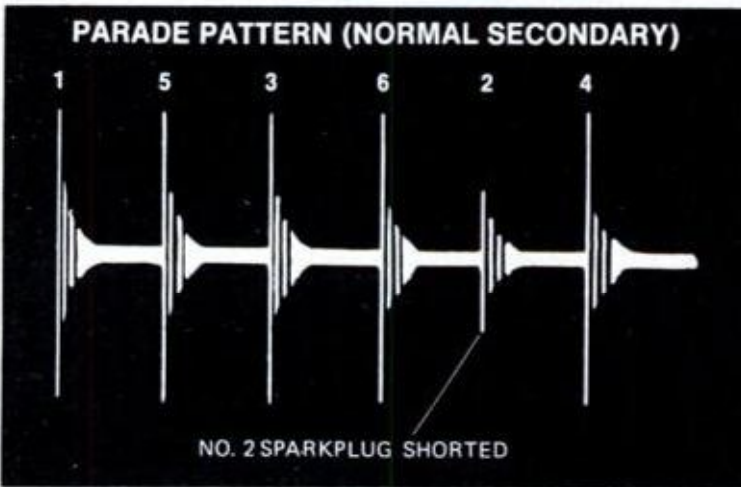
Make and Model	Prices (Kit/Assembled)	Approx. Assembly Time (Hours)	Number of Cylinders	RPM Ranges	Dwell	Spark Test	Diode Test
Heathkit CO-1015 Ignition Scope	\$130/\$200	9 ¹	3, 4, 6, 8	1000, 5000	Yes	Yes	No
Heathkit CM-1050 Engine Analyzer	\$65/\$100	12	3, 4, 6, 8	1200, 6000	Yes	0-50 scale	Forward-reverse
Eico 888 Engine Analyzer	\$55/\$80	7 ⁴	4, 6, 8	1200, 6000	Yes	Hi-lo ²	Forward-reverse
Radio Shack ArcherKit 28-3323 Auto Analyzer	\$55/n.a.	10	4, 6, 8	1200, 6000	Yes	Hi-lo ² and light	Forward-reverse
Heathkit CM-1045 Small Engine Tune-up Meter	\$40/n.a.	8 ⁴	1, 2, 3, 4	3000, 15000	Yes	No	(Use ohms)
Heathkit ID-29 Auto Tune-up Meter	\$30/\$43	13 ⁶	3, 4, 6, 8	1500, 4500	Yes	Yes	No
EMC 100K/100	\$25/\$31	2 ⁴	4, 6, 8	1200, 6000	Yes	No	(Use cont.)

Notes: ¹Plus two hours for optional inverter. ²Readings for reference comparison only. ³Includes projecting handle.

IGNITION SCOPE WAVEFORMS



Inductive pickup in several Heathkits (see table) snaps around plug lead for simple hookup.



Bolt-on inverter kit lets a.c.-powered Heath scope run from car battery via lighter socket.

Oscilloscope display shows in detail the functioning of an ignition. The standard-ignition secondary display (top left) represents an overlap of patterns from each cylinder; note the dwell-angle scale that appears on the scope face. Parade pattern in lower drawing shows the cylinders individually; note effect of shorted No. 2 sparkplug (second from right).

Condenser	Voltage Ranges	Amperage Ranges	Ohmage Ranges	Size (Inches)	Cord Storage	Remarks
0 Checks all ignition functions	None	None	None	10½ x 7½ x 17½	No	A.c.-powered oscilloscope with 12-v. inverter optional (\$25/\$33), inductive pickup, manual on greaseproof paper
2 Sub and leakage	3.2, 16, 32	-5 to +90	1K, 100K	7½ x 10½ x 8¾	Yes	Point resistance and alternator checks, inductive pickup
2 Sub and leakage	3.2, 16	90	20K	5¾ x 11½ x 5	No	Meter protectively recessed, case key-slotted for wall mounting
2 Sub and leakage	3.2, 16	90	20K	6½ x 12½ x 6½	Yes	Extra large meter
Wo	20	No	100K	9½ x 5½ x 9³	Yes	Tough but bulky case, continuity/points light, inductive pickup
Wo	15	No	No	9½ x 5½ x 9³	Yes	Same case as CM-1045, instructions in lid, not for solid-state ignition, no batteries required
Wo	No	No	Continuity check	5¼ x 6¾ x 3	No	

1*Estimated. n.a.—not available.

Backpack paint-removing machine

A wire brush on a flexible shaft removes peeling paint fast, makes surface preparation a breeze.

by Parry C. Yob

Scaling paint presents no problems for a power-driven wire brush which cleans itself. Mounted on a backpack, the weight of the motor is easily carried for hours, leaving your hands free to work.

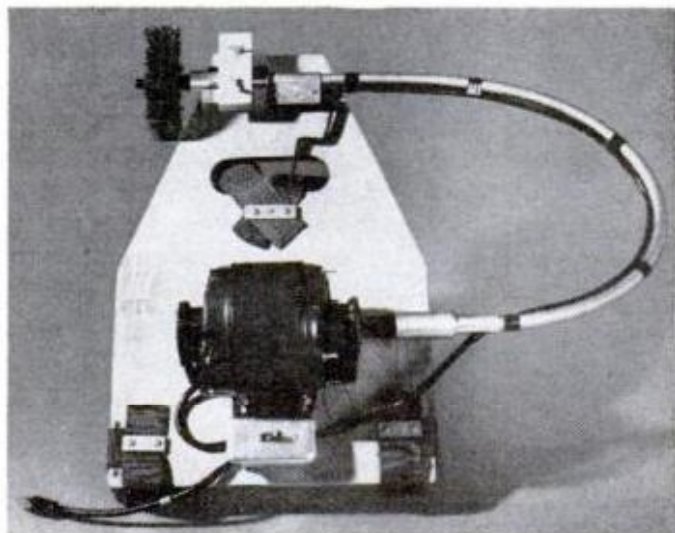


By far the most time-consuming and back-breaking task of any house-painting job is the removal of flaking, peeling and loose paint. Hand brushing, scraping or sanding can take endless days for an ordinary-size home, and other methods are not much better. Electric and gas paint-burners create a gooey, sticky mess which is often harder to eliminate than old paint, while power sanders are too heavy to hold up all day, and the sandpaper quickly becomes clogged with paint residues. Now, however, you can put your problems behind you by making the outfit shown here.

Built like a backpack frame, this simple machine transfers all its weight to your hips and shoulders and allows you to work for long periods without fatigue while the motor-powered wire brush quickly whisks away all loose material.

Start by cutting a piece of 1/2-in. plywood to the dimensions shown in the drawing; then use a hole saw to make the rounded ends of the hand-hold slot. Finish the straight portions of the hole with a sabre saw. Use 1 1/2-in. No. 10 wood screws and white glue to attach the two 3 1/2x4-in. cleats to the back of the board, and sand all edges and corners so they are splinter-free.

Use 2-in. webbing to form the shoulder and hip straps for the motor pack board, and short aluminum pieces to hold the

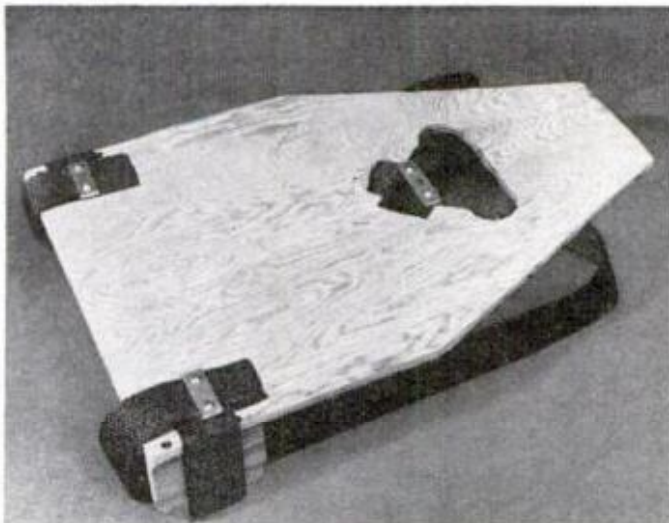
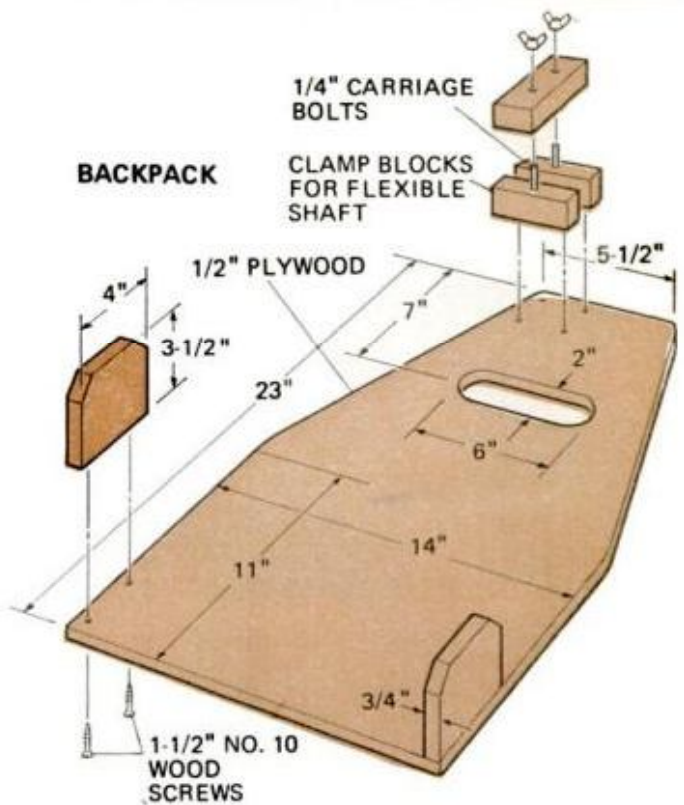
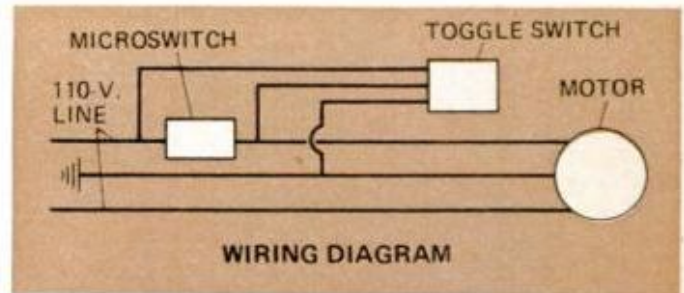


As shown here, machine is for right-handed painter. For left, motor is mounted with shaft to the left, and handle clamp to right side of pack board.

straps in place as shown in the photos. The hip strap is stretched tightly across the cleats and brought around the board so that when the roundhead screws are used to attach the strap to the edges of the cleats, the webbing will strengthen the assembly. The shoulder straps should run through the slot in the board and be attached as shown before you cut them to length. With the upper ends attached, place the straps over your shoulders and move the board as high on your back as possible. Then adjust the straps so that they feel quite snug but are still comfortable and mark them for attachment to the bottom end of the board.

If you wish, at this point you can slip a pair of backpacker's shoulder pads over the straps before final attachment. These can be purchased at any hiker's or outdoor-supply store. Short 1/4-in. carriage bolts are used to attach the motor to the backboard, and the motor can be 1/4 or 1/3 hp. The one shown here is a furnace-fan motor from Sears, and the flexible shaft was also obtained from the same source.

A three-wire, grounded power cord is used to bring power to the motor, and it should be No. 16 or larger wire. The ground wire is run to the switch box, then on to the motor frame, and an ordinary household toggle switch is placed in series with the circuit. A second length of three-wire cord

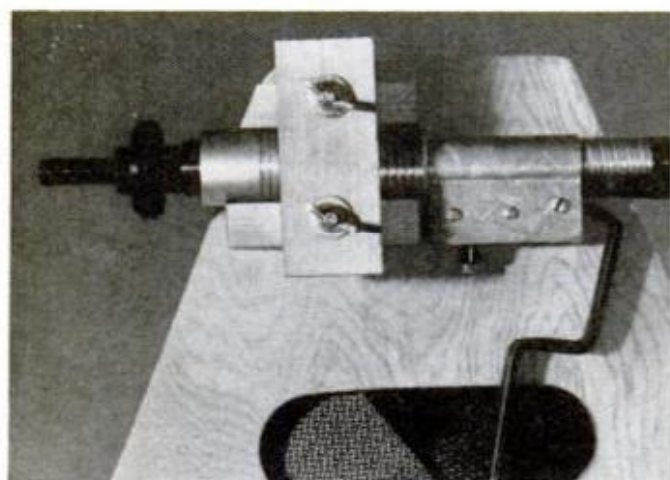
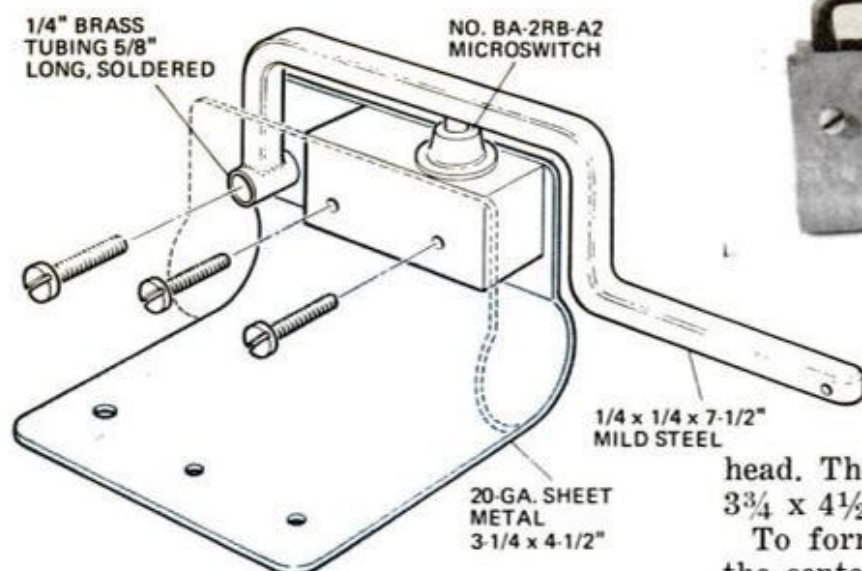


Web straps are brought through carrying hole to bring top of board closer to shoulders for easier support. Metal cleat holds ends of webbing straps.



Body side of pack board shows hip strap stretched tightly across cleats and attached with roundhead screws. Shoulder strap passes under hip strap.

Dead man's switch



Wood cleats glued to pack board form a channel for the flexible-shaft handle when stored. The crosspiece is held with wingnuts and two 1/4-in. carriage bolts.

is connected so that its black lead is attached to one binding screw of the switch and its white wire is attached to the other screw of the toggle switch. The green ground wire is attached to the switch box. This second piece of power cord is taped to the flexible shaft and the black and white leads will later be attached to the terminals of the microswitch.

The microswitch is wired in parallel with the toggle switch and connected so that it is in the normally open position, which means that the switch is in the off position any time the switch button is not pressed. The purpose of this dead-man's switch is to provide a safety feature when you're working from ladders and scaffoldings. Although the machine is designed to always leave one hand free for grasping a ladder, it is possible that you might accidentally drop the flexible shaft head. In this event, the motor will shut off when you let go of the shaft



Switch handle is bent from 1/4-in.-sq. steel so that it will pass around microswitch. Pivoting hole is made by soldering a short length of brass tubing to the steel handle.

head. The switch housing is made from a 3 3/4 x 4 1/2-in. piece of 20-gauge sheet metal.

To form the housing, bend the metal in the center, then place a piece of metal rod or pipe in the bend with a 5/8-in.-thick block of wood between the sides of the metal. Use a vise to clamp the metal down against the block to form the straight sides of the housing. The mounting holes in the switch are used as a guide for drilling the bolt holes in the housing. Placement of the third hole in the housing will depend on the diameter of your flexible shaft, and this hole should be drilled after you have made the switch handle.

The switch handle is made from a 7 1/2-in. length of 1/4-sq. mild steel, and it is bent to shape using the assembled switch and housing as a guide. A 5/8-in. piece of 1/4-in. copper or brass tube is soldered to the end of the handle to make the hole which acts as a bearing. The third hole in the switch housing is now drilled in a location which will cause the microswitch to close when this handle is squeezed almost against the handle of the flexible shaft.

To use your paint remover, place a 6-in.-dia., coarse-wire brush on the shaft head, plug in the cord and squeeze the handle. A 1-in.-wide brush works well for removing narrow bands of paint scale, and two of these brushes can be mounted side by side for greater coverage.

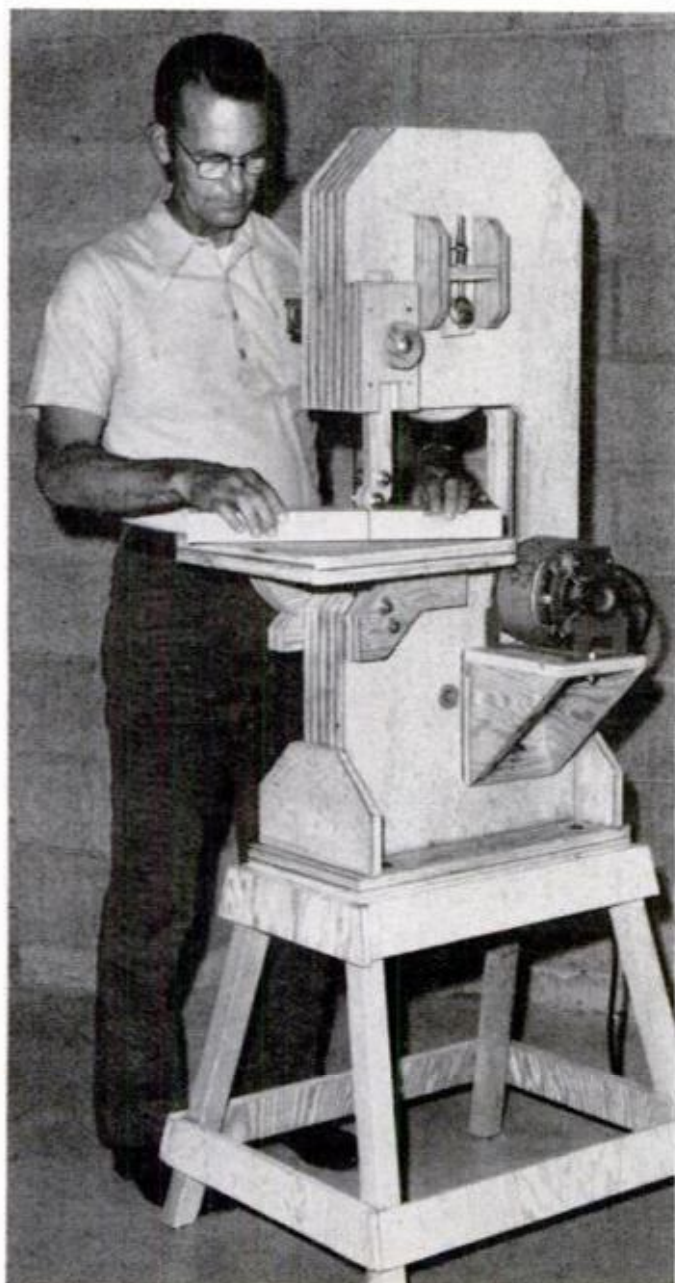
When you're standing on the ground or using the unit as a stationary brushing machine, use the toggle switch instead of the handle switch. With the shaft head clamped to the pack board, the machine becomes a handy bench grinder or buffer.

As a safety note, you should always wear a face shield when working with a power brush. Sometimes a small wire will break and it could fly off with enough force to cause an eye injury. ★★

Build this 12-inch bandsaw for your shop

You can make it for less than \$50. It uses V-pulleys for wheels, V-belts for tires, has tension and tracking controls and can be driven by any used appliance motor.

by John A. Hoffmann



This build-it-yourself wood/metal-cutting bandsaw will prove handy when it comes to contour, straight-line and resawing operations. You can build it for a lot less than you can buy one, and to make it even easier, you can buy a hardware kit. Any motor ranging from $\frac{1}{6}$ to $\frac{1}{3}$ hp will drive it. There are 12 steps to build it:

Step 1. Lay out all pieces as shown on page 160, then cut them out. All 48 separate parts can be cut from one 4x8-ft. sheet of $\frac{3}{4}$ -in. plywood.

Step 2. Drill the holes and make the cutouts in part 1. Using glue and $1\frac{1}{4}$ -in. No. 8 screws spaced 4 to 6 in. apart, start building up the sandwich by adding stiffeners 3, 4, and 5 to the inside of part 1 and countersink the screwheads. Chisel away enough wood from around the three holes so you can also countersink the bolt heads for the motor shelf, and insert three $\frac{3}{8}$ x 2-in. carriage bolts.

Step 3. Make the cutouts in part 2. Using glue and screws, attach the upper wheel hanger, parts 21, 22 and 23, to the outer face of part 2. The bottom edge of part 23 is to be flush with the top edge of the 2x4-in. cutout. Be certain the $\frac{15}{16}$ -in. distance from the edge of part 23 to the center of the $\frac{3}{8}$ -in. hole is from the face of part 2 to the hole. This piece could accidentally be installed in a reverse way, which would cause the upper wheel hangers to bind. Position a similar hanger on part 1 the same distance down from the top and attach it in the same manner. Add part 2 to the rest, using glue and flathead screws.

Step 4. Position part 20 so the cutout mates with the opening in the bottom of the built-up assembly and attach it with glue and flathead screws. Glue and screw parts 19 to the front and rear faces and to part 20.

Step 5. Assemble the saw stand as shown, using glue and screws at all joints to produce a sturdy assembly, and then attach the built-up assembly to part 20 of the stand with $\frac{3}{8}$ x 2-in. carriage bolts.

Step 6. Cut the 37-in. V-belt and press

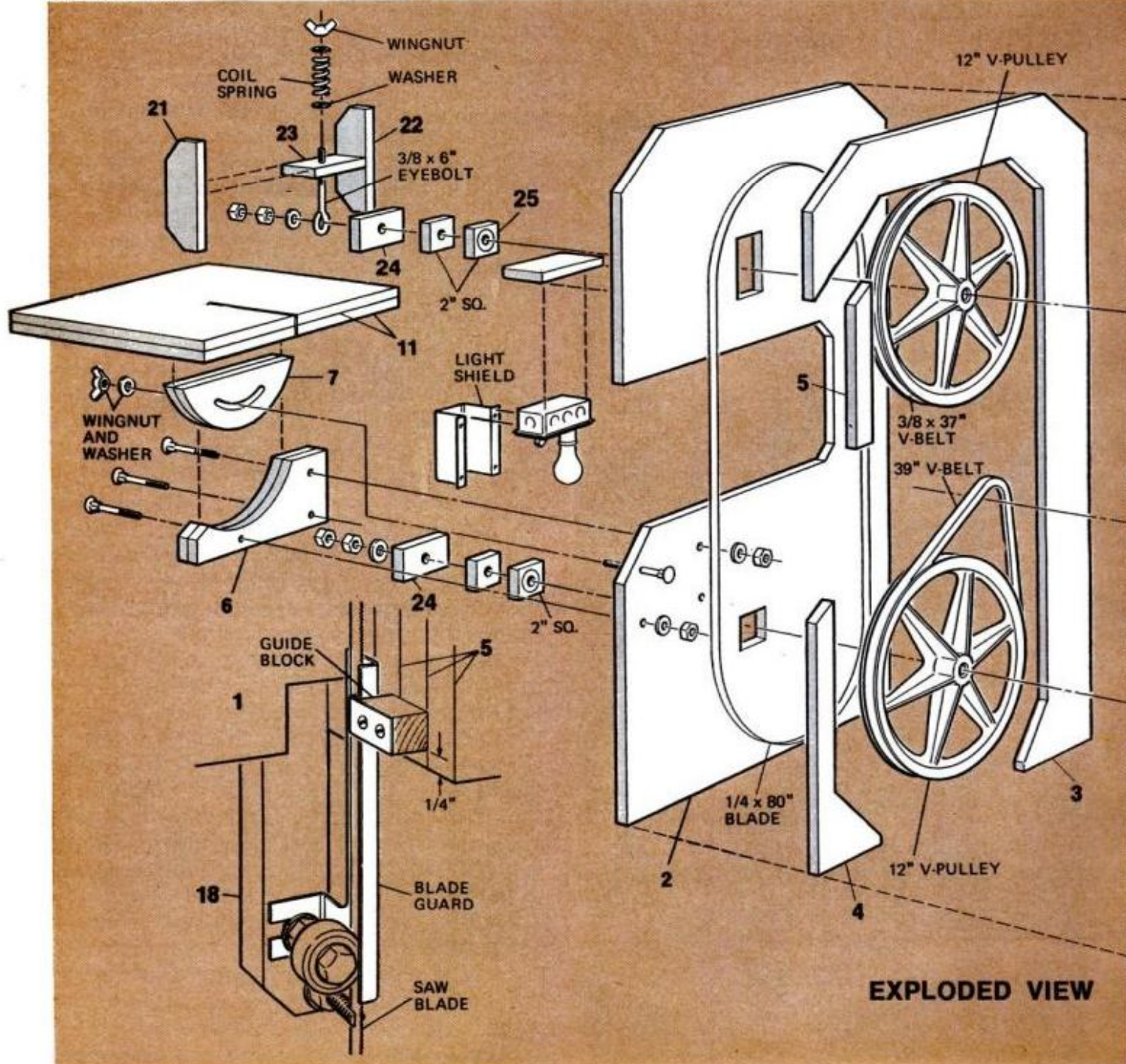
it into the groove of one of the 12-in. V-pulleys. Trim the ends of the belt so that they lack approximately $\frac{1}{8}$ in. of butting. Fill this gap with glue. The belt forms the tire for the upper blade wheel. Parts 24 and 25 are used to install the upper wheel. Part 24 is a 2x3-in. plywood block; parts 25 are 2x2-in. blocks. These three blocks for part 2 are all fastened together with flathead screws and center-drilled with a $\frac{1}{2}$ -in. bit.

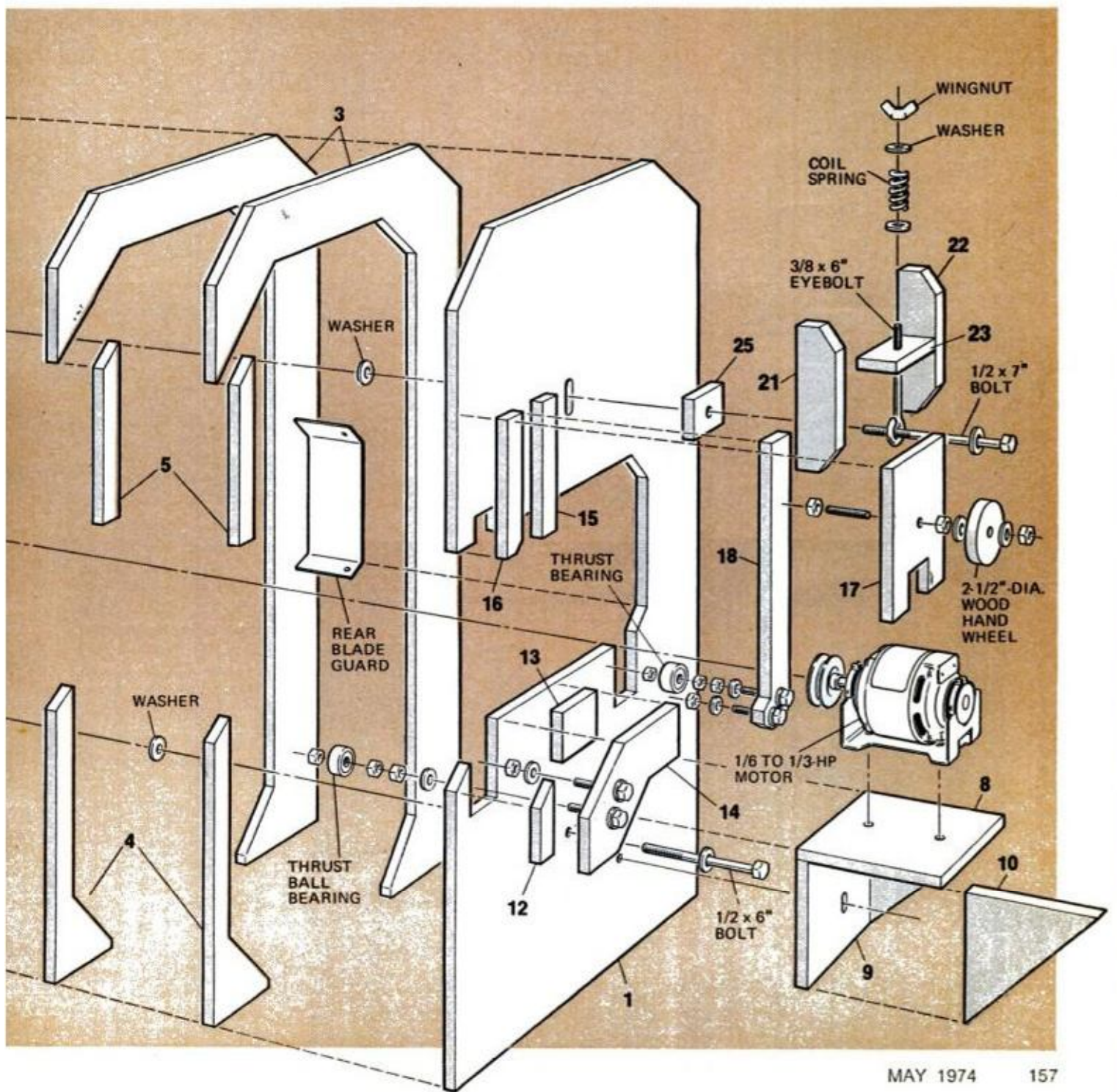
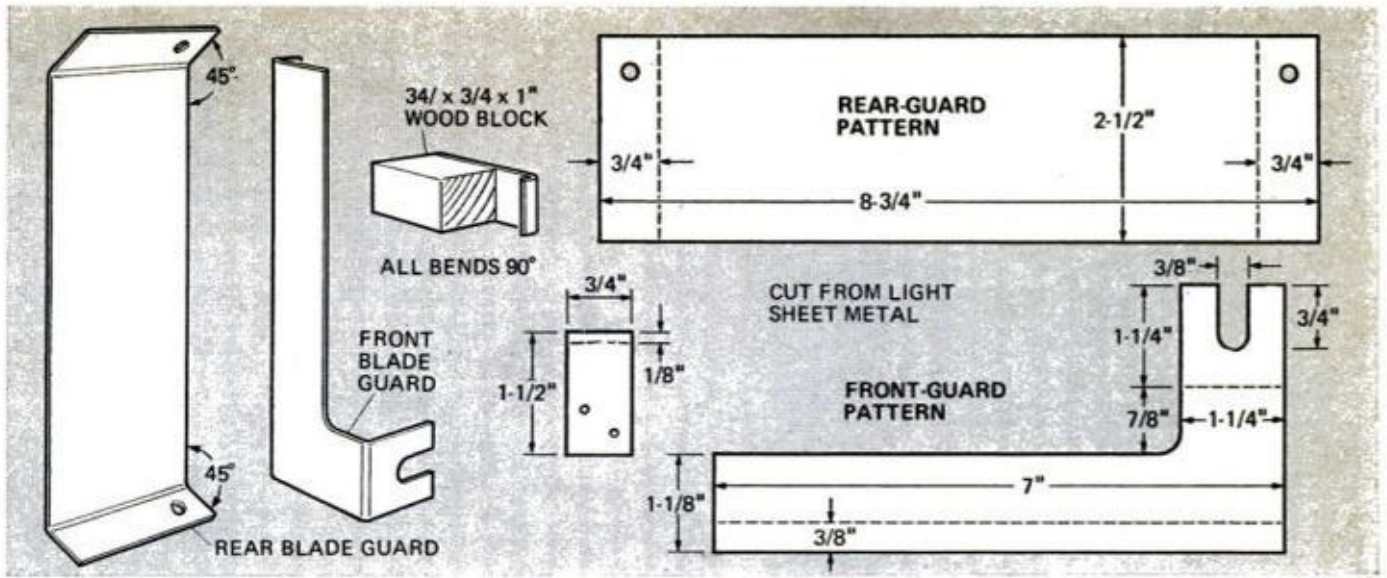
To install the upper wheel, insert a $\frac{3}{8}$ x 6-in. eyebolt in each hanger bracket. Then add a washer to the $\frac{1}{2}$ x 7-in. bolt, pass the bolt through the eyebolt on the right side of part 1, install a 2-in.-square block,

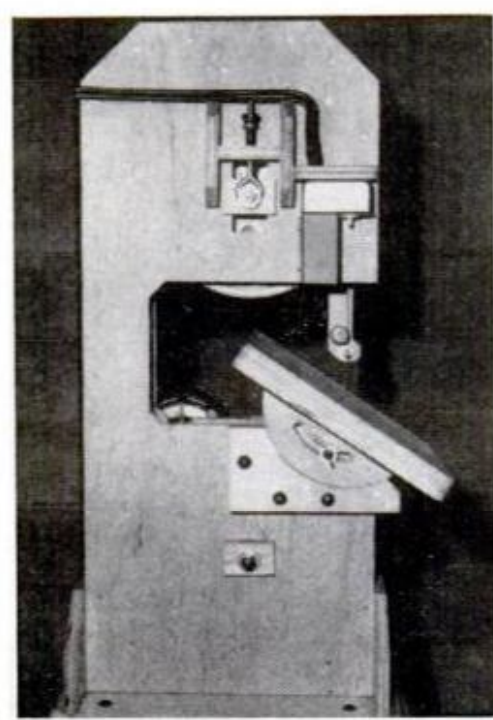
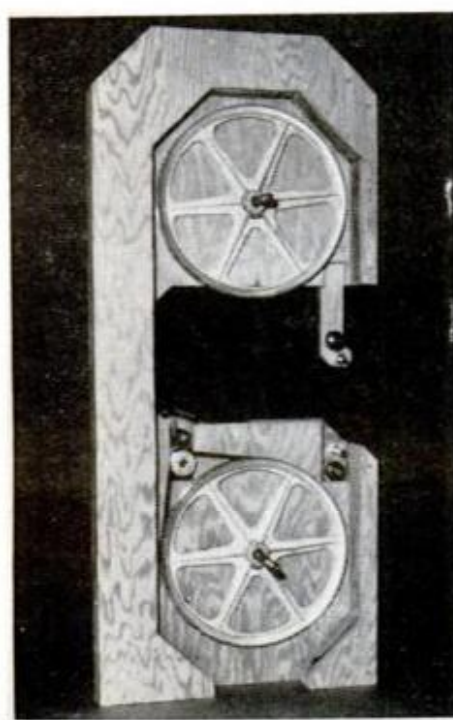
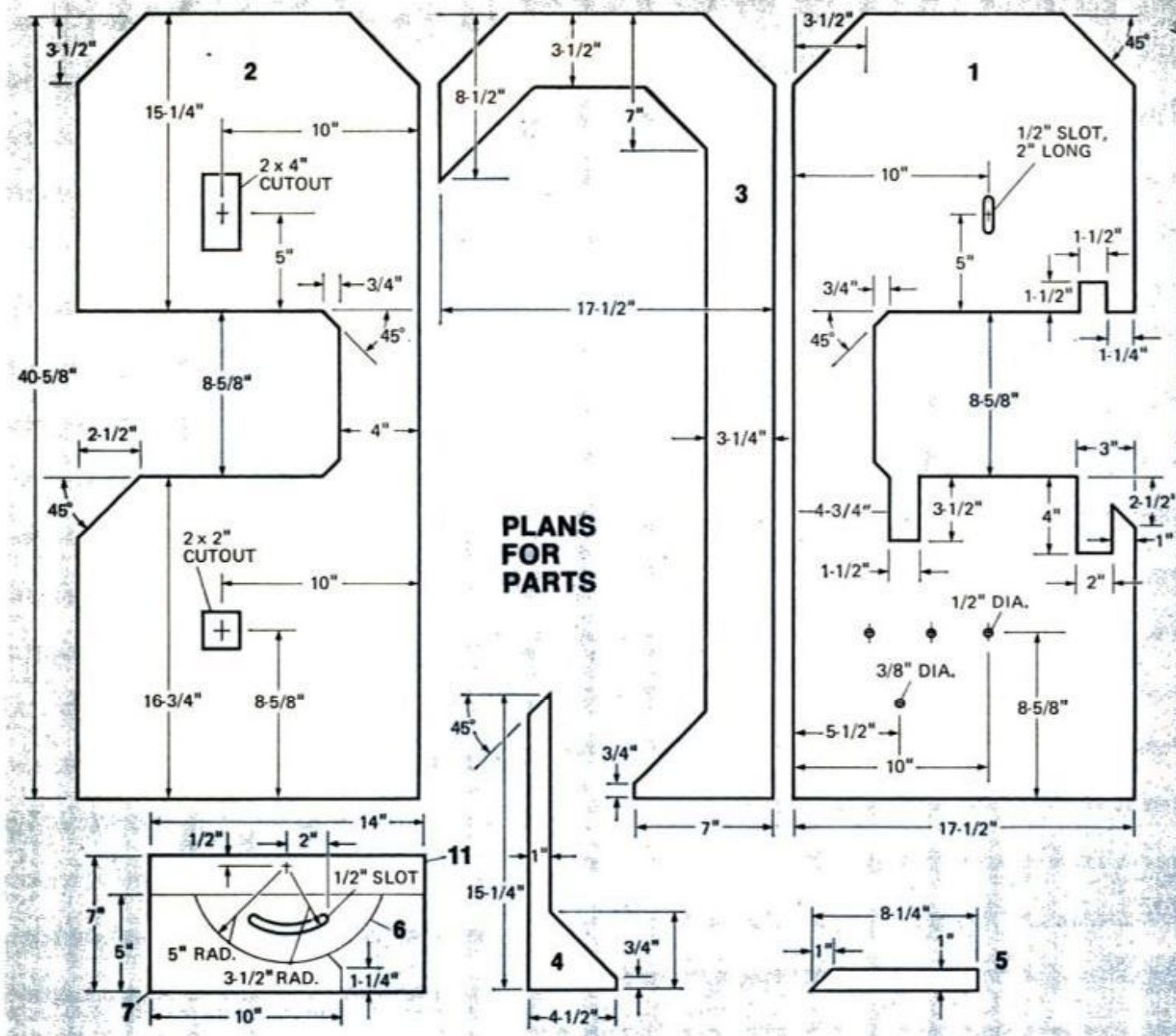
pass the bolt through part 1 and add a $\frac{1}{2}$ -in. washer. Apply some light oil to the faces and bore of the bronze wheel bushing. These are "Oilite" bushings and should not require further lubrication. Install the upper wheel on its bolt, loop the saw blade over the wheel, add a $\frac{1}{2}$ -in. washer, the block assembly, the eyebolt, another $\frac{1}{2}$ -in. washer and finally a $\frac{1}{2}$ -in. hex nut.

