

Popular Mechanics

**MOTORIZED SCOOTER
TOWS YOU ON
OR UNDER THE WATER**

Build it from inexpensive
PM plans Page 69

First of the 'new'
electric cars Page 90

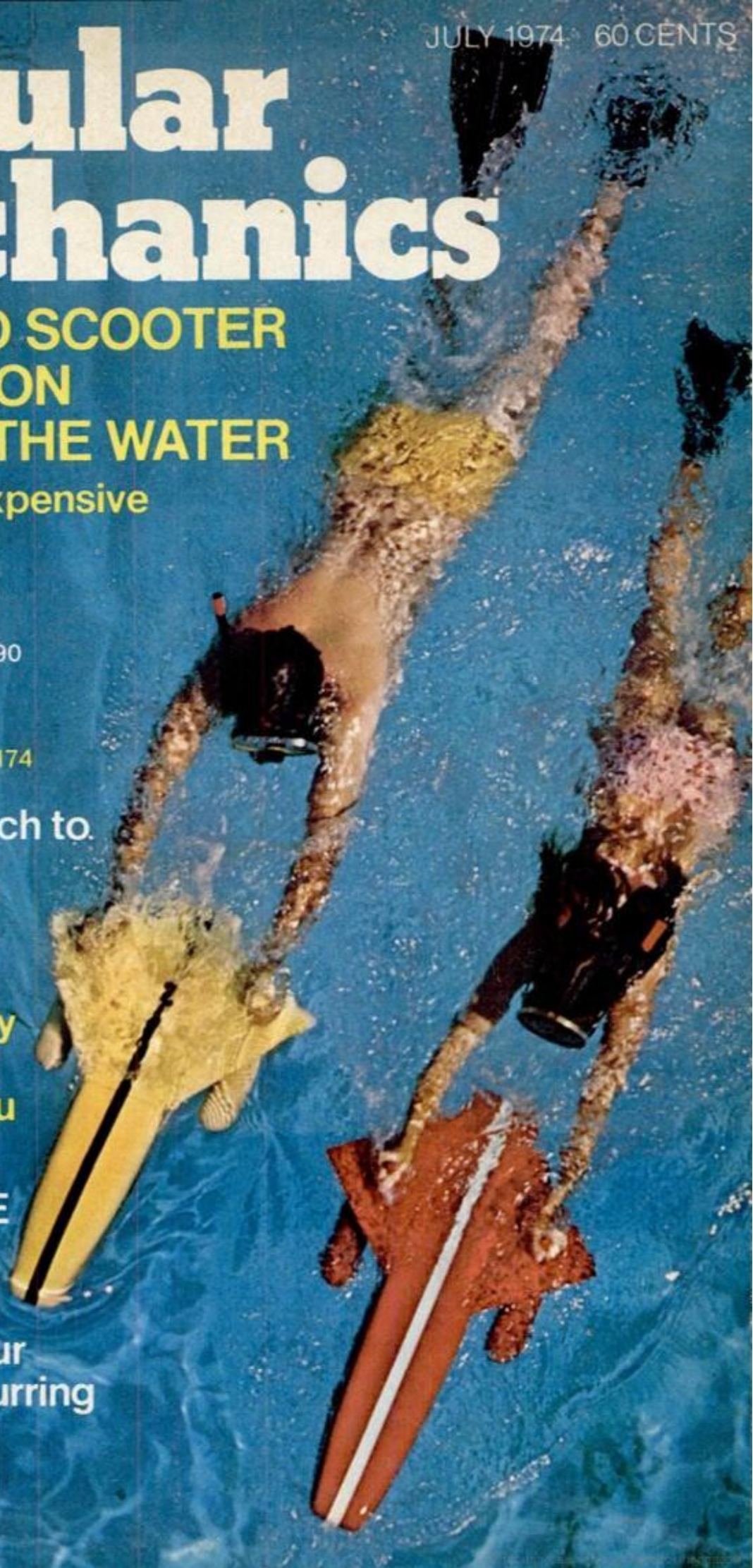
Add a motor to
your bicycle Page 174

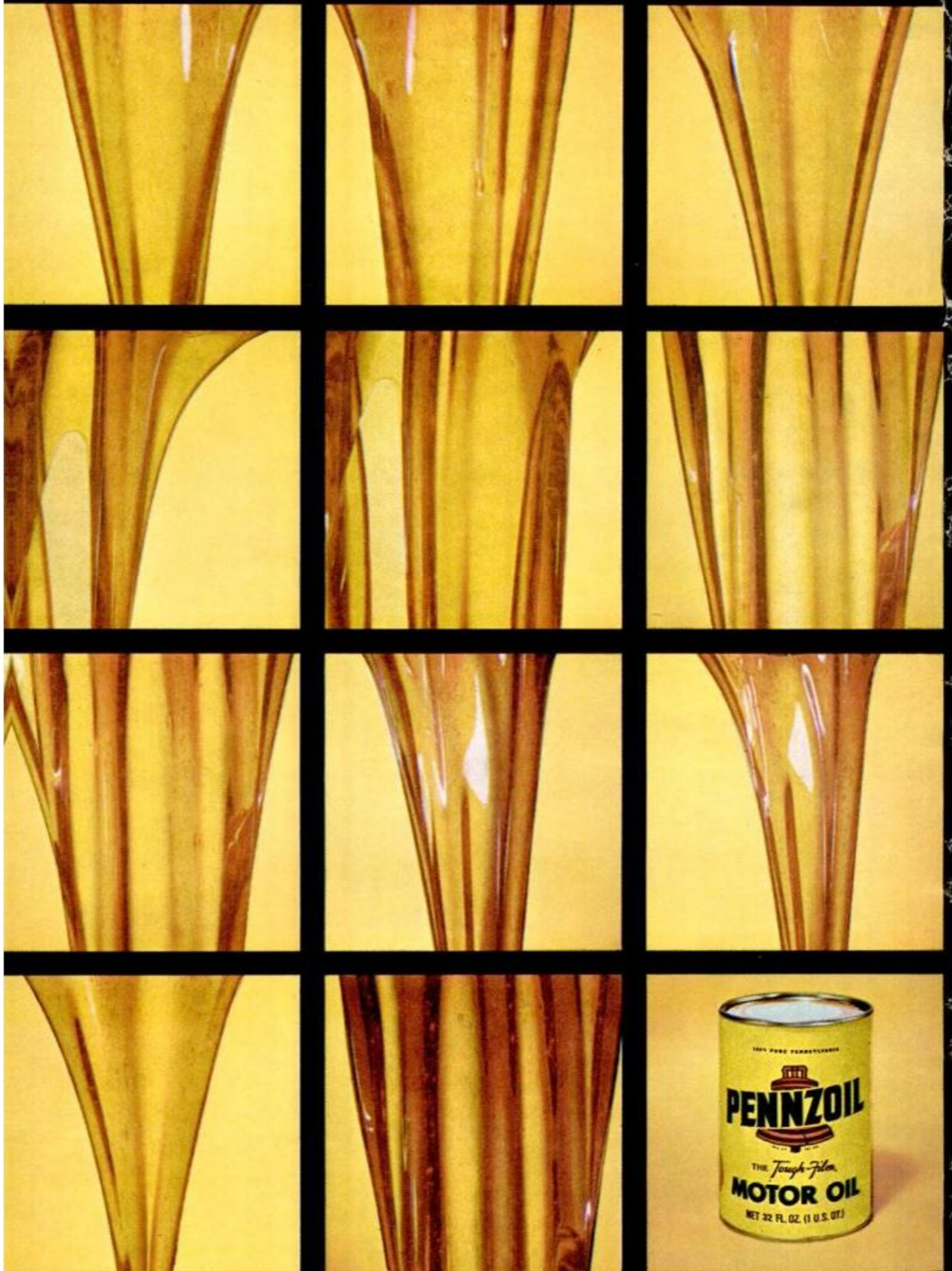
New: Quick switch to
standby electric
power for your
home Page 102

What owners say
about their
Mazda or Subaru
Pages 96 and 120

**CLIP-AND-SAVE
KNOW-HOW**

- How to solder
- How to keep your
power mower purring
- How to restring
a tennis racket





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Subaru

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This One



D3L4-X1A-QJ19

See your Yellow Pages for the dealer nearest you. Or call, toll free, 800-447-4700. In Illinois 800-322-4400. Subaru automobiles manufactured by Fuji Heavy Industries, Ltd., Tokyo, Japan. Imported by Subaru of America, Inc., Pennsauken, New Jersey.

*Survey conducted by National Analysts. †Effective on cars sold on or after May 15, 1974.

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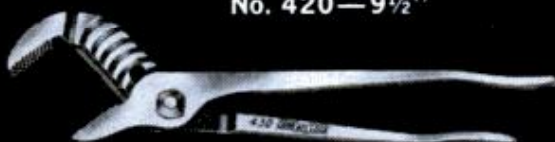
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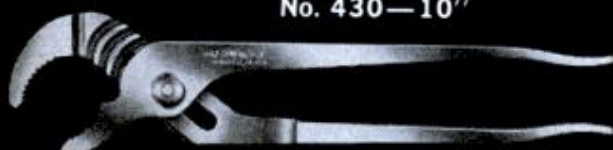
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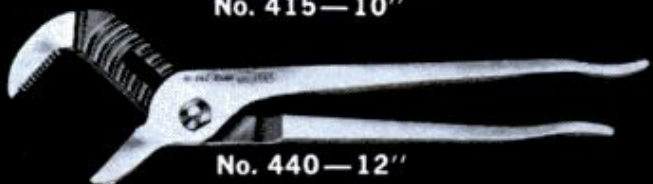
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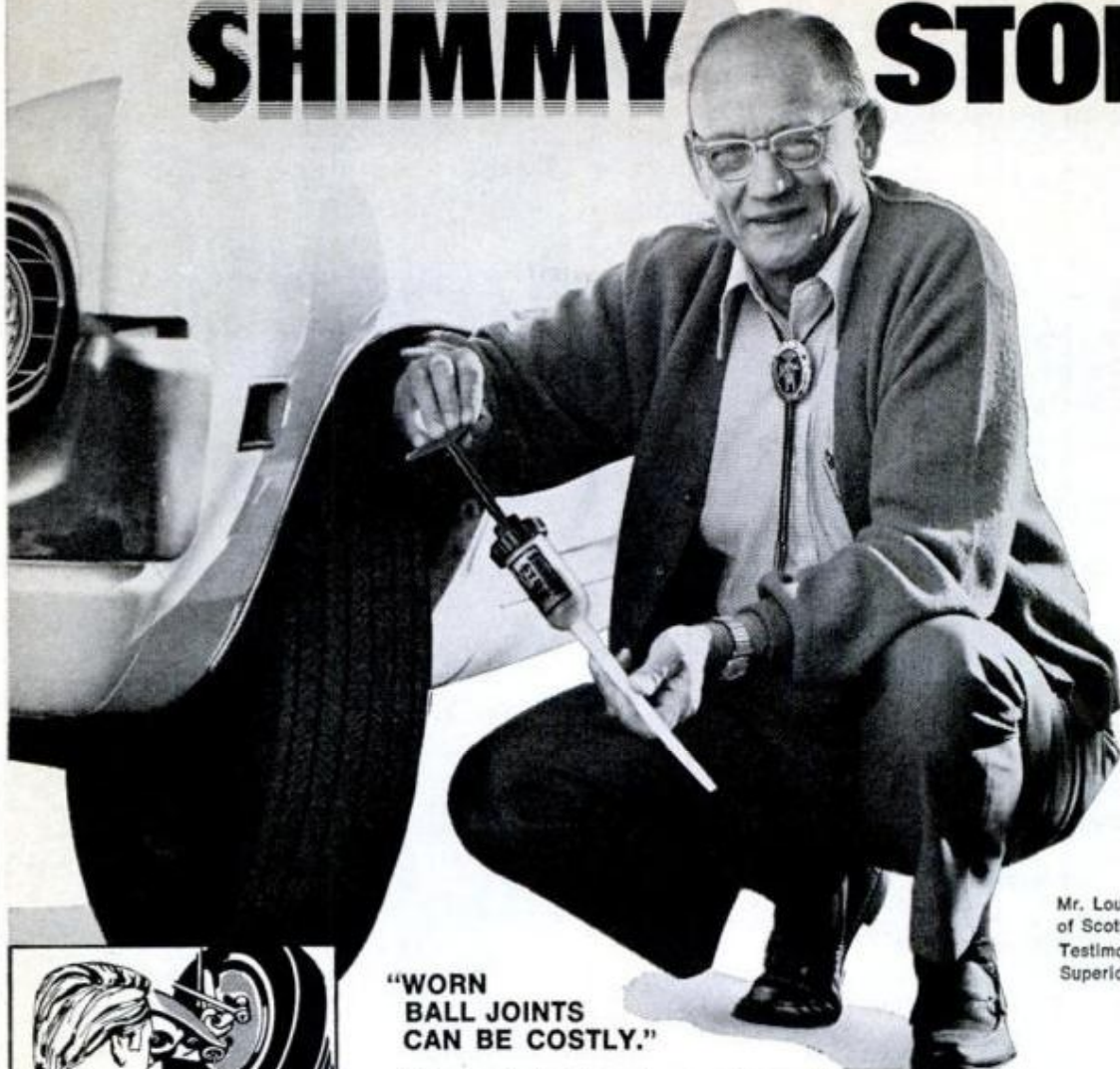
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Mr. Louis W. De Krauze
of Scottsdale, Arizona.
Testimonial on file with
Superior Industries.

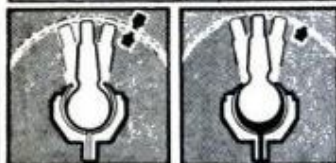
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BALL JOINTS
CAN BE COSTLY."**

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AS GREASING
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Popular Mechanics

®

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ON THE COVER: Motorized scooter tows you on or under the water—you can build it from PM plans for less than \$140.

Photo: Jerry Imber, Cypress Gardens, Fla.

AS A SERVICE TO READERS, *Popular Mechanics* publishes newsworthy products, techniques and scientific and technological developments. Due to possible variance in the quality and condition of materials and workmanship, *Popular Mechanics* cannot assume responsibility for proper application of techniques or proper and safe functioning of manufactured products or reader-built projects resulting from plans published in this magazine.



If it's tough getting gasoline, why waste it? Just remember to tune up with AC Fire-Ring Spark Plugs

With the gasoline situation being what it is today, it seems a shame to waste gas on an untuned car. And did you know that a balky car with just one spark plug misfiring can waste up to 12 percent of your gasoline? That's nearly 2½ gallons in a 20-gallon tankful.

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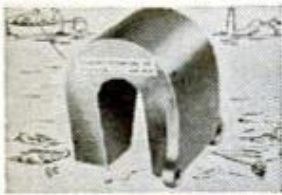
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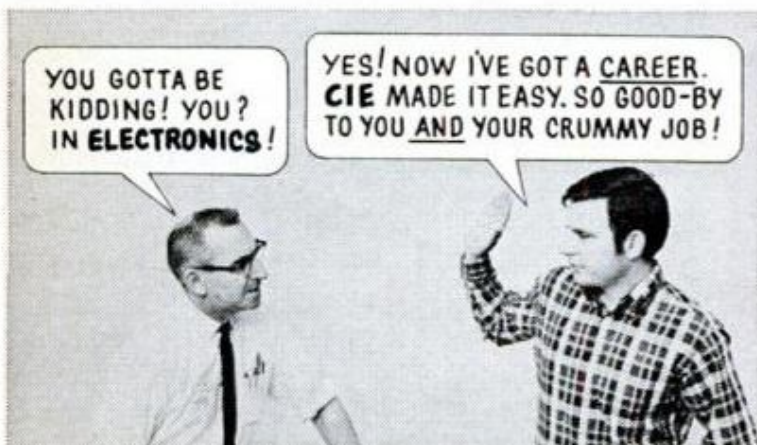
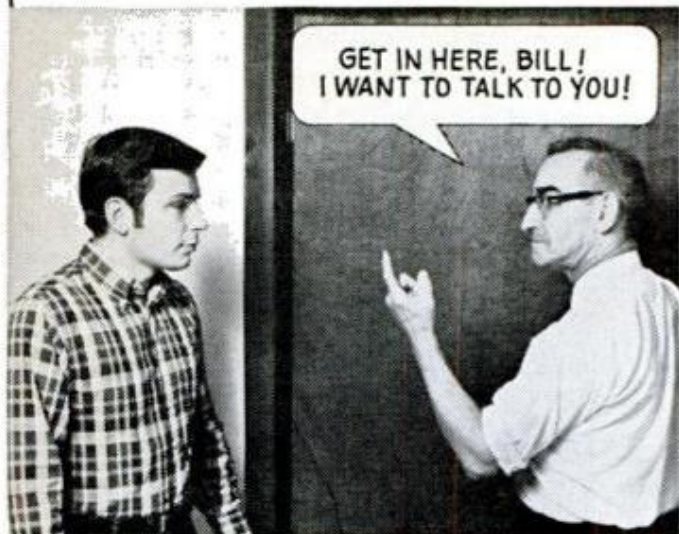
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POPULAR MECHANICS IS PUBLISHED MONTHLY by The Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A., Frank Massi, President; John R. Miller, Executive Vice President; Randolph A. Hearst, Chairman; Harrison A. Mitnick, Treasurer; Harvey L. Lipton, Vice President and Secretary; Hearst Magazines Division: Richard E. Deems, President; Raymond J. Petersen, Executive Vice President; William S. Campbell, Vice President and General Manager; John F. D'Avolio, Vice President and Resident Controller; Albert A. Rachoi, Vice President and Director of Circulation; Joseph F. Kern, Vice President for Popular Mechanics. Single copy in the United States and Canada, 60 cents. Subscription prices: United States and Possessions, \$5.97 for one year; \$10.97 for two years; \$14.97 for three years. Canada, add \$2.00 for each year. All other countries, add \$4.00 for each year. When changing address, give old address as well as the new, with zip code, and allow six weeks for change to become effective. Second-class postage paid at New York, N.Y., and at additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 1974 by The Hearst Corporation. All rights reserved. Printed in U.S.A.

The day Bill told off his boss



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LETTERS

TO THE EDITOR

Backpacker

The *Backpack Paint-Removing Machine* (page 152, May *PM*) is a good idea! I used an old washing-machine motor. Instead of the microswitch, I used a pushbutton switch.



PLAINFIELD, N.J.

R. K. PEDERSEN

Not a secret anymore

I read with a great deal of interest *Re-Siding: You Can Do It Yourself* by Harry Wicks (page 96, June *PM*). Too often that kind of valuable information is kept a guarded trade secret.

NORTH BABYLON, N.Y.

GEORGE SALLS

Car Care Guide

I am a 20-year-old amateur auto mechanic and college student. I must commend you on the fine job you did on this year's *Car Care Guide* (page S1, May *PM*). The guide has improved 100 percent over last year's. If you continue doing such a fine job on articles of this type I will be forced to stop buying *Playboy* and start buying *Popular Mechanics* instead.

Also, I would like to get something off my chest that has been burning me since you published *One (Young) Man's Shop* in February 1973 (page 98). I feel that the amateur auto mechanics of this country are not receiving a fair shake in your workshop

(Please turn to page 10)

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LETTERS

(Continued from page 8)

series. All the shops you feature are for woodworking.

HERSHEY, PA.

DAVID HOUSER

For a guy who doesn't buy Popular Mechanics, you sure read it a lot. The PM adviser says that all you have to do is shell out a mere 60 cents more a month and you can have PM.

As for home shops for auto mechanics, that's a great idea. There's nothing we'd like better. Send us snapshots. We'll come out and photograph the best ones our readers have.

As one who prefers to maintain and service his own vehicles to the maximum rather than resorting to "servicing" by the dishonest and unqualified "mechanics" I have had the misfortune to encounter, I found your *Car Care Guide* to be the most concise, informative summary I have ever read on car maintenance.

FARMINGVILLE, N.Y.

FELIX L. RUSSO

In your section about wheel bearings, it was not mentioned that some automakers recommend the bearing adjustment nuts be torqued when replaced. You can cause severe damage to the axle and bearings if the adjustment nut is too tight!

SHINGLE SPRINGS, CALIF. JACK G. HATFIELD

Phooey!

A couple of comments on articles appearing in your May issue:

West Coast Editor Michael Lamm wrote, "The Corolla became the first really successful subcompact brought into this country" (*Owners Report*, page 92). Need I point out for Mr. Lamm's edification that a car known affectionately as the VW Beetle has been among the most eminently successful automotive products imported to our shores? Suggest that Mr. Lamm get his head out of the sand.

Then you report—with a straight face yet—that the world's bicycle speed record has been broken (*World's Fastest Bicycle*, page 147). Again it was done on a bicycle enclosed in a partial vacuum created by a speeding automobile. Big deal! This is un-

(Please turn to page 12)

GEL GASKET



You know what it is...

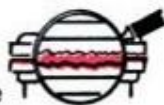
1. **Quick.** Apply a bead of Gel Gasket. Bolt the parts together. Drive away. No waiting for anything to dry, cure. No need to retorque. Gel Gasket is ready when you are.



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This is what it isn't.

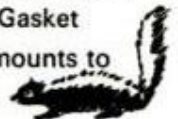
1. **Glue.** Gel Gasket isn't sticky or tacky like the gasketing sealants you're used to. That's why parts can be disassembled so readily.



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3. **Smelly.** Gel Gasket contains no solvents that evaporate. So it doesn't shrink. That's why parts assembled with Gel Gasket can't leak, and you get what amounts to perfect metal-to-metal contact.



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LETTERS

(Continued from page 10)

doubtedly the most asinine commentary on sports since basketball ceased being a game and turned into a simple height-contest. Shucks, if Jim Runyon were allowed to run inside a pace car he'd probably do the mile in three minutes flat. Next you'll be reporting that somebody has fractured the high-jump record by leaping a crossbar beyond which lies the floor of the Grand Canyon.

Phooey!

MADISON, WIS. ROBERT G. WOMBACHER JR.

Mike says that in 1970 when the Corolla first appeared here, it was indeed smaller in all dimensions and lighter than the Beetle. (We're not certain that'll get all the sand out of his hair.) As for the way bicyclists want to set speed records, we hold no brief for the pace-car method. But don't take anything away from Dr. Allan Abbott, who pedaled 140 mph. That's an amazing accomplishment.

Unbelievably good!

Your March issue was excellent. But I bought it for the article, *Coming: Smaller Cars From Chrysler* (page 90). That article was unbelievably good! If the designers at Chrysler don't see it Illustrator Harry Bradley's way, they will come out on the short end.

Are you going to run any more previews like this in the near future?

SPRINGFIELD, TENN.

DOUG DEAN

In the very near future. See August.

Phone company wants to know

In reference to *Let Your Family Listen With This Easy Phone Amp* (page 132, Feb. '74 PM), many customers are unaware of the tariff regulations requiring the installation by the local telephone company of a protective connecting arrangement between customer-provided equipment and the telephone network.

While customers are often of the opinion that they can install communications devices which they have purchased, or in this instance constructed, without telephone company contact, the fact is that the con-

nection of such devices to the telecommunications network requires telephone company involvement.

Devices such as this amplifier can create problems by sending nonstandard electrical signals into the switching network. And in this instance, a faulty switch or incorrect wiring could cause the telephone tip or ring to be connected to 117 volts.

Telephone company installers are trained to install protective connecting arrangements to which customer-provided equipment may be connected. The installation charge ranges from \$20 to \$30 and there is a monthly charge, which varies from 50 cents to \$6.50.

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MANAGER

Now the list is complete

Your *Guide to the '74 Gas-Thrifty Get-There Machines* (page 86, April PM), which listed "all the 1974 motorcycles sold in the United States," totally neglected to mention Puch motorcycles.

Puch makes a terrific 125 and 175-cc moto cross, with or without lights. The bikes are made in Europe and have been sold here for several years. I own a 1969 model.

Your careless oversight is a gross injustice to the Puch Co., dealers and the owners of these fine bikes.

REDMOND, ORE.

LOREN R. LOOP

Puch also makes enduros of the same displacement. You can get information about them from Puch Distributing Corp., 9825 Mason Ave., Chatsworth, Calif. 91311. The bikes come from Austria and have made their mark in European and U.S. racing.

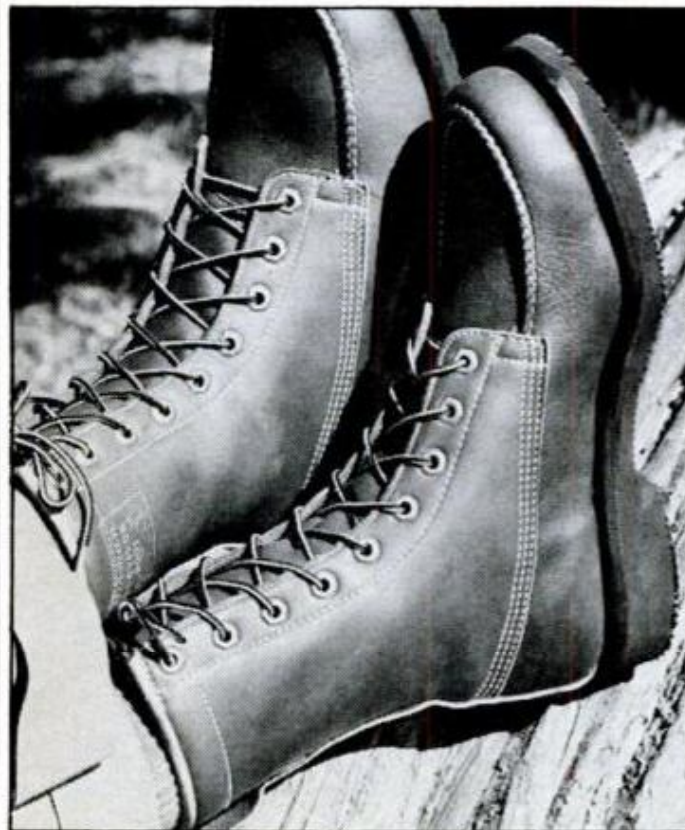
Safe turn

In *How to Commute Safely by Bicycle* (The Bicycle Shop, page 20, Feb. PM) Eugene Sloane refers to accidents caused by storm-sewer gratings—or, as we call them, catch basins.

I work for the Department of Public Works in Hanover, Mass., and we lifted out the covers (most are square) and turned

[\(Please turn to page 15\)](#)

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your home
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LETTERS

(Continued from page 13)

them 90° so that bicycles would be going across the slots, rather than with them, making it safer for the riders.

HALIFAX, MASS.

RALPH GUSTAFSON

Who did the face-lifting?

I enjoyed your April issue with its *Home Ideas Guide*. In particular I was attracted to the house shown on page 147. ('Move' Into a New Home by *Face-Lifting the Old*). I wonder if you could provide the name of the builder or architect who designed this remarkable conversion.

BLOOMINGTON, MINN.

HARRY WHITE

We neglected to mention in the article that the architect responsible for this impressive transformation is Thomas Obermeyer, 2405 Russell Ave. South, Minneapolis, Minn.

Puzzling pannier pockets

In *Best Bicycles and Gear for Commuting, Shopping and Touring* (page 90, June PM), I'm surprised to see on page 95 that the TCS panniers have a long pocket toward the front and a short one at the rear. Wouldn't there be better heel clearance if the short pocket were toward the front?

ELMHURST, ILL.

GARY HICKS

You weren't half as surprised as we were to see that arrangement. The panniers somehow were put on backwards for the picture. (Don't blame author Eugene Sloane; he supervised most of the photography, but, unfortunately, was not on hand when we had that picture taken. The Touring Cyclist Shop panniers are beautifully designed and constructed—with plenty of heel clearance.

Beach house

Over 40 years ago I read my first issue of PM. You can't imagine how it feels to appear on the cover . . . and then read your beautifully condensed story inside (*The 'Airplane' Beach House*, cover and page 101, May PM).

METAIRIE, LA.

CHARLES COLBERT

Architect Charles Colbert designed the "swinging" beach house that was featured on our May cover and shown in drawings inside. He is currently at work building a prototype. ★ ★ ★

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THE BICYCLE SHOP

BY EUGENE A. SLOANE

Making a freewheel bigger

You can change the gearing on your bicycle to make it easier to climb hills with a touring load in three ways. As discussed here last month, you can change the entire freewheel, with its five cogs, to one having a wider gear range. You can also change individual gears on the freewheel and save money by using the same freewheel body, provided you use the same make cogs. And, third, you can either change individual chainrings to ones with less teeth, or change over to a triple from a double-plateau chainset.

For example, you may have a Shimano, Atom or Regina five-speed freewheel with 13 to 28 teeth, which gives you a median range set of gears at the rear. While an entirely new freewheel will cost upwards of \$15, you can for a few dollars buy individual cogs with more teeth to replace the two or three largest cogs on your old freewheel. And so far as your old chainwheel set is concerned, you can change only the rings and keep the axle and all other parts.

This is especially vital these days when costs of good bike parts are skyrocketing out of sight. A Campagnolo bottom bracket set, including axle, rings, cups and bearings, costs around \$100; a Shimano set of the same parts, around \$65 and a Stronglight chainset about \$93. Individual rings, on the other hand, cost only \$15 or so each and, to change to a longer axle necessary to provide clearance when you add a third ring, would cost about \$14.

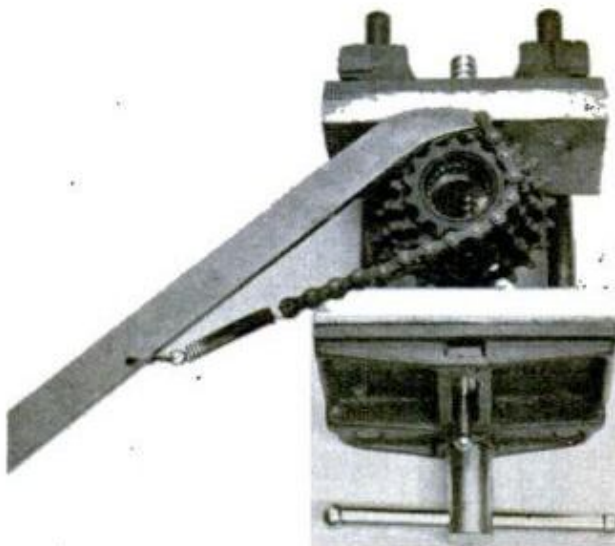
Let's start by improving the gear ratio of your freewheel. I assume you can buy larger individual cogs from your bicycle shop, or your dealer can order them for you. Let's say you have a Shimano five-speed cog with 13, 15, 17, 19 and 21 teeth. This is a close-ratio gear cluster which would make hard hill climbing. You can use the same body and change the cogs to 14, 17, 22, 28 and 34-tooth cogs.

If you will review the *June Bicycle Shop* (page 26) you will note that the 28 and 34-

tooth Shimano cogs have every other tooth missing to make chain shifting easier in these larger gears. Also, the same principle in cog changing applies to all freewheels, except that only Shimano and Maeda Sun Tour have 34-tooth cogs available and only Shimano has the alternate tooth design at this writing.

To change cogs you will need a cog remover (photo, below) as well as the freewheel remover described in last month's article. You can make your own cog tool by cutting out a piece of $\frac{3}{8}$ -inch steel in the shape of the tool shown, and attaching an eight-inch length of old $\frac{3}{32}$ -inch chain and a spring, as shown in the photo. Here are steps in changing freewheel cogs:

Step 1: Remove the freewheel. See the *June Bicycle Shop* for instructions.



Step 2: Put the freewheel between blocks of wood in a vise, holding the freewheel by the largest gear. Attach cog tool as shown, turn the tool counterclockwise to remove the cog, removing the smallest cog first. Remove all cogs. Save the spacers.

Step 3: Install new cogs, using old spacers in original sequence. Tighten cogs clockwise with cog tool (photo, page 22). On some freewheels, only the first three or four cogs are threaded on body, the last one or two being held by the first three and spacers.

(Please turn to page 22)

Winston



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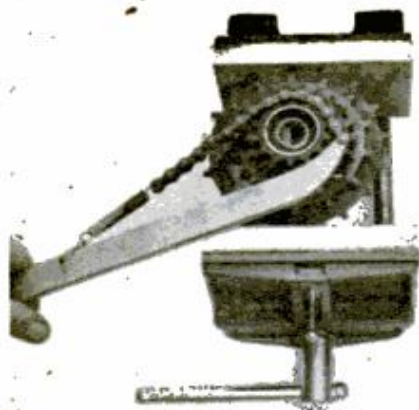
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THE BICYCLE SHOP

(Continued from page 20)



You will find, now that you have a new, larger set of cogs on the freewheel, that your old chain will no longer work. You won't be able to shift onto the largest rear cog or the largest front chainwheel because you have added a larger set of gears with more chain wraparound. Now the problem is how do you find the correct chain length



These are the same make of derailer and the same basic body (Shimano) but different cage lengths. The derailer at left has a long cage to handle greater chain length of wide-range gearing; that at right has a short cage for close and medium-ratio gearing.

for the new gears. But even before you decide on chain length, you will have to do something about installing a wide-range derailer, one with a long enough cage that will hold the proper tension on the chain to keep it from being so loose in some gears that it jumps off gear teeth or gets jammed between gears. So let's look at wide-range derailleurs. The photo above shows the same make derailleurs, exactly alike except that one has a long cage for wide-ratio gears and one has a short cage suitable for medium and short-ratio gears. Note that the derailer on the left has a

much longer cage than the one on the right. Both are Shimano Crane alloy; both have their specific applications. The low-ratio derailer (right) handles cogs from 13 to 28 teeth, the wide-ratio unit (left) handles 13 to 34 teeth. You may be able to get by with the 13-28 derailer if you have a close-ratio chainwheel, say one with 48 and 51 teeth, but don't count on it.

How to change derailleurs



Step 1: Loosen cable locknut on derailer, pull cable through. If cable is not frayed at the derailer end, sand it shiny, then coat with solder to keep ends from fraying so you can reuse cable. If cable is frayed any place, replace it. Removal is easier when chain is on the smallest rear cog.

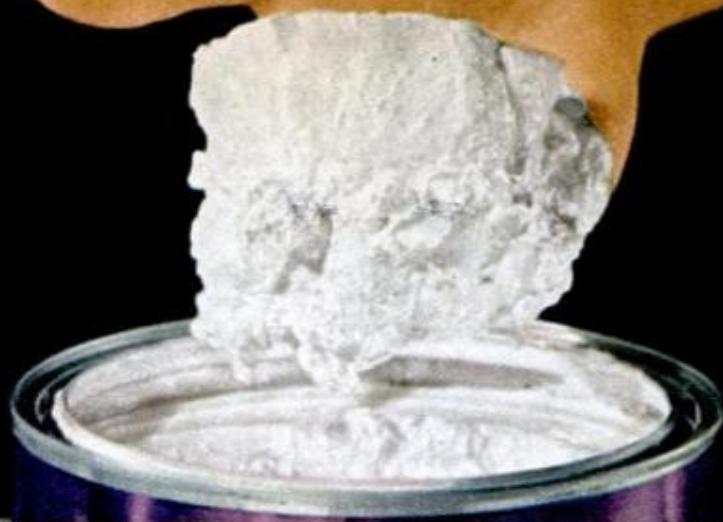
Step 2: Loosen derailer shaft with Allen wrench. However, if derailer shaft has nut on inside of wheel dropout, remove nut first. A six-mm Allen wrench fits most derailleurs. Remove chain with rivet tool.



Step 3: Reverse procedure, install wide-ratio derailer. If derailer is not the same make as the one removed, you may need longer cable and spaghetti covering. Adjust derailer by putting chain on small gear, tightening high gear stop bolt in place, repeating for large gear. Shift through all gears, make sure chain does not come off smallest or largest gears, re-adjust small and large gear stop bolts as needed. Photo shows stop bolt for small gear being adjusted.

Now that you have wide-range gears on the freewheel and a wide-range derailer that will handle them, you need to know how

(Please turn to page 24)



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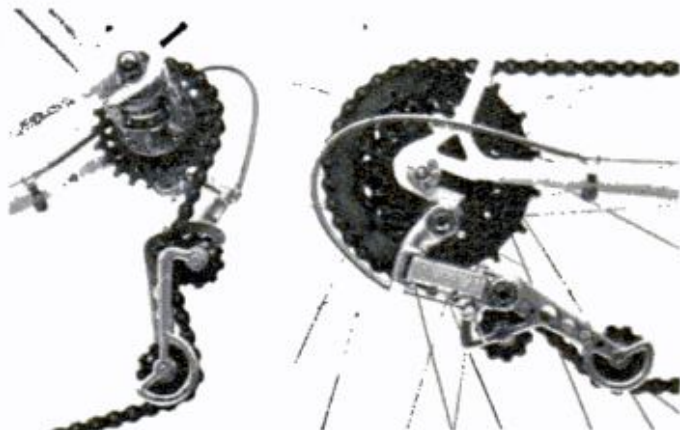
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THE BICYCLE SHOP

(Continued from page 22)

to add more links to your chain, as I mentioned earlier. First, though, you should never mix links from different makes of chains. Popular chains are Regina and Sedis in France, Diamond in the United States—and links are not interchangeable. Check for the maker's name on the sideplate of the chain. Here are steps in checking for correct chain length.



For a five-speed derailleur, when the chain is on the largest rear gear (applicable to wide-ratio gearing only), chain length is correct when the derailleur cage is straight up and down, perpendicular or almost so, to chain (above, left). For 10-speed wide-range derailleurs, chain length is correct when the chain is on largest rear and front gears and derailleur cage is flat, or nearly so, parallel to chain (above, right). Add one or two links as needed to lengthen chain, using rivet-removing tool. Remember not to mix makes of links, and for Heaven's sake be sure to use 3/2-inch derailleur-width chain and not mix up with 1/8-inch three-speed chain. For chain-rivet tool instructions please refer to April '72 *Bicycle Shop* (page 31). Do not push the rivet all the way out, but leave about 1/16 inch inside the chain plate to make reinstallation easier. After riveting, twist chain at the riveted link(s) from side to side to loosen links and prevent tight link that can make the chain skip or jump.

Next month I will finish this series on gearing by showing how to convert a double to a triple chainwheel (or a 10-speed to a 15-speed), and to chain chainrings for wider gear ratios. If you have a wide-ratio 14 to 34-tooth freewheel and a 32 or 36 small chainring and 48 to 51 large chainring up front, jumps between gears can be too large on the flats. So converting to a triple chainwheel, with an intermediary 42 ring, can give you smaller incremental gear selections.

Personally, on the flats I prefer close to medium-close gear ratios, but I need wide-range gearing on hills. A good compromise can be a 15-speed gear system, which is mainly what I'll discuss. ★★★

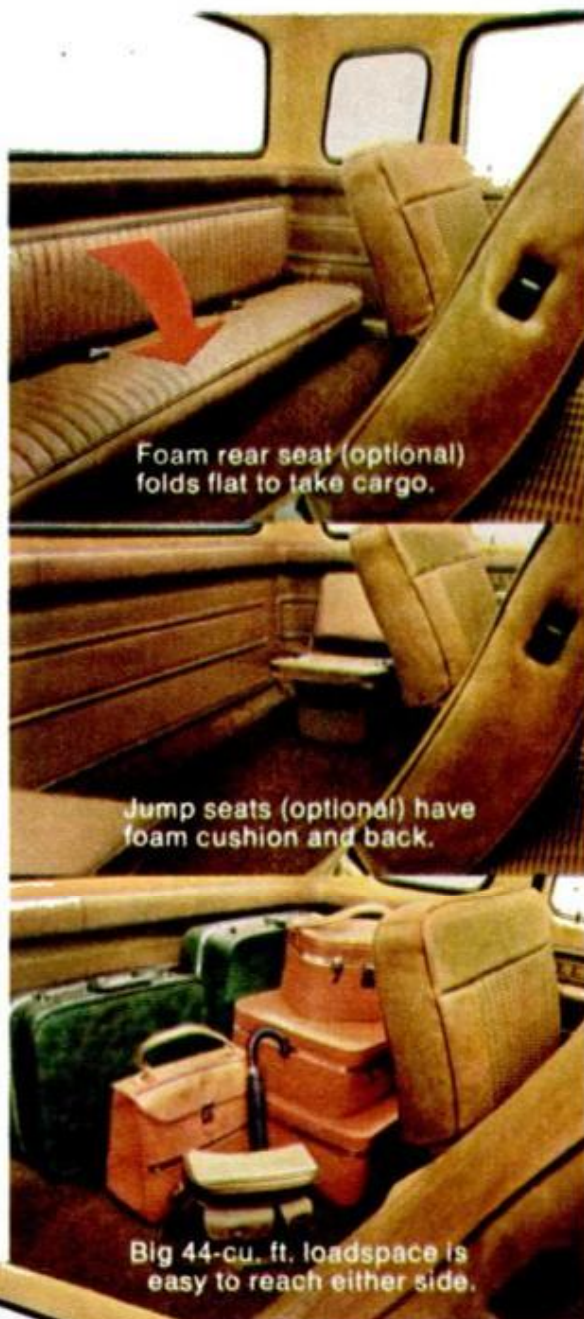
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I'd like to give this to my fellow men... while I am still able to help!

I was young once, as you may be—today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my

summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

I am printing my message in a magazine. It may come to the attention of thousands of eyes. But of all those thousands, only a few will have the vision to understand. Many may read; but of a thousand only you may have the intuition, the sensitivity, to understand that what I am writing may be intended for you—may be the tide that shapes your destiny, which, taken at the crest, carries you to levels of independence beyond the dreams of avarice.

Don't misunderstand me. There is no mysticism in this. I am not speaking of occult things, of innumerable laws of nature that will sweep you to success without effort on your part. That sort of talk is *rubbish!* And anyone who tries to tell you that you can *think* your way to riches without effort is a false friend. I am too much of a realist for that. And I hope you are.

I hope you are the kind of man—if you have read this far—who knows that anything worthwhile has to be *earned!* I hope you have learned that there is no reward without effort. If you have learned this, then you may be ready to take the next step in the development of your karma—you may be ready to learn and use the secret I have to impart.

I Have All The Money I Need

In my own life I have gone beyond the need of money. I have it. I have gone beyond the need of gain. I have two businesses that pay me an income well above any amount I have need for. And, in addition, I have the satisfaction—the deep satisfaction—of knowing that I have put more than three hundred other men in businesses of their own. Since I have no need for money, the greatest satisfaction I get from life is sharing my secret of personal independence with others—seeing them achieve the same heights of happiness that have come into my own life.

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to

gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

I have a business that is peculiar—one of my businesses. The unusual thing about it is that it is needed in every little community throughout this country. But it is a business that will never be invaded by the "big fellows." It has to be handled on a local basis. No giant octopus can ever gobble up the whole thing. No big combine is ever going to destroy it. It is essentially a "one man" business that can be operated without outside help. It is a business that is good summer and winter. It is a business that is growing each year. And, it is a business that can be started on an investment so small that it is within the reach of anyone who has a television set. But it has nothing to do with television.

This business has another peculiarity. It can be started at home in spare time. No risk to present job. No risk to present income. And no need to let anyone else know you are "on your own." It can be run as a spare time business for extra money. Or, as it grows to the point where it is paying more than your present salary, it can be expanded into a full time business—overnight. It can give you a sense of personal independence that will free you forever from the fear of lay-off, loss of job, depressions, or economic reverses.

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and

ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

In this message I'm not going to try to tell you the entire story. There is not enough space on this page. And, I am not going to ask you to spend a penny now to learn the secret. I'll send you all the information, free. If you are interested in becoming independent, in becoming your own boss, in knowing the sweet fruits of success as I know them, send me your name. That's all. Just your name. I won't ask you for a penny. I'll send you all the information about one of the most fascinating businesses you can imagine. With these facts, you will make your own investigation. You will check up on conditions in your neighborhood. You will weigh and analyze the whole proposition. Then, and then only, if you decide to take the next step, I'll allow you to invest \$15.00. And even then, if you decide that your fifteen dollars has been badly invested I'll return it to you. Don't hesitate to send your name. I have no salesmen. I will merely write you a long letter and send you complete facts about the business I have found to be so successful. After that, you make the decisions.

Does Happiness Hang on Your Decision?

Don't put this off. It may be a coincidence that you are reading these words right now. Or, it may be a matter that is more deeply connected with your destiny than either of us can say. There is only one thing certain: If you have read this far you are interested in the kind of independence I enjoy. And if that is true, then you must take the next step. No coupon on this advertisement. If you don't think enough of your future happiness and prosperity to write your name on a postcard and mail it to me, forget the whole thing. But if you think there is a destiny that shapes men's lives, send your name now. What I send you may convince you of the truth of this proverb. And what I send you will not cost a penny, now or at any other time.

VICTOR B. MASON
1512 Jarvis Ave., Suite M-2-DH
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DETROIT LISTENING POST

Chrysler compact shaping up

Here are more details on the small car Chrysler is working up in France. (This information is right off the specs, as were the car's dimensions disclosed in *DLP* last month.) The C-180, its code name, will be a four-seater, but a third person could squeeze in the back seat. Chrysler is completing a study on what surgery will have to be done to Americanize the car in terms of MVSS—motor-vehicle safety standards. The company is looking at two optional engines, a 1639-cc six-cylinder code-named the C-160 and a two-liter engine.

Chrysler is also doing an engineering appraisal on a small car with front-wheel drive. This may or may not be related to the compact it is developing in France.

A car that's too new?

American Motors is trying to solve what it foresees as a problem with its forthcoming small car, Pacer, before it becomes a problem. Will people accept it? Is the design too far out, too different? That may sound like press-agent stuff to whip up interest in the car. I don't think so. Everybody at the company feels AMC is going to have to do a preselling job on the car to get people warmed up to the idea of a different package, a different shape.

"It will be a visibly different car, maybe even controversial," company chairman Roy Chapin said in an interview I had with him. "It's an idea that represents a transition between what has been and what's coming. Today versus tomorrow." How do you overcome opposition to a car that hasn't even gone into production?

That isn't a new problem in Detroit. Chevrolet faced a similar situation in 1959, just before it brought out the rear-engine Corvair. Chevy was afraid people would shy away from a rear-engine U.S. car, so it started a campaign to talk up the rear engine. By the time Corvair was ready, the nay-sayers had been pretty well worn down.

U.S. car buyers talk a good game of liking boldly innovative cars and damning Detroit for not being more imaginative. But when it comes to plunking down the money, most buyers prefer to let the other guy go first.

AMC has been looking at a Nov. 26 introduction for Pacer, but that may have to be changed to early next year. The first-year production target for Pacer is 75,000 units.

AMC considering one-seater

In that interview with Chapin, I asked about the possibility of American Motors bringing out a one-seat, two-person car. Back in the '50s' AMC's predecessor company, Nash-Kelvinator, imported a two-person car, the Metropolitan, from England. The Met had a back seat, but it was mostly cosmetic. You could perch a 5-year-old on it by positioning the kid sideways. But that was about it.

Chapin says, "A two-seater is a good possibility, but four-seaters are more practical for average American-car usage. We think the coming market for small cars will require a practical approach, rather than mere concentration on smallness."

Gas-pinching transmission

An automatic transmission that gives almost the same fuel efficiency as a straight stick? Impossible as it sounds, GM has one. The company has turned out a few test jobs and will get into production a year from now. The unit will be for small cars with small engines, including the Wankel.

Four new Fours on the way

All automakers now have new four-cylinder engines under way—in this country or overseas. But they won't be the soft-pedal putt-putts Detroit was considering a few months

(Please turn to page 32)

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Husband and Wife Have Going Business

Here's the story from Dick and Jo Ann Koester after being in business 10 months: "We have acquired another Foley Saw Filer and for the past two months we have been in full-time operation. As we live in a small town of 150 population in farm area we use our truck to pick up saws in five nearby towns. With a family to support and plans for building to our house we had to pick up business fast and already sharpen an average of 15-20 saws a day. Business for the future looks even better as good machine filing is our best advertising."

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DETROIT LISTENING POST

(Continued from page 30)

ago. With several states agitating to lift the 55-mph speed limit (or ignoring it), Detroit can't see building engines with a top speed of 60. You can always legislate speeders to slow down, but if you design an engine to peak at 60, you're stuck with it. So you'll see new Fours in 1976—with reserve pep along with economy.

Got you coming and going

An idea American Motors has been tinkering with for a decade will get its first real tryout on a production car on the '75 Gremlin. Bumpers will be interchangeable front and rear. The company has been experimenting with interchangeable fenders, doors and hood/deck lids since the early '60s. Both bumpers on Gremlin will meet the government standard requiring the bumper to take a five-mph impact without damage.

Junior Cadillac delayed

Cadillac's long-touted junior car won't be out this year, maybe not even next year. The car was in the works for this year, according to sources at Fisher Body where it was being framed for production. But while that car has been scrapped, there will be a chopped-down Caddy—next year or in 1976.

GM is looking at two body sizes; one being slightly smaller than its current mid-size cars and another slightly larger. Either way, Cadillac will have to share the body with other GM divisions. The earliest the car could come out would be the fall of 1975. But with all of GM's problems trying to increase production of bread-and-butter cars, Cadillac may have to wait another year to launch its luxury compact.

GM developing new Six engine

GM is working on an all-purpose six-cylinder engine that can be used in any size car from an economy Cadillac to the smallest compact. This is a tricky engineering job—if the engine is overpowered, it can't be used in a small car; if underpowered, it can't be used in a big car, without modification. GM's goal is to design an all-purposer that doesn't have to be modified. ★★★



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APPLIANCE CLINIC

BY PAUL MANN

Unsuspected danger

I own a Model 77C Maytag clothes dryer. My problem is that the main gas burner does not shut off when the timer switch goes off. I paid a serviceman \$89 eight months ago to fix the dryer, but it has done the same thing twice since then. The only way I can put out the flame is to shut off the gas supply. What do you suggest?—M. Carosello, St. Louis

Maybe the gas-burner solenoid, or its circuit, is defective. If the solenoid stays in the energized position at the end of the drying cycle, the gas valve stays open.

But another cause of your problem is more likely and far more serious. The gas valve itself may be sticking in the open (or a partially open) position. It may be hitting on the seat and not closing, or it may be sticking because of dirt. In either case, when the gas valve fails to work properly, the chance of a gas leak exists.

If I were you, I would call my local gas company immediately and describe the trouble to the emergency service department. Gas companies are super-cautious when it comes to possible leaks. They will check and recheck until the problem is found and fixed.

Let me add one more point that could save money for those with gas appliances: When any problem strikes any gas appliance, call your local gas company. Charges for repairs are usually rock-bottom and repairs are often made free of charge.

Cold storage

I have a new General Electric refrigerator, which has been in use for only a few months, that I want to store. Can you offer some advice?—Dan Garcia, San Jose, Calif.

GE suggests the following:

- Place the unit in a dry area.
- Be sure the plug is pulled from the wall receptacle.
- Wash out the refrigerating compartment with soapy water, rinse it thoroughly with

fresh water and allow compartment to dry.

- Keep the door or doors open to prevent buildup of odors.

General Electric claims that keeping the door open on a new refrigerator offers little danger to children since the latch is magnetic and takes only 12 pounds of effort to push open from the inside. But I would prefer taking the door or doors off the unit to make it 100 percent safe.

Mind what you're doing

Our Frigidaire Custom Imperial electric stove with "Heat Minder" burner is about 10 years old. I would like to do away with the Heat Minder and think that if I disconnect the two wires, I can use the burner as a regular burner. A serviceman says it can't be done. What is your opinion?—Otto Stein, Dallas

The two wires you refer to are, I imagine, the sensor wires. If this is what you mean, then the serviceman is correct—your scheme won't work as the element either will overheat or won't heat at all.

The job can be done, but I suggest you have a professional do it if you are not sure how to handle it. You have to buy a bimetal turn-switch of the type that controls the other large burner. Disconnect the two wires and discard the sensor. Now wire the burner into the switch by disconnecting the other wires attached to the burner and attaching each to its proper switch terminal—they're color-coded. What you are doing is simply removing the automatic feature and making the burner manually controllable.

Airing problems

The fan motor of my Amana airconditioner squeals. It sounds like a wheelbarrow when the axle is dry and needs oiling. When the fan motor is spun by hand, you can feel the

(Please turn to page 36)

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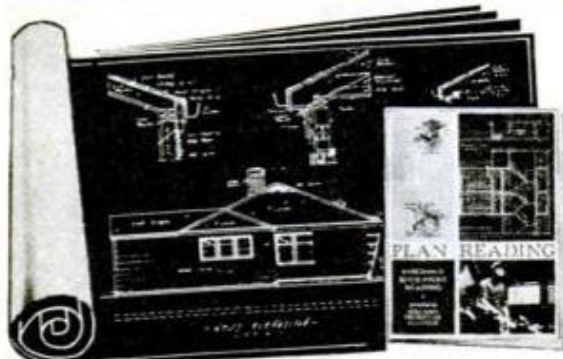
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APPLIANCE CLINIC

(Continued from page 34)

shaft vibrate. What is wrong? Another question: The unit is used only at night and, at present, it doesn't have a condenser fan. How important is this?—Winston A. Cardinez, Trinidad, West Indies

Your squeal problem probably is the result of dry or worn motor bearings. Many Amanas have oil cups on the motor housing. Look for them. If they're there, apply three drops of lightweight household oil to each cup. If the squeal does not stop or if there are no cups, the motor will have to be taken apart for repair, or replaced. Check the price of repair unless you can do it yourself; it often pays to just replace.

You should not run an airconditioner without a condenser fan—night or day. The fan keeps the coil cool. Without it, heat may build up to a level that will cause overload and possible damage.

Rapid fire

Some time ago we purchased a Singer Stylist sewing machine for our mother. We have no complaint with the operation of the unit—just with its speed. It is uncontrollable, and several trips to the repair shop have proved fruitless. After several minutes of use, the foot control becomes warm, and regardless of the amount of pressure on the control, the machine runs with bursts of speed. Please help.—Gene C. Snyder, Arcadia, Ohio

The fact that the foot control "becomes warm" indicates a defect in the control. Perhaps the part was defective to begin with, or it may have been jarred. This control has carbon discs that can come loose if it is dropped or bumped. If the speed is too high and the foot control is in good condition, the speed can be reduced by adjusting either the control or the drive belt. In any event, you should contact an authorized Singer sewing-machine center in your area. If you are skeptical about repair facilities available, then write to the Customer Service Dept., Singer, 30 Rockefeller Center, New York, N.Y. 10020. ★★★

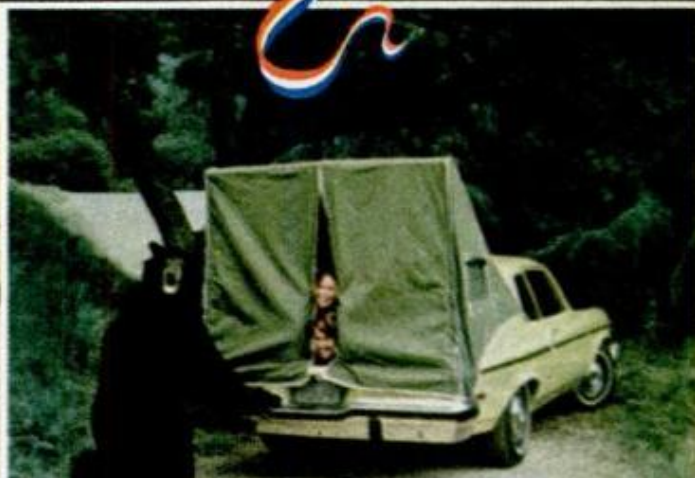
If you have a question about any appliance, send it to Appliance Clinic, Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Sorry, but letters cannot be answered individually. Problems of wide interest will be answered in this column.

CHEVROLET MAKES SENSE FOR AMERICA



THE MOVING VAN NOVA.

The compact Nova 6 Hatchback is a very sensible car to have on moving days. Its hatch opens a lot wider than the hatches you'll find on many economical compact cars. And with the rear seats folded down, you get six feet of flat load space. Almost like having a wagon. But whether you're carrying people or things in your Nova 6 Hatchback, the six-cylinder engine under the hood helps you carry them economically.



THE NOVA MOTEL: LOW DAILY RATES.

The Nova 6 Hatchback looks like a fairly small compact car. Until you see the bedroom. To turn a Nova 6 Hatchback into a bedroom, you simply open the hatch, fold down the rear seats and attach the tent-like Hutch—an available feature that can make this Hatchback even more economical and sensible when you're on the road.

THE ROOMY, FAMILY NOVA 3+3.

This Nova 6 may be a perfectly sized car for families today. It has room for six passengers, and its four doors make entry and exit quite simple for all. (*Automotive Industries'* Roominess Index indicates that no domestic compact at any price has more head and shoulder room, front and rear, than Nova.) And because it's a Nova 6, you don't have to sacrifice economy to get all this room and comfort.



THE \$2677* NOVA.

People seem to have trouble believing the low base price of a glamorous 2-door Nova Coupe like this one. But it's absolutely true. For a lot of people, this basic Nova 6 model is the most sensible. It has room for six passengers, and an economical six-cylinder engine under the hood. You can rely on the value of the Nova 6. Chevrolet has been building and refining this sensibly sized, practically priced car for thirteen years.



CHEV
NOVA 6
Chevrolet



*Manufacturer's Suggested Retail Price, including dealer new vehicle preparation charge. Destination charges, optional equipment, state or local taxes are additional.

CAR CLINIC

BY MORT SCHULTZ

Frozen Citroen

I tried starting a 1967 Citroen that has been sitting outside for a year by hand-cranking. Apparently it is frozen, because it wouldn't budge. What do I do now?—Walt Latting, Scotia, N. Y.

The piston rings have probably seized. This can happen when you put a car into storage without taking the precaution of removing sparkplugs and filling each cylinder with oil. You may be able to free pistons by taking out plugs and pouring a cup of rust-eating solvent, such as CRC, into each cylinder. Let the solvent do its work for an hour or so before trying to turn the engine over. Failing this, the engine will probably have to come apart.

Did you first try to start the engine with the self-starter? You could have jammed the Bendix against the flywheel ring gear, which would make it appear as if the engine was frozen. An indication of this would be if the starter gave a clunk, and that was that. If this is the problem, then loosen the bolts holding the starter and draw back to release the Bendix.

Another possibility is that the clutch disc has frozen against the flywheel. This could have happened if you didn't disengage the clutch before storing the car. A seized clutch disc can increase resistance on the flywheel, making it seem as if the engine is frozen. Try freeing the clutch by rocking the car back and forth. Failing this, the disc will have to be freed by hand.

Optional trouble

I am suddenly having a problem with the automatic cruise control of my 1969 Pontiac Catalina (78,000 miles), which is equipped with a 400-cu.-in. engine. My dealer's solution is to replace the control box with a new one costing \$60. It seems the slide valve doesn't open to allow vacuum to work the bellows that operates the throttle. Can't this box be rebuilt?—Albert W. Mitchell, Portland, Me.

If your dealer is correct in his diagnosis,

he is right in his remedy. The regulator ("control box") is a sealed unit that can't be opened and repaired. It costs \$60.50.

Power on

Can power steering be added to a 1970 Chevrolet Biscayne?—A.C. Kelley, Greenville, S.C.

Yes, and power brake, too. See your Chevy dealer for the kits.

A vintage question

I need a taillight assembly for a 1954 Chrysler Crown Imperial. Do you know where I can get it?—Joseph Curcio, Philadelphia, Pa.

According to *Restorer's Guide*, published by the Chrysler Corp., several companies throughout the country can help. Those in your area include Garton's Auto Parts, Fifth and Vine, Millville, N.J. 08332; Joe Rezzino's, Box 1215, Scranton, Pa. 18501; and Morris Sarnoff's, 1167 Park Ave., Vineland, N.J. 08360.

I suggest that anyone seeking information regarding restoration or maintenance of older vehicles built by Chrysler Corp. should write for a copy of *Restorer's Guide*. It offers valuable information. Address your request to Historical Collection, Dept. CIMS 417-24-18, Box 1919, Detroit, Mich. 48231.

Nova distributor

I have a 1972 Chevrolet Nova with L-6 engine that is on its third distributor. The first one failed after 9000 miles—the second after 2000. The bushings on the shaft went bad on both. What's the solution?—William J. Doerrie, Mineola, N.Y.

The procedure, given in service bulletin 74-T2 (10/23/73), tells Chevy dealers to add shims to the outboard side of the distributor to compensate for excessive dwell varia-

(Please turn to page 40)

The Challenger. New Viceroy Extra Milds.

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but lots of taste.

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

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CAR CLINIC

(Continued from page 38)

tion that wears out the distributor's lower bushing. This repair also applies to 1973-74 models.

Pass the gas masks

My 1971 Ford LTD gives off a terrible gas odor. I have been told to live with the condition, but that is hard to do. Please help.—Dr. Carl N. Chapman, Nevada, Mo.

The accelerator-pump diaphragm or power valve may have developed a hole that lets gasoline in the carburetor leak into the cylinders after the engine is shut off. This will cause the engine to "flood" and emit the odor. It may make the car hard to start.

The carbon canister of the fuel-evaporation emission-control system may be clogged or its filter fouled. If the car has seen 50,000 miles, change the canister. If not, replace filter in the canister base. Also check hoses going to the canister from fuel tank and carburetor, and going from canister to carburetor. If a hose has developed a hole, the gas odor may come from that.

There may also be a fuel-line leak.

Tough conversion

I own an immaculate 1968 Chrysler Newport with 361-cu.-in. engine and automatic transmission, but get poor gas mileage. Is there a way of putting a 225-cu.-in. slant Six in this car and coupling it to my recently rebuilt A-727 Torqueflite transmission?—Rev. Tim Davison, Kansas City, Mo.

The job is not easy, but it can be done. You'll need a torque converter, flex plate and new transmission case since the guts of the A-727 will have to come out of its present case. You will also have to weld on mounts for the engine and transmission. And you may need a new rear axle, but won't know for sure until you get everything together and see if your present rear axle will handle the load.

Before you start, I think you should get in touch with a Dodge dealer who specializes in taxis and light trucks. Dodge has

produced cabs and trucks having the 225-cu.-in. and A-727 combination. The dealer can tell you in greater detail, and in dollars and cents, what is involved.

In shock

I have a question for you that only a girl can ask. I drive a 1966 Mercedes 230, and I would like to know why my car must have \$40 shock absorbers. What's so special?—Miss I.C. Blaszkowiak, Mansfield, Ohio.

You can use other makes of shock absorbers, but Mercedes emphasizes that the ones it makes are best for maximum performance. According to A.B. Shuman of Mercedes-Benz of North America, Inc., "There is more to the Mercedes shock absorber than meets the eye."

Mercedes shocks are gas-pressurized, which prevents aeration of shock-absorber fluid and contributes to spring action at each wheel. These shocks serve as limiters for downward wheel travel and are constructed for that purpose. Shuman puts it this way: "It's possible that if a person uses improper shocks, he or she could damage his or her rear end."

SERVICE TIPS

■ **Owners of 1974 models:** Remember not to leave the front-seat belts buckled or packages on front seats while your car is parked—this could kill your battery. The starter interlock is set up to draw current at all times to the weight detectors in the seat. This results in a very small, but continuous, drain on the battery which won't usually result in a discharged battery. However, leaving a package on the front seat or its belts buckled will cause a heavier drain.

■ **Rough engine operation.** If your 1974 Ford, Lincoln or Mercury with solid-state ignition runs roughly above idle speed, look for crossed wires in one of the distributor-to-module engine-harness plugs. They might be causing the distributor to be 22½° out of time.

