

Popular Mechanics

How good a driver are you?
Most people fail these 4 tests!

Make PM's home bar with everything - plus a sink

How to tune in ham radio's space station

An expert's 23 best woodworking tips

3 good reasons to buy a lifetime battery

You can lay a parquet floor

OHHHH WOW!
YOUR BOAT GOES SO FAST!

STAY COOL, CHICK!
I'VE GOT EVERYTHING UNDER CONTROL!

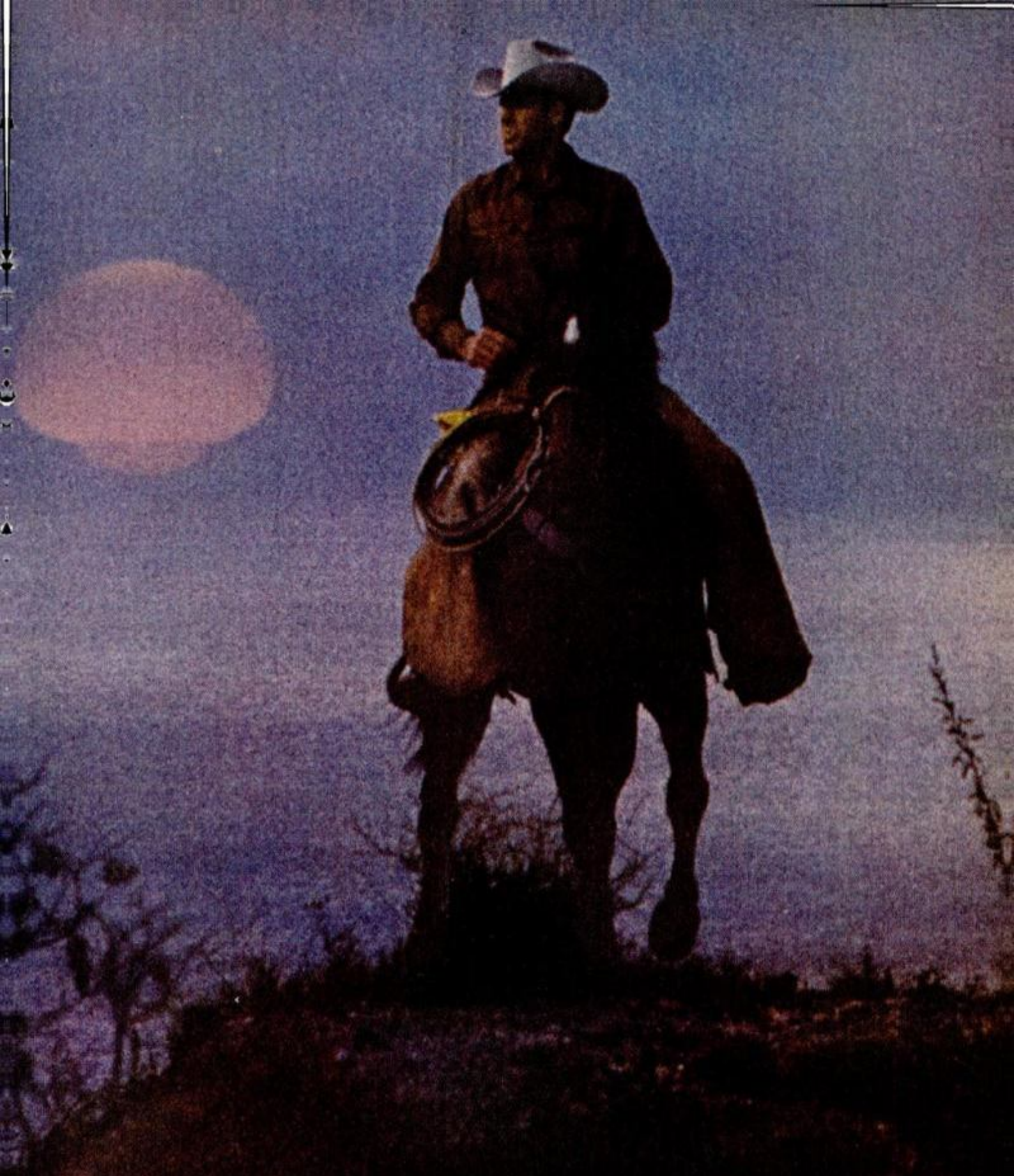
PM DRIVES THIS HOT HYDRO FOIL!

20 BRAND-NEW BOATS
NEW MOTORS
12 PAGES!

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Come to Marlboro Country.**

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





This One



79B5-2L5-E83Y

Kings: 17 mg. "tar," 1.1 mg. nicotine—
100's: 18 mg. "tar," 1.1 mg. nicotine av. per cigarette, FTC Report Apr. 75

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

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WORTH WRITING FOR

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ON THE COVER

PM's Bill McKeown (he should have such biceps) goes flying over the water in a hot new hydrofoil and—shades of Flash Gordon!—cartoonist Dick Giordano renders the event in shamelessly macho fashion.

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Popular Mechanics®

FEBRUARY 1976 • Vol. 145 No. 2

INTERNATIONAL EDITIONS: Australia, Caribbean, Mexico, Southern Hemisphere

SPECIAL FEATURES:

To avoid the accident you'd never forget, you've got to react faster and in a different way than ever before when driving into danger. Page 67.

Special section of 12 pages devoted to BOATS and equipment for this spring. PM's boating editor picks the top new models. Page 90.

What you should know before you buy a big bike gives all the information you need to move up to a large, powerful, comfortable motorcycle. Page 102.

Build this one-of-a-kind home bar—a detailed workshop project that has been designed exclusively for PM readers. Page 114.

Need a spare room for hobby or shop? Your garage will do if you know the three ways to use a one-car garage and still get your car in. Page 120.

10 handsome homebuilts you can fly is a look at the latest, smartest designs for amateur plane-builders. Page 72.



Moving up to a big bike 102

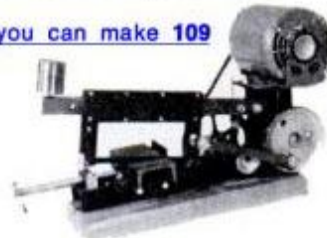


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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A. Single copy for the United States and Canada, 75 cents. Subscription prices: United States and Possessions, \$7.00 for one year; \$13.00 for two years; \$18.00 for three years. Canada, add \$3.00 for each year. All other countries, add \$5.00 for each year. Second-class postage paid at New York, N.Y., and at additional mailing offices. Authorized as second-class mail by the Post Office Department, Ottawa, and for payment of postage in cash. Registered as second-class matter at the Post Office at Mexico D.F., Mexico, June 20, 1950. © 1976 by The Hearst Corporation. All rights reserved. Printed in U.S.A.

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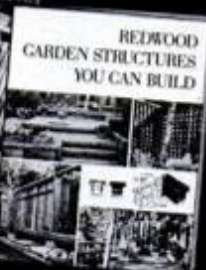
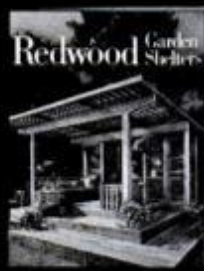
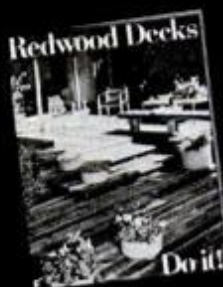


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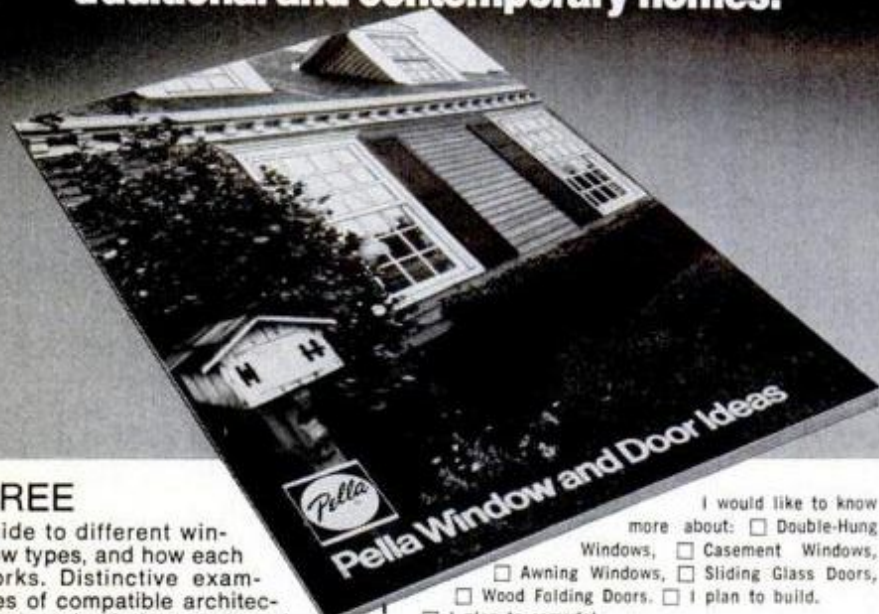
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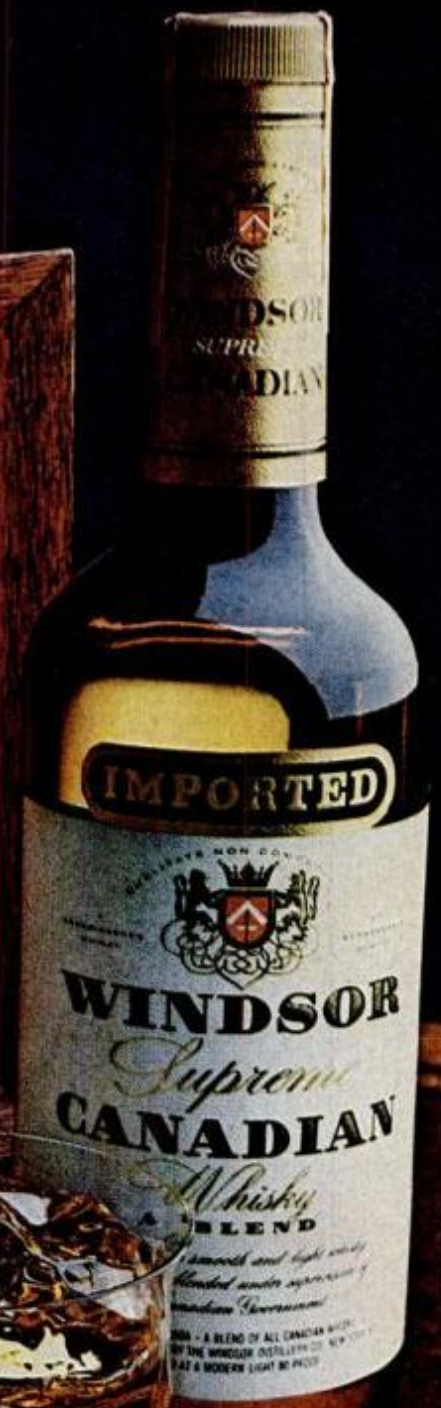
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POPULAR MECHANICS IS PUBLISHED MONTHLY by the Hearst Corporation, 224 West 57th Street, New York, N.Y. 10019, U.S.A., John R. Miller, President; Randolph A. Hearst, Chairman; Harrison A. Mitnick, Treasurer; Harvey L. Lipton, Vice President and Secretary; Hearst Magazines Division: Richard E. Deems, President; Gilbert C. Maurer, Executive Vice President, Operations; Raymond J. Peterson, Executive Vice President, Advertising; William S. Campbell, Vice President and General Manager; John F. D'Avolio, Vice President and Resident Controller; Albert A. Rachol, Vice President and Director of Circulation; Joseph F. Kern, Vice President for Popular Mechanics.

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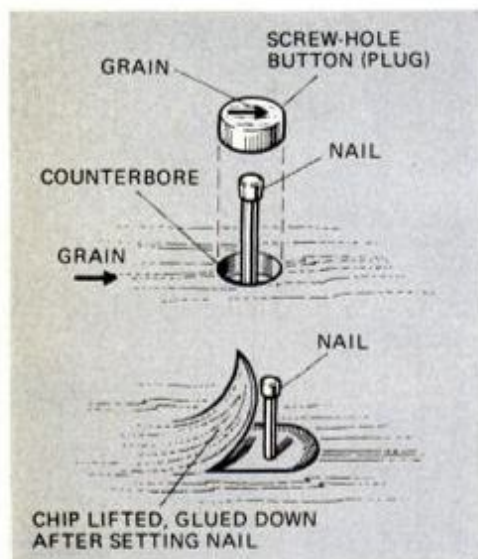
HOMEOWNERS' CLINIC

Two tricks for concealing nails

In repairing an old piece I need to conceal several nailheads on a flat surface. I don't want to use putty or filler as it will show after finishing. The piece is an heirloom and I must do the best by it. How do I bring off this trick?—Earl Dalton, Boston, Mass.

Two fairly effective methods are detailed below. In one, you drive a nail in a counterbore, the large diameter of which is $\frac{3}{8}$ in. This prevents splitting of the old stock. Then drive a wood button plug into the large diameter over a drop or two of glue. In placing the plug, make sure the grain of the latter matches and is aligned with that of the surface. Sand the plug flush.

In the second method, used by old-time cabinetmakers, you lift a chip with a gouge, drive the nail, seat it, and then glue the chip back in place. Sand the new surface flush.



Brick paint stains

Shutters and trim on my brick home have sometimes been painted with a chalking paint. Chalking has washed onto brick walls below and appears impossible to remove with paint removers, cleaners or solvents. I've been told sandblasting is the only sure method of removal. Is there any other, less expensive, way?—H. Bronson Smith, Columbia, S.C.

Sandblasting is the only sure method of removing paint stains from brickwork; the cause must be

removed by recoating the woodwork with a gloss outdoor paint. However, hard brushing with an extra strong solution of trisodium phosphate will often bring about a partial removal of the stains, making them less unsightly. Use two handfuls of the chemical to a gallon of water and apply with a stiff-bristle scrubbing brush. Wear rubber gloves and protect your eyes from splatters.

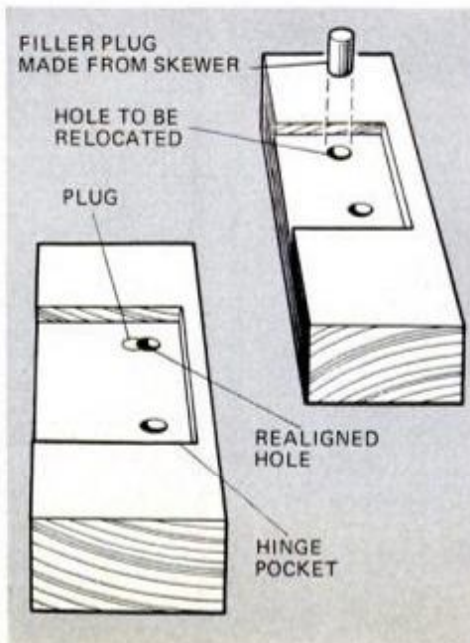
Garage-door weatherstrip

To keep out driven snow and rain I need to install a rubber weatherstrip along the lower edge of a metal garage door. How do I attach the strip to the metal?—Thaddeus S. Kornowski, Sterling Heights, Mich.

I assume the door is of the roll-up type. On all such doors I know of the bottom edge is flat, so that the rubber seal or strip can be attached with screws spaced every 6 or 8 in. along the length. On a metal door you use sheet-metal screws of the self-tapping type, drilling tap-size holes and driving the screws through the rubber seal. As you attach the seal or strip, keep it stretched fairly tight as you go; otherwise it may tend to sag or buckle between the screws.

Shifting tiny screw

I need to shift a tiny screw holding a hinge a little over half the diameter of the hole. How can I do this?—John Little, Sacramento, Calif.



You say "tiny" so I must assume the screw is a No. 1 or 0 size, and that your purpose is to tilt the hinge slightly. It's tricky, but usually can be done successfully as detailed, using a piece cut from a skewer (round toothpick) as a hole filler.

Cut a section of toothpick that will fit tightly in the existing hole, coat it with glue, tap in place in the hole and file the projecting end flush. Wait until the glue dries, then locate the new hole with a punch mark made with an awl and drill to the required depth.

Faucet washers wear out

I have to replace washers in faucets every six months or so. The seats seem in good condition, yet the old washers have rather deep grooves when examined closely. What's wrong?—Frank J. Hall, Bergenfield, N.J.

You may need to resurface the washer seats with a tool made for this purpose. Usually such a reseating tool is available from a local rental service for a nominal charge. Be sure washers are the right size.

Crumbling mortar

I recently bought an older home with fieldstone foundation walls. Mortar in the walls seems to be crumbling at the surface, inside and outside. How can I prevent this?—E.A. Gauthier, Manchester, N.H.

Repointing is the only permanent remedy but you can slow this deterioration for some time by using a clear masonry sealer. Brush off all loose material with a stiff-bristle brush. Then coat the mortared joints with the sealer, following instructions for application. You should understand that this is only a stop-gap procedure that will extend the life of the mortar for a year or more at a reasonable cost in time and cash outlay. ★★★

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

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per cigarette, FTC Report
MAR. '75.



**AMERICA NEEDS ONE MILLION MORE
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THE FUTURE BELONGS TO THE FEW OF US STILL WILLING TO GET OUR HANDS DIRTY.

If you like to work with your hands, you've got two advantages over people who work at a desk.

First, you're likely to end the day with a smile on your face rather than a knot in your stomach. Because you can see the results of your work right in front of you. Real. Satisfying. It's good to be able to say, "I built that...I fixed that...I made that happen." And to walk away from the job with no doubts about it or yourself.

Second, when you consider how technologically complex our life has become, with cars, appliances, and factories full of machinery—all in need of maintenance—you realize that America cannot do without her skilled craftsmen, repairmen, and mechanics. And it's satisfying to know you're needed and appreciated.

Why do we tell you this? We're ICS, International Correspondence Schools. And while we can't guarantee you a job—no school can do that—we can give you the first-rate training you need, especially if you're interested in one of the grow-

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field that interests you most and mail the postpaid card today. There's no obligation.

A lot of Americans these days are allergic to dirt under their fingernails.

That means more opportunity for those of us who aren't. Remember, it's your life. You might as well make the most of it.

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

*Source: U.S. Office of Education publication, "25 technical careers you can learn in 2 years or less."
†Source: 1974 U.S. Dept. of Labor Occupational Manpower and Training Needs

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LETTERS

TO THE EDITOR

Let 'em disappear!

The article, *How to Stay Alive on a Motorized Bicycle* (page 56, Dec. '75), had one item commendable for its accuracy. It is the caption on page 58 which mentions "two-stroke" engine. It is usually and wrongly called "two-cycle." Your accuracy is appreciated.

What is not appreciated is editorializing instead of facts, particularly your bias to force bike riders to use helmets! Let those that don't use them get killed young enough to eliminate their genetic strain.

R.W. LONG
MOORE HAVEN, FLA.

Repair tips confuse

Your Fuel-Injection System: How It Works and *How to Keep Your Fuel-Injection System Working Smoothly* (pages 97 and 100, Nov. '75) offer car owners an opportunity to become familiar with the newer fuel delivery systems. Unfortunately, trying to cover four different types in an all-inclusive article is confusing and has led to some misinterpretations. For example:

1. Pinching the hose on the pressure sensor is not a meaningful test, since it does not cause a vacuum change (air does not flow through the sensor). It is best to remove the hose which vents the sensor to atmospheric pressure (no vacuum).

2. The injector resistance test indicated will not identify a fault since most general-use ohmmeters are not sensitive enough to differentiate between 2.4 ohms (normal) and zero ohms (short).

3. Disconnecting the engine temperature sensor will not always give the result indicated. On most cars, the engine will not run when this sensor is open-circuited. Most importantly, none of these tests identify the most likely cause of failure. Effective diagnosis of an EFI system requires specialized test equipment.

4. A water-filled, or clogged, fuel filter is indeed a major problem but obvious symptoms like high-speed sputtering will be evident long before it affects starting. It goes without saying that heating the fuel filter and open-air-spray testing of injectors is a hazardous procedure at best.

DONALD F. HAZELMAN
JANBO INSTRUMENT CO.
EL MONTE, CAL.

The articles were designed to give weekend mechanics an introduction to fuel injection, not a complete course. All procedures we described are technically sound and recommended by experts (for example, Cadillac's technical service department and VW of America service training department).

A 'colonial charmer'

Here is a picture of a dry sink my son just made for me using your plans (*A Little Colonial Charmer You Can Build for \$45*, page 38, Feb. '72). He built it in his own shop from some used pine boards his uncle supplied. Needless to say, I am very



proud of the cabinet and of my son, who is 14 years old.

MRS. JAMES PARMITER
NORTON HILL, N.Y.

How to count aircraft

Enjoyed your story on the F-16 (*F-16: The Fighter Everybody Wants*, page 72, Nov. '75). However, you were way off base with the statement that if 3000 to 4000 F-16s are built, it would be "possibly the greatest number of any one aircraft type ever manufactured."

Look at some of the World War II production runs and you'll see what I mean: 12,731 Boeing B-17s and 10,123 C-47s were built, plus 803 DC-3s. From 1940 until 1953, 12,751 Vought Corsairs were made.

Even some civilian types have been made in total numbers two to three times your possible F-16 production. Cessna has made more than 15,000 of their 172/Skyhawk model. As far back as 1966, they made and sold

3000 of their Model 150 in a year.

ROBERT W. STAILEY
DUBLIN, OHIO

Yes, the statement was misleading. The intent was to imply that even more than 4000 may be built.

Airplane buffs have a field day when it comes to identifying various models in those big runs.

Many warplanes were so modified during extensive production-line changes that the later models bore little resemblance to their predecessors. About 13,000 P-40s were built, for instance, but the P-40E was in many ways a new plane compared to the original P-40.

Fantastic ceramics

Richard Dempewolff's article on ceramics (*Ceramics: Fantastic New Materials That Will Change Your Life*, page 52, Dec. '75) is indeed very exciting.

The great possibilities in the ceramic field point out a new and exciting field for young people. The article also made a tremendous contribution to those of us over 40. Millions of Americans earn their living either directly or indirectly from products and services that are dependent on those very metals that are so swiftly disappearing.

You've given us time to rethink our situation—to plan ahead and to find out about the unlimited possibilities of ceramics. Many thanks.

W. FRANK DUNN
DALLAS, TEX.

Doesn't make sense

I usually find your articles informative and useful, but *How To Stretch Your Gasoline Dollar: Retune for Regular* (page 64, Dec. '75) is an exception.

Assuming a motorist buys 1000 gallons of premium gas per year at an average of 6 cents per gallon more than regular, it does not take a C.P.A. to figure that at \$60 per year, it would take two to three years to recover the investment. Even to do it yourself and expend a day at hard labor—plus parts—in order to save \$1.15 weekly hardly makes sense to me. Also, how about the likely loss in performance and reliability that can result from this needless tampering?

KENNETH F. CAHN
LONG BEACH, N.Y.

Here it is from Firestone...



Big Rig Toughness on Little Truck Tires!

You probably think you've looked everywhere for ways to lower your costs and pick up your profits. But if you're running a panel or a pickup or a van and you haven't thought about tires, think about this:

Firestone makes their Transport* truck tire in sizes to fit smaller trucks, even vans and pickups. Which means you'll have rugged nylon cord body, long mileage tread rubber, and the same tread design we put on the big rigs.

How much do they cost? Even though you would probably expect to pay much more for these tires, in many sizes you pay *no more than for a passenger tire!*

You don't use handyman's tools as a professional — so don't use handyman's tires. Get the Firestone Transport at your Firestone Dealer or Store. A tough tire for tough times.



Firestone
TRANSPORT

A lot of tire for little trucks.

THE BICYCLE SHOP



When, not if, your bike frame becomes so scratched it needs touchup or complete repainting, you can bring it back to showroom condition with the easy steps following.

Some bike makers, such as Schwinn and Raleigh, provide spray cans of matching paint. They're okay for touchup, but even for these simple jobs I prefer a spray gun that gives a finer, glossier coating. Paint spray cans give a coarse spray that makes a professional painting job almost impossible. It takes three or four spray cans (at \$2.50 or more

stripe. It stops messy overspray, hazards of fumes in air, saves paint. This "gun" has many after uses.

Sandpaper: Use coarse sandpaper for spot removal down to bare metal. Use silicon carbide grade 400 fine sandpaper to wet-sand primer coats and dry-sand the next-to-last coat of finish paint.

Paint remover: To remove all paint from the frame, I recommend sandblasting. If you have an air compressor, you can buy a simple sandblast gun such as the W.R. Brown Co. gun which looks like a spray gun except for the hard steel nozzle. Use dry white silica sand (about \$2 per 100-lb. sack), an old bike box to collect and reuse sand, a simple filter to breathe through and face mask to shield eyes. Or send frame to a professional sandblast shop (about \$15). Or use chemical paint remover such as Martin-Senour No. 6801 Paint Blitz.

For general instructions, I urge you to buy the excellent Martin-Senour 68-page book *A Guide To Better Automotive Refinishing*, for \$2 from an auto parts store.

For spot repair

1. With rough sandpaper, remove scratched area down to bare metal. With finer sandpaper, feather-edge.

2. Mask areas where paint is not wanted, such as over stripes.

3. Spray primer and finish paints. Spray two coats of primer, allowing a half minute or so between coats. After six hours, sand primer with fine sandpaper, then spray finish coats, letting each get dry to touch before next coat (about 30 seconds). Hold air gun at right angle, move four to six inches above surface. Turn off gun after each stroke to avoid runny paint buildup. If paint runs, spray over lightly to flow out. Be sure not to spray in an arc; *gun must always parallel the work surface*. Practice on old pipe.

4. With fine sandpaper, lightly sand next-to-final finish coat, after six hours' drying time. Spray final coat, but don't sand it. Don't polish it for at least 90 days.

For complete frame finish

1. Remove wheels, fork, cranks,

(Please turn to page 16)



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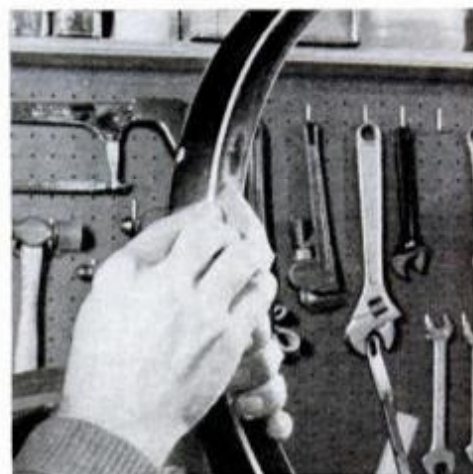
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Feather sand any damaged spots before you apply primer and final coat of paint.

per can) to do a complete bike, not counting undercoatings and primers. As for decals, you may wangle them out of the more-popular-make bike dealers, but don't count on it. I remove them with the old paint.

Here are the materials you will need for touching up spots or complete frame refinish:

Paint: I recommend an acrylic enamel, such as Martin-Senour, which combines fast drying and durability of acrylic lacquer with high gloss, flow and ease of handling enamel. See instructions on the paint can for correct reducer for various temperatures. Acid-etch bare steel first with Martin-Senour No. 6879 twin etch for good adhesion. Both paint and primer must be reduced (thinned) per can instructions for spraying.

Spray gun: I like a Binks "Wren" air gun (with compressor about \$75.) that can be adjusted to a spray pattern small enough to pencil

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THE BICYCLE SHOP

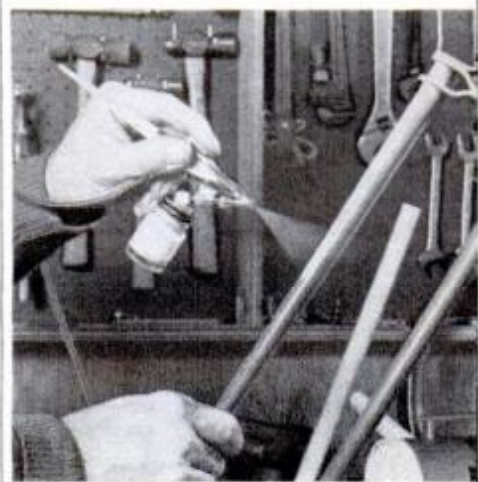
(Continued from page 14)

derailleurs, chain, bottom bracket handlebars, stem, seat and seat post. Mask threads on bottom bracket, derailleur "ear," fork top. Remove fixed cones on bottom bracket, headset and fork.

2. Mask all chromed areas. (You can redo pin striping with masking tape and Wren air gun later.)

3. If paint is not badly scratched or weathered, rough sanding is only preparation needed. If finish is badly scratched and marred, remove down to bare metal with sandblasting or chemical paint remover.

4. Immediately after sandblast or chemical paint removal, apply acid



This mini air gun is just right for refinishing bicycles or other small items

etch such as Martin-Senour Twin Etch to avoid rust and provide good "bite" for new paint adhesion.

5. Apply primer and finish coats as in steps three and four in spot finishing above.

Some tips

Stir primer and finish paints well. Use same type primer as finish. Use only reducers recommended for primer and finish and select reducer according to temperature (see instructions on can). Always spray in well vented area, never near flame such as a furnace or water heater.

I prefer the back yard on an over-60°-F. day in calm air. Hang bike parts from line or overhead pipe. Clean spray-can nozzle of accumulated dry paint every five minutes or so. If indoors, use face mask filter to avoid breathing paint mist. If you use chemical paint remover, be sure to wash off all traces of remover with soapy hot water; rinse and dry thoroughly. If frame was sandblasted, blow out all loose sand from frame before priming. Two coats of primer and three or four of finish should do.

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IMPORTS AND MOTORSPORTS



Another happy hatchback

You won't see this one until next month when it should be in the bull's-eye position in showrooms at Chrysler/Plymouth dealers nationwide. The Plymouth Arrow is certainly right on the mark in the styling department, also impressive in its mechanicals. Like the Dodge Colt, Chrysler Corp.'s other captive import (Colt and Arrow are made in Japan by Mitsubishi), the Arrow uses the 2000-cc overhead-cam engine with the just-introduced Silent Shaft feature. This twin-shaft arrangement reduces engine vibration.

The Arrow, slightly smaller and lighter than the Colt, will be available in three states of trim: the base model (above), and GS and GT versions. The GS trim includes more carpeting, comfort and convenience items; the GT adds some real equipment over that: five-speed transmission, radial tires, full instrumentation and more.

Basic dimensions and weight of the Arrow are:

Wheelbase	92.1 in.
Overall length	167.3 in.
Overall width	63.4 in.
Overall height	52.5 in.
Curb weight	2200 lbs.

We estimate that the base price will be about \$3000.

Amazing race

I don't know how they do it, but Subaru's four-wheel-drive station wagon at \$4149 has got to be the automotive equivalent of a good five-cent cigar. I drove all of the '76 Subarus at Sears Point International Raceway recently, but spent most of my time in the 4wd wagon on the off-road course in the hills above the

road circuit. It was great sport just getting up and out of places where two-wheel drives would fear to tread; it was even better trying to do it as fast as possible. I wondered why I didn't wind up with a headache the way my helmet was bouncing against the headliner, but I wondered more



how nothing on the wagon bottomed or broke.

All seven Subaru '76 models use the SEEC-T engine (for Subaru Exhaust Emission Control Technique) which does the cleanup job without need for add-on air pumps, metering systems or catalytic converters. The lean-burn design has a special air-intake valve to move extra air into the cylinders. The 1400-cc flat Fours give the Subarus an EPA of 39 mpg highway and 29 mpg city. The base two-door sedan is \$2899 with radial tires, power-assisted front disc brakes and reclining buckets. All are front-wheel drive, except that 4wd wagon, terror of terra firma and the not so firma.

Camping in

You won't notice the changes in VW's Campmobile unless you're invited over for a drink. The new swivel passenger seat and the floor plan make the mini-motorhome much more livable: The plumbing, sink, refrigerator and stove have been incorporated in one console on the left side of the vehicle to provide more floor space.




Under the hood—the rear floor that is—there's a bigger air-cooled Four: up to 2 liters from 1.8. The price now starts at \$6600, but it zooms up to \$8000 when completely equipped.

Motorize your Motobecane

Here's a development that's guaranteed to shock serious cyclists right off their saddles. But horsepower instead of legpower isn't taboo to everyone. This 11-pound, 0.8-hp gasoline engine fits on the front fork of a 10-speed or any other bicycle and turns the front wheel through a driving roller. It's double-muffled and lets you cruise at 16 mph at 0 rpm of the pedals. \$170. TAS Industries Inc., 12728 N.E. 15th Place, Bellevue, Wash. 98005. ★★



A man with dark, curly hair and a friendly smile is the central figure. He is wearing a light-colored, textured sweater over a checkered collared shirt. He is holding a pack of Salem cigarettes in his left hand and a lit cigarette in his right hand. The background is a soft-focus green field, suggesting an outdoor setting. The overall tone is relaxed and casual.

**People ask me
if I really enjoy
smoking.**

I sure do. And Salem Longs are why. They give me all the good cigarette taste I'm smoking for. Plus Salem's fresh menthol. And they're longer, too. That's why I enjoy smoking. That's why I smoke Salem Longs.

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

19 mg. "tar", 1.3 mg. nicotine av. per cigarette. FTC Report MAR. '75.

THE PM GARAGE



Two home sparkplug cleaners

Most home mechanics toss out their used sparkplugs, not realizing that cleaning can double or triple plug life. For years I've had mine sand-blasted at a local service station



Jaycraft Turbo-Blast

(15 cents apiece), and I usually get 40,000 miles from a set.

So when I began seeing ads for plug blasters to be used at home, I ordered two of them—a \$9.95 unit from Elco and the \$19.95 Jaycraft Turbo-Blast.

The Elco uses 12-volt current from a car battery and, in my opinion, does a totally inadequate cleaning job. I



Elco

rate it "not acceptable" for that reason alone. I noticed, too, that grit from the blaster can enter the electric motor, so I suspect it won't last long. And why should you have to run down your car's battery when you always do tune-ups near house current?

The Jaycraft Turbo-Blast does much better, but it's still not up to the standards of filling-station blasters. You must loosen hardened carbon with a scraper and wire brush (both provided) before blasting.

These plug blasters work on the same principle: a blower shoots sand or silicon beads toward the plug tip.

Elco has no real system to recirculate sand, so you have to turn it over and over in your hand to get the sand back in its hopper. Jaycraft recirculates the beads automatically.

If you're maintaining a fleet, consider the Jaycraft. Here are addresses: Elco International Ltd., Box 280, River Forest, Ill. 60305; and Jaycraft Corp., 760 North Marshall Ave., El Cajon, Calif. 92020.—*M.L.*

Audio tune-up guides

These Audel tune-up tapes are a delight to use, especially after you've struggled through straight printed instructions. Not that Audel asks you not to read—the tapes are in addition to printed instructions. But once



you've gone through the recording along with the Audel booklet, chances are you'll be able to do the tune-up and maintenance with just the tape, referring occasionally to pictures in the Audel booklet.

Audel Mini-Guides include audio cassette instructions plus an illustrated booklet. Mini-Guides are presently available for most Volkswagens, Ford products, GM cars, Chrysler Corp. models, Toyotas and Datsuns—all as far back as 1964.

The instructions assume you have never done a tune-up. You go step by step through cleaning, disassembly and reassembly. The only thing I recommend that they don't suggest is that you get a foot-pedal on/off switch.

This is a tune-up guide that really lets you do it yourself—no kidding. At \$7.95 per, it's a good deal, because you can save that amount many times over in shop labor charges.

Most auto stores carry Audel's

Can-Do Tune-up Mini-Guide book/cassette combinations, or you can order them from Howard W. Sams & Co., Dept. PM, 4300 West 62nd St., Indianapolis, Ind. 46206.—*M.L.*

Liquid patch for a car seat



When a rip developed in the driver's seat of my aging Dodge, I figured I'd either have to put on expensive new vinyl or cover the tear with not-quite-matching tape. Thus, I was happy to try a new product that promised to do the job inexpensively and leave the seat looking near-new.

It's Vinyl Liquid Patch (VLP), a fast-drying clear product that can be applied directly from its tube.

Following instructions, I drew the torn edges together and placed strips of tape across the tear at about 1-in. intervals. I applied VLP to the exposed edges and let it dry 30 minutes.



Then the tape was removed and the remaining portions treated similarly. Finally, a wide band of liquid went over the entire repair.

After four months, the patch is holding up very well. It's still slightly glossier than the seat (despite my attempts to sand it, as instructed) but it looks far better than before.

A one-ounce tube (which covers a 1 to 2-foot rip) is \$1.98 ppd.; Plasti-Dip International, 1430 West County Rd. C, St. Paul, Minn. 55113.—*J.A.L.*



PLYMOUTH VOYAGER

NO OTHER WAGON WORKS HARDER ON A GALLON OF GAS.

As a wagon buyer, you're a special breed with special needs. Try Voyager on for size. It comes with two different wheelbases, plus an extended body version that seats 15 people. Which is three more than any other wagon. Obviously, the more people room, the more cargo room.

**26 HIGHWAY MPG,
18 CITY MPG.**

That's according to the latest estimated EPA test results on Voyager's Slant 6 with manual transmission. If you don't think those are incredible figures, just compare them with those of any other wagon built anywhere in the world. Your

actual mileage may differ depending on how and where you drive, the condition of your wagon and its optional equipment.

**A TURNING DIAMETER
3-FEET SHORTER?**

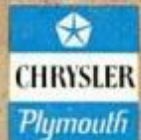
That's right. 3 feet shorter



than Ford or Chevrolet. Which means tight U-turns and easier parking. Especially with optional power steering. Plus standard power front disc brakes and independent front suspension.

HERE'S "THE CLINCHER"

For the first 12 months of use, any Chrysler Corporation dealer will fix, without charge for parts or labor, any part of our 1976 passenger cars we supply (except tires) which proves defective in normal use, regardless of mileage. The owner is responsible only for normal maintenance like changing filters and wiper blades.



In California, see your dealer for mileage data for California equipped vehicles.



The fresher your plugs

The more you think about it, the more it makes sense.

The more efficiently you "burn" your gasoline, the better your mileage. And the part that starts that "burn" is a spark plug.

So if your plugs are worn, fouled, coated or damaged you won't get that efficient burn.

Result. Wasted gas. Poor performance. Money lost.

