

MARCH 1979 \$1.00

**NOW: Programmed stereo
that thinks for you**

Popular Mechanics

**VW RABBIT DIESEL:
Happy owners average
46 mpg in 2,300,000 miles**

**OFF-ROAD TIRES:
PM answers the 10
toughest questions**



**8 LOW-COST
ULTRALIGHT PLANES
YOU CAN BUILD AT HOME**

GET READY FOR SPRING:
■ Plans: Make 4
folding lawn chairs
■ Build our
California hot tub



**CAMPING:
Make PM's luxury
camping van**

**PLUS:
25 top new RVs**



The signposts of success are clearly lettered.

A large, three-dimensional gold logo consisting of the letters 'V' and 'O'. The 'V' is formed by two thick, parallel bars that meet at a sharp point at the bottom. The 'O' is a thick, circular ring. The logo is set against a dark blue background that transitions into a lighter blue gradient at the bottom.

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Bottled in Canada. Preferred throughout the world.

Enjoy our quality in moderation.

Canadian whisky. A blend of Canada's finest whiskies. 6 years old. 86.8 Proof. Seagram Distillers Co., N.Y.C.

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SOMETIMES A PRODUCT JUST KEEPS GETTING BETTER AND BETTER.



The Kodak Carousel projector is a good example of such a product. Tried, proved, and improved over time.

It uses gravity to gently drop each slide in place. It's whisper-quiet, too.

It features a curved-field projection lens. For sharp edge-to-edge projection.

It uses the Transvue slide tray that lets you see the number of the slide shown, even in the dark.

It comes in many models. So you can choose just those features you want. Such as remote control. Automatic focus. Even automatic slide changing at timed intervals. And there is a wide variety of accessories made for it. Everything from special-purpose lenses, trays, stack loader to special "presentation aids."

See the Kodak Carousel projectors at your photo dealer's. And enjoy the projector that keeps getting better.

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KODAK CAROUSEL PROJECTORS

This One



642X-ZFN-HBG7

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INTRODUCING A NEW AMERICAN ROAD CAR.



LTD Landau 4-Door Sedan

**More front seat room
More rear seat room
More handling ease
More window area
More driver convenience
...than the 1978 LTD.**

The 1979 LTD was engineered to make driving on today's American Roads a pleasure. With a new combination of roominess, handling ease and driver convenience for the LTD. This new LTD is a beauty.

This year's LTD has been designed

with more passenger room inside to help give you comfort on even the longest trips—with more head room, leg room and shoulder room—front seat and back—than last year's LTD. Yet the new LTD is actually easier handling and easier parking than before, even in tough city traffic.

In addition to its standard 5.0 litre V-8 engine, the full-size 1979 LTD offers you an impressive list of standard features, in 2-door, 4-door and Wagon models.

Ford LTD for 1979. A New American Road Car designed to take you across town or across the country in

full-size roominess. See your local Ford Dealer, and test drive the new LTD on your own roads.

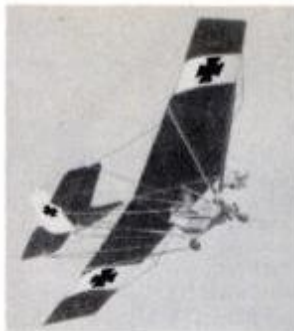


LTD Landau 2-Door Sedan

FORD LTD

FORD DIVISION





On the cover

It's a bird! It's a plane— or is it? Ultralight aircraft like the Weedhopper pictured here may weigh less than their pilots and have hang-glider-type construction features, but they're beginning to sprout wheels and full aircraft controls as well as tiny engines. Author Bill Allen, who took the cover photo, explores this new area of powered flight starting on page 87.

Popular Mechanics®

MARCH 1979

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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.

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One man, one scent.

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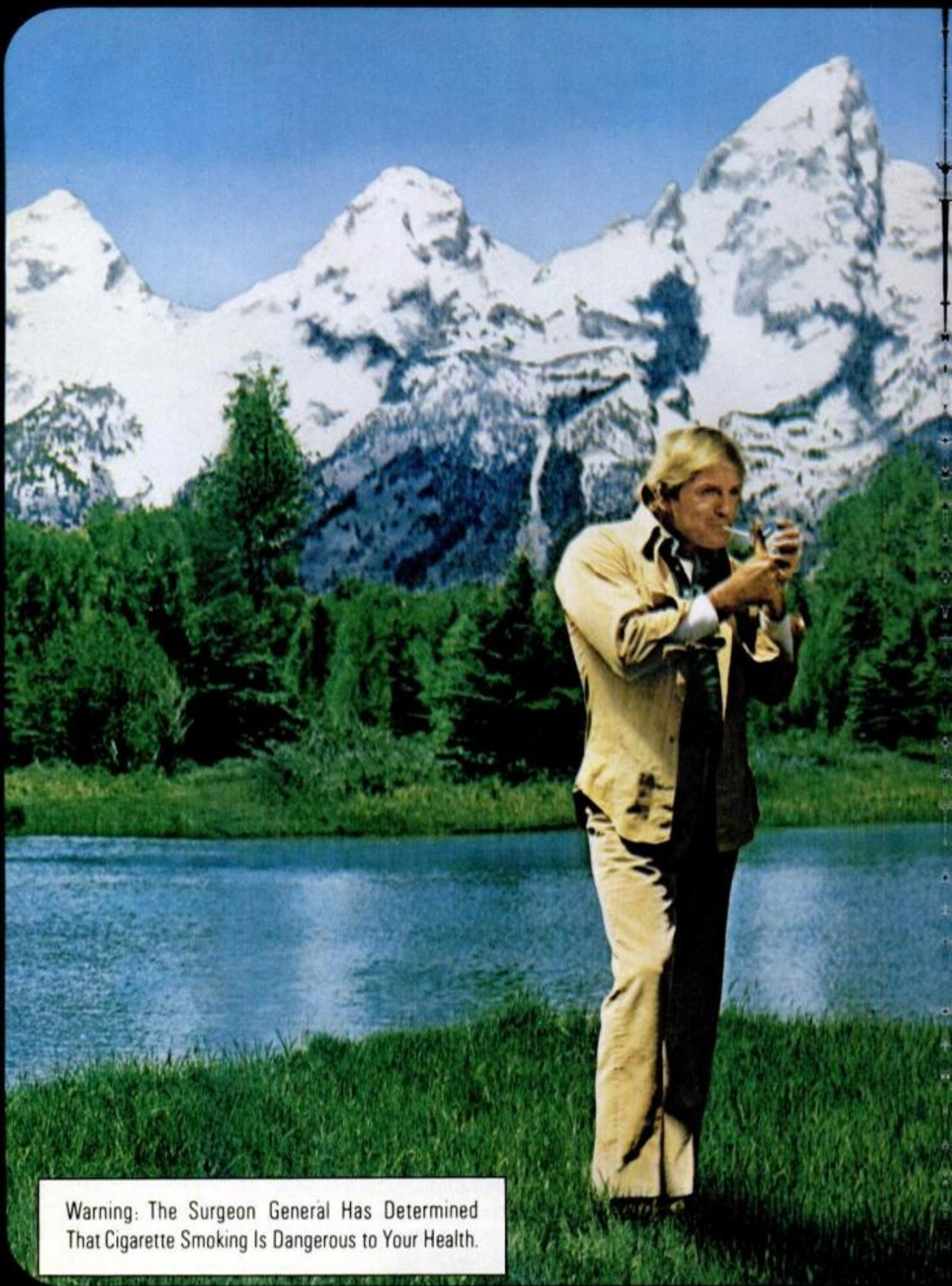
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LETTERS TO THE EDITOR

Remote possibilities

In the September PM (*The Home Inferno—Now It's Deadlier Than Ever*, page 96), a box on page 99 lists 10 rules for surviving a home inferno. Rule 9 refers to remote horns that will sound in rooms that are away from a smoke detector. I would be grateful for the name and address of any manufacturers of such devices.

SETH LILLY
FISHKILL, N.Y.

We've had several requests like Mr. Lilly's. A manufacturer of the remote horns is Chloride Pyrotector, 333 Lincoln St., Hingham, Mass. 02043. For more information on fire safety in general, write to the National Fire Prevention and Control Administration, Washington, D.C. 20230.

Smart kid

For all you people who think that 11-year-old people can't work on cars, do electrical work, or things like that, here is bad news. I am 11 years old, have a subscription to PM, do wiring in a house, and work on cars and lawnmowers. So what do you think about that, PM?

TED VIDIMOS
HIGHLAND, IND.

We're impressed both with your ability and your good taste in reading material.

For more about programming

I enjoyed reading Wayne Green's fabulous article *Now You'll Really Be Able to Use a Home Computer* (page 107, Nov. '78). Could you please give me Mr. Green's address so I can find out more about writing computer programs? Thank you.

MRS. A. CASH
ATTICA, MICH.

Wayne Green may be reached at: *Kilobaud Magazine*, Peterborough, N.H. 03458.

Diminutive racer

I thought you might like to see the results of my Mini-Indy, made from your plans (*Build the Mini-Indy Racer*, page 36, Aug. '75). I used off-the-shelf front spindles and rear axle, but otherwise followed your plans very closely. It is really a fun kart!

FRED SELENSKY
OKLAHOMA CITY, OKLA.



Reader Selensky's Mini-Indy racer.

That's a nice-looking vehicle you've got there, Mr. Selensky. Plans for the Mini-Indy and its updated cousin, the Mini-Indy II (May '78), are still available for \$5 from Stevenson Projects & Publications, Box 584, Del Mar, Calif. 92014.

Exhausted

Exhaust System Quiz (page 128, Dec. '78) was great except for the advice to put penetrating oil on frozen parts. Half the time, it does not work. Long ago a mechanic showed me a trick which amazed me. I did not believe it until I saw it work.

Heat the frozen nut with a torch; make sure the nut is good and hot. Then immediately douse it with ice water, preferably with ice cubes floating in it. The nut will come loose with little effort.

IGOR DE LISSOVOY
EVANSTON, ILL.

Good tip, but be careful using a torch near engines or other equipment where a fire hazard may possibly exist.

You asked for it

In the December *Imports and Motor-sports* (page 48) you say: "Why Toyota sedans sell so well with their boring and plain lines is a mystery to me." Do you suppose it could be that the public has decided an automobile doesn't have to resemble a rocket, an Indy racer or even a B-24 in order to be a sensible, practical form of transportation? I don't advocate eliminating radical or impractical designs; I confess to admiring many of them, but I outgrew my desire for an attention-getting vehicle a few years ago.

KENNETH R. WILDONER
RIVIERA, ARIZ.

Cult mentality

The article on cult cars (*Why Do These Cars Blow Horns at Each Other*)

(Please turn to page 12)

Learn Solar Technology

with NRI's
home study course in

Air Conditioning, Refrigeration and Heating.



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Get into the well-paid field of air conditioning, refrigeration, and heating with practical at-home training from NRI. Developed with technical assistance from the York Division of the Borg-Warner Corporation, your NRI program includes the latest advances to prepare you to service home and commercial air conditioners, refrigeration units, and heating systems...even heat pumps and solar heating.

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In addition to NRI's "bite-size" lessons for faster, easier learning, you get practical, hands-on experience. Training kits include circuit demonstrator, control simulator, joint-making demonstrator, leak detector, system analyzer and more. Plus a *Lammert* vacuum pump for system purging.

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Graduates of the Master Course may take advanced training at the York Institute Resident School at no extra charge. Working with expert instructors on a wide range of equipment, you'll receive practical experience equal to months of on-the-job work.

RUSH FOR FREE CATALOG

Just check the postage-paid card. No salesman will call.



Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

**New NRI Home Study Course Shows You How to Make Money Servicing, Repairing,
and Programming Personal and Small Business Computers**

Seems like every time you turn around, somebody comes along with a new computer for home or business use. And they're being gobbled up to handle things like payrolls, billing, inventory, and other jobs for businesses of every size... to perform household functions like budgeting, environmental systems control, indexing recipes, even playing games.

Growing Demand for Computer Technicians... Learn in Your Spare Time

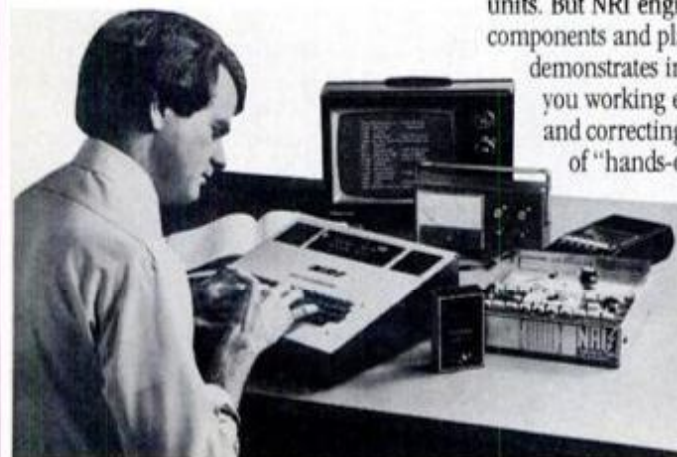
Even before the microprocessor burst upon the scene, the U.S. Department of Labor forecast over a 100% increase in job openings for the decade through 1985. Most of them *new* jobs created by the expanding world of the computer. NRI can train you at home to service both microcomputers and their big brothers. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends without quitting your present job.

No Experience Needed

You don't need prior training in electronics or computers to take this exciting new course. NRI starts you with the basics, gives you a firm foundation to build on. And your personal counselor is always available, ready to help whenever you have questions.

Assemble Your Own Microcomputer

NRI training also includes plenty of practical experience. You perform



meaningful experiments building and studying circuits on the NRI Discovery Lab.[®] Then you build your own test instruments like a transistorized volt-ohm meter, CMOS digital frequency counter... equipment you learn on, use later in your work.

And you build your own microcomputer, the only one designed for learning. It looks and operates like the finest of its kind, actually does more than many commercial units. But NRI engineers have designed components and planned assembly so it demonstrates important principles, gives you working experience in detecting and correcting problems. It's the kind of "hands-on" training you need to repair and service units now on the market.



Rush Card for Free Catalog... No Salesman Will Call

Send the postage-paid card today for our 100-page, full-color catalog. It describes NRI's new Microcomputer Technology Course in detail, shows all equipment, kits, and lesson plans. And it also tells about other NRI courses... Complete Communications with 2-meter transceiver... TV/Audio/Video Systems Servicing with training on the only designed-for-learning 25" diagonal color TV with state-of-the-art computer programming. With more than a million students since 1914, NRI knows how to give you the most in home training for new opportunity. If card has been removed, write to:



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Check them out at your nearest Firestone retailer. He'll show you how to treat your truck like a truck.

Firestone

LIGHT TRUCK TIRES

LETTERS TO THE EDITOR

(Continued from page 8)

er?, page 47, July '78) was poorly written. Most readers failed to understand that a cult car enjoys a degree of uniqueness that sets it apart from the norm, even though the everyday auto may be more reliable and comfortable. I would say that the number of "Me, too" letters for the most common autos is proof that the author failed to do the job. The article on classic car replicas (*How Specialized Automakers are Cloning the Classics!*, page 100, Nov. '78) was much better.

ELMER J. SCHROEDER
STAMFORD, CONN.

Mending fences

In *The Jets of the Eighties Take Off* (page 108, Nov. '78), the caption for the picture in the upper right of page 109 is in error. The caption says "Note that both make use of pronounced fence array on underside of wings."

The things protruding from the aft underside of the wings are the fairings covering the flap hinges and/or tracks. In early swept-wing designs, fences were frequently used on the upper surface of the wing to impede spanwise airflow. Other techniques have come along to control the three-dimensional flow over wings, and fences are seldom used in current designs.

W.J. BRANDEL
FAIRFAX, VA.

Bird lovers revolt!

Concerning *How to Spot a Turkey* (page 88, Dec. '78), apparently the author does not like birds and has no respect for them. I find it reprehensible that PM should find it necessary to print this type of article just to sell your magazine.

The best way to recognize a bad driver is to see if he has a copy of PM on the front seat next to him. I would strongly suggest that you grow up.

(NAME WITHHELD)

Ever-expanding aviary

I clipped *How to Spot a Turkey* for our teenage daughters to read, as much to prevent them from becoming turkeys, as to teach them to drive defensively.

However, I noticed that the article didn't mention another common species—the warbler—whose attention is diverted by adjusting his CB, dialing local radio stations, searching for 8-track tapes on the floor, or just singing along with Mitch.

DUEANN IRVIN
FAIRFAX, ALA.

JS&A's new program will save consumers millions.



Micro TV Breakthrough

Remember the \$400 Sinclair Micro TV? Here's the story on the greatest TV value ever.

That Sinclair TV shown above is small—the smallest TV in the world.

And when it was first introduced last year, it made history. So did its high price—\$395.

Our company never sold the unit for two reasons: 1) It was being promoted as a pocket TV and we felt it would not fit in most pockets and 2) We felt \$395 was too high a price for the unit regardless of its quality, size and features.

But we were wrong. Thousands of them were sold and it was selected as one of the most exciting new products of the year.

WE BOUGHT ONE

A few months ago we purchased a Sinclair TV and discovered another feature we didn't like. The unit included a 220-volt converter for European operation. This meant that every American who bought the set had to pay extra for the converter even though very few Americans would be taking their TV to Europe.

So we came up with an idea. We went to England and purchased thousands of sets directly from the factory without the converter. We were also able to save money by eliminating the normal mark ups by importers, wholesalers and distributors.

We can now offer you the unit for only \$249.95 and if you want the 220-volt converter, your cost is only \$19.95 extra.

LESS THAN WHOLESALE

JS&A would be offering the exact same Sinclair TV at a price less than Sinclair's actual wholesale price in the United States and we would still make enough profit to pay for the cost of this advertisement.

There is one feature we liked very much about the set. Its rechargeable batteries are built into the unit. Larger portable TV's offer \$60 optional rechargeable battery packs that must be purchased separately. Ours is built in and included in the price.

The Sinclair TV comes complete with an American AC adapter and charger, ear phones, carrying case, rechargeable batteries and a built-in antenna for both VHF and UHF. It

also comes with a cigarette lighter power converter, so you can watch all your favorite TV channels from your boat, plane, motor home or car without even using your batteries.

PHOTOGRAPHIC QUALITY

We were well aware of Sinclair's advanced electronics and quality features. But what we found particularly exciting was its picture tube. Even though the 2" (measured diagonally) tube is small, the TV's resolution resembles that of a clear sharp photograph. You can even read small telephone numbers when they're flashed on the screen.



The Sinclair unit is offered in this advertisement with the same accessories available in the \$395 system with the exception of the 220-volt power converter.

The Sinclair is also convenient. You can take it on trips and entertain your children while you fly or drive. You can keep it on your desk at work and monitor the latest news or stock market reports. And you can view the soap operas as you work around the house. We even took ours to the ball game to watch those instant replays.

BIG POCKETS

But don't expect to carry it in your pocket—it won't fit unless you have big pockets. The unit measures 1 7/8" x 4" x 6 1/4" and weighs just 28 ounces which includes the built-in batteries.

The TV is serviced in the United States by Sinclair's service-by-mail facility. If service is ever required during its one-year limited warranty, just slip it in its handy mailer and send it to them for repair. Your solid-state unit should operate for years without a problem, but if it ever needs repair, it's good to know that service is an important part of our program.

For \$249.95, the Sinclair Micro TV is worth your test. Order one from JS&A. Take it with you on a trip, bring it to your office, or carry it with you around the house. See how clear and sharp the picture is and how closely it resembles a black and white photograph. Then decide if you want to keep it. If not, no problem. Simply return your TV within 30 days for a prompt and courteous refund. We just want you to prove to yourself, the miracle of space-age electronics before you decide.

AMERICA'S LARGEST

Sinclair Radionics is one of England's largest electronics manufacturers and JS&A is America's largest single source of space-age products—further assurance that your modest investment is well protected even though the unit is offered at such a bargain price.

To order your Sinclair Micro TV, simply send your check for \$249.95 plus \$3.00 postage and handling (Illinois residents, please add 5% sales tax) to the address shown below or credit card buyers may call our toll-free number below. But please act quickly.

The Sinclair TV is an outstanding product that was priced too high. If you felt like we did and you waited, your timing is perfect. Order a Sinclair Micro TV at no obligation, today.

JS&A PRODUCTS
THAT THINK

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Roll your own electronic dice



Take a gamble—and even learn to build a printed-circuit board—when you make one of these unique, flashing dice arrays.

by Walter Sikonowiz

For thousands of years those innocent-looking, freckle-faced cubes we call dice have sealed the fates of countless gamblers—separating winners and losers on every toss. But whether they're used alone or in combination with other elements (as in the currently rejuvenated game of backgammon), dice serve only one purpose: to generate random numbers between one and twelve. Now, as luck would have it, random numbers have turned out to be as important to the scientist as they are to the gambler, and new electronic techniques have evolved to generate random numbers for probability and statistical applications.

However, these new methods are by no means limited only to serious applications. Strictly in the spirit of fun, you can use a little electronic wizardry to build a solid-state version of those ancient dice. You'll find the project is not just an eye-catching conversation piece; it's also a great way to add zing to many neglected board games you may already have at home. Furthermore, there's a hidden bonus: Electronic dice cannot be loaded—at least not

without redesigning our “honest” circuit. For the economy-minded, one electronic circuit can replace a pair of dice if two rolls are taken in succession; however, purists will most likely want to build a pair of circuits.

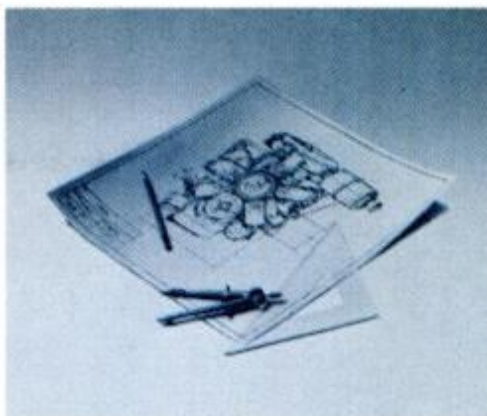
Lighting lady luck

As the photos show, the front panel contains an array of seven red LEDs (light-emitting diodes). Each one of the standard six faces on a die can be simulated by lighting some combination of LEDs in the array. To see how this is accomplished, take a look now at the schematic diagram.

Power for the circuit comes from six 1.5-volt AA cells, series-connected to yield 9 volts. When power switch S1 is closed and Roll button S2 is pressed, IC1 and associated components—R1, R2, R3, C2 and C3—cooperate to produce a square-wave oscillation at pin 3 of IC1. During the course of this oscillation, the voltage at pin 3 jumps up and down between ground potential and about 8 volts at a rate of approximately 50 kHz. (50,000 cycles per second). This

(Please turn to page 17)

Phase 2:
A 4.3-litre V8
diesel
for
mid-size
passenger
cars.



Only Oldsmobile now offers diesel V8s available in 19 different models.

Last year Oldsmobile introduced the world's first diesel V8 for full-size cars. This year we've introduced a new 4.3-litre diesel V8—especially for mid-size cars.

Only Oldsmobile now offers diesel V8s available in 19 different models—more than any other car line in the world.

Exceptional fuel economy. Now you can have the size car you want, with the fuel economy you need today. And you'll save money on every gallon based on the traditional price difference between diesel fuel and unleaded gasoline.

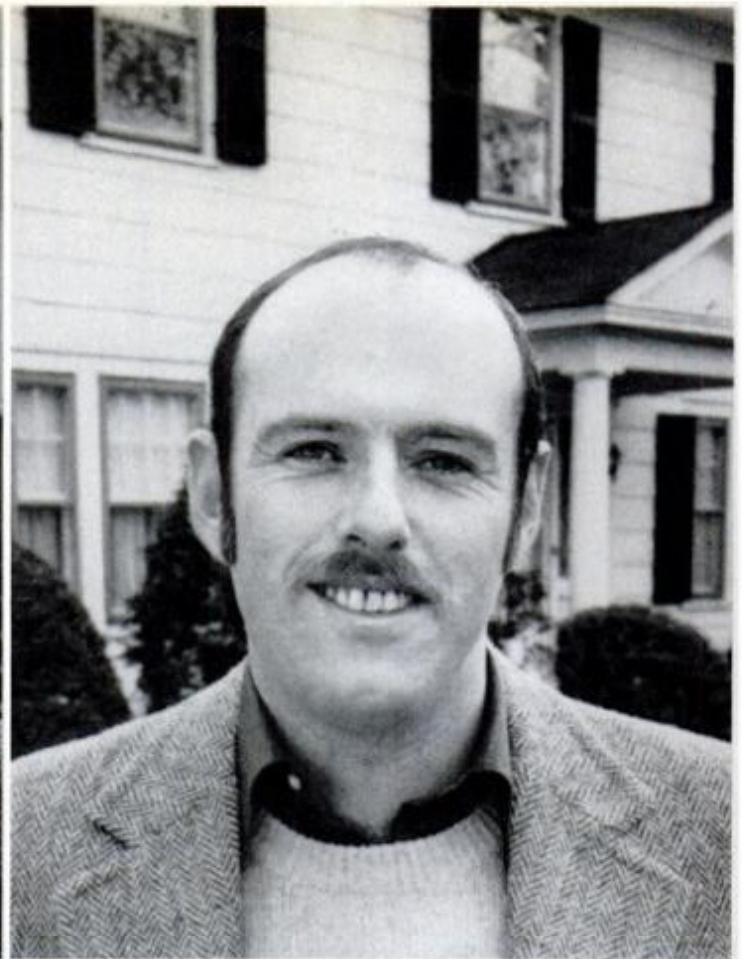
EPA mpg ratings—diesel V8		
Models	Estimated mpg	Estimated Highway
C. Salons (4)	24	32
C. Supremes (3)	24	32
C. Cruisers (2)	22	29
Delta 88s (4)	21	29
Ninety-Eights (4)	21	29
Toronado (1)	21	29
Custom Cru. (1)	20	28

Remember: Compare this estimate to the "estimated mpg" of other cars. You may get different mileage depending on your speed, trip length and weather. Your actual highway mileage will probably be less than the estimated highway fuel economy.

Smooth and quiet performance. Diesels traditionally haven't been famous for smooth, quiet performance. But these V8-design diesels may surprise you. They're unusually smooth and quiet for diesels, especially at cruising speeds. More miles per gallon... less cost per gallon... smooth, quiet performance. Too good to be true? Test-drive a diesel Olds today!

Oldsmobile
Have one built for you.





One of these homeowners is thrifty, safety conscious, and a sitting duck for financial disaster.

He doesn't even know it. He thinks he's done his best to protect his home and his possessions. He hasn't.

Many people, like the man on the left, believe they have adequate homeowners insurance. But inflation has been pushing up the value of their homes. They don't update their coverage every year. So when disaster strikes, they are unable to fully recover their losses.

Rising replacement costs are one reason. In the last 10 years the cost of re-siding a home jumped 132%, re-shingling a roof 155%; and repainting a living room 142%.¹ In the last five years alone, the cost of building a new home has increased 63%.²

As a group of property and casualty insurance companies, we don't want you to be a sitting duck by not having your insurance provide full protection for your home. Check with your agent to be sure your homeowners policy reflects the amount of additional coverage inflation has made necessary.

Here's what we're doing to help protect you:

- Offering policies with a built-in inflation clause.
- Supporting strict building codes to reduce fire risk.

- Designing new coverages to meet the special insurance needs of older homes.
- Helping to develop safety standards which protect life and property.
- Operating special claims assistance and damage repair programs in times of catastrophe.
- Conducting fire prevention and arson control programs.

Here's what you can do to protect yourself:

- Re-evaluate your home insurance needs annually with your agent.
- Take a higher deductible if you can. It lowers your premiums.
- Install a smoke detector or burglar alarm. Many companies offer premium discounts for such devices.
- Get a receipt or appraisal for all major household items (furniture, antiques, jewelry, art). Duplicate it and keep it and all such records in a safety deposit box away from your home.
- Inventory all your possessions and take photos of each room to document what you have.

1 Source U.S. Dept. of Labor 2 Cost does not include land Source U.S. Dept. of Commerce

This message is presented by: The American Insurance Association, 85 John Street, New York, NY 10038.

Affordable insurance is our business...and yours.

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Printed Circuit Board Processing

One of the major advantages of a printed circuit is that components can be packed together in a dense array. Another less obvious advantage of PC construction is its simplicity. Once the necessary techniques have been mastered, even the clumsiest, most fumble-fingered experimenter can easily produce neat, professional-looking circuits. If you've tried the alternative method of construction—Perfboard—you know about eyestrain, burned fingers and frazzled nerves; all these ills (and more) await anyone who tries to connect microcircuits together with wire. In the case of a printed circuit, however, the "wires"—actually, thin strips of copper foil—are already affixed to the board. Insert your components and solder; that's all there is to it.

Reproducibility, a term with two meanings, is the final and perhaps most important advantage of PC construction. In the first sense, reproducibility means that you can copy an inventor's circuit layout exactly if he provides PC artwork (such as we do here for the electronic dice). This is an important factor because some circuits require extremely careful layout; moving one component just a

few inches with respect to the rest of the components may cause the device to run amok. (The electronic dice project is quite stable, however.) In its second sense, reproducibility means any number of PC boards can be made from one piece of artwork; therefore, several friends can save time and money by teaming up on the same project.

The best way to learn PC processing is by means of a kit; this will cost from \$15 to \$45, depending on its size. Various types of kits exist. The so-called direct method is the simplest and cheapest, but it offers little advantage over Perfboard. For the experimenter wishing to duplicate magazine projects, *photoprocessing kits are the best investment*. Photo-kits come in two styles: positive or negative. Both are very effective; they differ only in the way artwork is prepared. In order to get acquainted with photoprocessing, let's examine some of the steps involved in the preparation of a typical PC board.

Generating the artwork. If a full-size PC outline accompanies a magazine article (like the one we show), you're in luck. Tape a piece of clear Mylar plastic from your kit over the PC outline. Using the opaque tapes and sticky, black donuts supplied, make an exact duplicate of the PC outline on your Mylar.

Exposing the sensitized board. In subdued light, lay your copper-clad board on a flat surface with its sensitized face upward. Place your Mylar artwork on top of the board's sensitive face. Finally, complete the sandwich by laying a piece of heavy glass on top of everything. Expose with an ultraviolet source for 10 to 20 minutes.

Either an EBV No. 2 500-watt photoflood lamp or a 250-watt UV sunlamp will make an ideal light source. Those familiar with photography will recognize this whole process as contact printing.

Development. Slosh the exposed circuit board



When you use a photographic-type PC-board kit, the first step is to cut out the PC template from page 18.

around in the sudsy, detergent-like developer for two to five minutes. When you're done, you should see areas of bright clean copper as well as other areas still protected by a dark greenish film.

Etching. Plunge the developed board into a tray filled with etchant; either ammonium persulfate or ferric chloride. In 10 minutes to half an hour, the etchant will have eaten away the areas of exposed copper, leaving only the film-protected copper pads and traces required by your circuit. During this step *you must wear goggles* because the etchant could easily splash into your eyes and cause severe burns.

Finishing up. Cut your board to size with a nibbling tool. Using a No. 67 bit, drill component-mounting holes through your board at each copper pad. Lightly buff the chemical residue off the copper traces with fine steel wool. Now, mount your components from the unclad side of the board so that leads protrude through to the foil side. (We also supply a guide to component placement.) Bend the leads over, solder them and later clip off the excess wire. That's it.

Photoprocessing kits, complete with detailed instructions, are available from a great many electronics retailers. Circuit Specialists (Box 3047, Scottsdale, Ariz. 85257), Burstein-Applebee (3199 Mercier St., Kansas City, Mo. 64111) and Allied Electronics (401 East 8th St., Fort Worth, Tex. 76102) are firms whose catalogs contain PC kits.

Use a printed-circuit-board kit like this from Calectro: \$18.50.



ELECTRONIC DICE

(Continued from page 14)

rapidly oscillating signal is fed to the input (pin 14) of IC2.

Counting the spots

Integrated circuit IC2 is a counter; it counts the oscillations fed to it by IC1. Each successive oscillation advances the count by 1 until a count of 6 is reached: 1, 2, 3, 4, 5, 6, 1, 2, 3 and so on. As you may have guessed, the six counts correspond to the six faces on dice. What we need now is a device to translate each specific count within IC2 into a unique pattern of lighted LEDs that will look like one of the standard dice faces.

This is exactly what IC3 does. For example, when IC2 commands that a "4" be displayed, IC3 responds by

illuminating four LEDs—LED1, LED3, LED5 and LED7. Note that the LEDs must be arranged as shown in the schematic and pictorial; alternative layouts may give nonsense displays.

As long as the Roll button is pushed, the patterns representing the faces of the little cube "tumble" more rapidly than the eye can follow. But as soon as S2 is released, oscillation and counting cease. IC2 now retains the count accumulated at the instant of S2's release, and this count will be visible to an observer as a pattern of lights. Because the circuit oscillates so rapidly, a person has absolutely no idea of the count present at the instant he releases S2. The resulting display, therefore, is determined purely by chance.

Because the circuit is simple, con-

struction is straightforward; either a printed circuit or Perfboard can be used. (See our special section on making a PC board for this project.) When purchasing components, be sure you understand the abbreviations in the schematic: "K" equals one thousand; "M" denotes a million; "m" or "mfd" stands for microfarad (a unit of capacitance), and "pf" means picofarad (a smaller unit of capacitance).

Capacitor C1 is a tantalum device; you should *not* substitute an aluminum electrolytic unit. IC2 and IC3 in this project are each a CMOS, an acronym for Complementary Metal-Oxide Semiconductor. The one important fact you must know about these devices is that they can be *destroyed* by static electricity. As a result, it is best to use IC sockets and

(Please turn to page 18)

ELECTRONIC DICE

(Continued from page 17)

to install the ICs in these sockets only after all soldering is completed. Until the time of installation, let the ICs remain as you received them—stuck into a piece of black foam. This black packing material is a special conductive plastic that protects the ICs until you are ready to use them. When you finally do install the ICs, try to make as little contact as possible with their pins.

As you lay out your Perfboard or printed circuit, use the PC outlines provided with this article as guides; they will save you considerable time. Connections should be made

using a soldering iron rated at no more than 25 watts. More powerful irons may cause overheating and destruction of components. Apply heat just long enough to melt your solder to a bright little blob, and be certain your solder is the rosin-core type—not acid-core. *Under no circumstances* should you use a soldering gun in the course of construction.

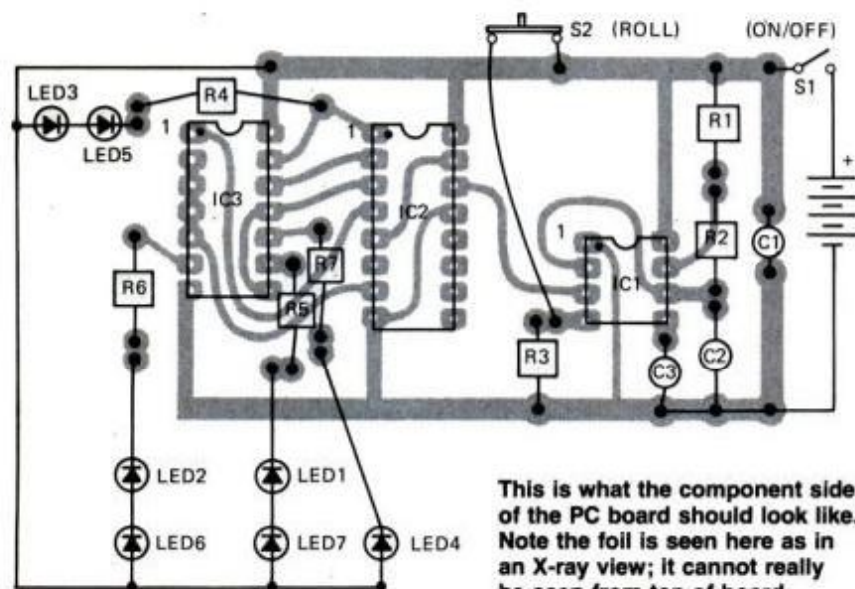
Everything in its place

Although this might seem obvious, you must be careful to orient your components correctly. Pin No. 1 of each IC is identified by a small circular depression that can be seen as you view the IC from the top. Pin numbering proceeds in succession

(2, 3, 4...) as you progress in a counterclockwise direction from pin No. 1 (still viewing from the top). The positive (+) terminal of C1 is marked by a small dot, usually red or white. If improperly installed, a tantalum capacitor will heat up or even explode once power is applied. Of course, batteries must also be installed correctly. Be especially careful here, since reversed batteries may quickly destroy your ICs.

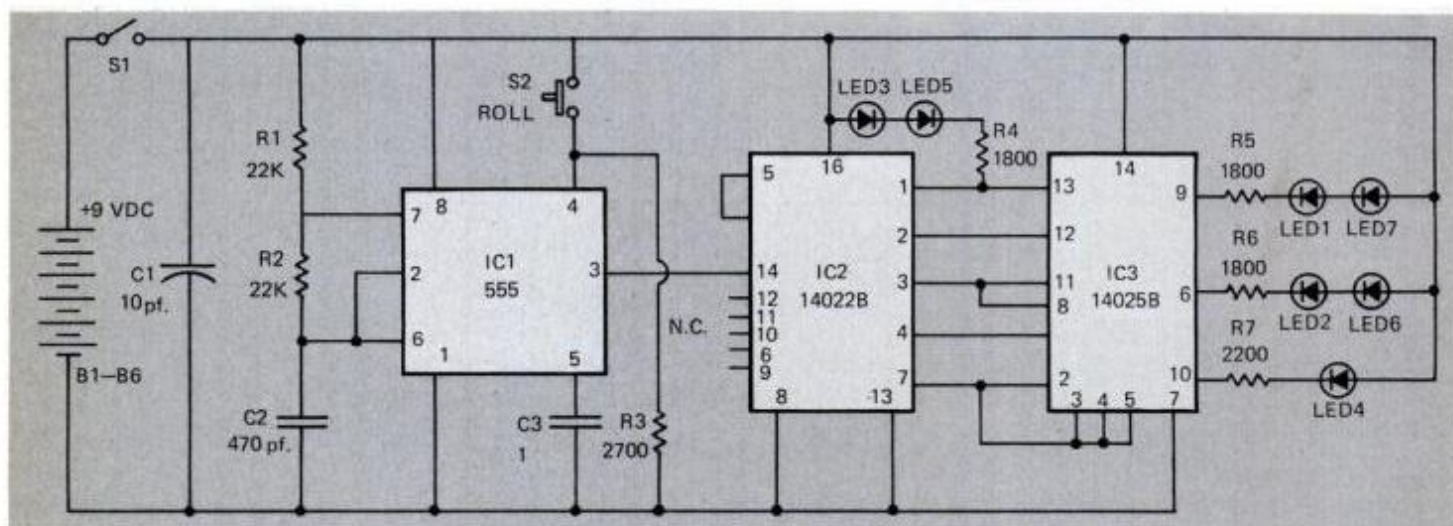
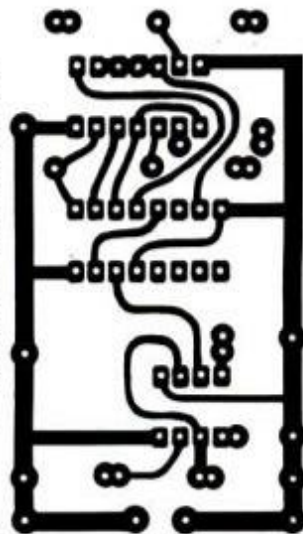
Arrange LED1 through LED7 on the front panel of your cabinet in exactly the order diagrammed. Drill seven holes with diameters just large enough to accommodate the LEDs snugly. Insert the LEDs and

(Please turn to page 210)

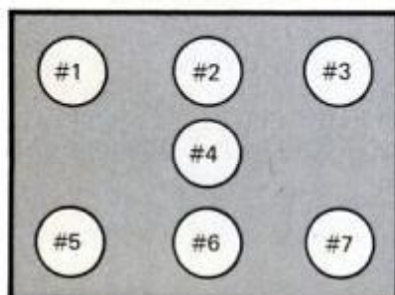


This is what the component side of the PC board should look like. Note the foil is seen here as in an X-ray view; it cannot really be seen from top of board.

Here (right) is the PC-board template you will need to "roll your own" electronic dice. As the text explains, this aid will be of great help when you fashion your own PC board for this project. Cut it out directly from the magazine and copy it as instructed in the PC-board kit detail. It is reproduced at the size you will need. All you have to do to the finished board is drill holes and solder in the components.



LED PLACEMENT



PARTS LIST—ELECTRONIC DICE

B1 to B6—AA penlight cells, 1.5-v., connected in series.
C1—10-mfd., 20-v. tantalum capacitor (Allied No. 881-0635 or equivalent)
C2—470-pf. polystyrene or ceramic capacitor
IC1—555 timer *
IC2—Motorola MC14022B octal counter *
IC3—Motorola MC14025B triple 3-input NOR gate *
LED1 to LED7—high-brightness, light-emitting diode (Allied No. 649-0630 or equivalent)
All resistors are 1/2-watt, 10%-tolerance
R1, R2—22,000-ohm resistor

R3—2700-ohm resistor
R4, R5, R6—1800-ohm resistor
R7—2200-ohm resistor
S1—S.p.s.t. switch
S2—Pushbutton switch, normally open
Misc.—Cabinet, wire, IC sockets, battery holders, PC board materials (optional)
Note: Allied Electronics' address is 401 East 8th St., Fort Worth, Tex. 76102.
 * Available from Circuit Specialists, Box 3047, Scottsdale, Ariz. 85257. Before ordering from a mail-order supplier request its catalog to obtain current prices.

Win a Canadian Experience

The best experience in drinking pleasure, Canadian Mist[®], brings you an opportunity to experience the best of Canada.

Win your choice of four extraordinary one-week, all-expenses-paid Canadian experiences for two.

1. Camping/Canoeing Canada — Saskatchewan — Clean sparkling lakes, unspoiled wilderness, breathtaking scenery. You can even experience a canoe trip along the historic Churchill River, the route of early voyagers.

2. Hunting/Fishing Canada — Track the majestic moose, great bear or elusive mountain ram. Challenge the giant lake trout or fighting pike. Your choice...they're waiting for you.



3. Vacation Canada — A Fly/Drive vacation to two beautiful provinces, Ontario and Quebec. Distinctly different...yet knitted together by history and geography.



4. Ski Canada — Experience the white powder of Canada's spectacular Rocky Mountains — Lake Louise, Banff, Whistler, Radium or Jasper. The choice is yours.



BONUS — Jeep Cherokee plus \$5,000 cash!

To be eligible for this sensational bonus prize, simply indicate how many times the word **CANADIAN** appears on the Canadian Mist bottle labels. In the event your liquor retailer is out of Canadian Mist, you can obtain free sample

labels by sending a self-addressed stamped envelope to: Bonus Labels, B-F SPIRITS LTD., P.O. Box 1080, Louisville, Ky. 40201.



1000 Other Prizes!

Choice of Chamois Cloth Shirt, Hiking Britches, Scarlet Union Suit or Chamois Cloth-lined Windbreaker from the Canadian Mist Trading Post.

Official Rules

1. On an official entry blank or plain piece of paper, print your name, address, city, state and zip code, affix the Cap liner from a bottle of Canadian Mist (any size except the 1.75 liter or miniature) or print the words "Canadian Mist." Mail completed entry to: Canadian Experience Sweepstakes, P.O. Box 36, New York, New York 10046. You may enter as often as you wish, but each entry must be mailed separately. No mechanically reproduced entries accepted. All entries must be postmarked by April 30, 1979.
2. Winners will be selected in random drawings under the supervision of Marden-Kane, Inc., an independent judging organization whose decisions are final. All prizes will be awarded and winners will be notified by mail. One prize

per family. All applicable taxes are the sole responsibility of the prizewinners. Odds of winning depend upon the number of entries received.

3. Sweepstakes open to residents of United States of legal drinking age under the laws of their home state.

4. Employees and families of Brown-Forman Distillers Corporation, its advertising agencies, Marden-Kane, Inc., liquor retailers or distributors and sales personnel of wholesalers in states where prohibited by law are not eligible to enter. Offer void in Calif., Ga., Ky., Kan., Mich., Miss., Mo., Okla., Penn., Utah, Va., Tex. or wherever prohibited or restricted by law. All Federal, state and local regulations apply.
NO PURCHASE NECESSARY.

Cap liner

PRIZES: Choice of trip to Canada (approximate value \$5,000 cash).

BONUS — Jeep Cherokee plus \$5,000 cash (approximate value \$11,500) and 1,000 other prizes: choice of shirt, britches, union suit or windbreaker (approximate value \$15).

Mail to:
Canadian Experience Sweepstakes
P.O. Box 49, New York, New York 10046

To win Bonus, also fill this in:
The word **CANADIAN** appears _____ times on the Canadian Mist bottle labels.

Name _____

Address _____

City _____

State _____

PLEASE PRINT

Zip _____

DETROIT LISTENING POST

Four-wheel-drive AMC Concord

Reports are that AMC will try to go Subaru one better by offering a full-time 4wd version of its compact Concord, possibly by a year from now. Several 4wd Concord wagons, using modified Jeep components, are now on test in the Detroit area.

Diesels in a "hold" position

While virtually every automaker, both domestic and foreign, is working on diesel engines to help meet future fuel economy mandates, *Ward's Engine Update* reports that GM, for one, appears to be delaying the OK for its divisions to go ahead with proposed diesel projects. There is some interdivisional rivalry involved, since Chevrolet, Buick and Cadillac all hope to join rival Oldsmobile as diesel manufacturers. But the largest uncertainty seems to center around health concerns and future diesel emissions regulations.

In the meantime, Mercedes-Benz, which plans to have diesels in 60 percent of the cars it sells here this year, is offering a Directory of Diesel Fuel Stations listing more than 13,000 places in the United States and Canada, where current oil-burner owners can fuel up. A copy is supplied with each new diesel Mercedes car, but it's much cheaper to order one for \$2 from Mercedes-Benz of North America, Box 350, Montvale, N.J. 07645.

Pontiac and Ford turbo plans

GM's Pontiac Div., worried about losing the high-performance image of its hot-selling Firebird TransAm, is planning to offer a turbocharged 301 Firebird engine next year when the 400 V8 will be scrubbed due to fuel economy regulations. Pontiac apparently feels that turbo V8s make more sense than turbo Fours since the added cost is about equal,



Chrysler 300 lives again! It's not a 300-horse Hemi like in '55, but this 1979 Limited Edition hardtop, now in Chrysler showrooms, brings back fond memories of American stock-car racing's early days.

and potential four-cylinder buyers who want more performance can opt for larger engines instead.

Ford, however, is taking the opposite tack. Plans there call for increased availability of turbocharged four-cylinders, including possible Ford-built units for '81 1.6 and 1.3-liter engines. This will give Ford small-car customers the opportunity to have four-cylinder economy along with V6 or V8-type power on demand.

Mustang Indy pace car

For the 11th time since 1932, Ford Motor Co. has landed the Indianapolis pace car assignment, this year with a specially modified 302 V8 Mustang hatchback coupe. Aerodynamic spoilers front and rear, a T-roof, special grille and hood scoop and orange/red lettering and decals on a black-and-silver paint job identify the pace car on the outside. Its chief interior feature is a set of excellent Recaro seats (in black-and-white checks) with adjustable backrest angle and thigh support.



Specially prepared Mustang will pace the 33 starters in Indy 500 on May 27.

A modified automatic transmission is coupled to a heavy-duty 302 with earlier 351 (Windsor) heads; special, larger valves; 1970 Boss 302 forged steel crankshaft and rods; four-barrel carburetor and high-rise aluminum intake manifold. Brakes and shocks are also beefed and special tires are fitted on the TRX alloy wheels for the 100-plus-mph speeds necessary for Indy pace-car duty. A limited number of dealer versions will get the neat seats and the graphics, but a sunroof instead of hatches and a standard (smog-legal) 302 V8 with Ford's four-speed manual transmission.

CAFE blues

Even while NHTSA is seriously considering raising its CAFE (Corporate Average Fuel Economy) requirement from 27.5 to as much as 30 mpg for 1985 and beyond, trou-

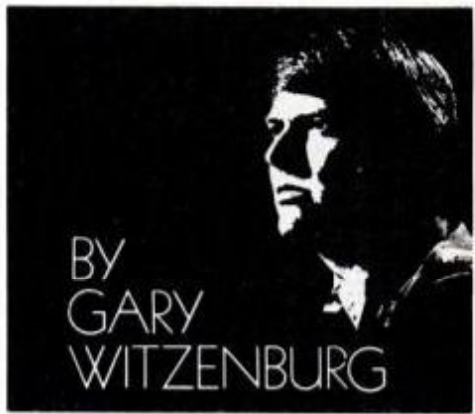
bled automakers already are pressed to meet the 19-mpg 1979 average.

Sales-weighted, computer-monitored fleet averages are raising sweat on legions of auto-executive brows as buyers continue to prefer low-mileage big cars over fuel-efficient smaller ones. Ford is hovering dangerously at 19-mpg (even 18.9 mpg at year's end could bring \$2.5 million in fines) because its mammoth 12-mpg Lincolns are selling well and 22-mpg Pintos are not. GM reported a 19.2-mpg average as of late November and is taking steps to get back into safer territory (discontinuing the 302 V8 option in Pontiac's subcompact Sunbird and phasing lock-up torque converter automatics into some intermediate models at midyear, for instance). Chrysler and AMC are better off, at 20 and 20.1 mpg, respectively.

This will have far-reaching effects on the cars and powertrains you and I can buy as requirements get more stringent in years to come. Larger, "family-size" cars and V8 engines will be in short supply and priced at a premium to discourage potential buyers. Ford already is charging over \$500 for its optional 302 V8 in Fairmont/Zephyr and Mustang/Capri, for example.

Meanwhile, Chrysler has said that it can't modify its light trucks fast enough to meet the 1981 truck CAFE requirement of 18 mpg for two-wheel-drive models, and has petitioned NHTSA for relief. Small-volume importers, such as Rolls-Royce and Ferrari, have been exempted from passenger-car CAFE rules, but larger foreign makers have to meet the requirements.

If you think emissions and safety regulations have created a lot of hassles, stand by for CAFE consternation. You ain't seen nothin' yet! **FM**

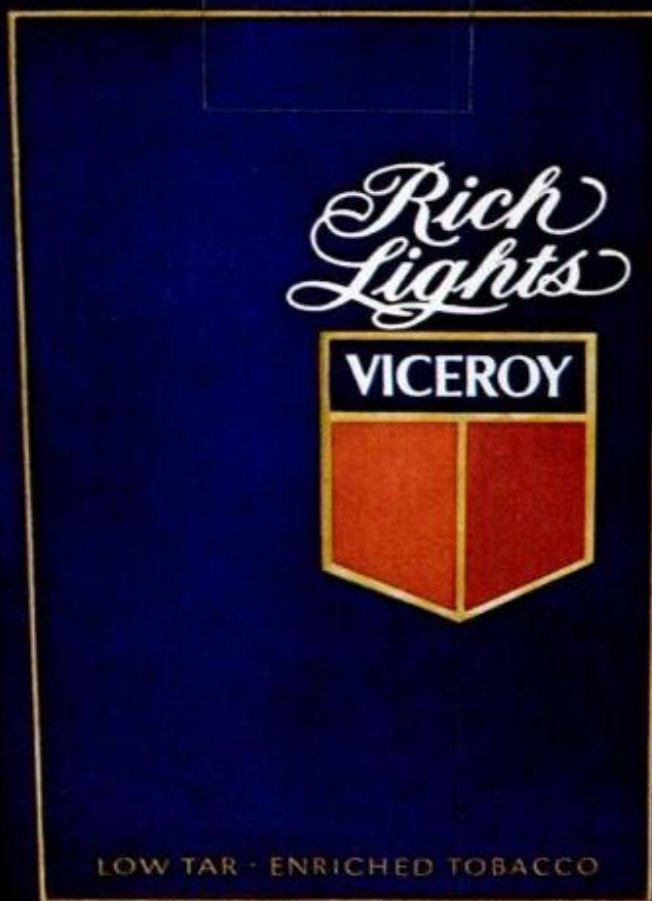


BY
GARY
WITZENBURG

7 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

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

Introducing
Rich Lights from Viceroy.



The first low 'tar' cigarette
good enough to be called *Rich*.

Kings and 100's.

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Quick-Change Artist.

When it comes to all-around performance, nobody out-performs Suzuki.

Case in point:

The TS Dual-Purpose Bikes.

These well-built machines are ideal for families who enjoy riding around town or the toolies. Because all four (TS-100, 125, 185, 250) are easy to ride, easy to service and all are easy on the family budget.

And, of course, all are equipped to handle open roads or open spaces with ease.

For instance, each is powered by Suzuki's proven Power Reed™ engine. Which delivers smooth power for street cruising and low-end power for mountain climbing.

Other neat features include adjustable laid-down rear shocks, tucked-in exhaust pipe, primary kick starting and street-legal lights and instrumentation. Also, the TS-185 and 250 now come with leading-axle longer-travel front forks for better control.

So you see, these bikes are built to go beyond the call of double-duty.

Now you know why the TS Dual-Purpose Bikes are among the world's great performers.



Suzuki. The performer.



Ride with care: wear protective apparel and help protect the environment. Member Motorcycle Safety Foundation.



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HOMEOWNERS' CLINIC

QUESTIONS ANSWERED

Condensation in insulated glass

Over the years condensation has formed between the sheets of glass in my double-insulated sliding glass doors. Upon dismantling the doors I found that they are sealed at the edges. Can they be separated so that they can be cleaned on the inside, then reassembled?—Marvin Blumenfeld, Aberdeen, N.J. and Elias G. Papadeas, Central Islip, N.Y.

Afraid they can't. These glass units are sealed at the factory. They have a double-seal construction system with dry air between the panes to reduce air-to-air heat (or cold) transfer. Your "seal" is obviously broken, allowing moisture and dust particles in the air to accumulate on the inside of the glass. See *Homeowners' Clinic*, Apr. '78, for more information.

Flexible drains

Each time I've installed a new lavatory sink in my home (three to date) I've run into the same problem: The drain lines are never in line. There are flexible and bendable water supply tubings available, but I've never seen a flexible drain pipe to make my installation easier. Seems like an easy invention.—J. Marron, Point Lookout, N.Y.

There is such an item on the market. The flexible, acid-resistant line is made of polypropylene. It fits the standard sinks and traps. The makers say it works even if the drain and trap are up to 2 inches out of line. As the flexible section is kept to the vertical piping, it should not collect debris in its corrugations. Known as Flexi-Drain, it is manufactured by Webstone Co. Inc., 38 Harlow St., Worcester, Mass. 01605.

Warming cold concrete floors

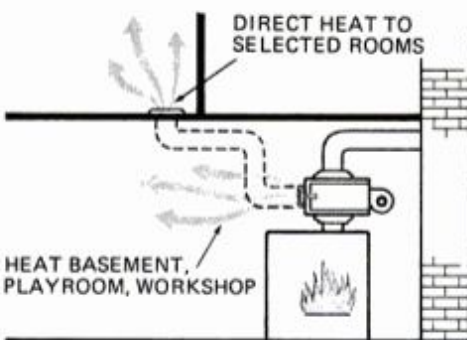
My condominium has concrete floors and ceilings which are difficult to keep warm in the winter. What can I do?—George Bolognese, Staten Island, N.Y.

Concrete will always be cold to the touch when it's protected from the sun. There are methods of heating concrete floors and ceilings, but they are buried in the slab at the time of construction (either hot water in copper piping, or electric heat cables are used). Heat cables can be fastened to your ceilings and plastered over, but as you already have a heating system, this would be im-

practical, and your floors would still be cold. The only solution to the problem that I know of would be to cover the floors with padded carpeting. That would surely help.

SERVICE TIPS

■ The Dolin Heat Reclaimer uses the waste heat from your burned furnace fuel that normally goes up the flue to the outside air.



Heat reclaimer is installed in the flue.

Basically, it is a self-contained heat exchanger which conducts the flue gases around many tubes, heating them. Air from the room is drawn by an electric blower, run through the hot tubes and discharged back into the house as warm air. The motor is thermostatically controlled. The manufacturer claims savings of fuel costs up to 23 percent, and that the device doesn't restrict the flow of gas through the flue, as long as the heat exchanger is cleaned periodically. The maker also recommends installation

by a licensed heating contractor. Be certain to check with your local building department to determine if it permits the use of a heat reclaimer unit. For more information write: Dolin Metal Products Inc., 475 President St., Brooklyn, N.Y. 11215.

■ Many homes built in the mid '60's were wired with aluminum because copper was in short supply. In recent years, several home fires have been blamed on faulty aluminum wiring. A federal court and the CPSC (Consumer Product Safety Commission) can't even reach accord on what, if any, danger exists. It's not our intent to become embroiled in the controversy, but here are some facts you should be aware of before you rewire:

Aluminum wire is used by many power companies to service homes. Usually a No. 6 braided wire is used, but size may vary. The coefficient of expansion for aluminum is much greater than for copper, brass or steel. When the metals experience a temperature change (from loading), aluminum wire expands and contracts more than brass or steel, thus terminal connections loosen more easily.

Any loose connection—copper, brass, steel or aluminum—will arc, creating a fire hazard. Aluminum oxidizes much more quickly than copper, causing a "shell" to form on the wire, building up resistance and possibly overheating.

These are only a few things to consider. If you have a totally aluminum-wired house, don't panic. Discuss these points with a reliable, licensed electrician:

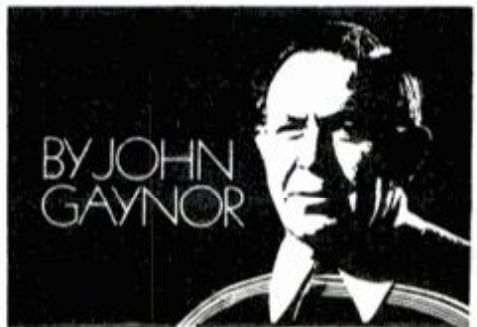
1. Feeder lines should be disconnected, cleaned and coated with oxidation inhibitor made specifically for this. Terminal lugs should be thoroughly tightened.

2. Depending on amperage, aluminum wire is usually required to be one size larger than copper to match conductivity. Make sure your wiring is the proper size.

3. Make certain all receptacles and switches are marked CO/ALR (copper aluminum revised). If so, have your electrician check for tightness. If not, replace.

To verify the type of wiring you have, turn off power to an outlet box, remove and inspect the receptacle. If your circuits are aluminum, have at least the above three items checked. If your circuits are copper and your home is about 15 years old, you should clean the feeder line. **PM**

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



BY JOHN GAYNOR

1979 Coachmen, The Name To Remember In Recreational Vehicles

There's a lot of excitement in the Coachmen lineup of new '79 recreational vehicles. RVs that you helped design. Your RV needs were detailed in an extensive consumer "livability" study; owners told us what they liked and disliked about RVs, as well as their eating, sleeping and traveling needs. The result? Recreational vehicles that give you a great sense of "fitness", of comfort with good taste and the reliability of quality construction.

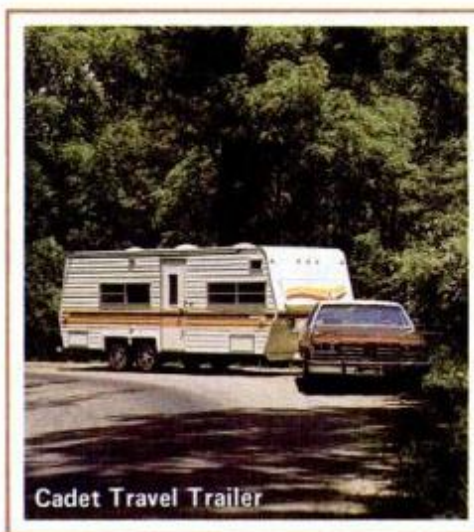
Coachmen offers dozens of family-pleasing floorplans. From the Deluxe line of Travel Trailers, QuinStar 5th Wheels, Leprechaun Mini-Motor Homes and Class A Motor Homes, to the economical Cadet Travel Trailers, 5th Wheels, Mini-Motor Homes and Truck Campers. The entire '79 line has been redesigned, including the versatile Travel Vans and Van Campers and the easy-towing Camping Trailers.

Stylish and aerodynamic exteriors. Colorful and easy-to-care-for interiors. Models that let you see the wide-open spaces outside while enjoying the wide-open spaces inside. Comfortable and efficient kitchens, remarkably roomy baths, lights where you want 'em. Plenty of outside and inside storage. Top brand name appliances and components. And all Coachmen recreational vehicles are backed with famous "Buck Stopper" service from dealers all over North America.

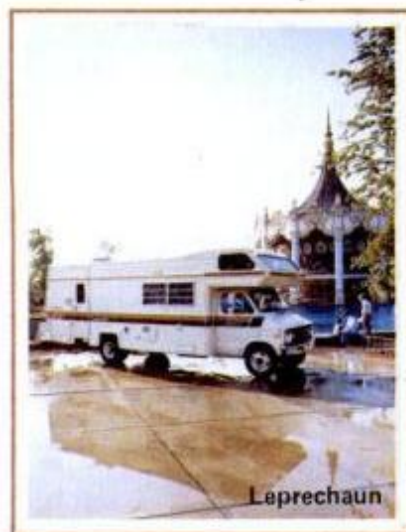
Write today or visit your local Coachmen dealer—he's in the Yellow Pages. And take a look at the recreational vehicles designed the way you want them. Coachmen for 1979—The Name To Remember in recreational vehicles.



Deluxe Travel Trailer



Cadet Travel Trailer



Leprechaun



Coachmen

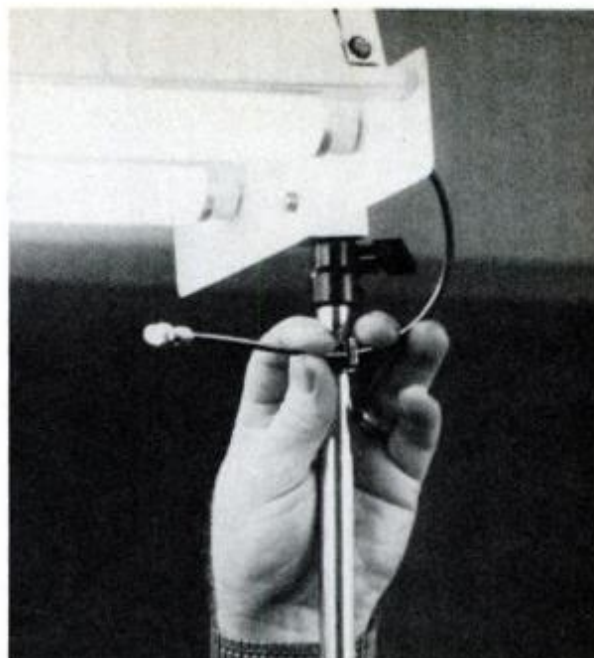
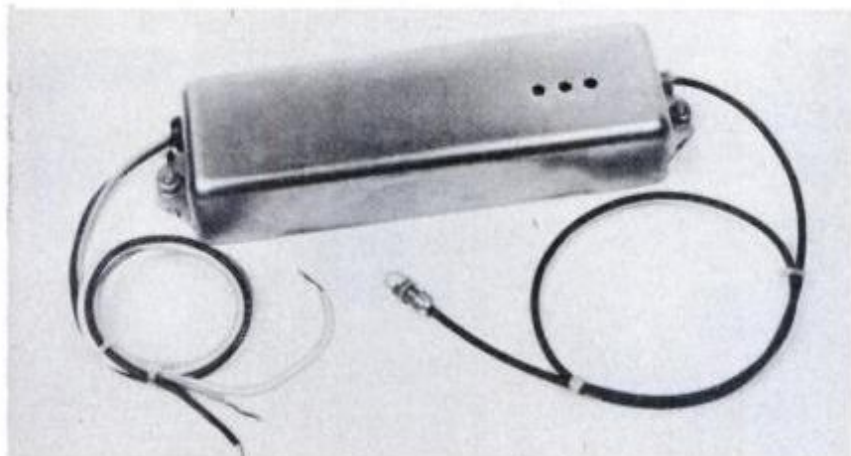
Recreational Vehicle Company

P.O. Box 810 • Dept. PM-3
Middlebury, Indiana 46540



Deluxe Travel Trailer & Travel Van

Energy-saving lighting control



ECALO control unit (left) is said to install in less than 10 minutes. Fiber optic bundle (right) senses ambient light.

A Rockville, Md., firm is marketing a fluorescent-light control system claimed to reduce electricity consumption about 50 percent. ECALO, an acronym for Energy Conserving Automatic Light Output, uses integrated circuitry to control the lights. A fiber optic bundle allows a photodiode to compare

ambient light with a preset, variable reference level. Thus, if light coming through office windows brings the total light level above the reference level, ECALO reduces arc current in the bulbs until the reference level is reached. The regulating unit, in a 40-watt ballast can, mounts inside a lighting fixture's ballast housing.

ECALO was developed by Don F. Widmayer, president of Controlled Environment Systems, Inc. He says lower power use and air-conditioning load (dimmer lights produce less heat) are prime sources of savings. Bought in volume, a four-lamp controller costs about \$20.—*Tom Sahagian*

Easco puts it all together, or takes it all apart...with ease.

If you've ever tried to tighten handlebars, take the back off a TV set, or put a bed frame together with a pair of pliers, then you know how much time and grief an Easco socket and wrench set can save you. There are dozens of jobs around the house you can handle with ease with Easco. Easco makes one of the largest lines of quality sockets and wrenches, hack-saws, hammers, trowels and heavy striking tools. If you want to know what quality *feels* like, wrap your hand around an Easco tool.



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PEAK PERFORMANCE.



Honda portable generator scales Mt. Everest without skipping a beat.

When you set out to climb a 30,000-foot mountain, you can't take a lot of stuff with you. Food, clothing—and a few necessary tools to get the job done.

One thing the American Bicentennial Everest Expedition had along was a Honda EM-400 portable generator. At the 18,000-foot base camp, the little Honda put out dependable power for charging batteries, running a soldering iron—even powering the radio to keep up vital communications.

The EM-400 puts out 400 watts (max. rating) of AC power; it'll power

small tools and accessories around the home or campsite. It also puts out 12 volts of DC power, so it will charge your car battery as well. It's simple to use; the quiet Honda engine is a four-stroke design so you never have to pre-mix fuel. And at a mere 39 pounds, it's easy to store and move.

Check out the Honda EM-400 at your Honda generator dealer today. It's a nice companion to have, whether you're climbing a mountain or just getting the odd jobs done at home.

HONDA GENERATORS

For the Honda dealer nearest you, call toll-free (800) 648-5311 and ask for Operator 99. For optimum performance and safety we recommend that you read the owner's manual before operating the unit. Honda also makes a line of lawn mowers, tillers, outboard engines, general purpose engines, and water pumps.
© 1978 American Honda Motor Co., Inc.

PHOTO HINTS

Marked filters save time

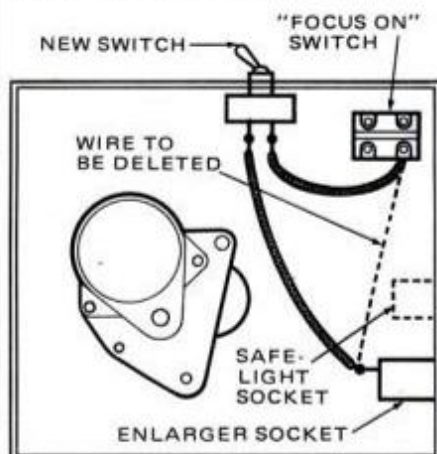


If you use an enlarging meter and poly-contrast paper in the darkroom, you know you must reset the meter's ANSI rating (similar to film's ASA rating) each time you change filters. To help remember which rating goes with what filter, use a label maker to mark each filter.—*Tom Bonner*

Blanket endorsement

If you have one of those space-age reflective blankets for camping, it can do double duty as a photo reflector. Outdoors, use it to soften shadows. Indoors, with flash or flood lighting, it works as well as a special photo umbrella—and costs much less.—*Bob Berger*

Switch doubles timer utility



An on-off switch added to your darkroom timer lets you use it for developing, as well as for enlarging. Mount a 2-amp. single-pole, single-throw toggle switch on the timer housing and disconnect wire leading from enlarger socket to the "focus on" switch. Attach this wire to a terminal of the toggle. Run a wire (No. 16 minimum) from other terminal to enlarger socket.—*John A. Kirwin*

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automatic garage door opener system by Alliance

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available. And SEQUENSOR[®], the computer-controlled brain that handles 22 functions with error-free precision and solid-state reliability. Isn't it time you owned a Genie?



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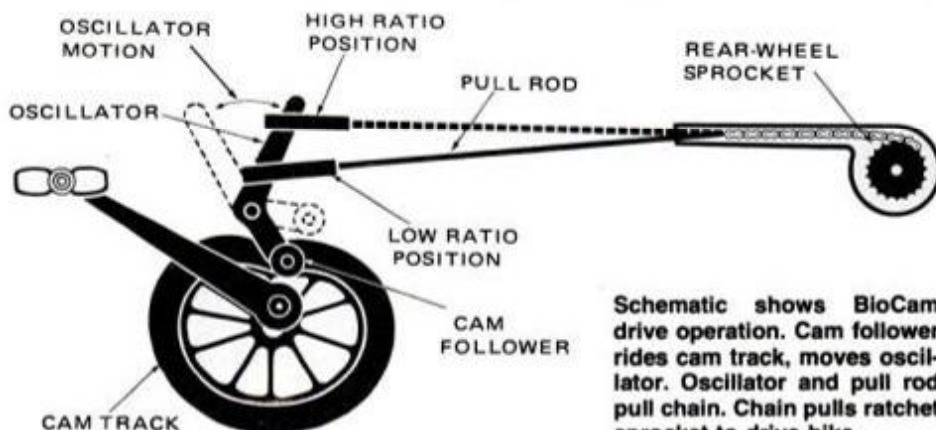
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Is this the bicycle of the future?



It looks like an ordinary bike, but plastic shields for pull rods tell you it's a BioCam.



Schematic shows BioCam
drive operation. Cam follower
rides cam track, moves oscil-
lator. Oscillator and pull rod
pull chain. Chain pulls ratchet
sprocket to drive bike.

The makers of the BioCam bicycle think they have built a gear-shifting device superior to the derailleur.

On the BioCam, the rotary motion of two cams is converted into the reciprocating motion of two pivoting arms (see diagram). The arms pull rods and chains that pull ratchets to drive the bike. "Gear" ratio can be varied by moving the rods up or down on the arms; up for higher, down for lower.

BioCam's inventor, L.G. Brown, makes several claims for the new drive. He says it is 25 percent easier to pedal because it allows the rider's legs to rest a bit during each revolution. Brown also asserts that BioCam provides a much wider gear-ratio range and requires less maintenance. Further, the ratios can be varied virtually infinitely within the range, and can be changed while moving or at a standstill.

On a test ride, pedal action felt funny at first, but the drive worked

pretty well. At a stoplight, a push on the shift lever gave a nice low gear from which to start off again.

There were problems, though. The bike weighed about 32 pounds, despite a lightweight frame. The gear-shift was difficult to move, and the bike made an awful whine when in motion. It can't be rolled backward, and pedaling backward moves the bike forward.

Brown, when told of these problems, said production models will have stronger ratchets that will enable the bike to roll backward and eliminate the whine. He said the new shifter will be easier to move.

BioCam, which should be available soon, will cost about \$750 in a deluxe version. Unfortunately, the drive is not available for retrofit because the BioCam frame requires a special bottom bracket for the cam mechanism. BioCam is manufactured by Facet Enterprises, 7030 South Yale Ave., Tulsa, Okla. 74136.
—Tom Sahagian

GM

MADE IN EXCELLENCE



Caprice Classic Estate Wagon

The New Chevrolet. America's best-selling wagon.

The New Chevrolet Wagon enters 1979 with two big years of experience and success behind it. It looks as new and contemporary today as it did the day it was introduced.

So it's easy to understand why it's the best-selling wagon in America.

The New Chevrolet offers the kind of features people need and want in a wagon. Everything from trim, contempo-

rary styling to plenty of practical room.

There's a convenient three-way door-gate, a four-foot-wide cargo area and even two lockable rear storage areas. Plus more.

Now's the time to make The New Chevrolet Wagon your Chevrolet wagon. Talk to your Chevy dealer today about buying or leasing the wagon America has driven to the top. The New Chevrolet.



87 Cubic Feet. Takes loads up to 4 feet wide through the rear opening. And with the rear seat down you get 87 cubic feet of cargo area.



Three-Way Door-Gate. Opens like a regular door, or the glass slides down for a reach-in window. The rear door also folds down.



Extra Storage. 2 cubic feet of convenient side-compartment storage, plus built-in utility trays for a variety of items.



Push-Button Seat Conversion. A touch of a button folds the second seat down. A fingertip control lowers the available third seat.



Underfloor Storage. On 2-seat models, 8.0 cubic feet of lockable storage under the rear cargo floor (less on 3-seat models).



THE PM GARAGE

CAPSULE REPORTS ON NEW AUTO PRODUCTS

Ventipane locks

If your car has front-quarter panes without the little lock buttons (as does my 1967 Camaro), you might think about investing in a set of locks.

Trans-World Imports markets a set for \$7.50 that slips onto the trailing edge of the pane. A hinged clamp then locks the vent firmly to the



New lock secures front ventpanes.

window's upright stanchion. The clamp is easily released whenever you want to open the ventpane.

Unfortunately the lock didn't work on my Camaro because the glass is curved. But it works fine on cars with straight side windows. I bought these locks from my local Chevrolet dealer. The U.S. distributor is Trans-World Imports/Exports, Box 2123, Toluca Lake, Calif. 91602.—M.L.

Gasoline dryer

If you're plagued in wintertime by water and condensation building up inside your gas tank, you'll want the insurance of a fuel dryer.

Prestone makes one called Prime. Among its benefits: It removes moisture from gasoline and diesel fuel and stops carburetor icing.

Prime's 60-percent methanol content absorbs water to make it "burnable." Most gas stations carry Prime; recommended price is 65 cents.—M.L.



Prime your tank.

Cracked-battery sealer

If your car battery develops a split seam, loose post, or cracked case, you don't have to junk it. You can now seal it with a new product from Qualco.

Instructions say to first stop the leak by tilting the battery or by carefully draining the acid into a glass container. The crack has to be clean and dry. Then open up the seam so you can squeeze a goodly amount of sealer down into it.

Trowel lightly with a screwdriver and let the compound harden overnight. That's it—your battery's as good as new.

Qualco's Battery Leak and Crack Repair costs \$1.19 at auto stores or from the manufacturer, Qualco Products Co., Fanwood, N.J. 07023.—M.L.

Tiny battery tester

I've owned a battery hydrometer for years. And for years it's lived in my garage. Which is usually where my cars aren't when their batteries get sluggish.

Now there's a tiny hydrometer that's inexpensive and small enough so I can buy one for each car, to be kept in the gloveboxes, ready for use. It's the Hydro-Mite tester, costing \$1.59 and smaller than a ballpoint pen.

Its plastic cap and unbreakable case guard against leakage. The Hydro-Mite uses three colored balls to tell the battery's condition. It's available at most parts houses or from the maker, Thexton Manufacturing Co., Minneapolis, Minn. 55435.—M.L.



Tiny hydrometer can fit in the glove box.



Battery sealer extends battery life.

Need a nut?

How long have you been procrastinating about getting organized? It's not easy to get it all together, but if you want to get a fresh start, or if you're just starting out with a new garage workshop, consider getting a 2100-piece assorted nut and bolt kit from J.C. Whitney. You can select either an SAE or metric-size kit that contains screws, washers and cotter pins, as well as the nuts and bolts, and all are zinc-plated steel. A kit is \$19.95, plus \$3.70 postage and that



Nut-and-bolt kit keeps you organized.

includes the enameled steel cabinet. J.C. Whitney & Co., 1917 Archer Ave., Box 8410, Chicago, Ill. 60680.—J.A.L.

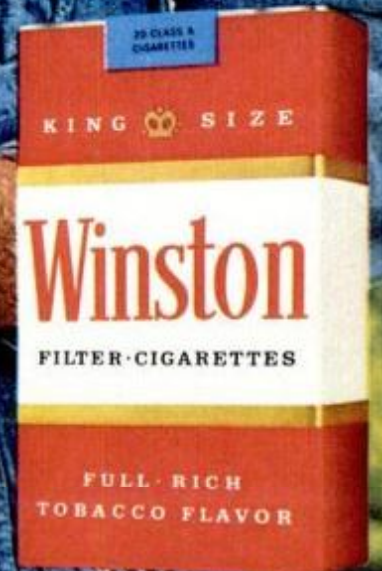
Emergency stick-um



Epoxy gum dries hard for quick fixes.

It's a sophisticated, space-age version of the old chewing-gum trick. Perma-bond calls its emergency road repair kit "Epoxy Strips," and it should be in every glovebox. When your radiator springs a leak, or worse yet your gas tank, just take the two strips in the kit—one black and one white—knead them together until the mass is gray and stick it over the leak. A kit is \$1.79. Perma-bond International, 480 South Dean St., Englewood, N.J. 07631.—B.H.

“I want the best taste
I can get.
I get it from Winston.”

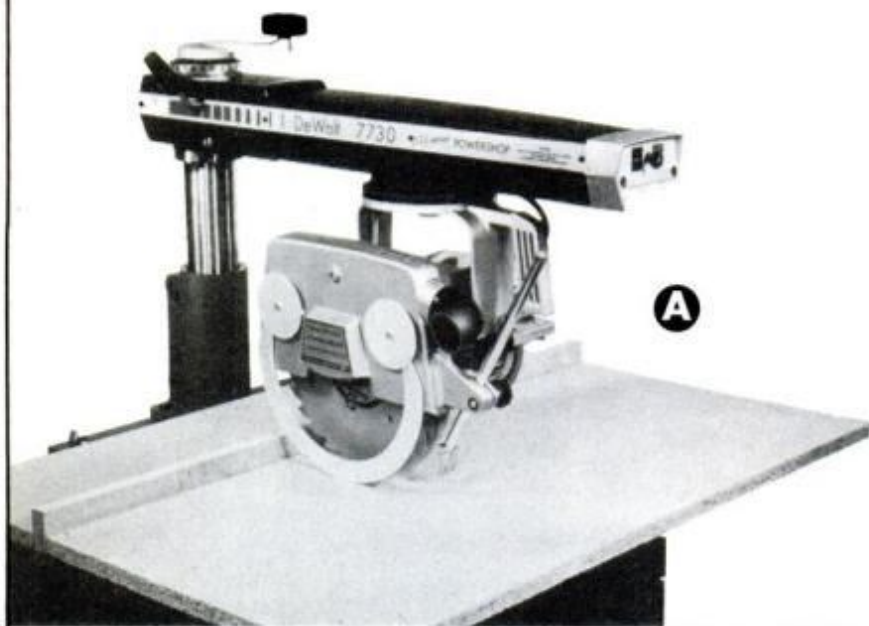


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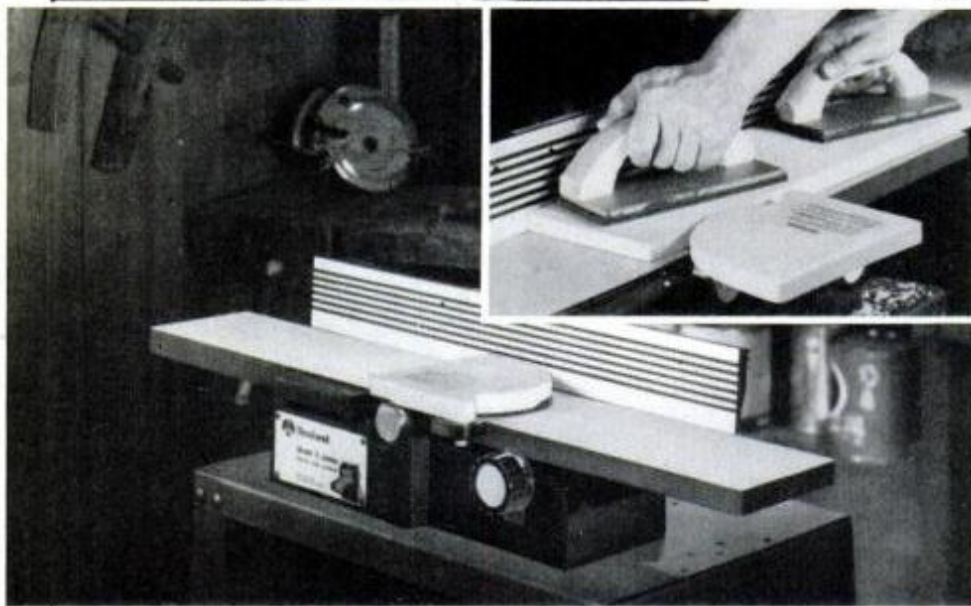
A

A. The DeWalt Powershop Model 7730 is a 10-inch radial-arm saw with a 2-hp motor. It features a roller head with four ball bearings, single-handed yoke-clamp and bevel handles, and a cast-iron arm. The saw has a manual brake and upper and lower blade guards. Measurement scales are in metric and English units. Almost all DeWalt attachments can be used with the 7730. It's about \$300, including how-to book, from DeWalt Div., Black & Decker Manufacturing Co., Lancaster, Pa. 17604.



B

B. If you already have a table saw, consider parking this 6-inch jointer alongside it. Rockwell's Model 6 has a 7000-rpm motor with lifetime lubricated ball bearings. Its cutter head is the two-knife, cartridge type with high-speed steel knives. The fence tilts from 45° in to 45° out with positive stops at 45° in, 90° and 45° out, and adjusts inward over the table for small work pieces. Safety features include a special switch and a guarded cutter head. About \$290 from Rockwell International, Power Tool Div., 1755 Lynnfield Rd., Memphis, Tenn. 38138.



C. X-14 Instant Mildew Stain Remover supplants messy, inconvenient and ineffective mildew cleaners, the maker claims. It's said to remove stains in seconds from bathroom tile grouting, vinyl car roofs, boat equipment or anywhere else mildew may form. A pint bottle is \$2.50 from White Laboratories Inc., Box 15335, Orlando, Fla. 32808.

D. The Chief Pro Pump can empty a swimming pool, irrigate farm land or pump out a flooded basement at a rate of up to 8400 gallons per hour. Use of fiberglass-reinforced plastic in the pump housing contributes to the unit's light weight of 41 pounds. The self-priming centrifugal pump is powered by a single-cylinder Clinton two-stroke engine and has a head lift of up to 78 feet. The cost is about \$260 from Clinton Engines Corp., Clark and Maple Sts., Maquoketa, Iowa 52060.

C



D



Devil's Backbone Reef hides the world's strangest shipwreck... and a case of Canadian Club.



© 1979 6 YEARS OLD. IMPORTED IN BOTTLE FROM CANADA BY HIRAM WALKER IMPORTERS INC. DETROIT, MICH. 86 PROOF BLENDED CANADIAN WHISKY

Since Columbus first came ashore here, sailing men have been littering the brilliantly blue Bahamian waters with shipwrecks. Some carried treasure, some crowned heads. But the strangest of all carried a train.

Hell for ships, heaven for divers.

The train lies off Eleuthera's northern tip, scattered on Devil's Backbone Reef. At least six wrecks are strewn here: a diver's paradise, we thought, and a perfect place to hide a case of C.C.

We headed for Romora Bay Club on Harbour Island. The club could provide us a launch and guides to explore the

reef. Nearby Dunmore Town could offer Bahamian entertainment, complete with Canadian Club. But no one could provide us with a reliable story of how or when the train had sunk on the reef.

Seek groupers, and bring muscles.

We combed Devil's Backbone till we found a devilish place to hide our Canadian Club.

To raise the C.C., you'll need scuba gear, guts and muscle: it weighs 200 pounds. Start where a "dinner boat" went down on Devil's Backbone. Follow a channel across the reef to an old Ward Line steamer wreck (try this only in bright sunlight or you'll lose your boat). Take a bearing from its bow. Not more than 200 yards along, where the reef slopes into deep water and a big Nassau grouper lives, we sunk the watertight case of Canadian Club.

May your seas for the search be as smooth as our whisky. Note: nonswimmers may discover their own Canadian Club adventure at bars or local package stores by just saying "C.C., please."



This is exactly where the case lies.



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Avis cars look young and run young. Because tough maintenance standards keep them in top condition. Many are tested by Autosense, the computer that checks over 80 critical maintenance functions.

Now you can buy a car like this as an Avis Young Used Car. Most include a Limited Power Train Warranty, honored from coast to coast, and good for 12,000 miles or one year, whichever comes first.

Outstanding selection of 78's available nationwide. (And, at some locations, 2- and 3-year-old cars that were on Avis leases.) Lots of options: air conditioning, power brakes and steering, automatic transmission, radios and more.

Plus reasonable prices.



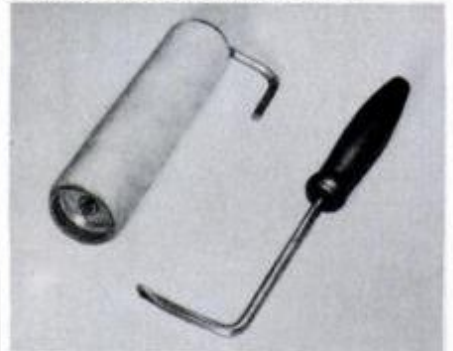
Young Used Cars. For Sale.

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For nearest location,
call toll free 800-331-1212.

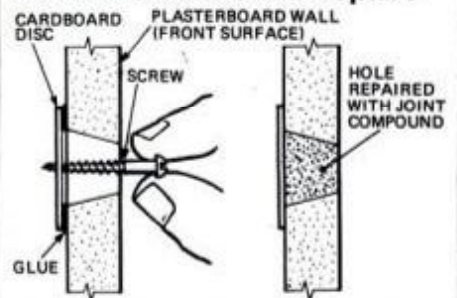
HINTS FROM READERS

Paint roller is garden tool



A discarded paint-roller handle is a useful garden tool. Cut the metal handle rod 2 in. past the bend and flatten the end. Use it to weed and break up soil.—*Earl T. Richardson*

Cardboard backs wall repairs



Cardboard glued behind a hole in plasterboard provides a backing for repairs. Cut cardboard larger than the hole, apply glue on the cardboard edges and push a screw into the center. When glue is tacky, roll cardboard in a cone shape, slip it through the hole, and, pull back. When glue is dry, remove the screw. Then spackle the hole.—*H.E. Moody*

Electric motor carrier



A car battery carrier can double as an electric motor carrier.—*Ken Patterson*

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

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

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

Exclusive! Build Engine as You Learn

You learn by doing with NRI "hands-on" training. Only NRI gives you all the parts and training you need to actually build a 3 1/2 HP Clinton 4-cycle engine and learn from the inside out as you progress. And your training includes real *professional* tools, including an inductive tachometer, volt-ohm meter, torque wrench, valve spring and ring compressors, a full set of quality wrenches and more...all to equip you for learning and earning.

Choice of Two Courses

NRI's basic course puts special emphasis on lawn and garden equipment, and teaches you the theory and practice of ignition, lubrication, cooling and starting systems.

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

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

More Training, More Value

America's oldest and largest home-study technical school, NRI has trained over a million students. And this experience means that you get the most in practical, effective training for your dollar. You get lessons



developed and tested by professional educators...expert help from instructors assigned to your course...a full set of quality tools...a complete, working engine that you build yourself...the best training and value for your money.

Find out for yourself how much NRI training can do for you. Send for the free catalog with all the facts and descriptions of every lesson. No salesman will call. Get started on your future today! If postcard has been removed, write to address below.

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Auto Repair

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America's winningest stock car racer says, "If you really want to learn how to repair cars, NRI is best." Includes professional tools like ignition analyzer scope, diagnostic engine analyzer, timing light, case hardened wrenches, and much more. Basic and advanced courses. Check postcard for catalog.

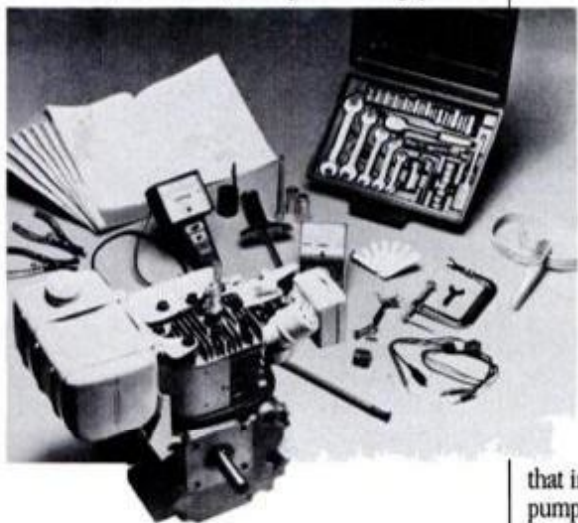
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Gets you into a wide-open, fast-growing area with practical training that includes lessons on solar heating, heat pumps, etc. Course is complete with professional tools and window air conditioning unit for demonstration and troubleshooting

practice. Two courses, with Master Course including optional training at York Institute Resident School at no extra charge. Check card for catalog.

Electrical Appliance Servicing

Good appliance repairmen are hard to come by. NRI trains you for your own full or part-time business in fixing everything from toasters to refrigerators and freezers. Step-by-step training includes professional appliance tester for fast troubleshooting. Check card for catalog.