The condition can be verified by disconnecting the engine-harness plug at the distributor and the four-way plug at the module, and checking for continuity. If wires are crossed, the engine harness will have to be sliced open and the correct wires spliced together. The dealer's authorization to do this job is service bulletin 62 (2/8/74). ★★

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.



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Fun with a chain saw

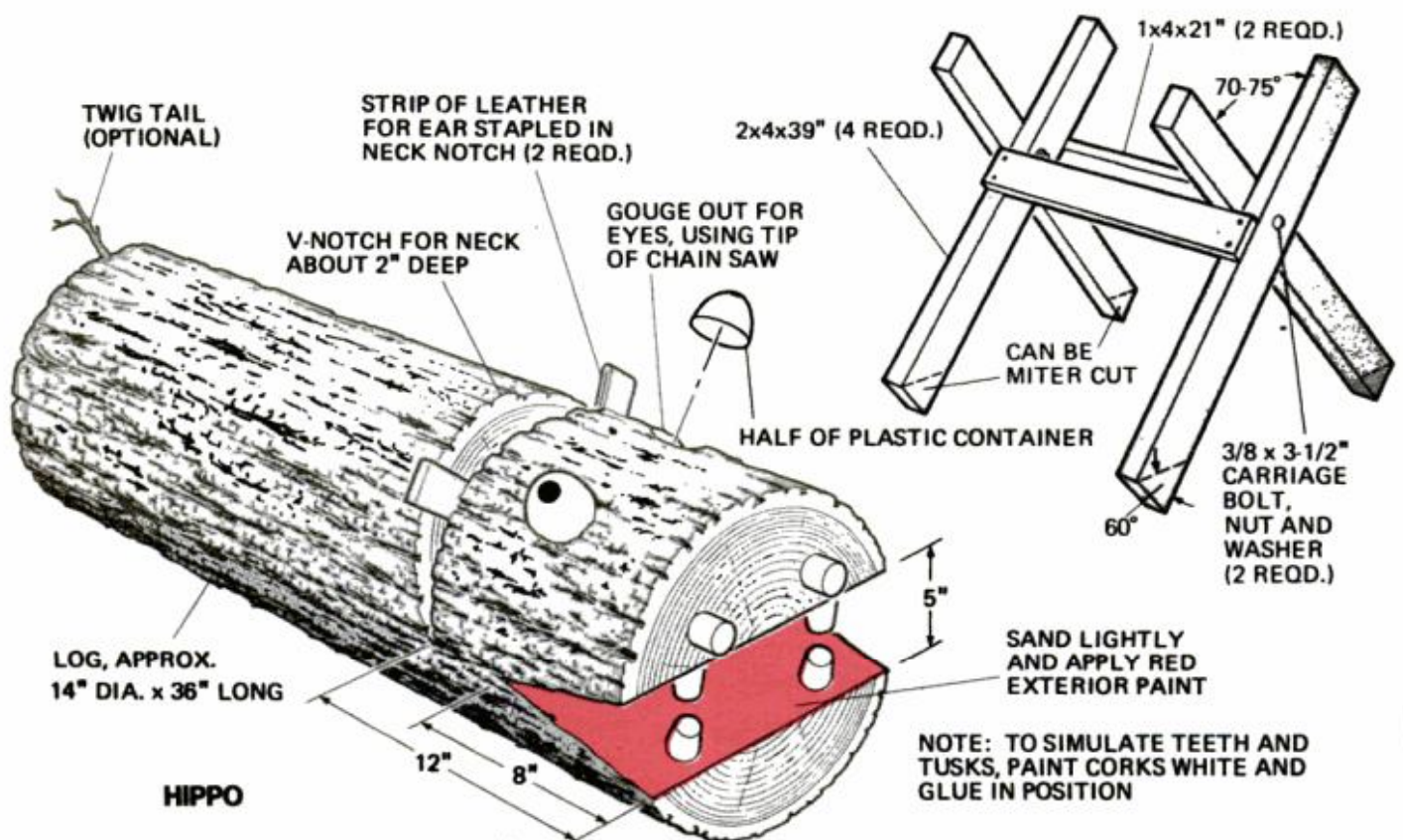
Most homeowners think of a chain saw as a one-purpose tool intended for cutting logs. But it's more than that: Carpenters, journeymen and wood sculptors have long known a chain saw can be put to good use on chores from rough carpentry to carving. The projects shown on the facing page are in these areas. The patio furniture, with its rough-hewn look, is whittled from logs in less time than you'd imagine. Planter, totem pole and the yard toy are fun to make and offer a real challenge to satisfy your creative urges.

First, build a sturdy sawbuck; it's an indispensable aid in chain-saw cutting. In this version, carriage bolts—instead of nails—are used to fasten the legs. When not needed, the buck can be closed flat and stored against a wall.

Important points to keep in mind when constructing your buck: The Xs should be joined at a distance about 12 to 14 in. from the top of the legs, and the angle between legs at top should be about 70 to 75°. In any event, it should not exceed 90°.

Some chain-saw know-how. As with all power tools, if basic safety rules are followed, the chain saw is a safe tool to work with. Before you use your saw, take time to read the manufacturer's manual, including the section on safety practices. To rip a log—for the tabletop, for example—place it on two or more supports. Make certain the log is held firmly with nails or cradles at the ends to keep it from rolling. For precision ripping, use a guide board to support the saw's weight as you cut.

All projects shown, except the table, are cut from single logs. Overall dimensions to suit your patio size can be used to determine the table size. The tabletop is held together by a pair of 2x4s nailed to its underside; two 5-ft. logs are split and nailed together to form the X legs. Legs are secured to the tabletop with nails after notching the appropriate logs where they meet the 2x4s. The only critical dimension for chair and stool is the seat height (for comfort). Floor to seat-top measurement should be about 16 in.—*Harry Wicks, Workshop Editor*



Art: Fred L. Wolff.



Not all felled trees wind up in the fireplace. Log projects in photo at left, viewed clockwise from hippo, are: three-legged stool, totem pole, picnic table, planter and four-legged chair. Projects were created using Sears's 14-in. Power Sharp chain saw. Table requires use of hammer, nails.



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For more information, see your hardware dealer or write: Grit-Edge Products, Dept. 625, Remington Arms Company, Inc., Bridgeport, Connecticut 06602.

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RECOMMENDED CUTTING APPLICATIONS FOR "GRIT-EDGE" BLADES

Material	Rod Saw	Hack-saw	Saber Saw	Circ. Saw
Ceramic Tile	X	X	X	
Slate	X	X	X	
Marble	X	X	X	
Flagstone	X	X		
Brick	X	X		
Glass	X	X		
Fiberglass	X	X	X	X
Tempered Hardboard			X	X
Asbestos Cement	X	X	X	X
Composition Board			X	X
Synthetic Marble	X	X	X	X
Plywood			X	X
Plaster			X	X
Counter Top Material	X	X	X	X
Hardwood Flooring			X	X
Stranded Cable	X	X		
Spring Steel	X	X		
Hardened Chain	X	X		
Stainless Steel	X	X	X*	
Tailpipe Bolts	X	X		
Cast Iron	X	X		

*requires coolant and variable speed machine.



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SCIENCE WORLDWIDE



Tunnel tests for Seattle tower

Wind effects on a 512-foot office tower and surrounding pedestrian plaza, planned for Seattle, are being tested in a Buffalo, N.Y., wind tunnel operated by the Calspan Corp. To ensure realistic airflow, an area of downtown Seattle about half a mile in diameter was reproduced to scale. The model "city" sits on a turntable, making it possible to subject the office tower to wind from 36 different directions. Calspan researchers are taking more than 20,000 measurements of pressures on walls of the tower model. From these and meteorological information, structural engineers will be able to compute wind pressures to be expected on the full-sized building's walls.

Infrared 'scope planned for Hawaii

The world's largest infrared telescope will be installed on 13,796-foot Mauna Kea, Hawaii's highest mountain. The 120-inch instrument will be used primarily to provide

data for NASA's planetary exploration programs. Infrared observations of the outer planets and their satellites can provide basic data on the temperatures and surface characteristics of these bodies.

An infrared telescope, while similar in appearance to a conventional optical telescope, is uniquely designed to eliminate the effect of undesired local radiation from the sky or the instrument itself. Completion of construction is planned for 1976, with the first observations scheduled for 1977.



What makes Sammy climb?

Children with vocal disabilities are encouraged to use their voices by making SAM (Sound Activated Monkey) climb a palm tree. When a child commands SAM to climb, a mike picks up the sound and the electrical impulses activate a tiny motor to pull the monkey part way up the tree. If the child does the exercise correctly, the monkey

(Please turn to page 48)

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SCIENCE WORLDWIDE

(Continued from page 47)

reaches the top in a series of hops. Long pauses between commands or too low volume will cause SAM to slip back. The device can be adjusted to require louder or faster speech. SAM, created by an English inventor, has proven popular with kids under treatment in a London therapy center.



A discovery in Northern California

Bacteria able to thrive in a concentrated alkaline environment were recently discovered in a Northern California spring. The spring's alkalinity was determined to be 10 times the level previously thought to be the maximum in which living organisms could survive. NASA scientists interested in the bacteria say their existence strengthens the possibility there is life in the heavily alkaline environment of Jupiter.

New microscope sees atoms

A microscope with the power to form an image 500 million times larger than the original object has been constructed by two University of Michigan scientists. (In terms of magnifying power, that's equivalent to making a small marble appear to have a diameter of about 2000 miles.)

In its present form, according to the scientists, the microscope's use is limited to the visualization of special types of atoms and molecules. The instrument uses electron waves as well as optical waves in forming its image.

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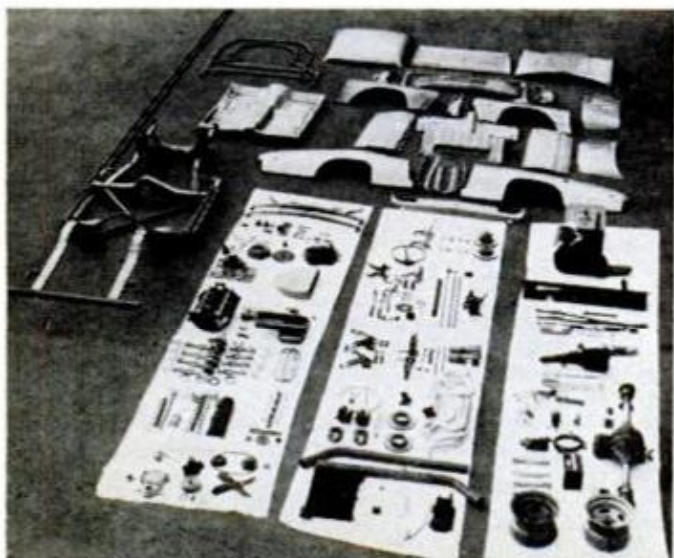
IMPORTS AND MOTORSPORTS

Chrysler's kit car

Now you can build your own Plymouth Duster or Dodge Dart Sport 340—a racing version, that is. The do-it-yourself racer, which you assemble from packaged components, can be adapted to either of the two popular short trackers: late-model



sportsman or late model modified. The kit approach lets weekend racers take advantage of Chrysler's long experience in preparing stock cars and can save long hours of trial and error in getting a car set up right. The five groups of components in the kit include the frame, front and rear suspension, roll cage, body panels and drive line. The address is Chrysler Kit Car, Box 857, Detroit, Mich. 48231.



Gosh oh Ghia

Is this really supposed to be the Capri of the 1990s or just an orgy porgy of Ford and fun? The Ghia studios, now owned by Ford, prepared this low-drag "economy"



car for the Geneva Auto Show suggesting it's a 1994 model. Called the "Coins," the experimental wedge is extremely lightweight and . . . impractical: The hatch is the only entrance, although the acrylic side glass can be pushed out in an emergency. The wiper motor, by the way, is in the airfoil over the windshield.



The Geneva show was a mix of the new and the nostalgic: This Panther Ferrari FF, as it's called by its maker, Panther West Winds of Surrey, England, is a replica of the Ferrari 125S of the 1950s. The roadster is powered by a Ferrari V12 engine and, at 1900 pounds, has astounding perfor-

(Please turn to page 52)

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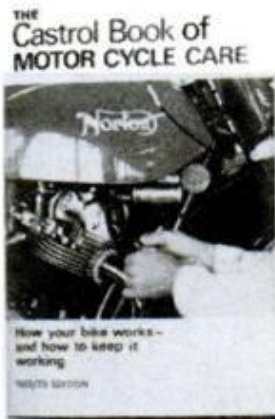
IMPORTS AND MOTORSPORTS

(Continued from page 50)

mance. Distributor for the United States is Edward Gaylord, 1918 Prairie Ave., Chicago, Ill. 60616.

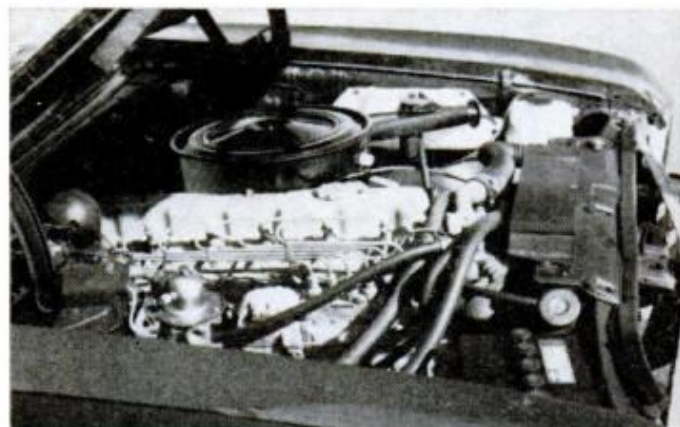
Book for bikers

Between lubes you can learn a lot about your bike from the *Castrol Book of Motor Cycle Care*. The book was a natural for the oil company that has been supporting motorsports for 75 years since it was founded in England in 1899. The 64-page booklet covers the modern motorcycle from basic troubleshooting to frame design. Excellent artwork and exploded views make it easy to read. It's \$1.95. Castrol Oils, Inc., Dept. MB, Continental Plaza, Hackensack, N.J. 07601.



Drop in a diesel

We did say in December 1973 (*The Diesel: New Future for an Old Engine*, page 122) that the only diesel cars made for sale here are Mercedes and Peugeot. But that doesn't stop you from buying a diesel Maverick or Nova or Duster. Not factory versions, of course, but conversions done by Diesel Eco-



Cars, Inc., 124 South Taylor, Oak Park, Ill. 60302. The new company takes American-built passenger cars, or pickup campers or vans, and installs 92-hp Chrysler-Nissan diesels under the hood. You can get the details from Diesel Eco-Cars president, Charles Lemme, at the above address. ★ ★ ★



The little one catches the big one.

While it takes up very little space, the little Pocket 40 takes a lot of great big (3½" x 4½") pictures.

This little Pocket can take stop-action pictures in bright sunlight, because of its 1/225-second electronic shutter. That shutter, together with the CdS

electric eye, gives you highly accurate automatic exposure control. And a sharp 3-element lens focuses down to 3 feet for close-ups.

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ALL OUTDOORS

Where the action is

Most popular of the summer pastimes, according to recent government surveys, are picnicking, sightseeing, driving for pleasure, walking for pleasure, swimming, fishing, boating, bicycling, camping, hunting and attending and playing other outdoor games and sports. Tennis, motorcycling and winter sports are among those showing the fastest growth.

Roll 'em

The same clever designers who brought us the house on wheels and motor homes almost as large as mobile homes have gone back to the drawing board. Now new mini-models are beginning to appear, and a check last month by this department showed recreational vehicle outlets around the country have a larger selection of gas-economizing camping and travel trailers, smaller pickup campers and mini motorhomes available. Additions range from a light aluminum Eagle 5 tent trailer by Apache for compact car towing by a family of six, up to a 40-foot fifth-wheel trailer by Ardon that expands with a seven-foot tip-out living room extension. RV shoppers are already benefitting from the energy shortage.

Environment versus outboards

A two-and-one-half year study, sponsored by the U.S. Environmental Protection Agency and the Boating Industry Assn., reports that damaging water quality with outboard motors would be so difficult that it just isn't likely. Several times more boats than would actually fit on the surface of a lake would have to be operated continuously in order to show any effect on water quality, according to the independent research teams that conducted the tests. Four lakes in Michigan, two with saturation boating and two with none at all were compared during the warmer boating months. Three in Florida received non-

stop year-around examination: one stressed with old-fashioned overboard drain operation, one with modern drainless outboards and a third that had no boating at all. Leaded and nonleaded gasolines were used; fish, plant, water and bottom sediment were tested, and only miniscule traces of hydrocarbons that had not biodegraded or evaporated could be detected. No adverse effects of any kind could be found, no trace of change in flavor could be identified by fish-eating scientists, and the stressed-lake fish, apparently, couldn't care less.

'Throw away that truss'

A number of items I've admired or tested are making outdoor sport more comfortable. Several backpack makers now produce bags that can be contoured to your back. Pack-size water purifiers are now available that claim complete filtration of bacteria plus bad flavors and sediment. Corning Glass has introduced a Photobrown, similar to its Photogray, that also darkens in sunlight and has some of the color advantages of shooting glasses tinted yellow. And some sporting goods stores now carry skin-protective tape that helps prevent friction blisters from boots, helmets and pack straps.

Sportsmen's Day

This year's National Hunting and Fishing Day activities are now set for Sept. 28.

(Please turn to page 57)



Compact camping on mini budget and fuel is goal of 13 new Holiday Rambettes like 12½-foot model above.

ALL OUTDOORS

(Continued from page 54)

For campers



Bugged outdoorsmen now get protection from biting flies, midges, gnats, no-see-ums—and mosquitoes—with new Deep Woods Off! claims maker, Johnson Wax.



Roll-up convenience for cookout campers, the 33-item Camping Caddy from Imperial Knife Co. has 24-piece stainless service for six, plus serving utensils: \$20.



Slingshot evolution, from forked branch of 1839 and wood-handled models to new arm-bracket Wrist Rocket and Falcon, is by Saunders Archery, Columbus, Neb.



Cookstove that can fit in a backpack, hunting jacket pocket, tacklebox or glove compartment, \$8.30 Ashflash Camp Master takes 14.1 or 16.4-oz. propane cylinder.



Survival tool with 40 advantages is reported for thin wallet-sized Walle-Hawk compass, knife, signal mirror, opener by Allison Forge, Box 404, Belmont, Mass. \$10.

(Please turn to page 58)

ALL OUTDOORS

(Continued from page 57)

For boatmen



Free wind replaces oars or outboard for a rowboat or canoe with the AFM Rowfish Sail Rig. Supplied with nylon sail, mast and boom of aluminum, leeboards, a rudder fitting and hardware, three kits with 45, 60 or 75-sq.-ft. sail are for boats 12 feet up at \$133, \$148 and \$187.



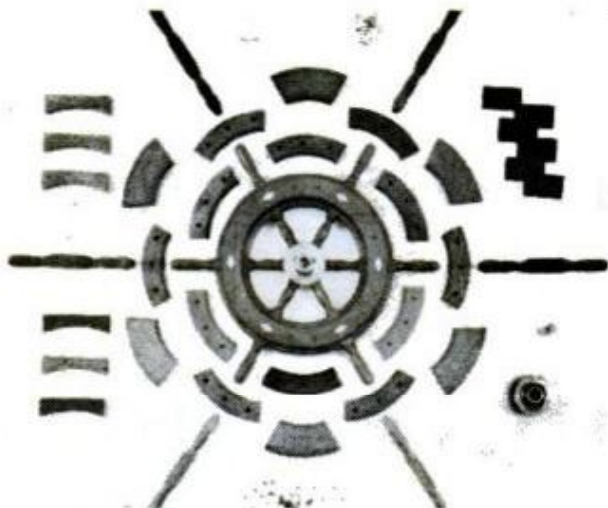
Surfboard turns sailboat with strap-on AFM Surfs'I kit that includes see-through sail, spars, leeboard for \$90 from A F Marine, Box 3, West Hempstead, N.Y. 11552.



Dual push for airboating, the Arrowcraft Twin 940 has twin 45-hp engines for thin water or ice speeds of over 40 mph. From Arrowcraft, Pearland, Tex. \$2995.



Low profile and weight for compact car trailing, 13-foot Boston Whaler at 300 pounds plus outboard and gear is still below most minis' 1000-pound-tow limit.



Ships' wheels in solid mahogany with brass fittings come in five sizes of kits. The 30-incher shown is \$120 precut from Captains' Quarters, Bar Harbor, Me.



Auxiliary for a sailboat, or trolling motor or extra emergency power for I/O or any craft, an outboard on N.A. Taylor's \$33.55 bracket spring-hinges up or down.

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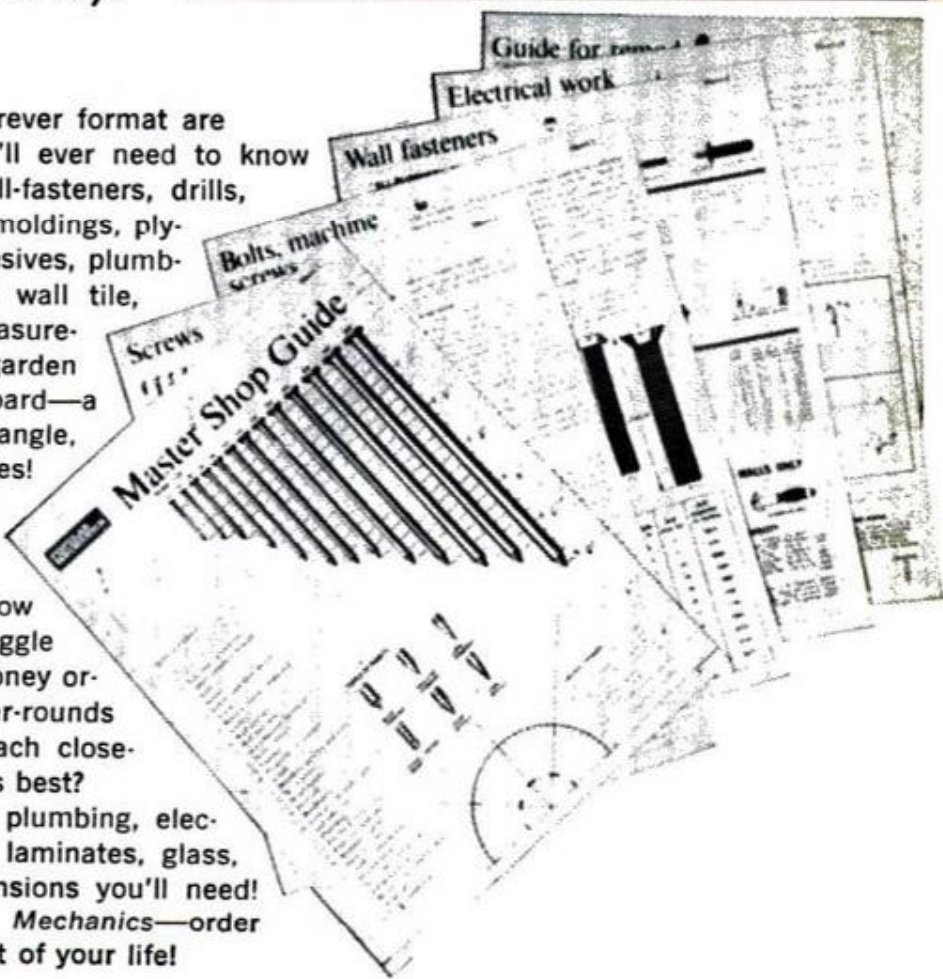


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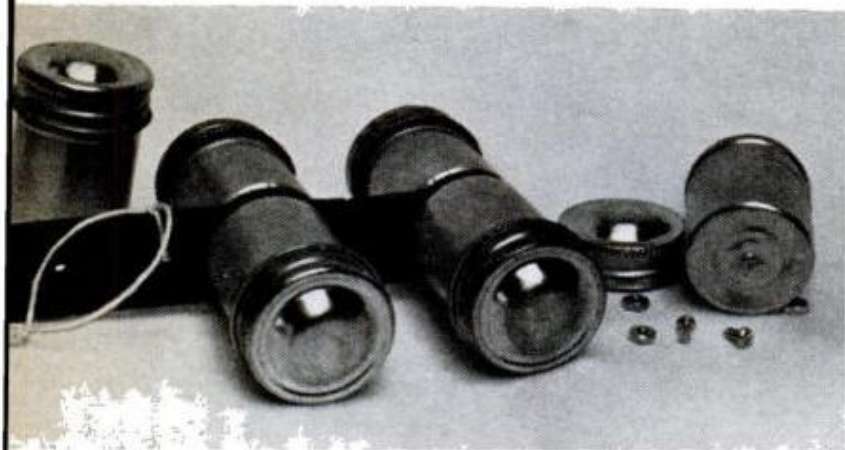
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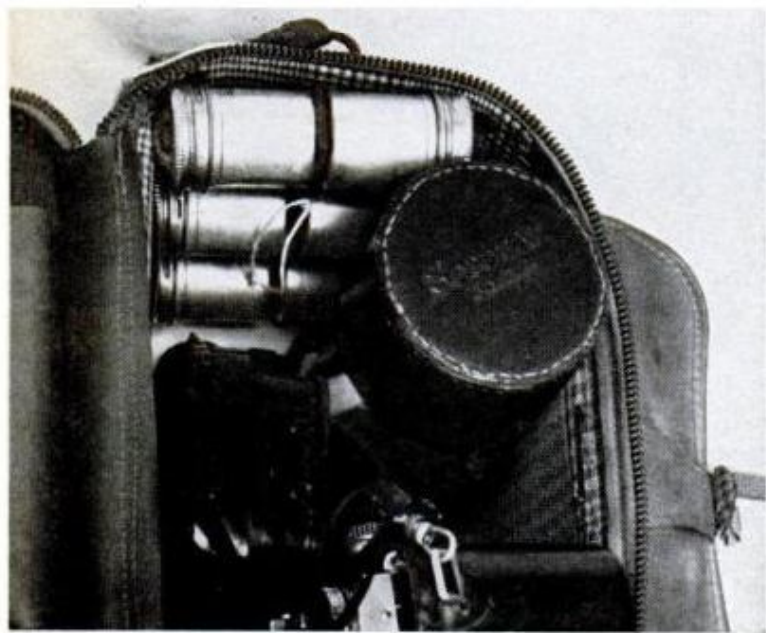
FROM READERS



Sink strainer filters an electronic flash

The effective output of shoe-mount or other small electronic flash units can be reduced approximately two f-stops for close-ups, by bending a 3-inch flat sink strainer to fit over the flash head. Spring tension will hold it in place. Since results will vary with different strainers, make some exposure tests before using this trick.

—Ed Johnsey, Dayton, Ohio



Film holder ends fumbling

Tired of groping for film in the bottom of your gadget bag? This easy-to-make film holder will end that. All you need is a 1x5-inch strip of hardboard, three 4-40 screws with nuts and lock-washers and six extra film cans. Drill a $\frac{1}{8}$ -inch hole in the bottom of each film can, and in the hardboard strip at the middle and $\frac{1}{2}$ inch from each end. Attach two cans opposite each other at each hole. The new plastic film cans can be spaced closer together, but washers should then be used. If you like, you can drill an additional hole between two cans for a string to hold the strip on your belt or shoulder strap.

—Gary Cosand, San Bernardino, Calif.

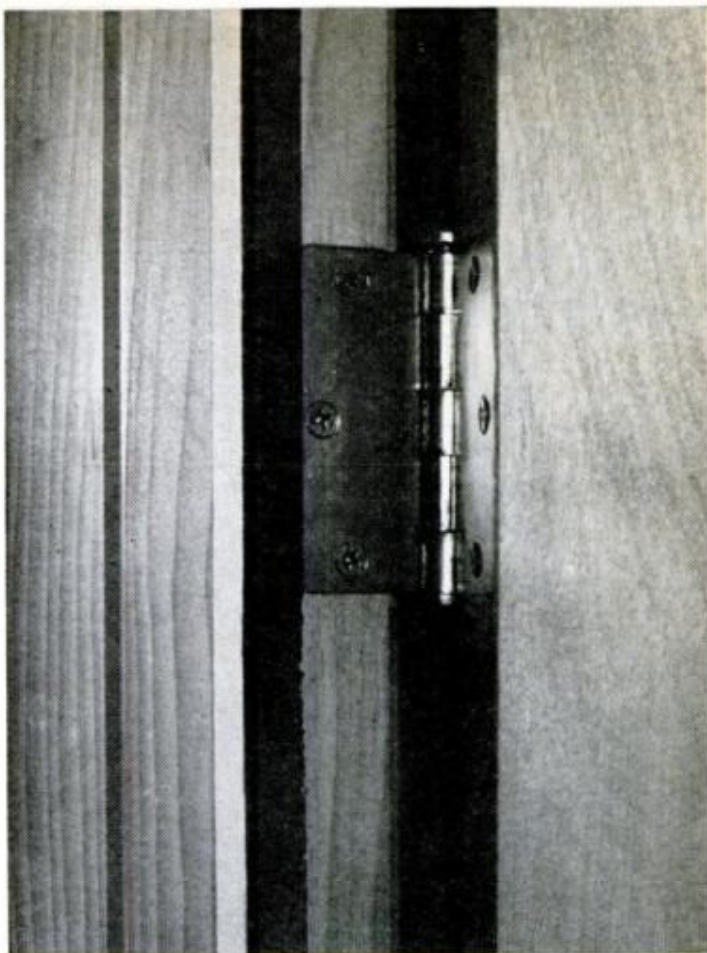


Automotive weatherstripping makes good light seal for darkroom door

Close your darkroom door and stand there long enough to let your eyes accustom themselves to the darkness. You'll probably find it's not that dark, after all. Few doors make really light-tight fits into their frames.

But there's an easy way to seal your darkroom door and make it really light-tight: Use automotive weatherstripping. Because the adhesive that comes on the back of the stripping is messy and doesn't hold well if moved, I first lay down a strip of double-sided masking tape which is clean, efficient and moveable. Then I run my black automotive stripping on top of this. The tape can be pulled off later, if need be, without marring the finish of the wood.

—J.D. Maxwell, Vancouver, Wash.



Minolta helps the band play on.



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For more information, visit your Minolta dealer or write Minolta Corporation, 200 Park Avenue South, New York, N.Y. 10003. In Canada: Anglophoto Ltd., P.Q.

7 ways to go without gas—and still get there

Some are oddball, some ingenious—but they all do the job. Here's a collection of the latest dodges designed to duck rising fuel costs.

by Sheldon M. Gallager



"Fishbowl on wheels" (above) provides good visibility if not racy styling. The little circular glass-windowed vehicle is powered by rechargeable batteries and was developed by Dutch civic leader Luud Schimmelpennick as an answer to fuel, fume and traffic-congestion problems in Amsterdam, Holland. The idea: For a small charge, you pick up one of the cars at any of several rental stations around the city, drive it to another station near your destination and drop it off. The scheme, now under test, would reduce the need for personal cars, cutting fuel consumption, traffic jams, parking problems and air pollution, claims Schimmelpennick. Meanwhile, Gert Eilermann of Cloppenburg, Germany, has gone back to the horse and carriage—only his carriage is a grocery delivery van (upper left). Tired of paying high fuel prices and road taxes, he removed the van's engine, hitched up Old Dobbin and now has a one-horsepower vehicle requiring no gas or license. And if you don't want to get a horse, you can always ride a bike. New Huffy model (lower left), made for commuters, sports a pair of saddlebags that cleverly convert into a businessman's briefcase. It also features a conventional coaster brake—the kind us "older" commuters grew up with—and a twist-grip three-speed shift, all designed to make it easy for Dad to operate.

[\(Please turn to page 64\)](#)



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7 WAYS TO GO WITHOUT GAS—AND STILL GET THERE

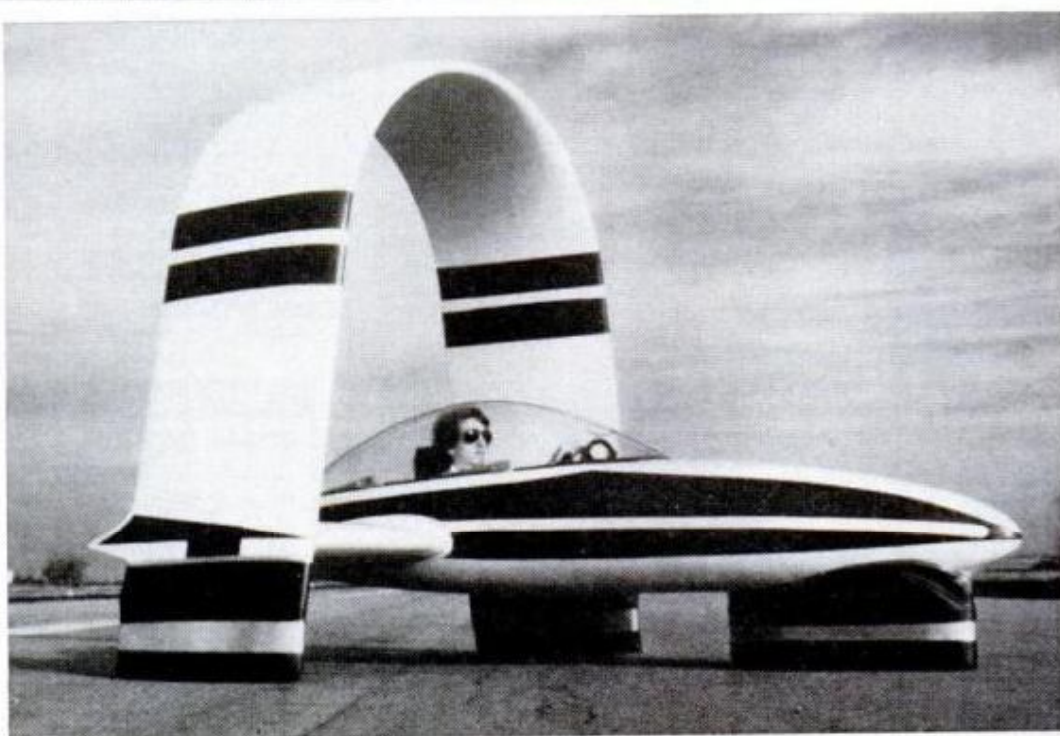
(Continued from page 62)



Plug-in car (upper left) runs on batteries, has its own built-in charger. You just stop at any handy 117-volt outlet and plug it in for a fast recharge. Called the Gilbert Patriot, the two-seater three-wheeler, designed for local shopping and commuting trips, is said to travel 50 miles on a charge at up to 50 mph. It's expected to go into production soon for \$2695. Further information from Walt Woron Assoc., 3012 Maple Ave., Manhattan Beach, Calif. 90266. Another three-wheeler (lower left) requires neither gas nor electricity so long as you have a strong back—you row it like a boat. Pulling and pushing on a central aircraft-like column drives the rear wheels through a chain and sprocket. The front wheel is steered by a foot bar. The car is geared for hill-climbing, will do about 20 mph, was built by Dr. Wolfgang Herbst, Föhrenstrasse 7, 8011 Putzbrunn, Germany. Below, the Italians have their own answer to the gas shortage—an eight-passenger pedal bus operating in Milan. The driver steers while the riders pump.



Arched-wing land sailer (right) breezes past gas stations, powered by wind alone. In tests it's hit up to 60 mph, its curved wing serving as a rigid sail. Only one problem: The wind has to be blowing in the direction you want to go—or nearly so. One novel feature is dual steering wheels. One turns all three wheels simultaneously so the car can "crab" to catch the wind; the other turns the front wheel only for normal steering. James Amick of 1464 Cedar Bend, Ann Arbor, Mich., is the inventor.





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An enduro bike is generally thought to have two purposes. Riding on the road, and off the road as well. But we probably don't have to tell you that such a motorcycle will serve about as

many purposes as you want it to.

From getting you to a place where the fish are still biting to getting you home from work while supper is still warm. From running errands around town to riding to places you didn't know existed.

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up to a big 350, wherein beats the heart of a true mountaineer.

All with an impressive array of features that make them equally worthy of both street and trail.

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HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

To roll the lawn or not

When should a lawn be rolled? Is this considered good practice? My lawn is rough and bounces the mower around, making it almost impossible to get a smooth, even trim.—John Wallach, Trenton, N.J.

If the soil is friable (easily crumbled), and of a loose, sandy or slightly gravelly composition, then rolling may help to level a rough, lumpy lawn without undue packing. Heavy soils should not be rolled, and are best leveled with a top dressing of black soil—or by lifting the high places and removing some of the soil underneath; water the ground well after the latter treatment. Rolling can be done any time the soil is slightly dry on top, never when it is wet. As a rule, early spring is the best season.

Decorating small room's walls

How should I decorate the walls of a small room that has two windows, two doors and an 8-ft. ceiling? I'm trying to decide between paper and paint. Can you make a suggestion?—R. Smith, Fort Worth, Tex.

I once heard it said that "paint pushes walls out; paper brings them in." This seems to be a fair rule of thumb, although it does not apply universally, of course. Paint in the lighter colors does tend to make a room look larger. Conversely, wallpaper tends to make a room seem smaller, especially if the paper is figured, textured or dark-colored. Papering the ceiling will close the room even more. You did not give the size of the room and it's not possible to be too specific at long range, but offhand I'd recommend that you stick with paint, using a light color of your preference on walls and white on the ceiling.

Pulling the pigeonholes

I want to refinish a shabby older-type desk in which the pigeonholes and small drawer

appear to be an inserted unit. I need to remove it in order to refinish the interior of the writing compartment. The unit won't pull or slide out from the front and I don't see any fasteners. Can you suggest a procedure?—James Coxie, Lansing, Mich.

Such separate units are usually fastened with either screws or small wedges, rarely with glue. Check the back panel of the desk for tiny screws or brads, or wedges tapped in from the back. You should find one of the three types of fasteners, but be especially careful in removing them—otherwise there may be damage difficult to repair. After refinishing, be sure to replace the unit in its original position and reuse the same fasteners.

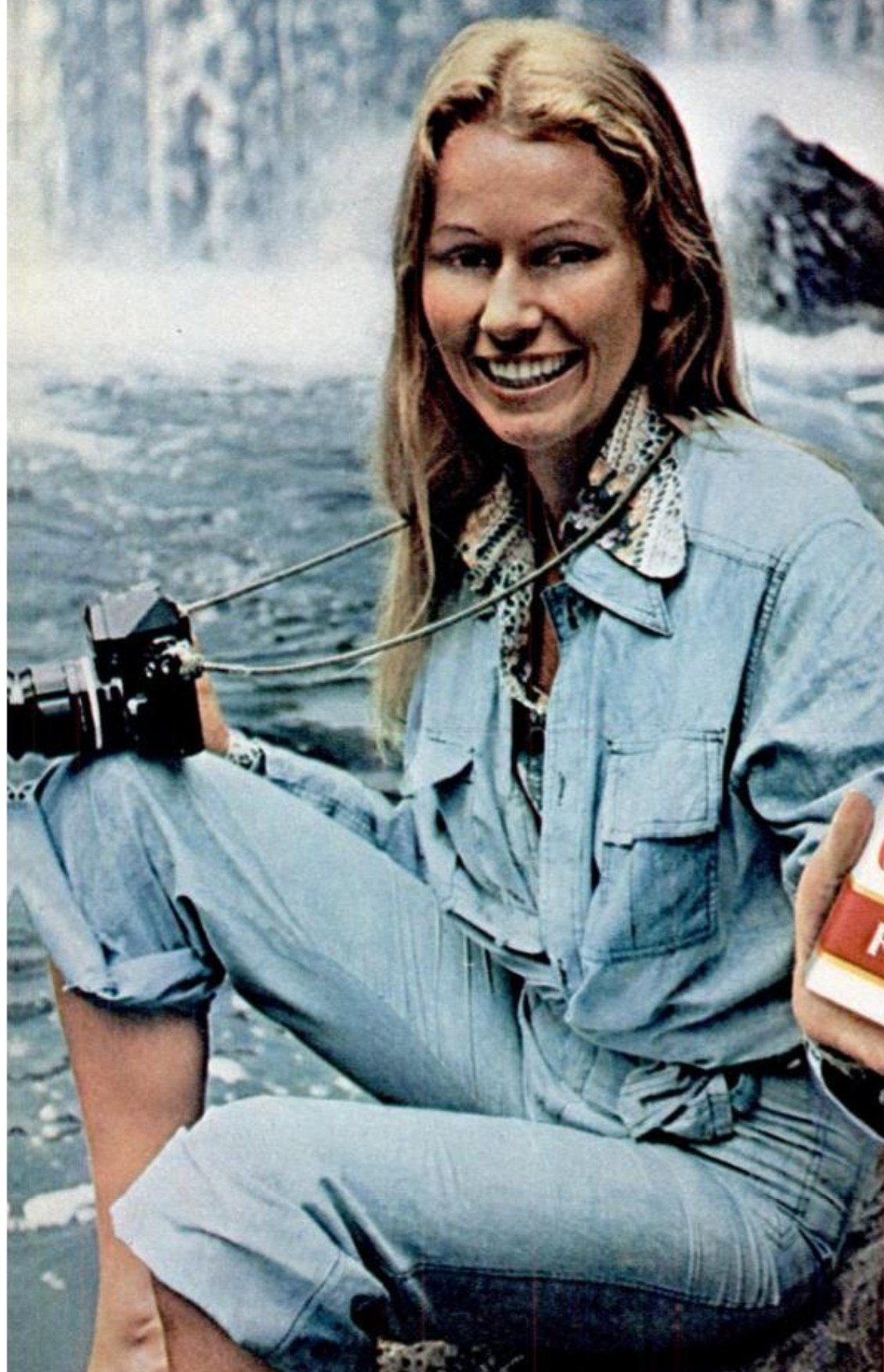
Glue guidelines

I'm a beginning woodworker, having just recently assembled a workshop with a few power tools. I'm puzzled by the array of glues available for joining wood in cabinet work. Can you give me some guidelines?—Stanley Ball, Kansas City, Mo.

For speed and convenience, many craftsmen use the familiar "white" glues,* but these offer limited resistance to moisture. Other skilled workers prefer the epoxies, while some still use the older casein glues. The hide glues are less commonly used, though obtainable in refined forms. When waterproof joinery is called for, the experienced craftsman turns to the resorcinols, two-part plastic resin glues that, like the epoxies, are mixed at the time of use. All the adhesives I've mentioned are quite reliable if you are careful to follow in detail the instructions on the containers. ★★★

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.

Have one of mine.



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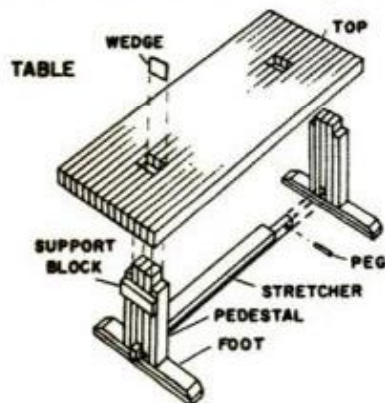
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won't end up with a tired, shaky arm or a sore, tingling grip.

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Find a store with a good tool department, you'll find Stanley hammers. Look at them.

hammers. Quality you *know* will help you do things right.

As for the butcher-block table and benches, you can put them together for around \$60 in materials. And



Heft them. You'll see that Stanley packs a lot of quality into its



you'll have a lot of pleasure doing it. To get the free plan, send your name and address to Stanley Tools, Dept. TM, New Britain, Conn. 06050.

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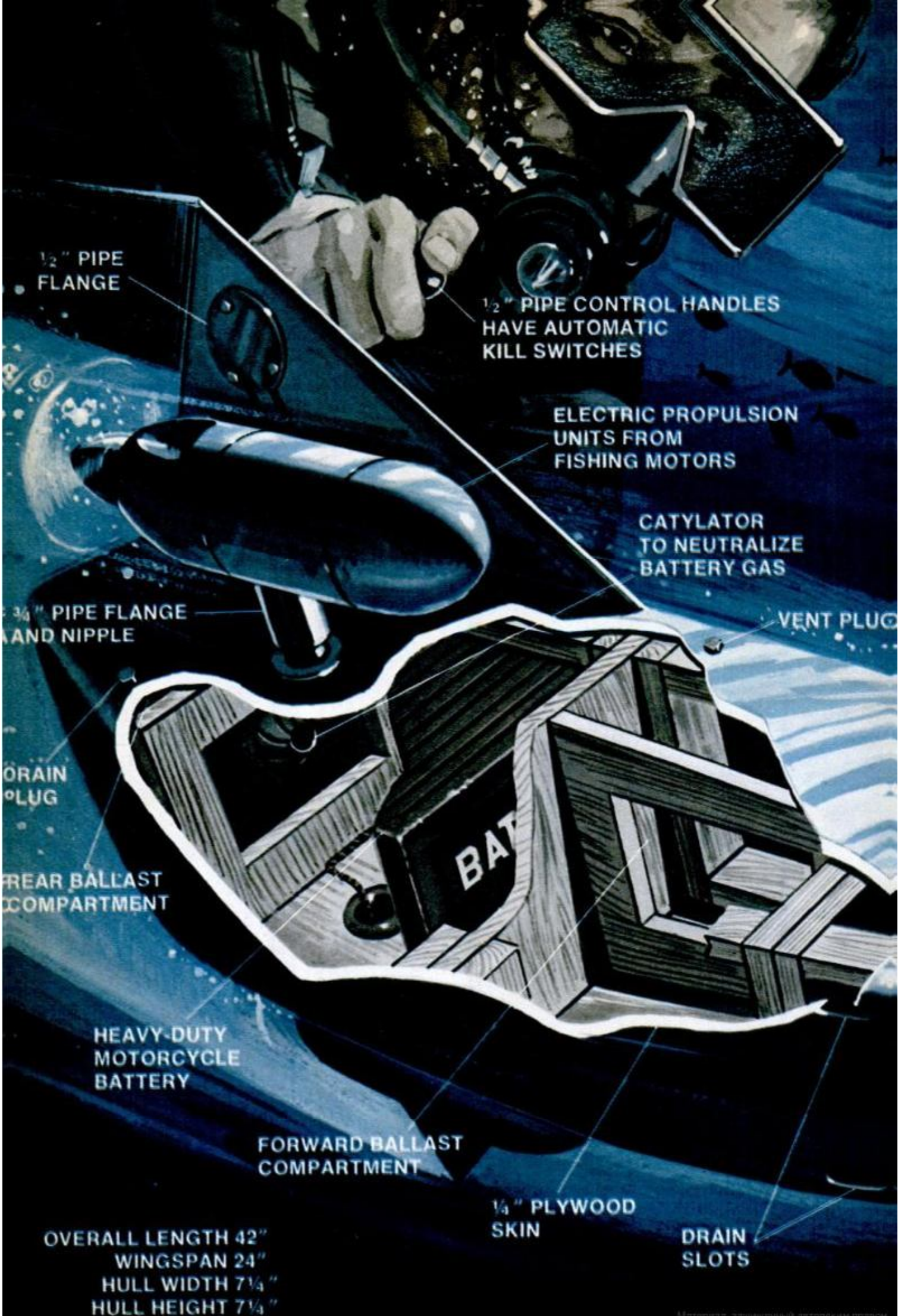
Build PM's Scuba-Tow

by Sheldon M. Gallager

Photos: Jerry Imber,
Cypress Gardens, Fla.



This self-powered sea scooter, patterned after costly commercial models, will pull you on or under the water for hours of effortless snorkeling or scuba diving. You can build it in a weekend or two for less than \$140 from PM plans. For more on this exciting project, turn the page.



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1/2" PIPE CONTROL HANDLES HAVE AUTOMATIC KILL SWITCHES

ELECTRIC PROPULSION UNITS FROM FISHING MOTORS

CATALYTATOR TO NEUTRALIZE BATTERY GAS

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3/4" PIPE FLANGE AND NIPPLE

DRAIN PLUG

REAR BALLAST COMPARTMENT

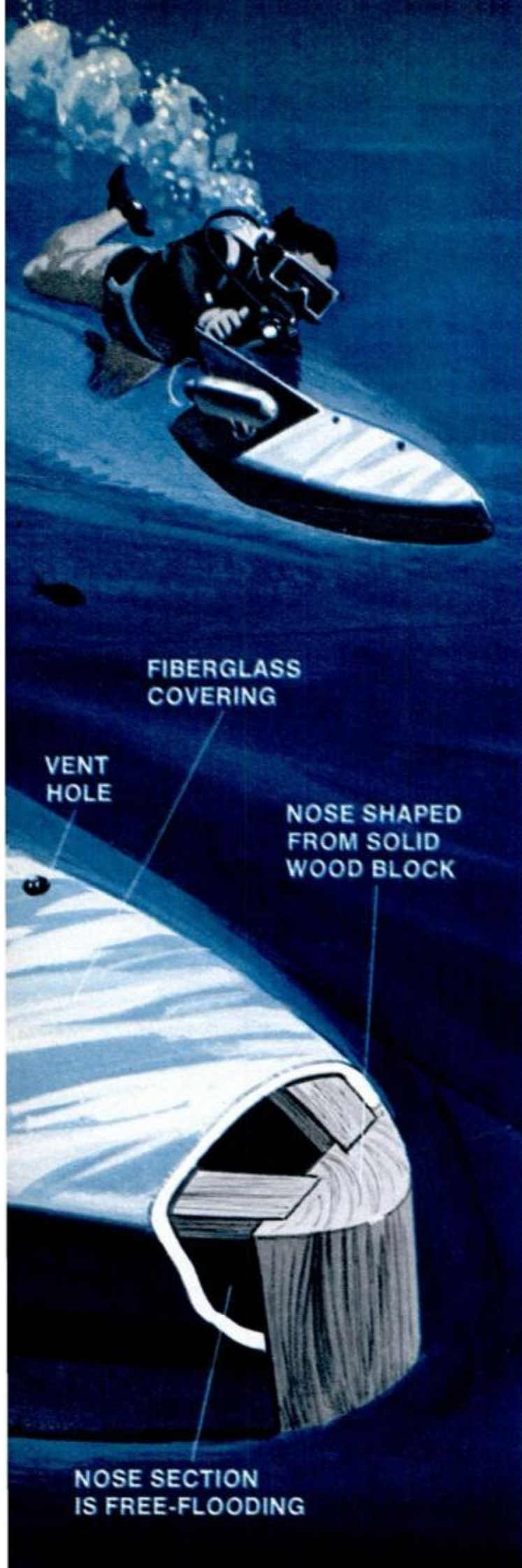
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FORWARD BALLAST COMPARTMENT

1/4" PLYWOOD SKIN

DRAIN SLOTS

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WINGSPAN 24"
HULL WIDTH 7 1/4"
HULL HEIGHT 7 1/4"



It comes as close to the sheer thrill and freedom of flying as you can get—except that you're flying through water instead of air. You point the nose downward, press the trigger switches in the handles and off you go, sweeping down in a graceful dive, banking like an airplane, twisting, turning, rolling, looping—all without any effort on your part: You just hang on and steer. Your "engine" is a self-propelled, electric-powered underwater scooter called Scuba-Tow. Technically known as a DTA—Diver Tow Assist—it's driven by two small electric fishing motors, their tiny plastic props safely shielded by a broad, swept-back stern wing that gives the slim, cigar-shaped scooter the rakish look of a jet fighter.

Commercial diver tows—the kind you've seen on Mike Nelson's *Sea Hunt* TV series—cost from \$500 to \$1300, but you can build this homemade version for less than \$140. It's 42 inches long and has a wingspan of 24 inches. Its two 12-volt, battery-powered motors pull you along faster than you can swim and with much less strain. While scuba gear can be used with the scooter, you don't have to be a scuba diver to have fun with it—that's what makes it an ideal project for

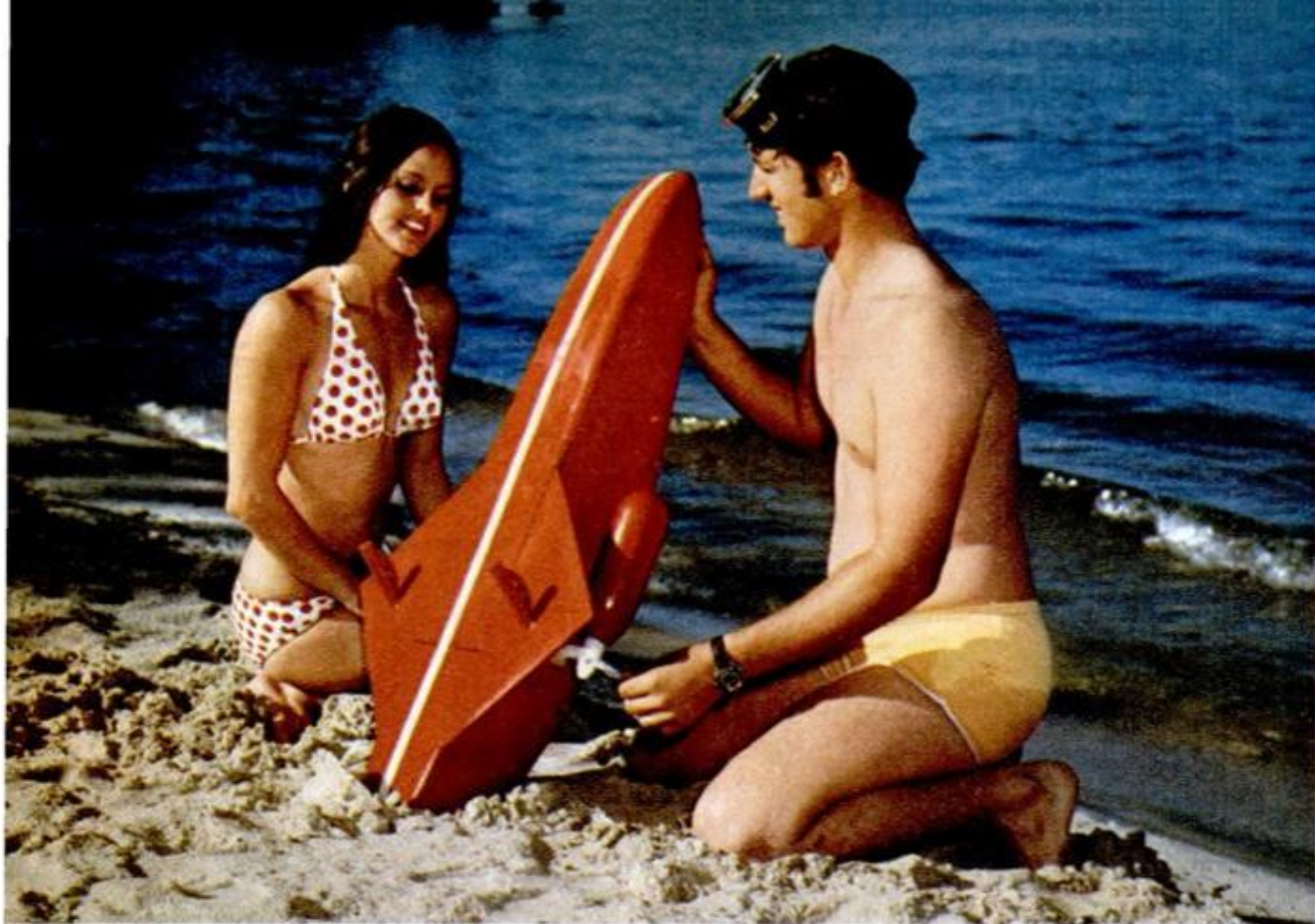


Rolling up and over in a full loop is one of the many graceful and exciting aquabatic maneuvers that you can perform with PM's electric Scuba-Tow.

Art: Ed Valigursky

JULY 1974 71

Материал, защищенный авторским правом



Lightweight scooter (above) is as easy to handle out of water as in. Note that tiny plastic propellers are carefully concealed under the stern diving fins, safely out of reach of swimmer's hands on top. Merely letting go of control handles automatically shuts off motors instantly. At right, girl swimmer demonstrates correct technique for holding and controlling the scooter, arms outstretched straight ahead. Scooter can be used either for surface snorkeling (near right) or with scuba gear for extended periods of underwater cruising (far right).

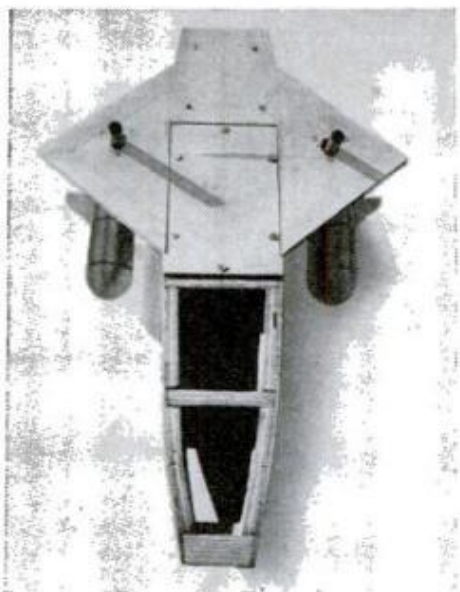
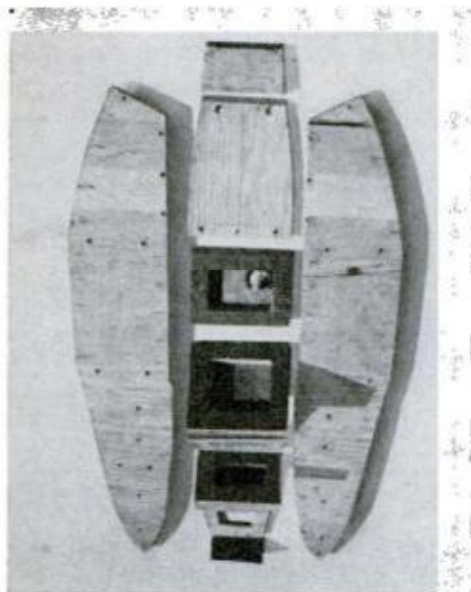
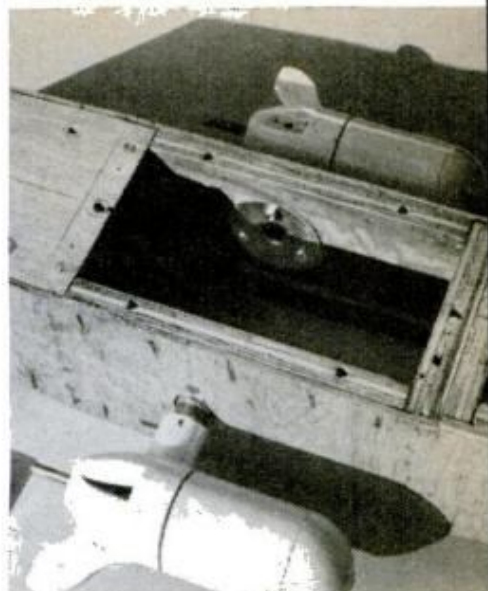
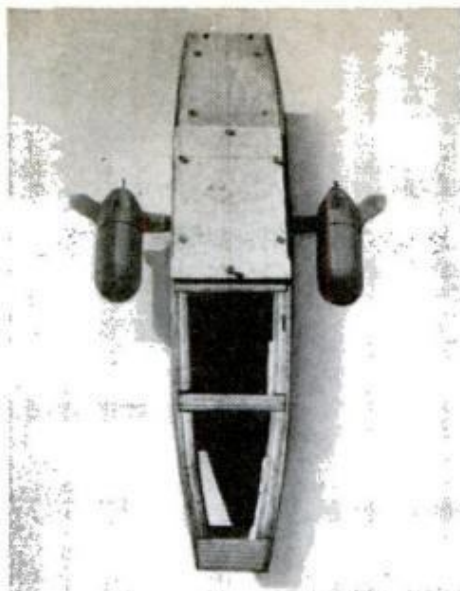
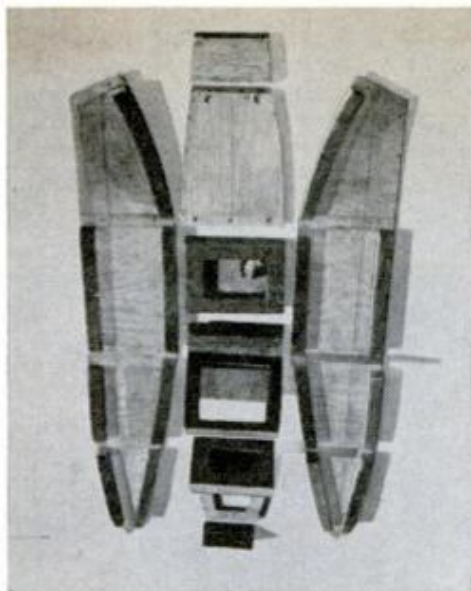


Fleet of scooters: Painted in colorful spray enamels, Scuba-Tows are inexpensive enough for everyone in the family to have one.

How to order PM plans for building the Scuba-Tow

For large, detailed plans plus a complete instruction manual on how to build this electric-powered underwater scooter, send \$7.95 to Popular Mechanics, Dept. ST, Box 1014, Radio City, New York, N. Y. 10019. The plans include full-size patterns for tracing and cutting many of the parts as well as suggested sources for the electric motors and other components.

Popular Mechanics disclaims all responsibility for the quality, condition, design, workmanship and materials of the scooter built from these plans, and for its proper and safe functioning in use. For those using scuba gear with the scooter, it is important to observe standard, accepted safety precautions at all times, especially when ascending. Since the scooter may take you up faster than your normal swimming rate, it is particularly essential to follow proper breathing procedures, remembering to exhale when rising to avoid excessive buildup of pressure within the lungs.



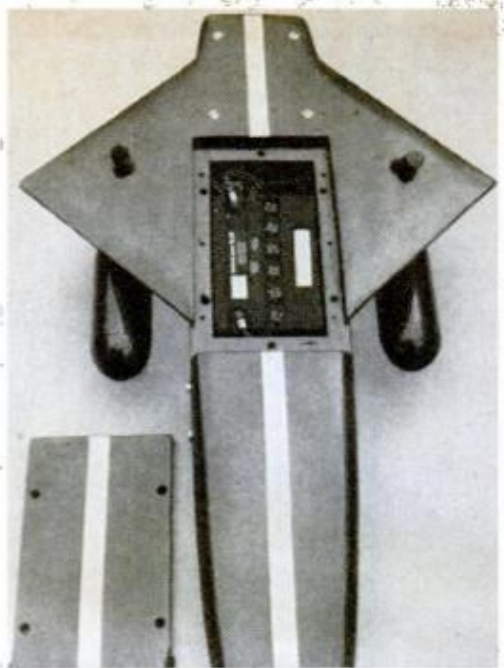
Simple construction is shown in photos at left. Top, bottom and side pieces are $\frac{1}{4}$ -inch plywood braced with cleats and bulkheads. These and delta wing can easily be traced and cut from full-scale patterns in PM's plans. Photo above shows how electric motors are mounted on hull with pipe flanges. Flanges are actually bolted on from inside with threaded necks protruding through hull wall. Pipe nipples are then screwed into flanges from outside and motor collars threaded onto nipples.

the whole family. Because it relieves you of the exertion of swimming, you can hold your breath underwater much longer than you normally would be able to, making it possible to use the scooter without an air supply. It can also tow you along the surface with only a face mask and snorkel for hours of lazy, effortless cruising as you look down at the fascinating scenes of sea life passing by below you.