How much better mileage will you get with fresh plugs?

We've been running extensive mileage tests on everyday cars like yours.

And so far nearly 3 out of 4 of the cars tested got better mileage when we

replaced the existing plugs with fresh Champions.

Just how often should you change plugs?

Here's a good, firm answer: It depends.

It depends on where you drive. Stop-and-go city driving will age plugs faster than highway driving.

It depends on your engine. An engine in good overall shape will be easier on its plugs than an engine that has some chronic problems.

It depends on your gasoline. For instance, many people must use unleaded gas in their '75-'76 cars. And many others use it hoping to get longer life out of their plugs and exhaust systems. But if your engine knocks slightly with unleaded gas, you're not doing your plugs any favors. So check your timing. And keep an eye on your plugs

for preignition damage.

We have, however, found that a plug loses efficiency after about 10,000-12,000 miles. So if you time your plugs with your odometer, you should be OK.



WORN OUT.
12,000 miles have taken their toll. Replace.



GLAZED.
Replace with a "colder" heat range.



OILY.
A sure sign of mechanical trouble. Replace plugs. Check rings.





the better your mileage.

The one-plug check.

There's an easy way to check your plugs. Pull just one. What happens to one generally happens to all.

Then trust your eyes. If a plug looks worn, it is worn (like the plug shown on the left with 12,000 miles on it). Check for pitted electrodes, or a burned insulator. If these conditions exist, replace the entire set.

The one-plug check can also warn you of other things. If it's oily, you may be a candidate for a ring job (sorry about that). And if it's fouled, better check your ignition system.

Are fresh plugs a replacement for a tune-up?

Absolutely not. Your condenser, points, etc., all age at their own rate. So eventually a whole tune-up will be necessary. And beneficial.

But when it comes to mileage, spark plugs are critical. And your plugs can be ready for replacement far before you need a whole tune-up.

Why should you fill 'er up with Champions rather than some other plug?

First, we've got your plug. Champion makes the right spark plug for nearly every engine made in the world. So when you need plugs, all you have to look for is the Champion sign. When you find our sign, you've found your plug.

Second, we've got proven performance. Champion plugs have powered more winning cars,



boats, planes, snowmobiles and motorcycles in the past years than any other plugs made.

And third, we've got new packs. With our convenient 4, 6 and 8 packs, you don't have a lot of loose plugs to contend with.

So remember. Fresh plugs mean better mileage. And when it comes time for you to buy your next set of plugs, remember the folks who are trying to help you save money with handy messages like these.



**Fill 'er up
with Champions.**

Toledo, OH 43661

DETROIT LISTENING POST



40 mpg-plus for Ford mini

If Henry Ford II has his way, which he usually does, the Ford mini coming from Germany in 1977 will beat Chevrolet's Chevette on miles per gallon. That means something over 40 to the gallon. Ford's chairman has set 40-plus as a minimum—emphasize minimum—goal for his engineers and he would like to top the target by enough of a margin to give Chevy cause for concern.

Unlike some of his subordinates, Ford's head man does not bad-mouth the Chevette. He thinks it's a pretty fair car and doesn't mind saying so.

Denosing the diesel

Bob Stempel, director of engineering for Chevrolet, says it's going to be a while before you will be able to buy a GM car with a diesel engine. The GM diesel is an Oldsmobile product, so what does a Chevrolet guy know about it? Stempel spent 14 years at Olds before moving to Chevy. He says the diesel has a lot of good things going for it, but it's going to take a few years to put a diesel-powered car on the streets because of the noise problem.

"There's a very major acoustical problem with the diesel," Stempel declares, "and you need something like a double engine compartment along with sound deadeners to quiet it down."

The sound problem isn't a problem if you're talking a price of \$15,000 to \$20,000. You isolate the engine and pack plenty of sound-absorbing material around it. But the higher the price of the car, the fewer you sell. Stempel didn't say so, but GM would like to keep the price around or under \$12,000. So the trick is to denoise the diesel in a way that won't kill the car by overpricing it.

Chrysler lean burn stalled?

What's with Chrysler's lean-burn engine? Is it off, on or in limbo? Chrysler has been backpedaling on the LB since it announced the engine last summer.

■ **Item:** The company said it would use the LB with two engines, the 400 and 440-cu.-in. V8s. Chrysler now says it will be used only with the 400.

■ **Item:** The firm said it would install the LB in 200,000 '76 models. That projection has now been whittled down to 30,000 or 40,000 cars.

■ **Item:** Chrysler said if the government would freeze the standards on controlling pollution, it would go lean burn on all cars beginning with the '77 models. But with the late start in getting the LB on the '76 cars, there's no chance of going LB on 100 percent of the '77 cars regardless of what happens on emission standards. Finally, there's the matter of getting dealers to purchase the special shop equipment that's required to diagnose the electronics on the engine to service it. Dealers say they are willing to invest in the equipment. But they want some assurance Chrysler is going to build enough LB cars to make the investment pay off.

While the Chrysler LB is lagging, the idea is still very much alive. And not just at Chrysler. I don't know about American Motors, but insiders at GM and Ford confirm reports that those companies are pushing lean-burn programs to catch up with Chrysler.

Vega engine to outlast car

The aluminum engine used in Chevrolet's Vega will survive even if the car doesn't. That's a twister of a story. At one time, as Chevy now admits, the company had so much trouble with the engine there was talk of dumping it. Or at least pulling it out and replacing it with a conventional cast-iron job until the problems could be solved.

It took almost five years to get the bugs out, but it is now one of the most efficient, problem-free engines in the GM catalog. It is the only GM engine carrying a 60,000-mile guarantee.

Chevrolet is now looking toward increasing the aluminum content by going to an aluminum head. If Vega gets clobbered into retirement by its new small brother, Chevette, the engine will be used in other Chevrolet cars, other GM makes.

Aluminum: faults and virtues

Speaking of aluminum, there's a lot of talk about the light metal finally

coming into its own in automaking as a result of the effort to get the weight out of cars to improve their mileage.

The guys I talk with have mixed feelings about aluminum. They say it's great for saving weight if it's used in sheet form—for body panels and major sections. But they don't like aluminum versus heavier, harder metals on parts where tolerances are critical. Aluminum can be machined for close tolerances, but it is more difficult to work with and production and fabricating costs are higher.

So you will see more aluminum being used for hoods and decks. But except for the Vega head, you won't see very much aluminum used for precision, working parts. Maybe in the future, but not in the next three or four years.

GM's last-forever battery

There's been talk around Detroit for years of life-of-the-car components—parts that will last as long as the car. The auto companies have done a good job of extending the life of many items. Parts last longer than they used to and require less frequent service. But they haven't reached life-of-the-car status.

The AC-De'co Div. of GM has developed a battery that would be life-of-the-car, but unfortunately it isn't available for automobiles. Not yet, anyway. It's called the Delco 1200 and it's a special heavy-duty job for trucks. The battery came out a year ago and AC has been keeping tabs on 300 batteries it sold to truck operators. Most of the trucks have run up 250,000 to 300,000 miles without a battery failure and one rig rolled up more than 350,000 miles with the battery still going strong. That's more battery than most cars need because cars are usually junked at 125,000 to 150,000 miles.

AC already has a maintenance-free battery for cars. This battery never needs water, checking, cleaning or service. But it's not a 300,000-mile battery. If they could just combine the longevity of the truck battery with the no-maintenance features of the car battery, that would be a real last-forever item. ★★★



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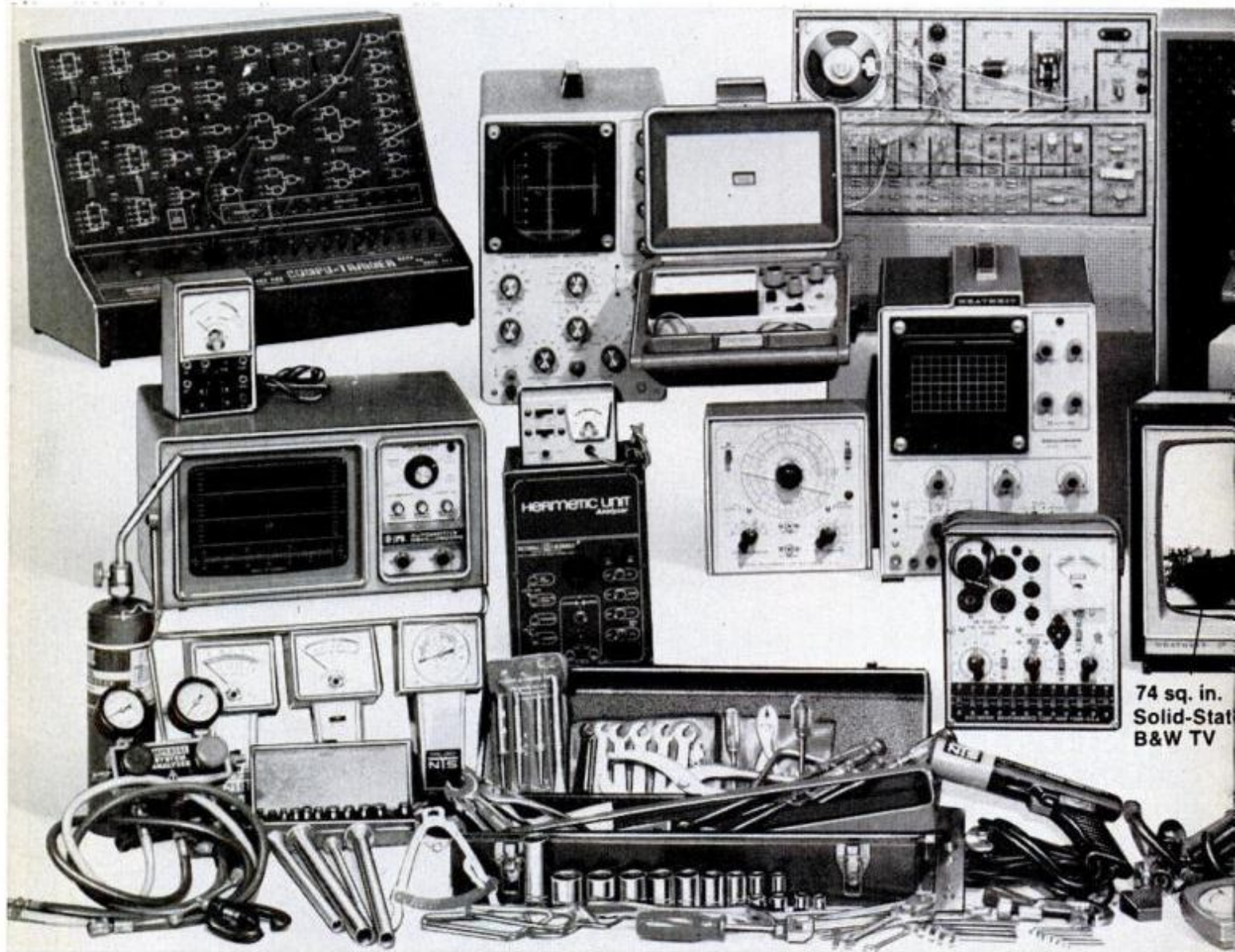
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ALL OUTDOORS

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No argument, except over method

There is no argument that we all want to protect and preserve the mountains, fields and streams that make up our outdoor heritage. But start discussing methods and you've got a fight right away.

Recently this department has been getting more letters calling for banning four-wheel-drives and snowmobiles, trailbikes and recreational vehicles, guns and powerboats, fish finders and climbing pitons. And then there are the writers who claim that any regulation, license, limit, or registration does no good and is an infringement on personal liberty. One group would probably claim that cars should be outlawed because they kill people. The others would cancel all drivers' licenses because they obviously don't prevent accidents.

Most of the damage to environment and people doesn't seem to occur, however, until the various machines are used by someone. Perhaps a moderate course somewhere between total prohibition and the repeal of all regulations, plus some constructive education, is a better answer to many outdoor problems.

Hy-foil bonus

Late word just in from Ken Cook, designer/engineer of the hydrofoil sportabout (page 94 of this issue), is that build-and-fly boatmen can cut costs now by buying the craft in kit form from the Red Bank, N.J., Hydrofoils Inc. Instructions with the new kit, however, should probably be followed closely—our impression of this form of flying afloat is that your creative modifications of the plans should come later.

Snow sport

Racing—the snomo competition that did so much to develop the sport—is back and just may build up snowmobiling again. Once more, factory teams are afield; names like Yamaha, John Deere, Mercury, Ski-Doo, Arctic Cat, Polaris and Scorpion are scoring at the SnoPro and SnoAm ovals and cross-country marathons. No snomo (or outboard or trailbike) owner likes a team of factory professionals to move in and wipe him out, but the builder demonstrations

do a lot to show what's possible with a hot machine. Action this winter indicates the industry shake-out may be over, and snowmobiling as a sport can get back to normal growth again.

► Farther afield, for skiers who can schuss over to Switzerland next month, the Engadine Eighth World Cross-Country Marathon is a 26.2-mile classic that just about anyone can try. Over 25,000 entries are expected, and all finishers within the six-hour time limit receive a stamped start number and printed results. Entry information is available from Swissair.

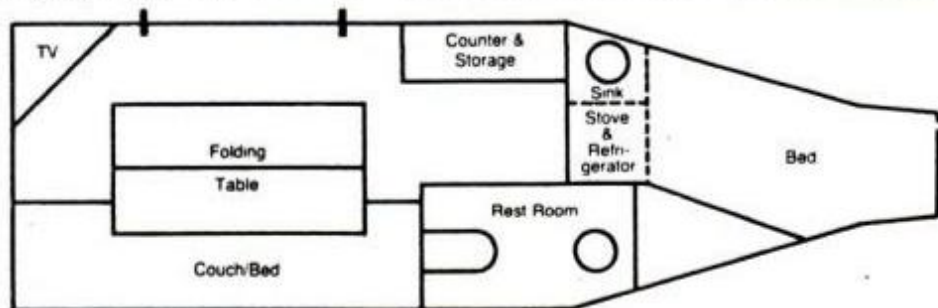
Vertical getaway

Not only is Winnebago sleeking up its familiar RV shoe-box shape, but it has streamlined one model into a chopper-built-for-six. Named Winnebago Heli-Home, it comes with air-conditioning, bath with hot shower, stove and refrigerator, dinette, bar, beds, and a rather considerable price tag of \$180,000 for the 800-hp Sikorsky H19 helicopter and Winnie conversion. But for a company that can

Administration, *Nautical Chart Symbols and Abbreviations*, giving important notation changes. Instead of the dot over each navigational buoy, for example, there's a circle reminder that the mark may swing with tide or current, or sometimes drag anchor, and become a collision hazard if visibility is low. There's a good review of all chart symbols.

For dodging water hazards, stuntman Hal Needham claims a world record with a 138-foot jump in a Cobia boat mounting a Johnson 135 outboard and a jet-assist rocket. The launch off a water-ski ramp was filmed for a new movie, "Gator."

High-flying RV, Winnebago's answer to technical climbing, is an 800-hp Heli-Home.



call one a business cost to take clients camping, or for a well-heeled outdoorsman, Winnebago seems to have the up-and-away answer.

Buoys that get around

Boat owners ordering updated charts each year—(You don't? You should)—ought to get a new booklet from the National Oceanic & Atmospheric

Fish story

Honest records of the largest fish ever caught are being compiled at the new National Fresh Water Fishing Hall of Fame at Hayward, Wis. Junior and senior categories for bait casting or spinning, fly casting, pole and line, and all tackle are being set up. Forms for submitting records are available. ★★★

Dodge is 3 up on every other pickup made in America.

1. Dodge has the lowest-priced pickup. Lower than Ford. Lower than Chevy.

If you know trucks, then you know Dodge. You know all about how tough we build our trucks. And you know how well we engineer them. But maybe you didn't know that Dodge makes America's lowest-priced full-sized pickup. The Dodge D-100.* (Based on comparison of manufacturers' suggested retail prices for 6 cylinder half-ton pickups excluding optional equipment, state and local taxes, destination charges.)

2. Dodge got the best gas mileage. Better than Ford. Better than Chevy.

Getting great gas mileage is getting to be a habit with Dodge.

In the latest EPA tests, a '76 Dodge D-100 powered by a 225/6 cylinder engine with a manual transmission turned in an estimated mileage of 25 miles per gallon on the highway. And 18 in the city. Of course, the actual mileage you get will vary depending on the type of driving you do, your driving habits, your truck's condition and optional equipment. In California, see your dealer for mileage data for California equipped vehicles.

3. Dodge has the biggest standard payload. Bigger than Ford. Bigger than Chevy.

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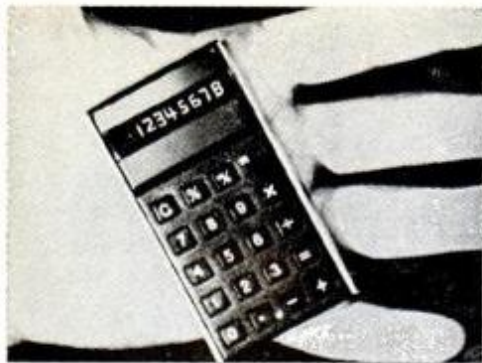
*Pickup shown - The Dodge D-100 Adventurer will be priced higher because of optional equipment

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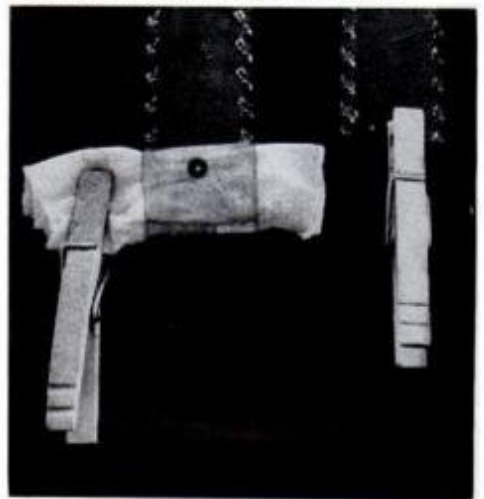
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FROM READERS

Drying film-tank aprons fast



Those plastic aprons used instead of reels in some developing tanks dry fast—except for the looped end. But you can easily speed up the drying process by stuffing a rolled-up paper towel inside the end loop to absorb moisture. Wooden spring clothespins at the apron ends keep it from curling; the clothespin at the looped end should be clipped to the paper towel as shown.

—Grace Weinstein, Los Angeles.

Filtering chemicals quickly



Photographic chemicals should be filtered before you use them to eliminate any impurities. But put the filter in your funnel and the long wait while the chemicals drip through can strain your patience. By putting the filter in a strainer suspended in a funnel as shown above, you can filter a gallon of solution in a few minutes. Make sure that you use a filter with no center hole.

—Lane Sander, Yakima, Wash.

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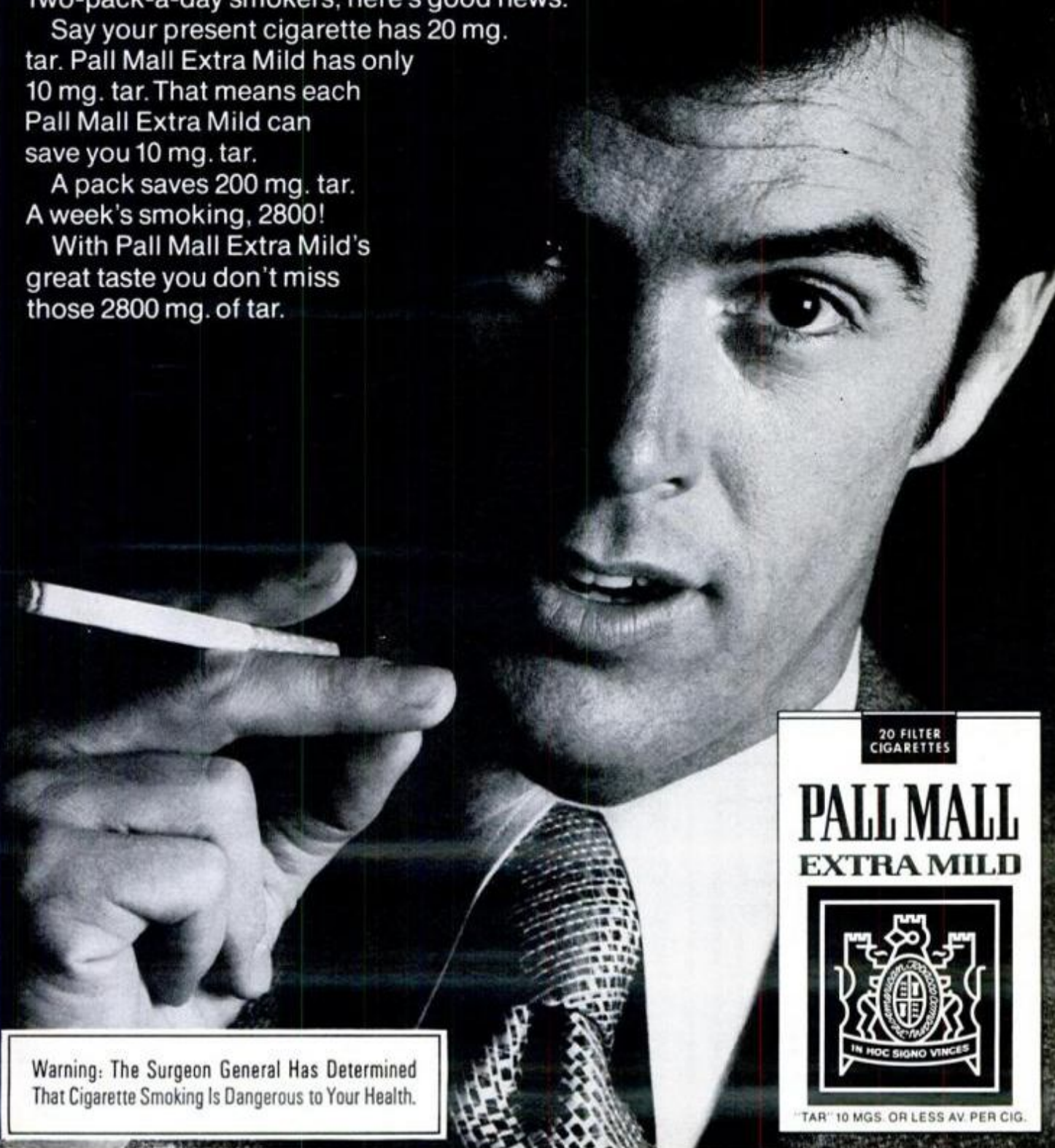
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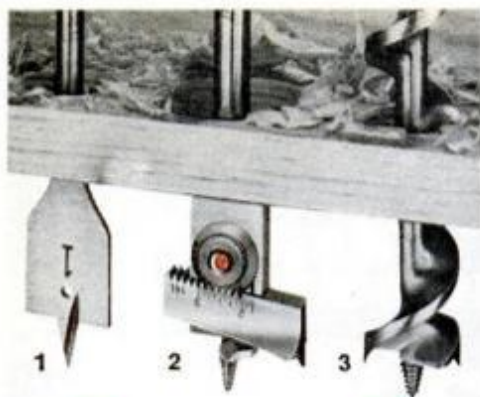
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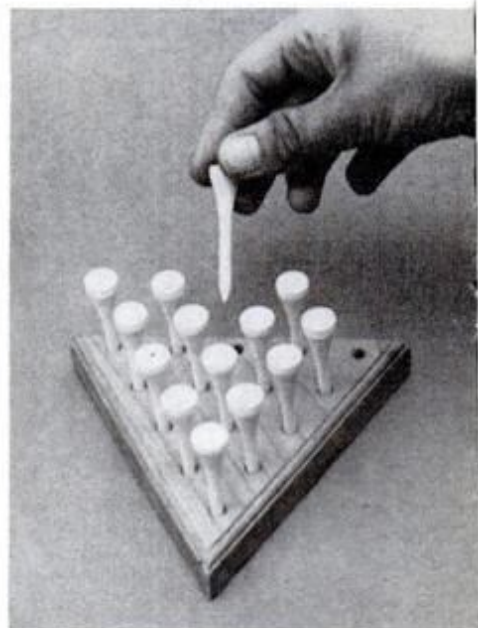
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QUICK SHOP PROJECT

Tee game

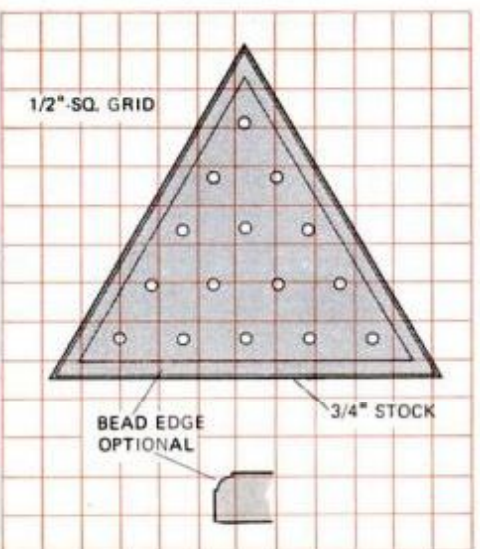


A simple and fast shop project, this puzzle can be turned out by the score for gift-giving or for use as door prizes at church affairs and the like. Playing the game, however, is a bit more difficult.

The object of the game is to eliminate all of the tees but one by jumping one tee at a time. There are about five combinations (I think) that will accomplish this feat. Just learning them will keep noisy youngsters quiet for a spell.

Make the puzzle board of hardwood if you want it to last. The beaded edge isn't a must, but it does dress up the appearance considerably. Use a tung oil to finish the wood.

—Mel Crosby



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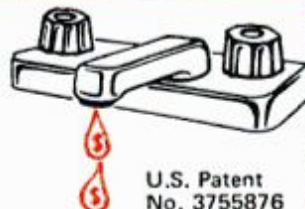
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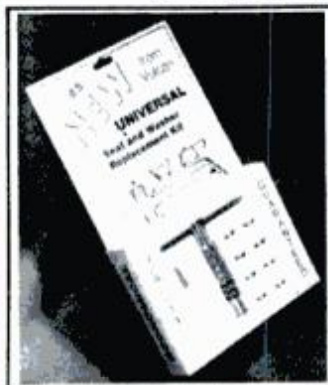


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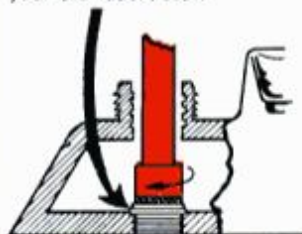
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- * "I am more than pleased with both the method of installing and the results. This is the first time in three years I don't have either a leaking faucet or one that swells and cuts off the hot water." J.M.C. Woodbridge, VA
- * "Please send me one dozen Vulcan Faucet repair seats and washers, with adhesive. You may like to know that I have installed 4 seats from the original kit and am very well-pleased and enthusiastic about your product." G.F.M. Sunnyvale, CA
- * "This item, I have been searching for, for at least twenty years." A.R.S. Cleveland, OH
- * "Your prompt revised instructions saved the day. Works fine! Will be happy to recommend your product to handyman friends and acquaintances." N.S.D. Montpelier, VT
- * "Some time ago I ordered two of your Universal Faucet Repair Kits and people thought they were so great I have exactly NONE! I'd appreciate it if you'd forward me another kit . . . You've a wonderful item and everybody should have one to conserve water if for no other reason." H.M.F. Hillsdale, MI
- * "I have been using your universal faucet repair kit, and am amazed at the restoration of old faucets. I am in need of additional seat and washer sets. Please find enclosed check for 12 additional sets." H.W., Apt. Hs. Mgr. Seattle, WA
- * "Several years ago I supplied all the faucets in my house with your seats and washers and, I am glad to say, I have not had a drip since. Now, I have some other faucets to take care of and as I still have your tool all I need are some seats, washers and adhesive. I am enclosing my check for an additional dozen sets." S.B.C. Montague, CA
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These seats come with 8 matching non-expanding universal mated washers made of Delrin® — a material so tough it is used in making gears. With these washers you also end the annoyance of old fashion rubber washers that swell and cut off your hot water — usually right in the middle of washing your hands or during a shower.

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- Vulcan Reseating Kit — Includes 8 stainless seats, 8 Delrin® washers, 1 tube adhesive, illustrated instructions PLUS 12 extra stainless seats, 12 Delrin® washers, 2 tubes adhesive — \$11.95 Ppd.
- Stainless seats with matching Delrin® washers, 2 tubes adhesive — \$4.50 per doz. sets, Ppd.

I understand that my money will be immediately refunded if I am not 100% satisfied with the kit.

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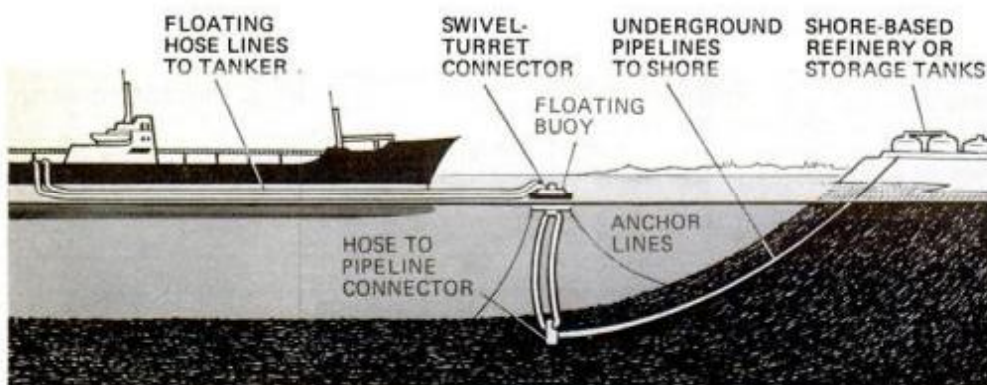
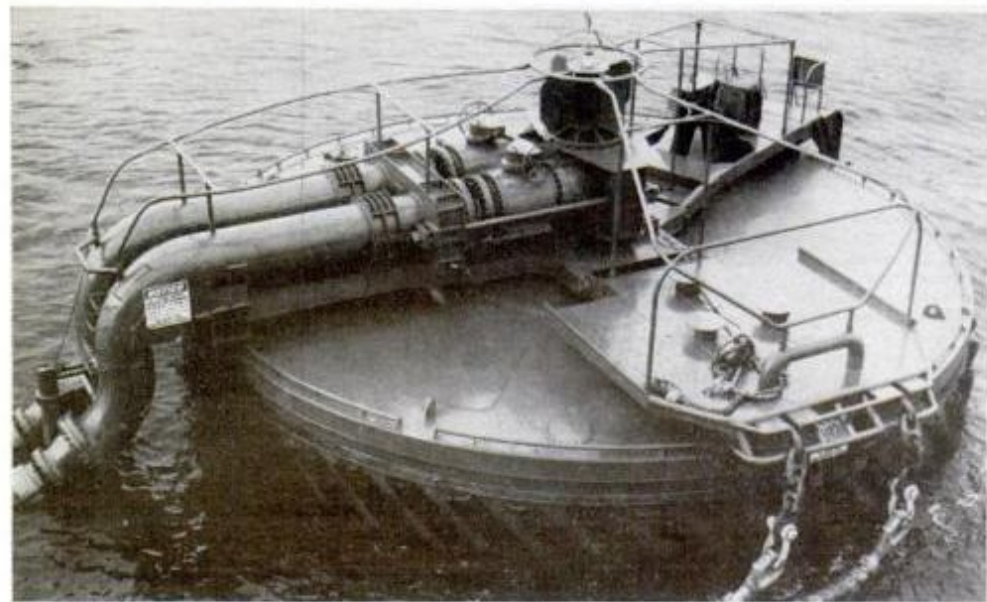
by Norman Sklarewitz

A huge, heavily laden oil tanker ties up to a floating buoy, hooks onto hose lines and starts pumping out its cargo—with no land in sight. It doesn't need any help, doesn't need to go through tricky docking maneuvers, doesn't even need a harbor to anchor in.

Pioneered by Imodco, Inc., of Los Angeles, such SBM (Single Buoy Mooring) terminals are saving precious cargo-transfer time and millions of dollars in port facilities. An SBM can be stationed up to 60 miles offshore, requires no operating personnel, is unaffected by raging seas and can handle up to five different liquid transfers at the same time. A tanker can, for instance, offload jet fuel, gasoline and diesel oil—all simultaneously—while also taking on fuel for its own use.

Lines below the buoy lead down to the bottom where submarine pipelines carry their contents to shore-based refineries or storage tanks. The

process can also be reversed—a tanker can be loaded from shore without ever coming into port. A swivel connector allows the ship to swing freely with wind, tide or current changes without interrupting the transfer. In multiple-buoy systems, a tanker is fixed-moored and often must suspend operations while it changes position or rides out a storm. SBMs range up to 50 feet in diameter and may weigh 140 tons. More than 100 are already in place, mainly in the Mid and Far East—helping to speed petroleum products to an oil-hungry world. ★★★



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11 kits with Quadraphonic Stereo and B/W TV...\$465

or low monthly terms

A complete course in B&W and Color TV Servicing, including 48 lessons (18 on color TV), 10 special reference texts and 11 training kits. Kits you build include 4-speaker Quadraphonic System, solid-state volt-ohmmeter, CMOS digital frequency counter, electronics "Discovery" lab, plus a 12" diagonal solid-state black & white portable TV to build and use. At each assembly stage, you learn theory and "Power-On" application of that theory in typical solid-state TV sets.



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This Master Course combines theory with practice, using the "Power-On" stages for experimentation and learning. Building NRI's equipment will give you the confidence and ability to service any color TV or Audio unit on the market. And you'll have a magnificent TV and quadraphonic system for years of trouble-free performance.

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America's coolest cigarette and the



Grand Prize:

The \$100,000 63-foot yacht "Lucky Lady" or \$100,000 cash! It's the actual boat used in the making of the spectacular new 20th Century-Fox adventure film, *Lucky Lady*, starring Gene Hackman, Liza Minnelli, and Burt Reynolds.

10,000 Second Prizes:

Two tickets for the picture *Lucky Lady*.
Two things about this sweepstakes are extra cool. One is the great taste of KOOL cigarettes. The other is the 63-foot, \$100,000 yacht "Lucky Lady." It's the yacht sailed by Gene Hackman, Liza Minnelli, and Burt Reynolds in

the production of the sensational new 20th Century-Fox movie *Lucky Lady*. And the yacht, or, if you prefer, a cool \$100,000 in cash, just might become yours if you win the KOOL "Lucky Lady" Sweepstakes. To enter, follow the official contest rules and mail in the entry blank. Then you'll be eligible for the drawing of the winner of "Lucky Lady," or two tickets for the film. Who knows? You may be sailing over cool waters or counting all that cool, green money. It's one of the coolest sweepstakes ever from the coolest cigarette ever. That's KOOL—Filter Kings, Super Longs, Milds and Box.



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Official Rules: 1. To enter, print your name, address, and zip code on the entry blank, or on a 3" x 5" sheet of paper. Mail to KOOL "Lucky Lady" Sweepstakes, P.O. Box 4448, Chicago, Illinois 60677. Enter often, but each entry must be mailed separately. **NO PURCHASE NECESSARY!** 2. Each entry must include two empty packs of KOOL, or a 3" x 5" piece of paper on which you have printed the words "COME UP TO KOOL" in plain block letters. Entries must be postmarked by March 1, 1976. 3. Prizes. The Grand Prize—the 63' yacht "Lucky Lady," valued at \$100,000 or \$100,000 cash. 10,000 second prizes—two tickets to the film *Lucky Lady*. Tickets are non-transferable and not redeemable for cash. 4. Grand Prize-winner chooses yacht or cash. The yacht will be delivered to the winner at its berth in California. Payment of Federal, state, and local taxes imposed on the prizewinner and the cost of delivering the yacht to the winner's home city are the sole responsibility of the prizewinner. Prize is non-transferable. 5. Winners will be selected in a drawing conducted by H.



Olsen & Co., the results of which will be final. The odds of winning will be determined by the number of entries received. All prizes will be awarded. Grand Prizewinner must agree to use of his name and picture for this promotion. 6. This sweepstakes is open only to residents of the United States 21 years of age or older. Employees of Brown & Williamson Tobacco Corporation, its affiliate companies, advertising agencies, H. Olsen & Co., 20th Century-Fox Films, Inc., and their advertising agencies, and their families are not eligible. Void in Missouri and wherever else prohibited or restricted by law. All Federal, state, and local laws apply. 7. For the name of the Grand Prizewinner, send a separate stamped, self-addressed envelope to: KOOL "Lucky Lady" Winners, P.O. Box 6353, Chicago, Illinois 60677.

KOOL "Lucky Lady" Sweepstakes
P.O. Box 4448
Chicago, Illinois 60677

Please enter me in the KOOL "Lucky Lady" Sweepstakes. I certify that I am at least 21 years of age and have read the official rules.

Name _____ (PLEASE PRINT)

Address _____

City _____ State _____ Zip _____ (REQUIRED)

NO PURCHASE NECESSARY

Kings, 17 mg. "tar," 1.3 mg. nicotine; Longs, 17 mg. "tar," 1.2 mg. nicotine, av. per cigarette, FTC Report Nov. '75

SCIENCE WORLDWIDE



To avoid a flash in the pan

The photo above doesn't show a visitor from outer space. It shows a man wearing light-actuated goggles developed at Sandia Laboratories, Albuquerque, N.M. They're designed to protect military pilots against eye damage and skin burns in the event of a nuclear detonation.

The lenses consist of a layer of ceramic sandwiched between polarizing elements. When a voltage is applied to the lenses, it induces atomic units to move into an "orderly" arrangement, permitting the transmission of polarized light. The goggles are "open." However, when a sensor detects increased light levels it causes the voltage to be cut off. Within microseconds, the goggles become opaque, allowing virtually no light to pass through. As the light intensity diminishes, the lenses gradually "open" again.

No refrigeration for this milk

Within 5 to 10 years, the purchase of unrefrigerated fresh milk could become commonplace, creating energy savings that ultimately would benefit the consumer. This revolution in marketing could be brought about by a process invented by scientists at North Carolina State University.