The lower blade wheel is installed in a like manner. Loop the 39-in. V-belt and the blade around the lower wheel and install the wheel. The $\frac{1}{2}$ x 6-in. bolt provides the shaft for the lower wheel and is installed in the same manner except for the 2-in.-square block which is omitted. Next install

Art: Fred L. Wolff

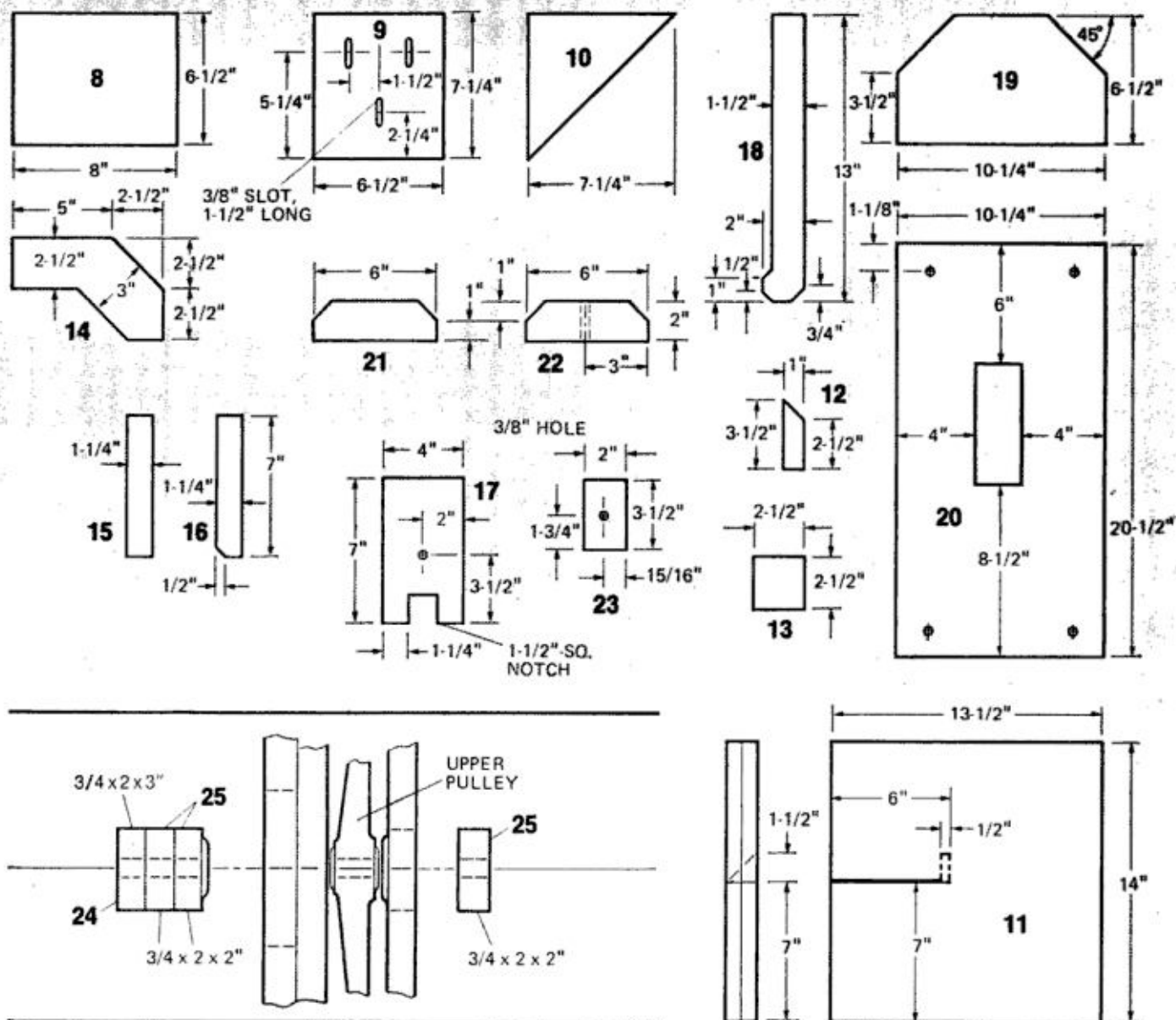






Front view of saw (far left) with front panel removed shows the two V-pulleys which are used as wheels and the belt for the lower wheel that serves as a tire for the blade and drive for the motor.

Completed saw with its front panel installed (near left) shows how table tilts on wooden trunnion and is locked by wingnut and washer. A socket adapter with a 40-w. appliance bulb provides work light.



the washers, blade-tension springs and wingnuts on the upper-wheel eyebolts and adjust for proper blade tension and wheel tilt.

Step 7. Assemble the motor shelf parts 8, 9, and 10. Drill part 8 to suit the motor being used and attach the shelf to part 1. Loop the drive belt over the 1½-in. motor pulley, adjust the tension by pushing the motor shelf up and tightening the nuts.

Step 8. Run the saw. The ½-in. nuts on the upper and lower wheel shafts should be finger-tightened only to the point where the shafts will not have a tendency to rotate. When you have these properly adjusted, hold them in place with a second nut to serve as a locknut. Drive belt and blade tension will always force the assembly against the top of the cutout in which it is fitted.

Step 9. Attach the two spacers, parts 12 and 13, of the lower blade-guide holder to part 1 with flathead screws. Part 13 protrudes ¼-in. above the throat of the saw frame. The holder itself, part 14, mates with part 12 and is to be ⅛-in. below the top edge of part 13. Temporarily attach the holder at this time.

Step 10. Attach the guide blocks for the work-height adjustment post, parts 15 and 16, to part 1 with flathead screws. Sand the edges of these blocks and the adjustable post, part 18, so the post will slide smoothly between guides. Recess a ⅜-in. nut flush with the inner face of part 17 and turn a 2¾-in. length of ⅜-in. threaded rod in it from the front side.

Temporarily attach the cover to the assembly with the adjustable post in place. Mark a vertical line on the post square

from the blade and remove the post from the saw. Locate and drill a $\frac{3}{8}$ -in. hole just far enough up on the vertical line so a $\frac{3}{8}$ -in. washer will not protrude beyond the bottom of the post. This will be the location of the blade antitwist guide. Elongate the hole slightly from front to rear so that the guide can be adjusted to compensate for wear of the V-belt tires on which the blade rides.

Now, move back $\frac{1}{2}$ in. from this vertical line and up far enough so the washers will not overlap and drill a second $\frac{3}{8}$ -in. hole. This will locate the blade thrust bearing. Reinstall the post and attach the cover block with flathead screws. The antitwist guide is a $2\frac{3}{4}$ -in. length of $\frac{3}{8}$ -in. threaded rod slotted with a hacksaw for a depth of $\frac{1}{2}$ in. at one end to receive the saw blade and the other for a screwdriver. The thrust-bearing holder is a $2\frac{3}{4}$ -in. length of $\frac{3}{8}$ -in. threaded rod. Tighten a $\frac{3}{8}$ -in. jamb nut against each side of the thrust bearing and position the bearing so that the blade runs close to but does not touch the face of the bearing.

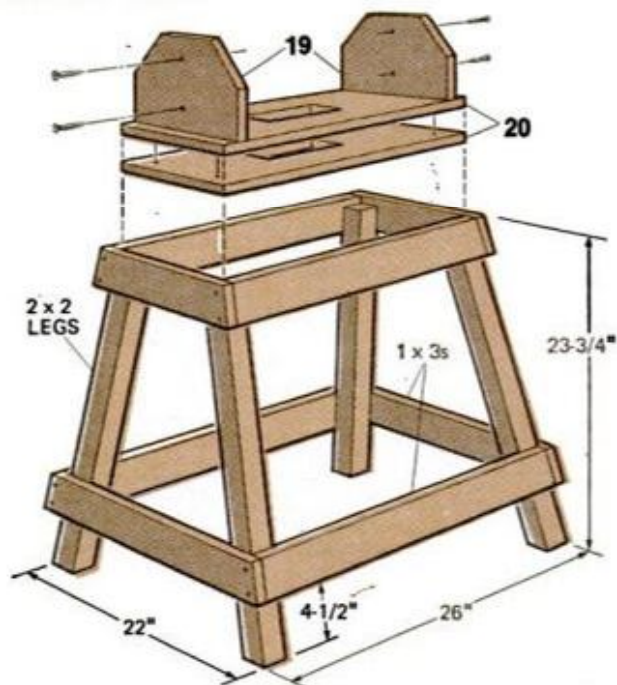
When in use and work is forced into the blade, the blade should ride against the bearing approximately $\frac{1}{8}$ in. in from the latter's outer edge. The antitwist guide is adjusted so the blade runs in the slot in the guide without rubbing and also not so deep that the teeth will contact the guide when the blade is twisted. Use $\frac{3}{8}$ -in. nuts and washers on each side of the adjustable post to hold the guides in place. The lower blade guides are installed in the same man-

(Please turn to page 166)

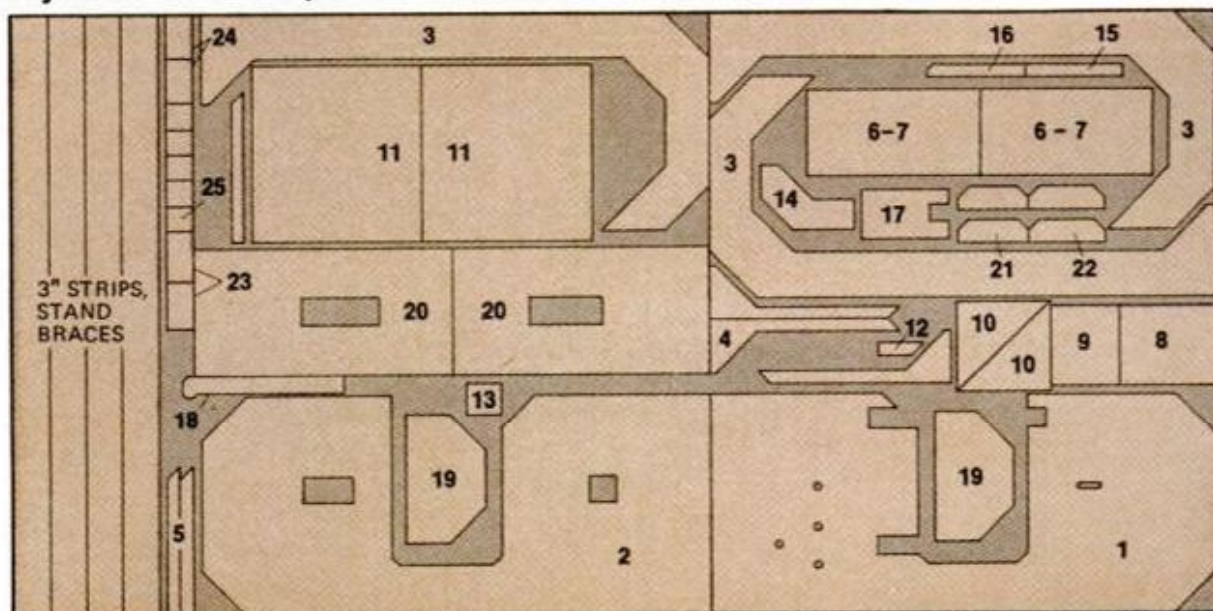
HARDWARE KIT INCLUDES

- 1 $\frac{1}{4}$ x 80" wood-cutting, bandsaw blade
 - 2 12" V-belt pulleys with Oilite bushings
 - 2 boxes $1\frac{1}{4}$ " x No. 8 flathead wood screws
 - 7 $\frac{3}{8}$ x 2" carriage bolts
 - 4 $\frac{3}{8}$ x $2\frac{1}{2}$ " carriage bolts
 - 1 $\frac{1}{2}$ x 6" bolt
 - 1 $\frac{1}{2}$ x 7" bolt
 - 2 $\frac{3}{8}$ x 6" eyebolts
 - 1 $\frac{3}{8}$ x 15" threaded steel rod
 - 18 $\frac{3}{8}$ " hex nuts
 - 6 $\frac{3}{8}$ " jamb nuts
 - 4 $\frac{1}{2}$ " hex nuts
 - 3 $\frac{3}{8}$ " wingnuts
 - 25 $\frac{3}{8}$ " flat washers
 - 8 $\frac{1}{2}$ " flat washers
 - 2 blade-tension coil springs
 - 2 blade thrust ball bearings
 - 1 $\frac{3}{8}$ x 37" V-belt
 - 1 $\frac{3}{8}$ x 39" V-belt
 - Complete set of plans and instructions
- Kit is \$29.95 postpaid from JayEI Enterprises, Box 254, Orion, Ill. 61273. Illinois residents add 5 percent sales tax.

Bandsaw stand



Layout of all wood parts on one sheet of $\frac{3}{4}$ -in. plywood



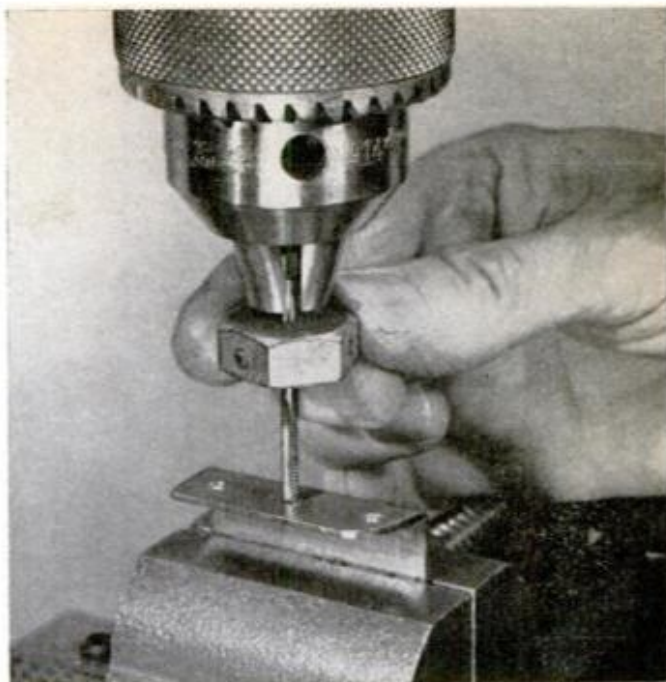
HINTS

FROM READERS



Nozzle-cleaning tool

A fast, easy way to clean paint spray nozzles is with a sewing-machine needle inserted in an old mechanical pencil. The needle, which is stiffer and sharper than wire, can also be used as a probe, teasing needle or perforating tool. Ease with which needle is installed depends on pencil construction. It may be necessary to cut off part of needle shank by grinding, or softening it with flame, then cutting with jeweler's saw or file.—*R. C. Rask, Denver*



Tapping small holes safely

You can avoid breaking small taps by using a drill press to hold and guide them. With the tap free-turning in the chuck and the work clamped in position, the tap is turned by hand to thread the hole. A simple "tap wrench" is made from a $\frac{3}{8}$ -in. length of $\frac{7}{8}$ -in.-hex. steel or the head from a large bolt. A center hole made with No. 27 drill accepts shanks of 6-32 and smaller taps; setscrews lock wrench on tap.

—*Walter Olsen, Newfoundland, N.J.*



Washer aids filtering

A large, heavy washer laid inside a funnel is a helpful "third hand" in filtering operations. The washer not only holds down cheesecloth or filter paper but allows use of small, irregular pieces of material that would otherwise not be usable.

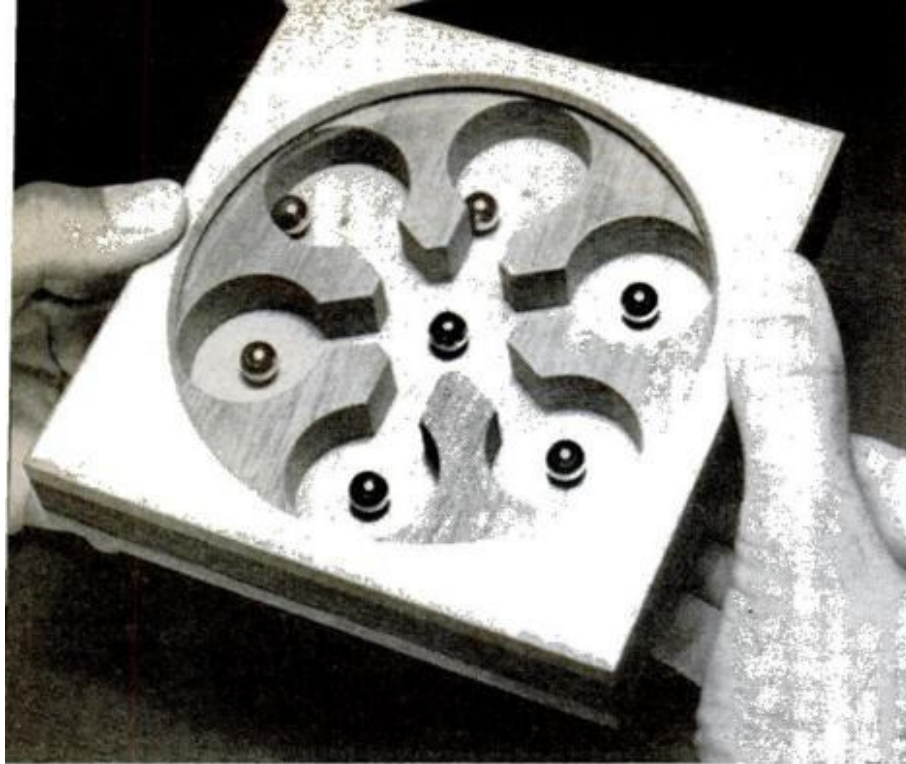
—*J. D. Maxwell, Vancouver, Wash.*



Saw extension

Dead tree limbs high off the ground can be trimmed safely without a ladder by using a saw extension handle. Bow saw shown was bolted to a 16-ft.-long 1x3 furring strip, both sturdy enough for the job and light enough to be manageable.

—*R. K. Pedersen, South Plainfield, N.J.*

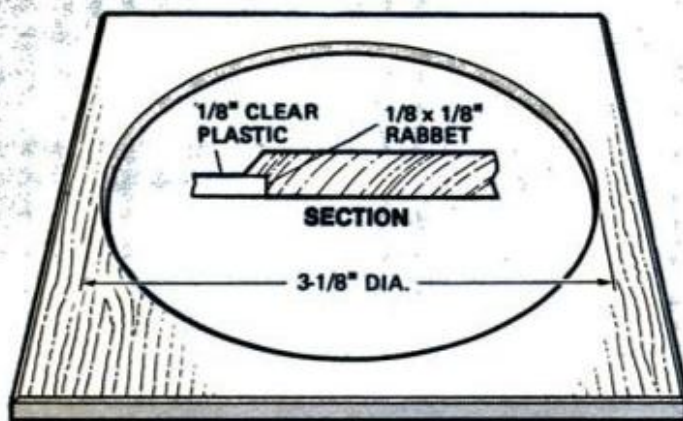


Patience... a game to test your cool

This challenging game
requires nerves of steel.

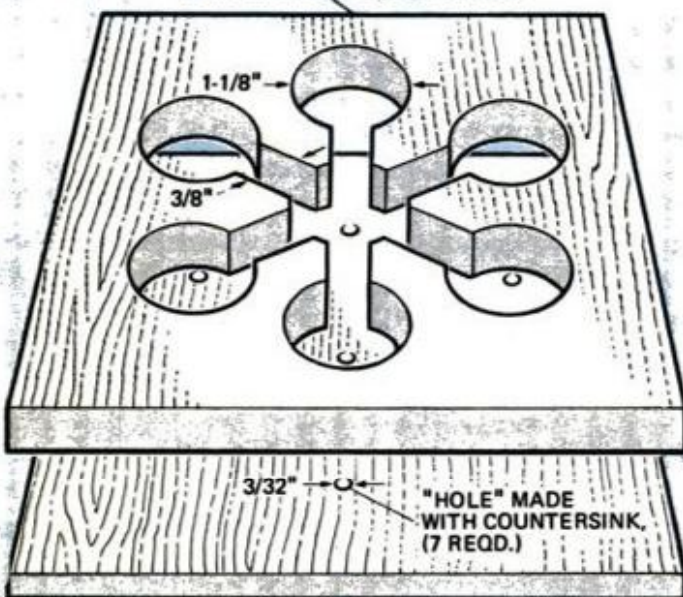
by Kenneth Wells

Sandwich assembly of parts

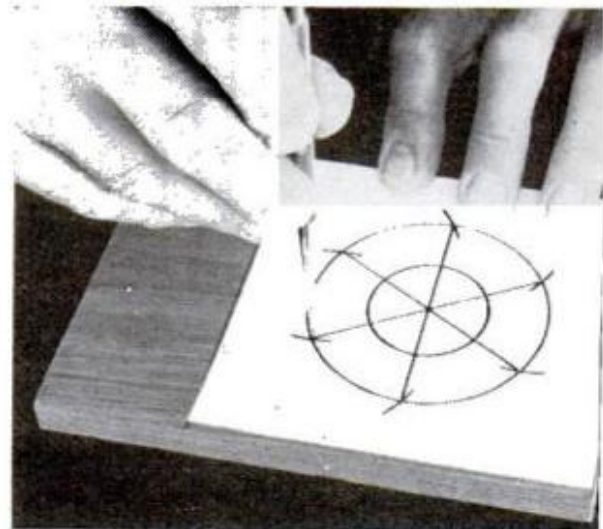


1/4 x 4-3/4 x 4-3/4" TOP PIECE (FINAL SIZE)

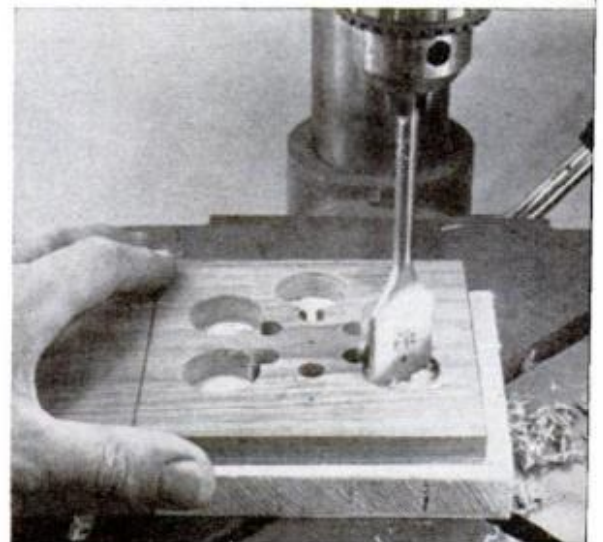
1/2 x 4-3/4 x 4-3/4" CENTERPIECE



1/4 x 4-3/4 x 4-3/4" BASE PIECE



Prick punch is used to transfer template holes to hardwood center and base members.



The 3/8-in. holes are drilled at points A first, then 1 1/8-in. holes at points B.

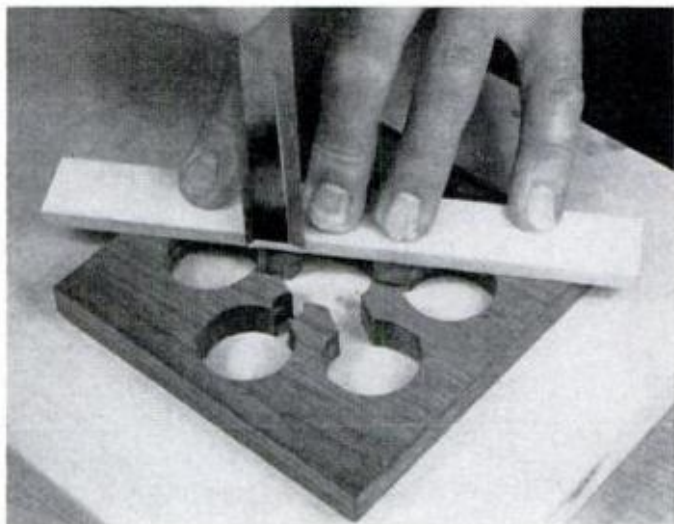
Patience is the name of the game and that's what it takes, plus a steady hand, to work this fascinating and sometimes frustrating game of skill. The object: Make seven steel balls come to rest in seven individual holes, but it isn't easy. Chances are, you'll give up more times than not.

To produce several for gifts or for sale, it will pay you to make a cardboard template to aid in quickly prick-punching the 13 holes to be drilled in the center member and the seven $\frac{3}{32}$ -in. V-holes in the base which are made with a countersink.

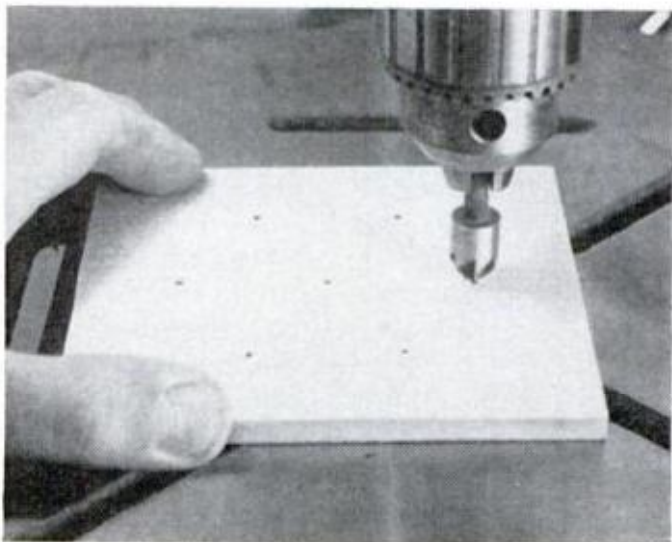
The five work photos take you through the important steps in making the game. The maple center and base members are cut $4\frac{3}{4}$ in. square, but the top member is cut oversize initially and then to its final size after a $3\frac{1}{8}$ -in. hole and rabbet are turned in it for a round $\frac{1}{8}$ -in.-thick Plexi-

glas window. You can use double-back, pressure-sensitive tape or small screws in the waste to mount the work (bottom side out) to a faceplate block.

Template holes A and B are used for marking the center member, holes A being made with a $\frac{3}{8}$ -in. twist bit, holes B with a $1\frac{1}{8}$ -in. spade bit. Template holes A are also used to mark the location of the seven V-holes in the base member. Sand the top of the base member smooth before gluing it to the center member, then apply two coats of white shellac and rub with fine steel wool. If you can't find the $5/16$ -in. steel balls locally, write Way-Mar Co., Box 164, Hartsdale, N.Y. 10530. For a full-size template (below), send a stamped, self-addressed envelope to Home and Shop Editor, Popular Mechanics, 224 West 57 St., New York, N.Y. 10019. ★★★

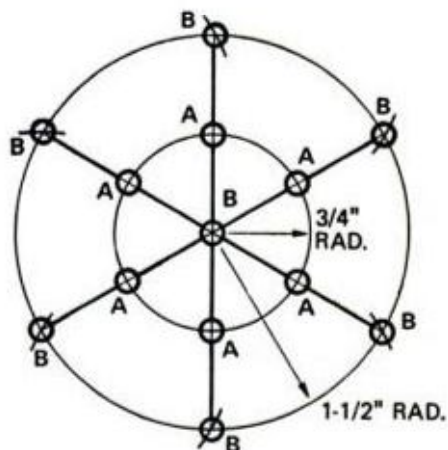


Paring the passageways between the $1\frac{1}{8}$ -in. holes is done with a sharp chisel guided by a straightedge.

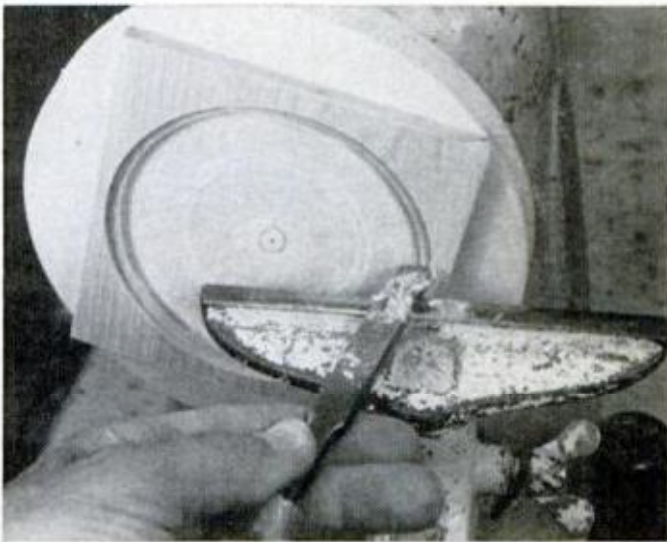


The seven V-holes in base member are made with tip of a countersink, each hole being only $3/32$ -in.

Template for hole centers



PM will send you free a full-size template in return for a self-addressed, stamped envelope (see text).

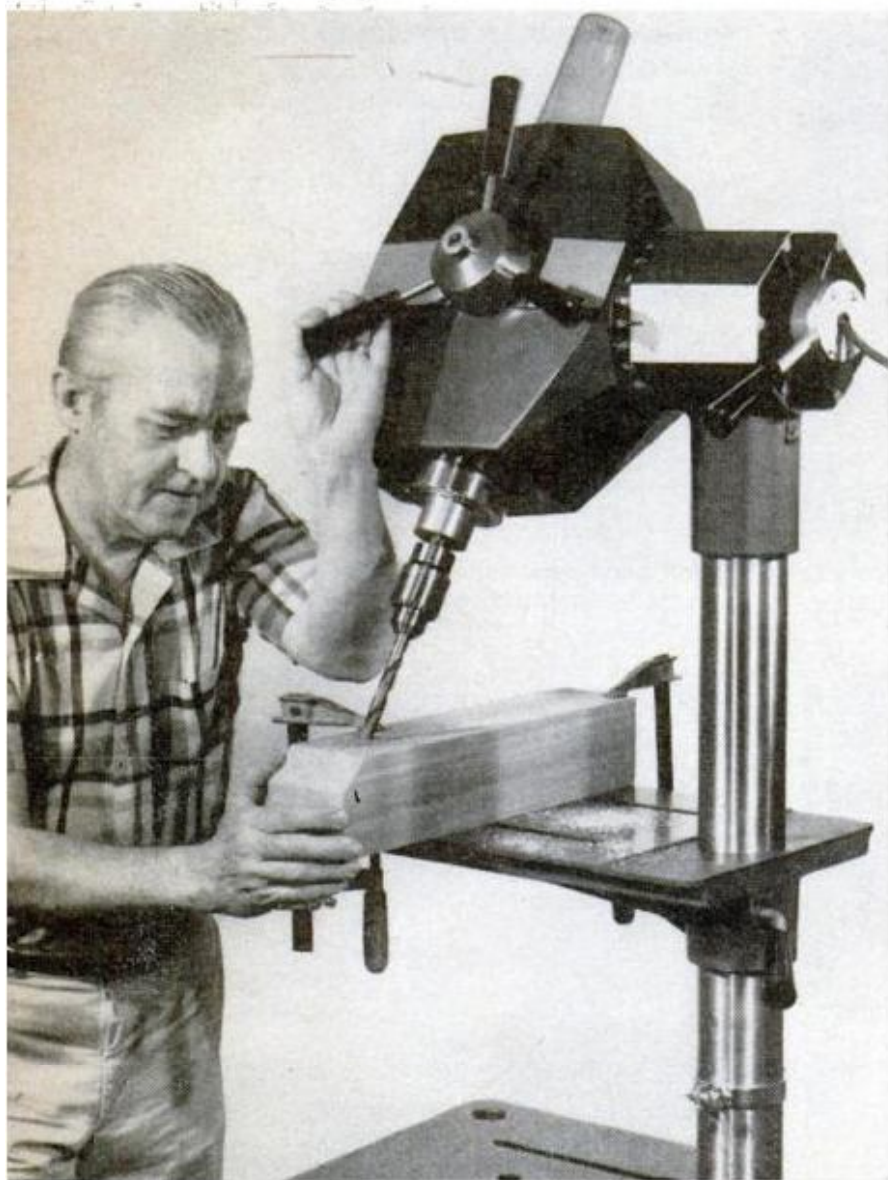


Circular opening and rabbet in top member are turned by mounting work on flat block fastened to faceplate.

A drill press that's three tools in one

by Wayne C. Leckey
HOME AND SHOP EDITOR

Photos: Robert D. Borst



Tilting the powerhead permits drilling at any angle. A calibrated tilt scale permits you to preset the desired angle, and a rear pivot lock holds this setting secure.

You already know about ordinary drill presses, but I have just tested one which is far from ordinary. Sure you can chuck a drum sander in it and smooth irregular curves, fit it with a buffing wheel for polishing, drill holes in steel, wood, plastic and glass and do all the other things you can do with any other ordinary drill press.

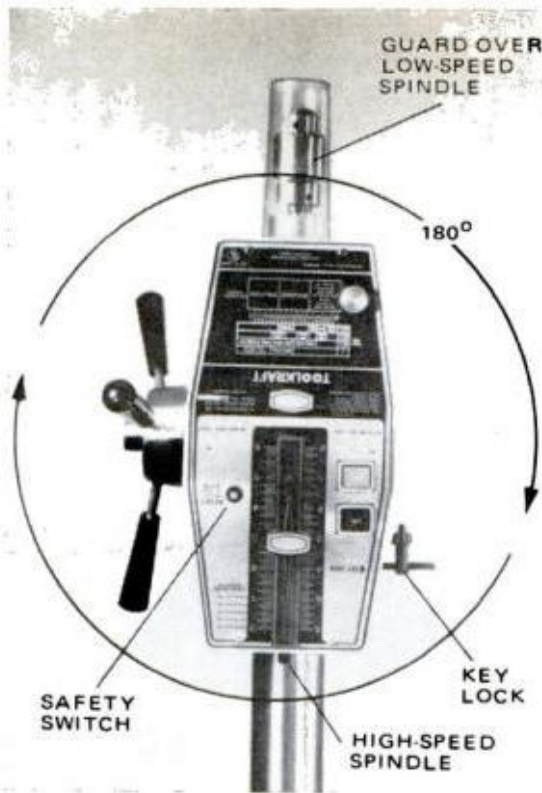
However, that's where the similarity ends. The unique dual-spindle, solid-state powerhead of this multipurpose drill press by Toolkraft can be set to provide a speed range as low as 500 rpm or as high as 21,000 by merely dialing a speed-selector knob. A red band moves across a calibrated window to the speed you should use.

This means that you not only own a drill press with infinitely adjustable speeds, but a precision high-speed shaper and router as well—three machines in one—something no other home-shop drill press offers.

It's made possible by separate high and low-speed spindles and a tilting $\frac{5}{8}$ -hp head which rotates. To change from one spindle to the other, you simply unlock and switch them end for end by rotating the powerhead 180°. There aren't any belts to change; motor and gear-drive assembly are completely enclosed in a self-contained unit.