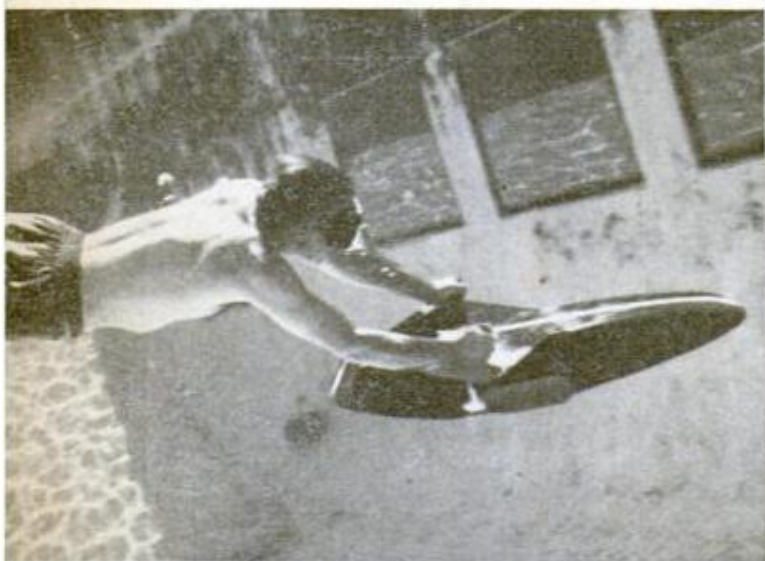
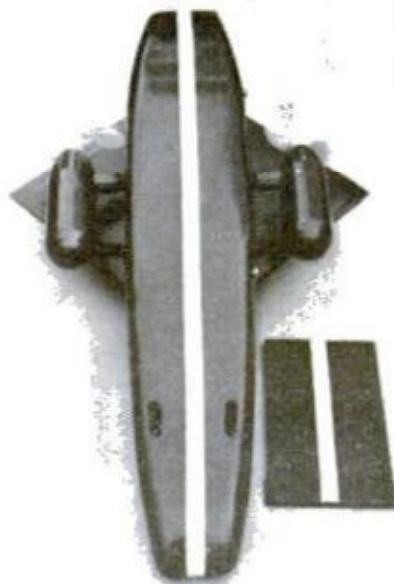
The Scuba-Tow was designed for PM by Kent Markham of Jacksonville, Fla., a marine expert who already has two other successful underwater craft to his credit: PM's *Two-Man Sub* (page 94, June '71 PM) and his earlier *One-Man Sports Sub* (page 90, June '68 PM). Complete plans for building Markham's latest design, a considerably simpler project, are available from PM for \$7.95 (see instructions for ordering at left on the facing page). The plans include full-

scale patterns for easy tracing and cutting of parts as well as detailed sources for other components.

The fishing motors used in the Scuba-Tow are made by Byrd Industries. By special arrangement with the manufacturer, readers will be able to purchase just the lower propulsion units without the tiller shafts and mounting brackets, thus saving money. The cost of the two motor heads with props comes to about \$85. What makes the motors especially easy to mount is the fact that they come with threaded collars that conveniently match standard $\frac{3}{4}$ -inch pipe thread. Ordinary pipe flanges are bolted to the sides of the scooter and fitted with short $\frac{3}{4}$ -inch pipe nipples. Then the motors are merely screwed onto the nipples, making an extremely simple, sturdy mounting arrangement. The wires from the motors are fed through the pipe flanges and into the bat-



With contours smoothly rounded and fiberglass covering applied, Scuba-Tow takes on slick, streamlined look resembling a delta-wing jet fighter. Photo at upper right shows cover plate removed to give quick access to battery for recharging or replacement. Cover requires removal of only six screws, is self-sealing on rim gasket to keep battery compartment watertight. Slots in underside of nose (lower right) let water drain from free-flooding bow compartment.



Personally putting Scuba-Tow through its paces is PM Executive Editor Shel Gallagher in special glass-walled test tank at Cypress Gardens, Fla. Tank permitted scooter's actions to be viewed and photographed underwater for thorough checking of its performance. Design was fully tested by both professional and amateur scuba divers before being finally approved for PM plans. Note absence of scuba gear here—not needed for short dives since you can have a lot of fun simply holding your breath. Because scooter pulls you along without requiring exertion on your part, you can stay down about twice as long on a single lungful than would be possible without power assist. Flippers, though not a necessity, do aid you in making rolls, loops, wingovers and sharp kick turns. Sensation is similar to that of aerobatic flying.

tery compartment for hookup to the control circuit.

Power is supplied by a heavy-duty 30-amp./hour motorcycle battery readily available from Sears, Roebuck for about \$27. Operated intermittently, the battery will give several hours of use and can be recharged overnight from an inexpensive home charger. Battery replacement takes only a few minutes so you can also take along a spare if you wish for use on long outings. The motors and battery represent the scooter's major cost; the rest of the parts consist mainly of scrap plywood, a few pipe fittings and other odds and ends. In fact, the construction is so basically simple you can build the scooter in a weekend or two.

To check out the Scuba-Tow, *PM* editors took it to Cypress Gardens, Fla., a promi-

(Please turn to page 163)

Hot homebuilt: Fast, fun and flashy

This 300-mph aerobatic two-seater drew so much attention when first unveiled its builders had to make plans for others to copy. Now anyone can have one like it.

by Sheldon M. Gallager
and Howard Levy

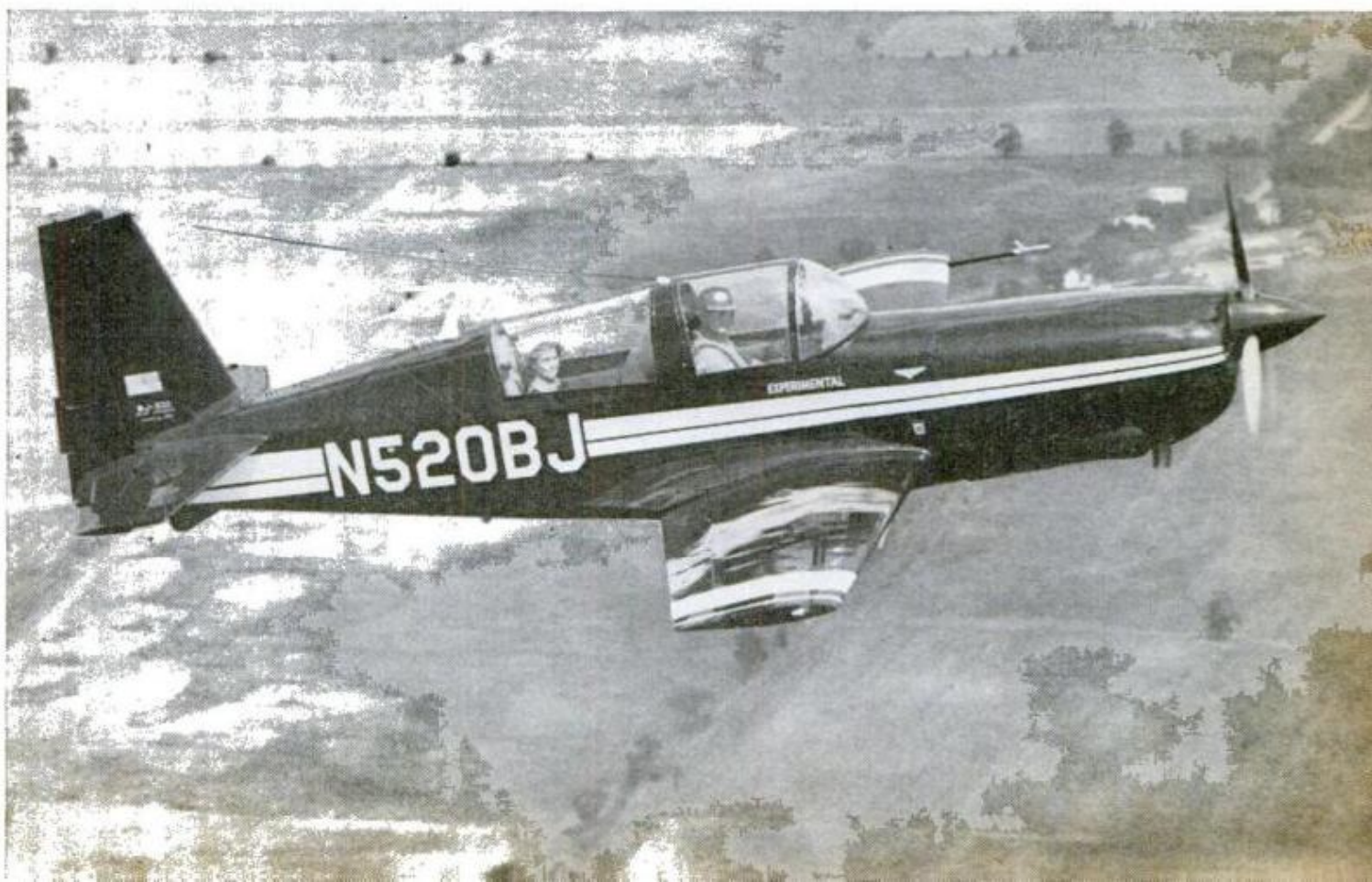
Photos: Howard Levy



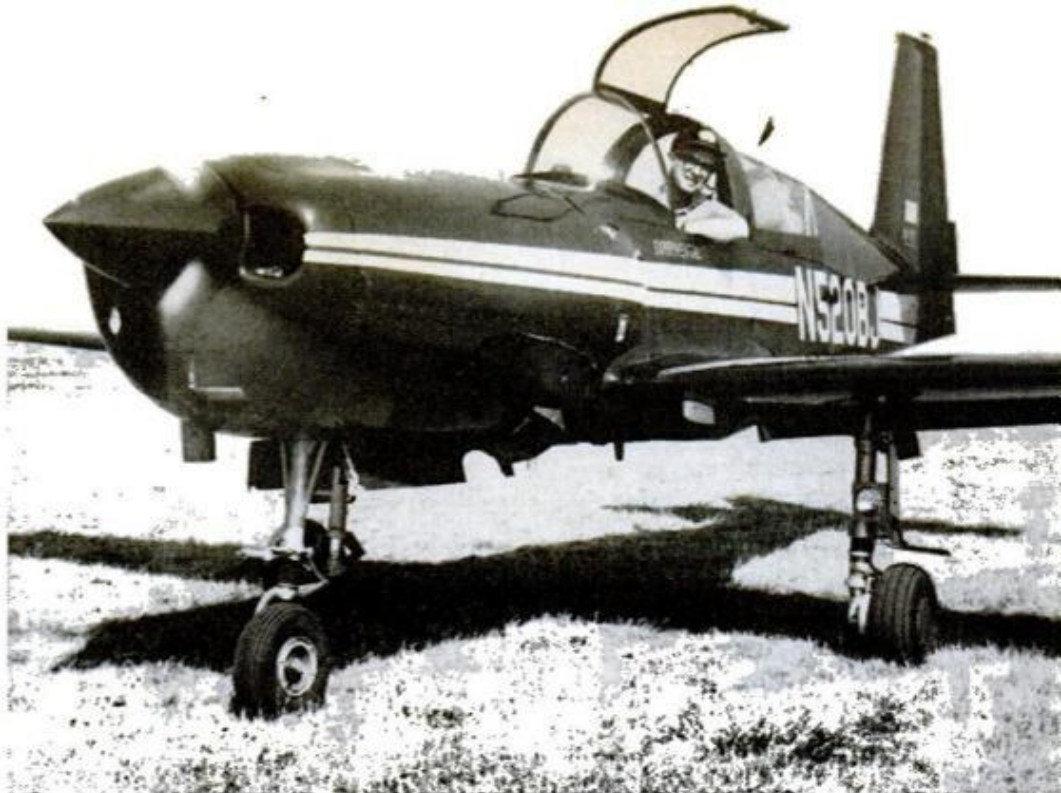
A bright blue streak flashed across the runway so fast you had to look quickly to catch it. As hundreds of heads swiveled to follow the vanishing speck in the distance, startled spectators exclaimed almost in unison: "What was *that*?" *That*, it turned out, was one of the hottest homebuilts ever to show up at the Experimental Aircraft Assn.'s annual "Fly-In" at Oshkosh, Wis., the yearly gathering place for thousands of amateur aviation enthusiasts.

The occasion was last year's EAA summer meet and the plane a masterful creation by two doctors—Dr. Bergon F. Brokaw, a general medical practitioner, and Dr. Ernest R. Jones, a structural engineer. Doctor Brokaw undertook the basic design and construction work, while Doctor Jones carried out stress analysis and structural development. Together, the two have come up with a ship of such spectacular performance and appeal that other homebuilders all over the

Tandem cockpit arrangement with large canopy provides plenty of room and good visibility for both front and rear pilots. With landing gear retracted (below), ship is "clean" and fast.



Long nose and streamlined prop spinner give ship a sleek, racy look, while canopy design is reminder of a fast World War II fighter. Tricycle-type landing gear is retractable and nose wheel, linked to rudder pedals, is steerable. In photo below, ship lifts off smartly under blast of its 285 horses.



Forward cockpit incorporates full IFR instrumentation for all-weather flying, plus such sophisticated navigational gear as DME and transponder avionics. After cockpit duplicates controls except for the radio equipment.

country are clamoring for a chance to have one like it.

It's not hard to see why. The BJ-520 (its initials stand for Brokaw-Jones) is slim, sleek and sinfully seductive—the kind of plane that draws crowds the moment it's rolled out onto the field. A luscious, long-nosed, low-wing tandem two-seater, it combines the rakish looks of a fighter with the graceful agility of a pylon racer. Fully aerobatic, it's so fast and powerful its ultimate top speed has not even been definitely determined yet—"in excess of 300 mph" is Brokaw's politely conservative estimate, generally believed to be a considerable understatement of the ship's true ability all out. What *is* known is that it will *cruise* at up to 300 mph, climb at the rate of 1500 feet per minute, and has no difficulty reaching a service ceiling of 24,000 feet—it really moves! Its powerplant is a turbocharged 285-hp Continental housed in a snout that looks like it stretches into the next county. Its hydraulically controlled tricycle-type landing gear is retractable to give it fast, clean lines in flight, and the nose wheel is steerable for easy ground maneuvering.

Designed for all-weather cross-country day or night navigation, the BJ-520 is fully equipped with IFR instrumentation, including such advanced aids as DME and transponder avionics (DME for "distance measuring equipment" and the transponder an automatic radar beacon transceiver). Operating range is 900 miles on a fuel capacity of 66 gallons, making it a ship you

Large flaps, shown in down position at right, provide good lift and stall characteristics, making the low-winger safe and easy to handle despite its high speed. Note three-blade prop.



Tall tail fin adds improved stability and control in flight. Significant of plane's many refinements are the independent trim tabs in rudder and both elevators, as shown at left.

can safely take anywhere any time. Dual controls enable it to be flown from the front or rear cockpit, although Brokaw personally prefers the forward seat for most flying because of its somewhat better visibility and more complete instrumentation. All radio and navigational gear is located in the front cockpit only to save costly duplication in the rear.

While the BJ-520 is definitely no docile pasture-strip hedgehopper, it is not beyond the capabilities of average pilot skills, Brokaw believes. Landing speed is a trifle hot 95 mph, but the ship is stable, responsive and easy to control. Large flaps provide good lift and stall characteristics and permit safe handling despite the craft's high speed. Landing roll without panic braking is 1500 feet from touchdown and takeoff run is 1700 feet—both readily manageable on small airport strips. Maximum stress limits have not yet been announced, but the plane has been approved for unlimited aerobatics, indicating its inherent structural strength and airworthiness.

Proving that it can take it as well as dish it out, the tough little ship recently came through a potentially hazardous mishap virtually unscathed. A minor malfunction of the hydraulic system in the retractable nose gear prevented the wheel from fully extending and locking in the down position during a landing approach. After several attempts to "bang" the gear down by bouncing the plane hard against the runway under power—itsself a good test of ruggedness—Brokaw

decided on a two-wheel, tail-down landing. Coming in nose high, he was able to roll the ship neatly to a near stop on its main gear before it gently dipped its snout into the dirt at the end of the runway. Total damage: one bent prop blade. With the hydraulic ailment repaired and a new prop installed, Brokaw was back in the air two days later.

Construction is all-metal with stressed-skin covering. Overall length is 22½ feet; wingspan, 20½ feet. Wings have a 36-inch chord and use a laminar-flow airfoil with 78.3 square feet of area and a loading of 33 pounds per square foot. Empty weight is 2020 pounds; gross, 2907. Wheel wells in the underside of the wings are currently left open, but Brokaw expects to add covers and other drag-reducing refinements that will eventually increase top speed an extra 10 mph.

Construction time ran over a period of seven years at an approximate cost of \$20,000—not a "simple" project for the beginning homebuilder, but one that has generated so much interest and excitement that Brokaw has been induced to provide plans for others to copy and will soon offer kits as well. Information about prices for plans and kits can be obtained from Dr. B.F. Brokaw, Route 3, Box 58B, Leesburg, Fla. 32748.

For readers interested in learning more about the plane before purchasing plans, a basic information package, including stress analysis and structural design details, is available for \$6. ★ ★ ★

How to keep your power mower purring

Data: Mort Schultz

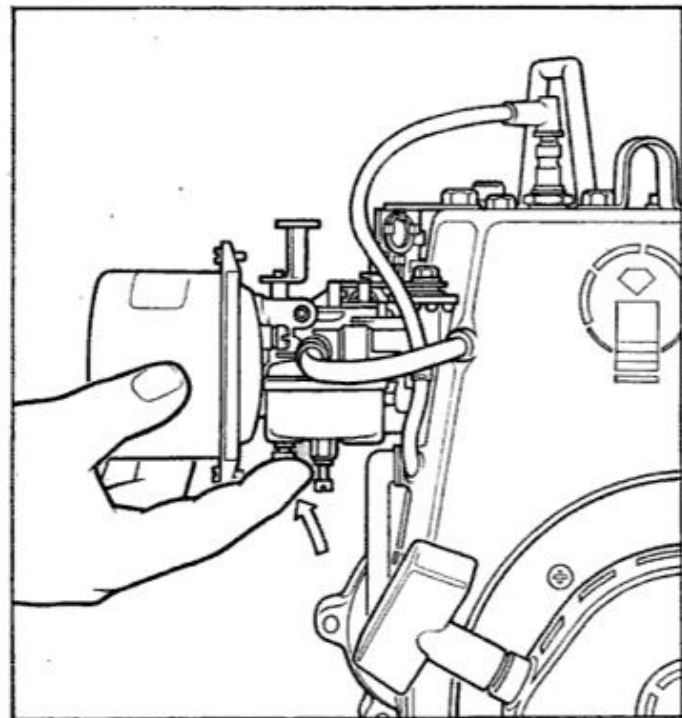
Failure to start, hard starting and stalling are common mid-season problems that strike gasoline-powered lawnmowers and tractors. The most common causes include lack of compression, lack of or too much fuel in the cylinder, and no spark.

But a major reason for trouble can often be averted by knowing the difference between four and two-cycle engines: In four-cycle engines, ignition occurs with every fourth stroke of the piston. Four-cycle engines burn straight gasoline and possess a separate lubrication (oiling) system. It is

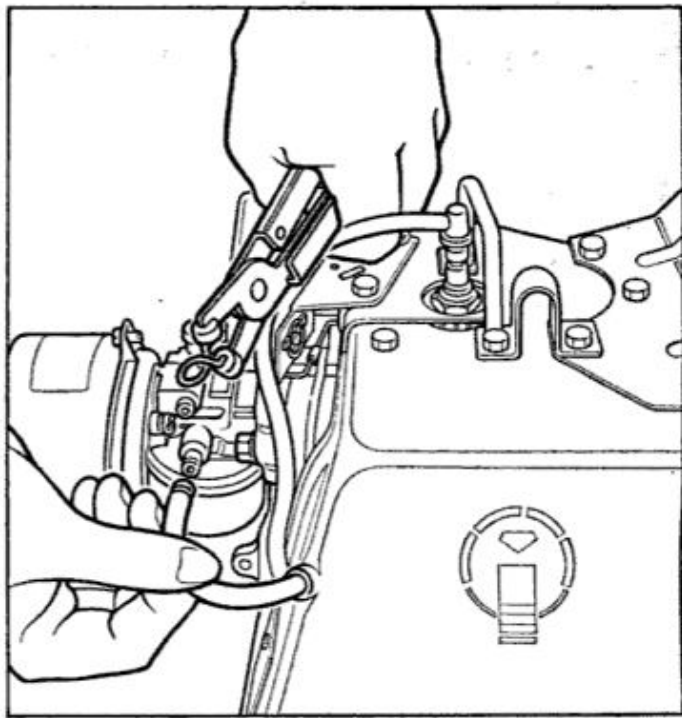
imperative that gas and oil *not* be mixed.

In two-cycle engines, ignition occurs every second stroke of the piston. The engine runs on a mixture of oil and gasoline, and failure to mix the correct proportions of gas and oil *properly* is the single greatest cause of trouble (other than sparkplug failure). If yours is a two-cycle engine, consult the owner's manual to determine correct proportions and what kind of gas and oil is recommended. Gas and oil should be thoroughly mixed in a clean container *before* you pour it into the fuel tank.

Engine won't start

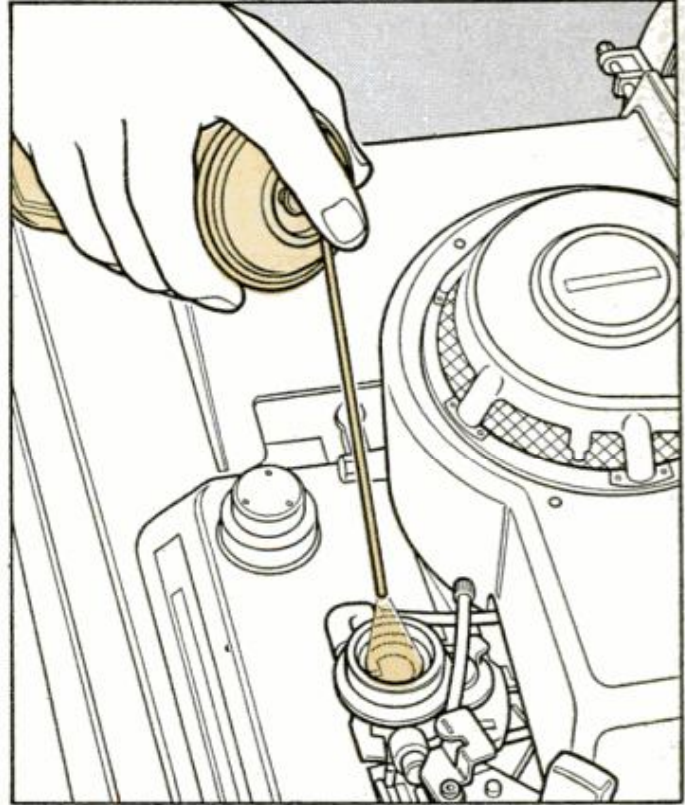
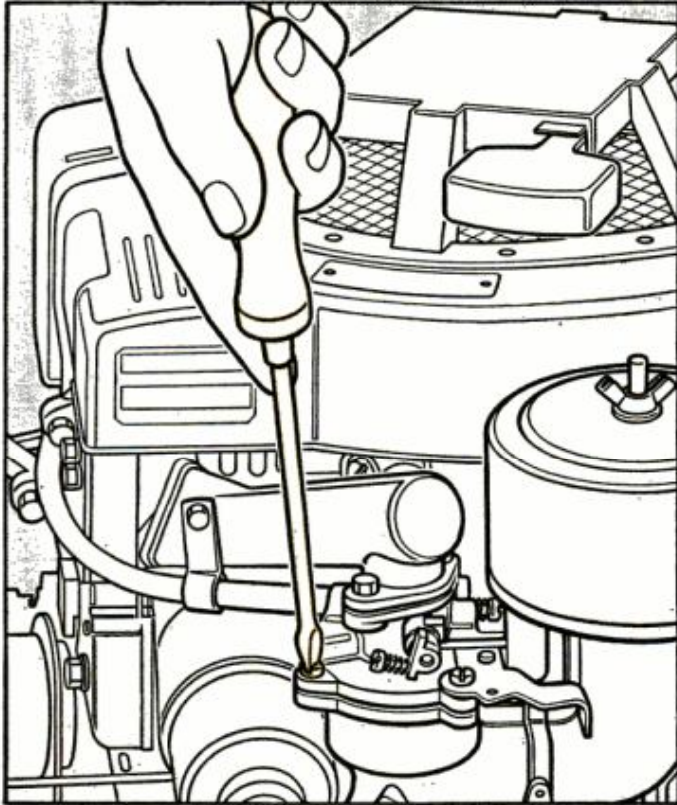


An engine won't start or will stall if fuel isn't getting to the carburetor, and from carburetor to cylinder. First, remove the sparkplug and inject two or three squirts of fuel into the cylinder using a clean oil can. Reinsert the plug and crank the engine. If it doesn't start, the cause of the trouble is elsewhere, but if the engine does start, runs for a few seconds and then stops, the problem will be found in the fuel system.



See if there's a drain valve in the base of the carburetor bowl. Press it (above, left). If no fuel leaks, there's an obstruction in fuel line or fuel tank. If fuel leaks, there's probably an obstruction in the carburetor. If there is no drain valve, disconnect the fuel line at the bowl (above). If no fuel comes out, look for a blocked fuel line or obstruction in the fuel tank. If fuel leaks, a fouled carburetor is indicated.

Blocked fuel line



If the fuel line is blocked, the first step is to check for contaminated fuel. Let some fuel drop into your hand; if water and dirt remain after the gas evaporates, dump all fuel and wash the fuel tank thoroughly with kerosene. It may also be necessary to clean the fuel line and carburetor.

To troubleshoot when fuel isn't getting to the carburetor:

- Replace a bent or clogged fuel line.
- Tighten all carburetor bolts, fuel-line connections and fuel-pump housing (if present) because air leaks destroy the vacuum necessary to pull fuel to the carburetor.
- Clean choke linkage and choke-plate pivots; repair damaged choke parts. Lack of choking action will make engine hard to start; choke stuck in closed position will flood engine and prevent starts.
- Clean or replace a dirty fuel filter. One kind is

a wire-mesh screen in the fuel line shutoff adapter; other engines have filter bowls.

- Replace the fuel-pump diaphragm if it has any holes.

- Clean clogged screens of fuel pipes that extend from carburetor into fuel tank of diaphragm-type carburetors (those without separate fuel pump).

If fuel is not getting from carburetor to engine:

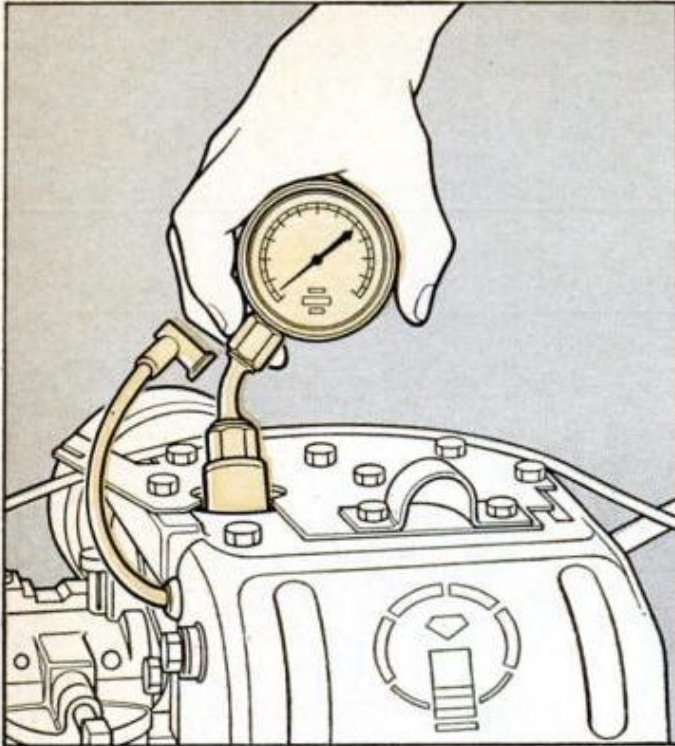
- Clean the air cleaner; a dirty air cleaner causes engine flooding.

- Lightly tap the bowl of a float-type carburetor with a screwdriver to loosen a stuck needle valve.

- Adjust the carburetor. Turn idle-mixture needle in until finger-tight, then back out one turn. Adjust idle speed by backing out adjusting screw, then turning it in until it just touches throttle lever—then give it one more full turn.

- Disassemble and clean carburetor.

Inadequate compression



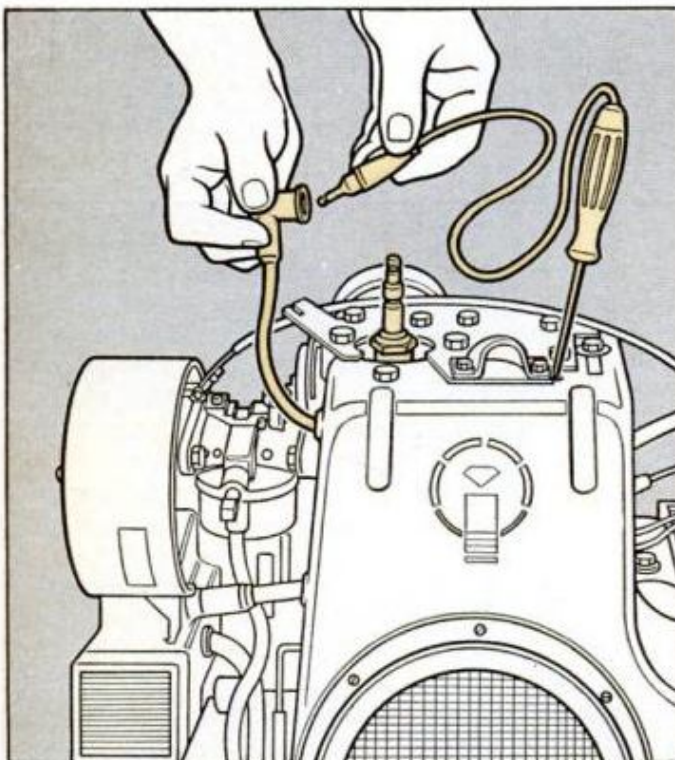
Stated simply, compression is the ability of the piston to compress the fuel/air mixture. Inadequate compression leads to hard starting and loss of power. Poor compression results when a cylinder is scored, piston rings stick or wear, valves stick or wear, or the crankshaft oil seal is damaged. The pressure loss reduces compression, which makes ignition more difficult.

One obvious sign that there is compression loss is a sloppy manual starting cord. If cord offers no resistance when pulled, and doesn't snap back with authority, then sufficient compression is questionable.

An accurate check can be made with a compression gauge. Remove sparkplug, insert gauge fitting firmly, and crank engine until the gauge reaches its maximum reading. *Minimum* compression of two-cycle engines is 60 psi; of four-cycles of 4½ hp or less, 65 psi; and of four-cycles above 4½ hp, 70 psi.

Compression loss may be caused by a loose sparkplug. Seat the plug by hand and give it one-half turn with a socket wrench. See if the problem isn't alleviated.

Garden tractors



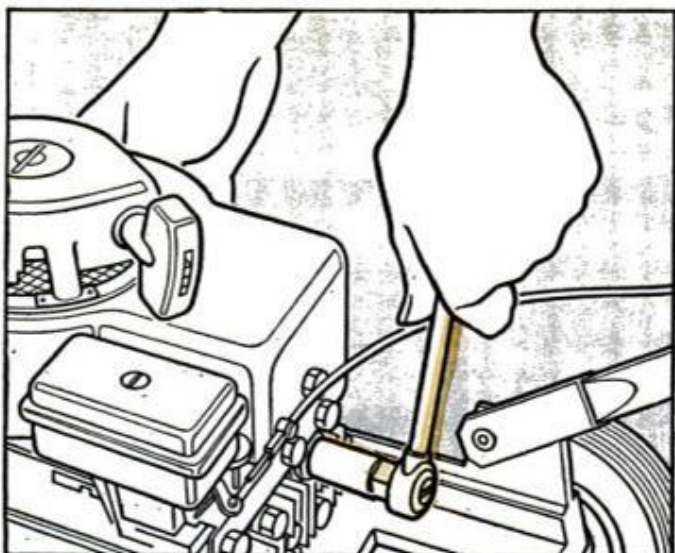
Garden tractors with high-horsepower engines usually have transformer-coil ignition systems that are like those in cars, but most power mowers use a magneto system. Magnetos make their own electricity by a magnet-equipped flywheel that revolves around stationary field coils. An ignition system may be breakerless; that is, it may employ solid-state components rather than mechanical breaker points.

You can test a magneto system by gapping either a 14-mm or an 18-mm sparkplug to 5/32-3/16 in. Attach it to the sparkplug lead and ground it against the cylinder head as you crank the engine. A blue spark should jump the electrode gap.

The same test can be made of a transformer-coil ignition system, but use the engine's sparkplug at its normal gap.

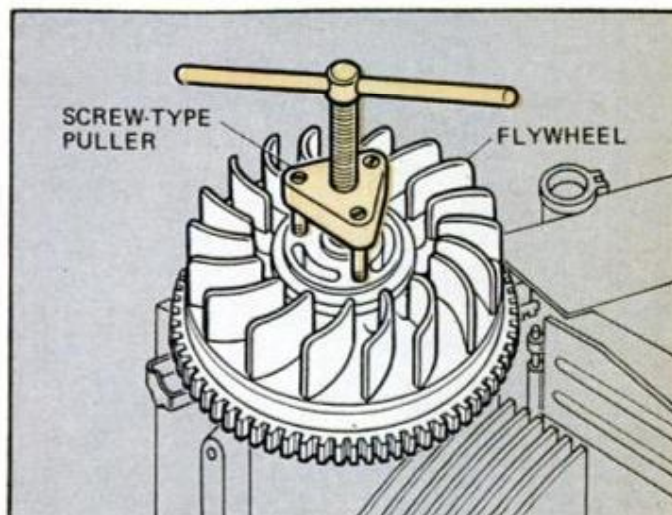
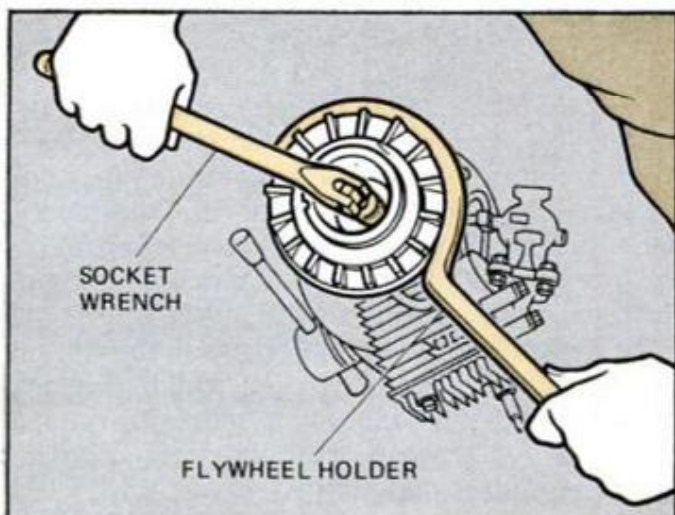
Use a spark-intensity tester for checking breakerless systems (left). Disconnect the lead from the sparkplug and attach the tester to the lead's metal terminal. Touch the test instrument's probe to ground as you crank the engine. The test light will flash if the system is operating properly.

About sparkplugs



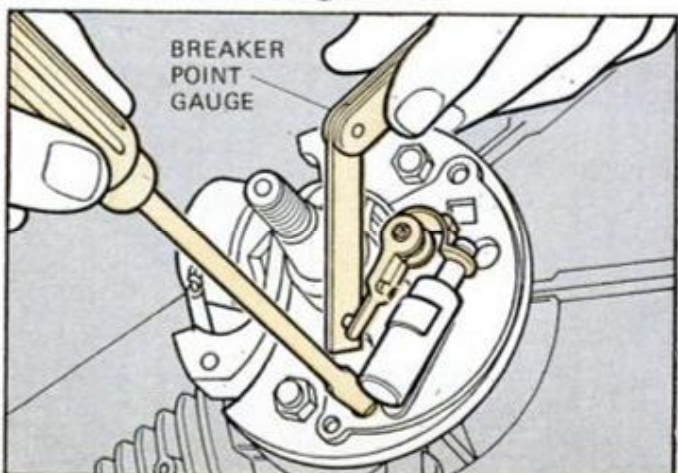
The sparkplug is one of the biggest single causes of engine problems. First, check the owner's manual to make sure you're using the right one. Then, make certain the plug lead is connected tightly to the plug terminal, and to magneto or coil output. If the lead's insulation is cracked, replace the lead. Buy a new sparkplug if the insulator is damaged or if electrodes are worn, burned or heavily coated with carbon or oil. Carbon on a plug usually means an engine is operating on an overly rich fuel mixture or that ignition output is below par; oil on electrodes usually means that pistons rings or valve stems (four-cycle engine) are worn; burned electrodes indicate that the engine is probably overheating. See that electrode gap is set to manufacturer's specification: Again, check your owner's manual.

Magneto repair



To repair magneto ignition you have to remove the flywheel. On most two-cycle engines, first remove the flywheel nut. Some of these nuts have a right-hand thread; others, left-hand. If flywheel moves as you turn nut, hold it fast with a flywheel holder. With nut off, it can usually be removed. On most four-cycle engines, hold the flywheel with a flywheel holder as flywheel nut is removed. Install a knockout puller, hold flywheel firmly, and rap puller with hammer to jar the flywheel loose.

More about magnetos



Magneto repairs also involve checking all leads for tightness and cleanliness, and testing high-tension wires to assure that no shorts exist. Replace breaker points if they are burned or pitted. Replace the condenser each time you change breaker points. Gap points to .020 inch (double-check gap in owner's manual). Test ignition output again. Now if the system fails to respond, a major overhaul is called for, including replacement of coils and magnets, and timing the system. ★★★

Pan for gold this summer—here's how and where

Today's prices for pay dirt could pay for a prospecting vacation.

by Bob Behme



Glitter, mixed in the black sand of the author's pan above, may mean flecks of heavier gold remain after lighter materials have been washed away, right, by swirling half a pan of water to sluice out dirt, clay and sand scooped from the stream bed. Light plastic pans are available for backpackers.

For outdoor adventure—and an outside chance to strike it rich—remember there's still gold in them thar hills. Finding it need be no more complicated than it was for prospecting Forty-Niners, and today's pay dirt pays a lot better.

Two years ago the price of gold began to climb from \$40 an ounce to \$150, \$180, and now over \$200 per ounce for attractive nuggets of unrefined placer that still contains impurities. Harry Schultz, a London-based economist who probably knows more about trading precious metals than any other man in the world, predicts prices could top \$400 an ounce. "There will be no significant increase in free-world gold production before 1980," he estimates.

For us, this means an occasional pastime of prospecting could turn into a very well-paying hobby. Gold has been discovered in eastern as well as western states, and the search combines neatly with camping and hiking. It can be done as easily from a backpack as from a recreational vehicle, and for the occasional prospector a pan and a few inexpensive accessories will do the job.

Tools. The number depends on the areas you work, the frequency with which you try panning and the amount of gold you want. An occasional prospector, working stream beds, can find a surprising amount with just seven items.

A pan is basic. No one prospects streams without one. South American Indians use conical wooden bowls. A frying pan makes a fair substitute but few things are as effective as a standard slant-sided pan. Most are oiled before they are sold. Heat older pans instead of removing the protective lubricant. Blackened oil shows the gold



color as well. Newer nonoiled pans may be painted matte black. You can find both types in the gold country and some can be ordered by mail. A 12 to 14-inch pan costs about \$2.

You will need tools to loosen and retrieve sand and gold from stream-bed cracks. A screwdriver works, but a special crevicing tool is better. Priced at \$2, it reaches places other tools can't. A small hand pick or rock hammer is also handy, used to break crevice edges to open chambers below. A 22-ounce size is popular and is priced under \$10.

To look beneath the water, add a face mask and snorkel. They are handy when water is waist deep; even better in deeper pools. The cost: \$7 and up for a mask and breathing tube. Wet suits and air tanks are not needed unless you are serious about prospecting.

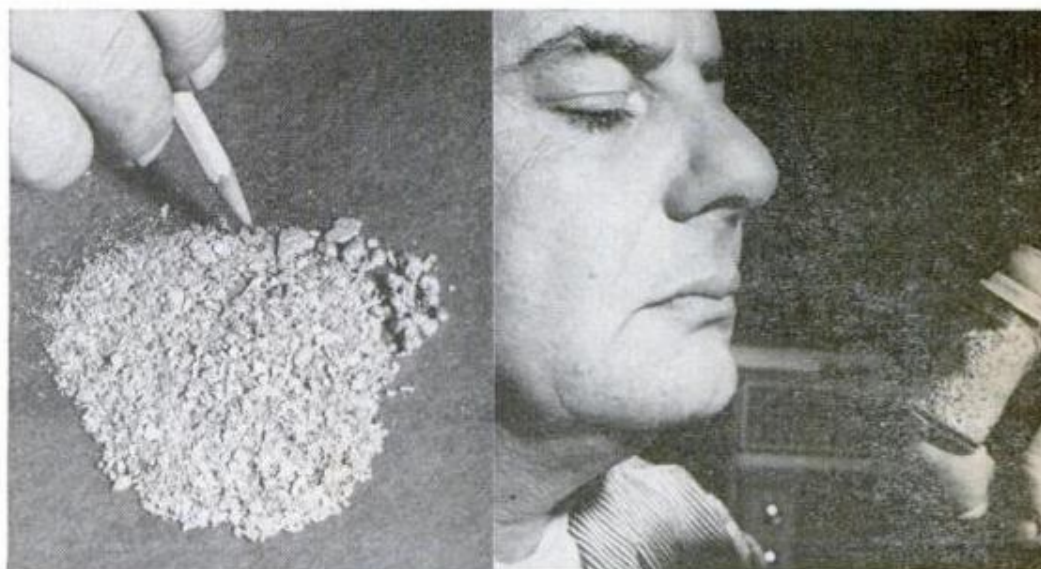
The fifth tool is a hand-operated suction pump that can reach into crevices to draw out sand and, hopefully, gold. A plastic

good job. If you don't have one, a container can be purchased for less than 50 cents. A "recovery" unit is also a good idea. It is simply a chamois pouch and a touch of mercury. The two are used in combination as explained later.

Finding gold. A noble metal, gold is dense with a unique color. Nothing exactly duplicates its look or feel. It bears the chemical symbol Au, has an atomic number of 79 and weight of 197.2. A cube 14 inches square would weigh one ton.

Since it is heavy it is found wherever it settles to the bottom of a stream. The most likely places include roots and grasses along a bank, in bedrock crevices, behind boulders, in sandbars and in places where the current slows or changes direction. Look for cracks and lines in stream beds. These are best when they cross a stream at right angles since many provide catch basins for flakes. Use your crevice tool and suction sniffer. Large boulders often

Two-week vacation turned up gold-flecked sand (right) with a value of about \$300 at today's prices. Part-time prospector Dayton Butler (far right) checks a vial of small gold particles weighing 2½ ounces and worth nearly \$500. Small plastic medicine container is well suited for holding the gold dust and nuggets.



meat baster works, but has a large nozzle which won't fit into smaller openings. The tube must be emptied after each intake. A professional version, called a sniffer, costs about \$5 and has a smaller nozzle and special chamber to trap sand so the pump can be used several times without emptying.

To round out the kit, add a container for the color you find, but forget about leather pouches, boxes and envelopes. Gold can be lost from all three. A small plastic vial is best and an empty medicine tube does a

have plants growing in cracks and, at high water, these also trap gold. Remove the plants, shake dirt from the roots and work it carefully in your pan.

Riffles, indicating places where a stream runs over rocks, are excellent. The water changes speed and sometimes direction, and gold may collect. Divide a riffle into quarters and then forget the first upstream section since the water there is too fast. Disregard the final portion as well since only fine flakes are there. Concentrate on the middle second



Mini-Dredge, from Keene Engineering, is light enough at 28 pounds to backpack in. Vacuumed gravel washes down riffle gratings of flume.

bag and squeeze. The mercury will flow through pores in the leather and the gold remain trapped inside. Be sure to save the mercury; it can be used again.

Gold can only be removed from deeper water by dredging or with skin-diving equipment. Later, when you become a more dedicated hobbyist, you may want to invest in a full setup: wet suit, air tanks, gold dredge, sluice box and more to try these areas. The equipment, available from prospecting houses, can cost \$700 and up.

As long as you remain a hobbyist and prospect for fun, you're welcome on public lands almost everywhere. There are no regulations prohibiting panning for pleasure on any federal land, although portions of streams may be claimed by private owners under local or federal mining acts. The only way to know whether an area is open or closed is to check at a local county recorder's office. Claims will be filed there.

Most campers are happy enough to keep the "color" they find—and the flakes do make a great conversation piece—but others melt them into jewelry or mount small nuggets, and still others sell them. Gold in its natural state can be sold without restrictions or licenses; gold amalgam, acquired by mixing with mercury to recover it and then cooking off the mercury in a retort, can be held and disposed of in amounts up to 200 fine troy ounces at a time.

Once refined, gold can be sold only to the government. Obviously, the metal at its present value can make prospecting a profitable hobby. And, as geologist Chris Beecher points out, each year's storms and freezing weather cause the mountains to erode slightly, crags to crack and crumble into rushing streams as new fragments of gold are exposed and washed down. While you are not likely to find surface accumulations from millions of years like those discovered by early prospectors, there's a chance of new deposits being uncovered every year.

A hazard of the hobby, in fact, may be the unexpected. One amateur prospector, with face mask and snorkel, was recently working a stream in California's Mother Lode when he found a chunk of gold the size of his fingernail and worth about \$200 by current standards. He grabbed the gold, leaped from the stream and tore off his

and third quarters. Here you can find the most gold and larger flakes. Be certain to work along each bank, especially in areas where the current changes direction.

How to pan. The object is to concentrate heavier materials in the bottom of the pan as you float off the lighter "fines" as clay, sand and dirt. Fill a pan half full of sand and clay. Submerge it so it fills with water. Then remove larger rocks and break up clay, dirt balls and sod with your hand. Incline the pan away from your body and move it with a quick circular motion so the swirls, churning the contents. Let the water flow gently over the lip of the pan, flushing away the silt, and repeat until only the heavier materials, generally black in color, remain. If you are lucky, the black sand will hold gold flakes and possibly nuggets.

Sometimes the gold is large enough to be removed by hand but most often you find smaller flakes. Some can be removed with tweezers, but the smaller will require amalgamation, a job for the "recovery kit." Remove as much sand as possible; then add mercury. The gold will cling to it. You then dispose of the sand and, to separate the gold, put the mercury inside the chamois

mask as he shouted the good news to his friends. Suddenly horror spread across his face. He had pulled the dental bridge from his mouth as he removed his breathing tube and it had spun off down the stream. He dived back into the water; this time prospecting in earnest. His teeth, with gold bridge attached, were worth \$300!

Where to look. About 125 years ago, the lure of gold drew thousands of Americans to California, and 50 years later a quarter of a million more headed north to the Yukon. Now the magic is working again, and though the western states are the best prospecting areas, gold has been discovered in enough places in North America to give any weekend prospector a chance for color.

East: While not available in quantity, gold can be found from Maine to Florida. Georgia is especially good and smaller streams can be profitable. Gold has been discovered in the Appalachians. For help in Maine, read *Maine Mineral Collecting*, a geological survey available from the Dept. of Economic Development, State Capitol, Augusta, Me. In Florida, try *Rocks and Minerals of Florida* by E. Bishop and D. Lee, published by Florida Geological Surveys, State Capitol, Tallahassee, Fla.

Midwest: Prospectors have found color in areas around the Great Lakes and some around Traverse City, Mich. where a fossilized coral called the Petoskey Stone is common.

Indiana is also good and a book, *Gold and Diamonds in Indiana* can help. It is available from the Indiana Geological Survey, Dept. of Conservation, University of Indiana, Bloomington, Ind.

West: Wyoming has gold and one of the best areas is near the Wind River. Many prospectors like Lander and areas on the Green River, especially those noted for petrified wood and agate.

Colorado has several good regions. One of the best is near Cripple Creek. For local information, read *Colorado Gem Trails and Mineral Guide* by Richard M. Pearl, Sage Books, 2679 York St., Denver, Colo. \$3.95.

Streams in New Mexico also deliver color, and one source of help is *New Mexico Guide to Gems and Minerals*, Paul W. Johnson, Mentone, Calif. 92359. \$2.

California is the most productive state. In the central section, the American, Feather, Bear, Mokelumne, Merced and Yuba Rivers are good. In the north, try Klamath,

(Please turn to page 161)

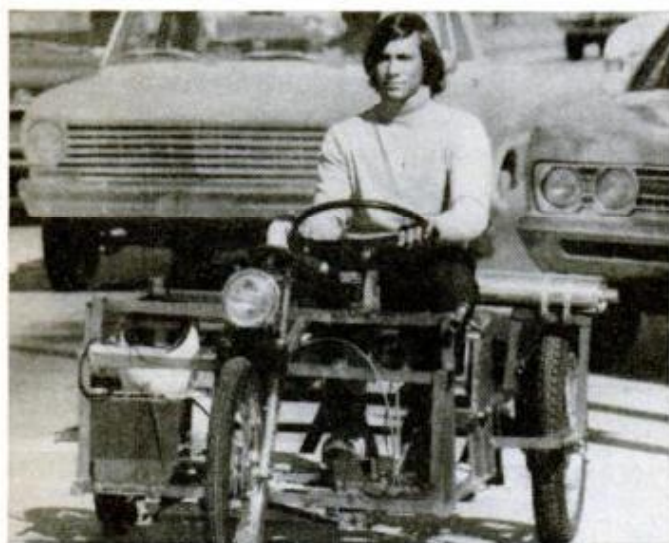
Where it's at for '74 prospectors

West is best, but gold can be found across the country. Washington, Oregon and particularly California are productive. New Mexico, Wyoming and Colorado have all shown color. Great Lakes states have gold; it has appeared along the East Coast. Alaska and British Columbia are notable.



At 90 miles to the gallon, who cares what it looks like!

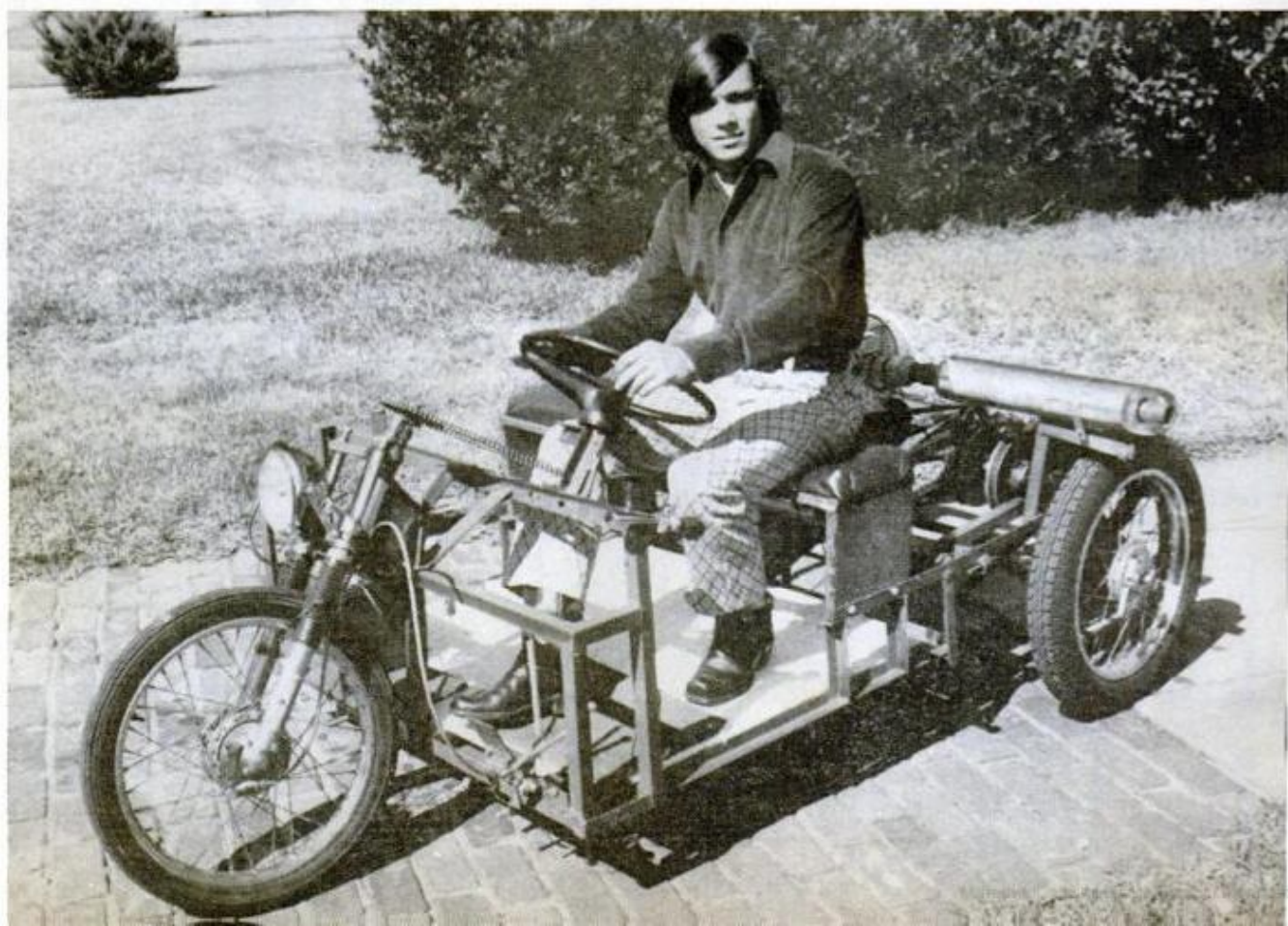
by Sheldon M. Gallager



It looks vaguely like a motorized bed-frame, but its young inventor, Aaron Fechter of Orlando, Fla., doesn't care. It gets him where he wants to go at a phenomenal 90 miles to the gallon—and that's what counts. With fuel prices likely to remain high, shortage or no shortage, Fechter figures he's got a winner and is already planning to put his homemade contraption on the market this fall as a two-man mini-car priced to sell for around \$1500. It's licensed for street use under motorcycle regulations and meets all state safety requirements.

Fechter, a 20-year-old graduate of the University of South Florida, cobbled up his ingenious three-wheeler from angle iron, motorcycle parts and a 12-hp Tecumseh mower engine. The drive, similar to that used in karts, consists of two variable-speed pulleys turning a single rear wheel through a chain and sprockets. The pulleys—two Comet torque converters—are mounted in parallel on a common jackshaft to divide the load and produce a smooth flow of power. The use of a single driven rear wheel eliminates the need for a differential, and the infinitely variable pulley drive provides, in effect, an automatic transmission.

Moving briskly along in Orlando, Fla., traffic, inventor Aaron Fechter has no trouble keeping up with other motorists in his homemade mini-car. Vehicle gets an incredible 90 miles to the gallon, is powered by a 12-hp mower engine. It can hit up to 55 mph, seats two and is street-legal under motorcycle regulations.

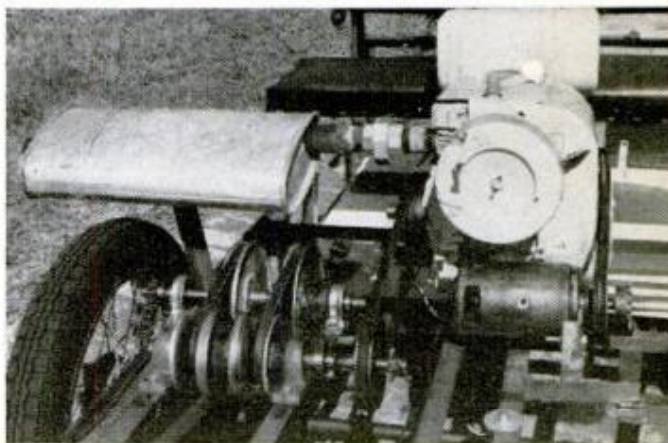


The "front end" is simply the wheel and fork assembly from a motorcycle welded to the frame. Steering is accomplished through a clever chain and sprocket linkage with a 4-to-1 reduction—four turns of the steering wheel to one turn of the front wheel—to give smooth, jerk-free automotive-type control. The rear wheels are also from a motorcycle and turn on a "dead" axle bolted to trailer springs for an easy-riding suspension system. All brakes are the original drum type that came with the motorcycle wheels. Foot pedals provide accelerator and brake control just as in a regular car.

The vehicle's light weight—barely 250 pounds—enables it to attain good speed as well as its amazing gas economy. It can hit up to 55 mph with one rider and 45 with two—enough to let it compete safely with higher-powered monsters on the open road. Its self-shifting transmission gives it hefty hill-climbing power and plenty of zip for accelerating into traffic or passing other cars.

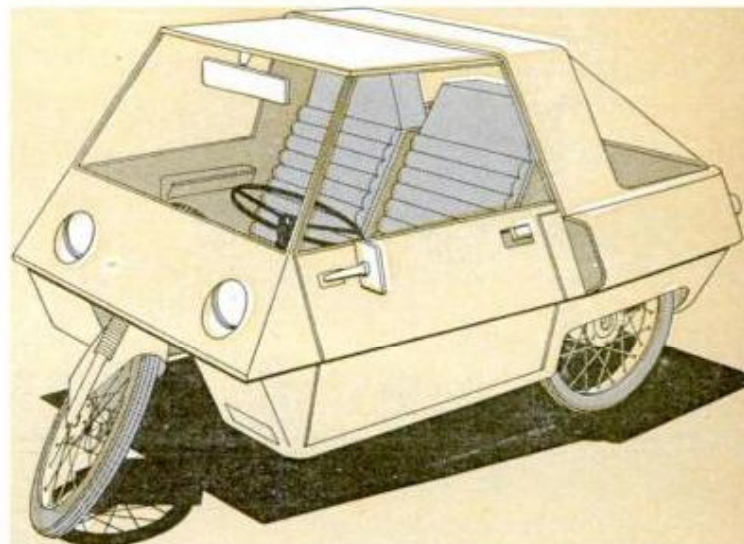
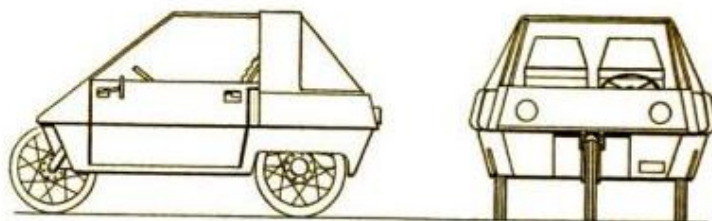
Fechter's reasoning for the three-wheel design is that it's a lot safer than a regular two-wheeled motorcycle, yet retains the basic simplicity of a motorcycle. There's no complicated steering geometry to contend with, no wheel-alignment problems, no clutch or transmission to get out of whack. Maintenance costs are nil. If necessary, the entire engine can be replaced for \$170—the price of a comparable new one and much less than what the average motorist spends on yearly servicing and tune-ups.

Aware that his concoction is not likely to win many beauty prizes in its present form, Fechter, with the help of a professional designer, is planning a smartly styled fiberglass body that will slip over his "bedstead" and transform it into a trim little fully enclosed runabout for all-weather use. An idea of what this body will look like is shown in the drawing at right below. The current version has a single motorcycle headlight, but with the added body will be fitted with dual headlamps, rear-view mirrors, windshield wipers and seat belts to make it street-legal under standard motor-vehicle regulations, instead of in the motorcycle classification. This means potential owners will not have to first pass a motorcycle-operator's examination in order to drive it. The car will be called the "Jutta" after the name of a German friend. Fechter, who lives at 2025 Stryker St., Orlando, Fla. 32805, will announce plans for the vehicle's production later this year. ★★★



Twin variable-speed pulleys, paired side by side on one jackshaft, transmit power from 12-hp engine to left rear wheel (lower photo above). Standard automobile muffler channels exhaust out to side, silences noise. Top photo shows chain and sprocket linkage from steering wheel to front-wheel fork, giving 4-to-1 reduction for smooth directional control. Below is artist's concept of fiberglass body designed for car.

Art: Roy Grinnell



Bass boat with everything

Here's the almost-ultimate rig for outsmarting a lunker in comfort.

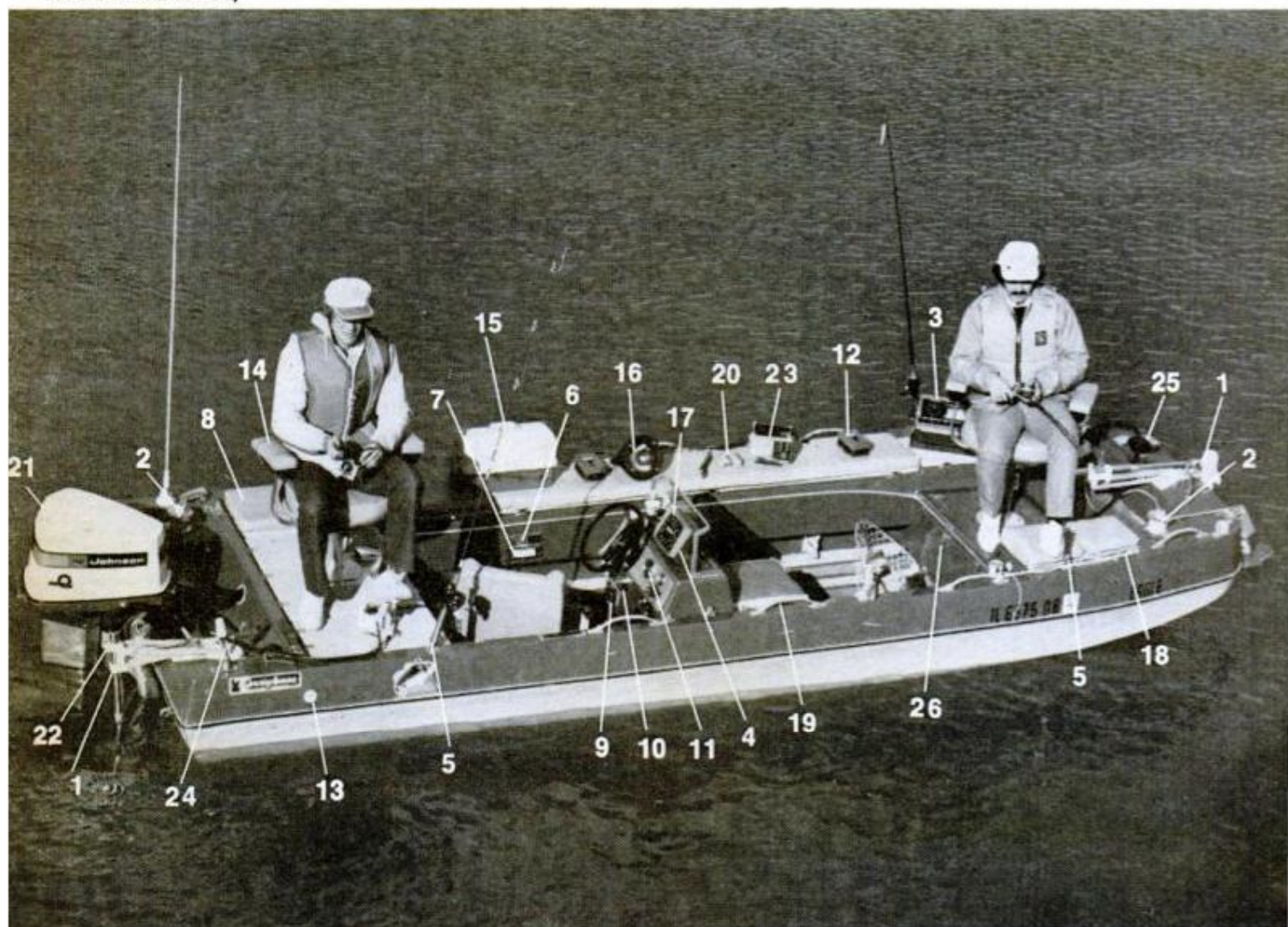
by Bill McKeown
OUTDOORS EDITOR

Outsmarting a bass can be costly this summer if a fisherman goes all out to outfit his bass boat. Here's PM's pick for a well-stocked Terry Bass model, as accessorized by Bill Cullerton of Chicago.