Milk is normally pasteurized or partially sterilized by bringing it to

high temperatures for a short time. Not all bacteria are killed; those remaining will turn the milk sour if it is not refrigerated. However, heating the milk to very high sterilization temperatures gives it a "cooked" flavor distasteful to most milk drinkers. Their process, explain the scientists, restores good flavor to sterilized milk. They say they have isolated an enzyme, sulfhydryl oxidase, that causes a group of chemicals—the sulfhydryls—to convert into disulfides, restoring the milk's flavor. The sulfhydryls are produced in milk proteins when heated.

"The ability to process ultrahigh-temperature sterilized milk with a flavor indistinguishable from the present pasteurized milk would mean that, after processing, the milk could be transported and displayed in the grocery without refrigeration," say the researchers.

Data transmission by laser

A worldwide laser communications system will soon be under development for the Air Force by the McDonnell Douglas Corp. It would use three synchronous satellites 22,000 miles above the Earth to relay messages over laser beams among aircraft, ground stations and other satellites. The space laser would be able to transmit a billion pieces of data per second, say McDonnell Douglas officials, which is 20 times the volume of data now sent over a commercial satellite communications link.

Have a chunk of water

One pound of a new "superslurper" can turn 1400 pounds of water into a rubbery gel. Superslurpers, recently developed by Dept. of Agriculture scientists, are starch and petro-chemical combinations that hold water in a swollen duplication of their dry forms. Dry films, for example, expand and thicken to become gel sheets. Flakes or powders become piles of water made up of particles resembling crushed ice.

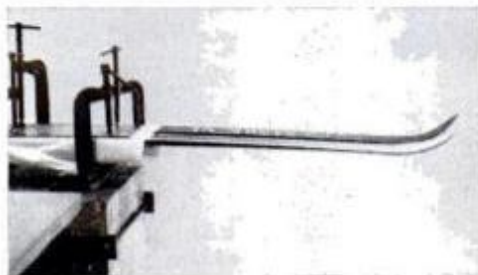
The scientists foresee many fluid-handling applications for the slurpers. Mixed with a sandy soil, they would stop wind erosion. They also could be used to gel water for easier handling of industrial and animal

wastes. As a coating on bandages, they would keep wounds dry. In a series of tests, diapers coated with a superslurper absorbed 20 times more urine than did standard cotton jobs. That alone should make the slurpers a success.

For skiers who get bad 'vibes'

Fast-moving downhill skiers sometimes have trouble with hard-packed snow. It sets up excessive vibrations in the skis, causing a skier to lose control. A new ski made by Olin Ski Co., Middletown, Conn., gets around the problem neatly.

The ski is made like a sandwich, with structural fiberglass components on top and bottom and a layer of damping material in the middle. The "damper," which runs almost the full length of the ski, is a polymer made up of tangled, chainlike molecules. When a vibrational force is applied,



the molecular chains become extended. When they meet resistance from neighboring molecules, they discharge energy in the form of heat. Then, because of the elastic nature of the chains, they quickly "snap back" to their original form, reducing vibrational magnitude. In the photos above, the Olin ski and that of a competitor had similar vibrational forces applied to them. As the bottom photo shows, the competitor's ski continued to vibrate after the Olin ski had come to rest. ★★★

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When is a full-size Chev



When you're six people and could use the room.

Sure, the six of you would be almost as comfortable divided into two smaller cars. But that's not economy. Or you'd *all* fit into some compact model. But that's not comfort.

Slip into a full-size 1976 Chevrolet sedan (either Impala or our luxurious Caprice). Now, *that's* room. According to published dimensions, our full-size 4-door sedans are roomier than those from our nearest sales competitor—more shoulder and leg room in both the front and rear seats.

While we're talking room, note that the trunk of a '76 Impala or Caprice sedan will hold almost 19 cubic feet of luggage (more than shown here).



'76 Caprice interior with available 50/50 split front seat.



When you hook up your trailer and know you Chevrolet was built to tow it.

The full-size '76 Chevrolet with proper trailering equipment can pull loads up to 6,000 pounds. That's about a ton more than the recommended limit for any American-made compact.



1976 Caprice Classic Sport Sedan.



Want an economy car?

When you look at resale. On a nationwide average, 3- and 4-year-old Impala and Caprice coupes and sedans have a higher resale value than the most similar models from our nearest sales competitor.

In fact, a 4-year-old Caprice sedan has a higher resale value than most other full-size sedans.

21% better mileage
EPA city test

When you consider Impala's improvement in city mileage over 1974.

According to city mileage tests conducted by the EPA on 1974 and 1976 models, the Impala Custom Coupe with standard 350-2 V8 power team shows a 21% improvement in fuel economy. (Highway mileage tests were not run by the EPA in 1974.)

EPA Buyer's Guide ratings for all 1976 Caprice and Impala sedans and coupes with standard 350-2 V8 are 21 mpg City, 18 Highway.

Remember: EPA mileage ratings are estimates. The actual mileage you get will vary depending on the type of driving you do, your driving habits, your car's condition and available equipment. For California EPA ratings and power team combinations, see your Chevrolet dealer.

When you could save over \$530 in recommended maintenance costs on the '76 model, compared to the '74.

In 50,000 miles of driving, if you follow the Owner's Manual for recommended service, a full-size 1976 Chevrolet with a standard 350 V8 engine using unleaded fuel could save you over \$530 in maintenance costs, compared to the '74 model using leaded fuel.

While parts and labor costs will vary throughout the country, we've used current list prices for parts and lubricants, and a figure of \$12 an hour for labor.



When you realize a full-size Chevrolet is probably priced lower than the full-size you had in mind.

Comparing Manufacturers' Suggested Retail Prices for base models, you'll find full-size Chevrolets are priced lower than *all* full-size cars from our nearest six sales competitors. For that matter, they're not priced much higher than similarly equipped smaller cars.

The full-size 1976 Impala or Caprice: It could be your next economy car.



Chevrolet

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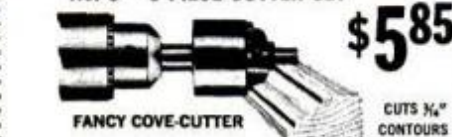
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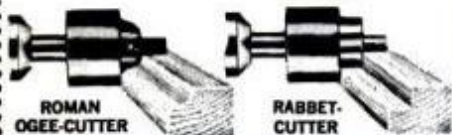
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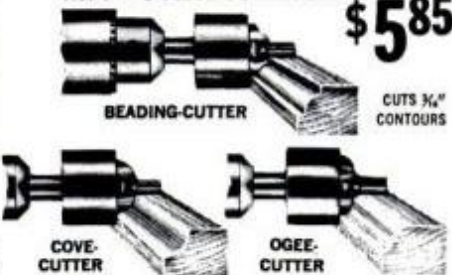


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HINTS

FROM READERS

Weatherproof cover



Poke shackle and hasp's eye through holes in the side and bottom of a plastic bag and you'll have a waterproof cover for an outside padlock that let's you unlock the lock from the open end.—Walter E. Burton

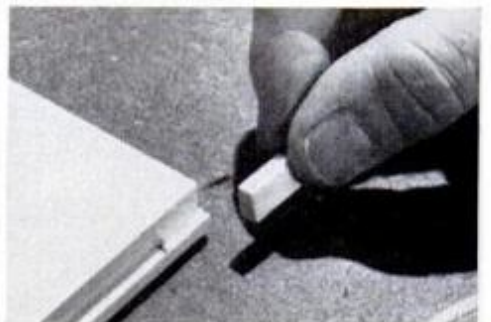
Channel your router



When using a portable router to plow a dado across a wide board, guide router with a straightedge clamped at each side of its base. The cut will be straight and true its full length.

—Harvey Plunksetter

Blind as a rabbet



Quickest and simplest way to form a rabbet is to run the cut completely through from edge to edge, then glue small blocks back into the cut at each end. This way there's no need for a chisel.—Rosario Capotosto

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CAR CLINIC

BY MORT SCHULTZ



Holy Holley

I own a 1971 Chrysler Newport which has a 360-cu.-in. V8 engine. Although the car is in excellent condition, I'm prompted to trade it because of an irritating problem, which seems minor, that I can't get repaired. When the engine is warmed up, it won't start after being turned off 10 minutes or so, although the starter cranks normally. As long as the engine is cool, it starts perfectly. I have had the carburetor cleaned and rebuilt twice at a cost of over \$100. I would buy a new carburetor, but I don't want to replace it with another Holley, because I fear the same trouble. Can you help me?—Andrew A. Zadany, Corning, N. Y.

I'd say your carburetor has a grand case of percolation fever. Heat concentrated on the carburetor is causing gasoline in the bowl to percolate when the engine is turned off. The gasoline boils over into the engine, causing an overly rich fuel mixture when you try to start the car. It's as if the engine has been flooded, and the same starting problems associated with flooding are present.

Although you don't say so, I guess you have a Holley 2210 two-barrel unit in the car since this is standard for the 360-cu.-in. engine. A reliable carburetor, it shouldn't be condemned, because certain adjustments which should be made during overhaul to avert percolation may not have been made. One is the float setting, which any competent mechanic doing an overhaul knows about. The other adjustment isn't as common and may be overlooked. It's the bowl vent-valve clearance adjustment.

This valve in the Holley 2210 permits pressure that could cause percolation to relieve itself. It's a positive means of preventing percolation, but it operates correctly only if adjusted to specification.

To check the bowl vent-valve clearance, start the engine and see that it's running at correct curb idle speed (700 rpm). It should be possible to insert a 0.015-in. feeler gauge between the bowl vent-valve plunger stem and operating rod. If adjustment is necessary, bend the tang on the pump lever until you get the correct clearance.

Finally, I explained your problem to the technical services department at Chrysler and was urged to inform you to have service bulletin 14-17-74 applied. This deals with stumble during light acceleration and/or choke sticking caused by carburetor air horn warpage. According to the company, air horn warpage could affect your car's performance.

Coast to coast

Whenever I come to a hill with my standard shift 1973 Plymouth Duster, I shift to neutral gear and coast. I cover a lot of distance and I'm saving gas, but am I causing any damage?—P. L. Sarma, Edinboro, Pa.

The money you're saving, plus more, will be needed to pay for the brake job you'll soon need. The lost braking effect provided by the engine during a downhill run has to be taken up by the brakes, with greater wear and tear on linings. Nor is coasting a particularly safe driving procedure since it leaves you virtually at the mercy of your brake system and a strong foot. What if your brakes start overheating and fading? I'd forget it.

Leak no more

General Motors has informed me that "the condition you are referring to is an oil weep, rather than an oil leak. This oil weep is a normal condition of an engine and would not warrant further repair." My car is still within warranty, having less than 7000 miles. Do you consider any form of oil seepage, from an engine this new with this low mileage "normal?"—J. P. Ahlsvede, Milwaukee, Wis.

I sure do. There's a vast difference between a leak and seep (or weep). A leak is a defect.

A seep is normal, characterized by a quantity of liquid that has oozed through fine pores or small openings. You won't find a puddle on the ground beneath the car. Nor will the loss show up as a drop in oil level on a dipstick.

A leak is characterized by dripping, like water dripping from a defective faucet. If you let the car sit still awhile, a puddle will form on the ground, and the loss will show up on the dipstick as a definite drop in oil level.

Thinking positively

My 1975 Oldsmobile Starfire has an out-of-balance bounce above 50 mph despite dealer and tire-store efforts. I've now been informed this is an inherent problem I'll have to live with. Not having this profound advice prior to purchase, I guess I'm stuck—Don Johnson, Minneapolis, Minn.

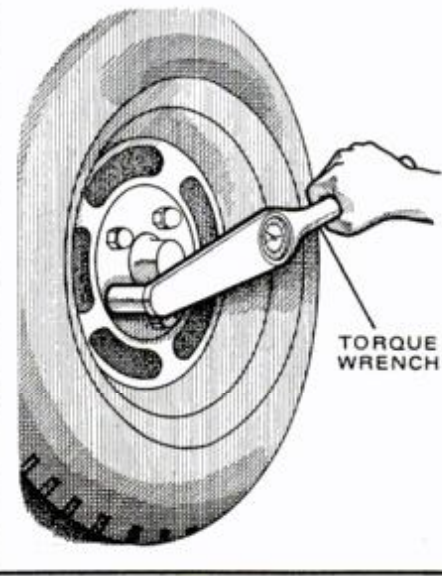
Maybe so, but you shouldn't be pessimistic until the following have been tried.

1. Increase tire air pressure to 30 pounds.

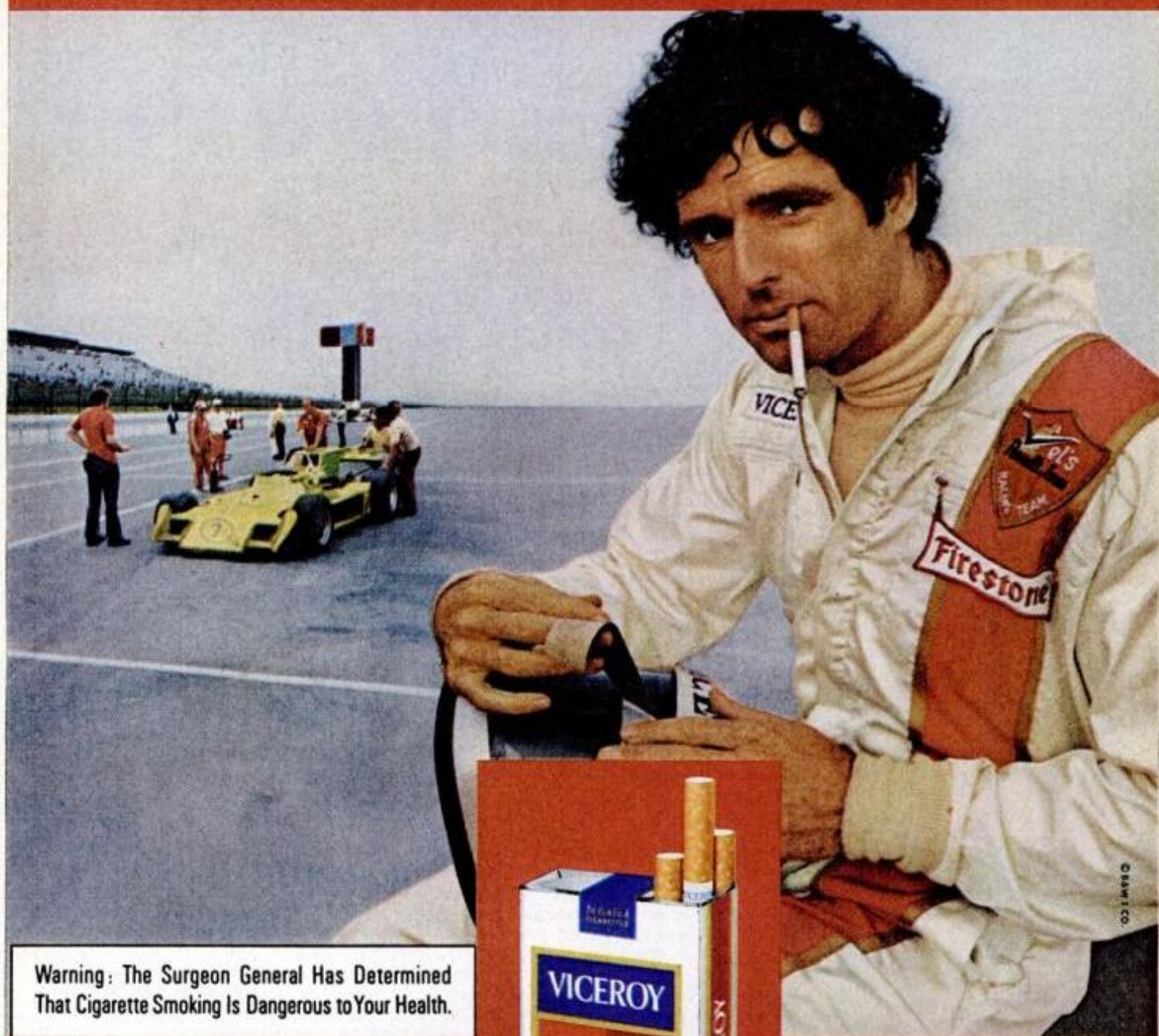
2. Readjust tie-in to zero (disre-
(Please turn to page 54)

Give yourself a brake

There's a right way and a wrong way to tighten wheels after changing a flat, rotating tires or putting on snows. The wrong way is with an impact wrench, which will over-torque the wheel and distort disc brake rotators and drum brake drums. Distorted braking parts cause pulsation in the pedal and greatly reduce braking effectiveness. Don't use a power wrench and, above all, don't let anyone else. Speak up, and don't listen to any stories that a power wrench won't hurt anything. The right way to install wheels is with a torque wrench that permits tightening wheel nuts exactly to the specification provided in the manufacturer's service manual.



**“Why Viceroy? Because I'd never
smoke a boring cigarette.”**



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16 mg. "tar," 1.0 mg. nicotine,
av. per cigarette. FTC Report Nov. '75

Enjoy Viceroy flavor—now in a bold new pack.

Viceroy. Where excitement is now a taste.



Model 120-K
Solid 3/4" Cherry
74" x 16 3/4" x 10"



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Announcing Emperor's

SUPER SALE!

AMAZINGLY LOW PRICE

on the classic Model 120-K

DO-IT-YOURSELF CASE KIT

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8950 **FACTORY DIRECT**

WHEN PURCHASED WITH MOVEMENT
OR, CASE KIT ALONE \$99.50 Reg. \$129.50

Assemble your own clock, complete with Westminster chiming movement, Tempus Fugit Dial, for just \$204.00; complete with Moving Moon Dial, Westminster chiming movement (as shown), for just \$219.00. Compare your finished clock with those retailing up to \$750.00.

VOLUME PURCHASE! GREAT SAVINGS!

Emperor Clock Company, world's largest manufacturer of grandfather clock case kits, has always been able to give you unbeatable low prices because of our great buying power. A short while ago, Emperor made a fantastic, high volume purchase of native Pennsylvania cherry hardwood... before the recent price increases in cherry. Now, Emperor passes its volume purchase savings on to you with this offer of beautiful Model 120-K cherry at an amazingly low price. Take advantage of it. Do it now while the supply lasts.

EASY TO DO! ALL MITERS PRE-CUT!

From a small beginning six years ago, Emperor has grown to become the world's largest manufacturer of grandfather clock case kits by supplying the do-it-yourselfer with easy to assemble precision cut kits. Now, Emperor makes it even easier by cutting all miters on newly acquired production equipment. There's no guesswork involved with the Emperor case kit. All kit pieces have been accurately crafted, pre-cut and factory sanded on both sides for easy assembly. Divided swan neck and finial, waist and dial face door, dial frame and sculptured base front pre-assembled. Emperor uses only the finest Pennsylvania cherry, a hard, strong and close grain wood, so the clock you assemble and finish will give you a great feeling of proud accomplishment. Complete hardware and assembly instructions. Each piece may be reordered separately. No wood-working experience necessary.

- Four full-turned hood columns
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- Full-length waist door
- Floor levelers

MONEY BACK GUARANTEE

If for any reason you are not completely satisfied, return in original carton within thirty days for prompt refund... no questions, no excuses.

SUPER SALE OFFER EXPIRES MARCH 31, 1976

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CAR CLINIC

(Continued from page 50)

gard the "book" specification of 1/8-3/8 in.).

3. Balance wheels and tire assemblies with assemblies mounted on the car.

4. Make sure that your high-speed bounce isn't really a vibration caused at and around 50 mph by two other problems bugging the Starfire: A. the exhaust system grounding itself against the underbody (have your mechanic see the *Olds Service Guild*, Aug. 1975, page 87); B. engine vibration caused by high-speed miss or broken power-steering support bracket (see the same reference, page 82).

5. Check tires and wheels for an out-of-round condition and replace faulty components.

Faith and hope

I have this shimmy problem with my 1973 Capri when I apply the brakes (discs in front, drums in rear). I was told that wheel bearings may need adjustment, which was done with no results. Now I'm told rotors on the front wheels are probably out-of-round and need turning. Can I trust this or am I being led to an expensive repair?—Richard Pra-

del, Greencastle, Pa.

Trust. Whoever is advising you sounds good. When the bearings were adjusted, the easiest and least expensive repair was made first. The trouble no doubt lies with the rotors. By turning the rotors in an effort to solve the problem, rather than replacing them (which, in the end, may have to be done), your mechanic is

trying to save you money. Listen to him.

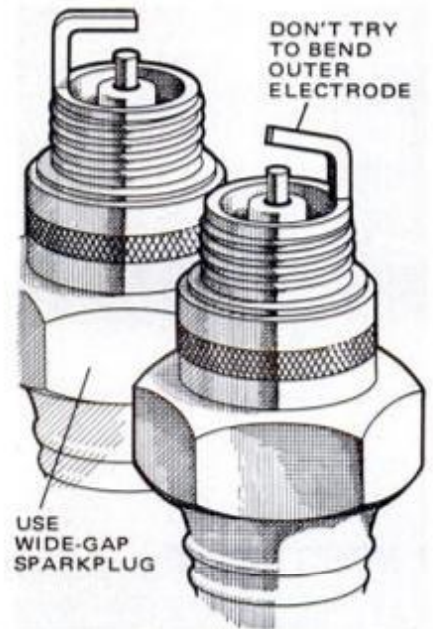
But before turning rotors, try something else. It's been found a brake-shudder condition in 1971-74 Capris could be caused by materials in older brake pads. Heat causes pads to transfer pad material to rotors. The uneven buildup gives the same effect as out-of-round rotors.



PM CAR CARE

Bad arithmetic

If you own a 1974, 1975 or 1976 domestic model, the engine probably uses wide-gap sparkplugs that keep emission levels within spec. When wide-gap plugs are specified for an engine, you must use wide-gap replacements. Doing otherwise will create an engine misfiring condition and result in poor performance. "Doing otherwise" means taking a conventional sparkplug usually gapped, at most, to .035 inch and trying to convert it to the wide gap of .044 inch, .060 inch, .080 inch or whatever the manufacturer may specify by bending the ground electrode. The electrode attains an abnormal angle that causes rapid center electrode wear.



We don't deal in broken promises

When a mechanic comes looking for a heavy-duty rust-buster, he uses Solvo-Rust. It means business. Solvo-Rust's new Molybdenum Disulfide formula works fast to free rust. Solvo-Rust actually penetrates the pores of metal parts to loosen up deposits of rust, corrosion, scale, paint, varnish, carbon and gum--and

to keep those parts loosened up a long time. Stock Solvo-Rust in five and fourteen ounce aerosols and the handy one-pint spout top can. Solvo-Rust. The heavy-duty rust-buster from Permatex. It means business.



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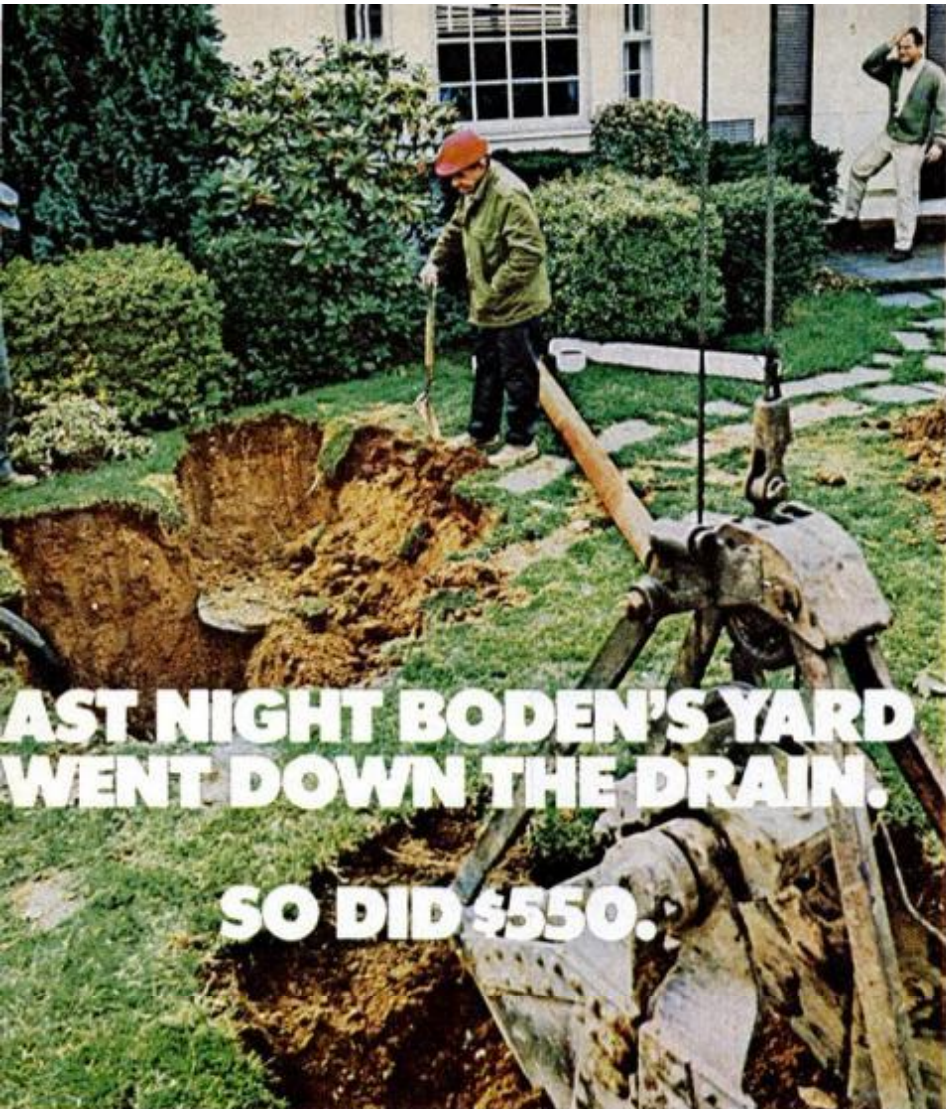
Permatex
NASCAR Race Schedule

PERMATEX "200"
Riverside, CA, Jan. 17, 1976

PERMATEX "200"
Daytona Beach, FL

Feb. 13, 1976

PERMATEX "300"
Daytona Beach, FL, Feb. 14, 1976



**LAST NIGHT BODEN'S YARD
WENT DOWN THE DRAIN.
SO DID \$550.**

Don't you wait for septic tank or cesspool trouble to start. Use Rid-X® now. 50¢ worth once a month can save you hundreds of dollars.

The Bodens are real people. Their cesspool really needed work. This picture was taken as it was being done. The job really cost \$550.

It could happen to you! For years the Bodens were like most home owners. Their sewage system worked fine, so they ignored it. Meanwhile, trouble built up underneath their feet until one day, it surfaced. They learned the hard way—when you see septic tank or cesspool trouble, it may be too late.

That's why you should start using Rid-X now, before trouble starts. Today's modern detergents, bleaches and lyes can destroy the active bacteria your sewage system needs to work efficiently. Rid-X is a beneficial bacteria additive made to help reactivate that essential bacteria action; to help liquefy waste matter, oils and fats. Rid-X works to keep septic tanks and cesspools trouble-free.

Don't confuse Rid-X with liquid and caustic products made to simply unclog drains. Rid-X is specially made to work inside septic tanks and cesspools. Just 50¢ worth, flushed down the toilet bowl once a month, can save you hundreds of dollars! Buy Rid-X today, at your hardware or food store.

SPECIAL COUPON OFFER.

Get a discount coupon worth 50¢ towards your purchase of Rid-X (it's like getting the first month's supply free)—plus a free 16-page booklet on septic tank-cesspool maintenance. Send name and address to Rid-X, P.O. Box 225, White Plains, N.Y. 10606.



Ask your mechanic to sand rotors thoroughly, rather than turn them to overcome obvious high spots. Then have him install a new set of transfer-resistant brake pads (part No. D 4 R Y-2001-A). These pads have a thin abrasive coating that further cleans rotors of materials transferred from old pads to rotors. The shudder may not disappear completely for up to 1000 miles. That depends on how much you use your brakes. The more you use them, the more abrasive-coated pads will be able to clean away old material, and the quicker the shudder will vanish.

Not on the level

My 1970 Buick Estate station wagon is equipped with an automatic-level control system. I pull a 19-foot Aristocrat trailer using an Eaz-Lift hitch. Recently I added a 25-gallon gas tank in the well of my wagon which, when full, adds about 200 pounds. I also carry a cartop 12-foot, 140-pound boat. With this added weight, the automatic-level control system isn't strong enough to lift car and trailer to level position, and sway bars are straining more than usual. My Buick dealer is uncertain what can be done. Can you help?—Don Diehm, Watsonville, Calif.

You've tipped the balance, and a need for overload springs in the rear is apparent. The automatic-level control system may have to be disconnected and air shocks removed. It depends on how you approach the problem. There are two ways:

1. Get rid of the automatic-level control system and install rear load carriers. This is a combination shock and overload-spring unit that, when coupled with present springs (if they're in good shape) will give ample support.

2. Retain the automatic-level control system and add leaf-type overload springs. This will give you more than enough strength to support the added 350 pounds.

You have several factors to consider before deciding—including the price and ease of removing the overload springs when you're not pulling a trailer if you want the most comfortable ride. I think the guy best qualified to discuss the pros and cons is a reliable trailer dealer.

SERVICE TIPS

■ Oldsmobile suggests that you check to make certain you get the right replacement when the time comes to get a new battery in your 1975 Starfire. A mistake was made on some original battery labels. The recommendation says to get a Delco

Y-87 or R-87 replacement, but if you tried to put one in your car you would find that there isn't enough clearance between caps and hood. The right replacement is a Y-87PT or R-87PT.

■ Ford Motor Co. has traced an engine overheating problem to installation of the wrong radiator. The trouble applies to 1974 Torinos and Montegos with a 351 W-2V engine, 3.25 rear axle and no air-conditioner that were built before June 19, 1974. The problem may not have shown up yet, but it could when you run the car at high speeds in high temperature climates or when you put the car under a really heavy load, such as pulling a trailer.

The erroneous radiator can be identified by looking at the upper left section of the radiator frame between the tanks. The wrong unit has part No. D40F-8005-CA stamped there. Have your Ford or Mercury dealer replace the radiator with the higher-capacity model (part No. D3V4-8005-A). This shouldn't cost you a cent. If you get any flak, be sure to refer the dealer to service bulletin 88, article 1105, page 29. ★★

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.

The whole neighborhood wondered what Frank Mallon was up to in his workshop.

Word had it he was up to something mighty peculiar. And when he didn't show up for bowling practice one Wednesday night, the Wabash Cannonballs (that was the name of his neighborhood team) began to wonder, too.

So it was that a bunch of the boys decided to pay their "star" a visit, and talk him out of his workshop and back into action.

It didn't happen that way, though.

Matter of fact, it was Frank Mallon who talked the Wabash Cannonballs out of their bowling night and down into his workshop. What was it... what could be exciting enough to keep a bunch of ten-pin tigers from their favorite pastime? One of the most fascinating learn-at-home programs in the world, that's what!

Actually build and experiment with the new generation color TV in Bell & Howell Schools' fascinating learn-at-home program. It will help you develop new occupational skills as an electronics troubleshooter.

You'll set up your own electronics laboratory to learn first-hand, the technology behind such innovations as digital-display wrist-watches and tiny pocket calculators.

In fact, as part of the program, you'll actually build and experiment with a 25" diagonal color TV incorporating digital features.

But most important of all will be the new skills you'll develop all along the way... the kind of skills that could lead you in exciting new directions. While we cannot offer assurance of income opportunities, once you've completed the program you could use your training:

1. To seek out a job in the electronics industry.
2. To upgrade your current job.
3. As a foundation for advanced programs in electronics.

Go exploring at home, in your spare time. No traveling to class. No lectures. No one looking over your shoulder.

Bell & Howell Schools wants to introduce you to the modern way to learn. It means you'll be able to develop new skills in your own home—on whatever days and hours you choose. So you don't have to give up your present job or paycheck just because you want to learn new occupational skills.

What's more, we believe that when you're exploring a field as fascinating as electronics, reading about it is just not enough.

That's why you'll get lots of "hands on" experience with some of the most impressive electronic training tools you've ever seen.

No electronics background necessary.

That's one of the advantages of this program. We start you off with the basics and help you work your way up, one step at a time. In fact, with your first lesson you receive a Lab Starter Kit to give you immediate working experience on equipment.

You build and perform exciting experiments with Bell & Howell's Electro-Lab®. An exclusive electronics training system.

First comes the design console. After you assemble it, you'll be able to set up and examine circuits without soldering.

Next, you'll put together a digital multimeter. This instrument measures voltage, current and resistance, and displays its findings in big, clear numbers like on a digital clock.

Then comes the solid-state "triggered sweep" oscilloscope. An instrument similar in principle to the kind used in hospital operating rooms to monitor heartbeats. You'll use it to analyze the "heartbeats" of tiny integrated circuits. The "triggered sweep" feature locks in signals for easier observation.

You'll build and work with Bell & Howell's new generation color TV. Investigating digital features you've probably never seen before!

This 25" diagonal color TV has digital features that are likely to appear on all TV's of the future.

As you build it, you'll probe into the technology behind all-electronic tuning. And into the digital circuitry of channel numbers that appear right on the screen! You'll also build in, remarkable on-the-screen digital clock that will flash the time in hours, minutes and seconds.

And you'll program a special automatic channel selector to skip over "dead" channels and go directly to the channels of your choice.

You'll also gain a better understanding of the exceptional clarity of the Black Matrix picture tube, as well as a working knowledge of "state-of-the-art" integrated circuitry and the 100% solid-state chassis.

After building and experimenting with this TV, you'll be equipped with the kinds of skills that could put you ahead of the field in electronics know-how.

We try to give more personal attention than other learn-at-home programs.

1. Toll-free phone-in assistance. Should you ever run into a rough spot, we'll be there to help. While many schools make you mail in your questions, we have a toll-free line for questions that can't wait.

2. In-person "help sessions". These are held in 50 major cities at various times throughout the year, where you can talk shop with your instructors and fellow students.

So take a tip from Frank Mallon. Find out more about the first learn-at-home program that could stir up your neighborhood!

Mail this postage-paid card today for more details!

Taken for vocational purposes, this program is approved by the state approval agency for Veterans' Benefits.

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696R5



On-screen digital clock



Channel numbers that flash on the screen



Automatic pre-set channel selector



Simulated TV test pattern.



APPLIANCE CLINIC

BY PAUL MANN

Mixing apples and oranges

We're having a problem with some kind of sediment clogging the small screen of our kitchen faucet. Every few weeks the screen becomes so badly clogged that water doesn't come out in a steady stream; rather, there is little pressure and water squirts in all directions. I suspect the trouble may be with our Frigidaire dishwasher, which empties into the garbage disposal. Am I right?—Sonia Kurtyka, Redford Township, Mich.

No, you're wrong. The dishwasher in no way can clog the sediment screen attached to a kitchen faucet. I suggest you call your water company if your water is supplied by the city, or have water tested if it's a private supply. The problem, if there is one, is confined to the water supply, probably with hardness, but I can't say for sure. I should point out that the purpose of the screen is to trap sediment, and that it should be cleaned out periodically anyway.

Strange happenings

My General Electric food disposal unit is the type that's turned on and off by twisting the cover. Of late, the unit stays on after I twist the cap to "off." It's weird. Any suggestions?—Martin Epstein, Pearl River, N.Y.

Yep. The trouble is caused either by a sticking switch plunger or by a defective on-off switch. The on-off switch is mounted on the side of the hopper, and the switch plunger protrudes through the hopper wall and plastic sleeve. The cap activates the plunger, which operates the switch.

Okay, you should start by testing the switch plunger. Turn off the power supply to the unit and work the plunger with your finger, if you can.

If action is sticking and not smooth, apply a drop or two of lightweight household oil to the plunger stem and work the oil in by moving the plunger. See if this clears up the trouble. If not, remove switch from the hopper.

If the plunger seems to work okay, test the switch. You can use an ohmmeter. Turn off the power supply and remove the inspection plate on the bottom of the disposer. Attach the leads of the ohmmeter to points A and B of the hopper switch as pointed out in the wiring diagram below. One ohmmeter lead is attached to the black lead A and the other lead is attached to the protector B. The sink cover should not be in position—that is, the on-off switch should be in the "off" position. The ohmmeter should show infinite resistance. If it doesn't, the switch should be replaced.

Removing the switch for replacement or to get at the plunger to try and free it isn't particularly difficult. The switch itself is held in place in the hopper by a single screw (see the illustration below). Remove the screw and carefully take the switch from the housing. Try not to damage the gasket; if destroyed, replace it. The

gasket acts as a seal to keep water out of the switch and to seal the plunger clearance hole in the hopper. See that it's repositioned properly to avoid future switch problems.

Now that the switch is out of the housing, try to free the plunger, if that's your problem, by cleaning dirt from around the plunger and lubing it. If the plunger is okay, and the switch is defective, you have to disconnect the cable leading from the switch to the stator housing. The switch and cable is a one-piece unit that will have to be replaced.

Grasping for a gasket

I need a gasket for the freezer door of my Hotpoint refrigerator-freezer (model No. 144EW114). I have been told there is no gasket to be had. Do I throw the appliance away?—H. E. Lefebvre, Vineland, N.J.

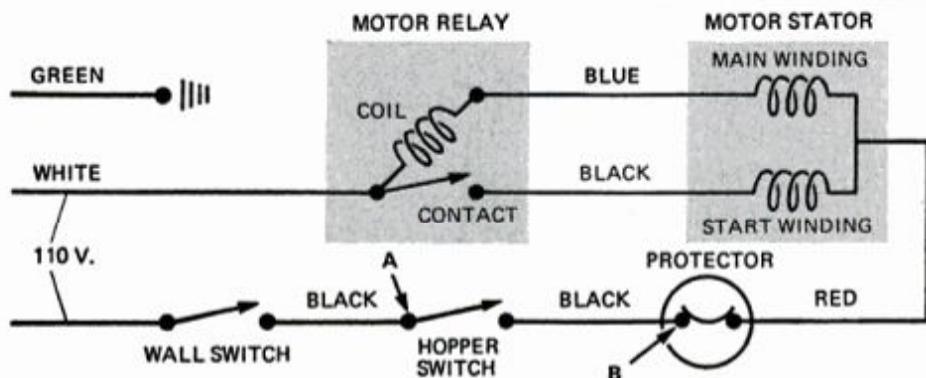
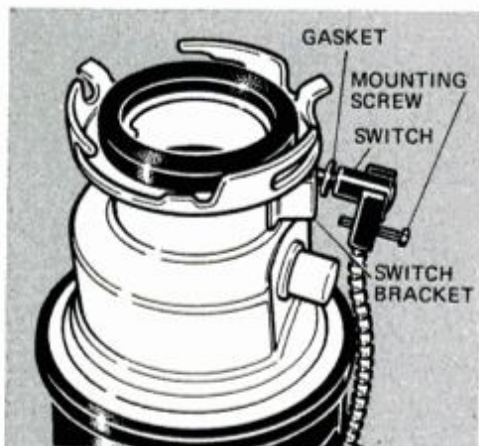
You've been given some wrong information. The part number for the gasket you need is WR 24 X 5028, and it's current, which means that the part is available from your local GE Regional Parts Center at Hickory and Castpa Place in Vineland (phone 696-1506). ★★★

Junk or keep?