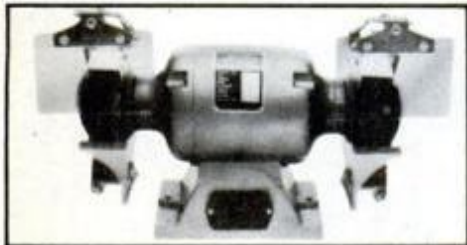
NRI Schools
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PM WORKBENCH

PM EXAMINES PRODUCTS AND SERVICES

Heavy-duty grinder

The Packard Industrial bench grinder is an all-ball-bearing, ½-hp hermetically sealed capacitor model. It features precision balanced ¾ x 6-in. wheels and a 110-volt, 3450-



Tool easily converts to buffer, polisher.

rpm single-phase motor. The tool-rest is fully adjustable. The grinder is available for \$59 from the Pacific Freight and Salvage Co., 12551 Saticoy St., North Hollywood, Calif. 91605.—J.P.

Manual tap

New tapping accessory for drill presses or lathes threads drilled holes manually at one machine location without your having to move the workpiece. It doesn't require a stand or guide, used with conventional hand-held tap wrenches. The centerline of the tap and the drilled hole are identical, since same spindle is used for both operations. Tap makes it easier for novice to produce accurate



Lathe or drill-press chuck is used to guide, support and maintain alignment while tap is being turned by hand.



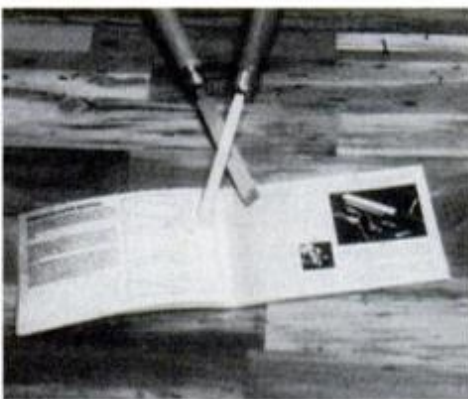
threads with less chance of breaking the tap. Tool No. 176 (No. 0 to ¼ in.) and No. 276 (No. 12 to ½ in.) are \$10.75 and \$13.90 respectively. From The Walton Co., Drawer 10299, Elmwood Dr., West Hartford, Conn. 06110.—J.P.

Fine turning tools

Greenlee's well-balanced lathe-turning tools are fashioned from high-carbon steel, tempered to 62 Rockwell hardness. The set includes a ½-in. and ¼-in. skew, a ½-in. diamond point, a ½-in. round nose, ¼, ½ and ¾-in. gouges, and a ½-in. parting tool. The handles, made from hard maple, are hand-finished for comfort and shaped for sure control. The overall length of each tool is about 18 in. The matched set costs \$91.55 from Greenlee Tool Co., 2136 12th St., Rockford, Ill. 61101.—H.W.



Eight-piece set includes how-to booklet.



Handy reference booklet, *Woodturning Hints*, includes tips on tool care and use.

Spout with automatic stop

Saf-T-Spout adapts to 1½ or 1¾-in. standard gasoline-can threads and virtually eliminates gas-tank overflow. Operated with the gas can vent closed, air is only allowed in tank through the spout. This arrangement allows fuel to flow until the fuel in the tank reaches the level of the spout. When you release the



Spring-loaded valve in spout halts fuel flow when tank is full.

pressure on the spring-loaded tip, the valve is closed and further flow is prevented when you remove the spout.—J.P.

Drives socket in close quarters

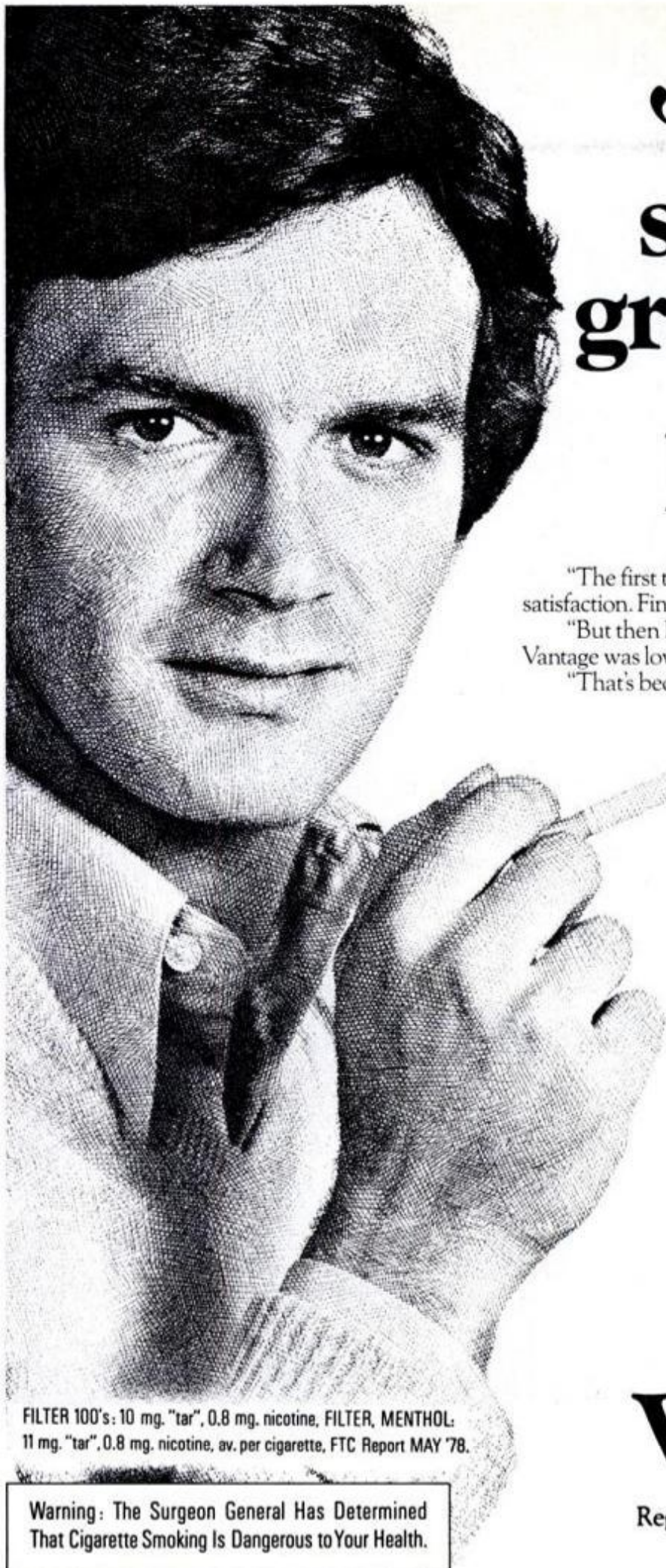
Tight Spot ratchet wrench is similar to a standard ½-in.-drive ratchet, but with one major difference. When stroke is limited by an obstruction, a lever on wrench flips out and can be squeezed to drive socket. \$19.95 postpaid from K.P. Enterprises, Box



Lever can deliver torque of 450 in.-lbs.

15503, Lakewood, Colo. 80226. Included with the wrench is a ½-in. bit, which inserts on either side of the ratchet body to reverse the ratcheting direction, plus a ⅜-in. adapter when requested.—J.P.

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



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"For me, switching to Vantage was an easy move to make. I didn't have to sacrifice a thing."

Peter Accetta
New York City, New York



FILTER 100's: 10 mg. "tar", 0.8 mg. nicotine, FILTER, MENTHOL.
11 mg. "tar", 0.8 mg. nicotine, av. per cigarette, FTC Report MAY '78.

Vantage

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Wheel Horse offers you a full line of quality products. From our new riding mower to a

tough 19.9 horsepower estate tractor, there's a Wheel Horse made to take on your job. Visit your nearest dealer and find out why you can do it all on a Wheel Horse.

See your Wheel Horse dealer during his Pre-Season Sale. Depending on the Wheel Horse model selected, he's giving away from \$60 up to \$300 worth of nursery goods FREE with the purchase of any Wheel Horse tractor.



**You can do it all on a
Wheel Horse**

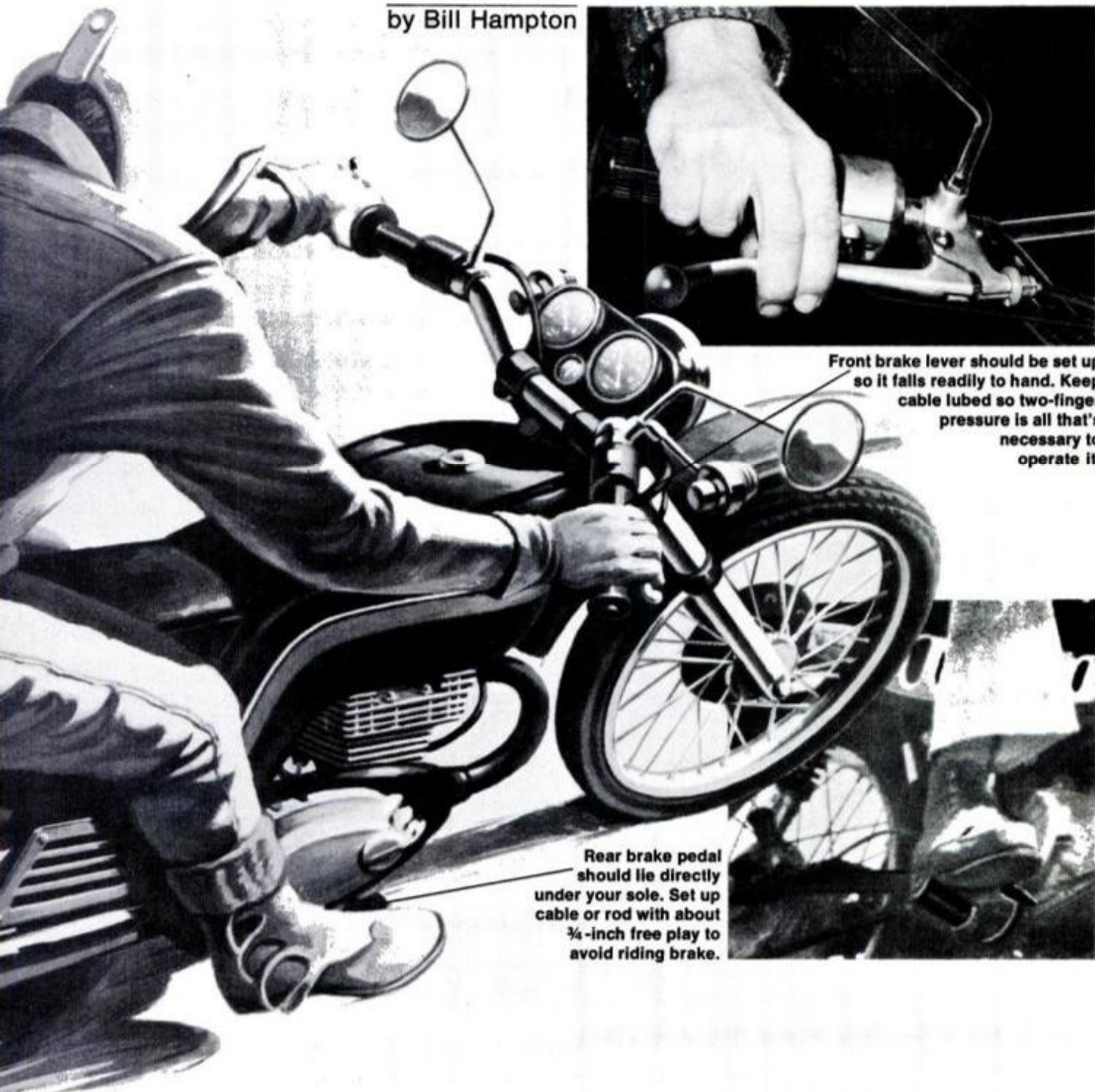
515 W. Ireland Road, South Bend, Indiana 46614.

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Offer good only at participating Wheel Horse dealers. Offer good from February 12 to March 25, 1979. Offer not valid in states of Illinois, Indiana and in parts of Ohio, Missouri, Kentucky and Pennsylvania.

How to improve your braking technique

by Bill Hampton



Front brake lever should be set up so it falls readily to hand. Keep cable lubed so two-finger pressure is all that's necessary to operate it.

Rear brake pedal should lie directly under your sole. Set up cable or rod with about $\frac{3}{4}$ -inch free play to avoid riding brake.

How quickly can you stop your motorcycle? You don't know? Well, you're not alone. Although most cyclists can tell you their bikes' 0-to-60 times or top speeds, only a few know just how many feet it takes to rein in their steeds.

In fact, many bikers never really master "braking" their bikes. One reason is that they never learn how to

use the front brake effectively. They fear it. Yet, the front brake can provide up to 75 percent of a motorcycle's stopping power. As long as the bike is upright on a stable surface, you can apply the front brake quite hard without getting pitched over the handlebar.

Use the front brake *together* with the rear brake, or you might prefer to apply the rear brake an instant before

the front brake. This action will help stabilize the machine somewhat just before the sudden transference of weight to the front end when the front brake is applied.

Downshift quickly through the gears as you brake, too. By doing so, you take advantage of a third "brake": engine compression—but this effect is provided more strongly by a four-

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WESTERN AUTO

IMPROVE BRAKING TECHNIQUE

(Continued from page 41)

stroke engine than by a two-stroker. Keep that in mind if you switch from one engine to the other.

The idea behind braking is to stop your two-wheeler in the shortest distance possible—WITHOUT LOCKING UP THE WHEELS! Once a wheel locks up, it loses its gyroscopic stability, and its tire loses traction. When it happens, the wheel speeds up in relation to the rest of the motorcycle.

Consider the front wheel: when it locks up, steering control is lost. The bike can drop quickly. If it does, you have virtually no chance for recovery. And if it's the rear wheel that stops turning, it also will accelerate in relation to the rest of the motorcycle. Because the bike is "hinged" at the steering head, the rear end will double up or "jackknife." It will try to drive right by the rest of the bike.

To regain stability and traction, the wheel(s) must rotate. That means getting off the brake(s) immediately.

Adjusting the brakes

How effectively you operate those binders depends a lot on how you set them up. In other words, you should set them up for easy, positive operation. Assume a normal seating position. With your hand resting on the handgrip, grasp the front-brake lever. Is it in line with your forearm? You shouldn't have to bend your hand up or down to work the lever. The forearm and hand should form a straight line. If not, you can't operate the brake lever effectively.

Now, if you can't reposition the lever-mounting clamp on the handlebar, raise or lower the handlebar until you arrive at the desired angle for the lever.

Also adjust lever "play" to suit the size and grip of your hand. If you have a small hand, you might want to have the lever move about a third of its total travel before it takes hold. Too much play, however, may allow the lever to bottom against the handlebar during hard braking, reducing the brake's effectiveness.

As for the rear-brake pedal, it should lie directly under the sole of the foot. Adjust the brake rod or cable so that the pedal will move about $\frac{3}{4}$ inch before it activates the brake. This will lessen your chances of "riding" the brake, should you unconsciously bend your foot while riding.

Practice stopping

Okay, now you've set up those

"stoppers." You're ready to practice hauling down that two-wheeler in as few feet as possible.

Leaving enough room to accelerate your bike, mark a reference line on the ground. If you wish, you can measure 10- or 20-foot increments from the reference line as a means of determining how many feet it takes to bring your bike to a stop.

You could start off by accelerating to a speed of 15 or 20 mph. Then, when the front wheel crosses over the reference line, apply the brakes. At first, use moderate pressures to decelerate. Get the feel of the brakes.

Make several runs, applying both brakes together. Strive for minimum stopping distance. When you've reached the point where you're stopping within the shortest distance possible, you're ready for the next speed stage.

Increase the acceleration speed by 5 or 10 mph and repeat what you did in the first accelerating/stopping stage. Starting off with moderate pressure on the brakes, gradually increase braking pressure until you're stopping in as few feet as possible.

After you've mastered the second stage, increase speed yet another 5 or 10 mph. Again, start out with moderate braking pressures. On successive runs, as you gain familiarity with the brakes, continue applying them harder until you've attained your minimal stopping distance.

By mastering one speed stage before you move up to a slightly higher one, you don't overextend yourself. This is the old one-step-at-a-time theory.

You need to sensitize yourself to braking pressures at different speeds. In time, you'll learn the critical point between maximum braking and wheel lockup.

Rolling the throttle

At first, you may find it difficult to operate the front brake hard and blip the throttle during downshifting. The trick is to roll the throttle on and off with the side of the thumb. Of course, during downshifting you must "fan" the clutch lever (let it out) to take advantage of engine compression.

With practice, it's possible to stop a bike travelling at 60 mph in as few as 130 feet. *With practice.* You can cut stopping distance dramatically by learning how to use your brakes properly.

So find yourself a deserted parking lot or back road and start learning how to stop your two-wheeler... FAST!

Even if the power company falls asleep, Panasonic can still get you up on time.

ZAP! A lightning bolt hits a power line. The power stops. So does the TV, the washer, the refrigerator. But not your new Panasonic FM/AM electronic digital clock radio (Model RC-320) with Sure Time, the Panasonic backup power system.

Let's say the power fails at 4:20 AM. Your Panasonic automatically switches to Sure Time power (Panasonic battery included). While the numbers black out, the clock mechanism keeps on working. When the power finally comes back on, the Panasonic automatically switches back to AC. The alarm is still right on time—7:15 AM. So are you. And if there is a power failure and the battery is weak, a flashing light will remind you to reset your Panasonic and check your other appliances.

And the RC-320's features don't stop

there. Regular time in one window and your alarm setting in another shine with easy-to-see fluorescent lighting. The time always stands out because the automatic dimmer control adjusts the brightness of the numbers to the brightness of the room. And with our "childproof" controls, even mischievous fingers will find it practically impossible to upset your time/alarm settings.

Panasonic has seven electronic read-out clock radios and six digital clock radios. All have advanced features. All let you rest easy.

Remember, what time you go to sleep is your business. What time you wake up is ours. Pleasant dreams.

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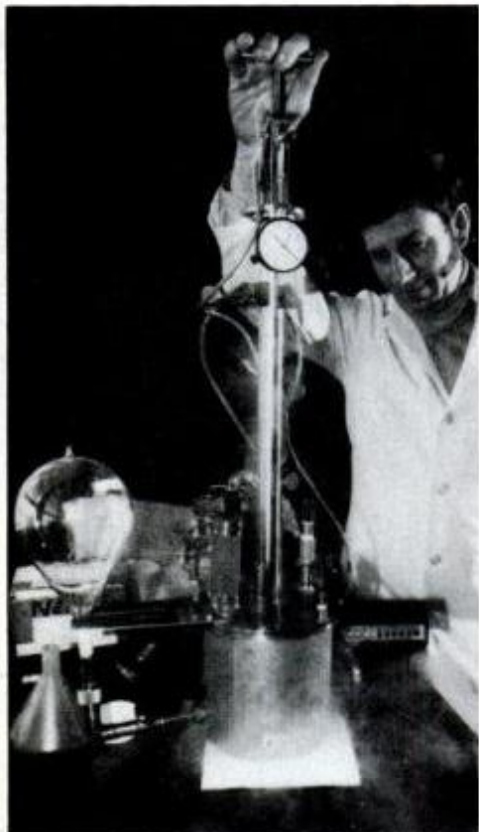
Fuel for long space trips

Recent work at Cornell University has raised hopes for a new and exotic rocket fuel, metallic hydrogen, which would be many times more powerful than current propellants. If hydrogen, the lightest of all elements, could be turned into a stable metal, it could be used to power spacecraft on long-range missions that scientists can now only dream about. Hydrogen in metal form might have up to 10 times the power per unit mass of existing liquid hydrogen fuel.

At Cornell, scientists headed by Dr. Arthur L. Ruoff took a step toward realizing the dream when they converted a small amount of xenon, a gas present in the air, into metallic form.

Ruoff produced the metal by subjecting frozen xenon to a pressure 320,000 times the pressure of the Earth's atmosphere at sea level.

The Cornell scientists imposed the pressure on a tiny sample of xenon placed between two diamonds. As the pressure between the diamonds rose to record heights, the conductivity of the sample soared more than a hundred billion times. The gas suddenly behaved as a metal,



Xenon gas stored in glass bubble, left, is cooled with liquid nitrogen. Pressure is applied by turning handle on top of unit.

and the team knew that it had succeeded.

Ruoff told PM that it might take up to three million atmospheres of pressure to turn hydrogen into a metal. Even if such pressure can be achieved, he said, no one knows whether hydrogen will remain stable as a metal.

But if it does, Ruoff said, rockets of the future might be powered by pellets of hydrogen injected into a hot chamber where they would turn back into gas, releasing energy.

Metallic hydrogen might also be a boon on Earth. Theoretically, the metal would be a superconductor—carrying electricity without transmission loss. Used in power lines, the new metal would slash the cost of delivering energy.

Buttoning up cavities

Doctors at the National Institute of Dental Research have developed a button-sized disc that can be glued to molars to fight tooth decay. The white button, about $\frac{3}{8}$ inch in diameter, releases fluoride gradually over a six-month period, according to Dr. James P. Carlos at the institute. In tests with beagles, he said, the button released about 1 milligram of fluoride a day, an optimum dosage for fighting decay. First trials on young-adult volunteers at the institute in Bethesda, Md., were to begin last month.

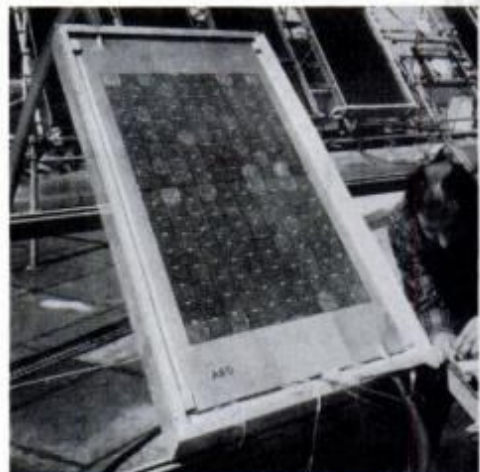
Trials on children will not start before late this year, Carlos said. If tests are successful, dentists will be able to attach the discs inexpensively during six-month checkups.

The total dose in the disc is low enough to be safe even if the disc accidentally breaks loose and the child swallows it.

Solar unit offers energy bonus

The experimental solar generator system in the photo above, right, produces electrical power at the same time it warms water circulating through a solar heat collector.

In the system, designed by German engineers from the AEG Telefunken Co., 10 percent of incoming solar energy is converted directly into electricity in 180 silicon cells. Part of the remaining solar energy that goes to waste in conventional systems is used to heat water circulating behind the cells. The energy bonus is made possible by using the solar cell array as the absorbing surface of a shallow collector.



German solar collector cuts energy loss.

The U.S. Department of Energy has been experimenting with similar systems for the past year. And scientists in this country report that the theory has promise for home heating and cooling applications. Liquid circulating behind the front panel in such devices carries off heat that would otherwise reduce the efficiency of the electricity-generating cells, one researcher explained.

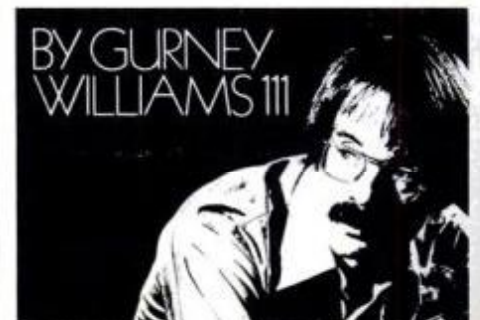
Robot raises F-16 production

The General Dynamics Corp. is using a robot to help produce the sophisticated new F-16 fighter.

The robot in use at the company's Fort Worth, Tex. division was put to work late last year to drill the 1100 holes in the graphite skin covering the tail of the Mach-2 fighter. The company was to shift the robot to another assignment this year—drilling and routing access panels. The robot should be able to work about three times as fast as conventional machines on the job.

The 6CM robot, first of its kind on the production line of an aerospace company, looks like a gigantic artificial arm. Its computer can be programmed to command its performance in other production-line assignments like painting, welding and assembly.

PM



For the price of a little fun, you can have some big fun.



If you're looking for a fun way to hit the road, we have a couple of suggestions.

First of all, you can buy yourself a sports car. A really good one will set you back \$20,000 or more, but you can find something nice for about \$15,000. For that kind of money, you'll get yourself a fancy engine, two comfortable seats and a dashboard full of racy gauges. Of course, you'll have to spend a lot of time and money getting it tuned up, but that's all part of the fun of owning a sports car.

For about the same kind of money, you can buy a 23-foot Itasca. And we'll throw in everything, including the kitchen sink. You'll get yourself two or three comfortable

armchairs, a couch, a dinette, a room where you and a few friends can spend the night, a place to clean up, a kitchen where you can get something to eat and a closet to hang your clothes in. Our Chevy engine will probably be a lot bigger and a lot less temperamental. And we'll even give you your dashboard full of racy gauges.

The choice is up to you. But confidentially, we think you're a lot better off in an Itasca. Even if you weren't considering a sports car.

Itasca®
The best way to say good buy.



Best thing that's happened to engines since high compression.



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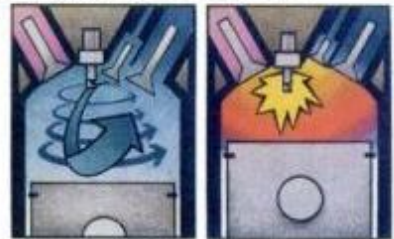
MCA-JET SYSTEM. A quiet revolution.



The high compression car engine marked the start of a new era in automotive power. We think our MCA-Jet System marks another.

If you're really into cars and driving, you'll appreciate the performance capabilities as well as the simplicity of our MCA-Jet principle. The system happens to be a cylinder head configuration that incorporates a third, or "jet," valve. An

extra strong swirl of air is introduced into the combustion chamber through this valve during the induction phase to produce a faster, more thorough burning of the fuel air mixture.



Induction and compression phase.

Ignition and combustion phase.

Net result: a quiet, smooth running, clean-burning engine that meets . . . even exceeds . . . the most stringent emission requirements in both Japan and America. With excellent performance.

Now you see why we call it our quiet revolution.



MCA-JET SYSTEM is standard with the Mitsubishi-built 1979 Dodge Colts and Challengers and Plymouth Champs, Sapporos, and Arrows; also with the all-new Dodge D-50 pickup and Plymouth Arrow pickup.



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The Mitsubishi Motors Corporation, builder of Plymouth Champ, is proud to have its car nominated for 1979 Motor Trend Import Car of the Year.

IMPORTS & MOTORSPORTS

New Datsun 310 Series



310GX coupe, here, and 310 sedan replace F-10 series.

It certainly wasn't love at first sight, but I got hooked on the Datsun 310GX before a week was out. In 450 miles of spirited driving, the front-wheel-drive, hatchback coupe (successor to the F-10) performed flawlessly and provided all the driving comfort, performance and utility I would want in a small car. At \$5369, the 310GX (and a hatchback sedan at \$4829) is in a very competitive small-car market, but it offers such a high level of classy comfort that when you slide into some of its competitors, you'll feel you're at the wheel of a garden tractor.

With 1400 ccs up front, it won't mow down all its competition. But the 310GX is a lively package that weighs in at 2000 pounds, measures 162.2 inches overall and is on a 94.3-inch wheelbase. I know it's an ugly duckling, but with the 310GX, looks aren't everything.

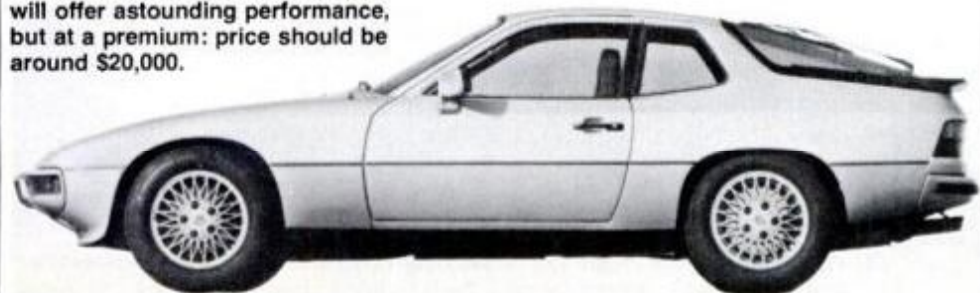
Turbocharger for 924



New turbo cranks 170 hp from 1984 cc.

The indicators that this Porsche 924 will run circles around sports cars of similar displacement (1984 cc) are the nose slots, hood duct, tail spoiler, new wheels—and a logo on the rear

Turbo version of the Porsche 924 will offer astounding performance, but at a premium: price should be around \$20,000.



deck that reads *924 turbo*. You'll see it soon—and hear the whine—when it goes on sale here. Next month we'll have a Firsthand Report on the 170-hp turbo from Mike Lamm, West Coast Editor who's back from visiting Porsche in Stuttgart, Germany. The base 924 (now \$14,000) gets a five-speed transmission this year.

Mid-engine BMW



BMW M-1 owes its fine lines to Giugiaro.

Wanna race? With 277 hp for the street version, you'd be tough to beat; if you take to the track for Group 4 racing, 470 hp is the power output; and if you want BMW to put your six-cylinder in top tune, you can expect 800 hp. The in-line Six displaces only a cupful over three liters, uses four valves per cylinder and is mounted longitudinally amidships. BMW designed the M-1 for racing but has begun series production for the road. Several hundred a year are expected, and it's still to be decided if we'll get a road version here. If so, it'll be the raciest, most expensive in the BMW lineup, which for '79 consists of the 320i, 528i and 733i sedans, and the limited-production 633CSi coupe.

Mazda 626

Mazda introduced their Capella in Japan last fall. The two-model series includes the four-door sedan, shown here (note the front-fender mirrors, tipoff that it's a Japanese version), and a two-door sport coupe. The company just introduced the car here as the Mazda 626. In size and price the 626 is a bit more than the successful GLC model. By the time this issue is on newsstands, we'll have seen and driven the 626 models



Four-door Mazda 626, step up from GLC.

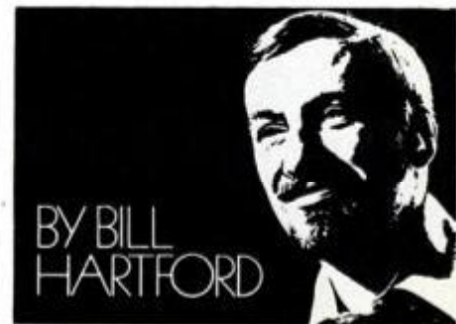
and scheduled a full report. Mazda engineers promise the 626 will be a high-quality, good-handling road car in European tradition—sort of an oriental BMW for less than \$7000. They certainly kept their promises about the GLC and RX-7. We'll see about the 626.

Restyled Corona

Toyota has redesigned its Corona line for '79. There's a four-door sedan, five-door hatchback (don't mistake it for a VW Dasher) and a station wagon that's been stretched to 178.7 inches on a 99.4-inch wheelbase. The wagon's a neat machine, and my choice. I'll take two. **FM**



Five-speed, 2.2-liter Four are standard.



BY BILL
HARTFORD



PM's Phoenix— an expandable van you can build for \$2000

by Robert Q. Riley and Dave L. Carey

Most campers and vans these days that are roomy enough to live in are too large for comfortable driving. Conversely, the compact fun-drivable rigs are usually too small to live in. And, no matter what its size, the seller will probably want all the money you have now, plus most of what you'll make for the next five years. What the salesman leaves, the gas station operator is likely to get.

For these reasons, PM decided to offer readers an alternative. We contacted Quincy-Lynn Enterprises, the Phoenix, Ariz., designers responsible

for our popular build-it-yourself van, "Boonie Bug" (page 94, March '74), and asked them to design a new van. We asked that the new design retain the rugged, mountain-goat qualities of Boonie Bug, but that it incorporate built-in features that would appeal to today's motor-homer, traveler and camping buff.

The result is PM's Phoenix, a build-it-yourself van that ex-

(Please turn to page 50)



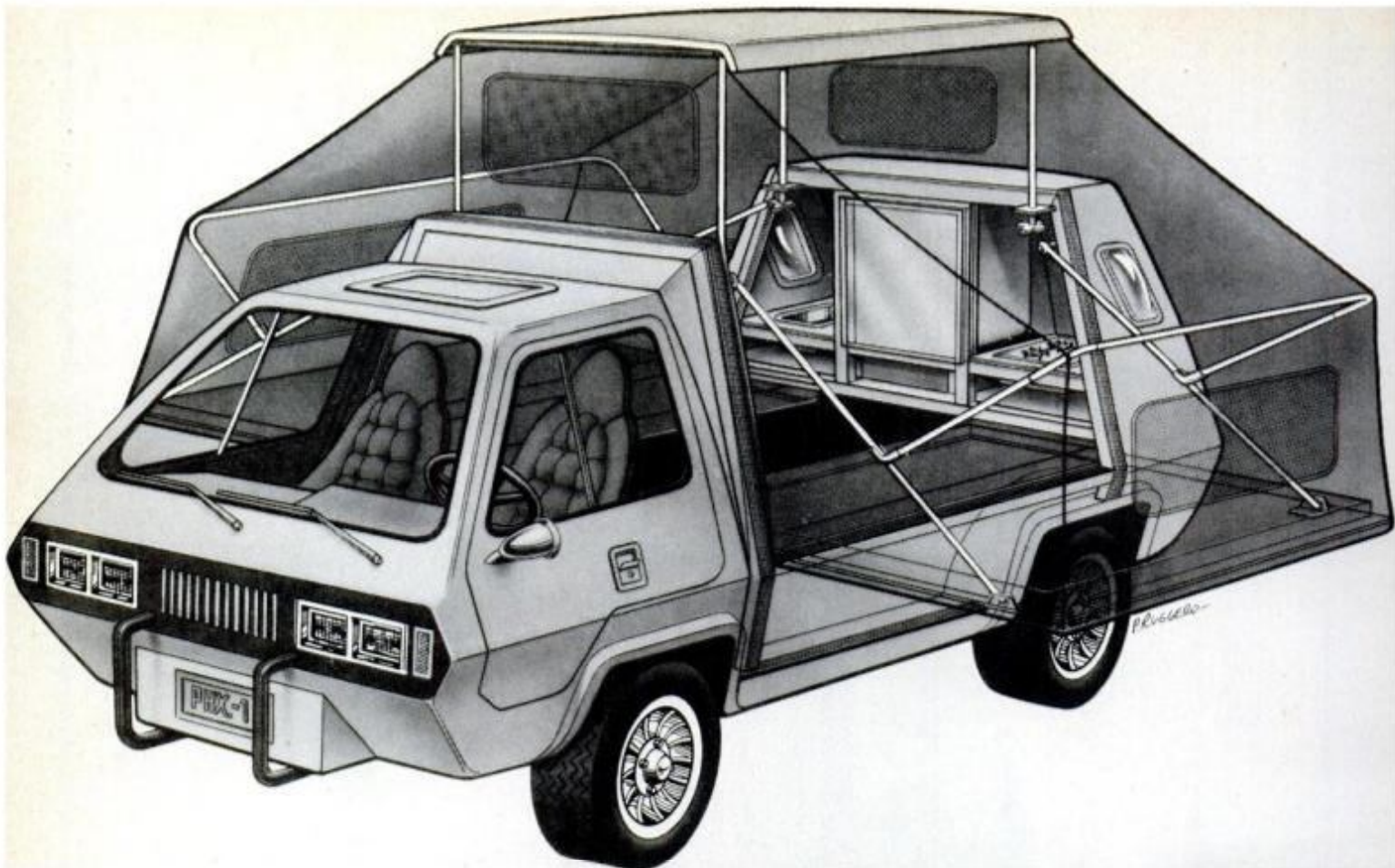
Futuristic aspects of our van include gull-wing doors (top), low frontal area and aerodynamic styling (above). Built on a VW chassis, it can be converted into a tent-camper (left) by two people in a matter of minutes.



**Just a reminder that the most impressive thing about Chivas Regal
is what's in the bottle, not what's on it.**

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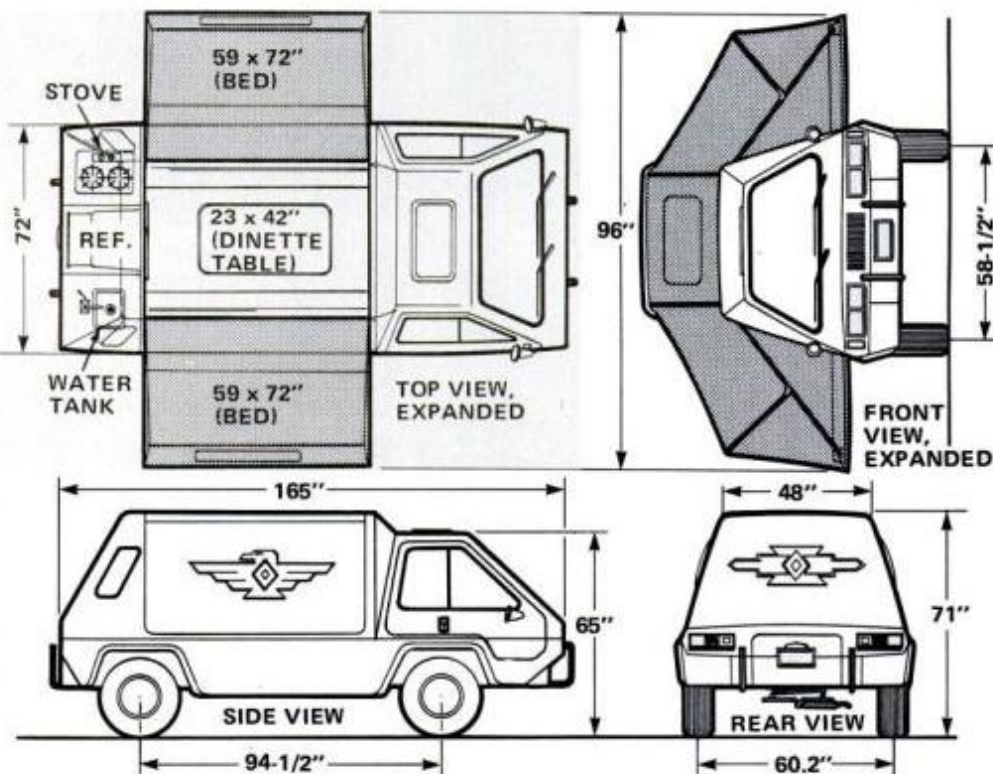
For a complete set of plans, which includes ten 17x22-in. drawings and a 24-page booklet, send your check or money order for \$15 to: PM Phoenix Camper, Box 1014, Radio City Station, New York, N.Y. 10019. Allow from three to four weeks for third-class mail; add 75 cents to your remittance if you prefer to receive faster first-class mail.

pands, tent-trailer style, into a camper. You can build it for as little as \$2000 and it will outclass many \$10,000 rigs on the market.

Closed up for driving, the Phoenix boasts the stylized exterior of a futuristic van. Measuring 13 feet 9 inches long, 6 feet wide, 5 feet 11 inches high, the rig is small by today's standards. Its low frontal area and aerodynamic styling, coupled with a curb weight of only 2000 pounds, makes it easy to handle and economical to drive.

Phoenix is built on a VW van chassis, which means that you have over 20 years of production models from which to choose. We paid \$200 for a wrecked 1969 van. (Bonus: The '69 came with the thrifty 1600-cc.) With over 500 pounds removed from the original curb weight, Phoenix performs *better* than the original van and delivers an *honest* 24 mpg. The ride is stock VW, soft and smooth.

Nitrogen-cylinder-assisted gullwing doors are reminiscent of the Mercedes 300SL, and they do pro-



vide easy entrance into the cab. The two bucket seats up front allow central walk-through space to the rear, which is set up with a 6-foot bench seat along each side. Each bench seat is equipped with a lift-up top, so food, clothes, and hunting or fishing gear can be stored inside. The storage area is 14 cu. ft. per side.

Appliances are located across the extreme rear. The two-burner stove

located on the left uses disposable cylinders. One cylinder holds enough fuel to cook for a family of four over a three-day weekend. These disposable cylinder stoves are the only kind legal without a power-vented hood. That can be installed if you need more fuel capacity.

Our (\$2000) estimated cost to build includes everything but the chassis and labor.

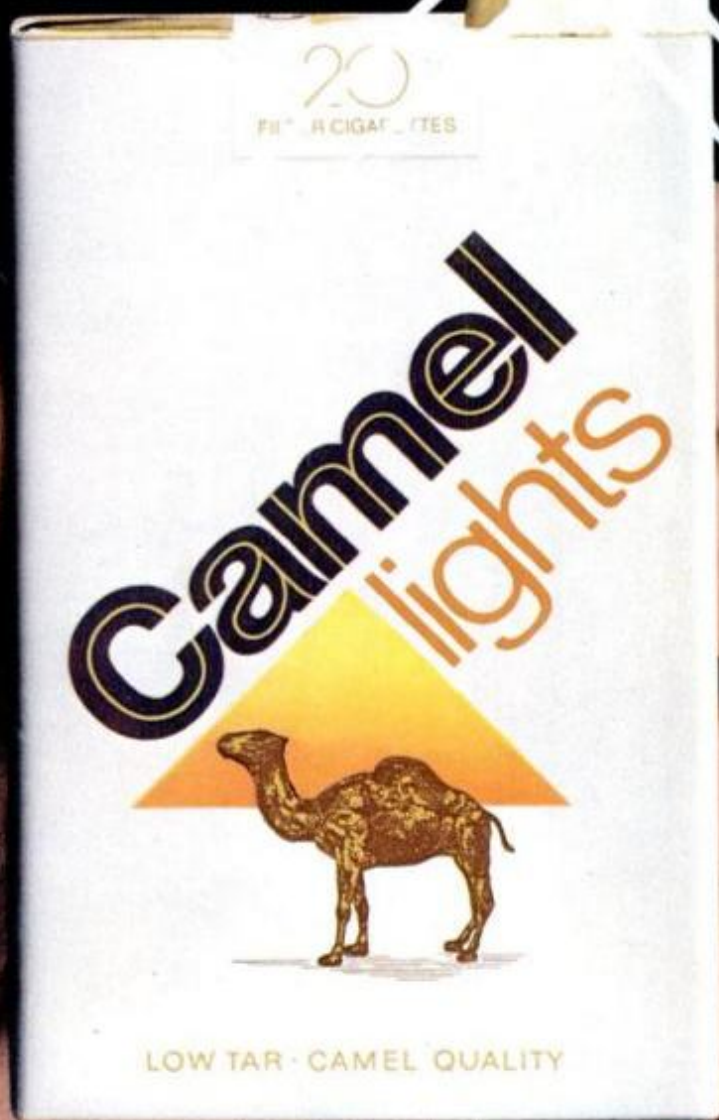
PM

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At 9 mg tar, it delivers all the satisfaction that's been missing from ordinary low tars.

Satisfaction. Only 9 mg tar.



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

9 mg. "tar", 0.8 mg. nicotine av. per cigarette by FTC method.

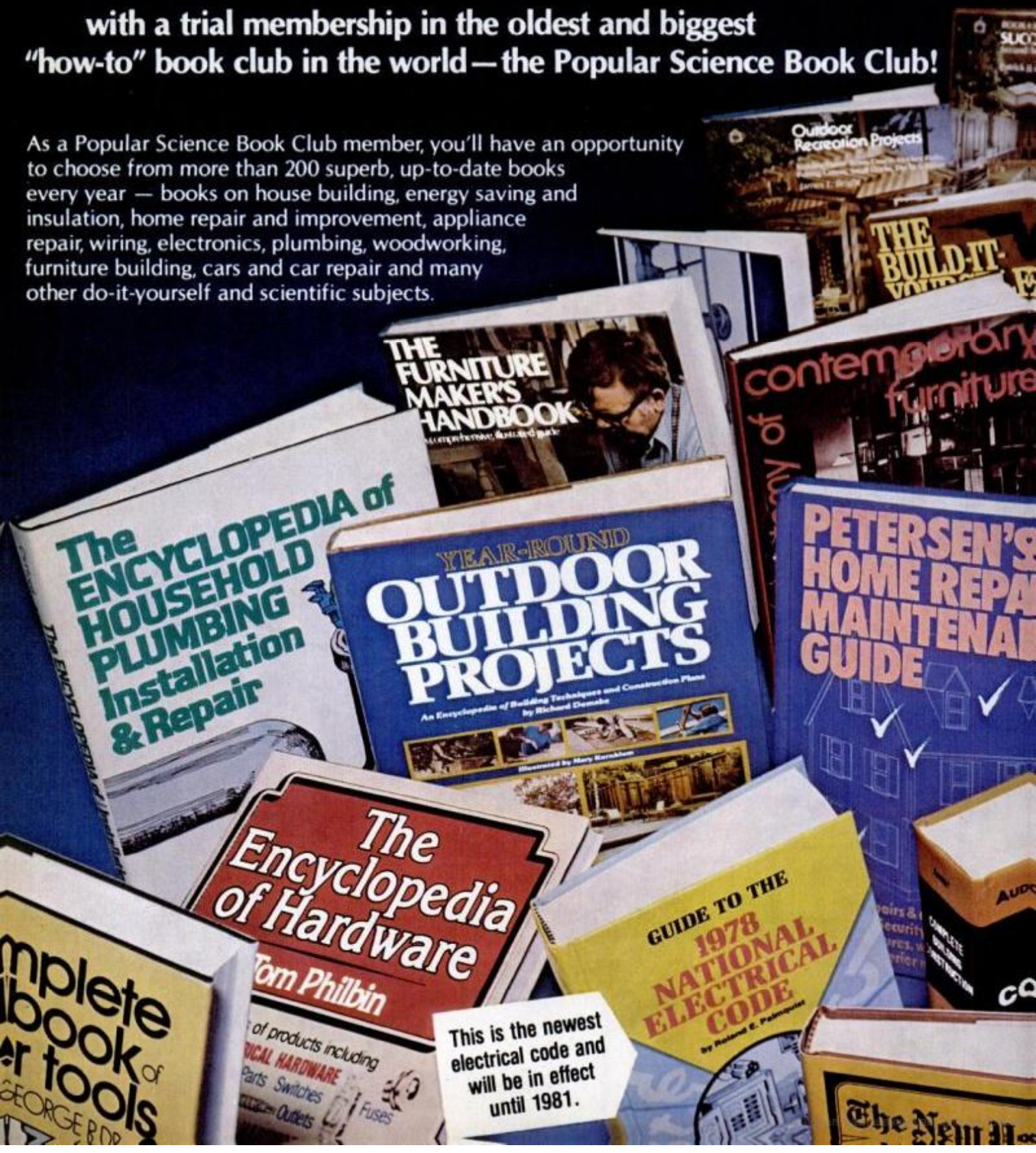
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These

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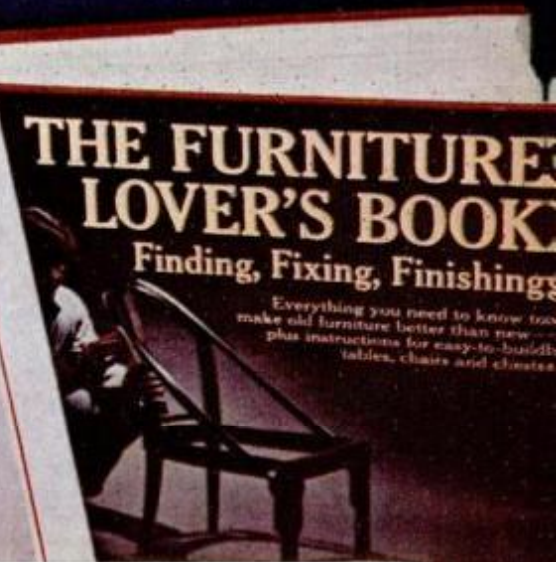
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Could our elite forces pull off an Entebbe raid? It may take two years, experts say.

Keeping 'em rough 'n ready

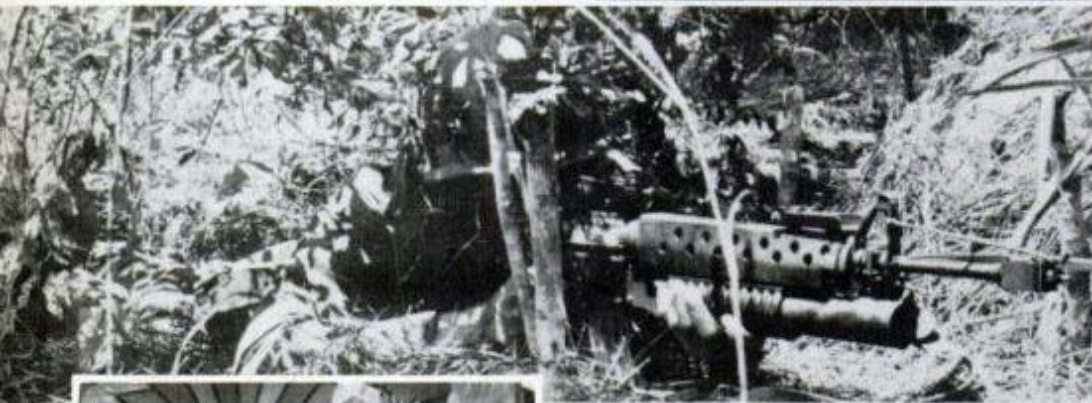
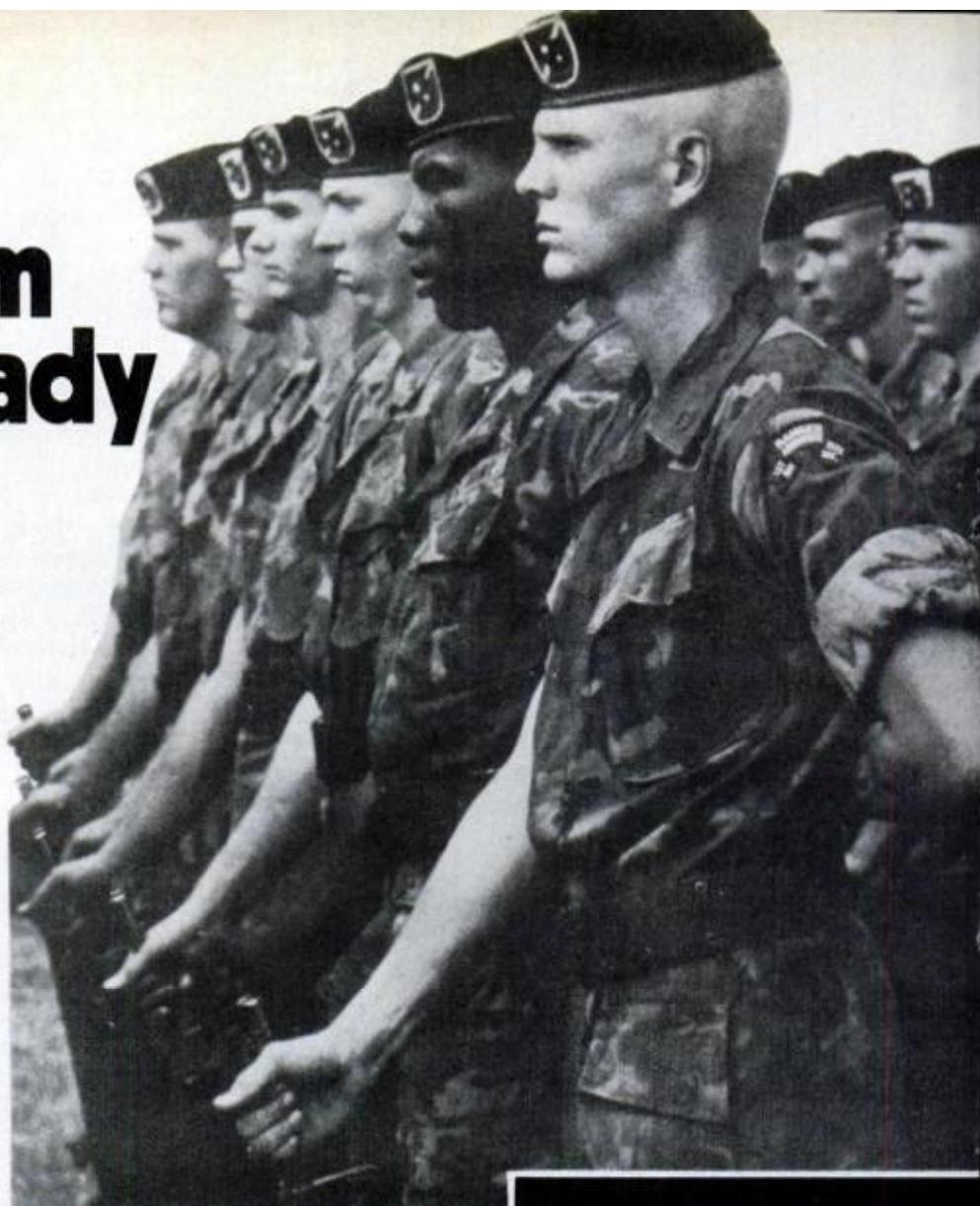
by Jack Galub

On Aug. 19, 1942, American Rangers, Canadian infantry and British Commandos stormed ashore at the French port of Dieppe. The raiders' secret target was a German radar station; they were not to knock it out but to learn what improvements had been made by the Germans in radio detection.

The raid was nearly a disaster. Without the air support and firepower they needed to punch their way through to the station, the raiders were driven back. Yet because they were able to cut its ground cables, the radar station was forced to switch to radio transmission, giving British monitors all the data they needed to jam German radar in the months ahead.

For the U.S. Army's Rangers, that action marked the start of a new

(Please turn to page 59)



Lean and mean Army Rangers (above) are all spit and polish on parade but aren't afraid to dirty up the uniform when it comes to their regimen of training operations. Routine special forces maneuvers regularly include paradrops and antiterrorist-type small-force airstrip "inserts" (below) as well as simulated combat drills with special equipment like the M-16 grenade launcher (left).



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KEEPING 'EM ROUGH AND READY

(Continued from page 56)

chapter in their long history. During it, Cpl. Frank Koons became the first American soldier to kill a German, and Lt. Edwin Loustalot became the first American killed in Europe in World War II.

More than 30 years later and some 5000 feet up, I watched another Ranger unit step out into space, parachutes billowing unseen in the night.

Faces blackened and equipment

muffled, the Rangers slipped through the woods, easily evading motor and foot patrols. The command post's perimeter was infiltrated just as silently.

Inside the division's operations tent, the commanding general and an aide looked up to see themselves staring into the business ends of M-16As. At that moment, they became POWs.

The "rifle puppies," as Rangers call themselves, scrubbed clean the operations map and slipped back into the night, quietly exfiltrating

back to a secure landing zone. Helicopters immediately moved in and lifted them out.

That capture of an "enemy" air assault headquarters took place during recent maneuvers in Europe. Entire U.S. brigades were airlifted to West Germany where tanks, trucks and other heavy equipment were in place, as they always are, waiting to be used in a NATO emergency.

When they go, Rangers carry all their equipment on their backs,

(Please turn to page 222)



The Navy's Seals (above) are an elite unit of volunteers who have qualified for underwater demolition teams, then work on undercover drills like helicopter "extractions" (below) from combat zones. Air Force's AC-130 "Spectre" gunship (below, right) mounts a 105-mm cannon plus twin 20-mm Gatling guns.



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ALL OUTDOORS

Snow sport

It's still not too late to buckle up for a chance to beat about 10,000 other cross-country skiers over a 26½-mile marathon course. The 10th annual Engadine Valley event is scheduled in Switzerland for mid-March, and only Norway claims a longer trail. Engadine winners are expected to finish in under two hours while more relaxed skiers take their time.

Or, strap on a crash helmet and thunder down the famous Olympic bobsled ice chute at St. Moritz. You sit between a pilot and rear brakeman on the three-man sled. After the run, you're awarded a certificate of courage, a color photo of your start, and a devil's vampire-blood cocktail at the bobsled drivers' Dracula Club. All for \$50 (plus airfare to Switzerland).

For snowmobilers who can find a flat enough course—usually a frozen lake with a smooth layer of snow—Ski-Doo and Polaris now have high-performance machines that report speeds over 100 mph.

Motown fish mecca

There was a time when, for out-

over 500 caught by anglers casting from the shores of the city park on Belle Isle.

Handline trolling for walleyes will start this month and continue through the summer, with bigger salmon catches forecast for this year as well. The city and industry spent nearly \$800 million and 20 years' effort to correct pollution that had gotten out of hand. But how many city park shorelines are there now where you can expect to catch a 10-pound salmon while your kids frolic in the playground?

Performance boating

Fast offshore and ski boats, the speed machines developed in California and Florida, are now available nationally from Wellcraft, Glas-tron/Carlson, Halter/Cigarette, Bertram and others. Most recently, the noted name of Chris-Craft has been added to the list. A new 31-foot outboard, a 660-hp twin sterndrive, and a 740-hp 38-footer have been fitted into the Excaliber by Chris-Craft.

Handling fast craft requires well-developed skills, and because of the growing number of speedboats, Merc has produced a new \$1 booklet

descriptions accurate and familiarly scary.

Getting the most from your propeller is covered in special detail in an additional \$2 booklet also from Mercury. Pitch, rake, cupping, ventilation, torque and prop choice are among the topics covered. Johnson has a free pamphlet explaining two-cycle engine operation and its advantages over four cycle. Evin-



For driving in ice, snow, mud or sand, studded Centipede Traction Mats from Sonic Inc., Chicago, come in RV sizes, as well as compact-car and dual-wheel-truck models.

rude's latest publication is a booklet on outboard handling.

And performance from low horsepower is demonstrated with an added spring entry to the Evinrude and Johnson motor lines. New little twin-cylinder, water-cooled motors, just announced, get 4.5 hp from 5.28-cu.-in. displacement. They use breakerless CD ignition, twist-grip throttle arms with stop buttons on the ends, and start in neutral with a shift into forward or reverse. Built-in fuel tanks can be supplemented with remote hookups, and the little mills will come in standard and long-shafted models.

Action aid

For gunning without problems, listings in the *Shooting Preserve Directory*, free from NSSF, 1075 Post Rd., Riverside, Conn. 06878, may be the answer.

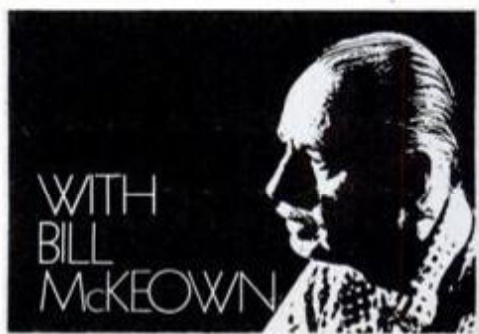
PM



How fast will a bass boat go? This one, rigged for speed by Allison Craft, Louisville, Tenn., and with Benny Robertson driving, set a record of 107.4 mph, and then added another at 79 mph towing a water skier. Power was from the big 235-hp Johnson.

standing sportsfishing, you headed for Bimini, Bahamas, Wedgeport in Nova Scotia, Cabo Blanco in Peru, Hawaii or Australia. It's still great there, but now anglers add unbelievable names like Waukegan, Ill.; Bangor, Me.; Milwaukee, and Detroit. Detroit, with its industry and sewage-polluted waters? Not anymore. Proof that we can renew resources has most recently been demonstrated ashore at Motor City as Detroit rejuvenated its downtown area. Now salmon have been transplanted in the river, and last fall Motown had its first run of cohos with

available from dealers or Mercury Marine, 1939 Pioneer Rd., Fond du Lac, Wis. 54935. It describes setup methods for optimum performance, the alarming spins a steering wheel can take under sudden throttle changes, on- and off-plane handling, and even essential small items like sunglasses or goggles to prevent windlash at speeds over 50 mph. Trim, ballast and engine height in relation to speed are all touched on. The vivid explanations of full-throttle handling should interest any boatman; from test driving different hulls over 100 mph, we found the



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APPLIANCE CLINIC

QUESTIONS ANSWERED

Iron bound to stop leaks

What can we do with a General Electric Self Clean Steam and Spray Iron (model F24OWH) that leaks water? The leak seems to be located at the back edge of the soleplate.—Mrs. E.G. Ouimette, Biloxi, Miss.

How sure are you that the iron is leaking? According to General Electric, in most cases of "leaks" the complaint is not justified. To find out for sure, fill the tank carefully with water—steam button down. Lay the iron on a paper towel for 15 minutes. Do not plug it into an electric outlet.

At the end of 15 minutes, check the paper towel. If it is dry, there is no leak.

You may be spilling water when filling the iron, or you may be filling it with the steam button up. Furthermore, operating the iron with the steam button up when it isn't hot can release water.

If a leak exists, there are several places where it might be. Since you think the leak is at the back edge of the soleplate, first investigate the water-level tube elbows. If the rear elbow is damaged, water is likely to leak from the rear. Replace the water level tube assembly.

Other areas where leaks can occur (all up front) are at the water-level tube front elbow, at the gasket that seals the tank to the steam dome assembly, at the fill-hole gasket and at the dumping valve in the steam dome. Unless you have had experience repairing steam irons, leave the job to a GE service center. It's complicated work.

Operate, Doc

We have a Corning ceramic countertop, four-plate range. We wish to convert over to a conventional electric model. The opening in the countertop is 32 by 21 inches. We've not been able to find an electric range that will fit. Any ideas?—Dr. P. Ocroinin, Sherwood Forest, Md.

Get a larger unit. Enlarging the opening is much easier and less expensive than closing the hole to accommodate a smaller range.

We did some searching and began getting discouraged when such major companies as Whirlpool and GE told us that their units were smaller than 32 by 21 inches. Then we got lucky. The Kitchen Appliance Div. of McGraw-Edison Co. in Chattanooga, Tenn., markets a Modern Maid unit

that's larger. There are two models: (X)ET 480 and (X)ET 378. (X) is a letter denoting color, for example, "K" for chrome, "F" for avocado and "H" for harvest gold. The 480 has a combination grille; the 378 doesn't. Both units measure 36 by 21 inches. Just open up that 32-inch opening in your countertop to fit the new unit.

Rust bucket

We recently purchased a Kenmore washing machine. Within two weeks the basket developed many tiny rust spots. Sears replaced the appliance. Within a week—same problem. This time the basket was replaced—again, rust. Now, Sears is telling us not to presoak clothes—something we did for 10 years with our old washer. What do you say?—Elon J. Peters, Amarillo, Tex.

Stop presoaking clothes. You were lucky with your old washer, or maybe it wasn't designed like your new model. The basket of this model

has about 1100 ¼-in. die-punched drain holes. Die-punching is done before the basket is porcelainized, and produces tiny raised sharp edges on the backside of the basket. In the porcelainizing process, many of these edges are left uncoated. These edges, exposed to water, detergent and/or bleach for prolonged periods will rust. Truly, Elon, there is no need to presoak.

Hose job

What is the recommended schedule for replacing washing-machine intake hoses? Our machine is 16 years old. One of the original hoses burst after eight years. A replacement set recently deteriorated on the inside, as initially revealed by gray, then black spots and streaks on white synthetics. I ran a rag-covered rod through both hoses. The rag picked up black smudges, confirming my suspicion. I make it a policy to replace hoses every five years, and I attach a tag to the hoses with the date they were last replaced. Comments?—H. Whit Pearce, Siler City, N.C.

We doubt if any washing machine manufacturer recommends when to replace hoses—at least not those we checked (Frigidaire, General Electric, Speed Queen and Whirlpool). In fact, Whirlpool says that hoses rarely cause problems. The only recommendation is to make sure you replace old hoses that fail with ones designed especially for washing machines—not garden hose. The hoses on a washer have to withstand high temperature and pressure.

Hibernating appliances

We are moving into an apartment that's equipped with a stove and refrigerator. I want to store mine. Should I take any precautions?—Steve Wojcik, Youngstown, N.Y.

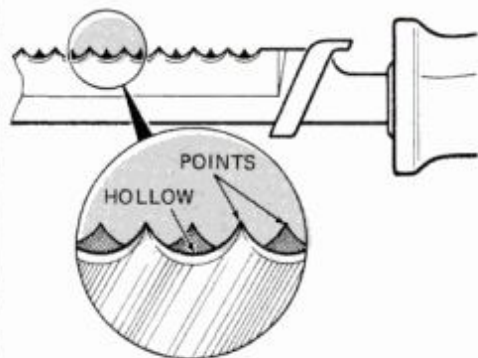
See that the units are clean and place them in a cool, dry area. Cover them with clean towels and don't stack anything on them.

Two extra considerations when storing refrigerators are odor prevention and safety precaution.

Store your fridge with its door slightly ajar to prevent permanent odor buildup. **Either remove the one-way handle or handles, or wrap a padlocked chain securely around the box (with the door wedged slightly open), to stop kids from entering and being trapped inside.** **FM**

SERVICE TIP

If your electric knife suddenly won't slice butter, let alone roast beef, pull the plug and make sure the blades are latched.



To check for wear align blades as shown.

Then, check the blade alignment with the blade assembly inserted in the knife handle. Plug the unit in and quickly turn it on, then off a few times until it stops with the points of one blade opposite the hollows of the other blade as shown above. In this position, the points of one blade should be at least one-half the height of the points of the other blade. If they are less, the blades are worn and should be replaced.

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

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It's the sound of a twin. The classic vertical twin engine. Narrow and lean, it's also wonderfully simple and reliable. With a wider range of power than a four of the same size. So it pulls like a freight train without you pumping the gearbox.

How well does it handle? Even the experts were amazed. "Incredibly," wrote *Motorcyclist* magazine, "we found the huge

rear tire and the altered geometry on the 650 Special made it even more neutral and precise than the already fine handling standard."

And how does it look? The sleek teardrop tank, the special paint, chrome in just the right places, and that clean, classic profile all say one thing.

Style.

So when people talk behind your back, you won't have to worry about what they're saying.

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PM LOOKS AT 3-D DUPLICARVER

It may sound unbelievable, but this new tool *does* reproduce three-dimensional shapes in wood. On top of that, it's easy to use. I'm a novice when it comes to carving, but began to feel confident after only an hour of practice. The tool is also extremely well designed. Inventor Don Laskowski scrapped 12 different prototypes on his way to the bug-free '79 production model.

The tool works this way: Contours of a pattern are traced with a stylus by hand and simultaneously carved in a block of wood by a router. You have fingertip control, since the router-and-stylus assembly is precisely counterweighted. Roughing out the shape is done first with a 3/4-in.-dia. stylus and a 1/2-in. bit. Smaller styluses and bits are used as the work progresses. A 1/8-in. chuck adapter allows the use of extremely fine bits—but you may want to add final touches with a Moto-Tool, or by hand. Sand lightly before finishing.

Hobbyists, gunsmiths, furniture makers and antique restorers will find many uses for this tool. Almost any object can be duplicated.—*Joseph R. Provey, Assistant Home and Shop Editor*



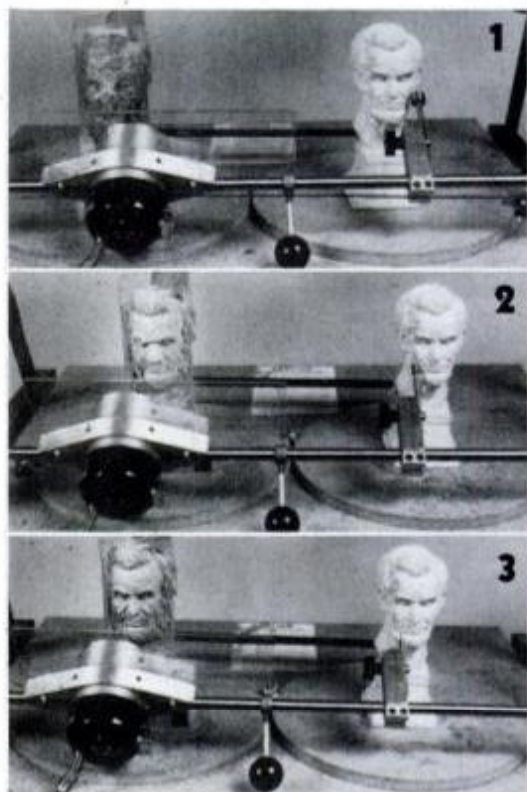
Duplicarver lets you carve intricate shapes in hardwoods using your own patterns.

SPECIFICATIONS—3-D DUPLICARVER

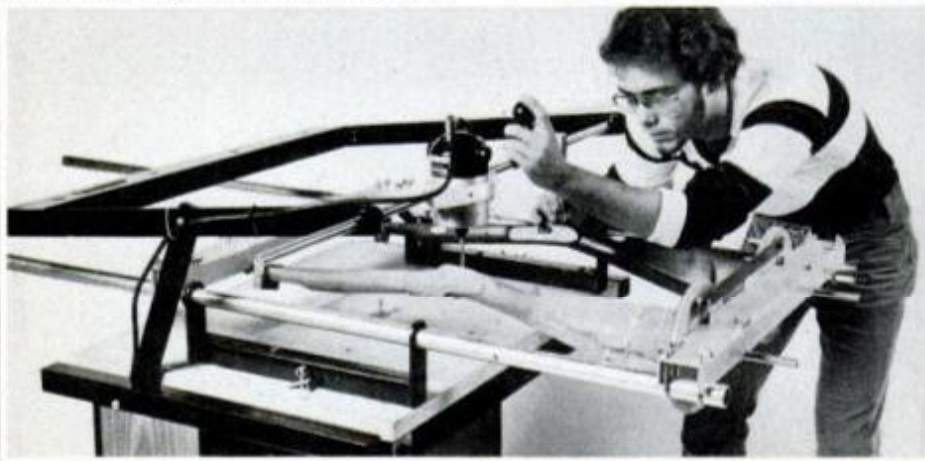
Main frame: steel construction; leveling mechanism
Router: 115-v., 1/2-hp, heavy-duty, industrial model
Speed control: allows any setting from 0 to 23,000 rpm
Area: 24 x 30 x 36 in. high
Minimum operating space required: 5 x 5 ft.
Maximum workpiece size: 14 in. dia. x 22 in. high
Prices: basic unit, \$499, includes 5 styluses, 4 router bits, small starter carving kit; spindle carving accessory, \$79.95; overhead shaper adapter for producing variety of molding shapes, \$39.95
Manufacturer: Laskowski Enterprises Inc., 2346 Fisher Ave., Indianapolis, Ind. 46224

Tool carved duplicates (right) of a clock case, oval frame and antique table leg.

With spindle carver attachment (below), gunstocks, long objects can be shaped.



Bit, corresponding stylus diameters decrease as you go from roughing (1) to detailing (3).





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TRACTION OF
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QUICK
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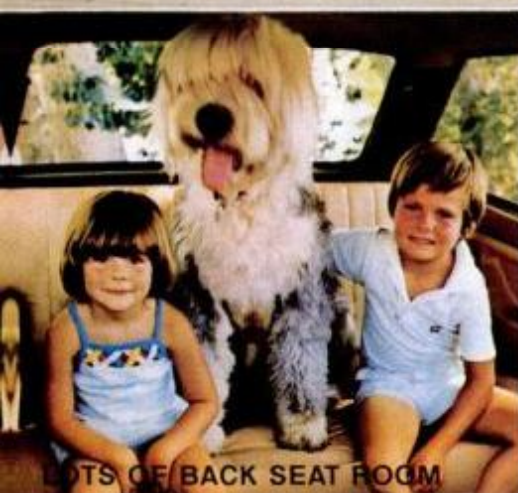
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is lower. Actual hwy. mileage will probably be lower than estimate.

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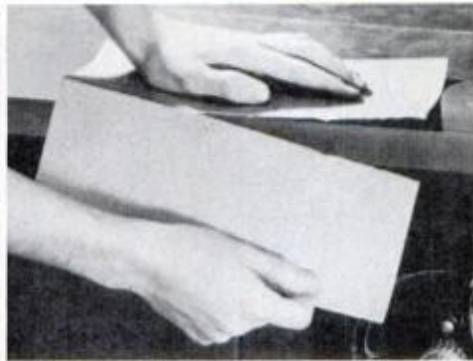
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WORKSHOP MINICOURSE

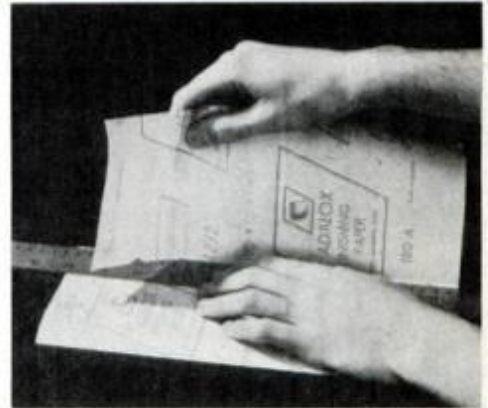
USING SANDPAPER



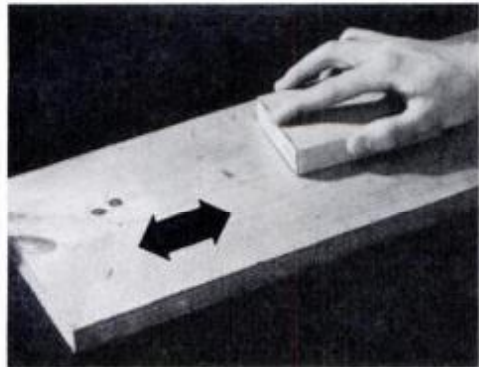
To tear sandpaper to size, fold neatly and press firmly along the line to be torn.



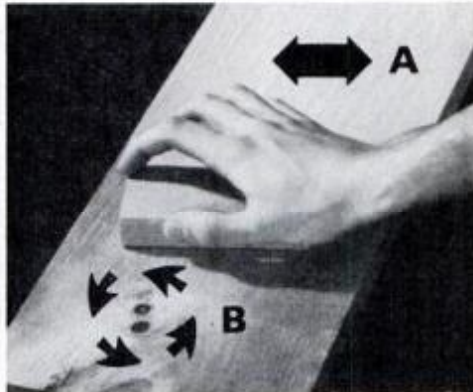
Easiest method for tearing is to use a hard edge, such as a saw table, and tear as shown. Note that sheet is being torn so halves are sized for pad sander.



Alternate paper-tearing method is to use steel straightedge as shown here.



Sand large, flat surface by rubbing with the grain (arrow); use a backup block as shown to prevent scooping or dishing of wood as a result of finger pressure.



Sanding across the grain (A) or with a slow circular motion (B) guarantees those uncraftsmanlike abrasive scratches.

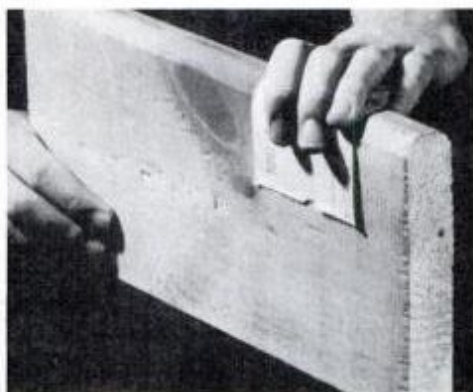


Use a backup block when sanding narrow edges to avoid rounding the corners.

To sand properly, know the four common abrasive coatings. Flint paper wears out quickest; aluminum oxide and garnet papers cost more, but last longer; emery cloth, the most durable, is desirable due to its flexibility. Abrasive backings, rated according to various qualities, are as follows: "A" is for flexible papers, "C" and "D" for cabinet work, "E" for machine sanding where considerable heat is generated, "J" and "X" cloth-backed papers for hand sanding and power sanding, respectively.

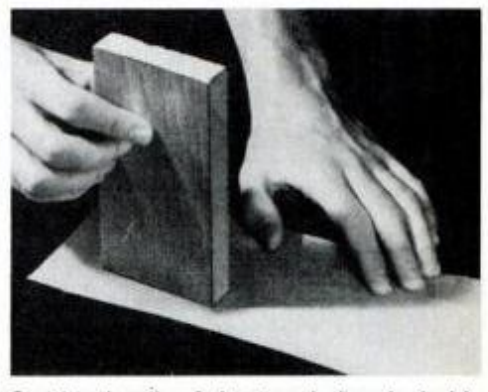
Open and closed-coat designations refer to the percent of the backing area covered by abrasive grains. Open coats have 50 to 70 percent coverage; closed coats, 100 percent. Use open-coat paper on painted surfaces or softwoods where clogging of paper is a problem. Use closed coats where clogging is not a problem (such as with hardwood) and faster cutting action is desired.

In general, sanding begins with a coarse-grade paper, proceeds with several medium grades and ends

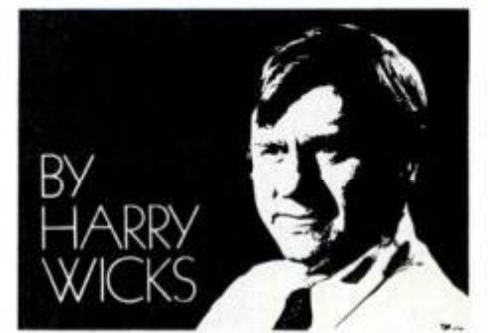


Round corners should be sanded free-hand; simply curl fingers to suit as shown.

with a fine one. Don't start with a grade so coarse that it will make scratches in the surface to be finished—you'll simply be defeating your purpose. Most furniture projects start with a coarse 1/2-grade or 60-grit paper. Between sanding with various grades, clean surfaces and wipe with a water-dampened cloth. Allow wood to dry; resand. Dampness raises fibers for easy removal during the next sanding. **FM**



Sand end grain of short workpiece by holding paper on bench surface, rubbing block against it. Prevents misshaping.





Liquid Velvet.

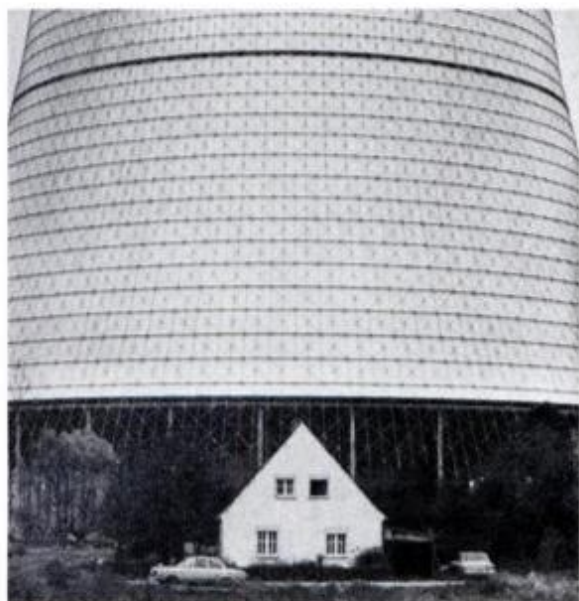


There are a lot of whiskies out there. Straights. Blends. Canadians. But none can give you the exceptional feel of Black Velvet® Canadian Whisky. A premium import at a very reasonable price.

Try Black Velvet. And taste the Velvet difference.

BLACK VELVET™ BLENDED CANADIAN WHISKY, 80 PROOF. IMPORTED BY © 1978 HEUBLEIN, INC., HARTFORD, CONN.

IPM BRIEFS



PM's Whatsit

"Well, there goes the neighborhood," might have been the understandable reaction of this householder in Schmehausen, W. Germany, upon the completion of whatever it is that now sits in his back yard. Your clues are as follows: (1) It did not come down from the sky. (2) It is the watered-down solution to a problem that has caused heated controversy. Give up? Turn the page to find out.



PM QUOTES...

... Najeeb E. Halaby, former Federal Aviation Agency administrator and chairman of Pan American Airways, from his recently published (Doubleday) book *Cross-Winds—An Airman's Memoir*:

"Many of us recall events in our lives by the cars we drove, as one measures the age of a tree by its rings... a Pierce Arrow roadster like the one I inherited from my elegant father in 1928, the 1929 American Austin my doting mother gave me for a Christmas present, the old Maxwell with the fallback front seat from my student days at Stanford—and the 1930 Harley-Davidson motorcycle on which I roared like Tom Swift during those college years. There was the 1932 Chevrolet convertible... that Uncle Harry and I took to the air show at Mines Field in Los Angeles where I was fatally bitten by the flying bug; and the marvelous 1936 Ford V8 station wagon in which Yale Law School classmate Dick Galland and I roamed from New Haven to Smith and Vassar and the ski slopes."



I'll simply need yards and yards of crepe

This spring, should you know any young men whose fancy will turn to covering a VW Beetle entirely with fabric, the job will be a lot easier than it would have been heretofore. You can thank—or marvel at, if

you prefer—the Wetstone Craft Co. of Atlanta, developers several years ago of the Mod-Podge process for adhering decorator fabrics to anything that'll hold still...and a few that won't. The firm's Folks-

Podge kit comes complete with a life-size pattern that can be used for cutting out fabric to cover a Beetle, plus adhesive and finishing varnish.

For the hot spring colors, see *Harper's Bazaar*.



Petroenglish

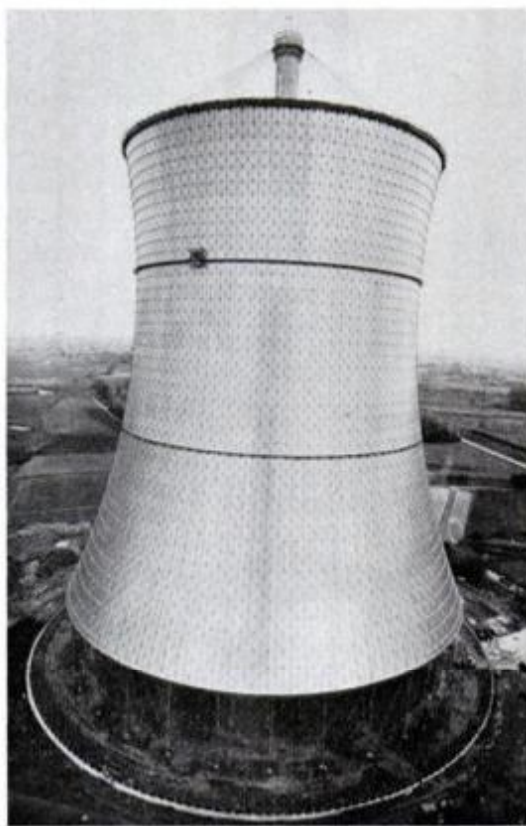
There's a language-instruction technique gaining favor that's acronymized as ESL—for "English as a Second Language." Basically, it's the Robinson Crusoe method; the teacher speaks nothing but English in class—with "charades" where required—and all printed materials are in English only.

Does it work? A publishing company called Institute of Modern Languages thinks so emphatically—to the point where it is introducing an instructional series that will teach non-English speakers the language and impart a fundamental knowledge of basic industries and trades at the same time. Not surprisingly, the first book in the series is aimed at the petroleum industry. "A non-English speaker who stays with the program through all six levels," says an IML spokesman, "will arrive simultaneously at fluency and a basic understanding of the key oil industry processes."

Subsequent IML texts (\$4.95 each, intended primarily for company training programs and adult education classes) are planned to cover computer sciences, telecommunications, avionics and health services. The publisher is at 2622 Pittman Dr., Silver Spring, Md. 20910.

Whatsit revealed

This giant tower was built for the sole purpose of dispersing waste heat from a nearby nuclear-powered generating plant. It is the first of its kind, having been constructed by the suspension of steel netting from a central pylon almost 600 feet high. Aluminum sheeting is then screw-fastened to the steel to form the contours of a huge cooling chamber. Water from the plant's reactor system is passed through heat exchangers at the foot of the tower and is cooled by a column of air rising through the central area before being recycled through the plant. This is called dry cooling, an improvement over the previously employed wet cooling method which resulted in the formation of massive clouds of possibly polluted water vapor. Though one of the world's largest cooling towers, the Schmehausen version weighs only about one third as much as conventionally constructed towers of concrete. Its surface area totals more than 400,000 square feet of sheet aluminum—or enough to make a siding salesman salivate.



CCC "boys" on a reforestation project, circa 1935.

Let's hear it for the CCC

Some 45 years ago, a federal move to get some of the apple sellers of the Great Depression off the streets resulted in the formation of the Civilian Conservation Corps. Before it was disbanded in 1942, some three million men had served in the CCC, resulting in a minor boom for the shovel industry, countless drainage canals, retaining walls and land reclamation projects—many of which remain crumbling but still serviceable—and at least one bawdy song.

Last summer, about 500 former CCC corpsmen from 39 states gathered in West Sacramento, Calif., to organize the National Assn. of CCC Alumni (NACCCA). Since then, according to spokesman Jack Vincent, NACCCA has located more than 10,000 ex-CCC boys. "Finding the first 500 was a lot harder," adds organizer Vincent. (Interested alumni can write to him at 1709 Michigan, West Sacramento, Calif. 95691.)

Interestingly, with the current rate of inflation, plus the push for conservation of the environment and proposals out of Washington that range from a "domesticated" Peace Corps to some form of mandatory two-year national service, the mood of the country may not be too different from that in 1933, when the CCC was born.

The new one would be coed, of course.

Time, gentlemen

The odd—to us—opening and closing hours of British pubs have come between many a good man and his pint of bitter. But automotive engineer Mike Taylor of Somerset, England, built himself a mobile bar stool that entirely eliminates those precious seconds wasted in transition from walking to sitting. The battery-powered stool cost Taylor four months of design time and \$400 to put together. "There may be some American bar stools specially designed for racing that are faster," Taylor allows, but he claims his is the only one with rear disc brakes.

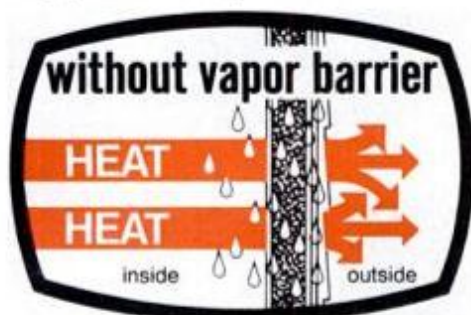
Keeps the wheels from lockin' up on those quick stops.



Your insulation's effectiveness can be reduced if you don't have a vapor barrier.

Now, a latex vapor barrier that goes on like paint.

Why you need a vapor barrier...



1. Warm moisture from inside your house penetrates exterior walls. This moisture can condense and freeze inside cold outer walls. Insulation and building materials get wet, frost forms, and heat is conducted to the outside.



2. One coat of Insul-aid™ puts a vapor barrier on your interior walls. Keeps most of the warm, moist healthful air inside. Your insulation stays drier, more effective. Helps keep fuel bills down!

Your family produces gallons of moisture a day.

That's right, the average family of four produces 4 or more gallons of moisture each day. Just from taking showers.



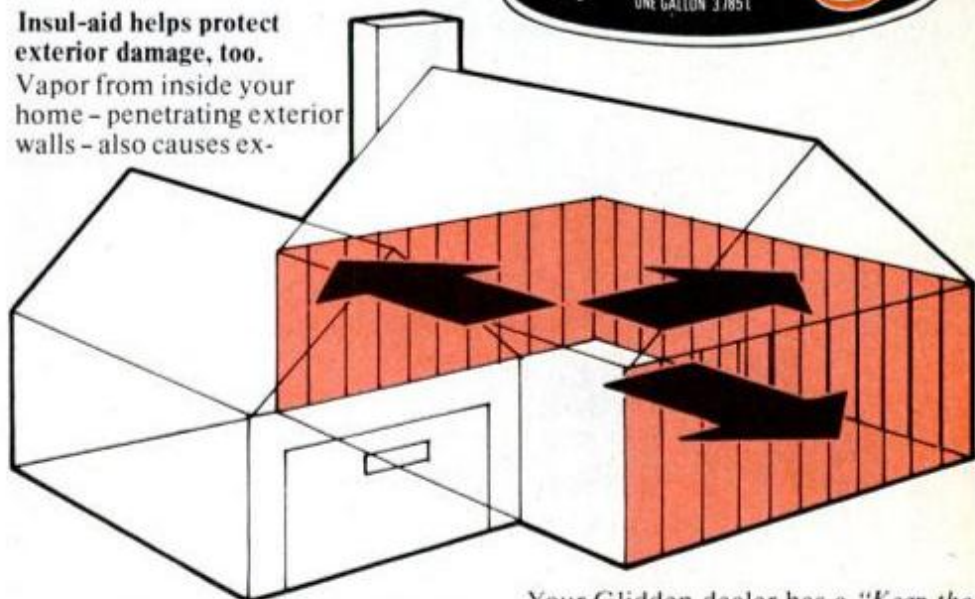
Washing dishes. Washing and drying clothes. Cooking. Breathing and perspiring. And if you have a humidifier, you'll produce gallons more moisture every 24 hours.

Independent tests show one coat of Insul-aid can cut heat loss through walls up to 20%.

If you're planning on painting, plan on using Insul-aid. And remember... you can do it just a room at a time, and only the interior walls that face the cold outside. In most rooms, that's just one or two walls plus the ceiling (but only if beneath cold attic space). And you'll cut heat loss through those walls up to 20%.

Insul-aid helps protect exterior damage, too.

Vapor from inside your home - penetrating exterior walls - also causes ex-



terior damage. The lack of a vapor barrier inside is the major cause of paint failure on the outside: peeling, blistering, staining can occur. Insul-aid keeps up to nine times more moisture inside.

Insul-aid exceeds FHA standards.


Minimum property standards of the Federal Housing Administration call for a vapor barrier having a vapor transmission rate not exceeding 1 perm to be installed on the warm side of the walls (except for unfurred masonry walls). Insul-aid more than meets this standard.