Tournament anglers consider a depth/fish finder and electric trolling motor essential, many items shown as helpful, and TV perhaps luxurious. More accessories could be carried aboard, but they might not leave room for the fish. ★★★

Fixtures for fishermen: 1. Front and rear MinnKota foot-controlled fishing motors. 2. Hole Checker foot-controlled electric anchor. 3. LRG 600 Flasher Graph Lokator by Lowrance 4. LFG 660 Lokator Sounder from Lowrance. 5. Anglers Pal rod holders (4) Model 200. 6. Ray Jefferson CB 605 radio. 7. Eight-track tape-deck model 808 by Ray Jeff. (Speakers are audio transducers that mount to hull causing it to produce sound—and may be more popular with fishermen than fish.) 8. Live well 40 inches long with recirculating pump. 9. LTD 200 Lowrance Surface Fish'N'Temp with sensor permanently outside hull. 10. Aquameter 555 speedometer. 11. Aquameter 250 tachometer. 12. BassOx Ray Jeff oxygen analyzer. 13. Crowell Mini King electric bilge pump. 14. Swivel fighting chair armrests with storage compartments. 15. Plano 8700 tackle box. 16. Humco Venus 71-6A 200,000-candlepower 12-v. searchlight. 17. Airguide 66-B compass. 18. Custom-made cushions snapped atop all compartments. 19. Four extra grab handles (plus four standard). 20. Lowrance LFF 100 Fish'N'Float Markers. 21. Johnson 115-hp motor. 22. OMC Trim'N'Tilt power trim. 23. Sony portable TV. 24. Navigation light. 25. Low-profile horn. 26. Storage compartment. Not shown: batteries, Perko switches, Taylor chart light, top.

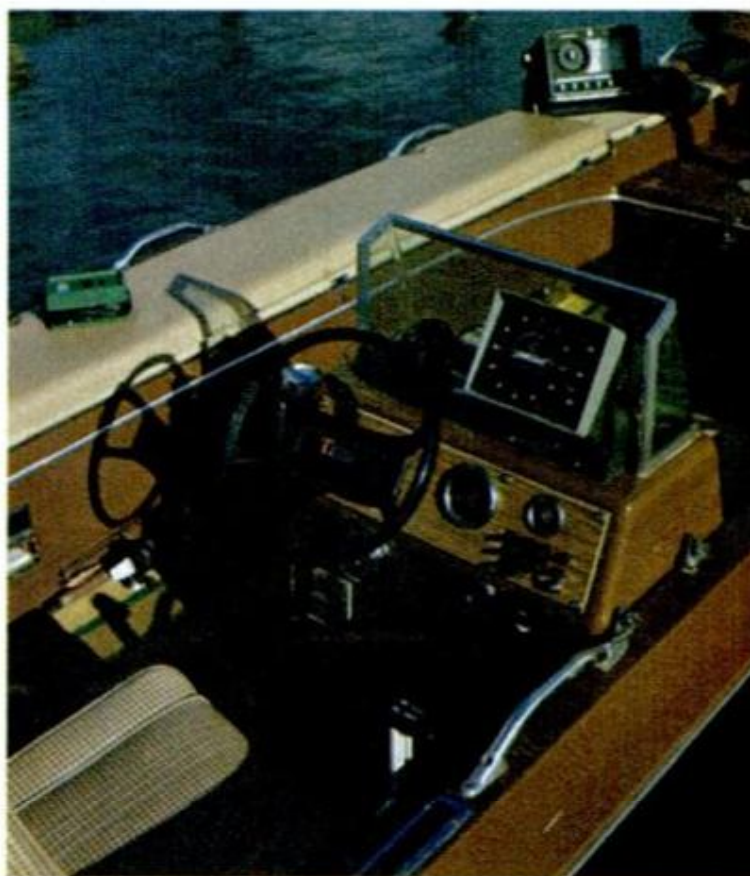
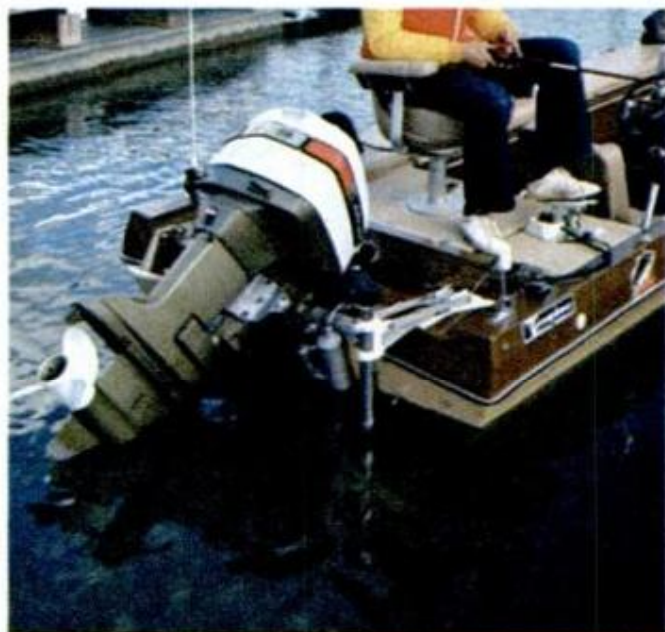
Photos: Bud Toomey





Stowage doesn't normally include loading down one gunnel as arranged here for photo purposes. Large compartments for gear and live-bait wells are part of well-designed bass boat. Owner didn't total the cost of this rig, but turned down \$20,000 from a well-heeled bass buster.

Steering console (right) in addition to full instrumentation, encloses a Zenith Transoceanic receiver for monitoring weather and marine bands, a Ray Jeff 23-channel two-way Citizens Band and three built-in tackle drawers.



Primary power, a Johnson 115-hp motor with OMC Trim 'N' Tilt, is aided by a stern-mount MinnKota 555 electric with foot control.



The horseless carriage returns—quietly

It travels at a trot—28 mph—offends no one with its exhaust, and gets you there and back—if it's not too far.

by Jim Liston
EDITOR

Detroit's Big Three should get such mail. "At last! What we've been waiting for all these years. We wish you every success with your little car."

"We're pulling for you. Why didn't someone do this sooner?"

From a minister: "I'm praying for you."

From a midwestern college: "Please send us three vehicles as soon as possible."

Love letters like this pour in every day to Robert G. Beaumont, 42, president of Sebring-Vanguard, Inc., developer of the CitiCar, the two-passenger electric vehicle shown here. Six years ago the former New York Chrysler dealer was convinced that America needed a car like this, but not quite sure what shape it should take. Millions of Americans caught in last winter's gasoline crisis couldn't have cared less about style or speed; any car that could be refueled from an electric outlet sounded simply beau-



Photos: Flip Schulke,
Black Star

Assembly line (facing page) is uncomplicated; light ABS plastic body (six colors available) is easily attached to aluminum frame.

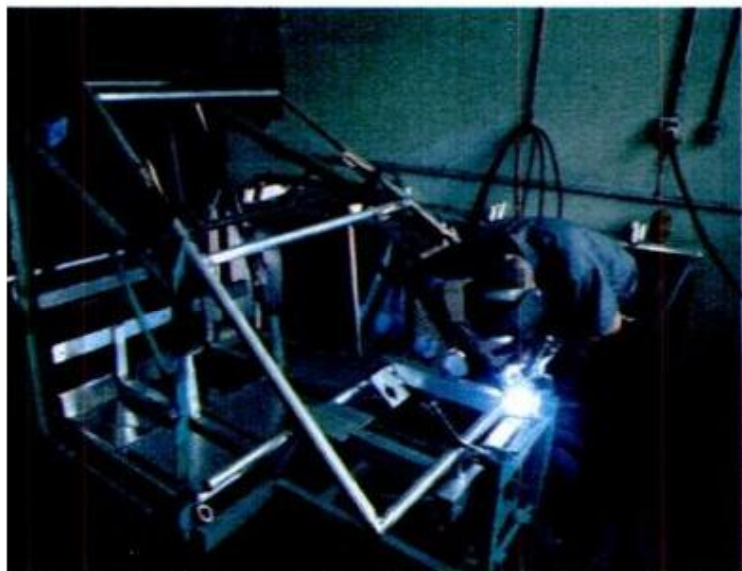
Commuters (left) whose daily driving is under 50 miles will find CitiCar ideal. "Fuel" costs are 1.5 cents a mile in most areas.



Shoppers can park little car (95 inches long, 55 wide) with ease. Wide doors and flat floor make it easy car to get out of. Bumpers are padded with rigid polyurethane. Car meets requirements for licensing in any state.

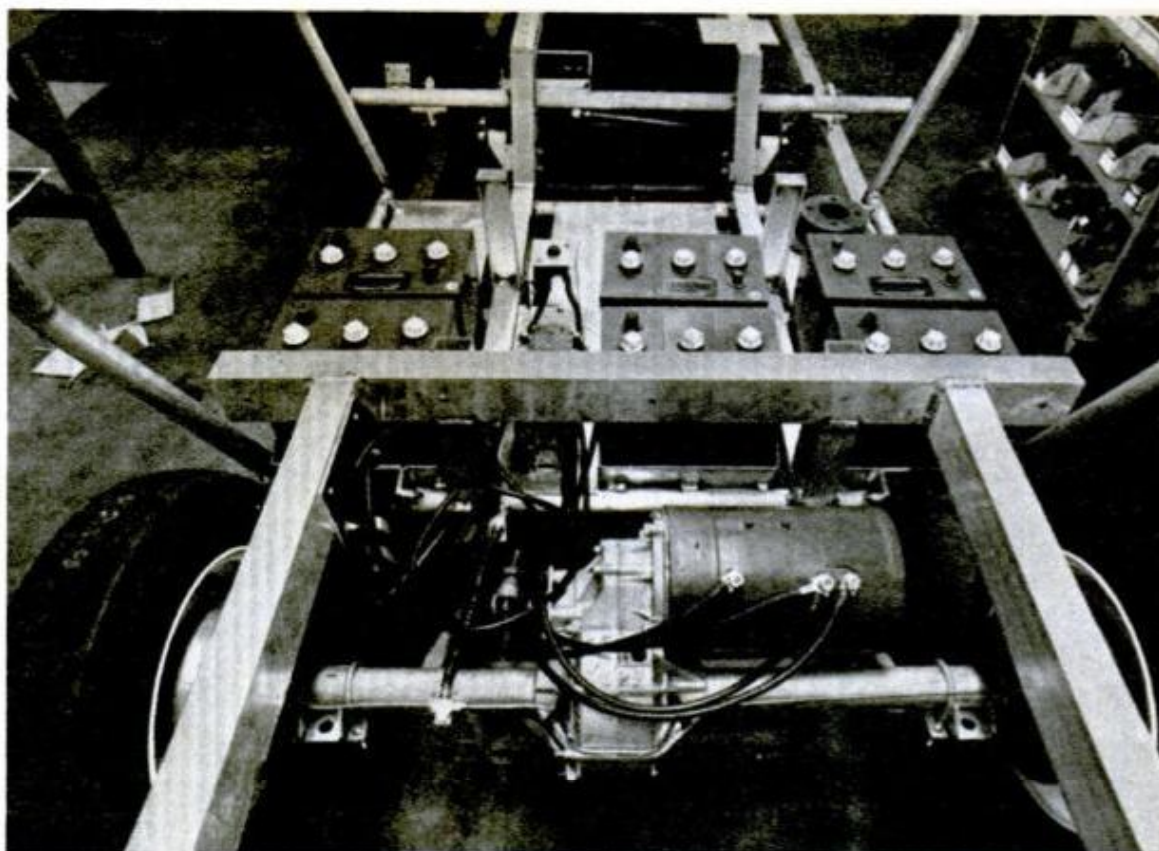
Aluminum tubing (bottom left) is heliarc-welded to make light, integral roll-bar-type frame.

CitiCar president, Robert Beaumont, poses with three earlier models from which today's car evolved. Distinctive wedge-shaped styling proved popular.



There is little to go wrong . . . practically maintenance-free.

Electric power for CitiCar is supplied by six 6-volt batteries. A 2.5-hp, 36-volt series-wound d.c. motor is coupled to the transaxle-drive unit. Controller (between batteries) is actuated by foot pedal. With the exception of the brakes, steering and charger, guts of the car are shown here. Servicing is chiefly battery care and lubrication.



tiful. Every time a photo or story about the CitiCar appears in the newspapers, letters and orders pour into Sebring, Fla.

There are, of course, orders from nice old ladies who want a little car that is easy to park. But what makes Beaumont sure that the day of the electric has really arrived are the letters from people who say driving a heavy, expensive car 20 miles a day no longer makes sense to them.

The CitiCar assembly plant is at the Sebring air terminal, until recently the site of Twelve Hours of Sebring, an international auto endurance race. Ironically the course provides a ready-made test track for a car with a 50-mile range. And what can you test at 28 mph?

Well, you can see what happens when you pull the wheel all the way over at top speed. We did and held it there. The tires squealed and we whirled round and round in a tight circle. But there was no lean, no lift; the low center of gravity resulting from the lightweight body and six 6-volt batteries under the seat keeps all four wheels firmly planted on the pavement. Again at top speed, we ran through a series of panic stops. The front disc brakes hauled the car down to a straight-line stop every time.

The ride—on leaf springs, no shocks—is firm but not harsh. We drove a rural

road and discovered the unique advantage of the electric: quiet. Aside from a barely audible whine from the motor and transaxle, you hear only the tires and the wind. And birds singing. This quiet operation contributes to safety because you can hear a car overtaking you or approaching an intersection.

Driving the CitiCar is simplicity itself. You turn the key—and hear nothing because there is no starter motor. Nothing happens until you flip a toggle switch on the dash—F for forward, R for reverse—and press the accelerator (controller). As the car accelerates you hear three distinct clicks from the controller. The first occurs as an 18-volt series resistor is engaged; the second as the resistor is dropped out and the full 18 volts is applied to the motor; the third when the full 36 volts is applied.

There is a fuel gauge that shows the amount of charge in the batteries so you won't run down without warning. The range is 50 miles; recharging is done overnight on seven kilowatts (average cost about 20 cents) by an on-board 110-volt charger that is simply plugged into a grounded household outlet. Operating costs are estimated to be 1.5 cents a mile for electricity including battery replacement. The six 6-volt batteries can be expected to

last three years and be replaced for about \$225.

The CitiCar is bound to be a low-maintenance vehicle; there is little to go wrong. The record of continuous service of rental golf carts shows that the single common failure stems from abuse of the batteries—letting them become completely discharged and letting them stand without recharging. This drastically reduces battery life.

Aside from good battery care there's little else to do. Lubing is as simple as greasing a garden tractor—just four points which can be reached under the front bumper. And since the car weighs only 1100 pounds, the tires will probably dry out before they wear out.

The body of the vehicle is of Borg-Warner's lightweight Cylolac brand ABS plastic; it can't rust, and has high-impact resistance. Because the color is pigmented all the way through the material, the inevitable dings won't result in chipped paint. This, with the aluminum frame, leaves little to corrode.

The makers of the CitiCar point out that while it has evolved from a golf cart, it is a unique lightweight vehicle. There are a number of companies electrifying Fiats, Volkswagens and Renaults, but, according

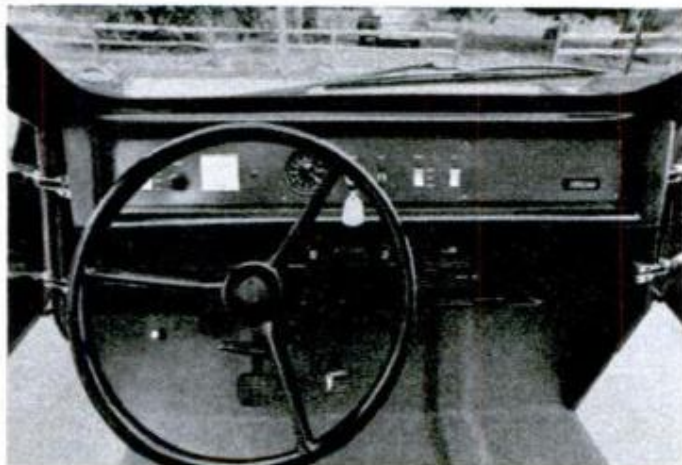
to Sebring engineers, they are taking the wrong approach by using a heavy frame and chassis. Vanguard started by building a light frame and restricting everything that added weight. How else does it differ from early electrics?

"Those were chain drives; we have the transaxle," says Beaumont. This is a combined transmission-differential which is coupled to the 2.5-hp electric motor. The transaxle has been proved dependable on rough terrain by years of golf-cart use. However, other engineers working in the electric-vehicle field maintain that a transaxle makes the motor captive to the wheels and limits speed. On a hill a 28-mph vehicle may well lose a third of its speed—be reduced to a climbing speed of 10 mph.

Vanguard had not tested the CitiCar on hills. (There are few hills in central Florida.) Overheating of an electric motor is possible on a 20 percent grade if the climb is long and sustained. The 50-mile range of the CitiCar is an optimum figure; it presupposes constant speed on level ground with minimum start-stop driving.

Despite its limitations, the lightweight electric vehicle offers some distinct advantages that will win it a place in many

(Please turn to page 161)



CitiCar's instrument panel is simple: Fuel gauge at left shows state of charge in batteries. Next to it is an optional speedometer and toggle switch for forward or reverse. Built-in charger is at the far right.

Bucket seats with headrests fold for access to package compartment. Removable side windows are available as optional equipment. A compact heater-defroster package is being developed.

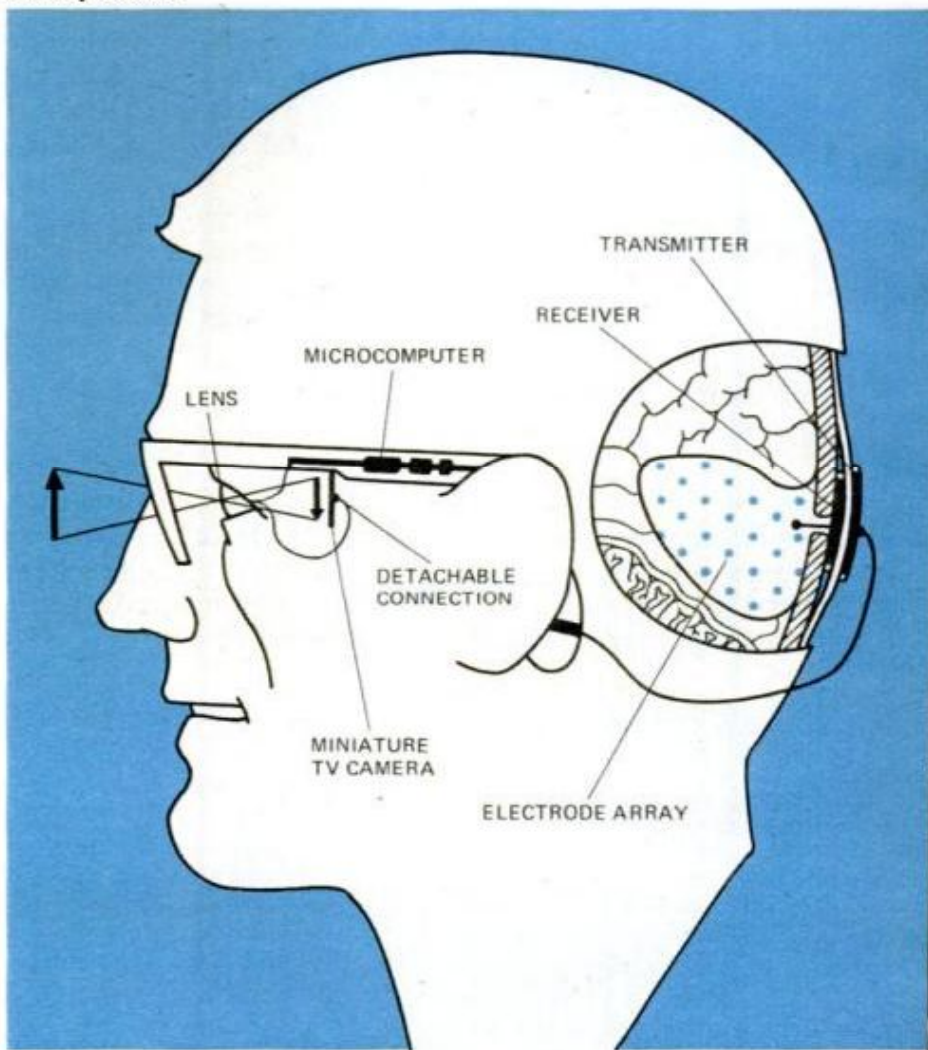
Refueling is as simple as plugging the onboard automatic charger into a 110-volt outlet. Batteries can be charged overnight for about 20 cents. CitiCar can be stored with charger plugged in; it won't overcharge. Car takes one-third the space of standard sedan.



TV implants may help the blind 'see'

by Ivan Berger
ELECTRONICS EDITOR

Art: Roy Grinnell



Future aids to the blind may feature a miniature, solid-state TV camera in an artificial eye feeding its signal through a microchip computer in an eyeglass frame to an array of electrodes implanted in the brain. Radio-transmitter-receiver connection between computer and the electrodes prevents infection of the wired openings. Current laboratory experiments (far right) are still impractical.

The eye can be compared to a television camera. Now researchers here and in England are experimentally transmitting "TV" pictures directly to blind persons' brains. Eventually, they hope to provide matching TV cameras to substitute directly for sightless eyes.

But that's in the future. The experiments to date have been crude, cumbersome and expensive—but hopeful. Since 1929, it's been known that dots of light (called "phosphenes") could be "seen" when the brain's visual cortex was electrically stimulated, and that several phosphenes could be excited at once to display patterns. Unfortunately,

the pattern seen doesn't match the pattern of the electrodes providing the stimulation; exciting a straight row of electrodes produces only random dots in the brain, and the electrode pattern producing a straight line varies from one patient to another.

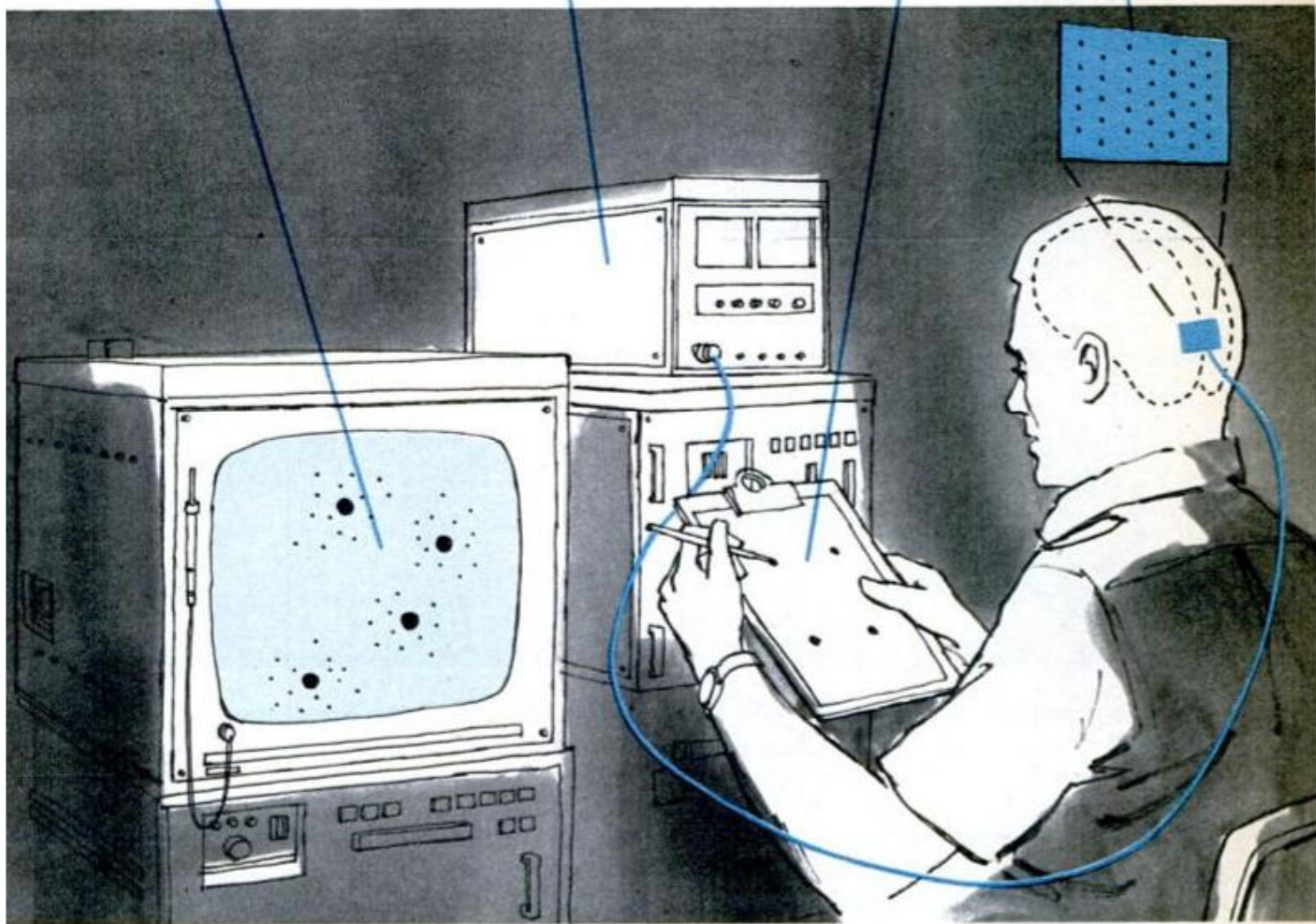
So, computers must be used to turn the image seen by the TV camera into a matching phosphene pattern. Computers will also be necessary to sharpen the picture's detail and contrast, and to control perception of brightness and shading. There's a reasonable prospect of specialized computers on integrated-circuit chips small enough to fit into a pair of eyeglass frames.

COMPUTER SELECTS AND STIMULATES MATCHING ELECTRODES IN BRAIN

ELECTRODES STIMULATE BRAIN TO "SEE" LIGHT-DOT PATTERNS

COMPUTER DISPLAY SCREEN SHOWS DOT PATTERN SELECTED BY EXPERIMENTERS

SUBJECT DRAWS PATTERN HE "SEES," FOR MATCHING AGAINST COMPUTER DISPLAY



Resolution of the phosphene "picture" depends on the number of spots stimulated. Today's experiments produce crude images, with only 64 to 80 spots (compared to about 400,000 for a TV picture), and the maximum number of spots that can be stimulated is about 250. But computer-processed signals from cameras with more light-sensing spots could produce clearer images—and 1024-spot camera sensors small enough to fit into an artificial eye have been developed.

The number of sensing spots isn't the only limitation on the practicality of electrode implants. More research is needed on the stimulation that the brain can safely take,

on electrode materials which will neither chemically affect the brain or be affected by it, on keeping the implants firmly in place and on radio connections between computer and implant (wired connections through the skull could get infected).

At best, the new system will be able to provide vision good enough to distinguish faces and telephone dials, read large print and avoid obstacles and traffic. And the most optimistic cost projections are in the \$5000 to \$10,000 range. But the principle is proven, and a practical system could prove an immense breakthrough for the blind, despite its limitations. ★★★

Mazda RX-4:

What, no altimeter?

Driving the new coupe is the closest thing to flying without leaving the ground.

by Bill Hartford

AUTO EDITOR

Photos: Irv Dolin



Let's get it out of the way right off: The RX-4 I drove for one week—and drove wherever I went as if I had to get up to flying speed before running off a short runway—got 17.6 mpg overall.

The car belonged to Mazda's eastern office and received no special underhood attention before I picked it up (it was, in fact, filthy from being on loan to everyone and his brother). If the car were mine, I wouldn't have driven it the way I did, and I'm certain that

20 mpg is what I could count on—and budget for, now that gas prices are airborne, too.

The profile of the RX-4 coupe is one of the cleanest around. The design clutter around the rest of the car, though, is quite annoying and it spoils what could have been an oriental work of art. The taillights (below) are unsurpassed for gaudiness and you find those little triangles that are representative of the Wankel rotor shape lurking every-

(Please turn to page 162)



Enthralled by performance, appalled by mileage

A nationwide survey
based on 950,000
owner-driven miles

by Michael Lamm
WEST COAST EDITOR

Snappy and peppy but disappointing when it comes to passing gas pumps—that's the Mazda consensus.

"Good pickup and handling," says a Santa Barbara physician, "but mediocre gas mileage." A Tennessee business manager: "Performance seems real good; gas mileage is lousy for a car of this size." An Illinois contractor: "We needed a second car and were told by the dealer that the Mazda's gas mileage would be around 25 mpg. We're getting more like 13-17. I had expected better."

So had 44.9 percent of the Mazda owners we surveyed. Although respondents average 15.7 mpg in town and 19.2 on trips, they feel this isn't enough. So their main complaint by a wide margin centers on lower-than-expected gas mileage. Many, however, believe that they were misled. As a California assessor says of his dealer: "Exaggeration of expected gas mileage!"

On the other hand, most owners feel that handling and performance make up for the lower mpg. "Sort of a cross between a 240-Z and a BMW sedan," says a California plan-



ner. A Georgia credit supervisor reports that "acceleration is excellent both at low speeds and for passing on fast highways." And a California housewife exults, "I just plain love the way it goes—lots of guts!"

Guts and guzzlers most often go together, and the fact that you can't have it both ways might be easier to take if some insurance companies didn't class Mazdas as high-performance vehicles. Several owners mentioned that their insurers were charging them extra for that reason. So the question arises: Is the Mazda an economy car or a performance machine?

Only 11.2 percent of the owners listed handling as their primary reason for buying a new Mazda, but 55.5 percent made it their No. 1 specific like. Power came in second at 36.5 percent, and performance ranked third at 29.9. Economy was given as a specific like by only 14.7 percent and, as

Mazda RX-2 series comprises a four-door sedan and coupe (above); the RX-3 series, a four-door wagon and sport coupe (right). This year they are joined by the new RX-4 series, offering a coupe (facing page), four-door sedan and four-door wagon. This PM owners survey, conducted just as the RX-4 was becoming available, reports owners' experiences with their RX-2 and RX-3 models only.



Photos: Irv Dolin

'There's no cheap look, no junky workmanship . . .'

mentioned, gas mileage became the No. 1 complaint of nearly half of all Mazda owners. So the insurance surcharge seems to be well founded.

There was almost universal agreement on the Mazda's workmanship: 82.7 percent marked it good to excellent. An Illinois apartment manager sums it up this way: "I'm totally satisfied with a well-built car, and the Mazda far surpasses any American car. There's no cheap look, no junky workmanship, no slap-it-together-and-to-hell-with-it quality. In my opinion, the basic reason for the popularity of foreign cars is that the American driver is fed up with cars that self-destruct after 37 months. I am 100 percent American, but the Detroit worker should wise up! *Earn* his exorbitant wage! Concentrate on good workmanship instead of fringe benefits."

One nagging complaint centered on cramped quarters, especially in the trunk and rear seat. A Texas telephone engineer opines, "With all that antipollution stuff and the spare tire located the way it is, luggage space is very small. Legroom in the rear seat is somewhat cramped, too."

Yet general comfort received multitudinous praises. A Kansas trailer driver: "Overall comfort excellent for a small car."

A New Jersey salesman: "Smooth and quiet ride—engine runs very silently." A Houston remodeler: "I couldn't believe a car could be so smooth, quiet, and easy to handle." Yet a Colorado electrician mentions, "I find my car comfortable, but when I have my seat all the way back, the dude in the rear seat suffers."

What do owners think of the rotary engine? Some 34 percent listed it as the main reason they bought the car. Here are some comments about the engine specifically: "Tune-ups are too often and too expensive." "Power when you need it." "Smooth and powerful acceleration." "Fabulous zip." "Lots of wheezing and popping from the tailpipe." "I bought the Mazda for its rotary engine and the possibility of many trouble-free miles over a long term of ownership. I figure low cost of maintenance with so few moving parts. I feel, though, that we paid about \$400 more for the rotary engine as compared with other cars. I would like better gas mileage." A few owners, too, mentioned plug fouling on nonleaded gasoline.

How do owners feel about their dealers? Our survey reveals a 50/50 split, half liking and half disliking. Comments: "Service department seems weak and dealer lacks

Summary of 1973-74 Mazda Owners Reports*

Total miles driven 957,756

Average miles per gallon:

Local driving 15.7
Long trips 19.2

Series:

RX-2 49.3%
RX-3 48.4

Body styles:

Station wagon 47.0%
Two-door coupe 29.8
Four-door sedan 23.3

Transmissions:

Automatic 54.2%
Four-speed manual 45.8

Why the Mazda?

Economy 38.8%
Rotary engine 34.1
Performance 19.2
Size 16.8
Reputation 11.2
Handling 11.2
Styling 11.2

Specific likes:

Handling 55.5%
Power 36.5
Performance 29.9
Comfort 27.5
Styling 19.9

Economy 14.7
Ride 14.7

Specific dislikes:

Expected better gas mileage . . 44.9%
Quality of materials 7.8
Poor dealer service 7.3
Rattles 5.4
Inadequate size 4.4

What changes would you like?

Better mileage 36.2%
More legroom 11.9
Bigger size 7.0
Change styling 6.5

Number of vehicles owned:

Mazda only 40.7%
Two cars 47.2
Three cars 9.3
Four or more cars 2.8

Other cars owned:

Chevrolet 18.0%
Buick 14.1
Ford 10.9
Pontiac 9.4
Volkswagen 9.4
Dodge 8.6
Oldsmobile 8.6

Comfort opinion:

Good to excellent 81.3%
Average to poor 18.7

Workmanship opinion:

Good to excellent 82.7%
Average to poor 17.4

Dealer service opinion:

Good to excellent 50.0%
Average to poor 50.0

Had any mechanical trouble?

No 53.0%
Yes 47.0

What type of trouble?

Timing 12.9%
Carburetor 11.9
Clutch 11.9
Sparkplugs 10.9
Electrical 6.9
Airconditioner 6.9

Did you repair it yourself?

No 99.0%
Yes 1.0

Dealer repairs satisfactory?

Yes 57.8%
No 42.2

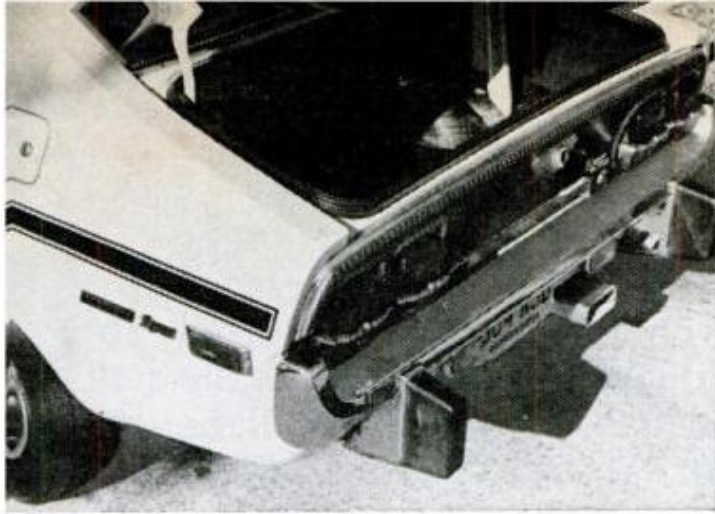
Age distribution of owners:

15-29 years 31.1%
30-49 years 42.4
50-plus 26.3

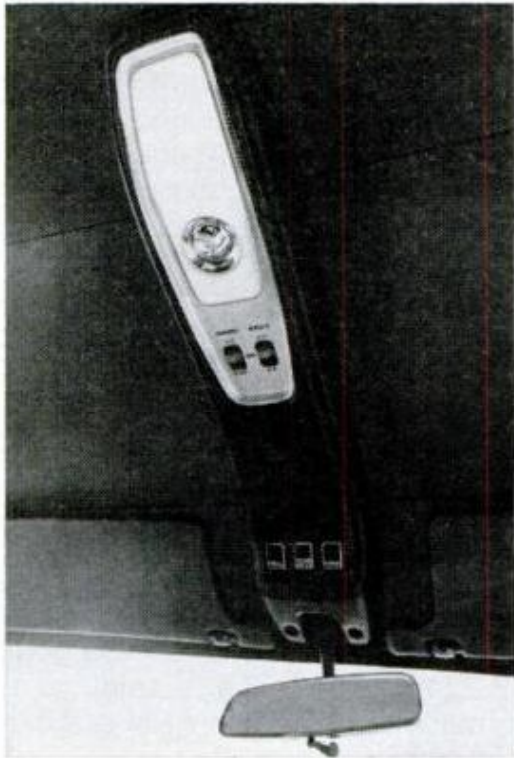
Would you buy another Mazda?

Yes 69.9%
No 30.1

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



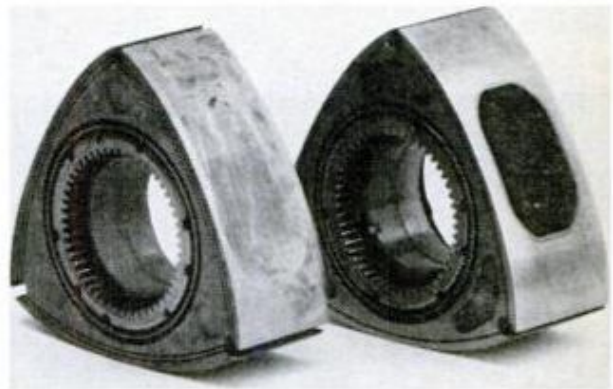
The RX-4 coupe (shown in these photos) and the sedan and wagon offer greater luxury than the RX-2 or RX-3 models. The top-of-the-line cars feature an especially refined interior with a cockpit for the driver that puts all of the controls and switches in exactly the right places. Superb layout in the coupe is augmented by an overhead console that includes a map spotlight. The trunk has high liftover; spare tire is out of the way under the floor.



knowledge of rotary engine and car in general." Flip side: "When I bought my Mazda, I received two radial snow tires mounted and balanced at no extra cost. This was *not* advertised, nor was it mentioned during the pre-sale negotiations. I estimate this to be a \$100 value that was just given to me by the Mazda dealer with no fanfare. How's that for good will?"

In the why-don't-they department, these suggested changes: "I don't want to go 130 mph, but I would like better gas mileage, so why don't they make a more economical rotary engine?" "I would like to see everything a little bit bigger—seats, legroom, trunk." "Faster wipers." "A rear seat that's easier to get into and out of." "Wagon's front seat should go all the way back even with the rear seat folded down." "More car width—it's too narrow." "My RX-2 burns a quart of oil every 600 miles—that shouldn't be."

And perhaps these comments tell a good



Wider rotor (right) is how Mazda increased the displacement of the new, two-rotor, RX-4 rotary engine. Displacement is 40 cu. in. x 2 as compared to 35 cu. in. x 2 for the RX-2 and RX-3 powerplants. Also visible on the new rotor is the deeper, differently shaped depression used on the rotor faces. Horsepower of the RX-4 engine is 110 compared to 97 hp for the RX-2 and 90 hp for the RX-3. Later this year Mazda will discontinue its piston-engine model 808, and, with the introduction earlier this year of the rotary engine pickup truck, have only rotary engine vehicles for sale in the country.



Handling, power, performance and comfort top the list of what owners like best about their Mazda RX-2 and RX-3 models. In our test, we rated the RX-4 coupe (above) high in these categories also.

deal: A Houston TV serviceman comments, "Mazda is about one step behind Mercedes in workmanship. I used to own a Mercedes 220, and the Mazda can run rings around it. My RX-3 is faster, quieter, and cheaper."

A Texas mechanical engineer: "Mileage must be improved if the Mazda is to remain competitive. The gas tank is too small for comfortable cross-country travel these days, because 14.5 gallons times 17 mpg equals only 246 miles per fill-up."

A Sacramento soldier: "I am very happy with my Mazda. I knew that fuel economy would be somewhat inferior to comparable small imports. I felt, though, and still feel that the advantages of the rotary engine outweigh the poor fuel mileage. I might be willing to trade some performance for better gas economy, yet there's no denying the fact that my RX-2 is a real pleasure to drive." ★★★



The RX-4 coupe (above) and RX-4 sedan and wagon are on a 99-inch wheelbase. This compares with a 91-inch wheelbase for the RX-3 models and a 97-inch wb for RX-2 models. The RX-4 is longer and wider, too. It remains to be seen (in a future Owners Report) what the reaction will be to the overall styling of the new line: RX-2 and RX-3 owners were more impressed by other attributes and rated styling behind handling, power, performance and comfort on their list of likes.

Taking the

Everyone is in the mpg rating game—and everyone comes up with different figures. So, how do you find out what a car really gets? Simple. Ask an owner. Or, better, let PM ask a thousand owners.

Last Fall Mazda was robbed of several mpg by the government. Mazda RX-2 and RX-3 models tested by the Environmental Protection Agency (EPA) got less than 11 miles per gallon. The same models tested by the manufacturer indicated that "17 to 20 mpg" is what could be expected. New tests conducted by the EPA this past April showed that 13 to 21 mpg was the more accurate mileage range that owners could expect. Mazda agreed.

Meanwhile, consumer organizations, auto dealers, car magazines, independent laboratories and so on are all publishing the results of *their* tests. So, whom do you believe? For our gas money, we'd say the people who own and drive the cars. Owners of RX-2 and RX-3 models are getting 15.7 to 19.2 mpg. That's just a small part of the information provided in PM's surveys of car owners.

No other test can rival what a *PM Owners Report* reveals: a fuel consumption figure that is determined by close to, or more than, one million owner-driven miles on several hundred cars in all parts of the country. Still the cars will be tested and the results published. Here, in a nutshell, is how *they* measure fuel economy.

The EPA's numbers are not even fuel economy figures. That is to say that the mileage figures it publishes are actually by-products of other tests. Each new car is tested by the federal agency to certify that it meets exhaust emission requirements. Using a formula they have developed, EPA engineers then translate the emission figures into fuel economy numbers.

Further, all of this takes place while the car is stationary, its rear wheels cradled in the two large rollers of a chassis dynamometer. As the car is "driven" according to a set pattern, its exhaust gases are being caught in bags where they will later

mystery out of miles per gallon

be analyzed to see if the car meets EPA standards for hydrocarbons (HC), carbon monoxide (CO), and oxides of nitrogen (NOx).

Carbon dioxide (CO₂) is also measured, and this, along with HC and CO, are used in the formula to determine how much fuel has been consumed during a 7.5-mile "drive" on the dynamometer.

"Make one mistake in the measurement, particularly in CO₂—which is something we haven't even had to be concerned with before—and everything could be wrong," says Dr. Craig Marks, technical assistant to the vice president of engineering at General Motors.

"We have no quarrel with the formula itself," he continues, "but the trouble with EPA's calculations is that it's on a single vehicle. We in industry say that the best way to test for fuel economy is to average the tests of a number of vehicles, driven *on the road*, and not on a dynamometer."

The EPA has asked the Society of Automotive Engineers—as spokesman for the auto industry—to come up with a driving cycle to replace their own highly-criticized test procedure. But industry and the SAE prefer a set of driving cycles.

"Our point," says Marks, "is that there's a range of fuel economy that people will get in driving. There isn't a mileage for a car. A driver should be given a choice of figures. Then he can relate one to the way he's going to drive."

The EPA's Urban Dynamometer Driving Schedule of 7.5 miles is likened by GM engineers to the worst downtown traffic you can encounter. In fact, the driving mode was based on a 12-mile trip in the morning crush through the most congested streets and freeways of downtown Los Angeles. Some idea of its severity can be seen in the fact that there are 2.4 stops per mile and that most of the trip is made in the 12 to 28-mph range, with the highest speed obtained being 42 mph.

Only one of GM's tests is anywhere near as severe as the EPA test. This is the Business District Cycle, which simulates driving conditions in heavy downtown city traffic. There are four prescribed stops per mile, top speed is 30 mph, and the average speed

is 16 mph. A Cadillac de Ville that was tested according to this cycle got 9.6 mpg, compared to 8.9 on the EPA test.

In each of the other tests General Motors uses to determine fuel economy, the Cadillac recorded even better figures. Which is just one of the reasons why GM is using a variety of driving cycles to indicate the fuel economy effects of various driving situations.

They also test 10 cars, using the average of all 10. Each car is driven over an identical route under similar conditions on city streets, urban roads and highways—not in a laboratory. If there is as much as two percent difference, up or down, from the norm, the figures for that car are thrown out and there must be a retest.

In GM's Suburban City Schedule, the vehicle is not driven over 40 mph, makes 1.6 stops per mile, and averages 24 mph. The Cadillac mentioned earlier got 12.0 in this test.

GM also has two runs over the highway. The first is meant to simulate driving conditions on rural paved roads and the second on Interstates.

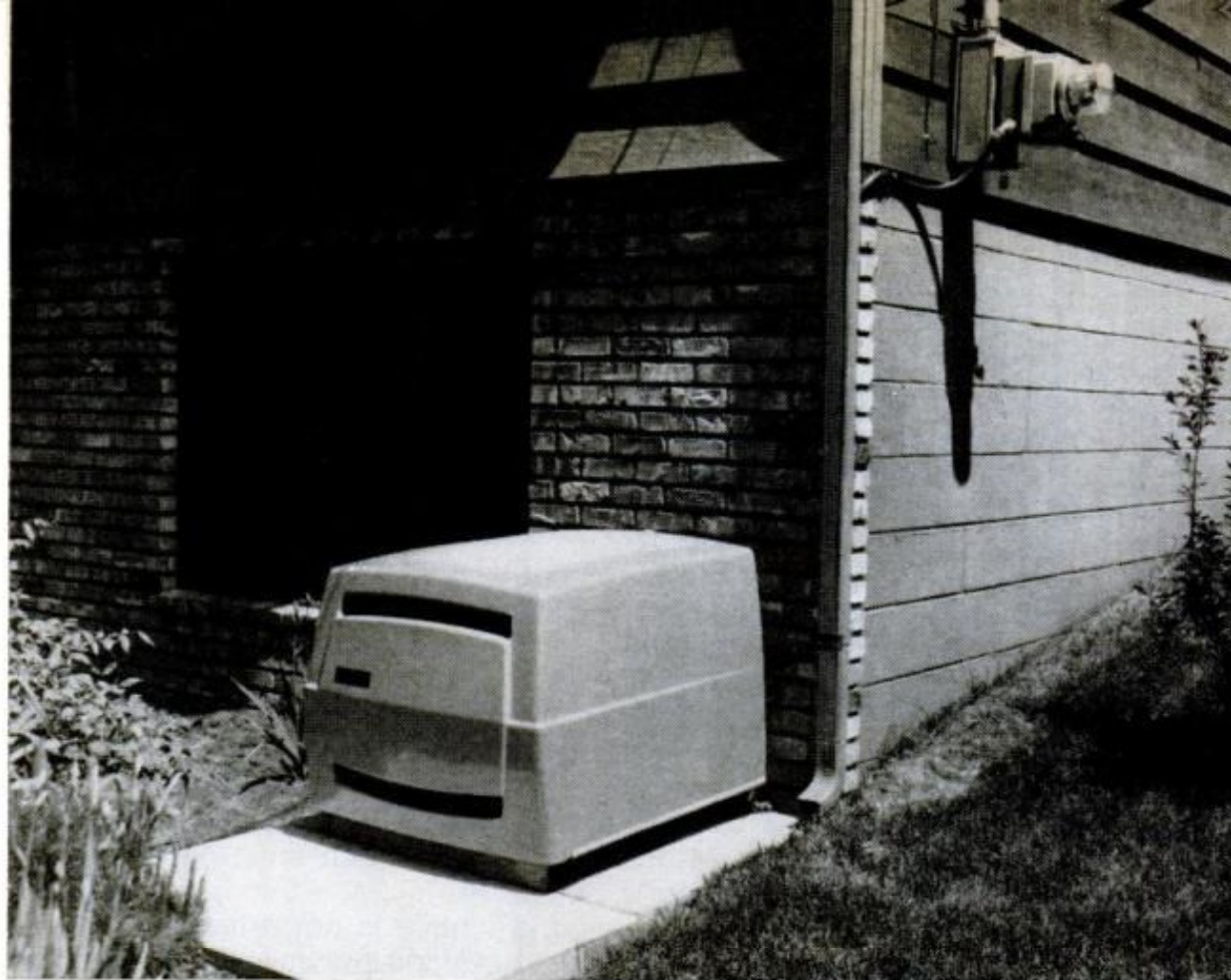
Other economy tests GM makes are strictly to establish optimum economy figures and comparative consumption curves. These are made while the cars are being driven at absolutely constant speeds, starting at 30 mph, then 40, 50 and so on. They are all conducted at the proving grounds under controlled conditions on level roads. Each car is driven in two directions, so as to average out any possible variation in wind or road surfaces.

Since these are engineering figures, General Motors prefers generally not to publicize them. No one drives his car in such a manner, they say, because of traffic and road conditions one encounters in everyday driving.

But, to counter the bad EPA numbers, Cadillac used some of the test figures in their advertising. The average mpg of 10 deVilles driven at a steady speed of 50 mph was 15.8 mpg, they said. One got as high as 16.3. The deVille referred to earlier got 16.6 at this steady speed of 50.

As for the other auto manufacturers, they use variations of the GM tests. Each, though,

(Please turn to page 162)



Your own electric power—whenever you need it

If electric power in your neighborhood goes out for a day or more, it can be disastrous for your home. In winter, pipes can freeze and burst. In summer, food can spoil. In any season, a basement can flood when a sump pump stops. Those living in the northeastern United States learned this during last December's ice storm.

Now Onan Corp. is offering what it calls "energy insurance" in the form of a complete home-standby power system. Like home fire insurance, Onan says, you may never need it but it's good to know it's there. Such a system can start supplying your home's electrical needs in minutes, and

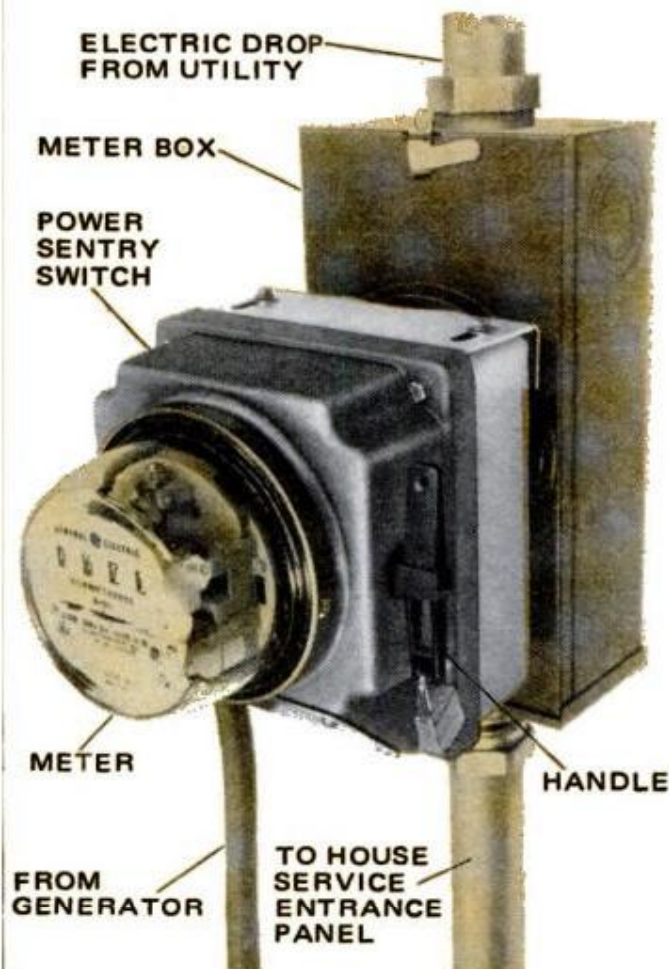
Home standby power system consists of 5000-w. gasoline-powered generator on concrete slab, Power Sentry Switch is for safe, instant transfer of house load from utility to generator and connecting cables.

keep you going until your local power company restores service.

Generators aren't new. What is new is Onan's Power Sentry Switch, for houses with up to a 150-amp. service, the means of bringing your generator on-line safely.

When you turn the handle of the switch, a solid click tells you that the house electric load has been transferred from utility to generator. Most important, it disconnects the house from utility lines *before* connecting the generator. This assures that current from the generator cannot enter utility lines—where it could prove fatal to power-company linemen working to correct an outage. With the Onan unit, it can't happen.

The switch's added advantage is that it is installed at the service entry, and requires no house rewiring. Putting it in is not too difficult for the experienced electrically inclined do-it-yourselfer, but codes must be followed, and in some areas they may require that a licensed electrician do the job. In any case, the work will have to be approved by your city or state electric inspector, and your power company will have to reseal the meter.



Power Sentry Switch is installed at house service entrance between standard meter and meter box without any other rewiring at service panel, keeps current from generator from entering utility's lines.

Price of the Power Sentry Switch (less installation) is about \$270. An automatic version, which will sense outages, start a generator and transfer house load to it by itself, switch back to utility power when the outage ends, will be available later this year at a price of about \$470. For those who own recreational vehicles with generators that produce 120/240-v. power, Onan offers the switch with waterproof receptacle kit and dual-twist-lock extension cord for about \$350. It can also be used with alternators run by farm and riding garden tractors.

How much power do you need? According to Onan, a 5000-w. generating set will meet the basic needs—lighting, food refrigeration and heat—of an average-size home. It will run from 6 to 12 hours, depending on the electrical load imposed, on a 5-gal. tank of gasoline (generating sets that run on LP and natural gas can be ordered). It occupies about as much space as a central air-conditioning condenser. A full system with 5000-w. generating set and Power Sentry Switch costs about \$1700. For information, write Onan Corp., Dept. PM, 1400 73rd Ave. N.E., Minneapolis, Minn. 55432. ★ ★ ★

HINTS

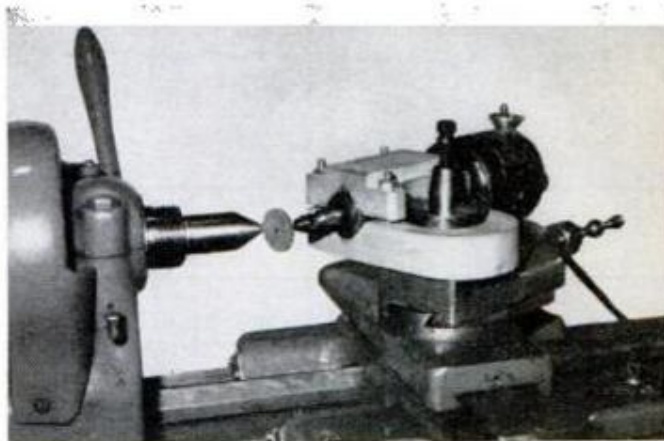
FROM READERS



Miter clamps for rabbet joints

Holding a rabbet joint squarely for gluing and nailing is made easy with a couple of miter clamps such as the types shown. They're especially good for wide work.

—Bertram Slanhoff, Scarsdale, N.Y.



Improved toolpost grinder

You can use a hand grinder as a toolpost grinder by clamping it in a mounting attachment like one I made of hard maple (other hardwoods could be used). Dimensions are to suit grinder, toolpost and rest, with grinder's centerline level with that of work. Toolpost and toolpost ring clamp the assembly to the compound rest.

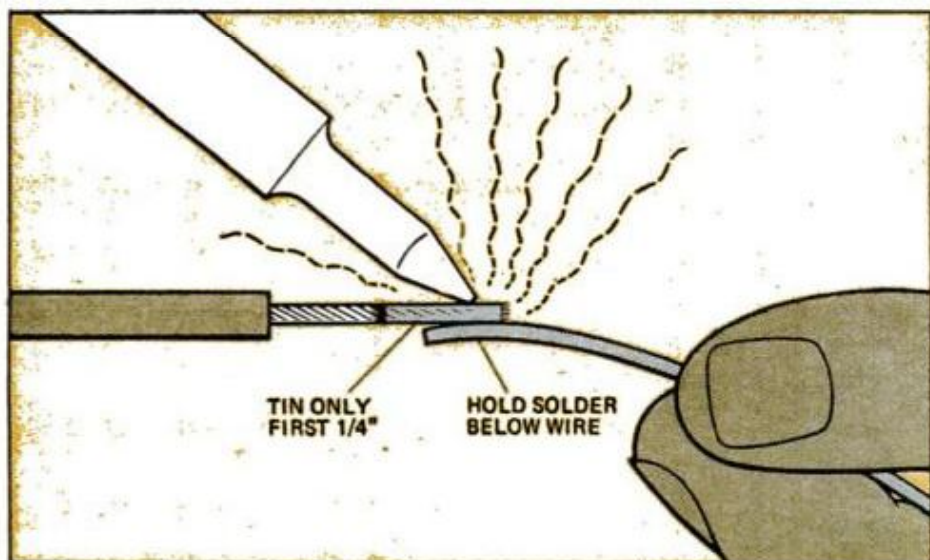
—Carl A. Traub, Milwaukee

How to solder electrical and electronic wiring



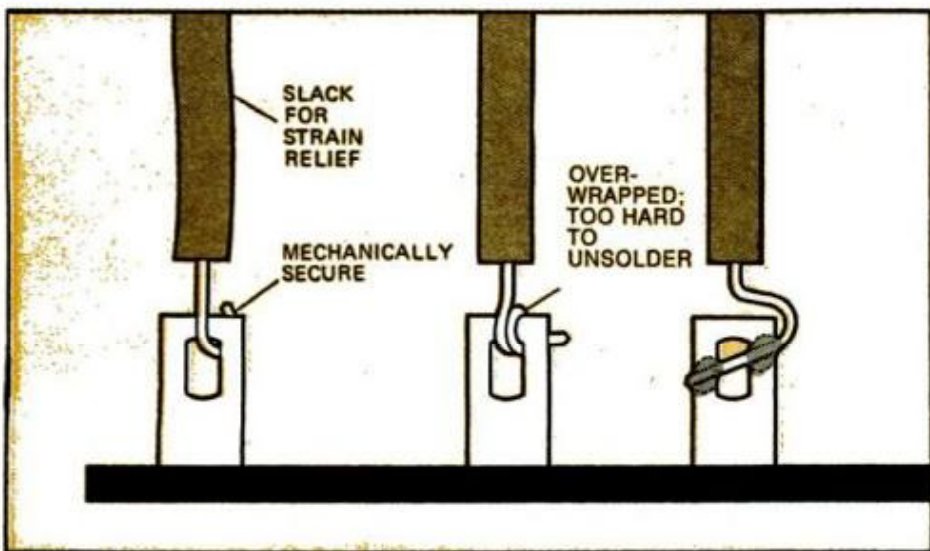
Keep your iron clean

A dirty iron won't transfer its heat to the joint efficiently. For best results, "tin" your iron's tip with a thin, shiny coating of solder before using it. After every few joints, clean the tip with a damp cloth or sponge—more often, if it acquires a dirty, dark, or charred look, like the one shown at the far left. After cleaning, if the tip has lost its shiny appearance, retin it with another thin coat of solder. When the job is finished, clean and retin your iron again before you put it away.



Tin wires carefully

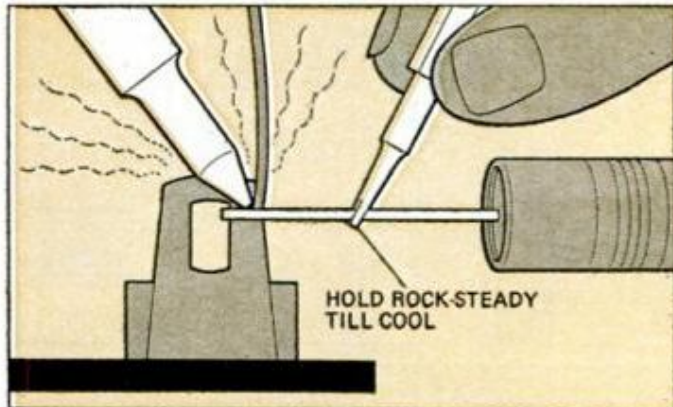
Tinning any wire with a thin coat of solder makes it easier to solder to a joint. Tinning stranded wires also helps hold the strands together at the tip. Hold the solder below the wire so it will soak in, not drip on, and remove it and the iron once the solder has soaked into the first 1/4 inch of the wire. Don't tin remaining wire—it could become brittle and the joint break if wires are flexed or pulled. When soldering shielded cable, be careful not to melt insulation by applying too much heat.



Make solid connections

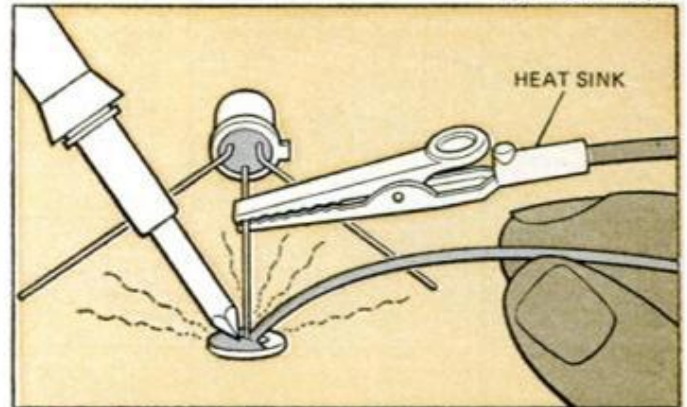
Before soldering, wires should be bent to form mechanically secure connections (far left) that can stay in place even without solder; the solder's job is to maintain good electrical contact, not to glue wires into place. Leave some slack in the wire, too, to prevent strain on the connection. Too complex a wrap (center) makes it harder to unsolder the wire for servicing. But a solder-only connection, with no wrapping, will usually yield a "cold-solder" joint, and often come apart.

Art: Peter Trojan



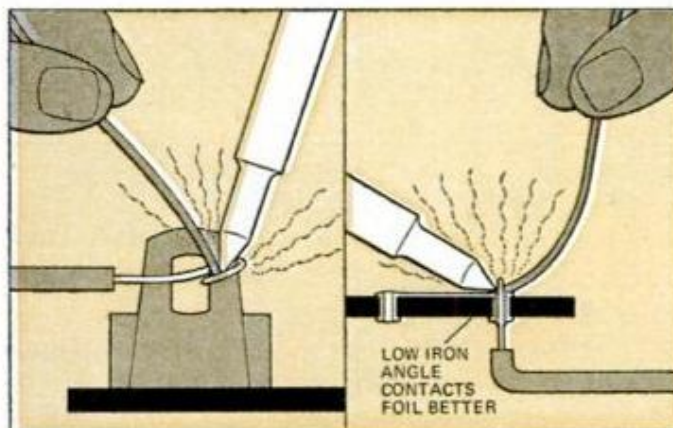
Keep wires stationary while cooling

Wires that move while the solder cools cause unreliable "cold-solder" joints. If you can't hold the wires in place with a good mechanical connection (as shown above, where a component lead is too short), hold them in place with soldering aids or other tools until the joint is cool. Brace your hands, if necessary, to prevent shaking. Don't try to hold wires in place with the soldering iron—they'll spring up again as soon as you take the iron away. Soldering aids, of metal that solder doesn't stick to, also have many other uses.