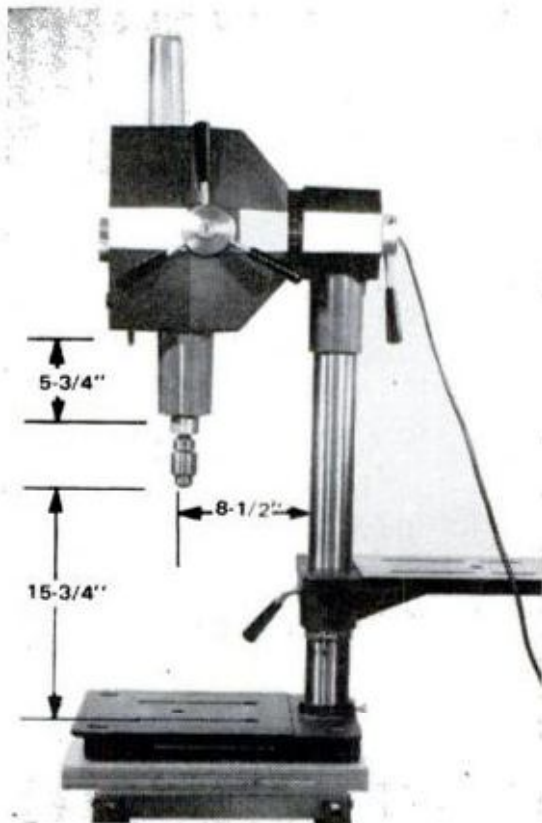
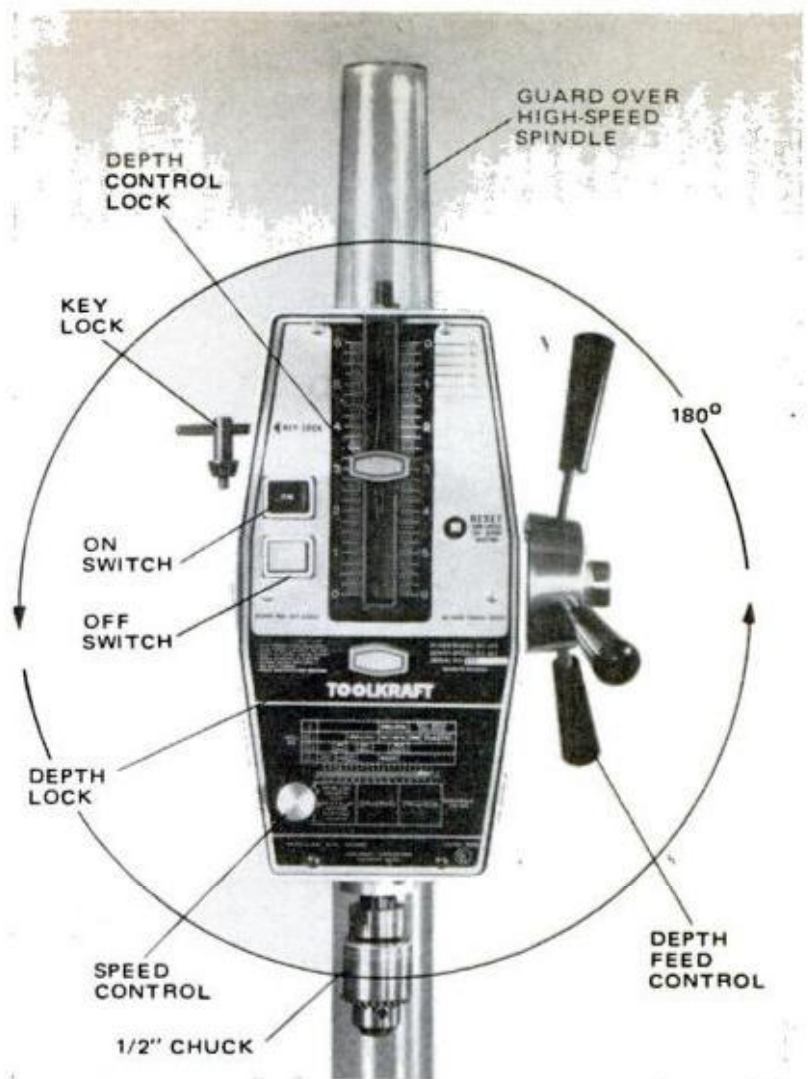
Other features of this advanced drill-shaper-router include a no-start, chuck-key switch—you can't operate the machine unless the chuck key is in place in its own "keyed" switch. This keeps a chuck key from flying—which could happen if it were left inadvertently in the chuck. The press has a separate ON-OFF switch, plus large drilling capacity—an 8½-in. throat which permits you to drill to the center of 17-in. work (20 in. when using the high-speed spindle) and a full 6-in. spindle travel.

What misgivings did I have about this machine? Few if any. It's noisy at 21,000 rpm, but remember, that's true of a portable router, too. You can't have high speed, so necessary for fine shaper

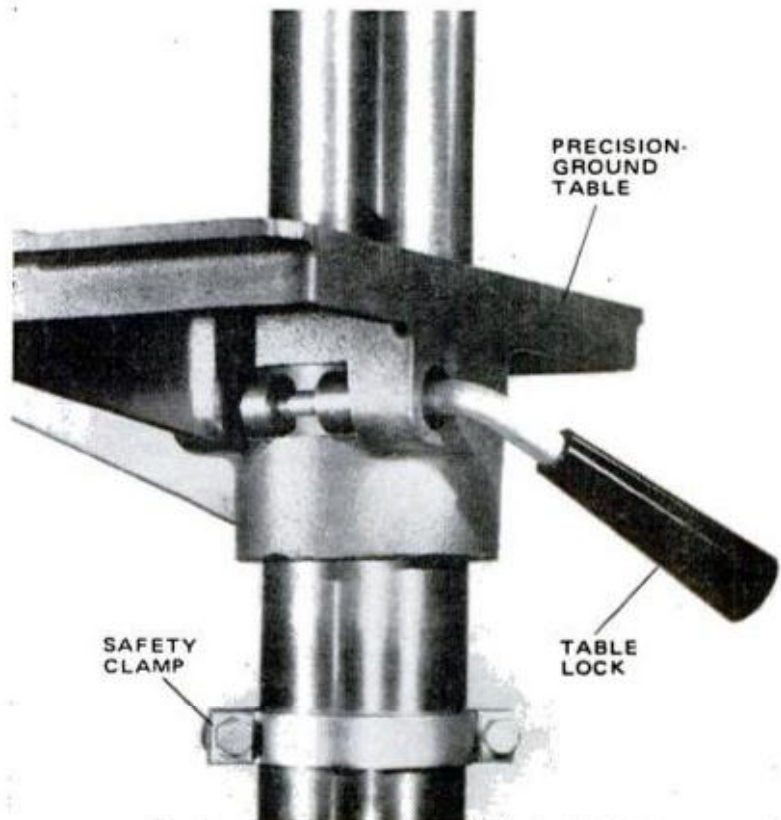


Rotating the powerhead 180° brings auxiliary high-speed spindle into play (above). Special spindle adapters take standard three-lip shaper cutters and router bits.

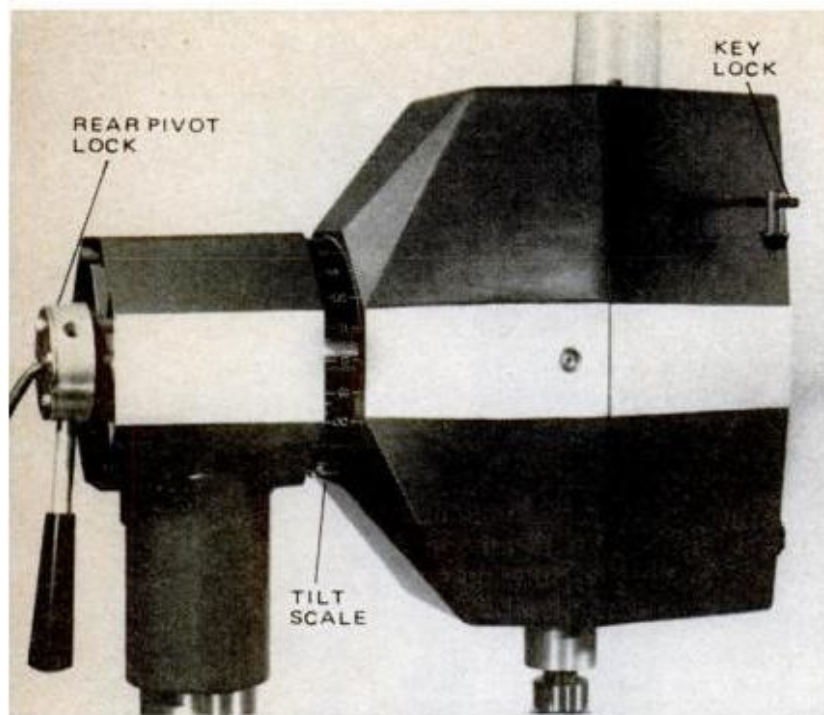
In normal drilling position (right), interchangeable plastic guard is placed over high-speed spindle. Up-front chart gives drilling speeds for different materials.



Machine has large drilling range: up to 6-in. depth in one operation, to center of 17-in. circle (20 in. with high-speed spindle).



Good safety feature—a column ring clamp—serves to prevent the table from falling and causing accidental body injury. Lever locks the table securely on the column.

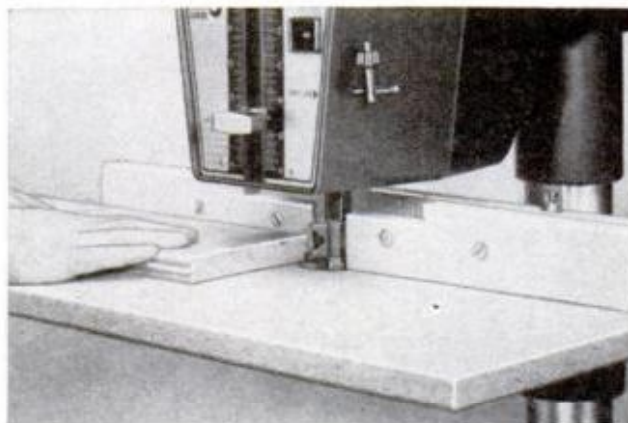


Calibrated tilt scale at rear of powerhead lets you preset the drilling angle. Pivot lock holds setting secure.

Separate adapters on high-speed spindle (right) permit shaping and routing operations like no other drill press.

work, without noise. However, I did wonder why some thought wasn't given to a built-in light. But outside of this, it's a unique machine.

It's available in both floor and bench models, both being identical except for the length of the column. The floor model retails for \$269.95; the bench model, \$249.95. For additional information, write to Toolkraft Corp., 700 Plainfield St., Chicopee, Mass. 01013. ★★★



BUILD THIS 12-IN. BANDSAW

(Continued from page 160)

ner, except they are $3\frac{1}{4}$ -in. lengths of $\frac{3}{8}$ -in. threaded rod and reversed, the antitwist guide being above the thrust bearing.

Step 11. The saw table, part 11, is made of two thicknesses of plywood. Make the saw kerf from the right side of the table and toward the center. Temporarily install one thickness of the table and shim as needed so the table is perfectly square with the blade.

The locking hand wheel for the adjustable post is a $2\frac{1}{2}$ -in.-diameter plywood disc, drilled for a $\frac{3}{8}$ -in. threaded rod and secured with nuts and washers.

The tilting-table assembly, parts 6 and 7, requires two thicknesses of plywood glued and screwed together. Locate all saw cuts prior to fastening the two pieces together to prevent any screws from interfering with the cuts to be made. After laying out all cuts, cut off the 2-in. strip along the top. Cut the 5-in. radius arc; then remove the unused portion of part 6. Place the rotating arc, part 7, against part 2 and the underside of the single-thickness saw table, line up the center of the arc with the blade of

the saw and mark the location of the arc on the underside of the table. Now, holding the rotating arc as is, place the tilting-table support, part 6, in position and mark its location on part 2. Next remove the temporary table from the saw and attach the arc to the underside of the table with glue and flathead screws driven from the top. The second table thickness may now be fastened to the first with screws driven from below.

Step 12. On the underside of the table make a mark $1\frac{1}{2}$ -in. from where the blade will run to the front of the table, part 11. This is to be chiseled out approximately $\frac{1}{2}$ in. wide and angled back 45° to allow clearance for the blade when the table is tilted. The tilting-table support may now be attached to part 2 as previously marked. Attach with three $2\frac{1}{2}$ -in. bolts. Slide the table in position on the saw. In the $\frac{1}{2}$ -in.-wide slot in the rotating arc, move back $\frac{3}{4}$ in. from the center line of the arc and drill a $\frac{3}{8}$ -in. hole in part 2. Center this hole in the $\frac{1}{2}$ -in.-wide slot so the arc does not ride against the bolt. Insert the $\frac{3}{8}$ x $2\frac{1}{2}$ " bolt from inside of part 2 and fit it with a $\frac{3}{8}$ -in. wingnut and washer. Your bandsaw is now completed. ★★★

PEDAL CARS: GASLESS WAY TO GO

(Continued from page 100)

made by Environmental Trans-Sport Corp. of Windsor, Conn. Easily the most sophisticated of the current crop of pedal cars, it uses a straight-line pedal action as opposed to the rotary bicycle type. The pedals move forward and back, their reciprocating action transformed into rotary motion at the wheels through drive rods and crank pins.

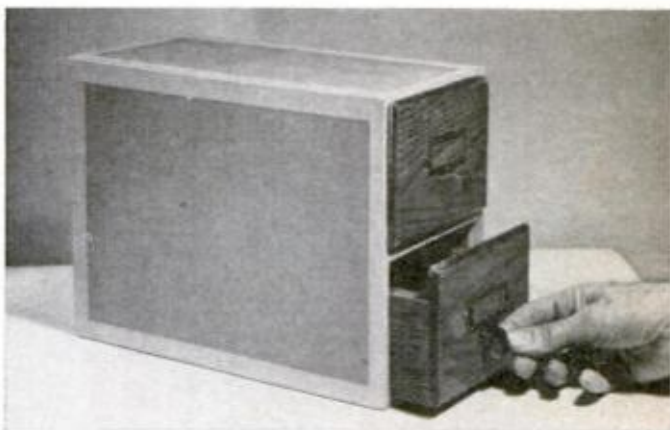
The arrangement is said to be more efficient than rotary drives, less tiring on leg muscles and safer to operate since there's no danger of getting your feet tangled with the pedals. In addition, the Pedicar offers five forward speeds, plus neutral and reverse; other models are limited to three forward speeds with no neutral or reverse. Other features include four-wheel stability with automotive steering, fully enclosed cab, disc brakes with separate parking brake, windshield wiper, headlight and rear-opening luggage hatch. Main drawback is the car's size—it seats only one.

Typical of three-wheeler models is the PPV (for People-Powered Vehicle), made by EVI of Sterling Heights, Mich. Unlike the Pedicar, it seats two, has dual pedal drive and is by far the handsomest of the lot. Tag-Along, made by Pedal Power, Inc. of Bohemia, N.Y., is a sort of compromise. Less lavish than the PPV or Pedicar, it's roomy if a bit boxy, has good four-wheel stability, seats two and is one of few models to offer full four-wheel braking.

Prices for pedal cars range from about \$300 for the Tag-Along to \$550 for the more elaborately engineered Pedicar. Do such vehicles make sense? Should you invest in one? It's still too early to tell. Pedal cars were originally developed primarily for fun use around parks, resorts, retirement villages, country clubs, college campuses and similar protected areas. Only recently have they been proposed for serious use on public roads. Also, current models represent early attempts at a brand-new concept. Future models will undoubtedly bring improvements in design. Meanwhile, if you can't wait, be sure to try before you buy. Check for adequate braking, ease of pedaling and proper safety precautions such as sufficient clearance around the pedal well to avoid foot-pinching. As recreational vehicles, pedal cars can provide relaxing pleasure and healthful exercise; as transportation, they have a way to go before they'll replace the automobile, gas or no gas. ★★ ★

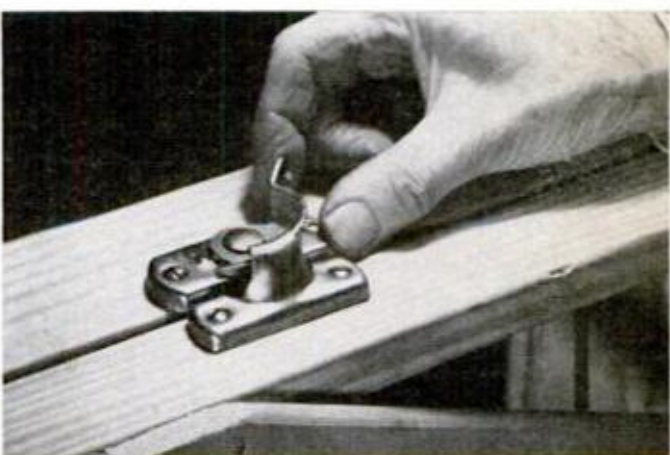
HINTS

FROM READERS



Saving wood with cardboard

Cardboard can often take the place of wood, as in the construction of a small cabinet for two existing drawers. A horizontally partitioned box was first built with one thickness, then reinforced with two more. Butt joints, overlapping in alternating directions, were assembled with white glue. Gummed paper tape was used on edges, plastic shelf covering on surfaces on which drawers slide.—*W. B. May, Oak Park, Ill.*



Better ladder lock

A screw hook and eye are often used to hold a stepladder closed for carrying, but they can easily come unhooked, letting the ladder fall open. To keep a ladder closed, try an ordinary sash (window) lock instead.

—*William Swallow, Brooklyn, N.Y.*



Popular Mechanics has joined with the Automotive Parts & Accessories Association (APAA) in sponsoring our second annual month-long promotion involving thousands of automotive retail outlets. You'll find a list of participating dealers on the following pages

Look for the two symbols in advertisements and in-store displays. They will help you identify products featured in the "May is Car Care Month" promotion.

Every car should carry the "Car Care Guide." It's like having a mechanic in your glove compartment.

The Second Annual 1974 Popular Mechanics "Car Care Guide" begins on the page at the right. It is a highly informative and

valuable magazine-within-a-magazine that belongs right along side your owner's manual.



(Fig. 1)



(Fig. 2)

To make it easy for you to save this Guide, we've made it a self-contained unit. Here's how to remove it from the rest of the magazine for easy reference:

1. Bend the magazine's pages away from the Guide's front cover.
2. Now, bend the magazine's back pages away from the Guide's last page. (Fig. 1)
3. Pull the Guide out. (Fig. 2)
4. Staple, or hole-punch the Guide.
5. Keep it for handy reference.



Look for the stores and products displaying the APAA's Symbol of Consumer Protection and PM's Product Feature Mark.

**Popular
Mechanics**

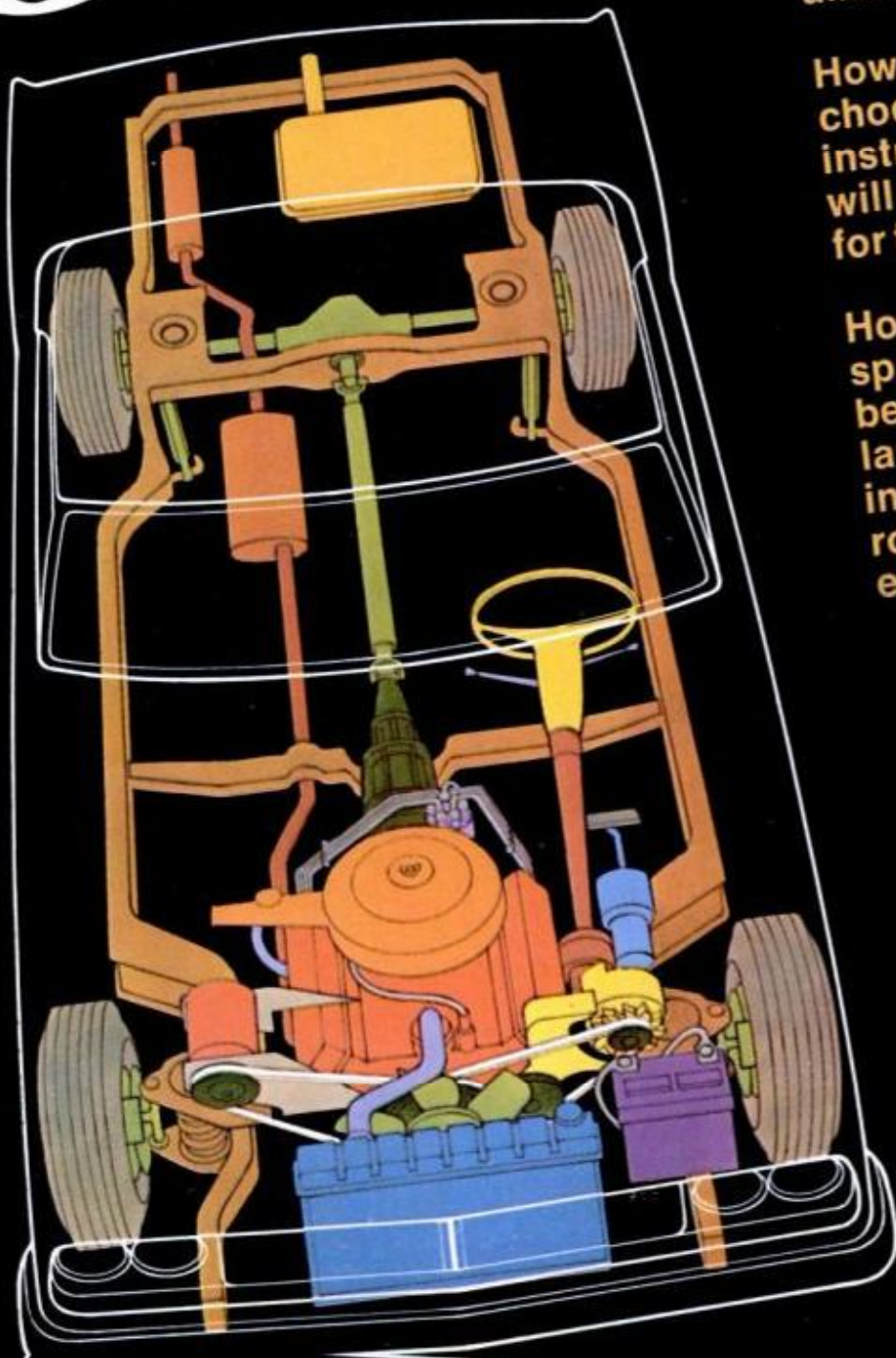
Car Care Guide

How to
service and
maintain your
car in
brand-new
condition
far longer
than you thought
possible!

How to
troubleshoot—
almost like a pro

How to
choose tune-up
instruments that
will pay
for themselves

How to
spot problems
before they
land you
in a nightmare
roadside
emergency





Rustproof your own car and save up to \$70.00!

Brand new! Now in your favorite store for the first time. An easy-to-use Auto Rust Proofing Kit that gives you easy step-by-step instructions for applying two exclusive formulas to protect all the interior and exterior surfaces of your car. Stops rust before it starts. Prevents further rusting. Now it's easy to keep rust off your car and \$70.00 in your pocket.

This new kit is from DURO, America's leading do-it-yourself products.

Suggested retail: \$16.95.

WOODHILL CHEMICAL SALES CORPORATION
Cleveland, Ohio 44128



© Woodhill 1974



A few words from
the original Mr. Fix-it
... Norman J. Freeman,
Chairman of the Board,
Woodhill Chemical
Sales Corp.

This new Auto Rust Proofing Kit we're introducing is another great product in a long line of great do-it-yourself products that we've been making for more than 52 years. I'm sure you know that we're the folks who brought you Plastic Aluminum, Liquid Steel, E-POX-E® Glue, Naval Jelly®, Black Knight and White Knight Auto Body Repair Kits, and the whole Body Shop concept featuring fiberglass repair materials.

Couple of years back we celebrated our 50th anniversary, and to mark it, we made up some gold plated Kennedy half-dollar pieces. Real collector's item. We've got 500 of them left. I want to give them to the first 500 people who mail me back the registration card that's in every DURO Auto Rust Proofing Kit. Mark your card to me personally, and I'll send you the gold plated Kennedy with my compliments. There are only 500 to send out, so be sure to get your kit fast at your favorite automotive department.



WOODHILL CHEMICAL SALES CORPORATION
18731 Cranwood Pkwy., P. O. Box 7183,
(216) 475-3600, Cleveland, Ohio 44128

Popular Mechanics

Car Care Guide



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Battery and
charging systems

Cooling system

Tires, suspension
and steering

Engine and
exhaust system

Brakes and
transmission service

Safety equipment
and accessories

Body care
and appearance



Car Care Guide

Your car's first 100,000 miles

This is a rough year. In these dry-tank days, who needs trouble? Like a roadside breakdown . . . with many gas stations closed for the weekend.

If you've decided to keep your car "until it falls apart," you're not alone. But you *are* on your own these days if the old crate comes unglued at midnight. Never was there a better time to start taking better care of your car.

Owners used to think of trading when their cars were three years old or reached 30,000 or 40,000 miles. Now it, seems, life will begin at 40 for a lot of middle-aged, "standard-size" cars. These aren't worth much in trade, but with gas costing what it does, such older cars with fewer emission controls begin to look "economical."

But how long can you keep a car running? There's no reason—except neglect—that today's cars can't deliver 100,000 miles and more of trouble-free service. Trouble-free doesn't mean maintenance-free; the more regular the maintenance, the less chance of trouble.

You don't have to be a master mechanic to get your car past the 100,000 mark. But you do have to be hooked on the habit of

regularly scheduled maintenance. It's that simple . . . and that tough. No skipped oil changes or lube jobs. No "economizing" on oil and air filter changes. No long stretches without major and minor tune-ups. No guesswork about when you had the last front-end job; when you last repacked wheel bearings, checked for transmission leaks, examined brake linings, replaced radiator hoses, flushed the cooling system or hosed out fender walls and rocker panels.

You don't have to be a mechanic to keep a regular service log on a car; in fact, you don't have to be a pro to do most of the work that will keep your car rolling smoothly past 100,000. You can do your own lubes, change oil, points and plugs. With the basic test instruments shown here, you can set point dwell and ignition timing—you can do your own major and minor tune-ups.

Your car doesn't have to shine to be in good running condition, but you'll find that when you restore the finish you're not satisfied until the engine is purring nicely again. Making an old car look like new is easier these days. Because style changes have slowed down, even a five-year-old can be mistaken for a new model. And new waxes and cleaners restore the glow to everything from vinyl tops to black tires.

So whether you have a zingy new compact you want to keep youthful or a middle-aged standard you want to see grow old gracefully, you'll find the help you need in PM's *Car Care Guide*. Remove it from the magazine, keep it in the glove compartment, and—by all means—keep a regular schedule of maintenance. This is a rough year, but everything will run smoother if you do.

EDITOR

The 2nd Annual Popular Mechanics/APAA "May is Car Care Month" Program

by Victor Gelb, PRESIDENT
AUTOMOTIVE PARTS & ACCESSORIES ASSOCIATION

Once again, the Automotive Parts & Accessories Association, representing some 40,000 retail outlets, is combining forces with POPULAR MECHANICS and its nearly six million readers to make driving safer, more economical and enjoyable.

This year's program is vastly larger than last year's, with more retail outlets and manufacturers and more diverse products.

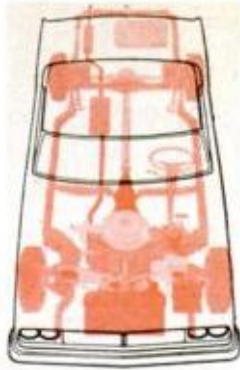
A list of retailers with specific plans for Car Care Month begins on Page S8. However, watch your hometown newspapers for advertising from other participants. Many newspapers also are planning special "May Is Car Care Month" sections in cooperation with APAA and POPULAR MECHANICS. These sections will offer further tips to help you get more satisfaction, safety and economy as a car owner.

As "Official POPULAR MECHANICS/APAA Car Care Month Headquarters," your favorite outlet will be featuring many of the following products as well as offering other items and services of special value during May.

8-Track Stereo Tape Player with AM/FM Radio by **Automatic Radio**
8-Track Stereo Tape Player with FM Radio by **Automatic Radio**
Handy Dandy Electrical Circuit Tester by **Burnworth Tester Co.**
Champion Spark Plugs by **Champion Spark Plug Co.**
Vinyl Top & Upholstery Brush by **Clean Rite Products Co.**
Giant Tires by Giant Div. of **Cooper Tire & Rubber Co.**
Blue Label Hand Cleaner by **DL Skin Care Products**
Engine Analyzer by **Dixco**
TDL Tach-Dwell-Light by **Dixco**
D.C. Power Timing Light by **Dixco**
Chinook Engine Heater by **Do Ray Lamp Co.**

Rally Car Wax by **Du Pont**
Electric Fuel Pump by **Dupree Products**
Battery Charger from **ESB Brands**
Silicone Glass/Windshield Seal by **General Electric**
Silicone Battery Care by **General Electric**
Silicone Hi-Temp Instant Gasket by **General Electric**
Silicone Auto Lube by **General Electric**
Silicone Clear Ignition Protector by **General Electric**
Silicone Auto Seal by **General Electric**
Silicone Carb Cleaner & Lubricant by **General Electric**
Silicone Instant Gasket by **General Electric**
Plus 25 Headlamps by **General Electric**
Titan Hydraulic Jacks by **Hollywood Accessories**
Maxi Oil & Air Filters by **Lee**
Car Care Portable Auto Ramp by **Petersen Industries**
Car Care Portable Ratchet-Type & Pin-Type Jackstands by **Petersen Industries**
"Maxi-Tune" Ignition Analyzer and four other products by **RAC**
180° Space Age Electronic Tachometer by **RAC**
Switch Panel Quad by **RAC**
Astro Dual Oil-Amp Gauge by **RAC**
Super D.C. Power "Supertronic" Timing Light by **RAC**
Liquid Wrench by **Radiator Specialty Co.**
Radiator Caps by **Robertshaw Controls**
Thermostats by **Robertshaw Controls**
Turtle Wax Self-Polishing Paste Wax by **Turtle Wax Inc.**
Silicone Spray Lubricant by **Union Carbide**
Vinyl Guard by **United Chemco**
Classic Car Air Freshener by **Vantage Industries**
WD-40 by **WD-40 Co.**
Rust Proofing Kit by **Woodhill Chemical Corp.**

Car Care Guide



TUNE-UP INSTRUMENTS

The first investment in good car care should be instruments that let you tune up your car at home. The test equipment needed to keep your car in tune yourself also makes it possible for you to troubleshoot and diagnose problems that would otherwise cost you money to have someone else solve.

We're not talking about the basic things that all car owners should have just to keep

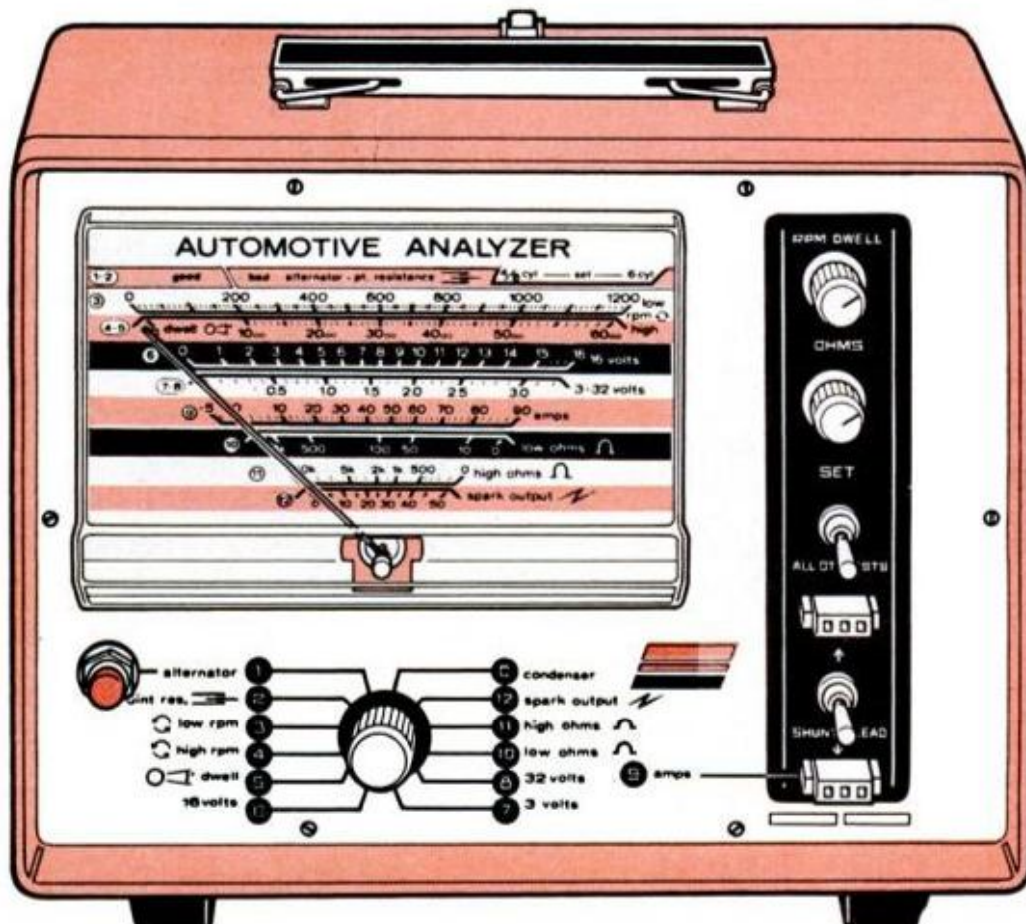
their cars running—distributor point files and feeler gauges, sparkplug gapping tools, battery hydrometers and chargers—but the instruments that can tell you *how* your car is running; or *why* it's not running, or not running right; or just *where* the problem lies.

The instruments that tell you what your senses can't tell you about your engine can be as simple and inexpensive as a compression tester or as sophisticated and costly as a diagnostic oscilloscope. In between are the instruments essential for accurately setting ignition timing, cam angle or dwell and generator or alternator output voltage; and those for checking primary and secondary sides of the ignition system, engine vacuum and fuel-pump pressure and even exhaust emissions.

These are the instruments that will free you from scheduling service appointments, suffering aggravation and incurring expenses that could have been avoided.

Engine analyzer

If you don't own any other test instruments, the analyzer is the best all-around unit to consider. It combines in one package the functions of the dwell meter, tachometer, ignition tester and voltmeter. A good engine or automotive analyzer, as it's variously called, repre-



sents an investment of anywhere from \$40 to over \$100—depending on its features. Engine analyzers and most of the other instruments, too, are available in kit form so you can build them yourself.

Included with any good analyzer will be a complete operation manual that details the tests the instrument will perform and the connections to be made under the hood. Don't buy any instrument that doesn't include instructions on how to use it!

For portability, analyzers contain built-in power supplies—usually several C or D cells which are installed in a battery tube. A good habit to get into is removing the batteries after you use the analyzer and before you put it on the shelf for what may be several months; you'll avoid a mess and possible damage to the instrument if the batteries leak inside the case.

A typical automotive analyzer, such as that shown on the opposite page, has a large, easy-to-read meter face with scales that correspond to the positions of a main function switch. The meter should utilize a D'Arsonval movement, which is the most accurate and sensitive type. The circuits in the analyzer are designed to measure specific functions. You just turn the function switch and take a reading from the appropriate scale on the meter face.

Here is a list of some of the work you can do with the analyzer. Refer to the switch positions at left.

Alternator diodes. The diodes in your alternator, which convert the alternating current (a.c.) that has been produced by the alternator into direct current (d.c.), can be checked as good or bad.

Distributor point resistance. Excessive resistance across closed points indicates that you have burned or misaligned points, poor grounding of condenser or distributor, or other wiring problems.

Low rpm check. Measurement of engine revolutions per minute in increments of 10 allows you to make an accurate idle adjustment.

High rpm check. A zero to 6000-rpm scale allows testing and adjustments of timing advance, charging system and carburetor.

Dwell measurement. Dwell is the amount of time that ignition points remain closed, as measured by degrees of rotation of the distributor cam. This angle, which is about 60° for a four-cylinder engine, a little less than 40° for a Six and about 30° for an Eight, affects the spark timing and must be adjusted accu-

ately. Adjustment is made by setting the point gap.

16-volt scale. Measurement of voltage with a full-scale deflection of 16 volts allows accurate setting and diagnosis of 6 and 12-volt systems. Very accurate adjustment of voltage regulators is possible.

3-volt scale. A full-scale deflection of three volts allows incremental measurements of .1 volt for tracing voltage losses.

32-volt scale. This can be used for measurements on 24-volt charging systems.

Ammeter. The zero to 90-ampere current measurement scale is used for checking current regulator settings, alternator output and the current draw of components in the electrical system.

Low ohms. Resistance measurements are made in checking for continuity; no resistance indicates possible shorts, infinite resistance an open circuit. It checks coil primary windings and ballast resistors, for example.

High ohms. High resistance measurements are necessary for checking such things as condenser leakage, ignition cables and coil secondaries.

Spark output. Check of ignition coil output is read on a relative scale on a zero to 50 scale. If equal readings for all sparkplugs are not obtained, your problem exists with the coil, ballast resistor, cables or plugs.

Condenser. A substitute condenser is placed in the ignition circuit to check whether the installed condenser is open or shorted.