Some readers who are not do-it-yourselfers have asked me to tell them at what point they should get rid of an appliance that isn't working rather than having it repaired.

When the repair cost nears or exceeds that of a new appliance, buy a new one. The cost of repair is not always less.

I had a hand-held food mixer go bad not long ago. It needed only new brushes, a simple repair, but I figured it would be a good time to learn how much a repair shop would want. Its cost was \$8—\$6 for service (this shop's flat minimum rate) just for accepting the appliance and \$2 for parts. Heck, I can buy a new hand-held food mixer in a discount store for \$8. ★★★



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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The Aspen wagon has everything going for it.

Even if you never wanted a wagon... you'll want the Aspen wagon. That's how perfect it is. Its size alone will make you want to drive it. And once you do, the ride will make you want it even more. So before everybody gets there first, you ought to go down and take a look at the small wagon that'll probably become the biggest hit in America.

The Aspen wagon has a special size all its own.

Smaller than the big and bigger than the small, the Aspen carries only 100 pounds less than a full-sized wagon and over 200 pounds more than a subcompact wagon. So you can move into a smaller wagon for economy without having to get tiny about it.

The Aspen wagon has a ride that rivals that of a full-sized car.

The unique Isolated Transverse Suspension is rubber isolated to reduce noise and vibration transmitted to the passenger compartment. This gives Aspen an extremely comfortable ride. And for a small wagon... that's unbelievable.

The Aspen wagon achieved EPA estimated highway mileage of up to 30 MPG.

According to EPA estimated mileage results, the Aspen wagon got 30 MPG on the highway and 18 city. The coupe and sedan got 27 MPG highway and 18 city. All were equipped with a 225 Six and manual transmission. (Your actual mileage depends on driving habits, condition of your car, and options. In California, see your Dealer for mileage results.)

The Aspen wagon offers the important convenience features of a luxury car.

A long list of options includes everything from power seats and windows to electric door locks and automatic speed control.

Here's "The Clincher:"

"For the first 12 months of use, any Chrysler Corporation Dealer will fix, without charge for parts or labor, any part of our 1976 passenger cars we supply (except tires) which proves defective in normal use, regardless of mileage." The owner is responsible for maintenance service such as changing filters and wiper blades.



ASPEN

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Silent film editors that convert to sound



Adaptable editors for sound or silent films (rear to front): Bolex 180 Duo, Elmo 912, Goko G-1001. All share editing accessories shown in front and, in more detail, below.



Sound reader attachment is battery powered, has volume control and earphone.



Frame counter lets you time scenes and find frames for easy reference later.



Film cleaner helps protect edited film against dirt which can cause scratches.

Sound films are easy to shoot in the new single-system cameras that record sound on a magnetic stripe along the film. But editing those films is hard unless you have an editor that lets you hear as well as see what's on them.

These three silent editors adapt in seconds to do just that: A simple attachment (with a "tape head" to read the sound track and its own transistor earphone amplifier) slips into the accessory shoes of the latest Bolex, Goko and Elmo editors. The same shoes also take frame counter and film cleaner attachments, useful for silent editing, too.

All three editors obviously come from the same factory, but there are differences: The Bolex has the biggest screen (but takes up the most storage space), the Goko has the easiest framing adjustment, but only takes Super-8 or Single-8 film (the others take regular 8-mm, too). All three had good rewinds geared to let you wind smoothly and rewind fast, with reels up to 800 feet long. I didn't like the frame-marking punch, though: As with most editors, it punches a hole right through a scene. That makes the punched frame easy to spot, but ruins it if you should change your mind and want to use that frame. I prefer editors that notch the edge of the film, but that's probably impractical for striped sound films.—*Ivan Berger*



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● (We challenge ANYONE to dispute this Fact).

★ Never wears out or needs any Maintenance!



● gives you Maximum Power with continuous PEAK PERFORMANCE

...while reducing Maintenance and Operating Costs!

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Each Unit Tested to 15,000 RPM.
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★ "EASIEST-TO-INSTALL" UNIT ON THE MARKET.
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The shrinking of the zoom

Zoom telephotos are getting compact, sharp and less expensive.



85-210-mm zoom Tamron (above, left) and Sun (above, center) are hardly bigger than nonzoom 200-mm Vivitar tele (above, right). Sun's lens hood is detachable; others' slide back. Special features (right) include interchangeable camera adapter and "EE" diaphragm setting for camera with electric eye (Tamron), and handy tab for quicker zooming on Sun telephoto.

Zoom lenses are getting almost as light, compact, sharp and inexpensive as fixed-focal-length ones, to judge from the 85-210-mm Spiratone/Sun and Tamron zooms that I've just tested.

Zooms have always had two advantages over fixed lenses: You have only one lens to buy and carry to match the coverage of two or more conventional lenses. It's quicker to adjust a zoom lens than to remove a lens and mount another one. And zooms give you not only the standard focal lengths like 85, 105, 135 and 200-mm, but all the nonstandard ones in between. So if you need a 167½-mm lens to frame your picture precisely as you want it, then only a zoom will do.

But zooms are larger, heavier and more expensive than any one of the lenses they replace. And they're never quite as sharp as lenses of fixed focal length.

When comparing the Spiratone/Sun and Tamron to a modern 200-mm lens, though, the zooms stand up quite well. In size, the Tamron is just under 6 inches long, the thinner Sun



lens 6¾ inches—an inch or two longer than our reference 200 mm, but shorter than some others and a bit slimmer. In weight, both the 26-ounce Tamron and 22-ounce Sun are heavier than our 18-ounce reference, but again lighter than some older 200-mm designs.

The big question is performance—and these zooms do perform. Our reference telephoto did have slightly better contrast and sharpness than the zooms, but not to any great degree. You'd be more apt to feel hampered by the one-stop difference between the f/4.5 zooms and an f/3.5 tele. Price of the sleekly styled Tamron lens is \$310; the Spiratone/Sun is \$110-\$125, depending on the mount that is selected.—Ivan Berger

SOME STRONG REASONS WHY DATSUN IS THE NUMBER ONE SMALL PICKUP.



Two bed sizes. Datsun gives you two tough choices. You can get our Li'l Hustler with a 6-ft. bed. Or our Li'l Hustler Stretch with a longer 7-ft. bed.

Outstanding economy. Datsun Saves. If you harbor doubts, just witness Li'l Hustler's gas mileage figures: 31 MPG highway, 22 city. These are EPA mileage estimates with manual transmission. Of

course, your actual MPG may be more or less, depending on the condition of your truck and how you drive.

Strength in features. Our truck buyer's checklist begins: all-steel body and bed. Muscular 2000cc overhead cam engine. Rugged ladder-lattice frame. Tough torsion bar front suspension. Heavy-duty truck tires. And more, too numerous to mention.

Strong backing. To keep your Datsun trucking, there are nearly 4,000 factory-trained service technicians coast-to-coast. Plus a vast computerized parts network. That's how we plan to stay number one.

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Datsun Daves



The proud smoke

Product of a proud land.

Tobacco. It's as proud a part of the American tradition as The Alamo. At Liggett & Myers, we've made tobacco into a cigarette worthy of that tradition. The rich, mellow, distinctively smooth L&M. Smoke it proudly.

For color poster of The Alamo without commercial identification, send 2 L&M pack bottoms and 75¢ to P.O. Box 60-1904, Minneapolis, MN 55460. Offer void to persons under 21 years of age. Good in U.S. only, except where prohibited, licensed, taxed or restricted by law. Offer expires December 31, 1976. Allow four to six weeks for delivery.

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

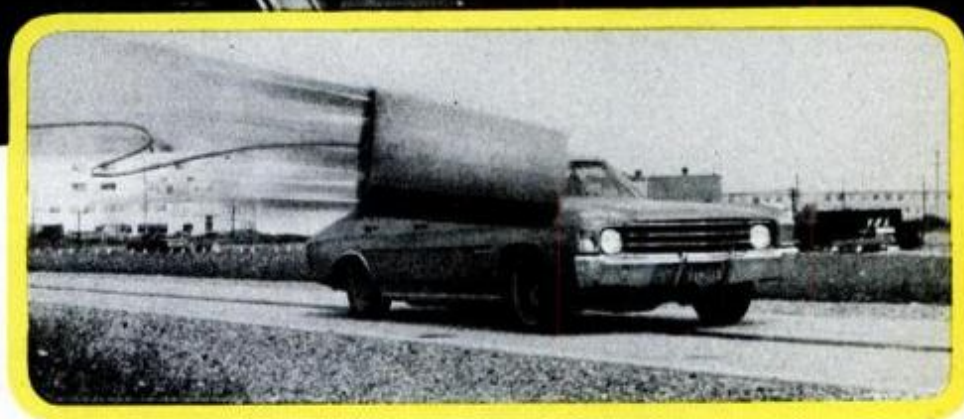
Filter King: 18 mg. "tar", 1.2 mg. nicotine av. per cigarette, by FTC Method.



How to avoid the accident you'd never forget

You've got to react differently than you ever have before—just jamming on the brakes may not be enough to save a life.

by Jim Liston



Plastic barrel is shot out in path of the car in one of several driving tests recently conducted by the Calspan Corp. The barrel was tethered so it would stop in the middle of the lane. Most of the drivers "killed it" by locking up their brakes and sliding into it. Only one evaded the barrel by quick, evasive maneuvering.

You're driving at 30—well within the limit—on a two-lane road when out of nowhere a boy on a bike zips from behind a parked car, looks up, tries to stop and falls sideways in front of you. You grip the wheel, jam on the brakes, hear your tires squeal and feel a soft thud as the car skids to a stop.

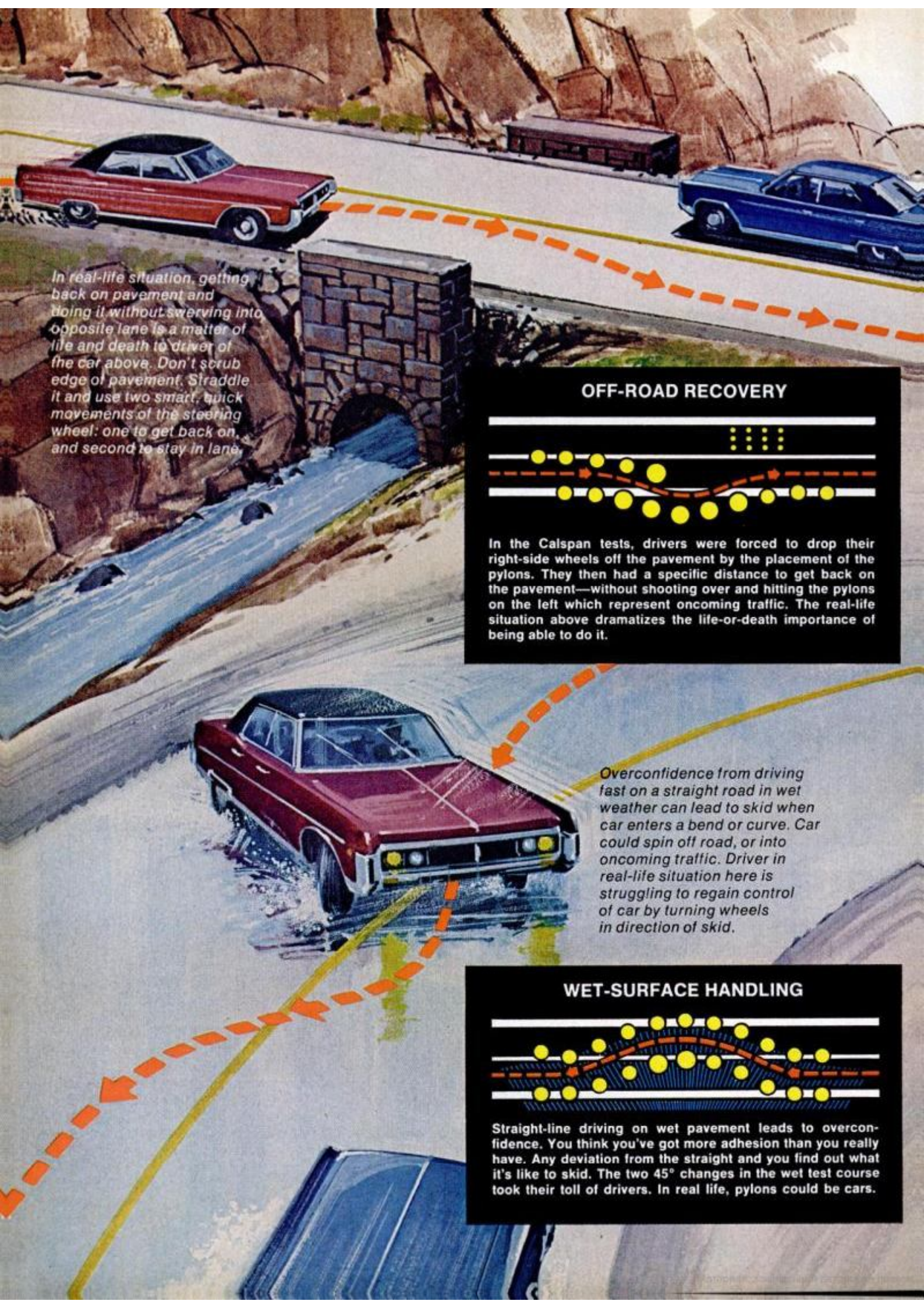
What has happened in seconds will be replayed for you over and over through many sleepless nights, because the unthinkable has happened: You have hit a child.

If, in fact, you ever hit a pedestrian—even though you are not at fault—it will be *the accident you can never*

forget. Yet what chance do you have when someone suddenly runs out in front of you? If you react like 33 of 34 drivers tested at Calspan Corp.'s Buffalo proving ground recently, you'll hit the pedestrian.

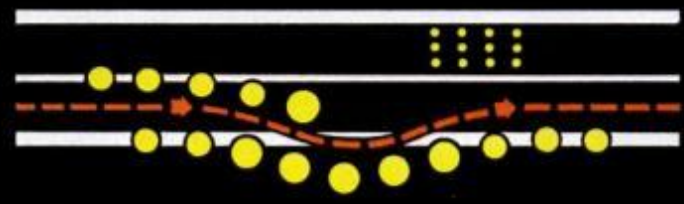
Researchers, studying how average American drivers handle a car in an emergency, devised this test:

As a car speeds down a straight-away on the driving course, it crosses a tape set 110 feet from a small shed at the side of the roadway. From the shed a plastic barrel—the "pedestrian"—is shot in front of the car. Calspan engineers carefully timed this so a driver traveling about 50



In real-life situation, getting back on pavement and doing it without swerving into opposite lane is a matter of life and death to driver of the car above. Don't scrub edge of pavement. Straddle it and use two smart, quick movements of the steering wheel: one to get back on, and second to stay in lane.

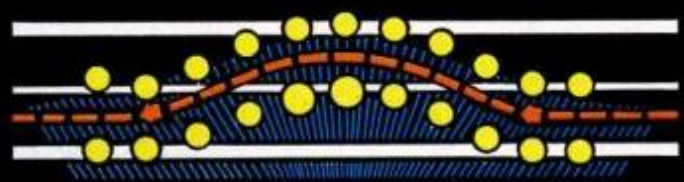
OFF-ROAD RECOVERY



In the Calspan tests, drivers were forced to drop their right-side wheels off the pavement by the placement of the pylons. They then had a specific distance to get back on the pavement—without shooting over and hitting the pylons on the left which represent oncoming traffic. The real-life situation above dramatizes the life-or-death importance of being able to do it.

Overconfidence from driving fast on a straight road in wet weather can lead to skid when car enters a bend or curve. Car could spin off road, or into oncoming traffic. Driver in real-life situation here is struggling to regain control of car by turning wheels in direction of skid.

WET-SURFACE HANDLING



Straight-line driving on wet pavement leads to overconfidence. You think you've got more adhesion than you really have. Any deviation from the straight and you find out what it's like to skid. The two 45° changes in the wet test course took their toll of drivers. In real life, pylons could be cars.

mph couldn't possibly avoid the barrel by braking, but had enough time to steer around it. The barrel was tethered; it could go only as far as the center stripe, leaving open a 10-foot left lane and a hard-packed shoulder. Driver after driver slammed into the barrel after braking. Some then tried to steer with their wheels locked. One out of four lost control of the car when surprised by the barrel. Others "froze"—did nothing. Only one driver, a woman who was traveling at 44 mph, avoid-

ed the barrel by steering around it. "It's smarter to chance steering around an obstacle than to lock up and slide into an accident," says Roy Rice, Calspan's project engineer.

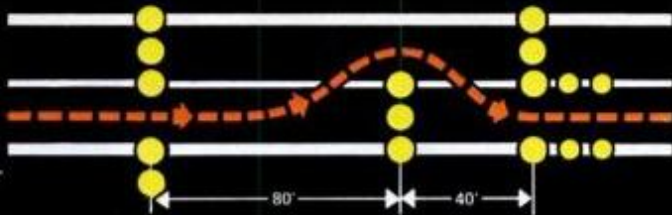
Avoiding a pedestrian was but one phase of the 18-month, \$100,000 study for the General Motors Corp. Calspan researchers found that the impulse of most drivers to use panic

braking rather than evasive action accounted for errors in other simulated emergencies.

"The typical driver didn't use the full potential of the car in terms of its cornering capabilities and handling qualities—even at 30 to 40 mph," says Rice. "He seemed unaware that it's virtually impossible to overturn the modern American car on an unobstructed surface."

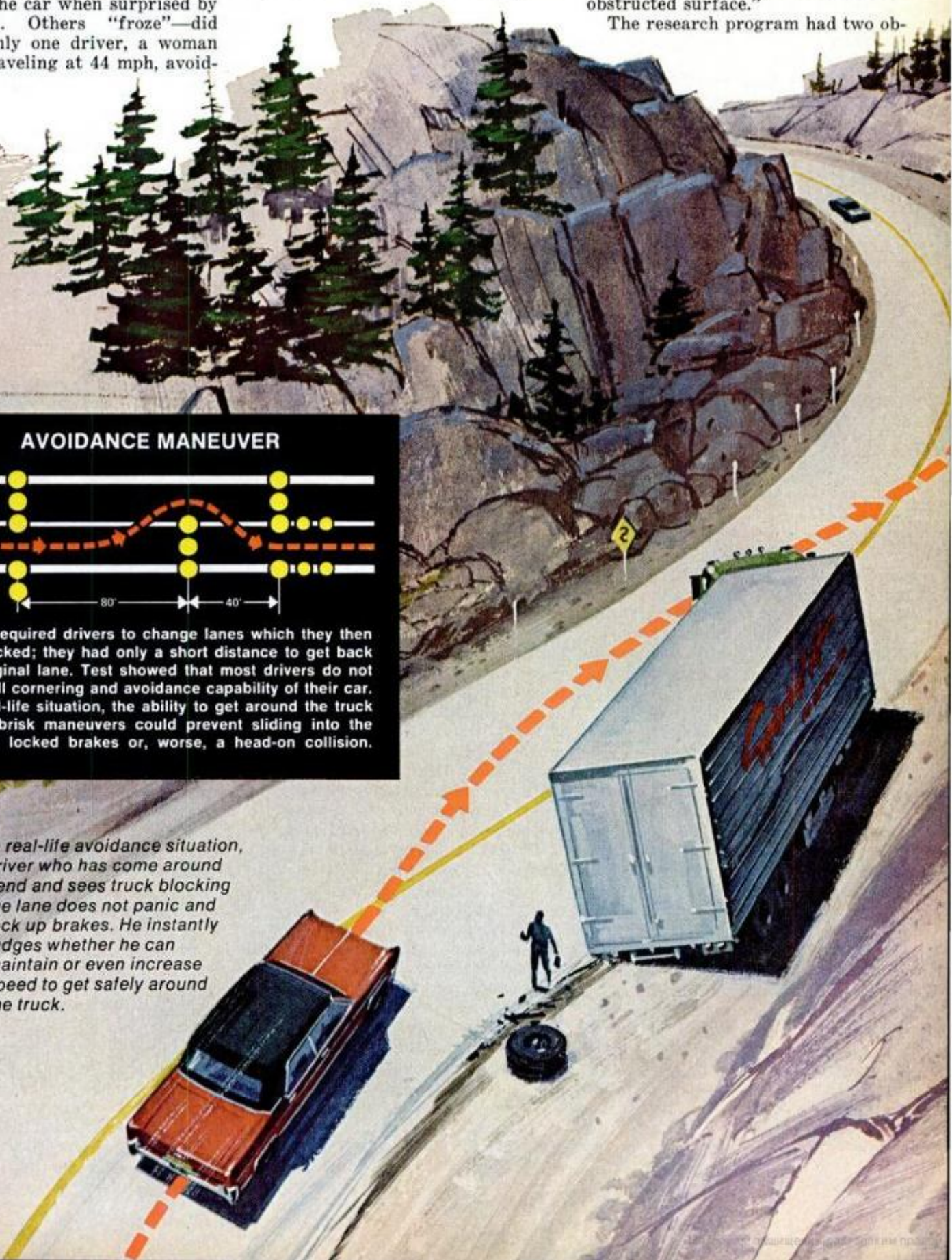
The research program had two ob-

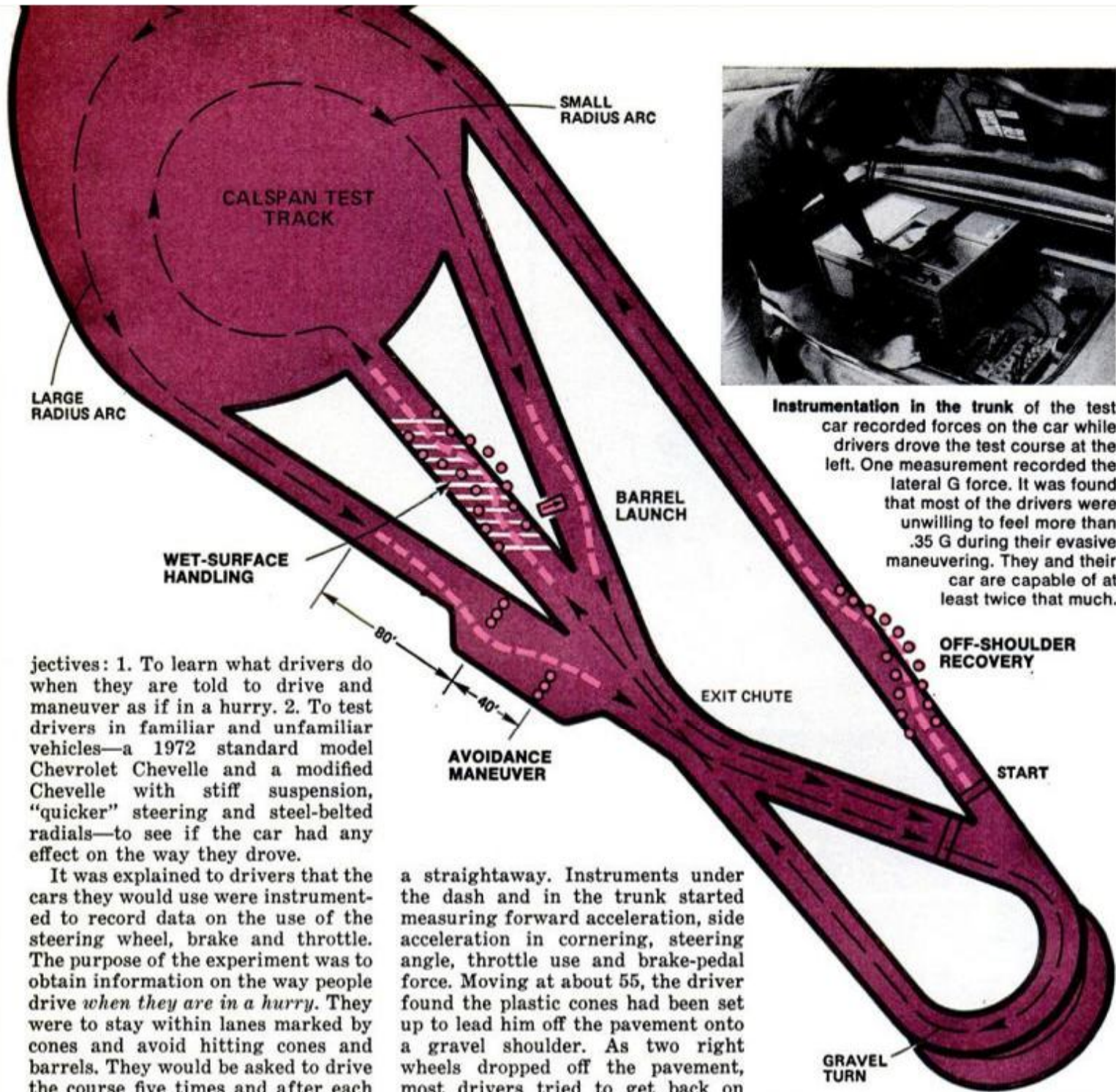
AVOIDANCE MANEUVER



This test required drivers to change lanes which they then found blocked; they had only a short distance to get back to the original lane. Test showed that most drivers do not use the full cornering and avoidance capability of their car. In the real-life situation, the ability to get around the truck with two brisk maneuvers could prevent sliding into the truck with locked brakes or, worse, a head-on collision.

In real-life avoidance situation, driver who has come around bend and sees truck blocking the lane does not panic and lock up brakes. He instantly judges whether he can maintain or even increase speed to get safely around the truck.





Instrumentation in the trunk of the test car recorded forces on the car while drivers drove the test course at the left. One measurement recorded the lateral G force. It was found that most of the drivers were unwilling to feel more than .35 G during their evasive maneuvering. They and their car are capable of at least twice that much.

jectives: 1. To learn what drivers do when they are told to drive and maneuver as if in a hurry. 2. To test drivers in familiar and unfamiliar vehicles—a 1972 standard model Chevrolet Chevelle and a modified Chevelle with stiff suspension, “quicker” steering and steel-belted radials—to see if the car had any effect on the way they drove.

It was explained to drivers that the cars they would use were instrumented to record data on the use of the steering wheel, brake and throttle. The purpose of the experiment was to obtain information on the way people drive *when they are in a hurry*. They were to stay within lanes marked by cones and avoid hitting cones and barrels. They would be asked to drive the course five times and after each trial they would be scored on time and the cones or barrels hit.

“Assume you find yourself in a situation requiring you to drive a strange automobile at the maximum of your ability on a road you have never traveled before. Time is an extremely critical factor, but just as critical and important is your safe arrival at your destination, requiring you to accurately maneuver this vehicle through various road configurations, conditions and hazards. The cones will tell you where the patch may narrow or curve. The barrels represent *fixed obstacles* (tree, other vehicle and so forth) in your path. Your score will depend on both your speed and accuracy through the course.”

Off-road recovery

With that, the driver took off down

a straightaway. Instruments under the dash and in the trunk started measuring forward acceleration, side acceleration in cornering, steering angle, throttle use and brake-pedal force. Moving at about 55, the driver found the plastic cones had been set up to lead him off the pavement onto a gravel shoulder. As two right wheels dropped off the pavement, most drivers tried to get back on immediately. But because the tires were scrubbing the edge of the pavement, drivers had to muscle the steering. As a result, the car snapped back and shot over to the opposite lane. The pylons went down like pins in a bowling alley—proof the driver was in the oncoming lane.

In subsequent runs over the course, many drivers discovered the secret of off-road recovery; Don't *ease* the car back on the pavement; your tires will scrub the edge of the road. Instead, straddle the edge, get back with a sharp turn and a quick return to the straight-ahead steering position the moment the tire hits the pavement.

Continuing on course, a driver found the pylons leading him into a gradual curve to the left. (This and a small-radius curve were simulations of long and short freeway exit ramps.) He'd been told to hurry so

he took this as fast as he could. Since the curve was unbanked, he found it hard to keep from drifting to the outside and knocking down pylons.

Avoidance maneuver

Drivers accelerated as they came off the curve. Barrels blocked their lane, but a lane was open to the right. As they neared it, drivers discovered it was only a few car lengths long. They'd have to make a lane change and get right back. To do this, many drivers used hard or panic braking, often locking up all four wheels. When they tried to steer around the barricade with wheels locked, they had no control. Others got around it but not back into their lane without knocking down cones because they didn't swing the wheel over hard enough.

To establish that it was possible to

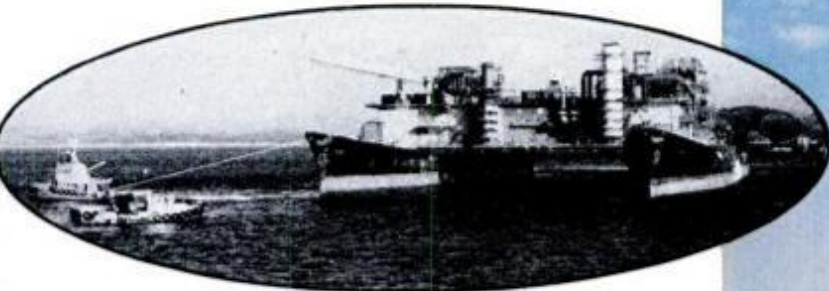
(Please turn to page 124)

IT'S NEW

NOW

World's mightiest offshore oil rig

Taller than a 50-story skyscraper and nearly as big as a football field, the mammoth structure at right is the world's mightiest offshore oil-drilling rig. Called the *Beryl A*, the huge Mobil Oil platform will operate in the stormy waters of the North Sea near the Shetland Islands off Scotland. It will pump and process up to 100,000 barrels of oil a day, can store



900,000 barrels in its hollow concrete "legs" and has accommodations for 120 technicians. To get the upper section onto its supports, the double-decker platform was first constructed across two modified tankers (above), then the columns were sunk to just above water level and the platform moved over them and attached. The giant weighs 330,000 tons and towers 300 feet above the waves. Its cost? A cool \$300 million.

Hot torch

You can braze or hard-solder with this Mapp gas torch said to create as much heat as expensive acetylene rigs. Nozzle swivels for easy handling in awkward spots, fits propane tanks for lower-temperature soldering jobs. TurboTorch has two nozzle tips, igniter, brazing rods, heat shield. \$36.45 ppd. Wingersheek, Inc., 2 Dearborn Rd., Peabody, Mass. 01960.



Roll your own fireplace 'logs'—from paper

You save on fuel and also get rid of old newspapers at the same time with this handy paper-log roller for fireplace use. You just feed in the paper, turn a crank and out come neatly rolled cylinders ready for tying into log-size bundles. The cast-iron roller with turned wood handles also makes an attractive fireside accessory, is \$29.98 with 200 wire ties. Extra ties: \$4.98 per 500. Christen, Inc., 59 Branch St., St. Louis, Mo. 63147.



Look of oak for prices of hardboard

What a big difference a small, inexpensive improvement can make in a room is shown in photos here. At right is room before addition of decorative paneling along one wall, as above. Paneling is Masonite's new Briarcliff design—prefinished hardboard simulating warm, rich oak paneling in 4x8 sheets.



Versatile wrench and bit driver

Squeeze-action socket wrench gets into tight places where you can't swing a handle. Tite Sqez set has English and metric sockets, adapter for Allen and screwdriver bits. \$19.95. Three Sons, 245 East Gunhill Rd., Bronx, N.Y. 10467; also Consumer & Industrial Tool Corp., 7300 Melrose, Buena Park, Calif. 90620.





Canard-winged VariEze is a mini version of its famous bigger brother, the VariViggen (page 145, March '73). It's shown here fitted with special auxiliary fuel tank in rear seat just before setting world distance record. For more, see article that follows.



Osprey 2 is two-place model of earlier single-seater version, has surprisingly sleek lines for an amphibian. Hull is polyurethane foam covered with fiberglass. Powered by 150-hp Lycoming, plane can hit 145 mph, cruises at 130, lands at 60. Length is 21 feet; wingspan, 26. Plans are \$150 from George Pereira, 3741 El Ricon Way, Sacramento, Calif. 95825.

10 handsome homebuilts you can make and fly

Here's a look at some of the latest, smartest designs for amateur plane-builders. Most can be constructed from available plans, some even from ready-to-assemble kits.

by Sheldon M. Gallager and Howard Levy

Partially completed Corsair (minus one wing) looks like the real thing except it's a 1/2-scale replica of the famous World War II fighter. The wings fold, as did those on the original, and the gear retracts into wheel wells on the underside. Top speed is about 165 mph with 70-hp VW engine. Plans are \$125; a wood kit without engine, \$400. War Aircraft Replicas, 348 South 8th St., Santa Paula, Calif. 93060. Also available are plans and kits for scaled-down versions of the Focke Wulf FW-190, Sea Fury and P-47.

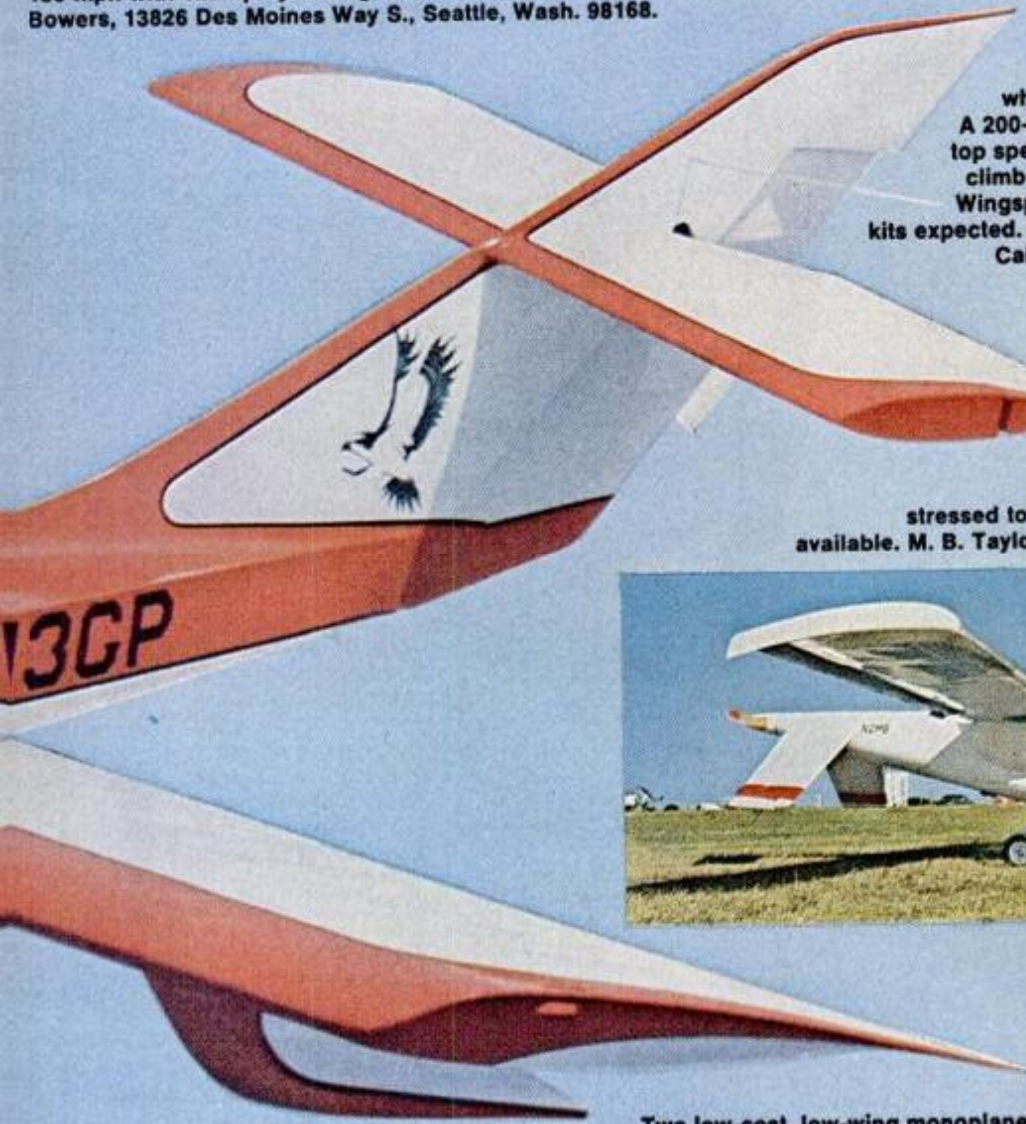




Spencer Air Car (above) is roomy four-place amphibian with 285-hp Continental engine. Wingspan is 37 feet, max. speed 150 mph. Plans \$185; kits also available. P.H. Spencer, 8725 Oland Ave., Sun Valley, Calif. 91352. Sporty Namu II (facing page) seats two, does 135 mph with 125-hp Lycoming. Plans available. Peter Bowers, 13826 Des Moines Way S., Seattle, Wash. 98168.



Super Fli (above) is aerobatic single-seater, has been flown by top aerobatic pilots who report good handling. A 200-hp Lycoming provides a top speed of 200 mph, a rate of climb of 3000 feet per minute. Wingspan is 24 feet. Plans and kits expected. Kraft Systems, 450 West California Ave., Vista, Calif.



It looks like it's upside down, but it really isn't. The Mini-Imp (below) uses an inverted-V tail and new NASA-designed airfoil for high performance. Takes engines from 60 to 100 hp, is stressed to 9 Gs for aerobatics. Plans \$200; kits available. M. B. Taylor, Box 1171, Longview, Wash. 98632.