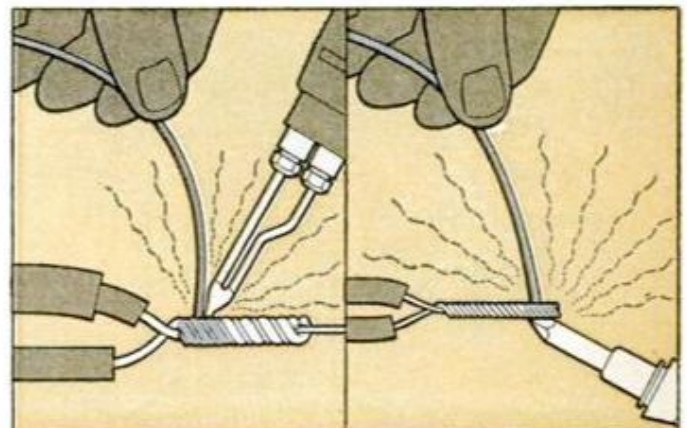
Heat sinks protect transistors

The heat of soldering can cook transistors and integrated circuits. If you're not using sockets, clip a heat sink between the joint and the transistor body to prevent this. Commercially made heat sinks are good, but you can also make your own from an alligator clip with a stub of heavy copper wire attached; or cement some felt into the clip's jaws and moisten it before each use. With no heat sink, use the least-powerful iron that will bring the joint *quickly* to soldering temperature. Too-small irons will cook more transistors than you'd think.



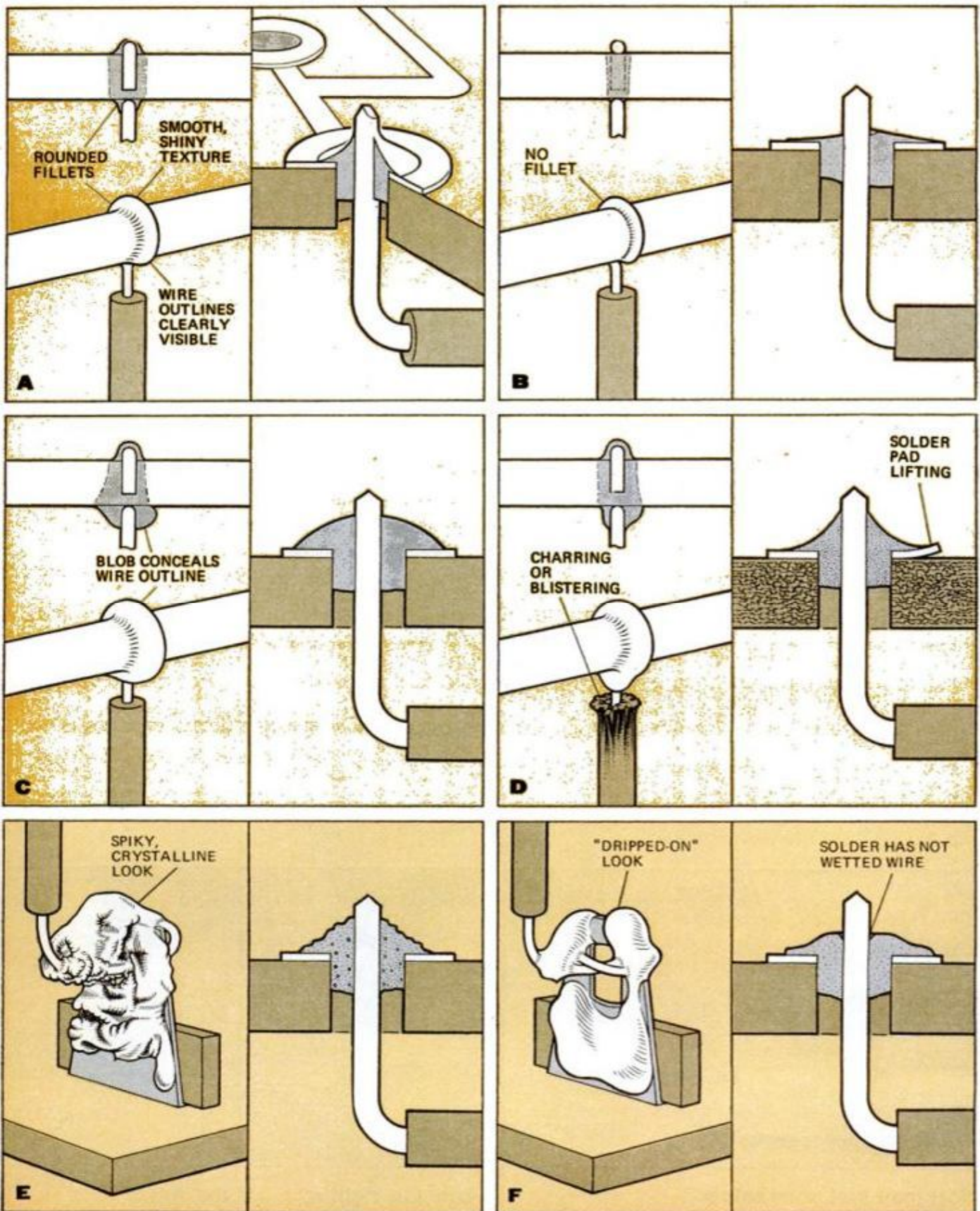
Heat joint first, then solder

Don't just melt the solder and drip it onto the joint. First, heat the joint with the iron for a few seconds, then move the solder into contact with both the iron tip and all the parts or wires to be soldered. When the joint is hot enough, the solder will flow over and into it, wetting it evenly, filling in spaces, and cooling to a smooth, silvery sheen. If the joint takes more than three or four seconds to heat, though, you're using too small an iron for that job; try a slightly heavier one.



Use the right iron for the job

Electronic soldering is usually done best with medium-wattage pencil irons—hot enough to heat fine electronic wires quickly without cooking components. Heavy household wiring jobs are best done with high-wattage guns, powerful enough to heat the joint rapidly without having to bake wires and insulation for minutes; guns, which cool off between joints, are also handier than continuous-heating irons for use in the awkward places typical of house-wiring and other electrical situations.



How to tell good solder joints from bad ones

Good solder joints (A) are smooth and shiny, with the outlines of all wires and contacts clearly visible, but with rounded fillets of solder filling in the gaps and corners where wires meet.

Insufficient solder (B) leaves no fillets, may not maintain a reliable connection. Too much solder (C) covers a connection with big blobs (which sometimes cause short-circuit bridges between

conductors on circuit boards); there may be a good joint underneath, but you can't see it to tell.

Overheating (D) chars wire insulation and it may lift solder pads from circuit boards or harm delicate components. Cold solder joints may have a jagged, crystalline look (E), a dripped-on, blobby appearance not conformant to outlines of joint (F), or merely a hazy, milky sheen (not shown). ★★★

Sitting on an open patio during a cool summer evening sounds great, but how many times have you been chased inside by mosquitoes and other nighttime insects? I was chased for the last time when I rigged up the hanging bug trap you see here—it solved the patio bug problem for good.

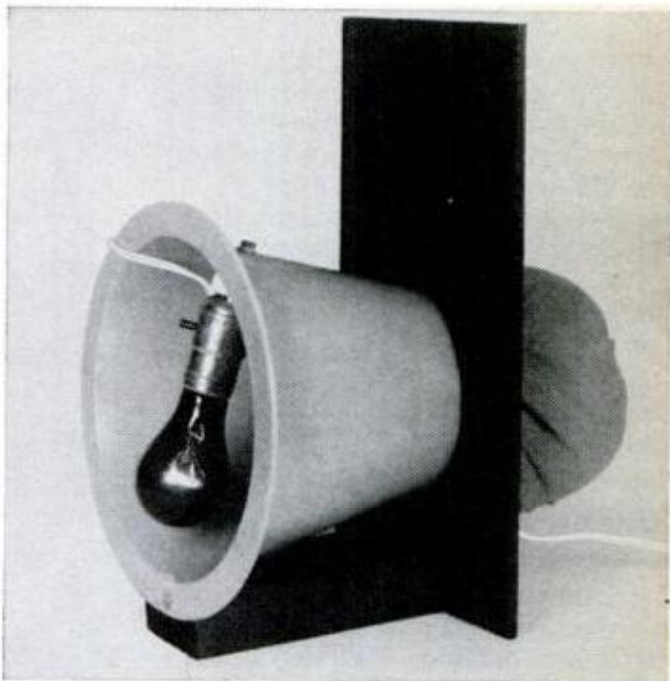
Knowing that black light attracts most insects, I placed a 100-w. black-light bulb in a plastic flowerpot after cutting a hole in the bottom. Using the pot as a funnel, I fastened it over a same-size hole in a piece of plywood, then bolted a small electric suction fan (4½ in. sq.) to the back to suck the insects from the bulb into a bag made from pantyhose. Once drawn in the trap, the bugs can't escape back through the fan—it works like a charm.

I bought the fan in a surplus store for \$3 and attached it to the back of the plywood with four small stovebolts. The drain hole in the bottom of the plastic pot can be enlarged to 2 in. or so with a round file, leaving a flange around the inside for attaching the pot to the plywood with two small bolts. A short ¼-in. pipe nipple and nut holds the socket to the pot.

I made the trap from discarded pantyhose by cutting off the legs as shown below and tying the ends in a square knot. The elastic top of the hose grips the fan snugly.

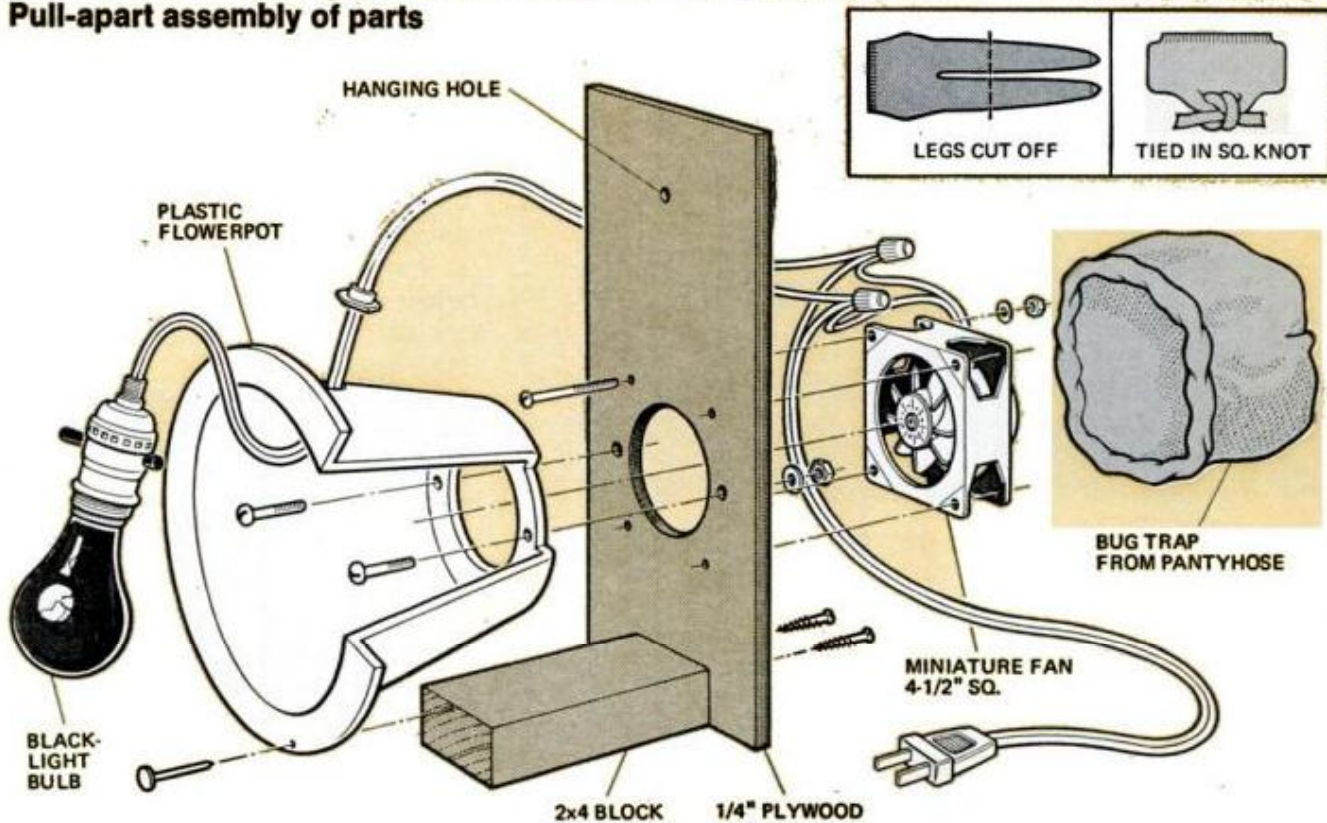
—M. J. DiStefano, Bradford, Mass.

Say good-bye to patio bugs



When mosquitoes flock to light bulb, fan immediately sucks them into hosiery trap for later disposal.

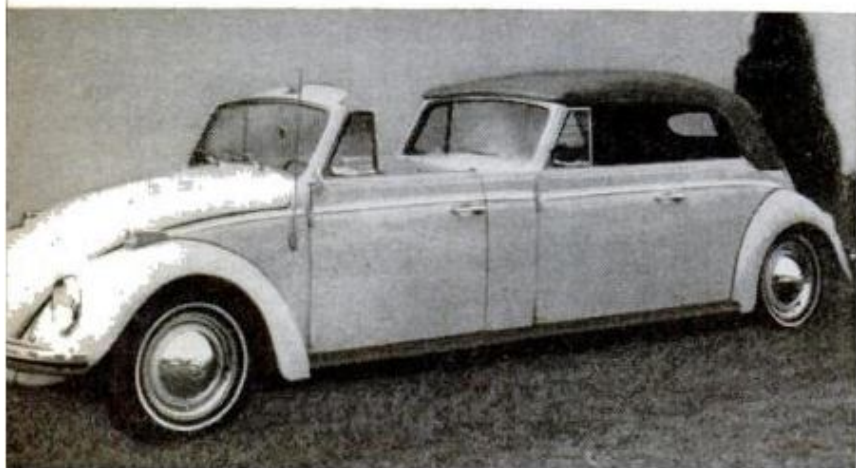
Pull-apart assembly of parts



IT'S NEW NOW

Flying high—on the ground

Learning to fly a high-speed single seat plane is tricky because there's no way for an instructor to ride along with the student. Bede Aircraft of Newton, Kans., came up with this clever answer—a mobile flight trainer to help beginning pilots learn to handle its kit-built BD-5 sport plane (see *BD-5: Bullet-Nosed Beauty You Can Build Yourself*, page 174, Nov '72 PM). The simulator consists of a full-size BD-5 mounted on the end of a pivoting boom attached to front of a pickup truck. An instructor drives the truck along the runway at speeds up to 70 mph while the student practices realistic landings and take-offs without actually leaving the ground. An intercom between truck cab and cockpit enables the instructor to relay commands to the pilot while he's in "flight."



Combine two VWs and you get one 'Super-Beetle'

Carl Schneider of La Crosse, Wis., is the proud owner of the world's only four-door convertible Volkswagen. Unusual double-length "Super-Beetle" has the front end of one car joined to the rear of another, and a standard 1500-cc VW engine. Schneider, a VW dealer, got the idea when asked to come up with an economical "limousine" to transport visiting dignitaries in town. Several state governors and beauty queens have ridden in the "double-bug."

New battery shape: It's flat

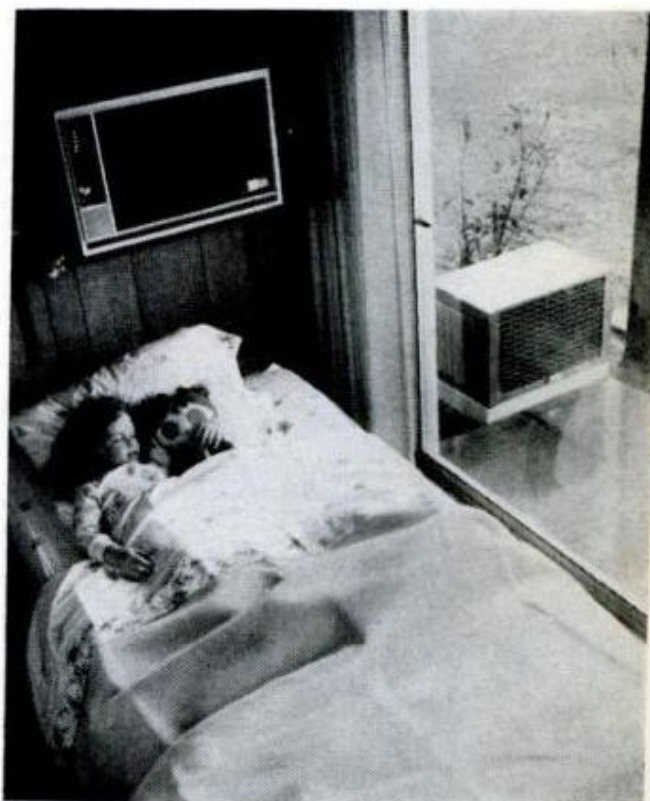
First new shape in batteries to come along since the 9-volt transistor type is the wafer-thin "Flat-Pak" shown below with standard round sizes. The tiny rectangular cell delivers 6 volts, has keyed contacts to prevent wrong insertion and opens the way to new miniaturized battery-powered devices. Mallory Battery Co., Tarrytown, N.Y.





New wrinkles in keeping cool

For central airconditioning, Carrier offers top-of-line "Super E" condensing unit (below) in 2, 2½ and 3-ton capacities, boasting higher efficiency, lower sound levels than previous deluxe models. Carrier Air Conditioning, Carrier Parkway, Syracuse, N.Y. 13201. For room additions, mobile homes, cottages, Sears modular system (right) puts condenser outside like central systems, leaving windows unobstructed. Prices start at \$219.95 for 6000-B.T.U. model.



NOW

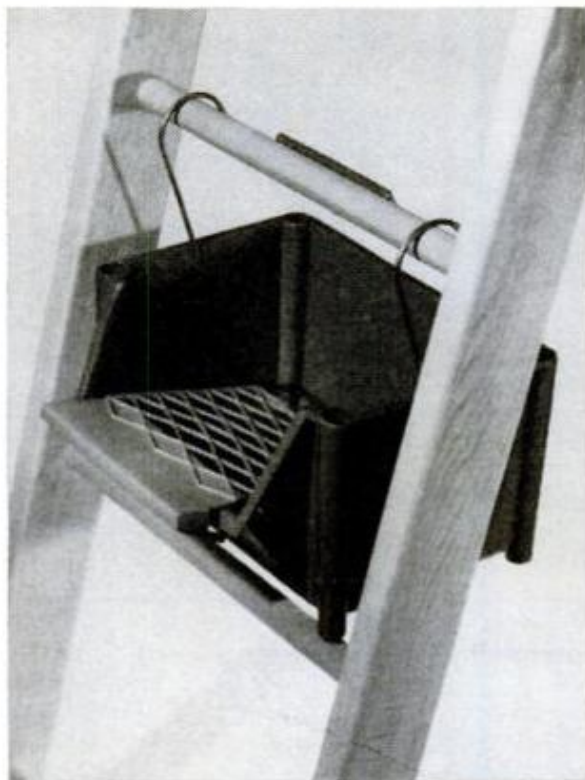


New light on pocket photography

Ricoh's new \$110 Ricohmatic 110X camera (top) has a backlight compensator in its electric-eye exposure control, so you can expose backlit subjects or bright snow and beach scenes accurately. The 110X also has a 25-mm, f/2.8 lens, shutter speeds to 1/250 second, and focus settings for 3, 5 and 12 feet and infinity. Soligor's Pocket Flash Adapter (bottom) fits Kodak Pocket Instamatic 20, 30 and 40 models, lets you use any "hot-shoe" electronic flash. It's \$6.

Take-along 'paint box'

Paint Box Bucket has drop front, hangs on exterior ladders, sits on stepladders. Ideal for flat applicators, can also be used with brushes, rollers—or as a tool tray. Polyethylene plastic cleans easily; \$2.75. Product Development and Manufacturing Co., Box 727, Mendota, Minn. 55050.



Stringing phone cables the quick way—with a bow and arrow yet!

The man at left isn't having a shootout with passing motorists using a bow and arrows. He's a telephone installer for Florida's General Telephone Co., and he's getting ready for an unusual job—shooting telephone cables through buildings. The phone company came up with the novel technique to speed the work of running long lines across inaccessible false ceilings in supermarkets, factories and other large structures. The installer simply shoots an arrow across the ceiling with a string tied to it, then pulls the cable through with the string.

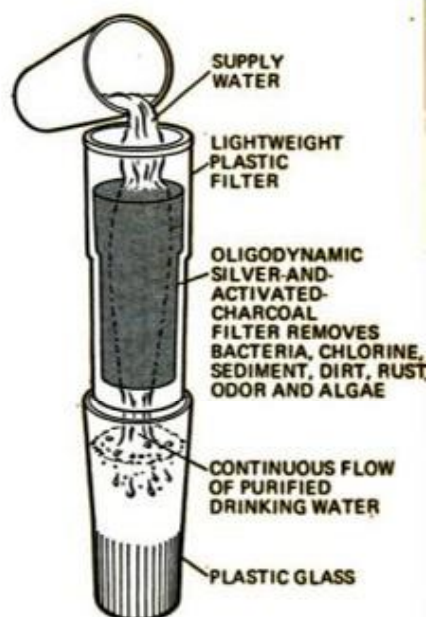


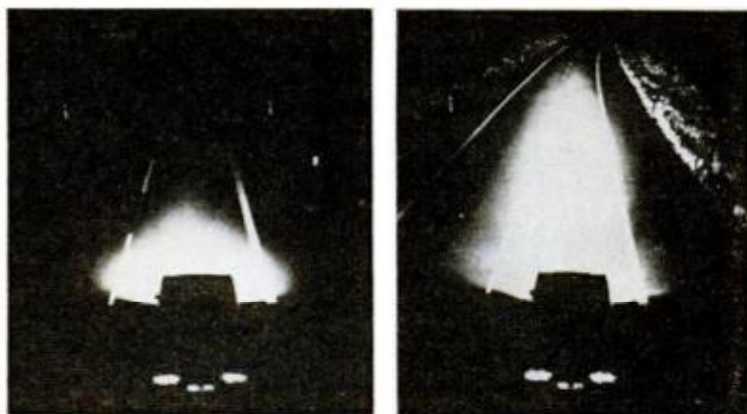
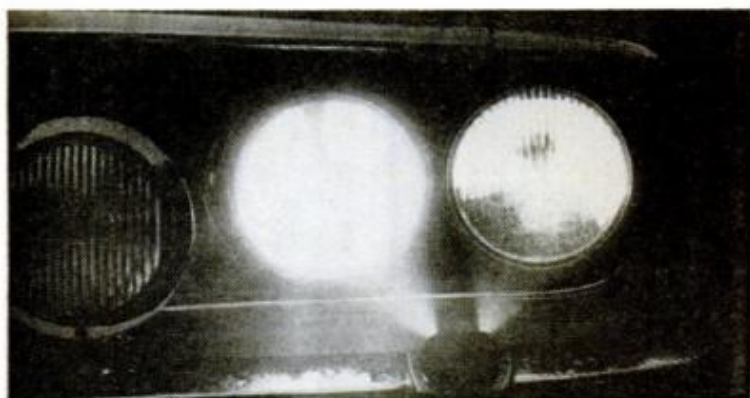
Bicycles built for lots of things

Would you believe a bicycle built for 16? Shown at upper right, the mass carrier is the work of Carl Canty of Hull, England. It weighs 1 1/4 tons loaded and is pedaled by the 10 outboard riders—ideal for large-group outings. Bike at upper left has two-wheel power for extra speed and hill-climbing ability. Rear wheel is powered by conventional pedals, while front one is driven by hand cranks in place of usual handlebars. Inventor is Dr. Siegfried Lehr, Rehmstrasse 30, 8 München-Neuried, Germany. Another German inspiration (left), a sun and rain canopy, keeps tandem riders cool, dry.

Portable purification plant

Waterpack water purifier removes bacteria, insecticides, algae, rust, sediment and chlorine from up to 1500 gallons of water for less than 3 cents per gallon. For travel, emergencies or routine home use, it improves flavor of beverages and of foods cooked with water. It comes with carrying case and tumbler. Available in department stores, Waterpack sells for \$39.95 suggested retail; for information, write Pollution Control Products, Inc., 1040 Bayview Dr., Fort Lauderdale, Fla. 33304.



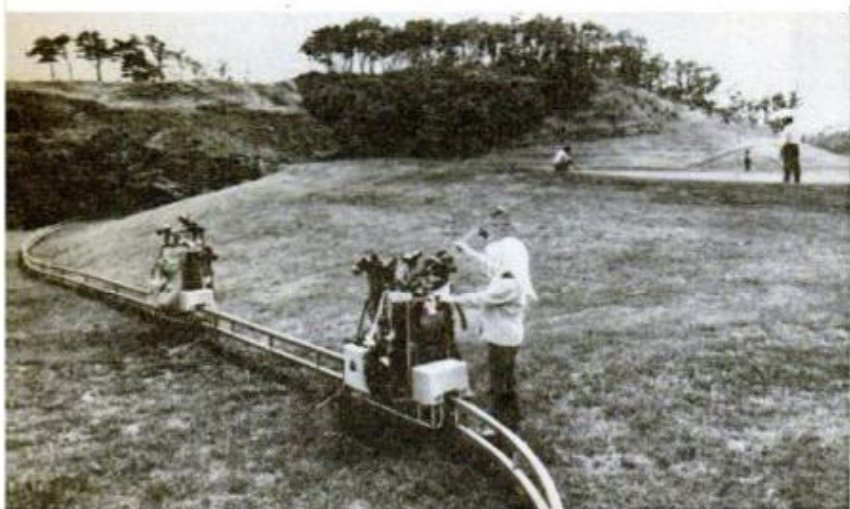


Brighter future for dirty headlights

First it was windshield washers; now it's headlight washers. Tiny water jets in the bumper spray your headlamps clean at the touch of a button in this new German invention. Proving that the system offers improved vision at night, lower photos above show view of road before washing (left) and after washing (right), indicating an increase of more than 50 percent in light output. Washer accessories fit most cars, come in two and four-headlight models, are sold by Messrs. Hella, Box 604, 4780 Lippstadt, Gemany. Prices vary with make of car.

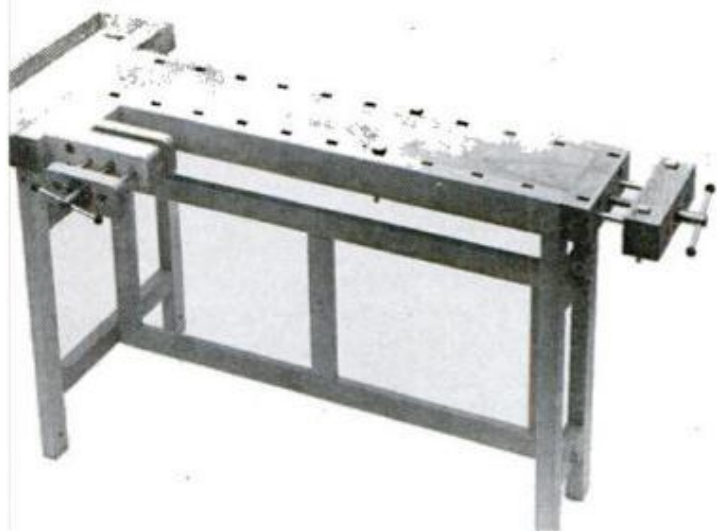
Wall-framing system in a complete package

An interior, nonbearing wall in a box—that's the Easy-Frame steel-stud wall system from Sears. One package includes enough studs, runners, adhesive and tape to frame 8 linear feet of wall up to 8½ feet high. Studs are adjustable for height needed and wedge in place between floor and ceiling. Installation requires no cutting or nailing. System can be used with gypsum, plywood paneling or fiberboard to complete the wall. \$24.95 per package (8-foot section).



Monorail golf caddy carries your clubs—but you still have to walk

You don't need a caddy to carry your clubs with this elaborate monorail system built at a swank golf course near Kobe, Japan. You just slip the clubs into a motorized cart and off they roll to the next hole for you. The system, involving more than 28,000 feet of monorail track, cost \$210,000 and was developed by Sanyo Electric Co. Now if they'd just add a seat on the cart, you could ride with your clubs in style.

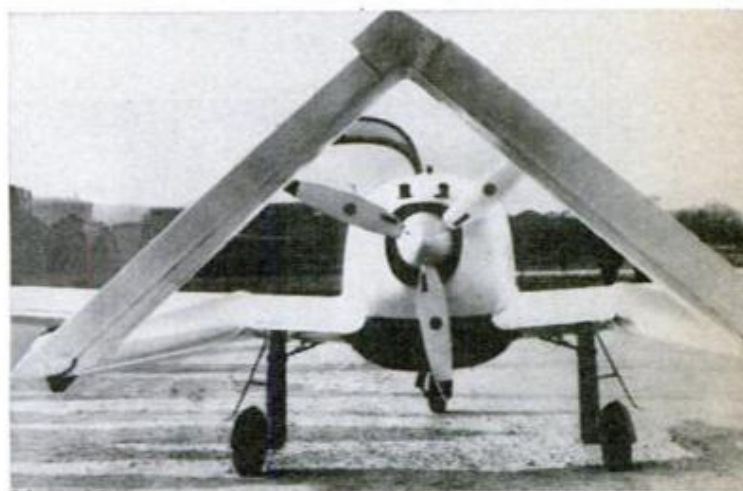


Fine workbench for woodworkers

Danish workbenches of lacquered beech feature both horizontal and vertical-hold vises, tool well (may be positioned at end or side of bench); steel dogs in bench slots that take the place of clamps. Virtually any kind of workpiece can be held in practically any position. Each vise has two guide rods for stability. Available in 49, 60 and 80-inch lengths. The 60-inch bench shown folds flat for storage, sells for \$249.95; 80-inch for \$349.95 f.o.b. Craft Products Div., Leichtung & Galmitz, 5195P Mayfield Rd., Cleveland, Ohio 44124.

Powered bike you can pedal, too

Cross a motor scooter with a bicycle and you get this Mars Electra, said to be the first truly practical electric two-wheeler. The battery-powered bike, first introduced in Europe, is now available in the United States, needs no license in many areas. It travels 25 miles on a single charge, hits up to 16 mph, can be recharged from any wall outlet. It can also be pedaled to save electricity or for an extra power assist on upgrades. For prices, write F. J. Kielian, Specialty Merchandising, 130 Drake Ave., South San Francisco, Calif. 94080.



Flying 'roof'

What looks like a plane with its wings folded is actually an unusual inverted-V tail on an experimental German ship designed by the University of Stuttgart. The rooflike tail, mounted on twin booms, forms a tunnel around the airstream from the single pusher prop. Effect is said to reduce drag while providing exceptional stability and control. The two-place FS-28 is powered by a 115-hp Lycoming engine, cruises at 167 mph and can land at 50 mph.

NOW

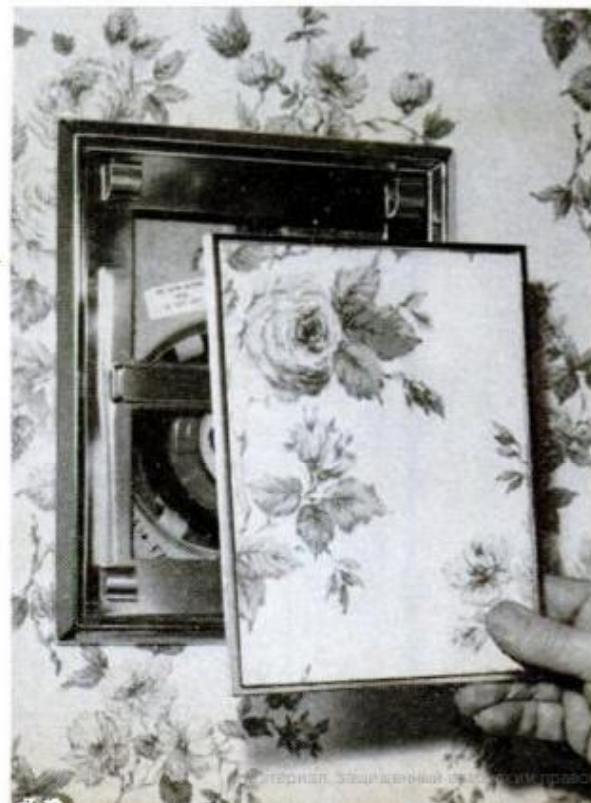


Home-brew yogurt machine with timer

Natural Yogurt Maker cooks up yogurt the way you like it—soft and delicate or firm and tart—in its six 8-ounce storage-serving jars at a third the cost of store-bought yogurt. Model shown, \$19.95 suggested retail, has timer that shuts machine off when yogurt is ready; standard model is \$11.95 suggested retail. Electric Char-B-Que, 371 Essex Rd., New Shrewsbury, N.J. 07753.

Nearly invisible exhaust fan

It's hard to spot this exhaust fan on a wall or ceiling when its center panel is decorated to match the surrounding surface, yet it moves 80 cubic feet per minute through its concealed air-intake ports. Less than 4 inches thick, the fan has a self-lubricating motor, mounts between 16 or 24-inch o.c. studs or joists. Beveled trim is bright aluminum. \$33.90. For information, write Nutone Div., Scovill; Madison and Red Bank Rds., Cincinnati, Ohio 45227.



Three new additives for your car

Ethyl Corp., long an industrial supplier of petroleum additives, has three new products for consumer use—its first. "Motor Saver," an oil additive, is said to reduce harmful oil deposits, prolong engine life. "Oil Saver" is designed to prevent excessive oil burning, smoking in older cars. "Performance Saver," a gasoline additive, keeps fuel systems clean to improve performance and fuel economy. At service stations.



Inexpensive files you fold yourself

Fold-your-own file boxes assemble in minutes as sturdy, colorful four-slot storage compartments for important papers and plans. Of heavy cardboard, they stack vertically or horizontally, come in black, blue, green, yellow or wood-grain finish. \$1.99 each from Pacific Diversified Products, 732 S.E. Powell Blvd., Portland, Ore. 97202.

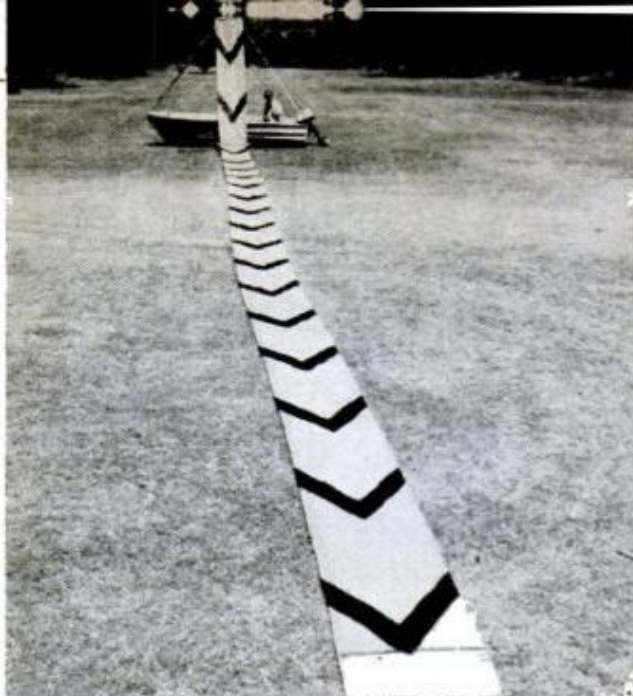


Casual hassock kits

These toadstool-shaped hassocks are made from shag carpet, carpet padding and rough wood. Do-it-yourself kits include all materials cut to size except wood, which you supply from scrap. \$17.50 postpaid. Carpeting is multicolor tweed in tones of red, green or gold; wood bases can be stained or painted to match or contrast. Also available are instructions alone, for those who have materials on hand, for \$2.95 postpaid. Toadstools, Dept. PM, Box 1044, Mason City, Iowa 50401.

Spot has halogen brightness

Hand-held quartz-iodine spotlight illuminates objects more than ½ mile away. H3 halogen bulb, brighter than sealed-beam units, has 2½ times their life. Spot plugs into any 12-volt cigaret-lighter receptacle, is chrome-plated, has switch in pistol grip; \$24.95 postpaid from Glen-Bel Enterprises, Route 5, Crossville, Tenn. 38555.

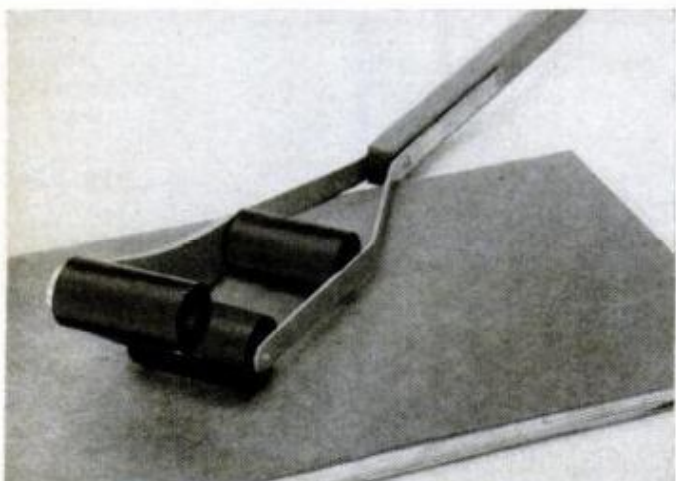


Distress signal for land or sea

Stretch out this long, brightly colored orange and black streamer and you have a highly visible distress marker that can be seen for miles. The strip floats on water for use by boaters in trouble at sea, or can be laid out on land to help guide rescuers. Radar-reflective, it can also be detected during night searches. Inventor is Ean MacDonald of Perth, Australia.

High-pressure roller for laminates

For working with laminates or veneers, Rollo Press provides more pressure with less work. Extra-long handle gives excellent leverage for best bond between laminate and board. Handle is removed for working edges. \$25.90 plus shipping; without handle, \$18.95 plus shipping (California residents add tax). Niemi Enterprises, Dept. PM, 21370 Applewood Dr., California City, Calif. 93505.



Phone light warns of missed call

If you're expecting an important phone call but are out when it comes, this red signal light flashes on, telling you your phone has rung so you can call back. It also functions as a visual aid for the hard-of-hearing. Device is powered independently from a wall outlet and triggered by a simple suction-cup inductive pickup, needing no direct connections to your phone line. Hot Lite is made by Hot Lite, Inc., 945 Central Ave., St. Petersburg, Fla. 33705.



Diving board has its ups and downs

Diving students in Mobile, Ala., have a choice of any diving level with this elevating board. It enables trainees to start out low (below), progress to high levels (left) as proficiency develops. Arrangement saves space and provides more flexibility than two or three fixed platforms. A hydraulic scissors jack, designed by Southworth Machine Co., Portland, Me., actuates it.



Full-cycle dishwasher for countertop

A countertop dishwasher that works the way the big ones do, Dishmaid washes, rinses and dries a complete service for four, using about one-third the water and one-eighth the electricity large dishwashers require for a load. Dishmaid measures 17¼ by 20½ by 22 inches. Available in stores or from the manufacturer, Zurn Industries, Consumeraids Div., 5533 Perry Hwy., Erie, Pa. 16509, it carries a list price of \$119.95.



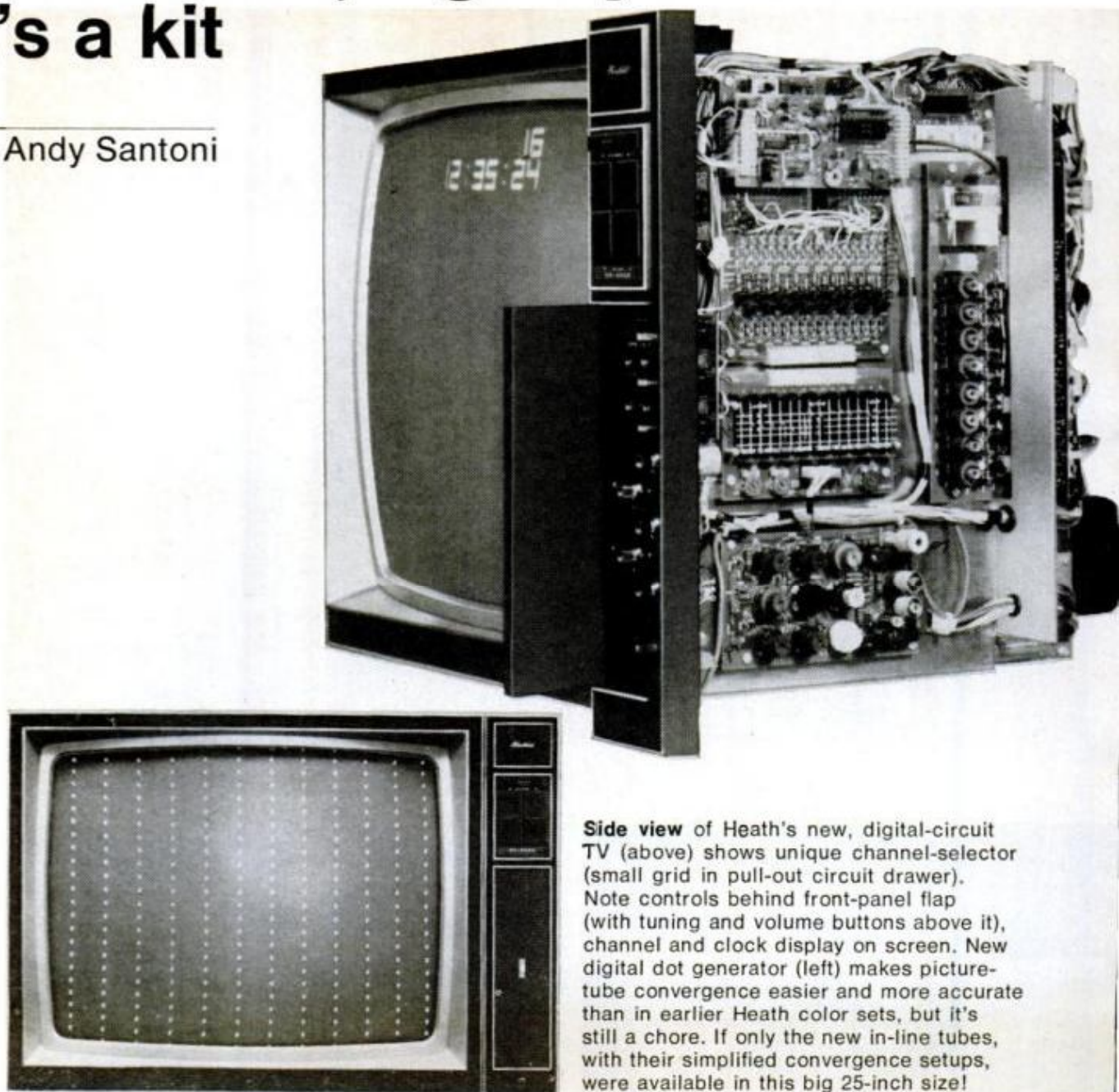
Handy aids for car care



Two new car-care aids from Turtle Wax are a self-polishing wax (left, above) and a general-purpose lubricating spray (right). The car wax, in a bubble-top container including applicator, is said to last four to six months and resist car-wash detergents. \$3.98. The spray, called Trouble Shooter, lubricates to quiet squeaks, displaces moisture to stop rust, penetrates to loosen nuts and does other odd jobs. \$1.79. Turtle Wax, Inc., 5655 West 73rd St., Chicago, Ill. 60638.

World's first pushbutton, digitally tuned TV— it's a kit

by Andy Santoni



Side view of Heath's new, digital-circuit TV (above) shows unique channel-selector (small grid in pull-out circuit drawer). Note controls behind front-panel flap (with tuning and volume buttons above it), channel and clock display on screen. New digital dot generator (left) makes picture-tube convergence easier and more accurate than in earlier Heath color sets, but it's still a chore. If only the new in-line tubes, with their simplified convergence setups, were available in this big 25-inch size!

Just as the first TV sets with pushbutton tuning are beginning to hit the stores, Heathkit has come up with one—the new GR2000—whose pushbuttons replace not just the tuning knob but the other most-often-used controls as well. But Heath doesn't quite build a pushbutton TV—you do, from Heath's kit.

On its front panel, you'll see no knobs—just four big, black buttons in a square: the tuning and volume controls. Push the lower right button, and the set goes on, its volume rising till you release it or push the lower-left button to lower the volume again. The

upper right and upper left buttons tune up and down through 16 preselected channels.

How do you know what channel you're watching? Channel numbers appear on the screen as you tune, in any position, and at any brightness you desire, staying on screen for as long as you wish (in practice, I found it didn't bother me to leave them on all the time); just preselect position, brightness and time with controls in the handy, pull-out circuit drawer.

That display is the outward sign of Heath's big circuit innovation: a tuner taking its cues from digital control impulses,

rather than from potentially troublesome mechanical turrets or switches. Each of its 16 channel positions can be set to any UHF or VHF channel, so you can line up the channels in any order you choose (grouping the ones you watch most often—even repeating your favorites—if you like), with no “blanks” to pass over between occupied channels. Each channel has its own fine-tuning adjustment (also in the circuit drawer); you never have to readjust when changing channels. (There’s also an automatic fine-tuning switch hidden with other controls behind a front-panel flap.) Channel-display numbers are set independently; that’s handy if UHF signals reach you on a cable system’s VHF slots—just set the display to the station’s true number.

Some of the GR-2000’s other features were also designed with cable (and other problems) in mind: There are antenna inputs for 75-ohm cable as well as standard (or shielded) 300-ohm twin-lead, the tuner is thoroughly shielded to prevent interference between cable and broadcast signals, and new, solid-state IF filters lessen adjacent-channel interference.

More pushbutton pairs behind the front-panel flap control color and tint—but these (and volume buttons) work only if you buy the optional remote control. Otherwise, you must adjust hard-to-grip slider controls. Conventional knobs control brightness, con-

trast, vertical and horizontal hold, and tone.

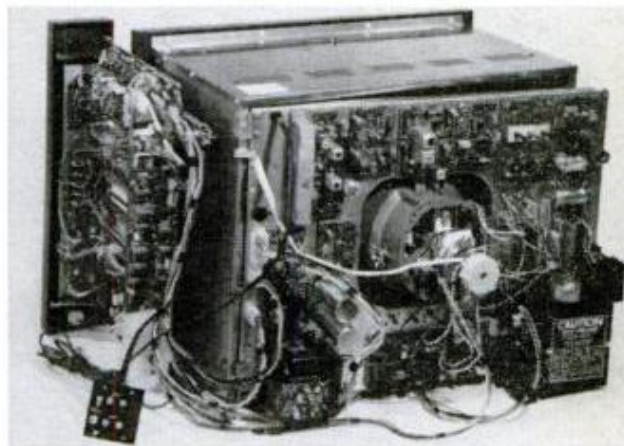
There are some hidden extras here, too: A switch on the tone control knob shuts off the speakers and the powerful (by TV standards) two-watt amplifier, to feed a high-quality audio signal to your hi-fi amplifier. A switch on the brightness knob shuts off the power that normally remains on the tube filaments for quick warm-up, and on the optional digital clock whose readout appears with the channel display.

Unfortunately, that’s not all that’s hidden: The control identification markings hide beneath their knobs when you operate the set below eye-level—as you will, with any of Heath’s classy but expensive (\$140 to \$180) cabinets.

But the set’s not just convenient—it’s good. The picture on the 25-inch (315-square-inch), black-matrix picture tube is sharp and clear, easily as good as any I’ve seen. The optional remote control is an improvement, too. Unlike Heath’s earlier ones, it has separate controls to tune up and down the channels, raise and lower volume in a series of 16 small steps, and recall the display to the screen, as well as adjust color and tint. And you can turn the set on even if you’ve mislaid the remote controller—you couldn’t on some earlier Heaths.

That quality and convenience should last, too. The set is all solid-state, except for the

(Please turn to page 163)



Back view shows why set takes over 50 hours of work. Slide-out drawer at left holds channel-selector, digital display, convergence, and optional digital clock and remote-control modules.

Tasteful cabinets are available in four modern or traditional styles, from \$140 to \$180 (this is the \$140 contemporary version), or set can be custom-mounted in a wall or existing cabinet.

PM OWNERS REPORT: SUBARU DL AND GL

If the dealers were only as good as the economy and handling!

A nationwide survey based on 1,450,000 owner-driven miles.

by Michael Lamm
WEST COAST EDITOR

Subaru takes great pride in pointing out that its DL/GL series is styled specifically for the U.S. market. After its ill-fated attempt to sell the "roller-skate" 360 model here late in the 1960s, Subaru realized that when it comes to putting their money where their mouth is, Americans want more in a car than just astronomical fuel mileage.

The Fuji DL/GL line first arrived on

these shores late in 1972. The GL sport coupe looks, feels and in many ways behaves like a small GT. Its standard equipment list alone lifts it above run-of-the-mill economy imports. Tach, clock, AM radio, radial tires, front disc brakes, rack-and-pinion steering, reclining buckets, rear-window defroster and electric fuel pump are among the no-cost extras. With all this, the GL coupe is only a little over \$3000 and the DL sedans and wagon range from just under \$3000 to a little over.

From an engineering standpoint, Subaru has chosen front-wheel drive and a flat, water-cooled Four. In cross section, this en-





Subarus are styled specifically for the American market, and the GL coupe's long hood and short deck give it the mini-ponycar GT look. Low, flat roof brings grumbles from drivers over six feet tall, and there's minimal leg and headroom in the back seat. Trunk, though, holds plenty. Spare was recently moved from under hood to beneath trunk floor. Gas tank rides over "axle."

Photos by the author

gine looks very much like the Beetle's. The Subaru's suspension uses MacPherson struts up front and torsion bars on semitrailing links in the back, so all four wheels are independently sprung. The body is unitized, and brakes use the dual-diagonal hydraulic system pioneered by Saab. To give ample trunk space and for safety's sake, the Subaru's gas tank stands well ahead of the rear-axle centerline. So it's an unconventional car, but one that's very nicely thought out.

Still, most owners bought their Subarus on the basis of economy, pure and simple. An Illinois lock designer sighs, "I bought my DL sedan at the height of the gas shortage, when everyone thought the government was going to give us 30 gallons a month. My Ambassador wouldn't get me to work and back on that, so I bought the Subaru."

When used to it, many owners delight in the Subaru's handling. Much of the credit goes to the front drive, which also turns out to be the car's second strongest selling point. "Driving on snow," says a Jersey teacher, "the car is incomparable for control and traction." An Ohio psychologist: "Able to go up and down slippery hills where American cars and VWs can't." "I own a Toronado," exults a San Francisco

engineer, "and I say the Subaru GL is as close to a small Toronado as I can find." A Kalamazoo salesman: "Am most impressed with the front-wheel drive—stability on curves and in the wet is amazing."

Ride is generally judged comfortable and quiet, with several people commenting that the water-cooled engine makes less noise than similar air-cooled Fours. While the Subaru takes big bumps in stride, minor roughnesses like tar strips become very noticeable.

We got a wide range of differing opinions on interior comfort, though almost 80 percent judged it good-to-excellent. Drivers under six feet tall call front-seating and legroom quite adequate, but those over that height disagree. The car has a fairly low, flat roof, so in the coupe especially, riders feel cramped. Rear legroom is scant at best unless the front seats are pushed all the way forward, in which case all riders suffer together. Writes an Ohio engineer: "Rear passengers better be small, thin or non-existent."

Owners appreciate the front buckets' reclining feature, but some drivers mention back fatigue on trips longer than about 25 miles.

One persistent owner complaint centers

Complete instrumentation includes tach and clock as standard in GL. Owners like instrumentation, dash, center console. Automatic transmission isn't available, but manual four-speed shifts smoothly.

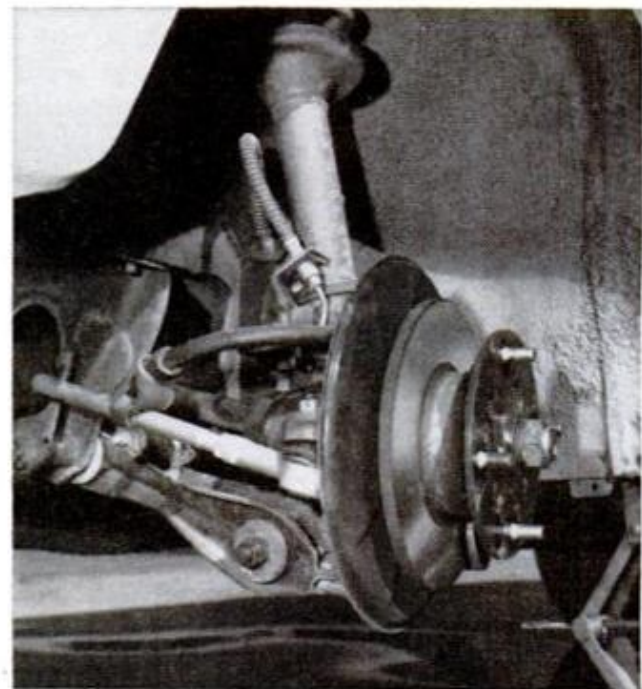


Coupe's inadequate rear head and legroom leaves this seat for children only. Front buckets recline, some owners feel their contouring causes backaches on trips. Shoulder belts interfere with entry.

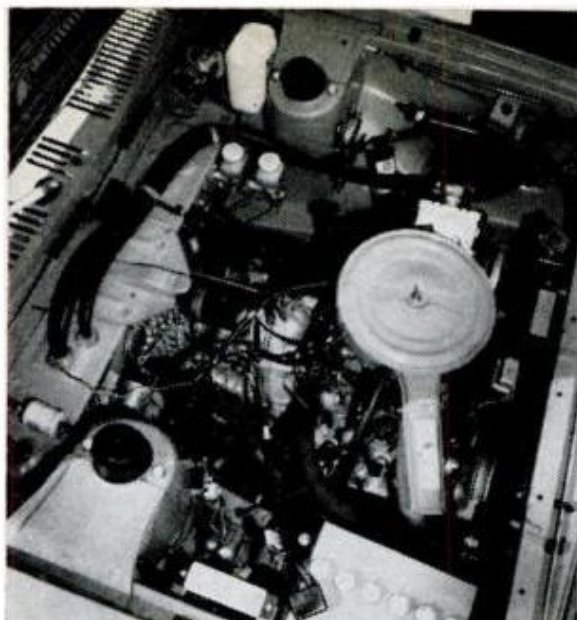
on dealers. Most Subaru franchises have gone to dealers who've taken on the car as a second or third line. Often a Pontiac or Jaguar dealer will "dual" in Subaru. So since Subarus aren't the dealer's primary line, customers feel they're being neglected. A Massachusetts technician sums up many owners' feelings this way: "Replacement parts aren't available within a reasonable time. My dealer has had my car for one month, waiting for a transmission oil pump. He also seems ill-equipped to service the car. His people keep telling me lies, crossing up each other's stories. I'm fed up." So are more than half our respondents, and fully a third rated dealer service "poor."

General workmanship comes in for high praise, with 79.3 percent of the owners marking it "good-to-excellent." While engineering also gets good marks generally, several readers called our attention to a potential safety hazard. Apparently snow thrown up by the front tires can encrust and freeze the throttle linkage, making it stick open in cold weather. A deflector might solve this.

In the station wagon, owners would like a bit more cargo space. To extend the bed, the second seat folds on itself and then nestles behind the front seat. But to accommodate it, the front has to be shoved



Only the GL coupe uses front discs—the other body styles have drums all around. MacPherson struts up front and trailing links with torsion bars behind add up to independent springing at all four corners.



Same key fits all locks, including the off-center trunk; as well as the gas filler and doors. Flow-through vents exhaust via louvered ports in C-pillars.

Horizontally-opposed Four delivers 62 bhp net, is water-cooled. Front-wheel drive is tops with owners, who delight in handling on ice, snow.

fully forward. This once again makes for cramped driving. Yet many owners praised the DL wagon's two-part tailgate, in which the lower section drops to extend the floor length by 17 inches. Wagon owners would appreciate a larger gas tank. It holds only 9.5 gallons, compared with 13.2 in all other Subaru body styles.

What improvements or changes do owners suggest? Many would like to see a hatchback added to the line. And an automatic transmission made available. Plus a sunroof. More space between pedals. Heater and vent controls simplified. An antidazzle rear-view mirror. Disc brakes and rear defroster available on non-GL models. More

head and legroom, and—Subaru of America should choose its dealers more carefully.

The wrapup goes to a Montana mail carrier, who says, "I drive 81.5 miles each day, six days a week. Some of my roads are a mile above sea level and have heavy snow in winter. This Subaru wagon does amazingly well—in cold weather my gas mileage averages 28-30 mpg. In warmer weather it's 31-33. This isn't a guess—I keep records. The car is a pleasure to drive, especially on icy or snowy roads, where fwd is a real bonus.

"My advice to GM, Ford and Chrysler is to stop stealing ideas from each other and steal the whole Subaru ball of wax." ★★ ★

Summary of 1973-74 Subaru DL and GL Owners Reports*

Total miles driven	1,457,166
Average miles per gallon:	
Local driving	25.8
Long trips	30.3
Series and body style:	
GL sport coupe	38.0%
DL 2-door sedan	37.5
DL 4-door sedan	18.6
DL 4-door wagon	5.9
Why the Subaru?	
Economy	69.0%
Front-wheel drive	27.3
Handling	12.2
Styling	12.2
Price	11.9
Size	9.7
Specific likes:	
Economy	78.8%
Handling	64.4
Front-wheel drive	27.5
Comfort	23.8
Styling	11.9
Ride	10.6
Specific dislikes:	
Scant legroom	12.1%
Poor dealer service	7.0
Mandatory shoulder harness ..	6.4

Rough ride	4.8
Leaky vent system	4.8
Number of vehicles owned:	
Subaru only	29.7%
Two cars	53.2
Three cars	14.1
Four cars	2.4
Five or more cars	0.6
Other makes of vehicles owned:	
Chevrolet	18.9%
Ford	18.0
Oldsmobile	16.2
Pontiac	10.5
Dodge	8.8
Plymouth	8.3
Comfort opinion:	
Good to excellent	79.4%
Average to poor	18.8
Workmanship opinion:	
Good to excellent	79.3%
Average to poor	20.7
Dealer service opinion:	
Good to excellent	50.0%
Average to poor	49.9
Had any mechanical trouble?	
No	70.1%
Yes	29.9

What type of trouble?	
Electrical	10.3%
Timing	8.2
Choke	7.2
Carburetor	7.2
Transmission	6.2
Clutch	6.2
Did you repair it yourself?	
No	89.7
Yes	10.3
Dealer repairs satisfactory?	
Yes	65.4%
No	34.6
What changes would you like?	
More legroom front and rear ..	19.2%
Add automatic transmission ..	7.1
Plusher interior	5.4
Better vent system	4.9
Reshape and restyle seats	4.9
Age distribution of owners:	
15-29 years	32.7%
30-49 years	39.1
50-plus	28.2
Would you buy another Subaru?	
Yes	90.4%
No	9.6

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

Steady . . . aim . . . shoot!

Gunstocks, pistol grips and other gadgets keep your shots steady, even with long telephoto lenses.

by Ivan Berger
PHOTOGRAPHY EDITOR

Holding a camera steady is a tripod's job. But holding a camera steady while you move it is another problem—and a common one for users of telephoto lenses and for movie makers. Here's a variety of gadgets that will help.

Gunstocks turn your camera into a rifle,



A sampling of camera gunstocks



DASCO DELUXE TRIGOMATIC, \$50



SPIRATONE DUAL-RANGE TELEGRIP, \$11



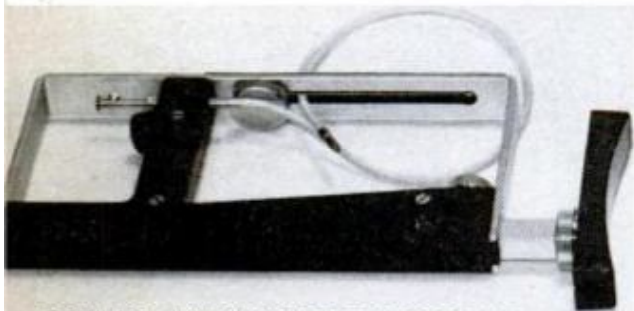
BOGEN GUNPOD, \$18



PORTERTOWN SWAGMAN GUNSTOCK, \$15



TELESAR TELESHOT 250, \$25



ROWI NO. 1136 SHOULDER SUPPORT, \$27



LPL CHEST POD, \$6

SCHIANSKY STATICFIX, \$5



Swagman gunstock converts to "riflepod" (above) with clamp-on, inverted-Y-shaped legs. Bottom crossbar also swings down and telescopes (right) to form monopod-like foot. It's \$15 from Porter's Camera, Box 628, Cedar Falls, Iowa 50613. Bogen gunpod also has swing-down leg.



LPL chestpod folds compactly, has 90° side tilt for vertical-format pictures, expands from 6½ to 9 inches in height. Schiansky Staticfix, which is otherwise similar, is not equipped with the tilt and height-expansion features.



Most gunlike, Dasco Trigomatic was also most comfortable (and most costly, at \$50 for this deluxe version), needs a tripod thread adapter to match most cameras. A cheaper, squared-off version is \$27. From Porter's.



Soligor shoulder bracket's handle attaches to camera bracket or front of telescoping rod, or can be used as pistol grip. Camera bracket revolves for vertical-format pictures. It's \$45.



Rowi No. 1136 shoulder bracket collapses into very compact rectangle. Normally, it's a \$27 item, but this Questar version, modified for longer expansion, is \$21.

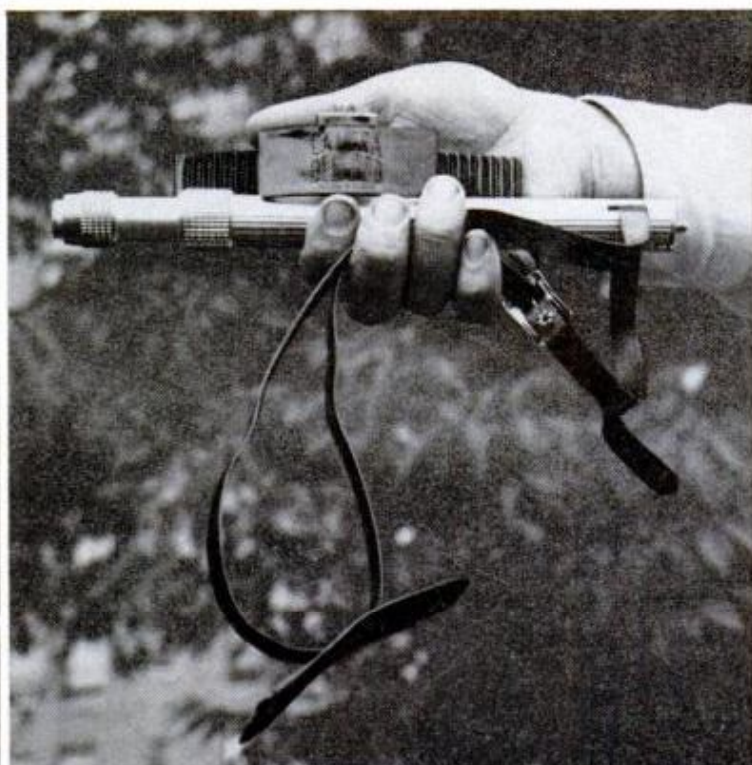


For extra bracing, Peter-Lisand shoulder brace rests on shoulder and waist. This is \$100 professional movie version. Amateur version is \$65.