Dwell/tachometer

When you do a basic engine tune-up, you set dwell and engine revolutions per minute. If you're just getting started in do-it-yourself work on your own car, and think that simple tune-ups are all you'll be doing, the combination dwell meter tachometer is the best instrument to start with. Later, you may find you want to do more yourself, but for a gradual approach to acquiring test equipment, a dwell/tach is the best start. Most models are priced less than \$50.

As mentioned, dwell is the amount of time your distributor points remain closed, and if you've ever set points using a feeler gauge, you might wonder why a meter is needed to check the dwell. Even careful setting of the points won't always result in an accurate dwell angle. Variations within established tolerances and wear and age take their toll in the precision fit of most moving parts. New points might vary slightly in fit from those you've just re-

(Please turn to page S10)

Popular Mechanics and APAA have put car care everywhere

All of the retail outlets listed below are your "Car Care Month" Headquarters. To help make it easier for you to take care of your car at less cost, these stores will be featuring "Car Care Month" specials on most of the products advertised in

this "Car Care Guide."

We want "Car Care Month" to help everyone—that's why we've put it everywhere.

These chain store outlets can be found in virtually every state. Look for their store that is closest to you.

Check the listing for your state, and you'll find at least one of these stores near you. Also, look for their announcements and advertisements in your local newspapers.



Alabama

K-Mart Tire Service

Alaska

Valu Mart

Arizona

Miner's Auto Supply, Inc.

Arkansas

K-Mart Tire Service

California

'Appy's Auto Parts
Fisk Tire Center/Big Brake
4 Wheels Auto Parts
Freeway Auto Parts
Grand Auto
Kearny Mesa Volkswagen
King Auto Supply

Kragen Auto Supply Co.
Levins Auto Supply Co.
Mitcom, Inc.

Connecticut

Aid Auto Stores
Barkers Auto Service
Bradlees

Delaware

Penn Jersey Auto Stores

District of Columbia

Penn Jersey Auto Stores

Florida

Aid Auto Stores
K-Mart Tire Service
Nationwide Auto Parts
Pan American Tire Co.

Georgia

American Tire Co.
K-Mart Tire Service
Southern Auto

Idaho

Statewide Stores, Inc.
Thrifty Auto Supply

Illinois

Advance Auto Supply Co.
Bounty-Line
DuPage Automotive Supply Co.
Flame Auto Parts
Hardware Corporation
of the Midwest
K-Mart Tire Service
Major Motor Supply Co.
Strum Auto Supply
Vanderhoot & Sons

Indiana

Calumet Auto Warehouse, Inc.
Fleenor Auto Stores
Guarantee Auto Stores
Mr. Wiggs Department Stores
Nationwide Auto Parts

Iowa

Champion Auto Stores
City Automotive Supply
Esco Supply Co., Inc.
Gibson Discount Center
Mid-West Auto Parts Co., Inc.
Ranks
Robinson Wholesale
Strum Auto Supply
The Big-E
Vander Haag's Inc.

Kansas

Fisk Home & Auto Center
Giant
K-Mart Tire Service

Kentucky

Fleenor Auto Stores
K-Mart Tire Service
Mr. Wiggs Department Stores
Nationwide Auto Parts

Louisiana

Fisk Home & Auto Center
Globe Tire Service
K-Mart Tire Service

Maine

Kauf's Auto Stores
Bradlees

Maryland

Beenman Auto Parts
Hi-Gear Discount Auto Centers
Murphy's Mart Auto Service
Penn Jersey Auto Stores

Massachusetts

Big N Automotive Department
Bradlees
Consumer Auto Parts
Jack & Harry's Auto Stores

Michigan

Forest City Automotive
K-Mart Tire Service
Knowles Auto Parts
United Auto Parts
Western Auto Associate Store
Yochum Auto Supply

Minnesota

Big Wheel
Holiday Auto Center
Thrifty Auto Stores

Mississippi

Bob's Discount Center of Oxford

Missouri

Rupp Automotive, Inc.

Montana

Super Fair
Valu-Mart

Nebraska

Ranks
Skaggs Auto Center #9

Nevada

Valu-Mart

New Hampshire

Bradlees
Kauf's Auto Stores

New Jersey

Aid Auto Stores
American Battery Co.
Big N Automotive Department
Bradlees
Penn Jersey Auto Stores

New York

Aid Auto Stores
Big N Automotive Department
Bradlees
Carle Place Automotive Dist. Inc.
National Accessories Stores
U-DO-IT Self Service
Auto Repair Center

North Carolina

Advance/Auto
K-Mart Tire Service
Nationwide Auto Parts

North Dakota

Champion Auto Stores
K-Mart Tire Service

Ohio

Big N Automotive Department
Fleenor Auto Stores
General Electric
Hart's Tire Service
K-Mart Tire Service
Mr. Wiggs Department Stores
Murphy's Mart Auto Service
Nationwide Auto Parts
Protecto Auto Center, Inc.
Schottenstein's Tire Service
Streetsboro Housemart

Oklahoma

Guy Henshall Auto Parts
Supermarkets
Oertle's Automotive Service Center

Oregon

Statewide Stores
Super-Value Tire Discounters

Pennsylvania

Auto Giant Stores
Big N Automotive Department
Bosco's Department Stores
Gimbels Automotive Center
Just Rite Muffler Shop, Inc.
K-Mart Tire Service
Marino Home & Auto Supply
Murphy's Mart Auto Service
Penn Jersey Auto Stores
Robert Hall Village Car Care Center

Rhode Island

Jack & Harry's Auto Stores

South Carolina

Advance/Auto
Harold's Auto Supply
K-Mart Tire Service

South Dakota

Champion Auto Stores
K-Mart Tire Service

Tennessee

Advance/Auto
Gulley Performance Center
K-Mart Tire Service

Texas

Gibson's Discount Center
Globe Tire Service
International Automotive
Warehouse
Jack's Auto Supply
K-Mart Tire Service
Kragen Auto Supply
Leonards Auto Centers

Virginia

Fisk Home & Auto Center
Hi-Gear Discount Auto Centers
K-Mart Tire Service
Murphy's Mart Auto Service
Penn Jersey Auto Stores
Robert Hall Car Care Centers

Washington

Joe's Auto Supply, Inc.
Thrifty Auto Parts
Top Auto Supply Stores
Valu-Mart

West Virginia

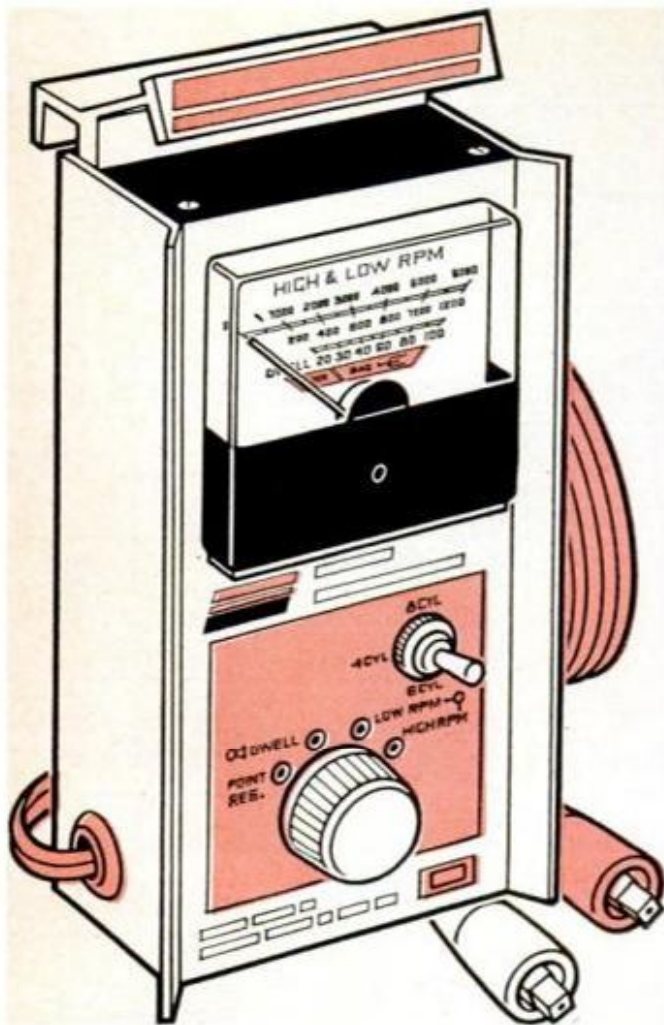
K-Mart Tire Service
Murphy's Mart Auto Service

Wisconsin

Gimbel's Automotive Center
K-Mart Tire Service
Moreway
Nationwide Auto Parts
Prange-Way Auto Center
Theresa Auto Parts

TUNE-UP INSTRUMENTS

continued



placed; wear on the breaker cam or distributor shaft bearing might create a "wobble" to throw off your feeler gauge setting; also, there could be some malfunction in the ignition circuitry that you'd miss by setting and adjusting mechanically. It's always better to make settings and tests while the engine is running, and the dwell meter is the tool that makes this possible.

Timing light

Every time distributor breaker points are replaced or adjusted, it's important to check the ignition timing: a change of just one degree in dwell causes a one degree change in timing. The timing light is necessary to adjust spark timing so it occurs at precisely the right time in each cylinder. This may be just before the piston reaches the top dead center position (TDC) or just after, depending on your engine.

The timing light is simply a strobe light connected to a running engine in such a way that

its flashing will make the timing marks appear to stand still. There are two types, neon and xenon. The neon light is very inexpensive. It's connected directly in series in the No. 1 spark-plug circuit, using the spark voltage to light the tube. Because current in the sparkplug wire is so minimal, the neon tube doesn't give a very bright flash and must usually be used in a darkened area.

The xenon light draws its power from the car battery or an external connection, and uses the No. 1 plug's voltage to trigger, rather than produce, its flash. The xenon, while considerably more expensive (about \$25 for d.c., \$16 for a.c.), fires with a much brighter flash and greatly simplifies accurate settings.

The timing light is aimed toward timing marks located on the engine's lower front fan pulley. If the engine has accumulated a film of dirt and oil, it may be necessary to wipe off the pulley and timing index plate before starting the engine. Many mechanics use yellow chalk or crayon to make the timing marks even more visible.

With the engine running, the timing marks appear to stand still. You can see if the index mark coincides with the correct degree of advance mark as recommended in the owner's manual (or on the under-hood decal on newer cars). If there's a difference, loosen the distributor hold-down nut and turn the distributor body to align the marks.

New engines should be set exactly to spec. It's the surest way to meet exhaust emission requirements and get the best performance from the engine. There's usually a 2° to 3° tolerance in the timing requirements. The greater the advance, generally, the more engine pep you'll get, but don't go beyond the limits, or you'll get "ping." This can sometimes be eliminated by using a higher-octane gasoline, but it can produce problems with the emission control systems installed on newer engines.

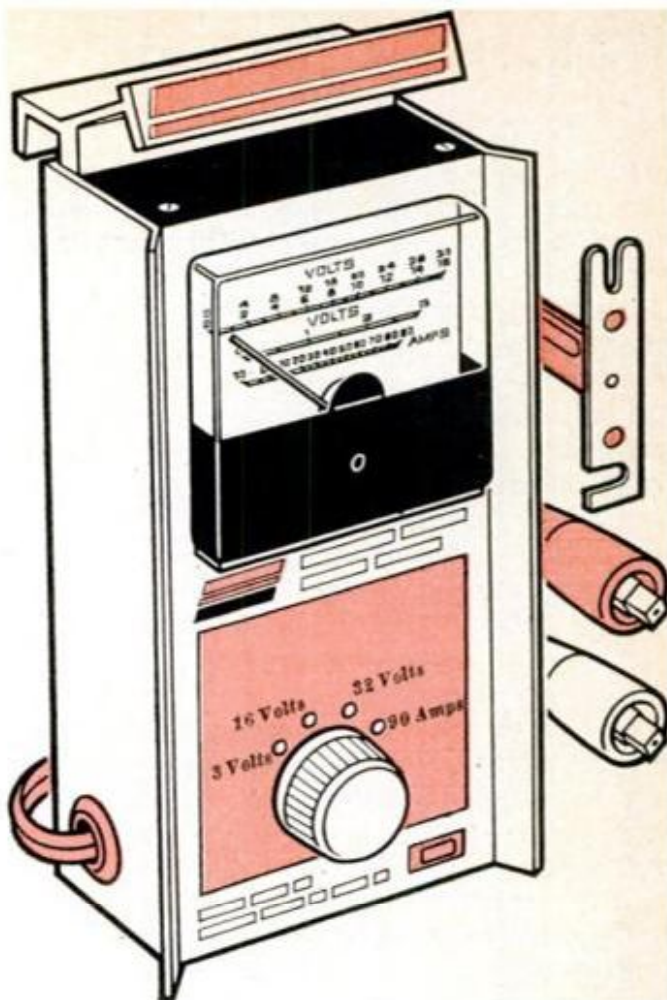


Generator-alternator-regulator tester

There's not much you can do to maintain or troubleshoot your car's charging system without a voltmeter/ammeter to measure its output. The voltmeter and ammeter functions of this instrument (also found in the all-in-one auto analyzer) make it possible to check that the alternator or generator is producing current and voltage to spec, and that the regulator is controlling this output to keep your battery fully charged but not overcharged.

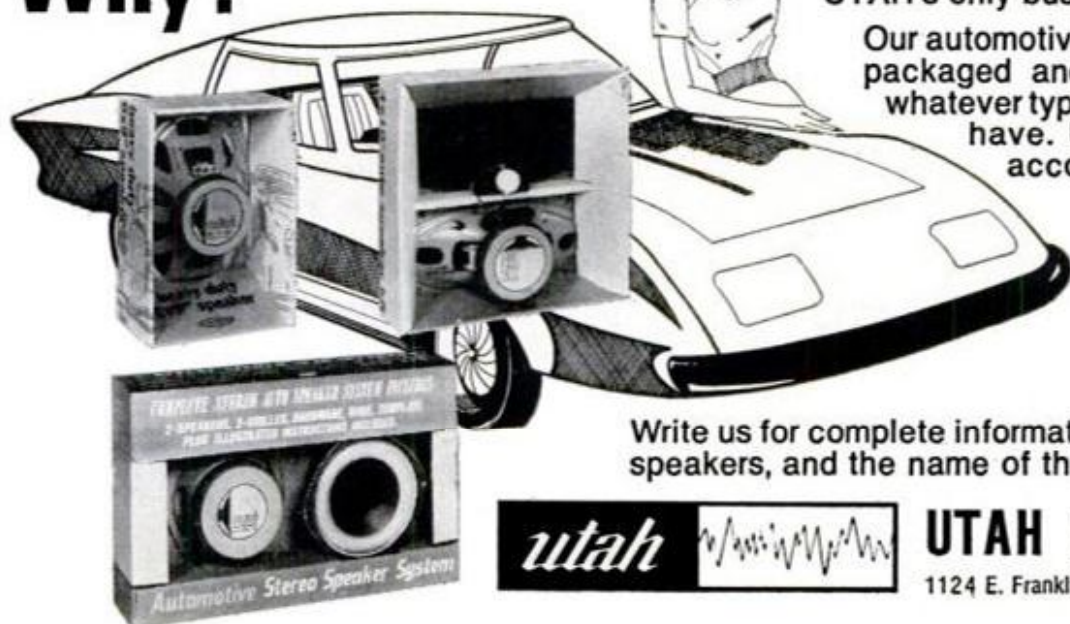
Basic voltmeters and ammeters are inexpensive, but the features of an automotive generator-alternator-regulator tester are worth their price of roughly \$20 to \$40. The most sophisticated will measure and check diodes, resistance, battery capacity, voltage losses, fuses and shorts. They also include (since current must be measured in series with a circuit) a battery-post adapter or ammeter shunt that allows the ammeter to be placed in the circuit quickly and conveniently.

Output at the terminals of both alternators and generator is d.c. (the diodes in an alternator have already converted the alternating current to direct). This output is being gener-



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TUNE-UP INSTRUMENTS

continued

ated as long as the engine is running. The advantage of the alternator, of course, is that the same output is generated at much lower rpm.

It's the job of the regulator to control the charging rate to the battery. The regulator incorporates three "switches" to do this: the cutout relay, voltage regulator and current regulator.

The cutout relay opens the circuit to keep the battery from discharging when the engine is stopped or the generator is rotating slowly and generating a voltage less than that of the battery (with an alternator, the cutout relay is not needed since the diodes perform this "switching" function).

The current regulator automatically protects the generator from overloading when the current requirements of the electrical system are high and the battery is low. It limits output to a safe value.

The voltage regulator protects the battery from overcharge and the electrical system from excessively high voltage. It does this by automatically cutting resistance in and out of the circuit as necessary.

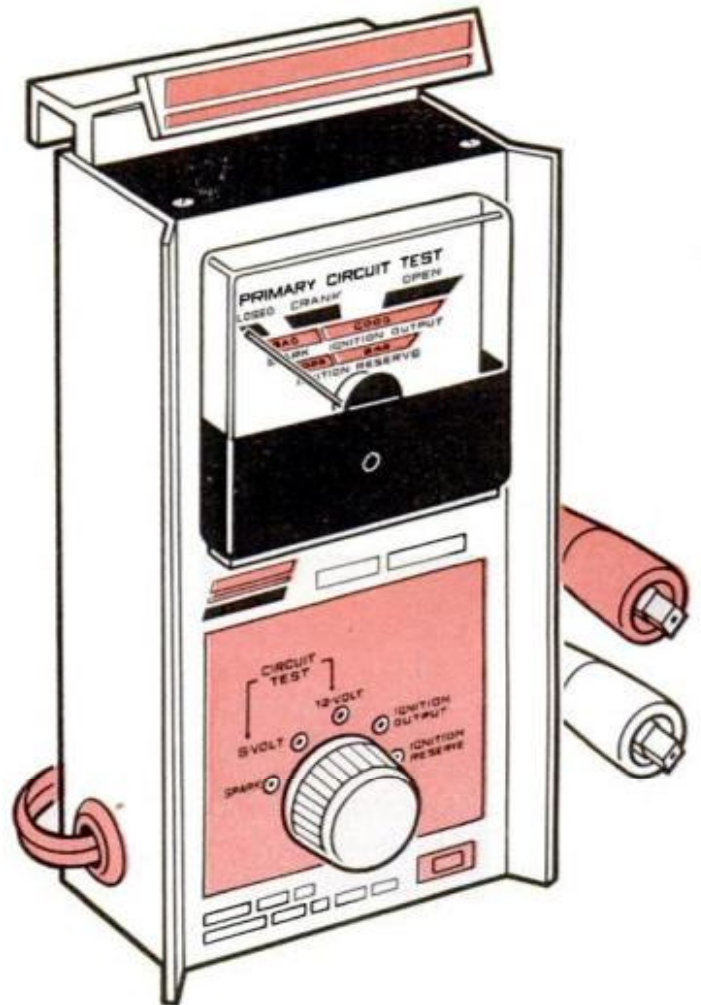
Adjustment of the all-important regulator is easy with the instrument designed to do the job.

Ignition tester

The two automotive systems requiring diagnosis when your car turns over but refuses to start are fuel and ignition. You can almost check that fuel is reaching your engine cylinders by just using your sense of smell, or better, looking into the carburetor throat while you actuate throttle linkage. If you're getting fuel, you've quickly isolated the problem to the ignition system. But troubleshooting ignition system components, more often than not, requires a measuring instrument to find out why ignition voltage isn't being produced or, if it is, what's happening to it and why it's not firing your plugs.

The ignition tester, which can cost from \$10 to as much as \$40 or \$50, will check both the primary side of your ignition circuit and the secondary side or high-voltage spark-output side.

With the better testers, you can diagnose the problem even when you're unable to start the car. Points, distributor cap, ignition switch, ballast resistor, condenser, coil output and



polarity, plug wires and resistance can all be tested.

Most instruments come with foreign and domestic sparkplug adapters and some include insulated pliers also.

Compression tester

A reading of the pressure built up in each cylinder by the piston on its compression strokes reveals the condition of rings and valves. New-car owners usually don't need a compression gauge as a diagnostic tool until they have many thousands of miles on their car. Since it provides a quick check of the condition and operation of piston rings and valves, it's a good instrument to use in checking older cars and good to have along if you're looking at used cars.

You simply record readings for each cylinder and analyze the results. The gauge is held in the sparkplug hole after all plugs are removed (or screwed into place if the gauge is the more desirable screw-in type—about \$15). Crank the engine for at least four compression

Panasonic introduces souped-up stereo.

If you're the kind of guy who's into Holley carburetion before the engine gets dirty. Who wouldn't go to the candy store without Hooker headers. Who can't settle for standard equipment. You should check out the new 8-tracks from Panasonic.

On the left, our 4-channel 8-track matrix system. The CX-675. When you hook up 4 speakers, you get all 4 corners of the music. In all 4 corners of your car.

On the right, the CX-475. Our 8-track with Dynamically Boosted Sound. Push a button. And it puts back the highs and lows that road noise takes

away. You get great stereo from 0 to 60.

Or if you like your 8-track stereo straight, try the economical CX-375. It's small enough for the glove compartment. It's music enough for the rest of your car.



But whichever you choose, you get the same dynamite

package of features. Like Vertical Head Movement. It's our built-in shock absorber. So the music doesn't bounce when your car does. Like our automatic and manual program selector. So you can change tunes while you're changing lanes. And a 12-watt dual-channel amplifier. Because great stereo begins with plenty of power.

And because a great cartridge player is only half of a great stereo, Panasonic has 9 different kinds of speakers.

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TUNE-UP INSTRUMENTS

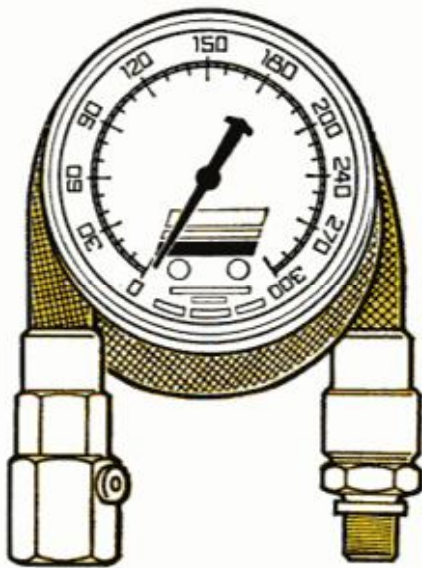
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strokes and note the reading obtained for each cylinder.

With a sound engine, the normal readings should build up evenly to the compression specs for your car, and the variation between cylinders should not vary much more than 10 pounds.

When the piston rings are worn, you'll get a low reading on the first stroke and pressure will build up on successive strokes but not to spec.

A valve problem is indicated whenever



you get low compression on the first stroke and compression doesn't build up much on successive strokes.

If you repeat the procedure after squirting about a tablespoon of SAE 30 oil into each cylinder and get an increase in readings, you can be sure the problem is worn or poorly seated piston rings; no increase in readings confirms bad valves. Other diagnoses are also possible: Low readings in two adjacent cylinders, for example, point to a leaking head gasket.

Vacuum gauge

This is going to be a big year for the old vacuum gauge. They're being mounted on the dashboard in many new cars and being called names like mileage minders and fuel savers. All they do in that capacity is help you pay attention to how hard you're stomping on the gas pedal. Connected to your engine's intake manifold, the gauge measures the difference between the pressure inside the manifold and the atmospheric pressure outside, or more



practically speaking, how hard the pistons are drawing in air for combustion.

Throttle position and engine speed affect the vacuum reading which at idle is normally between 15 and 22 (inches of mercury). Open your throttle too wide and too suddenly and the reading drops off into the wasteful fuel consumption range marked on the face of the gauge.

It's as an engine diagnosis tool, though, where the simple, inexpensive (\$5 to \$15) vacuum gauge pays for itself many times over. (Good gauges also will have capability to measure pressure so you can check operation and condition of your fuel pump.)

By observing the action of the pointer needle on the vacuum gauge you can diagnose dozens of possible engine malfunctions. For example, a pointer that wanders erratically is a sure sign of a problem that's not affecting all cylinders equally. If a pointer steadies at higher rpm (about 2000), suspect ignition and timing and the centrifugal advance in your distributor. On the other hand, if the erratic sweeps become shorter and more rapid, check for sticky valves, broken or weak valve springs and intake system leaks.

A steady but low reading on the gauge means a loss of power that has affected all cylinders alike. Test for late timing and intake-system leaks—possibly a warped intake manifold or a leak past the carburetor flange gasket, or a vacuum leak in vacuum-operated accessories.

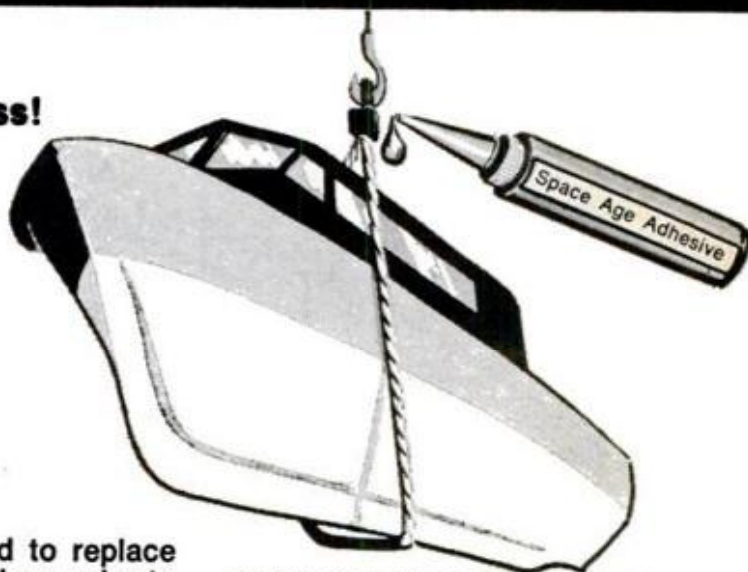
The vacuum gauge will also check malfunctions in other systems, the PCV system for example. It can be used in setting carburetor idle mixture (where legal) and in checking for restrictions in the exhaust system.

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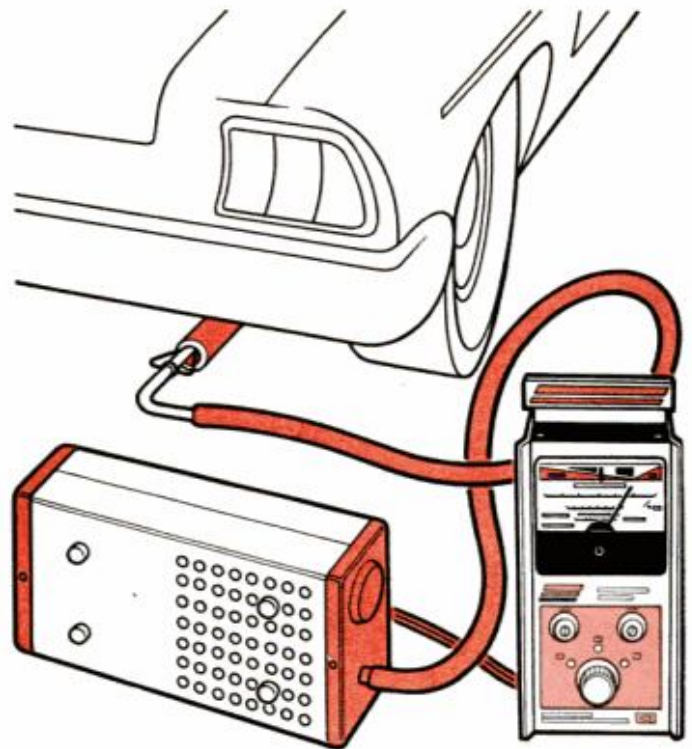
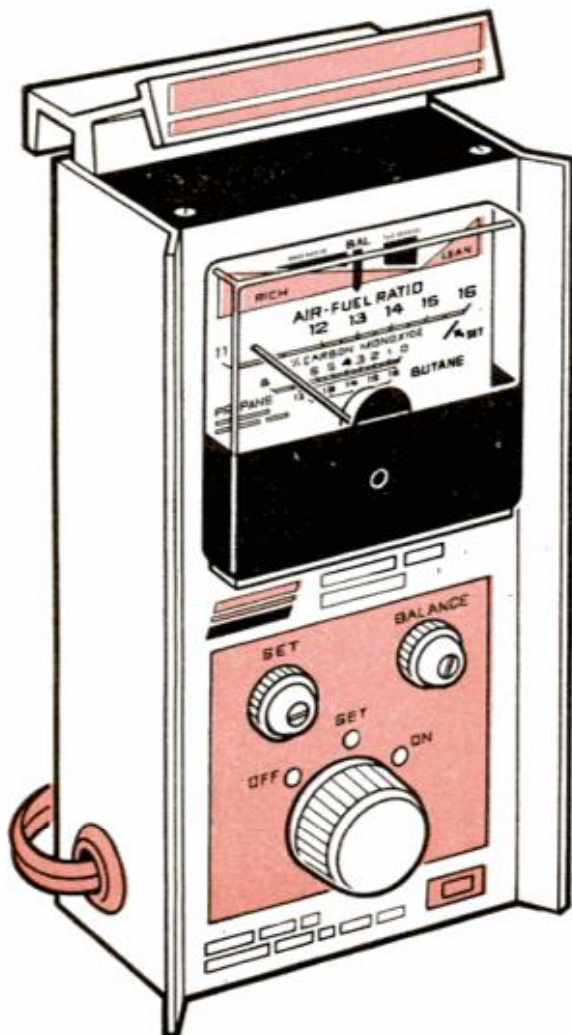
Exhaust gas analyzer

Exhaust emissions are now being measured as part of some states' annual inspections. If they're not within specs for your car, you fail. You've got a certain amount of time to tune up or hand over your registration. As with safety inspections, if you can check out your car at home and repair it beforehand, you'll be sure to pass and save yourself a lot of trouble.

Exhaust gas analyzers or combustion analyzers for home use start at more than \$50 but still may be worth the investment—especially as more states require emissions inspections.

The instrument measures the completeness of combustion in your engine by analyzing the contents of the exhaust gases. The sensing unit, shown opposite, has a pickup hose that is inserted in the exhaust pipe. Some sensors can be attached to the rear bumper so you can take readings as you drive. The readout on the meter indicates air-fuel ratio from rich to lean, and percent of dangerous carbon monoxide in the exhaust.

Since the instrument measures combustion



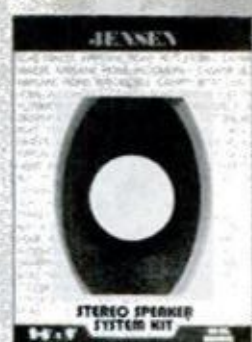
efficiency, it is a valuable for checking your carburetor and getting as many miles per gallon that you can from your car. An engine running at about 2000 rpm, for example, should be burning a mixture of air-to-fuel of about 14 to 14.5 to 1. If you read anything richer, check the carburetor float level, metering rod, jets and look for air restrictions. Similarly, if the reading indicates too lean a mixture, check carburetor components again and look for air leaks.

In addition to enabling you to pass emissions inspections and diagnosing your carburetor, the exhaust gas analyzer can be used by the more enthusiastic to study carb performance with the engine under load. During a road test, the metering system can be thoroughly analyzed. A similar test at a shop that also sells you a fully rebuilt carb will cost as much as the instrument. Take your pick.

Diagnostic oscilloscope

The cathode ray oscilloscope, long used by the professionals for analyzing voltage waveforms and magnitudes in the primary and secondary circuits of your car's ignition system, is becoming increasingly available to the amateur mechanic at prices he can afford. Some basic units are less than \$200. Most moderately priced instruments are in the \$200 to \$400 range.

Once you've used the "scope" it's hard to go back to what you'll consider primitive meters. The waveforms or patterns you read on the scope are produced by applying your ignition-circuit voltage to the vertical deflec-



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When you're out traveling, it's nice to have your favorite sounds along. Jensen makes it easy. We have a full line of mobile high fidelity speaker system kits that can move your sounds on the road—or anywhere. Jensen's Syntox-6® ceramic speaker magnet weights range from 4.8 ounces to 20 ounces for super-sound reproduction. All models have exceptional frequency range and outstanding power ratings. Kits are ruggedly constructed and come with installation instructions plus all the gear for easy hook-up. Travel with your sounds — travel with Jensen.

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tion terminals. The horizontal sweep is linear and represents relative time during the ignition cycle. Also on the horizontal is a scale marked off in degrees for reading dwell angle.

To analyze the primary side of your system, you pick up the voltage across the distributor points and you read the 40-volt vertical scale. The picture you get starts with the spikes showing the spark as the points open and ends with a steady horizontal line showing zero voltage when the points are closed. You can read the length of the line on the dwell scale. Also visible are the coil and condenser oscillations.

To analyze the secondary, high-voltage side, you pick up the voltage at ignition coil secondary output to the center of the distributor cap, and you read the 40-kilovolt vertical scale. The secondary picture or trace also is comprised of a spark zone showing when the points open, a coil and condenser zone and a dwell zone when the points close again. The pattern you get is easily compared to a standard trace. Variations are diagrammed in operating manuals so you can diagnose malfunctions.

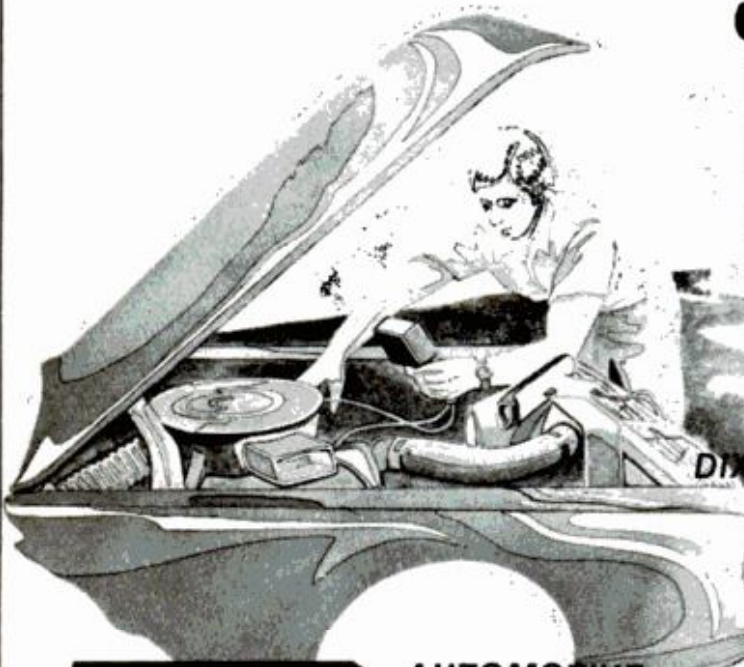
Not only does the scope pinpoint malfunctions in any ignition component and wiring, but it lets you "see" harder to diagnose



problems like excessive cam wobble. The diagnostic oscilloscope also checks your alternator, letting you analyze the pattern of its voltage ripple.

Sometime you may want to spend \$3 or \$4 for a remote starter switch. It lets you start your car from under the hood. What a luxury!

when you need a first class tune-up... ...you need first class instruments!



Dixco makes them! Timing Lights, Engine Analyzers, Compression and Vacuum Testers, Tach-Dwell-Points Testers, Remote Starter Switches and more. We manufacture them to meet the exacting demands of professional mechanics whose livelihood depend on the best...we make them the same way for the home mechanic!

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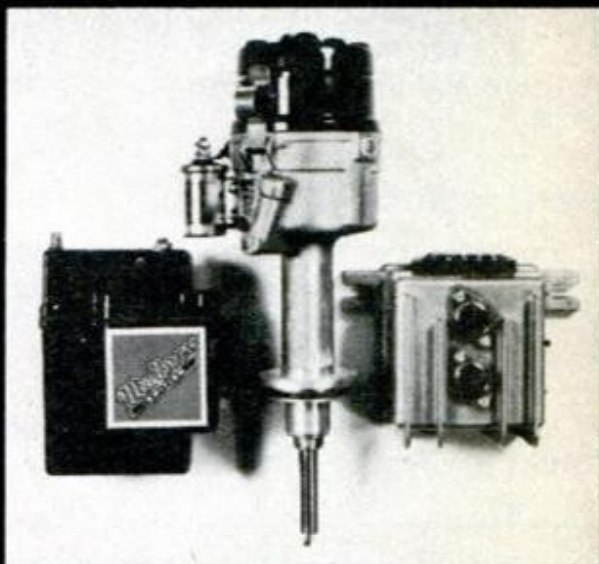
WITH FULL LIFETIME WARRANTY

Fuel economy and the ignition system...

Fuel economy has always been desirable—but with the energy crisis and soaring gas prices, it is essential! The secret of fuel economy is efficient fuel combustion... largely dependent on the ignition system. The stock ignition in your car may be subject to a variety of problems which cause low voltage to the plugs and inaccuracy in timing. This may occur even in a well-tuned engine. The result is poor combustion—along with its accompanying by-products of poor fuel economy, poor performance and air-polluting exhaust.