Colorful Acroduster I (above) is versatile new competition aerobatic bi-winger you can build from a kit. Wings have symmetrical airfoil for inverted flight, incorporate four ailerons, give roll rate of 240° per second. Top speed is 195 mph with 200-hp Lycoming engine. Wingspan is 19 feet; length, 15 feet, 9 inches. Fuselage and tail are aluminum; wings, Dacron-covered wood. The kit is \$5500 from Stolp Starduster FORB-43R1 Twining, Riverside, Calif. 92509.

Two low-cost, low-wing monoplanes are the Hauscat (right), patterned after Grumman Bearcat and Mono Z (below), a single-seater version of earlier Zenith (page 162, March '74). Both are VW-powered and cost about \$2500 to build. Plans are \$125 for Hauscat, Yvan Bougie, 11 Terrasse-Robert, Nitro-Valleyfield, Que.; \$130 for Mono Z, Chris Heintz, 236 Richmond St., Richmond Hill, Ont.



VariEze: A plane

by Sheldon M. Gallagher and Howard Levy

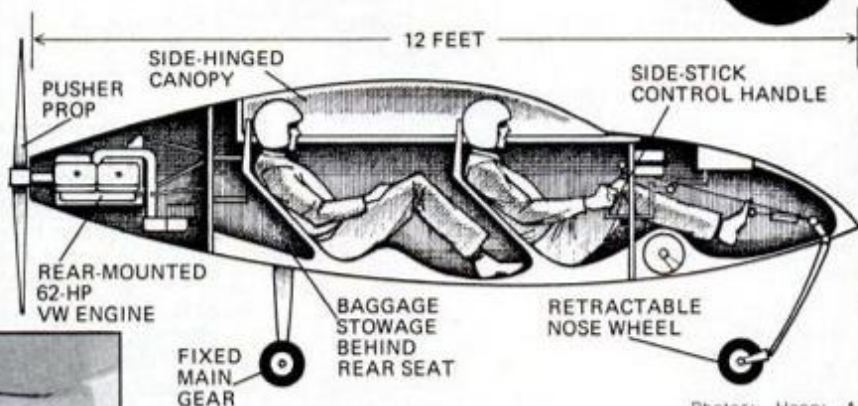
Twin tail fins

contain rudder controls but aren't really tails in conventional sense. They're wingtip "winglets" that help break up vortex turbulence to reduce drag. Photo below shows specially shaped luggage carriers that fit like a "boot" into limited storage space behind rear seat.

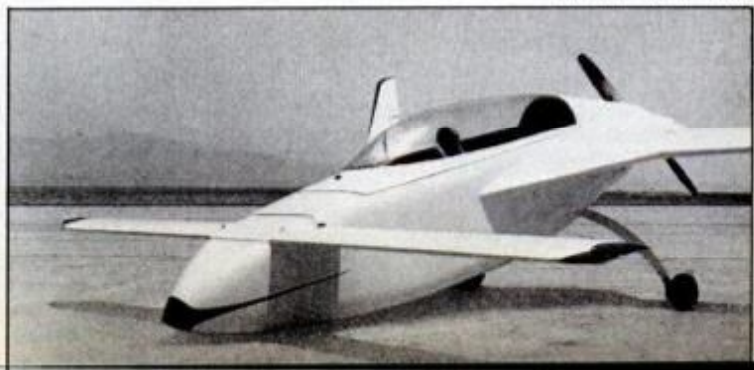
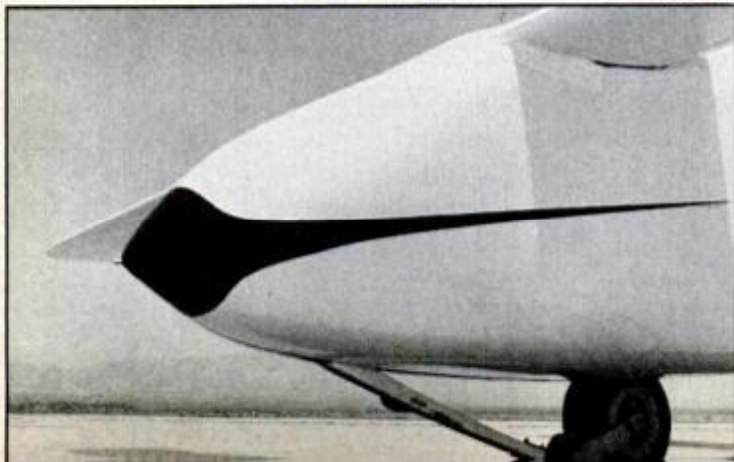


Sharply swept-back main wings contain no control surfaces, making them aerodynamically "clean" for minimum drag, high performance, easy construction. Elevons—combined ailerons and elevators—are up front.

Retractable nose wheel allows plane to "kneel" like a camel. This makes getting in and out easier, raises rear prop for convenient hand starting and compensates for tail-heavy condition with no pilot aboard. Drawing at right shows compact dovetailing of cockpits to save space.

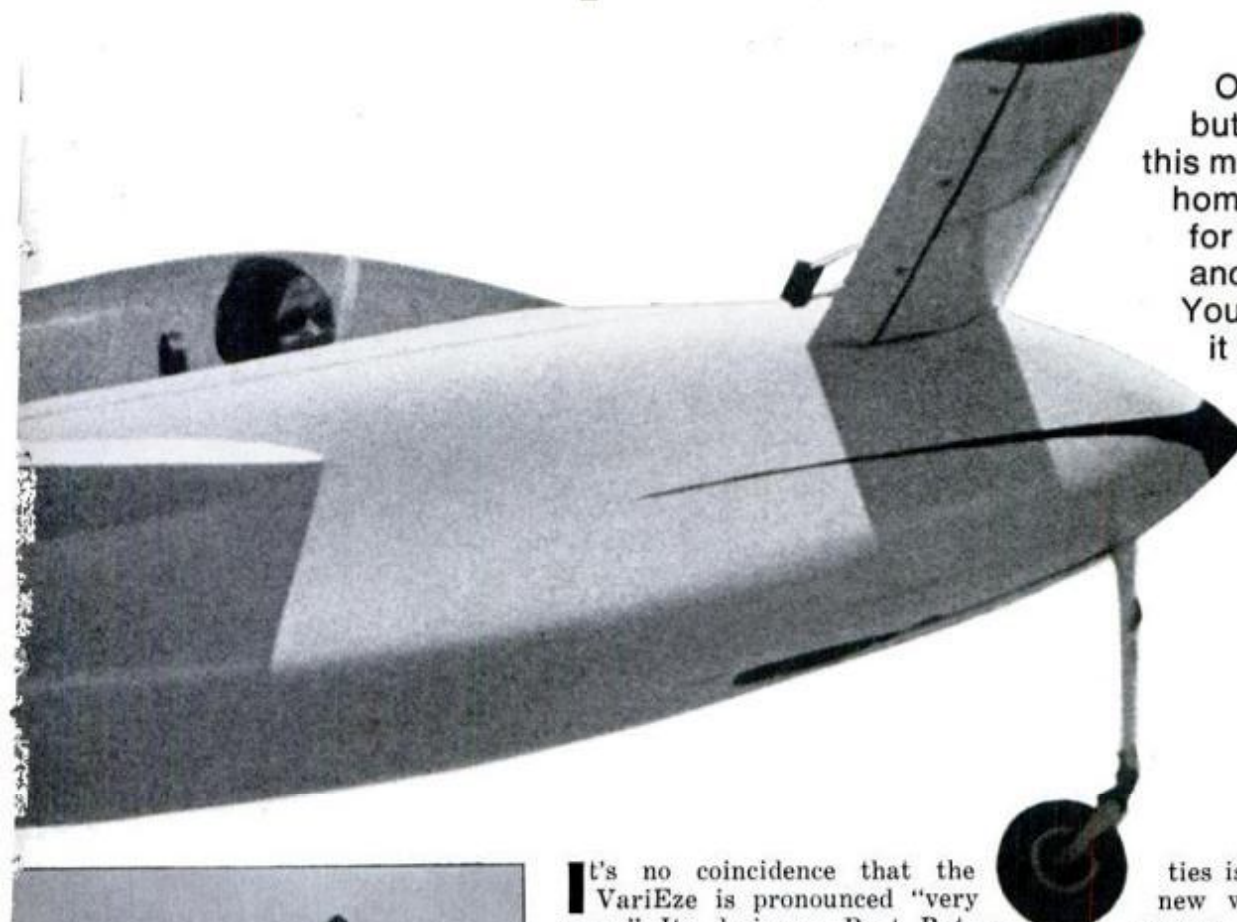


Photos: Henry Artot



that lives up to its name

Odd in appearance but not performance, this mini canard-winged homebuilt is designed for easy construction and superb handling. You'll be able to build it from plans or kits.



Rear view shows pusher prop and wide-bodied fuselage that flares into wings. Fuel tanks are housed in these thick wing-root sections so they take up no space inside craft itself. Bow-shaped main landing gear strut is single piece passing straight through the fuselage. This eliminates separate struts, simplifies mounting, lessens impact strain on airframe attachment points. Engine is 62-hp VW, giving a 185-mph cruise speed.

It's no coincidence that the VariEze is pronounced "very easy." Its designer, Burt Rutan, planned it that way. He wanted a plane that would be easy to build and fly, yet embody advanced aerodynamic principles to give high performance, good maneuverability and safe handling. Rutan, former chief engineer for Bede Aircraft and now head of his own aircraft company, knows what he's about. The VariEze is all these things and more. It may appear a bit odd—until you see it fly. Then it becomes a gracefully soaring, spectacular sight.

At first glance, the VariEze looks like a mini scaled-down version of Burt's famous VariViggen (page 145, May '73). Actually, it's considerably more sophisticated. Like the VariViggen, it has a pusher prop and stubby nose wings called canards. Unlike the earlier craft, it gets a 185-mph cruising speed from a bitty 62-hp VW engine. The VariViggen uses 150 hp to cruise at 150 mph. Thus the VariEze is 35 mph faster on less than half the power—that's Efficiency with a capital E.

Record-breaking endurance

With a length of just 12 feet, the VariEze is even shorter than the little Bede BD-5 and manages to squeeze in twin tandem cockpits against the BD-5's single seat. One indication of the midget's capabili-

ties is that it recently set a new world nonstop, closed-course distance record for planes in its size class (under 1102 pounds). It covered 1638 miles in 13 hours, 3 minutes, for an average gas consumption of 3.1 gallons per hour—this time Economy with a capital E. The new record bettered by nearly 100 miles the previous mark.

Light weight, clean lines

The secret of the VariEze's superb performance lies in its exceptionally low weight—only 390 pounds empty—and its aerodynamically "clean" lines. There are no control surfaces in the main wings to disrupt a smooth airflow. This reduces drag and at the same time simplifies construction of the plane.

Small finlike "winglets" at the tips help break up vortex turbulence to further reduce drag. They also contribute to directional stability and incorporate rudder controls. The rudders work in an interesting way: Each one swings in only one direction—to the outside. You use the right rudder in a right turn, the left rudder in a left turn. In each case, the opposite rudder remains stationary. This unique arrangement simplifies control linkage hookup since you need only a single pull cable to actuate each rudder—the swing back to neutral position is accomplished

(Please turn to page 158)

New satellites make



EARTH STATION

Dr. Peter Penham, one of Africa's flying doctors working out of a little village on the northern slope of Mount Kilimanjaro, Kenya, has been bitten by the OSCAR bug. Somebody gave Pete an old radiotelephone, a vacuum tube and some coaxial cable. The doctor added some empty aspirin tins and a quartz crystal from his airplane radio. Right out there in the African bush he fired up a home-brew transmitter built on the aspirin tins and talked to the world through OSCAR—the Orbital Satellite Carrying Amateur Radio.

The excitement gripping Pete as he built the transmitter reached fever pitch as he sent a signal up to a satellite 900 miles overhead and heard his call letters, 5Z4JJ, coming back down to his receiver. His very first chat with another ham radio operator, through the satellite, was with amateur station 4W1ED, more than 1000 land miles away in Yemen.

Since his contact last year with Yemen, Pete has communicated with amateur radio operators in 18 different countries on three continents. Meanwhile, Suby, operator of ham station VU2UV in southern India, has been talking with hams in Finland, Rhodesia, Poland, Germany, Japan and the USSR via the satellite. Dick

Cotton, owner of station W8DX in Detroit has used OSCAR to talk with hams in 51 different countries on five continents.

Vic Politi, W1NU of Fairfield, Conn., is an amateur bulletin station, broadcasting news about OSCAR through OSCAR to anybody interested. Bud Schultz, W6CG of Anaheim, Calif., has earned an award for contacting other ham operators in each of the 50 states through the satellites.

Thousands are using OSCAR

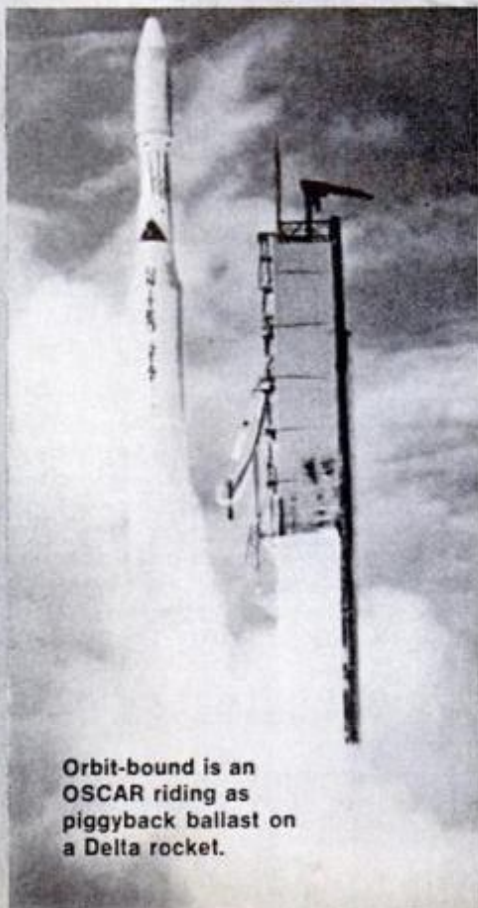
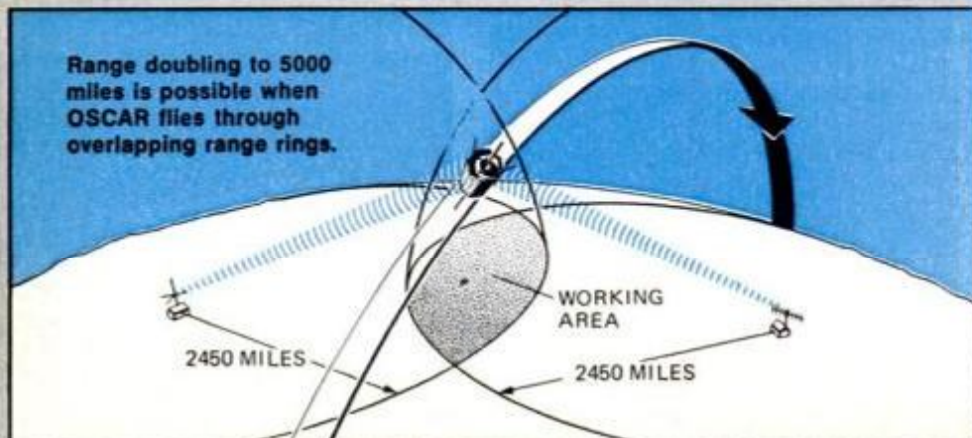
OSCAR satellites are the hottest news in ham radio. The hobby, which started radio broadcasting and point-to-point communications at the turn of this century, is in the grip of OSCAR fever. Thousands of hams in nearly every nation of the world are geared up and riding along electronically every day on two satellites they designed, built and financed. Many more are preparing for the ride.

There have been seven OSCAR satellites in orbit. All have gone into orbit as piggyback riders on rockets blasting government satellites into space. The National Aeronautics and Space Administration (NASA) uses OSCARs instead of deadweight ballast to further public education in

space science. Two ham satellites, OSCAR 6 and OSCAR 7, remain up there today, circling the globe in 900-mile-high polar orbits every couple of hours. OSCAR 6 was launched in 1972 alongside an ITCS weather satellite. OSCAR 7 rode aloft in 1974 with the NOAA 4 weather satellite and the Spanish INTASAT satellite. Hams use their satellites by transmitting signals up to OSCAR, which retransmits the signals back to Earth.

Satellites built by hams

OSCAR satellites have been built by hams from many countries. For instance, the 65-pound OSCAR 7 includes a telemetry system built by



Orbit-bound is an OSCAR riding as piggyback ballast on a Delta rocket.

ham listening more fun

You can tune in the fascinating worldwide network of amateur radio buffs whose 'homebuilt' satellites orbit in space.

by Anthony R. Curtis, K3RXK



RECEIVING ANTENNA

10-METER DIPOLE TRANSMITTING ANTENNA

RECEIVING ANTENNA

OSCAR 7

RECEIVING ANTENNA

SOLAR PANELS

OSCAR 6

RECEIVING ANTENNA

10-METER DIPOLE TRANSMITTING ANTENNA

TRANSMITTING ON 2 METER BAND

RECEIVING ON 10 METER BAND

SOLAR PANELS

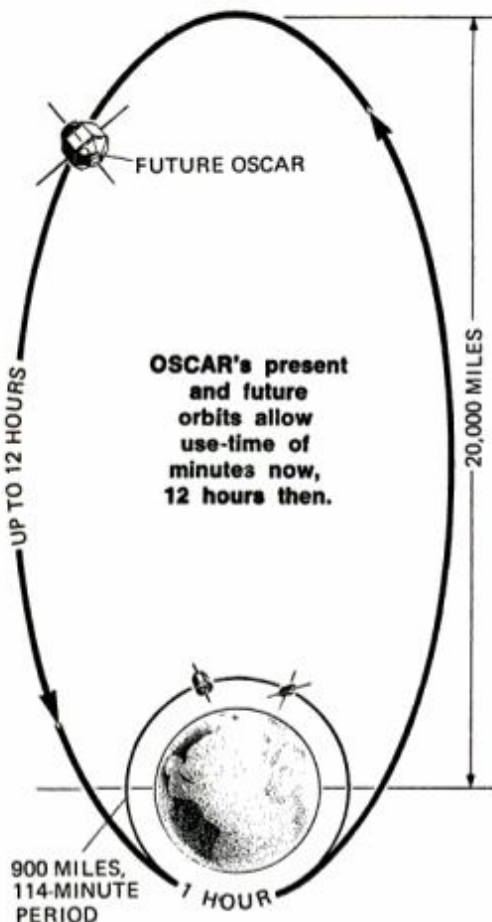
Designed, built and financed by hams, OSCAR 7 and 6, above, receive and retransmit signals from and to Earth stations like those shown here. You can listen in.

EARTH STATION





A typical Earth station will use relatively low-powered rigs to talk through OSCAR.



Australian hams, one retransmitting system built by German hams, another rebroadcaster built by Americans, a beacon transmitter built by Canadian hams and another beacon built by a San Bernardino, Calif., ham club. New and even more sophisticated amateur satellites are under construction.

OSCAR fever hit me hard. Sputnik, Pioneer, Vanguard, Exp'orer, Apollo—18 years of space satellites in the news made me dream of getting into the space age. When amateur satellites made space communications possible for the man-on-the-street, I had to be in on the action. Thousands of other hams had the same gut reaction.

Anybody can listen

First, I wanted to hear the Morse-code telemetry beacon from the satellites. Then I wanted to be able to transmit through the satellites to other hams and shortwave listeners. I had a shortwave receiver just like any shortwave radio listener's. The radio was capable of being tuned to the amateur radio 10-meter band. Both OSCARs transmit down to Earth on frequencies between 29.400-29.550 MHz. Most popular general-coverage shortwave radios cover 550 KHz to 30 MHz which spans the OSCAR downlink frequencies. Anybody with one of these receivers can sit at home and listen to OSCAR.

Amateur radio operators transmit up to OSCAR on frequencies in the two-meter ham band. OSCAR repeats what it hears by retransmitting down in the 10-meter ham band. It is only necessary to listen in on 10 meters to hear everything going through OSCAR. Signals passing through OSCAR are in voice and in

(Please turn to page 131)

OSCAR HISTORY

Amateur radio will mark its 15th anniversary in space this year. It was 12:42 p.m. on Dec. 12, 1961, when a Thor-Agena rocket lifted on a pillar of flame from Vandenberg, Calif., carrying a 10-pound OSCAR satellite aboard as ballast.

Working evenings, weekends and during every spare moment in basements, garages and attics, hams have built seven OSCARS. Here's a rundown:

OSCAR 1 carried a transmitter with power of only one-tenth of a watt which transmitted telemetry in a beacon to Earth for three weeks.

OSCAR 2, launched June 2, 1962, was identical to OSCAR 1 with telemetry-beacon transmissions lasting 18 days.

OSCAR 3, launched March 9, 1965, was amateur radio's first active communications satellite. It received ham signals and retransmitted them at the high output power of one watt. It made history as the first free-access communications satellite. One hundred different amateur stations in 16 countries communicated through the satellite during its two-week life.

OSCAR 4, launched Dec. 21, 1965, was an active satellite with three watts output. It did not make a good orbit, but hams did communicate through it, including the first direct U.S.-to-U.S.S.R. contact via satellite.

OSCAR 5, launched Jan. 23, 1970, was built by students at Melbourne University, Australia, and launched from the United States under auspices of the AMSAT. Its batteries lasted 1½ months.

OSCAR 6, launched Oct. 15, 1972, is still going strong as an active repeater satellite. It hears ham signals and retransmits them. The 40-pound satellite can store messages and repeat them. It can be turned on or off by ground command. Transmitter power is one watt.

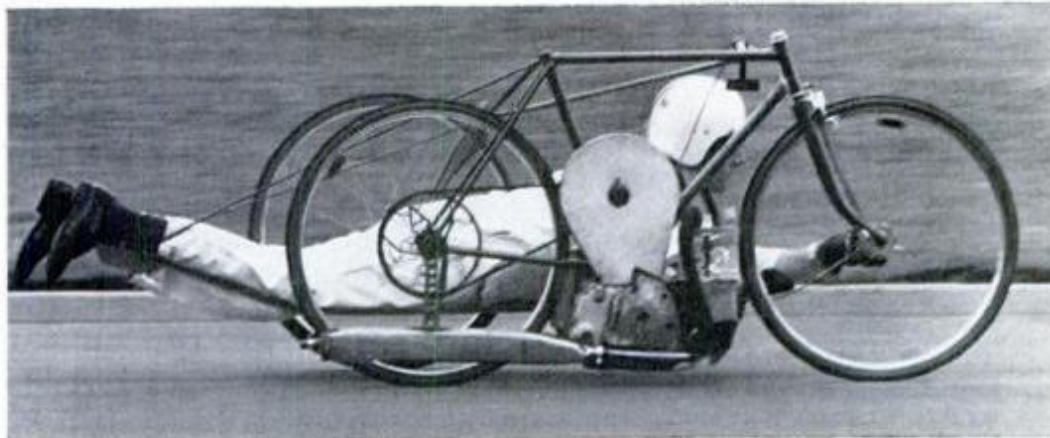
OSCAR 7, launched Nov. 15, 1974, was built by hams in Germany, Canada, Australia and the United States. It has two separate communications repeaters on board with two watts power. It can store messages for later replay, be turned on or off at ground command. Medical data, weather bulletins and other emergency communications have been transmitted through the 65-pound OSCAR 7.

WHEN TO LISTEN FOR THE OSCAR SATELLITES*

Day	Date	OSCAR over eastern U.S. p.m. EST	OSCAR over central U.S. p.m. CST	OSCAR over western U.S. p.m. PST
Sat.	Jan. 31	8:25-8:45	9:20-9:40	9:15-9:35
Sun.	Feb. 1	7:25-7:45	8:20-8:40	8:15-8:35
Mon.	Feb. 2	8:20-8:40	9:15-9:35	9:10-9:30
Wed.	Feb. 4	8:15-8:35	9:10-9:30	9:00-9:25
Fri.	Feb. 6	8:05-8:30	9:00-9:25	8:55-9:20
Sun.	Feb. 8	8:00-8:25	8:55-9:20	8:50-9:15
Wed.	Feb. 11	8:55-9:15	9:50-10:10	9:45-10:05
Thur.	Feb. 12	7:50-8:10	8:45-9:05	8:40-9:00
Fri.	Feb. 13	8:50-9:10	9:45-10:05	9:40-10:00
Sat.	Feb. 14	7:40-8:00	8:35-8:55	8:30-8:50
Sun.	Feb. 15	8:45-9:05	9:40-10:00	9:35-9:55
Mon.	Feb. 16	7:35-7:55	8:30-8:50	8:25-8:45
Wed.	Feb. 18	7:30-8:00	8:25-8:55	8:20-8:50
Fri.	Feb. 20	7:20-7:55	8:15-8:45	8:10-8:45
Sun.	Feb. 22	7:15-7:50	8:10-8:45	8:05-8:40
Wed.	Feb. 25	8:20-8:40	9:15-9:35	9:10-9:30
Thur.	Feb. 26	7:05-7:25	8:00-8:20	7:55-8:15
Fri.	Feb. 27	8:15-8:35	9:10-9:30	9:05-9:25
Sat.	Feb. 28	8:50-9:10	9:45-10:05	9:40-10:00

*These are the best listening times though the satellites can be heard at other times. A complete list of times for any month of the year is available from AMSAT.

IT'S NEW NOW



One way to save on gas

If you don't mind doing your traveling lying face down, you can get 845 miles to the gallon in the bike-like rig at left. British designer Brian Beattie accomplished the feat in a recent fuel-economy competition staged by Shell Oil at Appleton, England, beating out six other contestants. His machine is built of bicycle parts and powered by a 50-cc moped engine. Steering is by a single control arm that also contains throttle and tachometer. Beattie's next attempt will be to establish a 1000-mpg record.

Ford engines fly again

With a growing shortage of aircraft engines for light planes, builders are turning to automotive conversions to fill the gap. Converted VWs are used in many small planes, but more power is needed for larger craft. A possibility is Ford's 400-cu.-in. V8, shown being tested here by Geschwender Aeromotive, Inc., Box 5152, Lincoln, Neb. 68505. When turbocharged, such engines are capable of producing up to 1600 hp. Another possibility is Ford's little Pinto V4.



Small tiller with a big bite

Designed for handy use in back-yard garden plots, Gilson's new 2-hp Compact Tiller features a fold-up handle that lets it store in a small space, even fit in the trunk of a car (above). It weighs only 51 pounds, yet has 9-inch-diameter tines that bite through hard sod and soil, dig to a 6-inch depth. Tilling width is adjustable from 6 to 18 inches. Gilson Brothers, Box 152, Plymouth, Wis. 53073.



Darkroom advice on tape

Now you can do darkroom work easily and accurately as a friendly voice tells you exactly what to do and when to do it. The voice in the dark comes from a cassette tape, one of six new instructional recordings put out by Kodak. The timed, step-by-step tapes cover the processing of black-and-white film and prints, color slides, color negatives as well as several types of color prints. Sold for approximately \$6.90 each at darkroom supply houses. Kits of chemicals also available.

Presto—change your pickup into a dump truck

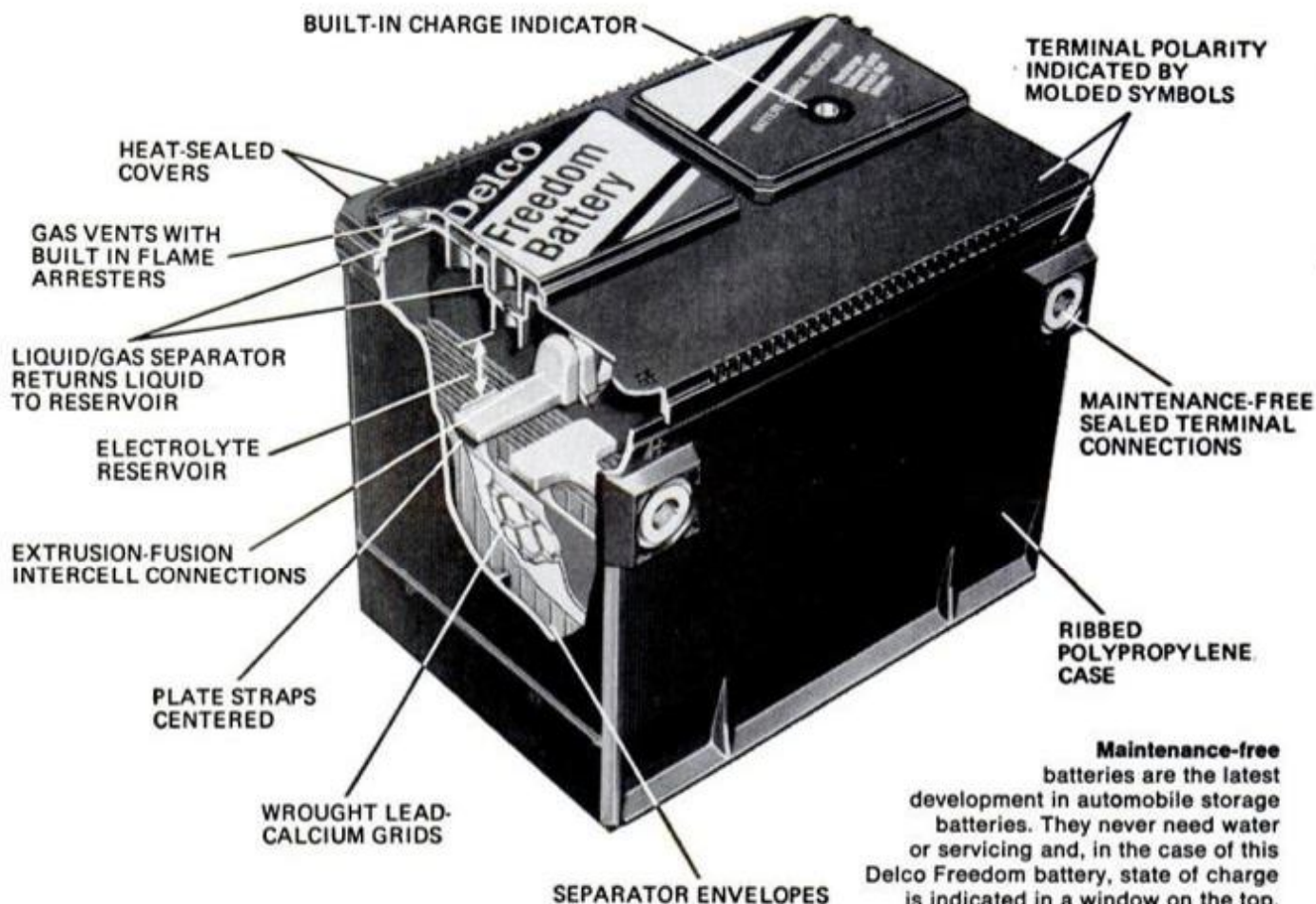
You can turn your pickup into a dump truck for fast unloading with this conversion lift. Called Jet Hoist, the electro-hydraulic unit fits most 1/2, 3/4 and 1-ton pickups without changing body lines. At the press of a button, the lift tilts your truck body to off load more than two tons in 15 seconds. Installation requires welding, but you can have this done at a welding shop or Jet Hoist dealer if you don't have your own equipment. Price not yet announced, but the accessory will be available soon. Truckers Supply, Inc., 1000 North First St., Garland, Tex. 75040.



All about batteries

How they work, how they're made, how to buy one and how to take care of it.

by Michael Lamm
WEST COAST EDITOR



Maintenance-free batteries are the latest development in automobile storage batteries. They never need water or servicing and, in the case of this Delco Freedom battery, state of charge is indicated in a window on the top.

Racing out the door that cold, blustery morning, you hop into your car, buckle up, hit the starter, and—nothing. No groan, no click, simply *nothing*.

Terrific. Dead battery.

Car batteries usually get sold in panic situations. You have very little time to think about or to choose what sort of battery you ought to get. You'll need a new one as soon as possible, sometimes within the hour.

Be ready to make a choice

This article is intended to prepare you for that critical, harried morning when you have to have a new battery right away.

After you've established that you really *do* need a new battery (keep in mind that plenty of other automotive ailments show the same symptoms as a dead battery), the buying scenario typically runs something like this:

You're late for work. You rush

down to the nearest filling station or store that sells batteries, and all of a sudden you're brought up short. Here are seven batteries on display, all in your group size, all fitting your car, all looking very much alike, all carrying different prices. Prices, in fact, range from \$20.95 up to \$52.95.

Why, you ask the salesman, does the most expensive battery cost more than twice as much as the cheapest battery?

"Warranty," replies the salesman—not because that's the real reason or the only reason but because "warranty" is the simplest difference to explain. The \$20.95 battery is warranted for 18 months, while the \$52.95 unit is guaranteed "for life"—as long as you own your car. Between these two extremes, you can buy batteries warranted for 24, 36, 42, 48 and 60 months.

Look for cranking performance

The question, then, would appear

to be, "How long do I plan to keep my present car?" Most people buy batteries on some quickly computed formula involving price and warranty.

Yet price and warranty aren't the important considerations. Much more important is a criterion most battery buyers haven't yet heard of, much less understood. It's called *cranking performance* or, in the vernacular, cold-cranking power.

Cold cranking ratings came into general use in 1972. These figures mean simply the number of amps the battery can put to your starter at zero degrees Fahrenheit.

Before you reread that sentence, think about this. As you're standing there in the store, noting that all those seven batteries in the display look alike, consider the difference in performance. On a zero-degree morning, the 60-month battery can shoot around 500 amps. to your starter. The 18-month battery delivers less than

half of that amount—say 240 amps.

The question now becomes, "How many cold-cranking amps. is my car going to need on the coldest morning of the year?"

If you drive a small car with a small-displacement engine, and if you live in a warm climate, the "18" will do just fine. But if you own a big American sedan with a V8, the "18" won't get you by, not even in sunny Florida and surely not in the chilly deeps of the Midwest or Northeast.

How, though, can you actually tell the cold-cranking requirement of your car? Very simple. *Take your engine's displacement figure and match it with the new battery's cold-cranking rating. In cold climates, add 20 percent.*

That's the most important statement in this article.

Take this example. You live in Minnesota and drive a 1973 Torino with the 351-c.i.d. V8. You'll need a battery with a basic cold-cranking rating of at least 351 amps. And since you live in Minnesota, you'll have to add the extra 20 percent: 71 amps. In other words, ignore warranty and ignore price, but buy a battery with a total cold-cranking rating of not less than 422 amps.

Even if you plan to trade off your Torino in a year, you ought to choose a 48 or 60-month battery. Anything less powerful is very likely to leave you stranded the next time a cold snap hits. Only *after* you establish

your car's cold cranking requirement should you shop for warranty and price.

And watch for reserve capacity

Now there's another rating that helps tell you about a battery's performance. It's called *reserve capacity*. Reserve capacity is a number that tells you how many minutes your car can keep running at night if your alternator happens to go out.

The figure is calculated for an 80° F. night in which you need to run a 25-amp load: lights, wipers, other accessories, plus ignition. In other words, if a battery has a reserve capacity rating of 100, it means you can drive for 100 minutes on a balmy night without your alternator before the car quits.

There's no direct relationship between reserve capacity and cold-cranking performance, but they do generally go up together.

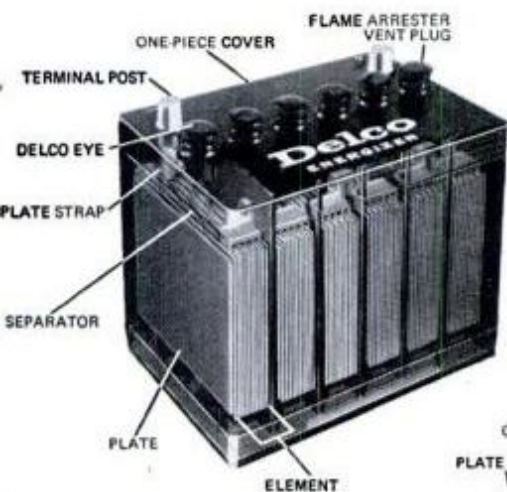
So now we've established four basic criteria you ought to weigh when buying a replacement car battery:

- Cold-cranking rating,
- Reserve capacity,
- Warranty and
- Price.

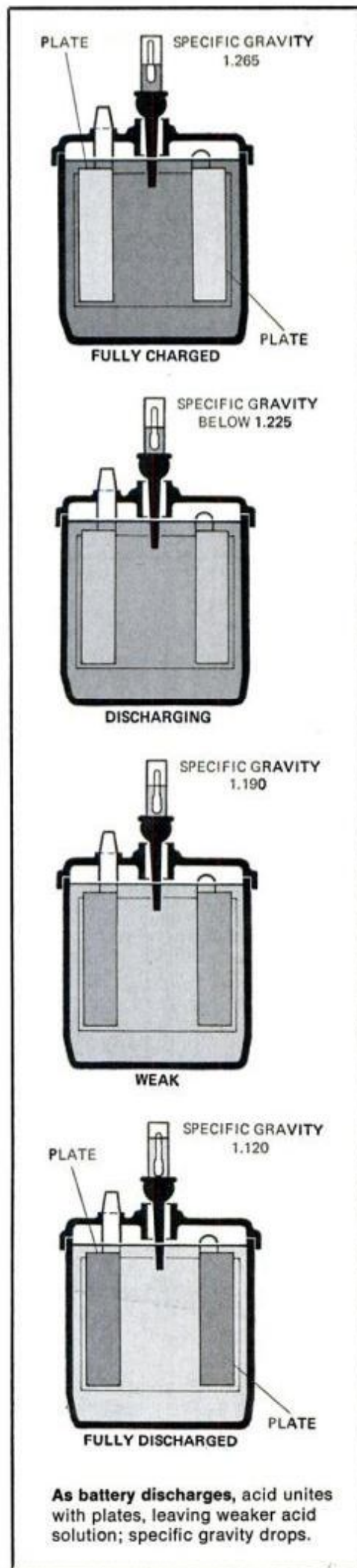
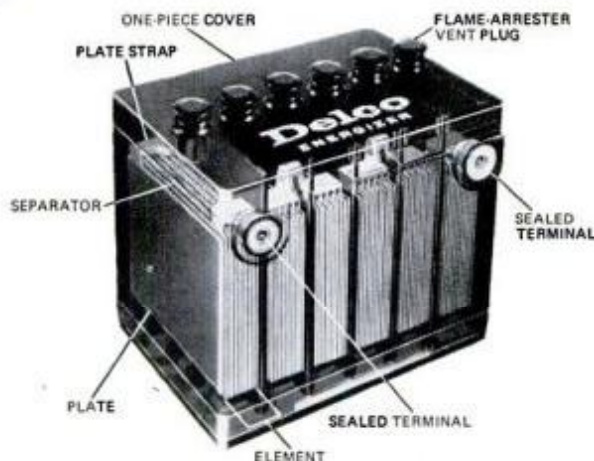
Of the four, the first and by far the most important is cold cranking. Remember to match it to your engine's cubic-inch displacement, and add 20 percent if you live in a cold climate.