Rowi chainpod is a small plastic tube with two tripod-screw endcaps (one U.S. and one European thread), connected by a long chain. Screw one end to the camera, drop the other, step on that end and pull up. It steadies the camera amazingly, and takes about as much space as two rolls of film. Cost? Just \$2.95.

Unipods take less than one-third the weight and bulk of tripods—and they can double as walking sticks. This Miida version has a hidden secret (above right): three short steadying legs within the tube. Unfold them and step on one (top right) to get, if not rock-steadiness, pebble-steadiness at least. Three-section version extends from 22 to 60 inches, costs \$21. Four-section version shown costs \$23, extends from 18 to 66 inches. Another version we liked was Accura's five-section zoompod, which collapses to 15¼ inches, expands to 58 inches, costs \$18 and is well-made, but lacks the Miida's steadying legs.



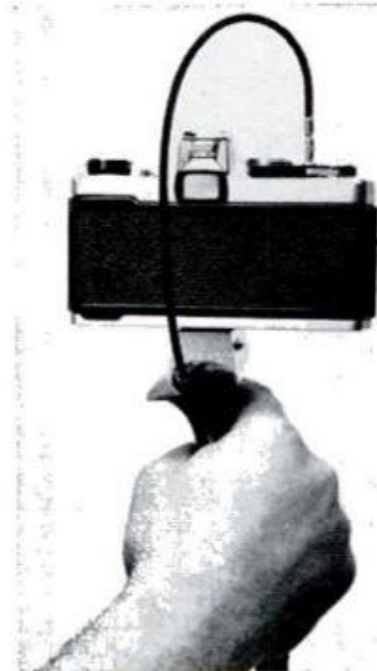
Testrite beltpod uses your neck, hands and belt (above left) as steadying points, but it can make you look a little bit ridiculous. Folded (above right), it's a mere handful, and so's its price: \$8.

giving you complete freedom of movement, yet they still reduce camera shake. They vary widely, so try one for size before buying any. Chestpods are more compact, but harder to use.

Monopods are lighter and more compact than tripods. If they're tall enough to bring the camera's eyepiece up to your eye while

you stand normally, their one leg and your two legs become a fairly steady "tripod"—but again, you should try it for size, if you're tall.

Pistol grips beneath the camera are good for quick-draw shooting; beneath a telephoto lens with its own tripod socket, they act like very compact gunpods. ★★★



Pistol grips give quick aim with short lenses, make good support for long ones with tripod sockets. This Patterson model has adjustable tilt for comfort, is \$11 with cable release.



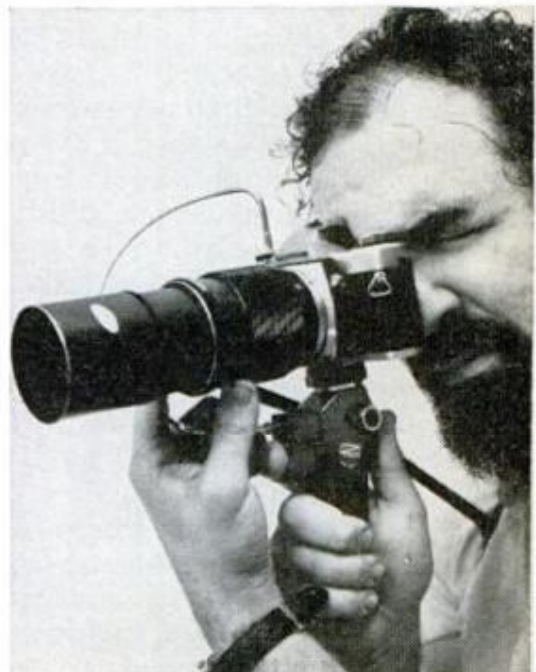
Versatile Miida pistol grip can fit under or on either side of camera; side-mounted, its shoe holds flash for better-angled lighting. Dual cable-release sockets make it possible for the bracket to trigger two cameras at the same time. Outfit has a price tag of \$22, exclusive of the second cable release, which is extra.



Accura Store-A-Grip serves as camera handle and flash holder, and holds two rolls of film in its hollowed-out area. \$10.

Sunset Master Grip has anatomically curved handle, built-in cable release, in 35-mm (\$20) and 2¼x2¼-inch (\$21) sizes.

Kilfitt Kigrip has removable shoulder rest, so it can double as a shoulder-pod or pistol grip. It's a steep \$60, but very well made. From Karl Heitz.



Two rugged garden tractors from a maker of big trucks

by Glenn S. Hensley



Anyone familiar with big trucks or rugged farm equipment knows the name White. Now a division of the White Motor Corp. has produced a line of garden equipment—ranging from an edger-trimmer to a selection of tractors—that could make the name equally familiar among homeowners.

When I learned that White Outdoor Products were going to introduce their lawn-and-garden line in 1974, I quickly put in a bid to try out the new tractors for *Popular Mechanics*.

White delivered two of the first top-of-the-line models to come out of the plant. One was a geared transaxle model, the Yard Boss GT-1600; the other, a hydrostatic drive model (infinitely variable forward and reverse speeds), the Yard Boss GT-1650. Both have 16-hp Briggs & Stratton engines.

Before going further, I must explain that magazine-production schedules sometimes

require a writer to work months in advance. Though the thermometer may be in the 90s as you read this, the tractors arrived at my home near St. Louis during a record-breaking stretch of cold, snowy weather. The mercury was at minus 2° F. when I got my first look at the two White Yard Bosses.

The 1650 hydrostatic model, fitted with a 54-inch dozer blade, 100 pounds of wheel weights and tire chains, was a welcome sight. My drive was covered with layers of packed snow and ice. On the other hand, the 42-inch mower mounted under the 1600 model could do little but indicate with a vibration-free whir that it was ready to do its job if the season were greener.

It took careful use of the choke to coax the two engines into life. But start they did, and the warmth from the exhausts felt good on that bone-chilling morning. However, I soon came to the conclusion that the ex-

haust system could stand some improvement.

The test machines were equipped with a muffler and tailpipe on the right side of the engine. The short tailpipe pointed rearward and terminated under the right footrest. I found that some exhaust fumes were deflected upward by the top of the belly-mounted mower. In addition, it was all too easy to come in contact with the hot tailpipe while standing by the machine.

Later, I mentioned the problem to a White executive and got an immediate, positive response. He said White would offer buyers—at minimal cost—a tailpipe extension that will exhaust fumes to the rear. In addition, shielding would be added to the tailpipe to minimize the possibility of burns. For the future, he said, a redesigned engine will completely eliminate the two problems.)

After a few minutes of familiarization with the controls, I turned the electric-start key and took off aboard the 1650 to shove snow from the driveway. Despite normal difficulties involved in pushing packed snow and ice, the unit never lacked for power. It didn't take very long to create piles of ice and snow.

As with any hydrostatic-drive tractor, the engine is most effective in the "fast" position on the throttle quadrant. A U-jointed shaft carries power from the engine to the hydrostatic pump on the 1650. Braking, by using the hydrostatic speed and direction lever, is positive and effective. For parking—and starting the engine—a brake pedal with a locking mechanism is provided.

The 1600 Boss, with its four-forward-speed transaxle, sports one of the smoothest clutches I've encountered in a tractor of its size. Its no-nonsense throttle is equipped with click stops. Disc brakes provide positive stopping action.

How tight will these tractors turn to get you around a tree or flowerbed? I measured the turning radius at about five feet. But this measurement was made on an icy driveway. With better steering traction, the turn could be tighter.

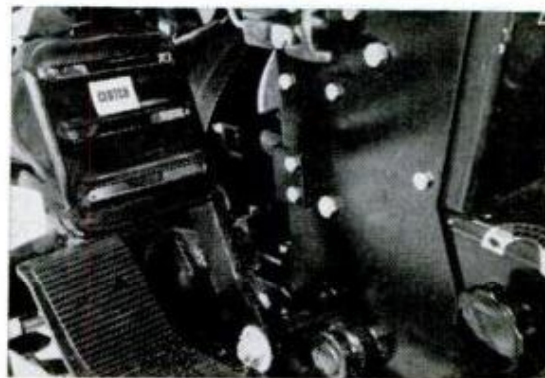
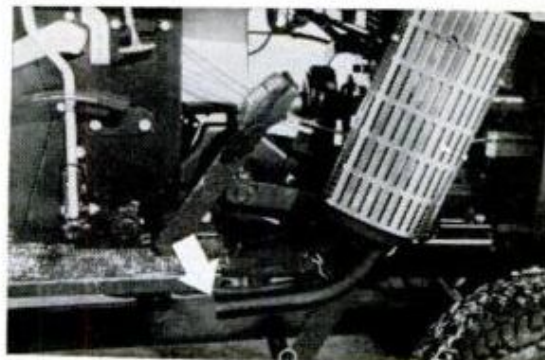
Both models proved easily steerable using only one hand on the wheel. Both demonstrated good stability on inclines. Visibility of work areas, nighttime lighting and placement of operator controls are excellent on both tractors.

List price for the Yard Boss GT-1650 is \$1825; for the Yard Boss GT-1600, \$1485. A large selection of accessories is available for both machines. ★ ★ ★



Author refuels the Yard Boss GT-1650 during cleanup of his driveway. Gas tank, battery and air cleaner are all easy to get at under tractor's hood.

Shift pattern on the GT-1600 is next to shift lever. Warning against shifting while in motion is needed because unit's transaxle isn't synchromesh.



Though muffler (top photo) is well shielded, it's all too easy to make contact with hot tailpipe. The massive clutch pedal is ridged to prevent foot from slipping.

Darkroom in a suitcase travels with you

by James L. Abbott

Photos by the author



Ever come back from vacation only to find you or your camera hadn't been shooting properly—or that your local lab had finished *off* your pictures instead of finishing them?

That never happens to me. I take my darkroom with me—in one ordinary “two-suiter” suitcase measuring only 7 by 17 by 24 inches, and weighing less than 35 pounds. Within minutes I can set it up (even where no electricity is available) and start developing my day's color slides, or developing and printing black and white. If I've missed anything important, I know in plenty of time to reshoot the next day.

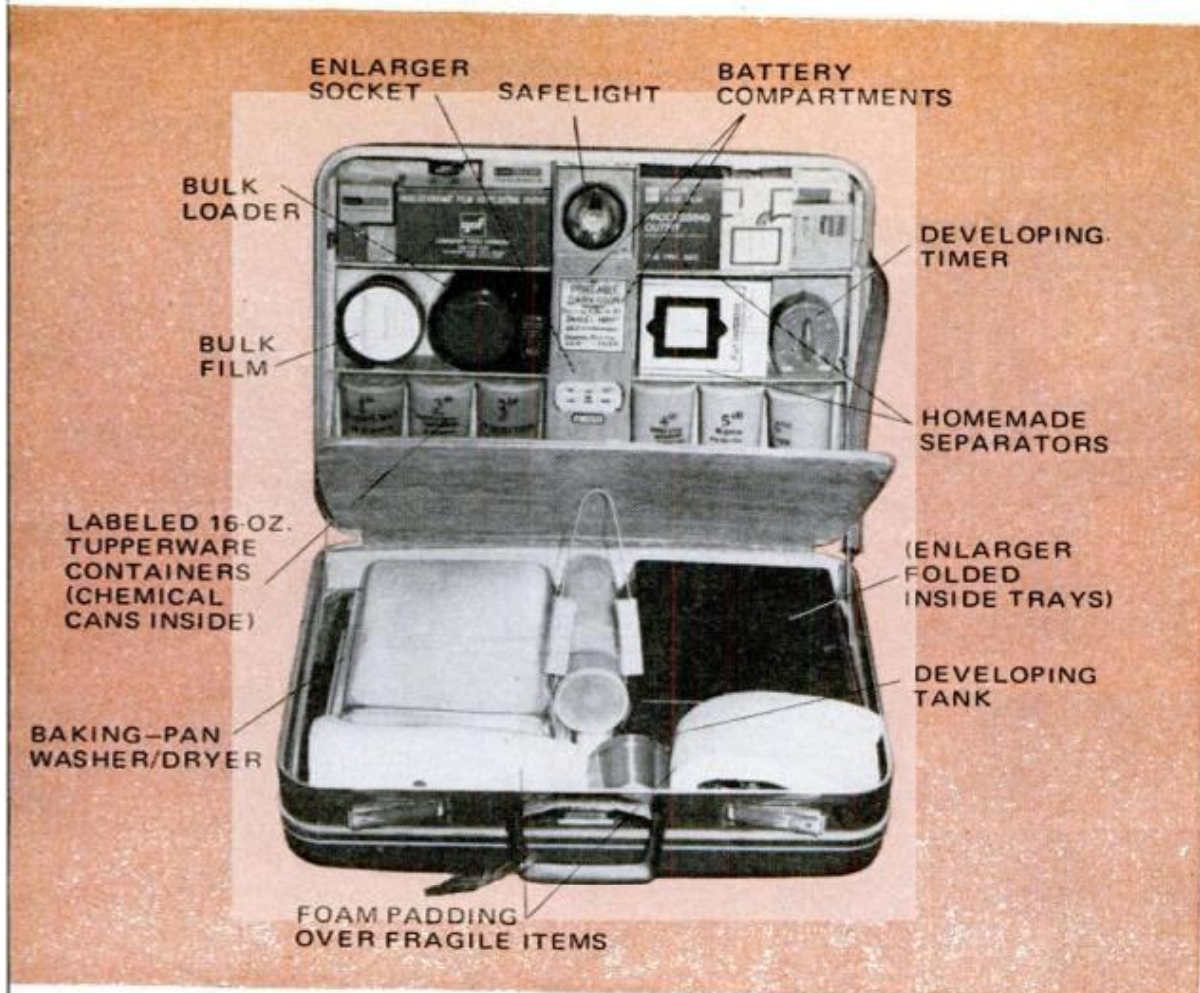
The case is adapted specifically to my equipment—you'll have to adjust its dimensions to your own. But the principles involved will be the same.

First principle is packing minimum equipment. I use the smallest enlarger I could find, the Durst J35 (no longer available). Like many small 35-mm enlargers on the market today, it disassembles quickly for packing. For U.S. travel, that and good quality are about the only strict requirements. For foreign travel, you might try to find an imported enlarger that can adapt for Europe's higher voltages (about 240 volts). I got around that by replacing my Durst's lamp and socket with a six-volt flash-lantern bulb for battery operation here, abroad, or outdoors. But be careful when you mount the new bulb that its center is exactly where the old bulb's center was; otherwise, your prints won't be evenly exposed.

My safelight, built into the case lid, is a 12-volt truck running light with an orange lens. Two six-volt lantern batteries in compartments in the lid power both the enlarger and the safelight. Running the enlarger's six-volt bulb on 12 volts increases its brightness; it also shortens the bulb's life (carry extras)—but not too much, since the enlarger usually runs for only seconds at a time.

For chemical mixing and storage, I use 16-ounce Tupperware tumblers with lids. They're unbreakable, and they easily hold small chemical cans, or foam-wrapped breakables such as small bottles and thermometers. If you don't need to store anything in them, they can be stacked to take less space.

For a print washer, I use a 9 by 12-inch baking pan with a string of $\frac{1}{8}$ -inch drain holes drilled half an inch below each edge; water comes from a faucet hose into a $\frac{3}{8}$ -

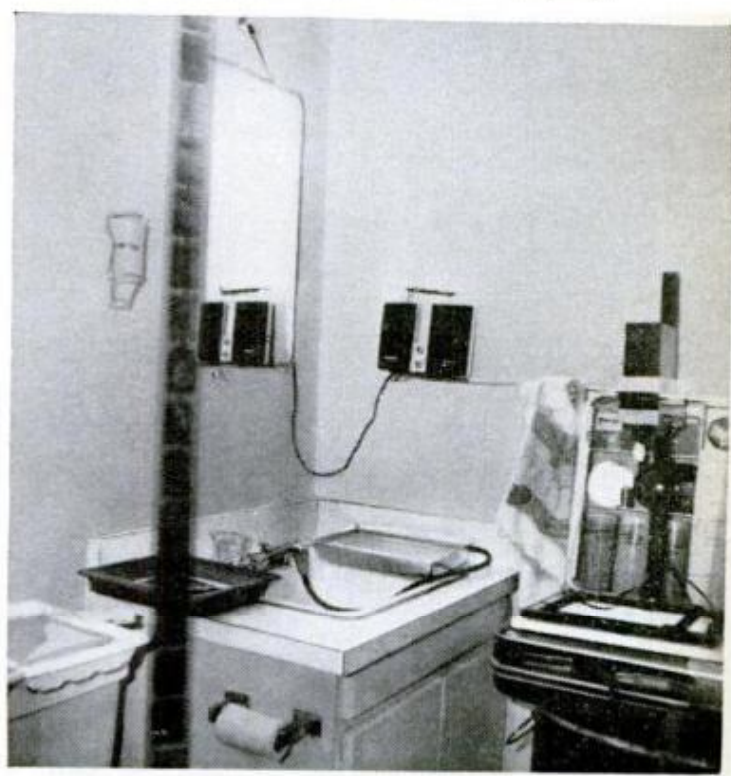


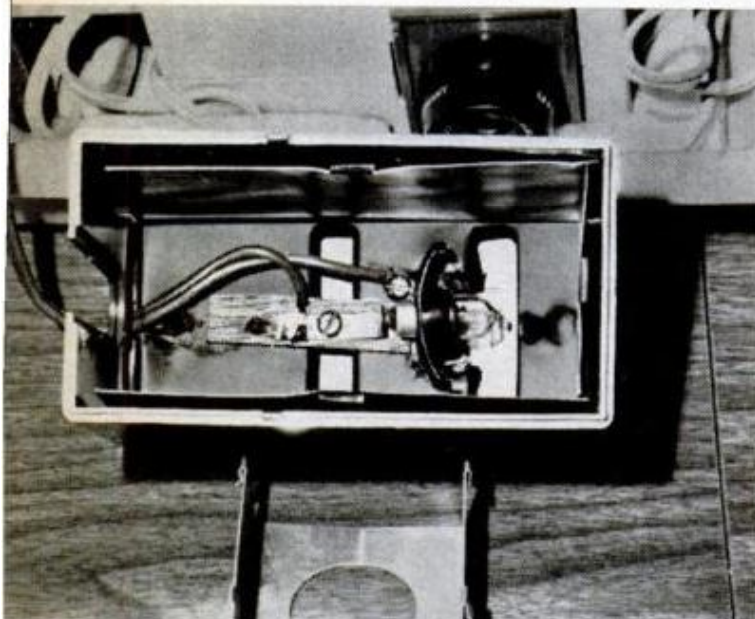
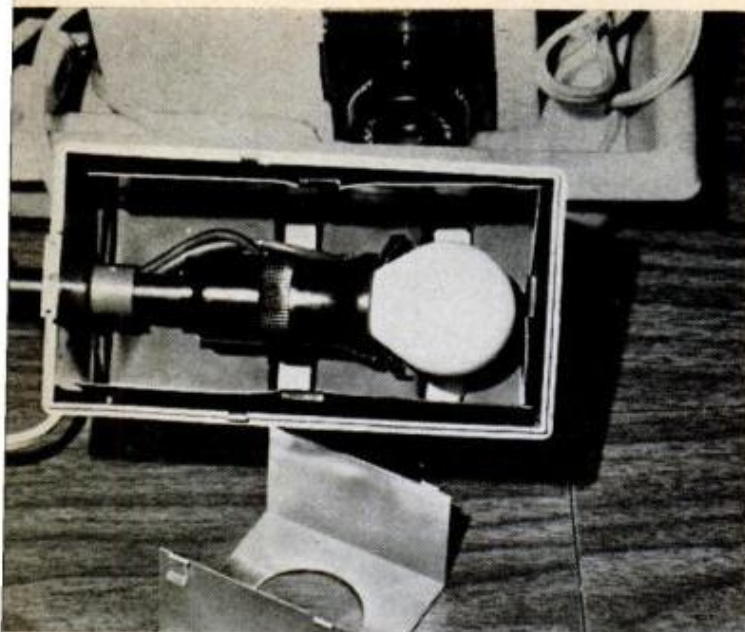
In the suitcase is a complete darkroom outfit, cleverly tucked away in homebuilt compartments, or one item inside another.



Unbelievable amounts of darkroom gear can fit; compact, take-apart enlarger is the key item.

Bathroom into darkroom takes only blankets over the windows, my suitcase and a radio for company.



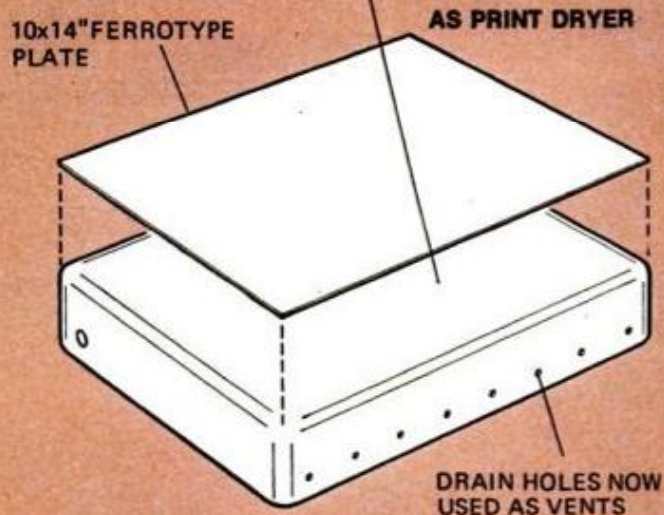
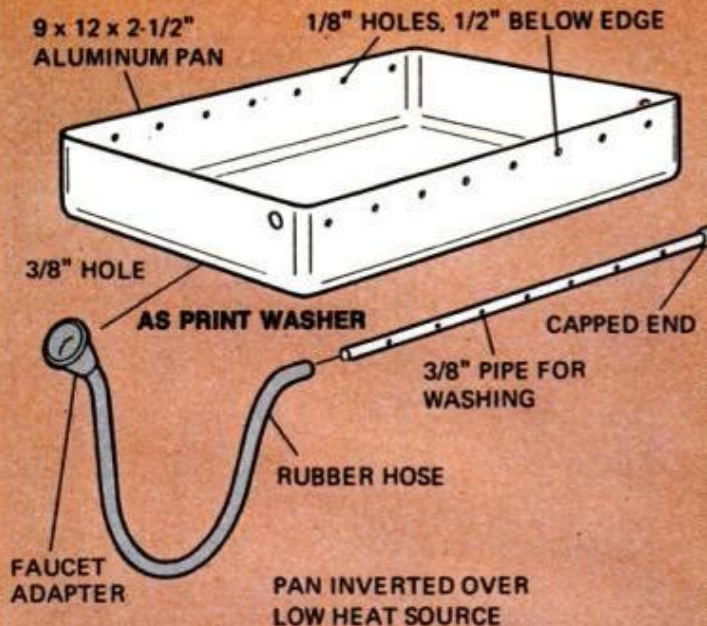


For travel, I replaced my enlarger's 110-volt bulb (top) with a six-volt flash-lantern bulb and socket, carefully centered in the old bulb's position so the print will still get even exposure. The six-volt bulb runs brightly on 12 volts from two lantern batteries in series—and battery power works in foreign countries with different voltages, or even outdoors.

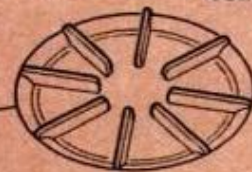
inch pipe with a capped end and $\frac{1}{8}$ -inch holes drilled in a row along it. For a dryer, I invert the same pan over a low heat source (candle, catalytic heater or stove) and lay a ferrotype plate atop it; the drain holes now serve as vents. Using a 10x14-inch ferrotype plate, you should be able to peel off three 5x7 prints every five minutes or so at moderate heat (below 150° F.) In hot weather, you can use the pan as a water bath to cool tanks, trays and solutions.

I keep my equipment to a minimum; any inconvenience resulting from that is outweighed by the convenience of being able to

BAKING-PAN WASHER/DRYER

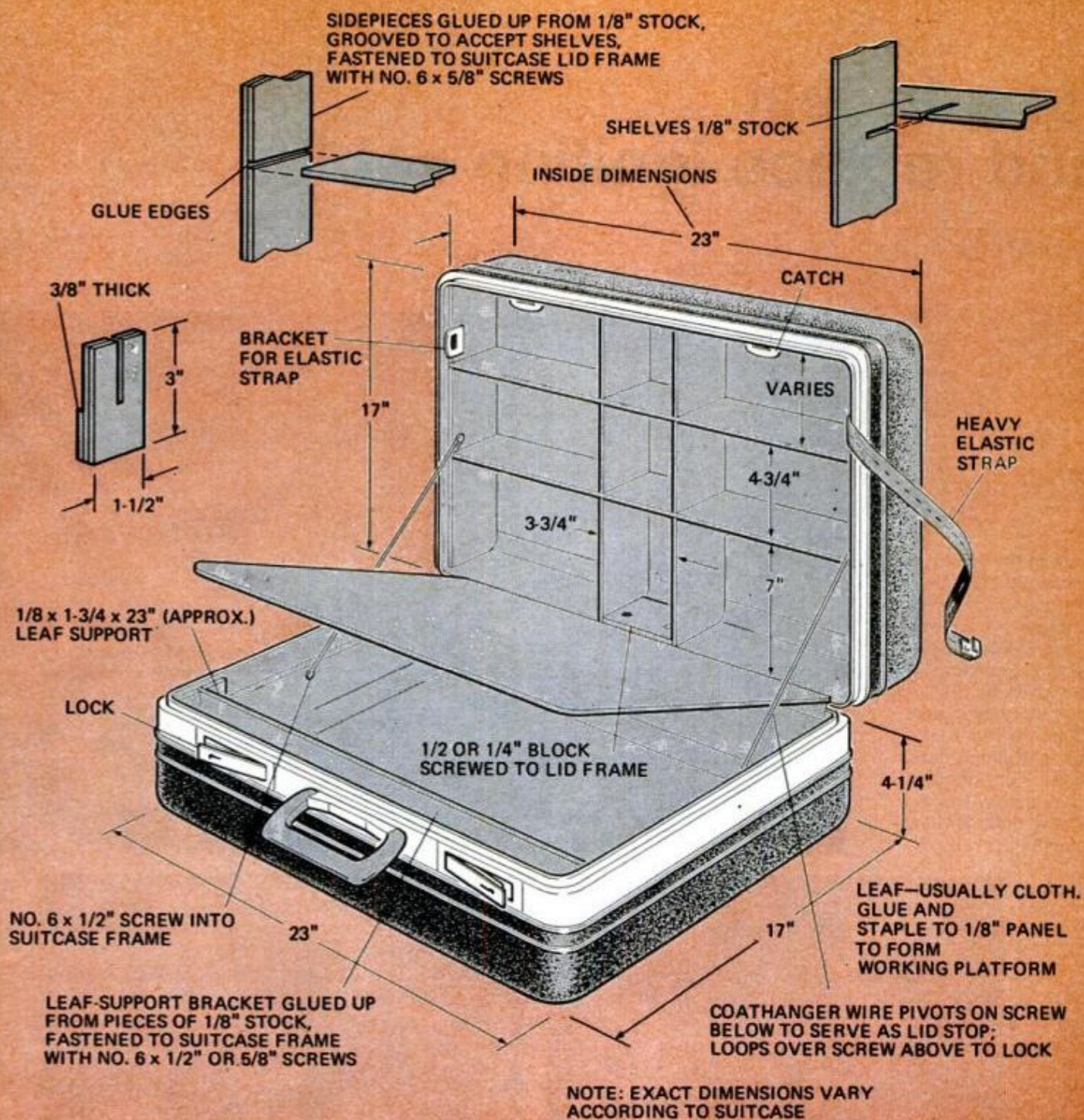


POSSIBLE HEAT SOURCES:
CANDLE
STOVE
HEATING PAD
HOT PLATE
CATALYTIC HEATER



carry everything. Trays do double duty as containers for paper, the enlarger head is cushioned well with foam rubber. My chemicals are all 16-ounce sizes or smaller (Kodak's four-ounce black and white chemicals are great) in powder or concentrate form whenever possible.

Since you can't always buy the film you want at the prices you're used to, and since some countries limit the number of rolls of film you can take in with you, I pack a bulk-loader, spare cartridges and film in long rolls of 27 $\frac{1}{2}$ to 100 feet (at about half the cost of the same film already loaded into



cartridges). I also pack a changing bag—useful not only for loading the bulk-loader and developing tank, but for removing broken or jammed film from a camera without exposing it.

Of course, my suitcase only holds a darkroom setup, not the darkroom. But my changing bag takes care of anything that requires *absolute* darkness, and with blankets over the windows and paper stuffed under the door, any room can be an adequate darkroom for printing. You can even do it on an outdoor picnic table after dark.

To keep things from rattling around, the

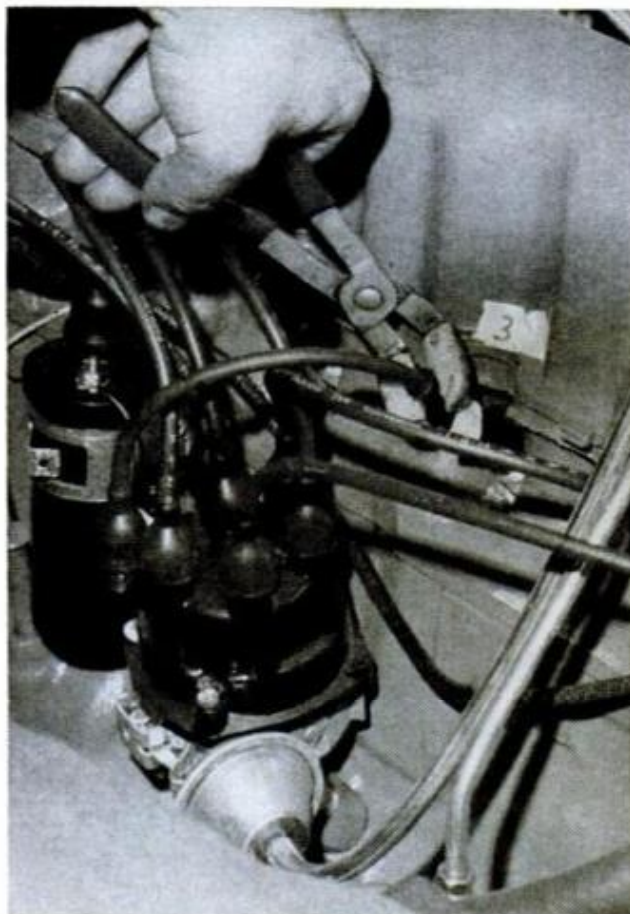
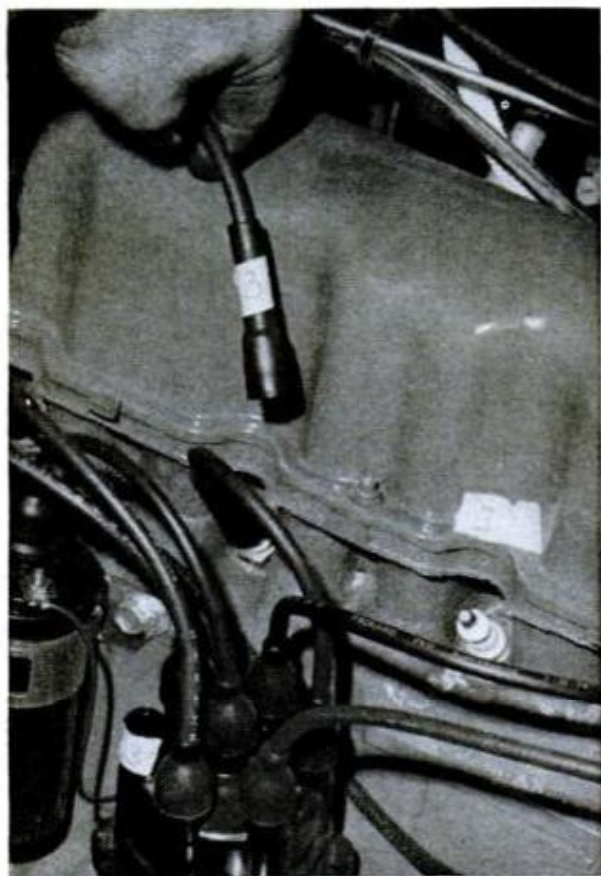
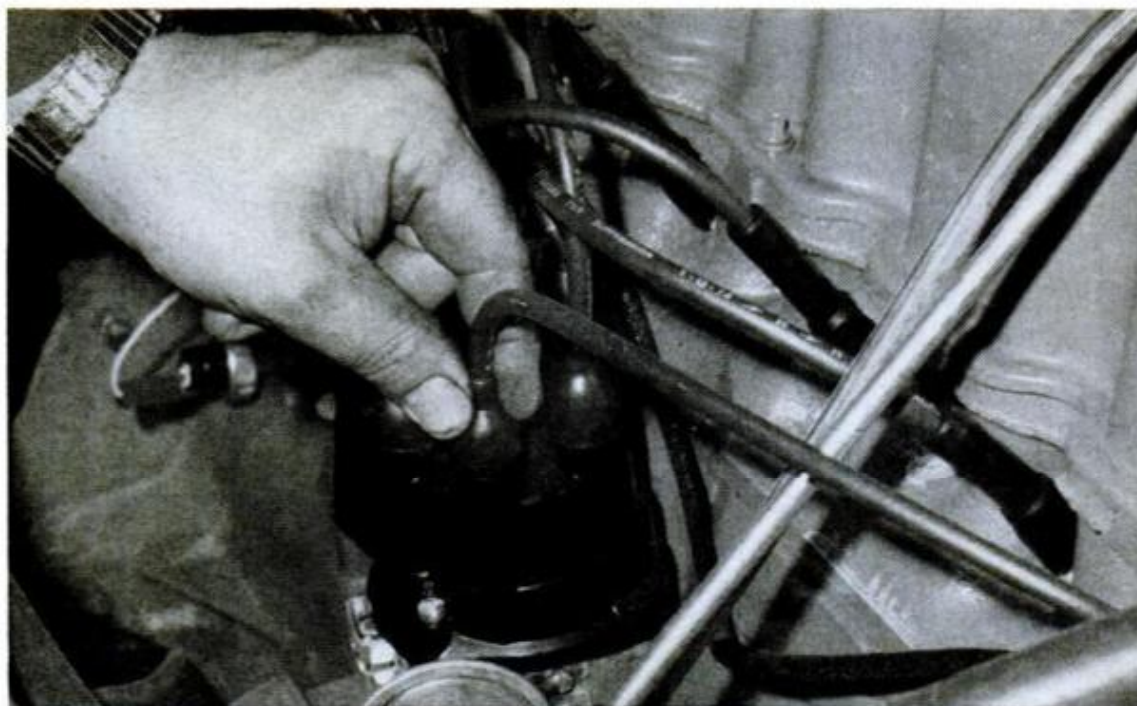
lid of the suitcase is divided into custom-fitted compartments by partitions of 1/8-inch plywood or hardboard, with a fold-down leaf keeping everything in place when you open the lid. The larger items are crammed tightly into the bottom of the suitcase; insulate anything that rattles with spare socks or other clothing items.

All this may seem a lot of trouble and expense. But my whole initial outlay, suitcase, enlarger and all, was just under \$125 a few years back. My savings in film, processing and postage have run as high as \$44 per trip since then. ★★ ★

How to test and replace ignition cables

by Mort Schultz

Think of the boot as a handle: Pull on the boot (right), never on the cable. As shown below, identify cables and their positions at the distributor with tapes that have been marked by numbers. The sparkplug pliers, (below, right) remove cables easily, won't damage them and are inexpensive to buy.



Nothing lasts forever—not even the thick cables extending from each sparkplug to the distributor-cap towers on your engine. Don't overlook, either, the thick cable from the center tower of the distributor to the ignition coil high-tension tower. These cables transmit current surges (about 20,000 volts per surge) to your sparkplugs; if they're not in good condition, your engine may misfire.

Misfire is failure of a sparkplug to fire and ignite the fuel mixture. Unburned (unused) fuel is expelled out the exhaust (who can afford that now?). Obviously, misfire also robs an engine of power.

As for a cable, the way in which misfire occurs depends largely on the degree of damage to the cable and the amount of resistance offered by engine compression.

That is why one engine may misfire only when the engine is under load; another at all throttle speeds, and a third only when the air is damp. (Moisture is an ideal conductor; a cable beginning to fail may do so only in the presence of moisture.)

In a sound electrical system, the path of least resistance (over which electricity finds it easiest to flow) is across sparkplug electrodes. However, when a high-voltage cable develops a defect in its insulation, this path may be through the insulation to a ground presented by the engine near which the cable passes. If the cable "sparks," less or no current will be available at the sparkplug for it to spark.

When engine misfire occurs—no matter under what conditions—think cables! Repairing "something else" when it isn't the problem costs money for nothing. Testing cables takes a few minutes and doesn't cost a cent.

Many factors you can't control affect the life of high-tension cables. Age, heat, cold, oil and grease attack insulation, making it brittle and causing it to crack. Where salt is used on roads during winter, cables can become coated with salt spray. A salt-coated, cracked cable will short out since salt is a conductor.

Corona (the magnetic field surrounding high-tension wiring) is another phenomenon affecting cables. The magnetic field created by high-current surging is so strong that it breaks down oxygen, converting it to ozone which is particularly detrimental to rubber insulation.

Disconnect and examine one high-tension cable at a time. At the distributor cap, grasp



Look closely at cables for cracks and frayed areas, and gently bend them to check for brittleness.

a terminal boot and disconnect it from the tower with a twisting, pulling motion. You should never pull the cable itself. Sloppy handling of cables is the main reason they fail before their time.

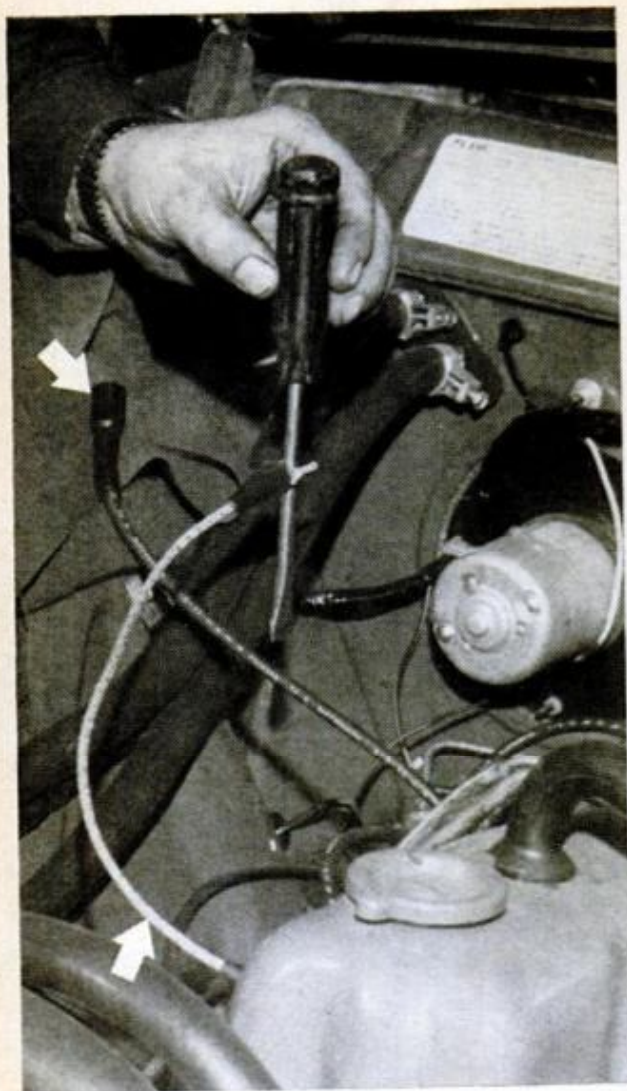
When the cable has been disconnected from the tower, trace the cable to its sparkplug. The process of relating the distributor-cap tower to its cable and then tracing each cable to the specific sparkplug it serves is very important.

For a simple way to identify components, use masking tape. Suppose the cable you disconnect serves the first sparkplug on the left-hand (driver's side) bank of a V8 engine. Snip off three pieces of masking tape and write on each the designation "L1," meaning first plug left side. Stick a strip on the distributor-cap tower, another around the cable and the third near the sparkplug. Disconnect the cable at the plug—grasp and pull the boot only, not the wire.

A good tool you might consider buying is a sparkplug-cable pliers. It helps prevent cable damage and lets you grasp the terminal boot firmly. The "scissor-grip" permits a tight hold as you pull off the boot.

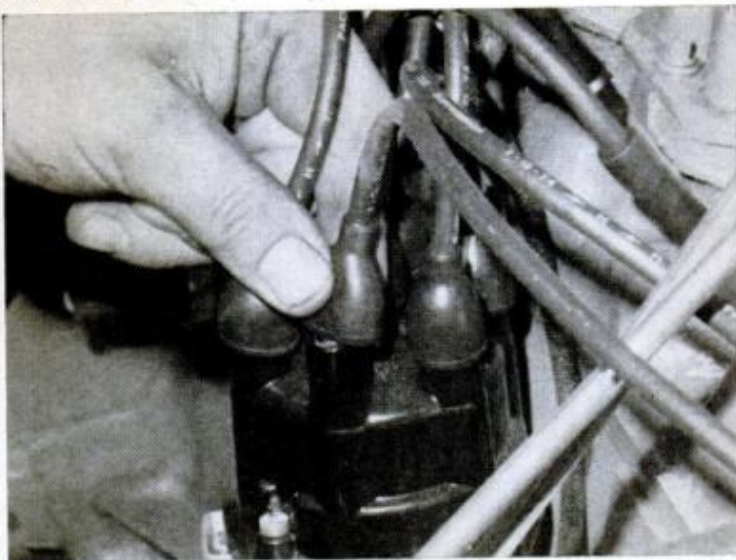
With the cable disconnected and all components identified, clean the cable with a kerosene-moistened cloth. Wipe it dry with a clean cloth. Now, bend the cable over its

Faulty cables can cause engine misfire

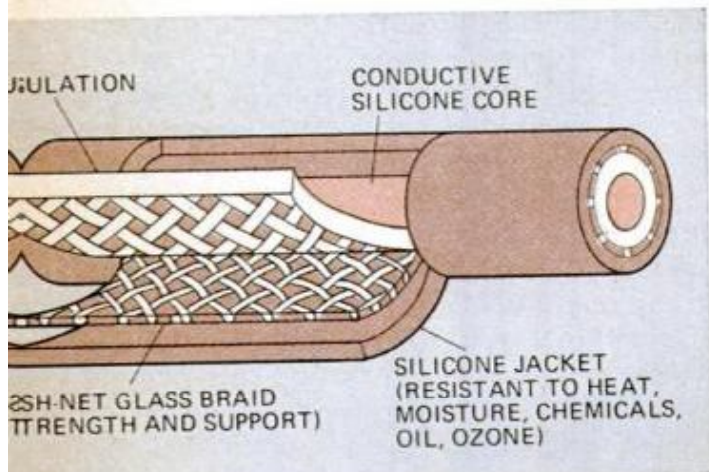
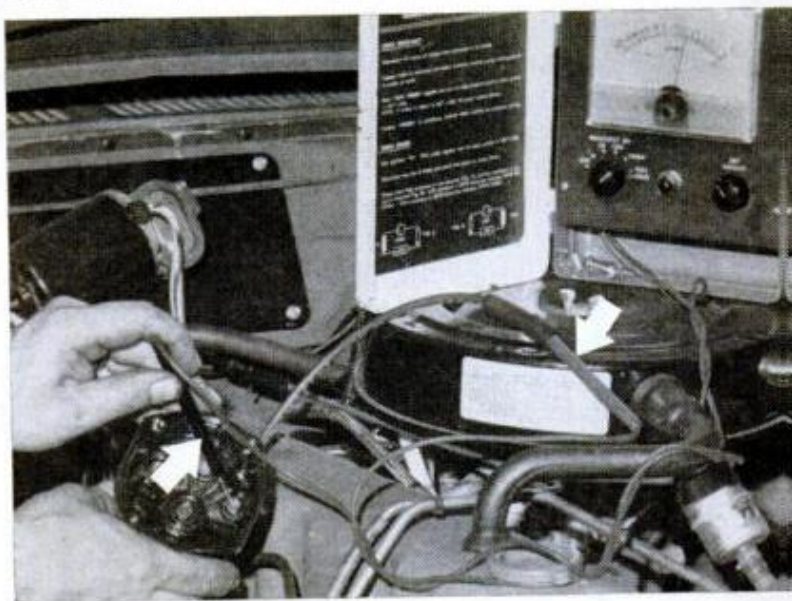


To probe a cable (above), disconnect it from sparkplug and place sparkplug end where it won't ground out (top arrow). Probing instrument is connected to a good ground (lower arrow). Then, with engine running, probe along entire cable; spark jumping to screwdriver means faulty cable.

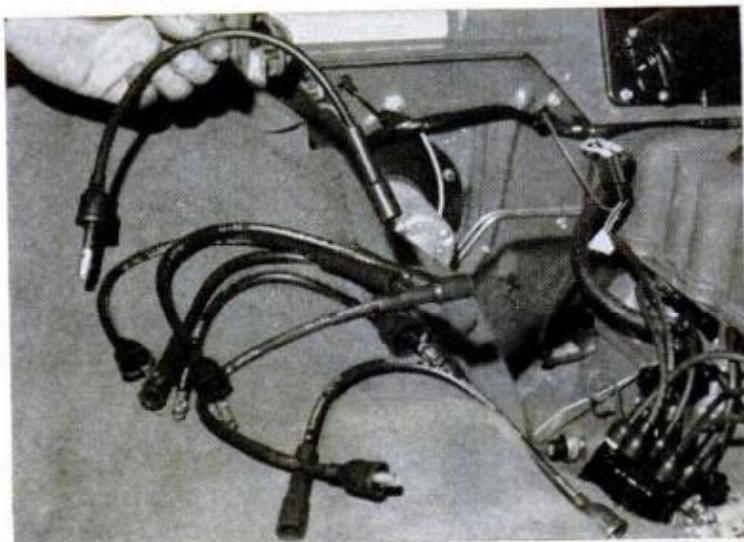
Seat cables by pushing down lightly while squeezing the boot to release trapped air (below).



Use an ohmmeter to check resistance of ignition cables (below). Arrows point to the probes.



A good replacement high-tension cable (above) is well made and therefore expensive. As shown at the right, a set of custom cables comes already assembled and ready for installation on your car.



entire length. Discard it if cracks show, if it is chafed or if insulation is brittle.

Also examine cable terminals. If black, the cable was not making firm contact with the sparkplug terminal or the terminal in the distributor-cap tower. Arcing resulted, which meant that electricity was forced to jump a gap. (Caution: Boots covering the sparkplug end of cables are often molded on. Do not attempt to break the bond just to examine the terminal.)

If a terminal has actually disintegrated, replace the cable. If it is just coated with carbon, wipe it clean.

If a cable shows evidence of arcing at the distributor-cap end, remove the distributor cap and clean deposits from each socket with a distributor-cap cleaning tool. Clean the coil tower. Deposits increase resistance.

The visual inspection shows clearly if cables are cracked and also lets you check the condition of terminals. You can also "probe" the cables to reveal small punctures that might go unnoticed. To make the probing test, get a jumper wire with an alligator clip at each end. Clip one end to a clean ground on the engine and the other to the shank of a screwdriver.

Start the engine and let it idle. Remove one cable from the sparkplug. Be sure that the boot end of the cable is positioned so it doesn't point to a ground. Probe all around cable and its boot. If a puncture is present, a spark will jump from the defective area to the probe. Discard the cable.

To test the high-tension cable between the center tower of the distributor and the coil tower, keep the cable connected, but be sure to disconnect one sparkplug cable.

If cables pass your tests, reconnect them. To install cables into distributor towers enter each terminal into its tower. Push lightly as you pinch the large diameter part of the boot to release air trapped between the boot and tower. Continue pushing until the cable is firmly seated.

Before seating cables on sparkplugs, wipe off sparkplug insulators. All connections must be secure to avoid arcing.

Even though cables pass all tests up to this point, they may still be the cause of misfire. A cable that looks perfectly sound can be damaged internally. Internal damage is caused primarily by manhandling. When a cable is pulled, the inner core can break.

This increases resistance, reducing current to the sparkplug.

If you have an ohmmeter, you can find out if cables are damaged internally by testing resistance. Do one cable at a time, as follows (this test assumes that your car is equipped, as practically all have been since the early 1960s, with electronic suppression cable, identified by marks on it):

1. Disconnect the cable from the sparkplug and attach a sparkplug adapter between the cable and sparkplug if your ohmmeter lead has an alligator clip.

2. Remove the distributor cap, but keep cables connected.

3. Connect ohmmeter between sparkplug adapter and the correct electrode inside distributor cap for the cable you are testing. If ohmmeter leads are probe types, you can disconnect the cable from the plug and insert the probe so it touches the terminal. Check that probes make good contact.

4. If resistance is more than 30,000 ohms for cables up to 25 inches long and 50,000 ohms for cables longer than 25 inches, remove the cable from the tower and check its resistance by probing the terminal. Replace cables that fail to meet the 30,000 or 50,000-ohm specifications.

5. If a cable meets specification when disconnected but fails to meet the test when connected, a problem exists in the distributor cap. Clean out deposits from inside the cap and test again.

6. To test the cable between the coil and distributor cap, connect the ohmmeter between the center contact in the cap and either primary terminal at the coil. Combined resistance should not exceed 25,000 ohms. If it does, remove the cable at the coil and test resistance. If it is more than 15,000 ohms, replace the cable. If less, check for a loose connection at the tower and for a faulty coil.

The best replacement high-tension cables are expensive, but worth it. The latest design uses tough silicone rubber for the core, jacket and even boots. It is by far the sturdiest and longest lasting cable yet made. You should get an easy 50,000 miles of service unless you start playing tug-of-war.

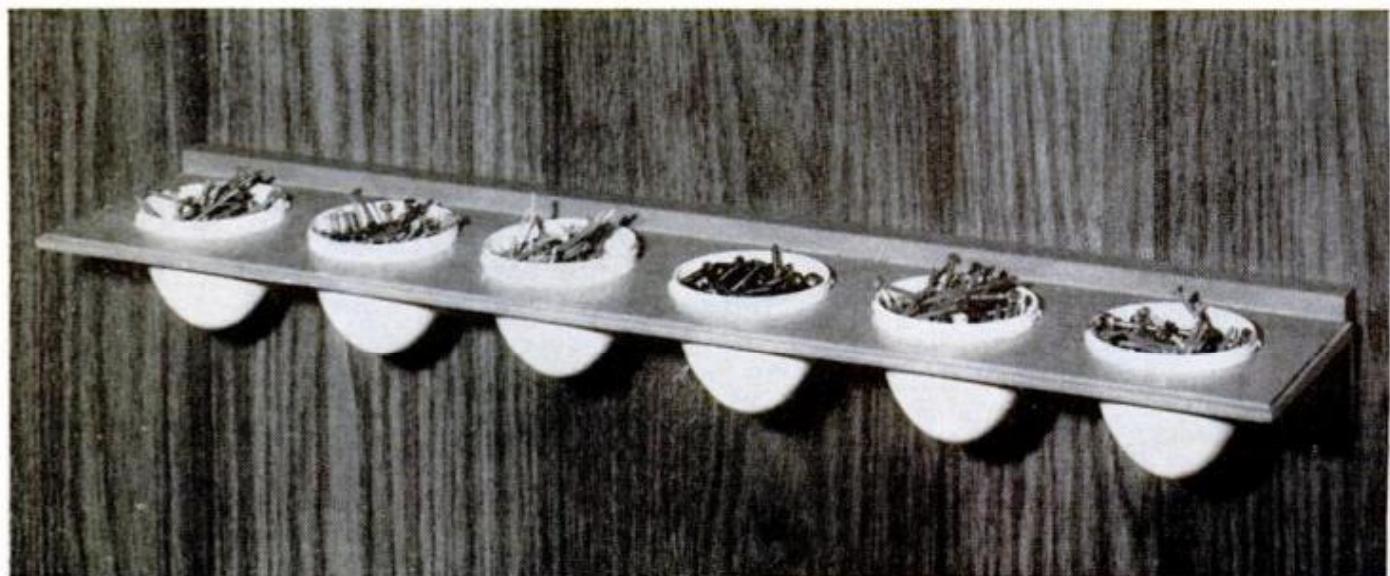
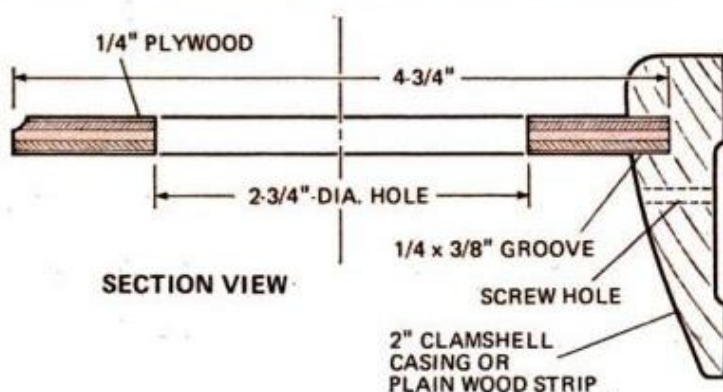
Most cable makers offer sets as "custom" or "universal." A "custom" set is designed for a specific engine; a "universal" set for several engines. ★ ★ ★

Five clever projects for convenience —and the fun of it

Hold-everything shelf

Many throwaway containers have been put to use in the home and workshop to hold a variety of things. Baby-food jars have made great holders for screws, nails and the like. Modified bleach bottles have served a multitude of uses from grain scoops to paintbrush holders to funnels. Still another container which lends itself to holding things is the egg-shape one in which L'eggs panty hose are sold. It consists of a two-part white plastic shell. The half shells provide perfect little cups when supported by a shelf for brads, screws, nails, you name it. Being conical in shape, they make it easy to pick out the very last brad, and the upper half of the shells can serve as covers.

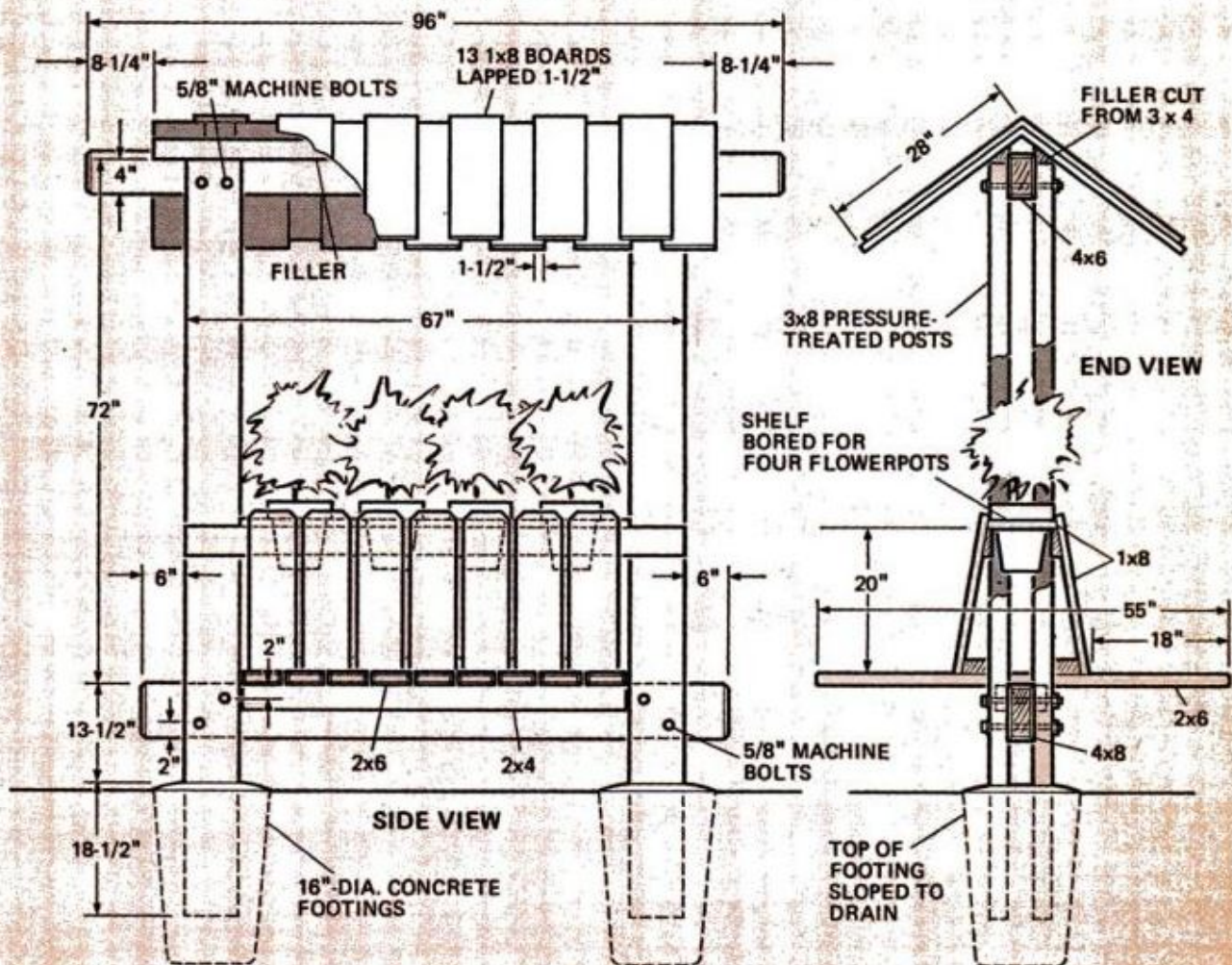
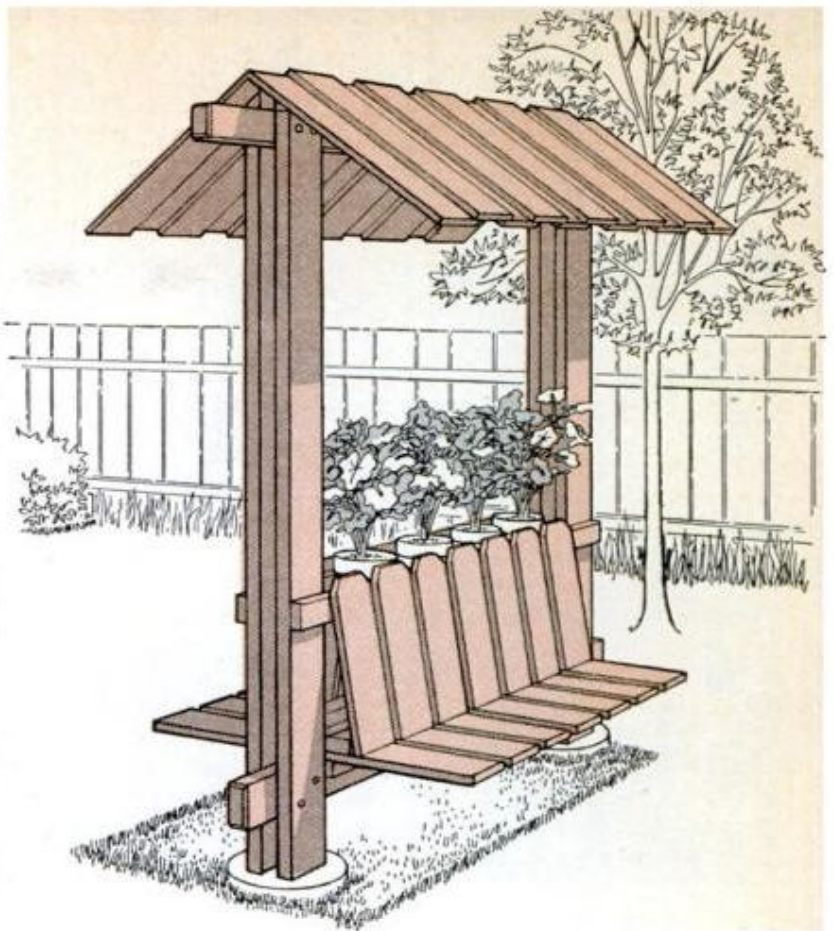
A row of holes 5 in. on centers is made in a scrap of plywood with a circle cutter chucked in a drill press; then the plywood is glued in a groove run in a scrap of clamshell door casing.—Wyatt Yousay



Flowerbox bench

When you sit on this garden bench, you need not necessarily turn your back on your neighbors or yard. Its two-way seat lets you view and admire your lawn and flowers in the comfort of a chair from two directions. Besides offering a shady retreat, the bench will add a colorful spot to your back yard for it's not only a bench but a "flowerbox" as well. Holes in a shelf at the top of the seat backs accommodate four 8-in. flowerpots.

Designed by architect Melvin Kroker for Western Wood Products Assn., the bench makes use of common sizes of stock lumber to simplify its construction. A starting point in its construction is setting the pairs of 3x8 posts in concrete with space between for 4x8 stretchers which are bolted to the posts at top and bottom. The important point here is to see that each pair of posts is braced plumb prior to pouring the concrete.





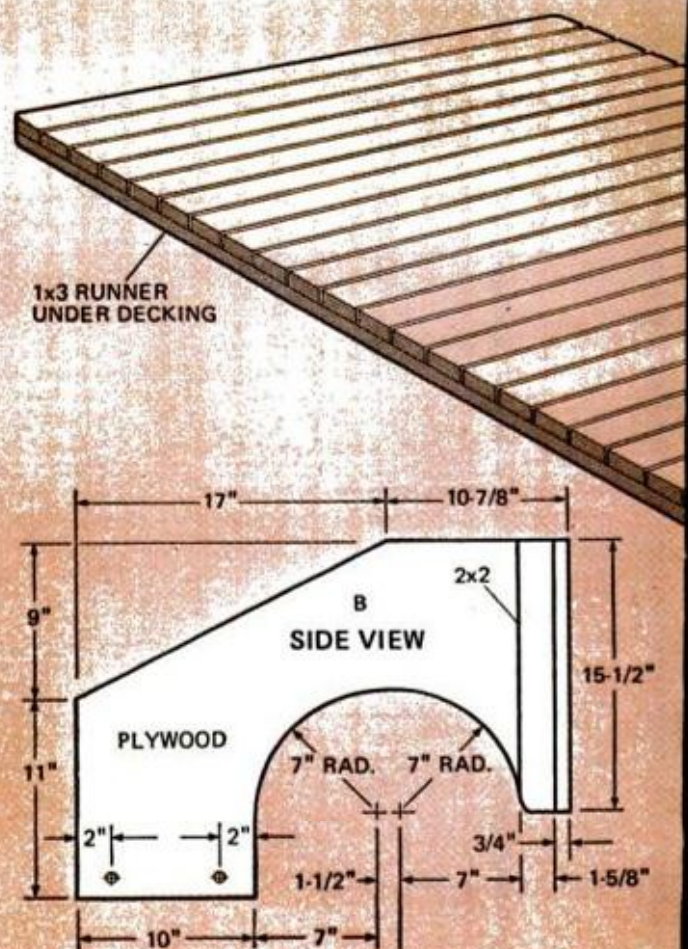
Inflatable outboard

Not too many outboard motorboats can be transported in the trunk of a car, but this one can. The boat itself is an inflatable one (71x147 in.) which can be purchased at an army surplus store. It becomes a motorboat seating six when you fit it with a wood floor and a cantilevered outboard-motor bracket. It makes a great little (and inexpensive) family fun boat. I built the whole thing for about \$200—and the price includes a \$135 motor.