Now Mallory, the leading performance ignition, provides the leading fuel economy ignition. You can have increased economy by just adding a Mallory Voltmaster Mark II Coil for more voltage and shorter rise time to provide better combustion. And the system improves with the addition of a vacuum and centrifugal Double-Life Distributor for consistent point operation and strong coil output. The system is even better yet with a Super-CD Capacitive Discharge Amplifier for a precise spark and increased plug and battery life. All three of these components can be installed at one time or added separately.

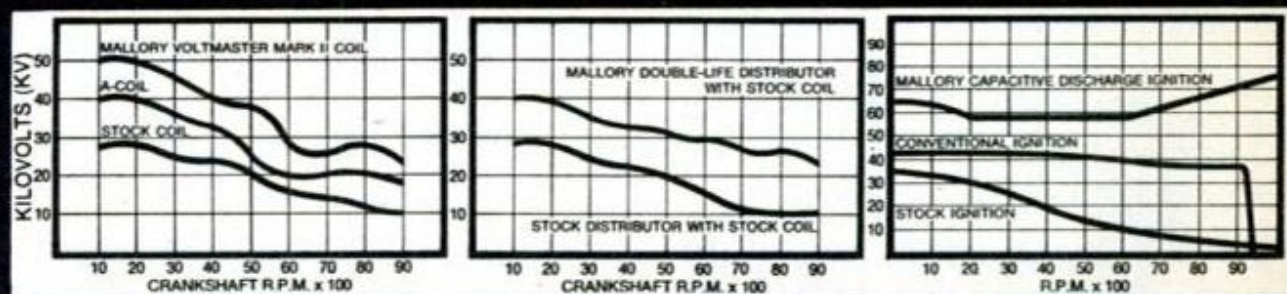
You may elect to install the ultimate ignition instead—a complete Infrared



Breakerless System. It uses the Voltmaster Mark II Coil and the Super-CD Amplifier along with the amazing Mallory Infrared Distributor. This system times the engine more accurately than any ignition system yet developed.

This equipment can mean dramatic improvements in fuel economy... and improved performance too! All this, and cleaner exhaust as well!

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LUBRICATION

Lubrication is the most important service for your car, and the easiest for you to do yourself. Changing oil and oil filters, replenishing fluids and greasing should be done at regular intervals. The type of driving you do should dictate the frequency of lubrication: Cut in half the intervals recommended in your owner's manual if you do most of your driving in heavy traffic or on dirt roads, if you pull a trailer, or if you drive short distances in cold weather.

How to select engine oil

Buy oil specified as SE quality for a new, healthy engine (engines that see less severe service than conditions mentioned in the preceding paragraph and are '70 models or older can safely use SD oil).

You can use SD or SC oil for oil-burning engines.

Oil is also classified according to weight. Multiweight oil protects engines over a wide

temperature range, so there's no real selection problem (SAE 10W-40 lubricates from -10° to $+90^{\circ}$). But you must select single-weight oil according to temperature if you don't use a multiweight oil.

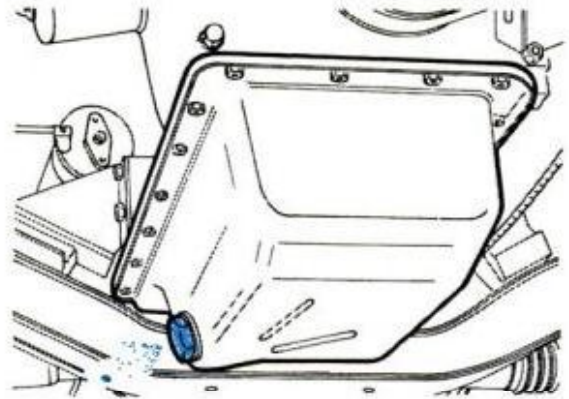
How to change oil

Warm up and turn off engine.

Remove oil pan drain plug and let the oil drain out.

Replace plug's gasket if cracked.

Reinstall plug snugly.



Turn off warmed-up engine, remove oil drain plug and give hot oil ample time to drain.

One side waxed with paste wax.
One side waxed with new Liquid Kit.

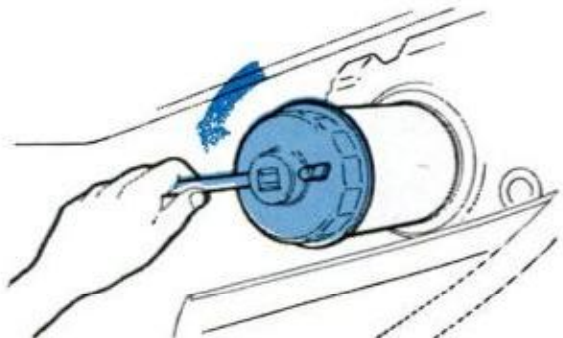
Before you pour fresh oil into your engine, install a new oil filter, despite the fact that most manufacturers say it's not necessary to do this every oil change. If you don't change the filter every time you change the oil, at least remove it, empty the dirty oil from it and replace.

How to change an oil filter

Unseat filter with wrench.

Smear thin coat of oil on new filter's gasket (are your hands clean?).

Seat new filter by hand until the gasket just begins to compress; then give it an-



Loosen oil filter with a filter wrench, if necessary. Install the new filter hand-tight.

other half to three-quarter turn *by hand*.

Caution: Tightening the new filter with a wrench can wrinkle or damage gasket, causing oil leak.

Fill crankcase with oil.

Start engine and check for leaks at drain plug and filter.

Fluid levels that should be checked during lubrication are radiator, battery, brake master cylinder, transmission, steering and differential.

How to check the radiator

Keep engine cold.

Remove radiator pressure cap (if car has coolant recovery system, check level at see-through plastic tank).

Bring level to mark by adding desired proportion of ethylene glycol and water.

Correct coolant level is about 1½ inches below top of filler neck (most radiators are marked). Correct level with coolant recovery

(We can't tell them apart either.)

Long lasting paste wax protection in an easy to use liquid.



LUBRICATION *continued*

system is marked on a see-through tank.

Important: When adding coolant to recovery system, pour into plastic tank.

How to check the battery

Remove electrolyte port covers after wiping them clean.

Check level.

Add water until level reaches bottom of ports or level marks.

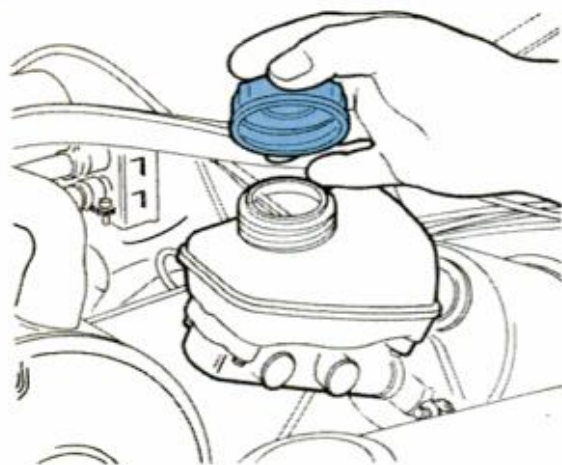
For maximum battery life, use distilled water, or rainwater. You can use tap water if it is low in mineral content.

How to check brake fluid

Clean off and remove the master cylinder cover.

Is fluid within $\frac{1}{2}$ inch of top?

If not, add type of fluid recommended in manufacturer's service literature.



Some master cylinder covers are screw-type, while others are held by spring clip or bolt.

How to check the automatic transmission

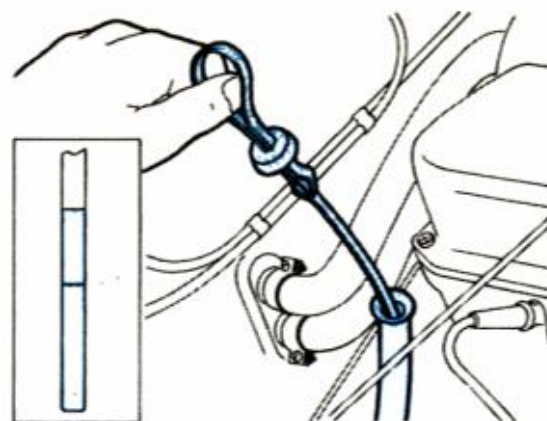
Drive car to bring transmission to operating temperature.

Park on level surface.

Wipe dipstick cover clean, draw dipstick from tube and read level.

Add fluid recommended by manufacturer to bring level to Full mark.

Caution: Check owner's manual service data or car dealer to determine if transmis-



Automatic transmission dipstick is in rear of the engine compartment. Do not overfill.

sion gear selector should be in N or P, and whether engine should be idling or shut off for fluid check.

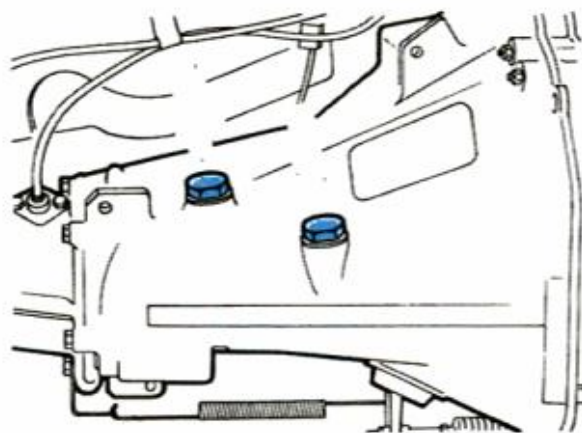
How to check manual transmission

Park on level surface.

Remove filler plug from gearbox after wiping plug clean.

Check fluid level with finger if not visible.

Fill to plug hole as necessary.



Most manual transmissions have two plugs: a filler plug and below that a drain plug.

How to check power steering

Warm up engine; let it idle.

Turn steering wheel full left and then full right several times.

Caution: Don't hold at either extreme.

Shut off engine; remove cap from power steering reservoir after wiping cap clean.

Add power-steering fluid to bring level to Full mark on dipstick.

ARE AUTOMOTIVE ADDITIVES JUST ANOTHER 'PUT-ON'?

Perhaps you just can't get yourself to believe that an additive in the fuel system can possibly solve what seems to be a mechanical problem: getting an engine to start easier, idle smoother or stall less.

The next time you're in an automotive department, stop in front of that big rack of additives. Remind yourself that every year, car owners buy over 500 million dollars worth of these various chemicals. Maybe they know something you don't.

Here at GUMOUT, we produce an additive that cleans the inside of a carburetor. Every carburetor needs cleaning because the gasoline passing through gradually builds up deposits of gum and varnish. This prevents the carburetor from feeding the proper mixture of fuel and air into the engine. As a result, the car becomes hard to start, idles roughly, loses pep and pick-up and stalls easily. Carburetor gum also increases the emission of dangerous fumes, and wastes gasoline. Newer cars are even more prone to these problems because of the anti-pollution devices which are now part of the fuel system.

If you are experiencing any of these problems, we suggest you put aside your skepticism toward automotive chemicals long enough to add a can of GUMOUT carburetor cleaner to your gas tank. See for yourself how much difference a clean carburetor can make!

GUMOUT will clean your carburetor on the inside while you drive, removing gum and varnish deposits from all the jets and passages. Try GUMOUT and see for yourself how much better your car performs. Easier starting; smoother idling, more lively acceleration, improved gas mileage, and a decrease in dangerous exhaust fumes.

GUMOUT is also available in a Jet-Spray can that's used by professional mechanics for quick cleaning of carburetor linkage, automatic chokes, and PCV valves.

Get GUMOUT wherever automotive products are sold.

GUMOUT Cleveland, Ohio 44104



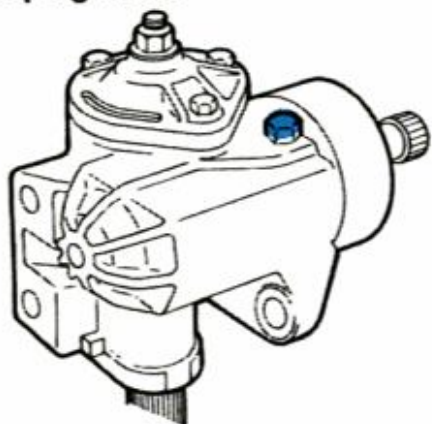
LUBRICATION *continued*

How to check manual steering

Wipe plug area clean.

Remove plug and check lube level.

Add steering gear oil until level reaches bottom of plug hole.



Manual steering gear has a plug for checking lubricant level. Add lubricant as necessary.

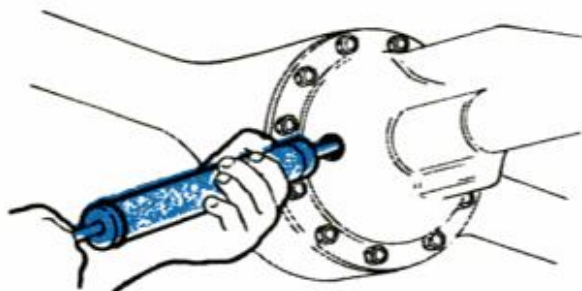
How to check the differential

Wipe plug area clean and remove plug.

Insert pinky to first joint—feel fluid?

Add fluid, as necessary.

Caution: Limited-slip differentials take one kind of fluid—conventional rear ends another. Don't use the wrong one.

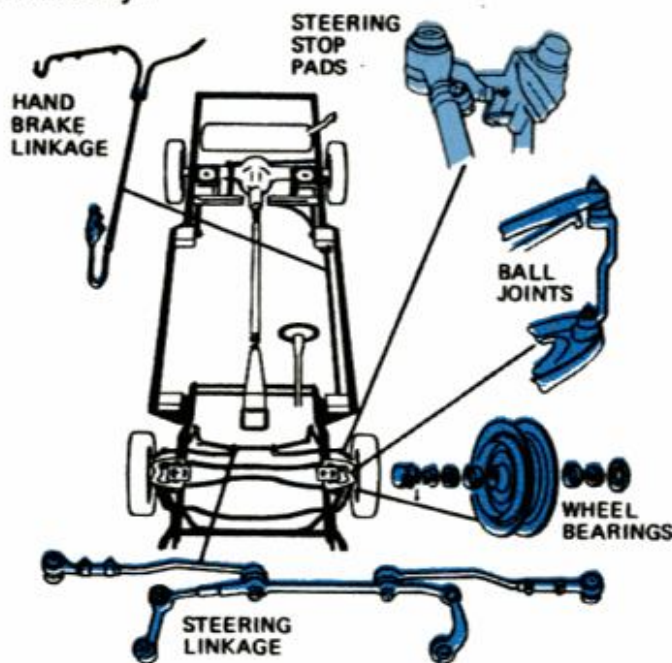


Suction gun provides convenient method for topping off or changing rear-axle lubricant.

Chassis lubrication involves greasing front suspension and steering linkage ball joints, and front-wheel bearings. Charts showing exact lubrication points are printed by manufacturers in their service manuals.

Ball joints are located on the upper control arm and on the lower control arm. Most cars have ball joints at steering-linkage pivot points also. Use a hand grease gun that takes cartridges of grease. Note that some imported

cars are equipped with lifetime lubrication of front ends and no ball-joint lubrication is necessary.



Typical chassis lube points are shown here. Try to get the lubrication chart for your car.

How to lubricate ball joints

Wipe plugs clean.

Unscrew metal plugs; pry out rubber ones.

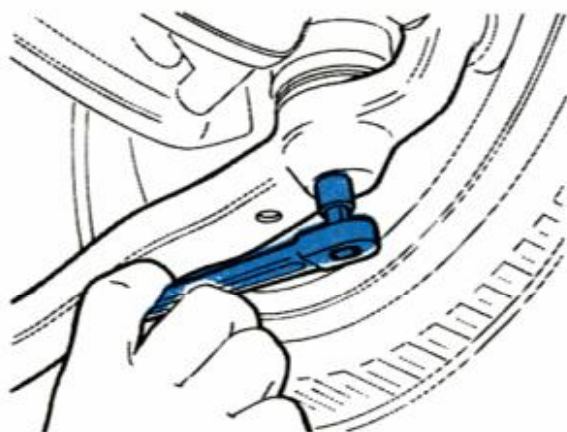
Insert appropriate-shaped grease fittings into plug holes (fittings are straight, or bent 45° or 90°).

Attach grease gun. Use extension adapter to reach joints on upper arm.

Pump in amount of grease specified by the manufacturer, or until rubber boots just begin swelling.

Caution: Forcing in excess grease can damage seals.

Detach grease gun, reinstall plugs (use new rubber plugs) or leave fittings in place of plugs.



Insert grease fittings if they're necessary to lubricate ball joints. Then use grease gun.

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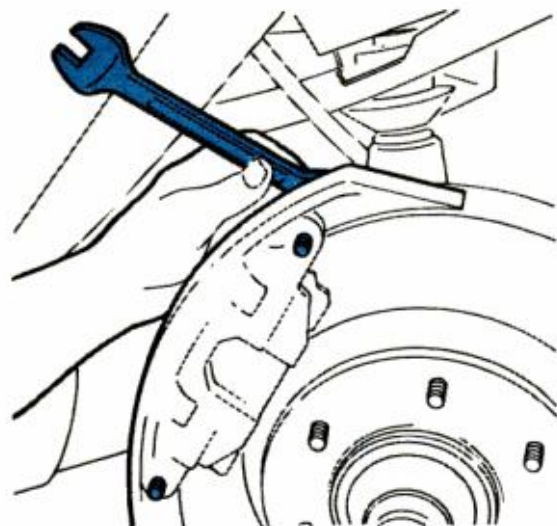
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If necessary to lube front-wheel bearings, remove caliper by detaching retainers (studs) and lifting caliper off the rotor.

Each front wheel rolls on two bearing assemblies that can burn up if not greased regularly. Lubricate bearings every 15,000 miles.

Removal of bearings is done the same way whether cars have disc or drum brakes, except that calipers of discs must come off. This is done by removing retaining pins that hold the calipers.

Caution: After loosening caliper retainers, slide caliper away from rotor and support on steering knuckle arm. Don't let caliper hang by its brake hose.

How to remove wheel bearings

Chock rear wheels and jack front end.

Remove wheel cover and grease cap.

Remove and discard cotter pin (Use a new one when reassembling.)

Take off locknut.

Unscrew adjusting nut.

Wipe dirt from wheel spindle.

Jerk wheel toward you and push it back . . . outer wheel bearing and thrust washer will drop on spindle.

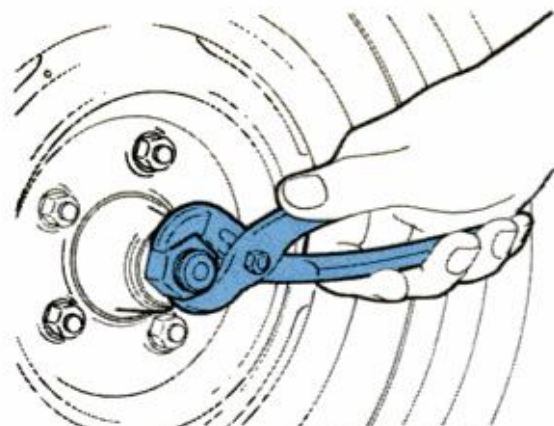
Lay bearing and washer aside.

Caution: Place parts on sheet of clean wrapping paper or rag. Protect the bearings from dirt.

Lay wheel face up on clean surface.

Gently tap around race of inner bearing with brass drift until bearing and grease seal fall from place.

Lay bearing aside; discard seal.



After removing grease cup, cotter pin and castellated locknut, unscrew the adjusting nut.

After bearings are out, shine a light inside the hub and inspect caps. Knock out a damaged cup. Install a new cup by tapping it into place with a brass drift.

Important: If you replace a cup, replace its respective bearing, and vice versa.

How to service bearings

Wash bearings thoroughly in kerosene or wheel-bearing cleaning solvent; let dry.

Dip bearings in lightweight engine oil.

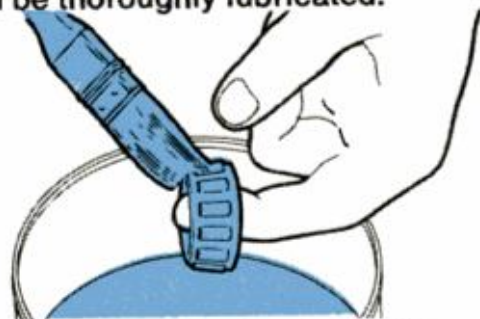
Inspect each bearing—discard if damaged or blackened.

Spin bearings. Discard if needles bind or scratch.

Work bearing into an amount of high-temperature wheel-bearing grease in your hand until grease oozes between needles.

Clean insides of wheel hubs with kerosene or wheel-bearing cleaner and apply a light coating of bearing grease.

Important: New bearings, as well as old, should be thoroughly lubricated.



Never hold bearings by needles. Handle as shown here.

Install bearings by reversing the removal procedure. Complete lubrication by greasing the chassis points, hinges, latches. Spray weatherstripping with silicon spray.



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IGNITION SYSTEM

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How to test sparkplug cables

Replace cables and boots that are obviously cracked and brittle.

Attach jumper to a clean ground; connect other end to a screwdriver.

Start engine and remove one cable from sparkplug.

Caution: Remove cables by pulling with a twisting motion on boots—not on cable!

Test insulation with screwdriver.

Replace cables if sparking occurs.

Reattach cable and test others.



Use jumper to test distributor-to-coil and sparkplug cables.

Remove sparkplugs next, but when detaching cables identify them so you can reconnect them correctly. Writing numbers on pieces of masking tape and adhering the right piece to each cable is the method to use.

How to remove sparkplugs

Keep engine cold.

Loosen sparkplugs one turn.

Blow particles away with syringe.

Caution: See to it that no particles fall inside cylinders.

Remove each plug and mark it with its respective cylinder number.

The firing ends can tip you off to operational problems. Normal operating plugs get coated with brown or grayish-tan deposits. Problems are indicated by the following:

Carbon—engine's been running on rich fuel mixture. Check for improper choke operation and clogged air cleaner. Excessive engine idling and slow-speed driving also foul plugs. Switch to hotter plug.

Oil—valve seals or piston rings are worn.

Blistered insulator and/or extensive electrode wear—overheating. Check for lean fuel mixture, overadvanced ignition timing, stuck manifold heat-control valve and clogged cooling system. Extensive high speed or heavy load (trailing) driving also cause overheating. Switch to cooler plugs.

The correct heat range plug is one meeting thermal conditions inside the cylinder head. If colder or hotter plug is needed, consult auto parts and accessories dealer to get correct one.

Caution: In switching, move up or down the heat range scale one notch at a time.

Clean, gap and reuse plugs having minimum electrode wear and no damage.

How to clean sparkplugs

Spread ground electrode carefully.

Caution: Use only bending tool of sparkplug gapping gauge. Other tools will ruin plugs.

Scrape deposits from insulator nose with wire brush or hacksaw blade ground to 1/8-inch taper at one end.

Insert ignition point file between electrodes; file electrodes clean.



Make several passes with a file to get rid of deposits and to brighten the two electrodes.

Clean whole plug with mineral-spirits-dampened cloth.

Clean deposits from threads with small wire brush.

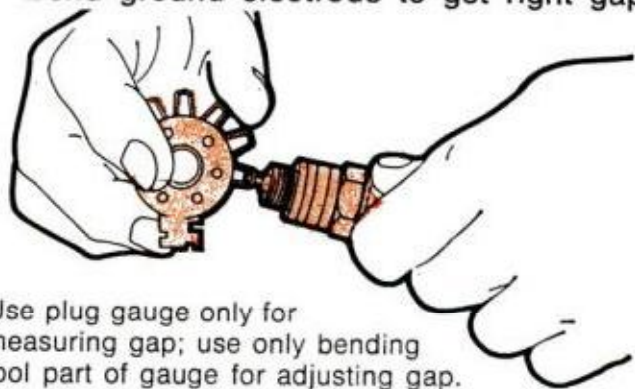
How to gap electrodes

Important: If new plugs are being used, they, too, must be gapped.

Consult owner's manual or service data decal pasted in engine compartment for gap specification.

Insert feeler gauge between electrodes—correct gap is attained when you feel a slight drag as you move gauge.

Bend ground electrode to get right gap.



Use plug gauge only for measuring gap; use only bending tool part of gauge for adjusting gap.

Before reinstalling plugs, take cylinder compression readings to determine engine's internal condition.

How to take compression

Push compression gauge fitting into cylinder.

Crank engine until gauge reaches maximum reading.

Record and analyze readings.

If lowest reading is 25 pounds or more less than highest, valves are leaking. If overall compression is below minimum allowable specification for engine, rings are worn.

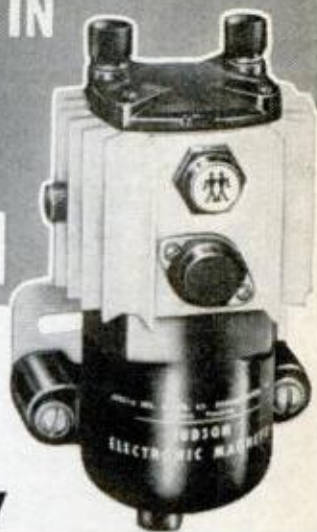
If you're reusing plugs, install them in ports from which they were taken. Some types have gaskets. Get new gaskets from auto parts dealer since old ones may not let plugs seat firmly, creating a compression leak.

How to install sparkplugs

Wipe dirt from port threads.

Screw plugs in finger-tight.

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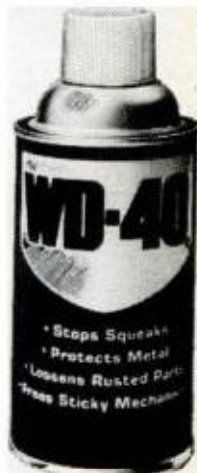
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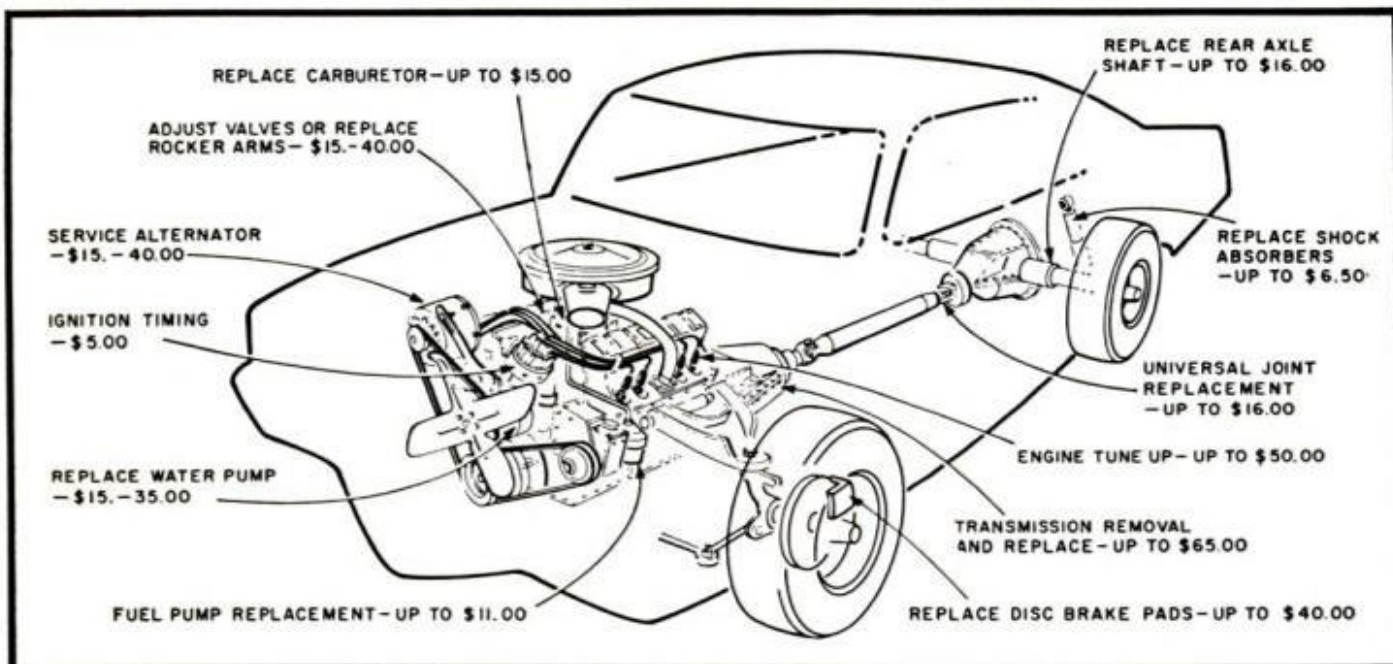


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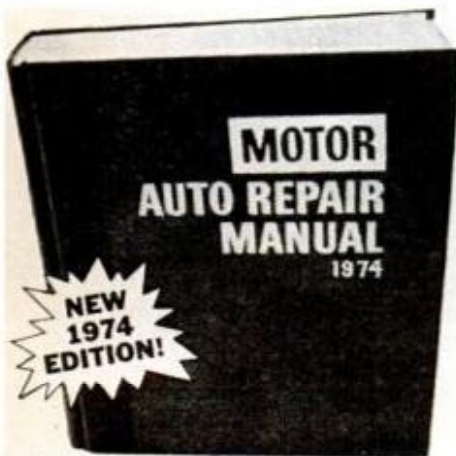
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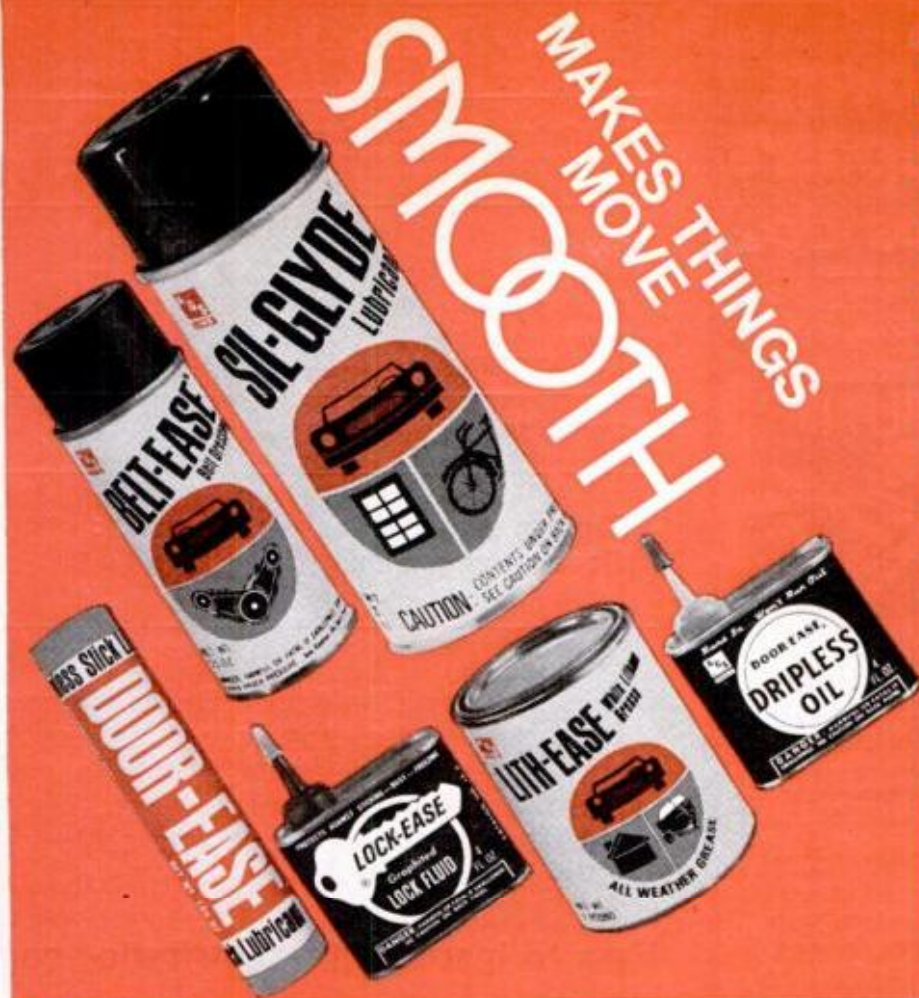
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10	12	10
12	18	16
14	25	22*
14 (taper seat)	15	15
18	35	25
18 (taper seat)	17	15

*Tighten Mazda plug 8-13 ft.-lb.

Tighten plugs with torque wrench:
Reconnect cables.

Continue by servicing the distributor. Remove high-tension cables from cap and identify them—each must be reinstalled into its right tower. Slide back terminal coverings. If terminals are black or burned, replace cable and look for damaged cap.

How to inspect the distributor cap

Remove cap.

Look for hairline cracks, eroded towers, carbon tracks, burned or corroded terminals—replace damaged cap. Clean towers.

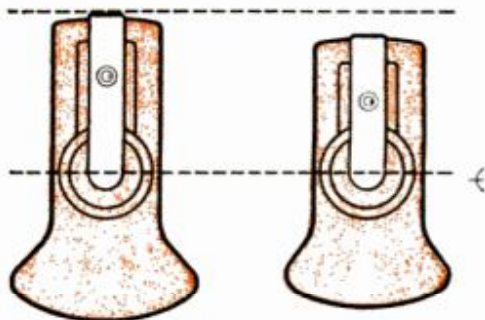
Turn rotor by hand as far as possible and release it. It should spring back. If rotor action is sluggish, overhaul distributor.

How to check the rotor

Pull rotor off distributor shaft.

Inspect for corroded or broken contact and cracked body.

Replace a damaged rotor.



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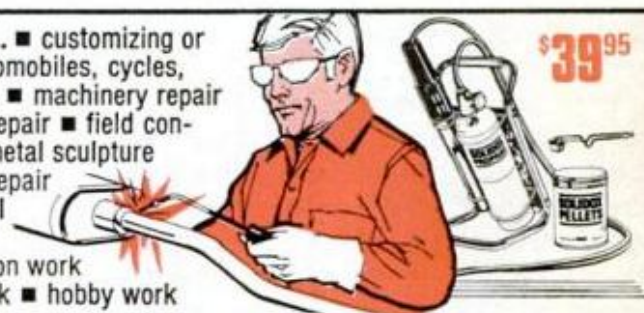
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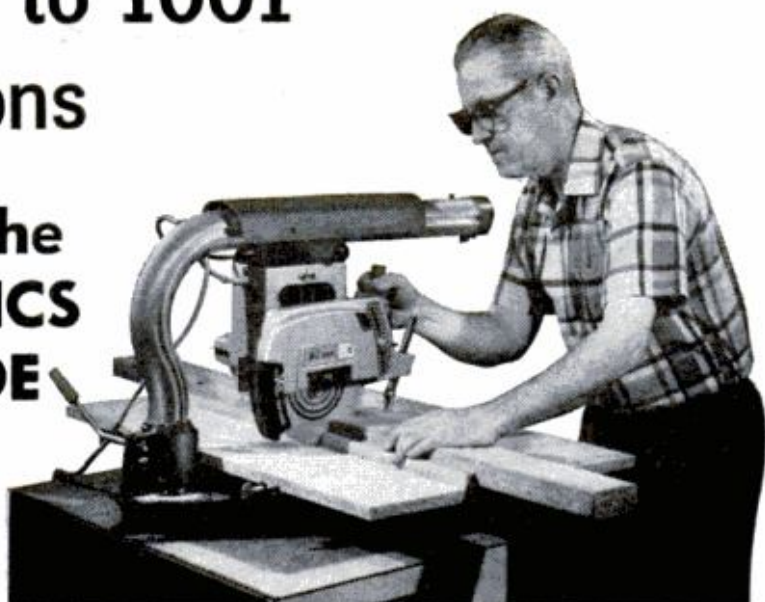
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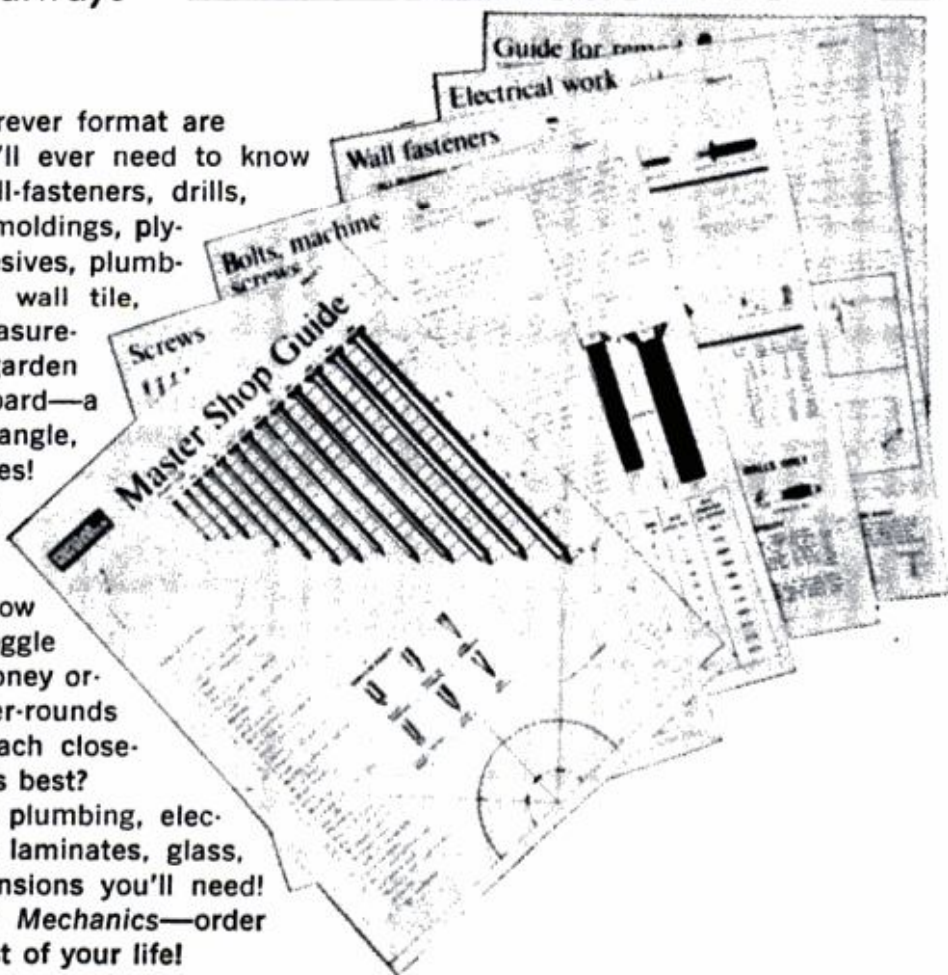


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IGNITION SYSTEM *continued*

Examine distributor contact points by spreading them apart. Service and reuse points having a grayish tint and/or slight roughness.