Your Glidden dealer has a "Keep the Warm Inside" brochure with the whole story. And he has the Insul-aid you need to do it.



SCM GLIDDEN COATINGS & RESINS
SCM CORPORATION, CLEVELAND, OHIO 44115



Ruth Honda
Gwinn, Michigan

**IF SUBARU
ISN'T
ONE TOUGH CAR,
MY NAME
ISN'T HONDA.**

Speaking as a Honda, I love my Subaru. I love the front wheel drive and all the features that are standard.

I love the gas mileage too. This Subaru 4 Door Sedan delivers an estimated 43 highway mpg and (29) estimated city mpg using lower cost regular gas. (In Calif., it's 39 estimated hwy. and (23) estimated city mpg using unleaded)*

And believe me, I know from years of experience that Subaru builds a car that's tough. So it'll last.

Visit a Subaru dealer. And tell them Honda sent you.

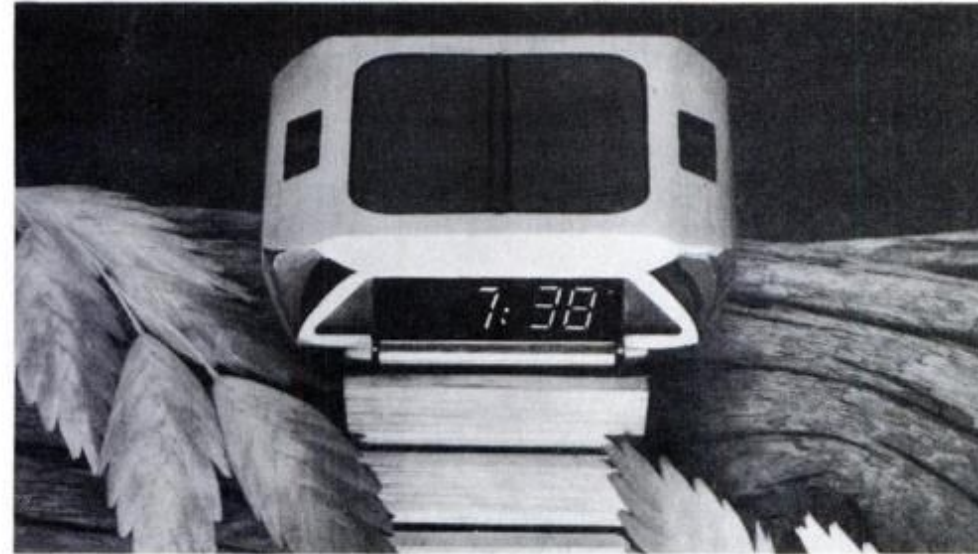
For your nearest Subaru dealer call 800-243-6000[†] toll free.

SUBARU INEXPENSIVE. AND BUILT TO STAY THAT WAY.

*1979 EPA estimates for 5 speed manual transmission. Use estimated city mpg for comparisons. Your mileage may differ depending on driving speed, weather conditions and trip length. Actual hwy. mileage will probably be less than hwy. estimate. Actual city mileage will be less in heavy traffic. [†]In Conn., call 1-800-882-6500. Continental U.S. only. ©Subaru of America, Inc., 1979.

Own the World's most perfect watch...

The only "PURE-SOLAR" timepiece in existence. Guaranteed to outperform any watch sold today...or costs you nothing!



The Sunwatch...never needs batteries...accurate to within 1 second per month...virtually indestructible, beautifully styled sport/dress watch.

An engineering/design breakthrough in space-age timekeeping technology...that now makes all other watches obsolete: ■ 100% sun-powered, no batteries that need replacing. ■ Clearly visible by day or night. ■ Unique side-window view, simplifies reading. ■ Built-in computer calendar — no need to ever re-set the watch (Not even in 31-day months and leap years!) ■ Unprecedented accuracy — you program the Sunwatch's computer to stay accurate within 1-second per month!

A "State-Of-The-Art" timepiece that combines solar age energy efficiency with a unique feeling of futuristic elegance and beauty. 10 years ago the Sunwatch was an idea, years ahead of its time, on the drawing board of Roger Riehl, a noted expert in solar energy, integrated circuitry, and computer chip technology. As a result of these years of costly and extensive research, Mr. Riehl's dream of a perfect watch has been realized, and this is now available through the Starshine Group, a California-based marketing organization specializing in unique, innovative products.

The objective in producing the Sunwatch was to put an end to all the difficulties other watches create. For instance, with the Sunwatch you will never have to worry about accuracy again. For the rest of your life, you will know you are on time — almost to the second! You will also never again stop to check the time only to find that your watch batteries are dead. The Sunwatch powered by stored light energy, never needs a battery replacement.

Another important feature is that you don't have to strain your eyes to read the numbers in bright sun or dark rooms as with other digital and conventional watches. The Sunwatch has 4 built-in varying light intensities which automatically adjust to the immediate light conditions, making it easy to read at all times, day or night. These necessities of correct timekeeping are now possible for the first time with this remarkable achievement in watch design.

Technical Data & Special Features:

■ **Tiny silicon solar power cells** are the incredible power source; they are constantly being energized from natural sunlight or even an ordinary light bulb while you are wearing your watch. The watch operates on this stored light energy and will work even after being kept in a drawer or suitcase for several days. However, should storage in darkness for a long period result in the watch losing its charge, a few hours in the sun (or overnight under a lamp) will charge it back up to normal (Note: if this happens and the watch display loses its charge due to a long period of darkness, the internal operation continues on keeping the same accurate time. Therefore upon re-charging the watch, the display readout will show the correct, up-to-date time, just as if the watch

had never lost its charge. This is because the display will automatically shut off at low charge levels, leaving enough energy to continue the internal time-keeping functions).

■ **No Resetting Needed Until 2100 A.D.** Thanks to its own specialized **Micro-Circuit Computer**, the Sunwatch is electronically programmed to display the correct month and day with NO resetting for the next 123 years! (Of course, in 2 or 3 seconds, you can easily change the time (or any other display) at your option, should you need to change time zones, etc.)

■ **Permanently Sealed Lexan Module**, protected by U.S. and Foreign Patents until 1992, encapsulates all energy cells, solar panels, quartz crystals, Computer-On-A-Chip, Readouts, etc. This hermetically-sealed watch module is also filled with a special gelatin which absorbs tremendous shock, making the Sunwatch virtually the Most Indestructible Watch Ever.

■ **Completely Waterproof** (You can safely suspend it in boiling water for 30 minutes!) It's because of the permanent lexan seal mentioned above.

■ **Shock Resistant to 5000 G's** (You can literally crash it into a rug-surfaced brick wall at 90 M.P.H. without noticeable effect!)

Free Custom Engraving: At your request, each watch will be hand-engraved with your name (or any name you specify) to label and personalize it yours for a lifetime.



Limited Warranty is Your Protection. The Sunwatch is covered by a 2 year limited warranty issued by Riehl Time Corporation (Manufacturer of the Synchronizer 2100), and included with your watch. A copy of the warranty may also be obtained free of charge by writing to Starshine Group, 924 Anacapa St., Santa Barbara, Calif. 93101. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Never Needs Batteries. Tiny silicon solar cells gather and store energy from sunlight, daylight, even an ordinary lightbulb. What a relief never to replace batteries!



No Resetting — Ever. Micro circuit computer is programmed to display the correct month and day with no resetting until 2100 A.D.

■ **Temperature and Pressure Resistant** Freeze Sunwatch in a block of ice for a year or wear in 750 feet deep without damage.)

■ **Natural Side-View Window** lets you tell the time, day, and date without twisting your arm into an obvious, awkward position.

■ **Continuous Seconds Display** — Useful for pulse-taking, stopwatch timing, etc.

4 Different Readout Modes: Mode #1... Displays the time in hours and minutes (as shown). **Mode #2...** Displays the month and day in numerical form (i.e., 3:13 for March 13). **Mode #3...** Displays the day of the week (alpha form) and the seconds counting off (i.e., TU: 48 for Tuesday, and 48 seconds after the minute display in Mode #1.) **Mode #4...** Displays the leap year status, and the programmable speed calibration setting that the watch is currently set at. (i.e., 23:45. The first digit "2" means that this current year is 2 years after the most recent leap year. The next 3 digits tell you that your Sunwatch is operating at a speed setting of 3:45. This setting can be changed by you in just seconds to anywhere between a range of 0:00 to 7:77. This allows you to adjust your watch speed to compensate for local climatic and magnetic conditions, etc. After a little experimentation you will soon find the proper setting to keep your Sunwatch accurate to within an unprecedented one second per month. (That's 5 times better than the latest Quartz Accutron!)

The exciting Sunwatch offers split-second accuracy based on solar energy and advanced design features, all packaged in a striking, contemporary styled timepiece that is virtually indestructible even under the most severe conditions. The Perfect Watch of a lifetime for Business People, Professionals, Teachers, Athletes, etc.

The Philosophy behind the Watch and this advertisement... Our objective is to acquaint you in a straight-forward manner, with the honest facts and features of a timepiece that we (and several thousand current Sunwatch owners) genuinely believe to be the most advanced, most practical watch in production today. We have attempted to tell you as much as possible about the Sunwatch because we know it sometimes can be difficult to make an intelligent purchasing decision of this importance, from just a few words and pictures.

Should you decide to try wearing and using one, we will engrave your name on it at no charge, and send it to you by United Parcel Service (or USPS if UPS doesn't service your area). You then have 2 weeks to literally "try it on for size" and see for yourself how incredible this watch actually is. If you decide you don't care to keep it for any reason, you can return it to us (within 2 weeks of receipt) for a prompt refund, or a credit to your charge card.

Credit Card Orders Call Toll Free 1-800-235-6945, ext. 1045. Calif. Residents Call: 805-966-7187.

Note: Thousands of earlier models of this "pure-solar" timepiece have been sold nationwide for as high as \$500 or more. Recent cost reductions in certain components now make the watch much more affordable (see coupon below) and one of the best timekeeping investments you can make today.

Starshine Group.

924 Anacapa St., Dept. 667, Santa Barbara, CA 93101

Please rush me _____ Sunwatch(s) in smart, slimly-styled stainless steel — For only \$129.95 each, I will wear the watch for 15 days; then if not completely satisfied may return it for a full refund of purchase price. Please add \$3.95 per watch shipping & insurance.

Please send me _____ Sunwatch(s), gold plated with matching band — only \$159.95 each. If not completely satisfied, return it for a full refund of purchase price. Please add \$3.95 per watch shipping and insurance.

Enclosed is \$_____ Check or Money Order (Calif. residents add 6% sales tax).

American Express VISA (BankAmericard)
 Master Charge Diner's Club Carte Blanche

Credit Card # _____ M.C. Bank # _____
Issue Date _____ Exp. Date _____

Signature _____

Name to be engraved _____

Name _____

Address _____

City/State/Zip _____

© 1978 Starshine Inc.

Make this chisel holder from scraps

This little chisel holder will protect the cutting edges of up to 40 tools, and you can build it in a single work session using scrap lumber.

The rack stores tools properly—with their blades suspended in air, rather than stuffed in a drawer. It also makes it easy to identify and grab the one you want because you won't have to sort through a pile of tools. Best of all, you can take holder and chisels to where you're working, and that's always a plus.

Our holder is made of 1x10 pine stock, although you can use 3/4-in. plywood. A drawer fits in the back of the chisel holder for storing sharpening stones, oil and other odds-and-ends. The drawer pieces are scraps of 1/4-in. plywood.

Begin by cutting the two side pieces (A). To assure their being identical, lay out one piece using the dimensions given and cut it out with a sabre or bandsaw. Use the first side you cut as a pattern for cutting

out the second side.

Next, cut the shelves (B, C, and D) and bottom (E). The hole diameters are sized to receive the handles of most chisels and keep blades from touching and nicking each other. Long blades may have to rest on wood below. Check your chisels and if your handle sizes vary bore the various holes to suit.

If desired, you can add a decorative cove to the front edges of the two sides and three shelves, as shown in the photos. This is easily done if you use a cove cutter attachment in your router.

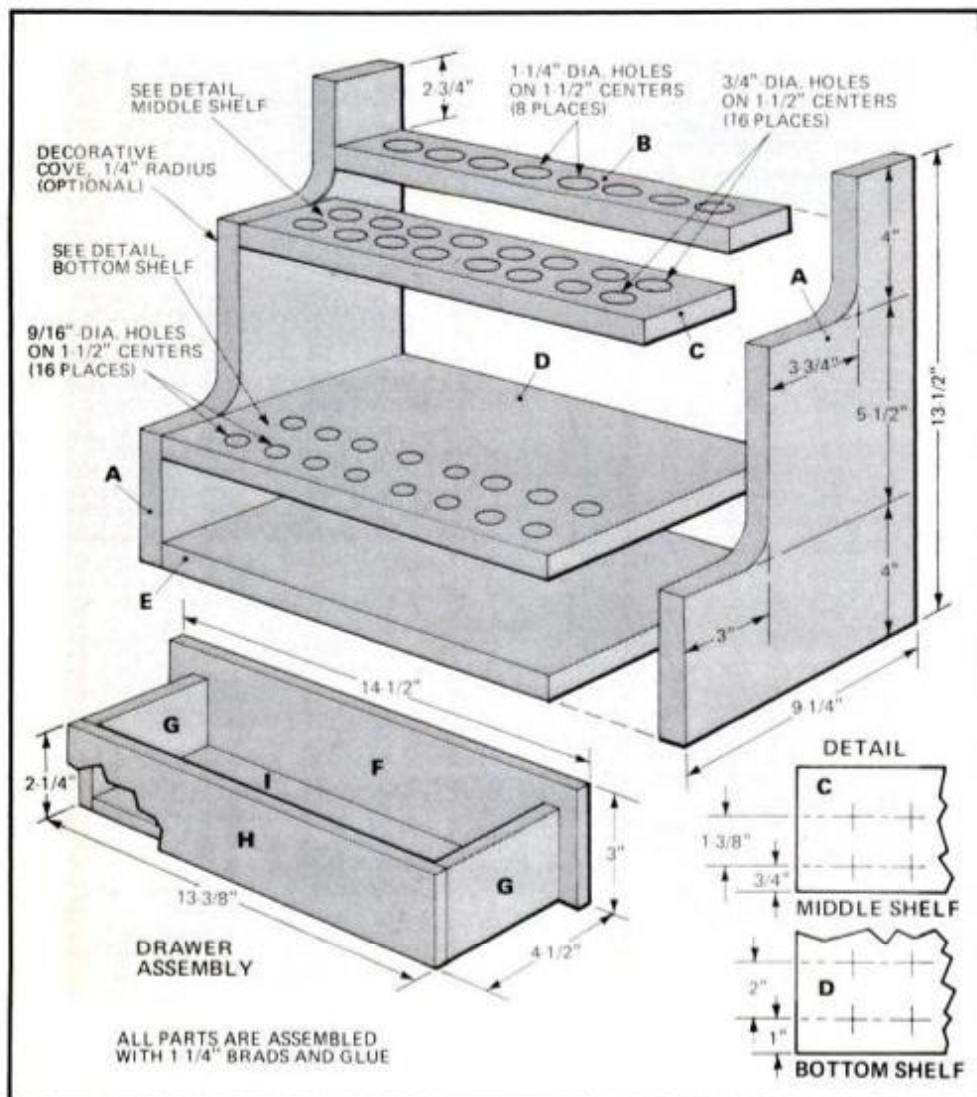
Test-fit all pieces and check for square. Then sand all exposed surfaces and assemble the rack using white glue and 6d finishing nails.



Set the assembly aside until the glue dries.

Cut drawer pieces (F, G, H and I) from plywood, using dimensions shown. Sand exposed surfaces and assemble drawer with brads and glue. If drawer binds, free it with a silicone lubricant.

After the glue dries, finish the chisel holder as desired, but remember that it's best if chisel edges do not touch paint. If you prefer a natural finish, your best choice is two coats of polyurethane varnish.—*Will Martin*



MATERIALS LIST—CHISEL HOLDER

Key	Pcs.	Size and description (use)
A	2	3/4 x 9 1/4 x 13 1/2" pine (sides)
B	1	3/4 x 2 1/2 x 13 1/2" pine (top shelf)
C	1	3/4 x 3 3/4 x 13 1/2" pine (middle shelf)
D	1	3/4 x 9 1/4 x 13 1/2" pine (bottom shelf)
E	1	3/4 x 9 1/4 x 13 1/2" pine (bottom)
F	1	1/4 x 3 x 14 1/2" plywood (drawer front)
G	2	1/4 x 2 1/4 x 4" plywood (drawer sides)
H	1	1/4 x 2 1/4 x 13 3/8" plywood (drawer back)
I	1	1/4 x 4 x 12 1/2" plywood (drawer bottom)



Small drawer in back is perfect cache for honing stones, knives, other small items.

MERCURY. SWIFT, SURE POWER TO GET YOU HOME.

At times like this, you'll be glad you own a Mercury.*

Because when it comes to sure, dependable power, Mercury is engineered for fail-safe performance.

QUICK, SURE STARTS.

The Merc exclusive solid state Thunderbolt® CD sealed ignition delivers up to 40,000 volts of dependable starting power. Self-cleaning PermaGap® spark plugs fire a hotter, faster spark around 360° electrodes (they usually last for seasons instead of months). And your Mercury will never need an ignition tune-up for the life of the engine.

TROUBLE-FREE RUNNING.

You can depend on Mercury to deliver smooth, full power season after season. Because only Merc has MerCarb® fixed-jet carburetion that automatically meters the precise fuel/air mixture from idle to top speed. MerCarb carburetion is factory-tuned and never needs adjustment.

BETTER PERFORMANCE.

Mercury speed is legendary. But there's more to Mercury

performance than going fast. It means maximum boat stability and better handling through advanced lower-unit design.

And increased turning power and less chance of cavitation with Quicksilver® Hi Rake™ cupped propellers that bite and hold better than ordinary props.

Fail-safe performance. It's engineered into every mid-range Mercury outboard from 40- to 140-horsepower. At times like this, you shouldn't settle for less.

THE MID RANGE MERCS.
40 TO 140 HORSEPOWER.



MERCURY
OUTBOARDS

A BRUNSWICK COMPANY

ANNOUNCING 4-WHEEL-DRIVE CHEVY LUV.

A TOUGH HALF-TONNER WITH A BETTER MILEAGE RATING THAN MANY CARS.

The Series 9 Chevy LUV model with 4-wheel drive is brand-new and a winner! Motor Trend magazine presented this tough import with its "Truck of the Year" Award. It features impressive fuel economy, solid engineering, traction, drivability, and plain ol' fun. A 2-speed transfer case, free-wheeling front hubs, styled spoke wheels and all-terrain tires are standard. Now at your Chevy dealer.

23

EPA estimated MPG. 21 in Calif.
Remember: Compare this estimate to the "estimated MPG" of other vehicles. Your mileage may differ, depending on your speed, trip length, weather and 4-wheel-drive usage.



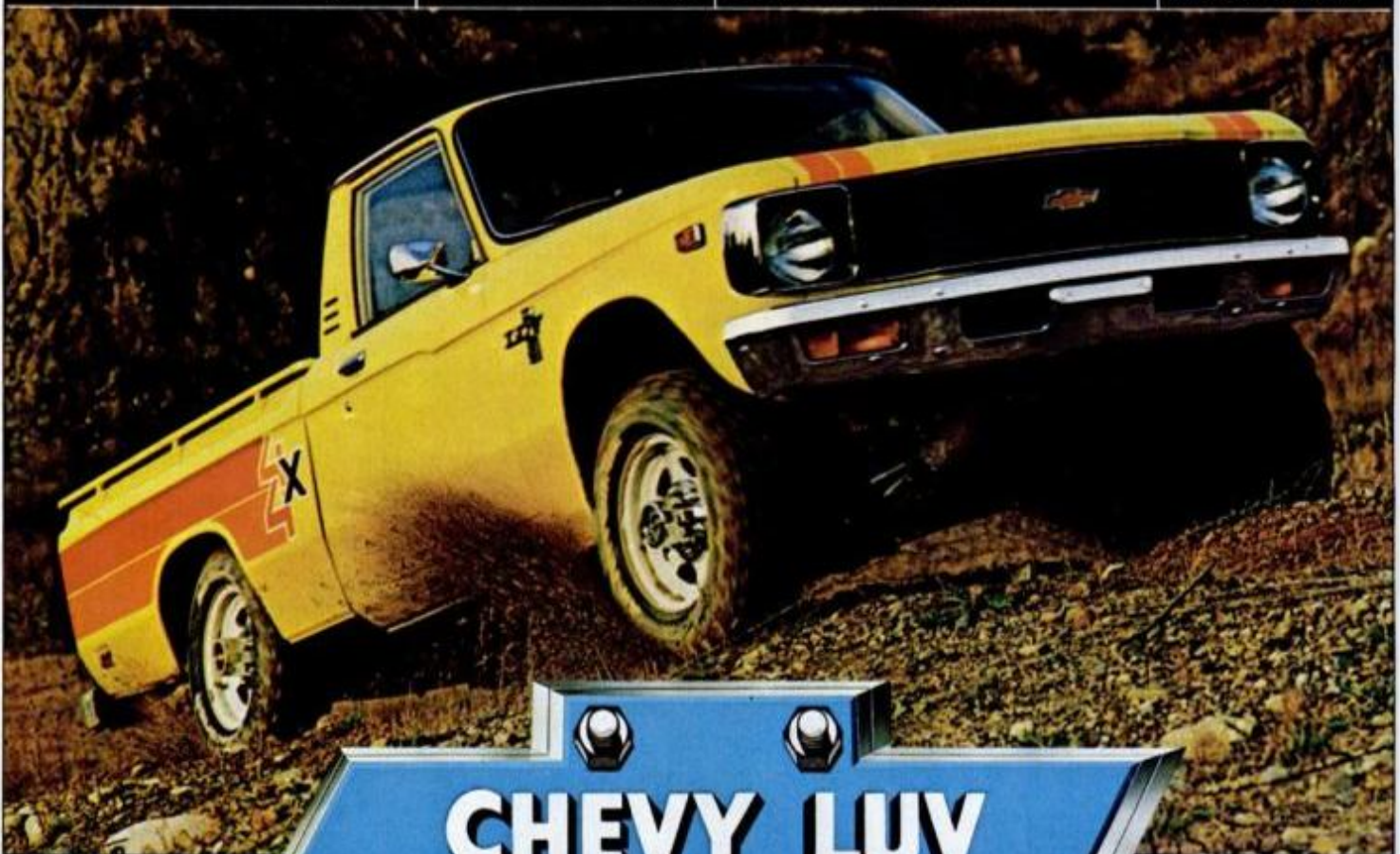
Tough independent front suspension with front stabilizer bar helps absorb bumps.



Higher ground clearance, lower entry height than many full-size 4-wheel-drive pickups. Test drive one now.



Tighter turning circle than any full-size 4-wheel-drive pickup.



CHEVY LUV

BUILT TO STAY TOUGH

CAR CLINIC

SOLUTIONS FOR MECHANICAL HEADACHES

BY MORT SCHULTZ



Cranky dipstick

The manual for my 1973 AMC Hornet says the crankcase holds five quarts of oil. My engine dipstick shows that the crankcase is full after four quarts are added. I tried a new dipstick. It confirmed what the old one showed. Who's lying... the manual or the dipstick?—Ray Sorg, no address given

Probably the dipstick tube. Could be it was mispositioned in the engine to begin with or somehow slipped down. In any case, I'd fill the crankcase with five quarts. Pull the dipstick, note the oil level and stamp a reference mark at that level. Use this new mark as your FULL indicator.

Got to be this or that

About 1500 miles ago I had a rebuilt 350-cu.-in. V8 engine put in my '74 Pontiac. The engine's been popping back through the carburetor, with the noise especially severe under heavy acceleration. Two mechanics have looked at the engine and associated systems. They fiddled with adjustments or whatever before throwing in the towel. You're my last hope.—Bruno Mayer, Pittsburgh

If it isn't outside the engine, it's got to be inside it. I faced a similar problem with a friend's Ford about 10 years ago. We removed the valve covers of his rebuilt powerplant and found that one of the rocker arms had been installed backwards, causing the pushrod to hold the intake valve open. As the fuel mixture burned, the flame shot back through the valve seat and intake manifold. You take it from here—the engine, that is. Right back to the guy who sold it to you.

Perkier Omni on the horizon

Three months ago I bought a new Dodge Omni with four-speed manual transmission. From the day I drove it out of the showroom it's been hesitating—surging as the service department calls it—at speeds of 50 mph and up. In eight trips back to the dealer, the engine has been tuned and

calibrated to the nth degree. Now they say the problem can't be solved. Can you help?—Fred L. Orloff, Willowick, Ohio

I have to assume that all this tuning up was done properly, that all vacuum connections are correct and tight, and that carburetor parts are okay. If this is all true, then I would have the dealer check the provisions of service bulletin 14-18-78. It states that 1978 Omnis and Horizons with manual transmissions may be loading up with gas, which causes "driveability" problems. The condition can be corrected by removing the secondary choke blade, which is the one toward the rear of the car. The fix applies to models built before May 15, 1978.

Gasworks

What about this propane-assisted method of making carburetor adjustments. What's it all about? Why is it used?—Anthony Blake, Brunswick, Ga.

It's "all about" on-the-nose idle mixture adjustments. The catalytic converter is so efficient that the emission level of carbon monoxide is too low to be measured precisely by infrared exhaust analyzers. This makes it difficult to tune carbure-

tors exactly. Complicating the problem has been the advent of difficult-to-remove, idle-mixture-screw limiter caps. It was once possible to take off caps and increase the richness of the fuel/air mixture to get a CO measurement.

The propane enrichment procedure makes it possible (and simple) to adjust the idle mixture. Propane gas added to the fuel mixture produces an effect similar to enriching the mixture by turning idle mixture screws. As the amount of propane metered into the engine is gradually increased, the fuel mixture becomes richer and engine rpm rises.

Automobile manufacturers have issued specifications that give the maximum rpm level to be attained with the propane enrichment method. These specs are on the vehicle emissions decal that's glued under the hood of the car. If engine speed increases to the specified rpm when propane is injected, the idle mixture is okay. If the highest rpm level reached by the engine is below spec, the idle mixture is too rich and an adjustment is needed. If the highest rpm level is above spec, the mixture is too lean. Adjustment or repair of a vacuum leak is necessary.

Ford cars have used the propane enrichment method starting with the 1975 models and Chrysler with the 1977 models. GM started the procedure with many of the 1978 models.

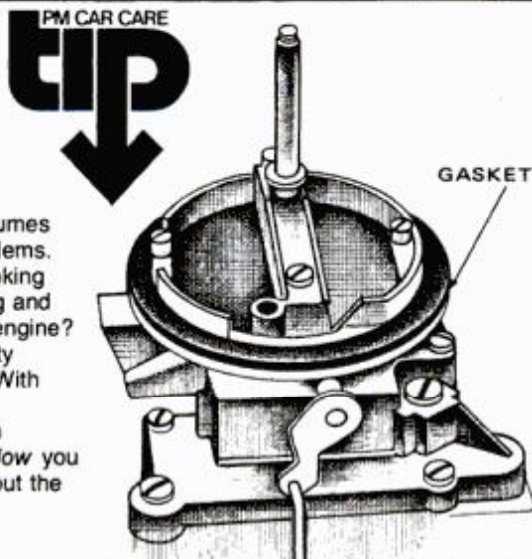
Disco beat

I have a 1978 Buick Century station wagon. From the beginning, a loud tapping noise has come from the engine. The dealer claims the noise is not being made by a valve lifter and I shouldn't worry. The Buick zone representative has checked the engine and he concurs with the dealer. The

(Please turn to page 74)

The rest of the story

You think you know everything you need to know about the carburetor air cleaner, just because you change the filter often? A dirty filter has a choking effect on the engine that consumes fuel and, in time, leads to starting problems. But, did you know that the innocent-looking gasket between the air cleaner housing and carburetor air horn could damage the engine? If this gasket is cracked or missing, dirty air is drawn into the engine's innards. With some carburetors, a gasket that isn't positioned squarely on the air horn can interfere with choke plate movement. Now you know everything you need to know about the air cleaner, so act accordingly.



CAR CLINIC

(Continued from page 73)

noise is loudest when a stethoscope listening tool is held against the water pump. The sound is rhythmic. Please help. My warranty is running out.—C. D. Parker, Durham, N. C.

This reminds me of a problem that some '75 Cadillacs had. Their water pump attaching bolts were slightly too long. The fuel pump lay near the water pump. Every time the fuel pump arm was on its downstroke, it made contact with the oversize bolt. To find the violating bolt, we backed out each bolt, one at a time, until the noise stopped. When the offending bolt was uncovered, we put a flat washer under its head to "shorten" its length. This is worth a try.

Geiger counter not needed

The automatic transmission of my 1977 Mercury Monarch developed a slight leak at 5000 miles. I'm losing an ounce of fluid a week. The dealer has replaced all seals and gaskets, and the front pump. Now we're at a loss. Where do I go from here?—Frank Geiger, New Providence, N.J.

Back to the dealer to find out which transmission you have in this car. He can tell by the code on a decal

on the door pillar or on the tag attached to the transmission.

If it's an FMX transmission, it may have a leak, which is difficult to locate unless you know exactly where to look. It's at the transmission case-to-cooler line fitting. Refer the dealer to service bulletin 129.

Rainy day blues

My 1976 Capri II with 2.8L engine starts well except when the tempera-

ture is 30° to 40°F. and it's raining. Then, the starter turns the engine, but the engine won't start. The dealer has replaced sparkplugs, ignition coil, battery and battery cables. Sparkplug cables and distributor are okay. Electric connections have been sprayed with waterproofing. Can you help?—Bruce Rilner, Toledo, Ohio

For some reason—maybe the temperature or the dampness (no one has figured out which)—this car's

PM CAR CARE

TIP

AIR Force

Air Injection Reaction (AIR) systems have been with us since 1965. AIR provides more complete combustion and, thereby, helps reduce hydrocarbon emission. Does your car have AIR? If so, when was the last time you replaced its filter? What filter? The one that should be replaced every 12,000 miles. Some AIR systems use filter elements inside removable housings. They are easy to replace. Other AIR systems use a filter that is inside the air pump. It's tricky to replace and has to be done according to the service manual. With still other systems, air is filtered through the carburetor air cleaner element. To keep your act clean, find out which setup your car uses. Then, see that the filter gets replaced.

AIR MANIFOLD
CHECK VALVE
AIR NOZZLE
VACUUM SENSING LINE
BACKFIRE-SUPPRESSOR VALVE
AIR SUPPLY PUMP
AIR FILTER

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it saves money.

Here's why:

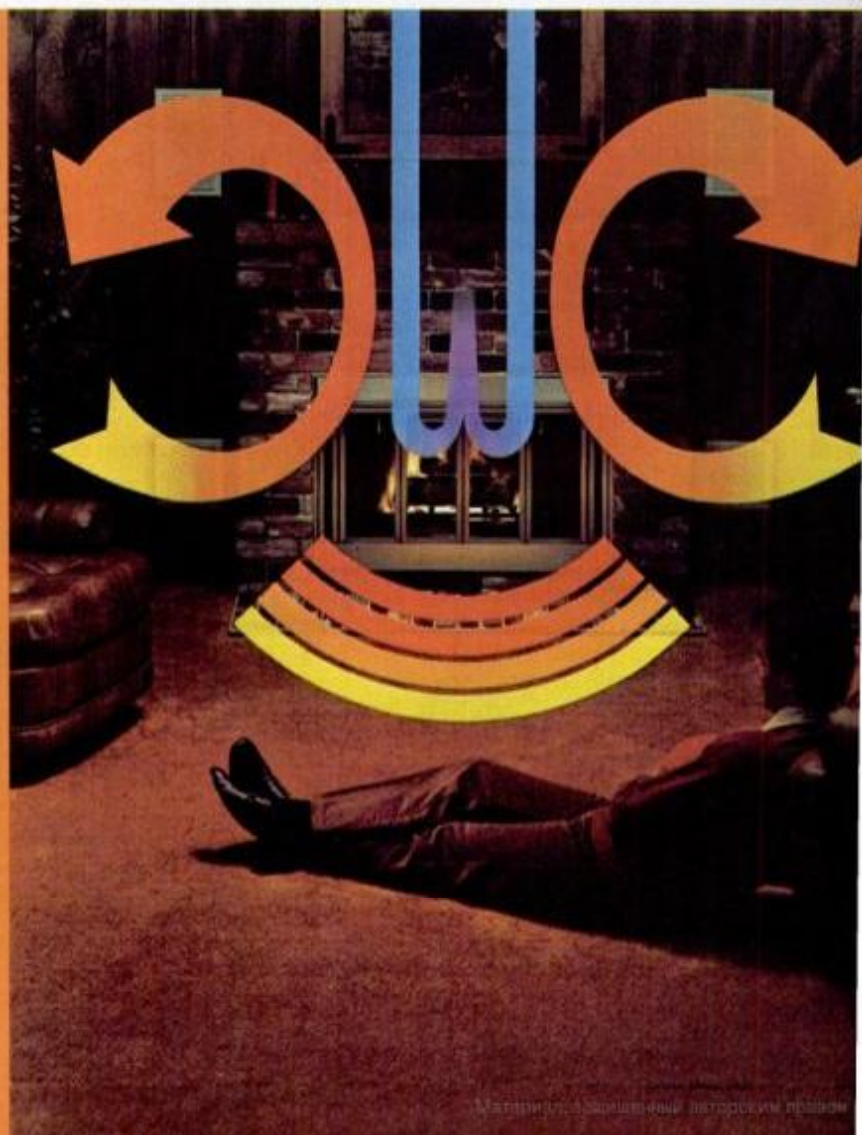


FORCED-AIR
HEATING
SYSTEM*

OUTSIDE AIR†
FOR
COMBUSTION

GLASS DOORS†
FOR ENERGY
SAVINGS/SAFETY

*Standard †Optional



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starting voltage drops to 8-9 volts in cold, wet weather. Ford's solution, outlined in service bulletin 112, is to connect a jumper wire from the

CODE FOR 1978 GM ENGINES

Code	Engine Identification	Division
A	231 V6	Buick
B	350 V8 (EFI)	Cadillac
C	196 V6	Buick
D	250 I6	Chevrolet
E	98 (1.6L) I4	Chevrolet
F	260 V8	Oldsmobile
G	231 V6 (2-bbl. turbo)	Buick
H	350 V8 (Corvette L82)	Chevrolet
H	305 V8 (4-bbl.)	Chevrolet
J	98 (1.6L) I4 high output	Chevrolet
K	403 V8	Oldsmobile
L	350 V8	Chevrolet
M	200 V6	Chevrolet
N	350 V8 (diesel)	Oldsmobile
R	350 V8	Oldsmobile
S	425 V8	Cadillac
T	425 V8 (EFI)	Cadillac
U	305 V8 (2-bbl.)	Chevrolet
V	151 I4	Pontiac
W	301 V8 (4-bbl.)	Pontiac
X	350 V8 (4-bbl.)	Buick
Y	301 V8 (2-bbl.)	Pontiac
Z	400 V8	Pontiac
1	151 I4 (2-bbl. closed-loop emission)	Pontiac
2	231 V6 (2-bbl. closed loop emission)	Buick
3	231 V6 (4-bbl. Turbo-charged)	Buick

unused terminal on the starter solenoid to the battery side of the ignition coil. By doing this, 12 to 14 volts are delivered directly to the starter motor. This is done as follows:

1. Equip one end of an 8-foot length of 16-gauge insulated wire with a ring tongue terminal.

2. With a 10-32 hex nut, attach the ring tongue terminal to the unused stud on the starter solenoid.

3. Route the wire across the dash panel, through the brake-line plastic bracket clips and wiring loop straps, and along the left fender apron to the coil.

4. Attach this end of the jumper to the battery wire at the coil.

A note from Mort

I've received letters from owners of GM cars asking me to tell them which divisions built their engines. To identify the engine, check the Vehicle Identification No. (VIN) on the upper left side of the instrument panel at the left corner of the windshield. Match the fifth character of the VIN (letter or digit) with the chart (left) to identify the engine and division. While this applies to 1978 models, it may reveal data about your model. Many engine codes remain the same for years.

SERVICE TIPS

■ The TruFlex Rubber Products Co. claims that its relatively new procedure distributed to tire repair shops is effective in repairing sidewall punctures in radials. According to the Rubber Manufacturers Association, as I write this there is still no industry-wide approved procedure for radial sidewall repair—not even the TruFlex procedure.

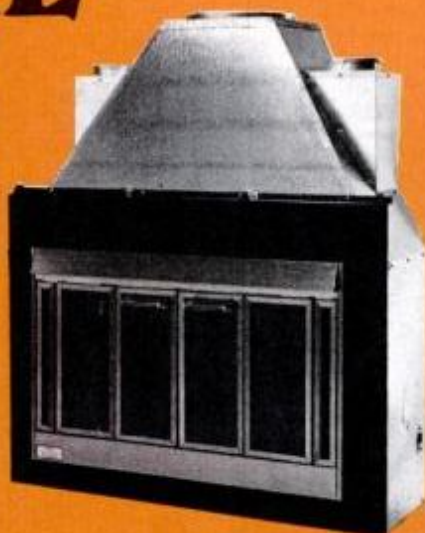
■ Chevrolet says that a long drive at highway speeds in hot weather can cause a limited-slip differential to chatter or make moaning sounds during tight turns. If you hear noises under these conditions, the unit has to be flushed and refilled as follows: with the axle hot, drain the lubricant and clean the magnetic drain plug. Refill the differential with GM GL-5 (part No. 1052271). Lift both rear wheels and run the car in DRIVE or high gear for three or four minutes. Run the wheels at a speed equivalent to below 30 mph, and don't accelerate or decelerate rapidly. Drain the lubricant and refill it with GL-5, plus four ounces of rear-axle additive (part No. 1052358). Drive the car through 10 to 15 figure-eight loops. If the noise occurs later on, add another four ounces of the rear-axle additive. **PM**

GOT A PROBLEM WITH YOUR CAR?

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

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AND SAVE

heatilator
AMERICA'S LEADING FIREPLACE SYSTEMS

Here's the first 110 SLR with interchangeable lenses



Pentax System 10 and accessories (left). SLR body has flash, winder and 24-mm "normal" lens attached. In foreground, left to right: W21 close-up lens, UV filter, 18-mm wide-angle lens, 50-mm telephoto lens, rubber lens hood. Camera, winder and flash (right) fit into palm of hand. Winder and flash attach and detach very quickly.



Even the most casual observer of the camera scene has noticed the remarkable reductions in size and weight of single-lens-reflex cameras (SLRs). Just when it seemed as though the cameras couldn't shrink another millimeter, Asahi Optical Co., maker of Pentax, has introduced the System 10 automatic 110 SLR.

Aha! you say, it's a 110 camera with that tiny negative. Quite true. But it's a 5.6-ounce 110 with a lot of big-camera features. Most people, upon first seeing it, react by saying "it's so cute!" But this camera is no toy. It's fully automatic with interchangeable lenses, automatic flash, autowinder and other accessories.

Taking pictures

The System 10 is simple to operate, with only two controls. The film-wind lever advances the film with two strokes per frame; the shutter button, when pressed part way, lights a viewfinder LED for exposure information. When the button is depressed fully, the shutter is released. Film speed is determined via notches in the film cartridges; the camera is programmed to accept 400, 100 and 80 ASA film (that means underexposure of less than half a stop when shooting with ASA 64 film).

Exposure is automatically selected by the camera in a range from one second at $f/2.8$ to $1/750$ second at $f/13.5$. A green LED shines in the viewfinder if exposure is okay; a yellow-orange one lights if flash or a shutter speed slower than $1/30$ is needed. It has no manual override.

Like its bigger brethren, the System 10 sports through-the-lens me-

tering, and split-prism focusing. Unlike them, the lens diaphragm is inside the body, not in each lens. For now, Pentax offers three lenses: 18-mm $f/2.8$, 24-mm $f/2.8$ and 50-mm $f/2.8$. These correspond approximately to 35, 50 and 100-mm lenses in 35-mm format. The three fit easily in the palm of your hand.

To obviate the need for the film-wind lever, and thus make the camera a single-control item, an auto-winder is available. It quickly attaches to the body with a thumb-wheel and moves film at about one frame per second. It winds directly to the first frame and to the end after you shoot the last frame. It will not fire continuously. Two AA batteries provide power.

Other accessories have been made especially for the System 10. The AF 130P flash (which also uses two AA batteries) synchronizes with the camera automatically at $1/30$ second at $f/2.8$. Range is about $2\frac{1}{2}$ to 15 feet, and recycling time is about seven seconds.



System has five close-up lenses, four filters, three hoods, case (not all shown).

Also available are ultraviolet and skylight filters, lens hoods and screw-on close-up lenses. With the S16 close-up attachment on the 24-mm lens, a maximum reproduction ratio of 1:4.1 is possible, according to Pentax. I wouldn't be surprised to also see colored filters and a zoom lens or two in the near future.

How it worked

System 10 is a bold move for Pentax. The components seem well-made and reasonably rugged. I used them for several weeks and came to a few conclusions.

On the plus side: System 10 delivers sharp pictures, even up to 8x10 enlargements. Also, it is more versatile than any other 110 camera. Its SLR shape makes it easier to handle and less susceptible to camera shake. Its bright viewfinder and split prism make focusing much easier than on many rangefinder 110s and 35s. And it is smaller and more pocketable than cameras with half its features.

The system is too rigid, however, for the serious photographer. The lack of manual control precludes creative use of shutter speeds and depth of field. The normal lens should be faster—at least $f/2$. People who think some compact 35-mm SLR's are too small to handle easily will certainly not like this Pentax. Due to the nature of the 110 format, film flatness could be a problem.

Firm prices for System 10 were unavailable at press time, but here are some educated guesses: in discount stores, camera and basic lens should run about \$180. Whole package (left) should be under \$375.

—Tom Sahagian

This 4-speed has something no other 4-speed has.

Stick shift fanciers. Economy car devotees. You're both going to love this one.

It's called TWIN-STICK. Devilishly clever. And exclusively yours when you choose the

Mitsubishi-built 1979 Dodge Colt or Plymouth Champ Hatchbacks. Here's

how it works. Release the clutch and push the lever into **ECONOMY** mode, and you've selected the four-speed range designed to deliver optimum fuel efficiency. Choose **POWER**, and you get livelier performance. For running through the gears, you use the regular H-pattern lever.

Averaging the mileage achieved in both **POWER** and **ECONOMY** ranges resulted in EPA estimates of

32 EST. MPG, 44 EST. HWY. with the 1.4 liter



MCA-Jet engine. Use the EST. MPG number for comparison purposes. Your mileage may differ depending upon speed, weather and trip length. Actual highway mileage will probably be lower than the HWY. EST. Calif. estimates are lower.



TWIN-STICK is standard on the new 1979 Dodge Colt or Plymouth Champ Hatchbacks.

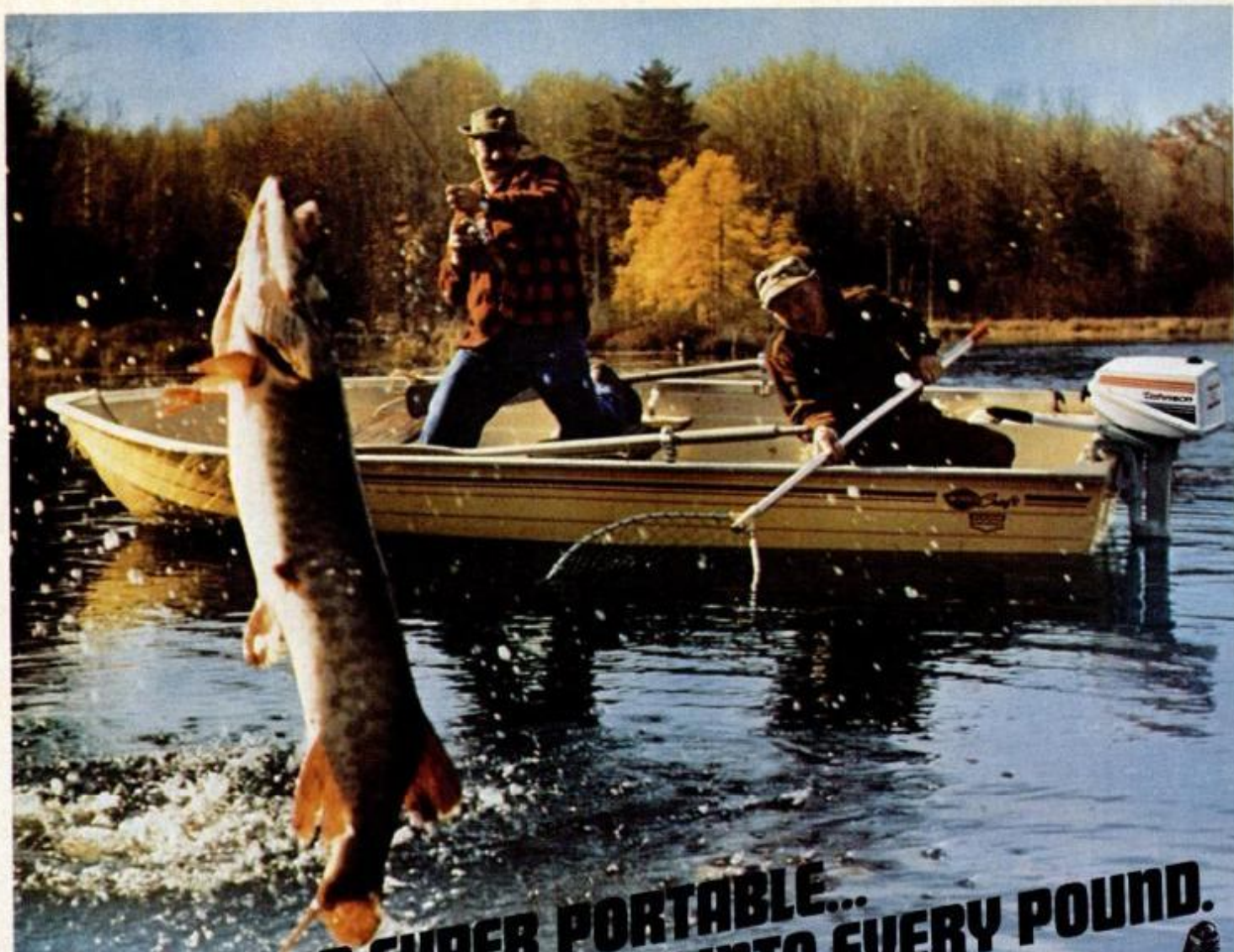
You get the benefit of a total of eight speeds to play with. Which means you can get the optimum gear for just about any driving situation that comes along. City or country. Uphill or down. Or passing gas stations.

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Full F-N-R gearshift means quick, easy maneuvering. Twin cylinders and MagFlash® electronic ignition deliver smooth, consistent running at all speeds, from extra-slow troll to full throttle. An extra-long steering tiller with twist-grip throttle, idle adjustment and stop button gives you fingertip control. And a 2.1-quart built-in fuel tank lets you slow troll over 3 ½ hours on a single fill-up. (A remote tank adaptor kit is available as an accessory.)

And that's just for openers. A new idle speed exhaust baffle, sound-sealed powerhood and rubber-mount isolation system provide quiet, smooth running. Stainless steel drive and prop

shafts, a double-sealed gearcase and built-in sacrificial zinc anode resist corrosion, salt water or fresh. And shallow-water drive, combined with the protection of a rubber clutch propeller hub, lets you fish just about anywhere your boat will go.

Our new 4.5 is as feature-filled as you'd want a fishing portable to be. And like all our '79 Johnson® outboards, it's backed by our 58-year tradition of economy, performance and dependability. See our newest Sea-Horse—and our complete line, from 2 to 235 hp—at your Johnson dealer. Or write for free catalog of Outboard Marine Corporation, 200 Sea-Horse Drive, Waukegan, IL 60085.

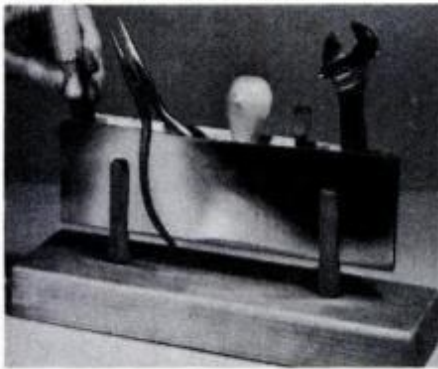


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HINTS FROM READERS

Clothespin toolholder



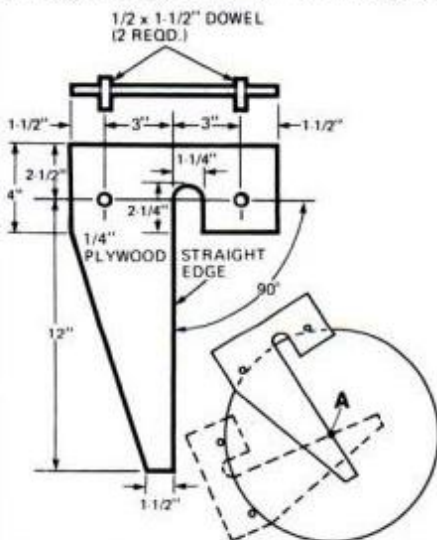
Make a toolholder with a 9x10-in. piece of sheet metal, two wooden clothespins and a 1-ft. piece of 2x4. Bore holes in the 2x4, and glue in the clothespin heads. Fold sheet metal in half, slide it into clothespins.—*Howard E. Moody*

Weed Whip

Fashion a weed whip from an old hacksaw blade and a broomstick. Bend the blade into a loop and fasten it to the stick (golf-club fashion), using a pair of stout woodscrews.—*K. M. Wilson*

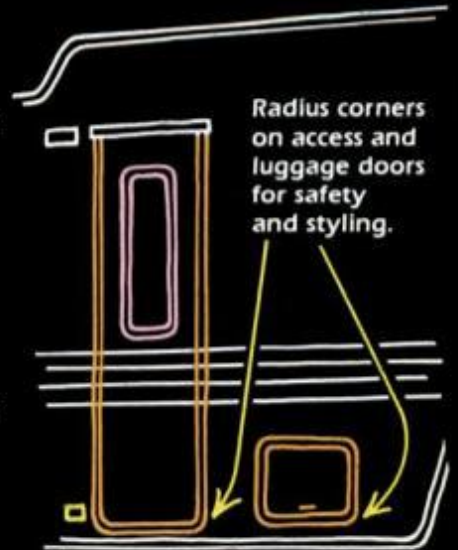
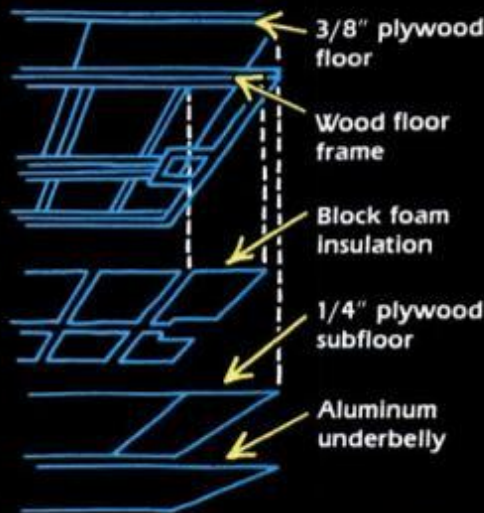
Center finder

Using plywood and two pieces of dowel, make this jig for finding the center of large circular objects. Be sure the two dowels are the same distance from the straightedge and on a line per-



pendicular to it. To use the jig, push the dowels against the round rim and draw a line along the straightedge. Reposition the jig and draw another line. The two lines intersect at the center point.—*Percy W. Blanford*

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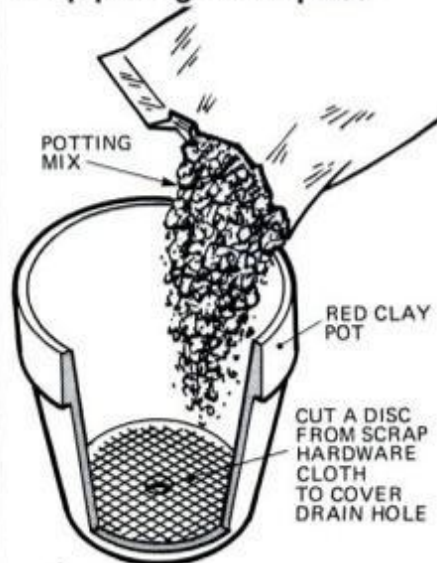
Name _____

Address _____

City _____ State _____ Zip _____

HINTS FROM READERS

Keep potting mix in place



Cut discs of discarded window screening and place them in the bottom of plant pots so soil won't fall out the drain hole. Cut over-size discs for pots that have side drains so screen covers these holes.—*Charles H. Hardy*

One-man shed assembly

To erect a sheet-metal shed by yourself, use carpet tape to hold a wrench on the inside wall with nut gripped in the wrench jaws over the hole. Insert screw from the outside and tighten it with a screwdriver.

—*Herman E. Koranek*

Incinerator-ash tamper



Tamp incinerator ashes and you won't have to empty them as often. You can make a tamper from a 1½ x 6-in.-square wood block mounted on a 1-ft. section of broomstick. Cover the tamper bottom with sheet metal secured by brads.—*Walter E. Burton*

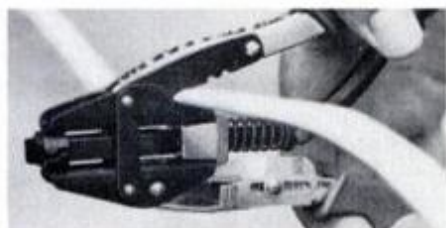
PM LOOKS AT INSULEATER



To strip, insert wire into self-centering knives to depth of strip desired. Then quickly close and release handles.

The Insuleater is a multipurpose tool, used for stripping and cutting wire and even for crimping terminal connectors to wire ends. Although it's handy for all three jobs, stripping is what it does best. Just insert the wire and squeeze the handle—there is no need to pull. I found it especially handy for working in tight spots.

As this report was about to go to press, the manufacturer shipped me a new, self-adjusting version of the tool. The adjusting slide (in photo below) has been replaced by adjustment screws on the tool's nose. Although setting the slide is no longer required, screw adjustments may be needed when working with wires that have unusually thin or thick insulation.—J.P.



To cut wire, insert between blades with handles fully open and squeeze.

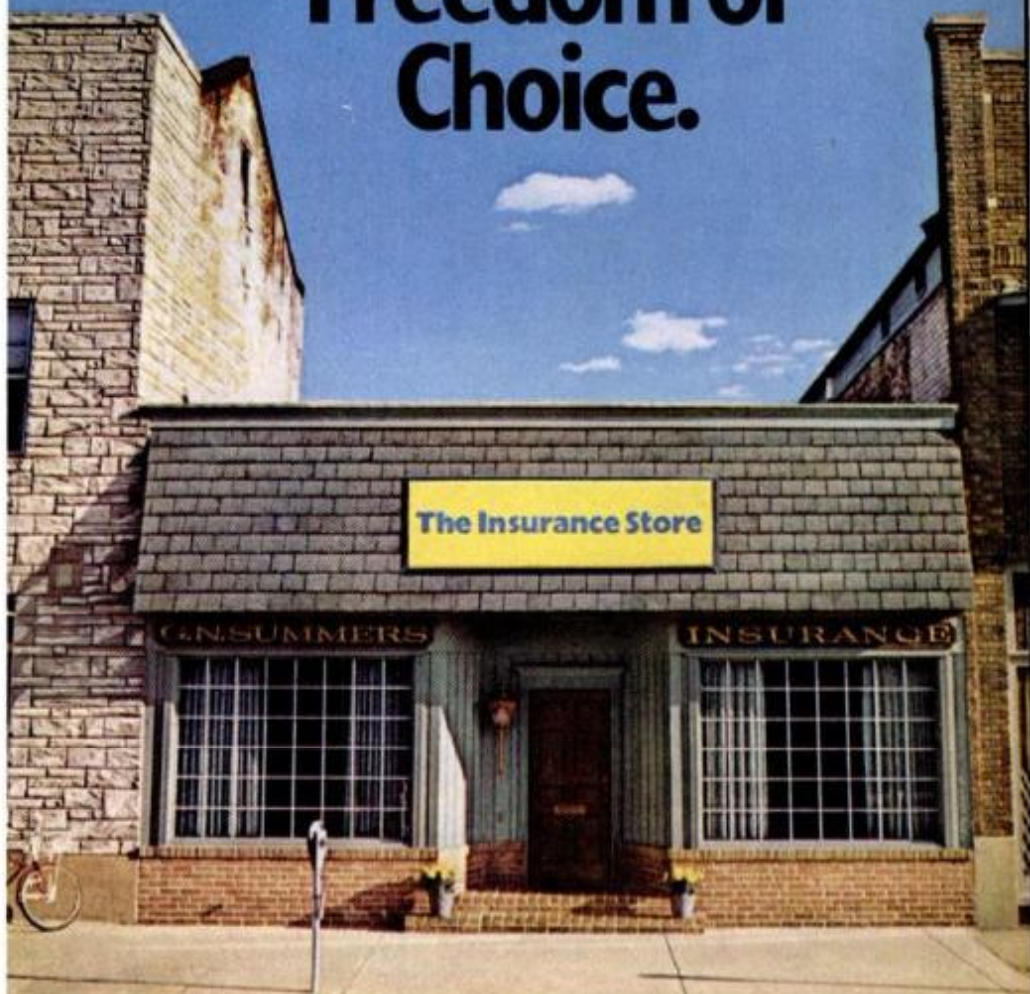


Set and lock sliding gauge mechanism to the wire size you're working with.

SPECIFICATIONS—INSULEATER

Handles: Steel, plastic coated, noninsulating
Stripping capacity: All wire sizes up to 1/4-in. o.d.; all types of insulation
Wire-cutting capacity: Up to 1/2-in.-wide plastic-coated cable
Price: \$26.50 postpaid, replacement blades available
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Tune in on the airborne action

• You can easily eavesdrop on jumbo jets or private planes. Just tune to the frequencies PM lists here.

by Roy B. Goshorn

You may already have discovered the air communications band of frequencies on your multiband radio. If so, you know the fascination of eavesdropping on pilots transmitting from cockpits of giant airliners and control-tower operators responding from their perches high over sprawling, busy airports.

Sometimes, there may even occur the stark drama of hearing a pilot

say, "Tower, this is PSA 182. We're going down." That was the final transmission from the Boeing 727 that crashed in San Diego last year, killing 144 persons.

Day-to-day listening

Thankfully, all air-to-ground communications are not this gruesome. But, for those who occasionally tune the 108- to 136-megahertz portion of the frequency spectrum, there is always intriguing listening. Through international treaty, English is the official language of all air-to-ground communications on the worldwide 108- to 136-mHz band. Near some metropolitan areas, the radio channels can be crowded at times with pilots and ground controllers alike, speaking in clipped phrases to save time. The talk is direct and straightforward to prevent any misinterpretation.

It may take some time and effort for the novice to decipher the generally used expressions or terms like Squawk Ident, ILS, Outer Marker, Victor, Vector and Transponder. A glossary of some common terms appears at the end of this article.

The armchair traveler, via his radio, can fly along at high altitudes with jetliners, monitoring their progress by tuning in the 11 flight control centers around the country. Equipped with high-powered radar and at least a half-dozen or so VHF radio communications frequencies, they control all high-alti-

(Please turn to page 84)



GE Model 7-2971 offers 10 bands of exciting listening, includes all aviation frequencies. Price: \$120.



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So mosey on over to your Monroe dealer and ask him for a set of Radial-Matic shocks. They'll make Old Paint ride like the great horse Silver.

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AIR-TO-GROUND COMMUNICATIONS—FREQUENCY ALLOCATIONS IN MEGAHERTZ

City/Airport	Control Tower	Approach Control	Departure Control	Ground Control	Center	City/Airport	Control Tower	Approach Control	Departure Control	Ground Control	Center
Boston	119.1	120.6	124.1	121.9	134.75	Milwaukee	119.1	126.5 123.8	125.35 119.65	121.9	125.1
New York Area Kennedy	119.1	127.4 118.4 132.4	121.1 123.7 134.9	121.9	120.2* 120.95*	Dallas/ Fort Worth	126.55 124.15	123.9 125.8 119.4	118.55 127.75	121.8	124.7 126.0 127.6
LaGuardia	118.7	134.9 127.3	120.4 124.45	121.7	133.2*	Houston	118.7	120.8 124.35 127.25	120.8 123.8 119.7	121.9	128.7 125.0
Newark	118.3	125.5 127.6	119.2 135.35	121.8	133.3*	Oklahoma City	118.3	119.3 124.6 124.2	124.6 121.05	121.9	128.3
Buffalo	120.5	123.8 126.8 134.05	125.5 120.05	121.9	125.55	St. Louis	118.5 120.05	125.15 126.5	124.9 127.25	121.9	125.5 121.25
Philadelphia	118.5	126.6 125.4 128.4	119.75 124.35	121.9	120.85	Kansas City	118.1	132.95 126.6	118.9 123.95	121.8	119.65 135.3
Pittsburgh	119.1	123.95 124.15 126.2	118.7 119.35 124.75 125.9	121.9	120.6 122.1 124.4 128.45	Minneapolis/ St. Paul	118.7	119.3 126.35	120.0 124.7	121.9	125.9 125.5
Washington	119.1	118.3 124.7	118.1 126.55	121.7	118.75	Fargo	118.6	119.8	120.4	121.9	127.35
Atlanta	119.1	127.9 126.9	125.7 125.0	121.9	121.35 127.5 127.05 118.9	Denver	118.3 119.5	128.05 125.3 120.5	128.05 123.85	121.9	125.8
Miami	123.9 118.3	126.85 120.5 128.0	133.2 118.1 125.75	121.8 127.5	127.0	Salt Lake City	118.3	124.3 126.8	124.3 126.8	121.9	134.8
Nashville	119.1	124.0	118.4 119.35	121.9	125.4	Las Vegas	119.9	127.15	133.95	121.9	134.65 137.7
Louisville	119.5	124.5 120.5	124.5 120.5	121.9	128.55	Albuquerque	118.3	124.4 123.9	124.4 123.9	121.9	124.7
New Orleans	119.5	125.5 120.6 124.45	123.85 118.1	121.9	124.1	Phoenix	118.7 120.9	119.2 123.7 120.4 120.7	119.2 124.9	121.9	124.5
Cincinnati	118.3	119.7 124.9	119.7 124.9	121.7	132.6	Los Angeles	120.8 118.9	124.5 128.5 124.9	125.2 124.3	121.75 121.65	128.2 126.35
Cleveland	120.9	124.0 124.5	118.9 118.15	121.7	127.5	San Diego	133.3	127.3	127.3	121.7	133.4
Detroit	121.1	124.05 125.15	120.15 118.95	121.8	119.95	San Francisco	120.5	134.5 123.85 132.55	124.4 120.9	121.8	127.8 125.5
Chicago	118.1 126.2	119.0 125.7	125.0 125.4 127.4	121.9	127.95	Seattle	118.3	119.2 119.5	120.4 123.9	121.9	121.2 128.5
						Portland, Ore.	126.2 118.7	119.8 118.1	124.9 127.85	121.9	124.2 125.8

*All three New York City area airports share four Center frequencies.

All megahertz frequencies listed by airport areas above have been assigned by the Federal Aviation Agency with the approval of the Federal Communications Commission.

Some frequencies are in operation only when the air traffic flow at an airport becomes congested and more communication channels are needed. Thus, there's a choice of several frequencies at many airports for approach control

and departure control. Some selected terminals subject to heavy congestion periods list more than one channel for control towers and ground controls.

Rarely do airports change transmission frequencies. However, this has occurred in cases of unusual interference problems. For up-to-date information in your area, telephone the closest FAA installation. This may be listed under U.S. Government in your directory. If not, call your local airport for the number.

TUNE IN AIRBORNE ACTION

(Continued from page 82)

tude flights within the continental United States. A jetliner flying from New York City to Los Angeles passes through five or six areas controlled by different centers.

Listeners near airports may choose to tune in on local control towers, which broadcast takeoff and landing instructions to aircraft in their area; or they may choose to listen to the various "approach" and "departure" radar-control channels that direct and guide planes to and from the airport. Listeners near a major terminal may find the chatter on "ground control" or "clearance delivery" channels interesting. The ground-control frequencies, quite active, instruct planes taxiing along the runways, while clearance delivery operators issue pilots flight

plans and navigational instructions prior to take-off.

Pilots and some would-be pilots like to monitor their local airport control-tower frequency to learn runway information, wind direction, altimeter settings, traffic flow and who's flying today. In foul weather, the radio frequencies come alive with chatter between the ground-based controllers and pilots trying to pick their way through the clouds.

Know where to tune

By learning the most-used radio frequencies in your area, you can tune to the Federal Aviation Administration (FAA) Flight Service Stations as they receive and transmit flight plans from thousands of private and corporate aircraft. Hundreds of FAA/FSS installations dot the country.



Lafayette Radio sells Soundesign's seven-band portable. It covers CB, police and shortwave, as well as aviation. About \$60.

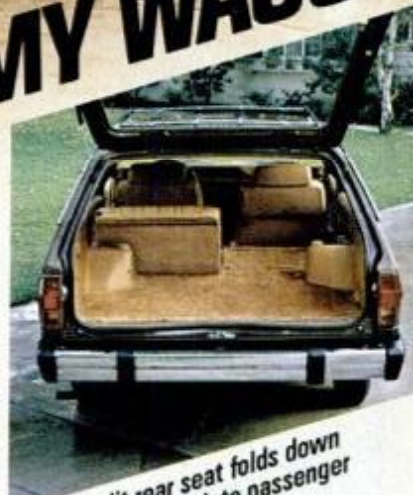
Other air communications buffs like to eavesdrop on airline-company frequencies. Pilots on these chan-

(Please turn to page 214)



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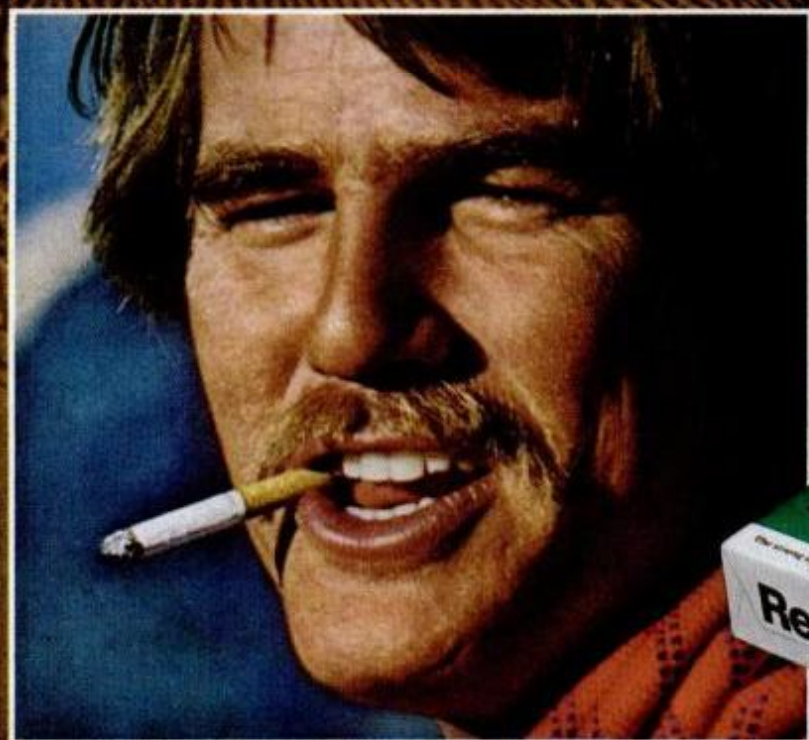
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ULTRALIGHTS: They're re-inventing the flying machine!

Suddenly the skies are filling with a strange new breed of hybrid aircraft that are part glider, part airplane and all fun. You can build one from a kit and may not even need a license to fly it!

by Bill Allen

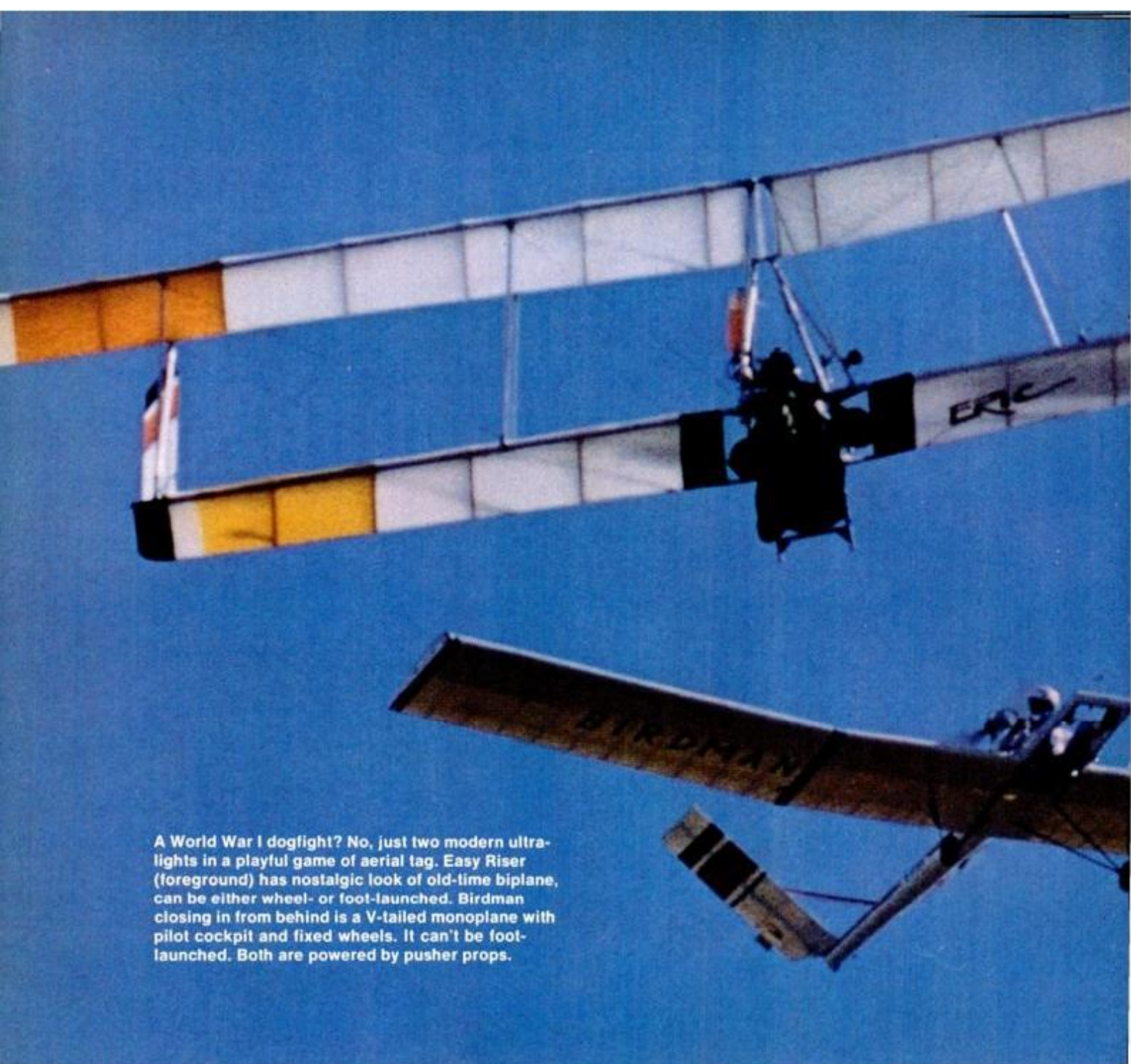
PM photos: Bill Allen, Howard Levy, Ed Sweeney

Soaring aloft at a "breathtaking" 30 mph is Klaus Hill in his big-winged Hummer, one of most advanced examples of new ultralight aircraft. Powerplant is 17-hp one-lung snowmobile engine mounted above slim aluminum-tube "fuselage." Craft sports pilot's seat, steerable landing gear, is cleverly controlled through "ruddervators" in dual-function V-tail.



If it were three-quarters of a century ago, the pilot above might be Wilbur or Orville Wright flying one of the famous brothers' filmy little stick-and-fabric contraptions in man's final, epic victory over gravity in powered flight. But it's not 1903. The time is now, and the pilot is Klaus Hill, designer of the Hummer, an equally filmy but highly efficient product of modern technology. The Hummer is typical of a brand-new breed of ultralight aircraft that

seem to be part hang glider, part sailplane, part true airplane and part something else, all in an elusive mixture that no one yet—not even the FAA—can quite fully define. Whatever you call them, these quaint, intriguing, often ingenious new flying machines represent sport aviation's latest, most exciting thrust. They promise some giant bureaucratic headaches, but also the fascinating possibility of low-cost personal flying with—in certain cases—little or no



A World War I dogfight? No, just two modern ultralights in a playful game of aerial tag. Easy Riser (foreground) has nostalgic look of old-time biplane, can be either wheel- or foot-launched. Birdman closing in from behind is a V-tailed monoplane with pilot cockpit and fixed wheels. It can't be foot-launched. Both are powered by pusher props.

governmental regulation. The significance of this is far greater than may be immediately apparent. Just imagine hopping into your ultralight, firing up its mini-engine and soaring off into the skies—without even having a pilot's license. If you live near a field or have a fair-sized back yard, you might actually fly out of your own home "air base." Many ultralights are currently flying without either aircraft registration or pilot licensing and may be permitted to continue doing so provided they meet certain FAA requirements.

Another feature of ultralights is that they are designed to fold or disassemble in such a way as to be easily trailered or cartopped to and from a launching site. You don't

need airport runways because these featherweights take off and land on grass or dirt, and you don't pay hangar fees because your garage is your "hangar." You can build an ultralight from a kit and probably pay far less for it than you did for the family car.

When is a glider a plane?

In what might be called the "gray area" of sport aviation, traditional distinctions between aircraft types are fast breaking down and bold new design approaches are proliferating at a rapid pace. What only a few years ago were relatively simple foot-launched, flex-wing hang gliders—little more than man-carrying kites—are now sprouting

small engines, rigid wings and tails, wheeled landing gear, sophisticated aircraft-type control systems, even nice, comfortable pilot cockpits complete with joy sticks, throttles and flight instruments. When does a hang glider become an airplane? It's getting harder and harder to tell.

Adding power to gliders—while possibly bothersome to some purists—does offer definite advantages. For hang gliders, it means getting airborne without jumping from cliffs or running your legs off down steep slopes—especially welcome if you live in flat country where hilly launch sites just aren't handy. For sailplanes, it means the convenience of self-powered take-



A twin-engine hang glider? Yep—it had to come! This Manta sports pair of 5½-hp chain-saw engines said to give 51-pound thrust. Dual system holds 40 minutes' fuel, weighs 26 pounds, will be sold under Gemini name as add-on power pack to fit most hang gliders.

offs without the cost and complications of having to hire a tow plane. Once aloft, you can switch off your engine and glide gracefully on the wind—but the prop is always there to help you stay up or get you quickly and safely back home.

Hill's Hummer is a prime example of the dramatic cross-pollination taking place between gliders and airplanes. It uses hang-glider construction techniques, but looks and flies like a real airplane. Its "fuselage" is a 19-foot-long, 5-inch-diameter aluminum tube to which are attached a pilot's open-air seat, wheeled landing gear, a huge wing with a 34-foot span and an ingenious dual-function V-tail. Mounted behind the pilot and above the keel tube is a pusher prop driven by a tiny 250-cc, 17-hp

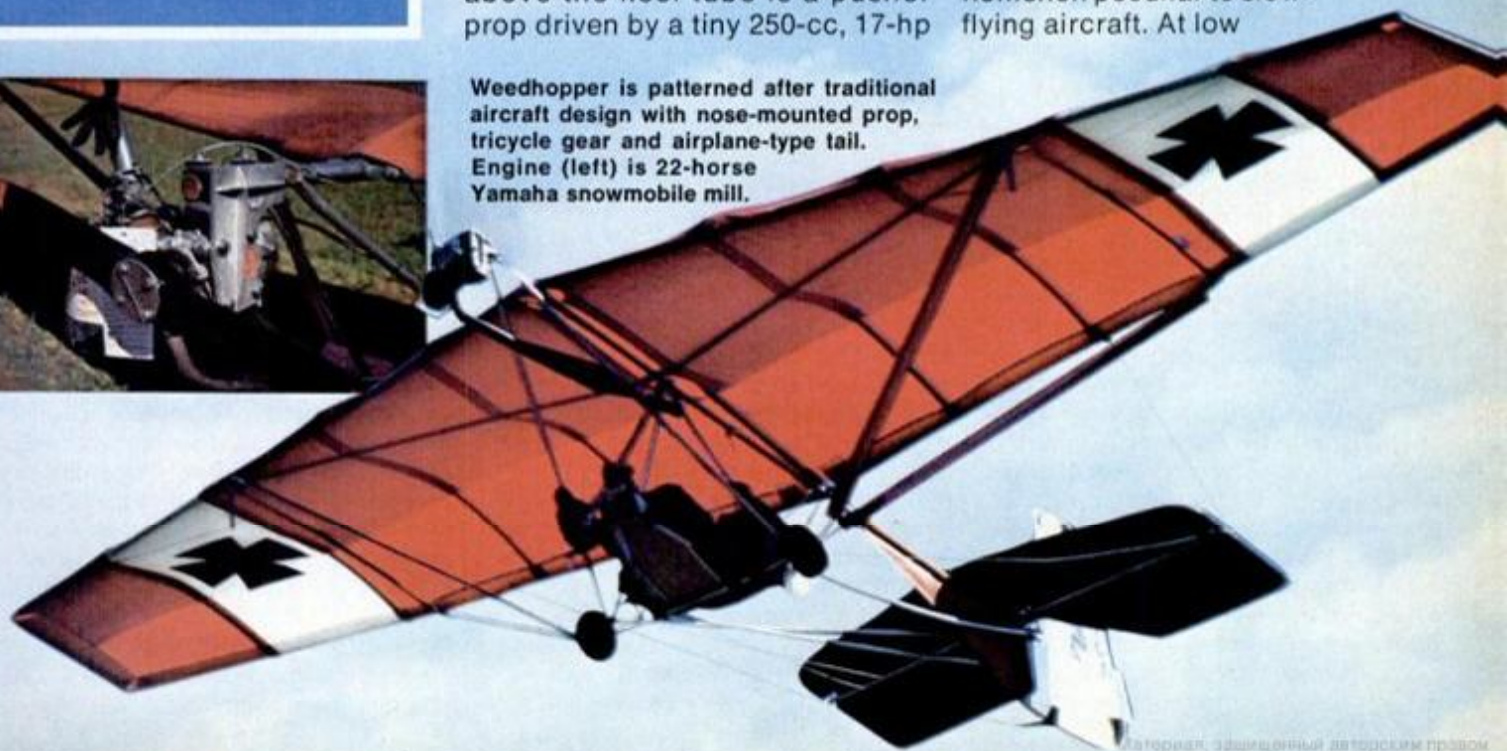
modified Chaparral snowmobile engine.

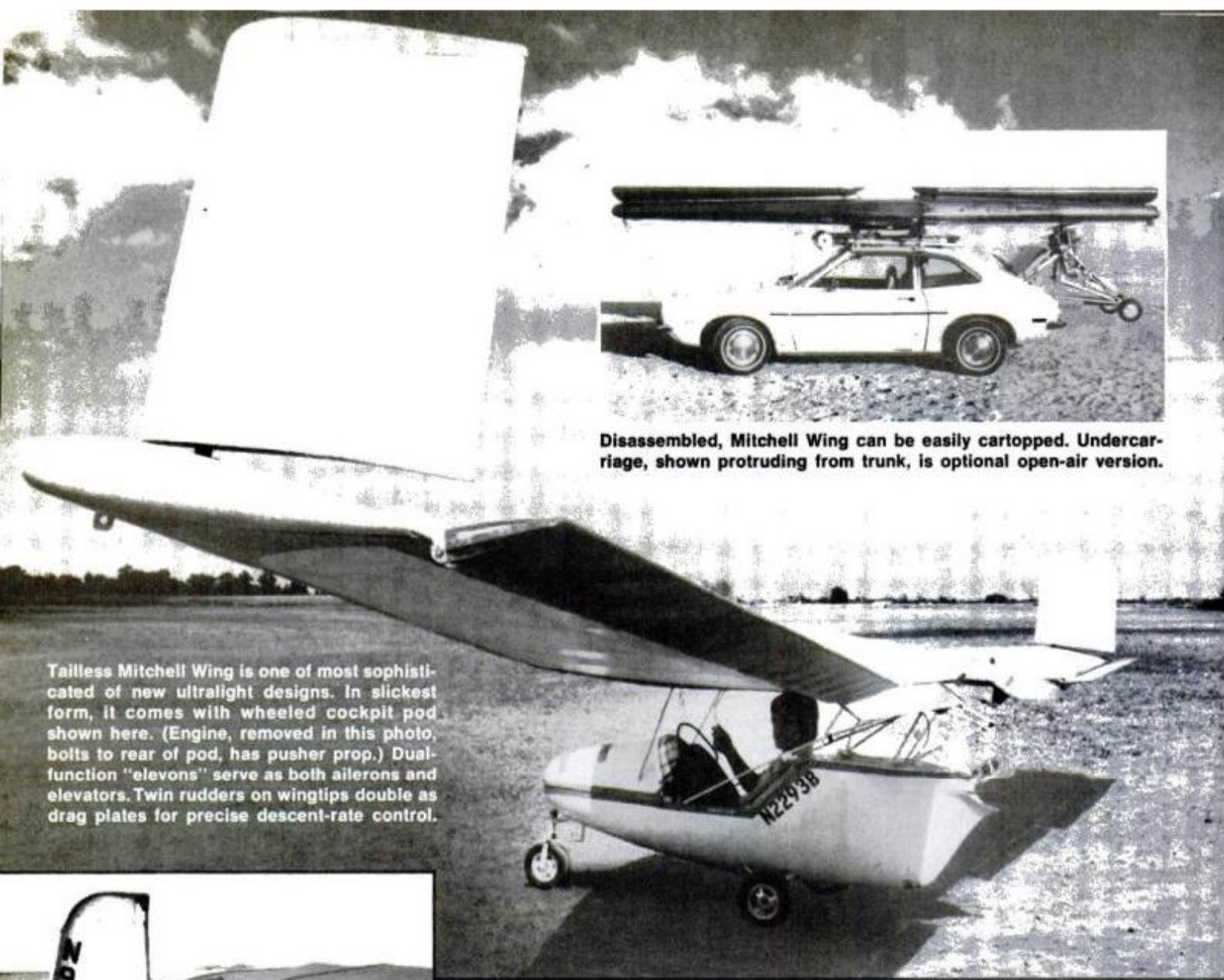
Despite this minimal power, the Hummer cruises happily along at a breezy 32 mph, hits top speeds of 45 to 50 mph and can climb 350 feet per minute. Its secret is low weight—a mere 170 pounds empty. Gross weight is 370 pounds, meaning it can actually carry a payload (pilot and fuel) greater than its own weight. Its wing, which unbolts and folds in two at the middle for trailering, consists of a simple nonribbed aluminum-tube frame covered with Dacron-sailcloth sleeves that slip on and off like socks.

There are no ailerons, yet the craft provides the effect of true three-axis control. This is made possible through an unusual phenomenon peculiar to slow-flying aircraft. At low



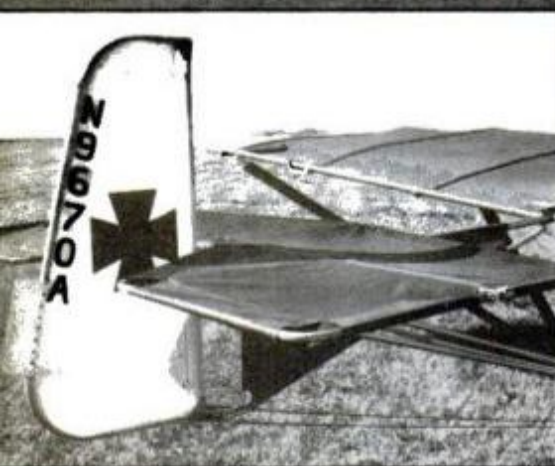
Weedhopper is patterned after traditional aircraft design with nose-mounted prop, tricycle gear and airplane-type tail. Engine (left) is 22-horse Yamaha snowmobile mill.





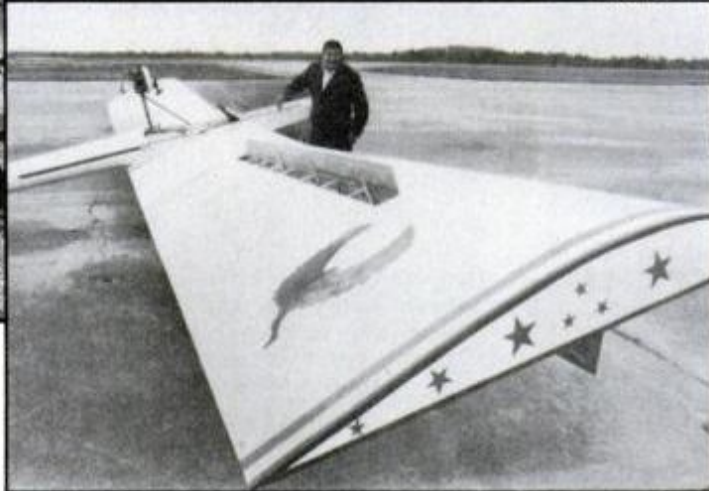
Disassembled, Mitchell Wing can be easily cartopped. Undercarriage, shown protruding from trunk, is optional open-air version.

Tailless Mitchell Wing is one of most sophisticated of new ultralight designs. In slickest form, it comes with wheeled cockpit pod shown here. (Engine, removed in this photo, bolts to rear of pod, has pusher prop.) Dual-function "elevons" serve as both ailerons and elevators. Twin rudders on wingtips double as drag plates for precise descent-rate control.



speeds, a plane can be banked by rudder alone because, as it turns, the inside wing slows down, loses lift and dips, while the outside wing speeds up, gains lift and rises. The result is a natural roll in the direction of the turn without the need for ailerons. (A fast airplane, not sensitive to this effect, would make flat, sloppy, skidding turns if ailerons were not used.)

In the case of the Hummer, all control is through "ruddervators"—combination control surfaces that function as both rudders and elevators. Moved differentially—one "inward" and the other "outward"—they serve as twin rudders. Moved collectively—both "up" or both "down"—they become elevators. These are connected to a single control stick that acts as a mixer to coordinate the two



Various types of control systems are used on ultralights, each designer preferring his own method. Weedhopper (far left) has no ailerons, but gets effect of three-axis control through conventional tail with rudder and elevator (see text explanation). Birdman (near left) has "spoilerons" that act as ailerons, spoilers. Mitchell Wing has "elevons" and rudders (see above).

functions. Hooking the rudders to the stick instead of to foot pedals gives the pilot the same "feel" he would experience if flying a conventional airplane with ailerons. Moving the stick sideways banks the craft to the right or left, while moving it forward or back controls dive and climb. There are foot pedals, but these are connected to a steerable tail wheel and are used only for ground maneuvering.

The Hummer can take off in 150 feet—half the length of a football field—and land in a distance only several times its

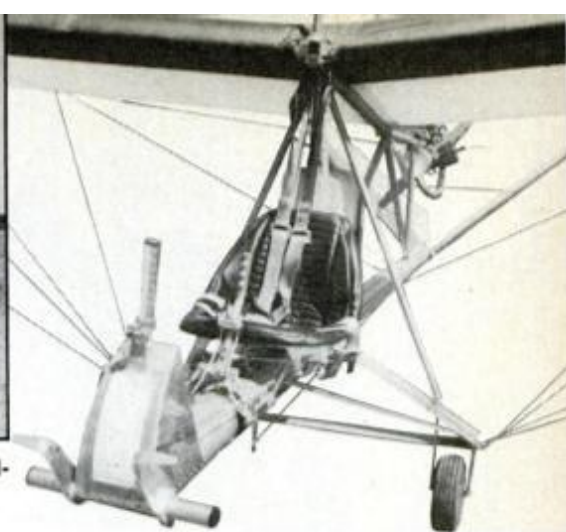
own length. Its comfortable—if somewhat drafty—"cockpit" features a padded bucket seat and mini-instrument console that reads out forward airspeed, vertical speed and engine rpm. The entire craft can be assembled or disassembled by one man in 15 to 20 minutes. Full kits are planned for about \$2500. Construction time is estimated at 50 to 70 hours.

New power for ultralights

Of similar construction is John Chotia's colorful, eye-catching Weedhopper



With wings removed and folded, Hummer (shown in flight on first page) is ready for trailering. At right is close-up of pilot seat, main wheels, foot pedals for ground steering.



(shown on the cover) with reclining pilot seat, tricycle landing gear and 28-foot Dacron-covered wing. Like the Hummer, the 160-pound craft has no ailerons but sports a conventional airplane-type tail with separate rudder and elevator. Both control functions are hand-operated through push-rod and cable linkages. A footrest is used only for ground steering which is done by means of a swiveling nose wheel.