Once you've set that, this figure will dictate warranty and reserve capacity pretty much automatically. If you think you'll keep your car longer than the cold-cranking rating dictates, by all means go to a more generous warranty.

The longer the warranty, of course, the higher the price in any given line. By and large, the major chain stores give the best prices. Next come the automotive supply stores, the filling stations and the new-car dealers. Even when you find yourself in an emergency situation, try to do a little



Familiar storage battery (above) has terminal posts. Fast disappearing, this type of terminal battery requires special care in servicing: Tools like clamp spreader and clamp puller are needed. Sealed, side-terminal battery (right) is now used in all new General Motors cars. Secure connection and less corrosion buildup on the terminals are big advantages.

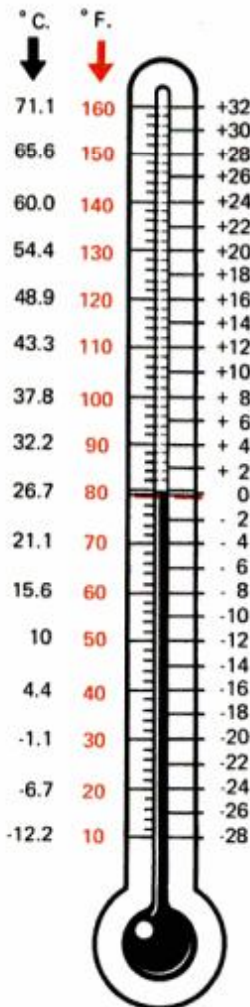


comparison shopping by phone. Compare prices per cold-cranking ratings and warranty.

Warranties

I don't mean to imply that battery warranties aren't important. They are, but you have to see them in perspective. Battery warranties come in various forms. The most common warranty gives an initial free replacement period of 90 days. If a battery is going to fail from defects in materials or workmanship, it'll do it during those first 90 days.

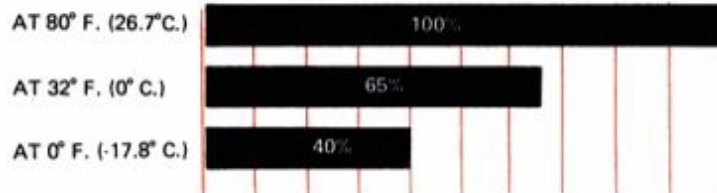
After that, the rest of the warranty is broken down and prorated by months. For example, if you buy a 36-month battery for \$36, each month is worth \$1. If, then, the battery fails at 24 months, you can apply the remaining 12 months (\$12) toward another battery from the same store.



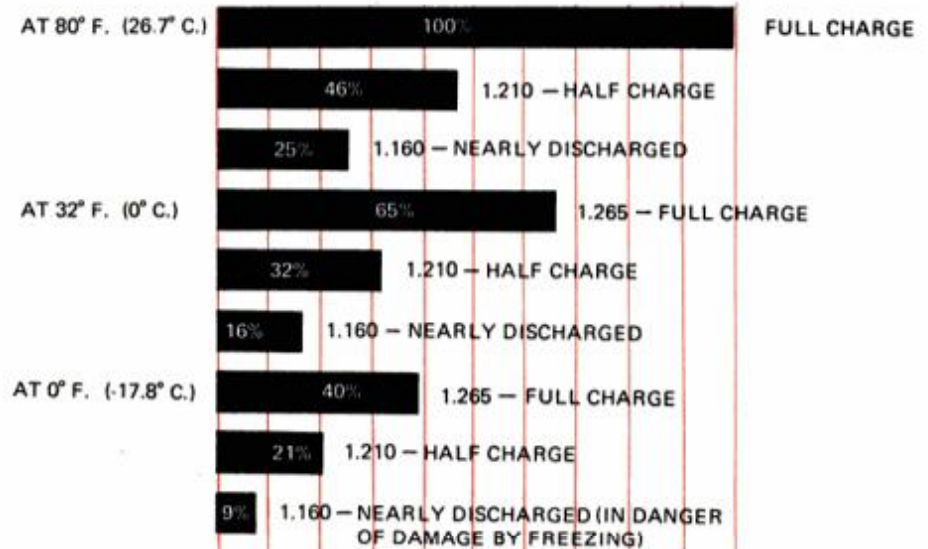
TEMPERATURE COMPENSATION OF SPECIFIC GRAVITY READING

To correct specific gravity reading as obtained on hydrometer, add .004 for each 10° F. increase over 80° F. Subtract .004 for each 10° F. under 80° F. Scale shows +.002 to +.032 and -.002 to -.028.

CRANKING POWER AS AFFECTED BY TEMPERATURE



CRANKING POWER AS AFFECTED BY CHARGE AND TEMPERATURE



Battery capacity is greatly reduced by cold as lower temperatures have numbing effect on electrochemical action. Drop from 80° F. to 0° F. leaves fully charged battery with only 40 percent of its cranking power.

Cranking power of battery is maximum at 80° F. and when fully charged. Note that at 0° F. even a fully charged battery has only 40 percent of its cranking power available—less if not fully charged, as shown above.

Note the obvious: Any warranty is only as good as the warrantor. Choose a retailer whose reputation and products you trust. Pick one, too, with a large enough network of cooperating dealers or retailers so you don't have to go back to that same store to collect on the warranty.

Many stores now market what they call "lifetime" batteries, which they warrant fully for as long as you own your car. You can't switch it from car to car or owner to owner, but if a lifetime battery fails before you get rid of your car, you bring it back and get another lifetime battery that's just like it.

Lifetime batteries can't, of course, last forever, as their makers freely admit. What they're banking on, though, is that you'll get rid of your car before the battery dies. It's a gamble. So, if you're planning, to keep your car longer than 60 months (five years), lifetime batteries can be a very good investment.

- They're all rugged and have high cold-cranking and reserve ratings.
- Some are less expensive than 48 and 60-month batteries from other

(Please turn to page 144)

BATTERY TOOLS

- Hydrometer
- Clamp spreader
- Post brush
- Clamp puller
- Battery lifter strap
- Petroleum jelly or protective spray
- ½-inch and 9/16-in. box wrenches
- Battery charger
- Load tester



Proper care of your battery requires that you have the right tools. Hydrometer (right) is basic for determining state of charge.

Back-yard fish farming for food and fun

by Gurney Williams

They call it a Mini-Ark because, like the Biblical Ark, it may help to keep us afloat—not in floods—but in a time of dwindling food supplies and an exploding world population. Actually, it doesn't look like an Ark at all. It looks more like three small greenhouses stepped down a hillside. Inside these strange, shedlike structures they grow fish.

Smile if you like, but this little back-yard fish farm designed and built by the New Alchemy Institute in Falmouth, Mass., on Cape Cod produces more than 100 pounds of good-eating fish a year. The fish grow to edible size on nothing more than algae and tiny water animals scooped free from local ponds. Aside from this, the Ark is a completely enclosed, self-operating system—in ef-

fect, a totally self-contained, self-sustaining environment. No fuels are used, and no pollutants foul the atmosphere. The sun heats the water in which the fish are bred, and wind power circulates the water through the system. Everything is free.

Not gold but just as good

Alchemists of the Middle Ages tried to turn base metals into go'd. The six-year-old, nonprofit New Alchemy Institute has no such visionary goal, yet what it produces does glitter—a bright hope for the future. The Falmouth farm is merely a small-scale prototype of what could be much larger Arks all over the world turning out substantial quantities of much needed good, healthful, high-protein food. Already the institute is planning to build a bigger version of its Ark on Prince Edward Island later this year.

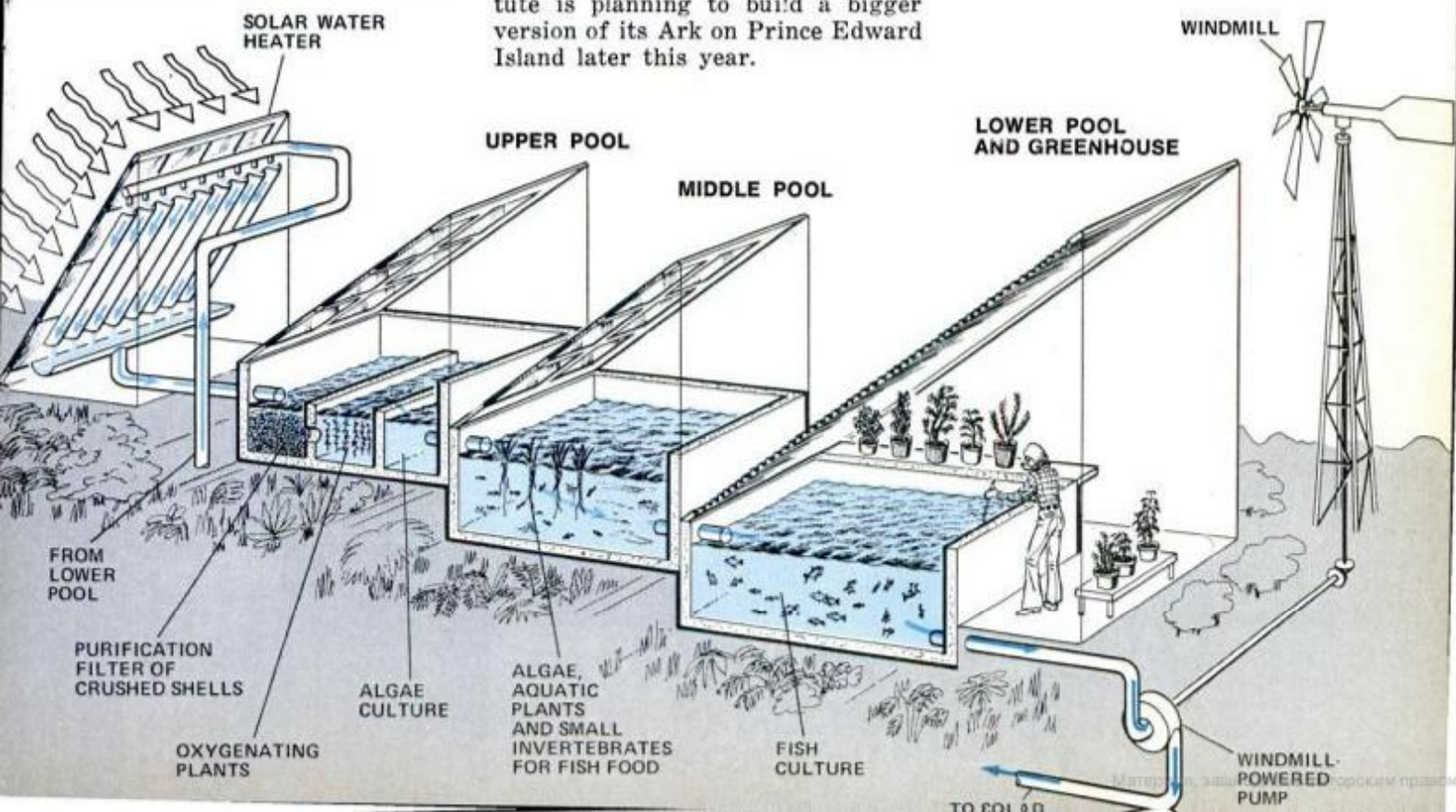
It looks like three greenhouses, but it's New Alchemy's fish farm at Falmouth, Mass. At right, researcher checks one of the breeding pools.



Scientists at the institute built their Mini-Ark almost entirely of scrap materials and scrounged parts—old storm windows from house wreckers for their glass-roofed pools, discarded bathtubs for filtering tanks, an auto-engine crankshaft for the windmill drive. It took a lot of ingenuity and experimentation, but the project was fun—and paid off.

Basically, the system consists of a

(Please turn to page 146)

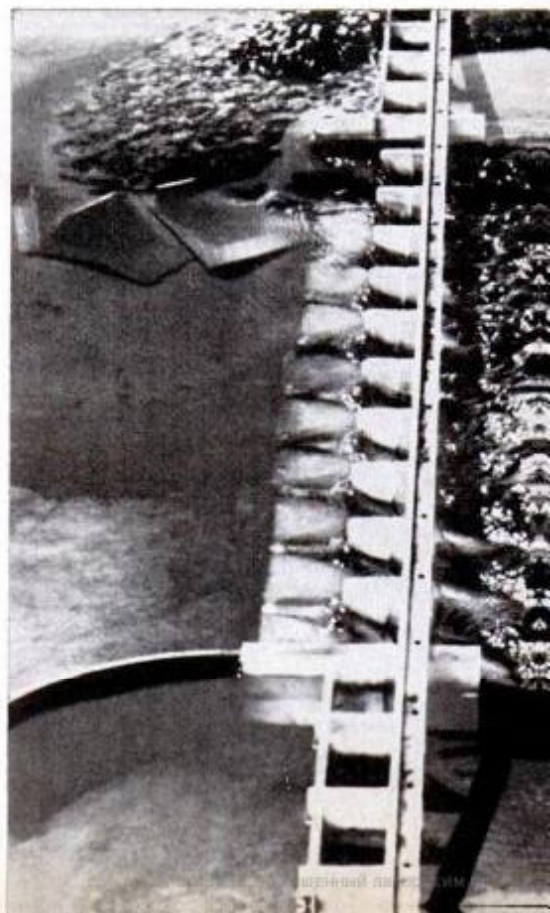




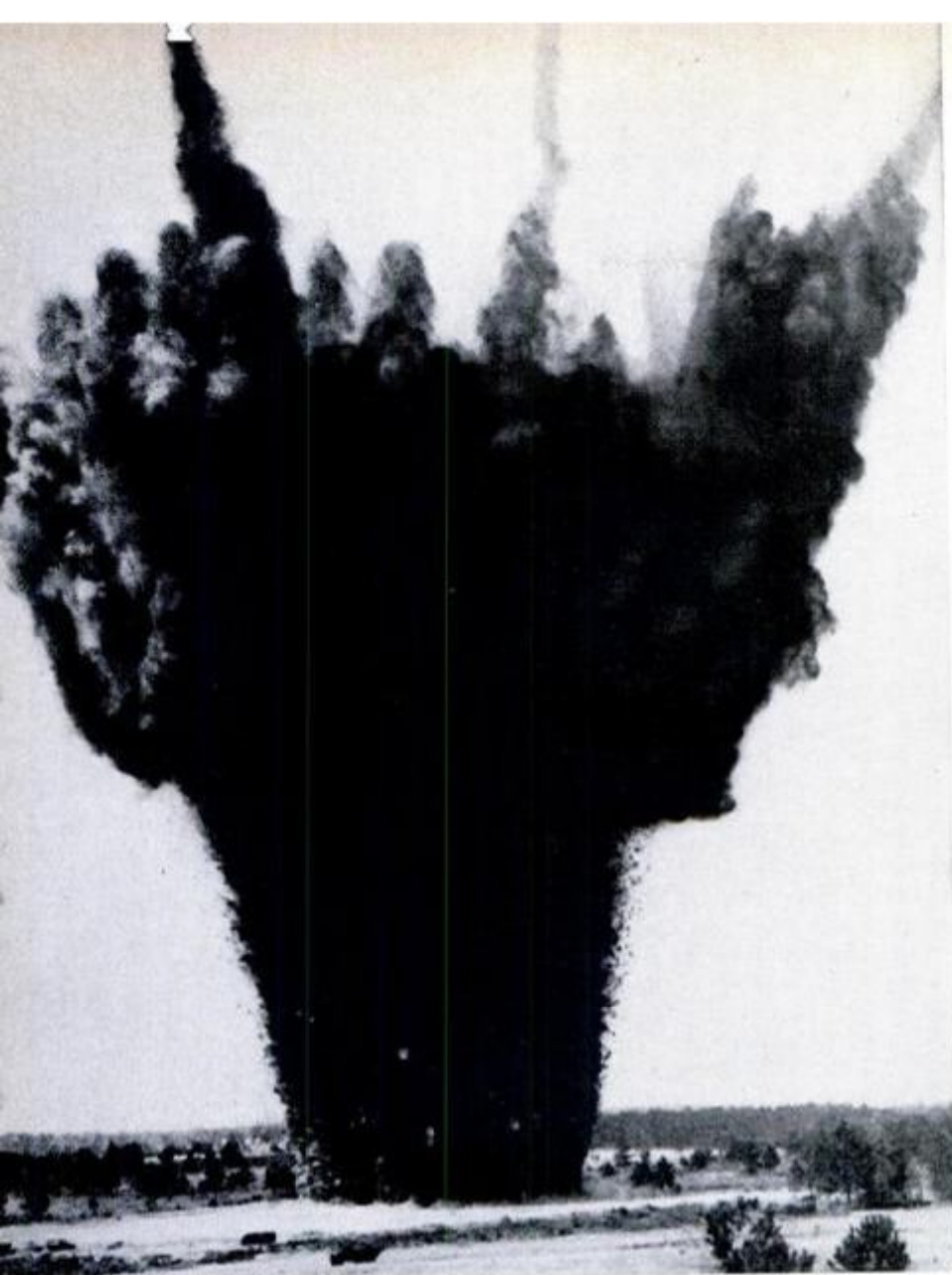
Strange wars are being fought by our Gulliver force

Using Lilliputian models and giant explosions, the U.S. Army Corps of Engineers is solving mysteries, testing theories and handling emergencies.

by Dan Fales
MANAGING EDITOR



A tidal model of New York Harbor (top) is used to study navigation, shoaling and environmental problems. During the 1973 flood, the Mississippi Basin model (above) was reactivated to predict flood problems. A new model (right) of the diversion structure was built and a quick-fix found for the failing wing-wall abutment protection shown at the top of the photo.



On a raw, rain-soaked afternoon, a scouting team suddenly found itself thrust into a strange battle. During a routine check of the massive levee along the frothing Mississippi River, the team came upon the sight they feared most. It was the ripping failure of a wing-wall abutment on a diversion dam that keeps the Mississippi from being captured by the nearby Atchafalaya River basin. It was April 12, 1973. The Mississippi was in flood, and the battle to save the dam was underway.

The diversion structure had been built to save New Orleans—not from floods, but from economic disaster. In 1952, the Mississippi had been in danger of breaking through to follow the channel of the Atchafalaya that runs eight miles west of the Old Muddy. If the hydraulics of both systems were left untouched, the Mississippi could have cut out of its present banks, leaving all downstream cities high and dry. This would include the world's third busiest port—New Orleans.

Corps moves to the front lines

As the wing-wall crumbled the word went out to hundreds of troops to mobilize and fight the swelling Mississippi. It was the U.S. Army Corps of Engineers that would do the fighting. Though not generally a frontline unit in the military, the Corps in this case became one.

As engineers arrived at the failing diversion gate, another group of engineers was reactivating a miniature model of the Mississippi River. The model is used to determine river reaction to different natural influences, including floods. Most of this work had been done over the years at a fairly relaxed pace. But now time mattered. Working around the clock, hydraulic engineers figured out on the model a quick-fix plan. Hoping they were right, the Corps started dumping tons upon tons of rock in a prescribed pattern around the failing structure. It took 16 barge loads, but the plan worked, and the Mississippi went right on rolling where it was supposed to roll.

Just one of hundreds of wars

Though dramatic, this was just one of hundreds of wars that have been waged by the Corps of Engineers. These are full-scale wars against such formidable enemies as pestilence, flood, hurricanes, congressmen, earthquakes, preservation-

Note truck size (top) relative to the giant explosion used to test the effects of underground explosive devices. Another "blow-up" (left) shows fly ash in concrete magnified 2000 times by an electronic microscope.





Vegetarian fish (above) are white amur to be used in planned attack on lake-clogging hydrilla. Testing effects of 1000-year storm will be done on model (below) of proposed atomic energy powerplant off New Jersey coast.

ists and the 1000-year storm. The weapons in these wars are not atomic bombs or doomsday machines. The weapons are men, specially trained and armed with facts, figures, computers and the brains to use them. The battlegrounds are in miniature and located at the Corps' Waterways Experiment Station (WES) in Vicksburg, Miss. The miniatures are exact scale models of actual sites. As on the tiny Lilliputian world of Gulliver, one heel step can crush a forest. But unlike *Gulliver's Travels*, an account of a Corps' battle reads like a chapter from *Future Shock*.

Worst possible storm in 1000 years

Right now, a team is studying the effects of the worst possible storm and accompanying waves that could occur in 1000 years off the coast of New Jersey.

Why? A breakwater must be designed to protect an atomic powerplant.

Teams are also working on the effects of earthquakes; on the use of fish to rid southern lakes of choking vegetation; on the building a miniature watershed to control a miniature lake. Another team has investigated the mysterious case of the failing concrete.

Still more teams are working on the Corps' No. 1 project—using dredge materials to build marshes.

And finally there are teams pushing the state of the art in weapons effects and explosive excavation.

And then there's the team working on the most adventuresome project of all—building the world's largest model. It's a 10-acre replica of the 64,170-square-mile Chesapeake Bay area. This model, located on the Bay itself, is even bigger than the five-acre Mississippi River model and the two-acre New York Harbor model. These massive and permanent models are used for ongoing studies to solve shoaling and navigational problems, determine the effects of new marine structures, detect the track of polluted waste and understand the natural factors affecting water quality.

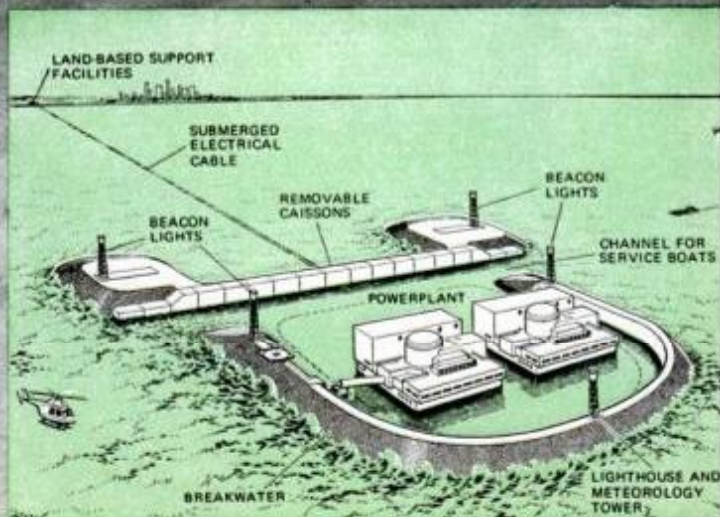
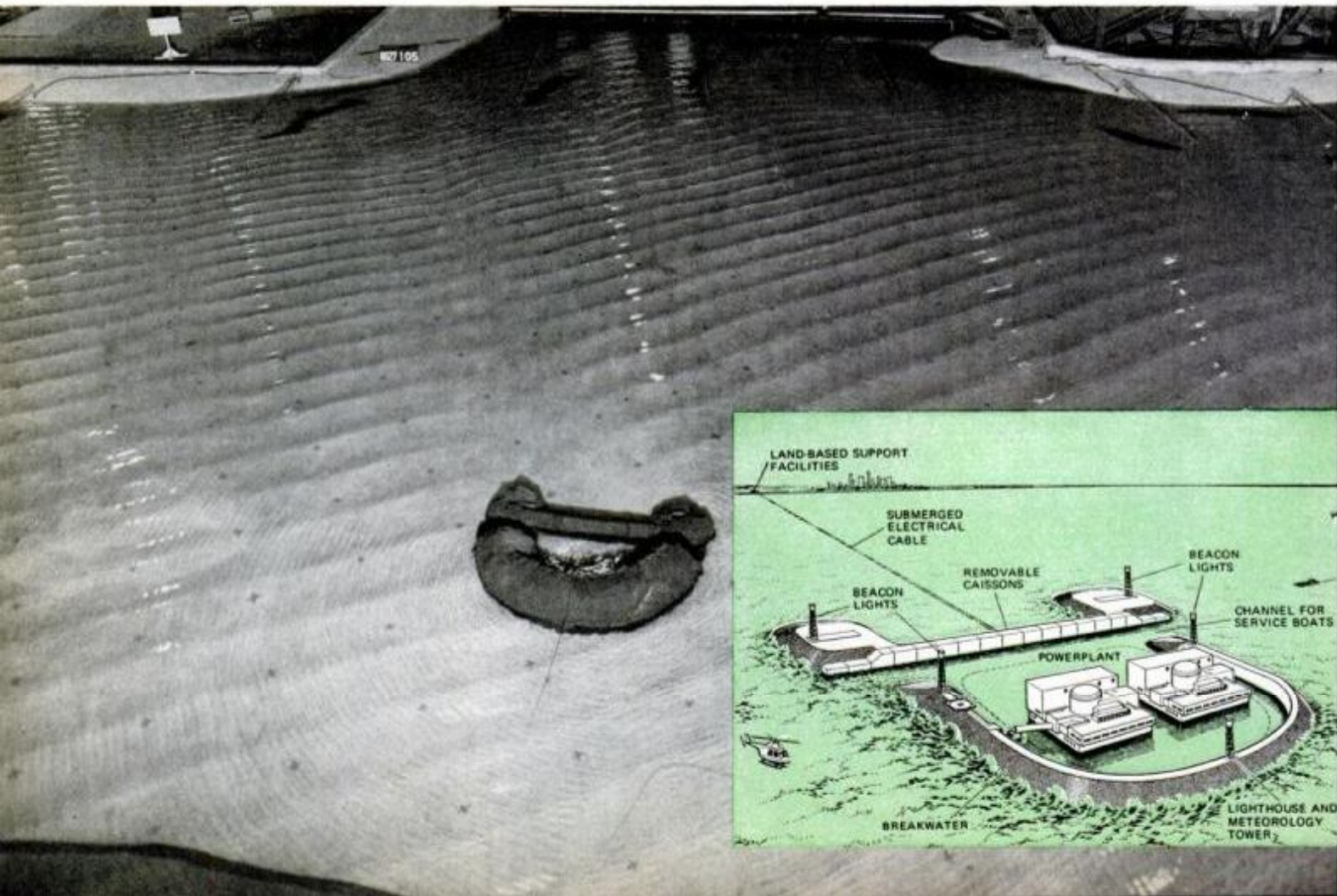
But the Corps works with smaller and temporary models, too. So it is with the project of the Public Service Electric and Gas Co. of New Jersey.

Atomic plant off New Jersey coast

Just off the coast in the Atlantic Ocean, PSE&G is planning to build an atomic powerplant that will supply the state with electricity. One concern is the structural integrity of the protective breakwater surrounding the plant.

To find out what's needed, the Corps was asked to build an exact scale model to test the effects of

(Please turn to page 154)



IT'S NEW NOW



Riding the rails—bicycle style

Today's thousands of miles of abandoned rail lines make ideal bike trails for seeing the country without fighting road traffic. William Gillum designed this outrigger so he could literally ride the rails without falling off. Those interested in doing the same can obtain information from American Railbike Assn., Box 9952, Colorado Springs, Colo. 80932.

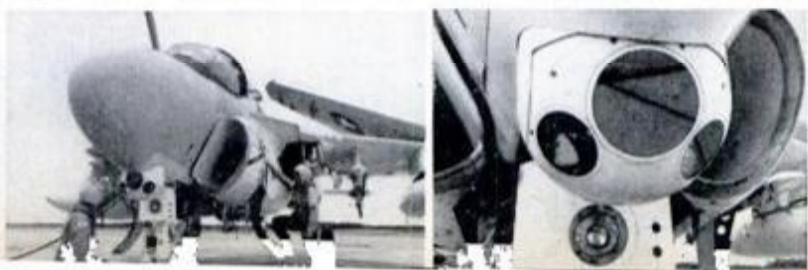


Boat speedometer/odometer shows both speed and distance

Latest instrument for boaters not only shows speed, but also clocks how far you've gone—an important aid in navigating, racing and locating fishing and diving spots. Both readouts are digital and in 10ths of a mile. Distance is computed electronically from speed and elapsed time. \$450. Bay Laboratories, 20160 Center Ridge Rd., Cleveland, Ohio 44116.

Newest aerial target tracker sees all, knows all

The big "eyeball" under the nose of this Navy Intruder combines radar, laser imaging and FLIR (Forward-Looking Infrared) to track any target, visible or invisible. FLIR provides an actual image of the enemy—not just a radar blip—and videotape gives "instant replay." The ball swivels in any direction, can even "look back" to see if a target has been hit.



'Survival' rifle stores in itself

It's handy to take a rifle along when camping, backpacking or fishing in the wilderness, but conventional types are heavy and awkward to carry. This .22-cal. "survival" weapon breaks in two, the barrel and ammo clip storing in the stock. Disassembled, it's 16½ inches long and weighs 2½ pounds. Charter Arms Corp., 265 Asylum St., Bridgeport, Conn. 06610.

Have windmill, will travel

You can take this portable, foldup windmill on camping trips, mount it on a boat or in other remote locations for free electric power. The 9-foot-diameter propeller generates up to 500 watts of 12-volt d.c. depending on wind speed, has high-wind and no-wind safety features. Wind Wizard weighs 48 pounds, is \$695. Edmund Scientific, Barrington, N.J. 08007.



How to tell when you need a better camera

A better camera can make you a better photographer—but only if it helps you get shots your present camera can't take.

by Ivan Berger PHOTOGRAPHY EDITOR

The time to buy a new camera is when your present camera cramps your style—and not before. Within limits, the cheapest Instamatic, used with care, can shoot as good a picture as the most expensive Nikon, Hasselblad or Leica used with equal care.

But there are a lot of pictures that an Instamatic just can't shoot at all. And that doesn't just apply to simple cameras: The most expensive camera in the world will sooner or later stub your toe on its limitations (though often there's an accessory available to un-stub your toe, again).

Before you run off to buy a camera that will do more for you than your present one, make sure you need to do more. Here's a guide to what better cameras and their features can do for you, and to tell if you need them.

■ **Dim light is a problem** that most under-\$100 cameras cope with poorly, but which most over-\$150 cameras handle well. Under-\$100 cameras have "slow" lenses with apertures of about $f/8$ to $f/11$, which don't let much light in to reach the film. Better cameras have lenses of $f/2.8$, $f/1.8$ or faster, which let in at least eight times as much light, letting you shoot when it's eight times as dark.

Less expensive cameras may also have other dim-light disadvantages: Their shutters may operate no more slowly than $1/30$ or $1/45$ second (the more time the light has to reach the film, the more light will reach it). And if they only take 110 or 126 cartridge films, they can't use such fast films as Tri-X, which don't need as much light.

■ **Action foils** the cheaper cameras, too. Stopping action takes fast shutter speeds, which many of the least expensive cameras lack. Simplified electric-eye cameras may have fast speeds available—but their electric eyes are probably programmed to use those

(Please turn to page 160.)

RANGEFINDER CAMERA



TWIN-LENS REFLEX



SINGLE-LENS REFLEX





Available light capability to shoot indoors without flash requires "fast" lens and ability to use fast films.



Time exposures lasting several seconds can yield night shots like this; shots lasting minutes can look like daylight.



Fast action requires fast shutter speed in situations like this to prevent blur. Speeds of 1/250 or 1/500 usually suffice.



35-mm negative size



Size makes a difference: 35-mm negative requires more enlargement (for the same size image) than 2½-square, 120 image, and the difference shows.



2-1/4 x 2-1/4" (120) negative size

Sharper, crisper print from 120 negative is closer to contact-print size, hence closer to contact-print quality.



Wide-angle lens emphasizes perspective and has great depth of field as shown, lets you get wider area on film.



Long telephoto lets you shoot "close-ups" when you can't get close; compresses space between distant objects.



Macro lenses and a wide range of other close-up accessories (bellows, extension tubes) let you make small subjects big.

Boats '76

Performance rivals pretty looks in the new pleasure craft we pick as top '76 models.

Cars may be going compact, but on the water the new boats that set the trends are getting bigger. Not that there will be any shortage of little fishing skiffs this year, or canoes, dinghies, inflatables or folding models that beat fuel prices with power from oars and sails. But more builders are adding larger models to their lines. Unlike travel on land, a big boat usually offers more safety, plus accommodations and comfort.

It's true that more gas is required to push a large hull as a rule, but since pleasure boating is for fun there's no necessity to travel at full throttle or keep up to minimum highway speeds. The higher cost of gas has improved sailboat sales, yet power-craft purchases are going up as well.

Let's take a close look at the '76 boats from the bottom up. Hull styles vary from deep-Vs to flat-bottomed jonboats. The Vs may rock at the dock and worry your wife, but they can cut through heavy seas. The flat-bottoms and tri-hull types are more stable at anchor, but can pound when driven fast over rough water. On sheltered and shoal waterways, however, they are usually your best selection:

Check for generous hull flotation that will keep your choice upright and on top of the water no matter what. No craft is worth the money if it's going to drown you. Every hull must have enough flotation so it will continue to float with you and all your gear even after a following sea sloshes aboard and swamps it. Look for the capacity plate that tells what weight of passengers and equipment the hull can handle, and how much horsepower push you can safely use. Pioneered by the Boating Industry Assn., capacity plates this year are required on all new outboard boats under 20 feet that can mount motors.

Your new hull this year will be of plastic (usually fiberglass reinforced), marine aluminum or possibly wood. All work well and will have long life if

by Bill McKeown
BOATING EDITOR



Cruising families and offshore fishermen alike have roomy new models from which to choose. Chrysler's Conqueror 21 (top) sports new "300" sterndrive using 265-hp V8 power. The Bayliner 2750 trailerable, twin-cabin express features the newly popular center cockpit (above). Wellcraft's 21-foot Nova Fisherman offers walkway around cabin.





Sleekest of slick new line of Glastron/Carlsons could be the CVX-20. Rated for up to 60 mph with 460-cu.-in. jet power, this ski boat features stripped decks with no windshield or cleats, red or blue metal-flake finish, seating for six. Other CVs are 16 to 26 feet.

Year of the classy performers

Newest of Seabird models, this 28-footer incorporates improved bottom design with luxury appointments. Jim Wynne deep-V hull has propeller pockets that allow lowering engines and moving them back with straighter shafts for better balance and performance.



Boats '76

built by reputable manufacturers; wood will require extra care and maintenance.

Above the waterline of the hull of your choice, the amount of topsides (freeboard) can determine much of what your boat can do. The higher the sides, the bigger the craft as a rule, and the more big waves the sides can keep out. They also help keep youngsters and fishermen from falling overboard, but make it very hard for anyone



Style and speed are attractions of MFG Royal Caprice 19-foot stern drive Bowrider. Also available in cuddy, fishing models, it joins new MFGs to 25 feet.

First of the Glastrons to offer bowrider design with a deep-V hull, the new SeaRider V-195 with Merc or Glastron stern-drive, has stern ladder, optional hardtop.



Bass Runners from Chrysler now come in 15, 16 and 17-foot standard and professional models with added ice-chest seats for helmsmen, built-in live wells, platforms.

Large-boat styling introduced to outboard bowrider gives Wellcraft's Airlot 165 outboard raked side rail and windscreen lines of Wellcraft offshore Novas.



in the water to climb back aboard.

An excellent development is the assortment of transom platforms and swimming ladders you will see this year on many of the craft of our choice shown here. For safety, the engines should be shut off before a swimmer approaches the propellers, of course, except in the case of jet power. But used carefully, these features can be a great aid for water skiers and swimmers, and might also save a life.

During the last several years, the cockpit space of runabouts has been notably enlarged without increasing outside dimensions of the boats. Eliminating the foredeck and replacing it with extra seating provides much more usable passenger seating, and now there appear to be more bow riders around than decked-in sport models, though both are popular. The walk-through windshield with hinged center section makes passage for-

ward easy, but check the windshield installation to be sure it is secure—often the top of the shield is used as a grab rail for passengers boarding or leaving your boat.

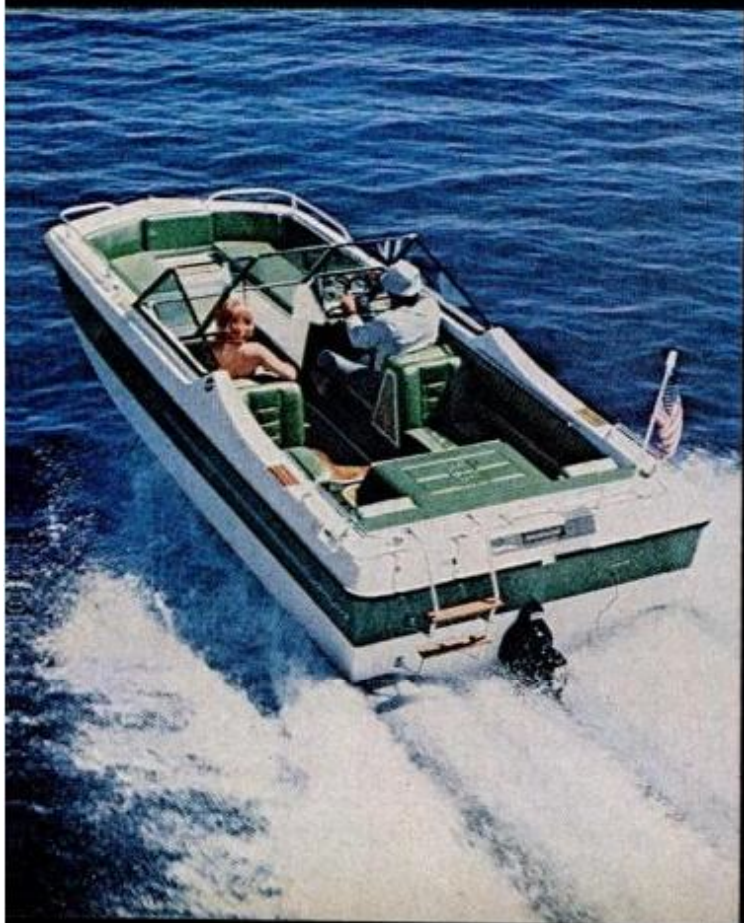
Alternate excellent use of an open cockpit is the new variety of fishing arrangements. This year you'll find center and side-steering console designs in sizes up to 30 feet. Latest bass boats are adding additional wet and dry wells and

(Please turn to page 136)



Many builders are offering bigger models, and the new line-topper from Mirro-Craft, its Mariner Express Camper 21, has aluminum hull, fiberglass deck.