How to service points

Pass a clean fine-cut contact point file between points.

Wipe points clean with a mineral-spirit dampened cloth.

Caution: Don't clean points with emery cloth or sandpaper.

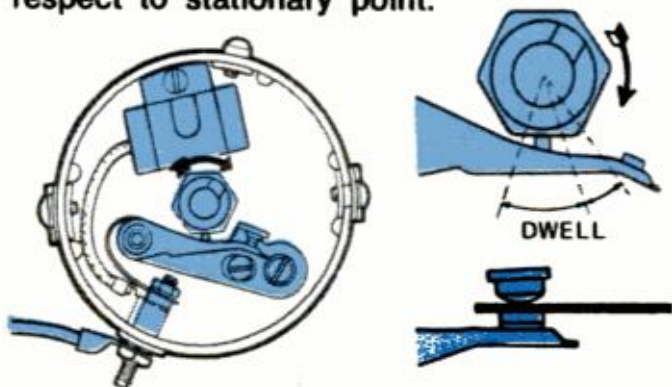
Replace badly burned or pitted points, but find the reason first. Point damage results from an improperly adjusted or inoperative voltage regulator, bad ballast resistor, defective condenser, high resistance in the condenser circuit, oil or vapors seeping into the distributor, excessive lubricant thrown off by the distributor cam and picked up by points, weak contact point spring tension, and improper gapping at the time points were installed or last serviced.

How to set point gap

Position breaker arm rubbing block on high point of cam lobe by cranking engine or turning over by hand.

Insert feeler gauge between points (gap's okay when gauge offers slight drag).

Set gap by loosening screw holding movable point, and opening or closing it in respect to stationary point.



Distributor details show how to set contact point gap properly.

Some distributors have two sets of points. Adjust gap of each individually.

Lubricate, but don't overlubricate, the distributor cam. Too much grease burns points.

Replace wick cam lubricators—don't attempt to relubricate them. Distributors without built-in lubricators should have one drop of distributor cam lube no larger than the head of a match to one cam lobe.

How to reassemble the distributor

Reinstall rotor and distributor cap.

Seat cables firmly in towers by pushing down hard and squeezing coverings to release trapped air.

Check cable between distributor's center tower and coil at coil for damage.

Clean coil tower.



Clean off all deposits from the terminal towers.

Set point dwell and ignition timing. Dwell refers to the length of time that points remain closed. Timing refers to the moment that sparks are delivered to cylinders. Timing is set with a stroboscopic timing light. Check the service decal in your engine compartment for specs.

How to adjust dwell

Calibrate and connect dwellmeter.

Idle engine; read meter.

Shut off engine if adjustment's needed and remove distributor cap and rotor if necessary (some distributors can be set through a window on side of housing, but be sure to close window after adjustment).

Turn ignition key on and crank engine as adjustment is made.

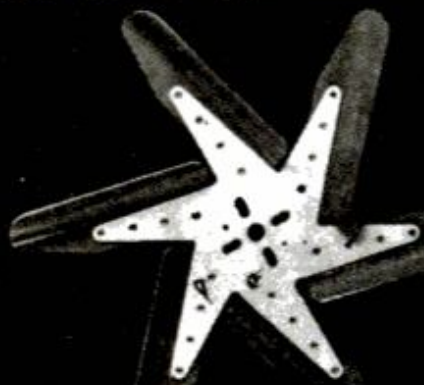
Reconnect everything and retest.

How to adjust timing

Warm up engine.

Connect timing light and tachometer as outlined in instruments' manuals.

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IGNITION SYSTEM *continued*

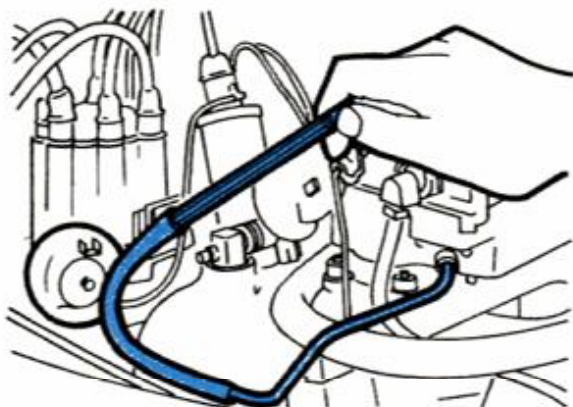
Disconnect and plug vacuum advance hose.

Start engine and aim timing light at timing mark and pointer.

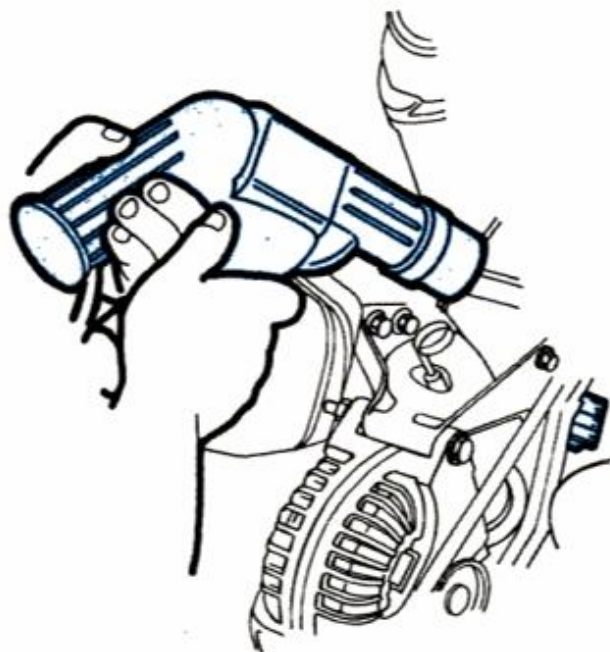
Important: Sight straight—don't tilt the instrument. Timing is correct when timing mark appears stationary in relation to the pointer.

Set timing to spec by loosening and rotating distributor until timing mark lines up with pointer and holds steady.

Tighten distributor; retest.



Most ignition systems are timed with the vacuum hose plugged.



Aim timing light straight at the timing mark to read degrees.

How to check vacuum advance

Disconnect vacuum hose; let engine idle. Flick finger back and forth over hose.

Replace hose and/or vacuum chamber if there's no suction.

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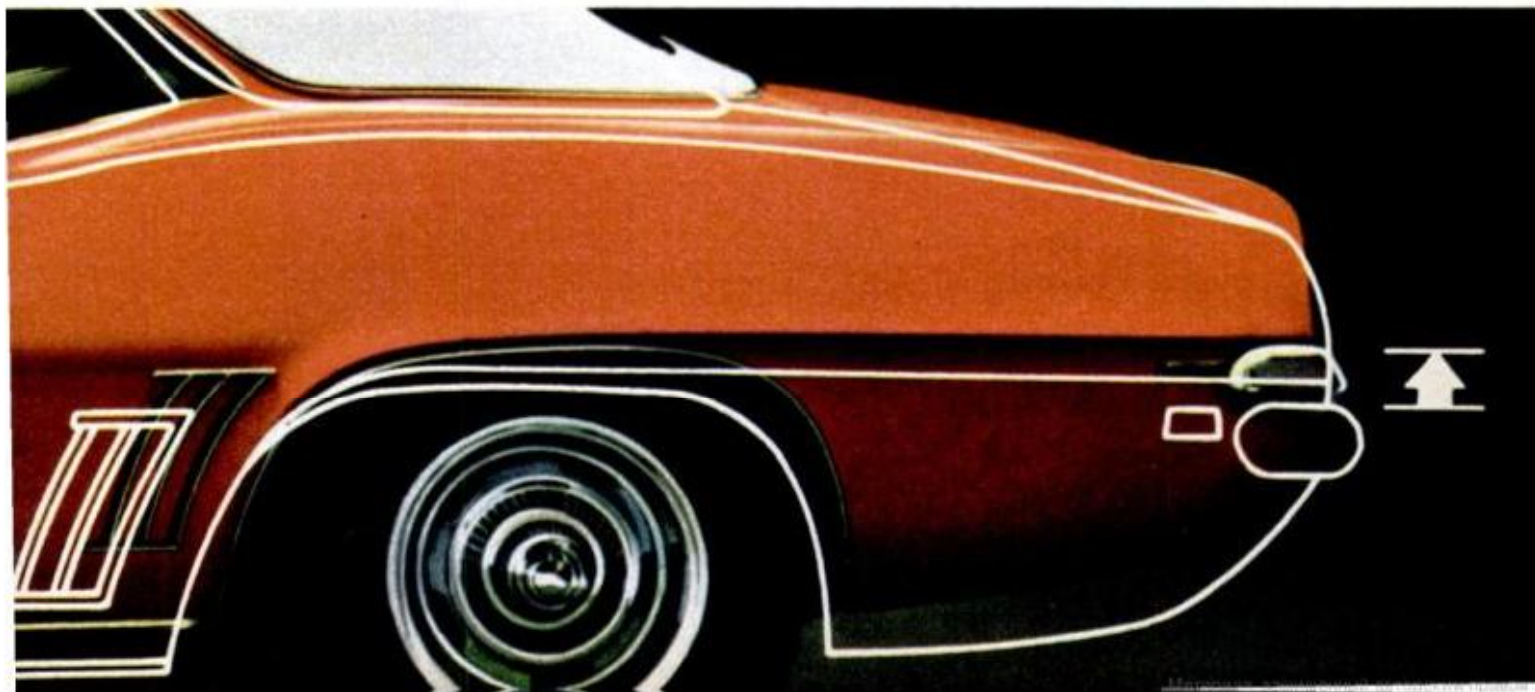
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FUEL AND EMISSION CONTROLS SYSTEMS

Fuel system service includes replacing filters and making carburetor adjustments. Emission controls systems service includes testing the PCV system, replacing the fuel evaporation control system filter, testing the thermostatically controlled air cleaner and cleaning the exhaust gas recirculator.

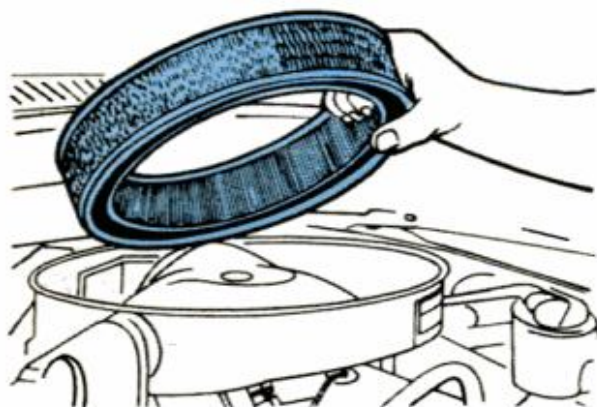
How to service carburetor air cleaners

Unscrew carburetor air cleaner cover.

Remove filter.

Tap filter on hard surface—if dust falls, replace or clean (replace paper filter; wash polyurethane filter in kerosene and reuse if it comes clean).

Caution: When refitting cover, do not overtighten fasteners—you'll distort the carburetor body.



A clogged air-cleaner element wastes gas and can cause stalling by flooding the engine.

Replace the fuel filter next. Two types are in widest use: in-line and integral. In-line filters are positioned in the fuel pump-to-carburetor line. Integral filters are located in the carburetor inlet.

How to replace an in-line filter

Keep engine cold.

Place rag beneath filter to catch leaking gas.

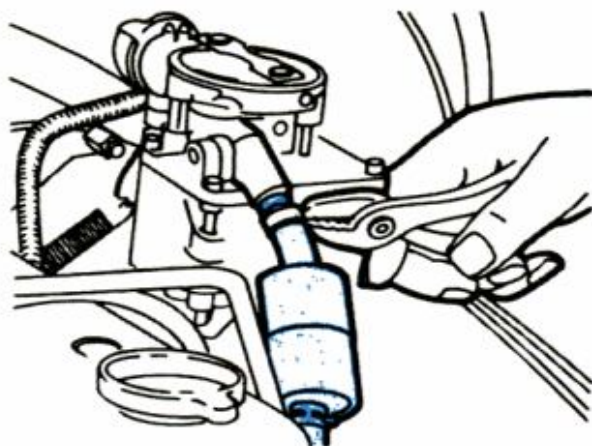
Release clamps holding filter.

Pull filter off.

Insert new filter and secure clamps.

Caution: In-line filters usually have an arrow stamped on them that's intended to

show direction of the fuel flow. Observe this arrow to make sure that the filter is mounted properly.



Replace an in-line fuel filter by releasing its clips and pulling filter hoses off the fuel line.

How to replace an integral filter

Start with cold engine and place rag beneath carburetor inlet.

Disconnect fuel line connection at fuel filter nut.

Remove fuel filter nut.

Remove filter and spring.

Blow on filter's fuel inlet end.

Replace or clean filter if air doesn't pass freely (replace paper filter; clean bronze filter in kerosene).

Replace filter spring if it has lost tension—reuse if not.



To remove an integral fuel filter, disconnect fuel line and filter nut. Filter lies in the inlet.

How to test automatic choke

Keep engine cold.

Remove carburetor air cleaner cover

Press gas pedal to floor once and observe choke plate—it should close over carburetor throat.

Start engine—choke plate should open gradually until it's wide open.



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FUEL AND EMISSION CONTROLS SYSTEMS *continued*

Don't forget to clean dirt from linkages and pivot points with automatic choke cleaner. Do not oil! Be sure plate moves freely. Once the plate is free, make sure choke adjustment's correct if hard starting's a problem. Two types of chokes are in widest use: carburetor-mounted and manifold-insert.

How to adjust carburetor-type choke

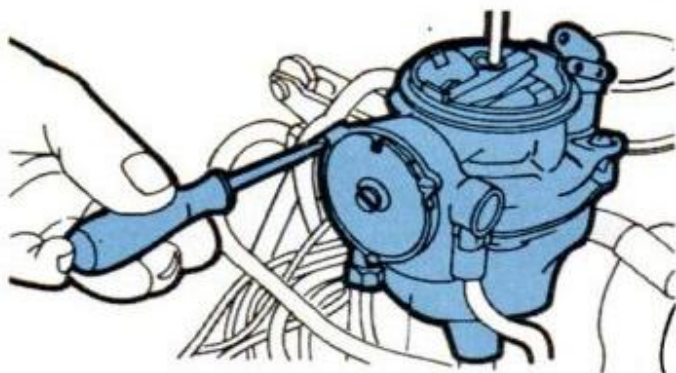
Make sure engine's cold.

Loosen choke cover retaining screws.

Rotate cover from present setting one notch to lean or rich side (engine can be hard-starting, because fuel mixture's too rich or too lean).

Tighten cover.

Start engine—if starting is still difficult, move setting one notch more, but that's the limit.



Carburetor-mounted choke is adjusted by loosening the cover and rotating to lean or rich side.

If engine still doesn't respond, move adjustment cover back in other direction unless you know for sure that condition's being caused by fuel leanness or richness. Failing this, the cause of hard starting is elsewhere.

How to adjust manifold-insert choke

Start with cold engine.

Remove cover holding choke control inside manifold and remove control.

Loosen locknut and adjust the control (control is marked for leanness and richness).

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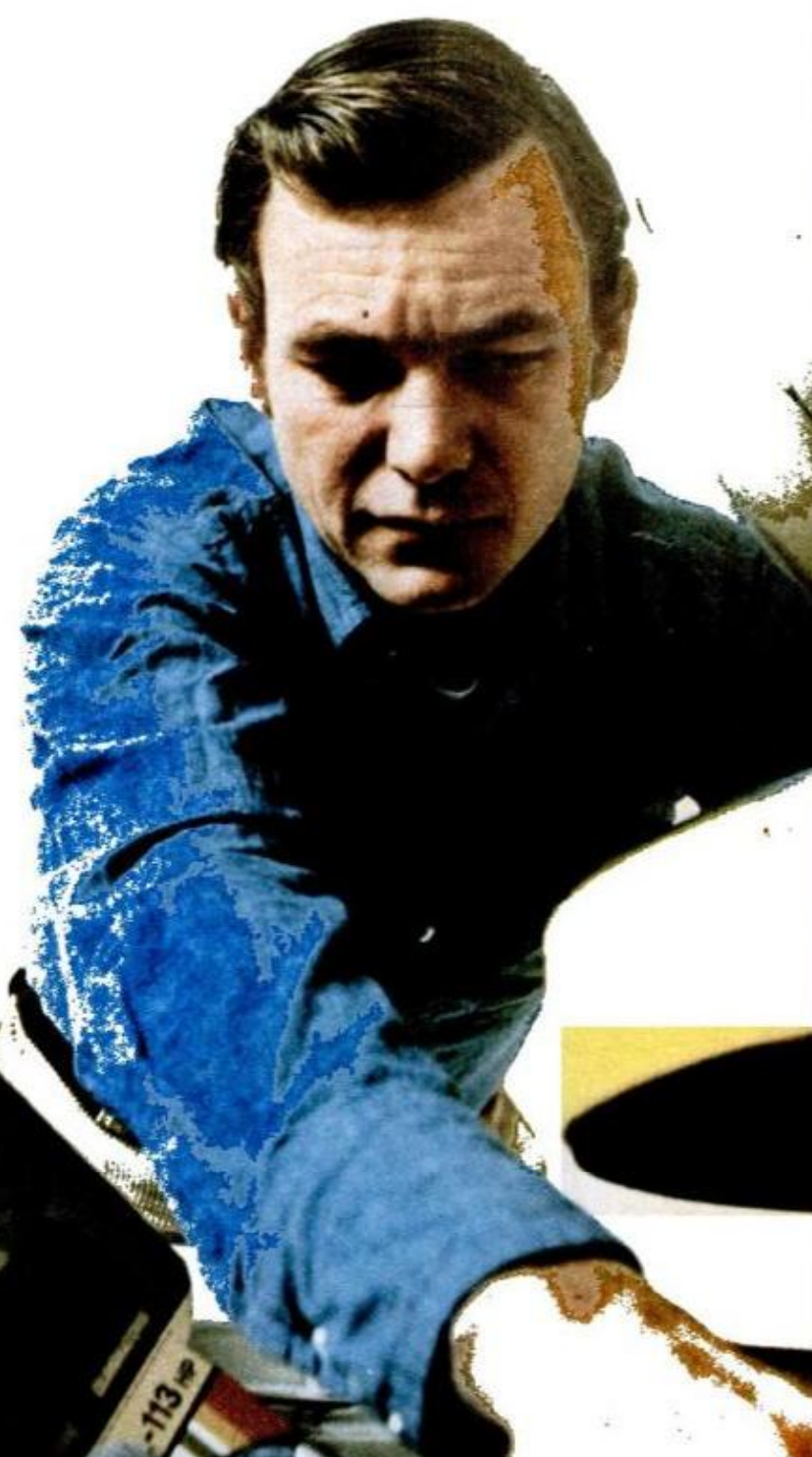
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FUEL AND EMISSION CONTROLS SYSTEMS *continued*



Control of manifold-type choke is found inside the well housing.

Adjust the carburetor's slow (curb) idle and fast idle next.

How to adjust slow idle

Warm up engine.

Connect a tachometer.

Give the accelerator pedal a couple of light jabs to clear the carburetor; let engine idle.

Adjust the idle-speed screw or the solenoid until the tach registers the recommended rpm.

Caution: There's considerable variation among manufacturers regarding conditions for making this adjustment. Check manufacturer's literature.

How to adjust fast idle

Warm up engine; connect tach.

Place transmission in Neutral.

Position fast-idle screw or lever on high step of fast idle cam.

Turn screw or bend lever so that tach reads the fast-idle rpm recommended by manufacturer.

Depending upon the model year, cars that have been built since 1963 possess one or more of the following emission controls systems: positive crankcase ventilation, fuel evaporation control, exhaust and exhaust gas recirculation which helps control nitrogen oxide. Their periodic maintenance helps keep pollution at minimum levels and forestalls engine operating problems.



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AT HARDWARE AND AUTO STORES

FUEL AND EMISSION CONTROLS SYSTEMS *continued*

How to test the PCV valve

Let engine idle.
Pull PCV valve from rocker cover.
Place finger over valve—if valve isn't plugged, you'll feel strong vacuum and will also hear hissing with finger off valve.
Shake valve—you should hear click.



Check operation of PCV valve.

If valve doesn't pass checks, replace it. Makers generally agree valve should be replaced every two years. Test rest of system.

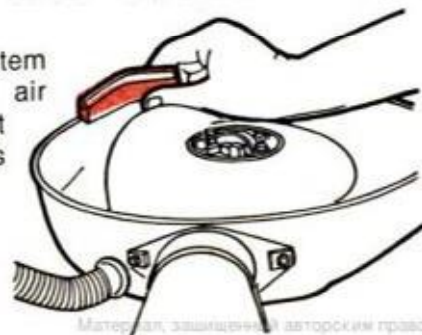
How to test PCV system

Replace any cracked or brittle hoses.
Start engine and remove air intake cap.
Place stiff paper (oaktag or equivalent) over opening in rocker cover.
Let system stabilize for a minute, by which time paper should be sucked against opening with noticeable force.

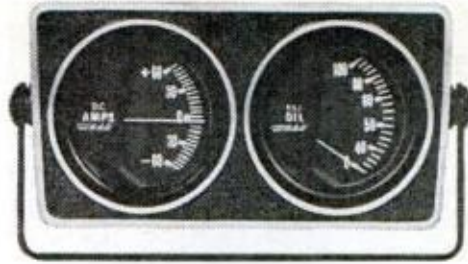
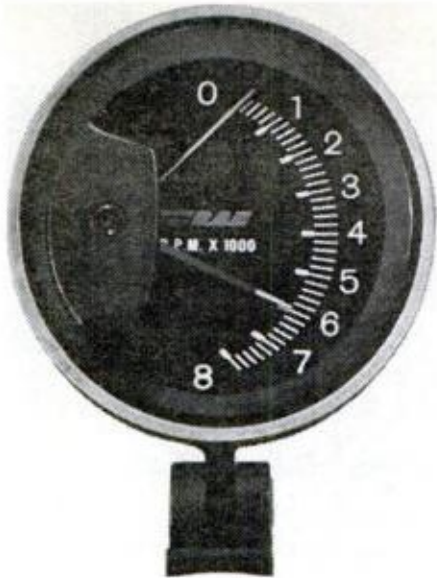
If system doesn't meet objectives, clean out PCV valve hose with crankcase ventilation system cleaning solvent and clean out passage in lower part of carburetor by hand with suitable-size drill bit.

Important: Many carburetor air cleaners have a small filter that cleans air passing through to crankcase by way of air intake cap. Clean filter if it's metal—replace if cotton.

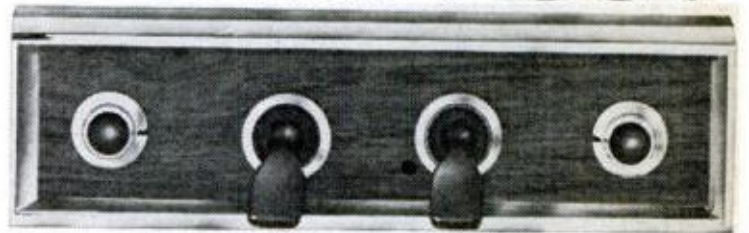
Look for PCV system filter at end of air intake hose that attaches to carb's air cleaner.



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Rite Autotronics Corporation,
Los Angeles, California

FUEL AND EMISSION CONTROLS SYSTEMS *continued*

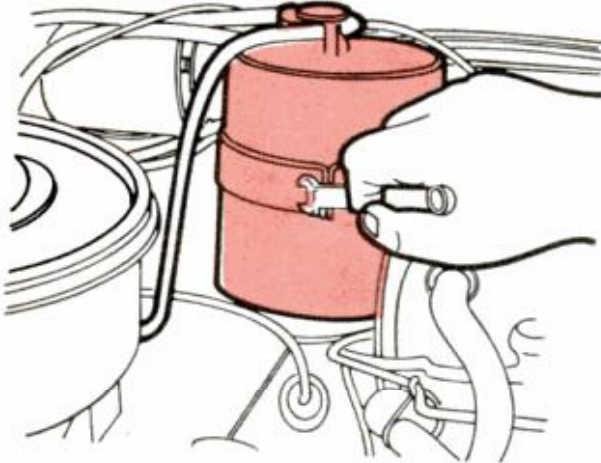
How to service evaporation system

Locate fuel evaporation control system charcoal canister.

Check hoses going to and from it—replace if cracked or brittle.

Remove canister.

Turn upside down and remove filter from base for replacement.



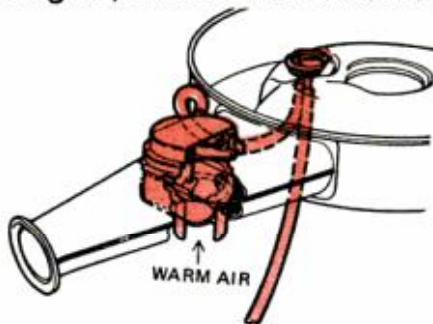
To remove filter from the base, detach the charcoal canister.

The thermostatic air cleaner is the main part of the exhaust emissions control system needing periodic checks. Cars equipped with a manifold heat control valve beneath the exhaust manifold should have this valve checked and serviced since it works together with the air cleaner.

How to service air cleaner

Examine hoses and ducts to make sure all are intact and in good condition.

Start engine, which should be cold.



During warm-up, thermostatic air cleaner shuts off cool air from the snorkel.

Look into snorkel—flapper valve should be closed.

Watch to see if valve opens as engine warms up.

Caution: In very hot weather, valve may not close, even with engine cold.

If valve fails to open, disconnect hose from vacuum motor. If vacuum is present (hold finger over hose), replace vacuum motor. If there's no vacuum present, make sure that the vacuum hoses aren't pinched, cracked or leaking. If hoses are okay, replace the sensor element.

How to test heat valve

Be sure engine is cold.

Try moving counterweight found beneath exhaust manifold—it should jiggle easily.

Apply heat valve lubricant to counterweight pivots to keep valve operative.

How to free heat valve

Apply liberal quantity of heat valve lubricant to counterweight pivots.

Tap counterweight lightly with hammer.

Try to move—if counterweight's frozen solid, replace heat valve.

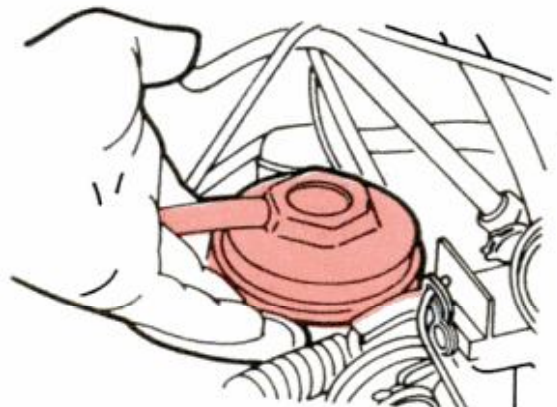
How to check the EGR (exhaust gas recirculation) valve

Replace damaged hoses.

Start the engine.

Press gas pedal until engine speed hits 1500-2000 rpm while touching bottom of EGR—you should feel a diaphragm open as acceleration takes place and should feel it close as engine speed is reduced to idle.

If EGR fails to respond, replace it.



EGR valve has become standard on cars built since 1973.

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BATTERY AND CHARGING SYSTEM

For quick starts and long battery life, periodically test and clean your battery. Check specific gravity and performance under load. Clean the battery to keep corrosion off terminals and check water weekly.

How to test specific gravity

Note: Never take specific gravity readings right after adding water.

Draw electrolyte from a cell into a battery hydrometer and take reading (float must ride freely and readings must be taken at eye level).

Important: Specific gravity varies with temperature. For very accurate readings, if your hydrometer does not have a correction scale, insert thermometer into center cell. For every 10° above 80°, add .004 points to reading—for every 10° below 80°, subtract .004 points.

Compare readings, looking for a variation of .050 points or more between cells, which means that low-reading cell is shorted and battery has failed.

Add and average readings; then compare result with the following:



Hydrometers that have built-in temperature correction scales reveal readings; there's no need to make any calculations.

Specific Gravity	Condition of Battery
1.260+	100% charged. No action necessary.
1.250-1.260	75% charged. No action necessary.
1.225-1.250	50% charged. Charge battery.
1.190-1.225	25% charged. Charge battery and retest. If specific gravity doesn't hit 50% charge zone, it's likely to fail soon.

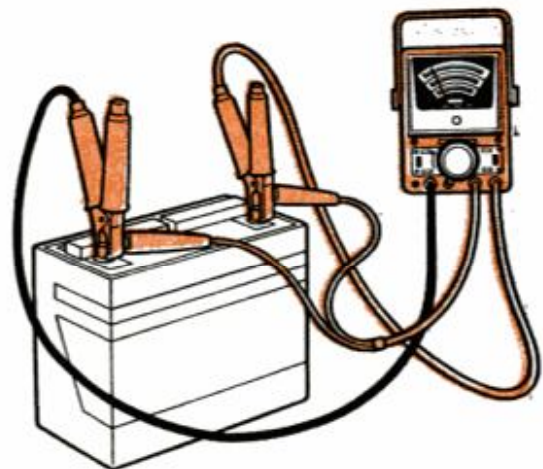
Specific gravity may indicate a fully charged battery, but still the battery may not be able to meet the load imposed by starting. Perform a capacity test ideally with a variable load tester.

How to test capacity

Connect tester as outlined in instrument's instruction manual.

Adjust load-control knob so ammeter reads three times battery's amp.-hour rating, which might be stamped on battery case (if not, assume a 60-amp.-hour rating for 12-volt battery and 100 amp.-hours for 6-volt).

Read voltmeter—it should show 9.6+ volts for a 12-volt battery and 4.8+ volts for a 6-volt.



Tester hooked up for a capacity (variable load) test.

Charge battery—preferably at a slow charging rate—and retest if specs aren't met. It's time to replace battery if it fails load test.

How to charge a battery

It's not necessary to remove battery from car for charging, but if you do, disconnect the ground cable first; then "hot" cable (use battery terminal puller if terminals are stuck fast).

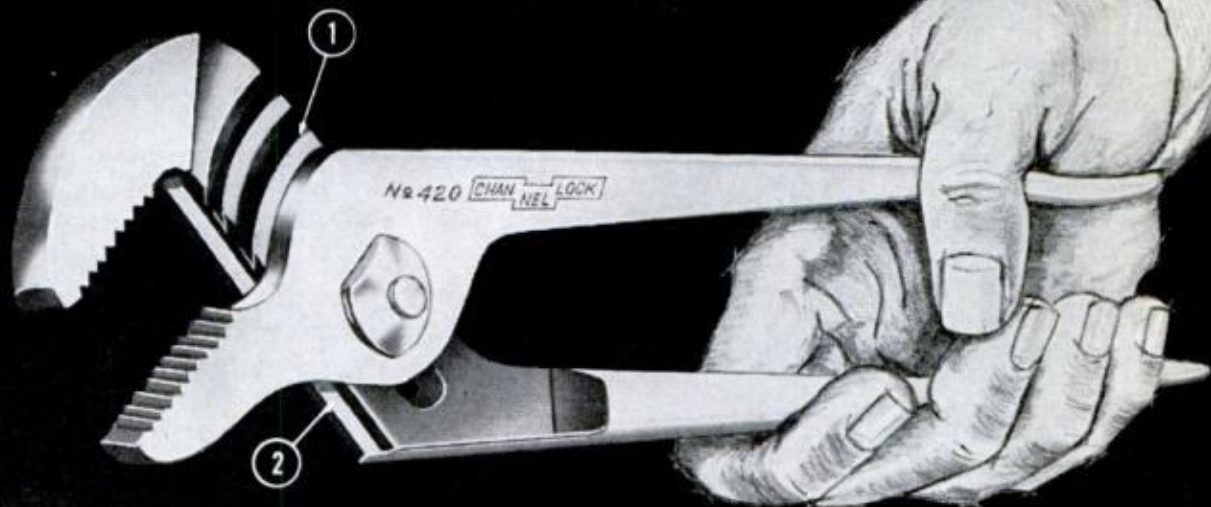
Place battery on wooden platform and remove electrolyte port covers.

Connect charger positive lead to positive terminal and negative lead to negative terminal.

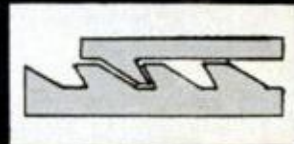
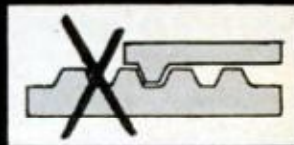
If charging rate does not automatically taper off during charging, test specific gravity every few hours so battery won't overcharge.

Caution: A charging battery generates hydrogen gas; keep away from flame or sparks.

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BATTERY AND CHARGING SYSTEM *continued*

When putting a battery back into the car, connect "hot" cable first, then the ground cable. Best time to clean your battery is when it's out of the car.

How to clean a battery

Disconnect cables and remove battery.

Be sure electrolyte port covers are tight; lay pieces of masking tape on top of them to keep cleaning solution out of holes.

Scrub battery with 1:1 solution of baking soda (or ammonia) and water.

Flush with fresh water.

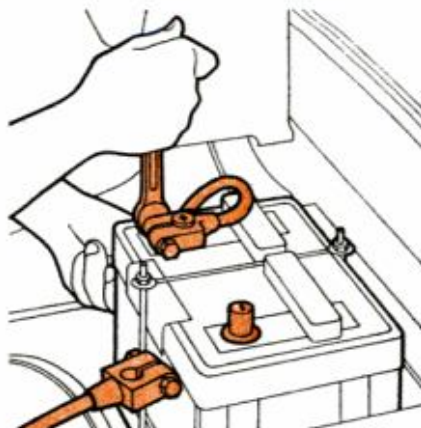
Repeat cleaning until fresh application of cleaning solution doesn't fizz.

Clean battery holder in same way.

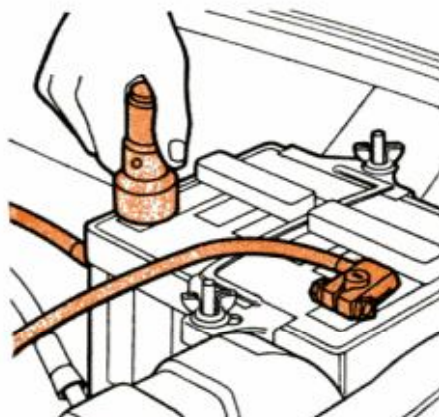
Inspect cables—replace if frayed, if wires are exposed, or if insulation's brittle or cracked.

Use battery cleaning tool on terminals.

Place battery back in car, attach and tighten terminals, and apply thin coat of petroleum jelly to terminals and posts.



Disconnect battery correctly (the negative terminal first) for its removal from your car.



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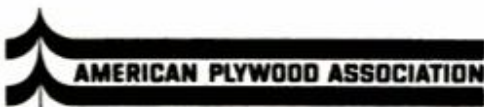
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BATTERY AND CHARGING SYSTEM *continued*

Check battery water weekly. For longest battery life, add distilled water or water low in mineral content. Do not overfill.

Trouble in your car's charging system is indicated by a discharge reading on the instrument panel ammeter or by a lighted indicator light. Test the alternator, or generator, and regulator.

Some quick checks can be made on your alternator, generator and regulator to determine the cause of a no-charging condition. First check that the alternator drive belt is properly tensioned and is driving the alternator. And check all electrical connections.

Do the same if your car has a generator. Also check that brushes are making contact. Remove protective cover, lift brushes from their seats, let them snap back against armature. If brushes are worn down, replace with spare set which you should keep in your car. If these checks don't solve the no-charging condition, check regulator.