The motor-support bracket is anchored to the wood floor and is made so it clears and does not rub the neoprene-coated canvas boat. The slatted wood floor is made of a size to fit the particular inflatable boat; the dimensions given are for my boat. The floor consists of four 1x3 runners and 1x3 cross slats screwed to them. The 2x2s to which the motor-support board (A) is fastened have a series of holes to provide adjustment. Parts A and B should be cut from marine plywood and painted with a good quality boat enamel.

All bolts and wood screws should be galvanized; while pine can be used for the floor, redwood is better. The 71x147-in. inflatable boat deflates to 8x24x24 in., small enough to be stored on a shelf over winter.

—Lester Walker

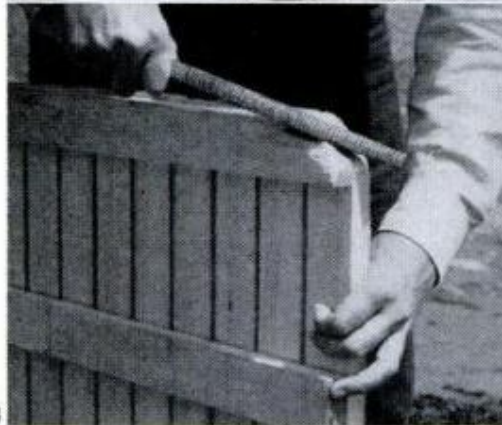
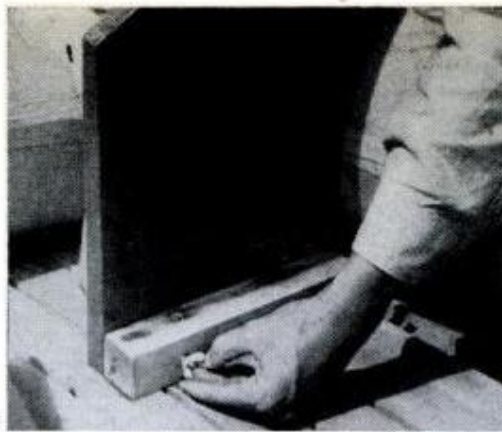


1. Motor-support brackets are attached to wood floor with two 1/4 x 3-in. galvanized bolts which pass through 2x2 cleats. Wingnuts are used for easy detachment.

2. Motor-clamp board spans outer ends of the support brackets, is bolted to 2x2 cleats. Wingnuts are also used here to aid in quick dismantling.

3. Square corners of slatted floor are rounded to conform to inside shape of the boat. Rounding can be done before assembly with sabre saw, then filed smooth.

4. Slatted wood floor is inserted and removed while boat is inflated. Motor-support brackets are attached to the floor cleats after floor is in place.

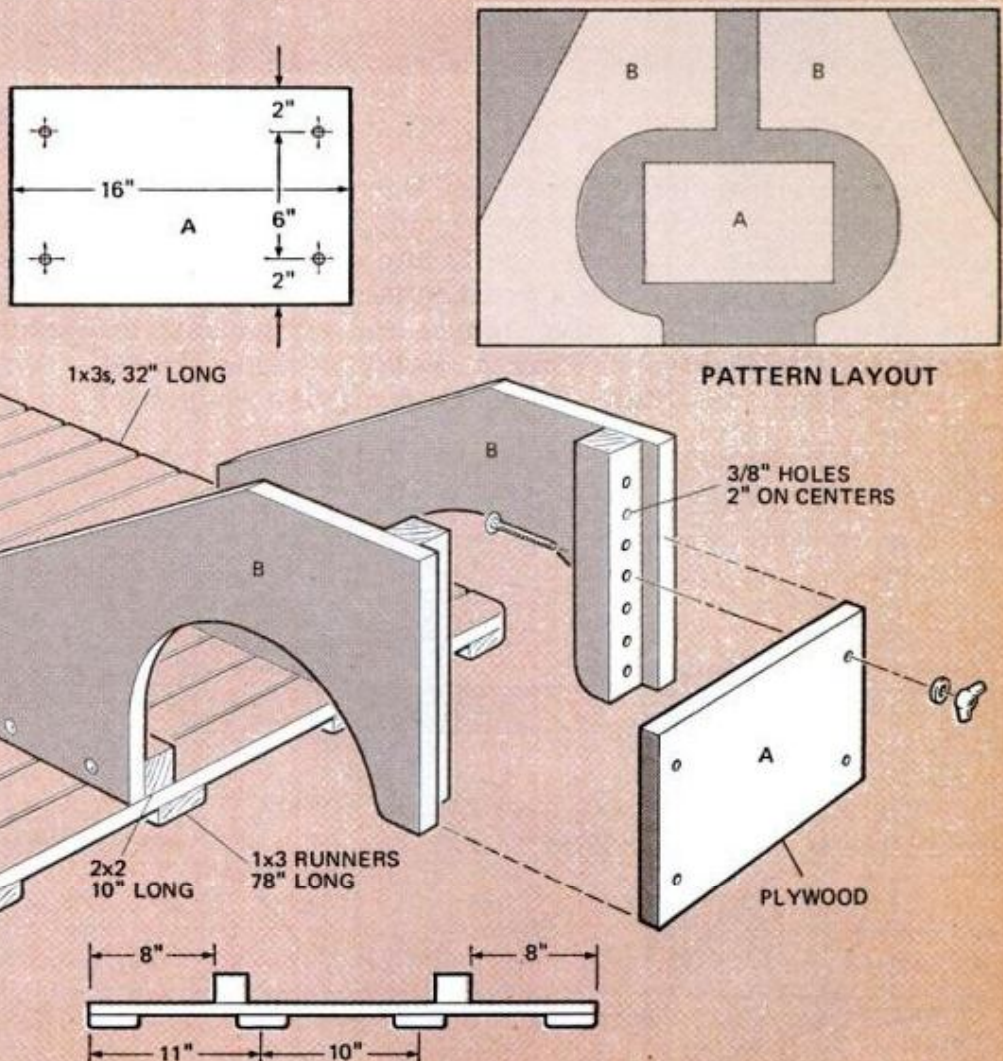


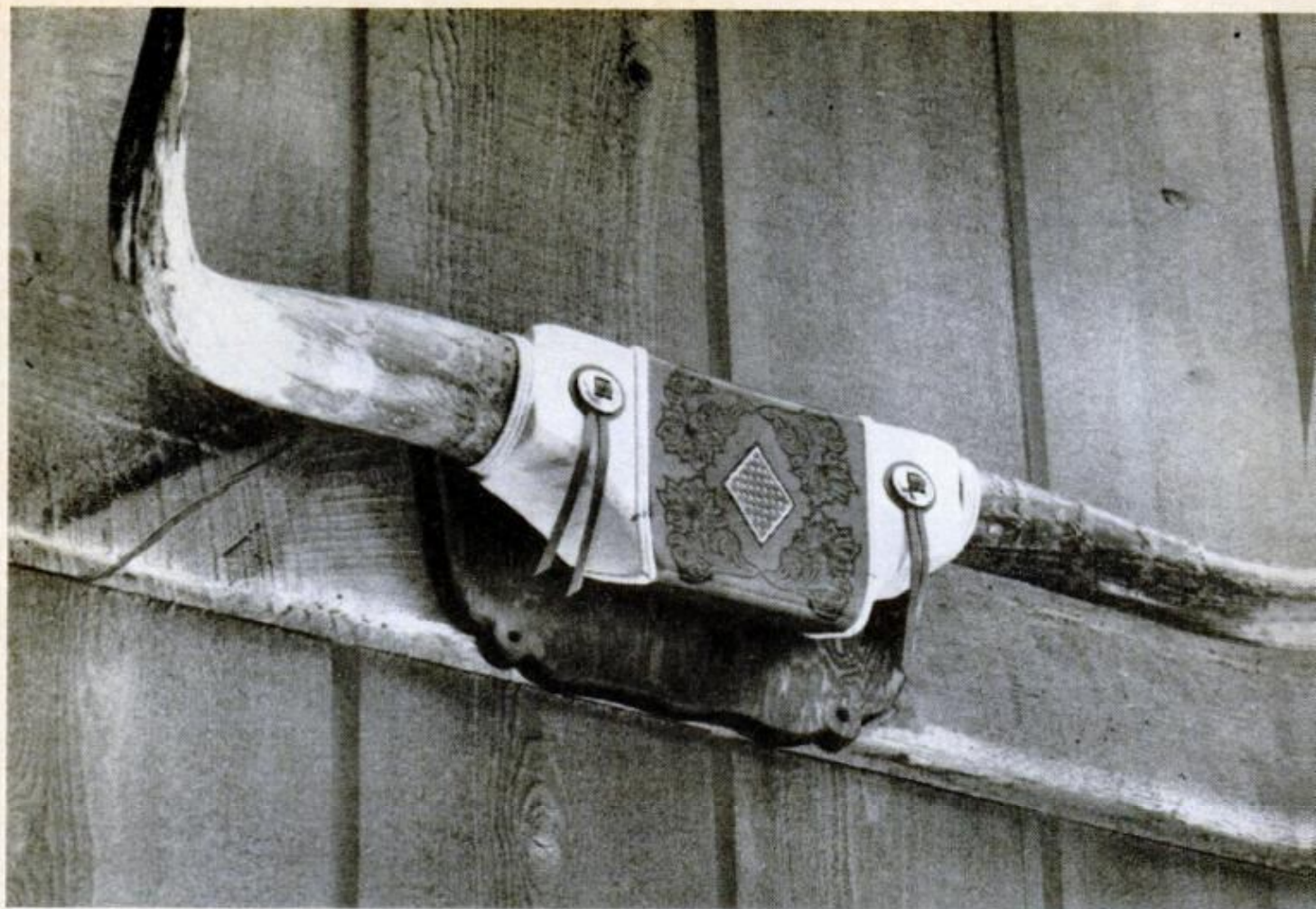
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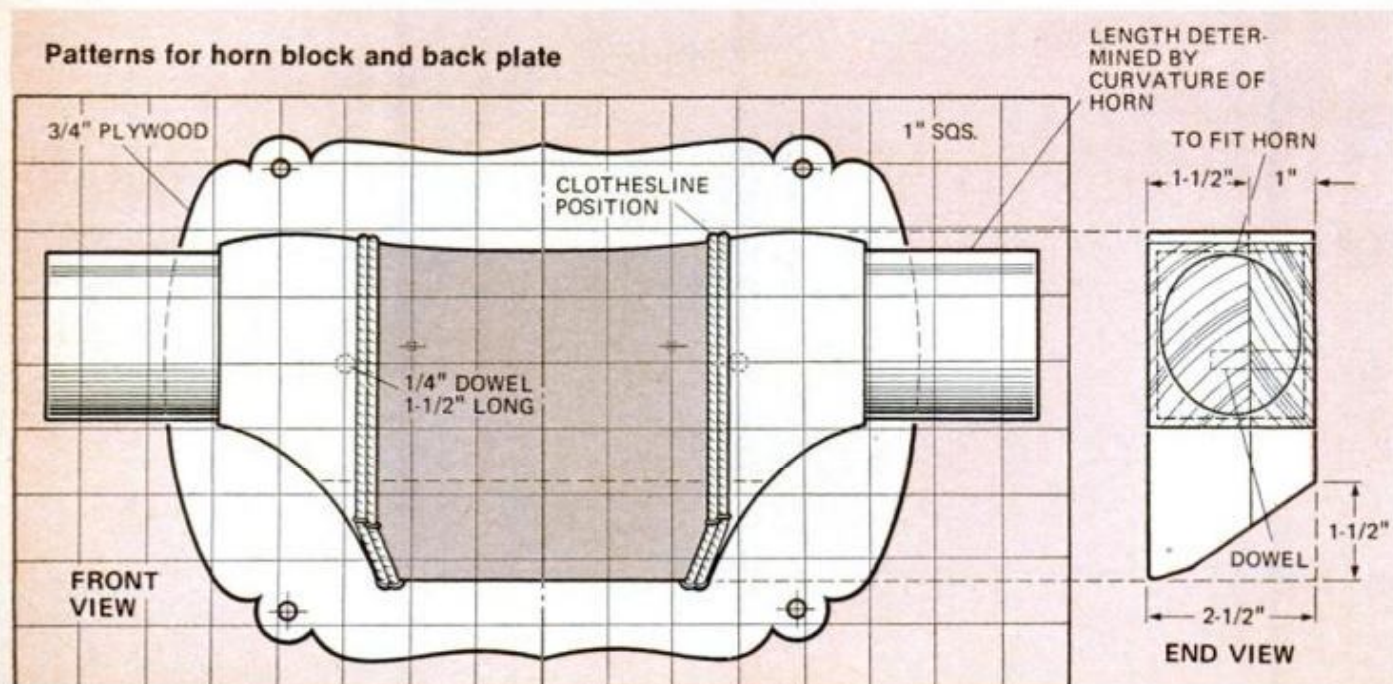
Trophy-room decoration

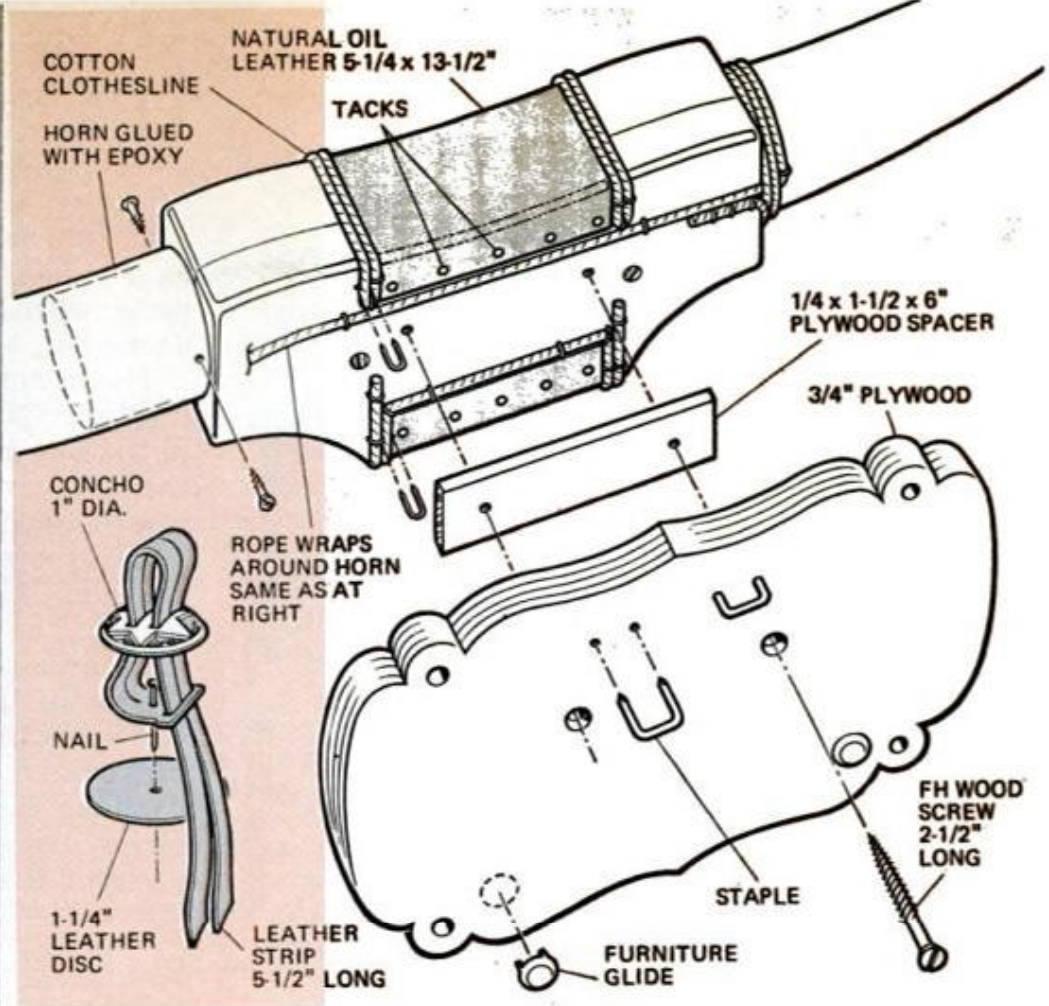
Sportsmen who would like to make this beautiful "trophy" for their den needn't be headhunters. The horns are free to anyone who roams an area where a great number of cattle are grazing. Mine happen to be souvenirs I picked up on a recent vacation in the Lone Star State. You may not

find matching horns, but you can come close.

The hollow horns are epoxied and pinned to "dowel" stubs at the ends of a $2\frac{1}{4} \times 5\frac{1}{2}$ x 16-in. center block built up from two pieces and bandsawed to the shape shown below. The $1\frac{1}{2}$ -in.-long stubs are rounded with a rasp or Surform tool to fit the horns.

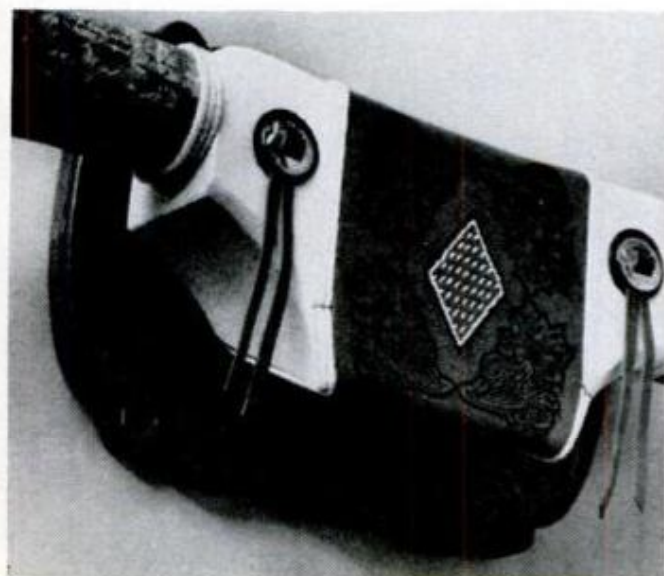
This shaped block is eventually screwed to a $\frac{3}{4}$ -in. back plate (stained walnut) with





1/4-in. spacer (painted black) between. But first, the block is painted with a light-gray spray enamel and given a coat of clear acrylic. When dry, the center portion is covered with a 5 1/4 x 13 1/2-in. piece of natural oil leather tacked in back. Four leaf designs are traced on the leather (use full-size pattern below, right) around a center diamond shape, outlined with a pen and ink

and then filled in with sienna water color. The rope decoration is cotton clothesline starting at the back, wrapped three times around one horn, brought across the back, wrapped around the second horn and anchored with a staple. Two rope strands are added to each edge of the leather. Finally, the conchos and leather strips are added. —Peter Trojan



Leaf designs on leather can be traced from full-size pattern at right, followed by inking and painting.

Actual-size leaf pattern





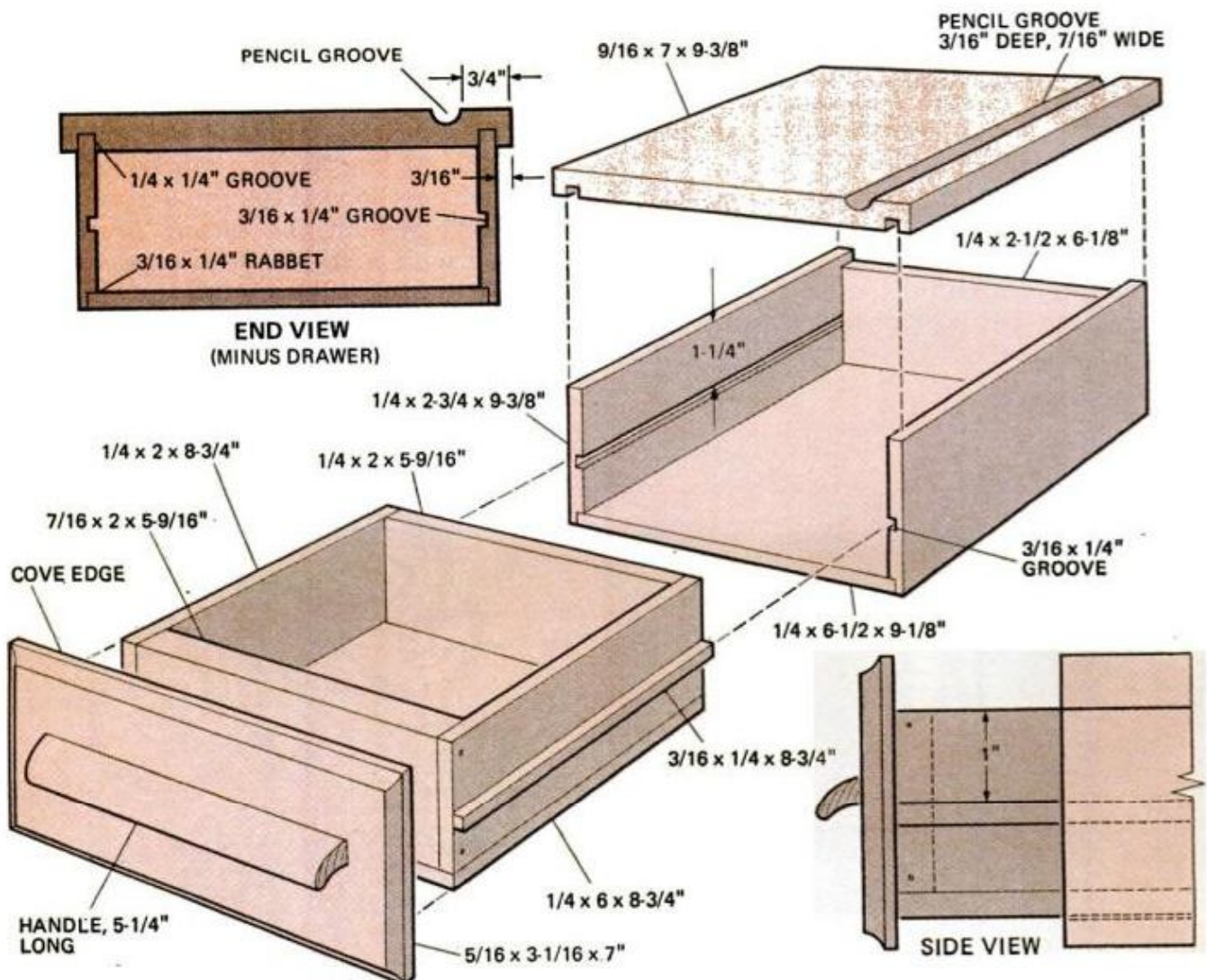
Telephone caddy

How many times have you wanted to jot down a telephone message only to find no pencil or paper handy? It won't happen with this telephone caddy. Serving as a base for a cradle phone, it is fitted with a drawer for pad and phone list, and a pencil groove.

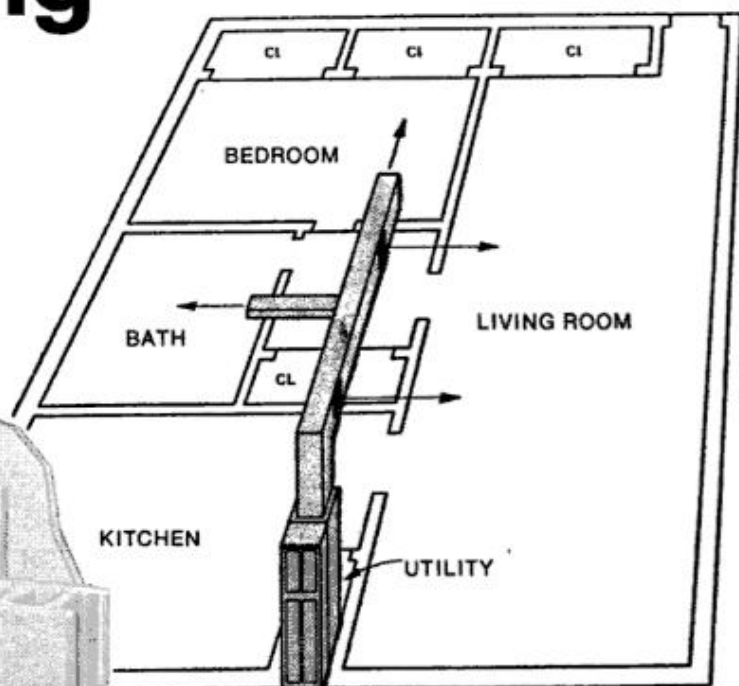
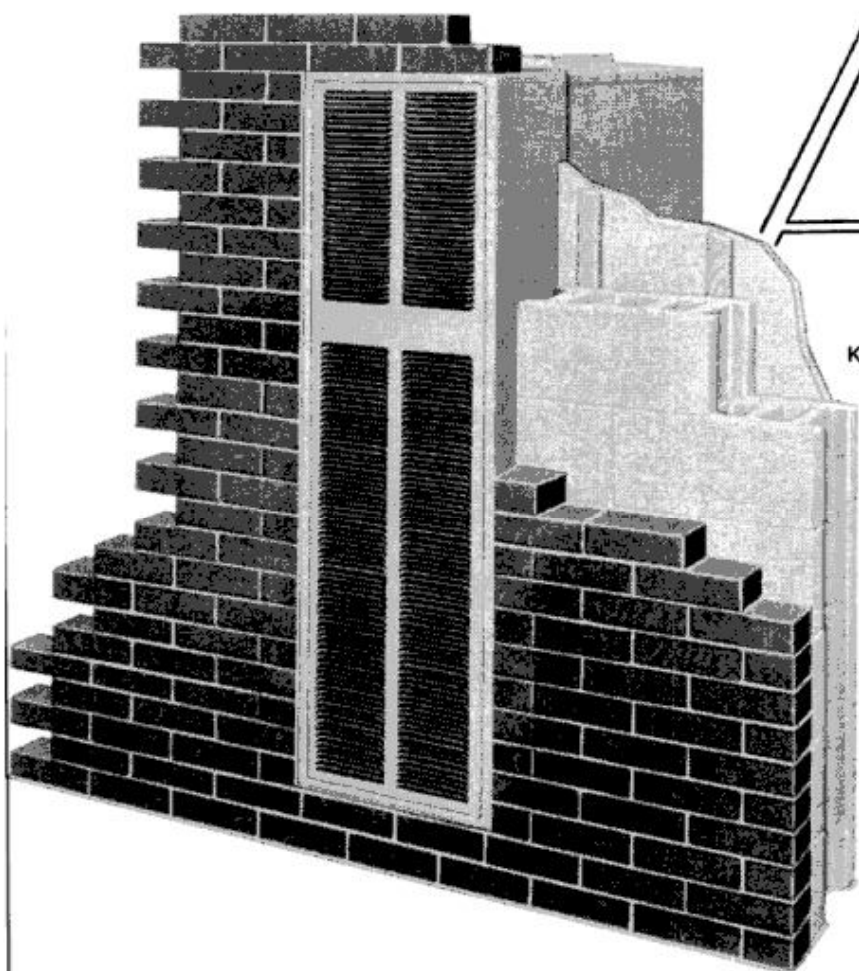
The bottom of the box, as well as the back, is housed in rabbets cut in the side members. Those housing the back are blind rabbets which stop $\frac{1}{4}$ in. from the top. The $\frac{3}{16}$ x $\frac{1}{4}$ -in. grooves for the drawer guides are run, of course, before final assembly. The top of the box, grooved to fit over the side members, butts the top of the back.

While dimensions are given for the drawer, the job is to fit it so it slides easily into the box. The lipped drawer front laps all four edges of the box flush.

—Elmer E. Scott



Through-the-wall heating/cooling unit



Typical installation for Climatrol's year-round total electric heating/cooling system which is designed for ducted air distribution. Ideal for apartments, townhouses, single-family and industrial-built modular houses. Models are UL-listed, meet latest National Electrical Code. Optional galvanized wall sleeve to facilitate installation in walls up to 12 in. thick is available. A 24-v. heat/cool thermostat is standard.

Concealing from view the outdoor compressor of a central air conditioner is no problem with this dual unit for there is none—it's designed to be installed flush with the wall. The new Climatrol 753-1, which is a total electric cooling/heating system, virtually hides itself by blending in with the overall facade of the building. Measuring 31 in. deep, it fits an outside wall opening 16x56 in., and distributes cool or warm air to various rooms through a central duct.

Each of the four basic models in 1½, 2, 2½ or 3 nominal tons of cooling is available with a 5, 10 or 15-kw (17,000, 34,100 or 51,200 B.T.U.) electric heating section. The top of each unit is flanged to facilitate air-duct connection. Return air can be ducted or returned directly through the front or bottom of the units, and each electric heating

element is supported on ceramic holders. Models having secondary heating stages also have a time-sequence energizing control to reduce power surges.

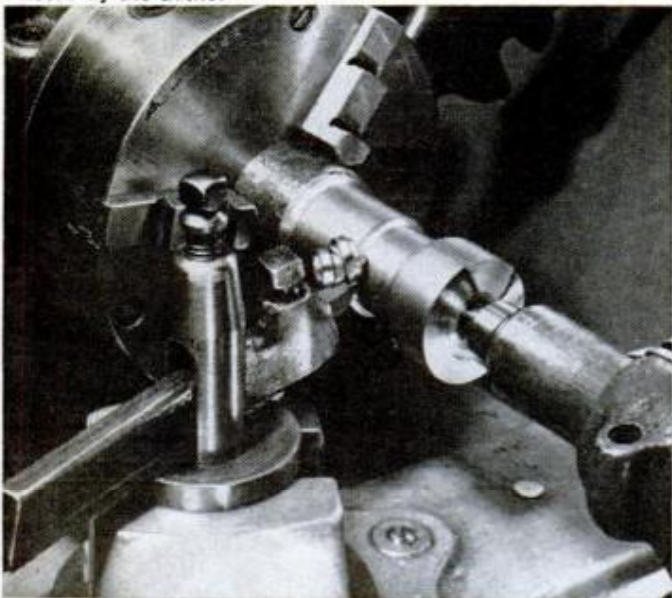
All controls are fully automatic. For example, when the thermostat is switched from heating to cooling, the higher air volume is adjusted within the unit. When switched from cooling to heating, the air-moving blower is automatically readjusted to a lower speed. This feature eliminates the need for seasonal lower-speed adjustments. The internally protected hermetic compressor is equipped with pressure valves and a crankcase heating device.

The units are shipped completely wired and assembled. For more information, write Mueller Climatrol Corp., 255 Old New Brunswick Rd., Piscataway, N.J. 08854. ★★★

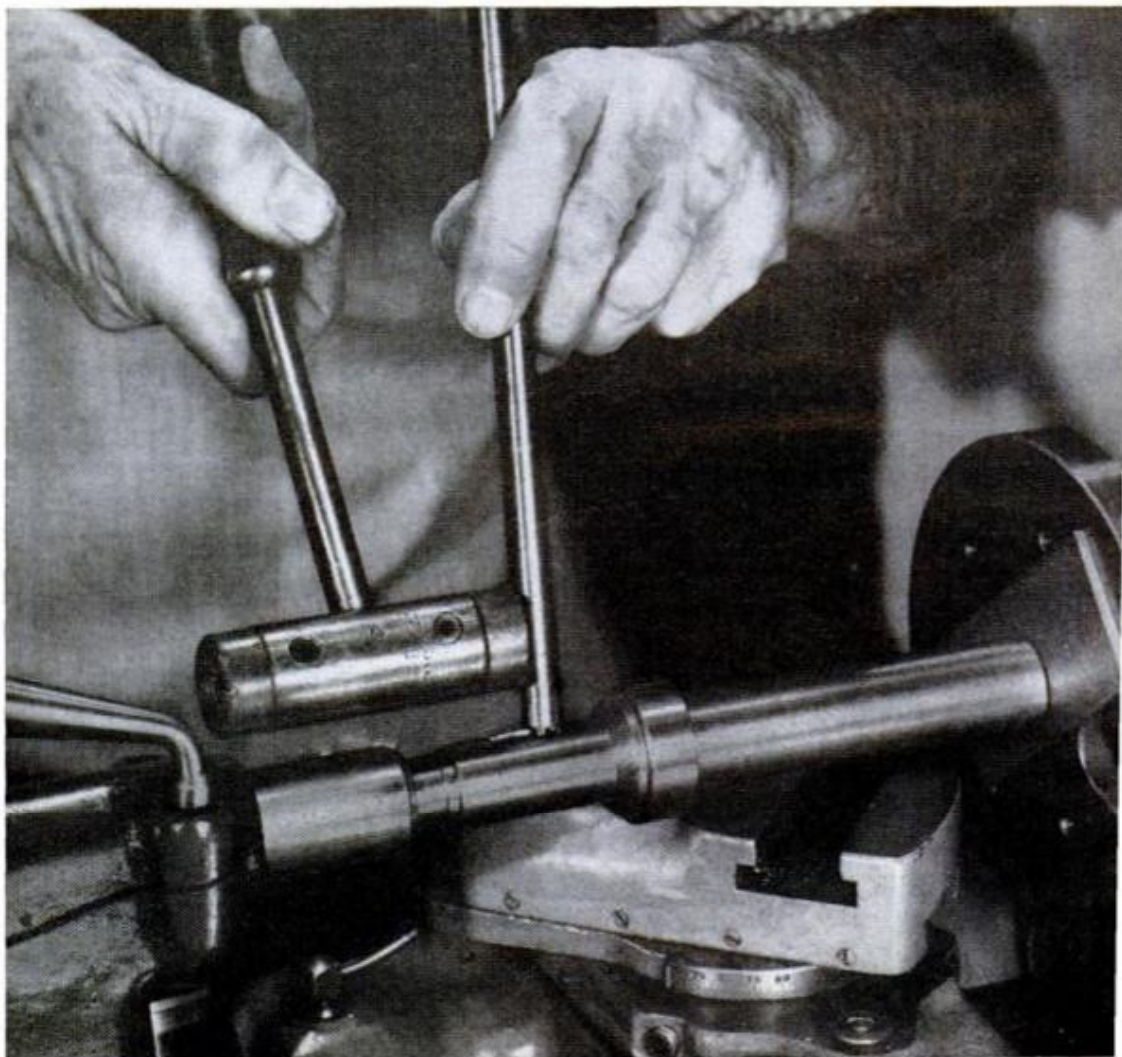
A center marker for lathe work

by Walter E. Burton

Photos by the author



Center marker blank is machined (above) while supported at outer end by the tailstock center for greater rigidity. When marker is used in a lathe (right), pressure of tailstock center holds workpiece in alignment while extension bar on the marker-punch "handle" is struck with a mallet.



With this tool it is no trick to locate and punch-mark the center of a bar to be mounted in a lathe for machining. And the tool itself makes an interesting lathe project. The marker is essentially a tailstock cup center with built-in punch operated from the side. If carefully made, it can be accurate and fast.

The marker has a conical cup which accepts the end of the bar to be center-punched. The bar end, which is square with the axis and uniform in circumference, centers automatically in the cup. Then the sliding punch is brought forcibly against the bar to make a mark which later can be enlarged, or shifted, if necessary, with a hand punch, prior to center-drilling.

The tool will also mark centers on hexagon and other multisided bars.

The body, A in the drawing at right, can be machined from hardenable tool steel or

from cold-rolled steel. After the outside of the marker has been machined, a 3/16-in. axial hole is drilled through its length. The conical cavity is then formed. In the drawing, a 50° angle is indicated. If this is changed, some alterations in punch dimensions might be needed.

Next, cut the body to length and reverse in the chuck to enlarge the axial hole to 5/16 in., to a depth of about 1-9/16 in.—that leaves a portion (3/16-in.) of the bore between it and the cup. The outer end of the 5/16-in. hole is threaded for the 3/8-16 mounting stud D, or sleeve F.

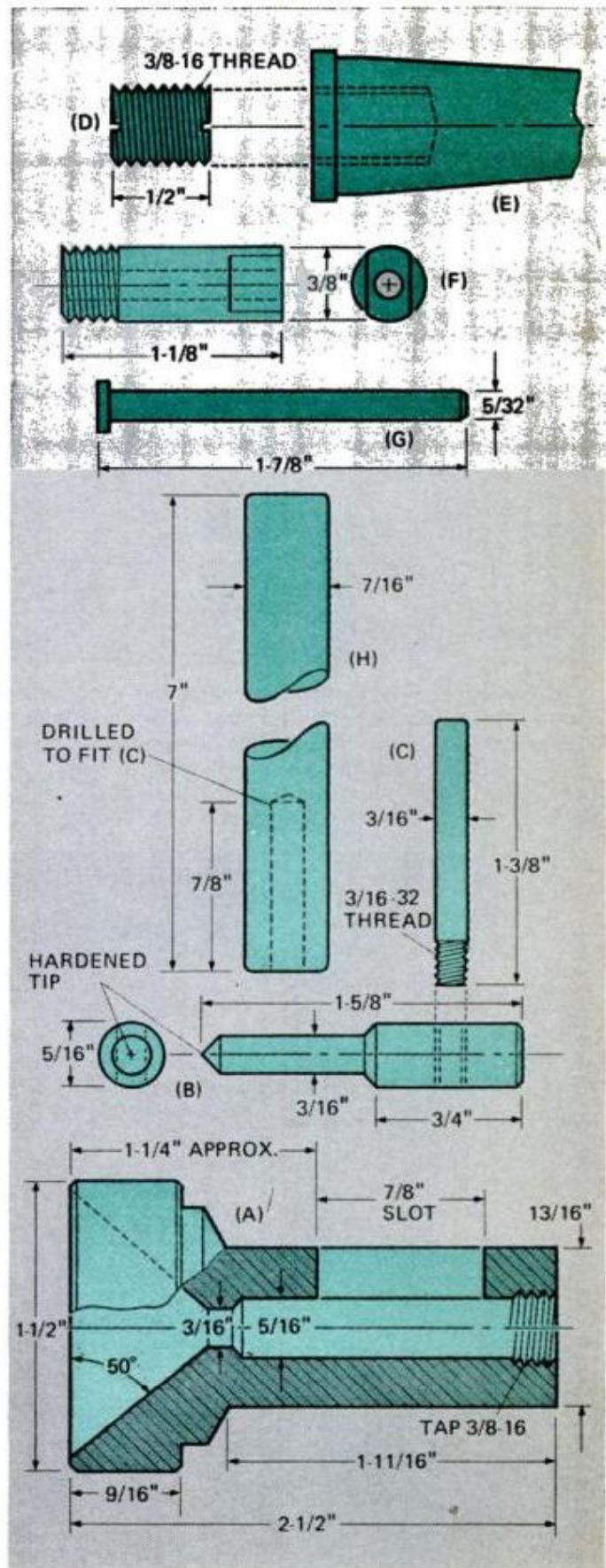
The punch (B) is of hardenable steel such as drill rod. Diameters of the small and large sections are regulated so the punch slides easily but with minimum lost motion in the bore of body A. Handle C projects through a slot in the side of A and is usually the means by which the punch is operated.

Threaded stud D allows coupling body A to taper shank E for mounting the tool in a Morse-taper spindle or drill press. Cross slots are for screwdriver removal of the stud. The taper shank of a broken drill bit can be used for E.

The tool can be used as a hand-held, bell-cup center punch by substituting sleeve F for the tapered shank. This is made from a 3/8-in. bolt, in which sliding pin G (made from a large nail) operates. With plug and pin in place, a light hammer blow on G will mark center. Punch and bar must align.

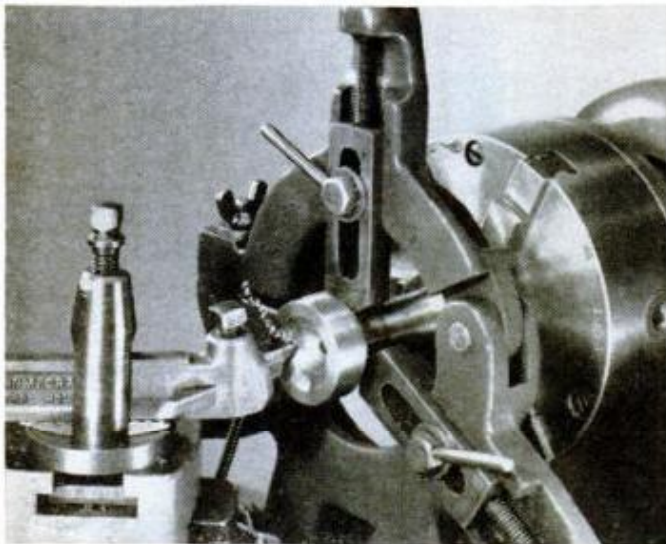
When the center marker is used in a lathe tailstock or drill press, the punch must be operated by means of handle C. You could strike C's side with a hammer, but this might bend it. Bending is less likely if an extension bar (H) is slipped over C and the outer end of H is held steady while the bar is struck near the marker body.

Before marking a bar, its end must be squared and any burrs removed. Support the bar during the center-marking operation, so it will be in alignment with the marker while its end can shift laterally to center itself in the cone cup. Clamping a bar, especially a short, rigid one, in a chuck may cause its outer end to be off center and supported too rigidly to seat in the cup

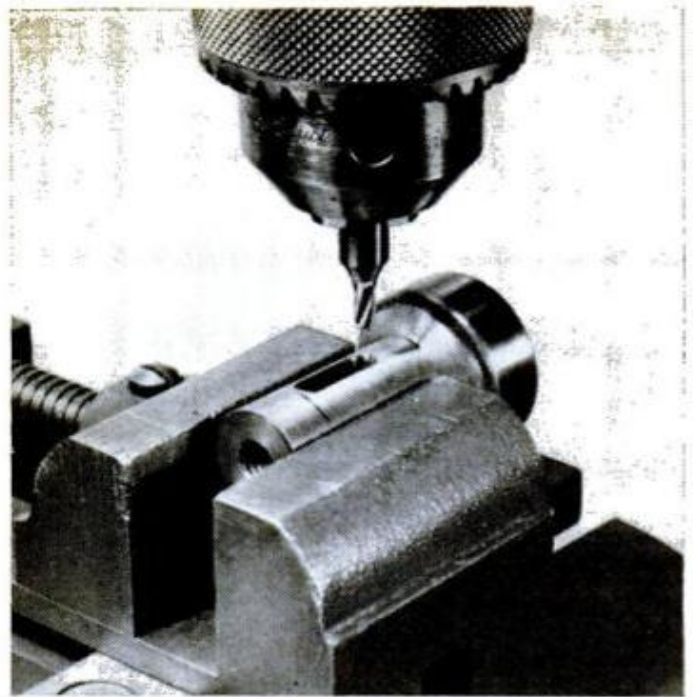
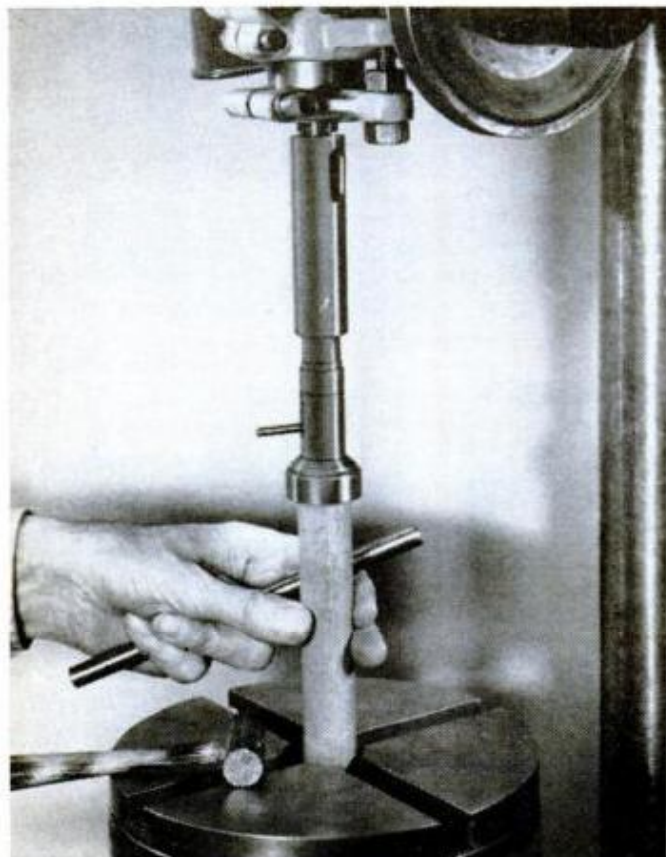


properly. It is better to rest the bar against the end of the headstock spindle (or something covering the spindle, such as the flat plate in the photo at bottom of page 146, with the tailstock spindle forced against the bar end with enough pressure to hold everything in place while the punch is operated. The same goes for a drill-press setup.

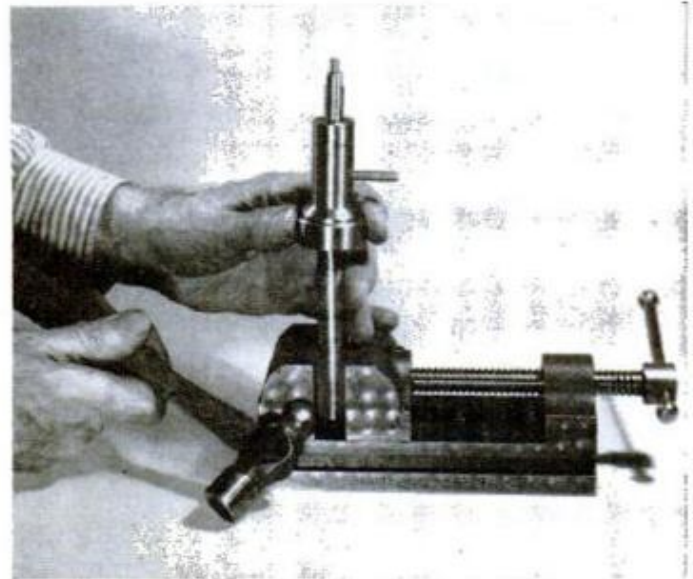
The center marker will handle workpiece diameters from about $\frac{1}{4}$ in. to nearly the maximum diameter of the conical cup. ★★



Conical cup in marker body is machined by feeding tool with compound slide set to give cone angle (above). Outer end of body is steadied by steadyrest. Below, tool being used on drill press to establish centers on wood dowel to be lathe-turned. Dowel is being shifted into visual alignment with marker.



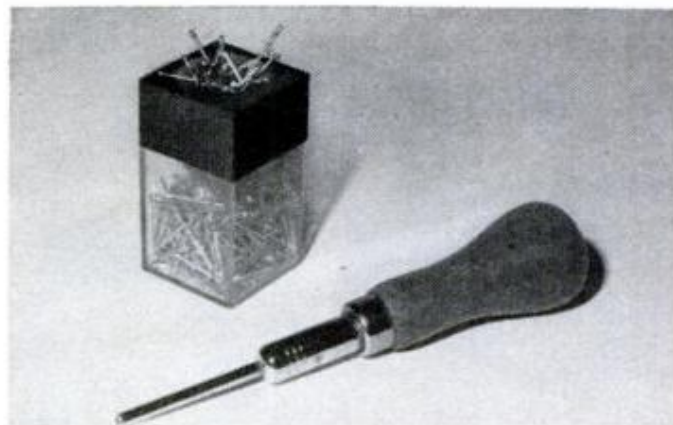
Slot is cut in marker body with end mill in drill press chuck (above). A milling-table attachment, not visible in photo, controls vise movement. Though intended for lathe or drill press, marker can be used as hand-held, bell-cup center punch as below. Sliding-pin arrangement subs for tapered shank.



Center marker parts, with the exception of extension arm H, are shown above. The body, A, can be machined from hardenable tool steel or cold-rolled steel.

HINTS

FROM READERS



Magnetic holder for parts

Magnetized paper-clip containers of the type sold in most stationery stores are handy to have in the shop for storing a variety of small parts made of ferrous metals, such as the wire brads shown. When the container is tipped upside down, the brads are there, ready to use.

—C.H. Maxwell, Vancouver, Wash.



Newspaper transfers patterns

To transfer large drawings onto plywood or other materials, you can use the classified pages of your newspaper, rubbed with a thin coat of paraffin, instead of carbon paper or pencil rubbing. Newsprint will not rub onto hands, and close spacing of ads in small type will produce a followable line.

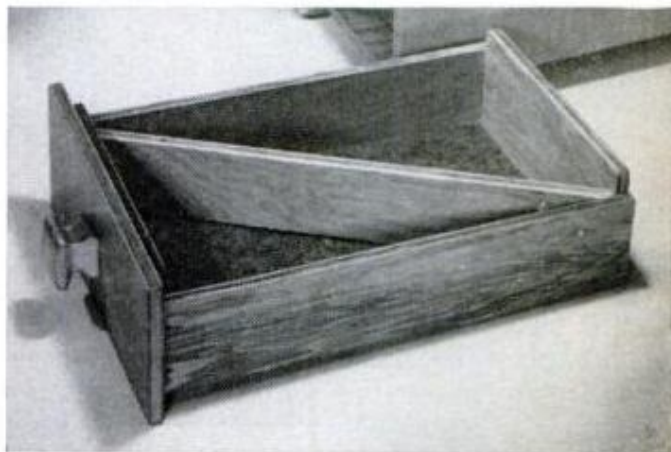
—Frank E. O'Connor, Gulfport, Miss.



Glovebox organizer for pen and tire gauge

A double fuse block of the spring-clip type (sold in auto-supply stores) can be mounted in your car's glove compartment to allow neat, convenient storage of a tire-pressure gauge and a pen or pencil. Use pliers to bend the clips out wide enough for the articles they will hold.

—Kenneth M. Kaufman, Elbridge, N.Y.



Quick drawer divider

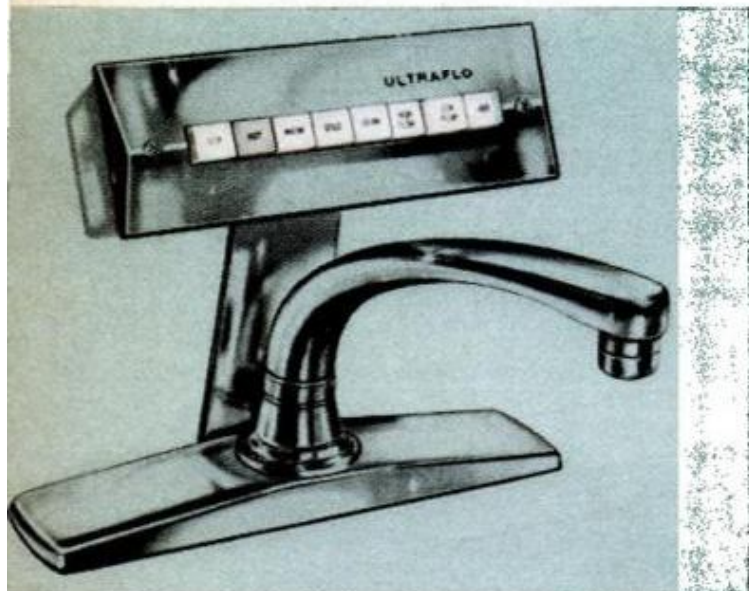
You can divide a drawer in half without nails, screws or brackets. A length of wood or heavy cardboard fitted diagonally between two opposite corners will halve the drawer exactly. It is self-securing (cut and try for best fit) and can be lifted out for easy cleaning.

—Allen Wilks, Matawan, N.J.

Now: Water by the button

Turning a faucet is a thing of the past with a new plumbing system called Ultraflo. You start the water flowing by merely pressing a button.

by Wayne C. Leckey
HOME AND SHOP EDITOR



DISP	HOT	WARM	COLD	DRINK	HI FLO	LO FLO	OFF
------	-----	------	------	-------	--------	--------	-----

There are eight buttons for the kitchen sink. When OFF button is pushed, the only water left in the line is in the 3-ft. section between water tank and valve unit.

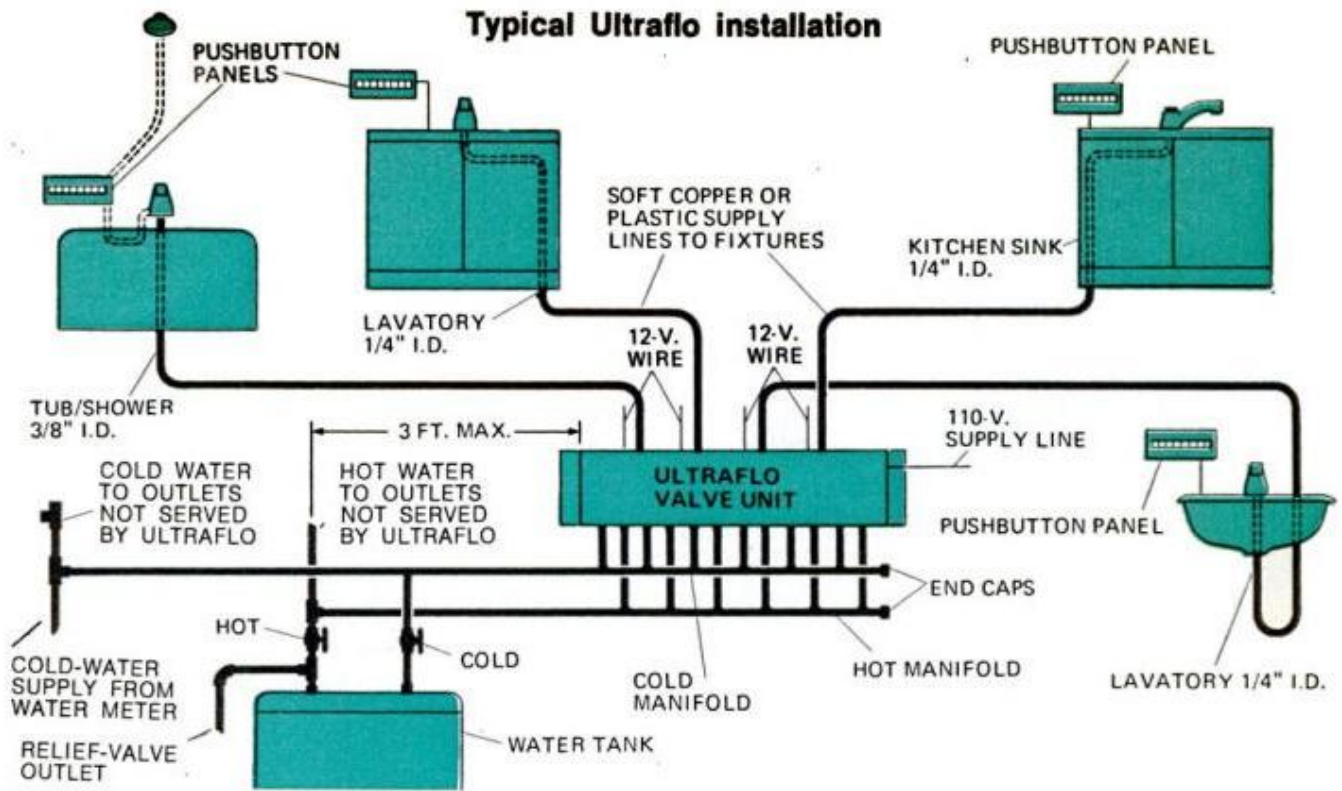
You can now turn on a faucet by pressing a button. It's all made possible by a console containing banks of solenoid valves located near the water heater. The banks are electrically operated (12 volts) by pushbutton control panels located at your kitchen sink, bathtub and lavatory. There are eight button selections for the kitchen sink marked: DISPOSER, HOT, WARM, COLD, DRINK, HI FLO, LO FLO and OFF. At each lavatory and bathtub there are four button selections. If you want hot water, you press the HOT button and in seconds you have water of a pre-selected temperature. No longer is it necessary to let the water run to "hurry" it (hot

or cold) to the faucet—it's there as soon as you press the button.

Not only does this unique system eliminate the need to replace faucet washers and help save water and the cost of heating it, but the system costs less to install since it replaces the conventional two-pipe (hot and cold) system with only a single line. Flexible copper or plastic tubing no larger than $\frac{1}{4}$ or $\frac{3}{8}$ in. is all that's needed to supply each fixture because you no longer have to manually mix hot and cold water as with a conventional system. It's done for you at a water-mixing source.

At the time of installation, the rate of

Typical Ultraflo installation



How Ultraflo works

KITCHEN SWITCH

HOT
WARM
COLD
DRINK
DISPOSER
HIGH FLOW
LOW FLOW
OFF

BUTTON PROVIDES

Water directly from the hot-water supply.
Hot and cold water blended to preset temperature desired by the user.
Water directly from the cold-water supply.
Water directly from the cold-water supply bypassing the water softener (when applicable) to provide more palatable drinking water.
Simultaneous operation of disposal unit and cold-water flow.
Maximum preset water flow desired by user.
Reduced water flow when desired.
Shutoff of all activity generated by the switch.

LAVATORY SWITCH

HOT
WARM
COLD
OFF

BUTTON PROVIDES

Water directly from the hot-water supply.
Water blended to preset temperature desired by the user.
Water directly from the cold-water supply.
Shutoff of all flow of water to the fixture.

SHOWER/TUB SWITCH

WARM
WARM 2
WARM 3
OFF

BUTTON PROVIDES

Water blended to preset temperature desired by the user.
Water blended to greater temperature than the WARM setting.
Water blended to higher temperature than the WARM 2 setting.
Shutoff of all flow of water to the fixture.



HOT **WARM** **COLD** **OFF**

LAVATORY CONSOLE

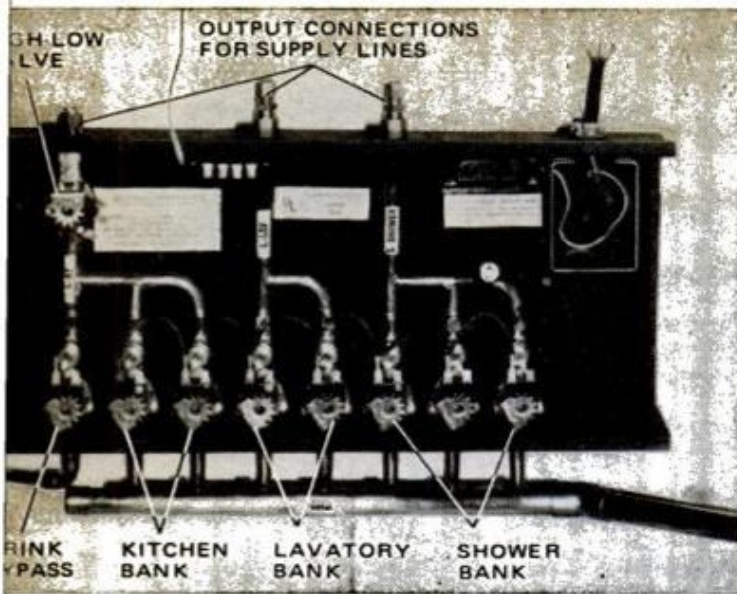
There are four button selections for the remote control at lavatory.



WARM **WARM 2** **WARM 3** **OFF**

SHOWER/TUB CONSOLE

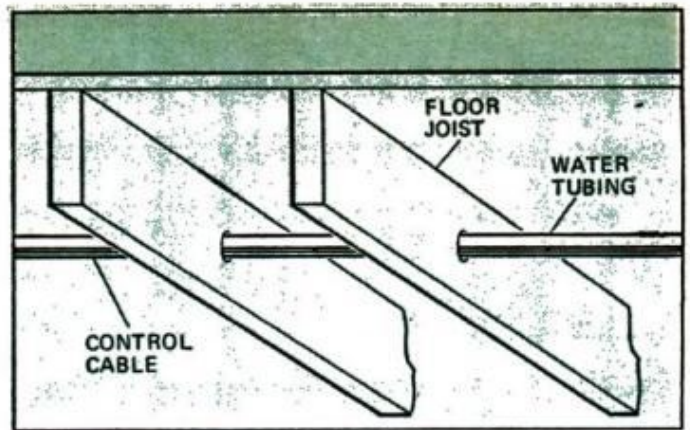
Switch offers three preselected temperatures for shower or tub.



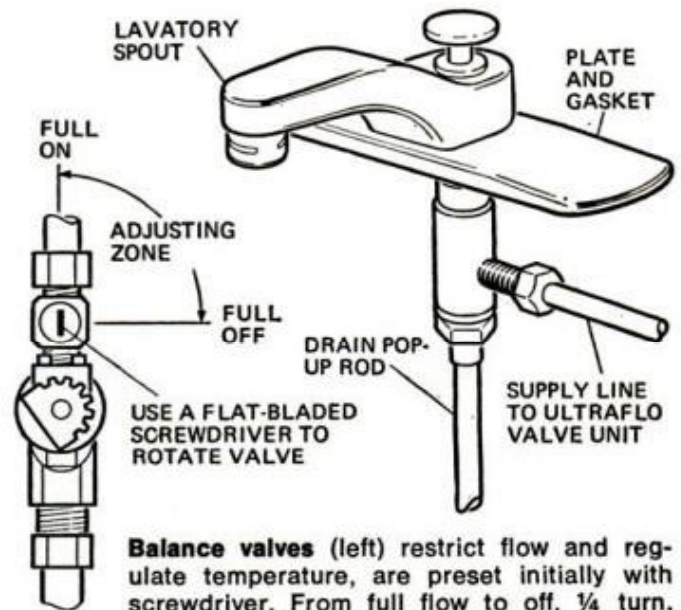
Valve unit, near hot-water tank, contains solenoids, adjustable for preset water temperature and flow.

flow and temperature of the water is preset. Temperature range is from 102° to 114°F.—102°F. is lukewarm; 114°F. is as hot as one can stand. For bathing and showering, the temperature is preset at 106° to 108°F. Presetting the flow and temperature settings of the solenoid valves requires the flat blade of a screwdriver. Once set, the valves normally do not require readjustment.