Unlike the Hummer, the Weedhopper has a tractor prop and nose-mounted engine supported ahead of the pilot on tubular struts. The prototype shown here uses a 22-hp Yamaha motorcycle engine, but Chotia has now developed his own powerplant designed especially for ultralights. Called the Chotia 460, this versatile 456-cc, 18½-hp, single-cylinder power pack offers a number of virtues: low operating rpm (3500), light weight (31½ pounds), low compression, easy tuning and reliable battery ignition. The Chotia 460 may well supplant many present powerplants which tend to be jury-rigged adaptations of motorcycle, snowmobile or industrial engines not designed for aircraft use. The disadvantages of these are greater weight, excessively high rpm and generally short useful life.

The Weedhopper cruises at 30 mph, climbs 320 feet per minute and has a range of 30 miles on a single gallon of fuel. It will be supplied in kit form, including the new Chotia 460 engine, for around \$2200. Construction time is said to take only 40 hours. (For source information on this and other ultralights, see listing at the end of this article.)

Other new engines for ultralights are also coming on the scene: The 24-hp, twin-opposed, 7500-rpm, two-cycle Dyad, originally designed for RPVs (remotely piloted vehicles), is now seeing use on some sailplanes. Despite its relatively high rpm, its extremely low weight—only 12½ pounds—makes it an attractive choice for light-aircraft use. The almost vibrationless Sachs Wankels have been intriguing experimenters, although they're not now readily available. Made in 58-, 109- and 160-cc sizes, with

power ratings of 8 to 32 hp and in weights from 10 to 25 pounds, these little rotaries promise ultralight builders a wide range of power options if supplies increase.

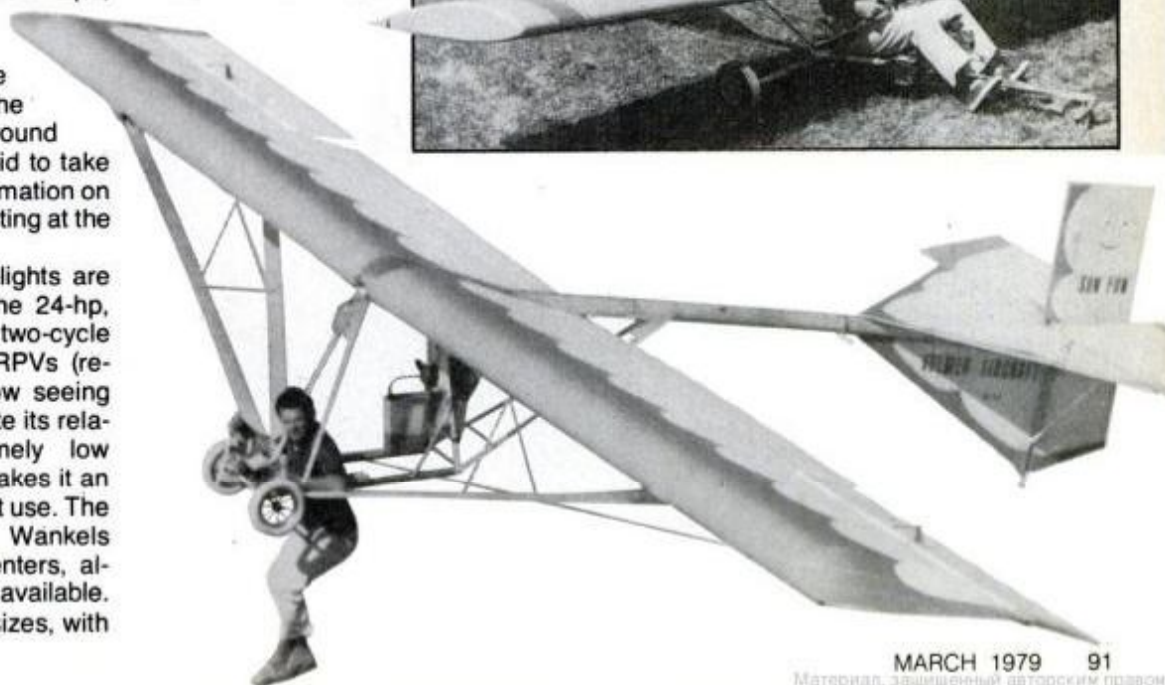
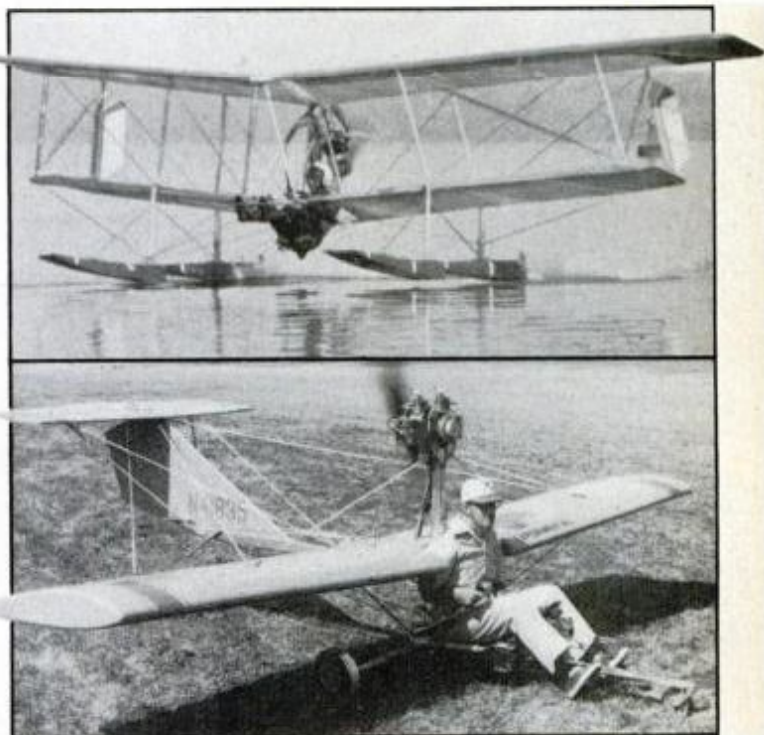
One of the most unusual innovations is a twin-engine setup which pairs two 5½-hp chain-saw powerplants on a hollow connecting tube that also doubles as the "fuel tank." The engines are modified Swedish A. B. Partner types directly driving small props at 5500 rpm. The 26-pound rig, marketed by Gemini Interna-

tional, is designed to bolt quickly onto virtually any rigid or flex-wing hang glider. Gemini also produces an accessory tricycle landing gear with steerable nose wheel and a powered version of the Fledgling II hang glider, a derivative of an earlier Klaus Hill tailless monoplane.

Meanwhile, the McCulloch MC-101 and Chrysler/West Bend 820 engines continue to be favorites for adding power to simple foot-launched hang gliders

(Please turn to page 202)

Ultralights come in odd and unusual forms. At top right is seaplane version of Easy Riser fitted with add-on floats. Pilot sits in slinglike seat, can lower feet for foot-launching with floats removed. At lower right is PDQ-2 with distinctive T-tail, full-span ailerons, pylon-mounted engine. Side stick works something like a boat tiller. Tri-gear craft can't be foot-launched. VJ-24 at bottom has rudder, elevator, ailerons, is foot-launched (wheels for ground use only).



Lifesaving

Doctors today are saving lives with Lilliputian scalpels, splinter-sized needles, wisps of thread and very steady hands.

by Gurney Williams III

A 35-year-old businessman was walking down the hall of his office when the floor seemed to slide away under him. He staggered and fell as the walls appeared to swirl. The nauseating dizziness continued even after fellow workers helped him back to his desk: He found he didn't have enough sense of balance to sit upright in his chair.

The terrifying 20-minute episode, as doctors later analyzed it, was the first sign of a stroke—an arterial obstruction partially damming off blood flow to the brain. Dr. Jack Fein of New York, to whom the case was referred, said the man was in extraordinary danger. Five years ago, he probably would have died.

But today the businessman is alive and healthy, one of thousands of beneficiaries of surgery performed under the lenses of microscopes, with scalpels and other tools whose tips are so small they can hardly be seen by the naked eye.

Zoom-lens microscopes

Using microscopes with foot-controlled zoom-systems, surgeons across the country in recent years have reattached severed limbs, and restored sight to eyes that are clouded by hemorrhaging. They have reversed vasectomies with a better-than-even chance of success, removed tumors and redirected blood flow in the brain to save lives. In the course of their work, many have become accustomed to watching life processes on a Lilliputian level. They've cheered at the pulsings of tiny pink vessels, and they've tracked nerves like a pilot following road patterns through a bomb-sight.

Almost all microsurgery operations are dramatic. Fein's work often draws small audiences of medical students and others who come to watch the procedure on a closed-circuit color TV system which also records operations on videotape. There were about 10 observers, he

surgery—under a lens

said, on the day of the businessman's operation.

Much of the equipment Fein used to work on the surface of his patient's brain was delicate and sophisticated. Forceps are so delicate, for instance, that dropping them from a height of half an inch could throw them out of adjustment. But the principle behind the operation was simple. It involved finding an artery on the outside of the man's scalp, cutting a silver-dollar-sized hole through the scalp, and splicing the outside artery into a vessel supplying blood to the brain. The connection, located higher than the blockage, would allow an adequate supply of blood without having to open up the clogged vessel.

Needle thinner than hair

The operation takes about four hours. The hardest work is stitching the open end of the outside vessel down over an oval-shaped hole cut in the cerebral artery. Fein attaches the two vessels with 30 stitches, or sutures, using a splinter-sized curved needle, and thread a fifth the

thickness of human hair. The site of the stitching, magnified 40 times by the microscope, is bloodless. Clamps on either side of the hole in the whitish vessel squeeze down just enough to stop blood flow.

The critical moment comes when these clamps are released and blood is allowed to flow through the new junction for the first time.

What happened in the case of the businessman was typical. As soon as the clips were opened and removed, the vessels began pulsing rhythmically. They turned from white to pink. There were no leaks. Within seconds of watching the throbbing arteries, everyone knew the man who would have died young without the operation now had a good chance to lead a normal life. The operating room crowd applauded.

That kind of scene has become

more common in recent years as equipment has improved and success rates for microsurgery have risen. At Albert Einstein College Hospital, where Fein practices and teaches, he has performed the five-year-old operation about 60 times, 30 times in the past year. Only one patient died and the death, Fein said, might have been unrelated to the operation. Fein anticipates doubling the number of such operations each year for the immediate future.

Other surgeons we talked with across the country confirmed that more and more microscopes are appearing, draped in white as an additional precaution against infection, in the operating rooms of large hospitals.

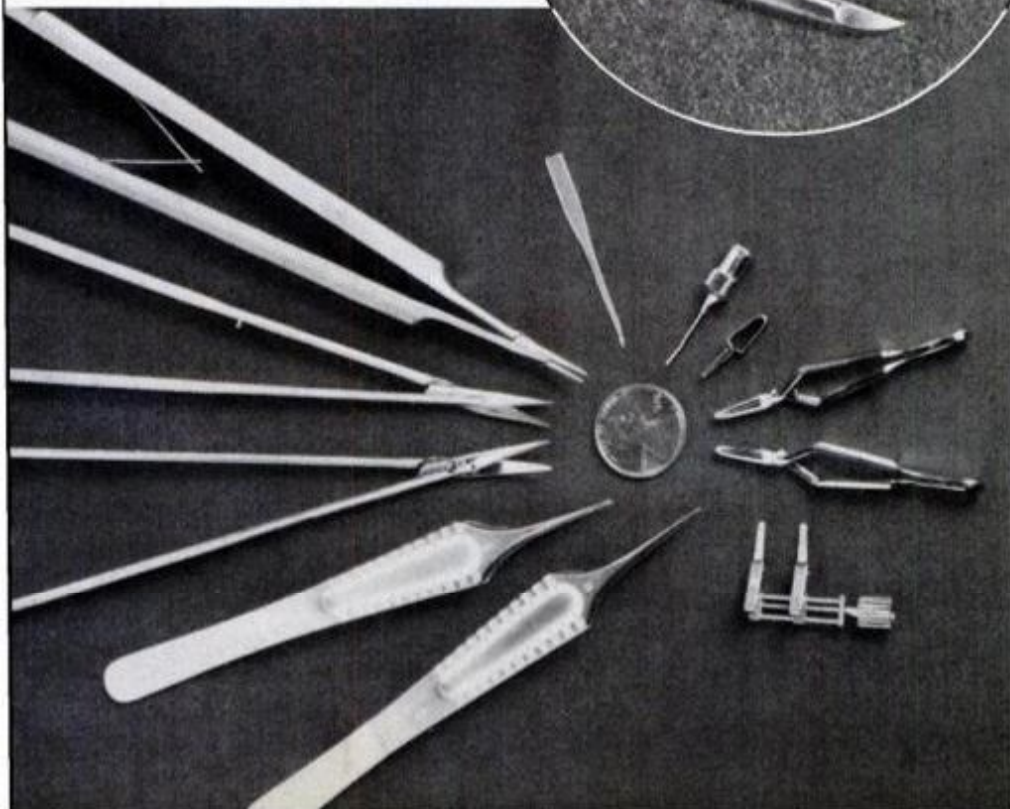
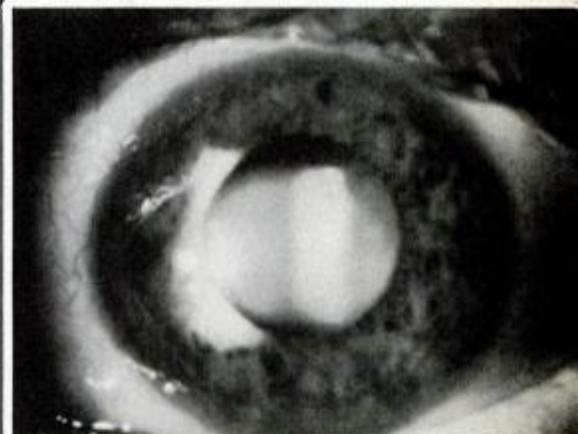
The trend means some retraining for doctors who are unaccustomed to working with the equipment and techniques. Microsurgery calls for ascetic discipline and a tremor-free touch: a slight twitch of a wrist during an operation on the brain can cause life-threatening damage to a blood vessel.

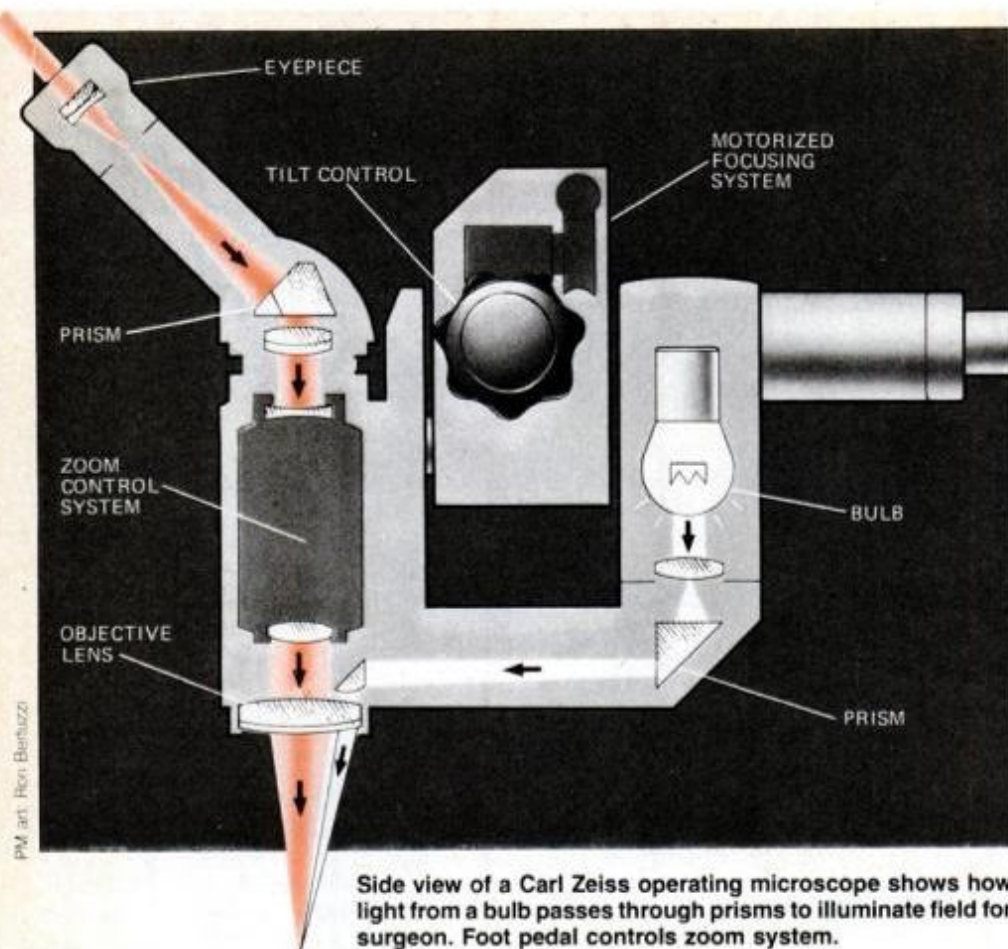
A sampling of microsurgery instruments includes a tiny scalpel, enlarged at right. Other instruments below, clockwise from scalpel, include irrigating needle, four vessel clamps, two forceps, two scissors, and a needle driver. Total cost: about \$675.



Blurring in the eye below is caused by hemorrhaging of small vessels on the retina. Bottom photo shows the same eye two years after microsurgery. The operation—called a vitrectomy—offers some hope for patients blinded by the diabetes-related disability.

Wilmer Ophthalmological Institute, Johns Hopkins Hospital





Side view of a Carl Zeiss operating microscope shows how light from a bulb passes through prisms to illuminate field for surgeon. Foot pedal controls zoom system.

The meditation stance

To keep hands rock solid during microsurgery, surgeons adopt a posture that makes them look as though they're meditating. Their hands rest side by side on a flat surface to control any trembling from wrist or arm. They sit straight-backed; a prism system in the microscope bends images through 90° so surgeons don't have to lean forward. Prior to surgery, they avoid strenuous lifting work which can produce slight quivering for hours after the work is done. Many cannot drink coffee before an operation.

Apart from the fear of trembling on the job, microsurgions need to adjust to what one called the "unreal feeling" of performing major surgical procedures in an area often no bigger than a fingernail.

Mile-long millimeter

"All doctors looked at slides under a microscope in medical school," said Dr. William Shaw, chief of plastic surgery at Bellevue Hospital in New York. "But it takes a lot of retraining to learn what you can do to change the scene under the microscope. At first, you think you're moving a millimeter, and you wind up moving a mile."

At a research laboratory at New York University, Dr. D.L. Ballantyne Jr. invited me to have a look through a Zeiss operating micro-

scope to get a feel for what microsurgions see.

An Olympian view

The view was startling. It looked like an aerial photo of a silvery pipe floating on a brilliant blue lake. The pipe was cut in the middle. As I watched, a curved needle held in the jaws of what looked like a giant pair of tweezers was driven into the pipe's wall on one side. Pulling black cable behind it, the needle arched across the gap and plunged decisive-

How surgical splice helps stroke victims

Working under a microscope, surgeons locate cerebral artery carrying weak blood supply, clamp off vessel, cut an oval hole (1). They then pass clamped scalp artery (vessel outside skull) through bone and suture it down over the hole (2). Jeweler's forceps help tie 30 knots for leak-free connection between vessels (3). When clamps are removed, blood from outside artery pulses into brain, compensating for poor blood flow caused by blockage below surgery.

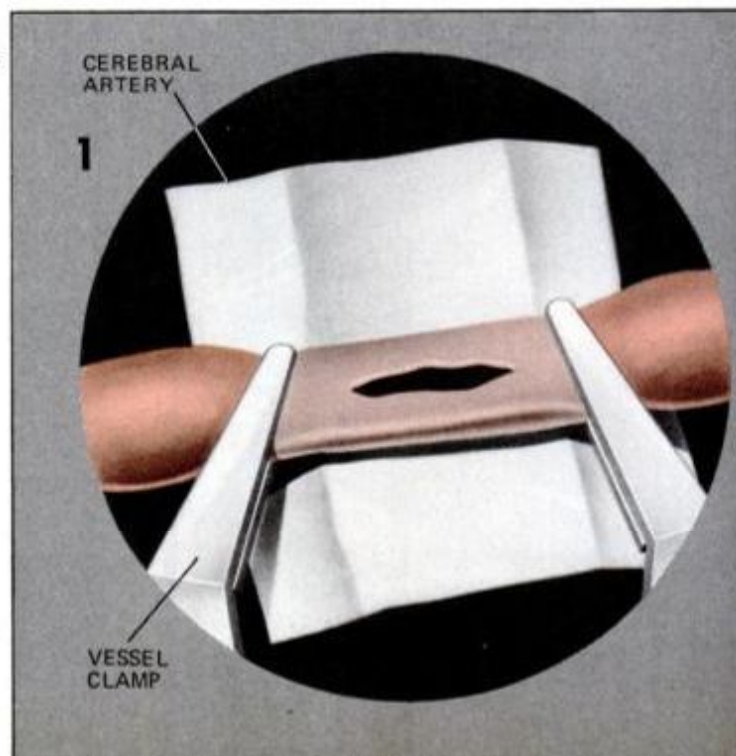
ly through the wall of the pipe on the other side of the lake. Then the view changed suddenly. With a whirring sound, the microscope zoomed up and away to a higher perspective, revealing what looked like pink land bordering the lake. In a few seconds, other impersonal instruments had worked the cable into a loop, and pulled a free end through the loop to make half a square knot. The two ends of the pipe came together over the blue lake as instruments pulled the cable taut.

I backed away from the eyepiece and looked down at the brightly lit table. There was a small white rat lying there, its nose breathing ether and air from a test tube, its legs held fast to a dissecting board with rubber bands. I had been watching the reconnection of the rat's femoral artery, a sliver of a vessel carrying blood to the rat's left leg. The site of the reconnection, performed by technician Alice D. Harper, was less than an inch square.

Invisible thread becomes cable

The blue lake was a patch of blue rubber used as a backdrop to make the vessel—the broken pipe—stand out. Without the microscope, the needle was barely visible. And I couldn't find the thread—the "black cable" seen under the lens—at all.

The procedure I had watched, the reconnection of severed vessels, is the first skill microsurgions learn—the critical technique that enables them to reattach severed hands and fingers. The procedure was still in experimental stages 15 years ago. In 1977, the latest year for which figures are available, U.S. doctors performed 1300 such operations, according to government estimates. In



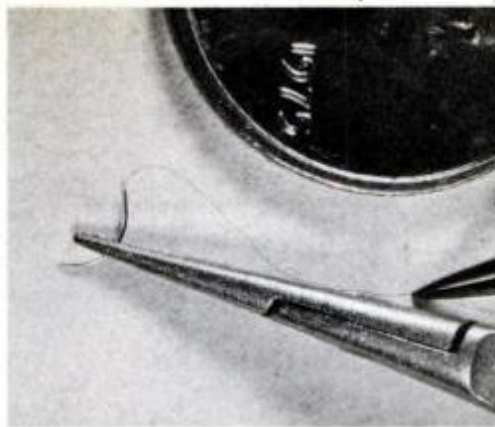
one famous case last year, Neil Armstrong, first man to walk on the moon, regained his ring finger through such an operation after the finger was torn off as Armstrong leaped from a truck.

Success rates on reattachments are impressive. Dr. Laurence LeWinn of New York Hospital says that about nine out of 10 of his operations result in fingers that function more or less normally.

The forgotten finger

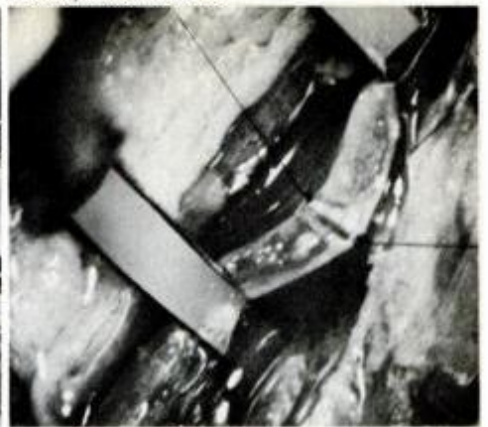
One of LeWinn's first patients when he began performing the operation a few years ago was a cook in an expensive New York restaurant who cut his right index finger off while chopping chocolate for a soufflé. In his haste to get to the hospital, he forgot his finger on the kitchen block. The maitre d' found it, wrapped it in linen, and packed it in ice in a silver wine bucket for delivery. Within an hour, LeWinn was at work fastening bones back together with a small pin, reattaching arteries, veins and nerves. The chilled finger regained its color and warmth. Shortly after the operation, it was moving again.

LeWinn said doctors today have learned to be more discriminating about when to reattach fingers. It isn't always a good idea, he said. "We've discovered that people who lose index fingers quickly learn to compensate with middle fingers. And sometimes the operation results in stiff and only partially functioning finger. So to put a patient through surgery and recovery sometimes seems to be a waste." But LeWinn will almost always try reattachment when several digits are cut off, or when children lose any



Needle driver holds half-moon-shaped needle used in microsurgery. Thread wisps are only a fifth as thick as human hair.

Photo by Vincent Carrasco



Microscopic view at New York Hospital reveals severed femoral artery of a rat, clamped down during operation.

finger, or whenever anyone loses a thumb.

Making toes into thumbs

"The thumb is your most important finger," he said. "We'll try to reimplant that in almost everyone." The thumb is so important, in fact, that surgeons over the past decade have come up with a microsurgical technique that works in cases where the thumb is too badly mangled to reattach. They amputate a toe and move it to the thumb's position. The toe looks normal on the hand. More importantly, it restores the hand's power to grasp.

Other surgeons are using the lenses and small-tipped tools of microsurgery to restore sight to patients blinded by diabetes.

Doctors aren't sure what leads to the condition, but about half of the more than 10 million victims of diabetes in this country notice some deterioration in vision. In a small percentage of these cases, new and abnormal blood vessels grow on the

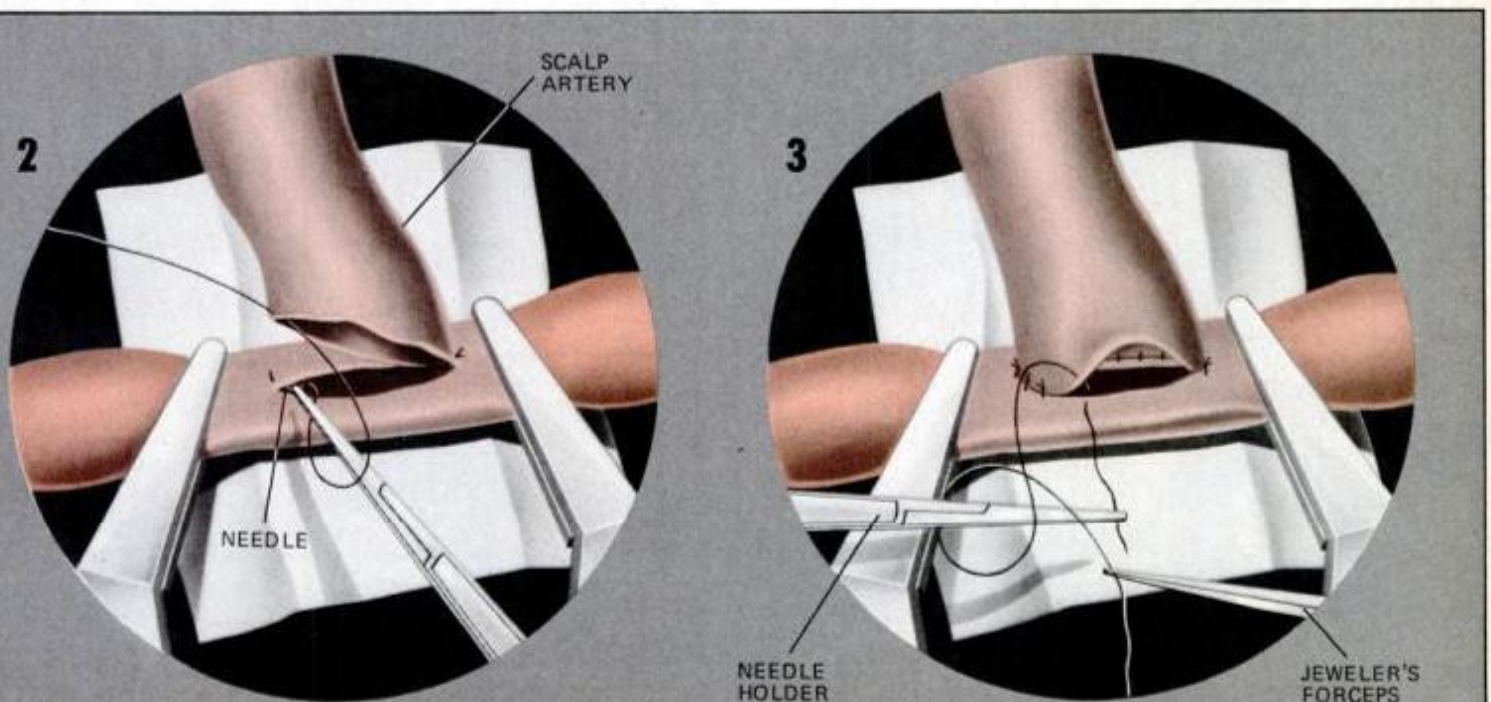
retina at the back of the eye. They push out into the clear jelly-like vitreous that fills the interior of the eye. Often, these spurious vessels develop small leaks, clouding the vitreous with blood.

Hope for blind diabetics

Within the past few years, a new operation has offered some hope for these patients. Working under a microscope, doctors insert an instrument into the side of the eye. It cuts into the opaque vitreous, draws it out and replaces it simultaneously with a clear solution. Many of the once hopelessly blind patients who have undergone the operation—called a vitrectomy—now see well enough to get around by themselves. A few can read.

The procedure is less than a decade old and all the returns aren't in yet on how successful it is. It doesn't always help. And it does entail risk. Some patients develop infection, cataract or other problems after

(Please turn to page 200)



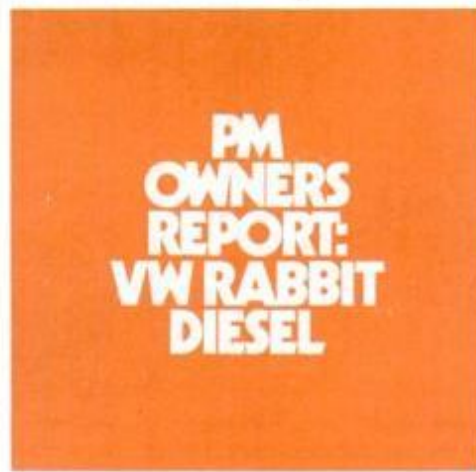
Rarely in the history of PM's Owners Reports have so many owners been so totally happy with their cars. Nearly 94 percent said they'd buy another VW diesel next time they're in the market for a new car.

Can the VW diesel do no wrong at all? It seems just about that way. Except for a twinge of dissatisfaction with dealer attentiveness and a few grumbles about not being able to order a five-speed gearbox (available in the 1979 model) owners of Rabbit diesels wear smiles virtually all day every day. The owners we surveyed bought their diesels in June 1978.

"This is a much 'bigger' car than I had anticipated," notes a Michigan educator. "It has an extraordinary ride, excellent handling, unbelievable traction in snow, and amazing economy. I've found zero items of misfit or mismatch. It's the best car I've owned in 28 years of driving, and



Round headlights distinguish diesel Rabbits from the U.S.-made gas models with rectangular headlights.



my only regret is that I had to wait too long to get it!"

An Ohio schoolteacher praises: "I've owned other VWs and have always liked them. This diesel—I like the fuel mileage, the fact that it'll never need a tune-up, and the fact that VWs don't get recalled. They're quality."

A retired electronics engineer from Maine writes, "I feel that every American should own, where practical, the most fuel-efficient car possible. I waited three years for an affordable diesel automobile from Detroit, then moved reluctantly to a Rabbit. I do find this car to be carefully conceived and assembled. Fuel economy is most satisfactory. Ride and comfort compare well with much larger American cars. Trunk space is well designed, am-

ple, especially with the folding rear seat. Finding diesel fuel is no problem, but I am annoyed at the discount pricing of fuel for truckers—a practice that should be stopped or equalized."

A Georgia senior-citizen's center director: "My 6-foot-6 husband fits inside fine. I'm especially impressed with the car's tightness of construction and its handling on curves and corners. Its stability in crosswinds is much better than our previous Beetle and VW bus."

An Ohio toxicologist shouts, "Great mileage!!! Great front-wheel drive!!! Great maneuverability!!! I bought this car for its excellent fuel economy and the



A Rabbit with a diesel powerplant has the fact spelled out on the rear decklid.

ability of the engine to last 200,000 miles before repairs are required."

And a California postman says, "I was completely sold by my first test drive. It's very comfortable on long trips. After I'd put about 4000 miles on this car, I drove

BY MICHAEL LAMM WEST COAST EDITOR

No way around it: You have to visit the 'gas' station once a month

Handling of the front-wheel-drive Rabbit is well liked by owners

Size and interior roominess is a plus

Better noise insulation would be appreciated by some owners



to Mexico City and Acapulco. The price of diesel fuel in Mexico is about 10.5 cents a gallon! My entire 5600-mile journey cost me a mere \$15.50!"

Dissatisfaction with dealers

The majority of owners had no complaints of any sort about their cars. Nearly 12 percent, though, told of dealer service problems. Dealer relations had been strained in some cases by what buyers felt were hard-line tactics during purchase.

"I have never felt so unimportant as when we bought our Rabbit diesel," complains a South Carolina electrician. "We were actually told that if we didn't want the car, it didn't matter to the dealer—he had plenty of other people waiting. The service department takes the same attitude."

A California payroll clerk grumbles, "The dealer put extra items on the car that I hadn't ordered. He charged me for those, plus another \$400 for 'inventory maintenance and flooring,' whatever that is. Sounds like extra profit for the dealer, doesn't it?"

An Arizona orthodontist: "Slow, almost reluctant service managers don't seem to know anything about diesels. When I ask them questions, they run back to a mechanic for answers."

And an Alabama safety supervisor: "This is my fourth Rabbit. I bought the first in Indiana, and the service there was fine.

The last three have come from two different Alabama dealers, and both are terrible. All I get is the run-around, and I have to leave the car overnight, even for minor service."

In fairness, most dealers did give satisfactory service. A New York engineer says, "My dealer's service people have helped me familiarize myself with the car so I can do minor servicing myself. I consider his people excellent."

And a West Virginia conductor observes, "Good dealer, both as regards sales and service. I've been treated with every courtesy and very promptly."

Before we leave the topic of service, a few owners mentioned that they felt their dealers were charging too much for oil filters. One respondent said he'd paid \$12.75 for a filter, and other owners set the price at around \$9. "Nine dollars strikes me as a bit much," complained a Texas housewife, "considering my husband can buy the same thing at Sears for \$1.99."

Complaints are scattered

When we asked for other types of complaints, 26.3 percent had none at all and said so emphatically.

A few wished out loud, though, that their Rabbits' front ventipanes would open. "Only two windows open in the whole car," frowned a Maine paper maker who commutes 70 miles a day to and from his mill.

Volkswagen reports that openable vent windows became standard equipment on up-option Deluxe (L) models, starting in mid-1978. They're not available, however, in VW's Custom versions, and they weren't offered at all in earlier Rabbits.

Airconditioning also became a minor area of contention with owners of early diesel Rabbits. Today, VW does offer factory air in its diesel cars, but at one time they didn't. In fact, Volkswagen even urged its dealers *not* to install hang-on, aftermarket airconditioners in Rabbit diesels. Some dealers installed them anyway and soon ran into problems with compressor mounts breaking, extreme engine vibration, and so on.

At any rate, we logged a number of complaints about early airconditioning—either that it wasn't available or that people were having problems. But both these situations have been remedied in the more recent models.

Of more scattered complaints, we received these:

"It's too easy to hit third gear when you try to downshift to first," frets a New York refrigeration engineer.

"Access to the rear seat is difficult with the automatic seatbelts," laments an Illinois auditor. As an aside, opinions about VW's passive restraint system ran about 50/50 pro and con. Some owners love it, others hate it.

A California candle designer is in the

(Please turn to page 196)

A NATIONWIDE SURVEY BASED ON 2,394,677 OWNER-DRIVEN MILES

The heart of the Rabbit diesel

Some engines find themselves doing things their designers never dreamed of.

Like the VW Rabbit engine. Developed in the early 1970s by Audi, it's currently not just Volkswagen's mainstay, but it also powers Porsches, Foxes, Gremlins, Omnis, Horizons, and European VW vans.

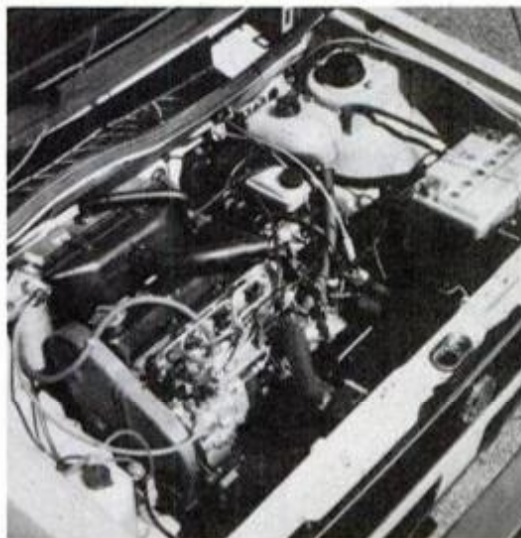
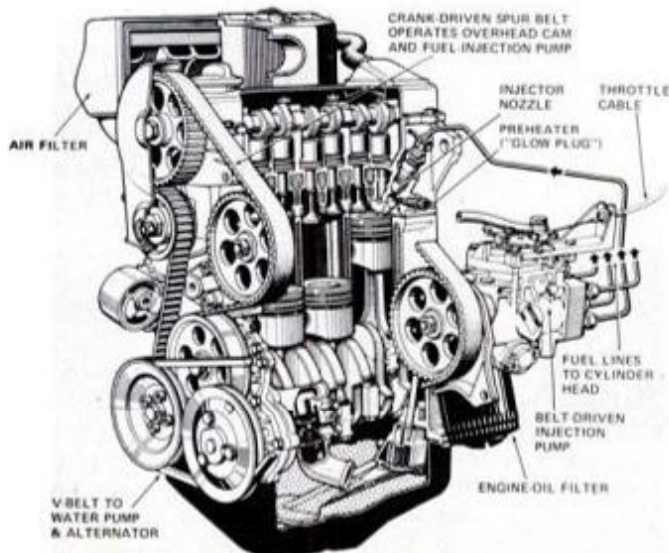
Because it was over-engineered from the beginning, this water-cooled, ohc, in-line

Four easily lent itself to dieselizing. Volkswagen introduced the Rabbit diesel in the United States in early 1977.

To convert to diesel, VW left the block and crankshaft virtually untouched, concentrating on head design, pistons, rods and the induction system. If you were to try to dieselize a gasoline VW Rabbit engine yourself, you certainly could, but the tab

would come to around \$2000, excluding labor. VW currently sells the diesel for \$200 to \$300 more than a comparable gas-fired Rabbit.

Because of its excellent fuel mileage (40-50 mpg, according to our survey), the Rabbit diesel engine will pay for itself after approximately 20,000 miles of driving.



The Rabbit's diesel engine is diagrammed (far left) and shown installed under the hood (left). According to owners, maintenance costs appear to be about the same as can be expected with gasoline-engine Rabbits. Recommended oil-change intervals are 7500 miles and major service is specified every 15,000 miles. Recommended overhaul of the diesel's fuel injectors is specified for every 60,000 miles of driving.

New rigs for rolling vacations

This year's RVs may be bigger and fancier than ever again.

by Bill McKeown RV EDITOR

This may be the year to shop for that new recreational vehicle. A preview of the latest models shows variety we may not see again. For several years the industry has been watching for an imminent crunch on the market for the big rigs that burn the most gas. So far, buyers have remained loyal and regulations have stayed lenient.

What's fun?

For a while there was a strong threat that vehicles used for fun would not be considered essential to the economy if fuel rationing came, and a line had to be drawn between useful and non-essential transportation. Should we be allowed to drive a motor home or tow a trailer out to a campground? If not, should owners of passenger cars drive to sports events, to the movies and the beach, to visit relatives on a day off? Was seeing the country less important than shopping the supermarkets?

After government hearings at which both sides were presented, it now appears that the right to relax the way we like best should determine the way we would use a gas allotment. Given a set amount of fuel, it would be up to each driver to decide how far he could go and the kind of vehicle he would use. So assorted types of big live-aboard rigs are still very much available this year. Smaller units, however, continue to grow in popularity.

What's different?

Mini-motor homes, those chopped-van conversions with bodies built behind and above the original cabs, are packing added living into up to 25 feet of vehicle. Now you can sleep up to six in one—two in the forward compartments over the driver, two by converting the dinette into a double, and two in a pull-out gauchó. The lowly bathtub has become a sign of luxury in many

rigs. Once only found in stretched-out motor homes, it now appears in more compact RVs, though usually not big enough for camping basketball players. A shower, along with hot and cold rolling kitchens, is standard now in running water for bathrooms and mini-homes.

Using a pickup truck body for a slide-in camper is still a handy way to make a work rig into a dual-purpose vehicle, though sales of the cargo-bed

units have fallen off. But now the mini-pickups, the Datsuns, Toyotas and Subarus, the Chevy LUVs and Ford Couriers, are built up with permanent camper conversions into mini-mini-homes. Chinook for several years has been making attractive installations, and now Champion Home Builders with the Galavan, Dolphin with its high-styled X-100, Sunrader with a back that lifts into a rear patio, and others, are joining the move to converting compacts. Most offer solid fiberglass-finished compact bodies, but a few use pop-up tops that can lift to expand headroom once the rig is parked.

Room to stand is always a challenge to engineers who hope to keep the wind resistance and center of gravity low, and to designers trying to get away from the shoebox look that used to be typical of so many RVs. In mini-motor homes, Diamond-Coons has come up with a stepped-back top for the G.T. Diamond that adds space and good styling. Revcon's streamlining helps a big 30-foot motor home look lean.

More room

The bunkhouse design, an arrangement we applauded several years ago when it first appeared, is now winning sleeping space in a number of new RVs. By stacking bunks double-decker style in a special narrow compartment, a large family, team, group of

sportsmen or just friends can be fitted into limited travel space. Children can turn in early without converting the living area of night-owl adults into a bedroom. Holiday Rambler, Monitor, Hop'Cap, Shasta, Coachmen, Winnebago, Itasca, Wilderness, Pace Arrow, Fleetwood, Tioga and Taurus are some of the trailer and motor-home makers that now offer this design.

Bigger still, and growing, are the fifth-wheel trailers that approach the mobile home in living space. Though still a small percentage of all RVs, they have been attracting numerous new buyers who like indoor room, don't mind driving a tow truck, and don't plan on finding a new campground every



New Leprechaun mini-motor home chopped vans from Coachmen fit sleeping for seven, even bathtubs, into 22 and 24 feet.



It's a Winnebago, but the new 26 and 29 Chieftains have less boxy look, 10 interior layouts, smaller "W" on side.

Football game tailgating by motor home can include wine steward, chef, violinist.





The chopped van mini-motor home, like Fleetwood's Flair, gives the feel of driving a smaller rig, but has headroom, accommodations, self-containment.



A camping trailer without the tent, the Apache solid-state Yuma I has new glide-out galley kitchen and can sleep six.



Twin rear windows indicate the newly popular big-family bunkhouse layout in this 25-foot Holiday Ramblette, designed in without raising the roof

Upper berth arranged across the rear of a Free Spirit Eagle Bunkhouse travel trailer (left) has slide curtain for view into living room.

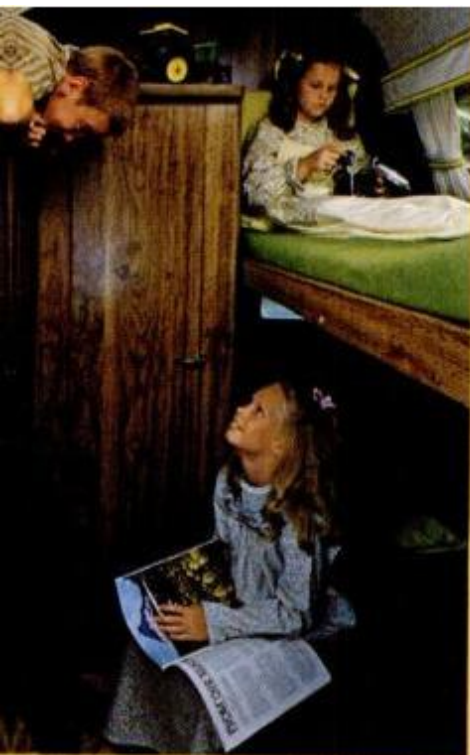


Pickups, even the mini-compacts, can mount Coleman's slide-in fold-down Country Squire and Country Squire Junior campers. Both have two doubles to sleep four.



And for compact cars, Apache's Mini Eagle 130 weighs only 510 pounds with a height of 3½ feet, but opens for two double beds.

Six models of Shasta mini-motor homes, including one with bunkhouse plan, join Shasta's van, fifth-wheel, and standard trailers.



Large accommodations in a small trailer: The Coachmen Sun Lite 160 sleeps six in a 16-footer. Other fold-down camping trailers in the line range from a 13-foot model, that can sleep four and has 6-foot-4 headroom, to the Sun Classic 210, sleeping seven.



Junior campers enjoy the clubby bunkhouse. This one is Free Spirit's Cub 25.



Which RV is which?



Camping (or tent) trailer



Travel trailer



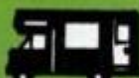
Pickup truck cover



Pickup camper



Van conversion



Mini-motor home (chopped van)



Motor home



With a steel-reinforced streamlined exterior and yachty decor inside, the new 25-foot Itasca Seafarer cruises and sleeps a crew of three to five.

Folded for travel and trailing, Coleman Country Squire (open, far left) looks like pickup cargo cover on standard or mini-truck, has good wind resistance, economy.



night. This is the type of rig favored for sun-belt trailer parks. Some rigs, like Jayco models, mount wide glass sliding doors and picture windows. Coachmen adds a nice touch in its 32-footer by enclosing the bedroom over the hitch in a separate room.

But the pickup trucks that mount fifth-wheel hitches on their cargo beds now are getting styling treatment. American Traveler, Blazon, Ozark Traveler and the 40-foot-long Arctic Sun from Dreamer all have pickups camouflaged to look a part of the extended trailer behind. Yet not all fifth-wheels are oversized. Play-Mor's model,

[\(Please turn to page 174\)](#)

Comfort-of-home camping is possible with big travel trailers like Coachmen's Deluxe Crestwood 26-footer. Refinements include optional layouts, extra insulation.



Now customizers are going to work on the newly popular mini-trucks to make them into vans, as with Ford Courier (above) enclosed with a panel body.

A conversion of a GMC by the Jimmy Div. of Consolidated Leisure (upper left), the semi-van with headroom at the rear approaches \$20,000 with options.

Only the name on the spare tire (left) hints that colorful Tailgater with rear canopy and swing-out stove for outdoor cooking is Winnebago Youth Van.

ON-THE-GO
CAMPING

Vans and rigs that

These extra size station wagons may be the family cars and muscle



Joining the RV makers with matching vans in their lines, Shasta customizes Dodge, Chevy and Ford Travel Vans. One Ford chassis is equipped with a trailer towing package.



For towing with minimum air resistance, trailers with streamlined aircraft design like the Avion are popular. Fleetwood has several models of Santana station wagon vans specially rigged as tow vehicles.



tow trailers

machines of the future.

What is more than a car, less than a camper, has four wheels, swivel seats and style to spare? That's easy. What vehicle developed as a sign of youth but was grabbed up by drivers of all ages?

It's obvious. The rig that started out as a panel truck and became a beach-boy symbol now is being bought by outdoor families and sporty older types as an ideal way to tote a tent or tow a travel trailer.

Builders of recreational vehicles are attempting to catch up and ease into the van conversion market with units that are bigger and more upholstered than station wagons, that can be fitted for compact camping, and that have cargo room to carry a load of friends and kids, plus gear. Big to park, but easy to drive, these RVs usually have sitting headroom and, unlike the raised-roof models, will fit into most garages.

Unlike the posh pads-on-wheels that are all mattress in the back, most family touring vans with their picture windows and four high-backed swivel seats have a small rear lounge that can convert into a bed. Often, unfortu-

Station-wagon luxury with room to spare is feature of Star Gazer (upper right), a GMC Starcraft touring van.

Standing headroom and bunks for six in 18½ feet are advantages of new raised-roof Xplorer 221 minihome.

nately, this is mounted across the coach, and a six-footer must sleep there while in a crouch. By stretching out at a diagonal, however, a touring couple can take turns resting; one can nap while the other drives.

Sink, stove and sometimes a self-contained toilet help the van to simulate a camping rig, but a rainy day in a campground without any room to stand may dispel that illusion.

Last year, Champion Homes introduced its Trans-Van with a slightly raised roof and a rear entrance with room for a six-footer to stand just inside the door while cooking at the galley. This year, similar models are available from a number of imitators.

Champion has gone on to add a four-wheel-drive standard van it calls a Wrangler and a Datsun mini-minihome conversion called a Galavan to fit this market. Hop'Cap has a stretched van named Mid Ranger, and Uni-Van from Mobile Traveler is another entry.

Styling innovations include a gull-wing replacement of the standard sliding side door; half lifts as a canopy and the other half drops to form steps. Leisure and Recreational Products (LRP) and Gerring, noted van customizers, are sources of this feature.

Watch these rigs for innovations. Dodge now offers a diesel engine option, and lightweight compact vans are sure to develop.

PM

ON-THE-GO
CAMPING

CAMP TRAILER WITH

What will the ultimate fold-down be like? We outfitted one to find out.

by Bill McKeown

If small cars are the transportation of the future, tent trailers may become the ideal campers to tow behind. Folded down, they offer minimum wind resistance and tongue-hitch weight, unobstructed visibility out back and tracking that follows a four-wheel drive

almost anywhere. Parked and opened up, they offer fold-out accommodations for a big family as well as space for almost everything *and* the kitchen sink.

A little camping trailer used to be considered an in-between rig—a step up from tenting but not quite a big travel trailer or motor home. But suppose all the features of the big ones—and then some—could be installed neatly in a compact trailer. We conferred with Starcraft, the noted recreation vehicle and boat manufacturer of Goshen, Ind. Into a Galaxy model, its engineers incorporated our recommendations, their



Pulled into position with the new Star Gazer touring van, Galaxy 6 has boat and bicycles which are to be unloaded from special racks before camper roof is raised.

For the many nights when a campground setup comes after dark, a spotlight shines on the hitch and a switch that lifts roof electrically.

Family members are taken care of with customized fittings. Dog-dish shelf attaches out of the way under outdoor barbecue.



Ready for a variety of climates and sports, this accessorized Galaxy 6 mounts a colorful canopy (1), side-mount picnic table (2), fishing skiff that can double as a bathtub (3), pressurized water system (4), side-mount barbecue grill (5), CB no-ground plane antenna (6), fold-down TV antenna (7), bicycle carrier brackets (8), fold-together picnic table (9), screen enclosure (10), portable generator (11), extendable clothesline (12), skylight (13).

EVERYTHING

newest innovations, and the prize-winning suggestions from the nationwide Starcraft Camper Club membership. The result gives an impressive look at things to come.

Camping combines a variety of outdoor activities and sports, and a tent trailer roof is a useful platform to start loading up for them. Four bicycles and an aluminum Starcraft fishing skiff are secured there with special hold-down brackets. A small outboard motor and excess luggage can be stored under the

(Please turn to page 172)



ON-THE-GO
CAMPING

The 12 most-asked questions about RV tires



Which ones to use. When and why to use them. And how much they should cost.

by Mort Schultz

They call them the difficult dozen—the 12 questions about off-road tires that owners of recreational vehicles most often ask their tire dealers.

Whether you consider yourself an off-road expert or you just steer your RV out onto the beach or into the woods occasionally, you've probably become aware that a flood of specialty tires are now becoming available. What are the features you look for before buying? Here are



Paddle tire is for sand, mud, not pavement, would have short, rough highway life.

answers, with a word of thanks for their assistance to the Firestone Tire Co., B. F. Goodrich and Dick Ceppek, who is a recognized authority on off-road tires. (Dick is the owner of a retail and mail-order tire outlet in South Gate, Calif.)

Question. What is an off-road tire?

Answer. A true off-road tire is a specialty tire that is of no use to most recreational-vehicle owners. For example, the paddle tire is designed for use in sand and mud and not for highways. If you drove paddle tires on paved roads, the soft paddle tread, extending from sidewall to sidewall, would give a very uncomfortable ride and wear rapidly.

From experience, you probably notice that you and other owners of four-wheel drives (4wd), vans and pickups spend more time on the highway than off the road. In fact, it's been estimated that most 4wd vehicles are driven on paved roads about 90 percent of the time and off-road only 10 percent.

What is commonly referred to as an off-road tire, therefore, has to be designed for service on the highway. But it also has to keep you moving over off-road terrain where traction is not as good.

Q. What distinguishes a regular highway tire from an off-road tire?

A. Tread pattern, primarily. Tires for use off-road have an open, deep-grooved tread. However, as with highway tires, this pattern comes in two designs: conventional and traction. Traction tread tires are also referred to as drive-wheel or snow tires.

Q. Is it advisable to buy off-road tires on the chance that my vehicle, which so far has been used only on paved roads, may someday see limited off-road use?

A. No. According to Firestone Tire Co., "The wear penalty for using off-road tires



Conventional heavy-duty truck tire is a good on and off-road compromise.

on the highway can range from 25 to 50 percent when compared with the use of highway-type tires on the highway."

At this point, we had better define the term "off-road." It means the outback, where chunks of rock, deep ruts, mud and sand prevail. Driving on country roads, of the hard-packed shale and dirt variety, should not influence you to buy off-road tires since highway tires would suffice.

Unless you have a bottomless wallet, you better consider the use tires will get. Off-road tires aren't cheap. The least expensive ones of quality are around \$100 each.

Q. I need tires on my 4wd, which I drive into the boonies often. Other-

wise, I use the vehicle on the highway and around town. What's best for me?

A. Best? Two sets of tires—one for regular and one for back-country use. It's also best to have two sets of wheels, so you can keep tires on wheels instead of mounting and demounting them when switching sets. Constant mounting and demounting can damage tire beads. Once a bead is damaged, you can throw the tire away.

Q. What if I can't afford two sets of tires and wheels?

A. Then buy one set of off-road tires and wheels to match. Most off-road tires are wider than regular highway tires for "flotation" in soft going. Wheels used with highway tires should not be used with off-road tires. By matching wheels to tires,



Primarily for off-road operation, this open tread can handle highways as well.

you will avoid poor performance, irregular tire wear, a possible safety hazard and maybe damage to the vehicle.

Dick Cepek recommends that you buy off-road tires and wheels from the same dealer.

"Who is going to take care of you if the tires don't run right?" he asks. "The wheel guy is going to tell you it's the fault of the tires and the tire guy is going to say you have bad wheels."

Q. Some pickups and 4wd vehicles I've seen have off-road snow tires on all four wheels. Do they give better service than conventional tread design?

A. Only in snow. If you drive in snow country and don't want to use tire chains, traction tread tires help keep you moving. Traction treads on the rear of your vehicle should keep you going if your area gets light or moderate snow. One traction tread tire for each wheel, front and back, is best if snow is heavy.

Good-quality off-road traction tread tires give adequate service on all kinds of terrain—rocky, sandy, muddy—when the



Though for highway use, open treads on the sides give traction tires a snow grip.

ground isn't snow-covered. However, if snow is not a factor, equip your vehicle with off-road tires having conventional tread. They offer a more comfortable ride on paved roads.

Q. Which tire is best for driving on ice?

A. Best answer is tire chains. No off-road tire provides traction on ice.

Q. Some off-road tires I've seen for my vehicle look much wider than others. Do wider tires give better performance?

A. Generally yes, but this business of width is confusing. Indiscriminately fitting a vehicle with wide tires can give problems. Approach width sensibly. Here are tips:

1. You can spend a fortune modifying your vehicle to get wide tires to fit. You can cut fenders, beef up the suspension system, rebuild the rear axle and the like. You have to judge whether minor or no modifications will suffice. Minor modification entails bending fender lips.

2. Once you deviate from the tire width suggested by the vehicle's manufacturer, consider tires in relation to the vehicle's axle ratio and engine revolutions per minute (rpm). Tires are a vehicle's final drive gear. Make sure, when considering the purchase of wider tires, that they won't

Width of high-flotation models helps keep tire from sinking in sand or mud surface.



result in engine lugging on the highway. An engine that operates outside its power curve gives poor performance, consumes more fuel and may be subjected to unnecessary wear.

3. Not all tires of the same size designation have the same overall diameter (OD). This is true of tires made by the same or a different manufacturer. For example, Firestone's 10-15LT All Terrain tire (conventional tread) and Firestone's 10-15LT All Terrain T/C tire (traction tread) have different ODs. The company warns that the two tires should not be mixed on 4wd vehicles. Doing so can result in drive-train damage.

4. The tire dealer you patronize should have charts giving compatible tire sizes for your vehicle's axle ratio and engine. If he doesn't, find yourself another dealer.



Off-road traction tires extend the open grooves to sides of tread for snow going.

Q. What part does tire construction play in the selection of off-road tires?

A. The same part it plays in the selection of highway tires. If you want the best and strongest, get radials. Belted-bias tires, which are less expensive than radials, are a second choice. Bias tires—the least expensive—aren't suitable for extensive off-road use.

Q. What is a tire's load range and how does it influence the kind of off-road tires one should buy?

A. Load range is an indication of the maximum cold inflation pressure for which particular size tires are rated. A tire's load range determines the amount

(Please turn to page 176)

New for RVs

Part of the fun is to make your rig personal and different. Now accessory manufacturers are providing the special items required. Want to add headroom, bedroom, extra storage, or built-in bucket seats? Aftermarket outfitters can do all.

The family car can be fixed for camping with reclining seats, plug-in coffee pot and refrigerator and a tent in the trunk. Station wagons and vans are easy to live aboard, with inflatable mattresses and a grub box. Cap covers for pickup trucks are made by a growing list of suppliers; Hop'Cap, Leer and Winnebago are among them.

California, birthplace of much van customizing, offers great varieties of side and sunroof windows from Stretch Forming, Elixir, West Coast Windows and Le Van. Chastain has truck bed Rumble Rider rear seats for minipickups. And to tow a spare car behind your motor home, Preco, in Omaha, provides a \$300 kit that makes it easy to trail an automatic-transmission model.



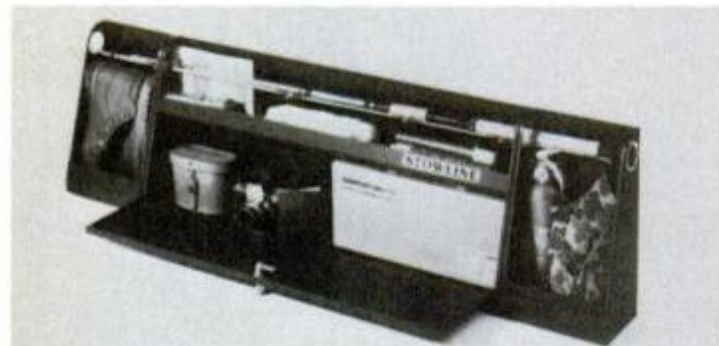
Raising the roof without shutting your rig out of the garage is possible with Viking's low-profile, add-on insulated fiberglass Sports Tops with roof racks for vans.



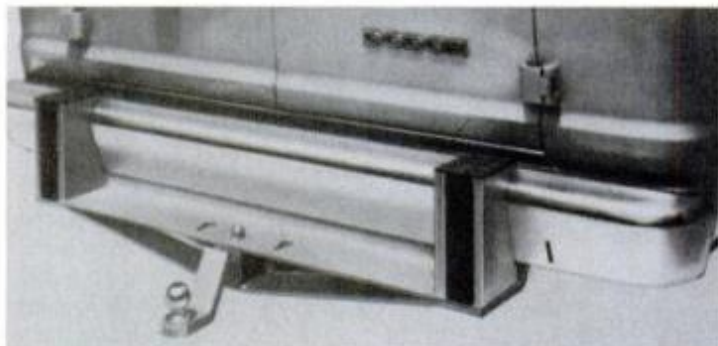
A back door for pickups, Leer's Town 'N' Country Cab-thru door of gray safety glass offers entry into Leer's slide-in camper or easy access to pickup cargo bed.



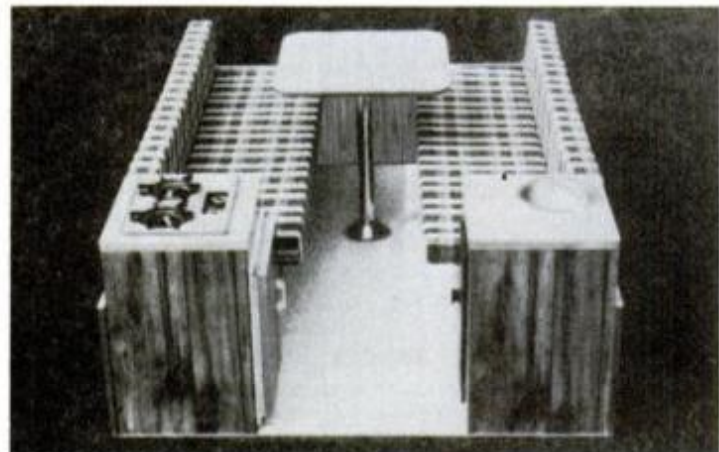
Blocked by a spare tire, a motor home's rear storage compartment is useless unless a hinged, spring-loaded tire carrier like Kenco Engineering's is bumper-mounted.



Bolted out of sight behind the front seat of a pickup, the Stowline Truck Caddy has shelves and racks for tools and gear, plus a lockable compartment. A rifle safe is also available.



Without welding, the Combo Trailer Hitch/Step Platform for vans can be bolted on to provide a ball or receiver hitch, rear step and bumper guard. It's from Avionic Structures.



For the van owner who wants to fit out for full-time camping or needs a unit that slides back out for cargo space, Vankit of Indiana has a two-sleeper with icebox, stove and sink.



Blazer and Jimmy 4wd owners can now order a convertible top that allows for a roll-up rear window. Dualmatic provides top with concealed fasteners in choice of black or white fabric.



Backpacking tents with free-standing support and wide peaks for added room are new from White Stag. High Country (above) has sheltered door to store packs, gear.

Not everything is more expensive. Going outdoors is still free, and though the costs for much camping gear have gone up, equipment now available has improved considerably. New fabrics, plastics and insulation have combined with new designs to make camping easier and more comfortable.

New tents

Bill Moss of Tent Works Ltd., Camden, Me., deserves credit for one of the most useful trends in outside living. Over 20 years ago his Pop-Tent was the first free-standing, quick-erecting shelter supported with flexible fiberglass poles. Gone were the pegs, poles and guy lines that stretched or shrank, tripped you in the dark, tangled at setup or takedown time and pulled loose in a wind storm. Now Moss has models from the Pocket Camper, Eave and Trillium up to a cottage-sized Optimum 200.

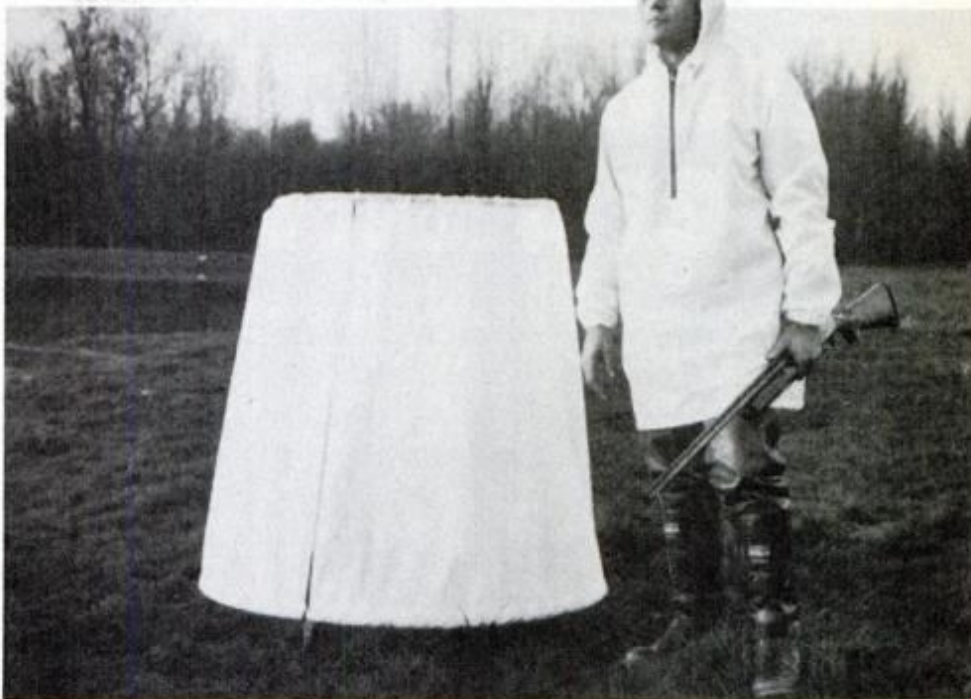
Free-standing models of sophisticated design and light weight are now also available from Early Winters, Don Gleason's, Eureka, Trailwise, JanSport, North Face, Sierra Designs, Coleman and more. Some require pegging around the edges only in strong winds; several use elastic shock cord inside tube poles to make joining up even easier.

Advances in materials

Waterproof breathable Gore-Tex is now used in many parkas and ponchos, and appears as a bivouac bag, sleeping bag, glove and tent covering material. Down, as the ideal insulating material, is being challenged by synthetics like Thinsulate, Hollofil and PolarGuard, that wash and dry more easily and claim as much or more heat retention.

Pack frames have become more flexible, campstoves more reliable, cooking utensils and food even more compact. Higher prices are providing more for the money outdoors.—
Bill McKeown

New for campers



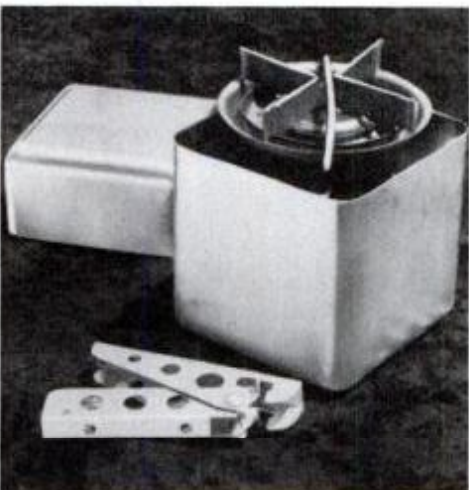
Matching shelter blind and parka, the Mini-Blind and Mini-Mate come in white or camouflage from Sports Haven in Seattle for hunters and wildlife photographers.



Van campers with Coleman's largest tent, the Villa del Mar, can now join the two with new van conversion kit that attaches to tent, fits van with sewn-in magnets.



A bivouac sack with space to spare for a single sleeping bag and big enough for two, the R.E.I. Co-op's ripstop nylon Bivi Sack can substitute for a tent.



Now compact little backpack stove from Peak 1 can be carried in its aluminum pot container/cook kit. Quart and 1/2-quart bottom and top are lifted with pot gripper.

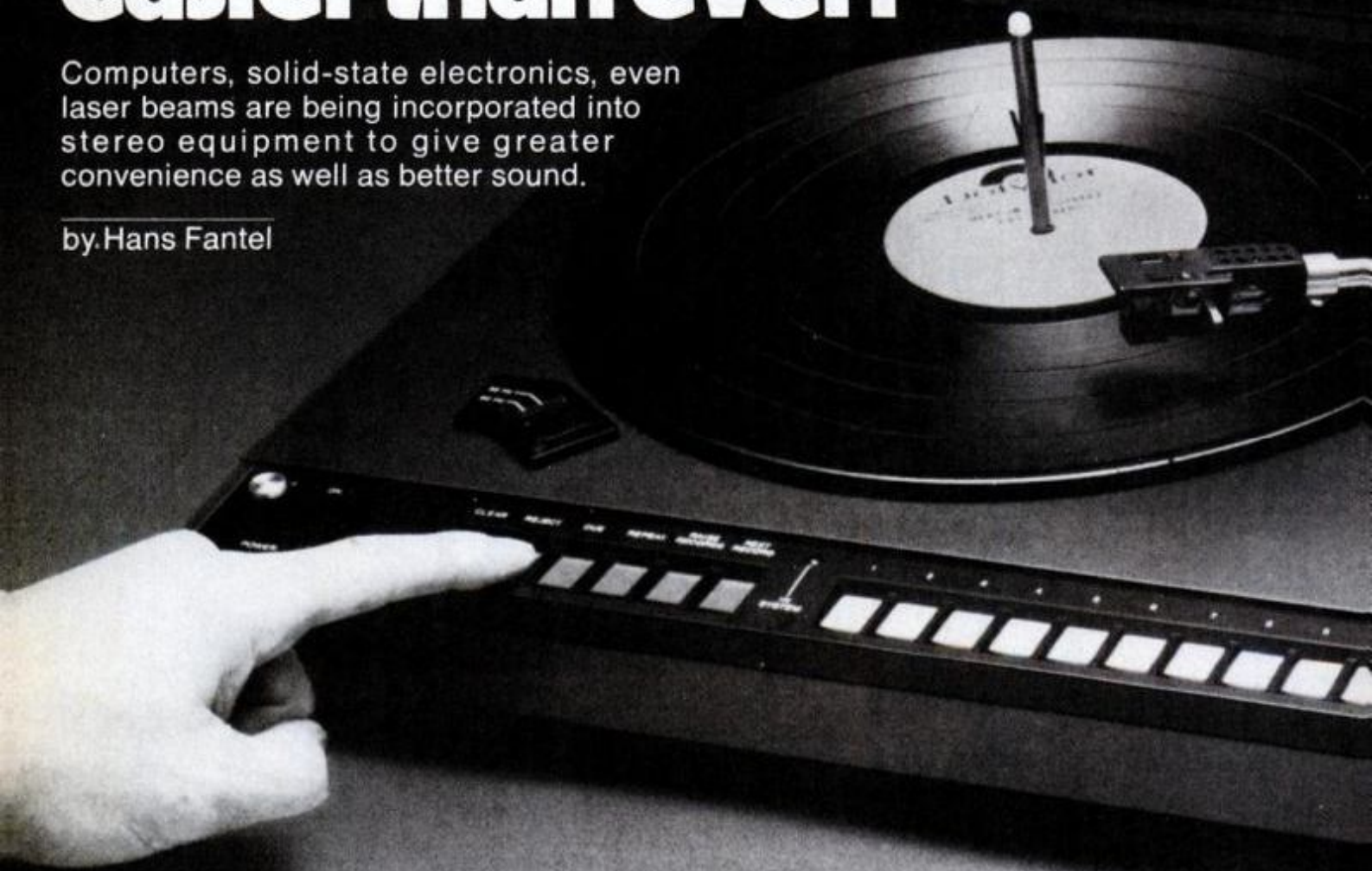


Folded up, and with propane container removed, Coleman's one-burner campstove stows compactly. In use, new X-shaped windshield protects 10,000-B.T.U. flame.

New devices make stereo listening easier than ever!

Computers, solid-state electronics, even laser beams are being incorporated into stereo equipment to give greater convenience as well as better sound.

by Hans Fantel



Check out the latest stereo gear now getting into the stores, and you'll spot three new trends:

- Increased automation.
- New controls to optimize performance.
- Special circuit refinements.

These innovations usually appear first at the top of the line; the most advanced designs—dangling the heftiest price tags. But, advances have a way of trickling down, so features now available only to fans with fat wallets may soon come within reach of the rest of us.

Automatic program search

From the way it looks, there must have been a marriage between audio

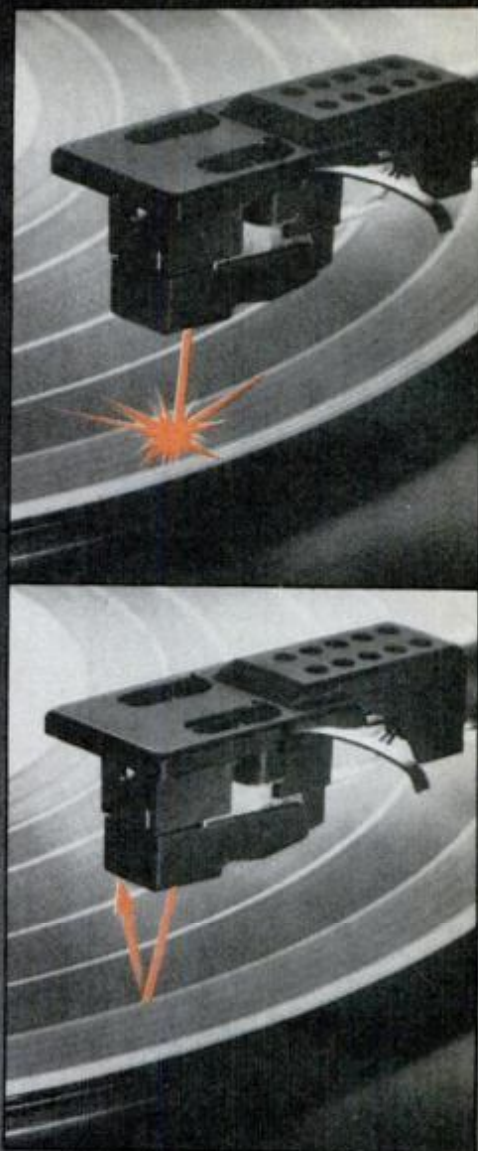
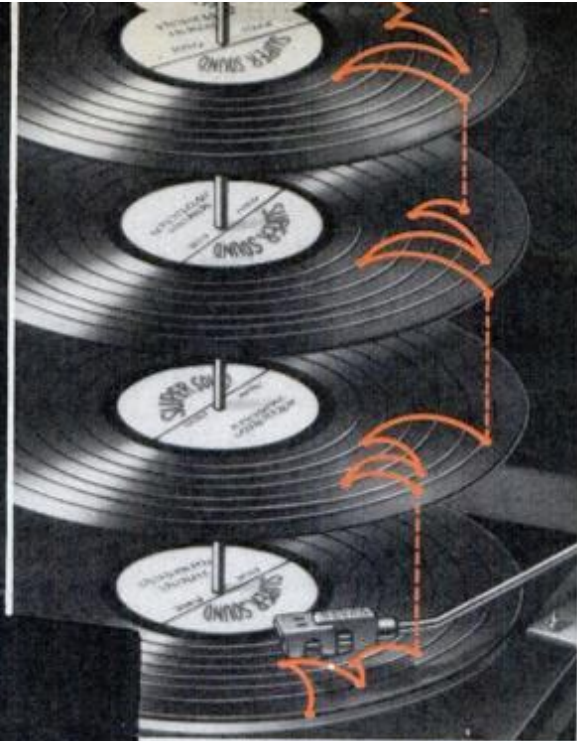
and the computer. Anyway, there's some offspring from this union. More and more audio components now have built-in "logic." They can run through several alternative programs of action in response to coded commands. They owe their "intelligence" to what is called a microprocessor—a tiny computer circuit that electronically makes decisions based on simple concepts like "yes," "no" and "either/or." This may seem elementary, but it goes a long way.

The first of these "smart machines"—ADC's Accutrac record changer—has been around for more than a year, but it's learned some fancy new tricks in its latest version (the +6). A photo-sensor on the tone arm registers light

reflections from the record, and thus can distinguish the groove tracks from the blank spaces between. Fed to the logic circuit and a small computer memory, this information enables the Accutrac to pick out, play, skip or repeat any record track in any programmed sequence you choose. What's more, it will do this for up to six records in a row, then *automatically re-stack* the records and do it all over again in the same or—if you like—different order of selections.

You punch your instructions into a keyboard that holds up to 27 preprogrammed cues—enough to tailor a whole evening's worth of music to your particular taste. The six-disc changer sells for \$300; for an extra

The Accutrac +6 turntable is representative of what's new in stereo—devices to make the listening ever easier. Manual or remote-controlled, the Accutrac can play any sequence of bands on up to six records.



The Accutrac's tone arm uses laser technology to sense when it reaches the end of a selection. Grooves on the record disperse the beam but the blank areas between the songs will reflect it back like a mirror.



\$50 you get a remote-control keyboard about the size of a pocket calculator to hold in your lap while issuing ultrasonic commands to the record player.

Similar programming options are now available in cassette equipment. If you ever tried to locate a particular piece of music on tape—hunting back and forth for the right spot—you'll be grateful for such computerized convenience. Again, the basic principle—as they say in computer lingo—is one of selective access and recall. In the Optonica RT-6501 (\$370) and the Sharp TR3888 (\$360) cassette decks, a built-in microprocessor counts the silent intervals between the separate pieces of music and assigns a number to each, which is displayed on an LED

panel. You can then punch in the numbers you want to hear and skip the others. The microprocessor will search the tape for the wanted piece in both forward and reverse motion.

Tape optimizing

Automation now goes beyond such handy frills and program selection. In Hitachi's new Model D-5500 deck the microprocessor adjusts bias and equalization separately to get the best possible performance from whatever type tape you slap in.

With all the different tapes now on the market—hi-bias, lo-bias, ferric,

chrome, ferrichrome, ferricobalt, and whatnot—it gets pretty confusing trying to set bias and equalization to match the requirements of each tape type. So the Hitachi does these chores for you, automatically and precisely. Just touch a button and its built-in robot engineer puts a test signal on the tape, measures the output, and adjusts all the variables until the maximum output is obtained from the particular tape you have chosen. Meanwhile, a bank of LED indicators tells you just what the computer is doing. A few seconds later, it lets you know that all circuits have been optimized. It then rolls the tape back to the start and all signals are *Go*. You're ready to record, assured you're get-



No, you're not seeing things . . . Toshiba's SA-7150 is a receiver without a tuning knob. It's the first receiver with a digital, frequency-synthesized tuning section.



Technics ST-9038, combined with the matching SH-9038 programming unit, lets you select your FM listening a week in advance. Upper readout is frequency; lower is time.

ting the best possible performance in terms of frequency response, noise and dynamic range. Naturally, such supersophistication doesn't come cheap. The D-5500 puts a \$1000 dent in your bank account.

Tuner automation

Automation has also come to FM tuners, most of it based on a new type of "front end"—the part of the tuner or receiver that pulls signals from the air. Since the beginning of radio, this was done by a variable capacitor: You twirled the tuning knob until the circuit was in resonance

with the frequency of the transmitter. No more. The tuning capacitor is gone—in some cases, even the tuning knob. Instead, a quartz crystal, like the one at a radio station or in a quartz watch, vibrates at a fixed frequency. Digital circuits then process this frequency, by dividing or multiplying it, to duplicate the exact frequencies of all the assigned broadcast channels in the FM band. That way, the receiver is locked to the transmitter frequency by the literally rock-steady crystal. No more hit-or-miss tuning and no more knob wiggling. It is actually impossible to

mistune these new "frequency-synthesized" FM receivers. Tuning, in effect, has become automatic.

Just let the tuner scan up and down the FM band while you watch the digital frequency readout. When the number of the station you want flashes on, stop the scan and your station is right there—"on the nose." For added convenience, most new digital tuners have up to a dozen selector buttons you can preset to your favorite stations.

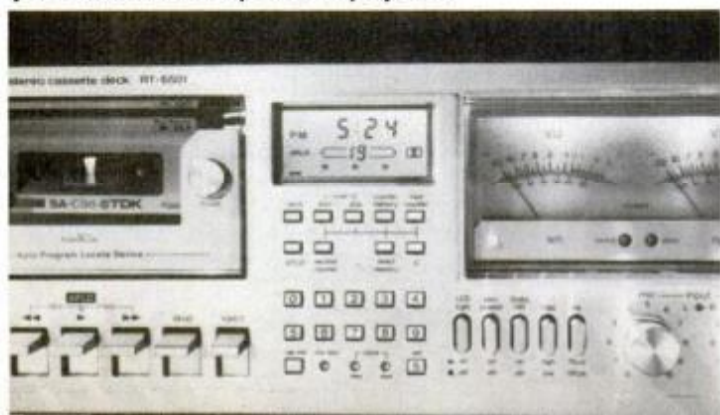
Outwardly, this resembles ordinary pushbutton tuning, like on a car radio. But it's nothing of the kind. On most car radios, the tuning button merely rotates a shaft to a mechanical stop, often resulting in haphazard tuning. By contrast, the station selector on the new tuners issues a precise command to the crystal-controlled frequency synthesizer to duplicate exactly the frequency of the station you want.

Carrying the idea of automatic tuning a step further, the brand-new Technics ST-9038 (\$600) offers an optional add-on unit containing a computer memory, enabling you to program your listening a week in advance. You punch in the dates and broadcast times for the programs, along with a code for any of eight different FM stations, and the optional SH-9038 programmer makes sure you don't miss a thing. If you can't be home to listen, it will switch on your tape deck to record the program for you and shut off everything promptly when the program is over. If you've got two separate tuners, the programmer can be instructed in advance to let you listen to one program, while recording another. My wife liked the whole idea, but when I told her the programmer costs an extra 600 bucks, she just said: "What? For a clock radio? And it doesn't even have its own speaker!"

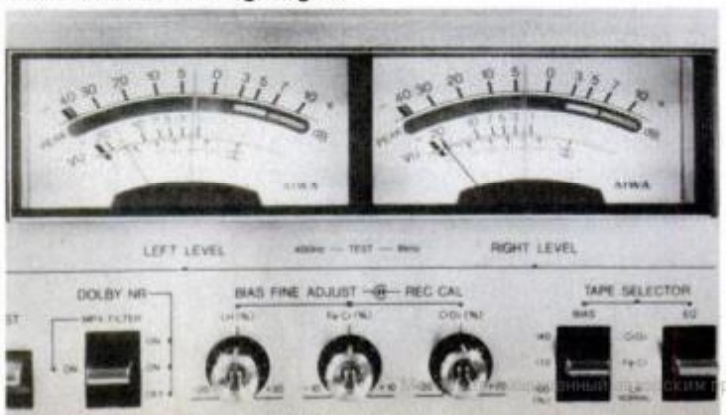
New controls

Giving the user a chance to make ultra precise circuit adjustments for optimum performance is the idea

Optonica's RT-6501 cassette deck has a microprocessor brain to count the intervals between separate selections. It then allows you to select the sequence of playback.



Aiwa's AD-6900 cassette deck is equipped with needles having two pointers. One of them gives the reading for peak power, the other indicates average signal.



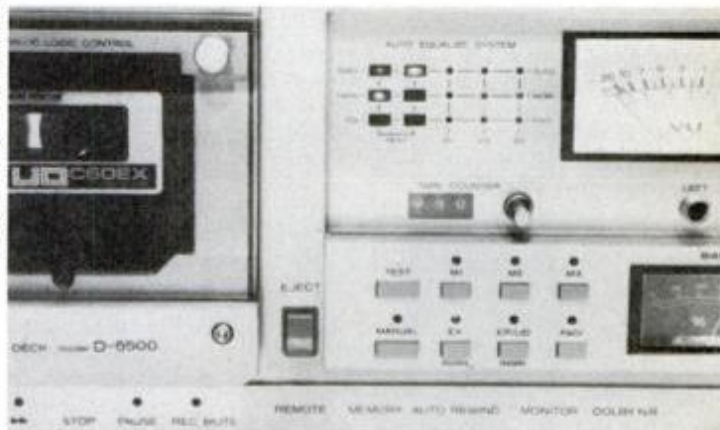
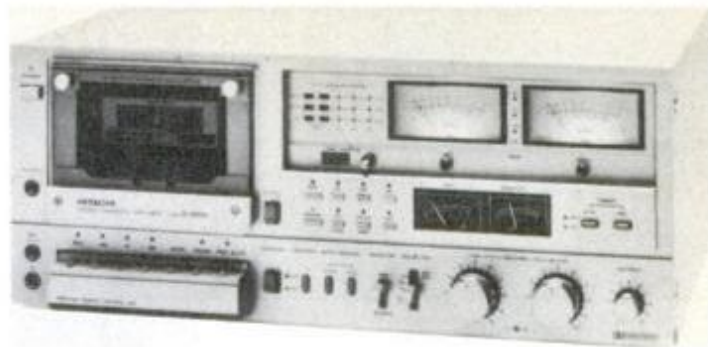
behind a whole set of new controls. A case in point is the "response tuning system" on the AD-6900, AIWA's top cassette deck. What it does is similar to the automated function already described in the Hitachi: It adjusts the bias current to the exact requirements of a particular tape. In this model, the process is not automated, and you have to watch the meters for the point of maximum response. But the test signals are applied both at the high and low ends of the audio range, to make sure that optimum response extends throughout the audible range.

Even the meters on the AIWA are unusual. Each has two separate pointers. One registers signal peaks that are important for avoiding distortion. The other is a standard VU-meter, which averages the peaks to give an indication of the overall signal level going on the tape. Like several other top-quality decks, AIWA also lets you switch the meter to peak hold. The needle then stops at the loudest signal, so you can tell at a glance whether or not the tape has been overloaded at any moment of the recording.

You'll also find several fancy new controls on the front panels of FM tuners, such as a switch labeled "IF Bandwidth." There's nothing iffy about that IF. It stands for Intermediate Frequency, and adjusting the bandwidth in that range helps keep overlapping stations apart.

For example, where I live—on a hilltop in western Massachusetts—just about every FM station from New Hampshire to Delaware chimes in on my rig. This makes it difficult to keep a weak station from being

Hitachi's D-5500 will select bias and equalization automatically for just about every type of tape now on the market. Just touch a button and the internal computer puts a test signal on the tape, measures the output, then adjusts everything until output is maximum. LED indicators let you know what's going on. It also has a slide-out remote control, so you can command its many functions from across the room.



overwhelmed by a stronger signal on an adjacent channel. Sure, higher selectivity would help. But higher selectivity also means higher distortion. Since FM tuners are designed mainly for fidelity, they often deliberately sacrifice selectivity on the assumption that in most places the FM band isn't that crowded.

The new IF bandwidth control solves this dilemma and lets you pick different values of selectivity, depending on what station you listen to. For a station coming in clearly, you can use the "wide" IF setting for maximum fidelity. To separate a

station from an interfering neighbor, use the "narrow" IF setting. It may increase distortion slightly, but at least you'll hear just one station at a time. This new feature now appears on many of the better tuners, including those by Pioneer, Sansui, Technics, Yamaha, Marantz, Kenwood and Mitsubishi.

For pulling in those tricky, far-away stations you also get a lot of help from the new Hi-Blend control introduced by Yamaha, Technics and Nikko. Weak signals from distant stations get distorted by being split into left and right channels in the tuner's stereo detector. The quick way of solving this problem is simply to combine the stereo channels and receive such stations in the mono mode. But that way, naturally, you lose all of the stereo effect. The high-blend control lets you settle for a compromise; it combines only the uppermost part of the audible range, where the distortion is most apparent, while stereo is retained in the rest of the spectrum. That way you get less stereo separation, but cleaner sound—the best trade-off for "difficult" stations.

Circuit refinements

Top amplifiers nowadays are so good that it's practically impossible to test them. Their specs are better than those of the test equipment. Even so, there's still room for innovations, like Hitachi's "Class G" circuit.

The G-circuit works like helper springs on a car or truck: It soaks up

(Please turn to page 182)



Philips has come out with a new line of turntables—the Series 7 models that combine belt drive with servospeed control. Performance matches the direct drive.

IT'S NEW NOW

Fishbowl variant

Alternative Aqua Systems give aquariums a different look. Wood-grained steel posts and wood shelves are combined into integral units in eight designs. Systems can hold both fresh and saltwater; no metal or toxic parts come into contact with the water, the maker says. Model 2325 (shown) has a 23-gallon tank, is about \$111. Aqua-Design, Box 558, Morton Grove, Ill. 60053.



Roll out the ice rink

You can put a skating rink over your swimming pool, tennis court or yard with this kit. Ethylene glycol fluid flows through flexible tubing in 4x50-foot grids to make ice; grids can be rolled up at season's end. The system is said to be simpler to construct and require less power to operate than other such units. Package with refrigeration module, vinyl liner, ground insulation, plastic edging, fluid and grids for a 20x50-foot rink is \$9990. Lumber for rink edging is not included. Devoe Sports Systems, 800 Eastern Ave., Carlstadt, N.J. 07072.

Well connected

Special seals make Econoseal connectors resistant to saltwater, gasoline, oil, antifreeze and hydraulic fluid, the maker says. Made in 3-, 4-, 7- and 9-wire sizes, they are useful in automotive, marine and off-road applications. From \$1.78 each. AMP Special Industries, Valley Forge, Pa. 19482.



Slide projector zoom

The Navitar f/3.5 zoom lens varies in focal length from 6 to 9 inches (152 to 229 mm) for long-throw slide projection. It fits all Kodak Ektagraphic and Carousel projectors, as well as many others. One of a full line of slide projection lenses, it costs \$330. D.O. Industries, 317 East Chestnut St., East Rochester, N.Y. 14445.