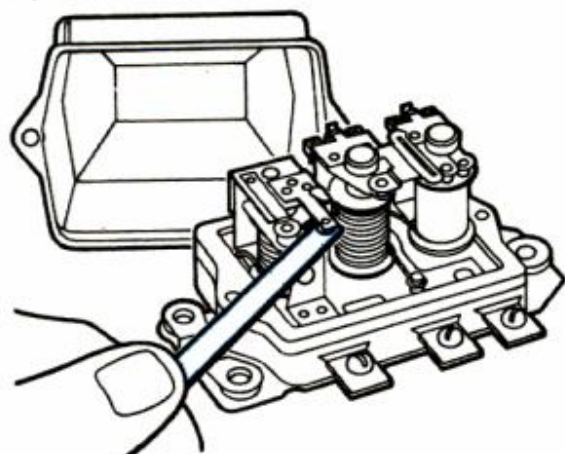
How to quick-check regulator

Remove cover from regulator. Break away any sealing material that may be used around cover bolt(s).

Alternately rev engine from idle to see if cutout relay is closing circuit between generator and battery (generator cars only).

If it does not cut in and out, clean contacts with point file.

Replace cover.



Remove the housing from your regulator and run a file between cutout relay contacts.

More thorough testing of alternator and regulator requires service manual for your car.

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BATTERY AND CHARGING SYSTEM *continued*

Generally, the alternator is tested on the vehicle to determine if the output is up to specification.

How to test alternator output

Connect a voltmeter/ammeter possessing a carbon pile rheostat to alternator as directed in service data.

Start engine and run at speed specified by manufacturer.

Adjust the carbon pile rheostat so that voltage specified by the manufacturer is obtained.

Read ammeter—output should be to manufacturer specification.

Caution: During output test, the voltage regulator is taken out of the circuit entirely. Complete test as quickly as possible, and do not exceed engine speed that's specified by the manufacturer. Your failure to follow this advice may result in a burned-out alternator.

If the ammeter reveals that the alternator is operating at its rated capacity, the problem you are having with the charging system is not being caused by the alternator. Turn your attention to the regulator. There are two types: electromechanical and transistorized.

How to test regulator

Make connections as described in manufacturer service data, but notice that for this test the regulator is permitted to remain in the circuit.

Run engine at specified speed.
Read voltmeter.

Voltmeter should show that the regulator is allowing the alternator to operate at the specified voltage, which is normally 14 to 15 volts. More or less voltage indicates a defect requiring calibration or replacement of the unit.

Transistorized regulators are often placed inside the alternator (Chrysler Corp. cars are an exception—you'll find the alternator on the firewall). This means that replacement of the



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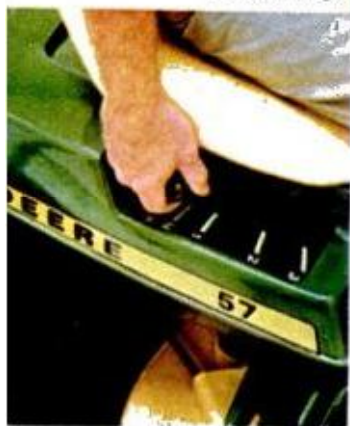
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BATTERY AND CHARGING SYSTEM *continued*

regulator may involve disassembly of the alternator.

When working with an alternator and regulator, several precautions must be observed to prevent damage and protect yourself from injury. They are as follows:

□ Never connect test meters without first disconnecting the battery ground cable. Make your connections; then check carefully to make sure that the polarity is correct. Reconnect the ground cable.

Caution: Be sure that the plus side of the circuit is connected to the plus side of the meters, and that the negative side is connected to the negative side. Reversing polarity, even momentarily, may ruin the diodes inside the alternator.

□ Never ground the field circuit between the alternator and regulator; you may damage the regulator and burn out the field wiring. Not all alternators are protected by a fuse.

□ Identify the output terminal of the alternator, and stay away from it. It is always "hot." Its accidental grounding will cause a short.

□ Make sure the ignition switch is turned off before going near the alternator or regulator.
□ Always use tools that are insulated with plastic sleeves or tape to prevent accidental shorts.

□ Be very careful when adding oil or coolant to the engine that none gets into the air intakes of the alternator. Oil and coolant will cause brushes and slip rings to slip, resulting in decreased alternator output.

Every electrical circuit in your car is protected by a fuse, fusible wire or circuit breaker.

How to replace a fuse

Use plastic fuse pliers to pull the faulty fuse from place.

Caution: Use of regular pliers can result in a serious short circuit.

Replace the faulty fuse with one of the necessary rating—the rating of the fuse needed to protect the circuit is usually stamped on the fuse panel.

If a fuse for a particular circuit keeps blowing, a malfunction exists that must be traced and repaired.

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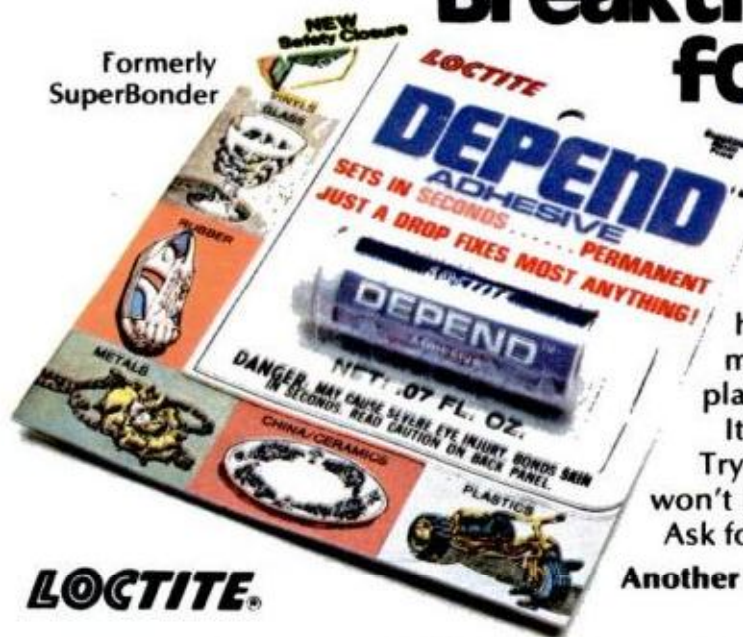
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COOLING SYSTEM

Annual maintenance of the cooling system will give you insurance against both overheating and overcooling, and also bar the formation of damaging rust and corrosion. This is the best way to prevent emergency breakdowns. Service includes the testing of hoses, checking the drive belt, looking for leaks, testing the radiator pressure cap, testing the thermostat, as well as draining and cleaning the system, and then filling it with ethylene glycol coolant.

A radiator cooling system has a minimum of four hoses: at top and bottom of the radiator and two hoses connecting with the heater. It may also have a bypass hose between the water pump and engine.

How to test hoses

Examine hose clamp area for the white or rust-colored deposits that signify a leak (tighten clamp or replace clamp and/or hose).

Squeeze hose—replace if it cracks or feels mushy.



Squeeze hose to check condition. Many-cooling-system problems can be detected by observation, without equipment.

How to inspect drive belts

Look for cracks and frays on inside and outside of the belt.

Look for a glaze on the inside of the belt (pulley side). If belt appears to be damaged, replace it.

Press in on belt midway between pulleys. It shouldn't give more than 1/2 inch (tighten it if it does).

How to replace and adjust a belt

Loosen nut that secures the alternator bracket.

Push alternator toward the engine enough to work old belt off pulleys.

Thread new belt on pulleys.

Pull back on alternator until belt "give" is 1/4 to 1/2 inch.

Caution: Use pry bar properly—wedge it between engine block and alternator's center casting. Avoid placing bar against alternator end plates.

Retighten nut to secure the alternator bracket.

Check belt tension again after a new belt has seen 100 miles of service.



Adjust belt tension by loosening the alternator bracket nut and pulling back against the belt.

How to replace a hose

Remove old hose and clamps.

Discard hose. Keep or discard clamps, depending on condition.

Brush pipe connections clean with wire brush.

Coat connections with water-resistant sealing compound.

Slide clamps up on hose and seat hose solidly on pipe connections.

Place clamps at least 1/8-inch from ends of the hose and tighten them securely.

Cooling systems can leak coolant from a radiator, water pump, thermostat housing or hose. They can also lose coolant internally because of a cracked engine, or air or combustion leak. If there's been no coolant loss from the radiator, there's no need to look for leaks. However, if the coolant level has dropped, and the leaking area isn't apparent through an examination, use a cooling system pressure tester.



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Left: Featuring a pillared porch with a dutch door. Shake roof topped with a birdhouse-cupola. 8 ft. wide by 8 ft. deep.

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Right: Dutch mini-barn with country charm. Looks small but is 10 ft. by 13½ ft. Roof design gives 8 ft. overhead room.

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Left: Delightful A-frame. Outside stairway to attic crawl space. 8 ft. by 12 ft. and almost 13 ft. high.

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Right: A little beauty for tools and kids. Looks more like a storybook cottage. 10 ft. square with 6 ft. porch.

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COOLING SYSTEM *continued*

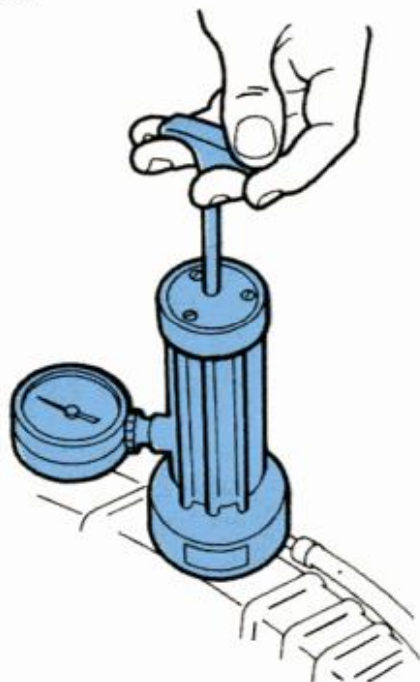
How to find an external leak

Remove radiator pressure cap and attach tester securely to radiator filler neck.

Pump up pressure so that the tester gauge shows pressure rating for the cooling system (you'll find rating stamped on the pressure cap).

Wait 10 minutes and recheck the gauge. If the pressure has dropped at all, a leak exists.

Pump up pressure again and look for leak at radiator, water pump, thermostat housing and hoses.



A cooling-system pressure tester helps to uncover coolant leaks.

Air or combustion gas leaking into the cooling system raises the coolant level in the radiator and forces the coolant out through the overflow tube (not applicable to cars equipped with coolant recovery systems). This problem results in the loss of coolant and is therefore classified as a leak.

Air can be drawn into a cooling system through a bad water-pump seal. Combustion gas can be drawn into a cooling system through a leaking cylinder-head gasket.

How to test for an air leak

Bring coolant level to normal with engine cold.

Attach a nonpressurized radiator cap to filler neck.

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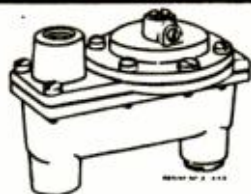
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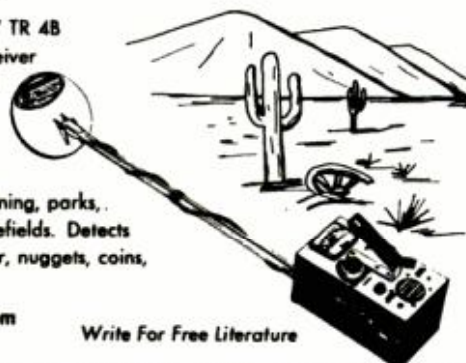
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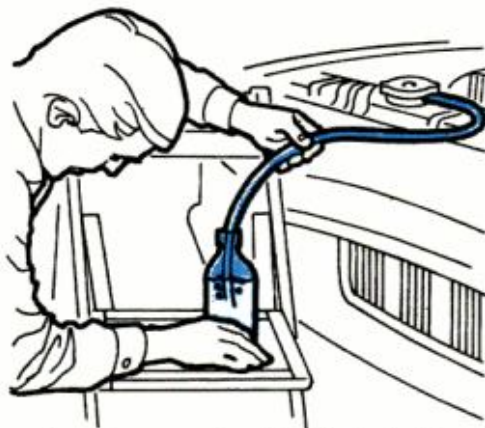


COOLING SYSTEM *continued*

Disconnect overflow tube from position at side of radiator and place end in a jar of water.

Run engine at fast idle.

If bubbling occurs in the water, an air or combustion leak exists.



An air or combustion leak in the cooling system will cause water in a jar to bubble.

A faulty radiator pressure cap keeps a cooling system from reaching maximum pressure. This results in overheating.

How to test the radiator cap

Note rated capacity that's stamped on the cap.

Attach cap to the cooling-system pressure tester.

Bring pressure up to cap's rated capacity by pumping tester.

Observe tester gauge. If it shows that the cap isn't holding the pressure to within one pound of its rated capacity, replace the cap.

A thermostat remains closed to permit a rapid warm-up of the engine; and then it opens to allow the coolant to circulate, thus preventing overheating.

If a thermostat sticks in an open position, the engine won't reach its best operating temperature. A sludge forms that hastens engine failure.

If a thermostat sticks in a closed position, overheating results.

A thermostat does not need to be tested unless overcooling or overheating occur.

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How to remove a thermostat

Drain coolant to below thermostat level (engine cold).

Remove hose (usually this is the top hose, but in some cars the thermostat will be found to be installed in a housing at bottom hose).

Unbolt thermostat housing.

Remove housing and discard the gasket. (When replacing the housing, always install a new gasket.)

Take thermostat from seat.



Remove the thermostat housing. When you replace it, be sure to install a new gasket.

If thermostat valve is open, try moving it. If it sticks, replace the part. If the valve is closed, test as follows:

How to test a thermostat

Note thermostat capacity (stamped on the body).

Hang thermostat from a wire suspended in a pan of cold water, making sure that bottom of thermostat doesn't contact bottom of the pan.

Insert a thermostat into pan.

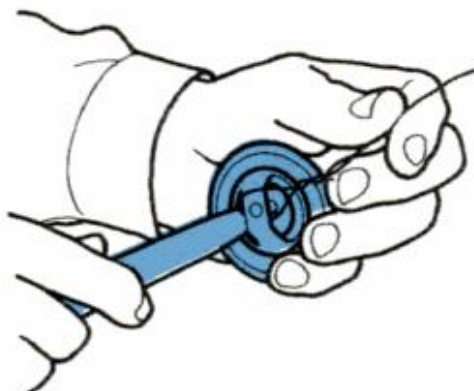
Heat water. Stir continuously.

Remove thermostat from water when temperature reaches rating.

Try inserting an .003-inch feeler gauge into the valve opening—it should fit. (If not, replace the part.)

Return thermostat to the water and watch

the valve action as the water becomes hotter. The valve should be fully opened when the temperature reaches about 20° above the rated opening. If it isn't, replace the thermostat.



After thermostat has been taken from hot water, check the valve opening with a feeler gauge.

Drain and flush the cooling system, and replace the ethylene glycol coolant. This job can be done every other year if a car's fairly new—it should be done every year as a car gets older.

How to clean a cooling system

Warm up engine.

Turn on heater.

Open radiator drain valve in bottom tank and remove engine drain plugs, if present (V8s generally have two plugs and Sixes have one).

Let coolant drain completely.

Close valve—reinsert drain plugs.

Fill system with water and a commercial fast-flush cooling-system compound (follow directions on can).

Run engine, letting flushing compound work.

Drain and reflush with water.

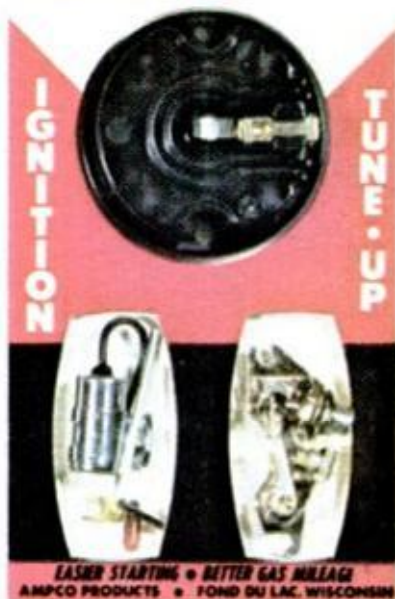
When water drains clean, fill radiator with a mixture of a high-quality ethylene glycol anti-freeze to meet the lowest anticipated temperature in your locale.

Important: All modern-day cars should be protected by ethylene glycol summer and winter. Use of ethylene glycol not only lowers the freezing point and raises the boiling point of water but also prevents formation of engine rust.

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Improper inflation ruins more tires than any other cause. Underinflated tires wear out faster on outside treads than in the center—they also squeal on cornering. Overinflated tires wear out faster in the center than on the outside, and they also give a harder ride.

How to inflate tires

Check inflation at least once a month with your own tire gauge (don't trust service station gauges).

But check inflation at once whenever there is a sharp drop in temperature because tires lose air pressure when the temperature takes a dive.

Make sure that tires are cold (a cold tire is one that hasn't been run in three hours or more and then is driven at low speed no farther than a mile).

Go by the manufacturer's tire-inflation specification in your owner's manual or on label glued to glove compartment door.

Never bleed air from tires if you check them when they're hot and find they have more than the recommended pressure.

If you have radials, don't overinflate them—sidewall bulge is normal when radials are properly inflated, so don't try to get the bulge out.

For safety's sake, inspect tires periodically.

How to inspect tires

Check tread depth. An unsafe tire is one that's worn to a depth of $\frac{1}{16}$ th inch in two adjacent grooves. New tires have tread wear



Check tread wear periodically with tread depth gauge.

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TIRES, STEERING AND SUSPENSION *continued*

indicators that show solid bands when wear is excessive. Measure depth with a tire depth gauge.

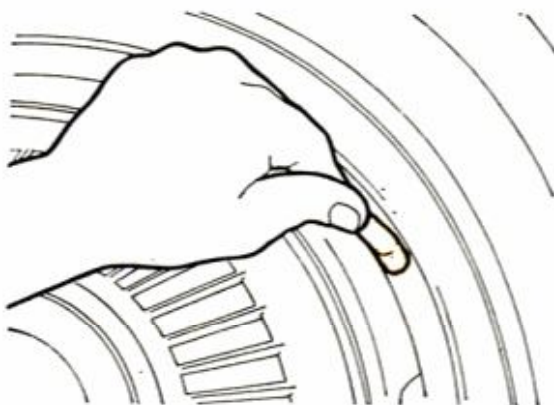
Probe cuts carefully with screwdriver. If its tip reaches cord, discard tire.

Pry stones and other objects from tread.

Inspect valve stem for cuts.

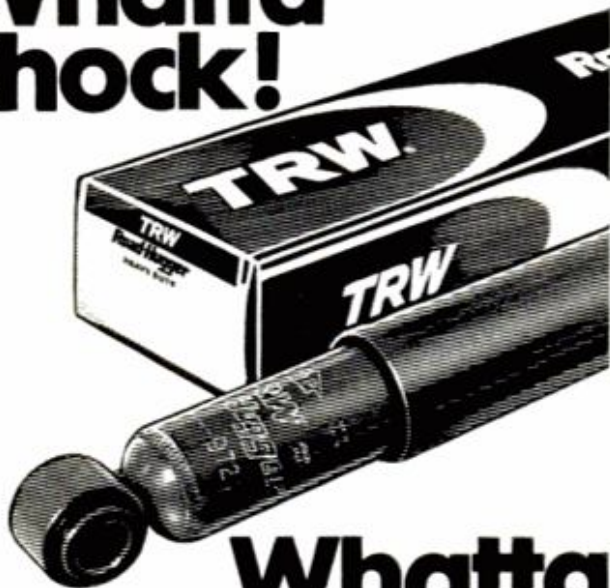
Look for bulges indicating a defective tire.

Look for cupping, flat spots and uneven wear—they are indicative of improper inflation, improper wheel balance, front-end misalignment, suspension or steering faults.



Valve stems should be inspected for cuts and cracks.

Whatta shock!



Whatta deal!

Buy TRW Road-Hugger Heavy-Duty Shock Absorbers now—and pay for only three... get the fourth one FREE. Save tire wear, steer better, stop safer. Road-Huggers are guaranteed for as long as you own the car. Removal and reinstallation not included.

TRW ROAD-HUGGERS

While driving, be sensitive to changes in handling. Vibration and thump signify unbalanced wheels, front end misalignment, a bad wheel bearing, loose steering linkage, worn shock absorbers or worn ball joints. To check wheel bearings, see lubrication section. Overcoming wheel balance and front end problems may have to be done professionally.

How to check shock absorbers

Raise car.

Examine each shock for oil leaks. If you



Check shock absorber for leaks. Replace if leaking.

High compression. Low compression. Which is tougher on your oil?

Using high octane fuel, high compression engines generate high heat. Low compression engines using low octane and leaner fuel mixtures can run even hotter. And heat is the main reason motor oil deteriorates. Today you have to name your oil. By type. By SAE Grade. By brand.



Recent governmental regulations aimed at controlling automotive emissions have resulted in the introduction of low lead fuels. These fuels, in turn, are made necessary by the advent of new catalytic reactors soon to be required on all cars. For these reasons, car makers have had to reduce the compression ratios of the new car engines. Here's why.

Refresher course on compression ratio. A high compression ratio (10.5:1 is typical) needs high octane gasoline, and a rich mixture of gas-to-air for good driveability. That way you get top performance... but a lot of unburned gasses are passed through the tailpipe into the environment.

A low compression ratio (9:1, for instance) can operate on lower octane gas and a leaner mixture of fuel that's compatible with emissions control systems. The results are more sedate performance and greatly reduced pollution. Plus one more thing: heat. Oil-killing heat.

How heat kills oil. As you know, oil gets thin when hot. But did you also know that oil can *thicken* under heat? The cause is oxidation. That is, oxygen molecules combine with "oil" molecules to make more complex molecules. Under high heat conditions over extended periods, the

oil can become dangerously thick. In extreme cases, it can become almost jelly.

A thickened, oxidized oil loses its ability to flow easily through the



engine. That causes metal-to-metal contacts. And vital parts wear more and more. In severe cases they seize.

Two ways to fight back.

1. Change oil more frequently

Because you can't judge when oil oxidation has reached the danger point, your best protection is to change oil more frequently. Your owner's manual gives you recommendations for normal conditions. But please read the little notes of caution that usually accompany the recommendation. Dusty roads, stop-and-go driving, sustained high-speed driving, heavy loads, extreme temperatures are all conditions requiring more frequent changes. Also be sure you choose the right SAE Grade for your driving climate.

2. Know your motor oils.

Today you have to be specific about motor oil. You should use one that is refined from the best grade of crude oil—then scientifically blended, fortified and proven. There's too much at stake to put just any motor oil into your crankcase.

You should also know that "SE" is a designation for motor oil which meets the requirements for high temperature engine performance and is recognized by the Automotive and Petroleum Industries. We advise that all fully equipped cars use it.

Why Quaker State offers quality protection. There's one thing about Quaker State Motor Oil that few others offer. 100% Pure Pennsylvania Grade Crude Oil. The world's choicest.

Then Quaker State Motor Oil is fortified with a blend of additives, so you can be sure that it will keep its cleaning and lubricating powers even when the going is hottest.

Remember. Ask for this fine motor oil by name wherever they care about cars. Quaker State.



Quaker State your car to keep it running young.

TIRES, STEERING AND SUSPENSION *continued*

see any shock leaking, or telltale signs that it is leaking, replace it immediately.

Lower car.

Bounce down and up on bumper at each corner several times, increasing length of stroke each bounce.

Release bumper at bottom of down stroke. Replace shock if up-and-down movement continues for two or more cycles.

To bench-check a shock, secure it in a vise, then push and pull it in and out by hand.

Compare resistance of shock with that of new shock.

Replace old shock that's weak.

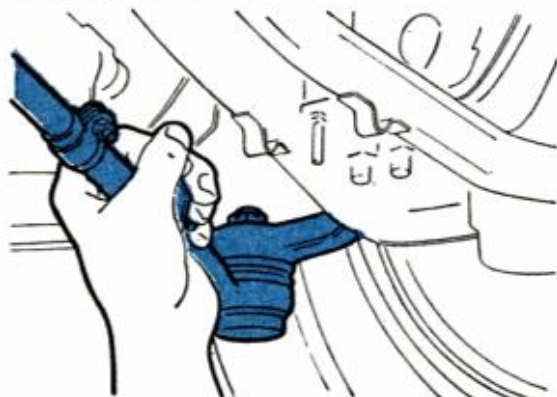
How to inspect steering linkage

Raise car.

Look closely at tie rods, idler arm, pitman arm and the relay rod—replace any bent parts.

Grasp and shake each part.

Replace a part if it's loose.



Check steering linkage for looseness. Replace worn parts.

How to check ball joints.

Note: Ball joints of many 1973-74 models have nipples, which if flush with or inside ball joint indicate a worn part.

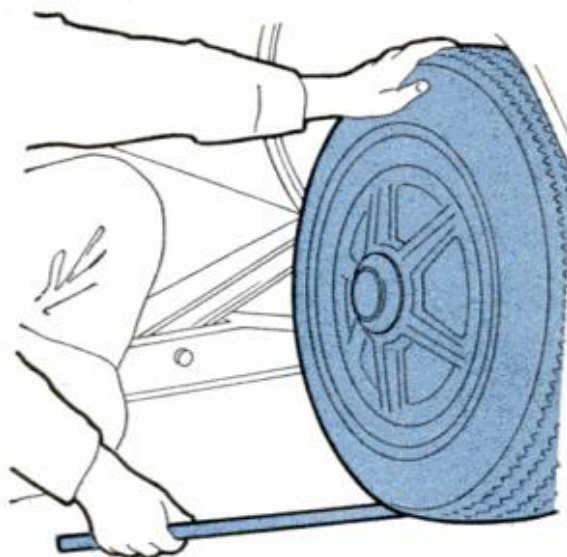
Jack up car so tire is just off floor and load is taken off load-bearing joint (in some cars, lower ball joints carry the load; in other cars, it's the upper ball joint—check service data).

Place pry bar beneath tire and place hand on top of tire.

Apply upward force to check axial play.

Suspect ball-joint wear if there is excessive motion as pry bar is pushed up and released. A clank would be sure indication of ball-joint failure.

Caution: Damaged steering linkage, worn shocks and ball joints constitute serious hazards. Take steps immediately to correct a deficiency.



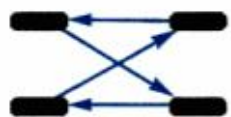
Check for worn ball joints by moving wheel up and down. Replace if worn beyond manufacturer's specs.

Firestone Tire & Rubber Co. contends that you will get 20 percent more use from tires if they're rotated every 5000 miles. Radials and conventional tires are rotated differently, as you can see here.

BIAS-PLY TIRES

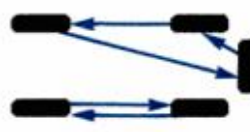


WITH SPARE



WITHOUT SPARE

RADIAL-PLY TIRES



WITH SPARE



WITHOUT SPARE

Tire rotation depends on type of tire and whether or not you're including the spare.



Only the 40,000 mile Firestone Steel Radial 500 can give you up to 30 extra miles from every tankful of gas...

When we matched our Steel Radial 500™ against our own belted bias tire, the Steel Radial 500 proved it could deliver up to 30 extra miles of highway

driving from a fillup. Ask your Firestone Dealer or Store for the complete test data. It'll show you how to put extra trips into every tankful of gas you buy.

...plus a 7 day, money back test ride.

You want to make sure that the tires you choose are the radials you'll like best. You want gas saving, plus a smooth ride, the quick, positive handling, and the steel belted strength you've read about.

Firestone is so sure of its Steel Radial 500, that you can buy a set and drive

them for seven days, and get every cent back if there's anything about them you don't like. Do you know of anyone else with that kind of a promise built into a radial tire?

Firestone Steel Radial 500. The only radial that's got it all. Only from Firestone.

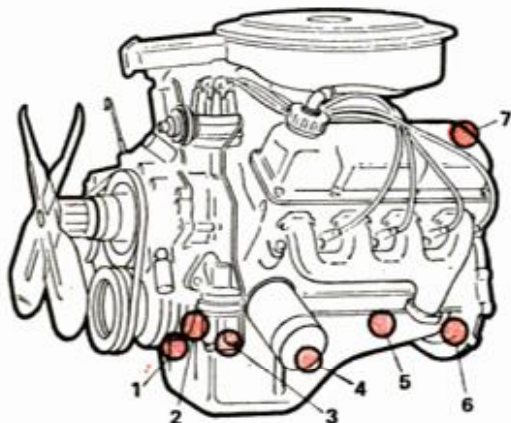
Firestone Steel Radial 500 The Gas Saver

ENGINE AND EXHAUST-SYSTEM LEAKS

If your engine's using an excessive amount of oil, there may be an external leak.

How to check for leaks

Check the garage floor for oil or fluids. Lift car and check for oil around front oil seal (1), timing-gear cover (2), fuel pump (3), oil filter (4), oil pan (5), rear oil seal (6) and valve cover(s) (7).



Check for engine oil leaks.

Tighten timing-gear cover, fuel pump, oil pan, oil filter (by hand) and valve covers. If leak doesn't stop, replace gasket or part. Replace leaking oil seals.

Many components operate on vacuum—vacuum-assist power brakes, for example. Also, if an engine leaks vacuum, it will idle rough and stumble on acceleration.

How to test the vacuum source

Tighten intake manifold bolts to stop possible vacuum leak.

Warm up engine and connect a vacuum gauge to main vacuum port on manifold.

Let engine idle—read gauge.

A vacuum-gauge reading of 15 to 21 inches of mercury is normal, but check specs because it varies from engine to engine due to differences in valve overlap. See Tune-Up Instruments section about vacuum-gauge readings.

How to verify a vacuum leak

Connect a tachometer; start engine.

Apply heavy oil along intake manifold and carburetor joints.

Energy Crisis or not CompuSpark is the Hottest Thing Since Rome Burned

"Best Helluva Ignition at any price... PERIOD!"



Tom McCahill

Automotive Authority
Noted Test Driver
Journalist

Tom McCahill



"When Gaylord Electronics first approached me with their CompuSpark, I figured it was just another CD unit to put to the test."

"After the first 10,000 miles, I checked my point wear and plugs. They were like new, so I decided to go another 10 grand. I have just skipped my 40,000 mile tune-up and am close to 50,000 miles, and I am saving over 20 percent on my gas bill. It's 'The Best Helluva Ignition' at any price... Period!"

Best wishes
Tom McCahill

CHECK THESE COMPUSPARK FEATURES

- Increases gas mileage as much as 20%—many owners report more! Few say less.
- Instant and reliable all-weather starts.
- Tune-ups virtually unnecessary for as much as 3 to 5 years of normal driving.

Double Guarantee

Give it a fair trial for 60 days and remember our 37 month free repair or replacement policy. We will send you a refund check if you sincerely think that CompuSpark does not measure up to our claims.

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The front-wheel drive Subaru. Did we design it with the fuel shortage in mind?

It sure seems that way, doesn't it?

Some Subaru owners have written us claiming more than thirty miles per gallon.

On the average, the Subaru gets around twenty-five miles per gallon on regular.

The U.S. Bureau of Highways tells us the national average for gas mileage is about 13.5 per gallon.

This means that Subaru, with its Quadrozontal Engine, gets almost twice the national average.

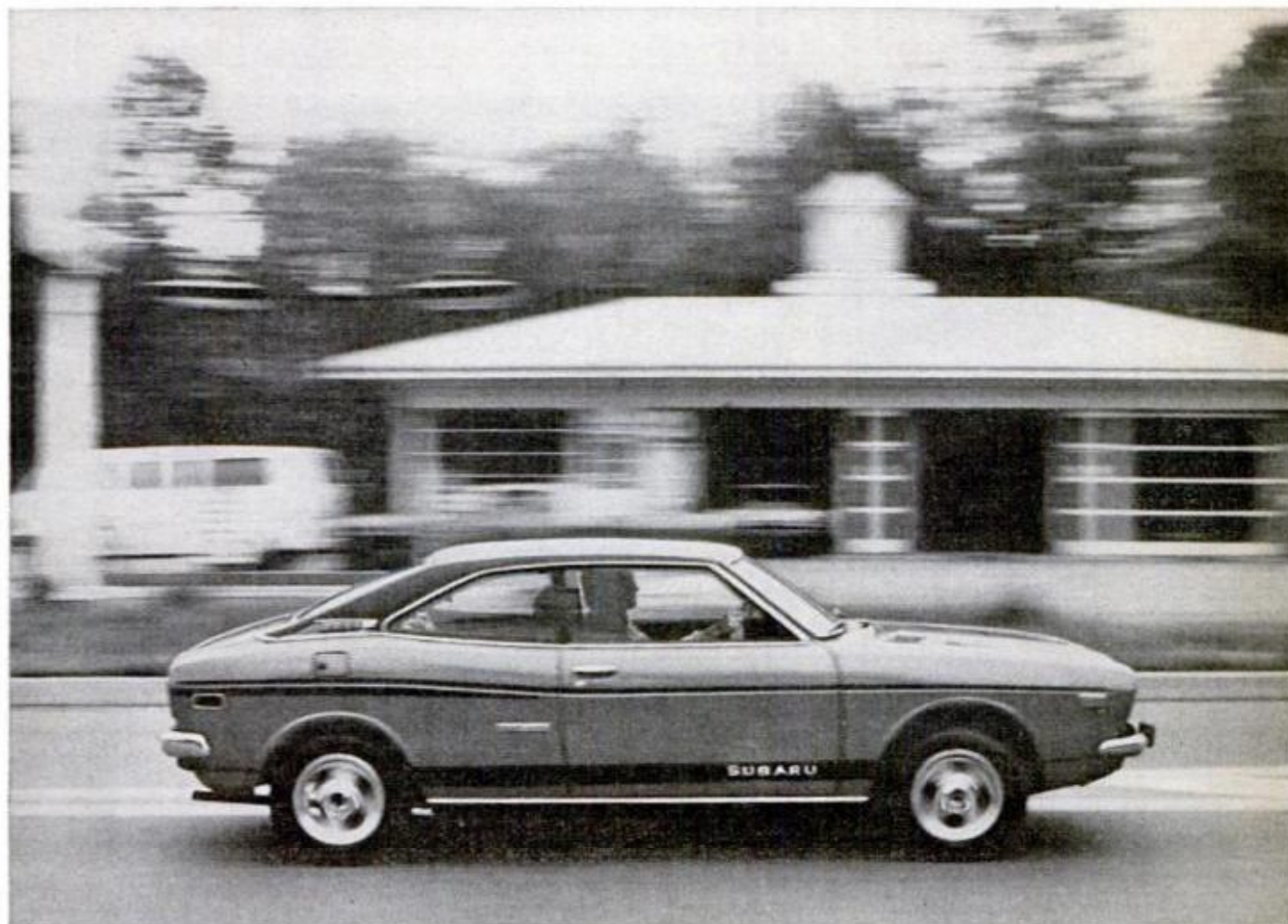
And in some cases even more.

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How's your mileage these days?

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You could buy it for gas mileage alone.
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ENGINE AND EXHAUST-SYSTEM LEAKS *continued*

Leak exists if idle speed increases, idle smooths out or oil is sucked in.

Tighten bolts; replace gasket if needed.

A vacuum hose is usually to blame for failure of a vacuum-operated component.

How to find a bad hose

Trace each hose branching off engine's main vacuum source to make sure it's connected securely and is straight—no bends or kinks.

Listen for hissing.

Pinch off each hose with a pair of pliers to find the leaker—hissing will stop.

Leaks from an exhaust system are dangerous, so inspect exhaust parts often.

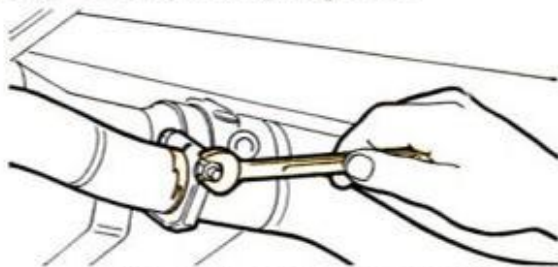
How to check the exhaust system

If you see no rusted-out section, turn off engine and tap each part with a wrench—a failing part will “clunk,” not ring.

Put your hand over each joint—if it's leaking, you'll feel “puffing.”

How to seal joints

Loosen clamp and coat joint with joint-connection sealer. Slide clamp over joint; tighten—but don't overtighten.



Apply joint connection sealer and tighten the clamps firmly.

If exhaust leak develops at manifold-exhaust pipe joint (white deposits on joint verify condition), remove gasket and coat joint with sealer before you install a new gasket.

A large advertisement for Castrol GTX Motor Oil. The background is a black and white photograph of a hand turning a key in a lock. In the foreground, there is a can of Castrol GTX High Performance Motor Oil. The text is overlaid on the image.

Faster starts

Drain out slowdown lubrication, sluggish performance and heavy engine wear. Clean up with Castrol GTX Motor Oil. For active, long life lubrication and superfine engine protection. For all makes and models of cars. 20W/50 or 10W/50.