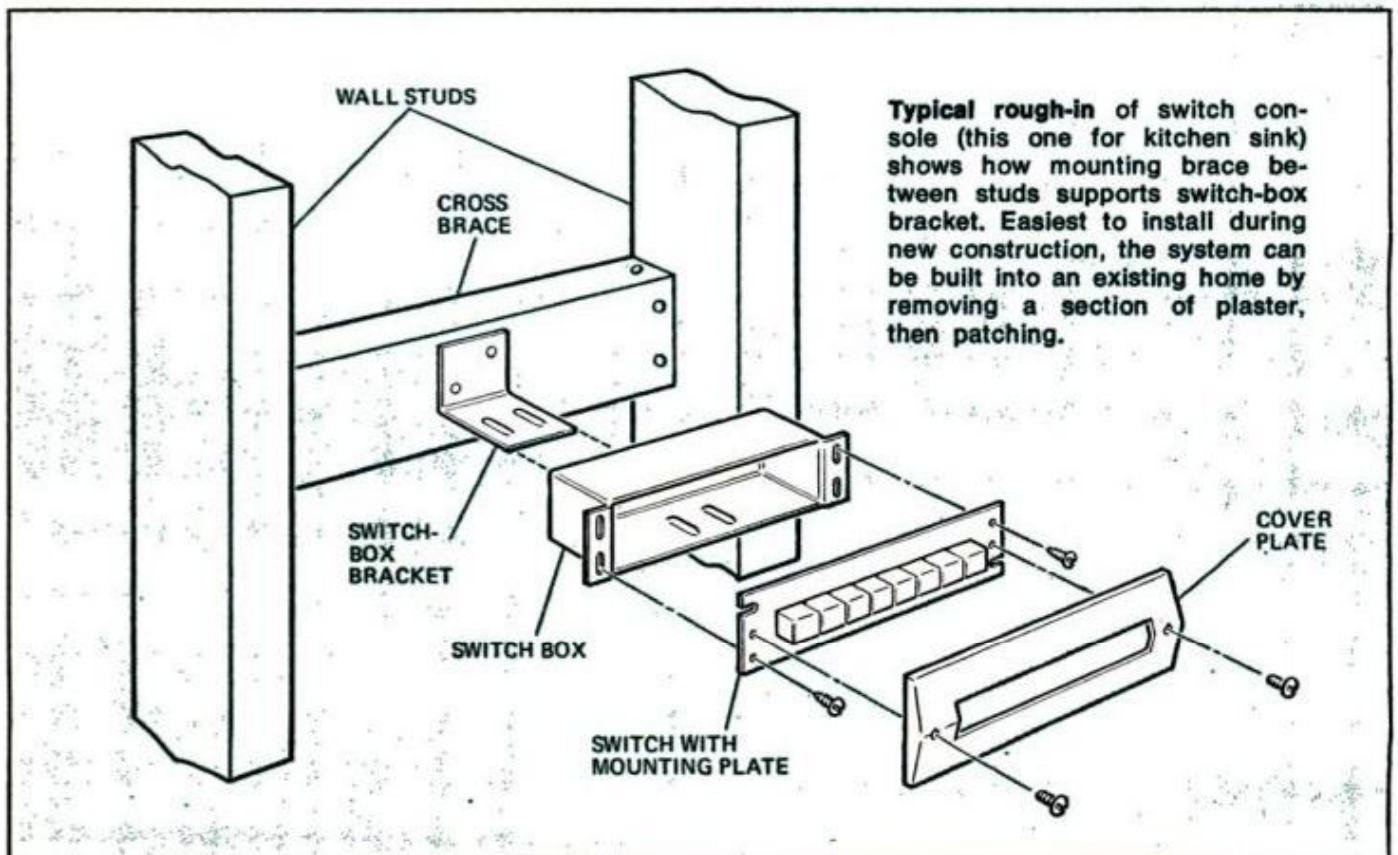
For more information about this unique, one-line pushbutton plumbing, write to the Ultraflo Corp, Box 2284, Sandusky, Ohio 44870. ★★★



Both single water line and 12-v. wiring are run between switch and valve unit through holes in joists.



Balance valves (left) restrict flow and regulate temperature, are preset initially with screwdriver. From full flow to off, ¼ turn.



Typical rough-in of switch console (this one for kitchen sink) shows how mounting brace between studs supports switch-box bracket. Easiest to install during new construction, the system can be built into an existing home by removing a section of plaster, then patching.

Photographed on Vancouver Island, British Columbia.



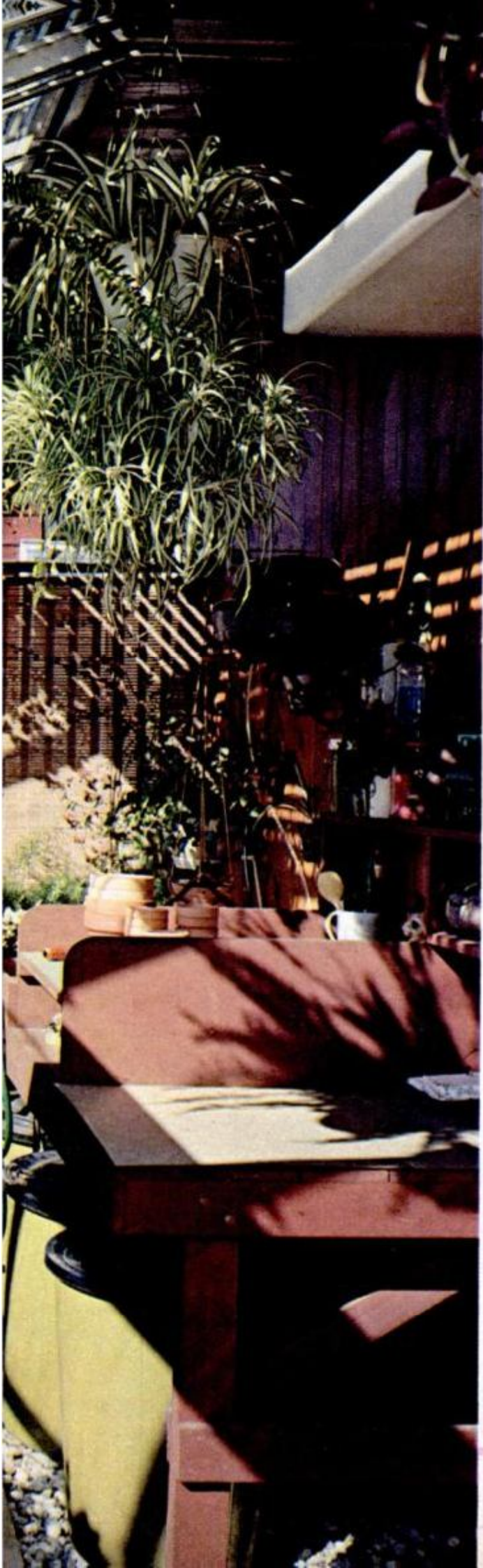
Canada at its best.

Try the light, smooth whisky that's becoming America's favorite Canadian.
Imported Canadian Mist.

CANADIAN WHISKY—A BLEND, 80 OR 86.8 PROOF, BROWN-FORMAN DISTILLERS IMPORT COMPANY, N.Y., N.Y. © 1973

Материал подготовлен редакцией журнала





Greenhouse at home: What a way to grow!

Built from a kit, it adds charm to your home, lets you enjoy gardening the year round.

by Robert D. Borst

Photos by the author

For years, gardening and plant growing has been a seasonal hobby for our family. Until now, my wife's enthusiasm for growing things was exceeded only by her lack of it when each growing season ended. The greenhouse shown on these pages changed that.

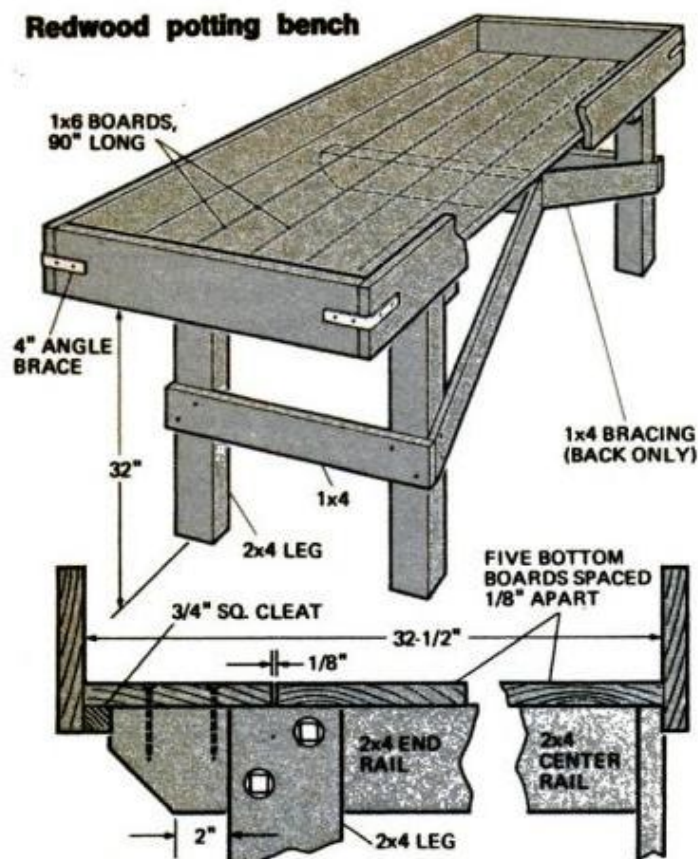
Connected to the house proper, the lean-to structure is reached through a door installed in an opening in the concrete foundation. We selected the lean-to from a number of styles offered by the manufacturer, Lord & Burnham, Irvington-on-Hudson, N.Y. 10533. Called Orlyt prefabricated greenhouses, their prices range from \$496 to \$2500 (cost varies with number of sections used). The six-section, 16-foot-long structure shown cost \$1510 delivered.

The greenhouse kit arrives in several pack-



Greenhouse for all seasons is available as gable-roof freestanding unit as well as lean-to shown. Handsome lights are Benjamin fluorescents by Thomas Industries.

Redwood potting bench



First step is to open all packages, remove and sort all parts into like piles. Parts are then checked against packing lists to make sure all parts are on hand before job commences. Next, blueprints should be carefully studied so assembly procedure is understood.

ages, so the first step is to unpack the parts and sort them into like piles for checking. Complete assembly instructions come with the kit. They should be read and understood before you start building.

The "hard work" part of the job is the digging, forming and pouring of footings. To ease the pouring task somewhat, we used transit (ready-mix) concrete wheelbarrowed from truck to forms. At the forms, the concrete was pushed into job-built "pour boxes" to speed placement in the footing forms (see photos, page 160). Since the glass is precut for an exact fit, the footings are poured *after* the structure is erected and glazed. Done this way, the structure will be absolutely square and the glass panels will slide into place effortlessly.

Our house is on sloping terrain. Thus, the greenhouse could be attached to the basement wall and permit a direct entrance from the basement. Here, it was a must to cut an

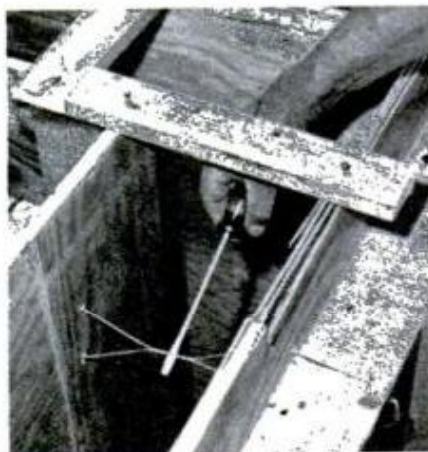
(Please turn to page 158)



After house shingles are removed, $\frac{3}{8}$ -in.-thick shims are nailed to the exposed house sheathing.



2x8 header is installed using lag screws. Deck bars of greenhouse attach to the header.



Concrete-footing forms are used; spreaders keep the batter boards from toeing-in during the pour.



Anchors hold greenhouse sills in place on concrete. This installation job must be accurate.



It's built to carry two kinds of campers.



First, there's the human kind. For them, we offer a cab with plenty of glass area for good visibility. And there's a wide choice of luxury interiors available.

Underneath, there's a long wheelbase with rear leaf springs. And independent coil spring front suspension. And standard power front disc brakes with audible wear indicators.

Then there's the other kind of camper—the made-of-metal kind. We've thought of that, too. We've developed special camper tie-down packages that are available to facilitate mounting. And there's Elimi-pitch that hydraulically snubs

the camper body in case it tries to pitch up or down.

Also available are dual rear wheels. Full-time four-wheel-drive. Or trailer towing packages that can handle virtually anything you want to pull—even fifth-wheel units.

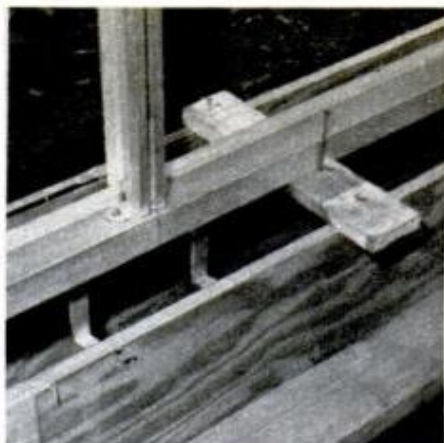
If you're in the market for a pickup, think about the two kinds of campers in your life. And get a GMC.



**The Truck
People from
General Motors**



Door frame (jamb) is positioned; the concrete footing—at door center—must be 1 to 2 in. above grade.



Greenhouse frame is braced in position; 1x2 spacers are installed between the sill and batter boards.



Deck frame is then fastened to the 2x8 header on the house by means of wood screws.



Ridge and 2x4 stringer for deck are attached next. Operable-vent section is located directly below it.



Vertical 2x4s are used temporarily to support the deck stringer during remaining frame assembly.



Vent shaft is then positioned and installed after the main members have been fastened in place.



Tongue-and-groove sheathing is fastened to the deck; then, following a chalkline, trimmed in place.



Operable vent sash is next to be installed. Vent operates by thermostat to aid temperature control.



Closure channel is attached to the doorbars and the door is hung in the gable end of the structure.

GREENHOUSE KIT

(Continued from page 156)

opening for the door before the greenhouse was glazed.

Utilities you'll need. Obviously, water is first. You'll be wise to install an ample num-

ber of hose bibbs for convenience. A tub for cleanup and pot-washing is also helpful.

You will want electricity for the operation of such basic equipment as an electric heater, lights, humidifier and grounded outlets. For safety, because the walks in a greenhouse

(Please turn to page 160)



Come to
where the
flavor is.

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

18 mg "tar," 1.2 mg nicotine av. per cigarette. FTC Report Mar. '74



Gauge determines precise location of the eave. Glazing, which follows, locks the structure square.



Vent-section glass goes on first, to be followed by panes on the roof, side (above) and gables (ends).



Glass panels are bedded in a foam tape. Joints are then sealed with a top compound similar to caulk.



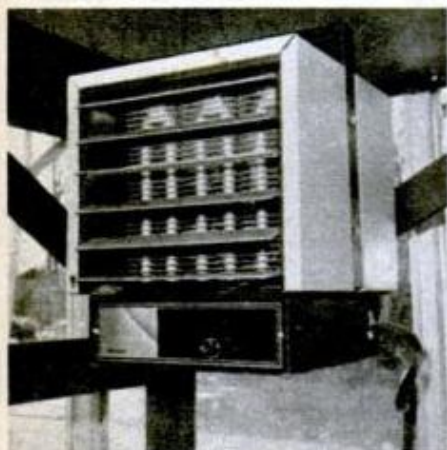
Bar cap is installed immediately, with sheet-metal screws serving to keep the glass pane in place.



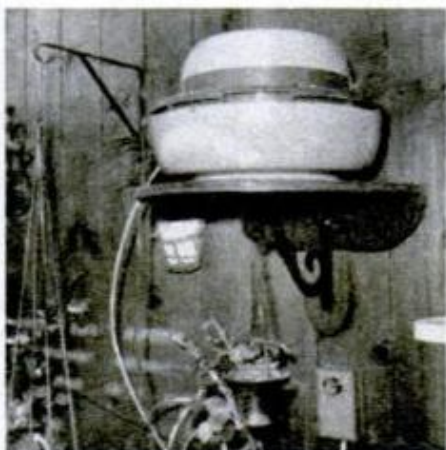
Concrete footings are poured after the frame is up, and glazed, to assure that glass panels will fit.



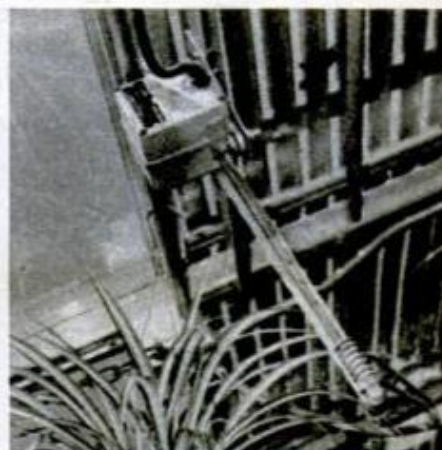
Concrete was pushed into trench through an 8-in.-wide opening in bottom of the pour box.



Electric unit-heater under potting bench is thermostat-operated, gives perfect climate control.



Humidifier, with humidistat, adds \$100 to cost of greenhouses. It is available from Lord & Burnham.



Vent motor, small and quiet, opens and closes the vent section automatically when necessary.

GREENHOUSE KIT

(Continued from page 158)

are usually damp, *every piece* of electrical equipment should be grounded in accordance with the National Electrical Code. If you decide to erect a freestanding rather than

a lean-to type of greenhouse, make certain that all of these utilities are provided (roughed-in) before you pour your footings.

For heat, we selected an electric space heater from The Singer Co., 62 Columbus St., Auburn, N.Y. 13021. It's rated at 17,000 B.T.U., other models are available. ★★★

PAN FOR GOLD THIS SUMMER

(Continued from page 85)

Scott, Smith and Trinity. Smaller streams in Butte, Placer and Trinity Counties are especially good. Information is offered in a free pamphlet, *Basic Placer Mining*, from the State Division of Mines and Geology, State Capitol, Sacramento, or from the division's office in the Ferry Building, San Francisco, Calif. 94111.

Oregon is a great gold state. Some prospectors like the Coastal Mountains from the California border to Coos Bay; others swear by Jackson Creek, the place where Oregon's boom began. Good spots include the Rogue and Illinois Rivers, especially at a spot called Sailor's Diggins on the Illinois. A single nugget worth \$3100 was discovered there. Also good: Little Fork of the Santiam, Quartzville Creek near Quartzville and Spanish Gulch near Antone.

Washington is another top state. Kittitas County is good, especially in William, Boulder and Liberty Creeks. Sandbars on the Columbia yield color. The action is best in Douglas County. American and Morse Creeks in the Summit can be recommended. At low water the banks of Roosevelt Lake often deliver gold, and the Skagit River in Skagit County is popular.

Alaska is the fourth largest gold-producing state in the nation. Try the rivers along the major highways, especially the Taylor Hwy. near Tok Junction, Elliot, Richardson and Steese Hwy. near Fairbanks and Seward Hwy. near Anchorage. If you have time, also try Cooper River, Forty Mile River and Birch Creek.

In British Columbia, gold is more plenti-

ful than people. Historic Barkerville in the Cariboo Area is popular; also Rock Creek on the Kettle River. The big bend of the Columbia and spots on the Peace River are good for weekend hunters.

Fitting Out. While general stores and trading posts in good prospecting areas usually stock basic gear for panning, specialty manufacturers can also mail-order new lightweight items that can be backpacked in. Keene Engineering, 11479 Vanowen St., North Hollywood, Calif. 91605, catalogs everything from plastic pans to sluice boxes, dredges, diving rigs, rockhound tools and a source for 250 treasure-hunting books. And write the U.S. Government Printing Office, Washington, D.C. 20402, for its 15-cent booklet, *Gold Regulations*, if you really strike it rich. ★★★

HORSELESS CARRIAGE RETURNS

(Continued from page 93)

family garages as a second or third car: It is quiet, nonpolluting, economical, easy to drive and park, practically maintenance-free and—apparently—long-lived. Those whose round-trip commute to work or shopping is within its 40-50 mile range will discover the convenience of having their own "gas pump" at home.

The 28-mph top speed won't matter to some people. But if never being able to do more than that would sour you on the car, leave it for others; there's a waiting list.

Price of the basic car is \$2268, f.o.b. Sebring, Fla. For information write: James Edgar, Sales Manager, Sebring-Vanguard, Inc., Box 1963, Sebring, Fla. 33870. ★★★

Next month in Popular Mechanics

- Build a hot tunnel-hull boat for under \$200 from PM plans
- Big telephoto lenses at bargain prices
- How we're using infrared to trap airborne drug smugglers
- First look at the '75s: Cars get exciting again
- Two PM Owners Reports: Buick Riviera and Renault
- It's New Now: 10 pages of picture news
- The pick of the hi-fi pickups
- Clean motorcycle that runs on propane
- This kill switch can save your life
- Vortex film washer that swirls hypo away
- Clip-and-Save Know-How: How to repair an electric iron
- How to make wood joints ■ How to remove a bearing wall

MAZDA RX-4

(Continued from page 96)

where. A couple of clean karate chops front and rear and the styling would have the finesse exhibited in the rest of the car.

The RX-4 coupe is very much a driver's car. The conveniences even include a pull handle inboard the passenger seat so the driver can release the seat back; it then snaps forward so rear-seat passengers can get in or out. Front buckets adjust fully for any driving position and *full* instrumentation is standard. One warning buzzer you'll be happy to have is that actuated by the tach: it reminds you to come back to earth if you've run up into the 6000 to 6500-rpm range.

Every control, instrument and switch is perfectly located—with the single, left-hand, steering-column stalk especially impressive in its integration of several functions: directionals, lights and wipers. *Plus* an intermittent wipe position and headlight flasher for daytime signaling. "Cockpit" best describes the driver environment (see RX-4 photos that accompany the RX-2 and RX-3 Owners Report).

The performance of the coupe makes it the fastest Mazda to date. Nine-second zero-to-60 times can be done with ease—and without setting off the tach buzzer. It's hard to describe the rush of power you experience in this rotary coupe without resorting to advertising lingo expressions such as "turbine-like smoothness." The heavier weight of the RX-4 (over that of RX-2s and RX-3s) is more than compensated for by the new, larger displacement, two-rotor Wankel. (Indicative of Mazda's success and confidence in its rotary design and engineering is the recently announced 50,000-mile/three-year engine warranty.)

The coupe's handling and braking is fully capable of meeting the level of performance afforded by the rotary's 110-hp output. Appropriately, 70-series radials are standard—are, in fact, needed to put this mini-muscle car firmly in contact with the road.

Radial tires are only one of the standard features included as part of the RX-4 package, which, at \$4150 (\$4095 sedan and \$4295 wagon) is one of the most competitively priced "super coupes" on the market. No, you don't get four-cylinder, 25-mpg economy, but you do get performance that would be hard to match with anything less than a half dozen pounding pistons. ★★

TAKING THE MYSTERY OUT OF MPG

(Continued from page 101)

has his own version of over-the-road city and suburban routes, and steady speed cycles.

Economy tests by other manufacturers, accessory suppliers, independent testing facilities, research companies, and a number of auto-oriented publications are, for the most part, variations of what the Big Three automakers use. Some may emphasize certain aspects more than others, but by-and-large, they include runs over specific courses (public or private) and/or runs on level roads at constant speeds.

Consumers Union, for example, tests for mileage over a 340-mile public road course, also over a simulated city traffic cycle, and at constant speeds on a "substantially level, measured section of road." In *Consumer Reports*, it then notes the tank mileage observed on the 340-mile trip and the "range of gas mileage to be expected in normal use."

The equipment used to measure fuel consumption varies from quite simple to the exotic.

To measure the distance a vehicle travels accurately, a fifth wheel is used. Like a unicycle in appearance, it attaches to the rear bumper. As the car moves, generators on the wheel read both the true speed at which the car is traveling and the distance it covers.

To measure the amount of gasoline consumed, the most common instrument has been a burette. This is a long glass tube, with graduations along its length to indicate volume. It is connected to the fuel system between the fuel pump and the carburetor. By means of a shutoff valve, the engine can be supplied only by what gasoline is in the burette. In this way, the distance the car travels for a certain volume of gasoline can be observed. This is then interpreted in miles per gallon.

Fuel flowmeters are now replacing the burette because of their ease of installation and instantaneous readout at any speed. More complicated fuel flowmeters actually measure the mass of gasoline going to the carburetor. This system is far more accurate, since the density of gasoline has a small, but definite effect on fuel economy.

But so much for the measurement of fuel flow: Next month PM will run reports on the Buick Riviera and Renault—complete with mileage the *owners* are getting. ★★

BUILD PM'S SCUBA-TOW

(Continued from page 74)

ment water-sport tourist attraction where there are special test facilities for underwater equipment. The scooter proved to be such a versatile and spectacular performer it became an instant attention-getter among both professional scuba divers and visiting sightseers alike; everyone wanted to try it. Besides being inexpensive to build, it possesses important features not found on most commercial models. Fore and aft of its center battery compartment are two ballast compartments that can be partially flooded to adjust buoyancy and trim for perfect running under a variety of conditions. For operating in deep water, it's usually set for slight positive buoyancy so it will rise to the surface and float if you should let go of it. This way, there's no danger of its sinking and becoming lost. In shallow water where you may want to park the scooter temporarily on the bottom while you go off exploring, it can be weighted slightly negative. For diving, the nose can be given a little down trim; for surface snorkeling, a little up trim so the hull will plane smoothly along the top. Buoyancy and trim adjustments are made by removing plugs in the sides and letting water fill the ballast compartments until the scooter rides just the way you want it to. Commercial scooters do not offer such adjustments.

Also unlike commercial models, the control handles are set wide apart on the wing-tips, giving you good leverage for making sharp turns and banks. These are used just like the handlebars on a bike to steer you easily wherever you want to go. With a little practice, it's possible to execute a surprising number of intricate maneuvers like corkscrew rolls, overhead loops, wing-overs, even inverted "flight" upside down. Automatic "kill" switches in the handles stop the motors the second you release the trigger grips so there's no chance of the scooter running away from you accidentally.

For good looks and durability, the scooters shown here were given a fiberglass covering before painting. This could be omitted, however, if you use waterproof glue and several coats of hard-finish marine paint to assure watertight construction. One caution: Since the battery discharges small amounts of possibly explosive oxygen and hydrogen gases, be sure to install the catalytor indicated in the plans. The catalytor converts the gases into harmless nonexplosive vapor. ★★

PUSHBUTTON, DIGITALLY-TUNED TV

(Continued from page 119)

picture tube. The tuner, with no moving parts, should be wear-free. The IF sections' LC-type filters (common in hi-fi FM tuners, but a first in TV) eliminate the traps and transformers that need realignment in conventional IF strips.

As usual, Heath provides do-it-yourself service that can save you quite a bit over the long run—but with some improvements over its previous practice. The troubleshooting, diagnostic and service instructions are now in a manual of their own, not buried in the construction manual. The built-in dot generator used in correcting picture convergence and pincushioning is a new (and again, digital) design that produces sharper dots for easier adjustments. The commonly used settings for channel and display presets, time-setting, convergence and remote control are grouped in the circuit drawer (it has an inconspicuous latch to keep unauthorized hands out).

Heath calls this its "easiest-to-build" color set, and it probably is. Lots of integrated circuits, prefabricated wiring harnesses, sockets for most transistors and ICs, and circuitry divided into about 20 small boards see to that. But easy doesn't mean simple: Counting the optional clock and remote control, and the handy volt-ohm meter kit Heath provides for checkout, you'll have over 50 hours of construction and adjustment time from cartons to operating TV. The instruction books are clearly written and almost error-free—but there are nine to go through. Thorough, clear checkout procedures, and the test meter provided, make it unlikely any wiring error will become a major, destructive mistake. But considering the project's scope, only an experienced or *very* patient kit-builder should try this project.

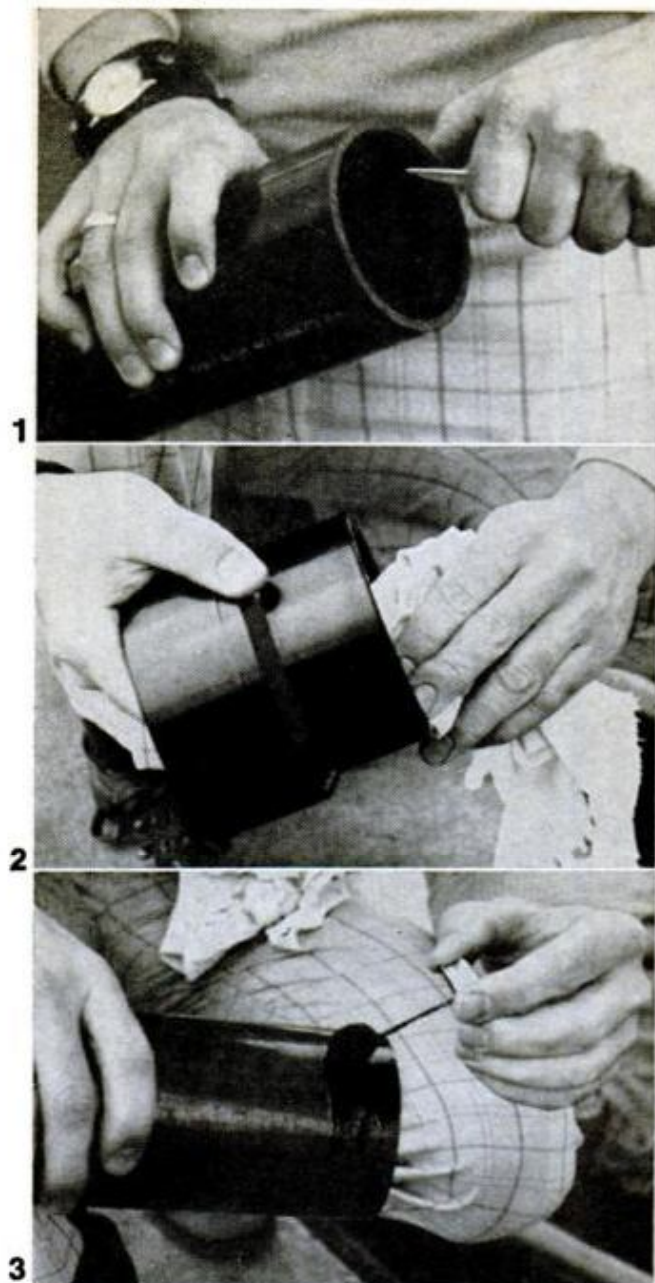
As usual with Heath color sets, you save more money on long-term service than on first cost. By the time you add the price of the basic kit (\$650), the remote and clock options (\$80 to \$30), and a cabinet (\$140 up), the GR2000 costs about as much as a conventional 25-inch remote-control console—though the conventional set would not have the Heathkit's clock, its many service features or the gee-whiz aspect of its new circuits. Still, there's the satisfaction of saying "I built it myself"—though, with a set that works this well, your friends might not believe you. ★★

Underground drainage system ends foundation flooding

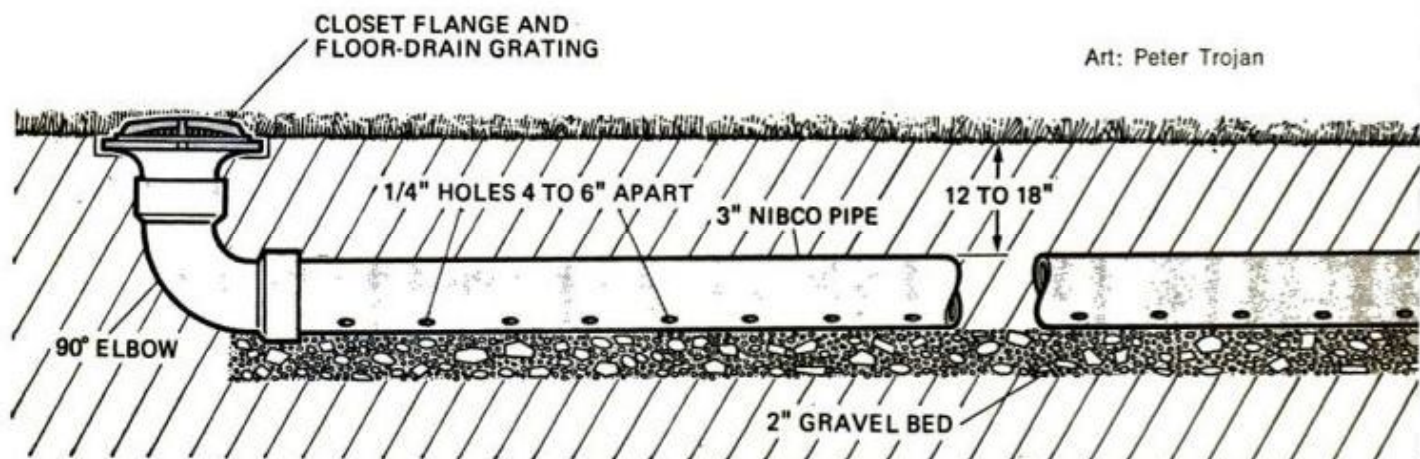
If you're not bothered with water pouring from your downspouts and flooding the foundation of your home, you either (1) live in a desert-like area or (2) have already provided for underground drainage to carry roof water a safe distance away.

Installing a downspout drainage system is a simple job which consists of laying lengths of 3-in. perforated ABS (acrylonitrile butadiene styrene) plastic pipe in sloping trenches 12 to 18 in. deep and tying-in the downspouts with a few simple fittings. The far end of the underground pipe comes to the surface (see drawing) so excess amounts of water from a heavy downpour can bubble up through a grating and spill out onto the lawn. With the perforated pipe resting on a 2-in. bed of gravel or crushed stone, most of the water from a normal rain will seep through before it builds up and will be absorbed by the gravel. By control-

How pipe joints are 'welded'

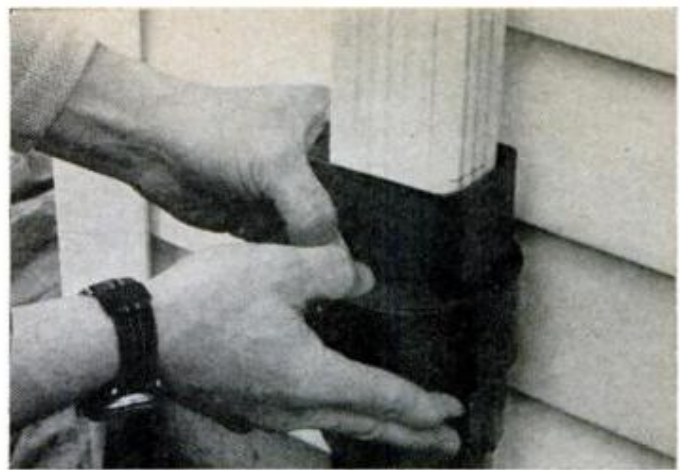


To join pipe and fittings, burrs on ends of pipe are first trimmed with a sharp knife (1). Then both pipe and fitting are wiped clean with a cloth to insure a good bond (2). Solvent is applied to outside of pipe and inside of fitting, inserted and given a 1/4 turn to spread solvent evenly (3). It sets almost instantly.





Drill drainage holes, $\frac{1}{4}$ in. in diameter, 4 in. apart in bottom of pipe so remaining water will drain out.



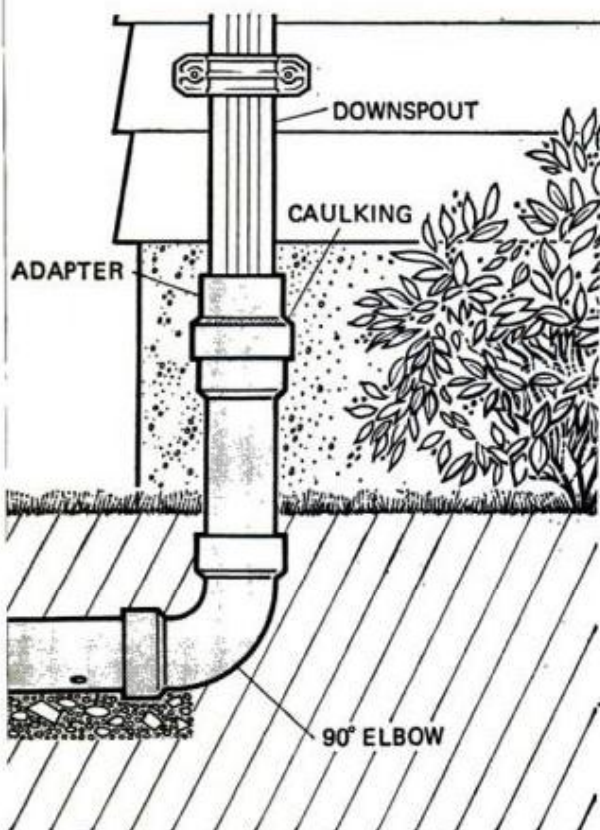
Downspout is connected to underground pipe with fitting that slips over its end; then joint is caulked.



Nibcaware closet flange is attached to far end of drainage pipe to bring grating nearly flush with ground.



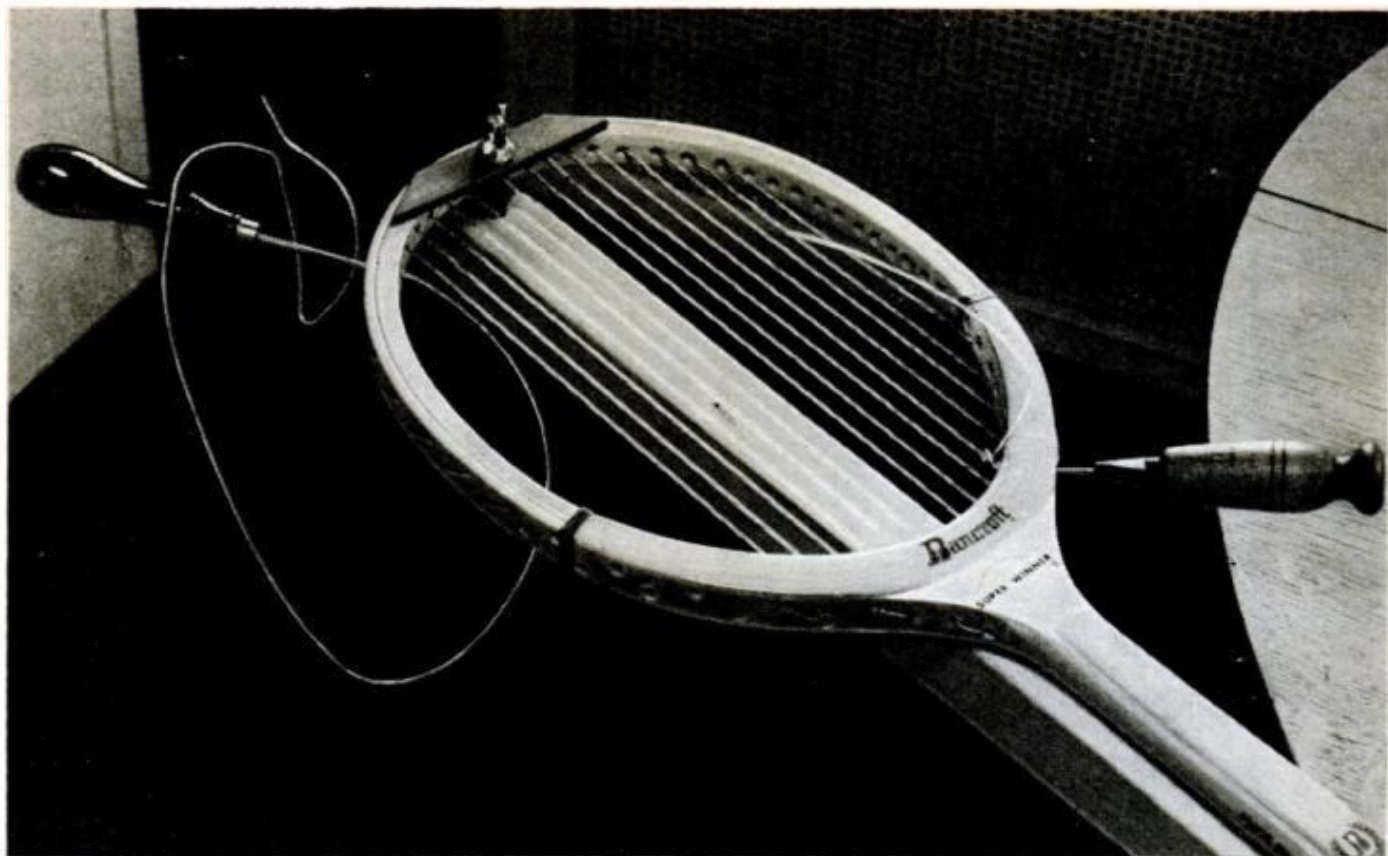
Round grating from a floor drain is attached to closet flange with short lengths of copper wire.



ling the outflow from your downspouts in this manner, you can eliminate washouts and other damaging effects of ordinary downspout drainage.

Plastic pipe such as that made by Nibco of Elkhart, Ind., is a natural for an underground drain since it can't rust or corrode. Fittings are actually "glued" to the pipe with a cementlike substance called solvent, and the downspouts are connected with special adapter fittings which slide over the ends. Each trench is sloped a minimum of $\frac{1}{4}$ in. per foot and lined with gravel to provide a "dry well."

To prepare the pipe and fittings for gluing with solvent, first wipe each piece clean to insure a good bond. Apply the solvent to the outside of the pipe and the inside of the fitting, then press both together and give the fitting a quarter turn to spread the solvent evenly. The solvent will set almost immediately. Use the guide markings which you'll find on Nibcaware fittings to assure proper alignment. ★★★



Photos: Andrea Herrick

Simple jig for holding racket is length of wood and clamps, but it can turn kitchen table or workbench into rig for racket repairs.

Restring your own tennis racket

These simple techniques and tips save playing time—and money.

by Elmer K. Norton

It's Saturday morning and during a warm-up rally you pop a string on your favorite racket. No need to give up the weekend matches or play with an uncomfortable borrowed racket. If your restringing and repair shop is closed or miles away, try some of these simple shortcuts I've developed over 25 years. With a little practice you can save time, a lot of money and get surprisingly good results.

Less than \$12 can provide you with a jig to hold the racket and materials for re-

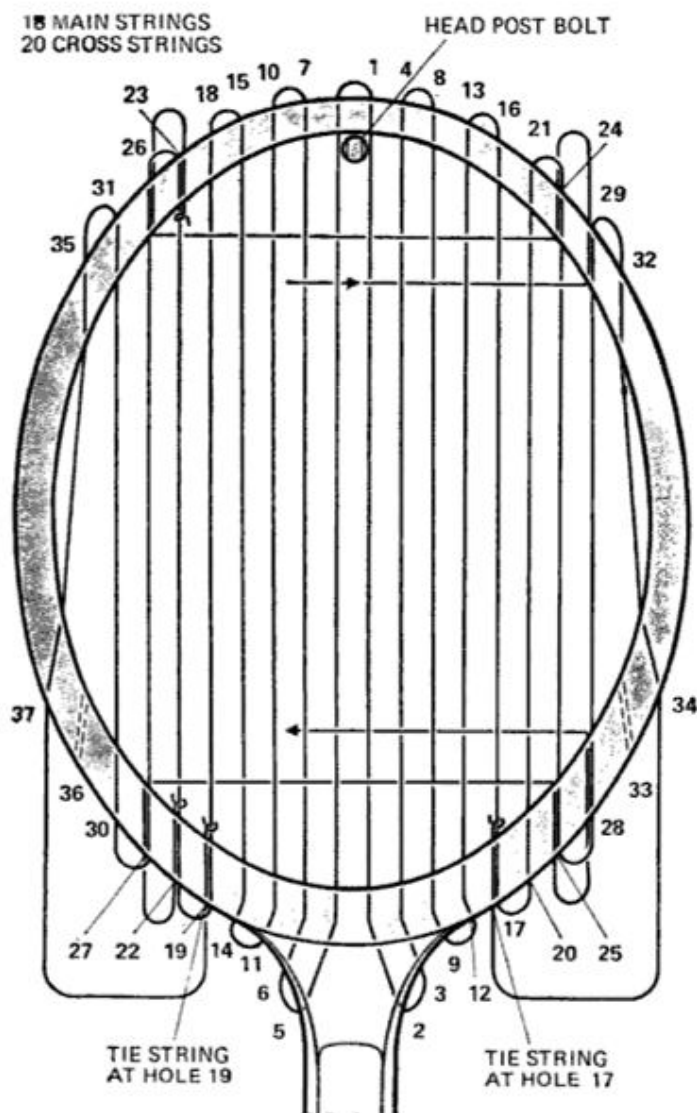
stringing and replacing your grip as well. Sending your racket out for restringing alone might cost you \$10 to \$13 in nylon, \$20 to \$24 in gut. A professional restringing machine can cost over \$400.

Materials you will need for our method shown here are simply a three-foot length of 1½x1½ stock, preferably hardwood, an eight-inch length of 1½-inch dowel (like that on which rugs are sometimes delivered) that you will cushion with a wrap of leather or adhesive tape. Also two three-inch or four-inch "C" clamps to hold the wood base and your racket to your workbench or kitchen table plus a four-inch ¾-16 NC hold-down bolt with wingnut to secure the head of the racket, and some scraps of hardwood so the clamps don't scratch your racket handle. A couple awls from a hardware store will hold the string in place.

I recommend nylon string in a 35-foot length from your tennis shop or mail-order supplier, at about \$4.50 or \$5, for your 18 main and 20 cross strings. Nylon lasts several times longer than gut and is much easier to work with. Mail-order sources include The Tennis Center, 68 Harrison Ave., Congers, N.Y. 10920, and Tennis Acces-

sories, 616 Schreiber Ave., Coplay, Pa. 18037.

Clamp down your racket, as shown, with the side grooves slanting down and toward the head of the racket. All strings always go into the lower hole and out the upper hole of the groove. Starting with the main strings, the vertical ones, cut a 19-foot length of nylon and thread through the two top holes so that half (9½ feet) goes on each side of the center-post bolt holding the racket head. The bolt is filed flat on each side to protect strings from damage. Thread



these main strings down through the first holes on each side of the neck.

Sight through these holes to see their direction and then carefully but firmly insert one awl into No. 1 to hold the string in place. Wrap the string coming out hole No. 2 one and a half turns around the string-tightening dowel handle and, using the frame for leverage, turn to tension the string. Be sure the string coming out is straight so you are not tightening against added friction. Insert the second awl in

hole No. 2 and remove the tightening handle. Thread the string through holes 3 and 4, tighten, and insert the awl in hole 4. Repeat this procedure on the other side through holes 5, 6, 7. Awls are now in holes 4 and 7.

Continue this threading and tightening process alternately in numerical order, as shown, until there are 16 strings threaded and awls are in holes 29 and 31. Strumming each string as it is tightened will give you an indication of proper tension. Thread 32 and 34, then 35 and 37, being careful to skip holes 33 and 36. Pull strings extra tight, insert awls, rethread those loose ends through holes 17 and 19, and tie off each with a simple half hitch. If the nylon is slippery, add an extra half hitch; then cut off excess string ¼-inch from the knot.

Cross strings are threaded from the remaining 16-foot length. If hole 22 is a top hole, thread one end up through and half hitch to the main string there. If a bottom hole, No. 20 on the other side must be used instead. Thread the other end through hole 27 and weave under and over the main vertical strings over to and through hole 25 on the opposite side. Tighten, insert awl and continue weaving across and up the racket until 20 cross strings have been strung. The 20th string goes through hole 26, is tightened, threaded through hole 23 and then tied to the main string there and cut off. During cross-string threading when a main string already occupies a hole, it's helpful to sharpen the tip of the cross string; snip it off diagonally to a point.

Now go over the racket with a slim dowel or pencil (since your awl might cut into a string) and straighten those strings out of line so that they all cross at right angles and are parallel.

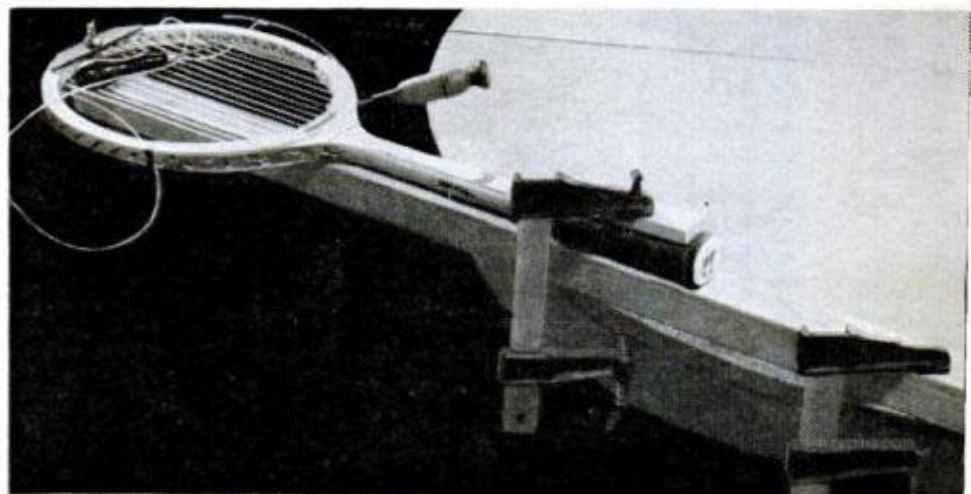
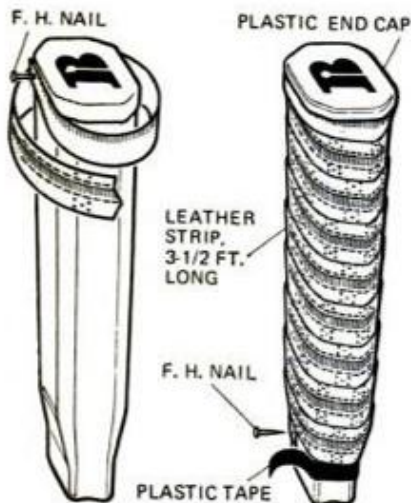
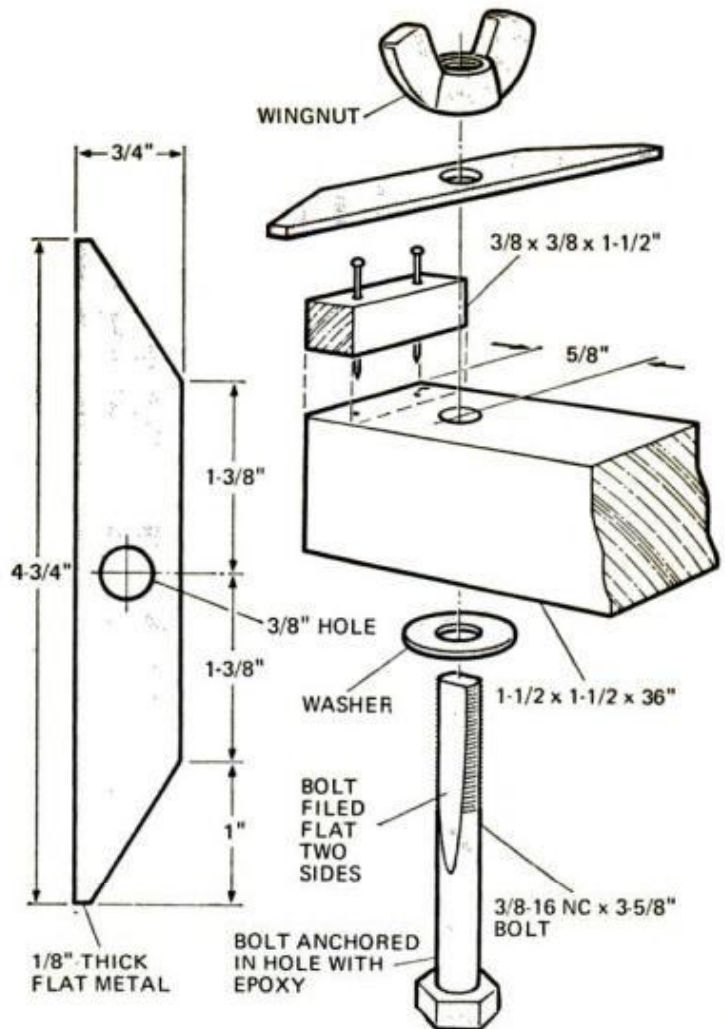
Grip replacement is also not too difficult—once you know how. A good quality leather grip, about 3½ feet long, is approximately \$3 from a sporting goods store or tennis shop. Remove the old grip, and coat the handle with mucilage or shellac. Air until tacky. With a ⅜-inch flat-headed nail, secure the tapered end of the grip strip flush with the butt end of the handle, nailing through ¼ inch from the end of the leather. Hold the racket head between your legs and wrap the grip flush around the butt end and then on down the handle clockwise with the leather layers butting or slightly overlapping, if so designed. Tack the finished end with a ⅜-inch nail, trim

off excess leather with a razor, and cover the nail and edge with two or three turns of 1/2-inch plastic tape.

Gut restringing can be attempted after you have become proficient with nylon. Because of gut's reaction to moisture (a rain shower can ruin its tension), it should be treated with preservative after stringing and occasionally during active use after exposure to damp conditions or when the strings are becoming slightly frayed.

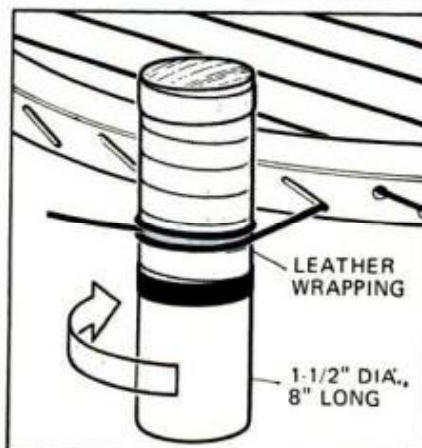
Mix one part of white three-pound cut absolute shellac with five parts of water-free ethanol in an 8-ounce salad dressing jar with screw top. Store a 3/4-inch brush with cutdown handle inside the jar. When strings are frayed or damp, first dry with talc or a fluffy towel, then paint on a light coat. Thin mixture with alcohol from time to time. Too thick a coat or too frequent use makes gut strings lose resiliency. Never use it on any type of nylon strings.

The stringing method outlined here can also be used with all metal rackets except the Wilson Steel and Seamco Aluminum. The rig works as well with squash, paddle and badminton rackets, although badminton strings are 19-gauge and much thinner. ★★★




Racket jig uses bolt cap (at upper right) to hold head of racket plus C-clamps to secure brace to table. Renewing grip (above) starts with leather strip 3 1/2 feet long which is stretch-wrapped down handle and secured with nail and tape ring.

Tensioning of new strings (right) is done with 1 1/2-inch-thick dowel with leather or adhesive wrap. String looped around handle is turned to tighten, held with awl while next length is laced in place. Cross strings weave under, over main.



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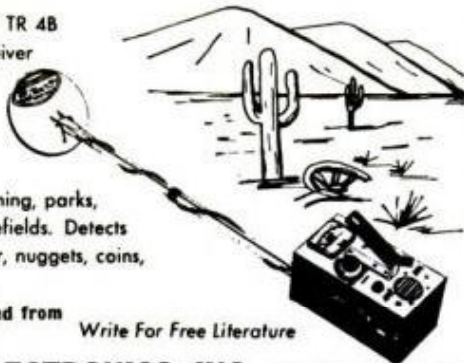
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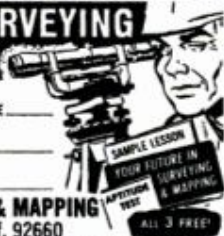
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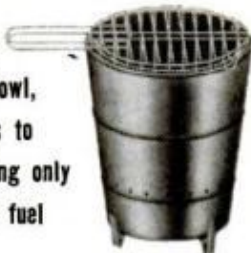
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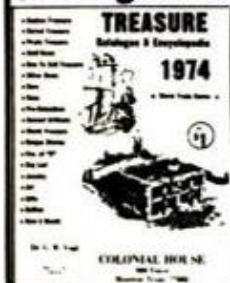
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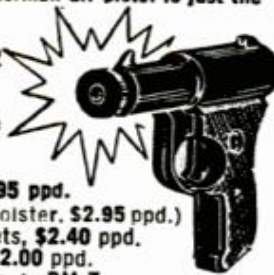
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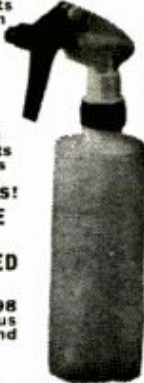
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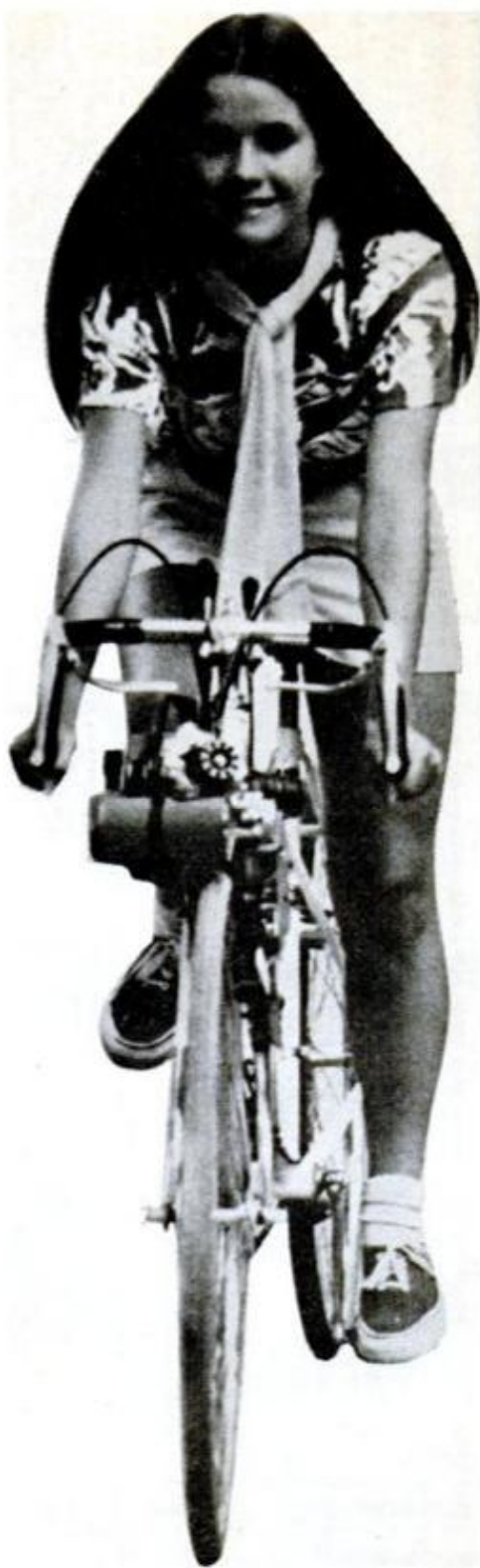
Little motors that make uphill bicycling easier

There are times when even the most dedicated bicyclist appreciates a little extra power to help him get up a hill. That extra boost is now available in the form of light-weight gas and electric motors.

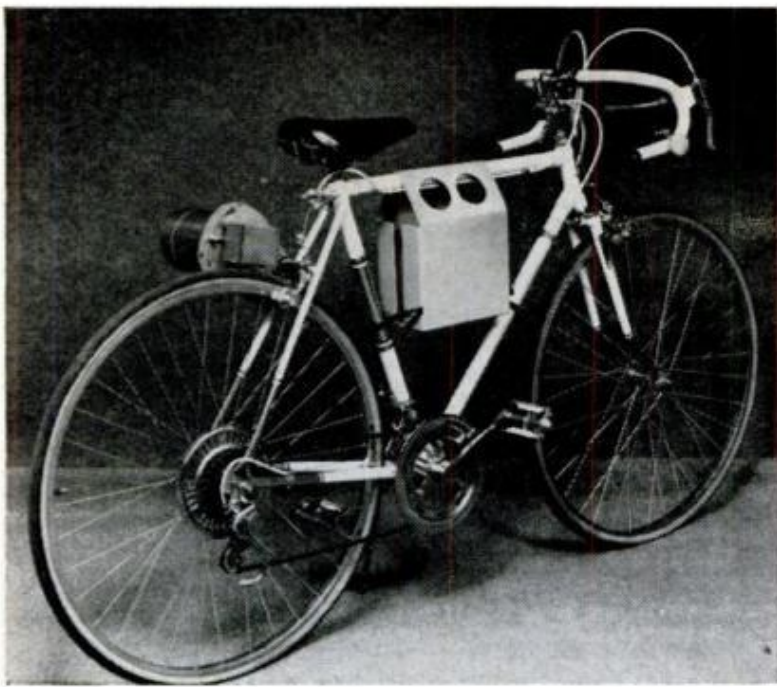
Of course, engines for bikes aren't a brand-new idea—in fact, advertisements in *PM* 50 and 60 years ago urged readers to update an "old-fashioned, slow-going, tire-some bicycle" with an add-on engine.

But today's power units are lighter, and they're mainly considered as auxiliary to the pedals. The O&R engine below gets 100 to 150 mpg; the electrics, up to 50 miles before needing recharging.

Some states and communities look on a motorized bike as a motorcycle, so ask local police about legality. (And see next month's *Bicyclists, Start Your Engines*, page 74, for more on pedals and power.)

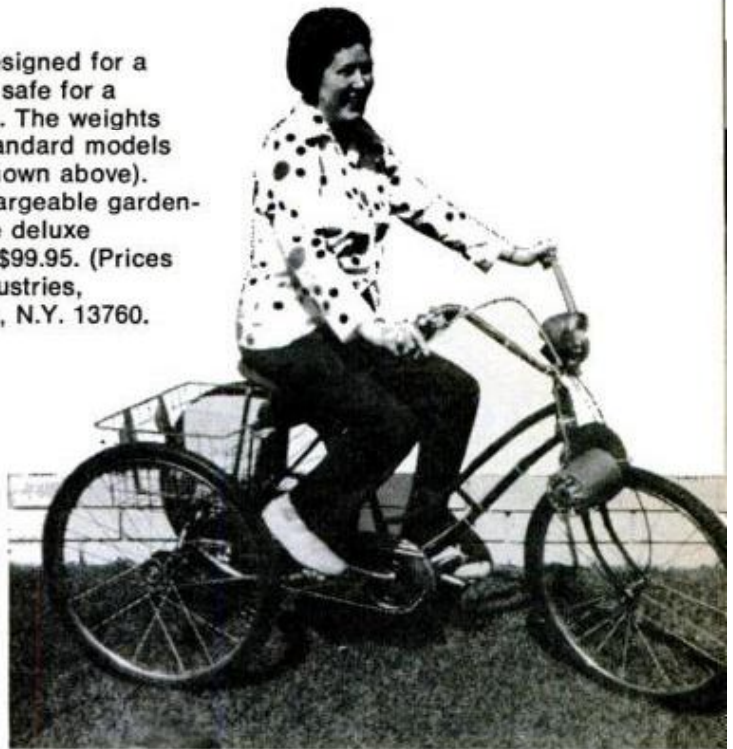


Chicken Power! is the name of this seven-pound gasoline engine (above and left) that adds the power of almost one full horse (or an estimated 650 chickens) to a bicycle. The tiny two-cycle engine attaches to almost any style or size bicycle, including 10-speeds and three-wheelers. When engaged by a hand lever, the motor's spring-loaded drive wheel presses against the front wheel to provide forward motion. Speed is regulated up to 18 mph by a handle-grip control. The engine kit is \$89.95 from O&R Engines, Inc., 3340 Emery St., Los Angeles, Calif. 90023.



Electa Ride is a battery-powered system with a motor that mounts on the front or rear wheel of any bicycle with caliper brakes (left) or on the front wheel of a tricycle (below). The battery pack is carried on the bar, or, in the case of a girl's bike or tricycle, in a basket. The bicycle motor gives a speed of 15 mph. The standard model motor weighs about 7 pounds; the deluxe model, which uses a heavy-duty ball-bearing industrial-drive motor, weighs 15. The battery adds 20 pounds.

The **Electa Ride** model that's designed for a tricycle drives at a speed that's safe for a retirement community—six mph. The weights and prices of the deluxe and standard models are the same as for bicycles (shown above). All units are powered by a rechargeable garden-tractor-type battery. Price of the deluxe model is \$129.95 and standard, \$99.95. (Prices are without battery.) Palmer Industries, Box 707 Union Station, Endicott, N.Y. 13760.



Go-Pak Mark II is a 25-pound addition to any bike designed to assist the rider in pedaling. Powered by a rechargeable 12-volt garden-tractor battery mounted on bar (or luggage carrier), two motors on back wheel operate when rider presses a handlebar-mounted switch. Speed is up to 15 mph. Kit with battery is \$129.95 from Green Cross Industries, Go-Pak Div., 1401 Fairfax Trafficway, Kansas City, Kans. 66115. Optional trickle charger is \$12.95.

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(Continued from preceding page)

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