Fire extinguisher for boats

The Fireboy Jr. Model 15 is an automatic fire extinguisher for boats with engine compartments of up to 75 cu. ft. The nonelectrical unit uses Halon 1301 extinguisher. At under six pounds, it can be mounted with two bolts. About \$100 from Convenience Marine Products Inc., 100 Commerce Ave. S.W., Grand Rapids, Mich. 49503.



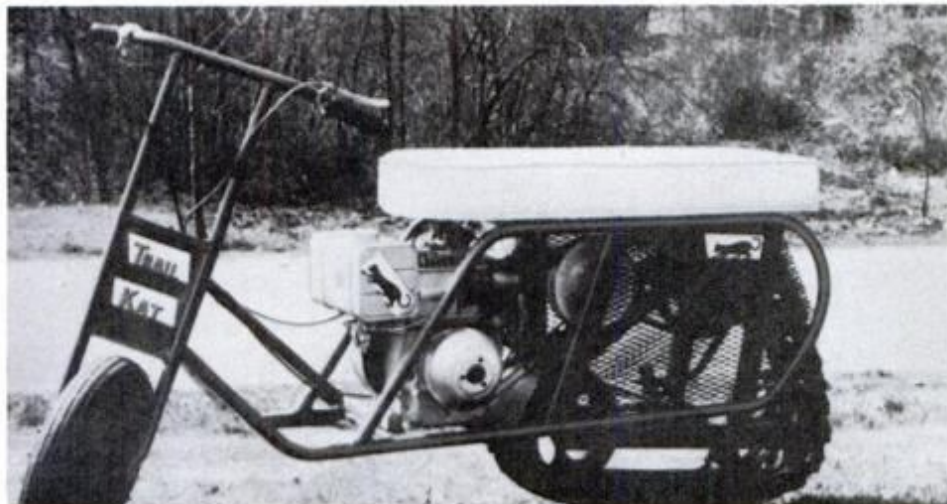
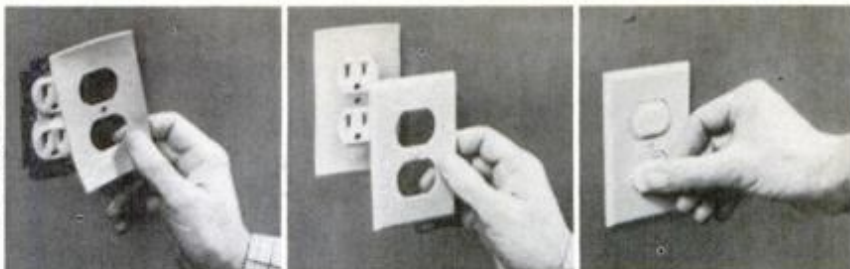
Reach for the sky



The Spray Pal Hanging Plant Mister waters hard-to-reach plants. The 22-ounce bottle has a mix and measure guide built in; the gooseneck tube is fully adjustable. Spray can vary from a fine mist to a stream. About \$2.50. AFA Corp., 200 Industrial Blvd., Box 908, Toccoa, Ga. 30577.

It's an ill wind . . .

that blows through your wall outlets and switch boxes, wasting energy. Draft Sealers fit between wall and cover plate, reducing infiltration through outlets by 93 percent, the maker says. Plugs for socket holes block air and keep children's fingers out, too. A kit with eight Sealers and 10 plugs is about \$4. Armstrong Cork Co., Lancaster, Pa. 17604.



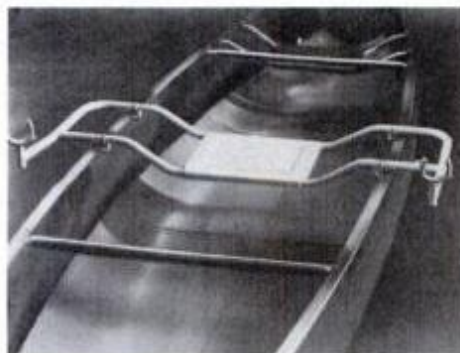
Tracked trail bike

Trail Kat has a tracked rear drive to prevent slipping, the maker says. The rubber track has a "footprint" of about 100 square inches; a bogie-type suspension smooths out bumps. All sprockets and chains are up out of the way of dirt, mud and sand to reduce wear. Production is planned for later this year. Trail Kat, 19906 122nd Place S.E., Renton, Wash. 98055.



This'll give you a lift

The CV60 Buoyancy Compensator provides 25 pounds of buoyancy; another 12 reserve pounds are available by opening zipper at bottom. The ballistic nylon vest has a bottom harness panel that fits over a scuba diver's abdomen and is said to provide more comfort than other designs. It's \$135 from Dacor, 161 Northfield Rd., Northfield, Ill. 60093.

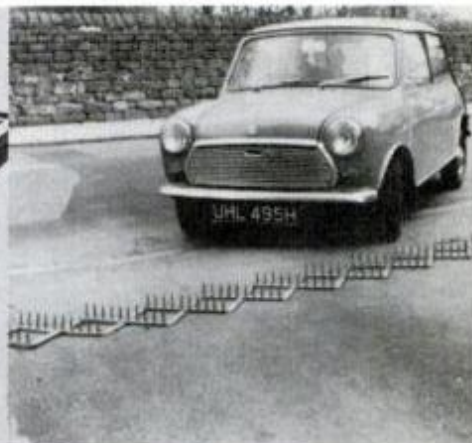
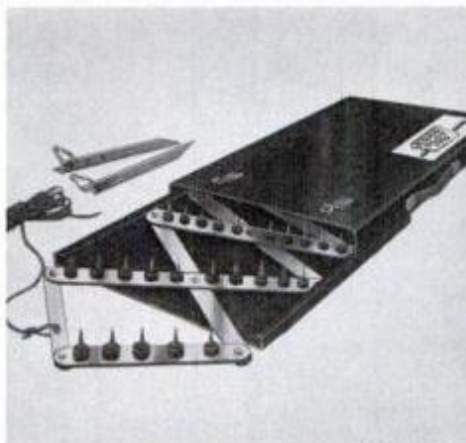


Row, row, row your canoe

For those who like to row for exercise without having to buy a scull, an attachment for a canoe may meet your needs. This aluminum rig weighs about 8 pounds and adjusts to fit most canoes. Rig without oars is available for about \$75. For further information, contact Ed Nelson, Grumman Boats, Marathon, N.Y. 13803.

Taking the wind out of your tires

Worried about foreign insurgents invading your driveway? Tired of having fleeing criminals smash through your roadblocks? Road Bloc 170 is said to be 100 percent effective at stopping cars and pickup trucks moving faster than 20 mph. Unit weighs 36 pounds and can be deployed in seconds, the maker says. Individual spikes are replaceable. It's \$1950 from H.L.B. Security Electronics, Ltd., 211 East 43rd St., New York, N.Y. 10017.

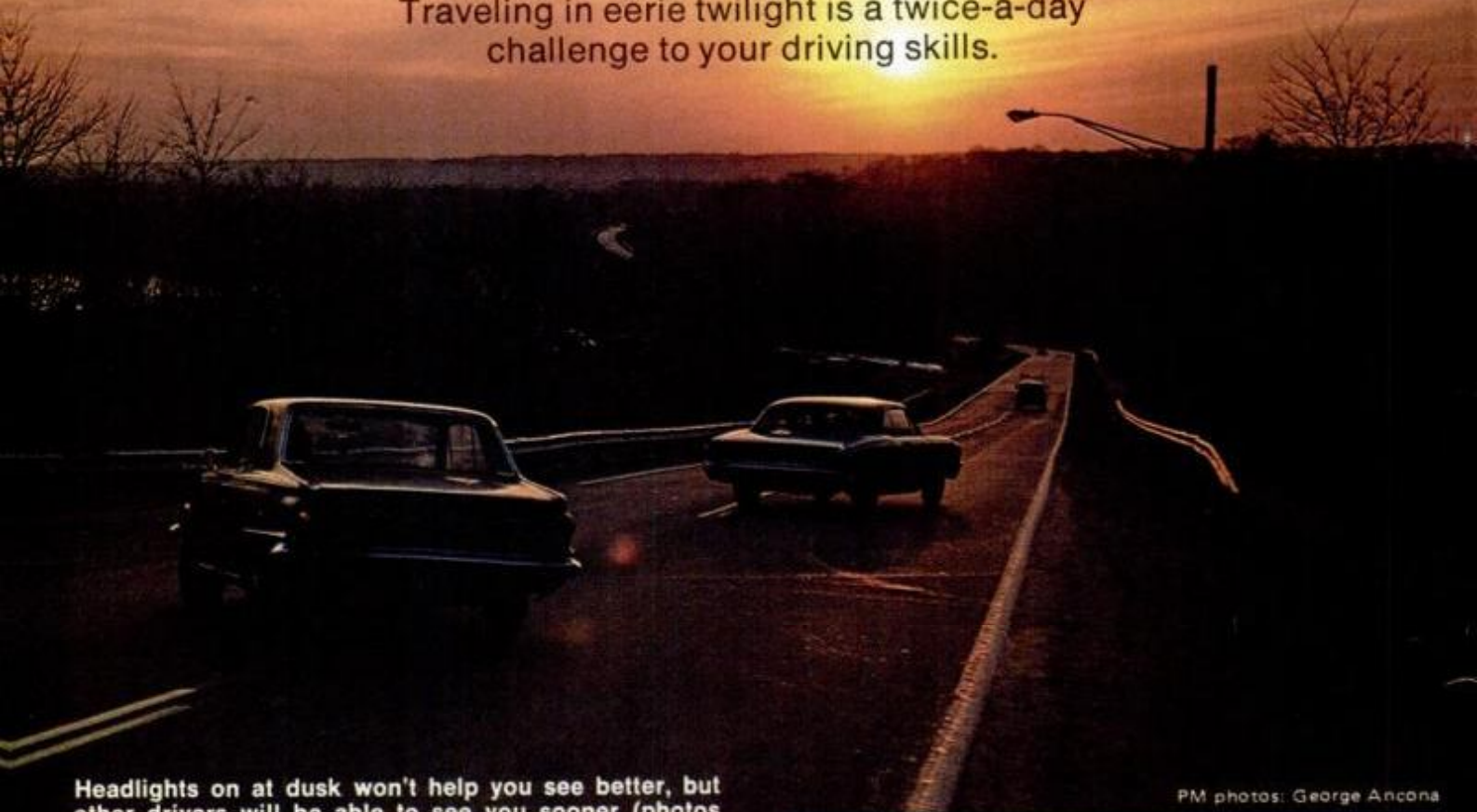


All hail

Plug-in attachments transform a Vecta radio direction finder into a hailer, fog siren and listening device with a claimed range of about 200 yards. The listening device picks up sounds from sources that may be obscured by fog or darkness. About \$340. VT Sales Corp., 1331 South Dixie Highway W., Pompano Beach, Fla. 33060.

TWILIGHT!

Traveling in eerie twilight is a twice-a-day challenge to your driving skills.



Headlights on at dusk won't help you see better, but other drivers will be able to see you sooner (photos below), especially at intersections (above). Sunset and sparkle of lights and reflections (right) can prove deadly.

PM photos: George Ancona



The most dangerous time of any day is that hushed interval just after sunset that we call dusk, twilight, or nightfall. More Americans are killed and maimed during this seemingly lovely interlude than at any other time of day.

National Safety Council statistics report that nearly one-third of all auto accidents occur during the hours of 4 to 8 p.m., which comprise the evening twilight period at varying times of the year. This dangerous period also accounts for more than one-quarter of all auto-related fatalities each day. Pedestrians fare even worse. Fully one-third of all traffic-caused deaths occur at twilight, with children *twice as likely* to be struck down as adults—truly a grim record of carnage for the hours when most of us are unwinding from the activities and stresses of the day.

But what is twilight, and why is it the deadliest time of day on our roads and highways? First the what.

If the Earth were airless, there would be no twilight and night would follow day (and vice versa) in an instant—just like that! But our unique atmosphere diffuses and refracts the sun's rays about 35 miles into the dark side of the Earth and the resultant ever-changing half-light is, of course, twilight. At the equator this twilight band zips around the globe at 1050 mph. As one progresses to the pole, this velocity drops off noticeably and at 40°N., it is 804 mph.

Twilight actually occurs *twice* daily—before sunrise and after sunset. By far the more hazardous of the two is evening twilight, when natural illumination steadily deteriorates from day into night. This time of day coincides with the daily peak in traffic volume, when millions of Americans stream home from work or school. At morning twilight, however, traffic volume is at its lowest ebb of the day and illumination steadily increases from night to day.

Treacherous lighting

The most dangerous part of evening twilight is *civil twilight*, which starts at sunset and ends when the sun is 6° below the horizon or when one can no longer read a newspaper outdoors by natural light. Civil twilight varies in length from an annual average of 24 minutes in Miami to 29 minutes in New York City to all "night" in Fairbanks, Alaska. Twilight usually affects the tail end of

the summer evening traffic crush, due in part to Daylight Saving Time. By late October, however, the inexorable approach of winter gradually shortens the day by some 4½ hours, resulting in later sunrises and earlier sunsets. On the last Sunday in October this trend worsens abruptly, with the sudden shift back to Standard Time. Unsuspecting drivers are immediately thrust into the heart of the most dangerous situation of all—peak traffic conditions, when the lighting is most treacherous and changing. Not all drivers adjust successfully to this sudden change.

Evening twilight, with its ever-shifting, ever-decreasing illumination, is the very worst time of day for effective vision. Dr. Merrill J. Allen, Professor of Optometry at Indiana University, authority on highway vision and safety, tells us that, "as the natural light fades, the driver's eyes are unable to adapt as quickly as the light level falls."

Loss of depth perception

Visual adaptation to increasing darkness thus lags, since sky lighting exceeds that of most highway objects. After sunset, such objects are virtually shadowless and are further diffused by bluish sky light. At the same time, colors fade, resolution decreases, and large objects are often recognized only at the last moment, and fortuitously at that. This unnerving lack of contrast also decreases a driver's general orientation and depth perception—itsself a very serious handicap—especially if you're unaware that it is even happening! Objects are never as distant as they appear at twilight. In fact, this very uncertainty causes the perplexed driver to look again for verification at a time when ever-increasing darkness remains a step or two ahead of him.

Twilight visual problems often start *before* sunset, when direct sun glare overstimulates the eye's photopic (day vision) cells, seriously retarding the eye's soon-to-be-needed ability to adapt to darkness. A tip: if the sun is really getting to you at this time of day, pull off the road for a few minutes until after sunset. The worst thing you can do at this time is don sunglasses to combat the unwanted glare. Instead, you should adjust the sun visor to screen out as much excess light as possible. All too often, drivers wearing sunglasses at sunset forget to remove them when twilight sweeps quickly over them. On the other hand, the sun visor can be used *after* sunset to screen out distracting sky light and allow the eyes to adjust more quick-

Tips for twilight driving

Here are additional safety precautions for driving at dusk:

1. Check your car's head and tail-lights, reflectors, windshields and wipers regularly. Keep them clean and replace promptly when necessary.

2. Keep interior illumination to an absolute minimum. Extraneous lighting seriously retards the eye's adaptability to low light and darkness.

3. Don't smoke if you can help it. What you *don't* need is a swirling cloud of unburned carbon particles fogging up your eyes and the windshield at this critical time of day.

4. Keep a sharp eye out for pedestrians, on or near the road. Remember, people are comparatively small objects, and when dressed darkly, are almost invisible at 55 mph in marginal lighting. Never assume them to be where they should be or to act in a predictable manner. Always expect the unexpected.

5. Decrease your overall average speed by *at least* 10 mph at dusk. At this time you need all the extra reaction time and road space you can get when the unexpected occurs—*it does*, sooner or later.

6. If you doubt your ability to cope with twilight driving, pull off the road for a snack or a rest—not a drink—and wait a few minutes for full darkness.

7. Above all, obey that classic rule of safe driving at all times: drive defensively—see aggressively!

ly to the darkening conditions already prevalent at road level.

Not only must a driver see effectively at twilight—he must be seen by others as well. Therefore, turn on your low beams at *sunset*—if not before. On overcast days or when local terrain, obstructions, and so on, create unexpected shadow pockets of "instant twilight," sunset lighting conditions occur even earlier.

Most states require headlights to be turned on a half-hour *after* sunset. Disregard this outmoded law for your own safety by snapping on your low beams (not high beams) even earlier, whenever light conditions become less than optimum. And remember, always slow down when passing from a bright area into a darker one. As for parking lights, safety experts urge drivers to forget about them at this time of day. Use them only for their expressly intended purpose. These same experts also warn us that low beams are of little use at twilight except to alert *other* drivers of one's presence.

According to critical tests conducted by Mercedes-Benz in West

(Please turn to page 190)

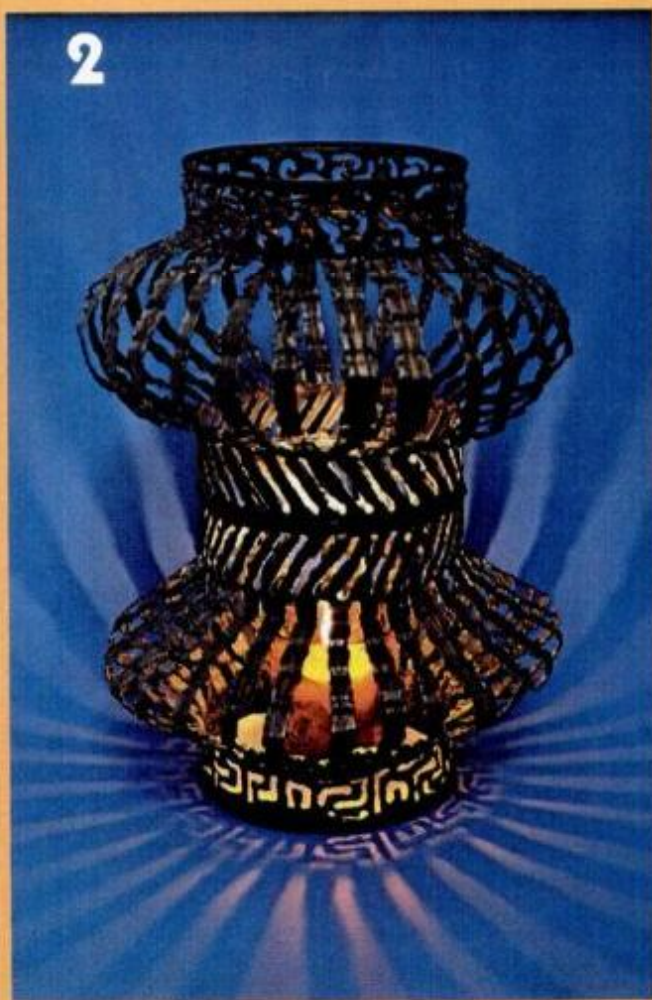
1



Gems from junk

Here are three projects by PM readers that you can make from tin cans.

2



3



1 To many people the Stutz Bearcat is the symbol of the Roaring 20s. This model is made of cracker tin and scrap materials.

2 A candle in this lantern casts a playful light pattern. Lantern is two juice cans seamed together. Cutouts are made by a torch.

3 Three-dimensional metal plaques are easy to create and make interesting hangings. Surface is the inside of a tin can.

The countless tin cans we use each year can furnish you with an endless supply of useful metal. Here are clever ways that three PM readers recycle the empties. The craftsmen point out that their projects are only starting points to be altered and embellished according to your own tastes.

—The Editors

Stutz Bearcat

The Stutz Bearcat is known as "The car that made good in a day." Enthu-

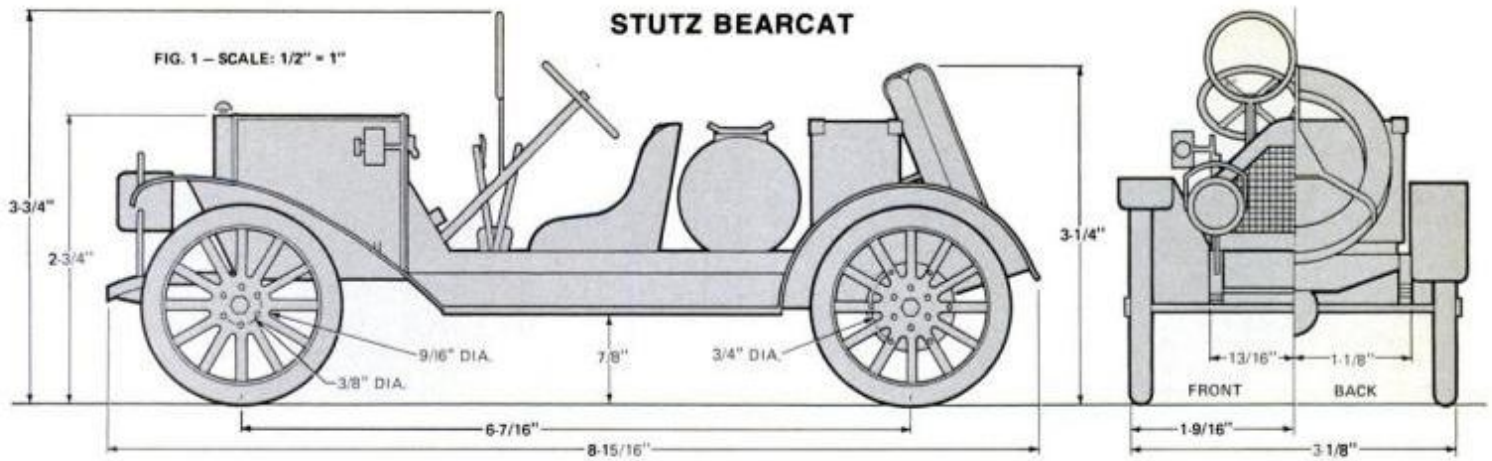
siasts say that it was and is America's greatest sports car.

This model of the 1912 Bearcat is built from scraps found in your kitchen or workshop. The only special purchases I made were from the local trophy shop: small roundhead brads used as lug nuts and a scrap (2x3-in.) of 1-mm brass commonly used in making award plaques which I used to make the radiator and the gas tank caps.

Chassis and many other parts were made from a Ritz cracker tin. That

particular type of tin is chosen because it's the right thickness and is already tinned inside. You can also use a Saltine or other 90-lb. gauge tin. Seat bottoms and cushions are cut from a can of lighter metal (not aluminum) such as a soft drink can.

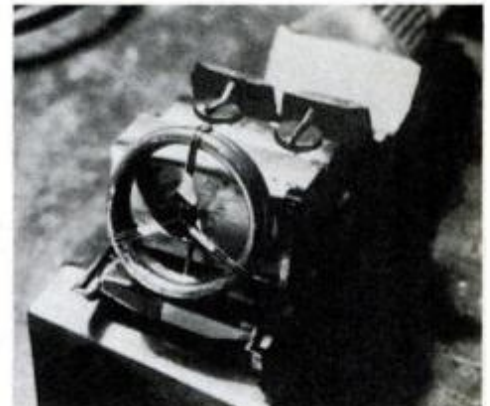
Other scrap materials you'll need are: 1 $\frac{1}{2}$ -in.-dia. dowel to shape the tires; $\frac{3}{16}$ -in.-dia. copper gas-line tubing of the type used on power mowers for tires and parking lights; gas-line connectors for headlights; coat-hanger and stiff wire for attaching



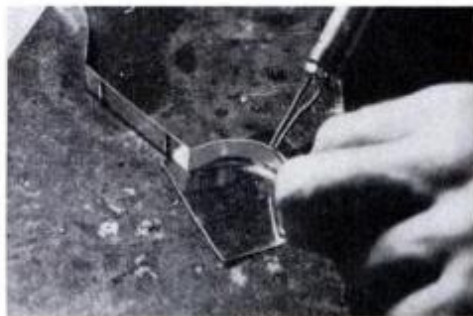
Tires are copper tubing shaped around a dowel. Shape seven tires, keeping them tight against each other; cut and solder.



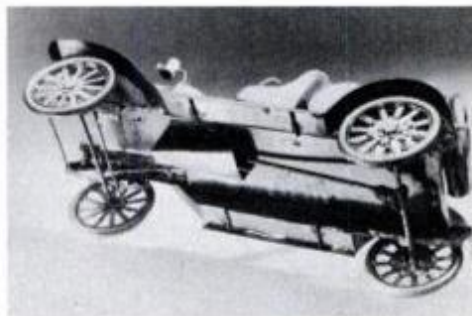
Seat bottoms and backs have textured upholstery made by scribing squares, then pressing with a punch or a stovebolt.



The gas tank, tool/luggage chest and spare tires with spider are placed on the frame. The fenders are attached later.



Fender/running board is bent to shape, placed on edge and soldered to the inside mudguard. Guard will be trimmed to fit.



View of car's underside shows tin transmission box and driveshaft (coat-hanger wire) soldered to the differential (a bolt).

parts; 1/16-in.-dia. brass wire for steering wheel, wind screen, brake lever; metal window screen (not aluminum) for radiator; 1 1/8-in.-o.d. conduit for gas tank.

Decorative hardware needed includes: small hex nuts for axles, small screws for radiator cap and differential. You'll also need black, yellow (a popular Stutz color) or your favorite-color metallic gold spray paints.

Tools needed are a small vise,

Stutz Bearcat builder Ray Owen manages a radio station in San Juan, P.R. He's made a garage full of model cars including landaus, racers, coupes and tourers—all based on authentic models. Besides making filigreed lanterns from tin cans, Charles Phillips designs and makes jewelry. His tin can work can be seen at Bellardo Ltd. in New York City. Larry Phillips finds sculphunch work to be an excellent way to relax. During work hours he has written numerous articles on aerial photography.

clamps, tin snips, 250-watt (minimum) soldering iron, drill, hacksaw, hammer, small file, compass with scribe point, 3/16-in.-dia. punch or stovebolt and sandpaper.

Forming the wheels is the most complex part of the job. Secure a length of 1 3/8-in.-dia. dowel in a vise and carefully wrap seven turns of 3/16-in.-dia. copper gas-line tubing tightly around it to form the tires (see photo above). Clamp the tubing in place and cut across the turns to form seven rings. Solder the ends of each together and set the six best ones aside.

Cut four strips of 1/8 x 4 1/2-in. cracker tin for tire rims. Insert them inside the tires, cut off the excess length and tack-solder.

With a compass, scribe only four wheels on cracker tin. (Spare tires

on this model don't need wheels.) To do this, scribe concentric circles of 3/8 in., 9/16 in., 3/4 in. and 1-7/16 in. diameters for each wheel to locate, respectively, wheel lug nuts, hubs, rear lug nuts (that attach the rear-wheel brake drums) and overall spoke diameters.

Scribe the spokes by halving, quartering, then by eye-dividing each quarter into three parts. Using the 12 scribed lines as a center, mark each spoke 3/32-in. wide; cut out the wheels and spokes. Then cut the two 15/16-in.-dia. rear brake drums.

To assemble the wheels, first add the roundhead brads used as lug nuts (see above). Clamp the brake drums on the rear wheels, bore holes as needed and solder the brads on the wheel backs. Then solder the assemblies inside the tires.

The axles are 3-5/16-in. lengths of coat-hanger wire. Remove paint from the ends with sandpaper. Bore holes in the wheel hubs; solder axles in place with hex nuts at ends.

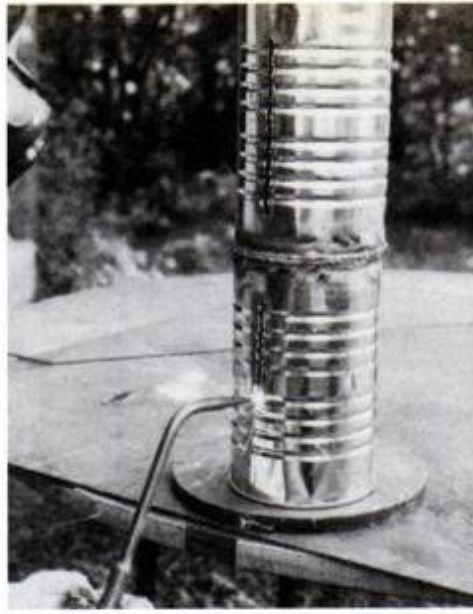
The car body

Now the car begins to take shape. The chassis is one piece of cracker tin cut and bent as shown in Fig. 3. (Fig. 1 is above. Figs. 2 to 12 are on page 186. Patterns are half of actual size.) Use a piece of metal or hardwood in a vise to get a clean bend.

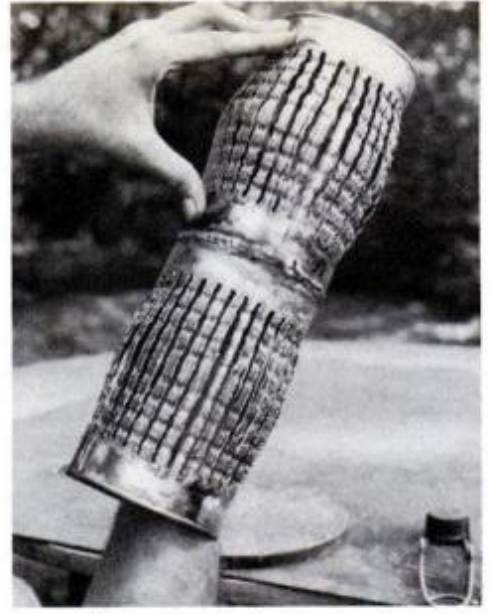
To make the radiator (Fig. 4), use



Cans are tack-welded in four spots to prevent warping, then seamed together by moving torch in small circles (see text).



Cut the second of the first pair of slits. Touch the top can's rim with torch to mark slit location; turn can 180° for next cuts.



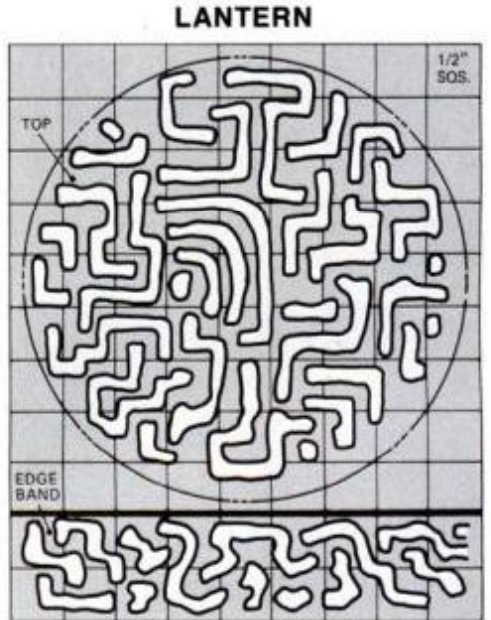
After slits are made, begin shaping cans. Position one hand inside the cans and slightly push outward on all the struts.



Place the work on a table and bend struts farther outward; then place one hand inside cylinder to finish the shaping step.



Top decorative design is cut. A lighted candle under it will cast this pattern on ceiling. Side bands, angles are final cuts.



something thicker than cracker tin, such as a 22-ga. (about 1-mm thick) piece of brass. Cut a radiator backing of cracker tin with the same dimensions without a center cutout. Cut and sandwich screening (window screen, other than aluminum which can't be soldered) in place and solder along the edges to join the pieces. Then file edges clean. Cut the firewall of cracker tin (Fig. 5).

The hood is a 1 $\frac{3}{4}$ x 3 $\frac{3}{4}$ -in. piece of tin shaped around the radiator, trimmed and soldered to the radiator and firewall. Solder this in place, slightly overhanging the front edge of the chassis. The triangular ends of the tin seat runners (Fig. 6) are soldered against the firewall; their bottoms run along the chassis.

Textured seat upholstery

Cut the seat back and sides (Fig. 8) out of cracker tin and shape the curve with your fingers.

Use thinner metal such as a soft-drink can (not aluminum) to make

the seat bottoms and back (Figs. 9 and 10). Before you cut them, emboss the metal to give it an upholstery effect. Here's how: scribe $\frac{1}{4}$ -in. squares, then tap the center of each square lightly with a punch as shown in the photo on page 119. Then cut, trim and solder in place. Position on the seat base frame (Fig. 11) and solder to the chassis.

Rear accessories

The big gas tank is a 1 $\frac{1}{8}$ -in.-o.d. conduit and the ends are tin. Filler caps are two thicknesses of brass with wire handles. Solder the tank in place (Fig. 2).

The luggage/tool chest is a simple 15/16 x 2-1/16-in. tin box soldered at the edges. Before you bend the tin, emboss the rivet lines. Don't forget to add corner reinforcements.

Next cut the spare tire spider (Fig. 12). Solder it to the two spare tires and position the assembly using a wire bracket.

Working on the underside of the

car, cut and install the front spring suspenders (Fig. 7). Cut two front and two rear springs. To do this, cut 3/32 x 3-in. tin strips. Make four layers, cutting each a little shorter than the previous one and shackle together with small tin strips. Leave the top stringer long enough to make adjustments. Install the springs so the car is level.

The fender/running board is a 9/16 x 9 $\frac{1}{2}$ -in. tin strip. You may need another tall can to cut the pieces. Shape the two fenders (Fig. 1).

Place the strip on a piece of tin which will be a mudguard and solder as shown in a photo on page 119. The front guards are angled to fill the space between the installed fender and the car frame. Trim to fit.

Make tin running-board reinforcements $\frac{1}{8}$ in. wider than the fenders. Position and bend outside edges over to hide running-board hangers.

These are of stiff wire that can be seen on the car's underside. Solder the hangers to the frame to align the running board and fenders. Then bend the inside mudguards over to meet the chassis piece and trim.

Attach the wheels by centering the axles on the springs and fastening them with a small shackle and solder. Axles shouldn't rotate. Add the tie rod between front wheels.

Cockpit pieces

The footboard is a scrap of tin, soldered in the cockpit front along the seat bracket angle.

The big steering wheel, used before power steering, is a 1-1/16-in.-dia. circle shaped from brass wire. Cut a tin spider with four spokes; solder inside the wheel. Bore a center hole and add the steering column, a 3/8-in. piece of coat-hanger wire trimmed after installation. Locate the steering column position and bore a hole for it through the footboard and the chassis piece so you can insert the column; trim and solder underneath.

The windscreen is a 1-1/16-in.-dia. circle of brass wire with a piece soldered at the bottom and attached to the steering column.

The coil box is tin and the spark adjustment is a bent brad. The passenger footrest is wire.

The brake lever is brass wire and the shift lever is tin. Attach using a quadrant of wire for realism.

Finishing touches

The parking lights are two 7/16-in. lengths of copper tubing with screws inserted. Attach them to the firewall with bits of brass wire.

The headlamps are gas-line fittings with wire handles. They rest on support brackets which attach through a small hole in the front spring suspender.

Add a small-screw radiator cap and wire hinges down the center of the hood. Wire also separates the

hood and radiator and the hood and firewall. Add wire latches along the bottom on each side of the hood.

On the underside add a tin transmission box, a driveshaft made of coat-hanger wire, and a steering link of coat-hanger wire connected to the tie rod. The differential is a screw cut to length with the driveshaft soldered on one end and the axle soldered on the slotted head.

Spray the underside with dull black paint, then spray several coats of yellow or other color on the entire body. Barely highlight the radiator, steering wheel, seat, tank tops and tires with gold, and your model is complete.—Ray Owen

Lantern

Two No. 5 juice cans are combined to make this lantern, and the small votive (church-type) candle placed inside it produces maximum light play on walls and ceiling.

To make the cutouts, you'll need a torch—preferably an oxygen-driven, acetylene type—which delivers enough pinpoint heat to cut a clean, thin kerf. Air-mix torches aren't hot enough. I use a No. 0 brazing tip and set both regulators at 5 lbs. The flame should have a pencil-point

sharp blue tip, the clear part of the flame extending 6 to 8 in. Actual cutting is done about 1/2 in. below the blue point. To prevent unplanned cuts, you must quickly and accurately present the tip to the can.

Goggles are a must for this work. I use the dark brazing-type ones. A safe rule is: When the flame is on, the goggles are on. Also wear heavy shoes covered by cuffless pants, a long-sleeved shirt, hat, heavy gloves.

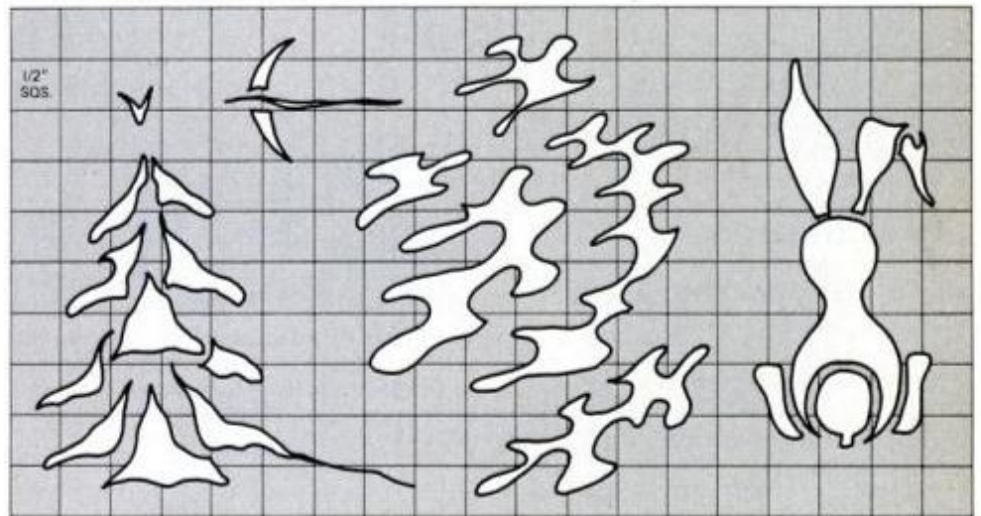
For maximum caution, it's best to play a fan on the cans as you work. Sometimes noxious gases are released around soldered seams and surfaces that have printing directly on them. Burn off cans with printing by placing them in a charcoal fire or fireplace—never on a range or in an oven. Work outdoors or in a large, well-ventilated room.

Preparing the cans

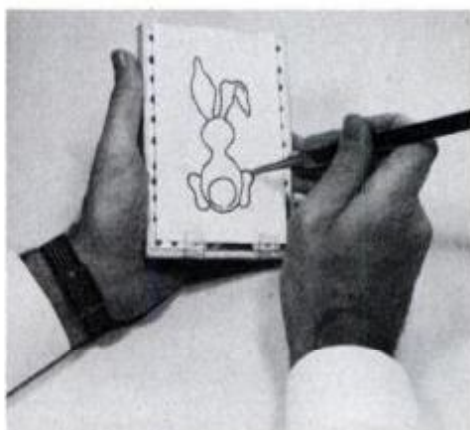
Remove any paper on the cans by cutting with one quick, vertical torch pass, and then peeling the paper off. Remove one end of each can by cutting as close as possible to the rim with a torch, or by using a can opener. If needed, shape the ends to return them to round, then place

(Please turn to page 186)

SCULPUNCH DESIGNS



Cut rims from a can after slitting it at the seam. Next, tack the can to plywood with the inside surface facing outward.



Center and tape the pattern over the tin; carefully outline it by punching holes with a nail or use a file ground to a point.



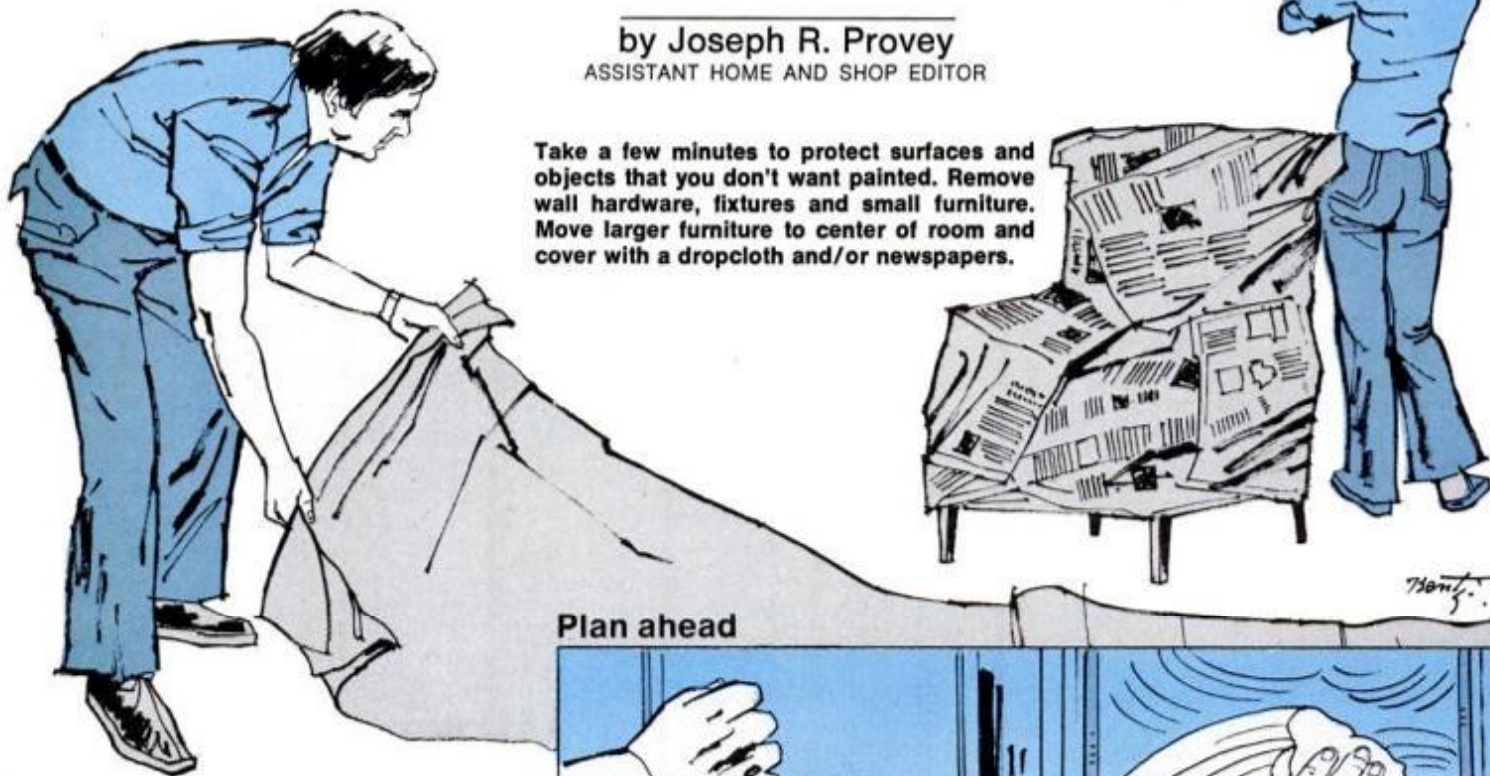
Punch holes in background to apply texture. This also raises the figure to give it a slight three-dimensional effect.

How to prepare surfaces so paint stays put!

Poor preparation guarantees paint failure and sloppy results. Here's how to make sure *your* paint jobs last.

by Joseph R. Provey
ASSISTANT HOME AND SHOP EDITOR

Take a few minutes to protect surfaces and objects that you don't want painted. Remove wall hardware, fixtures and small furniture. Move larger furniture to center of room and cover with a dropcloth and/or newspapers.



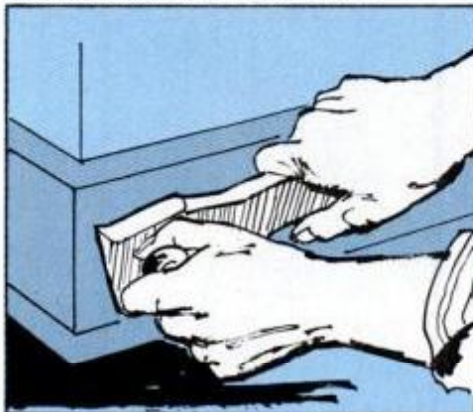
Plan ahead



Prior to painting windows, remove latches and handles. Also remove doorknobs for best results. Store screws and hardware in a jar or box for safekeeping.

Use masking tape for neat work around muntins and woodwork. A coating of opaque household glass cleaner will make splatters easy to wash off.

Get off to a smooth start



Scrape off peeling, blistered paint with a broad putty knife or with specially designed scrapers. Wide-blade tool is ideal for flat surfaces like baseboards.

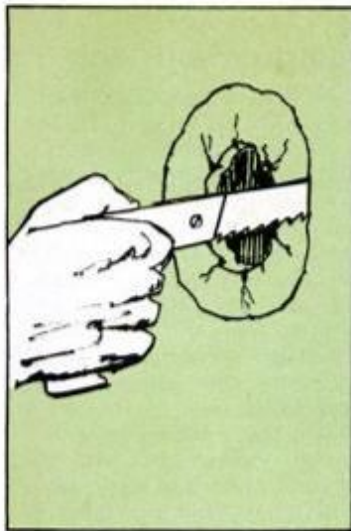


A teardrop-shaped tool is great for scraping moldings with curved and deep-cut grooves. Pull, don't push, scraper into loose or caked-on paint to remove it.

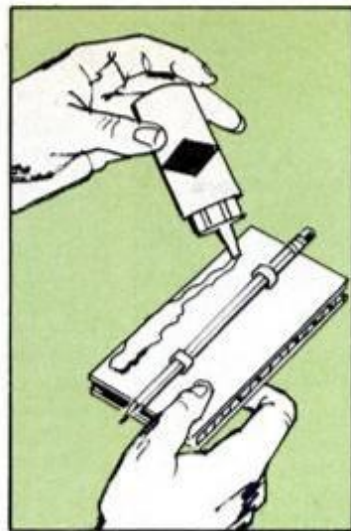
Painting the inside of a room is like putting icing on a cake—most of the work goes into preparing what's underneath the goo. Just as with baking, ill-conceived shortcuts can cause more work than if you had taken the time to do the job right in the first place.

Accept the fact that surface preparation and painting are inevitably messy. You can't be too careful about protecting nearby objects and surfaces. Masking tape is the paint-it-yourselfer's best friend. Apply it just prior to painting to protect bordering areas from splatter and paint mist. New, pressure-sensitive tapes, like Easy Mask by the Daubert Chemical Co., do not leave adhesive residues on surfaces they're meant to protect. These 3¾-in.-wide rolls provide extra coverage, but follow the manufacturer's caution and don't use Easy Mask on lacquer-based finishes or peel-off-type wall coverings.

More important than covering furnishings is protection for your head and body. A cap with a brim, an old long-sleeved shirt, jeans and old sneakers are ideal—they'll save you much scrubbing and shampooing. To protect your eyes, skin and



Use keyhole saw to cut away damaged area (round hole). Measure hole and cut rectangular patch backing from corrugated box material so that it's larger than hole. Backing must be narrow enough to fit in hole.



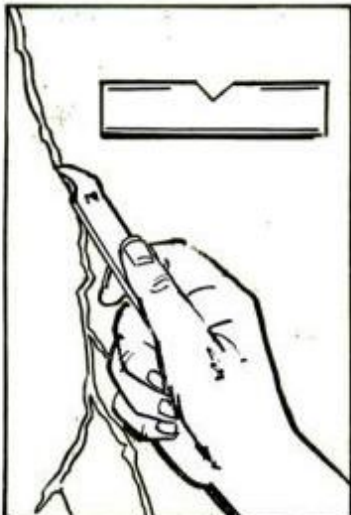
Punch two holes in corrugated backing, thread rubber band through holes and secure pencil or dowel through two loops. Dowel should hold to backing with slight tension. Squirt glue around perimeter as shown.



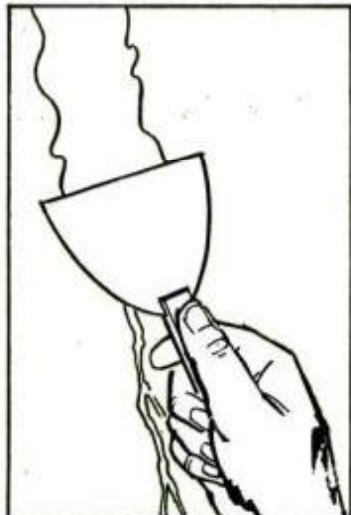
Bend patch backing slightly, if necessary, to insert and clamp in place as shown with dowel and rubber band. Allow glue to dry 24 hours, then snip off the rubber band with scissors. Push lightly against backing to test.



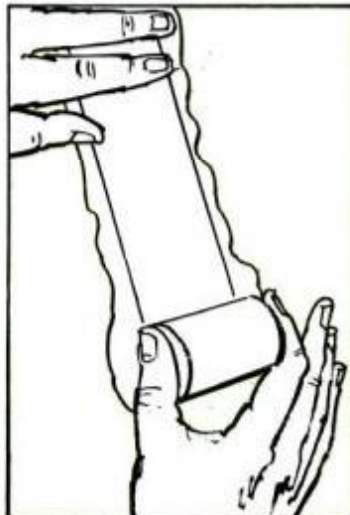
Moisten edges of hole and use tapping knife to fill in area with joint compound. Use tape with second coat to prevent cracks; finish with thin third coat. Sand compound smooth and then seal surface with primer.



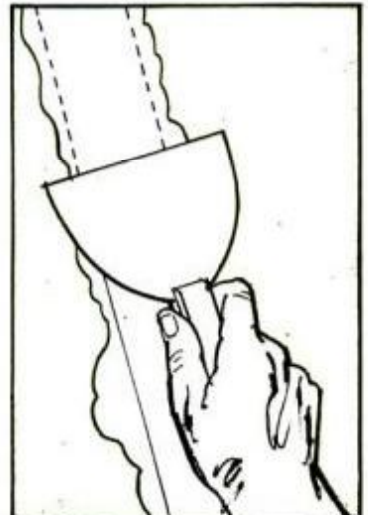
Clean out loose plaster debris from crack with utility knife or with punch-type can opener. If crack is in wallboard, use a sharp utility knife to cut paper layer on surface to prevent ragged tears while scraping.



Prepare crack for joint compound by moistening area using a damp sponge. Use a 4-in. tapping knife to force joint compound in crack and to provide a bed for wallboard tape. Gauze-type tape is best for plaster.



Carefully place tape over buttered crack with fingers. Use tapping knife at 45° angle to embed tape in compound and squeeze out excess compound. Apply a skim coat. Remove air bubbles with razor blade.



Apply at least two more coats, but wait for the previous one to dry. Sand away high spots between coats, being careful not to oversand adjacent paper surfaces on wallboard. Prime patch after final sanding.

lungs, use safety goggles, gloves and a combination respirator/dust mask as the task demands.

Scraping and sanding

Interiors usually require no extensive scraping, except where thick layers of paint have built up, or where moisture has caused blistering and peeling. If scraping is necessary, do it first.

Scraping tools come in all sizes and shapes. Use 1-in.-wide scrapers around window sash and trim, and 2½-in. bladed tools on baseboards and other wide surfaces. Several makers design their tools with double-edged, high-quality steel blades that can be file-sharpened or removed for easy replacement.

A scraper should be pulled at an angle into the affected area. Pushing a scraper into the paint will dull your blade faster. Apply a constant downward pressure close to the blade with one hand and guide the tool handle with the other. Try a shaving motion for best results. File blade corners round to eliminate the possibility of gouging wood surfaces. Follow up areas that have been scraped with a thorough sanding. Feather out small ridges so they will not show through the finished coat.

Scrapers are also best for cleaning flaking paint off flat metal surfaces. On irregular-shaped metal and on masonry surfaces, use a wire brush, or wire cup brush chucked in

a portable, variable-speed drill.

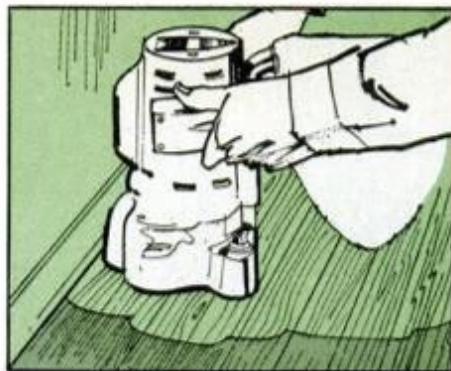
Surface patching methods

Before you put away your scraping tools and sandpaper, make a thorough inspection of all surfaces for holes, cracks, ridges, dents and chips. Use scrapers to clean damaged areas of loose plaster debris; abrasive paper to smooth out and remove finish from dents and gouges in woodwork. Don't think about picking up a brush until you have finished all patching.

Clean small nail, hook or screw holes in drywall or plaster and moisten them with a water-wet brush or sponge. Then press patching compound into the holes with a putty knife, slightly overfilling them.



When a floor has been worn to the bare wood in spots and has begun to crack or discolor, it should be sanded before refinishing. Rent a drum-type sanding machine with a dust-catching bag attachment for sanding the main floor area.



An edging machine, which can also be rented, cuts into areas close to baseboards and saddles where a drum sander can't reach. Be extremely careful to keep sander moving uniformly, so as not to cause uneven gouges (dishing) in floor.



Corners which cannot be reached with a drum sander or edging machine should be done with a well-sharpened scraper. Liquid removers are usually unnecessary and can leave residues which retard drying. Hand-sand to glasslike smoothness.

Resurfacing a wood floor

The power equipment needed to make refinishing your floors a do-it-yourself job is available at most rental stores. Have the dealer explain how to use his tools. Hire a professional if you have doubts—mistakes can be costly. The first cut should be made with coarse, 20-grit paper, the second with medium, 40-grit paper and the finish cut with 100-grit abrasive paper. For a hard, burnished surface, polish with steel wool pads and power polisher, also available at rental stores.

Keep in mind that sanding is always done in straight passes and *with* the grain. Keep the drum sander moving forward once it contacts the floor or you will cause uneven surface depressions. Lift the spinning drum off the floor *before* you stop. Make your passes in one direction only, overlapping the previous pass by about 2 in. Reverse direction of the sander to reach area close to starting wall.

Vacuum up dust thoroughly and wipe with a tack cloth before finishing. If there are stains in the floor, remove with a commercial, two-part wood bleach before finishing. Don't try to sand stains out if they have penetrated wood. Wear rubber gloves and goggles when using bleach and also when resanding spots later, so dust will not carry chemicals into your eyes. Read label instructions before using bleaches.

Sandpaper moistened with water does a clean job of smoothing and feathering the edges of the dried patch to the wall surface.

Patch doorknob-size holes in drywall by following steps in the drawings opposite. Don't apply too much joint compound at one time—the heavy glob may sag. Fill moderate-sized holes in two or three applications, letting each dry before proceeding to the next.

When large sections of drywall need repair, cut away the entire damaged section. Make the cutout as rectilinear as possible to simplify cutting the patch from drywall. Expose enough of the adjacent joists or studs to provide a place to nail the new patch. Toenail additional 2x4 nailers in position perpendicular to joists or studs and over the patch's two other joints.

The drywall patch should be the same thickness as the surrounding drywall. Nail it in place with gypsum wallboard nails, letting the last hammer blow make a slight dimple in the surface at each nail. Fill each dimple flush to wall or ceiling with compound. Also fill the channel between the patch and existing surface. Tape over joints the same way as you tape cracks (see drawings).

Hairline cracks in gypsum wallboard or in plaster should be opened

to about $\frac{1}{8}$ in. width and then filled in the manner prescribed for repairing small holes. Larger cracks around door frames or other areas should be repaired as shown in drawings. Moistening the crack with water prior to patching prevents the compound from drying out too quickly and assures a good bond.

When large, bulging areas of plaster have separated from the lath due to leaks or heavy impact,

remove all loose plaster. If the lath is unsound, replace it. If it's still serviceable, undercut the edges of the hole and push old plaster keys aside. Next, wet lath and edges of the opening with water and apply a first coat of patching plaster to cover the lath. Work it through the lath spaces to obtain good keying and cover lath to a depth of $\frac{1}{4}$ in. Score $\frac{1}{8}$ -in. grooves in the first coat while it's still soft and let it set.

(Please turn to page 230)

How to get surface clean



When refinishing concrete that has already been painted, scrape and brush away flaking paint, sand glossy areas, and wash with TSP (trisodium phosphate) or a detergent to remove grease, oil and dirt. Rinse and allow to dry before finishing.



Walls in kitchens or near furnace rooms usually require a scrubbing prior to paint application for best adhesion. Use TSP or commercially prepared detergents like Spic and Span or Soilax. Rinse with clear water and let dry before painting.

PM LOOKS AT:

LATHE ATTACHMENT FOR SHARPENING MILLING CUTTERS

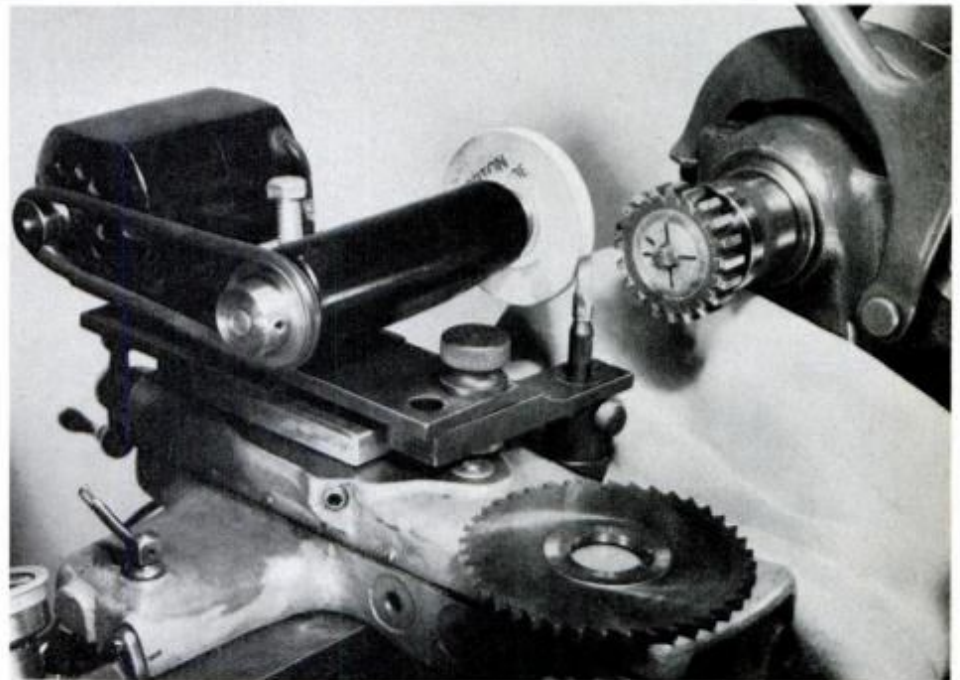
Style Craft's tool grinding fixture indexes and supports the teeth of most kinds of milling cutters while they are being sharpened with a lathe toolpost grinder. It is designed to attach to lathes with 9- to 18-in. swing (overbed) and is especially useful to those who cannot justify a special-purpose tool-grinding machine.

Once the fixture was adapted to my 9-in. lathe and toolpost grinder for testing, it worked smoothly and easily. Sharpening all the teeth on the straight-tooth cutters shown took only a few minutes. The fixture consists of a slotted base and a clamping arm fitted with a tooth rest and an adjustable tooth-rest holder. The base plate is bolted to the cross slide on your lathe and extends under the grinder to support the clamping arm. The tooth rest projects upward between the cutter and grinding wheel to position and support the tooth being ground. It should be located so that its tip just clears the grinding wheel. The tooth rest must be wider than your grinding wheel and positioned so the grinding wheel traverses off the cutter before the tooth rest does—or else the wheel will gouge the cutter.

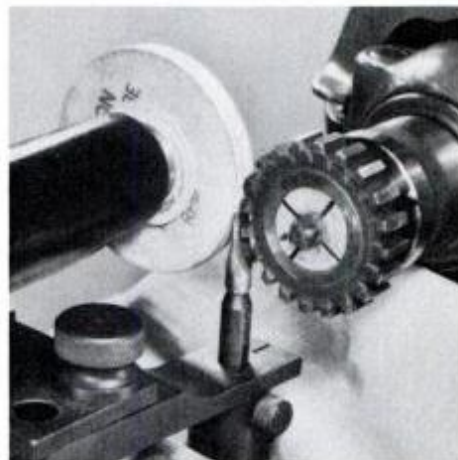
The cutter to be ground is mounted on an arbor or mandrel, supported either between lathe centers (without a dog) or clamped in a headstock collet. It should turn as freely as possible—even if this means disconnecting the lathe drive. To bring the cutter in contact with the grinding wheel, advance the cross slide until they touch. The cutter clearance angle is adjusted by selecting the height of the tooth rest according to the formula provided. It may be easier to set the clearance angle by eye.

When sharpening spiral cutters, the tooth-rest top should be ground to match the helix angle. As the grinder is slid against the helical tooth, the tooth rest rotates the cutter and holds the tooth constant in relation to the wheel position.

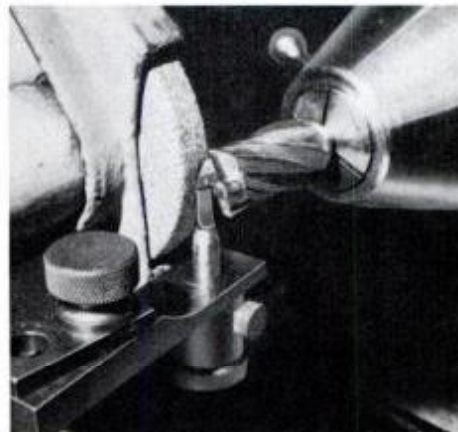
The outfit is priced at \$105 from Style Craft Furniture, 11709 Coldstream Dr., Potomac, Md. 20854. Extra tooth rests are available or can be made to suit your cutters from drill rod. A radius attachment for grinding convex and concave radius cutters is also available at extra cost.—Walter Burton



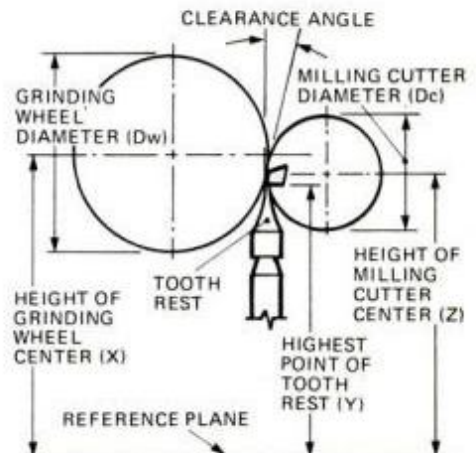
Tool-grinding fixture mounted on a lathe with toolpost grinder allows you to sharpen almost any milling cutter, including helical and straight types.



Tooth rest holds cutter tooth at proper height for sharpening. Adjust height by eye or use formula with diagram.



Pass helical cutter tooth across grinder using lathe's longitudinal hand wheel. Tooth rest turns cutter for orientation.



$$\text{CLEARANCE ANGLE} = 114.6 [(X/Dw + Z/Dc) - Y(1/Dw + 1/Dc)]$$

Use formula above to solve for tooth-rest height. Measure dimensions from common plane, usually the top of cross slide. Record for future setups. Note that clearance angle is the complement of angle ground on tooth; together they equal 90°.



Fixture is made of hardened tool steel, comes in neat wooden box complete with recesses for tooth rests, and an Allen wrench.

Build this workbench drafting table for under \$50

For about \$50 you can make this 31x42-in. drafting table. The major cost is a basswood board (Fig. A, below) you can buy for about \$30.

The board fastens rigidly atop a workbench (you can adapt the idea for any woodworking bench) and stores compactly when not in use.

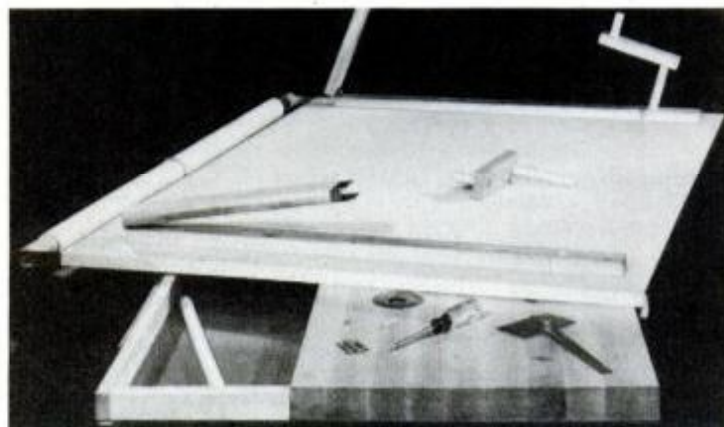
Begin fabrication by breaking the four edges of 1x2 strips with a plane to round them slightly. Cut 1x2 sup-

(Please turn to page 198)

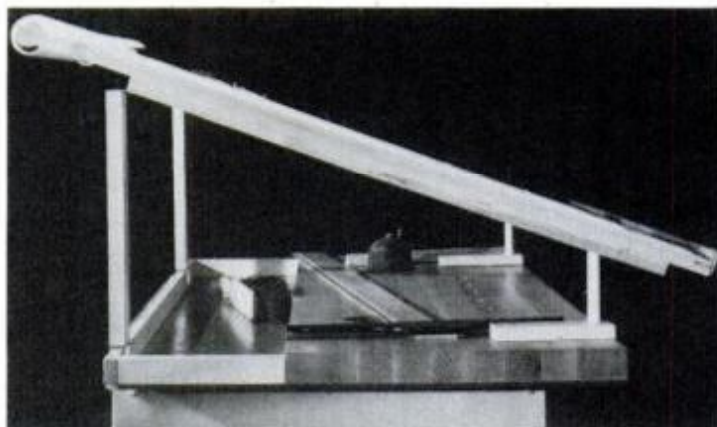
MATERIALS LIST—DRAFTING TABLE

Key	Pcs.	Size and description (use)
A	1	31x42" (drawing board, purchased)
B	2	3/4 x 1 1/2 x 27" (support strip)
C	2	3/4 x 1 1/2 x 12" (rear upright)
D	1	1" dia. x 42" dowel (paper-roll holder)
E	1	41-15/16" black finished cap molding
F	2	3/4 x 1 1/2 x 5 1/4" (steady rest)
G	2	1/8" dia. x 4 1/4" dowel
H	2	1/8" dia. x 2 1/2" dowel

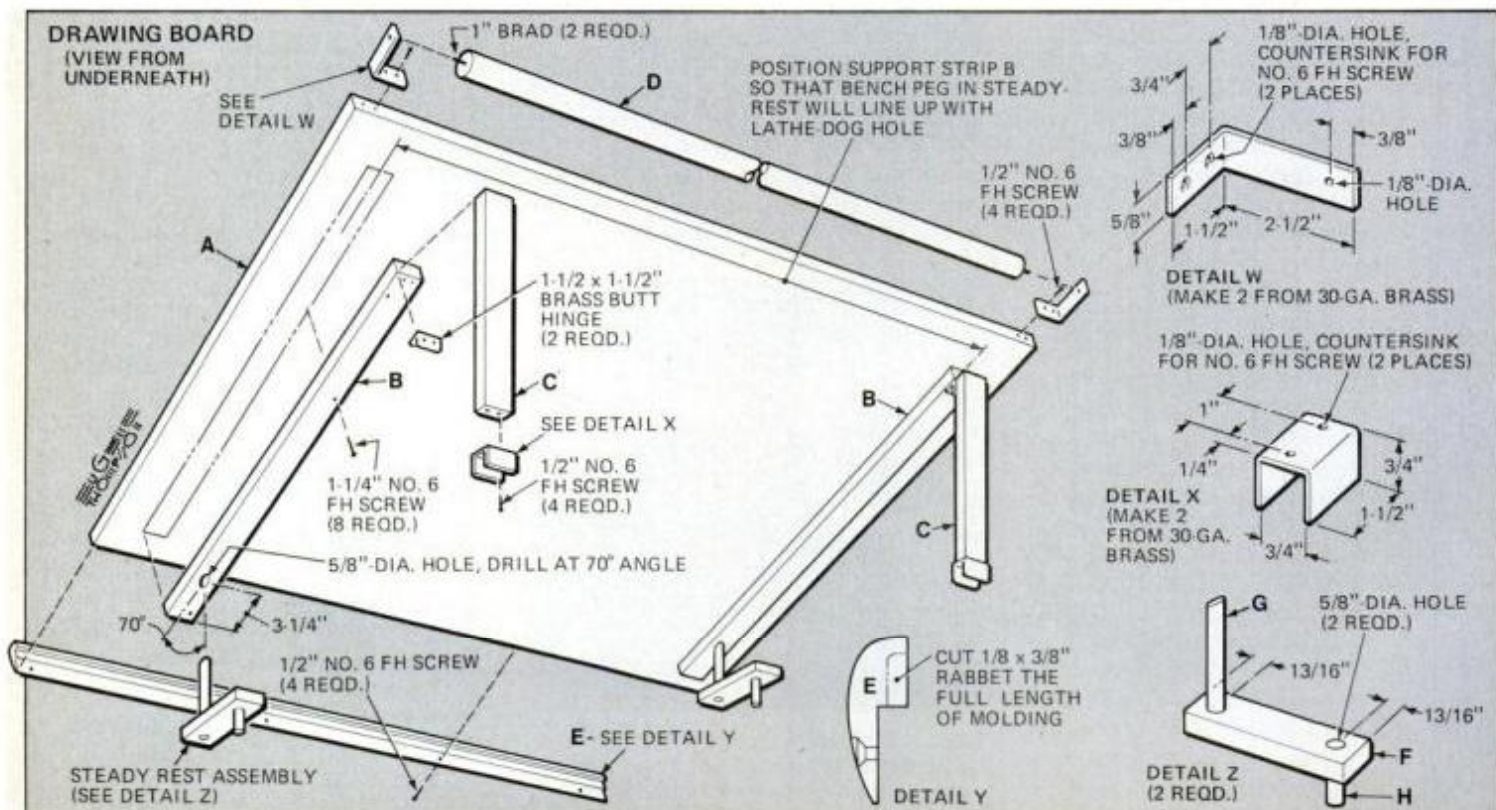
Misc.: 30-ga. sheet brass for "U" brackets and paper-holder bracket; 2, 1" brads; 8, 1 1/4" No. 6 fh screws; 12, 1/2" No. 6 fh screws; 2, 1 1/2 x 1 1/2" brass butt hinges. Design and construction: Ray Peterson



The board is supported by 1x2s (B, C and F) and two pairs of dowels. Cut and assemble wood to the board's underside.



The board is rigidly supported on top of the workbench. Pitch is adjusted by changing the front dowels as desired.



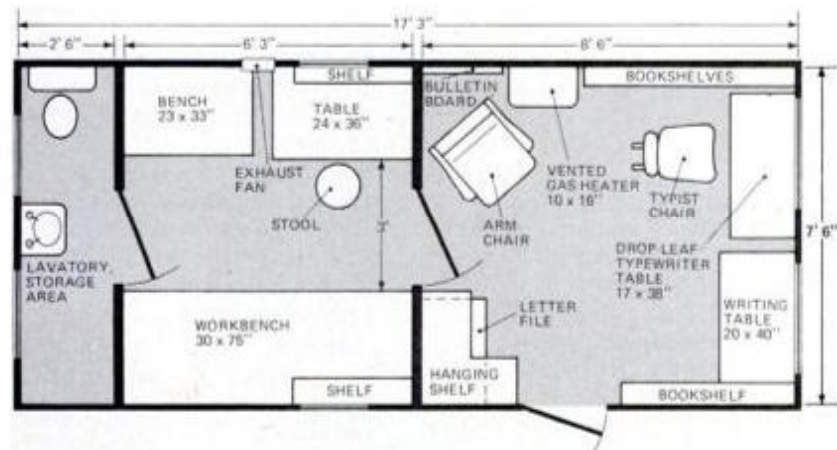
Workshop has wheels, will travel



Tools hang on perforated hardboard in easy reach. "Bench" is a kitchen cabinet.



Exterior view shows trailer/shop with the wheels removed, positioned on cement blocks.



The former kitchen-dining area is an office; original bedroom is a shop.



This office corner contains a drop-leaf typing table, an overhead shelf and adjustable bookshelves.

There are probably thousands of men-on-the-move who have had to give up their shops and hobby work due to lack of space. Over the years, on three separate occasions, I've had to store my tools after moving to a house that lacked work space.

After my last move to a new city, I decided to make a permanent shop setup. I bought a secondhand camper-trailer and converted it into a combined office and workshop. Now, if I move again, the workshop will go with me, regardless of how much space I buy or rent.

I bought the trailer through a newspaper classified ad. Sale of the kitchen appliances and hot water heater paid for carpeting, new linoleum and shelving. I had the trailer rewired by a licensed electrician in accordance with the codes in our area for 125/250-volt use, grounded to a rod driven into the earth.

The former kitchen-dining area is now a 7½ x 8½-ft. office. Carpeting is attractive and helps insulate. Ad-

justable bookshelves hold books arranged alphabetically by subject, for quick reference.

In one corner, a curly maple drop-leaf typing table that I built folds to yield space when friends visit. A reading lamp and comfortable chair are located nearby. Some of my wood sculptures hang on the walls.

A wall-hung propane heater warms the entire camper. However, the door leading to the workshop can be closed to confine dust and chips.

It's organized and compact

The former bedroom is now a compact 6¼ x 7½-ft. workshop, where I can sculpt and do other woodworking. The bunk beds are converted into a table-height workbench, with storage space for my hand grinder, router, drill and accessories. A wall exhaust fan aids ventilation.

One of the trailer wheel wells, which protruded a foot above the floor, was removed and the hole was covered. However, I can install a new well if I want to move the rig.

Walls are lined with perforated hardboard, to hang tools at arm's reach. Shelves hold varied supplies.

The small lavatory serves as a storage area and as a place to season woods for carving and sculpting. The sink could be made usable by hooking up a water hose to the water inlet and adding a holding tank. In that case, of course, drainage to a drywell would be required.

Advantages, drawbacks

All in all, I have a comfortable, efficient office/workshop that is relatively noise proof. However, there are certain limitations to the setup. Boards over 6 ft. long can be extended through the doorways, but are cumbersome to work on. I could solve this, though, by knocking out the partitions and using the entire trailer as a workshop.

Many visitors like a work space separated from the house and garage. Already I've had two buyers offer more than I've invested in it; I declined.—Maurice Aase

How to stop stalling

by Mort Schultz

One are the days when practically every engine stall could be blamed on an incorrect carburetor idle speed or choke setting. Emissions controls and vacuum systems are presently giving drivers the most fits.

Letters received in *Car Clinic* suggest that 85 percent of the cars experiencing stalling have a malfunctioning



Keeping the choke valve clean and working freely is basic preventive maintenance.

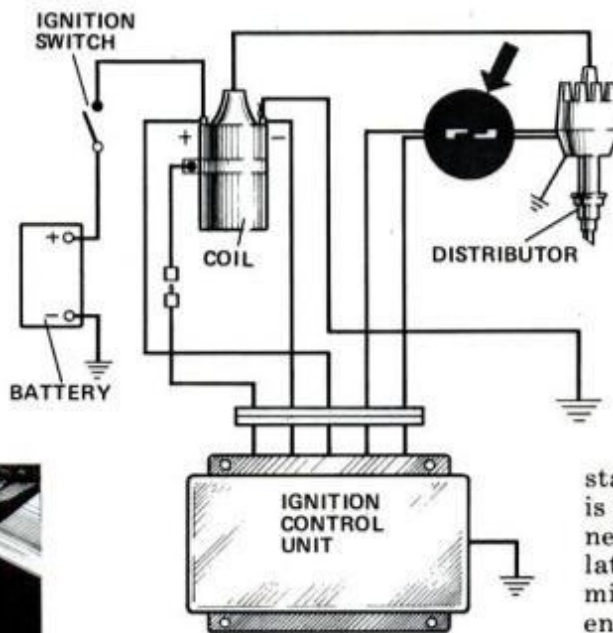
emissions control or vacuum-related component as the cause. By stalling, I mean an engine that quits running at idle or while the car is moving, when the engine is cold or warmed up.

Stalling has resulted in two recalls and one ongoing investigation by the U.S. Department of Transportation.

One recall concerns over a million 1975-77 Dodge Darts and Aspens, and Plymouth Valiants and Volares that stall on acceleration from a dead stop, when the engine is cold. The repair is to install a new accelerator pump seal and modify the exhaust gas recirculation system.

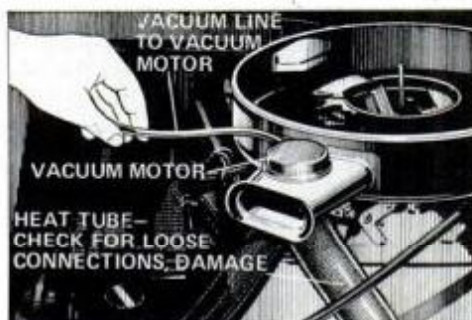
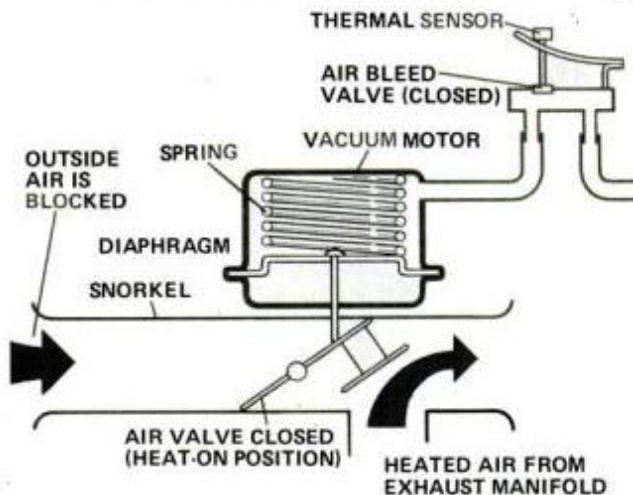
The other recall covers 500,000 1974 to 1976 AMC passenger cars and Jeeps with electronic ignition systems. The vehicles stall suddenly on-the-drive, when the two-wire connector hooking the electronic control unit to the distributor separates. The repair involves fastening the connector.

The investigation in progress as I



Connector (arrow) on electronic ignition systems of 1974-76 AMC vehicles loses contact and causes stalling—and it led to recall by the manufacturer. Problems like this make home troubleshooting tricky.

Thermostatic air-cleaner operation when engine is cold is shown below. As engine warms up, the air valve opens, allowing cooler outside air into the carburetor. Make sure the valve is working properly.



Apply vacuum to vacuum motor of thermostatic air cleaner to check its operation.

write concerns 1977 Buicks, Oldsmobiles and Pontiacs with V6 engines that stall on cold-engine driveaway. Approximately 450,000 cars are involved. Service bulletins instruct dealers to install a new thermal vacuum switch and vacuum break, and test the thermostatic air cleaner operation.

No laughing matter

Stalling can kill you. An engine that has a tendency to stall can die suddenly when the car is cruising, or when acceleration is necessary. Letters to *Car Clinic* relate incidents of engine stall in the middle of intersections and when entering freeway traffic.

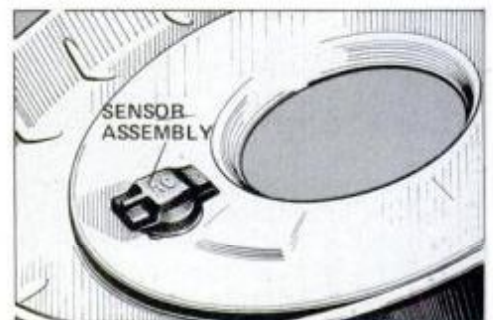
Stalling, therefore, should not be taken lightly. If you drive one of the cars involved in a recall or safety investigation, get it to a dealer. If you have a different make or model, find out what causes stalling and fix it.

There are many deficiencies that contribute. Initially, an engine tuneup should be done. Concentrate on the following:

- A compression test with the engine warm, to establish if stalling results from excessive carbon in the engine. This is especially important for an older engine. If compression is high, indicating carbon, GM's Top Engine Cleaner may help. Try several cans before deciding to dismantle the engine.

- Servicing sparkplugs, cables, ignition timing and distributor parts, and adjusting the point dwell of nonelectronic ignition systems.

- Testing the automatic choke to make sure it isn't sticking, and seeing that the choke is set



Sensor assembly is found in air cleaner housing and is easy to replace.

to the manufacturer's specifications.

- Setting slow (curb) and fast-idle speed to specification. If the carburetor has not been serviced in 30,000 miles, it probably needs overhaul. A worn accelerator pump, sticking needle valve, damaged float and clogged passages will cause stalling. Also, look for a throttle linkage that catches as the accelerator is pressed.

- Dirty carburetor air filter element and clogged fuel filter. If water has gotten into the fuel system, stalling will occur. When you disconnect the fuel line to replace the fuel filter, let some gas drop in your hand. If globules of water remain when the gas evaporates, the fuel system, including the tank, should be drained and cleaned.

- Clogged PCV valve.

- In older cars, stalling can be caused by a weak fuel pump which is not pumping enough gas. This is especially noticeable on hills.

Stalling affects cold engines

You should also keep in mind that you're inviting a stall if you start a modern engine and attempt to drive in freeway traffic, before it's properly warmed up. You can't get much speed or acceleration from a cold engine. On the other hand, you should avoid excessive idling to warm up the engine, especially one having a catalytic converter. Moderation is needed. Start the engine and drive the car slowly for a few minutes.

If the tune-up suggested above doesn't prevent stalling, the trouble is probably caused by:

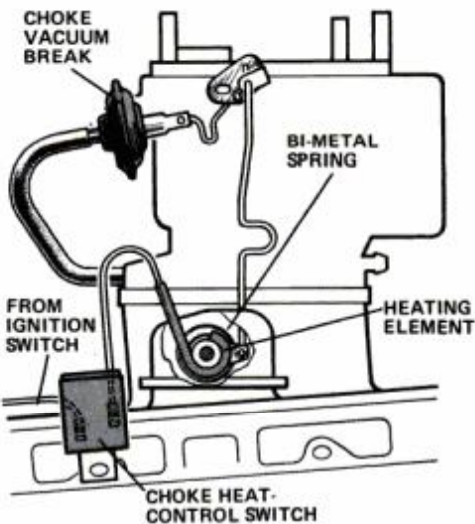
- An inoperative thermostatic air cleaner.

- Vacuum loss around the carburetor and intake manifold.

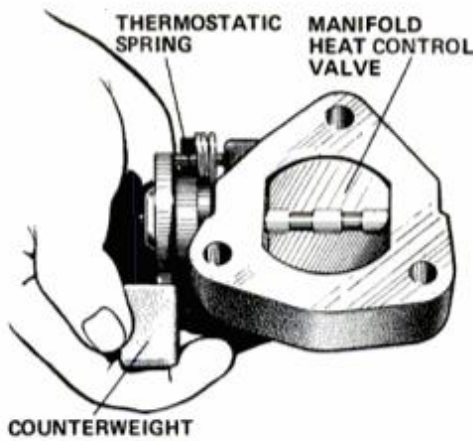
- Split, kinked or loose vacuum hoses.

- Damaged vacuum break.

- Inoperative manifold heat-con-



Choke vacuum break and control switch must work properly or stalling may result.



Manifold heat-control valve must work freely; be sure to check it regularly.

trol valve or vacuum-controlled fuel vaporization valve.

- Leaking exhaust-gas recirculation (EGR) valve.

- Cracked or loosely connected ignition wires.

Thermostatic air cleaner

The thermostatic air cleaner reduces the production of carbon mon-

ter, and check the door operation from the backside. Start the engine after it has been shut down for several hours or, if the engine is warm, place a damp rag over sensor in the air cleaner. The door should close.

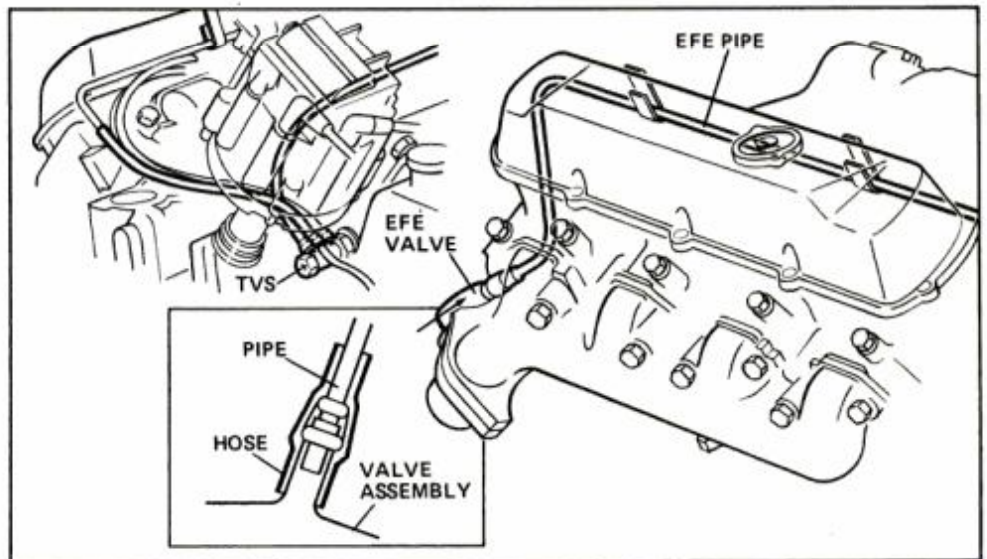
If the damper door isn't closed when the engine is cold, the hot-air tube to the air cleaner may be split or loose, or the temperature sensor or vacuum motor is shot. Check the hot-air tube. Replace it if it's damaged. Make sure the tube is secure.

Disconnect the hose of the vacuum motor at the engine end and apply vacuum. This may be done with a vacuum pump, or by putting the end of the hose in your mouth and drawing in.

If the damper door stays open, replace the vacuum motor. If the door closes, replace the sensor.

When the engine is warm, the damper door should open. If it stays closed, the fuel mixture will be affected and stalling can occur.

If the door is not open, replace the sensor, which usually solves the problem. But if not, the damper door



Early Fuel Evaporation (EFE) valve installation is shown here on late-model Cadillac. EFE system, along with thermostatic vacuum switch (TVS), heats fuel before burning.

oxide by regulating air temperature at the air cleaner inlet. A door in the inlet (snorkel) closes when the engine is cold to let hot air, diverted from the exhaust manifold, enter the carburetor. Carbon monoxide levels are reduced as the temperature of the fuel mixture, which includes incoming air, increases.

When the engine is cold, the damper door in the snorkel of the thermostatic air cleaner should be closed. Stalling can occur if it isn't, since the engine is calibrated to run when cold on the air/gas ratio provided by a closed damper door.

If you cannot see the door by looking into the nose of the snorkel, remove the air cleaner cover and fil-

is sticking and the mechanism will have to be replaced.

Tracking down vacuum loss

Vacuum may be leaking from the carburetor and intake manifold, or from a damaged or loose vacuum hose. Among the components that need vacuum to function are the air-conditioning and heating systems, EGR system, distributor-advance mechanism, power-brake booster, speed control, headlamp covers and automatic transmission modulator.

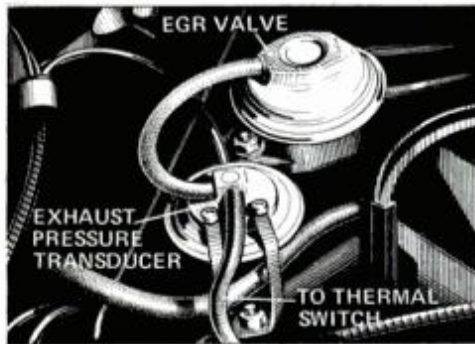
Maintaining adequate vacuum, which the engine needs to run at maximum efficiency, depends on vacuum hoses remaining intact.

The quickest way to determine if a

vacuum leak exists is with a vacuum gauge. Connect the gauge to a vacuum port on the engine and let the engine idle.

If the gauge shows a reading below the normal vacuum specification for the engine, examine each vacuum hose for a loose connection or split. Then, check for vacuum loss around the carburetor and intake manifold.

Let the engine idle as you apply a mixture of engine oil and kerosene to the crack around joining surfaces.



Back pressure transducer, if car has one, will be in tandem with the EGR valve.

Keep your eye on the vacuum gauge. If it shows an increase in vacuum caused by the oil-kerosene mixture sealing the leak, carburetor bolts are loose or a gasket is bad.

Note: A vacuum of 17 to 21 inches of mercury is generally considered normal. However, this isn't true for every engine, so check the manufacturer's specifications. If a vacuum spec isn't in any of your manuals, check with the service department in a dealership selling your car.

Damaged vacuum break

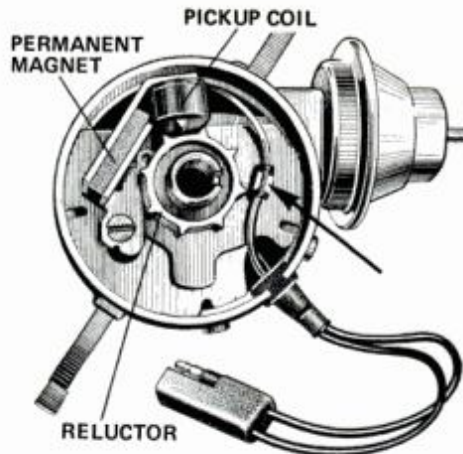
The purpose of a vacuum break is to prevent overchoking. When a cold engine is started, engine vacuum is transmitted to the vacuum break, causing the choke plate to open partially. If this did not happen, an engine would stall.

Check the vacuum break, which is on the carburetor, by starting the engine when cold. Alternately install and remove the hose from the vacuum break. The linkage should move. If not, replace the vacuum break. Its diaphragm has a hole.

About those heat valves

Some engines have a manifold heat-control valve which is operated by a thermostatic spring. Other engines have a vaporization valve, which operates by vacuum. GM, for example, uses a vaporization valve it calls EFE for "Early Fuel Evaporation."