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Build POPULAR MECHANICS' little CARRIAGE HOUSE! Simply great! A back-yard building that isn't an eyesore. Styling blends in with most homes. It will take your mower, lawn furniture and tools—or the kids' overnight guests. Use it as your shop or home office. Overall outside dimensions 10-ft. 4 in. x 12-ft. 4 in. For one complete set of plans send \$3.95 to **POPULAR MECHANICS Dept. FA, Box 1014 Radio City, N.Y. 10019.** For two sets of plans (you may need one for your local building department) send \$5.49.

Map Eater.

The Seiberling Steel Radial. Tempered steel belts cushioned for a soft ride. So strong, so steady, most people will get over 40,000 miles out of it. Get the details at your Seiberling dealer's. And take the better road on the Seiberling Steel Radial. For the dealer nearest you, dial toll-free: **1-800-447-4700.** (Illinois residents call 1-800-322-4400)



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The comprehensive kits include all parts, hardware, nuts, bolts and full assembly manual. The assembly manual includes over 150 photos and diagrams covering all phases of preparation and complete assembly.

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BRAKES AND TRANSMISSION

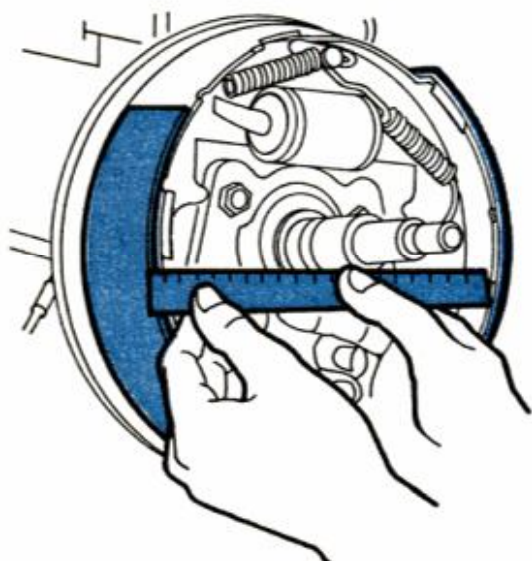
Periodic inspection of brakes will catch a wear problem before it becomes an emergency. Similarly, regular maintenance of your automatic transmission will avoid costly repairs.

How to check linings and pads

Pull wheels and inspect linings every 12,000 miles.

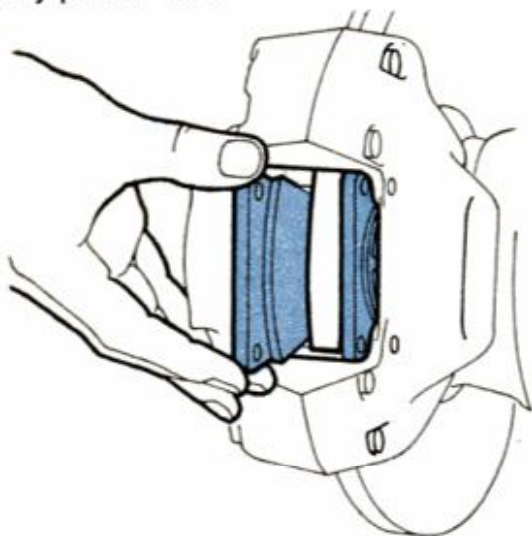
Replace shoes or pads if any part is worn to 1/32 to 1/16 inch of backing of bonded lining or rivet head of riveted lining.

Caution: Always replace shoes or pads in pairs to equalize braking action.



Measure brake linings and check against wear limits. Continued use will damage drums.

Between lining inspections, test brake system often by pedal "feel."



To remove disc-brake pads with this type of arrangement, take out holding pins and slide pads from brake caliper.

How to check hydraulic system

Apply heavy pressure to pedal for at least 15 seconds.

Feel for firmness—spongy pedal usually means that air's trapped in hydraulic system or there's a weak hose; pedal that falls away signifies a leak; low pedal signals the need for adjustment.

Caution: Before testing car with power brake, pump pedal a few times and then step down solidly.

How to check for leaks

Inspect master cylinder.

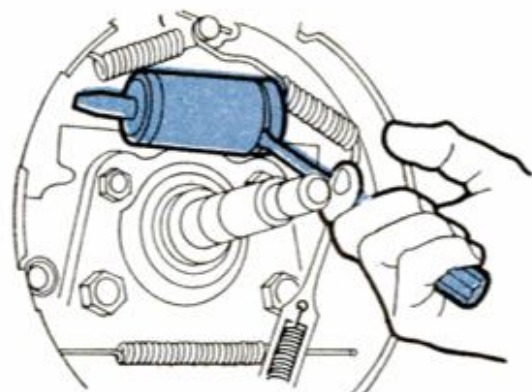
Tighten line connections if any fluid is present on housing, and be ready to overhaul or replace the cylinder if the leak persists.

Check all brake hoses as pressure is applied to pedal.

Replace a hose that leaks, bulges or feels soft.

Remove drum (not applicable to disc brakes) and pull back both wheel cylinder boots.

Overhaul or replace cylinder if fluid drips out.



Wheel cylinders that leak allow fluid to run over linings, leading to dangerous grabbing.

Air in a brake system, signified by a spongy brake pedal, should be bled.

How to bleed brakes

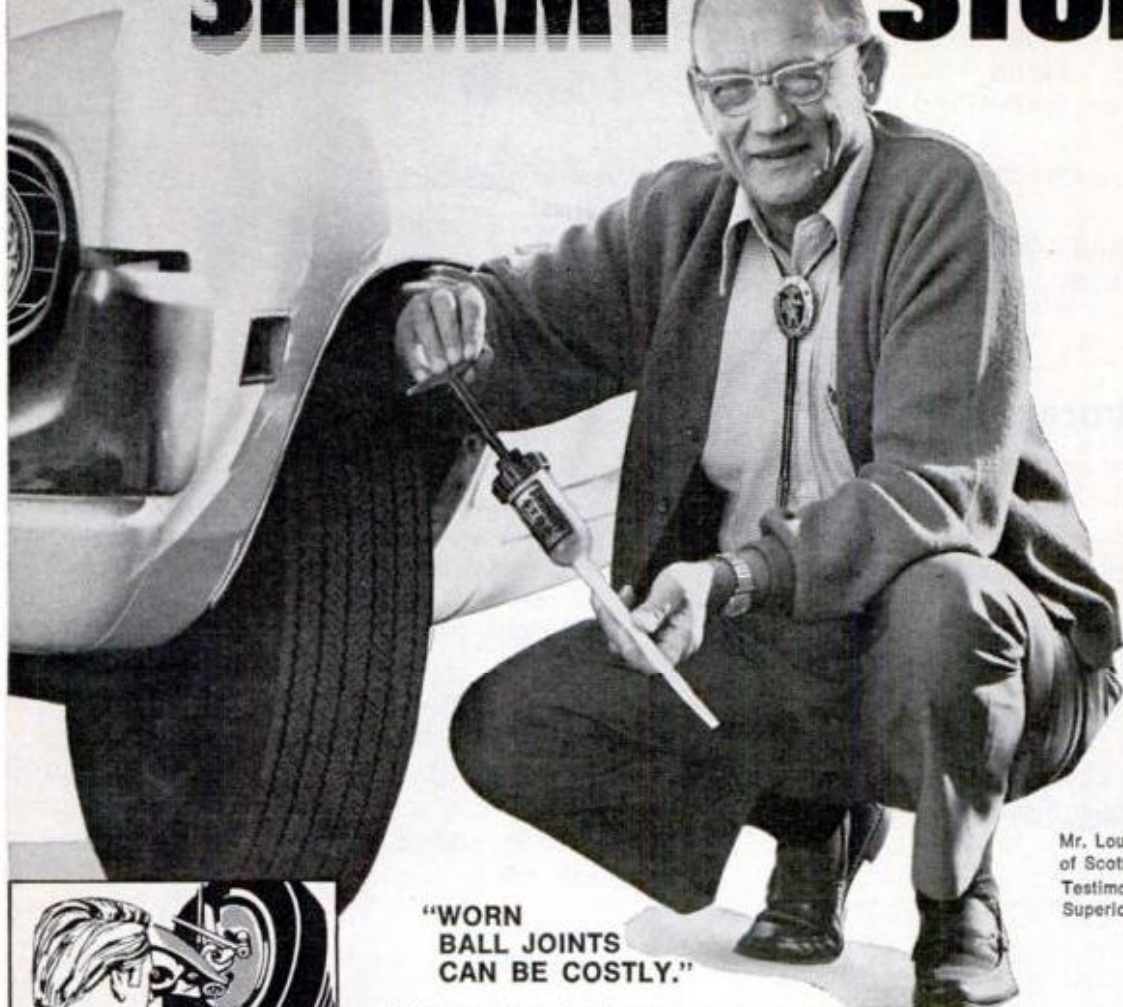
Check that master cylinder reservoir is filled to within 1/2-inch of top.

Attach a hose about 18 inches long to bleed screw on wheel. A vacuum hose usually works well.

Submerge other end in a glass container partially filled with fresh brake fluid.

Open bleed screw.

I saved \$60.00 and my tires with **SHIMMY STOP!**



Mr. Louis W. De Krauze
of Scottsdale, Arizona.
Testimonial on file with
Superior Industries.

**"WORN
BALL JOINTS
CAN BE COSTLY."**

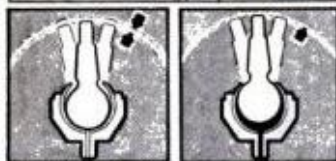
"My car's ball joints were loose," says Mr. Louis W. De Krauze of Scottsdale, Arizona. "The car wouldn't hold alignment. I was getting some road shimmy and the tires were wearing uneven and too fast. I was quoted \$60.00 to replace the ball joints. Too much. Then I heard of Shimmy Stop."

The Miracle Compound you shoot from a gun.

Shimmy Stop is installed fast & easy. It's "shot" into loose ball joints still within the auto manufacturers safety limits, and it restores them to a tight, long lasting new car tolerance. Your car's handling improves. You save on tires & expensive ball joint repairs too! Try Shimmy Stop. Available at your favorite automotive or discount store.



INSTALLS
AS EASY
AS GREASING
A BALL JOINT



BEFORE **AFTER**
You shoot a miracle self lubricating compound into the joint. It fills the void area, reduces tolerance to zero and lasts thousands and thousands of miles.



**A COMPLETE
DO-IT-YOURSELF
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Write for your **BALL JOINT GAUGE**.

Send 50¢ along with your name & address
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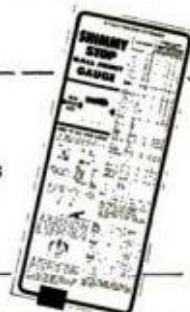
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BRAKES AND TRANSMISSION *continued*

Apply steady pressure on pedal.

Caution: Pressure must be kept on pedal until bleed screw is closed.

Close bleed screw when fluid in container stops bubbling.

Top off fluid in master cylinder after bleeding at all wheels.

Discard brake fluid collected in glass container—do not reuse.

How to adjust brakes

Note: Procedure applies to cars with self-adjusting brakes, which have been in use since the early 1960s.

Make a number of forward and reverse stops.

Caution: Be sure to make a complete stop at the end of every forward and reverse movement.

You should feel the pedal rise.

If pedal doesn't come up, linings are probably worn or self-adjusting mechanism is frozen.

An automatic transmission will last the life of the car if serviced every 24,000 miles (unless the owner's manual says to do it more often). Servicing involves draining fluid, replacing filter and in some cars adjusting bands (best done professionally or with manufacturer's service manual).

How to service the automatic transmission

Remove drain plug in transmission pan and allow fluid to drain.

If no plug is present, remove all transmission pan bolts except for two opposing bolts—one on each side. Loosen both of these bolts.

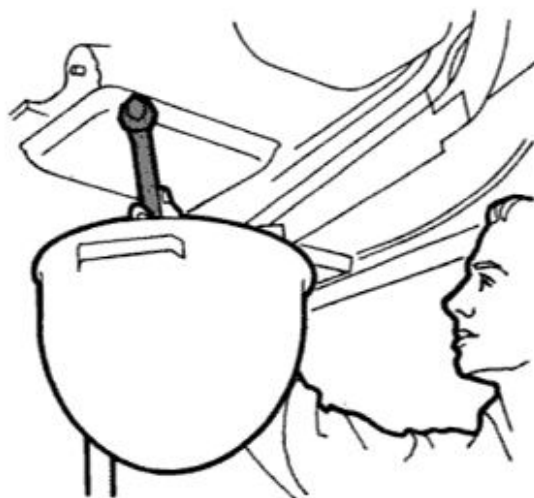
Pry pan loose with putty knife and let the fluid drain.

Remove the two bolts; then remove the pan completely.

Drain converter by removing plug (some have one and others have two).

Clean pan thoroughly.

Remove filter on transmission body and replace it with a new one.

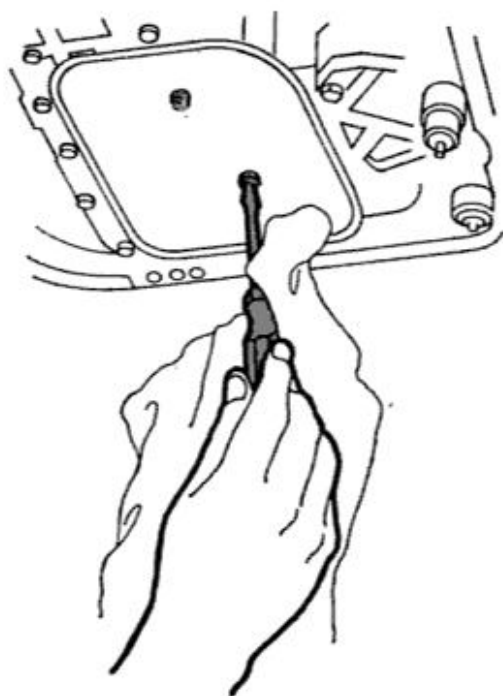


Remove drain plug to change the transmission fluid. Use a wrench of the proper size to avoid damaging head of the drain plug.

Reattach pan.

Caution. Use a new pan gasket.

Fill transmission with the fluid recommended by the manufacturer. In most cars, this fluid is added through the transmission dipstick tube.



Replace transmission filter when you change the fluid.



**For years
Europeans have been
fighting the high cost of gasoline
by riding on Dunlop Radial Tires.**

**You can do the same
on American Dunlop Radials.**

Everybody knows radial tires give better gas mileage and longer treadwear than conventional tires.

And any one of a number of companies can sell you radial tires. But not every company has the radial tire experience Dunlop has. We built our first Radial many years ago. We've been building, testing, developing better and better Radials ever since.

That's one reason why with over 150 tire brands to choose from, 4 out of 5 Dunlop customers say they'll buy Dunlops again.

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Ask your Dunlop dealer about our 40,000 mile treadwear policy.



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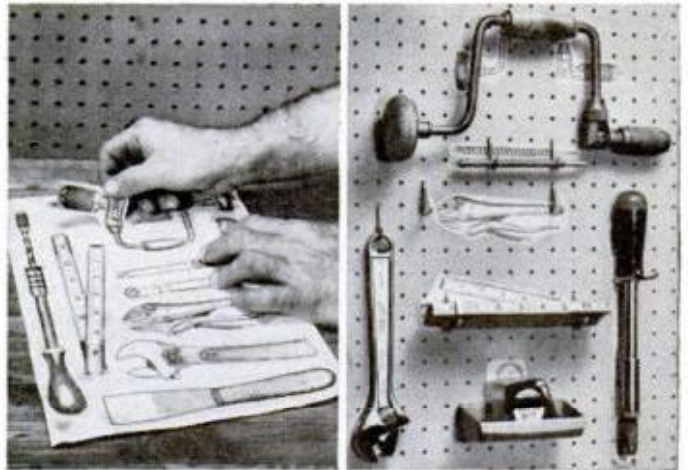
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Also enclosed in the kit is a blank sheet of the same special paper, printed in an overall color to match the tools. This sheet enables you to design your own drawings or silhouettes of any special tools you have.

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SAFETY EQUIPMENT AND ACCESSORIES

Your car's lighting system and windshield wipers and washers are vital to seeing and being seen. Replacing burned-out headlights is simple. Just remove bezel, remove screws holding lamp and pull lamp from connector. Replace with lamp of correct size.

How to adjust headlamps

Place car on a level surface 25 feet from wall on which are sketched the headlight center lines as shown below.

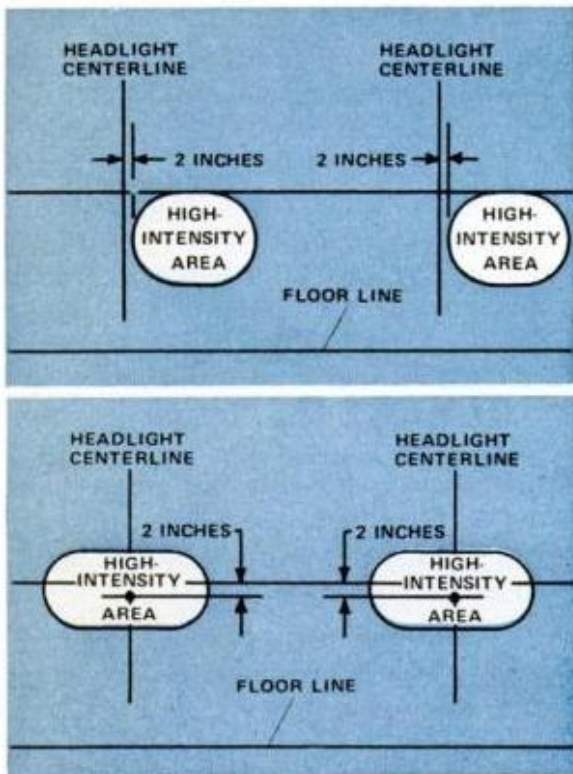
Place headlights on low beam.

Adjust lights to give low-beam adjustment shown below.

Place headlights on high beam.

Adjust lights to give high-beam adjustment shown at bottom.

Note: Lights of most late-model cars are adjusted using headlight adjusting screws accessible through bezels or using adjustment knobs behind lights under hood. If external adjustment isn't possible, remove bezel to get at adjustment screws.



How to replace other lights

Parking, front signal and front side marker: Remove screws holding lens or

reach underneath the bumper for the bulb.

Taillight, rear signal and rear side marker: Remove screws holding lens or look for access hole in trunk.

Replace damaged windshield wiper blades by pushing out old rubber inserts and replacing with new ones. Service sluggish windshield washers.

How to service windshield washers

Clean out holes of washer lines with a pin or thin-gauge wire.

Remove reservoir from place and pour washer fluid into clean container.

Clean strainer at bottom of reservoir or end of delivery hose with a small brush.

Reinstall reservoir and refill with water or with proper proportion of water to anti-freeze fluid for winter use.

Accessories that deserve attention include air-conditioning, tape deck and radio.

Check the operation of an air conditioner by looking into the sight glass that you'll find near or on the receiver-dryer unit. The receiver-dryer is a cylinder which stores and filters refrigerant. Observing refrigerant through the sight glass allows you to determine how your air conditioner is functioning.

How to check air conditioner operation

Clean off sight glass.

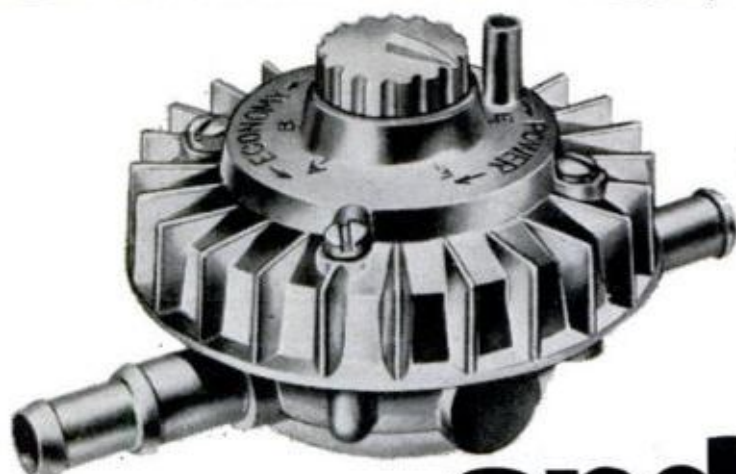
Set air conditioner controls for maximum cooling and run engine at fast idle.

Look into sight glass to see if there are



Sight glass of many air conditioners is positioned on top of the receiver-dryer cylinder. Check refrigerant level by looking for bubbles.

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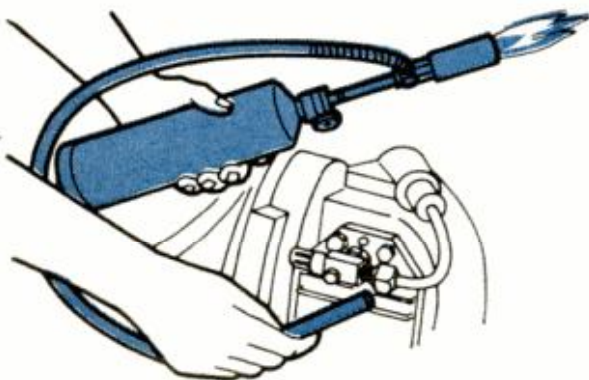
Units shipped prepaid, parcel post. Allow 2 weeks for delivery.

SAFETY EQUIPMENT AND ACCESSORIES *continued*

bubbles (use a flashlight if necessary). The presence of bubbles indicates that refrigerant isn't up to full charge.

Caution: Air bubbles appearing in sight glass when air temperature is below 70° may be normal; they don't necessarily mean that system is undercharged.

Keep watching sight glass as someone turns fan control on and off to cycle the compressor's magnetic clutch. If bubbles appear when the clutch is off and disappear when the clutch is on, refrigerant charge is adequate. Lack of bubbles during an off cycle means lack of refrigerant.



If a refrigerant leak is present, the flame of the propane torch detector will change color.

An airconditioning system that needs recharging often has a leak. Before recharging again, the leak should be found and repaired. This is done by scanning every inch of the system with a torch or electronic leak detector. Check the compressor, condenser, evaporator and all connections. A change in the color of the flame of a torch detector or a change in the sound emitted by an electronic detector reveals the leak.

When an airconditioner hose is found with bubbles in the outer skin, however, do not replace the hose. It will not cause an airconditioner system failure. What you should do is prick the bubbles to allow the trapped freon to escape. To prevent any further build-up of freon under the outer skin, several additional pin prick holes can be made. The hoses are designed to allow small amounts of freon to escape.

The most overlooked auto accessory that needs regular servicing is the tape player. The head must be kept clean of iron-oxide parti-

cles that accumulate on it from tapes. A build-up of deposits causes poor fidelity.

How to clean a tape head

Moisten cotton swab with commercial tape head cleaner or isopropyl alcohol (rubbing alcohol).

Turn on player and depress motor switch with eraser end of pencil.

Apply cleaner to tape head and capstan.

Dry tape head and capstan with clean cotton swabs.

Antenna trim may be the overlooked cause of poor radio reception. You can easily adjust the antenna trimmer to match the radio circuit to the antenna. In some cars, the antenna trimmer is in an access hole behind one of the control knobs (pull off knob). In other cars, the trimmer is found in the bottom of the radio adjacent to the antenna cable and is accessible through an access hole located in the instrument panel.

Adjustment through the knob access hole is usually made with a small screwdriver—adjustment through the instrument panel access hole is usually made with a 1/4-inch socket.

How to adjust antenna trim

Switch AM/FM radio to AM mode and leave on for about 15 minutes for circuits to stabilize.

Raise antenna of a whip-antenna-equipped radio (on fender) to full height.

Select a weak station near 1400 kc.

Turn antenna trimmer screw until maximum volume is attained.

Early rear-window defrosters were the blower type that directed warm air on the rear window. The latest type, however, consists of an electrical element either embedded in the glass or applied on the rear glass with an electrically conductive paint.

How to check rear-window defrosters

Check fuse. If blown, trace circuit for a short.

If fuse is okay, check for an open in the circuit, a faulty switch or faulty ground.

If there's a scratch on painted-on-type element, touch up with conductive paint.

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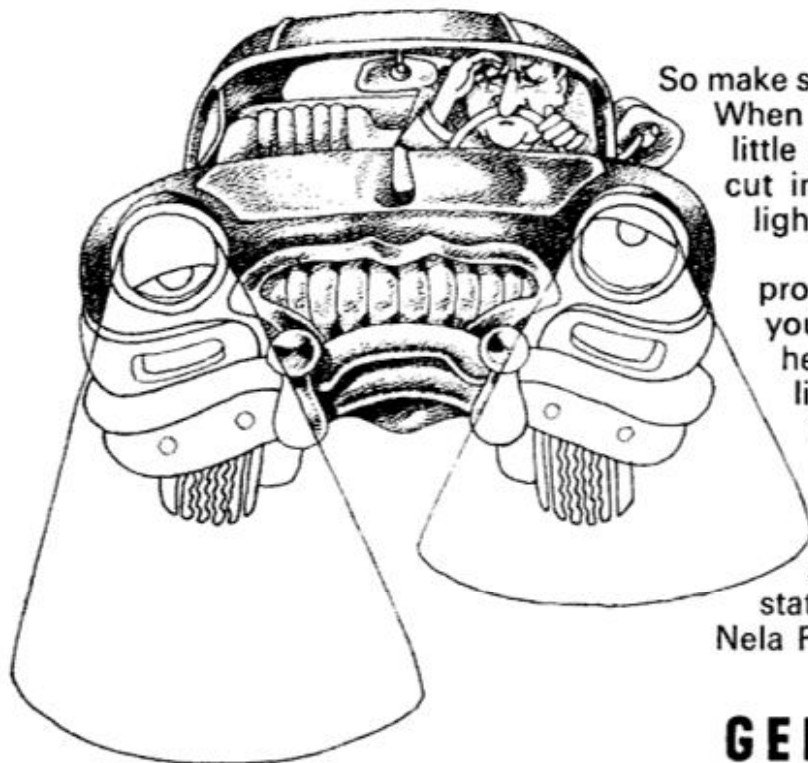
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GENERAL  ELECTRIC

BODY CARE AND APPEARANCE

Start by finding and fixing rattles. Then trace and block areas of wind noise. Repair dents and rusted areas, touch up paint, clean the interior and clean and wax the body.

How to get rid of air noises

Fasten loose weatherstripping with rubber cement.

Inspect door for holes in sheet-metal joints. Seal with body caulk.

Examine door-opening surfaces for solder lumps. File down or cut off the lumps with a chisel.

Roll up windows, close fresh-air inlets, start engine, turn on heater and set blower to top speed.



Cut off solder lumps and high spots that keep weatherstripping from sealing with chisel.



If air is leaking from inside to outside, you will hear hiss with improvised stethoscope.

From outside the car, let pressure build up inside for several seconds and then, while holding one end of a hose to your ear, pass

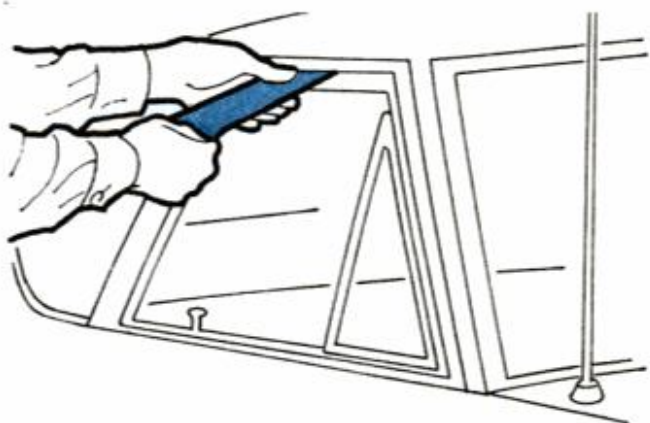
the other end slowly around door and glass edges. You will hear hissing where a leak exists if air's leaking from inside to outside. Repair area.

How to check weatherstripping

Place strip of paper between weatherstripping and door frame. Close door.

Try to pull out paper. Tight-fitting weatherstripping should hold paper snugly.

Important: Test every frame section!



Weatherstripping that fits tight should keep strip of wrapping paper closed in door snug as you pull on it.

If weatherstripping is worn, replace or shim with body caulk. But if weatherstripping is okay, door has to be adjusted.

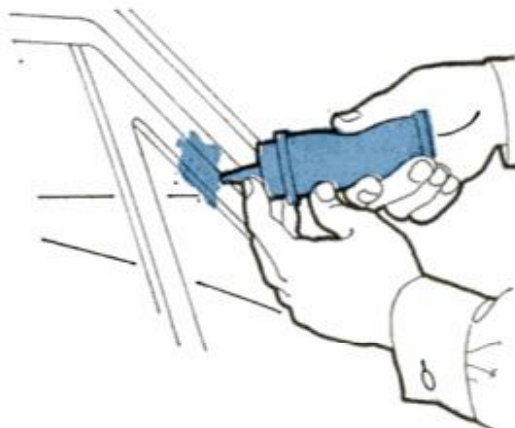
How to test for window leak

Close windows tightly.

Blow tracing powder along edges.

Look for traces of powder inside.

If powder is present, replace window seal or adjust window.



Spray tracing powder or chalk dust around windows to uncover a faulty or loose window seal.

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BODY CARE AND APPEARANCE *continued*

How to repair dents

Use an auto-body plastic filler.

Prepare surface by sanding damage until paint is removed to bare metal—make diameter of sanded spot at least 1 inch larger than dent.

Drill $\frac{1}{8}$ to $\frac{1}{4}$ -inch holes $\frac{1}{2}$ inch apart in dent if it's deeper than $\frac{1}{2}$ inch.

Apply plastic filler.

Spread with rubber squeegee and mold to contour of area.

Let harden.

Shape spot, using a grating tool.

Sand with No. 36-grit production paper; then with 80 or 100-grit sandpaper.

Paint.

How to repair rust spots

Break off rusted pieces.

Sand with No. 16 or 18 grit sandpaper.

Press adhesive-backed aluminum tape over hole.

Caution: Make sure edges hold.

Cover with auto-body filler.

Apply undercoating spray to underside.

Paint.

How to touch up paint

Consult car's identification plate for paint color number.

Buy right paint and compatible primer.

Wash area thoroughly—wipe dry with soft, clean cloth.

Caution: Once spot is clean, don't touch it.

Sand spot with No. 44 wet-or-dry sandpaper sanded frequently in clean water.

Dry with clean, soft rag.

Mask surrounding area.

Apply primer.

Let dry and sand lightly.

Apply finish coat by holding spray can 10 to 12 inches from surface and using quick, smooth strokes.

Note: If you've never applied spray paint, practice on tin cans. Also see *How to Paint With Spray Cans*, page 112.

Let dry for a week. Then rub lightly with auto-body rubbing compound.

To keep your car looking new, vacuum the interior often and get rid of upholstery stains at once with auto-upholstery stain remover. To keep the outside in mint condition, use a high-quality body cleaner and protective compound (cream, liquid or wax). Vinyl-top cleaners are available. Other cleaning compounds make short work of tough stains, such as tar and road oil, and you can buy car-washing soaps, when water isn't enough.

Tips on appearance

Instrument-panel chrome plastic strips with chrome rubbed off can be refinished using 3M Pressure Sensitive Tape No. 426. See your auto-parts supply dealer. Tape covering marred strip looks like the real thing.

To get hard-to-remove stains such as tobacco or film off interior glass, buy some GM glass cleaner (part No. 1050427) from a dealer. It does wonders.

Want to change a vinyl top's color? Kits at auto paint-supply dealers contain cleaner, paint and finish. Paint should be sprayed on. One manufacturer is Young Paint and Varnish Co., 1 South Ave., Fanwood, N.J.

Black, red and blue upholstery that fades can be restored, but prevention is easier. Park in shade when you can. To bring back luster, use an upholstery spray paint. Sears stocks one kind. GM has a dye called DyNu, available at its dealers.

To reduce glare reflected back off metal dashboards of older cars, get an acrylic lacquer paint and flattening agent from a supplier of auto paints. Add the light-absorbing flattening agent in a 1 to 3 proportion to the paint. Mix well and apply with a sprayer available from the supplier.

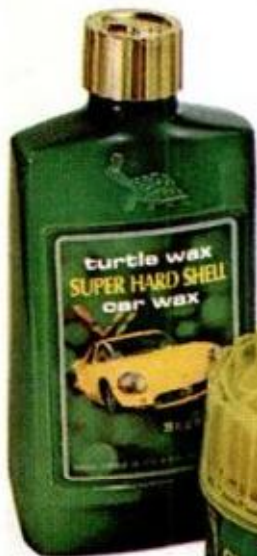
To remove a bumper sticker, soak it with gum label solvent available from stationery dealers. Then carefully work sticker from bumper with a sharp razor blade.

Can you repair a scratch in a windshield? If you can draw a fingernail across the scratch without having it catch, the scratch can usually be polished out. See a glazier or do it yourself by rubbing with jeweler's rouge you can get or order from a jeweler, or lapidary supply shop.



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THEY RIDE THE HAILSTORMS

(Continued from page 140)

fied executive jet operated by the National Center for Atmospheric Research (the Boulder-based government agency coordinating the NHRE work) tops the storm and "bombs" the cell with instrumented dropsondes from a special belly rack.

Wim Toutenhoofd's job is to fly through the storm's lower levels while a technician in the rear seat photographs water droplets and collects graupel, or soft hail, in a bottle on the side of the sailplane's canopy.

Bill Carley heads the cloud-seeding operation. He flies for Atmospherics, Inc., a California weather-modification firm with clients in many parts of the world. In Hail Alley, Carley's cloud-seeders use electrically fired flares, which cost \$12 each from the Navy (\$25 on the open market) and last 30-45 seconds.

Twin-engine Piper Aztecs fly close to the cloud base, in search of the strongest updrafts.

"Generally, once the cloud is well organized, you'll have what we term an inflow shelf," explains Carley. "It actually does form a shelf, and you can get the aircraft above it and find an area of relatively smooth air with significant updraft values."

It can be a rough ride. Carley, who has seeded thunderstorms in Europe, Africa and the United States, says no region has bigger, meaner storms than the American Great Plains.

None of the NHRE fliers has bent an airplane as yet, but G-meters have recorded gust loadings well above the Aztec's design limits. Even so, Carley's crews carry no parachutes, contending that they get in the way.

The season runs from mid-May to mid-August, and Dr. Swinbank and his associates then have the balance of the year to assess the data they've gathered to date. So far, data has been disappointingly scant. That's why the researchers are hoping for a bumper storm crop this summer.

The weather scientists are anxious to come up with answers to a number of important questions: What happens to a seeded storm when it shakes off the effects of the silver iodide? Does it rain more or less, hail more or less, or drop bigger or smaller stones? Does seeding reduce, increase or have no effect on total precipitation? Does the iodide residue cause harm at ground level?

Ask half a dozen eastern Colorado farmers what they think of the operation and you're likely to get half a dozen different answers. Not all favor the project. But then—farmers are a notoriously independent breed. ★ ★ ★

NEW COLOR TV TUBES

(Continued from page 89)

sent all the major tube innovations on the market today (with the exception of Panasonic's Quintrix, which may or may not be considered a major innovation): a Sony 114°, 17-inch; an RCA nonmatrix, slotted-mask, 15-inch; a Toshiba matrix, slotted mask 13-inch; a Magnavox with RCA's 17-inch slotted-matrix tube; and a GE nonmatrix, slotted-mask 10-inch. As a standard of comparison, I also borrowed a Zenith 17-inch, conventional-dot matrix set. The Zenith, Magnavox, Toshiba and Sony produced four of the sharpest and brightest TV pictures I've ever seen, though the Sony was not quite as bright as the first three. The two nonmatrix, slotted-mask sets, the GE and RCA, were not terribly impressive in any respect, with coarse-grained, soft-focus pictures. (The RCA 17, which I didn't have, should be as good as the Magnavox; RCA is considering a matrix version of its 15-inch slotted-mask tube, and it's easy to see why.)

What's next? More in-line, slot-mask tubes, for one thing, with some interest, at least, expressed by virtually every major manufacturer but Panasonic. (Panasonic seems more concerned with equivalent improvements in conventional tubes; in addition to Quintrix, they're working on a tube with about five times as many dots as today's round-dot screens, claiming that the finer dots allow two times finer resolution.) Philips of the Netherlands and Sylvania have tubes which warm up in five seconds, eliminating the electricity-wasting preheaters of today's "instant-on" sets, and using about 20 percent less power when the set is on, too. Several labs are working on single-gun tubes which will require no convergence and no screen grid.

And on the far, far horizon are picture tubes that aren't tubes at all, but flat, solid-state displays using LED, or liquid-crystal displays, or possibly some entirely new technology. But don't expect to have one of these in your home for at least another 10 or 15 years. ★ ★ ★

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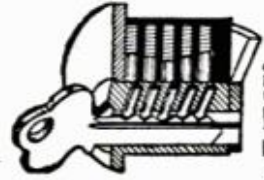
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(Continued from preceding page)

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