Bowrider stern-drive from Silverline with MerCruiser power rides on a tri-hull similar to new Kodiak Bass boat models, but flares gunnel into windshield.

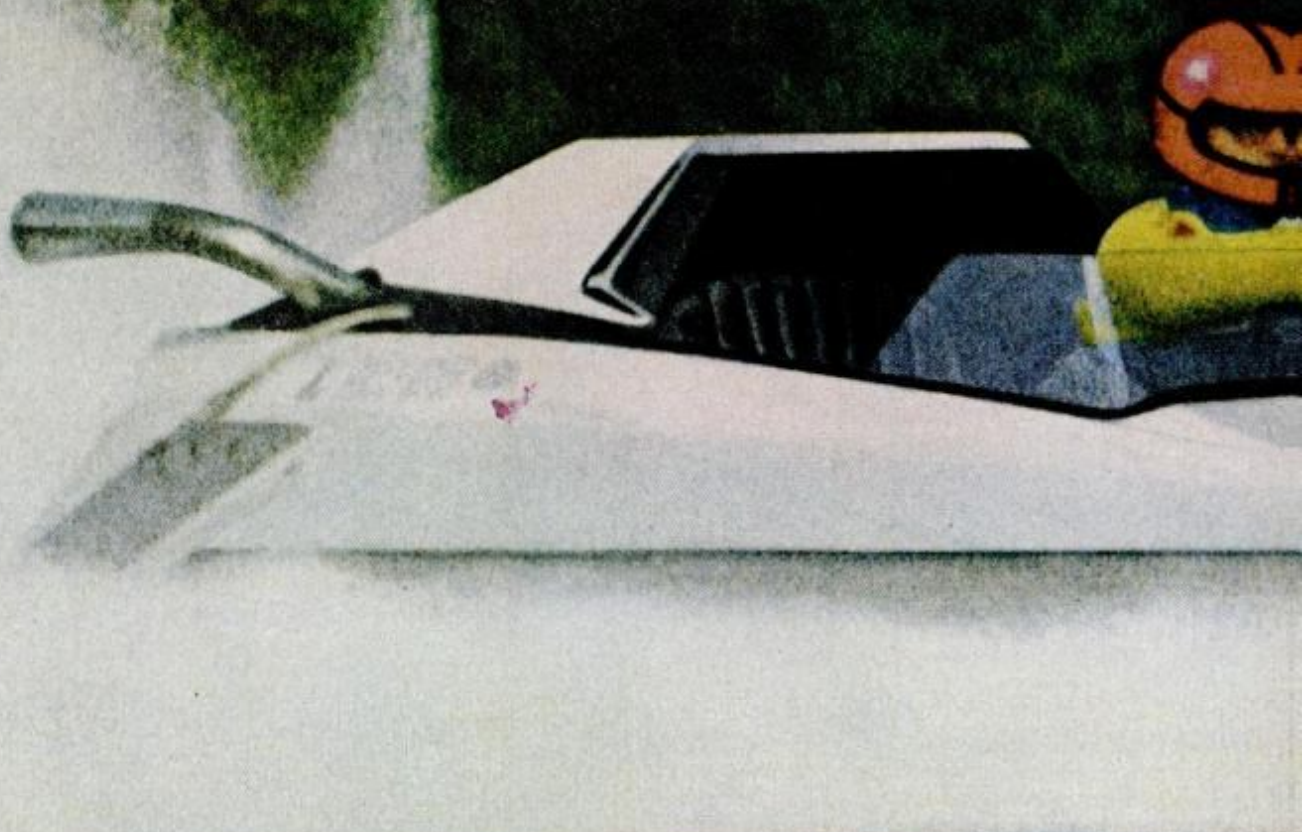


Sailing workboat lines rendered into a 13-footer in plywood, the Mini-Indy by Peter Stevenson has the character-boat look of a Chesapeake Bay skipjack.

Convertible tops improve many models this year or change them into campers. Shown are a new Viking Sport Deck 16, with Aquasport 22-2 Fisherman behind.



boats '76



PM drives a sportboat

This new high-performance hydrofoil really flies!

by Bill McKeown

Cross a boat with an aircraft and you get a waterborne flying machine that has been a tricky, flighty performer in the past. A few years ago we test-flew one with an elevator control column and rudder pedals like those in a plane.

But now Hydrofoils, Inc., in Red Bank, N.J., has engineered a simplified "sports car" model that has enough speed to fly just above the water without control complications. This craft has cornering

ability that should make the little boat suitable for race-course competition where the turns are tight and the water thin.

Hydrofoils' head, Ken Cook, has put into production a 16½-foot model with a trailerable beam of 8 feet with the foils up (13 when they're down); a draft of 36 inches that lifts to only 18 on plane; and the capability, Ken feels, of handling almost any marine powerplant around. In his Mirage prototype, he has a 350 Chevy running through a Casalle V-drive. He has gotten speeds of 60+ without ever fully opening it up.

Driving the Mirage proves Cook's theories. Once up and

flying with an impressive rooster tail arcing out behind the surface-cleaving prop, the hull holds a safe level attitude without any need for the driver to adjust flight height or trim. Small wedge fins at the bottom of the aft struts act as rudders, and in demonstration runs, weaving between fish stakes like a slalom course down a narrow channel, the speedster maneuvered with complete and responsive control.

The present price of over \$13,000 for your own two-seater, ready to fly, is similar to sports car prices. But boatmen looking for fast, new action afloat may find this form of flying the answer.★★★

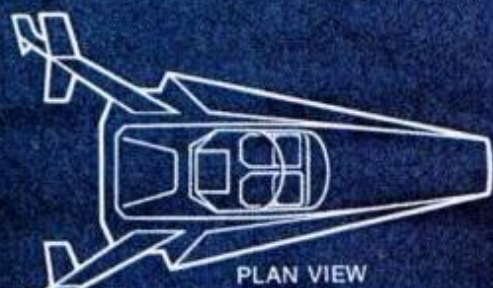
on stilts



Photos: Lorraine McKeown



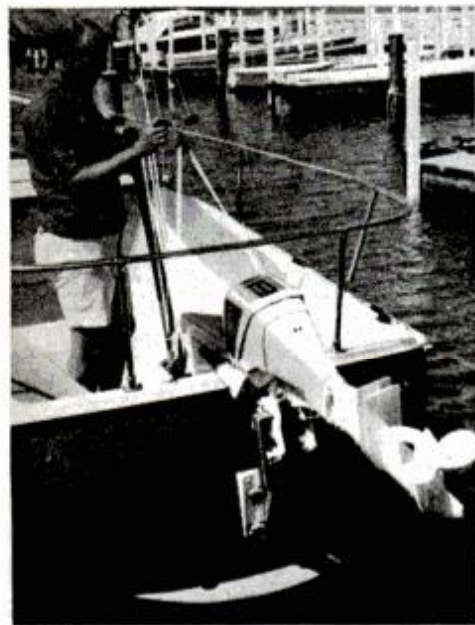
Level attitude of attack is described by designer Ken Cook (top) to PM's test driver McKeown. Aft struts in up and down position (shown in two photos above) reveal stainless lift discs and unique rudder wedges that tilt to provide tight turning radius.



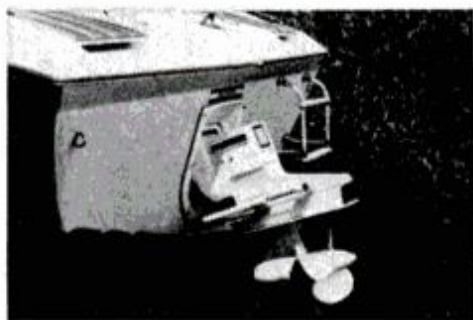
Two-seat cockpit with bucket seats (above) follows sports-car design. Idling past channel markers, hull off-plane draws 36 inches, but can moor alongside floating dock. With bow lifted, it showed no tendency to trip while accelerating.

New push power—big and small

by Ray Gill



Brand new for pleasure-boat performance, extra-length Chrysler kicker (far left) can reach the water from tall transoms, has a convenient starter on top. Mercury's newest motor for fishermen (above) is a 4-hp, 36-pound lightweight. The streamlined Chrysler 300 sterndrive (below) is offered with five gas and diesel engines, uses an improved clutch, steering in 105 to 265-hp range.



Small engines used to be your only choice for small boats. But now that's changed. This year you can harness up to 200 horses outboard of your transom or three times that many per engine inside as a stern-drive or inboard engine. You can do all that if your hull can handle herds that size. Yet the small, light models are still the most popular. And if your hull won't handle it or if you aren't ready for Merc's Black Max 175, Johnson and Evinrude's 200s or Chrysler's 135, previewed here last fall, there are still fleets of new little compacts, engineered for more dependability and less gas consumption.

Which ones are best? Just about all the models with well-known names have been around long enough to have the bugs chased out, and even makes with "off-brand" labels have often been built by some of the larger companies. Here's one buying guide: Check with well-established local dealers who will handle servicing.

What are your choices? Here are a number of outboard makers, in alphabetical order, offering improved models. A letter to any of them can

usually get you the nearest dealer's name or a source for ordering.

■ **Two tiny outboards**, the AquaBug and the SuperBug, come from Aqua-bug International, Rockville Centre, N.Y. The 11-pound AquaBug weighs less than the two gallons of gas that could run it for 10 hours at top speed, 50 hours for trolling. This 1.2-hp single-cylinder model has a rewind starter and adjustable shaft for shallow running. The SuperBug, at about 18 pounds, claims up to 3 hp.

■ **Chrysler Marine's** extensive outboard line includes two new models developed especially for use as sailboat auxiliaries. The 10-hp model has Chrysler's Autoelectric alternator and Magnapower ignition with electric start. The 6-hp manual starts with a horizontal or vertical pull

Less weight, fuel and maintenance are providing more performance from this year's compact new mini-kickers and sterndrives.

from above, has increased reverse thrust for dockside maneuvering, and 20-inch lower units. Other models include 3.6, 5, 8, 10, 15, 25 and a brand-new 35.

■ **Smallest this year from Clinton Engines**, Maquoketa, Iowa, is the K-150 that delivers 1.5 hp from 14.5 pounds. It has a recoil starter, air-cooled power head and one-quart integral fuel tank. Other improved compacts include the 3.5-hp K-350 and the K-751 at 7.5 hp. Clinton's deluxe line offers 5, 7.5 and 9.9 hp.

■ **Eska Co.**, Dubuque, Iowa, enters this year's the-smaller-the-better contest with new features that include freshly designed swivel and transom brackets with heavy-duty clamps. All Eska motors also feature tilt-locks for trailering and a new shallow-water drive with pin for angle adjustment. Models include 9.9 and 15-hp liquid-cooled motors with solid-state ignition, preset carburetors for easier starting and fuel economy. Eska's two 7.5 air-cooled models offer forward, neutral and reverse shift or forward and neutral with full pivot. Also in the line are 5.5, 4.5, and 3-hp models with improved weedless propellers, Power Loop and drainless crankcase design.

■ **Evinrude's** new 9.9 and 15-hp twin-cylinder models have been fitted with new combustion chambers for smoother operation at slower speeds, plus new long fold-back steering handles. The new Evinrude 6 has carburetion, manifold, gear ratio and propeller changes. Top-mounted controls are available for sailboat outboard-well installation. Both the 2 and 4-hp models have been restyled, with the 4 also offered with optional "Fisherman's Drive" angled lower unit. Besides the 25, there is an all-new 35 that looks no larger than the previous 18, but turns out nearly double the push.

■ **No need to mix gas and oil** for the Honda B 75. This 7.5-hp, four-stroke mill has overhead camshaft, separate crankcase sump for oil with less air pollution claimed as one result, and a quiet and vibrationless operation reported by this Gardena, Calif., branch of American Honda Motor Co.

■ **The newly-designed Johnson 6**, from Johnson Outboards, Waukegan, Ill., claims a major increase in speed as a result of a new air intake system and manifold, redesigned carburetor and a combustion chamber that

also adds fuel economy. And Johnson also continues its extensive Sea-Horse line of fishing and small-boat motors with models that run from the 2 and 4-hp mini-compacts up through 9.9, 15, 25, to the mid-range 35-hp Sea-Horse.

■ For several years it's been rumored that Mercury, of Fond du Lac, Wis., had a new fishing motor in the works. Now it's here, weighing only 36 pounds, with integral fuel tank, twist-grip throttle and an engine cutoff switch mounted at the end of the tiller for added safety. The Merc 7.5, 9.8 and 20-hp engines are also available with optional electric start and an alternator to charge the battery. The new Merc 40 has two cylinders, and the one-cylinder 4.5-hp Merc 45 is in the line as well.

■ This year, the Ted Williams line of Sears, Roebuck outboards from Chicago will include an 11-pound, 1.2-hp model, a single-cylinder 3, a Model 5 of 4.5 hp, 5.5, one 7-hp and three 7.5 models, plus 9.9, 12 and 15-hp motors from which to select.

■ Ter-Mar Inc., of Lehigh Acres, Fla., has introduced its new Mighty-Mite II, a 1.7-hp, 17-pound offspring of the 35-year-old Mighty-Mite. This one has a new automatic recoil starter, water cooling, underwater exhaust, and standard as long-shaft models among the many improvements.

■ Additional small outboards of interest include a 35-pound, air-cooled 4-hp model from Aero Marine, Northridge, Calif.; workhorses of 2, 3, 4.5 and 5.5 hp from British Seagull, Irvine, Calif.; air-cooled Sea King fishing motors of 1.5, 3.5, 5 and three 7.5 models plus water-cooled 6, 7.5, 10, 15, 25 and 35 units from Montgomery Ward, Chicago. Sports-pal, Emlenton, Pa., offers the 11-pound, 1.7-hp Tas Mini air-cooled. Triton Industries, Portland, Me., has a 4, 5.5 and a 7.5-hp. Volvo Penta of America, in Norfolk, Va., is coming on strong in the outboard field as well with a 5.5, two 10s, two 14s and two 25-hp units in the lower-power



Among muscle midgets are flyweight mini models like the Mighty Mite, 1.7 hp at 17½ pounds; 3-hp, 18-pound Super Bug and 1.5-hp, 14½-pound Clinton (above). New 15-hp Eska (right) is one of seven water and air-cooled outboards.

category. And for the jet set, Otterbine Industries, Malta, Ill., offers its unusual outboard jet drives of 2, 3, 5 and 7.5 hp.

Any boatman looking for plenty of power in a small package has a lot to choose this year.

Muscle for sterndrives

Both the big and small-capacity outdrives have been widening the spread of horsepower they can handle. This year it will range from 7.5 horses from gas and diesel mills up to 275 for standard rigs and 400 hp and more from racing mills like the Kiekhaefer Aeromarine K-Drive 400.

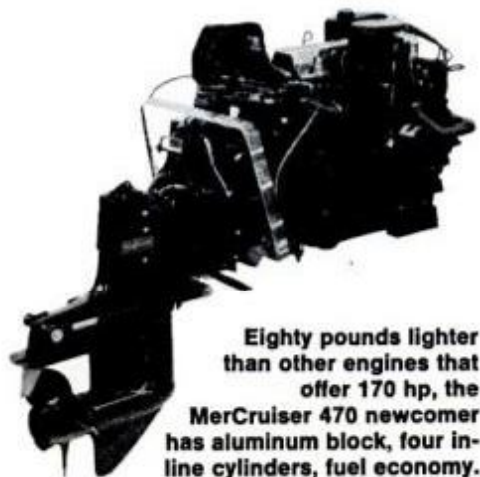
New gasket materials, plastics, alloys, plugs, liners and solid-state ignitions now make it possible for the good but earlier-designed engines to compete successfully with the recently designed models. In inboards, there are several new V4s and V8s, plus package units for more powerful jet drives. Vee drives make possible placing engines all the way aft in suitable hulls.

Here, alphabetically, are some of the companies and their new developments.

■ Chrysler Marine, of Detroit, is introducing its all-new "300" stern-drive with clean new lines, extra-slim lower unit, cone clutch, special steering suspension system, and capacity for gas or diesel engines up to 275. It is available with the new Chrysler 195-hp V8, or 240 and 265 gas V8s or 105 and 130-hp diesels. A 155-hp Six and 225, 250, 280 and 330 V8s are offered in inboard and vee-drive models.

■ Mercury Marine is offering an all-new four-cylinder, 170-hp stern-drive engine with aluminum block, plus its 120 and 140 Fours and a

(Please turn to page 128)



Eighty pounds lighter than other engines that offer 170 hp, the MerCruiser 470 newcomer has aluminum block, four in-line cylinders, fuel economy.

Boats '76

New gear for your boat

Next best to a new boat is new equipment to update your old one. Many new craft also come at bargain prices which may mean most necessary accessories are missing. Either way, good assortments of innovative and improved marine gear are available for this spring.

Among the best add-ons for convenience and safety are transom steps and swimming platforms. Hand grips hinged to double as steps are sold by many marine supply outlets. Better still are bolt-on platforms now standard on many bigger boats—they could be lifesavers if someone falls overboard. For landing a gamefish, resting after swimming or reboarding with scuba gear, they are excellent, too. For fishing craft 20 feet or longer, there are install-it-yourself tuna towers. Cabin cruiser owners can buy prefab flying bridges.

Any boat with a battery aboard may now mount gadgets ranging from marine radios to radar. Even an outboard skiff can be operated more easily with electric anchoring and trawling winches, ski-tow retriever, trolling motor, burglar alarm, plus bilge pump and gas-fume sniffer. Fish finders, searchlights and CB radios with batteries are small enough to carry on and off a dinghy or canoe.

New deck fitting material

Strong plastics are important in modern marine hardware. Ruggedness and anti-corrosion properties no longer need mean heavy fittings that require constant polishing. Look for items that bolt on, however, and install them with backing blocks for added strength. One sign of short-cut marine construction is often screwed-on cleats, grab rails and even engine controls that can pull loose when needed most. Refasten them with stainless-steel bolts when there are rust signs or if screws are used.

Boats and trailers exposed to salt deserve additional attention, and flush-out fittings for sterndrives and outboards can be found in many marine outlets. Waterproof grease for outboard lower units and trailer wheel bearings is worthwhile.

Trim-angle adjustment for larger outboards and sterndrives has become a well-accepted accessory. A carry-over bonus from race boats, trim buttons now mounted on the hand throttle allow a smoother, more economical ride. ★★★

Hand-held radar that gives distances in digital readout and audible sound, the Sonic Eye weighs four pounds, runs off a 12-volt battery, indicates direction and closing or moving away of target by sonic pitch. Measures 50 to 1000 yards.



Demountable compass that can be stowed safely out of sight when not used, Ritchie Model 15 has sighting slot for use as hand-bearing compass. Built-in compensators and red filtered light are included. \$40.



EPIRB, the Emergency Position Indicating Radio Beacon, is recommended for any boat that cruises out beyond the normal range of VHF radio. Broadcasting on aircraft distress frequencies, unit alerts planes within 200 miles to notify Coast Guard of a call for help. The unit is waterproof, it has self-contained batteries and it sends automatically with a flip of the switch. Narco Marine EPIRB is about \$169.



Warmth while water skiing in cold-water seasons is possible with Johnson ski jacket or ski shortie from OMC Accessories. Made of 1/8-inch neoprene, suits for men and women have blue and white outer skin. Popular with small-boat sailors who must beat through cold spray. Available from Johnson dealers.



High and low-tide times from a self-winding watch are now possible with new Heuer Solunar model. Particularly useful for hunters and fishermen who plan outings according to lunar time, and boatmen on tidal waters, \$195 watch predicts tide height two weeks in advance.

Underwater radar is almost the result with new Wesmar SS80 Scanning Sonar. TV-type screen is reported to show fish as well as channels, obstructions and bottom structure, measured for distance, relative bearing, depth. Ranges of 50, 100, 250 or 500 feet can be selected, and the transducer remotely aimed for horizontal to vertical scanning. \$1200.



Kanoe Kaddy, made by Gagne Associates, reportedly lets one canoeist pull 160 pounds of canoe and gear on a woodland trail. The 22-pound Kaddy is \$50.

Trim control with self-adjustment. Leveline trim tabs from Olson Industries have stainless steel spring claimed to adjust tab to best angle for speed of boat. Model TT-1 (\$60 per pair) is for boats to 24 feet; TT-2 (\$80) to 35.



Float plan for valuables is possible with Evinrude Float Bags from OMC Accessories. In flat model for a wallet, boat registration, a radio/telephone license and other papers or wider model for camera and watch, vinyl-covered bags keep moisture out, have noncorrosive zipper. Evinrude dealers stock them.



So waterproof it can be mounted almost at water level for tube float fishing, Allied Sport's Humminbird Super Sixty has wide number-spacing for shallow bass fishing, reads to 60 or 120 feet. \$220.

Wind speeds of 5 to 70 mph are indicated on this WinDial Wind Speed Indicator from Airguide Instrument. No current or batteries are needed for \$19.95 unit.



(More boat gear on following page)



Two-way warning for three boating hazards is claim of S-1 Seaguard kit from Underwood Service Associates. A siren and a rotating beacon warn of high bilge water, fire or intruders. Kit with entry/exit delay is about \$190.

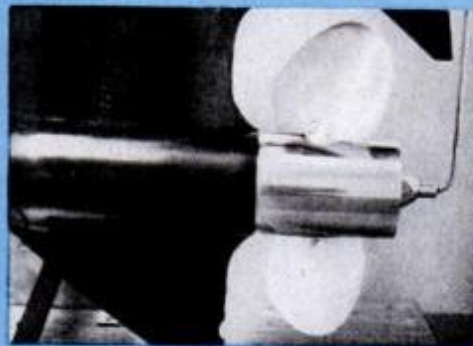
Boats '76

Boats '76



Bigger boats with more malfunction chances can play it safe with a TDT AutoWatch. Gasoline vapor buildup? Water in bilge? Engine heat up? Units can be wired to monitor 8, 16 or 32 problems.

Controllable pitch for outboard motor propellers is claimed for new hydraulic unit by Dirlik Marine Products. Dash dial adjusts blades from 14 to 26-inch pitch. Fuel economy is reported.



Steps toward safety, these stern add-on platforms are called Transom Decks by Bay Pattern Works. Mounted singly or in pairs, they aid swimming, skiing, skin diving, game fishing, prop repairs for any larger boat. Support arms adjust for level installation. Decks, \$69 each.

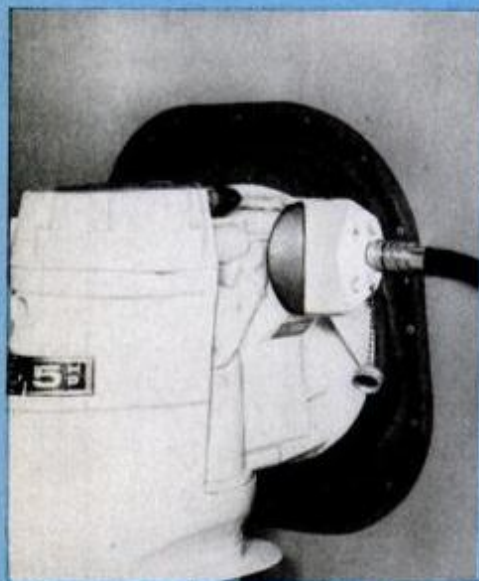


Life-preserver vests worth wearing all the time are by OMC Accessories through Evinrude outboard dealers. Camouflaged for hunter or pocketed for fishermen, they adjust in size, are C.G.-approved.

Pushbutton steering of small outboard is available for fishermen with Remote Con-Troll of Salt Lake City. With mount bracket and electric hand control, unit steers 7½-hp motors, or 15-hp outboards throttled down to trolling speeds.



Protection from road dust, and possible Projecting Load Law violation, is claimed for Prop Soc which fits over outboard or I/O. Made by Leaf Products.

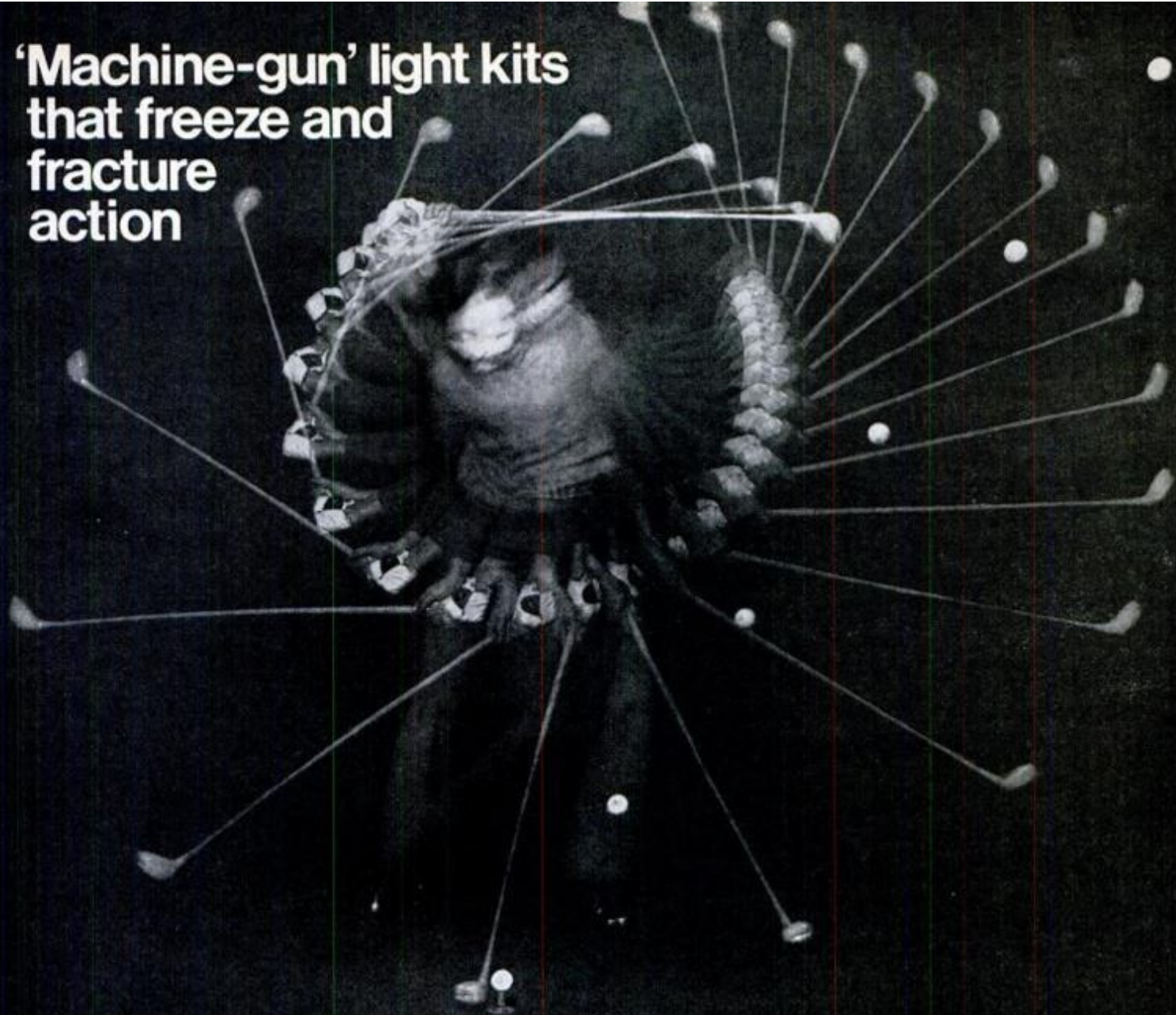


Freshwater bath for the inside of OMC Stern Drives is now available from OMC, Johnson and Evinrude dealers. Unit will flush out saltwater and silt or allow on-shore operation of engine for low rpm adjustments and tuning. About \$9.



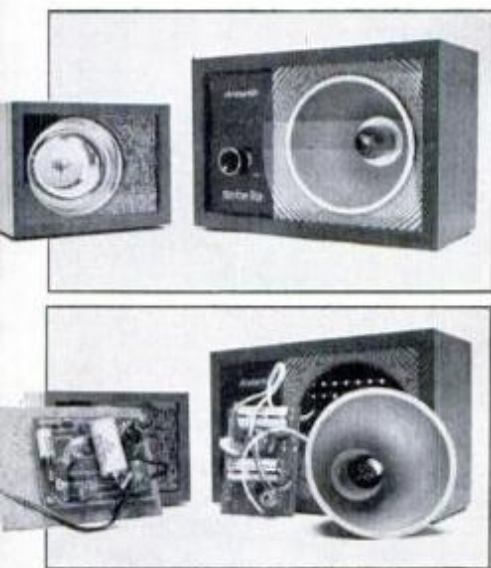
Turn a crank and up comes your boat, or down it goes into launching position. Handling boats of up to 15 feet and 200 pounds by one person is claimed for the \$190 Grove Boat-Lift from Grove Industries, Fresno, Calif.

'Machine-gun' light kits that freeze and fracture action



by Ivan Berger ELECTRONICS AND PHOTOGRAPHY EDITOR

Photo: Benn Mitchell



Rapid-fire repeating strobe lights in kit form include (top, left to right): Graymark 523-R and Radio Shack ArcherKit 28-3210. Inside views show simple construction.

Rapid-fire, repeating "strobe" lights are fantastic for visually freezing the action of rotating or reciprocating parts and for reducing other actions into overlapping slices to be seen and photographed. Now you can buy such lights in kit form at a modest cost—\$30 for Radio Shack's ArcherKit No. 28-3210, \$20 for Graymark's 523-R. You can build either in an hour or less.

It's a good thing the kits are simple, though, for the instructions aren't quite as clear as they should be, especially Graymark's—often where they can't be seen when you're working on steps relating to them.

Perhaps the most practical use for a repeating strobe is freezing action: Adjust the flashing rate so the moving part you're looking at (a fan blade, for instance) is always passing through the same position at the instant the light flashes. The part will seem to be standing still. We found

the ArcherKit better for this since it can be adjusted to flash at any rate from about 1 to 15 times per second; the Graymark's maximum speed is only about 5 flashes per second.

For photography, the advantage is reversed. We measured the Graymark's flash guide number at 12.5 and the Archer's at 8 for ASA 400 film. That means you can use it only for fairly close action with very fast film.

Some tricks to keep in mind when photographing with these repeating strobes: Use exposure time long enough to keep the shutter open the whole length of the action you're shooting—enough to catch several flashes. (The golf shot above, made with a professional repeating strobe unit, caught 25 flashes on the frame.)

Since the background of the shot will be exposed to every flash in the sequence, it must be as black as pos-

(Please turn to page 128)

What you should know before

They're expensive, heavy, less maneuverable, cost more to insure—but, boy, are they powerful, smooth and comfortable!

Big bikes are setting the trend. Motorcycles have matured from the short-hop, gas-stingy commuters of the early '60s into the superbikes and luxury tourers of the '70s. To many riders, high performance and comfort of the larger machines is what motorcycling is all about.

Big motorcycles generate a charisma—an image lacking in the smaller bikes. Aside from the head-turning appeal of massive engines and snappy styling, there's a certain inner satisfaction, even smugness, in knowing that the mere twist of the wrist can produce eyeball-sucking acceleration and speeds well over the century mark in a matter of seconds. And while wicking on occasion is undeniable fun, there's more to big bikes than just incredible speed.

The combination of long wheelbase and heavy mass goes far in smoothing out bumps and reducing fatigue. Motorcycles used to be considered either as sport or touring machines. The former usually had powerful but peaky engines and teeth-loosening, stiff suspensions for maximum handling. Touring bikes were relatively low on power, but compensated with more comfortable riding characteristics.

Big bangers for better touring

This distinction blurs with today's big-bore bikes, many of which combine the best features of both worlds. Compared to their teacup-displacement counterparts, the big bangers' stronger power allows higher gearing for lower cruising rpm. High engine rpm is a prime ingredient of fatigue. Greater engine flexibility also means fewer stomps on the old gearshift pedal.

When it comes to touring, there is no substitute for a well-engineered massive machine with lots of cubic inches. You could possibly travel coast-to-coast on something like a 175-cc bike, but you'd probably need a month to recover from the buzzing in your head.

Big-bike power is the only way to go for two-up touring. Large saddles minimize crowding, and the extra reserve of ponies make passing

safer. Fairings and saddlebags designed for the popular touring bikes add to the basic comfort. Fairings cut down fatigue-producing wind buffeting and offer some protection from the elements. Saddlebags are a neat way to store other weather protection and comfort items ranging from heavy underwear to rain suits. Saddlebags, windshields and fairings add weight and sometimes wind resistance to the bike. It takes power to overcome these culprits, and power is the big bike's forte. Many of these motorcycles come with high-output alternators that permit the installation of various luxury items from stereo radios and tape decks to accessory gauges and clocks.

Man-handling a monster

If heavy weight is an asset at speed, it is a liability at rest. Most large-bore machines (750 cc and up) check in around 500 pounds. (The Harley-Davidson FLH 1200 weighs close to 800 pounds), which means that unless you develop the knack of wheeling these monsters around, you're risking a trip to Hernia City. One method of snaking in and out of



BMW R90S, just under 500 pounds, puts out a strong 74 hp at 700 rpm. It's the most comfortable sports machine.

garages and parking spots is to sit astride the bike and paddle it around with your feet. It's easier to use the engine to move forward and foot-power for reverse. This assumes that you're sufficiently tall to generate the necessary leverage with your legs to push the bike around.

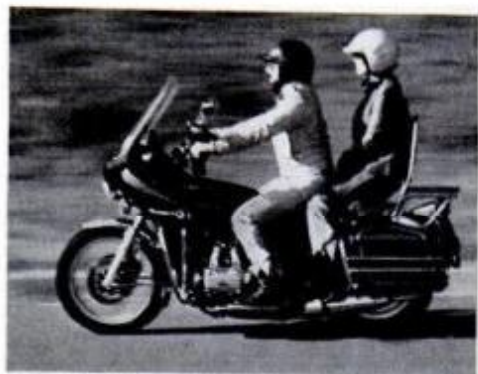
Some bikes, in addition to being long and heavy, are high. And if you belong to the short-leg set, you'll have to do your pushing by hand.

Stand on the left side of the machine a sufficient distance away so the bike will lean toward you. If you stand too close and the bike starts to tip away from you, there's little chance that you'll be able to keep it from falling over unless you hap-

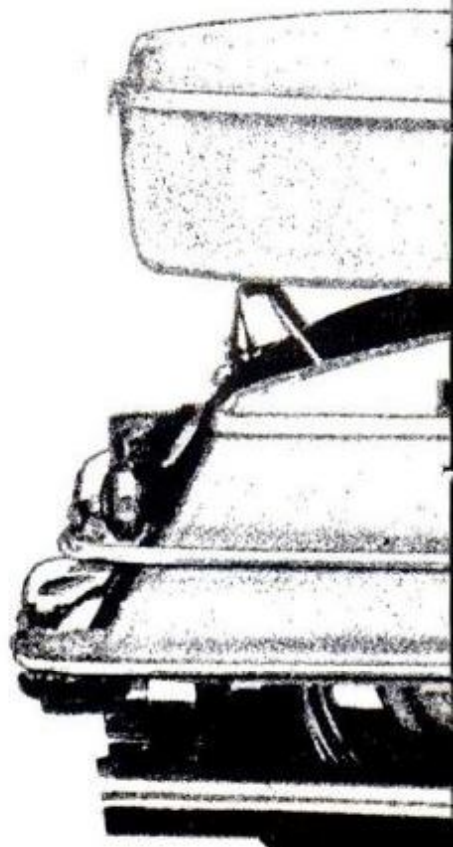
pen to be the Six Million Dollar Man. If you intend to roll the bike back onto its center stand and the ground is on an incline, have the rear of the bike facing downhill. When using the side stand, position the bike so it leans away from a downhill slope to reduce chances of it toppling.

How to hold it

If you angle-park at the curb on a crowned road or slight hill, let the bike roll back into the spot against the curb. This way you can drive out under power rather than trying to pull 500 pounds of motorcycle back up an incline. If there's no curb to prevent the bike from rolling, shift



Honda GL1000 Gold Wing is a whopping 650 pounder, and quietest of the big bikes. Like BMW, it has shaft-drive.



you move up to a big bike

by
Clifford
Gromer

the transmission into first gear and/or chock your wheel.

A recommended accessory for large motorcycles is a set of safety bars. This will protect your bike in case of a tumble and also keep the bulk of the bike's weight off your body in the event of a spill. The biggest hassle with a large, heavy motorcycle is wrestling it around. Once underway, almost all big machines quickly shed the feeling of heaviness.

Many riders move up to the big road-burners in stages, progressing from a 175-cc or 350-cc bike to a 750-cc or larger machine. While it's eas-

ier to learn riding basics on a smaller motorcycle, this is not essential. You can, under proper supervision, start your riding career on a big machine. The operating fundamentals are the same for all motorcycles. Uncle Sam has seen fit to standardize the location of controls and gearbox shifting patterns.

You'll find that compensating for the additional weight of a big bike is surprisingly automatic. If you normally ride to the limit, you'll find low-speed handling a bit more cumbersome. But what you lose by not being able to whip through sluggish traffic like a strand of buttered spaghetti

is compensated by increased stability on the highway. Once you get the hang of it, you'll find most big bikes really are nimble.

While there is much similarity in riding large and small bikes, there are differences between the two in other areas. Big bikes generally use heavier parts, which means you'll be shelling out more should you require a trip to the parts counter. Normal maintenance also may run higher. A four-cylinder engine has twice as many sparkplugs to replace as a twin. And if you are not the do-it-yourself type, you'll learn it's not cheap to have four sets of valves adjusted and four carburetors synchronized. If you like to flex your horsepower frequently, expect to become familiar with the jingle of your dealer's cash register, as you regularly replace chains and rear tires.

What about fuel economy? Some of the big bikes, under moderate riding conditions deliver very good gas mileage, on par even with some bikes less than half their displacement. Conservative driving can net you 40 to 60 miles per gallon.