Both mechanisms direct heat to the intake manifold to permit fuel vaporization as an engine warms

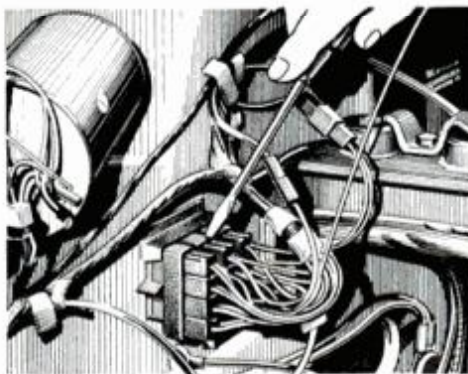


Ignition check (conventional or electronic) should include wires in the distributor.

up. If vaporization did not take place, the engine would stall.

To determine if a manifold heat-control valve is working, operate the valve's counterweight, with the engine cold. The counterweight is under the exhaust manifold, which gets skin-searing hot when the engine is warmed up.

If the counterweight doesn't move, the valve is stuck. Try freeing



Bulkhead connectors should be checked for tightness and absence of corrosion.

the valve by lubricating the valve shaft with manifold heat-control valve lubricant and tapping the counterweight lightly with a hammer. If this doesn't work, the valve or the manifold containing it should be replaced.

The valve shaft of a vacuum-operated vaporization valve should also be lubricated with manifold heat lube. This valve is controlled by a thermostatic vacuum switch (TVS).

The TVS closes the vaporization valve when the coolant temperature is below 120° F. This forces exhaust gases into the intake manifold to concentrate some heat on the fuel mixture and allow vaporization. The TVS switches off and the valve opens to permit normal exhausting of gases when the engine temperature reaches 120° F.

If lubricating the valve fails to bring free movement, check hoses for damage and connections for

looseness. If this doesn't restore vacuum to the valve, replace the TVS, which may be damaged, or the valve, which may be stuck.

If an EGR valve leaks, a loss of vacuum causes the engine to stall at idle and low speeds. Many of the bugs affecting EGR have been eliminated, but the part still deserves attention when stalling occurs.

EGR valves, except those with back pressure transducers, are tested in this way:

1. Set the transmission in PARK and run the engine at 1400 to 1600 rpm. Let engine warm up to 120° F.

2. Place a finger under the EGR valve and disconnect the vacuum hose. The valve's diaphragm should move down and engine speed should increase. Reconnect the hose. The diaphragm should move up and engine speed should decrease.

3. If this doesn't happen, feel the end of the hose for vacuum. If none is present, the hose or carburetor port may be plugged or leaking, or the EGR's thermostatic vacuum switch (TVS) may be shot.

Back-pressure models should be removed from the engine for testing with an external constant vacuum source.

One of the most devious stalls results when an engine on-the-drive suddenly cuts out, then starts right up. This should make you suspect a loose or bare primary ignition wire. Check connections at ignition and inside distributor for tightness.

Carefully look over the coil-to-distributor wire, especially inside the distributor. If insulation has worn away, a bare spot may be touching the metal housing. This will short the ignition system.

When nothing helps

Don't blame me if the procedures I've recommended fail to correct your stalling problem. It probably means that the solution is to be found in a service bulletin.

For example, did you know that 1977 Ford 400-cu.-in. engines which stall when cold can be fixed by installing a CSSH (Cold Start Spark Hold)? Or that a stalling-while-cruising problem with 1976 Chrysler Lean Burn engines may be corrected by installing a different distributor pickup coil assembly?

Of course you didn't. And neither did I until I checked the service bulletins, which is what you should do when a solution is elusive.

You "check" service bulletins by asking a service manager who handles your make of car to consult his bulletin index. If he is unresponsive, direct your inquiry to manufacturer or zone office nearest you.



PM's Gardening and Outdoor Living Guide



We've rounded up a yardful of ideas so you can make your grounds the garden spot of the neighborhood. On these pages you will learn about:

- California hot tubs.
- Folding lawn furniture you can build.
- How to pick garden cutting tools. Plus more—lots more.





Should a woman drive a tractor?

Absolutely. No woman should be hauling, digging, grading, or cultivating without a tractor. When you stop to think about it, no man should, either. It's much better to have a tractor do the work for you. A versatile, mid-size tractor. A Kubota.

KUBOTA. THE NEW BREED OF TRACTOR.

A lot of people who've never driven tractors before are now driving Kubotas. Why? Because Kubotas have finally filled the need for mid-size tractors. Kubotas range from 12 to 55.5 horsepower. Which means they're just right for all those mid-size jobs that larger tractors would be wasted on and smaller tractors wouldn't be able to do.

Kubotas are available with either 2- or 4-wheel drive. They come with front and rear power takeoffs. An integral hydraulic system. And a three-point hitch accommodating a full line of Kubota implements.

BAD NEWS FOR MECHANICS.

All Kubotas boast water-cooled diesel engines, which have no electric ignition system and never require a tune-up. Service is therefore reduced to a minimum. So if you're the type who enjoys fixing machines, a Kubota won't afford you much pleasure.

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Our mid-size Kubotas sport mid-size price tags. And our diesel engines are economical to boot. Kubota's spherical combustion chamber and automatic fuel injection assure optimum fuel

combustion. So running a Kubota diesel engine costs much less than running a comparable gasoline engine.

So, ladies, if driving a tractor sounds like a good idea to you, there's only one thing left to do. See your Kubota dealer and let him show you our complete line of mid-size tractors.

FREE HOT LINE. For specific information about Kubota tractors, call 1-800-241-8444. (In Georgia 1-800-282-1333.) Ask for Operator 63.

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PM3

 **KUBOTA®**

by Harry Wicks
HOME AND SHOP EDITOR

Conceived as outdoor baths, hot tubs—focus of that status and glamour fad from California—are now being installed across the country, even in the coldest climates. A typical hot tub is built of redwood, equipped with a heater to bring water temperature up to 105°F, a filter pump and a hydrojet pump to provide tub occupants with a massage effect. Tubs are available in a number of sizes from 4 to 8 ft. in diameter and from 3 to 6 ft. deep. Our version, 6 ft. in diameter by 4 ft. deep, is by California Cooperage.

Here are some points to consider regarding a hot tub:

- You can install one in a relatively small space, or on hilly property—in short, where you can't install a swimming pool.
- There is general agreement that a hot tub does have therapeutic value. Users and makers claim that the hot water and jet streams do, in fact, relieve muscle and arthritis pains. In fact, if your doctor prescribes a hot tub for health reasons, its cost and installation just may qualify for a tax deduction.
- Using a hot tub is a relaxing and pleasant experience. Despite the sexual connotation widely employed in promoting hot tubs, the principal



1. A 1979-style Saturday night bath in a hot tub surrounded by a handsome redwood deck—turning a small back yard into the family entertainment center.
2. Elevated decking plan includes planters and fencing.
3. Decking abuts tub around its circumference. Hydrojet pump provides "whirlpool" action.
4. Benches mounted on deck are spiked-together lengths of 2x4 redwood for a butcher-block effect. Tub-deck design, Richard K. O'Grady.

NOW YOU'RE REALLY IN HOT WATER...

IF YOU BUILD A HOT TUB,
CALIFORNIA'S GIFT TO GOOD,
CLEAN FUN.





Factory-numbered boards prevent chance of assembling the tub bottom improperly.



Inside circumference line is accurately drawn $\frac{3}{8}$ in. from edge (at bottom).



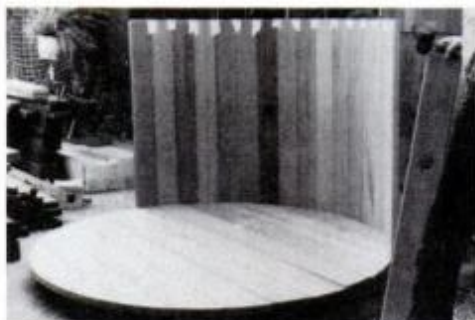
Staves for plumbing connections are located after determining where seats go.



Each stave is tapped with a mallet, so that slot engages, as in inset photo.



As each stave is placed, masking tape is used to hold a member temporarily.



Partially assembled tub, with its staves held together by masking tape.

hot-tub users appear to be families who jump in and share the relaxation.

Picking the location

A hot-tub installation can consist of simply parking one in your yard. But most choose to make the hot tub their outdoor family fun center. Thus, decks are usually installed to provide seating, gathering and dining areas. The tub shown, though home-assembled, is factory-made. On these pages, we also offer a version you can build from scratch, using plans that you send for.

Start by carefully laying out your entire yard in scale on graph paper. If your tub will be incorporated into a deck, make a floor plan sketch and indicate all dimensions on it. In order to determine the best location for your hot tub, consider these points:

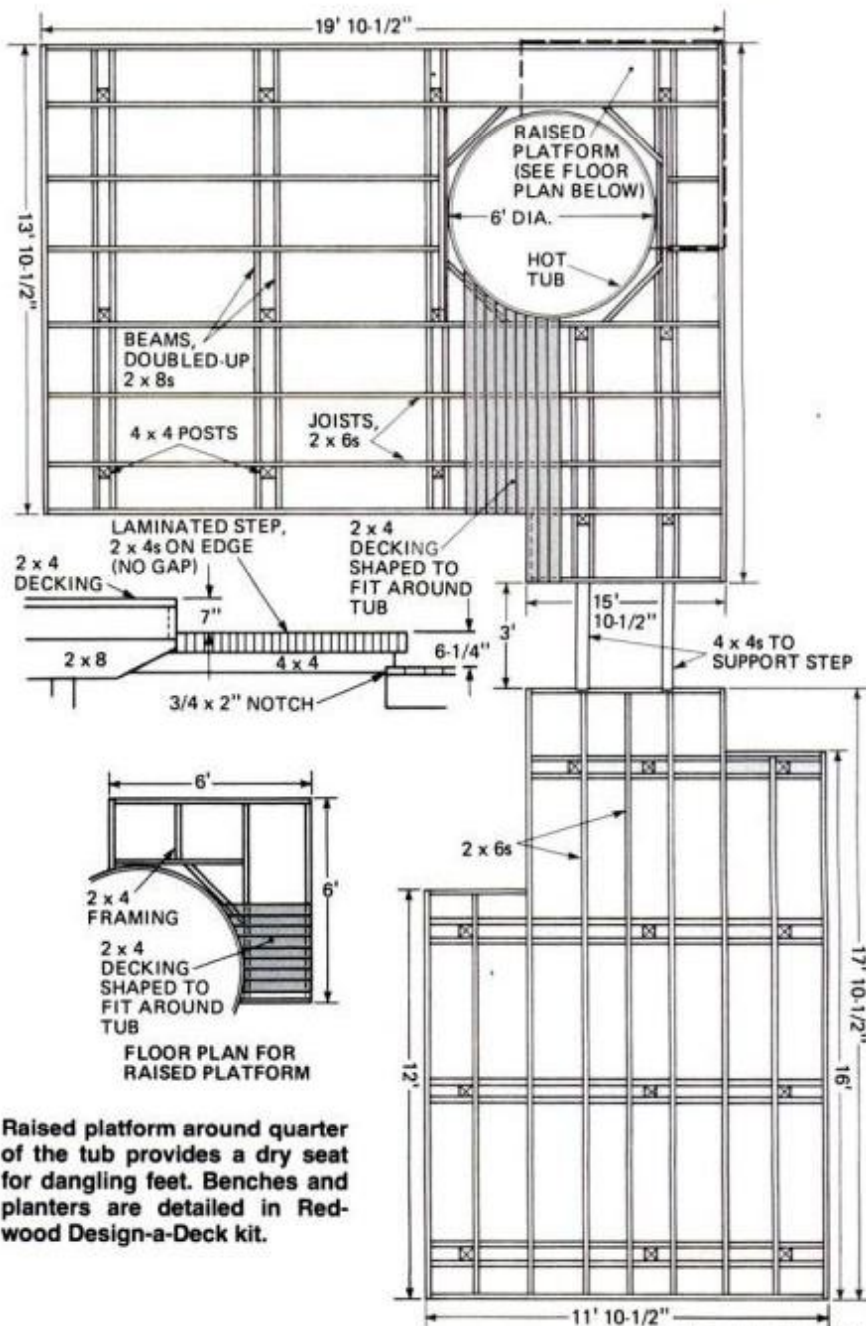
- **Esthetic values.** The tub should look pleasing; to emphasize the point, don't park it next to a compost heap, for example.

- **Convenience and privacy** are also important. Chances are, you will want it reasonably close to your house, and you obviously want it shielded from neighbors' view. (Ed. note: Purists use their hot tubs sans bathing suits.)

- **Exposure to wind, sun and shade** should also be taken into account before setting up the tub.

- Perhaps most important when picking

[\(Please turn to page 206\)](#)

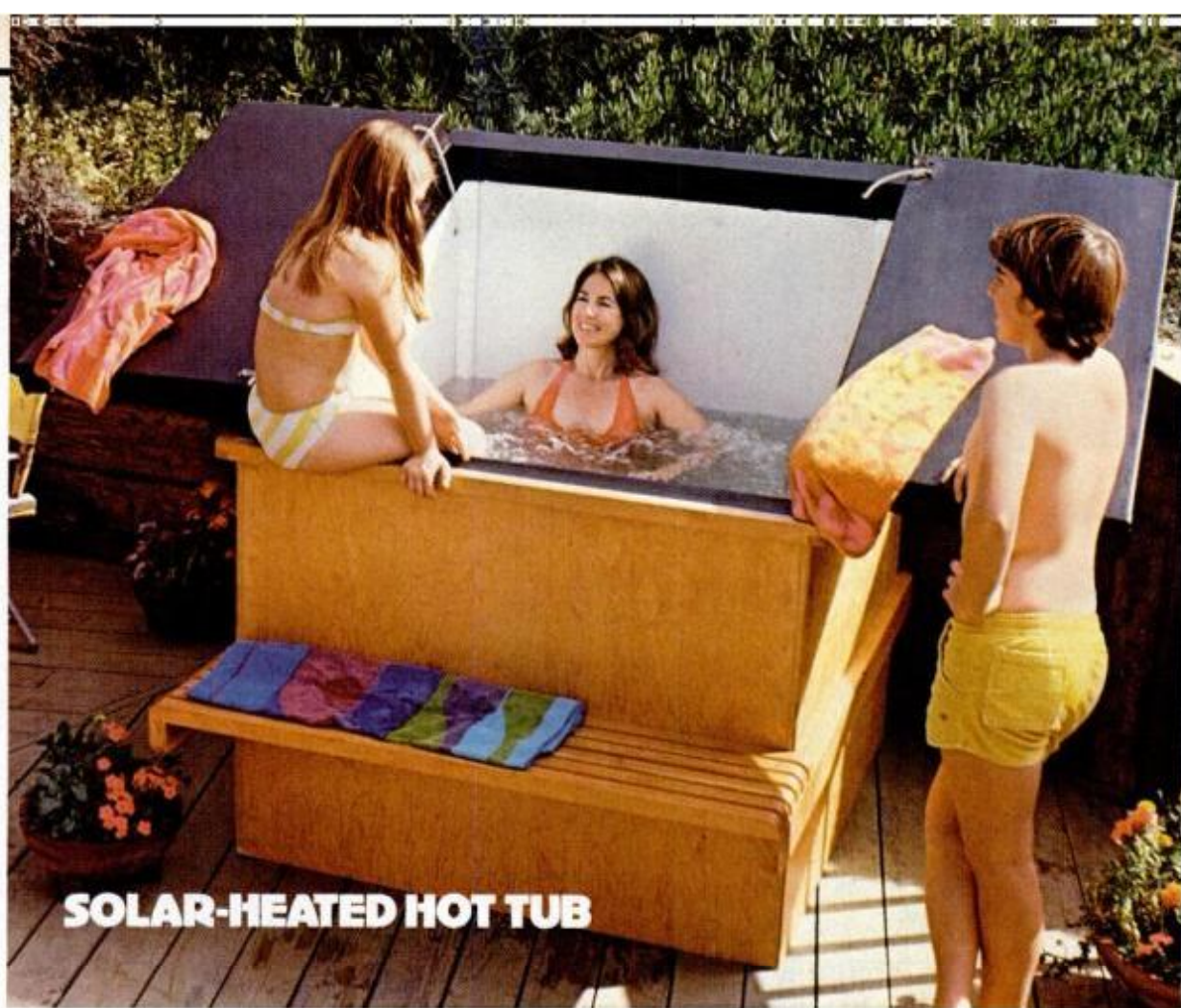


Raised platform around quarter of the tub provides a dry seat for dangling feet. Benches and planters are detailed in Redwood Design-a-Deck kit.

SHOPPING INFORMATION

Hot tub by California Cooperage, Box E, Dept. PM, San Luis Obispo, Calif. 93406; Plantings by Palos Verdes Begonia Farm, 4111 242nd St., Waverly, Calif.; Deck, benches and planters of garden-grade California redwood.

Deck design: Richard K. O'Grady;
Construction: Bruno Michetti;
PM color photos: Peter Samerjan.



SOLAR-HEATED HOT TUB

Build-it-yourself version is simple in concept. It calls for bubble agitation rather than a hydrojet, for example. (The bubble-making compressor can also be utilized for spray-painting tasks.) Cost to build this tub is under \$400.

Here's a hot tub you can make from standard lumber stock using simple but effective bubble agitation, coupled with a solar-heating-assist system that requires no soldering or expensive fittings.

The solar system, a low-pressure recycling system, does not mandate a plumbing hookup to the house. A Sears compressor unit mounted indoors charges the bubble systems, so you don't need any special outside electrical wiring.

The tub itself is a 4x4-ft. plywood cube with a leak-free plastic liner made from a sheet of polyethylene. Plastic-coated panels cover the interior sides of the tub, and the bottom



The top-cover doors (left) are framed fitted with clear acrylic and black polyethylene. Black plastic irrigation pipe (above) is sandwiched in between these layers.

is covered with indoor-outdoor carpeting. These protect the polyethylene liner from the sun for long life (our tub liner is still in good shape after two years of service).

Although the natural insulation of wood is very good, some heat loss does occur. To offset this loss, the tub has a wedge-shaped two-piece top cover that retains heat at night, and builds up the water temperature when the sun is up.

The top-cover doors are solar panels made up from looped black plastic irrigation pipe sandwiched between clear acrylic and black polyethylene. A small

fountain pump recirculates the tub water through the solar heater coils after the tub has been filled from the hot-water tap of your laundry room or service porch.

The bubble action is terrific, and a good soak in the hot water of your tub after a long day is a sure way to make the world look a lot more livable.

Cost to build the prototype tub ran under \$185. The compressor and air tubes for the bubbles will run another \$140 (this includes a paint spray gun setup in the bargain). The solar panels and small fountain pump add another \$50.

HOW TO ORDER PLANS FOR PM'S BUILD-IT-YOURSELF HOT TUB

Complete set of plans for building PM's hot tub is \$5 postpaid; two sets—you may need a second set if your municipality requires a permit—cost \$7. Send check or money order to Stevenson Plans, PM Hot Tub, Box 584, Del Mar, Calif. 92014. Allow two to four weeks for third-class mailing; add 75 cents for faster first class.

Landscaping edging -

A pro picks his favorite edging plants and



Edging a patio with ageratum or other flowers adds color and eliminates the need to hand-trim where a lawn abuts the patio.

No need to mow the problem strip between fence and sidewalk. Grow candy-tuft or another blooming plant. If you have a tree that blocks out sun so grass won't grow, as with the one at right, cultivate ivy or other plants that thrive in shade.

Walks, driveways, patios and swimming pools have one thing in common—all have edges which, if not properly planned, installed and maintained, can ruin the look of an otherwise well-kept landscape.

There are many solutions to the edging problem. One crisp edging requiring materials or plants is made by accentuating the cut edge of the lawn. With a flat spade or a power or half-moon edger, you can cut this edge around trees and shrubs, along the borders of vegetable gardens and flower beds or wherever an edge would give a clean look. This treatment is fine for a while, but it requires periodic maintenance.

Edging materials

Considerably more permanent are edges made of brick, patio block or special edging block. Lay these directly into the soil, or on a 2-in.-thick bed of carefully leveled builder's sand. Mortared joints



PM art. Gienna Putt

EDGING MATERIALS



1



2



3

1. Railroad ties are an attractive border for patio, walkway or garden. Bury them so that top surface is on grade (flush with ground). 2. Patio blocks give a trim appearance to plant borders. 3. Heart redwood and cedar edgings are rot-resistant. Or, consider the use of wood that has been pressure-treated.

where neatness counts

materials and gives tips for minimum upkeep. by D.X. Fenten

are optional when blocks are placed on sand. Metal and vinyl stripping edges are also available.

Wood—especially heart redwood and cedar, which are naturally rot-resistant—is an attractive edging material. Treatment with a preservative further prolongs its life. However, creosote, the mercury compounds and pentachlorophenol types give off fumes that are toxic to many plants. Pressure-treated wood isn't toxic to plants and also makes a good edger.

Position edging materials so they are almost flush with the ground. This gives you a path for lawn mowers and eliminates hand-trimming.

Green plant edgings

Plants and ground covers can soften the hard, practical line of brick, stone and wood, while not adding unnecessary maintenance. Several members of the ivy family, pachysandra or trailing myrtle make ideal green edges. Plant these low ground covers 8 in. back from the edge of the area. These plants will soon spread. They'll need trimming when used close to driveways or walkways. If they are in full sun, be sure to water them enough to prevent drying.

After you've snipped these edgings to keep them in bounds, root the cuttings in a glass partially filled with moistened perlite. You may have enough seedling plants to edge other areas.

Putting plants along the edges of service areas pretties them up. But, when they are lush and fully growing, some plants will narrow the walk or driveway. Find out how the plants you are considering will grow: how wide, how tall, how trailing, how dense, how lush. Then measure carefully at planting time.

Edging plants that flower

Some of the colorful plants that edge well but don't encroach include: candytuft, ageratum, lobelia and dwarf petunias. Speedwells in several varieties, coral bells and nepeta are also fine edgers and don't spread.

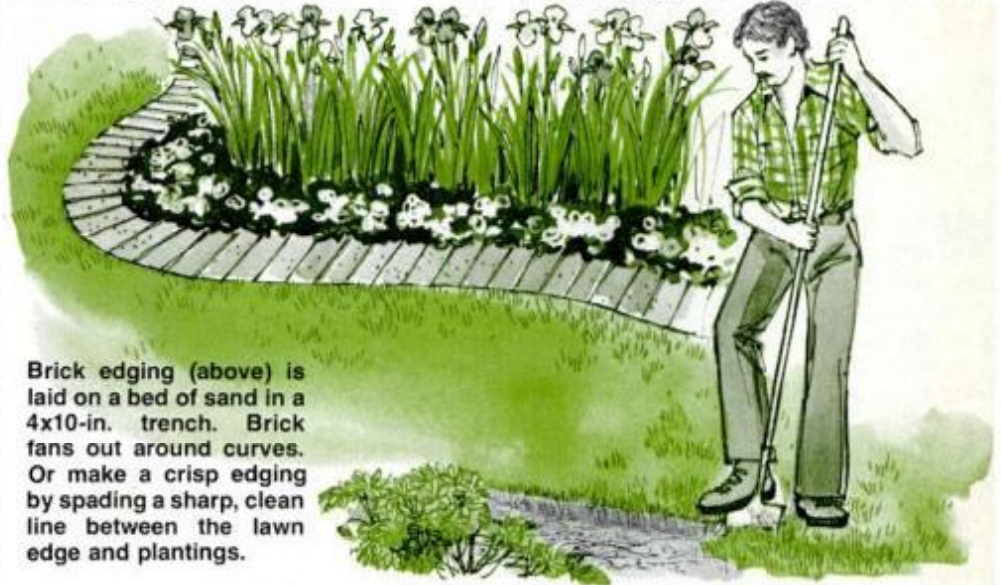
Use a bulb planter to make flat-bottomed holes for plant seedlings. A trowel will make conical holes, where air pockets that dry out roots and kill plants can easily develop.

Immediately after planting, water the area thoroughly and keep it moist until the plants are well established. Always plant some "in case" plants in another area for

transplanting in the event several newly planted border plants die.

Later in the season when everything is growing, take a good, long look at your edgings and check that they are what you planned—full but not crowded. If you were a bit chintzy with the plants and they haven't filled in quite enough, add some more. If they are too full and seem

to be crowding each other, do some thinning. Then, when everything appears to be perfect to your eye, take pleasure in knowing that the beauty and color you brought to your edging areas without much additional work is the added touch that will give your entire property a crisp, finished look. With minimal work you can keep edgings looking good all season.

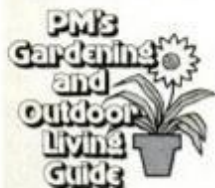


Brick edging (above) is laid on a bed of sand in a 4x10-in. trench. Brick fans out around curves. Or make a crisp edging by spading a sharp, clean line between the lawn edge and plantings.

SELECTED EDGING PLANTS

PLANT	HEIGHT (INCHES)	DENSITY	DESCRIPTION	CARE
Pachysandra	7	Quickly becomes dense carpet.	Evergreen groundcover. Individual plants, sawtooth leaves.	Virtually no special care. Likes moist, rich soil.
Ivy, English and Baltic	8	In a few years gives pretty foliage edging.	Handsome plants that grow together. Single plants that soon intertwine.	Easy care. Does very well in moist, rich soil. Shear to keep bushy.
Juniper, Wilton Carpet	5-6	Shortly becomes like silver-blue rug.	Silver-blue foliage year 'round. Several planted along walk provide natural edge.	Trim as required to keep in bounds. Give some sun and grow in well-drained soil.
Mugo Pine, Dwarf	18	If pruned it can become quite dense. Unpruned sometimes it looks scraggly.	Marvelous looking mound shaped plant of pine family. Good color.	Does well in sun or light shade. Prune to keep free of walk.
Barberry Dwarf	15	Very dense with spiny leaves. Can also be used as hedge.	Fantastic along walks. Shiny green leaves go to bronze in winter. Some have pretty berries for a long time.	Prune lightly to keep in bounds. Needs little care. Keep plants moist.
Boxwood	16	Very dense with tiny leaves.	Can be sheared to almost any shape. Stays trim. Lives a long, long time.	Some sun, some shade and moist soil will keep these thriving.

How a drip can save you some bucks



This diagram shows a basic trickle irrigation system. Antisiphon device prevents back flow.

What drips and saves both money and energy? If you have ever had a slow leak problem somewhere in your home, you will have a pretty good idea of how effective a trickle (or drip) irrigation system can be in your garden.

Trickle irrigation involves the frequent, usually daily, application of small amounts of water to plants. Water is applied slowly, under low pressure, to a plant's root zone.

Trickle irrigation saves water (and the energy needed to pump it) because it primarily wets the plants' roots. This leads to several other advantages: *weed control*—particularly when used in conjunction with a mulching system or black plastic ground cover—and *disease prevention*. The soil between plants remains dry, making it pretty tough for weeds to thrive. (To cultivate, you can temporarily peel back the emitting hose.)

The foliage of trickle-irrigated plants remains dry, and, since bacteria and fungi enter plants through pores in the foliage and depend on moisture to germinate, disease is reduced.

Setup of basic system

The main line of a basic drip irrigation system runs from a water faucet to the garden area. It can be a garden hose rolled out and connected when needed. You can also use 1/2-in.-dia. black plastic

pipe, which can be buried to facilitate lawn mowing. In cold climates, this main line must be drained for the winter—blown out with compressed air if there is insufficient pitch for natural drainage.

At the end of the main line a pressure control valve reduces water pressure to 15 pounds per square inch (p.s.i.). Beyond the valve, a header hose runs perpendicular to garden rows across one end of the garden, or across the center if rows are longer than 60 ft. The header is 1/2-in.-dia. black plastic pipe with end cap.

Attaching feeder tube

Small feeder tubes connect the header to sections of emitting hose running the length of the garden rows. Depending on the plants you are growing, you can put the emitting hose down the center of a double row of plants. An ice pick or punch makes holes for inserting the feeder tube. Ends of the emitting hose are sealed with electrician's tape.

Several types of emitting hose are shown below. For irregularly spaced plants, as in landscapings, individual emitters connected to emitting hose by small feeder tubes work well. You can purchase individual parts or complete kits at garden centers, farm suppliers and irrigation firms.—*Roberta Lawrence*

Gentle flow through a Dew-Hose, by Chapin Watermatics, Box 298, Watertown, N.Y. 13601, waters closely-spaced plants.



Shur-Flo emitters by Knobel Industries, 1146 Madison Ave., Livermore, Calif. 94550, are spaced as needed on plastic tube.



6 FACTS ABOUT TRICKLE WATER SYSTEMS

- **Install a trickle irrigation system on level or only gently sloping ground.** Low-pressure systems utilizing standard emitting hose must be level, or laid out so water runs downhill with no more than a 2- or 3-ft. drop. Pressure-compensating emitters are also available. Systems using them can be installed on gentle hills.
- **Generally, 80-lb.-test, 1/2-in.-dia. pipe is adequate strength for headers and main lines.** However, if your water pressure is greater than 80 p.s.i. you should consult an irrigation specialist first.
- **Black plastic pipe is affected by the sun.** It will soften and stretch when hot, and shrink as it cools. You should install a system on a cool day. Otherwise, the pipe may shrink and leave the ends of the plant rows without water.
- **A system utilizing black plastic pipe and individual emitters should last for many years, although you may have to replace an occasional emitter.** Hose made of thin plastic film may last only several years, but it is inexpensive to replace.
- **You can apply fertilizer to plants through the irrigation system.** For liquid fertilizers, an injection pump installed in the line can be used to supply a measured quantity of concentrated liquid to the garden area. These pumps are convenient, but expensive. Dry fertilizers are less costly than liquids and can be supplied from an in-line tank designed to withstand the pressure of your water system.
- **A trickle system can be automated.** The easiest way to automate one is with a 24-hour time clock that operates a solenoid valve. Select a solenoid valve that is normally closed. The clock can be set to open the valve once a day for an hour or two. The length of this watering time can be adjusted to suit varying weather conditions.

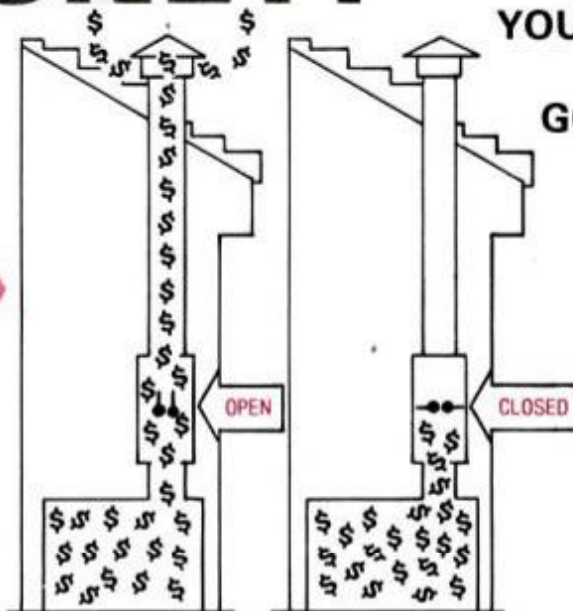
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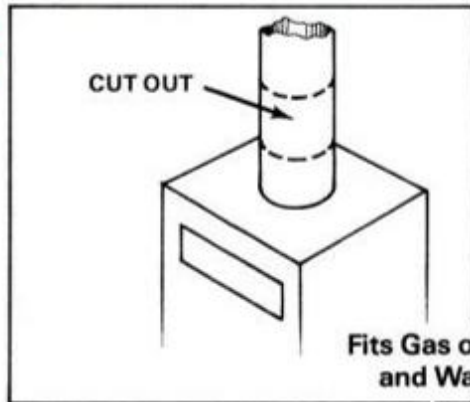
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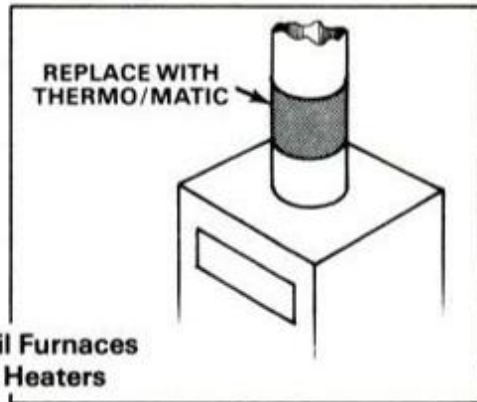
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Garden shears: How to pick the best of the crop

These flower and thinning shears by Corona have straight blades that can easily reach into plant centers without pushing foliage

and flowers aside. The 7¼-in.-long forged-steel tool has cushioned vinyl handles and is ticketed at \$8.

Here's a close look at some garden shears that are a cut above the rest.

With proper tools, the time you spend outdoors caring for your lawn and garden can be as enjoyable as admiring the end results.

The list of common homeowner garden shears includes: flower/thinning shears, grass shears, pruners, hedge shears and loppers. In deciding which of these shears you need, it's helpful to consider your property. Do you have flower beds or hedges? Do you have saplings or mature trees?

No matter what shears you need, select a quality pair. Quality garden cutting tools have three features that lesser tools lack: comfort, efficiency and durability.

How to spot quality shears

You can tell when you're holding a superior pair of shears. You can feel the balance and solid construction and see the finishing details. If your week's worth of gardening is lumped into a Sunday afternoon, the well-balanced handling of a good tool will cut down on fatigue.

Smooth action that helps produce clean cuts is built into well-made shears. Plants aren't frayed, ripped or heated and, therefore, have a fresher appearance and sprout sooner.

Over the long run, you can identify superior shears by their longevity and minimal maintenance needs. After years of

use, when other shears are discarded, you can buy parts for quality shears.

Construction of quality shears

Several important steps are involved in producing the garden shears shown: They are designed to meet high in-use standards; the best materials available go into them; close watch is maintained during production.

The blade curve in some good pruners, for example, is designed to hold the branch securely to make a clean cut. In poor tools, the branch slips from the blade when cutting pressure is applied.

A hardwood handle is generally one tip-off of a good tool. Similarly, high-carbon steel and chrome-vanadium steel blades wear longer.

The best production procedures go into

making these shears. For example, the blades are forged, rather than cast or stamped. The process involves heating the steel, then pounding it to shape. This compresses and restructures the steel to make a superior blade.

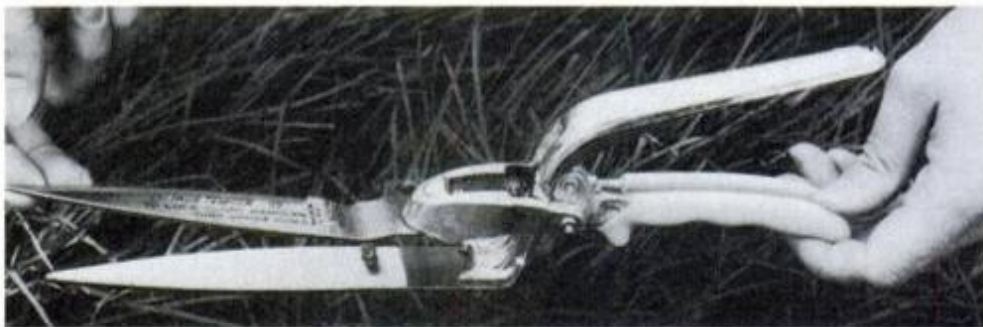
Uses, features of various types

Besides the general features good shears have in common, each type has special features, depending on the job it's designed to accomplish.

One-hand shears are for light outdoor work. The flower shears also help with light thinning. There are two styles of grass shears: the scissors-type and the vertical-squeeze variety shown below.

There are also two basic types of pruning shears: bypass pruners, which cut by the action of a blade and hook (some-

(Please turn to page 144)



There are several innovative details on these vertical-squeeze type grass shears, priced at \$8, by True Temper. The blades aren't connected by a common pivot pin. Instead, the top "floating blade" connects with a spring—the theory being that this

assures even cutting along the length of the blades. When not in use, a gravity lock holds the shears in closed position. Work it by simply closing the blades and turning the shears upside down. Blades are hollow-ground, high-carbon steel.

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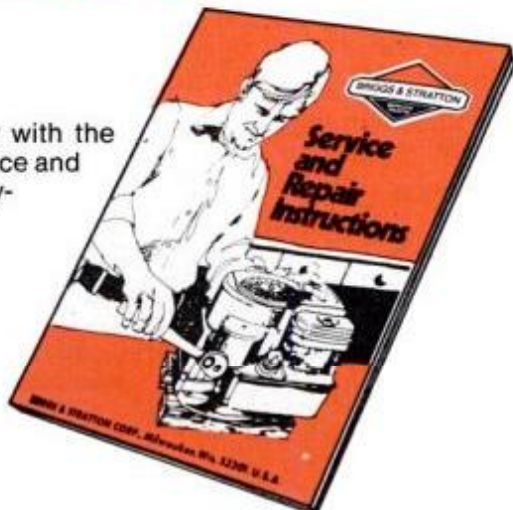


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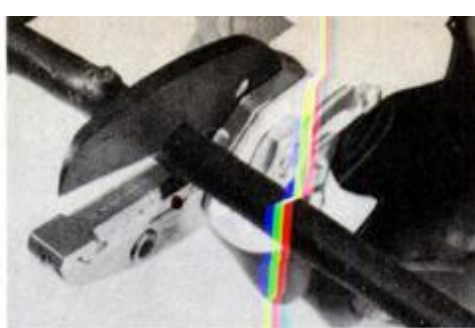
Naturally, for major, more complicated service and repairs, let your Briggs & Stratton dealer take over—at reasonable cost—using factory-trained people, factory tools, and those same precision Briggs & Stratton factory-original parts to put your engine back into high performance shape.

But if you can handle some of the work yourself, look in the Yellow Pages under "Engines—Gasoline" for your nearest participating Briggs & Stratton Authorized Service Center. Drive on over, look for the renew-it-yourself parts display rack, and pick up what you need along with the simplified but detailed Service and Repair Instruction Manual. Installation instructions are printed on each parts package.

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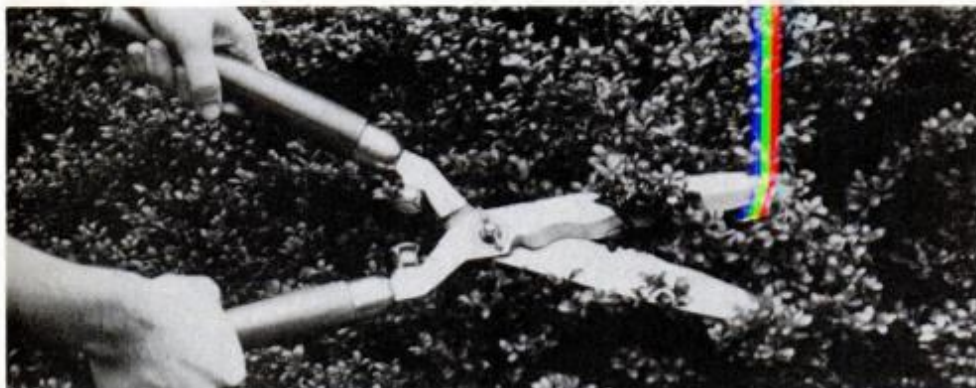


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The two basic types of pruning shears are the bypass pruners (top left) and the anvil pruners (top right). Female blade on these bypass pruners by Wilkinson Sword (\$23) has a groove to collect sap and keep blades

clean. A catch opens pruners to two positions for the small or large hand, thick or thin wood. Wilkinson's anvil pruners (\$11) have an aluminum anvil to minimize blunting of the cutting edge



Wavy blades of True Friends \$19 hand shears (top) are designed to maintain the proper cutting angle along their length. These have a shock absorber and hardwood handles. Blades on True Friends electric shear (\$193) have opposed cutting

action—both move simultaneously to reduce vibration. Blades are chrome-vanadium steel and have a 1/2-in.-dia. cutting capacity. Tool is double-insulated with a friction safety clutch to prevent motor damage if blades jam in use.



These anvil-type loppers by Seymour Smith (\$17) have a gear drive to develop extra cutting power—three times more than a conventional lopper of equal size, according to the company. The tool cuts up to 1 1/4-in.-dia. limbs. Blade is replaceable and the bronze anvil is reversible for additional use, and also replaceable.

GARDEN CUTTING TOOLS

(Continued from page 142)

times two blades) that pass each other, and anvil pruners, which cut with a straight blade against an anvil. Both types are widely used, but many professionals shun the anvil style because it tends to crush stems.

Hedge shears. Shears for shaping hedges and shrubs come in power and hand models. Some quality hand shears have a wingnut mounted at the pivot point for tension adjustment. One way of identifying a good hedge shear, according to a spokesperson for True Friends, is to quickly open and close it and "Listen to the whistle," which a good tool makes.

Electric hedge shears often feature two moving blades that reduce vibration. Teeth are sharpened on both sides to make clean cuts.

Lopping shears. The long handles on loppers give more cutting strength (greater leverage) and a longer reach than smaller shears. Loppers are available in bypass and anvil styles.

A last tip for identifying quality shears: When you shop, carry some paper with you. If the shears cut rather than bend it, you're probably holding a superior tool. **FM**

Manufacturers of shears in photos

- Corona Clipper Co., 14200 East 6th St., Corona, Calif. 91720
- Seymour Smith & Son Inc., Oakville, Conn. 06779
- True Friends Garden Tools Inc., 100 State St., Teaneck, N.J. 07666
- True Temper Corp., 1623 Euclid Ave., Cleveland, Ohio 44115
- Wilkinson Sword Ltd., British-American Marketing Services Ltd., 251 Welsh Pool Rd., Lionville, Pa. 19353.

Caring for garden shears

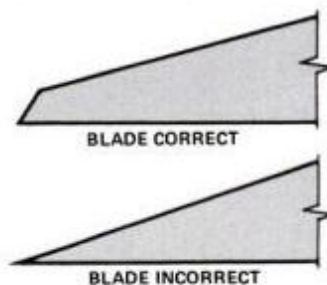
Quality garden shears should give you years of service. A thorough cleaning from time to time following the steps below will help maintain the tool at peak efficiency:

1. Disassemble the tool and rub off rust and grime with medium-grade emery cloth. Don't rub the cutting edge. (Omit this step on blades that are Teflon coated or that have been given some other special coating.)
2. Wash the blades in warm, soapy water and rub them dry.
3. Apply a thin coating of light machine oil before reassembling.

Sharpening tools

Blades on quality shears are often hollow-ground. A few light file strokes should be sufficient to sharpen them, unless the blades have become badly dulled or nicked.

1. Use a small (about 6 in.) smooth, single-cut mill file on shears with straight blades.
2. Try to maintain the factory angle on the cutting edge as shown above. If the blade is filed flat and thin with no bevel, it will either chip or roll.



3. Hold the blade in a vise and sharpen from the blade point toward the handle in one straight motion.

4. Avoid filing the flat side or inside of the blade. However, you can use the file on these surfaces to remove burrs that have been caused by filing.

5. Hooks on quality lopping and pruning shears rarely require sharpening. However, you can remove nicks with a round carborundum stone.

6. Wavy blades can be sharpened with a round, fine carborundum stone. Stroke over the wavy edge in the same manner as when sharpening a straight blade.

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913 When you need the perfect cut

H.K. Porter, Inc. is making available its 36-page color brochure detailing its complete cutting tool line. From hard and soft metals to plastics, cables and wires, Porter has the right cutting tool with over 100 different hand and power operated cutters. This catalog has been carefully organized to help select the proper tool for each application. Free.

914 Getting more of the outdoors

Find new freedoms in your life with these two full-color brochures from Holiday Rambler. Within these brochures you will find a complete selection of motorhomes, mini-motorhomes, travel trailers and fifth wheels. This is the way to really see the country. Free.

915 State of the arc

Arc Welding Projects is a 272-page book with plans, photos, drawings, instructions for making 114 different projects: tools, trailers, stoves, log splitters, boats recreational equipment, etc. This book shows you how to make these at a fraction of the cost of buying. And all it costs is \$4.00.

916 Seeing this, and Sawing that

Millers Falls, a division of Ingersoll-Rand, has published a 36-page catalog detailing its wide variety of metal cutting products. This booklet provides information on the company's complete line of blades and accessories from hacksaws and band saw blades to sabre and hole saws and mandrels. Completely illustrated, this brochure provides metal cutting comparison and trouble-shooting charts. Free.

917 PM's Complete Gardening Guide

Here is every bit of information needed to have a beautiful lawn and garden. All the basics with more than 20 fact-packed tables and charts, and 130 "show-how" drawings. 12 heavy plastic-coated cards—24 pages in all—spiral bound for quick reference. Only \$4.95 + 50¢ for postage and handling.

918 Keeping together

The 1978 Popular Mechanics Index and Shelf Wrapper actually converts your PM issues into a complete "reference library". The Index is of handsome, sturdy construction, that precisely encases twelve issues. There is also over 5,000 cross-reference entries of the articles that have appeared in PM throughout the year. All for \$2.99.

919 Light and water landscaping

In your own back yard, you can enjoy the sights and sounds of water splashing in a lighted fountain or tumbling over a natural rock waterfall—and with very little expense and effort! A new booklet from the Little Giant Pump Company explains how to landscape with light and water. \$1.00.

920 Deck and patio construction

Design ideas and construction details for decks and patios are contained in this new brochure from Koppers Company, whose Wolmanized wood

resists decay and insect attack. The eight-page brochure contains construction tips that include schematic drawings on ground-level and elevated decks, fastening the deck to the house and stairway sizes. Free.

921 Discover unusual tools

If you can't find that special little tool you've been looking all over for, you'll find it here. National Camera's Flasher catalog is packed with thousands of unique precision tools for the workshop. Free.

922 Build a mini-dozer

A brochure from Struck Corp. describes their Crawler Tractor Kit—it's a versatile outdoor machine you can easily assemble yourself. The Mini-Dozer's heavy-duty track gives you the same ground-hugging grip as its bulldozer big brother. A choice of three motor sizes, plus a wide assortment of attachments. 75¢.

923 Man-size tractors

Here's a complete information on the powerful, heavy-duty tractors from Engineering Products Co.—they're built for faster, easier grass cutting, snow removal, garden plowing, tilling, cultivating and many other chores. Includes descriptive information on 12, 14 and 18-horsepower tractors and attachments, as well as the complete specifications on all. Free.

924 No-Sweat

Anyone who has tilled his garden by hand will welcome this 14-page full-color catalog from Merry Manufacturing. The new catalog features six professional and home gardening tillers, detailing the full line of accessories and providing complete specifications for each model. Free.

925 Bringing out the best

Cabot's new handbook on wood and wood stains provides a great way to learn how to bring out the best in wood. Handsomely illustrated, this 16-page full-color booklet describes color effects, types of stains, how to apply them and much more. Only 25¢.

926 The grass is always greener . . .

LAWN CARE, put out by Scotts, the lawn and garden people, contains seasonal checklists, how-to articles, and the latest information on lawn and garden care. Now in its 50th year, this respected and colorful publication is available free.

927 A great guide to power lawn equipment

International Harvester's big 20-page brochure is a complete guide to all their power lawn products, from garden tractors and riding mowers to the walk-behind mowers. Also includes information on the full line of shredders, tillers and snowblowers. Free.

928 Discovery

Discover the outdoors with the Cobra 1979 Supreme Series. Cobra, who manufacture a complete line of motorhomes, Vans, fifth wheels, and mini-homes, is offering a beautiful 12-page full-color brochure, giving complete specifications and details of their Supreme series. And it's free.

929 Stop climbing the walls

Planning to panel a room and want to do a pro job? A brochure from HB Fuller gives you valuable tips and hints to make the paneling job easier. 35¢.

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Build PM's folding lawn furniture

It's handsome, sturdy and simple to construct. Complete plans let you get started right now.

by David Warren

Here's PM's way to build four classic wood-and-canvas folding lawn chairs. Since they fold compactly, you can use these inexpensive and quickly built chairs on your deck or patio, or at the beach, or even use them temporarily in a "first apartment."

Your decorating scheme, of course, determines the color of the wood and canvas. We used white maple for the wooden frames and sealed the wood parts with two coats of clear varnish. If you use interior varnish as we did, the furniture must be stored out of the weather when not in use.

The rivets and other miscellaneous hardware can be purchased at a hardware store and you can order 18-oz. chair duck through an awning fabricator. Look in the classified directory under "Awnings." You'll be able to select from a wide variety of patterns and colors.

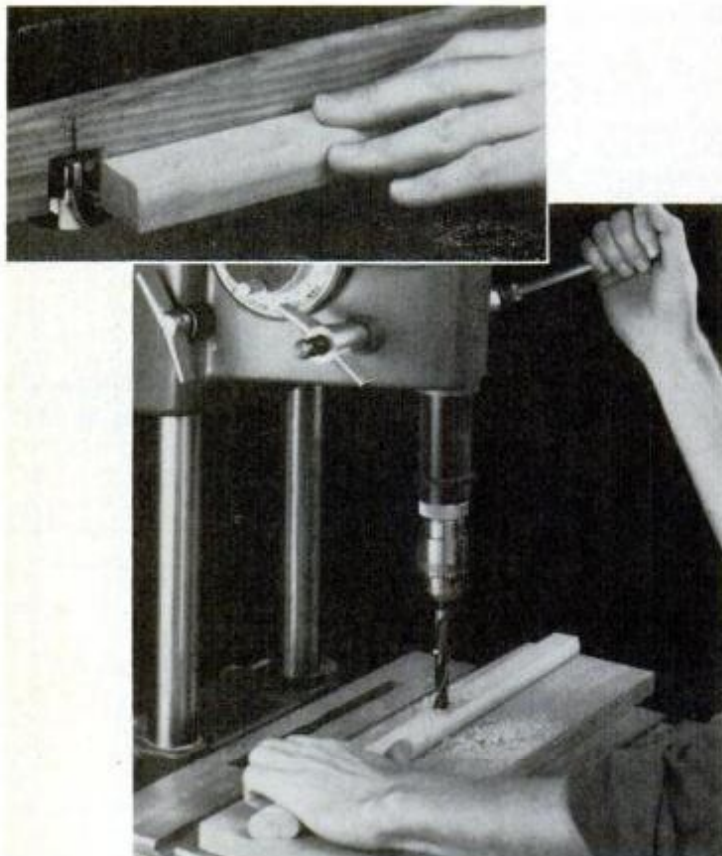
We built our chairs for average height, though it's easy to

revise the plans to suit shorter or taller people. But keep in mind that raising or lowering the cross members alters the angle at which to cut the feet so the chair sits level. To be safe, lay out these parts full scale on either plywood or cardboard so you can check dimensions and angles.

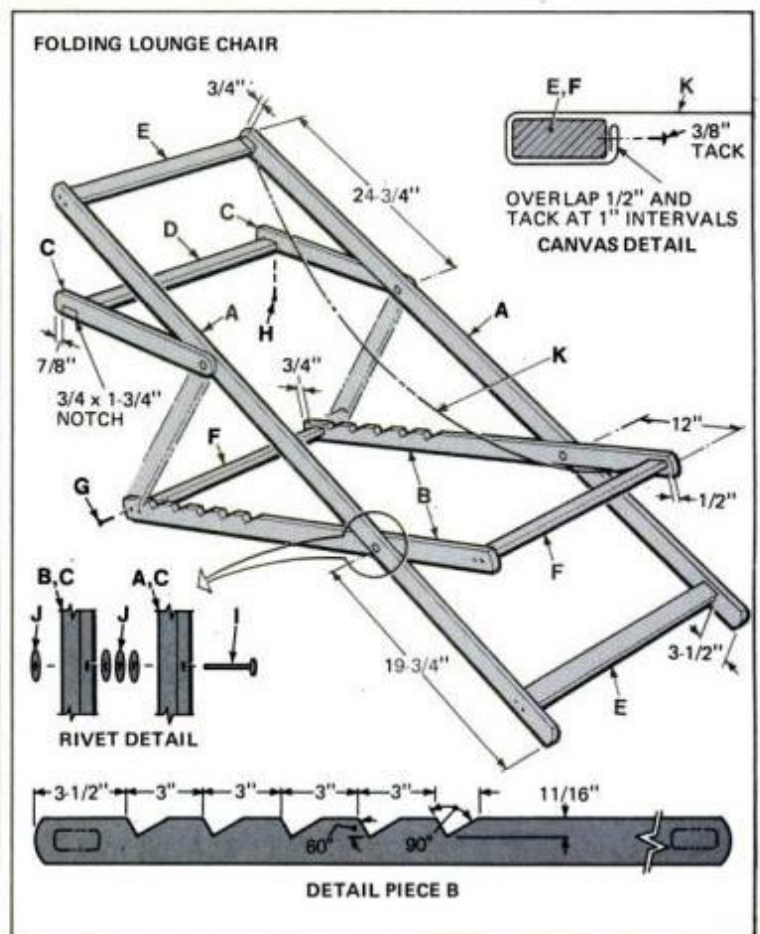
Folding lounge

Start construction of this chair by cutting out each pair of framing members plus the stop bar. Round the ends of the risers, seat bars and adjusting bars to a 2-in. radius with a band saw. Smooth the curved ends with a disc sander.

Lay out and cut the adjustment notches in the seat bars as per drawing. Cut the notch in the adjusting bar to receive the stop bar. Round the edges of each piece, except the stop bar, with a $\frac{3}{8}$ -in.-radius router bit or shaper cutter. Sand all surfaces smooth.



Round the edges using router mounted in table (top); pivot holes in stool legs are bored on drill press.





Great for patio, lawn, pool or courtside, PM's foldup furniture has sparkling eye appeal, yet rugged construction that will withstand the rigors of outdoor use.

Photos: Color, Feikamp-Malloy; black-and-white, Matt Doherty



Next, bore the two 3/16-in.-dia. rivet holes in each riser bar and the rivet hole in the seat bar. Bore the 11/64-in. body holes for No. 8 fh wood screws in the seat bar and riser bars and countersink them. Bore the corresponding 7/64-in. pilot holes in the ends of the four support bars. Similarly, bore and countersink the body holes in the stop bar and pilot holes in the adjusting bar for No. 8 fh wood screws.

Lounge chair

Assemble supports to risers, and supports to seat bar, with 2-in.-long fh wood screws. Then rivet riser bars to the seat bars and to the adjusting bars.

Sand and finish the wood and fasten canvas in place. Tack canvas to inside edge of support bar at the lower end of the seat bar. Space carpet tacks 1 in. apart. Then wrap canvas over tacks under bar, and around the bar one-and-three-quarter revolutions. Bring canvas up to the top bar. Measure and cut to length. Work canvas around top bar of riser in the same configuration as the other end and tack it. To do this, bring seat support up to the top support of the riser, which will loosen the material enough to allow you to tack it in place. Use two decorative upholstery tacks at the edges of the canvas on each of the bars.

Director's chair

Upper assembly—Begin construction by ripping the 2-in.-wide armrest tapers from 2 to 1-7/16 in. Start taper 1 3/4 in. from the end. Lay out and saw the tapered sides to 1-7/16 in.

Then turn tenon ends. Set workpiece up in lathe and turn the 3/4-in.-dia. tenon. Remove from lathe and round over the two upper edges of the arms with a 3/8-in.-radius router bit. Then saw the 2-in.-dia. front-end curves with a bandsaw. Repeat for second arm; sand both parts smooth.

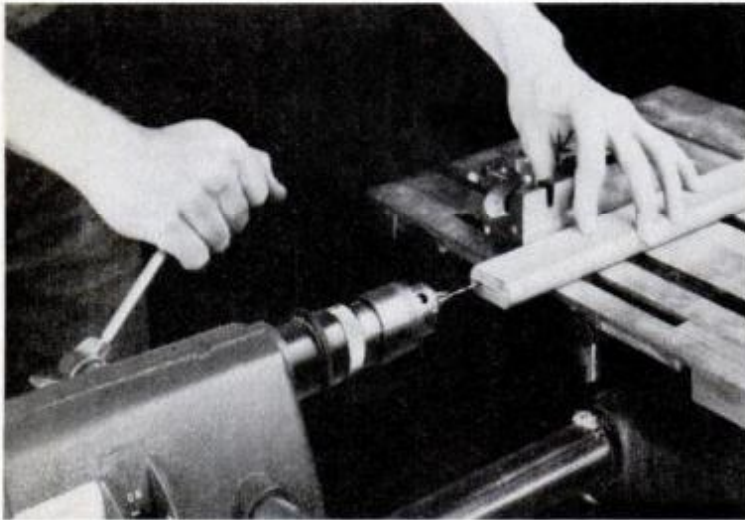
Next, rip 1 3/4-in.-square by 18-in.-long blanks for the turned back supports. Mark centers and turn pieces as shown in the drawing. Remove from lathe and plane the 1-in.-wide flat area on the front of the piece.

Cut the 3/4-in. dowels about 8 in. long for the two front supports. Then turn the 5 1/2-in.-long pieces with 5/8-in. tenons at each end.

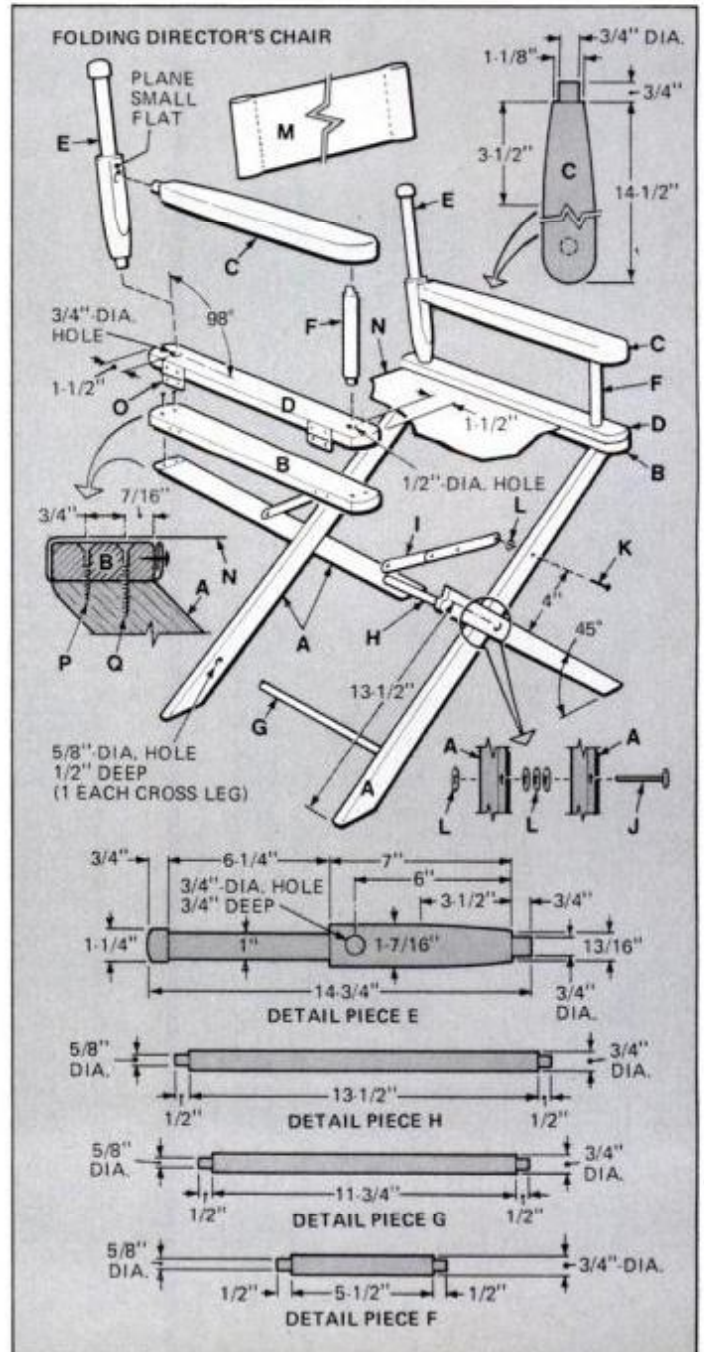
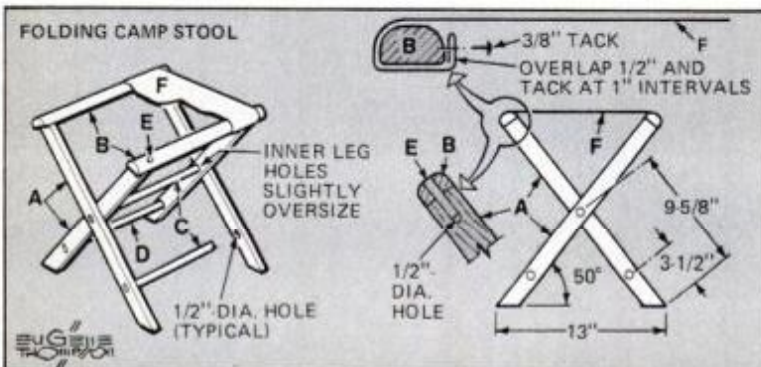
Next, cut the upper and lower arm support pieces together so they will match exactly.

Center punch for the 3/4-in. and 5/8-in.-dia. mortise holes in the upper arm support pieces. Bore the 5/8-in. hole 1/2 in. deep. Assemble the two uprights to the support and to the armrest. Mark the location of the round mortise in the rear upright so that the

(Please turn to page 151)



The strength of maple makes possible a light but sturdy chair; its hardness makes pilot holes necessary for wood screws. Bore 1/2-in. pilot holes in the ends of the lounge-chair stretcher, supports, other parts. Pilot holes can be bored with Shopsmith in horizontal position (above). Broad-headed rivets (left) are better looking than nuts and bolts and won't unscrew. They are sold at many hardware stores.



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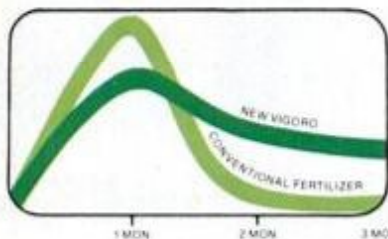
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LAWN FURNITURE

(Continued from page 148)

armrest will be parallel to the lower arm support.

Make a trial fit of the left and right upper chair assemblies to be sure they match. Then reassemble with glue. First glue both uprights to lower arm support. Then glue armrest to the rear upright and front upright.

Lower assembly—Rip four cross legs on table saw. Round four edges of each with $\frac{3}{8}$ -in.-radius router bit. Lay out and cut 45° angles at both ends of the cross legs as shown in drawing. Sand smooth. Bore $\frac{3}{16}$ -in. rivet holes in the centers.

Lay out and bore $\frac{11}{64}$ -in. body holes at top ends of legs and matching $\frac{7}{64}$ -in. pilot holes in bottom of lower seat support. Countersink holes in legs.

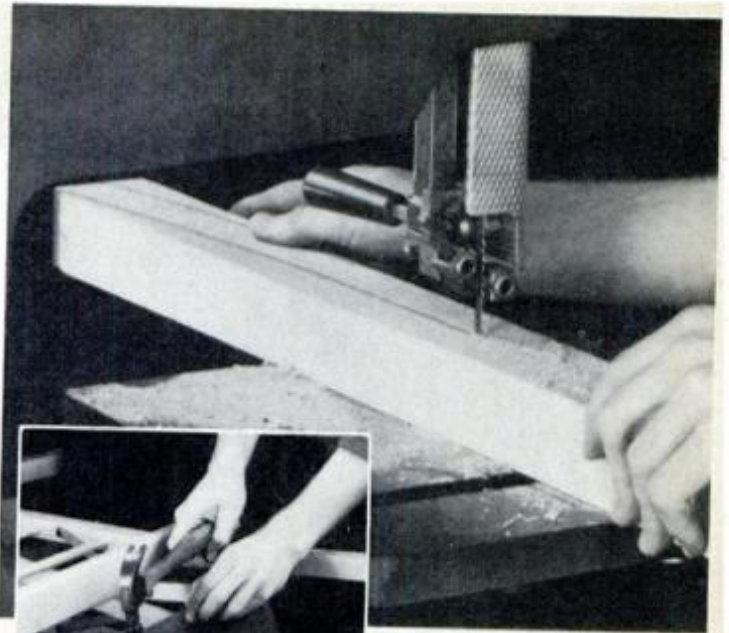
Bore the $\frac{5}{8}$ -in. blind mortise holes in the cross legs for the leg support stretchers. Make the right and left leg support stretchers by turning tenons at the ends of $\frac{3}{4}$ -in. pieces of doweling.



Several pieces require simple turning on lathe. Make the rough cuts with gouge, cut and trim shoulders with skew.

Assemble seat supports to cross legs with 1/4-in. wood screws as specified in drawing. Glue $\frac{3}{4}$ -in. round support stretchers to the cross legs. Then rivet cross legs together with three spacer washers between wood pieces. Next, bore pilot holes for the folding bracket hardware, and attach it.

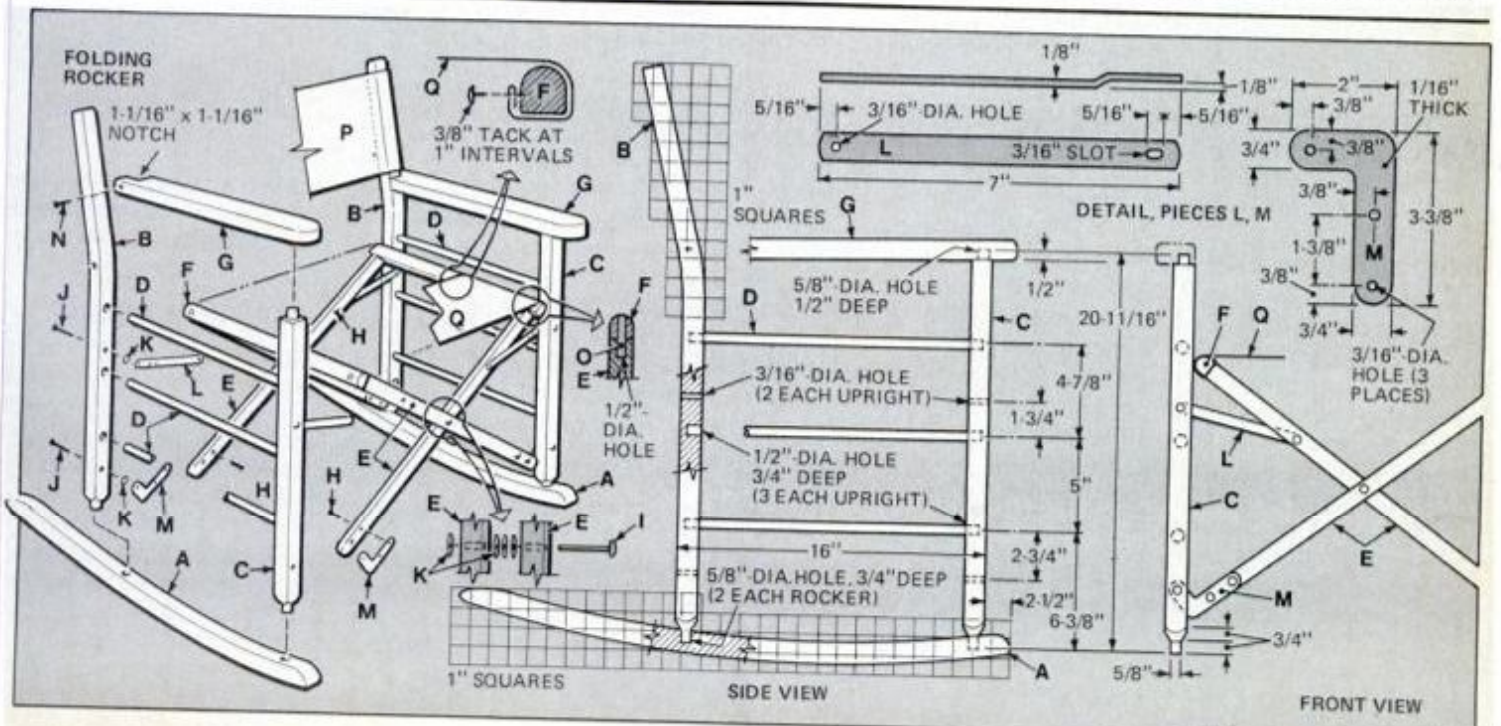
(Please turn to page 178)



Rocker runner (above) is cut out on bandsaw. Left, carpet tacks are driven through canvas and wood strip and into the seat support.



Sew a $\frac{1}{2}$ -in.-wide hem with a double row of stitching on both edges of canvas parts. We used a No. 18 needle for this work.



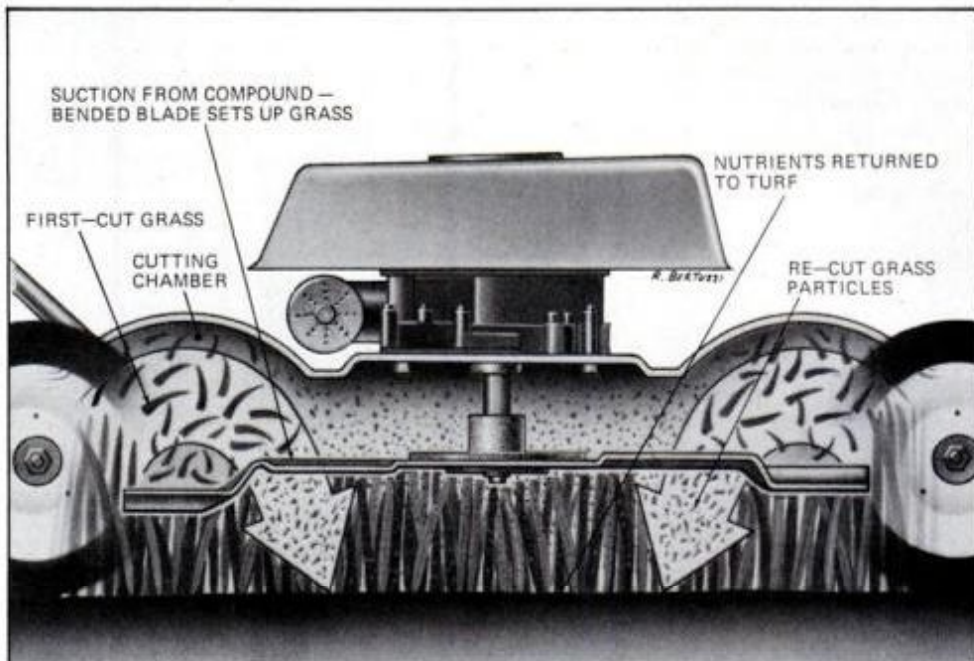
An expert's guide to the '79 crop of mowers

This year, as makers strive to satisfy customer demands, mulching-type units head the list of new mowers. Mulchers eliminate messy clean-up after mowing.

by Glenn S. Hensley

One of the first signs that spring is on its way is the sight of fragile, newly-sprouted grass pushing up around soggy leaves. Soon after, the dull, brown lawn becomes a green velvet cover. If not properly cared for, however, that cover can start to look like the coat of a long-haired dog that's just emerged from a cocklebur patch.

Makers of lawnmowers are presenting



Closed cutting chamber creates suction, straightening grass for even cut. Multipitched blade cuts, suspends clippings in cutting chamber where they are recut into tiny mulched particles, promoting fast decomposition. Cutting action then blows them deep into lawn.

Two hand levers operate Dixon's ZTR lawn tractors. Eight-hp model shown is \$1300. Tractor pivots in its own length due to independent drive-wheel control.



Toro's lawn tractor accessories include snowthrower and tire chains, blade, seeder-spreader, cart, bagging attachments.

a 1979 line that promises to ease your lawn-care tasks. Mulching-type mowers seem to be at the head of the line this year, as homeowner demand grows.

Why mulching mowers?

The mulching mowers have a good many advantages going for them. You'll find they eliminate raking, bagging and messing around with clippings. The machines are usually made with a deep blade housing and are fitted with a special aerodynamic-designed blade that has extra long cutting edges. This combination not only cuts the grass, but vacuums clippings up into the space above the blade. There, clippings are spun and sliced and then resliced before being blasted down

into the grass stubble. The action takes place across an entire cut path.

Lawn care experts tell us you get not only a well-groomed lawn, but that valuable plant nutrients are returned to the soil in the form of fine clippings. Such fine-cut clippings do decompose faster than long clippings and they aren't prone to forming much of a matted thatch layer.

When you bag clippings and have them hauled away, you're removing not only the plant nutrients they contain, but you're sending away valuable humus material that's necessary to the soil.

An added plus when you use mulching mowers: Your local trash collection service won't complain about the volume of material you're putting out. The mulcher will automatically handle your disposal problems as you mow. In the fall, it's handy to have a mulcher to chew up leaves, too.

Special handling of mulchers

Despite the growing interest in mulching mowers, they do require some special handling when used on an extremely lush lawn. They don't work perfectly everywhere. It is possible to jam up even the best of them, when wads of clippings pack the blade housing. If more than the normal interval passes between mowings, you'll also be in trouble if you try to shove your mulcher through the grass.

There is a solution, but it means more work. Don't try to cut as close as usual to the ground on your first pass through

A veteran mower of lawns, Mr. Hensley is editor of *Farm and Power Equipment*, a publication that serves equipment dealers.

grass that's taller than normal. Set the mower to its highest cutting adjustment and do the lawn. A couple of days later, lower the adjustment to the normal cutting height and go over the yard one more time. As a general practice, the new mulching mowers should be set to cut grass higher than you might do with a side or rear-bagger model.

Note of caution: Don't try to use a mulching mower on zoysia lawns. Those lawns have thatch build-up problems anyway and a mulcher could make the situation worse.

Here come the lawn tractors

In 1979 you'll see the advent of a number of new front-engine rider mowers. Some say these are especially built for the "boy in every man." In the 8 to 11-hp range, they are considerably less expensive than the full-fledged garden tractors with up to 20 hp. Yet, they still look like tractors. Incidentally, lawn tractor is the name most industry people use to denote the front-engine rider.

Industry authorities feel these smaller tractors' major appeal to those of us who cut lawns will be the price tag. For in-



Turn this 21-in. Simplicity mower (\$200) into a mulcher, side discharger, rear bagger or side bagging unit without tools.



Tilt-back shroud makes clean-up and service easy on Allis-Chalmers 21-in. mulching mower (\$200). Oil drain is under deck.



Bolens aims at the expanding mulcher market with a choice of 18, 20, or 22-in. mowers. Model 8648 (shown) is \$320.

stance, John Deere's Model 108 carries a list price of \$1350 and its 11-hp Model 111 is pegged at \$1500. A divisional marketing manager for the company says these prices are as much as \$900 below the next larger, true lawn-and-garden tractor it makes.

In looking at 1979 lawn tractors, you'll find them to be versatile machines, capable not only of mowing a lawn, but handling many other home chores. They'll pull carts, push small blades and power snow removal attachments when summer duties are done. Naturally, they won't do a job as rapidly as a larger unit. But if time isn't a consideration, they are generally quite satisfactory.

Makers offer a variety of tractor accessories. Some of the common ones are baggers, blowers and mulchers.

Bladeless mowers

In 1979 we'll see the first few, more or less experimental, efforts to design a full-fledged lawn mower using monofilament line, instead of a metal blade to cut grass.

Most machines are electric-powered and give a cut of about 20 in. Weed Eater, however, expects to sell its 21-in., gas-powered Grass Eater monofilament mower in selected market areas during 1979.

Toro's mower-trimmer, with a suggested retail price of \$150, appears to be a weed cutter with four wheels. Two 4-amp. electric motors propel four 6-in. flexible lines across a swath 20 in. wide. A switch on the handle feeds the line automatically, so that it extends beyond the outside width of the mower wheels. This is so you can use the machine as a trimmer, as well as a mower.

Weed Eater, a pioneer in the field of monofilament line cutters, says its entry is

(Please turn to page 154)

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LOOK FOR THE CAR CARE GUIDE IN THE MAY ISSUE OF POPULAR MECHANICS

'79 CROP OF MOWERS

(Continued from page 153)

a push-type machine with a single cutting-rotor head. The head utilizes four .080-ga. lines, lever-actuated for feeding. With a 3.5-hp gas engine, this rear bagger will carry a suggested retail price of \$280.

There's a definite advantage offered by the monofilament line mower: If you inadvertently run over the electric power cord, it won't slice through the insulation as a



MTD's model 139-796 (\$866) with optional bagging system, allows you to mow grass and bag it for disposal in one pass.



Toro's new 20-in. electric mower/trimmer (\$150) uses monofilament lines in place of a metal blade to cut grass.

metal blade is likely to do. In fact, the nylon cutting line is generally safer than steel blades.

More plastic

Although mulchers, lawn tractors and possibly monofilament line mowers share the limelight in 1979, the old favorites—the rear baggers, the side baggers, the rear-engine riders and the high-wheel

rough terrain units—are still being produced. But there isn't much that's drastically new on these models. Some makers have expanded their lines to include a wider variety of machine sizes. Others have changed their paint scheme. Some, perhaps wisely, have elected to keep successful designs in steady production.

You'll find increasing use of durable, poly-type plastics in 1979 machines, as



For the estate-size lot, Bush Hog's 2001 mower (\$810), shown under a Kubota tractor, is the answer. It gives a 60-in. cut.



John Deere 108 (\$1350) has an 8-hp engine, 5-speed transmission, 30-in. mower.

manufacturers search for ways to reduce problems associated with rust, to cut weight and to slice away costs.

You'll see plastic being used in discharge chutes and in ornamental parts on many new units. Gasoline tanks made of this material offer a definite safety advantage. They have no seams to leak, nor will they dent or rust.

More noise control

You'll find more attention directed toward control of engine noise in the 1979 lawn care machines. Look under the hoods and shrouds. Most likely you'll notice extra panels of sound absorbing material on the inside. In addition, better mufflers are helping to contribute to the peace of the neighborhood.

Reel-type mowers for the homeowner are almost extinct. Yard-Man does offer a

push-type reel mower, and a number of specialty companies produce heavy machines for ground maintenance duties. But costs of tooling, manufacturing and servicing those units have become almost prohibitive. They are of limited use when cutting high grass or weeds, which also works against them.

Prices of new units

While we're considering costs of production, how about the prices of 1979 mowers? They will probably be up 10 percent over 1978 prices for similar machines. They're really not similar, though, considering the added safety equipment on the new ones.

Some of this increase is a direct result of inflation. The costs you pay also include charges for more stringent safety



International Harvester's 1100 Cub Cadet (\$1790) has an 11-hp engine. A 38-in.-wide mower (\$316) attaches to it.

and environmental standards. Those have the net effect of reducing product efficiency and increasing unit cost to you.

One industry representative explains it this way: "Federal government actions will constitute the major focus of difficulty for the industry. These will come from new and modified laws, as well as rule-making. They will both directly affect the industry through business factors such as taxes, warranties, law-suit-enabling legislation, consumer actions, the control of energy and attempts to manage the economy."

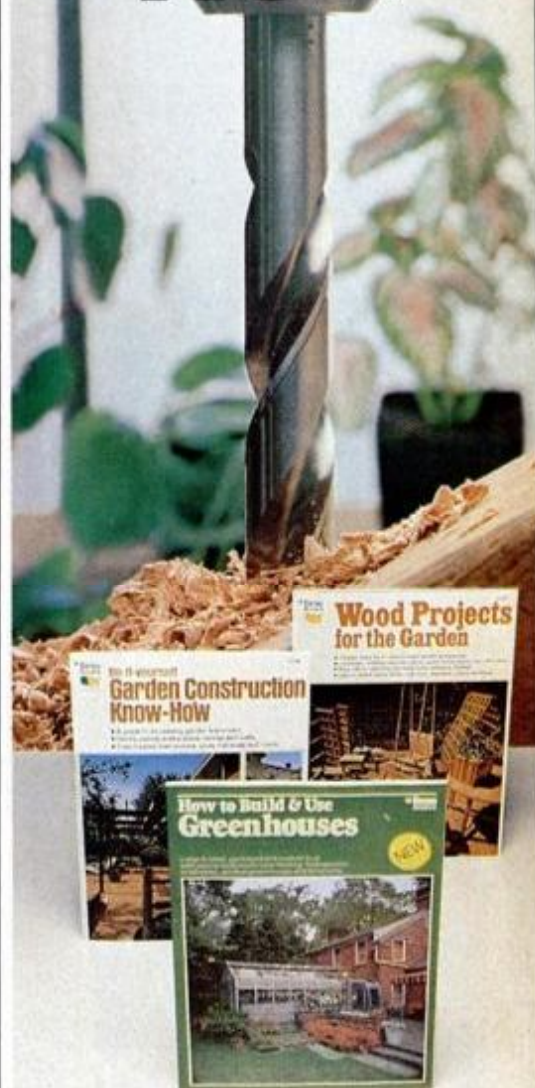
But in spite of industry worries, makers expect you to buy 2.2 percent more walk-behind units in 1979 than you did in 1978. They think you'll buy only 1.1 percent more lawn tractors and riding mowers than you did last year.

Future lawn care trends

Some makers are beginning to voice concern about how long individuals will be able to afford their own lawn-care machines. They're making guesses as to

(Please turn to page 156)

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'79 CROP OF MOWERS

(Continued from page 155)

when rising costs will force potential buyers to consider turning over their groundskeeping chores to a lawn-care service. However, that time has apparently not yet arrived.

The 1979 lawn care machines are lightweight and easy to operate. They offer safer operation and minimal maintenance, even if they do cost more.

Buy for your needs

If this is your year to purchase a new lawnmower, shop smart and take advice from your equipment dealer. If he's in



Jacobsen's twin-blade mulching mower is available in either push-type (\$210) or self-propelled (\$310) models.

business to stay, he'll offer you good, sound advice on machines to meet your needs. He'll offer you reliable repair service and parts. A good dealer will stand behind the provisions of your lawnmower's warranty.

When choosing a mower, remember that the average small city lot can probably be handled by walk-behind power mowers, either push-type or self-propelled. For larger lots up to two and a half acres, he'll likely recommend a riding mower. For estate-size lawns up to 10 acres, he will recommend a full-size lawn-and-garden tractor.

Remember, very generally, that you get about what you pay for. Buy an el cheapo model and most likely it will be ready for the junk heap in just a few years.

If you must mow on steep grades, let your dealer know that fact. He'll probably suggest that you buy a new mower that's two-cycle-engine powered. Run a four-cycle engine on too steep a bank and you can siphon the oil out of the crankcase in a hurry. Results can be disastrous. (Honda, however, offers a new four-cycle-engine mower this year, the HR-21, that is fitted with an oil pump to provide lubrication on slopes up to 20°.) Because it

(Please turn to page 158)

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'79 CROP OF MOWERS

(Continued from page 156)

uses an oil-gas mix, the two-cycle engine isn't plagued with crankcase oil starvation.

Plan ahead

Now, while March's blustery winds are still threatening your newly sprouted grass, is the time to consider your lawn-mower needs. To make a wise choice,



Sarlo's high-wheel mower handles bumpy terrain. Models begin at four hp (\$300).



Gilson's 11-hp lawn tractor (\$1280) has tight turning radius needed on home units.

consider the size of your property, the type of grass on it and the amount of money you want to spend for a mower.

Some homeowners enjoy caring for their lawns. For the rest of us it's a chore best done without. Whatever your feelings are, lawn mowing is an inevitable project and a good mower can ease the task.

One final tip before you sign on the dotted line for anyone's lawnmower. Check in which direction the exhaust system outlet points. Does it shoot hot gases into your face, onto your feet, or are those gases directed away from the operator? Summer's hot enough without having to march or ride through clouds of mower fumes. **PM**

HONDA BETS SAFETY WILL SELL

You'll find it hard to injure your feet or hands in whirling rotor blades on Honda's new HR-21 mower when you leave the operator's position. The company's engineers have devised a practical (but certainly not simple) means of stopping the blade while the engine continues to run.

This 21-in. machine offers several innovative safety features. In fact, the mower already complies with nearly everything the Consumer Product Safety Commission has been considering.

If you should accidentally slip your foot under the mower or lose your balance and fall, thrusting your hand into the blade area, you'll lose nothing save for your balance and your pride.

Likewise, if you must leave the mower handlebar to remove a toy, a rock or some other obstruction from your path, those whirring blades stop cold in seconds, thanks to a blade brake. At the same time, forward travel ceases.

It's not something you'll be able to take apart and reassemble without full service instructions, but the blade brake is an interesting piece of safety engineering. You can fol-

low its action on the schematic diagram at the bottom of the page.

The device is standard equipment on all the company's four models: push-type, self-propelled and with and without capacitor discharge ignition.

The discharge door automatically closes when the bag is removed. There's a replaceable side-guard plate on the deck to minimize the effect of thrown objects.

The cut-away drawing of the mower (below) shows the Honda HR-21's inner workings, including the blade-stopping device, automatic-closing discharge door and safety shield. It has a four-stroke Honda GV-150 3.5-hp engine. All wires are sealed and the sparkplug is protected by a guard and protective cap.

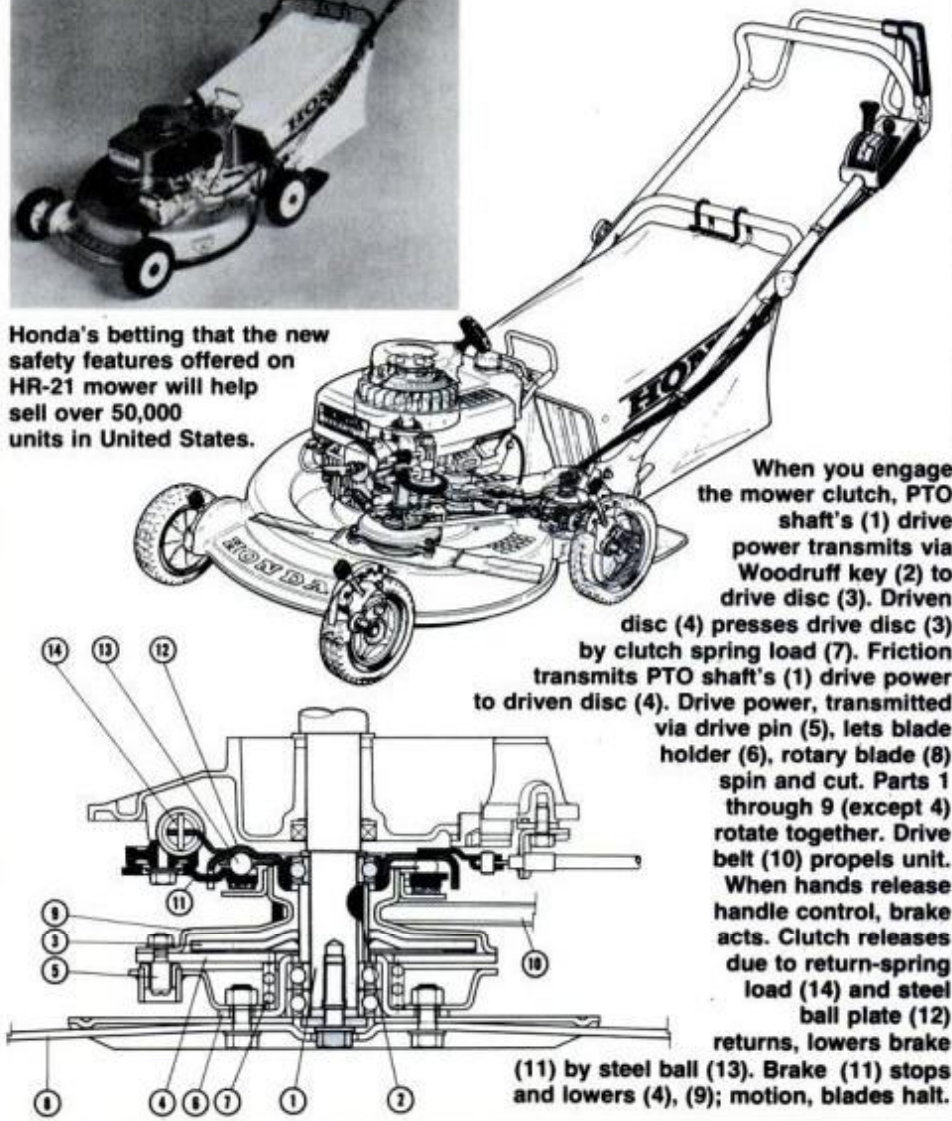
With suggested retail prices from \$350 to nearly \$450, the machines are relatively expensive, but Honda anticipates that safety will help sell the 50,000 units it is shipping to the United States.

Here's a handy feature you'll want to note. If you must cut grass on banks that slope up to 20°, Honda says its trochoid oil pump will supply lubrication to the 3.5-hp, four-cycle engine that these models have.

The company says, further, that the mower has three-way versatility. It can be used as a rear-bagger, a side-discharge unit (with an optional attachment) or as a mulcher.—G.H.



Honda's betting that the new safety features offered on HR-21 mower will help sell over 50,000 units in United States.



When you engage the mower clutch, PTO shaft's (1) drive power transmits via Woodruff key (2) to drive disc (3). Driven disc (4) presses drive disc (3) by clutch spring load (7). Friction transmits PTO shaft's (1) drive power to driven disc (4). Drive power, transmitted via drive pin (5), lets blade holder (6), rotary blade (8) spin and cut. Parts 1 through 9 (except 4) rotate together. Drive belt (10) propels unit. When hands release handle control, brake acts. Clutch releases due to return-spring load (14) and steel ball plate (12) returns, lowers brake (11) by steel ball (13). Brake (11) stops and lowers (4), (9); motion, blades halt.

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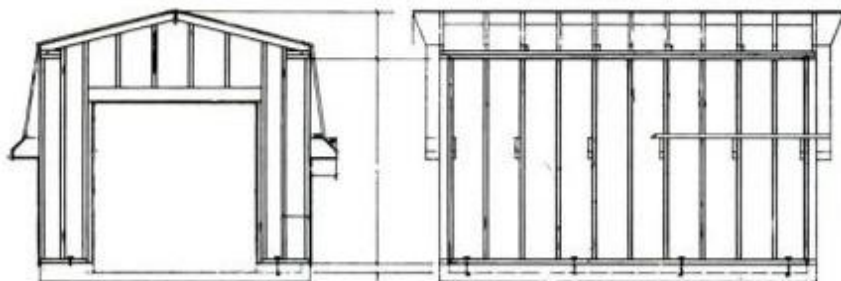
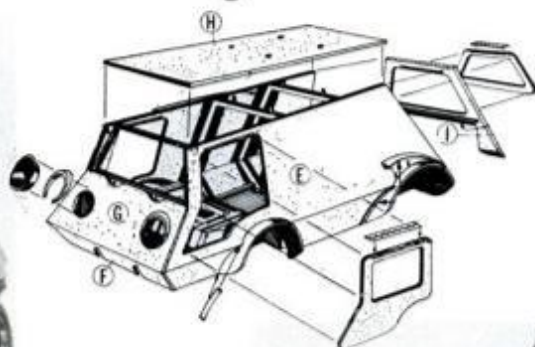
13 mg. "tar", 0.9 mg. nicotine av. per cigarette. FTC Report MAY '78.

IN THE AIR, ON LAND



SCAMP

BOONIE BUG



DUTCH MINI-BARN

Popular Mechanics plans have been helping readers do the "impossible" for over 75 years. Here are just a few of the exciting PM plan projects.

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(Featured in Dec., 1973 issue)

BOONIE BUG—A dynamic, new vehicle concept! Constructed from a VW bus chassis, the 'Boonie' offers the go-anywhere ruggedness

of an ATV, the sleeping and camping facilities of an enclosed van and the smooth-riding quality of a conventional station wagon at highway speeds—all rolled into the slickest looking vehicle ever! Do-it-yourself with PM plans. **\$14.95**

(Featured in March, 1974 issue)

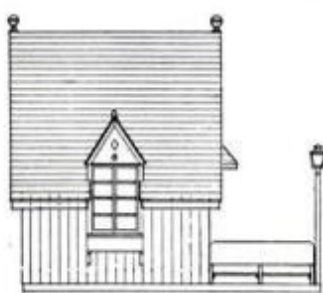
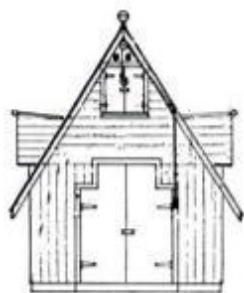
DUTCH MINI-BARN—You can erect our most popular backyard storage structure for under \$600. The roof design is somewhere between gambrel and mansard but it reminds us of Dutch colonial architecture. With 8 ft. of headroom inside and 10 ft. by 13½ ft. floor space it's fairly large although

it looks small. More than enough room for bicycles, lawn furniture, garden tools or use it as an office workshop or potting shed. Two sets of plans included, one for yourself and one for your building department. **\$5.95**

(Featured in August, 1972 issue)

STORYBOOK PLAYHOUSE—Put up a shed and the neighbors may hate you, but build this handsome little house and you'll be the hero of the neighborhood—especially among the small fry! This compact structure looks more like a storybook cottage than a tool-house—but you can readily use it for storage. In fact, wide barn-type

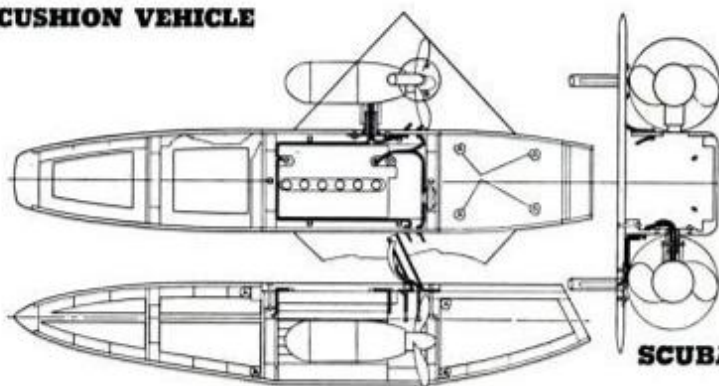
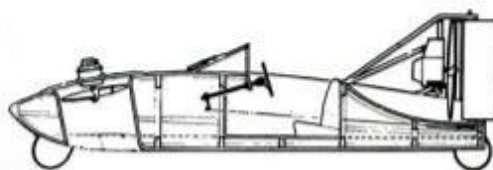
AND UNDER THE SEA



STORYBOOK PLAYHOUSE



LAND & WATER AIR CUSHION VEHICLE



SCUBA-TOW



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

(Featured in July, 1973 issue)

LAND AND WATER AIR CUSHION VEHICLE—A go-anywhere air-prop craft, the exciting Cobra ACV skims land or sea at speeds up to 60MPH. 14 ft. long, with room for two passengers this innovative vehicle will cost you less than \$800 to build. A unique project for the serious do-it-your-

selfer (caution must be paid in following all operating instructions). The joys of owning and operating this futuristic hover vehicle are truly inestimable. **\$12.95**

(Featured in Sept., 1975 issue)

SCUBA-TOW—The electric-powered sea scooter that performs like costly commercial models! Motorized Scuba-Tow will pull you on or under the water for hours of effortless snorkeling or scuba diving. Rugged, light weight and dependable—you can build Scuba-Tow in a weekend or two from PM plans. **\$7.95**

(Featured in July, 1974 issue)

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17 new helpers for yard and garden



The first mower with flexible cutting lines in place of a metal blade is Toro's 20-in. model priced under \$150. The mowing mechanism is two counterrotating discs with two monofilament lines on each disc that advance automatically as they wear down. The Toro Co., 8111 Lyndale Ave. South, Minneapolis, Minn. 55420.



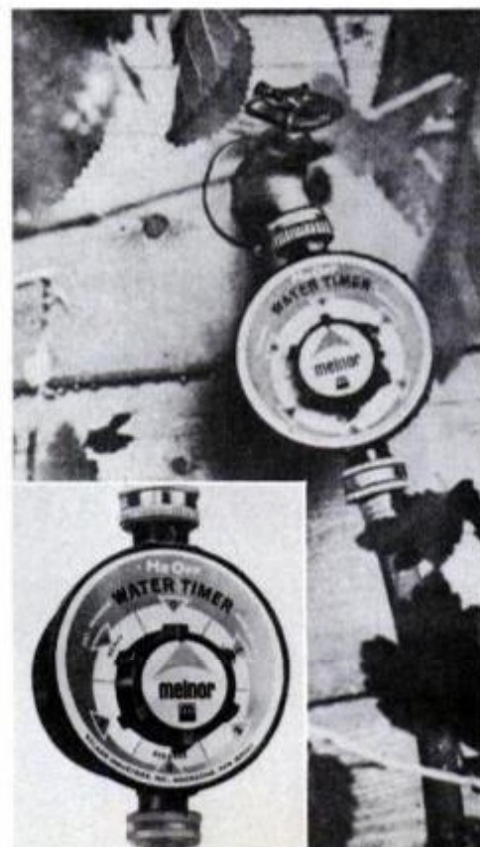
Safely transplant young flower and vegetable plants to permanent settings with this Ecol-O-Tool. The cylindrical blade measures 1½ (o.d.) by 2 inches. Roots of small plants remain intact within a protective layer of soil while being moved. Transplanter is \$8.95 postpaid from JWG Co., Box 93, Saratoga, Calif. 95070.



This cordless electric garden sprayer runs on rechargeable batteries. The polyethylene container comes in 1-quart, ½-gallon and 1-gallon sizes priced at \$20, \$30 and \$33 respectively. The nozzle is designed to spray a fine mist, then fold into the handle for storing. H.D. Hudson Manufacturing Co., 500 North Michigan Ave., Chicago, Ill. 60611.



A gas-powered blower, the PB-200, has been introduced by Echo, Inc. It delivers a 180-mph air blast that quickly clears sand, pine needles, snow and water off driveways, patios and walks; or, it will clean leaves and grass trimmings off lawn and from beneath bushes. Unit operates on a Kloritz two-cycle 21-cc engine. It's priced at \$160 by Echo, Inc., 3150 MacArthur Blvd., Northbrook, Ill. 60062.



Water automatically—by the gallon—with the Melnor Water Timer. It keeps track of the water flow and measures up to 750 gallons at a single setting. It delivers the preset amount, then shuts itself off. Use the timer to fill swimming pools and for darkroom work as well as on lawns and gardens. It's priced at \$12, from Melnor Industries, 1 Carol Place, Moonachie, N.J. 07074.



When the mowing gets tough, just touch a control bar on Jacobsen's Power-Burst Mower and a surge of reserve power is released to cut through tall, tough or lush grass. The 20-inch mower has a 3½-hp Briggs and Stratton engine, and is available either self-propelled at \$280 or push-type at \$215. Jacobsen Manufacturing Co., 1721 Packard Ave., Racine, Wis. 53403.

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Build this rugged butcher- block furniture



Block maple furniture combines clean modern styling with rugged good looks to make this table, chair and sofa look great in your living room. All three pieces are made from 2-in.-thick maple, chair and sofa are fitted with foam cushions for deep seating comfort. Plans and instructions for making all three pieces can be obtained by sending \$7.95 to **Butcher Block Furniture, Popular Mechanics, Box 1014, Radio City Station, New York, N.Y. 10019.**



The Redimix 12 compressed-air sprayer handles large or small yard and garden jobs. Empty it weighs only 4½ pounds; yet it actually has a usable capacity of 2½ gallons. It's priced at \$40 and may be obtained from the maker, Burgess Vibrocrafters, Inc., Grayslake, Ill. 60030.

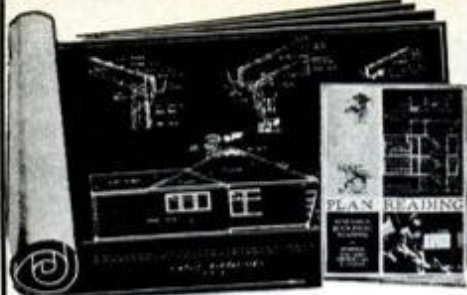


The Flymo Cushionaire rotary mower (\$120) moves on a cushion of air ¼ inch off the ground and, therefore, leaves no wheel marks. It mows under shrubbery and over curbs and edges, leaving a fine mulch. Manufacturer and supplier is Flymo Products Co., Woodbridge, N.J. 07095.



Soil Blender is a multipurpose garden tool priced at \$140 plus shipping. It uses an ingenious combination of counterrotating augers and blending blades that create a burrow-plow action, to dig, mix, till and cultivate the soil. Available from Garden Maid, Inc., Box 912, Lebanon, Mo. 65536.

(Please turn to page 164)



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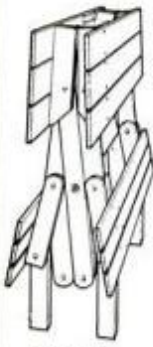
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Parking a bulky picnic table indoors when summer is over is practically impossible. So it sits in the yard or on the patio 12 months of the year. Not so with this unique design. Both table and benches fold scissor-fashion into an incredibly small unit which means the whole thing can be stored in your garage or basement with room to spare. And if made of redwood, the table will last for years. To obtain plans and instructions for building this stowaway table send \$3.95 to Popular Mechanics Plans Service, Box 1014, New York, N.Y. 10019.



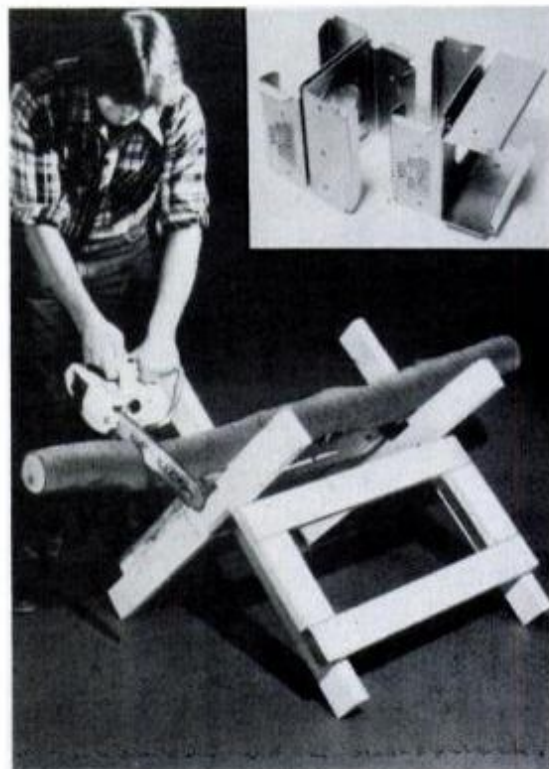
The Conreco Sawing Machine (\$300) is a wooden frame with chain saw and foot treadle to control the saw blade. Press the treadle and the blade descends; release it and the blade returns to an upward position. Hands and feet are safely away from cutting operation. Conreco Sawing Machine Co., Box 94, Villa Park, Ill. 60181.



Mix concrete, plaster and mortar for home or yard improvements in the Porta-Mix Electric Mixer. It comes with a ¼-hp motor and an on/off switch for \$199.50 postpaid. The mouth is less than 2 ft. from the ground for easy filling and the drum boasts eight mixing vanes that can mix 160 lbs. of material at a time. After use, the polyethylene surface is easy to clean. Drum is removable for car transport or compact storage. Foster-Hyatt, 1083 Bloomfield Ave., West Caldwell, N.J. 07006.



Turn the handle full-circle and this home helper can stir up 90 lbs. of packaged concrete mix in 90 seconds using the same rotating action as large mixers. Use it for small construction or repair projects, or to prepare potting soil, stir feeds or mix mulch. The steel drum has three mixing blades removable for cleaning. The unit, priced at \$130, weighs 50 lbs. and the drum measures 18x20 in. Manufactured by W.C. Bradley Enterprises Forge Dept., Box 1240, Columbus, Ga. 31902.



A pair of these brackets (inset), some 2x4s, a hammer and nails is all it takes to construct a foldable saw buck for many uses. Each bracket has prebored holes and a collar. One pair of brackets is \$6 from Stanley Tools, Division of The Stanley Works, Dept. PID, Box 1800, New Britain, Conn. 06050.



The Time-A-Matic an oscillating sprinkler with a memory, can be set to vary water flow from 0 to 1200 gallons. When watering is completed, unit shuts itself off. Maximum watering area is 50 feet by 70 feet. Costs \$39. Melnor Industries, 1 Carol Place, Moonachie, N.J. 07074.



Yard-Man's Model 21030 rotary tiller is made for back-yard and neighborhood gardens. A 3-hp engine makes it powerful enough to till an 18-in. swath 3 to 5 in. deep. The controls are on the handle which folds for easier storage. Spring-steel tines are said to stay sharp. Approximately \$250 from Yard-Man Co., 5389 West 130th St., Box 2741, Cleveland, Ohio 44111.

Gilson's new rear-tire tiller sports an 8-hp engine, 16-in. tires and five forward speeds. The 24-position swing handle adjusts up, down or sideways with single lever. All controls are on handle to enable operator to walk at side, not on tilled soil. About \$900 from Gilson Brothers Co., Box 152, Plymouth, Wis. 53073.



Weed Eater model 559 trimmer/edger automatically feeds nylon cutting line while unit is operating—there's no need to tap the tool on the ground or extend the line manually. The electric motor is top-mounted for better balance and easier handling, says maker. About \$80 from Weed-Eaters, Inc., Harwin Drive, Houston, Tex. 77036.



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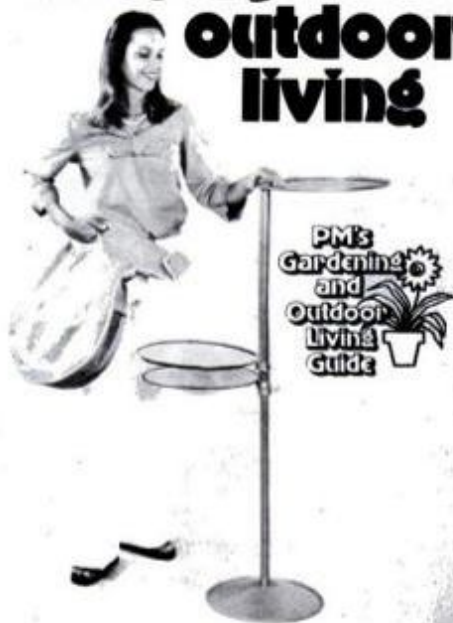
When you go out to compare tractors, compare mowers too. We think your search will end at a Bolens dealer. He'll show you ten different tractors ranging from 8 to 23 hp. For his name check the Yellow Pages. Call 800-447-4700 toll free anytime. [In Illinois call 800-322-4400]. Or, write the FMC Corporation, Port Washington, WI 53074.

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Products for easy outdoor living



Tote the 9-lb. Orbit grill to beach or picnic and set it up in 30 seconds without tools. The setup consists of a post, base, charcoal brazier and handy shelf for \$40. The \$16 vinyl case is optional. Orbit Industries Inc., 912 Railroad Ave., Winter Park, Fla. 32789, is the manufacturer.



This Armillary sundial is cast in bronze. It has an 8-in.-dia. base which features signs of the zodiac. Priced at \$175, it is 15 in. high with 10½-in. circles. Install it in the garden or on the patio. By McHutchison & Co., Inc., 695 Grand Ave., Ridgefield, N.J. 07657.



The umbrella chair in a bag (\$45) goes to beaches, boat races and outdoor concerts. Canvas seat adjusts to three levels. Umbrella swivels to block sun. Colors: green seat/yellow umbrella; orange seat/red umbrella. Great Eastern Lumber Co., 2315 Broadway, New York, N.Y. 10024.



The Vista patio-door system offers the esthetics of glass protected by insulated steel. Any one door of a two- or three-panel system can be made operable for maximum flexibility in decorating and use. Doors also come with weatherstripping. Two-panel systems start at \$425. General Products Co., Box 887, Fredericksburg, Va. 22401.



Destroy mosquitoes, wasps, moths and other flying pests that bug you with the Web, an attraction bulb and killer grid. The 30-watt unit, an alternative to chemical fogs and sprays, comes ready to hang for about \$160. Post-mounting kit is about \$35. Weber-Stephen Products Co., 100 North Hickory Ave., Arlington Heights, Ill. 60004.



The Patio Range combination gas grill/oven has dual burners and about 750 sq. in. of cooking surface. Unit will operate on LP or natural gas and features spark ignition—no matches are needed. Dual heat controls permit cooking and baking versatility, two wheels makes it easy to move from garage to patio. About \$440. Arkla Industries, Box 534, Evansville, Ind. 47704.

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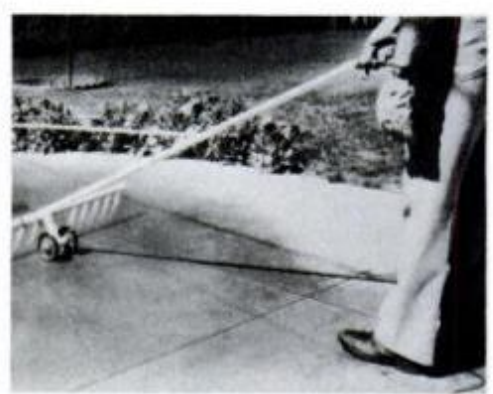
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Homebuilt patio sweeper does it with water

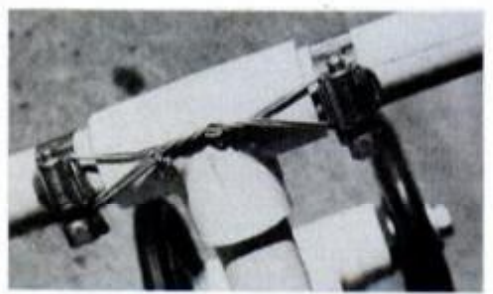


Patio sweeper, made for \$10, connects to garden hose via its handle of PVC pipe.

This inexpensive sweeper, made from 3/4-in. PVC pipe, sprays away debris. Make the spray assembly with two 2-ft. lengths of pipe joined with a connector tee and capped at ends. Drill 1/16-in. spray holes every 2 in. on pipes. The wheel assembly is simply a tee having its opposite ends fitted with center-drilled wooden plugs to act as bearings. Install the axle (bolt), washers, wheels; and secure with nut. Join the spray and wheel assembly to 5-ft.-long pipe (handle) with a short length of PVC, tee and cement. The tee must be rebored with a 1 1/8-in. drill to let the handle slide directly through to the spray assembly. Join handle top to hose with a coupling and brass pipe-to-hose connector.—E.V. Reyner



Wheel assembly includes tees, 3-in.-long PVC, 7/16-in. axle/bolt, washers, nut and 1 1/4-in. wood plugs cut with hole saw.



To adjust for spray direction, don't cement spraying arms to tee. Secure them with hose clamps, wired together as shown.

HINTS FROM READERS



Abrasive anchors handle

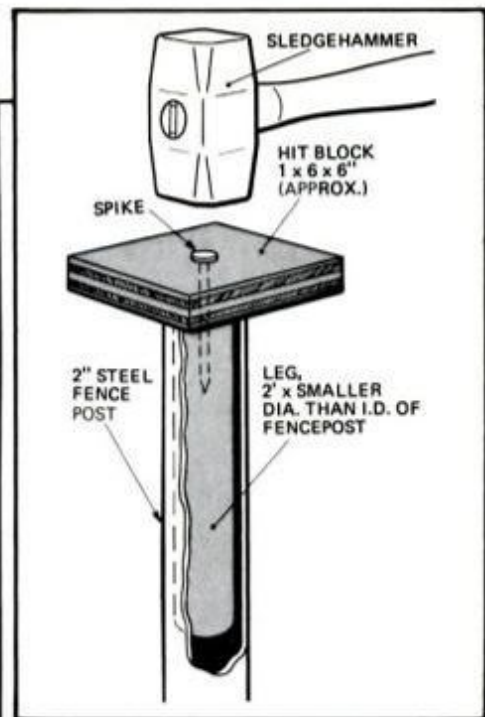
When auxiliary handle of electric grass trimmer can't be tightened enough to prevent slipping, anchor it with abrasive-paper shim. Fold strip of fine-grit paper, abrasive side out, and glue the folds together. Slip it under the handle clamp and then retighten it as much as possible.—*W. E. Burton*

Novel apple picker

A can fastened to a pole of any length allows you to pick bushels of apples from the ground. Use a 48-oz. can. Cut V-shaped notch 2½ in. wide and 2 in. deep at top of can. To dislodge apples, push can up under apple, with apple stem in V-notch, until it falls into can.—*Simon M. Schwartz*

Nonskid stepladder surface

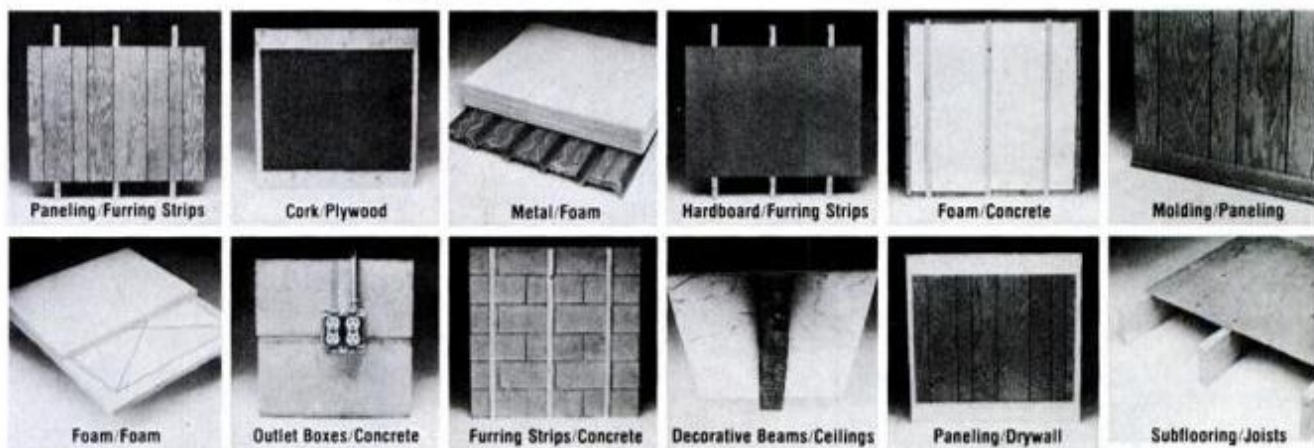
To provide a nonskid surface for a stepladder, varnish the steps and sprinkle sand or sawdust on the treads when the varnish becomes tacky.—*Lane Olinghouse*



Post driving aid

Keeps tops of thin-walled fencepost pipes from mushrooming when you drive them into the ground. Use a plywood hit block attached to a length of wood dowel that fits inside the fence post.—*Andrew Vena*

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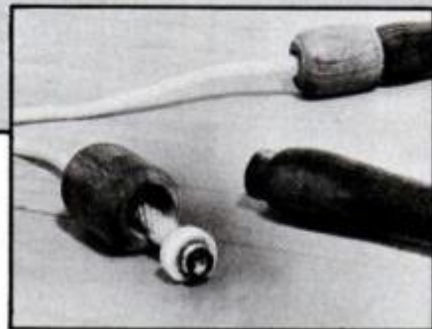
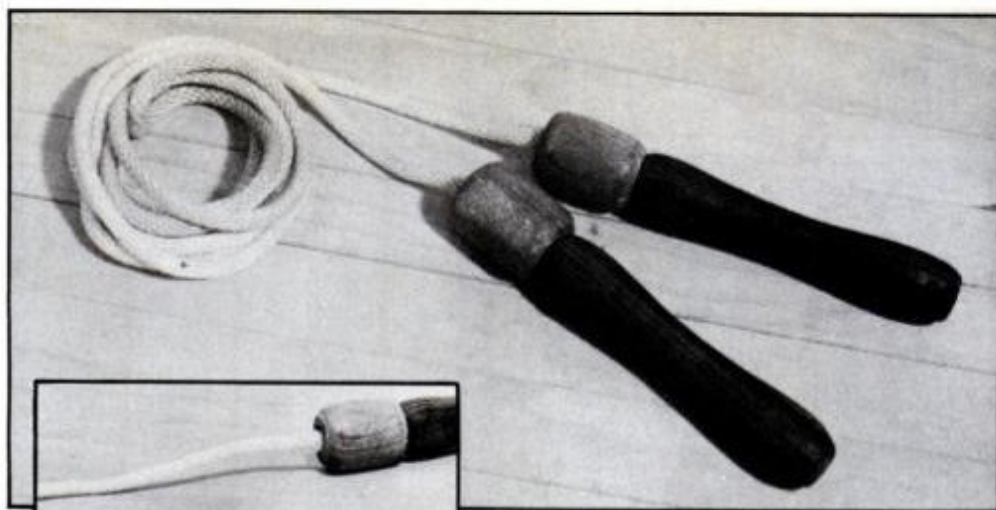


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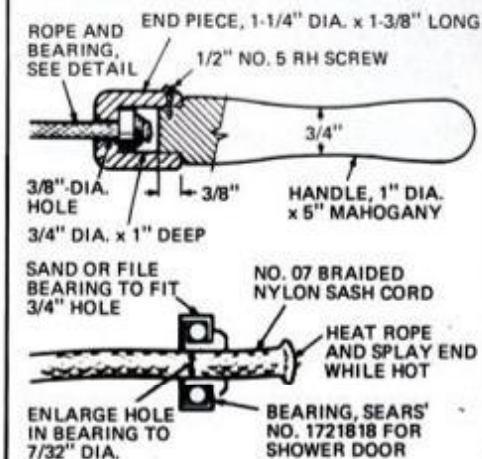
Rediscover the jump rope

Part of the pleasure of having an attractive, functional yard is the use that it can be put to for outdoor exercising as well as entertaining and other activities. One aid for physical fitness that can provide both fun and healthful exercise is the age-old jump rope, now enjoying a new-found popularity among both the young and old. While the rope can, of course, be used indoors, the outdoors offers infinitely more space and freedom—and there's no longer any danger of accidentally breaking delicate objects around the house.

The homemade jump rope shown at right incorporates a luxury feature that makes it especially easy to use. The lathe-turned handles are equipped with ball bearings that allow the rope ends to swivel freely without twisting, kinking and fraying. Turn each handle in two sections and insert a bearing in the hollowed-out end as shown. These bearings are readily available as stock parts for a Sears shower door.—James G. Gosselink



Drawing shows how jump-rope handles are turned in two sections with hollowed-out ends to receive ball bearings. Bearings are stock Sears parts for shower doors (No. 172818). Attach handle pieces with small screw, not glue, so rope can be replaced when worn. Rule of thumb for rope length: It should reach from armpit to armpit while passing under feet.



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CAMPER WITH EVERYTHING

(Continued from page 105)

boat. All are easily removed before the roof is raised.

Setup often comes after dark, so a spotlight is installed on the camper tongue next to the LP gas bottles to illuminate the jack, trailer hitch and StarRise switch which electrically lifts or lowers the Galaxy roof. After the roof goes up, an



Interior refinements include a swivel TV mount, rack on wardrobe door, fitted cabinets, towel racks, stereo and counter CB.

American Appliance mobile TV antenna is extended from its socket and opens like an umbrella. Fiberglass RV tops (and boat decks) do not act as an adequate ground plane for CB transmission, so we chose a special Avanti citizens band antenna that can also be mounted on a car windshield. The side awning, a Starcraft accessory, extends into position quickly, and can be left open at sides and front or enclosed with screening during bug season.

Better still, this rig sports that ultimate luxury of any tent trailer—a built-in air-conditioner. With it, sleep is no problem on a steaming night. Reverse cycle can provide quick warmth on a chill day, and



Porta Potti self-contained toilet has a hinged compartment, curtained enclosure, next to stereo speaker, voltage converter.



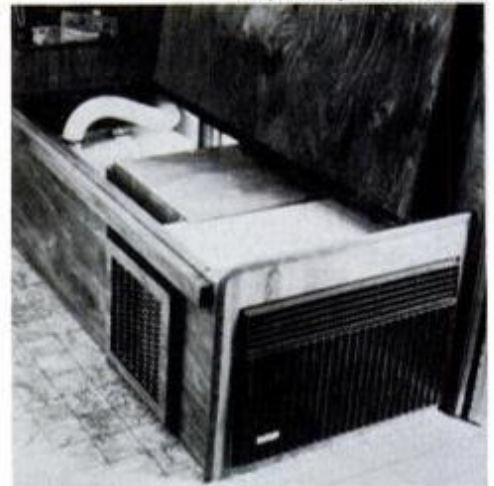
Add-ons that set up inside and out do double duty. Table (above left) with TV, radio, spotlight, hooks to side of camper; fit-together table (right) holds portable microwave oven. Both are powered by compact generator.

PM photos by Harlan Bourdon

when the no-see-um biting bugs come boring in and a slanting rain drives up the humidity, the camper can be completely zipped and buttoned up to keep out rain and insects, while the conditioner provides plentiful fresh air. The unit used here is a Whirlpool, and the underseat installation was one of the prize-winning suggestions from the 5000-member Starcraft Camper Club.

Other tips from them included a pull-out and retractable clothes line that extends from one corner of the camper to its telescopic pole, various strategically placed towel racks and electrical outlets to take pronged or cigarette-lighter plugs and assorted built-in storage compartments. A vanity arrangement, with mirror and fitted glass and toothbrush holders, was suggested for the wardrobe door and installed there, as well as a holder for fishing rods inside. Additional recommendations became insulated bottoms for the beds, to keep cold from frosting up from below; upper cabinets over the galley area, silverware and utensil dividers in the kitchen drawers, demountable pet feeder outside in the patio area, and a clever, fit-together picnic table that sets up quickly for outdoor family meals, reading and table games, plus a latch-on inside/outside table.

Electric conveniences picked for compact lightness include a portable Zenith TV and Panasonic microwave oven, Norcold refrigerator, two AudioVox stereo speakers installed in each end of the camper and powered by a Clarion cassette AM/FM radio built in under a counter, and a custom-mounted Cobra CB. Next to the door a hang-bracket and cigarette-lighter plug-in were fitted for convenient use of a Q-Bean spotlight. Back-



Outstanding feature is air conditioner built in under side seat, and vented out through a removable side panel.

woods power source comes from a Honda generator.

All standard and optional equipment generally offered for the camper was installed. The items included a self-contained Porta Potti toilet placed under a hinged dinette bench, a built-in 17,000-B.T.U. forced-air LP heater, a StarDome skylight in the roof, stainless steel sinks in the galley and an exterior fitting provided so that the dinette table can be used indoors or out. A StarGrill outdoor LP barbecue is also mounted outside.

Finally, the rig was fully fitted out with accessories to be sure it could handle the four Schwinn bicycles, water skis, kid games, Gott ice chest, food, clothes, cameras, Zebco fishing tackle, folding beach chairs, sleeping bags, and all the personal gear a family might bring. For compact camping in comfort, the future looks very favorable. **PM**

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These prices good thru May 1, 1979

NEW RIGS FOR ROLLING VACATIONS

(Continued from page 101)

16 feet long, is demonstrated in tow behind a Chevy LUV.

Tiny types

If mini compact cars are the fuel savers of the future, there are several tow rigs now ready to hitch up that might not strain a motorcycle. The 10½-foot Sunspot, from Sunline Coach, has just enough

room inside to accommodate a double-bed mattress on the floor. Serro, which is now offering its Scotty models from 13 feet up, has long been a leader in practical minitrailers.

In tent campers, Apache may have the lightest one at 510 pounds. Viking's Mini Gasser, Starcraft's Gas Mizer and the Venture Pump Passer are among other



A tow-rig pickup to match the Blazon fifth-wheel trailer out behind, the Elite Tow Lounge mounts the hitch in the cargo bed, can carry and sleep passengers in the cab.



Famous for motor homes, Winnebago now has three new travel trailers of 21, 23 and 25 feet with standard features like forced-air furnaces, four-burner ranges, two LP tanks, water heaters and more.

Combining features of the tent and solid-state models, Apache's Feather Deluxe trailer has a glide-out double bed that increases accommodations for up to six in this new 16-footer.

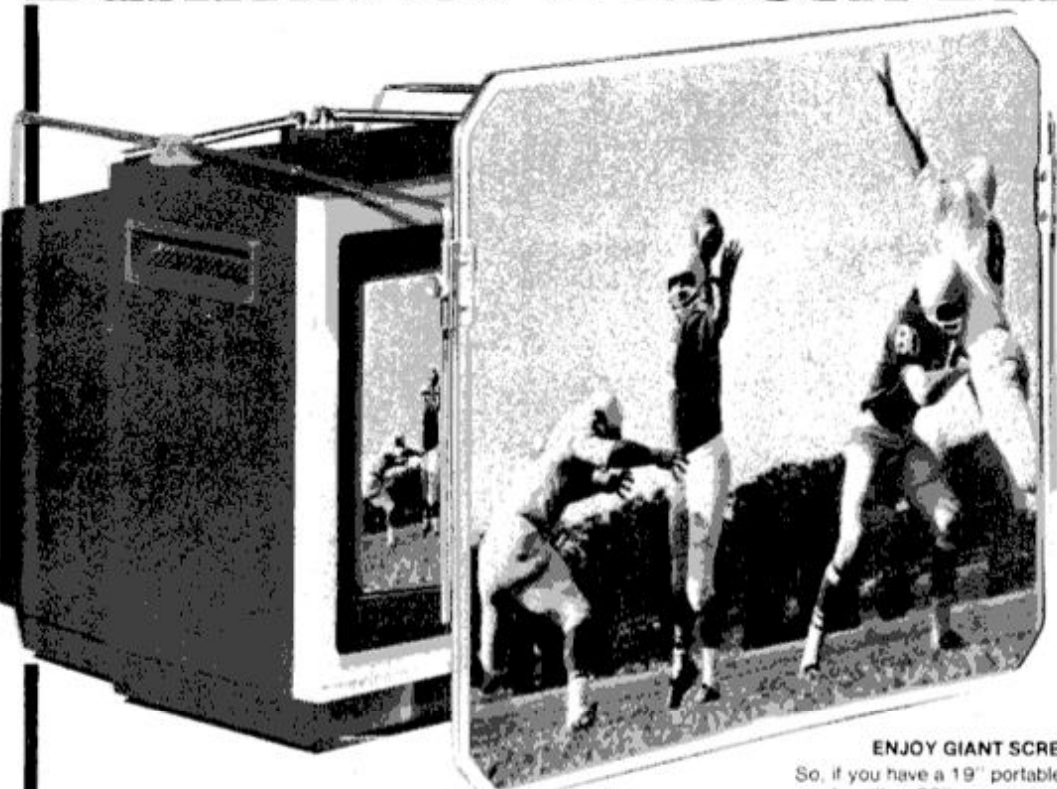


Small and light, with minimum wind resistance when folded, Viking's Mini Gasser is designed for compact-car towing.

flyweights planned to minimize gas guzzling.

But the days of the carefree recreational vehicle may be numbered. Currently, the manufacturers are bragging when their inner framing is made of steel instead of wood. Some interiors of motorized rigs have sharp corners that could stab a passenger, and none of them feature safety belts for the seats positioned behind the driver. Soon dash padding and safer RV steering wheels will be required in the lighter fuel-efficient rigs. Future RVs will never be the same. **PM**

The Incredible BEAMSCOPE ZOOM LENS



The Incredible Beamscope Zoom Lens represents a new application of technology to the field of T.V. Optics. One which we predict will tie the industry in knots, and force top management to re-examine their technical approach toward large-screen T.V. These are hard facts to face for an industry committed to charging more for what we believe is outmoded technology!

Today SONY, PANASONIC, G.E., ADVENT and SHARP, to mention only a few names, are marketing large-screen projection T.V. systems. These units are designed to offer dramatic theatre size screen presentation in your own living room. They are dramatic, and they are expensive! Expect to pay upwards of \$2,000 and more for a T.V. that must be viewed with separate movie-type screens, require precise placement of the lens with respect to the screen and can hardly be seen in daylight.

BEAMSCOPE SUPERIORITY

Beamscope provides a large-screen, theatre viewing system that can be used in any room, under any and all lighting conditions. Most important of all, it can be used with your present T.V. Depending on the size of the T.V., Beamscope will provide a superb picture, up to 475 sq. inch, with a diagonal measure of 30". The cost is not in the thousands, not even in the hundreds, but less than \$60! Football, basketball, hockey—bigger and better than you have ever seen them before. Every detail sharp and clear. The action easier to follow than it would be from the best seat in the house. Baseball, the races, your favorite program, Charlie's Angels, Chrissy and Janet of "Three's Company," come to life in your living room. And, what kind of quality can you expect for less than \$60., when SONY charges \$1,995 for its 40" video projection system. The answer is: Flawless! Beamscope not only gives you distortionless color and black and white but actually improves the color and sharpness of your present picture.

A PRODUCT OF COMPUTER SCIENCE

Due to the accuracy and precision required, Beamscope could not have been produced at a reasonable price without the aid of a computer. Simply stated, the Beamscope lens is constructed with thousands of spiral microgrooves, so small they can't be seen. They are cut with computer accuracy into one side of a specially fabricated, exceptionally hard acrylic. When the Beamscope is placed in front of your T.V. these grooves literally explode the picture up to twice its normal size.

DISCOVERED BY ACCIDENT

Interestingly, we discovered the Beamscope Lens quite by accident, because it was intended for use by the visually impaired. It has been thoroughly tested and is today being used at the Optometric Center of the Southern California College of Optometry, and numerous other low vision clinics, Universities and Institutes throughout the U.S. Obviously then, the T.V. Zoom Lens is no gimmick, but a scientifically designed optometrically approved, University endorsed optical break-through, manufactured to the highest quality standards.

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12 QUESTIONS ABOUT RV TIRES

(Continued from page 107)

of load the tire can support. For example, 12-15 size tires of B load range can support 1780 to 2250 pounds as you increase inflation pressure from 20 to 30 pounds per square inch (p.s.i.), which is the most air that these tires should have added to them when they are inflated cold.

If you want to carry more weight than this, you may be able to fit your vehicle with 12-15 size tires of C load range, which can be safely inflated, when cold,



New Continental ContiContact snow radial has self-cleaning tread, low road noise, stays pliable in cold, says maker.

to 45 p.s.i. At this pressure, tires can support 2850 pounds.

Q. Are you saying that I can increase the load I put in my vehicle just by changing to tires having a different load range?

A. It doesn't work that way. There is a limit to how much weight you can safely carry in a vehicle no matter what kind of tires you use. This limit is indicated by the axle rating, which you will find on a label attached to the cab. The label has been required for all vehicles manufactured since Jan. 1, 1972. (If you have an older vehicle, determine axle rating by calling a dealer who sells your kind of vehicle.)

Q. How can I find out the weight of my vehicle when it's loaded, so I can get tires having the proper load range?

A. The best way is to have the vehicle weighed, one axle at a time, at a state truck weigh station or a coal or scrap yard when your rig is fully loaded. Divide weight by the number of tires on the axle. Then use a load and inflation table to determine the required tire load range. Load and inflation tables are available at tire dealers or from the Tire Industry Safety Council, Washington, D.C. 20004. **FM**

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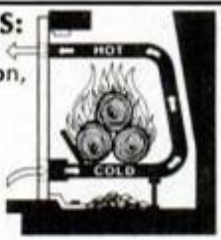
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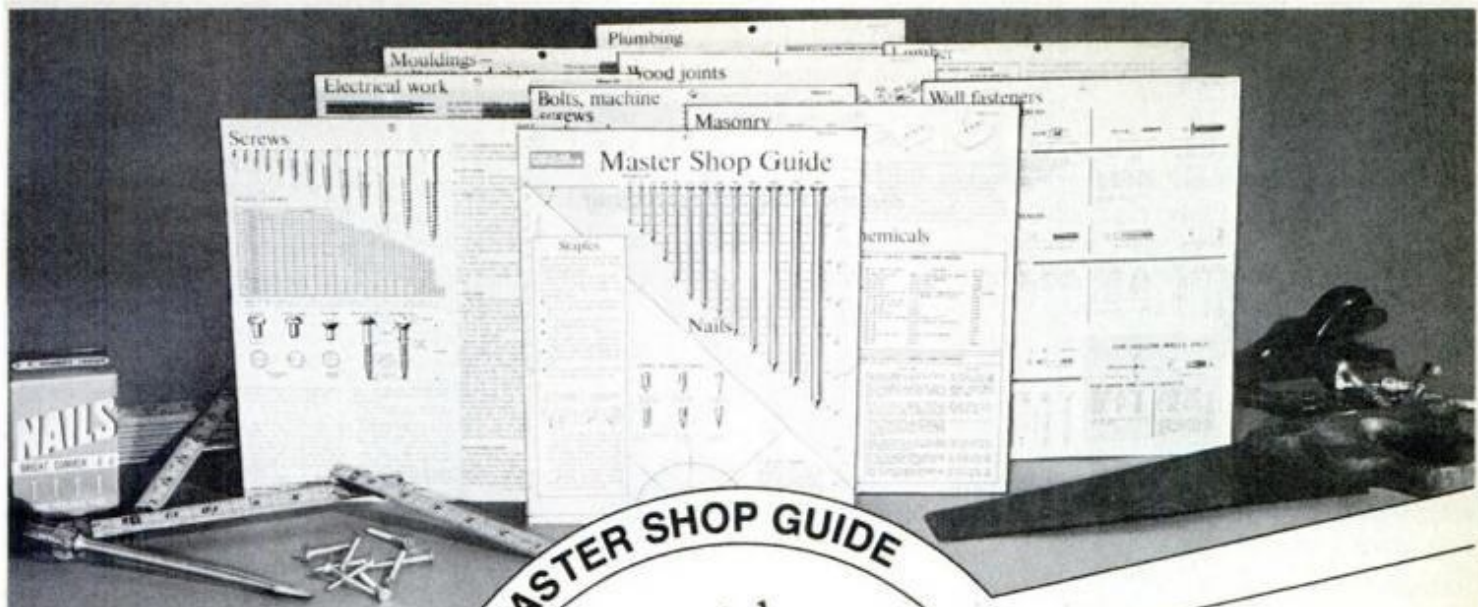
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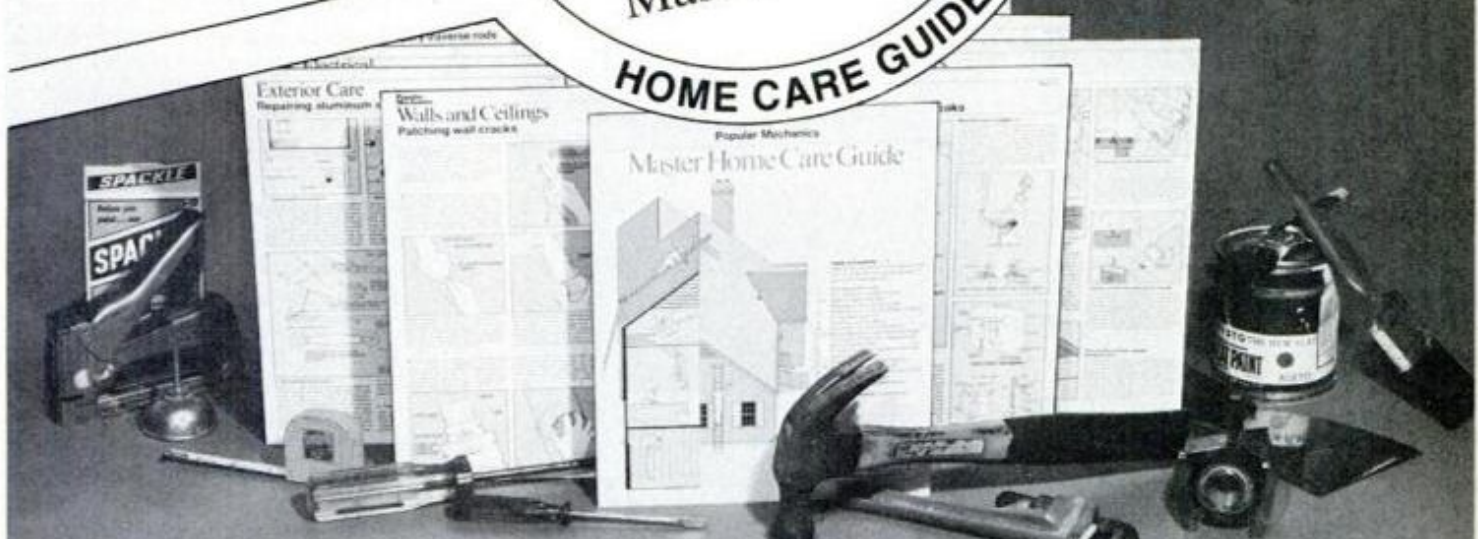
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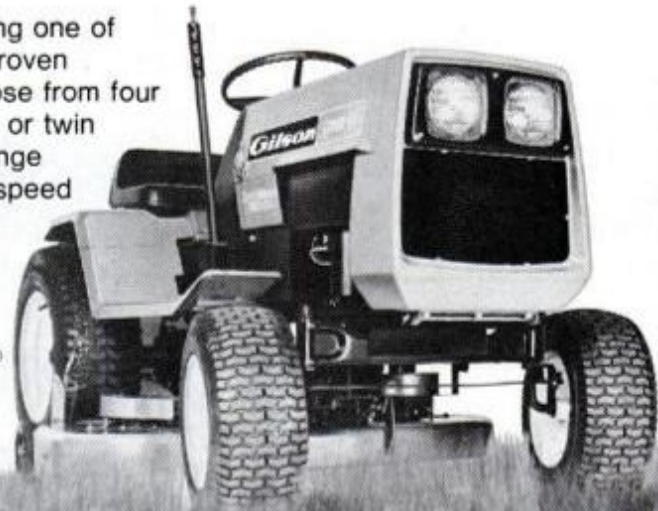
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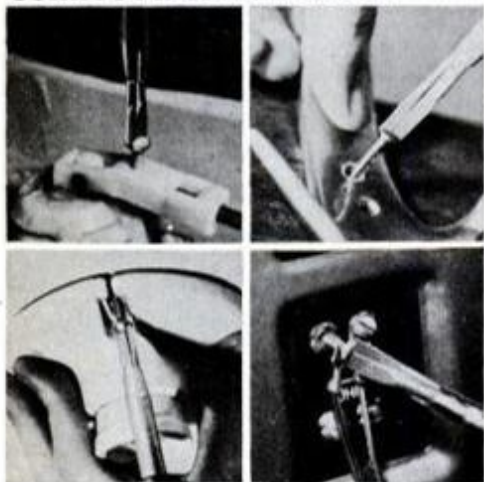
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LAWN FURNITURE

(Continued from page 151)

Join the upper and lower assemblies with a pair of tight pin hinges on each side. Sand and finish.

To install the canvas seat, remove the hinge from the lower seat support and then fasten the canvas to the outside edge of the lower seat support with decorative upholstery tacks spaced 1 in. apart. Double-stitch the back piece with loops at either end and slip it over the back uprights to complete the director's chair.

Folding lawn chairs

Rivets—Soft malleable iron rivets with large heads were used in all pieces except the campstool. Rivets give a cleaner, more professional appearance than nuts and bolts, and they won't come unscrewed and fall off.

Size the diameters of the holes so that the rivets will fit tightly. Use three retainer rings as spacer washers between two pivoting wooden members. Size the rivet so there is sufficient metal projecting to make a broad head. To form the head, put a retainer ring over the projection and a metal plate underneath the opposite rivet head. Then slowly peen over the rivet end to form a head. Use a lot of light taps, not a few heavy blows.

Gluing—Make final assembly of all dowel joints with plastic resin glue, which doesn't stain the wood if it oozes out. Have a small bucket of hot water and a rag available when you get ready to glue, and wipe off all glue squeeze-out with a hot damp cloth.

Finish—The white maple chairs were sanded thoroughly and finished with two coats of satin polyurethane varnish. First seal the wood with a thin coat of orange shellac. (Check label first to make certain your varnish can be used over shellac.) Let dry overnight and sand lightly. Wipe with a tack rag, and then apply the first coat of varnish thinned with turpentine (about 1 part to 4 parts varnish.) Allow to dry overnight and sand lightly with 220-grit paper. Dust, wipe with a tack rag and apply the final coat of varnish unthinned. When dry, apply nylon glides to feet.

Canvas—After the wood pieces have been finished, install the canvas. Cut all pieces of the 18-oz. canvas chair duck oversize. Each canvas piece should be a few inches longer than needed. Then cut to finish length during final assembly—after you have fastened one end in place and measured for the other end. Also allow for a 1-in. hem on both sides. Sew hems and end loops with double stitching. Space the rows ¼ in. apart. Use a heavy-duty needle and thread suitable for sewing this weight canvas on your machine. We used a No. 18 Singer needle.

Campstool

Rip the four legs and two top pieces to

(Please turn to page 180)

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LAWN FURNITURE

(Continued from page 178)

1¼ in. wide from ¾-in.-thick stock, and then cut pieces to length. Saw the 45° angle for the four feet.

Note: Increasing the length of the canvas piece so that the legs spread apart farther than 13 in. will make the stool lower. It may then be used as an ottoman. Or, by laying a sheet of plywood across the top, it may be used as a coffee table. If the canvas is lengthened, the angle for the feet will change accordingly.

Next, bore the ½-in.-dia. center pivot and lower stretcher holes through the four legs. The center holes in the inner legs should be slightly oversize for a free fit of the dowel pivot rod. Cut one lower stretcher dowel 11½ in. long and one 13 in. long. Also cut the center pivot dowel 13 in. long. Next, bore the ½-in. holes through the top seat support and into the ends of the legs (see detail in the drawing). Cut the four ½-in. dowel pins 1¾ in. long that join the seat support to the legs.

To round the four edges of the six pieces of stock, use a router rounding over bit with ¾-in. radius. Sand all surfaces smooth, and make a trial assembly of the stool.

Make final assembly of the top supports to the legs with dowel pins and glue. Next, glue the lower stretchers to each pair of legs. Then glue the center stretcher/pivot in place. Keep the glue on the outside legs only. Keep inside legs free to pivot.

Shellac and varnish the assembly. Lay out, cut, and hem the canvas. Then wrap canvas around left seat support, make a ½-in. foldover, and tack in place with carpet tacks. Space tacks 1 in. apart. Then bring canvas over and around right seat support. Cut off excess canvas so legs will have desired splay. Wrap canvas around top and fasten with tacks as you did the left side.

Rocker

Start construction by cutting out two armrests. Bandsaw the front curve of the armrests. (Cut rear notches after back uprights have been fabricated.) Sand smooth.

Cut two front uprights. Mark lathe centers on the two front uprights, and turn ¾-in.-dia. tenons at either end. Turn the top tenons ½ in. long and the bottom tenons ¾ in. long.

Lay out two runners per drawing, and cut out on bandsaw. Sand both edges using disc and drum sanders.

Next, lay out rear uprights as shown in the drawing. Cut off waste with a bandsaw. Mark lathe centers for turning. Set up securely in lathe and turn lower tenons ¾ in. dia. by ¾ in. long. For safety, rotate work piece in the lathe by hand a couple of revolutions, then run lathe at its slowest speed. Sand edges smooth. Mark cen-

ters and turn round tenons at both ends of the two front uprights.

Locate and bore the dowel and rivet holes in the front and rear leg uprights. Bore these blind dowel holes with a flat-profile wood bit ¾ in. deep. Bore the 3/16-in. rivet holes through the stock.

Use back uprights as patterns for the respective notches in the backs of the armrests. Cut notch, then bore ¾-in. blind mortises ½ in. deep in the underside of the armrests for the front upright tenons. Bore an 11/64-in. body hole through the back armrest and bore a 7/64-in. pilot hole into each rear upright for 1½-in.-long No. 8 fh wood screws. Countersink the holes in the armrests.

Next, cut the three ½-in. dowel stretchers that join the upright legs. Make a trial assembly of legs, stretchers, and armrests for each side to check that everything will fit.

To lay out precise locations and angles of mortises in the rocker runner, lay a runner on its side on top of bench. Place rocker side in proper location so the ¾-in.-dia. tenons touch the runner. Then mark center point and angle to bore the ¾-in.-dia. round mortise in the top of the runner.

To guide the boring of the mortises in the runner at the proper angle, clamp runner to 2x4 and, steadying the rocker on the drill-press table, bore two ¾-in. mortises ¾ in. deep in each runner. This method assures that the holes will be bored parallel.

Assemble each rocker side with glue. Clamp and allow to dry overnight.

Cut four crosspieces to size, and round one end of each on a bandsaw. On the other ends, lay out and bore a ½-in. hole ¾ in. deep. Cut out seat supports and curve upper edge as per drawing. Bore ½-in. holes ½ in. deep to join supports to crosspieces.

Mark and bore all 3/16-in. rivet holes in crosspieces. Cut ½-in. dowel pins that join crosspieces and seat supports. Assemble crosspieces to seat supports with glue. Clamp until dry. Then rivet the crosspieces together with a metal spacer between the two wood surfaces.

Steel hardware—Lay out the steel angles on 1/16-in.-thick stock. Cut out with a hacksaw and file edges smooth. Center-punch and drill three rivet holes. Lay out and cut four steel support pieces from ½-in.-thick stock. File the edges smooth. Center-punch and drill a 3/16-in. hole in one end and a 3/16-in. slotted hole at the opposite end. Form ½-in. offset bend using a metalworking vise and hammer. Rivet steel angles and steel support pieces to the crosspieces as shown in the drawing. Then rivet steel supports and steel angles to the uprights to complete assembly. Finally, sand and finish the chair and install the canvas. **PM**

MATERIALS LIST—FOLDING ROCKER

Key	Pcs.	Size and description (use)
A	2	1½ x ½ x 28½" (rockers)
B	2	1-1/16 x 1-1/16 x 30" (rear uprights)
C	2	1-1/16 x 1-1/16 x 19¼" (front uprights)
D	6	15½" x ½"-dia. dowels (upright supports)
E	4	¾ x ½ x 21¼" (crosspieces)
F	2	¾ x ¾ x 16½" (seat supports)
G	2	1-1/16 x 2 x 17½" (armrests)
H	12	1¼" x 3/16"-dia. rivets
I	2	2½" x 3/16"-dia. rivets
J	8	1½" x 3/16"-dia. rivets
K	40	3/16" I.d. washers slightly over 1/16" thick
L	4	¼" thick x ½ x 7" steel supports
M	4	1/16 x 2 x 3¼" steel angles
N	2	2" No. 8 fh screws
O	4	1½" x ½"-dia. dowel plugs
P	1	9 x 20½" finished-size canvas
Q	1	16 x 18" finished-size canvas; allow for sewing edges, wraparound and tacking

Misc.: Heavy-duty thread (synthetic), plastic resin glue, satin polyurethane varnish

MATERIALS LIST—LOUNGE CHAIR

Key	Pcs.	Size and description (use)
A	2	¾ x 1¼ x 66" (risers)
B	2	¾ x 1¼ x 44" (seat bars)
C	2	¾ x 1¼ x 21" (adjusting bars)
D	1	¾ x 1¼ x 23½" (stop bar)
E	2	¾ x 1¼ x 20¼" (supports)
F	2	¾ x 1¼ x 18½" (supports)
G	16	2" No. 8 fh screws
H	4	1¼" No. 8 fh screws
I	4	1½" x 3/16"-dia. rivets
J	16	3/16"-i.d. washers slightly over 1/16" thick
K	1	18 x 72" (approx.) canvas; allow material for finishing edges and assembly

Misc.: Heavy-duty thread (synthetic), 4 nylon glides, plastic resin glue, satin polyurethane varnish

MATERIALS LIST—DIRECTOR'S CHAIR

Key	Pcs.	Size and description (use)
A	4	¾ x 1½ x 27" (cross legs)
B	2	¾ x 2 x 16" (seat supports)
C	2	1-1/16 x 2 x 18" for turning (armrests)
D	2	¾ x 2 x 16" (arm supports)
E	2	1¼ x 1¼ x 17" for turning (rear arm supports)
F	2	9" x ¾"-dia. dowel for turning (front uprights)
G	1	18" x ¾"-dia. dowel for turning (left leg support)
H	1	18" x ¾"-dia. dowel for turning (right leg support)
I	1	¾ x 8" folding bracket
J	2	1½" x 3/16"-dia. rivets
K	2	1" x 3/16"-dia. rivets
L	12	3/16" I.d. washers slightly over 1/16" thick
M	1	6 x 21¼" finished size canvas
N	1	14 x 22" finished size canvas (allow material to finish edges and assembly)
O	4	Dull brass tight-pin hinge
P	4	1¼" No. 10 fh screws
Q	4	1½" No. 10 fh screws

Misc.: Heavy-duty thread (synthetic), 4 nylon glides, plastic resin glue, satin polyurethane varnish

MATERIALS LIST—CAMPSTOOL

Key	Pcs.	Size and description (use)
A	4	¾ x 1¼ x 19¼" (cross legs)
B	2	¾ x 1¼ x 15" (seat supports)
C	2	13 x ½"-dia. dowels (leg supports)
D	1	11½ x ½"-dia. dowel (leg support)
E	4	1¼" x ½"-dia. dowels (inserts)
F	1	13 x 14" finished size canvas (allow more material to finish edges and assembly)

Misc.: Heavy-duty thread (synthetic), nylon glides, plastic resin glue, satin polyurethane varnish



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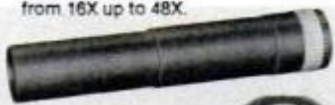
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EASIER STEREO LISTENING

(Continued from page 113)

the extra load when the regular springs reach their limit, like when you hit a bump. In music, the equivalents of hitting a bump are those thumping bass beats in rock music, a sudden cymbal crash or that explosive instant when the stick hits the drumskin. Power requirements jump for such crucial high-level sounds, and weak-muscled amplifiers "bottom out." Result: the sound gets fuzzy. But the G-circuit throws in a couple of auxiliary transistors to help ride out the sonic burst without distortion. Hitachi now offers three different Class G receivers, starting at \$430.

Turntable trends

For a while it seemed as if direct drive would become the standard for all fine turntables. But several makers are sticking with or swinging back to belt drive. They argue:

Direct drive, with the turntable mounted directly on the motor shaft, is certainly the simplest and most elegant solution to the problem of how to spin a platter. But to make it work properly takes tight tolerances and precision machining of all rotating parts, and that's expensive. Equally good performance, some engineers believe, can be obtained for a lot less—and more reliably—with the traditional belt drive. The elastic belt acts as a natural vibration filter. That's the thinking behind the Philips Project 7 turntables that have belt drive and a servo regulated motor. Even the cheapest model in this group, the AF-777, boasts splendid specs and lists for \$180.

B.I.C. also opts for belts in their new way to tackle a pesky and persistent problem: acoustic feedback. This occurs when heavy bass from the speakers shakes the floor. The vibrations then go right back to the stylus, where they started. A feedback loop develops—like a dog chasing its tail. Result—just about anything, from a growl to a howl.

Manufacturers deal with this problem in different ways. BSR and Kenwood use inherently nonresonant materials in the turntable base to keep it from wiggling. Pioneer and B.I.C. employ floating suspensions to isolate the turntable from the wiggly floorboards. B.I.C. has added a new wrinkle—spring mounts with variable tension.

Sampling these latest trends in different areas of audio left me happily convinced that the sap of invention is still flowing strong. There's no limit on new audio ideas. **PM**

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CPL David Shaul, Ft. Riley, Kansas

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PM-3

GEMS FROM JUNK

(Continued from page 121)

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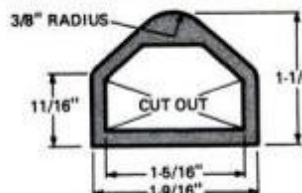


FIG. 4 - RADIATOR RIM

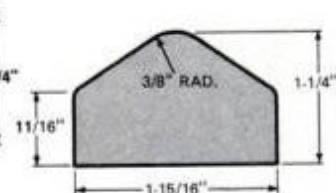


FIG. 5 - FIRE WALL

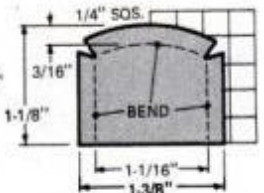


FIG. 10 - SEAT BACK CUSHION
(2 REQD.)

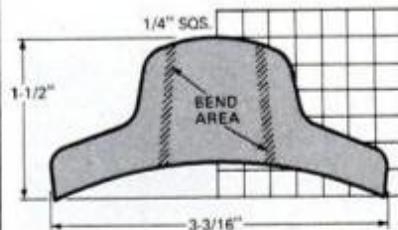


FIG. 8 - SEAT BACK AND SIDES (2 REQD.)

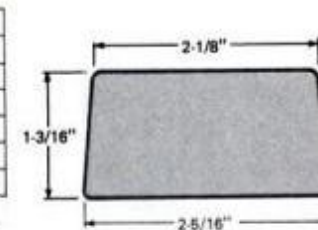


FIG. 11 - SEAT BASE FRAME

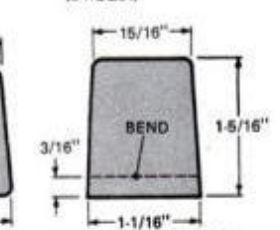


FIG. 9 - SEAT BOTTOM
(2 REQD.)



FIG. 7 - FRONT SPRING
SUSPENDER (2 REQD.)

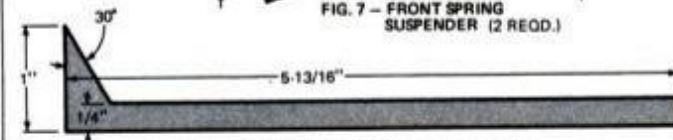


FIG. 6 - SEAT RUNNER BRACKET (2 REQD.)

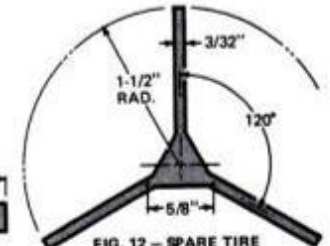


FIG. 12 - SPARE TIRE
SPIDER

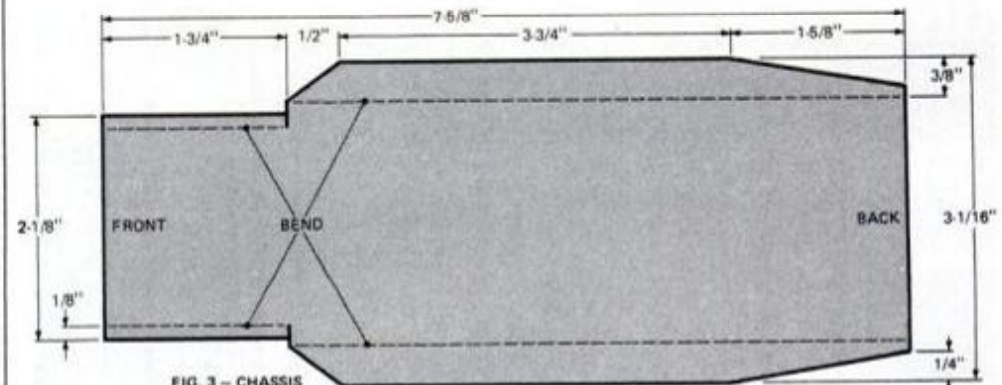


FIG. 3 - CHASSIS

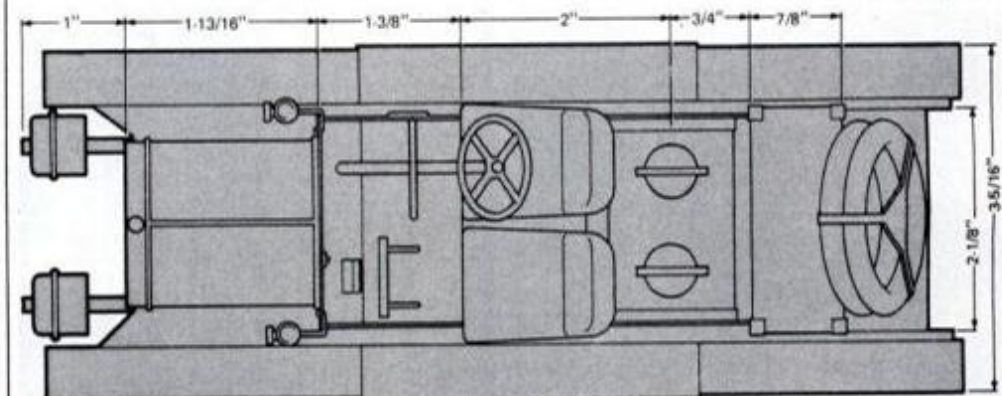


FIG. 2 - TOP VIEW

ALL DRAWINGS ARE 1/2" = 1"



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one on top of the other, open ends together.

First tack at the seam in four spots by putting the tip of the flame in between the cans and making a small circular motion to melt the material evenly so rims will fuse. If you get too near the rims, your torch will extinguish itself. Fill in between these tacks (see photo on page 120).

A glove is useful here to turn and hold the hot welded can in the proper position. If your torch blows a hole between the cans, place the end of a straightened coat-hanger wire at the point. Heat the area until the wire and metal can flow together. Then quickly pull the wire away and continue welding the seam. Be sure

(Please turn to page 188)

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GEMS FROM JUNK

(Continued from page 186)

to resist the urge to remove goggles.

Cut a slit on the top can beginning 1 in. from the top to about 1 in. from the seam between the two cans. The ridges around the can help you judge distance. On the bottom can cut a second similar slit directly below the first one, beginning 1 in. from the bottom can's top and ending 1 in. from its bottom. Then turn the cans 180° and cut similar slits. Before turning the cans, mark the slit position with a light brush of the

torch on the can top directly above the top slit. After making the second pair of cuts, turn the cans 90° and make a third pair; make a fourth pair 180° from that point.

You'll have four equal sections of the cans left that you can slit as many times as you dare—but don't make slits on the vertical seams. I made six cuts between the original ones. You can also make slant cuts (not too severe or you'll have trouble flattening the cans later), wiggly lines and square or round cutouts. Then cut out the bottom.

To bend the cans, reach inside

with one hand, being careful of any sharp edges. Supporting the outside with the other hand, push out each strut to slightly bend it. Then place the cans on a table and push down from the top until the struts are bowed as desired. Finish shaping with a hand inside the cans.

Draw, then cut the top and side bands in a design as shown in the plan on page 120. Cut angled slits in the middle, top and bottom bands. The lantern with a natural finish is complete.—Charles A. Phillips

Sculpunch designs

A sculpunch is a sculptured design that's made by punching tiny holes through a tin can that is flattened and nailed to a plywood backing. Punching the holes creates a textured background and raises the image to give it a third dimension. Many cans have an attractive silver, gold or greenish inside surface which doesn't need a finish.

Materials you'll need include: a tin can that doesn't have ridges around its circumference; plywood of any thickness; tacks that are shorter than the plywood thickness—solid copper ones can be used as decoration—felt for framing; white glue; a hanger.

Tools you'll use include a can opener, saw, tin shears, hammer and a nail for a punch or an old file ground to a point.

With a can opener, cut the bottom from an empty can. Then use tin snips to cut along the can's vertical seam. Next cut off the top and bottom rims. Then tack the can to plywood backing—inside surface facing out—being careful not to mar its tin finish. If tacks will show in finished work, space them evenly.

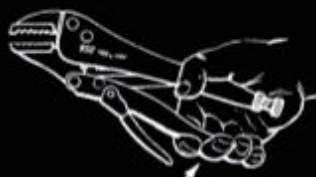
To transfer the design to the tin, tape the plan, properly centered, over the tin. Use the plans on page 121 or design your own. Then outline the design by punching through the paper. Pay special attention to subtle curves and corners.

Once the outline is completely punched, remove the paper and begin punching the background. The size of holes and distances between them are up to you.

You may choose to finish your piece by painting the edges of the plywood and allowing the tacks to show. Or you can frame your work with strips of colored felt cut wide enough to hide the tacks and the length of each side of plywood. Glue the felt strips on with white glue so they overlap at the corners. Finally, attach a hanger. This can be a simple loop of cord centered on the plywood near the top and secured with strapping tape.—Larry Philpotts



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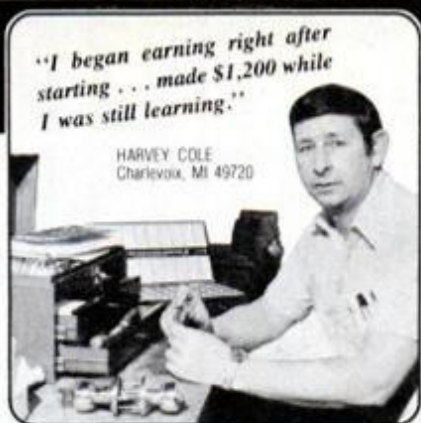
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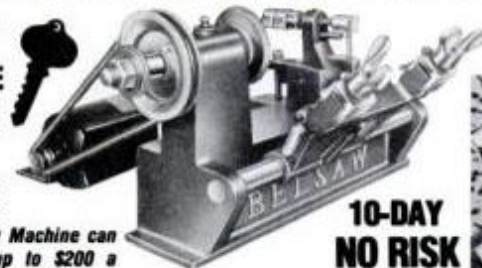
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TWILIGHT!

(Continued from page 117)

Germany, the color of your car plays a significant role in whether or not you pass through twilight on the road unscathed. The most visible color was found to be *white*, with a "perceptability" rating of 88 percent. Off-white and yellow scored next in visibility, while the worst colors to "wear" at twilight were medium blue, dark blue, deep green, and black. Just another factor to keep in mind when you must drive at this time of day.

The driver himself presents a number of interesting insights regarding the cause of so many accidents at twilight. To be sure, natural illumination is most unpredictable and variable at this time. Then, too, the driver is invariably tired and, perhaps, fuzzy around the edges after a long day on the job. His mental faculties can be likened to those of one who has driven 500 miles all day, according to Paul Blaisdell of the Association of Casualty and Surety Companies. No wonder he seeks only to get home or reach a recreational destination—and woe betide anyone who gets in his way! This condition has been called the "twilight neurosis," a dangerous combination of physical and emotional fatigue, coupled with haste and perhaps a dash of impatience to relax and unwind from the day's activities. Combine these with the treacherous visual conditions and heavy, high-speed traffic at twilight and you have a potent brew of trouble.

Alcohol, added menace

The final ingredient to this potentially explosive mixture, and often the worst killer of all, is alcohol. No one is certain how many drivers stop off for a drink or two after work and actually reach their evening destinations unscathed. You can bet your spare tire, though, that the accident and fatality rates for boozed-up drivers at dusk has to be nothing short of a national disgrace—and a largely unheralded one at that! Sure, the specter of the drunken driver at night is a horror to behold, but at least his presence is largely known. At twilight, however, the drunken driver menace is just another surprise card in a deck already heavily stacked against the sober, though tired and unsuspecting, driver.

Most of us know the particular dangers common to both day and night driving. At dusk, the driver must be ready for all of these, which include: slowing down suddenly and

(Please turn to page 192)

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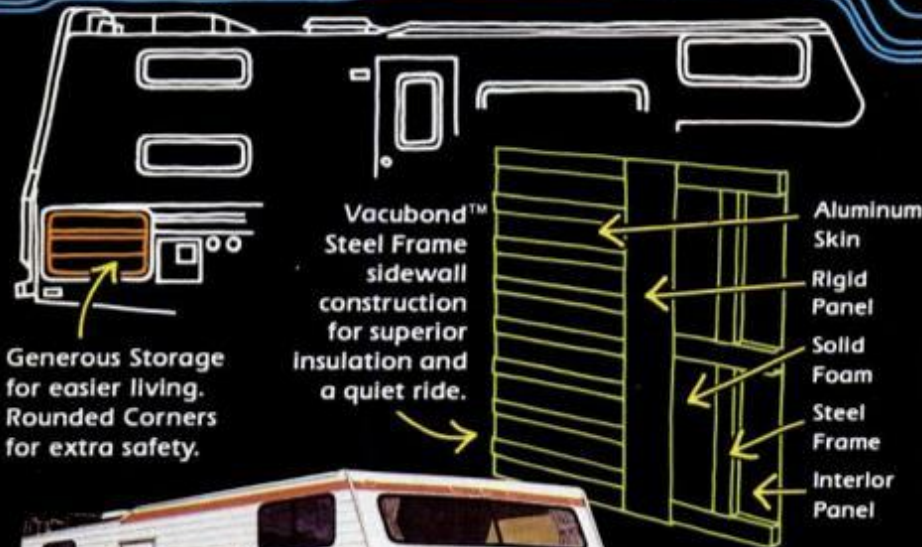
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TWILIGHT!

(Continued from page 190)

being struck from behind; being crowded or blocked in a turn or lane change; being struck broadside on entering or crossing an intersection; striking a halted or slow-moving object directly ahead; and veering by mistake off a roadway or out of an intended lane.

Check your eyes

A driver's health and age play an often-overlooked role in twilight traffic activity. Naturally, the most obvious precaution is good visual health. Have your eyes checked regularly and thoroughly and, if your vision is below par, have it corrected immediately!

Remember, also, that nearly every disease or illness affects the eyes in some way—never for the better. Beware especially of diabetes, cirrhosis of the liver, and some nutritional deficiencies. Pregnancy, too, can play an unexpected role—a fact many women drivers overlook. If you have any doubt, consult your family physician.

If you're over 50, remember that faulty vision shows up first under low-light conditions. Reaction times and judgment under sudden stress also falter with increasing age. Check with your physician on the advisability of driving at all under less-than-optimum daylight conditions.

A key factor in successful twilight driving is the eye's adaptability to darkness, or the time it takes for the eye to adapt effectively from high-to low-illumination levels. For example, it takes about five minutes of darkness for the eye's scotopic (night vision) cells to surpass the photopic (day vision) cells in sensitivity. Therefore, one can readily appreciate the acute split-second difficulties confronting drivers passing through the twilight time.

How do the dangers of twilight driving stack up against those of night driving—reputedly the worst time of all on our roads? Tests have shown that the average driver experiences *more* visual difficulty at dusk than at night with headlights, even though over-view luminance of objects on the road is technically greater at dusk. The sobering National Safety Council accident statistics would tend to back this up.

Over and above all the hazards of twilight driving, one remains the most dangerous of all—ignorance that such dangers even exist. Now that you know about the dangers, drive defensively and see aggressively!

FM

Five major power tools packaged into one unique, big-capacity unit.
Now you don't have to spend a fortune to enjoy a complete woodworking shop

Whether you're an experienced craftsman, a dedicated hobbyist, or a week-end "do-it-yourselfer", at one time or another, you've probably dreamed of owning a complete woodworking shop. And as anyone who has ever tried any woodworking project more complicated than nailing together a birdhouse knows, a table saw and maybe a couple of hand-held power tools just can't hack it!

At a minimum, you should have—in addition to that table saw—a top-quality vertical drill press, a lathe, a boring machine, and a disc sander. So equipped, the world of the true woodworking expert, and all its rewards, becomes your oyster!

But there are two problems. One is space. A woodworking shop with five separate major power tools takes up more space than a lot of people can manage to find in their basement or garage.

The second and larger problem is sheer cost. Those five precision power tools, purchased separately, have got to run you at least a couple of thousand dollars.

The Perfect Answer

Insurmountable problems? Not at all! In fact, some 300,000 woodworkers have already discovered the perfect answer—a single, precision tool that combines all five of the major power tools in one unit that actually takes up less space than a bicycle. . . and that can be yours for about ONE-THIRD of the price of the five separate units!

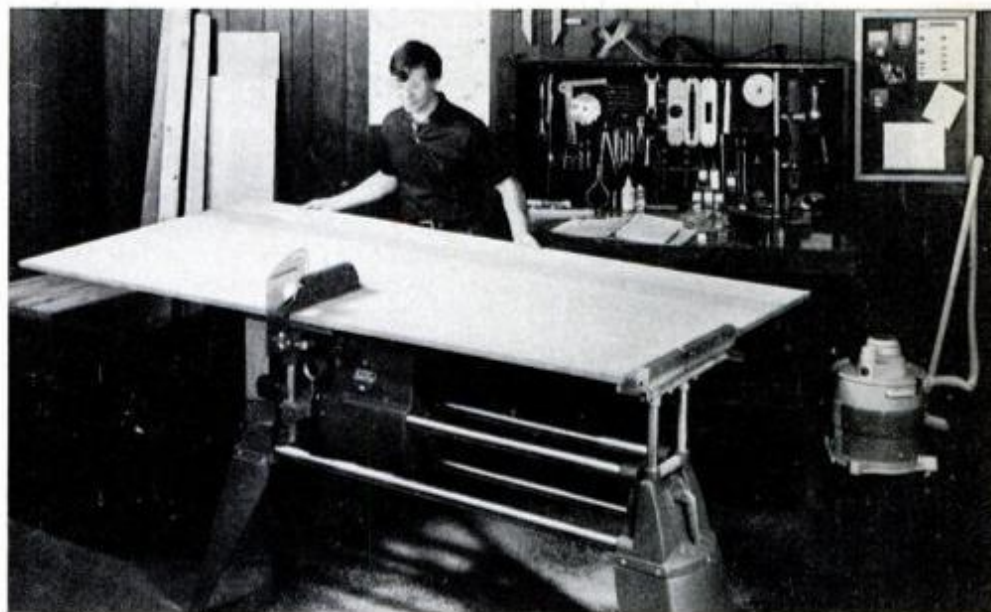
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Even if you have plenty of space and an unlimited budget, the Shopsmith Mark V can outperform a shop-full of individual tools. It's unique design not only gives you greater accuracy and more convenience—it allows you to do things you just can't do with other power tools.

This truly ingenious woodworking system combines a 10" table saw, a 12" disc sander, a horizontal boring machine, a 16½" vertical drill press, and a 34" lathe—all powered by a rugged 13.5 amp, 110-volt motor that develops 2 h.p. That's more than enough power for the toughest jobs. And an exclusive speed dial even lets you change operating speeds without turning off the motor.

After only a half-hour of practice, even a novice can change over from one tool to



any of the other four tools in less than 60 seconds.

With the 5-in-1 Mark V, you can perform literally dozens of sophisticated woodworking operations—including sawing, rabbeting, beveling, mitering, grooving, concentric drilling, spindle turning, doweling, edge sanding, and metal drilling. With optional accessories, you can perform more specialized operations such as mortising, dadoing, shaping, routing, molding and many others.

And the Shopsmith Mark V is so simple to operate that even beginners can easily build their own furniture and cabinets, make gifts, and do money-saving home repairs and complex remodeling projects. The skill. . . and above all, the accuracy. . . are built into the machine.

Send Today for Free Facts

And now you can use the coupon below to receive, by return mail, an informative free booklet, "What to Look for When You Buy Power Tools", plus all the facts about the Shopsmith Mark V and its "big-job" capabilities—and how you can actually test-use it in your own home without risk, for a full month.

There's no cost or obligation for this free information. It can help even inexperienced amateurs become skilled woodworking experts whose projects show a professional touch. For the real craft "buff", it's the low cost answer to a lot of frustrating problems.



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The Mark V as a 10" table saw offers a 3¼" depth-of-cut with a 48" ripping capacity. The exclusive Speed Dial permits power sawing of hardwoods.

The Mark V as a 12" disc sander gives you operations not possible on other sanders. . . like finishing edges to precise dimensions.



The Mark V as a lathe offers exceptional capacity with a 16½" swing for face-plate turning. Speed Dial allows a speed range of 700 to 5200 rpm.



The Mark V as a horizontal boring machine permits perfect doweling. The exclusive feed stop assures all holes will be exactly the same depth.



The Mark V as a 16½" vertical drill press can be set up to drill perfect screw pockets. The Mark V has an accurate depth control dial, ready made jigs, and the right speed for every operation.



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(Continued from page 97)

minority when she mentions, "Sometimes it's hard to find stations with diesel fuel." This complaint is countered by a New York book editor who says, "Diesel fuel is becoming increasingly available, even in sections where there is little heavy trucking."

Minor changes desired

In the area of "changes we'd like to see," owners made the following recommendations.

"Drip rails dump water onto the front seat every time I open the door in rainy weather. I'd like to see that changed."—Florida space manager.

"A little quieter engine; perhaps more soundproofing."—Oregon retiree.

"Position of the oil filter—it's impossible to change it without making a mess."—Colorado electronics company customer service representative.

"How about an automatic transmission?"—Michigan housewife. (The factory says there's to be one available for the diesel in 1980.)

"The price! However, you only get what you pay for and it's worth it."—Retired New Yorker.

"There ought to be a warning light to

remind the driver to push the glowplug button when needed for cold starting."—Michigan teacher.

"Airconditioning system does not cool the back seats without freezing the front seats. Seems that they need a vent in back that goes around the front seats."—Texas systems analyst.

"A turbocharger for better acceleration—although it's not bad as is—and maybe a fifth-gear overdrive to cut down rpm and noise around 60 mph. As it is, the car has to be geared lower than normal to make up for less horsepower than the gasoline Rabbit."—Colorado minister.

"More instruments like voltmeter and tachometer, an audible brake warning for discs and drums that need replacing."—Ohio consumer adviser.

A California computer scientist brings up the subject of dash design when he says, "The dash top should be like a shelf, or a tray, as in the Fiesta and other well thought-out cars . . . as it is, nothing will stay up there when you go around a corner."

But, as we mentioned at the opening, these complaints and suggestions pale beside the good feeling expressed by the great majority of Rabbit diesel owners.

"In what other car are you going to make it from Dallas to Seattle on \$25-worth of fuel?" asks a Washington salesman.

Mileage, room praised

An Ohio student: "It's fun to drive and very comfortable. The amount of room inside is amazing. In general, I think it's an excellent car."

A Colorado psychologist: "Incredible economy so far; excellent performance for the horsepower; very usable, both for city driving and for trips; it's great fun to drive and it carries a surprising amount of cargo."

A Colorado journeyman electrician: "On a recent trip to the Northwest and West Coast, the Rabbit diesel performed like a well adjusted Swiss watch. Neither a Lincoln Continental, nor a Cadillac handles as well. Our best mileage was between Twin Falls, Ida., and Provo, Utah—56 mpg. Lowest was 41 mpg. At one point, we had the speedometer needle up to 97 mph, and the car stuck to the road like glue."

A California tool designer: "I usually buy my cars used and drive them 10 years or more. I bought this one new and

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expect it to last a lifetime."

A California elementary school teacher: "This is the first time I've ever been in love with a car, and I'm almost 45 years old!"

A Georgia banker: "Because it's a seller's market, I paid nearly \$800 more than I should have for my diesel Rabbit. However, I expect to recoup much of that investment when the time comes for me

to sell it. The diesel will hold its resale value."

An Arizona rifle-barrel manufacturer: "I like the way it handles on the road. It's easy to park. And I also like the once-a-month trip to the gas station for my monthly tank of diesel."

An Ohio grocery clerk: "The car is extremely well put together. We were told by the salesman that diesel performance

would be sluggish, but we have not found this to be so. All in all, it is the best car we ever owned."

And finally, this comment from a West Virginia dental student: "I feel that anyone who is considering buying a small car should test-drive a VW Rabbit diesel. I thought I would never own a VW, let alone a diesel—until I drove one. And you can see the result!" **PM**

SUMMARY OF 1978 VW RABBIT DIESEL OWNERS REPORTS*

Total miles driven: 2,394,677	Poor dealer service 11.7	Comfort opinion (rear seats):	Good 40.8
Average miles per gallon:	High initial price 8.7	Excellent 22.9%	Average 12.7
In town (EPA 40 mpg) 43.2	Noisiness and rattles 7.5	Very good 35.1	Fair 9.2
Long trips (EPA 53 mpg) 49.0	Underpowered 7.1	Good 29.4	Poor 14.0
Body styles:	What changes would you like?	Fair 10.6	Number of vehicles owned:
Three-door hatchback 56.8%	No changes 13.2%	Poor 2.0	Rabbit diesel only 20.5%
Five-door hatchback 43.2	Five-speed transmission 9.0	Had any mechanical trouble?	Two cars 59.5
Why did you choose the Rabbit diesel?	Vent windows 7.7	No 61.1%	Three cars 14.3
Economy 75.9%	More powerful engine 5.6	Yes 38.9	Four or more cars 5.9
Diesel engine 25.7	Greater silence 4.7	What type of trouble?	Makes of other cars owned:
Handling 10.1	Workmanship opinion:	Fuel injection 12.2%	Volkswagen 24.8%
Performance 7.8	Excellent 56.9%	Airconditioning 11.2	Chevrolet 18.9
Size 6.2	Good 35.4	Brakes 8.2	Ford 11.2
Specific likes:	Average 5.0	Clutch 8.2	Oldsmobile 7.8
Economy 82.6%	Fair 2.3	Transmission 7.1	Dodge 6.3
Handling 55.6	Poor 0.4	Dealer repairs satisfactory?	Age distribution of owners:
Comfort 27.8	Comfort opinion (front seats):	Yes 67.9%	15-29 years 20.3%
Ride 11.6	Excellent 51.4%	No 32.1	30-49 years 46.8
Workmanship 11.2	Very good 35.4	Dealer service opinion:	50-plus 32.8
Specific dislikes:	Good 11.3	Excellent 23.2%	Would you buy another VW diesel?
No complaints 26.3%	Fair 1.9		Yes 93.9%
	Poor 0.0		No 6.1

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



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MATERIAL	ROD SAW	HACK SAW	SABER SAW	CIRC. SAW	BAND SAW
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Beryllium	•	•	•	•	•
Carbon	•	•	•	•	•
Cast Iron	•	•	•	•	•
Composites	•	•	•	•	•
Composition Board	•	•	•	•	•
Fiberglass	•	•	•	•	•
Foamed Glass	•	•	•	•	•
Friction Materials	•	•	•	•	•
Glass	•	•	•	•	•
Hardened Steel	•	•	•	•	•
Honeycomb Materials	•	•	•	•	•
Marble, Natural	•	•	•	•	•
Marble, Synthetic	•	•	•	•	•
Plaster	•	•	•	•	•
Plastic Laminates	•	•	•	•	•
Plywood	•	•	•	•	•
Stainless Steel	•	•	•	•	•
Stranded Cable	•	•	•	•	•
Superalloys, Iron-base	•	•	•	•	•
Superalloys, Nickel-base	•	•	•	•	•
Tempered Hardboard	•	•	•	•	•
Tires, Steel-Reinforced	•	•	•	•	•
Titanium	•	•	•	•	•
Tile, Ceramic	•	•	•	•	•

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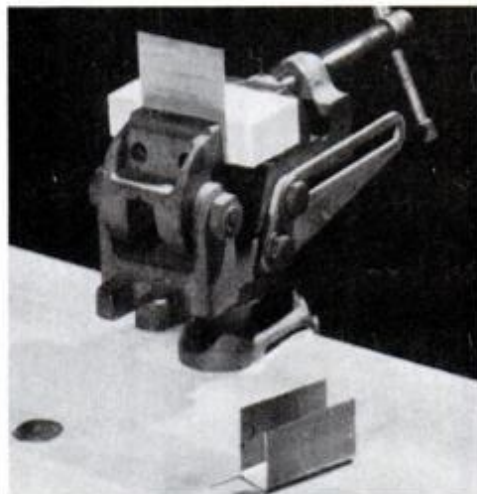


BUILD THIS WORKBENCH

(Continued from page 126)

ports (B), steady rests (F) and uprights (C). Bore a 5/8-in. hole through the supports at a 70° angle at one end and fasten butt hinges at the other end.

Bore holes in the steady rests, then cut two 2 1/2-in. lengths of 5/8-in.-dia. dowels (H). Cut two 5/8-in.-dia. dowels 4-3/4 in. long (G) and cut one end of each at a 70° angle. Sand dow-



Bend soft brass around a scrap 1x2 to form U-clips that hook to the tool well.

el ends and assemble the steady rest with white glue.

Lay out and cut brass stock for U-clips, then file the edges. Make the first 90° bend in a vise. Form the second bend over a 1x2, then bore two mounting holes in each clip.

Cut brass stock to make the holding brackets for the roll paper, file edges, bend. Then bore holes.

Assembling the support system

To locate the support strips, measure the distance between the centers of the 5/8-in.-dia. dog holes used on the workbench to support the drawing board. Screw the support strips in place on the board bottom. Next, assemble the rear uprights. Secure the U-clips to one end of the rear uprights with screws. Fasten hinges to the support strips and uprights.

Screw the paperholding brackets into position on the top edge of the board. Cut and attach the holder (D). Then, complete the project by installing molding (E) along the front edge to hold pencils.

To assemble the table on the workbench, place the steady rest dowels in holes on the workbench. While supporting the drawing board in the center, clip the uprights onto the rear of the well. Then insert a 5/8-in. dowel on the steady rest in the 70° angle hole in the support strip.—
David Warren

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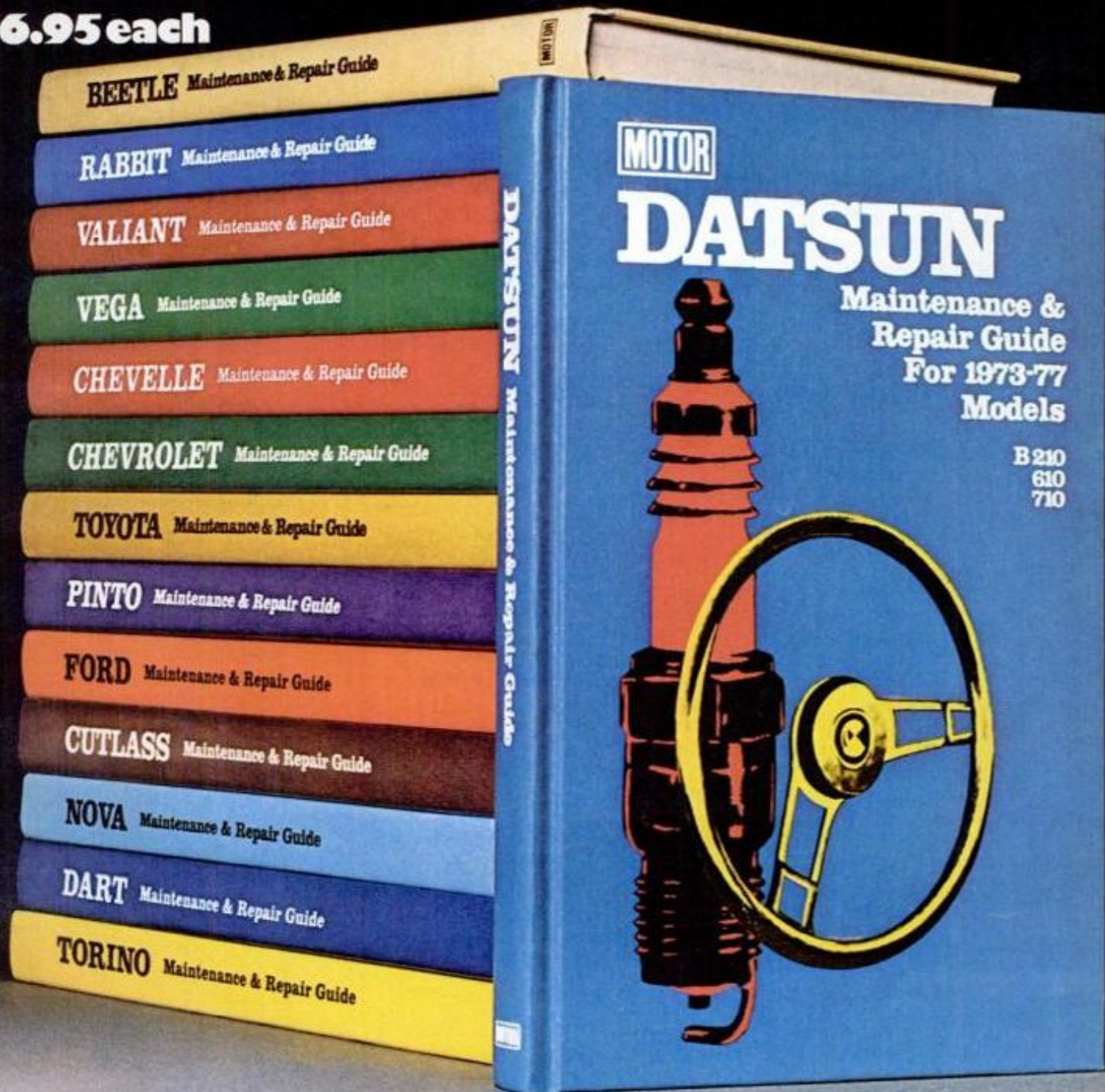
parts and tools to use. *What* to do to fix it fast—and right.

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LIFESAVING SURGERY

(Continued from page 95)

surgery. But many are willing to face the odds for the chance to see.

Reversing vasectomies

Microsurgery has also improved the odds in recent years for men who wish to reverse vasectomy.

At times in history, vasectomy—the cutting and closing off of the thick-walled tubes that carry sperm out of the testes—has been touted as a cure-all for afflictions including leprosy, alcoholism, tuberculosis,

poverty, and even the urge to steal chickens. Today, approximately 500,000 men each year undergo vasectomies as a convenient form of birth control. Operations take little time and often cost less than \$200.

In the past, the disadvantage has been that the process has been difficult to reverse. Thirty years ago, chances were only about one in four that a surgeon could re-establish fertility if a man changed his mind after vasectomy. Today, microsurgery has turned the odds around. Chances are now better than even, and some doctors report that four

out of five of their patients are able to produce sperm.

The typical patient, reports Dr. Larry Lipshultz in Houston, is a 30-year-old man in his second marriage. "He's had two children," Lipshultz said, "then gotten a divorce. After two years of remarriage, he wants another child.

"I tell him if the vasectomy was performed within 10 years, the chances are 60 percent for pregnancy. And if during the surgery I see sperm coming from the testicular side of the vasa, then chances are even better."

During the three-hour operation, Lipshultz removes the severed ends of the vasa, establishes fresh ends and sews them together, doing most of the work under a microscope. He charges \$750, but the cost can run as high as \$2000, depending on the doctor. Lipshultz currently performs more than 25 such operations annually, more than double the number three years ago.

A return of fertility, sight to the blind, the use of a severed limb—microsurgery has made possible all of these achievements in recent years. In years ahead it might help doctors in even more spectacular ways.

Dr. Shaw suggested one possibility. "A 13-year-old boy, let's say, suffers a painful elbow for a few weeks," Shaw said. "On an X-ray, doctors find a tumor on the bone, and it turns out to be malignant. Now, if you operate on the tumor, you risk spreading it. That's why doctors frequently amputate the arm in such cases."

Safer tumor surgery?

But theoretically—and currently this is just theory, years away from trials that would prove whether it worked—microsurgery could provide a way to save the arm without risking the boy's life.

During a half-hour operation, a microsurgeon would amputate the arm, carefully placing small clamps on each vessel. Then the arm would be moved to a laboratory where a surgeon and a pathologist would work together to cut out all the tumor. Then, Shaw continued, "You would ensure that there's no tumor spread within the arm by feeding arteries with a high concentration of chemotherapy, in doses that would harm the patient if the arm were attached." A few pints of blood would wash the tumor-killing agent out of the vessels.

Finally, after two or three days of treatment and tests, the arm would be reattached, under a high-powered microscope, giving the youth a chance for a normal life.



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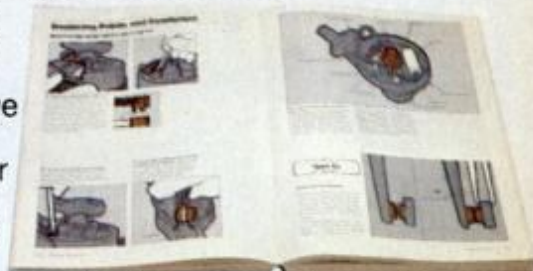
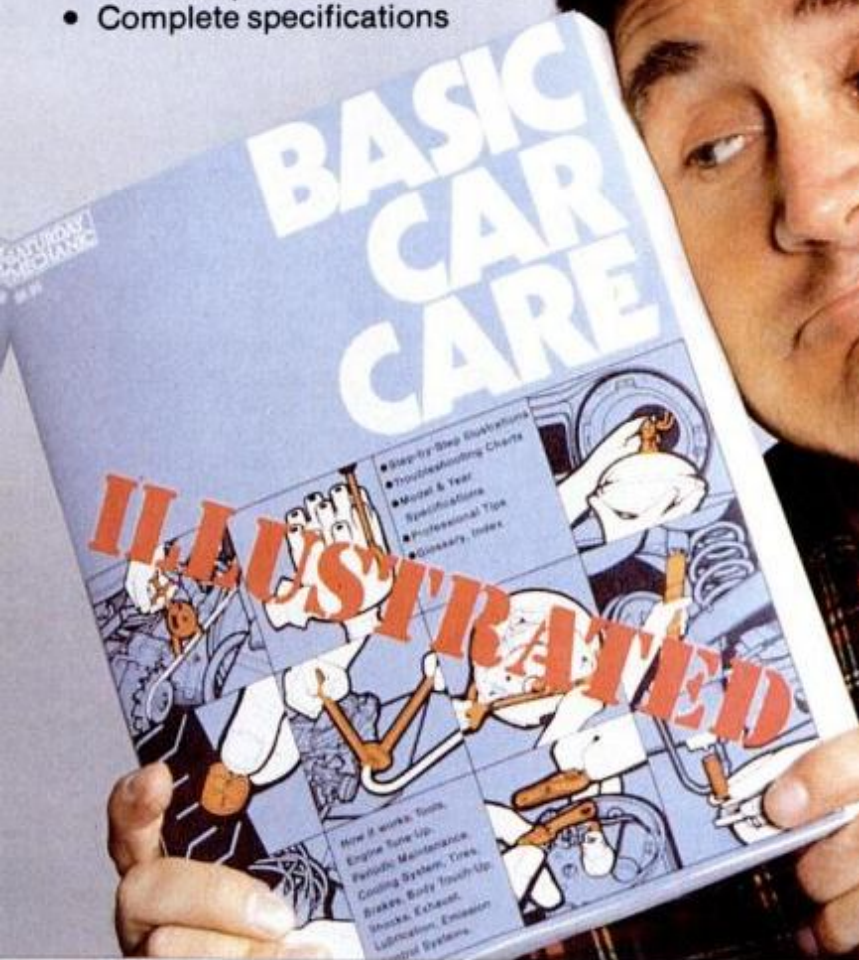
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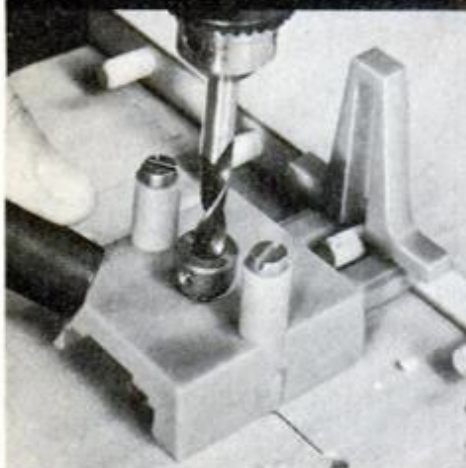


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ULTRALIGHTS

(Continued from page 91)

(page 62, Aug. '77). Both are relatively inexpensive, weigh about 12 pounds and put out 10 to 12 hp. The MC-101, once scheduled to go out of production, has been revived and will remain available.

The problems of thrust

The early practice of mounting engines at the rear or on the kingposts of flex-wing hang gliders has proven unacceptably hazardous because of instability from the high thrust line produced. This can cause control problems, especially in turbulence, and has resulted in several serious accidents. Since then, the popular Soar-master system has been introduced. Easily attached to many flex wings, it locates an MC-101 engine at a glider's center of gravity and runs a driveshaft to a propeller at the trailing edge. This improves stability and balance, although on at least some glider designs it still produces a somewhat higher than desirable thrust line. The new twin-engine Gemini power pack, mounted below the wing near the center of gravity, comes close to proper thrust-line location.

It should be noted that some glider manufacturers do not recommend adding power to their wings or insist on strict adherence to instructions on how to apply it correctly and safely. If you are considering adding power to a glider not originally designed for it, be sure that both its maker and the maker of the power pack agree on whether it should be done and advise you on proper installation and flight procedures.

Parachutes for ultralights

As interest in ultralights mounts, so does the concern for safety—so much so that some hang-glider pilots are now wearing parachutes, or at least their craft are. The new chutes attach, not to the pilot, but to the glider frame itself. If a mishap occurs, the chute is opened and lowers both pilot and glider to the ground together.

Says glider and parachute manufacturer Pete Brock of Ultralight Products: "If anybody ought to wear parachutes, it's powered hang glider pilots. That doesn't say the sport is unsafe; it's just good judgment to use every possible safety device available."

Rigid wings lead the way

Rigid-wing hang gliders not only enjoy a better safety record than flex wings, but are proving to be a key link in the evolutionary chain of ultralight development. John Moody of Milwaukee pioneered motorized hang gliding back in 1975 when he hung a 12-hp kart engine on a fixed-wing, foot-launched Icarus II and taxied his big feet across a grassy field to one of the first self-powered, flat-ground take-offs in hang-glider history. The creation, in

a later version known as the Easy Riser, became the Jenny or J-3 Cub of the ultralight movement—a testbed for new ideas and bridge to span the gap between glider and airplane.

A delightfully antique-looking tailless biplane, the Easy Riser still retains foot-launch capability, but, in subsequent forms, has been quick to adopt such added luxuries as cockpit comfort, wheeled landing gear, precision controls and other refinements. There's even a seaplane version with floats that looks remarkably like an early amphibious Navy biplane.

Channel crossing

Another pioneer in powered hang-glider flight is Volmer Jensen with his VJ-23 built of wood and later VJ-24 made of metal. The two craft differ in construction, but are similar in appearance. Jensen chose a high-wing, monoplane configuration with a conventional tail on a trailing boom. It is 17 feet long with a wingspan of 32 feet. In addition to rudder and elevator, there are ailerons in the wing for full three-axis control. So far, the VJ-23 and VJ-24 are designed for foot launching only.

Both Moody and Jensen are accomplishing spectacular feats with their amazing craft. Moody has flown his Easy Riser on long-distance flights of up to 100 miles nonstop. Last May, Britisher Dave Cook made the first hang-glider crossing of the English Channel in a Jensen VJ-23 powered by the little 12-hp MC-101. Cook covered the hazardous 25-mile stretch in one hour and 15 minutes, setting down on the French coast at almost exactly the same spot where Louis Bleriot took off in his primitive craft for the first airplane crossing of the channel in 1909.

Trend toward sophistication

More and more hang-glider manufacturers are now coming out with ultralights specifically designed for power. The Mitchell Wing, which, like the Easy Riser, started out as a simple foot-launched, powerless hang glider, is now produced in two motorized versions by its maker, M Company. One has an open-air pilot's seat and tricycle landing gear, while an even slicker model offers a semi-enclosed cockpit pod, also with tri-gear. Both have pusher-prop engines mounted below the wing, providing good thrust-line characteristics.

A tailless "flying wing," the Mitchell incorporates one of the most sophisticated control systems in current ultralight use. Combination "elevons" can be used either differentially as ailerons for roll control or collectively as elevators for pitch control. Twin rudders mounted on the wingtips also perform dual functions. Used differentially—both swung outward in opposite directions—they double as "drag plates" for precise descent-rate and glide-path control. The elevons are linked to a joy stick and the rudders operated by foot pedals, as in true airplanes.

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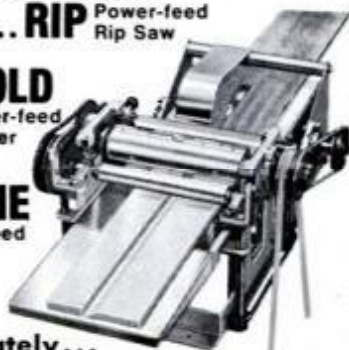
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The craft has a wingspan of 34 feet, cruises at 55 mph, climbs 200 feet per minute, can take off in 150 feet and land in 100. Kits, depending on model chosen, are priced at around \$2500, complete with engine. A foot-launched version is also available for considerably less.

Similar to the Mitchell Wing is a new powered ultralight just introduced by Striplin Aircraft. Like the Mitchell, it is a tailless monoplane, features an enclosed cockpit pod with tricycle gear, and uses dual-function elevons and rudder/drag plates. Unlike the Mitchell, it can be either foot- or wheel-launched even with the cockpit enclosure attached. For foot launching, the wheels are omitted and the pilot's legs extend down to the ground through bomb-bay-like doors in the bottom of the pod. Top speed is said to exceed 55 mph, with a climb rate of 300 feet per minute. Two kits will be available, one containing materials for home construction, the other completed parts ready for assembly. Prices are expected to run close to those for the Mitchell Wing.

Other ultralights

DSK Aircraft, kit maker for the Jensen VJ-23 and VJ-24, has now come up with its own kit-built powered hang glider available in either wood or metal construction. A high-wing, conventionally tailed monoplane with rudder, elevator and ailerons, it is basically similar to the Jensen designs, but adds a wheeled undercarriage with pilot's seat and full aircraft-type stick and foot-pedal controls. The wood version is called the Drifter and sells for \$2183. The metal model is named Flatlander and is priced at \$2447. Both weigh 147 pounds empty, have a 36-foot wingspan, use the Chrysler-West Bend 820 engine and can be either foot- or wheel-launched. Cruise speed is 36 mph.

Another glider manufacturer entering the powered-flight field is Sky Sports. Its latest offering is a simple 120-pound rigid wing that can be rigged for motorized operation and either foot or wheel launching. Older, but still notable in the ultralight area, are the Raz-Mut, Birdman and PDQ-2. All three are rigid-wing monoplanes with full three-axis control, pilot seats and wheeled landing gear.

The Birdman has a V-tail like the Hummer, but also incorporates "spoilerons" in the wing. These can be operated either singly for roll control or collectively as spoilers for glide-path control. Powered by a Chrysler/West Bend 820, the craft can hit speeds up to 50 mph and, once airborne, can function as a power-off sport sailplane. Its novel "tricycle" landing gear is half human, half mechanical. While it has two fixed wheels, it requires the help of legs to serve as the third member. However, despite the partial use of feet, it cannot be foot-launched alone. Kit price for the Birdman is about \$2500.

The PDQ-2 (page 134, Oct. '74) fea-

(Please turn to page 204)

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ULTRALIGHTS

(Continued from page 203)

tures full-span ailerons, Cessna-type drooped wingtips for added lift and a smartly styled T-tail reminiscent of the sleek F-104 Starfighter jet. Its powerplant is a modified VW providing speeds up to 80 mph. Its tri-gear even embodies wheel brakes for short-field landings—an added touch of aircraft realism. It can be built from plans. The Raz-Mut (page 54, Jan. '78) is also built from plans and also uses a VW engine. It gets speeds up to 85 mph, climbs 650 feet per minute, and—if you dare—can reach a ceiling of 12,000 feet. Like the PDQ-2, it has full rudder, elevator and aileron control, but in addition offers three-position flaps—another example of the advanced degree of sophistication ultralights are reaching. Both the PDQ-2 and Raz-Mut come close to being real airplanes; neither is foot-launchable.

An even grayer 'gray area'

Up in an even hazier region of super-light aircraft are such hard-to-define mavericks as veteran designer Hobie Sorrell's little 330-pound Guppy and Gary Watson's 273-pound Windwagon, raising still more questions as to just what constitutes a true airplane. Though considered by many to be in the ultralight class, the Guppy is actually a fully enclosed, cabin-type biplane with negative wing stagger resembling a miniversion of the famous old Staggerwing Beech. It's powered by an 18-hp Cushman engine, cruises at 65 mph and can be built for less than \$1500. Watson's Wingwagon (page 117, Feb. '79) is a 13-foot-long, low-wing monoplane that looks too small to even carry a pilot, let alone fly. You don't get into it, as the saying goes, you "put it on."

While classed as an airplane and FAA-regulated, the Windwagon is of special interest to ultralight enthusiasts because it's powered by a literally sawed-in-half VW engine, slicing the original four cylinders to two and cutting the weight in half. This is a significant development since early-model lightweight VW engines, widely used in homebuilt sport planes, are now in scarce supply, and the later models are too heavy for most ultralight use. Thus the new "half-engine"—which develops 30 hp and gives speeds up to 135 mph—may be just what ultralight builders are looking for.

Powered sailplanes

Another development in the ultralight boom is the motorized sailplane. A typical example of this new hybrid is the popular American Eaglet (page 170, Feb. '77). A 150-pound fiberglass/foam structure with a 36-foot wingspan, it has a 12-hp MC-101 with pusher prop mounted at the rear of the cockpit pod. A self-feathering propeller automatically folds when the engine is cut to streamline the craft for drag-

free, power-off soaring. That designer Larry Haig has struck a magic combination is evident from the sale to date of more than 350 kits at \$2450 each.

The Marske-Monarch (page 170, Feb. '77) is essentially a tailless, flying-wing type of glider to which has been fitted an auxiliary power pack for self-launch take-offs. It has separate ailerons and elevators, all notched into the wing. Also coming is a motorized version of the Monerai, a new metal-and-fiberglass sport sailplane weighing 220 pounds with a wingspan of 36 feet. Already available in unpowered form as a \$3190 kit, it will soon be offered with a pylon-mounted engine.

How will the FAA rule?

Sailplanes have traditionally been FAA-regulated, and powered versions will continue to fall under federal control. When it comes to hang gliders, the picture is still unclear. So far, the FAA has not regulated hang gliders—with or without power—provided they were foot-launchable. The advent of fixed landing gear, however, has changed the situation radically since wheels permit greater weight, size and power.

The FAA is certain to impose some restrictions on ultralights, but the big question is what the basis will be for determining when a hang glider becomes an airplane. A decision is expected soon.

Foot-launchability may continue to be the deciding factor. Opponents argue that it makes little difference whether you put feet or wheels on an aircraft—it's still the same aircraft. But the distinction, though subtle, is based on solid logic: So long as an aircraft is designed to permit foot-launch capability—whether or not it also has wheels—it cannot be made heavier than a human can handle. Thus it could not be big, powerful or fast enough to pose a threat to other air traffic. Such aircraft would also no doubt be required to stay away from airports, population centers, major highways and other places where they could become hazardous.

If foot-launchability is adopted as the requirement for nonregulated aircraft, it would rule out such ultralights as the Hummer, Weedhopper, Raz-Mut, PDQ-2 and wheeled versions of the Mitchell Wing, none of which can be foot-launched. However, an alternative criterion under consideration is wing loading, perhaps combined with limitations on weight and/or power. Many ultralight experts believe a wing loading of three pounds per square inch to be a good maximum to remain unregulated. The recently formed Ultralight Aircraft Club has settled on 50 hp as a proper power limit. If standards like these are adopted, they could turn things around dramatically. Wheeled craft like the Hummer, Weedhopper and Mitchell Wing, because of low power and light wing loading, would—ironically—be exempt from FAA regulation despite their non-foot-launch design

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However the FAA rules, there's a good chance you may be able to get airborne in some form without extensive flight training and pilot licensing. This is not to suggest, however, that you should just jump into an unfamiliar aircraft and head off into the unknown without basic flying knowledge. Hang-glider enthusiasts have long recognized the need for adequate preparation, safe equipment and strict self-regulation. There are many hang-glider schools across the country, and some are now offering instruction in powered, as well as unpowered flight. There are also many good flight-training manuals in libraries and bookstores. Anyone contemplating ultralight flying is well advised to study the subject first and take instruction with a qualified teacher.

Ultralights may be re-inventing the flying machine. But, whatever they are, they're opening the door to an exciting form of recreational fun and thrills. In this case, the sky's the limit—literally. **PM**

ULTRALIGHT SOURCE INFORMATION

The following list includes only products mentioned in the article above. Many more models and accessories exist, too numerous for coverage here. Information on these can be obtained from publications in the field noted below.

■ **Ultralight aircraft:** (Prices for information brochures, where available, are given in parentheses). Birdman, Birdman Aircraft, 480 Midway, Daytona Beach, Fla. 32014 (\$5); Guppy, Mike Kimbrel, 1333 Garrard Creek Rd., Oakville, Wash. 98568 (\$2); Hummer, Mountain Green Sailing, Box 666, Morgan, Utah 84050 (\$5); PDQ-2, PDQ Aircraft Products, 28975 Alpine Lane, Elkhart, Ind. 46514 (\$4); Easy Riser, Ultralight Flying Machines, Box 59, Cupertino, Calif. 95014 (\$1); Drifter and Flatlander, DSK Aircraft Corp., 13161 Sherman Way, North Hollywood, Calif. 91605 (\$5); Manta Fledgling II, Manta Products, 1647 East 14th St., Oakland, Calif. 94606 (\$1); Marske-Monarch, Jim Marske, 130 Crestwood Dr., Michigan City, Ind. 46360; Mitchell Wing, M Co., 1900 South Newcomb, Porterville, Calif. 93257 (\$5); Raz-Mut, Jean St. Germain, Inc., 924 Rue St. Pierre, Drummondville, Que., Canada (\$8); Sky Sports, Box 507, Ellington, Conn. 06029 (\$1); Striplin Aircraft Corp., Box 2001, Lancaster, Calif. 93534 (\$5); Volmer Jensen VJ-23 and VJ-24, Volmer Aircraft, Box 5222, Glendale, Calif. 91201 (\$6); Weedhopper, Weedhopper of Utah, Box 2253, Ogden, Utah 84404 (\$3); Windwagon, Gary Watson, Rt. 1, Newcastle, Tex. 76372 (\$1).

■ **Powered sailplanes:** American Eaglet, AmEagle Corp., 841 Winslow Court, Muskegon, Mich. 49441 (\$5); Monair, Monnett Experimental Aircraft, 955 Grace St., Elgin, Ill. 60120 (\$10). Marske-Monarch, Jim Marske, 130 Crestwood Dr., Michigan City, Ind. 46360.

■ **Engines and accessories:** Dyad engine, D. H. Enterprises, 4909 West Compton Blvd., Lawndale, Calif. 90260 (\$1); Windwagon VW engine, Gary Watson, Rt. 1, Newcastle, Tex. 76372 (\$1); Gemini power pack, Gemini International, 655 Juniper Hill Rd., Reno, Nev. 89509 (\$3); Soarmaster power pack, Soarmaster, Box 4207, Scottsdale, Ariz. 85258 (\$1); floats for Easy Riser, William Bradley, 307 Quaker Bottom Rd., Havre de Grace, Md. 21078 (\$1 plus SASE).

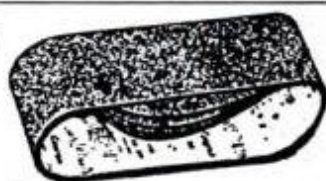
■ **Publications:** Glider Rider, Box 6009, Chattanooga, Tenn. 37401 (\$10/yr.); Hang Glider, Box 1860, Santa Monica, Calif. 90406 (biweekly, \$12½ yr.); Hang Gliding, U.S. Hang Gliding Assn., Box 66306, Los Angeles, Calif. 90066 (\$7.50/½ yr.); Soaring, Soaring Society of America, Box 66071, Los Angeles, Calif. 90066 (\$14/yr.); Sport Aviation, Experimental Aircraft Assn., Box 229, Hales Corners, Wis. 53130 (\$25/yr.); Ultra-Lite Aircraft Journal, 355 Grand Blvd., Bedford, Ohio 44146 (bimonthly, \$12/yr.)

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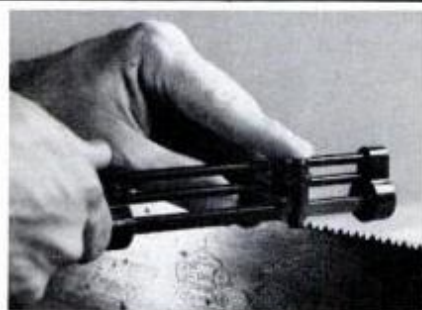
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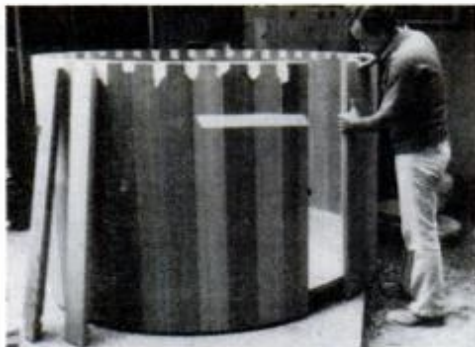
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FIND IT IN THE YELLOW PAGES

NOW YOU'RE REALLY IN HOT WATER (Continued from page 136)



Make certain that each stave is seated tightly against the adjoining one.



If needed, final "spacer" stave is force-fitted between first and last staves.

a location is power supply. Your tub will require 220-volt electricity (and gas, if your heater is the gas type). You should plan on using a licensed electrician (and plumber, if gas) to make the final hook-ups. It is very important that your installation conforms to local code and meets safety requirements. Thus, it makes sense to call in the professionals for these steps.

Also, keep in mind that a tub filled with water is heavy; our 4-ft.-deep by 6-ft.-dia. tub, for example, weighs in at 3000 lbs. when filled with water—more when people are added.

You can sink the tub into the ground, but the experts at California Cooperage advise against it. Their experience shows that burying a tub can bring on complications such as dirt contact, drainage, access to tub plumbing and location of support equipment.

Tub assembly

The tub shown on pages 132 and 133 is by California Cooperage. It comes complete as a kit, with easy-to-follow assembly instructions. Parts are numbered and the instructions are written step fashion to keep the assembler in sequence.

Generally speaking, the tub plumbing connections (or the predrilled staves, see

photos) are installed on the side of the tub toward the support equipment. The exact placement of these staves, however, depends on how you decide to arrange the two seats inside the tub. The easiest method is to take the seats and lay them out on the tub bottom, facing them as you will want them in the finished tub in relation to their surroundings.

On four-jet models, the stave package includes four staves predrilled for jets and two staves drilled near the bottom for tub outlets. Generally, it is best if the hot return line from the heater is connected to the higher jets and the direct return from the pump goes to the lower jets. The maker says this arrangement gives superior water circulation and jet action in the tub.

Once the tub is assembled, enlist the aid of three or four helpers to carry it to its final location. Instructions for plumbing and electrical connections and support equipment are included in the assembly booklet.

Total environment

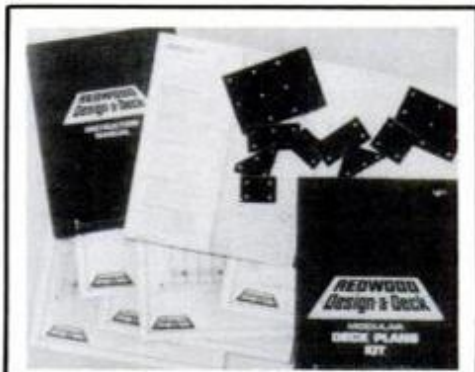
As can be seen in the color photos, our hot tub is the focal point in a handsome redwood deck setting. Here are several points to keep in mind about decks:

■ Most ideas for the deck were taken from the California Redwood Assn.'s Design-A-Deck Kit. Construction methods in it are simple and no complicated joinery is called for.

■ To save money, our deck is built of garden-grade redwood, rather than clear all-heart. The lower-cost grade is a stable wood that naturally resists warping, checking and cracking.

■ Because the tub shown is built in a temperate area, designer O'Grady assures that the tightly fitted 2 x 4s (used to form the butcherblock steps and benches) work just fine. If you live in an area subject to frost, however, you should leave some space between boards for positive water runoff.

For more information on hot tubs—models available, costs and so forth—write to California Cooperage at the address shown on page 135. For more information on redwood decks, see the Design-A-Deck Kit offer at left.



Most design ideas for the deck surrounding the hot tub, benches and planters were taken from "Design-A-Deck Plans Kit" above. To order, send \$4 to California Redwood Assn., Dept. PM 379, 1 Lombard St., San Francisco, Calif. 94111. Kit includes complete plans and a 20-page how-to manual.



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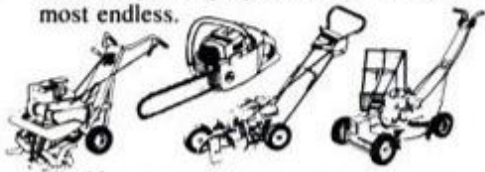
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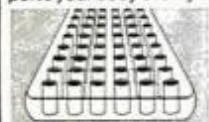


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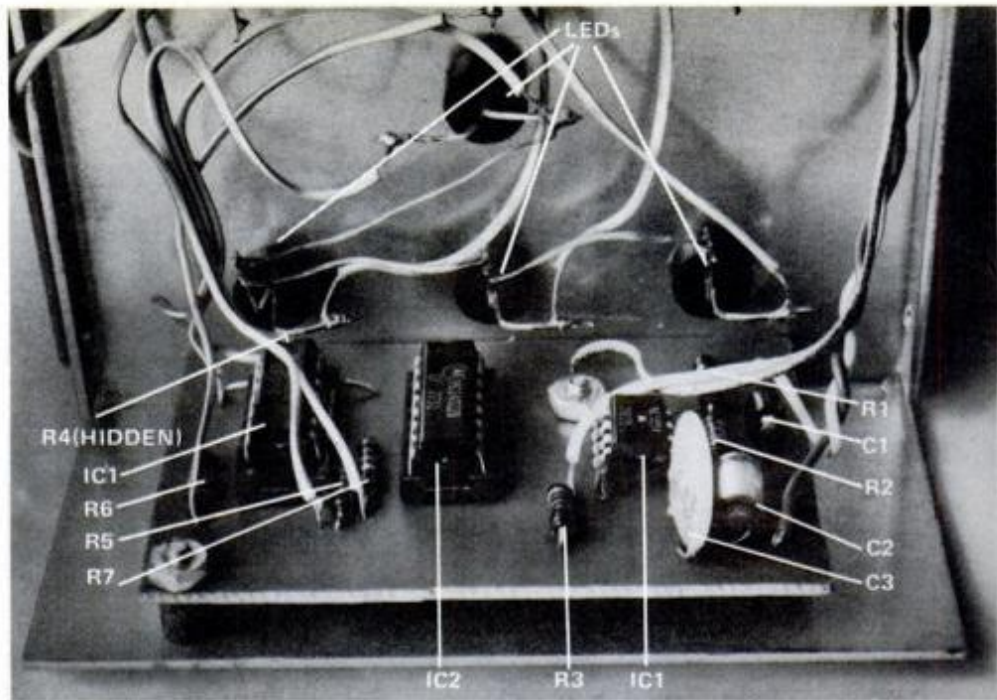
ELECTRONIC DICE

(Continued from page 18)

cement them in place with epoxy. Only the *high-brightness* LEDs specified in the parts list (or equivalent devices) should be used; regular LEDs may emit only a feeble glow at the low current levels used in this project. Like the other components, LEDs must be oriented correctly. As you look into an LED's plastic dome, you will notice a structure with the unmistakable shape of an anvil. The lead connected to this anvil is the LED's cathode (bar side of the schematic symbol). The other lead is the anode, represented schematically by an arrowhead.

When construction is finished, turn on S1. Press and release S2 several times until you establish that all six die faces light; be patient. Batteries should last a long time, but to insure long life, always turn your circuit off when it's not in use. For high rollers, alkaline cells are recommended.

If you press S2 and you get a mish-mash of designs instead of the normal six die faces, check the placement of your LEDs. Next to the schematic diagram is a small pictorial of just which LED should be



In this component-side view, note how the various pieces fit onto the finished PC board. You should wind up with a neat and uncluttered project in a couple of evenings.

placed where. If you are off in your construction by even the front panel placement of one LED your die may still work, but will not display the familiar patterns of everyday dice. This mistake can be easily fixed.

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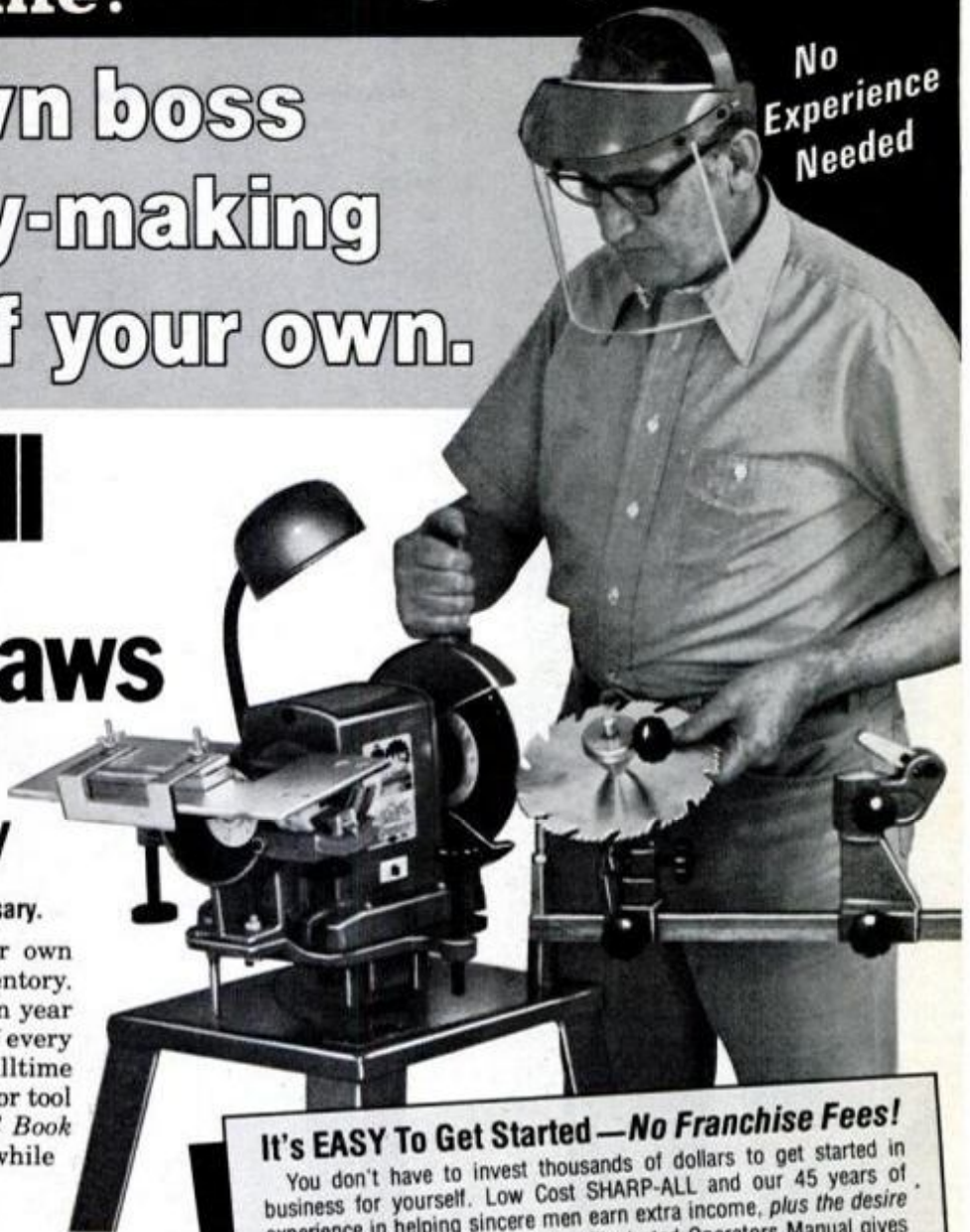
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TUNE IN AIRBORNE ACTION

(Continued from page 84)

nels speak directly with their home office to report equipment malfunctions, tardiness, severe weather, passenger messages and even such mundane things as how much food and liquor were consumed during a lunch or dinner aloft.

Listeners living near smaller airports or private airstrips usually keep their dials tuned to the UNICOM frequencies of 122.8 or 123.0 MHz. These air-to-ground channels are used by private pilots taking off, landing or requesting information from the ground-based airport oper-



Radio Shack's Patrolman 50 should be available when you read this. It covers shortwave and aviation, will retail at \$70.

ators. These frequencies also serve as a giant party-line advisory between pilots in the sky near the airport, to check their positions and intentions.

The air-to-ground eavesdropper should also be aware of the international VHF emergency frequency: 121.5 MHz. This channel is "guarded" or monitored by all airports worldwide and by most commercial and military aircraft. If there's a real emergency, and the pilot can transmit a Mayday, you may overhear all the action. No extraneous or unnecessary transmissions are allowed on 121.5 MHz. Even transmissions made by mistake are frowned on.

This frequency is also used to locate downed planes, or aircraft that may have become lost or disoriented. Many FAA/FSS centers have very accurate direction finders that receive the emergency channel. By asking the lost pilot to make a series of brief transmissions, two such stations can triangulate the broadcast direction to give his exact position and guide him to a nearby airport.

Federal law now requires all U.S.-licensed aircraft to carry a small emergency locator transmitter (ELT) which, in the event of a crash,

will automatically transmit a signal on 121.5 MHz. Because of the vast worldwide monitoring network of the "guard" channel, chances are that a downed craft can be detected and located quickly. An ELT is completely self-contained, with an antenna and long-lasting batteries. Most are mounted directly in the aircraft near the tail, and programmed to go off automatically upon a severe impact.

Don't expect to hear many military aircraft as you tune the VHF frequencies, even though you may live quite close to an Army, Navy, Air Force or Coast Guard base. Although most military aircraft have VHF radios, they, for reasons of their own, tend to use a specially assigned band of frequencies in the UHF range. These UHF channels, just above the American television band, are not receivable on most radios.

Getting in on the action

There are at least two dozen reasonably priced receivers capable of tuning the VHF air-to-ground communications band. It's perfectly legal to eavesdrop and no license is required for just listening. In other countries, check local communications authorities. (One restriction you should know—you cannot operate an aircraft-band receiver while flying aboard a commercial airliner. The obvious reason is to avoid the danger of panic that would likely break out, if a passenger happened to overhear a distress call being sent out by his own pilot. Even a routine



Regency Electronics makes digital flight scanner that is touch-programmable to any of the aviation frequencies. It's \$349.

report on approaching turbulence, or a minor mechanical malfunction of no real significance, could unnerve many uneasy air travelers. Also, radios operated within an aircraft could interfere with its communications or navigation systems.)

Several American and many foreign manufacturers include the 108 to 136-MHz aircraft band in their radios. Many multiband sets not only tune the VHF air band, but also re-

(Please turn to page 216)

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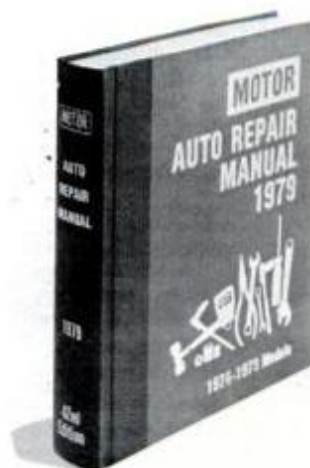
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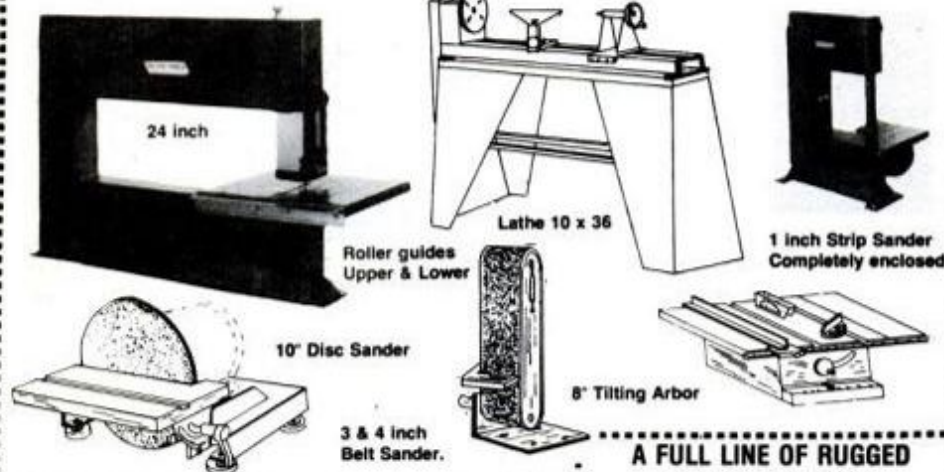
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TUNE IN AIRBORNE ACTION

(Continued from page 214)

ceive the AM/FM standard broadcast frequencies, several shortwave bands, police, fire, other emergency channels, and even a special National Weather Service channel transmitting continuous forecasts for your area. Most radios have a telescoping whip antenna to end the need for outside installation. Many solid-state sets operate on regular house current and off self-contained batteries. Some units include a desirable "squelch" feature, which quiets the speaker when no transmission is taking place.

Prices vary widely with the maker, but you can get in on aircraft monitoring for as little as \$6.95, with Lafayette's Radio Aircraft Converter kit No. TK-1003. This easily assembled device couples without wires to your standard home or car AM radio and converts it to tune the aircraft band. Lafayette and Radio Shack offer other kits that let you build a simple radio to tune the air and police bands. These do-it-yourself, no-tools-required kits sell for about \$12.95. The reception quality, however, can be less than in an already assembled unit.

A more logical step is one of the many off-the-shelf units, such as Radio Shack's AM/FM Aviation Jetstream Mini Monitor No. 12-608. This compact unit measures only 4 1/4 by 2 3/4 by 1 3/8 inches, fits easily into a shirt pocket and comes complete with antennas, earphone, carrying strap and battery. It tunes the aircraft band and the AM broadcast band.

In the medium-price range, Radio Shack, Lafayette and General Electric have several models. Other manufacturers, such as Juliette, Lloyds, Wards and J.C. Penney, have more. Most sets in this price range are similar to Radio Shack's new Patrolman 50 model. This multiband portable, which should be released by the time you read this, measures 9 by 11 by 3 1/4 inches and tunes everything from standard broadcasts through the aircraft band. It also includes the 450-mHz police band. This unit features a tone control, adjustable squelch, headphone jack and carrying handle. It runs on house current or batteries. Two self-contained antennas—one for AM, the other for FM, VHF and UHF—are included. The unit, No. 12-776, sells for about \$70.

In the high-price range, GE offers a 10-band portable that's just about the top in multiband portables. This model 7-2971 weighs 8 pounds and

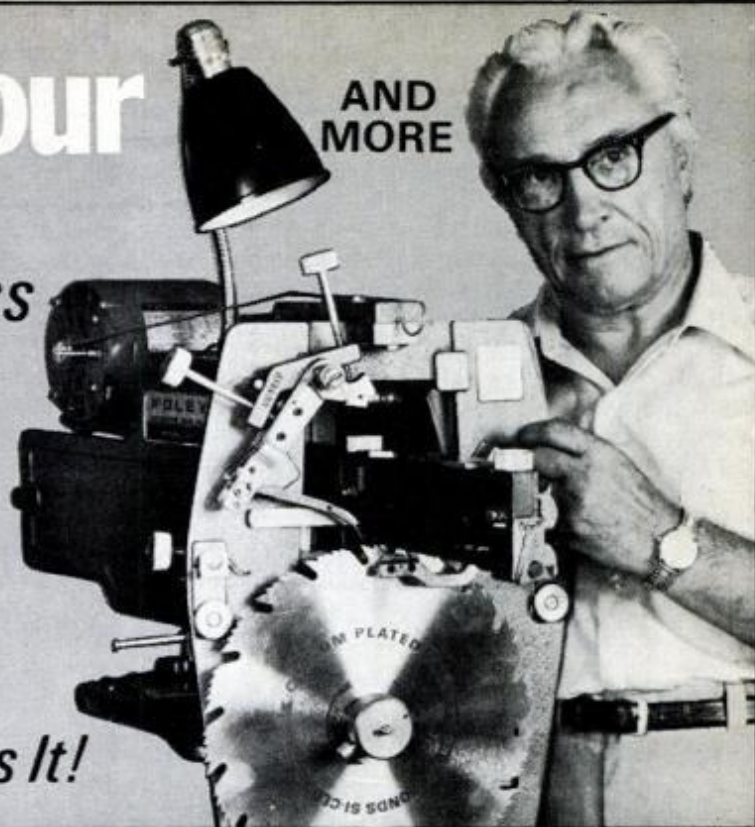
(Please turn to page 218)

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The sharpening business allows you to get started with only a minimum investment, requiring little space and effort for a successful operation. It lets you build and expand as fast, or as slowly as you like. You pocket most of the money you take in, because there are exceptionally high profits with no investment in merchandise.

If you need only \$200 or \$400 extra income each month, a sharpening business is ideal for spare time. The additional dollars can be SPENT for more of the good things of life. Or they can be SAVED in a rainy-day fund that the family can bank on.

More sharpening businesses are needed every year

As original equipment continues to climb in cost, owners are becoming more concerned that the equipment be maintained so that it performs like new. This means more companies, contractors, carpenters and home owners are having their old saw blades and tools resharpened many times, where in the past, they would have replaced them with new blades or tools. This is where you can step in with the much needed service of sharpening saws and practically any kind of tool.

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TUNE IN AIRBORNE ACTION

(Continued from page 216)

tunes all information and entertainment frequencies, plus police, aircraft, emergency, weather and even the CB channels. This \$120 luxury unit is self-contained, has a very large, easy-to-read dial and features an AFC (Automatic Frequency Control) circuit in the FM mode, which helps maintain tuning stability without drift.

Sad to say, only one manufacturer advertises a scanner that will tune the 108 to 136-mHz band. Regency

Electronics of 7707 Records St., Indianapolis, Ind. 46226 offers a Digital Flight Scanner capable of monitoring any of 10 preprogrammed frequencies. It works like the popular emergency-band scanners and uses no crystals for frequency selection. It is self-contained with its own antenna. No battery or portable operation is provided.

Some listening tips

Remember that, in most cases, aircraft transmissions will come in clearer and stronger than ground stations. This is due to the height of

the plane above the ground. Its transmitted signal has a more direct path to your set's antenna than a similar signal from a ground-based station. All transmissions are of short duration, so there will be times when you hear nothing.

If you wish to hear both sides of a conversation you must tune back and forth between two frequencies. The pilot will speak on one, and ground control on another.

Try several locations for your radio if signals are weak or garbled. VHF frequencies are tricky and may penetrate one room's walls more easily than another's. Near a window is usually a good place.

You may wish to also purchase an air navigational map of your area. These charts are available at most airports or from the government by mail. They show airports, cities, navigational radio aids, and list all presently used VHF and UHF frequencies for each map's location.

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GLOSSARY OF AIRWAY LINGO

Here are a few terms and expressions commonly used by flight controllers and pilots alike.

ATC: Air Traffic Control.

Airway: Designated route between two points.

Alternate: Place to land if the weather is bad at an intended landing field.

Center: ATC facility responsible for controlling the en route (high-altitude cruising) phase of a flight.

Clearance: Authorization from ATC to proceed with a flight.

Flight level: Altitude in thousands of feet.

Heading: Compass direction in which an aircraft is pointed.

Ident or Squawk Ident: Expression usually used by a radar controller when requesting a pilot to energize an identification feature of a radar transponder in the aircraft.

IFR: Instrument Flight Rules.

ILS: Instrument Landing System, combining two or more radio beams guiding a plane to a runway.

In radar contact: Ground controller term indicating an aircraft has been identified on radar.

Mayday: Internationally recognized distress signal.

Negative: Easily understood "no."

Omni: Short for Very High Frequency Omnidirectional Radio Range Station. Often called a VOR.

Outer marker: Low-powered radio beacon that marks the beginning of an ILS system some distance from the airport runway.

Roger: "Yes, I will comply" or "I understand."

Traffic: Term used to indicate other aircraft.

Transponder: Electronic "black box" mounted in an aircraft, which causes a distinctive blip on a ground-base radar screen.

Transponder code: Specific sequence of numbers providing coded display on ground-based radar screen.

Vector: Heading assigned usually by a radar controller who wishes the aircraft to proceed in a certain direction.

Victor: Term usually followed by a set of numbers, meaning an airway or highway in the sky.

VFR: Visual Flight Rules.

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KEEPING 'EM ROUGH 'N READY

(Continued from page 59)

from long-range patrol rations to their own artillery—a half-dozen 60-mm mortars. Ranger battalions—there are two in the country, one at Fort Stewart, Ga., and the second at Fort Lewis, Wash.—are the only Army units to have the small mortars.

If a country in which the battalions might have to launch deep penetration raids has tanks and other armored vehicles, the Rangers have antitank missiles in their arsenal. The new Dragon type can knock out any known Soviet armor.

Other standard equipment includes electronic night vision goggles that turn the blackest night into daylight, light machine guns and M-16A grenade launchers. Every Ranger also is given a Yetta, an individualized camouflage net to drape over his helmet and face, making him almost impossible to spot from the air and ground.

Because new capabilities are vital, much of the equipment and tactics used by our Rangers are still secret. But recently, the Army lifted the curtain to let me spend several days with the 1st Battalion (Ranger), 75th Infantry at Fort Stewart.

Initial briefings were given by Lt. Col. J.S. Stringham, battalion commanding officer, and his executive officer, Maj. Robert A. Guy, both of whom were handpicked for the demanding job of leading one of the Army's two elite battalions. Assigned as my escort was Headquarters Sgt. James H. Moller. I slept in his barracks room on an empty cot belonging to another Ranger away at an Army school.

Move fast, hit hard, get out

Rangers are light infantry trained to hit and run. To use them in conventional encounters is as wasteful as driving to the supermarket in a Ferrari. Rangers are trained to hit the enemy at night where they are least expected; up seemingly impossible cliffs; to come ashore on defended beaches so quietly that only accidental contacts might betray them; to rappel down from low-hanging helicopters where it is impracticable for the choppers to land; or to use their chutes.

Ranger operations include raids against deep enemy targets, such as nuclear storage and missile sites or against critical airfields or command centers, or to rescue American POWs or political hostages. They also might be used to jump into vital oil fields before defenders real-

ize they are being overwhelmed; to safeguard threatened American citizens overseas if there are no sea-borne Marines in the area, and carry out show-of-force missions to convince a possible enemy we are capable and willing to hit hard unless a problem is resolved amicably. Tragically, had there been time, they might have been deployed to Jonestown, Guyana.

To be able to carry out any of these assignments anywhere they might be sent, Rangers regularly maneuver in some of the wildest primitive areas of the world, from the jungles of Panama to the winter wastes of Alaska.

Fort Stewart itself, the largest Army installation east of the Mississippi, could be nicknamed "Old Boggy." Once you leave its built-up areas, there is little more than forest, winding rivers and low-lying swamps to comprise the base's 279,270 acres. Patrolling at night is a nightmare when clouds hang low, since there are no prominent terrain features to get a fix on.

The toughening begins

Ranger training covers escape and evasion, usually in pairs or no more than teams of four, including exfiltration (which usually is more dangerous than infiltration because the enemy has been hurt and is fighting back). Also, demolition of roads and bridges; combat swimming; Morse code; hand-to-hand combat; mountaineering and desert survival—all this plus the regular infantry fighting skills.

The day usually starts with rigorous physical training topped off by a three-to five-mile run at a seven-minute-per-mile pace... while wearing combat boots.

Companies and units then disperse for mortar firing, river fording, rope-bridge building, airborne training, patrolling, and other field exercises. Field work may run two, three or four nights at a stretch with only a bedroll and tarp for sleeping. If it rains, the Rangers improvise shelter when they can, and keep moving when they must. Eventually their own movement will help dry their clothing and boots.

Rangers wear camouflage combat fatigues instead of the standard infantry greens, and were among the first troops issued M-16A1 rifles equipped with 30-round magazines instead of the standard 20 rounds. Those extra 10 shells per magazine give them a welcome margin of power during fire fights.

When pinned down, Ranger units can call for air support from A-10 attack fighters or Spectre gunships.

The A-10 (see PM, page 102, April '78) is a twin-engined, heavily armored ground-support fighter fitted with an armor-piercing Gatling gun and assorted tank-killing missiles. The Spectre is the attack version of the familiar Hercules C-130 cargo carrier, loaded with a conglomeration of electronic sensors and weapons. Depending on the model, the Spectre carries a 105-mm howitzer or a 40-mm Bofors gun plus two 20-mm Vulcan cannons, and has a range of several thousand nautical miles with in-air refueling.

It can orbit a target area at night observing *everything* on the ground through a low-light TV system, infrared sensors, lasers and other still classified scanning apparatus, from as high as 18,000 feet. As it circles beyond hearing range in the dark, it can unleash a hail of killing salvos to wipe out an entire truck convoy, shatter strong points or destroy bridges before an enemy is even aware of it.

While the rain splattered down, we watched a Spectre slowly turn overhead. Its navigation lights were on (they would be turned off in combat). The forward observers' radio suddenly blared, "You have three jeeps under trees; two quarter-tons parked to the side; two communications jeeps up front and 35 men watching this demonstration."

The count was right. But they did fail to spot that I was out of uniform—wearing a camouflage shirt over green fatigue pants. Perhaps they were being tactful.

They must volunteer

Part of the group later watching the Spectre drench a selected target with white phosphorescence and live fire was a Ranger Indoctrination Program unit. To join the Rangers, a soldier must first enlist like everyone else in today's Army. After basic and individual combat training, he then volunteers for airborne training and becomes jump qualified. Only then can he ask for the Rangers.

Even having accepted the rigors of airborne duty, young soldiers often find the 5½-day weeks of around-the-clock Ranger field work, maneuvers, physical training and schooling too much to cope with. To precondition them for those constant demands, the school grounds them in everything they will be expected to know, from building a rope ladder to using a compass at night.

If they last through their nine months indoctrination in the battalion, they become eligible for actual Ranger School—where the 5½-day

(Please turn to page 224)

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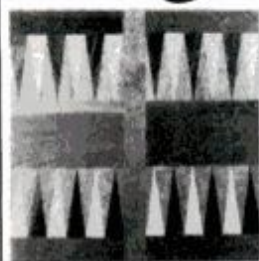
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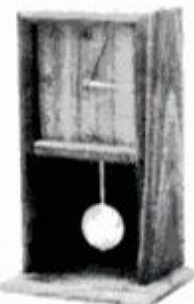
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KEEPING 'EM ROUGH 'N READY

(Continued from page 223)

Ranger week becomes something to look back at with longing. If they stand up to the incessant night work, the field exercises, the intensive training in individual combat, they can sew the Ranger School patch over the battalion insignia. They also become eligible for other Army schools that give them expertise in such critical skills as the marking of landing zones, demolition work, mountaineering and Arctic survival.

To remain a Ranger requires the highest levels of physical stamina, often including the ability to endure pain.

"When we do a night drop, we just don't know what will happen," Capt. Douglas Wise tells me. "I've broken my kneecap and not realized it until my leg collapsed the next morning. I've heard Rangers whisper things like, 'I think I've broken my leg,' so quietly that it's almost impossible to hear them. We do everything as though we're in actual combat."

Ankle and leg injuries are the most common. But a broken leg offers little respite from training. Profile Phys Ed, as it is called, is held every morning. Weights and punching bags are used, and it is common to see a soldier with a leg cast up to his knee working out.

As a unit, the 1st Battalion is one of the most highly educated in the Army. As one example, 1st Sgt. Ivan Ivanov would be outstanding in any unit: An expert in five languages—Romanian, Russian, Bulgarian and Serbo-Croatian—he was with the Special Forces' first combat unit in Vietnam. He has also attended the German Army Airborne and Ranger Schools, and is a qualified senior mountaineering and skiing instructor, learning some of his techniques while he was temporarily attached to the Spanish Guardia Civil.

Another former member of the Special Forces is Staff Sgt. William Donovan. Sergeant Donovan was a combat medic in Vietnam and then went on to study at various military medical schools. For all practical purposes, he acts as battalion surgeon with backup from Maj. Carl Graves, the 24th Infantry Division surgeon. Sergeant Donovan developed the Profile Physical Training program designed to keep injured Rangers up to par.

My escort, Sgt. Moller, is typical of the younger Rangers, many of whom have college degrees or some college training. He attended Florida State University before enlist-

ing. After Ranger School he qualified as a pathfinder and as a jump master. After he finishes his current enlistment, he plans to take a B.S. in business administration at Florida State and return to the Army as an officer.

Other Rangers have much the same story to tell: Two, three, even four and five years in college and then indecision. Once in the service, they asked for what they are convinced is the most demanding branch of the infantry.

For them, being a Ranger means learning to follow standing orders laid down by Maj. Robert Rogers in 1756. During the French and Indian War, Rogers raised a company of soldiers known as Rogers' Rangers, later immortalized in Kenneth Roberts' novel, *Northwest Passage*.

Rogers' techniques for night operations influenced Francis Marion, the Swamp Fox of the Revolutionary War, and later John Mosby, whose Confederate cavalry fought at night when night fighting was practically unheard of.

The Ranger idea gathered dust somewhere in the War Department until the Marine Corps assigned Capt. Evans Carlson to China at the start of the Sino-Japanese War in 1937. He marched with Mao Tse-Tung's Communist Army on their 2000-mile Long March and was so impressed by their guerrilla warfare capabilities that he organized a battalion of specialized Marines known as Carlson's Raiders during World War II. It was his unit that staged a 40-hour raid on Makin Island in the Gilberts and later spearheaded the landing on Guadalcanal.

Carlson's effectiveness, as well as the successful forays against the Japanese carried out by Merrill's Marauders in Burma and accomplishments of the British Commandos, enhanced the Ranger concept during World War II. Today's version of the Rangers did not take final shape until the late Army Chief of Staff Creighton Abrams convinced the Pentagon that the country, as well as the Army, could profit by maintaining Ranger-qualified battalions, even in peacetime.

'Charlie's Angels'

Recently, with the growing concern over possible terrorist acts against Americans overseas, the Department of Defense decided to set up a secret commando unit at Fort Bragg, N.C., under the command of Col. Charlie Beckwith. DOD has been close-mouthed about "Charlie's Angels," but it is believed

(Please turn to page 226)



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KEEPING 'EM ROUGH 'N READY

(Continued from page 224)

the unit includes a number of Special Forces, Rangers and other highly trained soldiers with the sophisticated weapons needed to deal with hijackers and terrorist groups.

The group is currently estimated at about 60 men, but may eventually be built up to 200. However, military experts' consensus is that it probably will take up to two years to bring the team up to the scalpel-like efficiency of the Israeli and German anti-hijack commandos. Two years, in other words, to reach "Entebbe capability."

All branches have 'elites'

The Marine Recon Battalions are the Leathernecks' elite. Recon patrols are made up of eight men able to live in the bush for five days at a stretch. Every man carries 40 pounds of food and equipment, including his weapons, ammunition and grenades. The two radiomen carry 60 pounds. They know how to set up radio watches, call in air and naval gunfire and how to fight and survive in enemy territory. They also are experienced in using a Special Patrol Insert and Extract Rig—a 120-foot strap rigged from a chopper to lift an entire patrol out of an area under fire.

The Navy's Seals are combination frogmen, paratroopers and commandos. All are volunteers selected from highly trained underwater demolition teams. They also must be qualified parachute jumpers and skilled in hand-to-hand combat. Many also are proficient in at least one foreign language.

The U.S. Air Force Special Operations School at Hurlburt Field, Fla., is the focal point of a number of programs, including training for special air-to-ground operations. A special squadron supports covert and unconventional warfare using aircraft equipped with terrain-following radar, inertial navigation, air delivery equipment and the Fulton Recovery System.

The Fulton can lift one or two airmen or up to 500 pounds of equipment from either land or water by using a helium-filled balloon, and a nylon lift line. Special protective suits are worn by the airmen.

Happily, any rivalry between these elite units other than a healthy striving for excellence is nonexistent. Skills and techniques are shared. Navy instructors help train Rangers, the Marine Corps sends its men to joint service schools and the Air Force puts on tactical demonstrations for footsloggers. **PM**

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9 steps to good snowthrower storage



Lightweight snowthrower, such as this one from Toro, can be stored on garage wall.

Proper off-season maintenance of your snowthrower will make the miseries of next winter less miserable. Use this checklist to be certain your equipment is stored properly:

1. Drain fuel tank. Then start the engine to use up remaining fuel in the carburetor.
2. Wash the exterior of the machine with a garden hose. Soap can be used, but avoid solvents.
3. Touch-up paint is available from your snowthrower dealer and should be used to prevent rust and keep snow from sticking.
4. Change the crankcase oil if applicable. Use oil recommended by owner's manual.
5. Tighten all loose fasteners. Replace damaged or missing parts.
6. Grease and oil all points recommended in manual. Remove the sparkplug and pour one tablespoon of engine oil into the sparkplug hole (two tablespoons for large, 5 to 10-hp machines). Pull the starter rope slowly to distribute the oil on the cylinder walls.
7. Replace the sparkplug with a new one, properly gapped.
8. Store covered machine in a clean, dry area. Large machines should be put on blocks to remove the weight from the tires.
9. If you've lost your owner's manual, most manufacturers will send a new one for little or no charge. When requesting a manual, include serial and model numbers—taken from the nameplate, *not* the engine. **PM**

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New Home Jogger with Mileage Computer

*fantastic price breakthrough
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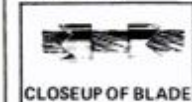
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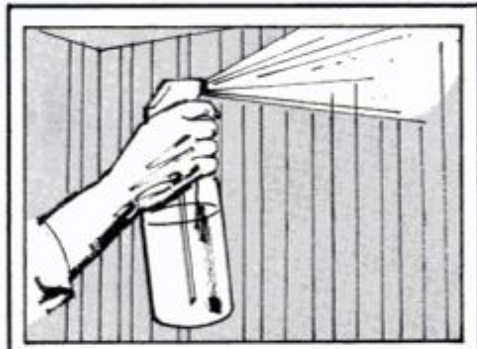
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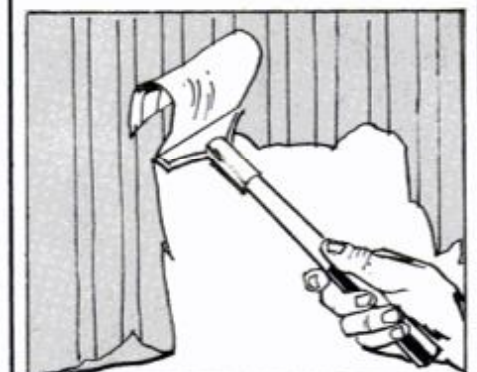
(Continued from page 124)

Moisten the entire area and apply a second coat of patching plaster flush to the surface.

On woodwork or wood floor, use



Remove small areas of one or two layers of wallpaper with a liquid wallpaper remover. Apply liberally to surface with a low-pressure sprayer, paint roller or brush. **Caution:** Protect surrounding surfaces from the remover.



Use a specially designed 4 1/2-in.-wide wallpaper shaver tool to remove paper. It holds a replaceable, razor-sharp blade in a steel handle. Start paper removal at base of wall and push tool at an upward angle into the wallpaper.

Painting over paper?

Painting over wallpaper may seem expedient today, but it will make the paper more difficult to remove in the future. The best way to prepare a papered wall for painting is to remove the wallcovering completely. For large areas, rent a wallpaper steamer. Afterward, use a no-rinse detergent to clean off the remaining paste and bits of old paper.

If you decide to paint over your wallpaper or vinyl wallcovering, first test-paint a small area to see if colors bleed through or if the paper loosens or lifts. If either happens, don't take a chance. Remove the paper. If you're satisfied it's safe to proceed, apply the correct tinted primer first. Use an alkyd or latex paint to prime wallpaper, depending on which paint you'll be using for the top coat. Prime smooth vinyl fabric wallcoverings with alkyd primer or flat alkyd paint. Apply a latex prime coat over smooth vinyl wallcoverings with printed designs. Or you may use a pigmented shellac sealer like Vim, Bin or Enamelac.

wood filler or wood plastic in nail holes and over scratches or gouges that go deeper than the old finish. Overfill the void slightly with a putty knife. When dry, sand flush.

Patches in plaster, drywall or wood should be sealed to equalize rates of absorption between the patched area and the existing surface. This will prevent dull spots that might otherwise show up in the top coat. Either shellac, pigmented shellac or a suitable primer will seal pores in patching material.

Patch holes and cracks in concrete before painting with a hydraulic cement like UGL's Drylok Fast Plug. Loose, broken mortar must be removed before patching.

Last steps before painting

Even the best-quality paint won't adhere well to crayon graffiti, tape adhesive or greasy, waxy or sooty surfaces. Wash dirty plaster or drywall surfaces with TSP (trisodium phosphate), starting with the ceiling. Then, beginning at the bottom, wash the walls. Use household bleach to remove mildew. Rinse, using a sponge and clean water.

On wood surfaces, use turpentine or a commercial wax remover and clean rags to remove old layers of wax. Next, wash the surface with a mild soap and lukewarm water solution. Work with only a small amount of water, and wipe dry immediately with a clean, absorbent cloth.

Metal cabinets, radiator covers, railings and the like should also be stripped clean of wax and dirt with turps. Roughen glossy areas on enameled metal surfaces with sandpaper to provide a better surface for paint adhesion. Wipe up all dust before refinishing.

Unfinished masonry or concrete surfaces should also be washed with TSP to remove oil or other contaminants before painting. If efflorescence (chalklike salt deposits) is a problem, scrub the area with a stiff brush and a 10- to 20-percent muriatic acid and water solution.

Commercially prepared acid treatments like Sears' Concrete Cleaner and Etcher or UGL's Drylok Etch not only clean surface chalkiness, but also etch or minutely texture the surface to assure a better bond with the paint. Follow directions to the letter when using an etcher—acid can burn skin. Wear chemical splashproof safety goggles, acid-resistant gloves and old boots. After a thorough rinsing and drying, apply a surface conditioner, like UGL's Drylok Sealer (for walls) or its Clear Concrete Protector (for floors) to prevent continued efflorescence. **PM**

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And even though the Paint Pistol costs you nearly a hundred dollars less than a fancy compressed air spray. It has several advantages over the latter.

Indoors or out, it effectively cuts drift and overspray. You need far less preparation. You don't have to lug a heavy compressor around—its built-in, mighty midget electric pump supplies all the

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The Paint Pistol eliminates the hazards of compressed air sprays and of at least one other airless sprayer that's over twice its price. Its low pressure presents no safety problem. And the motor is spark-free, surely an important consideration.

To Clean, Just Dunk The Pump And Shoot.

With the Paint Pistol, too, you can save an appreciable amount of money on paint compared to a brush, and there's simply no comparison with spray can paints—the savings are tremendous.

One of the many reasons for this product's trouble-free operation is the genuine sapphire orifice in the nozzle. Just as jewels in a watch prevent wear, this sapphire protects the nozzle from the abrasive action of the paint, providing long wear and helping the Paint Pistol retain its even spray.

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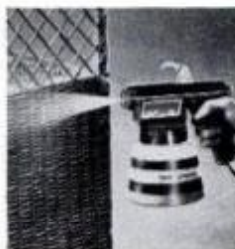
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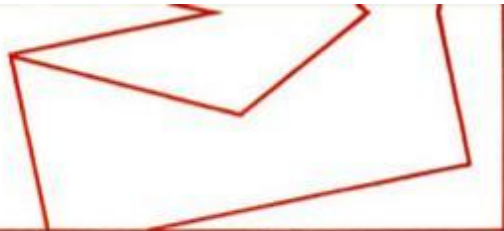


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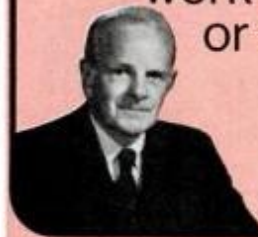
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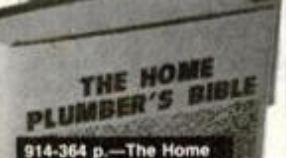
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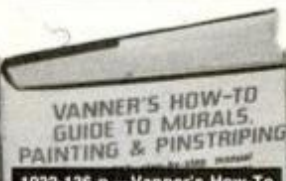
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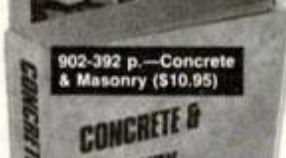
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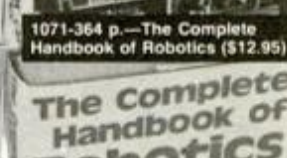
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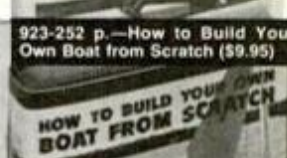
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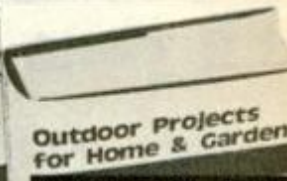
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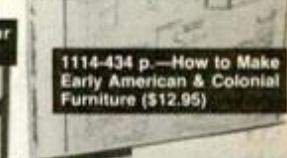
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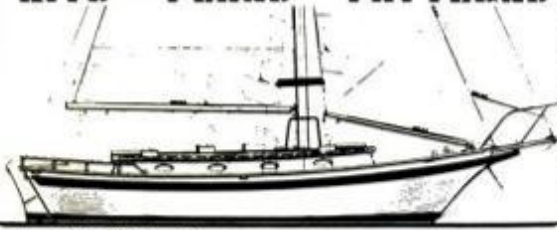
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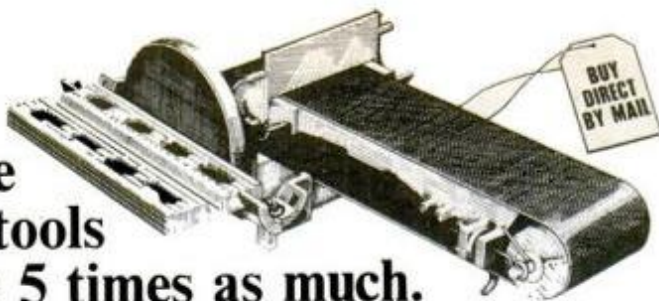
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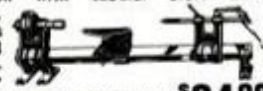


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SEAWEEEDS EXTRACT TEA. Samples and Information — \$2.00 check to: Kimiko's Health and Beauty Food Inc., 30 E. 37 St., New York, NY 10016

HEMORRHOIDS Cured permanently. Information free. Young, Box 9542-PM, Seattle, WA. 98109

PROSTRATE RELIEF! Free report. Prosc—PM-3, Box 5644, Santa Monica, California 90405.

UNIQUE! — Formula IV, Open Door to Health. Free Sample, Literature. **NEOZUPCO**, 1796 Mapledale Drive, West Bend, WI 53095

FREE! "Biorhythms explained." SASE, 1979 Calendar \$7.00 + Birthdate: Wiseman, Box 612M, Staten Island, N.Y. 10314

SAVE Money, space, weight. Food preservation by dehydration. Send for package, \$1.00 Handling and Postage. AMC, Box 94, Dutton, Mich 49511

EXERCISE At Home on build-it-yourself physical fitness equipment, including bicycle exerciser, rowing machine, belt massager, and abdominal board. Send \$5.00 for blueprints B1208 and Instructions. Popular Mechanics, Dept. HE, Box 1014, Radio City Sta., New York, N.Y. 10019

(Continued on next page) авторским правом

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HOW TO COUNT WORDS: Name and address must be included in counting the number of Words in your ad. Each initial or number used counts as 1 word: H.E.Kappel, 224 West 57th Street, New York, New York 10019: 9 WORDS. Zip codes are not counted. Phone #: 2 Words. Symbols used as keys are charged for. City or State count as 1 word each.: New Brunswick, New Jersey: 2 Words. Abbreviations such as C.O.D., F.O.B., R.P.M., U.S.A., P.O., 5x7, 16mm are counted as 1 word. (P.O.Box 392 counted as 3 words) Webster's International Unabridged Dictionary will be used as our authority for spelling, compound words, Hyphenations, abbreviations, etc. Please make checks payable to **POPULAR MECHANICS**.

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BETTER HEALTH

(Continued from preceding page)

SLEEPATRON - New device that soundproofs bedrooms electronically. Also induces sleep. Guaranteed. Free literature. Gardiner, 4729CA N. 7th Ave., Phoenix, AZ 85013

STOP Smoking! Easy reliable method. \$5.00. Holden, Box 472, McLennan, Alberta T0H 2L0.

ASTHMA, ALLERGIES: Respiratory problems, concerned about air pollution? Get Relief, Build air filtration unit, save \$200-\$500. Plans \$3.95. Kits Available. Ecopollo, Box 7364, Desert Station, Mesa, Arizona 85206.

MEM! IMPROVE LOOKS! Solve Skin, Hair Problems. Free Catalog. Brian Thomas, 1300-N Route 46, Parsippany, NJ 07054

SAVE 75% Or MORE on PRESCRIPTION DRUG COSTS. Selective Ventures, 736 2nd Street, Secaucus, New Jersey 07094

HEALTH Problems? Learn about natural healing. Free magazine. Provoker Press, St. Catharines 707 Ontario L2R 7C9

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FIRE Will Not RAVAGE Your HOME With A Tested And Proven System That Extinguishes Fire. Details \$2.00 To: Dept. PM3, Box 585, Rockford, Mich. 49341

WORK CLOTHING

WORK Shirts and Pants 6/\$14.00, Coveralls 3/\$18.00, Jackets 2/\$9.00, Leather Gloves 6 pair/\$12.75, Catalog \$1.00. Toll free outside Conn. 1-800-243-3570, Sara Glove Co., Inc. Box 4069-C3, Waterbury, Conn. 06704

DRINKING WATER PURIFIERS

WATER PURIFIED without chemicals - 1¢ / Gallon. Safewater, Box 39195-PM, Phoenix, Arizona 85069.

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BUILD A WINDOW GREENHOUSE - Converting a window in your home to a mini-greenhouse amounts to little more than attaching a box-like plexiglass enclosure to the outside. The beauty is that you don't do a thing to the window other than add screweyes to the frame - the window stays intact. No drafts in winter, no need for caulking. For plan send \$2.95 to: Popular Mechanics, Dept. HE, Box 1014 Radio City, NY 10019.

GARDENING & LAWN CARE

ROSES Be the Envy of your Neighborhood with a Beautiful Rose Bed. 9 Easy Steps. \$1.25 To: N. Kindred, General Delivery, Ross, Ohio 45014

PM'S BESTSELLING "COMPLETE GARDEN GUIDE" For the man who needs all the basics . . . fast! Superbly organized in famous "Master Guide" format. Dozens of tables, charts and illustrations. Literally crammed with timely bonus specialties like vegetables, fruits, nuts and herbs, garden pools, storage structures, planting dates. Only \$4.95 + 50¢ to cover postage and handling. PM Complete Garden Guide, Dept. HE, Box 1014, Radio City Sta., New York, NY 10019

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LEARN Flower Arranging and Floristry. Start business or hobby. Free information on home study course. Lifetime Career Schools, Dept. B-306, # 2251 Barry Avenue, Los Angeles, California 90064.

LEARN Landscaping and the growing of plants. Start a profitable business part or full time. Free information without obligation. Lifetime Career Schools, Dept. A-568, 2251 Barry Avenue, Los Angeles, California 90064.

GROW Ginseng! \$50 Pound. Have Seeds, Roots. Goldenseal. Full information. K. Collins, Viola, IA. 52350

WINEMAKING & OTHER RECIPES

WINEMAKERS-BEERMAKERS . . . Free supply catalog. Yeast. Equipment. Continental, Box 68016-PM, Indianapolis, Ind. 46268

FAMOUS Coney style chili and sauce recipes. \$1.00. Papa Zorba's Kitchens, 404 West Tipton, Huntington, Indiana 46750.

BEERMAKERS. English illustrated book including 25 quality beer recipes. 120,000 copies already sold. \$4.00. Vyvyan C.M. Golf Club Road, Hawkesbury, Ontario, Canada K6A 2R2.

WINEMAKERS-BEERMAKERS -Free catalog-Free Service-Large Selection: Kraus, Box 7850L, Independence, Missouri 64053.

MAKE Wine, beer, liqueurs, Beekeeping supplies. Free catalog. Bacchanalia, 273PM Riverside, Westport, CT. 06880.

WINEMAKERS-Beermakers: Free illustrated catalog of supplies. Semplex, Box 12276R, Minneapolis, Minnesota 55412.

FREE ENCYCLOPEDIA Winemaking, Beermaking, Supplies, Equipment, Ingredients. Vynox Industries, Box PM7498, Rochester, NY 14615

STILL! How To construct, operate! Manual \$1. Craig's, 612A South Hawley, Milwaukee 53214

WINEMAKERS - BEERMAKERS! EXTRAORDINARY INFORMATIVE CATALOG FREE, 350 Equipment ingredients items. DANENBERGER'S, Box 276M, New Berlin, Illinois 62670

BEERLOVERS! Brew American and European beer. Complete kits. Equipment. Supplies. FREE details. Duane Imports, Ltd., Dept. PM39, 508 Canal Street, New York, N.Y. 10013

BEER-WINEMAKING Supplies. 38 Imported Malts Free Catalog. Wine & Brew Hobby, P.O. Box 1866, Allentown, Pa. 18105

MOONSHINE! Whiskey, Gin, Vodka making manual. Special \$1.00. Gourmet, 5133-P Fairhill, Philadelphia, Pa. 19120.

BEERMAKERS, Winemakers, Free Catalog, Recipe. Finest Ingredients, Equipment, Service. SPI, Box 784 M, Chapel Hill, North Carolina 27514.

WINEMAKING/BEERMaking Supplies, Equipment. Free Catalog. Wine Hobby, P.O. Box G-104, Greenwood, Ma. 01880.

CHEFS SECRET! One Pot Gourmet Recipes. Famous Cheesecake. Secret Salad Dressing. Interchangeable Soups - \$2.75 in SASE. A. Viggiano, 132 W. Main St., Babylon, N.Y. 11702

EVERYTHING For Wine, Beer, Catalog: Jim Dandy Sales, Box 30377, Cincinnati, Ohio. 45230

BURGLAR ALARMS & HOME PROTECTION

MAGNETIC Padlocks \$8.95 ppd. Sherrillbrook Corp., Tennyson Circle, New Hartford, NY 13413

QUALITY Burglar - Fire Alarm Equipment at DISCOUNT - Prices!!! FREE Catalog! Steffens Alarm Supply, Box 624J, Cranford, NJ 07016

SAFEGUARD Small valuables, cash with "SOCKET-AWAY" electrical wall outlet with secret compartment. Easily installed, undetectable! \$8.98. Marcam, POB 355M, Westwood, N.J. 07675

BUILD Less \$25.00. Details \$1.00. Parts Depot, 1605 Wyoming, Cincinnati, OH 45205

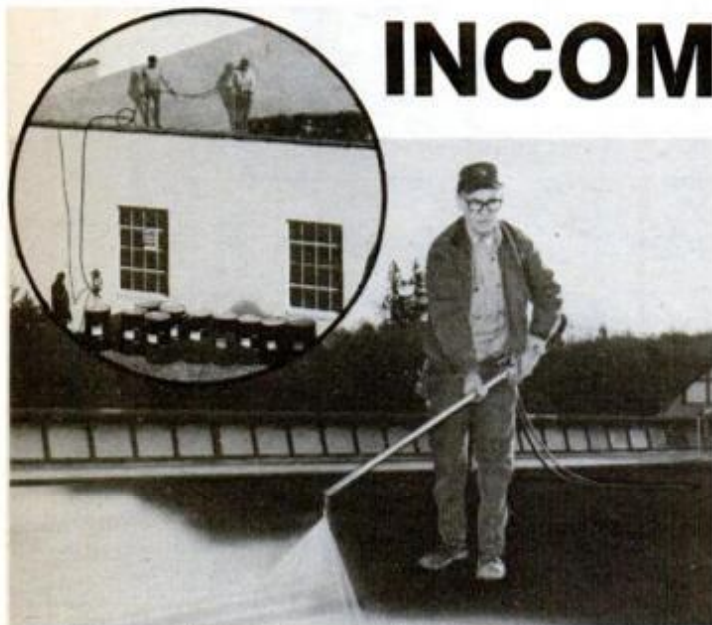
COMPLETE SELECTION of Burglar-Fire Alarm Systems and Parts. Free Catalog. Emel Electronics, Box 146-FD, Sheffield, Mass. 01257

SEAMLESS SPRAY PUTS YOU IN AN INFLATION-PROOF BUSINESS!

SELL PART-TIME MAKE FULL-TIME INCOME

**\$500 ON JUST
ONE ORDER...**

**LOTS MORE
IF YOU WANT IT.**



Make over \$500 on average Seamless Spray sale to schools, factories, shopping centers, etc. Many orders pay over \$1,000 commissions.

Make \$748 on a 10 barrel Seamless Spray order for Liquid Metallic Sidings. The easy, fast way to waterproof, caulk and insulate building exteriors.

Through a series of circumstances created by inflation, I can now offer one of the most unusual opportunities in the history of direct selling. And best of all, you need no specialized experience to handle it. Absolutely none whatsoever!

If you've done any selling at all you know you can't make it anymore selling nickel and dime items. You can't afford to bust a gut selling a half dozen orders a day and wind up making \$25 to \$30. You need a necessity that everybody needs—that's quickly and easily sold because it solves problems born out of the inflation.

We call our process SEAMLESS SPRAY. It fills a vacuum created by the soaring price of new roofs. Roofs everywhere are leaking—in desperate need of repair. Using our Seamless Spray Equipment, factories, plants, shopping centers, schools, hospitals, apartment complexes use their own maintenance people to renew, waterproof these roofs at a cost of less than 12 cents per square foot. We loan equipment absolutely free. On the average Seamless Spray order you make over \$500. You need absolutely no experience in our

business. Our program is organized step-by-step for easy, successful use whether you sell General Motors (they are Seamless Spray users) or the corner garage.

When I tell you, PACE saved one school \$28,400 with Seamless Spray roof renewal, you'll understand how fast you eliminate sales resistance. Your market is pre-sold. Roof contractors with their exorbitant prices hand you the business on a silver platter.

Give PACE as little as 8 hours a week—that's all we ask. Once you start making \$500 and more on one Seamless Spray order, then you'll consider full time PACING. In addition to Seamless Spray you'll also get our Siliconized PARK-KING Blacktop Sealer—our Liquid Metallic Siding—and a complete line of highly specialized Labor-Saving One-Coaters designed to save big money on all kinds of building maintenance. Each meets the BIG SELL concept, where you can make a Big Paycheck everyday you make calls with Pace.

"WRITE ME TODAY FOR ALL THE FACTS!"

R. H. Rogers,
PRESIDENT

Read about the Big Checks other new Pacemen are regularly receiving—how quickly they learn our business with no prior experience. How PACE helps them every step of the way. See how one satisfied Pace customer tells another. Write us a letter or mail the coupon. You'll get "Same Day Action" with all the exciting facts upon which you can make an intelligent decision.

**SHOW ME HOW TO USE INFLATION
TO MAKE OVER \$500 ON SINGLE ORDERS!**



PACE PRODUCTS, INC.

81st & Indiana Dept. PM-379
Kansas City, Missouri 64132

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Address _____

City _____ State _____ Zip _____

EVINRUDE 150. THE QUICKEST WAY TO A FISHERMAN'S HEART.

The Evinrude 150 is a V-6 outboard with the soul of a sports car and the guts of a truck.

In bass tournament competition, it lets you claim the spot you've staked out.

On long, big-water runs, it cruises with an ease that belies the miles you're putting astern.

The strongest slalom skier isn't strong enough to haul it down.

It's a one-of-a-kind blend of high-performance action, heavy duty power, and easy-going economy. A 150 horsepower V-6 with the displacement and heart of a 235. At full power, it's working no harder than a 235 loafing along at two-thirds throttle.



It gives new life to under-powered boats and to old boats that have taken on weight. Its high-torque power pops big-water bass rigs out of the "hole" with effortless ease, and cruises them *efficiently* faster than most boats can run.

The Evinrude 150 has the same 149.4 CID displacement and the same internal parts as its more powerful V-6 brothers. And the same top-line features: Firepower III electronic ignition, pulse-tuned exhaust, dual-overlapped ports, pressure back rings, built-in power trim and tilt, and swept-back Nitro Series lower unit.

And a very reasonable price, all things considered.



EVINRUDE 
PRODUCT OF OUTBOARD MARINE CORPORATION *first in outboards*

TASTE THE GOOD TIMES.

RALEIGH LIGHTS



Lights, 9 mg. "tar", 0.8 mg. nicotine; Lights 100's, 9 mg. "tar", 0.9 mg. nicotine av. per cigarette by FTC method.

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

Extra Burley tobacco fortifies the flavor.

Finally! Genuine tobacco flavor in a low 'tar' cigarette...plus Double Gift Coupons.

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