Insurance rates

You won't make out so well on insurance. Liability rates for big bikes are a lot higher than for small bikes. How much more depends on your insurance company. Often you can get a better

Harley-Davidson FLH 1200 is biggest of the big at 780 pounds and 1200 cc. It's popular for the "two up" style of touring or for police work.



deal on your insurance if you go through your auto broker. The problem is that many auto insurance companies do not like to write motorcycle insurance. You usually end up with a company specializing in bike coverage. Aside from higher liability rates, comprehensive (fire and theft) coverage also is more expensive because large bikes are worth more than small ones and tend to get ripped off more frequently.

Here are the comparative yearly rates charged by Midwest Mutual Insurance Co., a motorcycle underwriting specialist:

State	Engine Size	Minimum Liability Coverage	Liability + Comprehensive Coverage
Iowa	175 cc	\$24	\$65
	750 cc	48	204
	1000 cc	50	322
California	175 cc	55	117
	750 cc	140	279
	1000 cc	150	396
New Jersey	175 cc	70	132
	750 cc	130	310
	1000 cc	145	452

Two-cylinder models

If you're interested in a big bike, you'll find quite a variety to choose from. Consider the possibilities of engine design, for example. If you're a traditionalist and go for the "classic" vertical twin four-stroke, there's the Norton 850 Interstate tourer or the more sporty Commando in the roadster model.

It will be touch and go for a while to see if this last vestige of the once-mighty British motorcycle industry can survive. New models may be attractively priced, but if the company goes under, parts eventually will become scarce.

If you like your twin in a Vee configuration, Harley-Davidson mounts its one cylinder behind the other in the FLH 1200 and 1000-cc Sportster. With an uneven firing sequence, Harley's exhaust note is considered by some to be positively erotic. If you're not partial to a fore-and-aft Vee arrangement, Moto Guzzi offers an alternative by placing the cylinders on its Vee twin side by side, so the engine appears to be growing out from underneath the gas tank.

The only other way you can arrange two cylinders is to have them positioned straight out, 90° to the bike. That's exactly what BMW's been doing with its motorcycles for the past 50 years. BMW's opposed twins with their traditional shaft drive possess legendary smoothness and durability. BMW is more per-

formance-oriented these days with its 900-cc sport and touring models.

Three-cylinder jobs

If exotic machinery turns you on, Suzuki has a pair of bikes that should do the trick. Its 750-cc model is a reasonably priced three-cylinder, water-cooled two-stroke. The bike, with a very effective dual-disc front brake, has established itself as a reliable tourer.

The Rotary is Suzuki's "big gun." With an inherently smooth engine and excellent handling, it should appeal to those who want "something different." The design has not produced problems, but a malfunction on the road could leave you wondering.

If triples are your thing, but you prefer the four-stroke variety, there are two bikes you can choose from: Laverda produces a 1000-cc machine that mates a 90-hp bulletproof powerplant to a superbly handling frame. The \$4000 price tag might make you flinch, though.

Yamaha, after being out of big-bore action for a while because of a trouble-plagued 750 twin, has a brand-new entry. It's a shaft-drive, 750-cc, four-stroke triple with factory mag wheels and disc brakes front and rear.

Four-cylinder bikes

Motorcycle engines boasting four cylinders have been around since the '30s, but the design lay dormant for many years. Honda revived the arrangement in 1969 with its very popular 750 Four. The motorcycle, originally introduced as a touring superbike, was redesigned last year as a sport model featuring 4-into-1 exhaust pipes and very accurate handling.

Taking over as the top-of-the-line Honda is the 1000-cc Gold Wing shaft drive with a water-cooled opposed Four. Looking somewhat like a VW engine without fins, it sets a new standard for highway touring comfort. Exceedingly quiet, it is virtually vibration-free. When fitted with an accessory fairing, the Gold Wing closely approximates a two-wheeled automobile. Its only drawback is annoying idiosyncracies in city traffic due to excessive driveline play and a 640-pound weight.

Kawasaki rounds out the field with its famous vertically arranged four-cylinder Z bike designated the KZ900 for 1976. It created a sensation when first introduced in 1972. With the strongest acceleration capability of any production motorcycle, the Z is very docile and tractable around town. The Z's split personality is the closest thing to that happy situation

of having your cake and eating it, too.

Prices for the big bikes range from the low \$2000s all the way up to four big ones, with the majority clumping in at \$2500 to \$3000. If you're thinking that's what a car costs, you're right. That's what cars *did* cost—three years ago. Besides, no car can come close to equaling the excitement and freedom of a big bike. ★★★



Suzuki 750 is water-cooled, two-stroke triple that weighs in at 550 pounds. In full touring trim, as shown here, it's closer to 600 pounds. Fairing makes long-distance touring much less fatiguing.



Honda GL1000 Gold Wing can be set up for comfort. The "dashboard" here features extra instruments, stereo radio and digital-readout alarm clock.



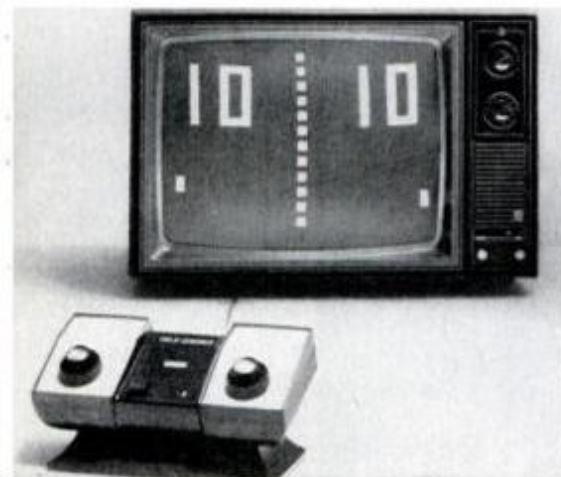
Kawasaki KZ900, quickest of superbikes, has 76 hp at 8500 rpm, weighs over 500 pounds. Quarter-mile times are between 12-13 seconds. Fuel tank holds 4½ gal.

IT'S NEW
NOW



Strap-on snow 'chains' take only minutes to install

These emergency snow cleats can be slipped on a tire without your having to jack up the car to get unstuck from a ditch or drift. The metal links are strapped on through slots in the wheel hub and pulled taut with a lever-locking buckle, taking only minutes to install. Sold in pairs, they're \$6.98 postpaid from Stock Sales Co., Box 606, Mineola, N.Y. 11501.



New TV table tennis game

If there's nothing good on TV you want to watch, just tune in a vacant channel and play your own game of "TV pong." This new, more sophisticated version of TV table tennis hooks up easily to any black-and-white or color set. It features a varied automatic serve, a "pong" sound with each hit, a paddle that can angle the ball to either side of the court and a digital display of the score on the screen after each point is made. The twin-knob control console (foreground at left) is a separate unit that can be placed up to several feet from the set. The accessory sells for just under \$100 from Sears.

Quick electrical fix kit

This handy electrical repair kit includes an assortment of 26 insulated crimp-on terminals and wire splices and a multi-purpose tool that cuts and strips wire, crimps terminals and shears bolts. The vinyl case contains instructions for using crimp-type terminals and splices and folds to a compact 3 by 8½-inch size. Kit is \$9.40 postpaid from AMP Special Industries, Box 1776, Paoli, Pa. 19301.



New twists in screwdrivers

These finely crafted cabinetmakers' screwdrivers feature flat shanks for a wrench when more torque is required and oval wood handles for a better grip than the conventional round type. Set of six in 3, 4, 5, 6, 8 and 10-inch sizes is \$18.80 postpaid. Woodcraft Supply Corp., 313 Montvale Ave., Woburn, Mass. 01801.



Fireplace heat saver

Waste heat that goes up the chimney is captured by this blower-powered exchanger and circulated through the room to add warmth and save fuel. Can be installed in any freestanding fireplace or stove using exposed circular flue. Sizes fit 6, 7, 8 and 9-inch-diameter pipes. \$89.95. Calcinator Corp., Bay City, Mich. 48706.

Compact car cooler

Ideal for snacking on trips, this slim, compact, insulated food carrier is designed to fit on a car seat between passengers. Called Sidekick, the 9¼-inch-wide portable cooler holds 12 12-ounce beverage cans as well as sandwiches or other food, keeping them cold six to eight hours. About \$9 at housewares, department stores. Rubbermaid, Inc., Wooster, Ohio 44691.



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It's not a hit and miss job—you need an orderly, logical approach.

“Where do I start?” That's a question do-it-yourself—and even professional—mechanics ask themselves when faced with troubleshooting engine misfire.

You start by defining misfire, putting the problem in perspective so it doesn't seem overwhelming.

Engine misfire occurs when the fuel charge in one or more cylinders fails to ignite. The condition generally results from lack of spark, a fuel-system problem that results in an excessively lean or rich fuel charge, or internal engine damage.

Misfiring wastes gasoline, causes a loss of power and increases exhaust emissions. An engine can misfire at idle or running at slower speeds, at higher cruising speeds (no load), or under load (hard acceleration or a tough pull up a hill).

What causes misfire?

To judge whether an engine is missing, warm it up. A cold engine frequently doesn't run smoothly, only because it is cold.

Engine missing makes the car kick or lope every time the affected cylinder (or cylinders) skips a beat. To uncover the reason, check the following in the order given:

1. Remove the carburetor air cleaner and examine the filter element. Replace the filter if dirt-clogged.

2. Examine the choke butterfly plate with the engine warmed up. The plate should be wide open.

If partially closed, free the plate by cleaning choke linkage and applying carburetor cleaning solvent to the plate's pivot points. If the plate doesn't function now, the trouble is a misadjusted choke or a bad part in the choke system.

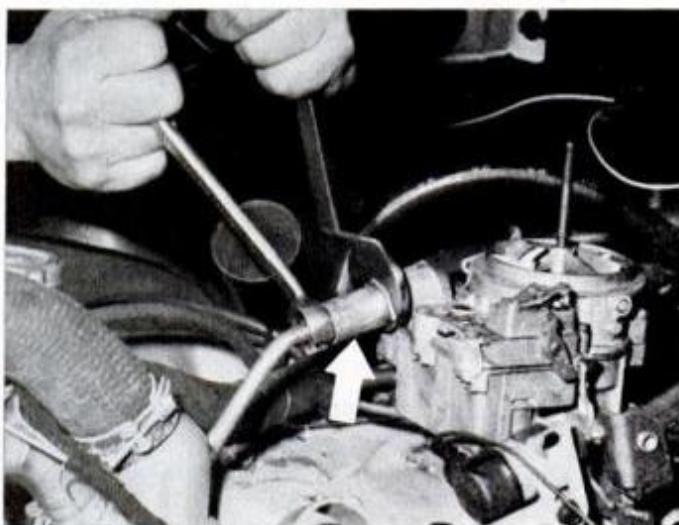
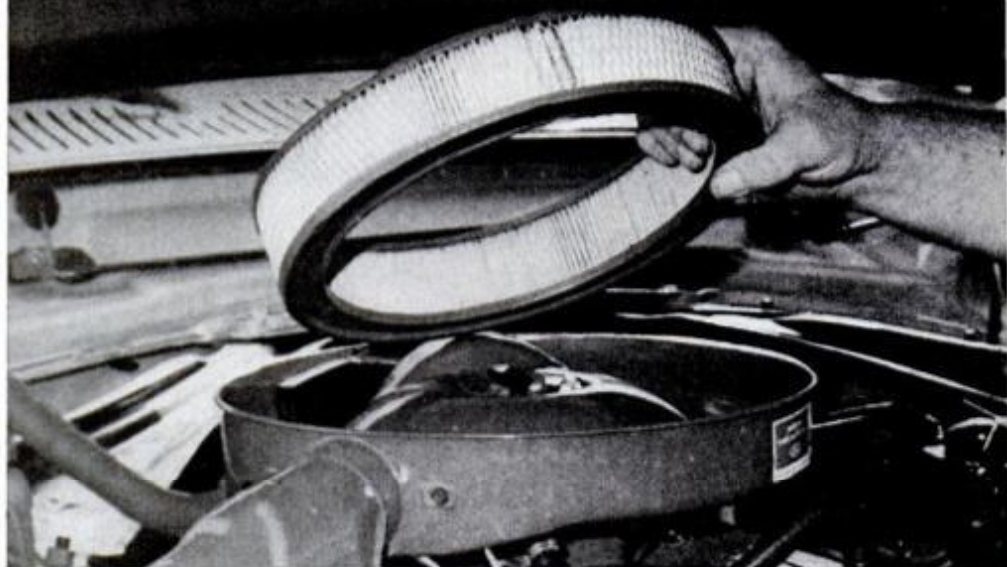
3. Look down the carburetor barrel and move the throttle lever by hand once or twice. Gasoline should squirt forcefully into the carburetor. If it doesn't, odds are the fuel filter should be replaced.

4. Two types of fuel filters are used. Most GM and some Ford Motor Co. models have the filter positioned inside the carburetor inlet. Most AMC and Chrysler Corp. cars, and other Ford models, have the fuel filter visible in the fuel line between fuel pump and carburetor.

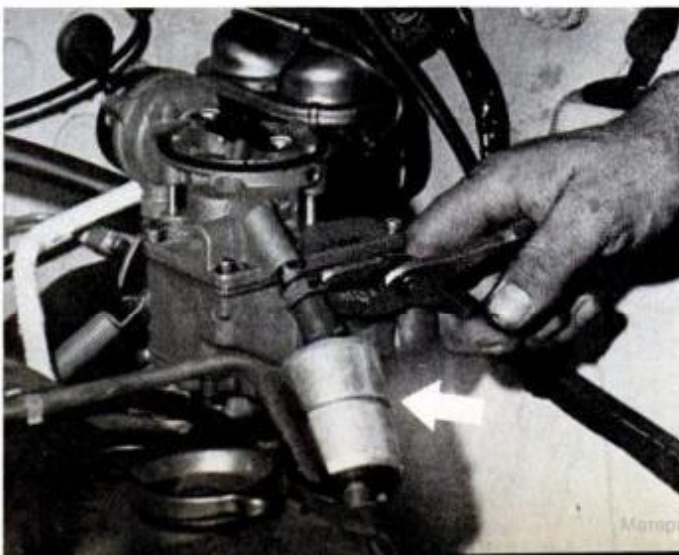
If you're dealing with an internal

Tracking down engine misfire

by Mort Schultz



To find the cause of engine misfire, start with the easy things to check and work your way up to the more difficult. Check the air cleaner on carburetor, replace if dirty and clogged.



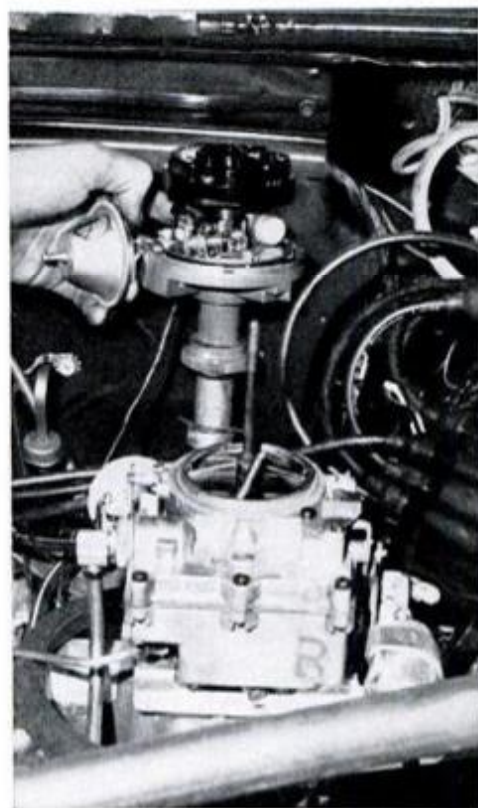
Check the fuel filter, replace if dirty or crimped. Fuel filter (left) is found at the carburetor inlet. Other type (below) is found in line between fuel pump and carburetor. Most GM and some Ford models have filter in carburetor inlet. Other Ford models and most Chrysler and AMC models have filter in exposed area between fuel pump, carburetor.



Remove sparkplugs. Check wide gap, electrode deposits, worn electrodes, damage.



Time ignition system. If timing cannot be set, suspect the distributor, assuming that breaker-point dwell is set correctly.



Remove distributor and check for worn distributor shaft.

now strong. If not, the carburetor probably requires cleaning.

To try to avoid a big job, you first attempt to restore the carburetor by using a commercially available carburetor cleaning kit. It contains a can of carburetor cleaning solvent and a tube that attaches to the carburetor inlet.

With the engine running, the cleaner flows into the bowl, through the needle valve seat, through passages and into venturis through jets. If the carburetor isn't too badly clogged, the method should work.

If it fails, you'll have to disassemble the unit, clean it by letting parts sit in a tub of cleaning solvent, install replaceable parts from a rebuild kit which you can buy at an auto parts supply store for your model of carburetor, and make such internal adjustments as float level and accelerator pump stroke.

6. Speaking of carburetor adjustments, it's possible that if your engine-missing problem is occurring at idle it's being caused by an incorrect slow (curb) idle-speed adjustment. Connect a tachometer and get the correct adjustment specification which, if your car is a '68 or later model, is given on a decal in the engine compartment.

If your carburetor is equipped with an idle-stop solenoid, idle speed is adjusted by turning the adjusting nut on the solenoid. If the carburetor has no idle-stop solenoid, the adjusting screw will be found protruding from the carburetor.

7. Missing at idle and slower speeds is frequently caused by

filter, let the engine cool and place a rag under the fitting to absorb gas that may drip. "Break" the connection, removing the fuel line and retaining nut. Take out the filter (paper or bronze) and the spring behind it.

Replace a paper element. Clean a bronze filter in kerosene or carburetor cleaner.

Install a new or cleaned element, using the old spring, and reattach the fuel line tightly.

If your car uses a visible inline fuel filter, wait for the engine to cool. Using pliers, slide off retainers holding the filter to the fuel line. Pull the filter from place and install a new one.

5. Activate the throttle lever by hand again and see if fuel flow is

vacuum loss around the carburetor-intake manifold joint. Prepare a mixture of one part SAE 20 motor oil and one part kerosene. Pour the mixture into a squirt-type oil can.

With engine running, spread the mixture around the joint. If idle smooths out (the mixture may be pulled into the joint), tighten carburetor mounting bolts and test again. If missing prevails, replace the carburetor mounting gasket.

8. Another cause of engine missing at idle and slower speeds is a vacuum leak in the crankcase ventilation (PCV) system. Start the engine and remove the PCV valve from the rocker arm or valve cover. Hold your thumb tightly over end of the valve. You should feel very strong suction. If suction is weak or doesn't exist, examine PCV hoses for cracks. Replace a bad hose and retest. If vacuum is still weak, re-

stops, the trouble is likely a leaky EGR valve diaphragm. Replace valve.

10. Examine each high-tension cable closely (all cables from distributor to sparkplugs and the distributor cap-to-coil tower cable). If insulation is cracked and brittle, replace all cables.

11. Take off the distributor cap, wipe it clean inside and out, and inspect it for cracks. A carbon path along the cap signifies a narrow crack. Replace a cracked cap.

Examine terminals inside the distributor cap for carbon that signifies arcing and the fact that cables weren't seated firmly in the distributor-cap towers. Clean terminals; if they are badly burned, replace the cap.

12. Remove the rotor from the distributor, and inspect it for cracks and an eroded terminal. If the ro-

tor is damaged, you should replace it.

13. Make sure distributor breaker points are properly aligned, with one point meeting the other squarely.

14. Test spring tension of the movable distributor breaker point by attaching a spring scale to its arm and pulling with a smooth motion. The breaker point should part company with the stationary point when the scale reads 17 to 21 ounces. If this requirement is not met, replace points. Weak tension causes point bounce, causing a misfire at higher speeds.

15. Condenser connections should be attached firmly to the breaker points.

16. Button up the distributor and connect a dwellmeter/tachometer. See that distributor point dwell is adjusted to specification (check the decal).

Note: Cars with electronic ignition do not have distributor breaker points, so you guys can forget about checks Nos. 13 through 16.

17. Remove and examine every sparkplug. Fouled, cracked, worn or improperly gapped sparkplugs are a major cause of engine misfire.

18. Test the engine for compression. If you find compression in one or more cylinders about 70-percent lower than that of the highest-reading cylinder, pour some SAE 20 engine oil into the cylinder and test again. If compression does not improve, missing is being caused by defective valve(s) serving the cylinder, such as a weak valve spring or a burned valve. Internal repairs are needed.

19. Reinstall plugs and connect your timing light. See that ignition timing is set to specification.

If you can't set timing properly, the distributor may have a worn shaft or a camshaft lobe may be worn. In any event, you have at last found the cause of missing.

20. If everything to this point checks okay, and the engine misses at higher speeds or under load, suspect that the ignition coil is breaking down under load. You can't test a coil unless you have an ignition-coil tester. Even then, you might not get a positive answer, since this tester is used with the engine idling and your problem is occurring at higher speeds.

You came this far without finding out why your engine misfires, so you might as well take a shot. Replace the coil.

Remember, checking for engine misfire can be a frustrating and tedious job. To save yourself trouble, check all possibilities starting with the simplest and working to the difficult. Persistence pays off. ★★ ★



Clean carburetor using a product that's commercially available.

If carburetor is too dirty, disassembly and complete cleaning will be necessary. (See text for additional checks.)

place PCV valve and recheck system.

9. If your car was built in 1973 or thereafter (1972 in California), it probably has an exhaust-gas recirculation (EGR) system. A vacuum leak in this system can cause engine misfire at idle and slow speed.

Essentially, the EGR system has an EGR valve and hoses. Inspect hoses leading from the valve for cracks and loose connections.

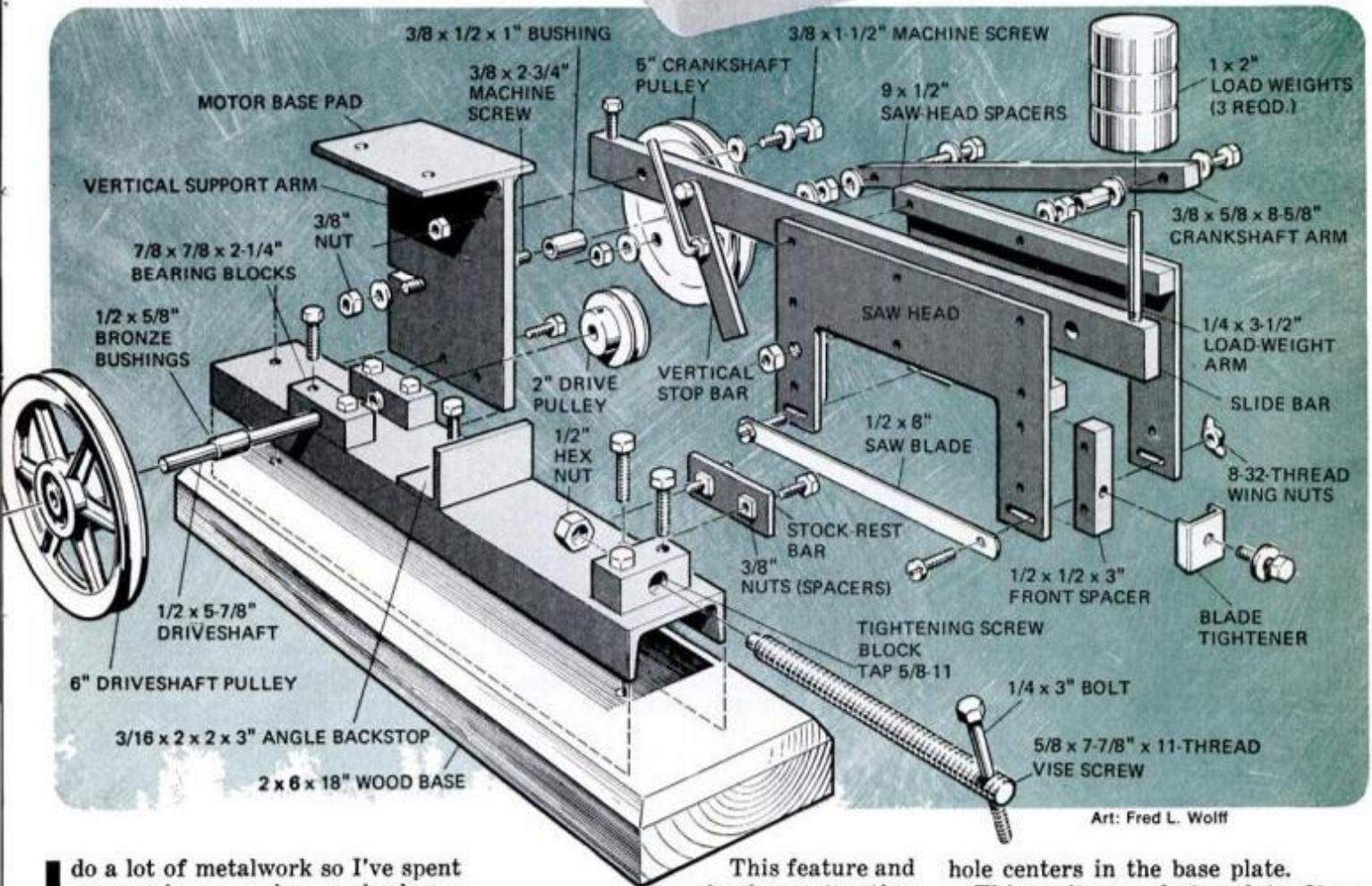
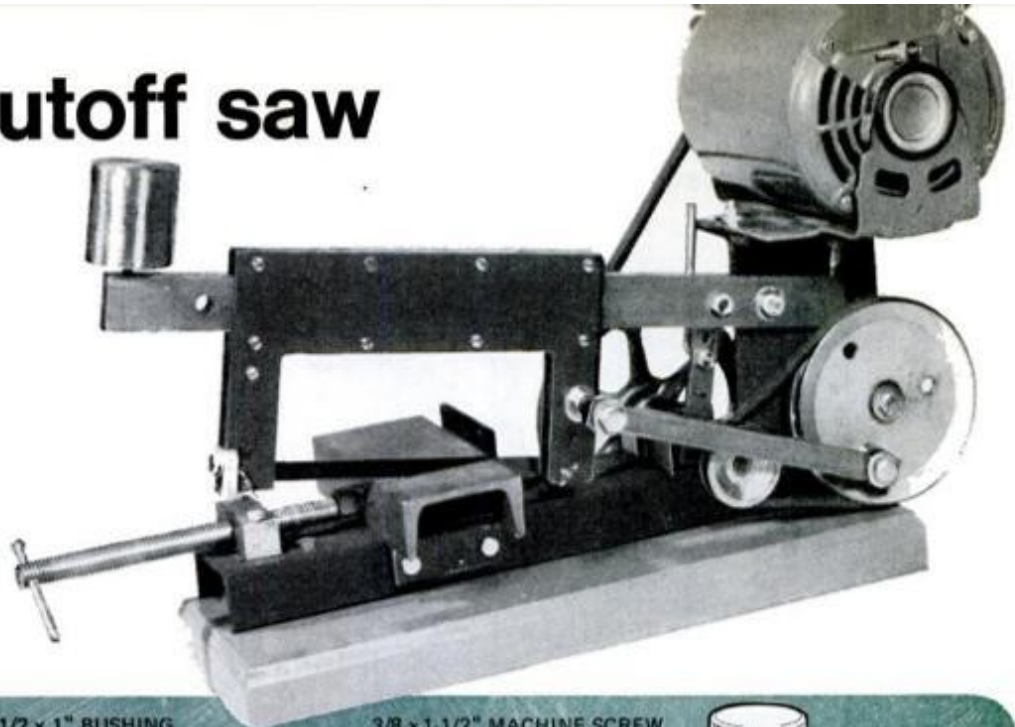
Warm up engine and pull off the hose attached to valve's stem. With the engine idling, pinch the hose closed gently with pliers. If missing



Low-cost cutoff saw you can make

Build this power tool and make hacksawing a lot easier and more accurate.

by W. P. Daniels



Art: Fred L. Wolff

I do a lot of metalwork so I've spent many hours using a hacksaw. While it's a valuable hand tool, it just doesn't have the stability for precise work where great accuracy is demanded. This started me thinking about a power hacksaw that would cut channels, angles and rounds with ease and precision even up to the 3-in. size.

The design I came up with can make cuts to a tolerance of a few thousandths of an inch, eliminating the tedious job of grinding and hand filing always necessary after hand sawing. Although it can produce work of machine-shop quality, it's not too huge or heavy to be portable.

This feature and simple construction make it an ideal workshop project.

All steel parts required to build this unit are considered stock items. You can buy them from a local iron-work shop, and even from some salvage yards—although it might take a while to find what you want there. For instance, the bronze bearings (also called bushings) can be bought from most iron or electrical shops, and the pulleys are the standard V-grooved type stocked by most hardware stores. The power source can be any 1/4-hp electric motor (or larger) with a No. 48 frame. If a different frame is used, just drill new

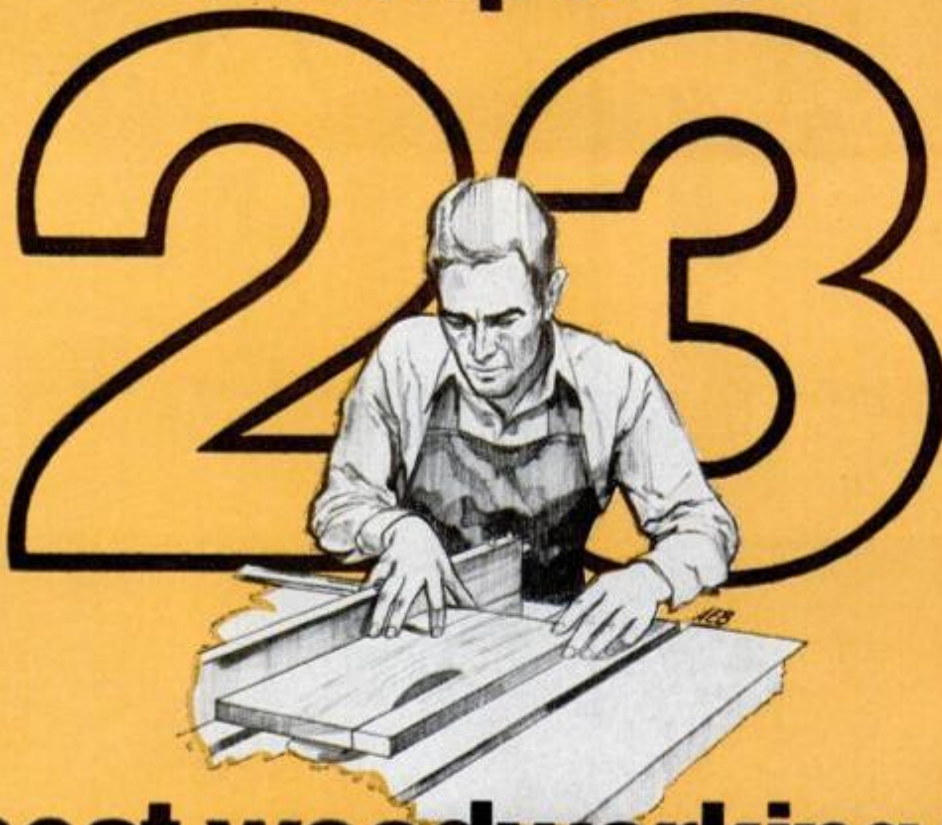
hole centers in the base plate.

This unit was designed to fit an 8-in. saw blade, but you might consider buying bandsaw-blade stock by the foot; it's much more economical. For general use, you'll get the most mileage out of an 18-tooth blade; for nonferrous metals, like aluminum or brass, an 11 or 14-tooth blade is best.

Few tools are necessary to build this saw so you should concentrate on the most critical part of the job—measuring hole centers and sizes. The design has some built-in tolerances if you follow the specifications for proper drill size, but the best policy is to aim for perfection, so

(Please turn to page 168)

An expert's



You can bore a hole from one side of a board and wind up with a splintered mess, or you can bore from both sides and have a hole as clean as a whistle. This is just one of the little tricks that is the mark of a good craftsman, and comes as naturally to the expert woodworker as blowing sawdust off the line.

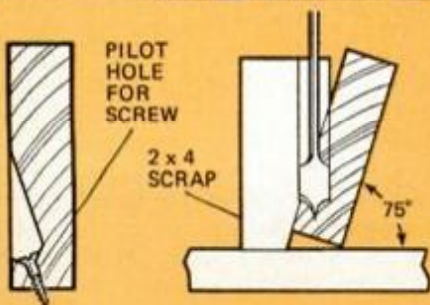
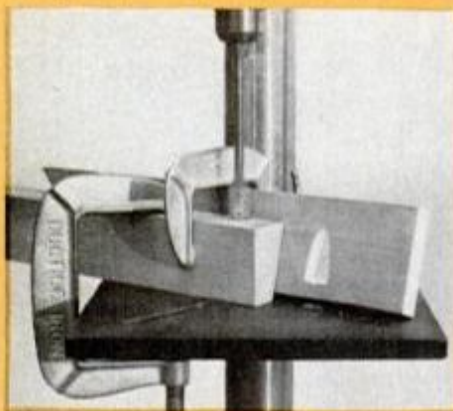
by Wayne C. Leckey
HOME AND SHOP EDITOR

Photos: Rosario Capotosto
Illustration: Adolph Brotman
Art: Peter Trojan

best woodworking tips

Angle in on screw pockets

Screw pockets for fastening tabletops are neatly formed in the table's aprons with a beveled 2x4 block clamped to the drill-press table. With the depth gauge set for the right depth, the work is clamped against the face of the slanting block. By cutting tangent to the surface, the bit forms a neat shouldered pocket for the screw. Using a much smaller drill, another hole is made in the bottom of the pocket for the screw.



Rabbet wood discs on table saw

Rabbeting a disc is normally a job for a shaper, but when you don't own one, you can do it with a semicircular jig attached to the rip fence of your table saw. To start, gently lower the disc into the spinning blade, then rotate it slowly with your right hand while pressing inward with the left.

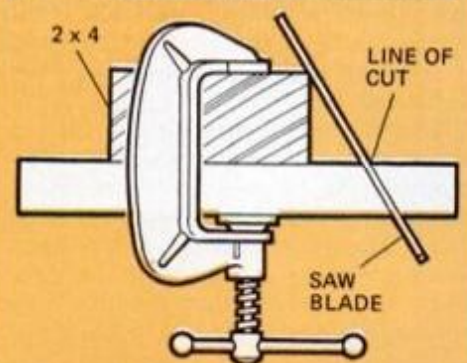
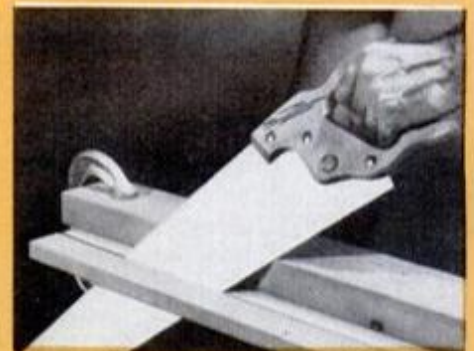


Prevent creeping with sandpaper

Workpiece creeping is difficult to prevent when you make angle cuts greater than 45°. The expert will cement a sandpaper strip to the face of his miter gauge to add a nonslip surface.

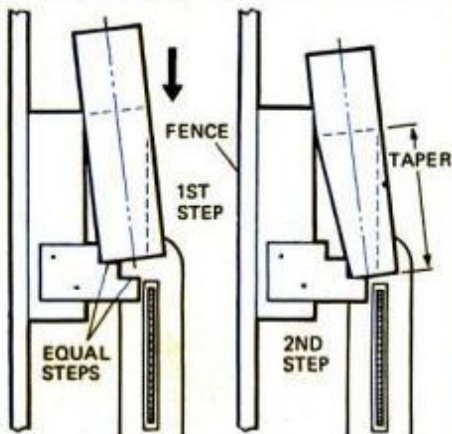
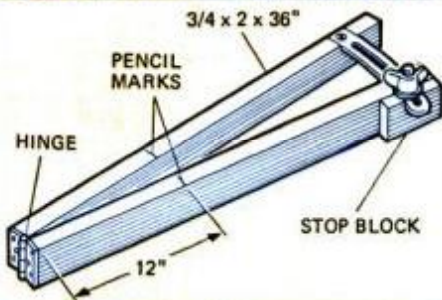
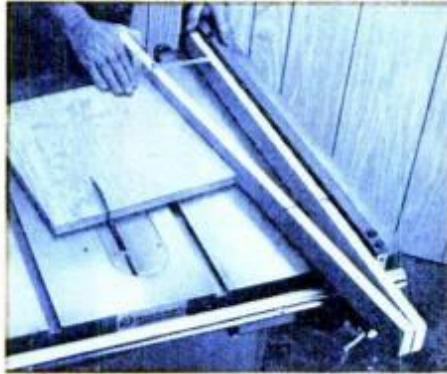
Guide your saw for a bevel

It takes a steady hand and a good eye to saw a uniform bevel the length of a board with a handsaw. However, there's nothing to it if you clamp a 2x4 scrap to the top of the work against which the saw blade can bear at an angle as you guide it along the pencil line. The 2x4 must be positioned to suit the angle that you are cutting; the greater the angle the farther the 2x4 must be from the line.



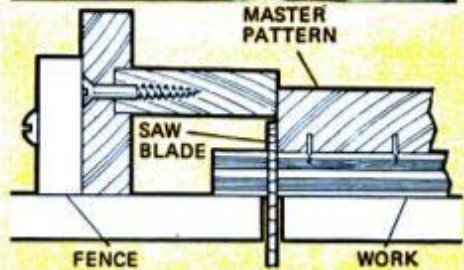
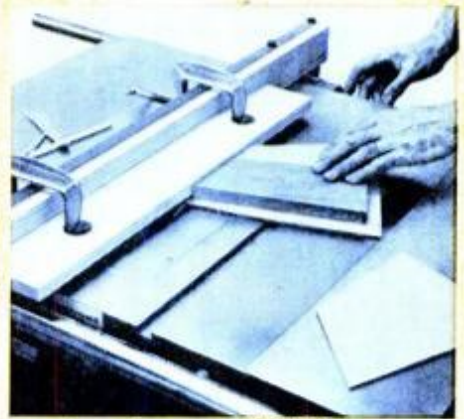
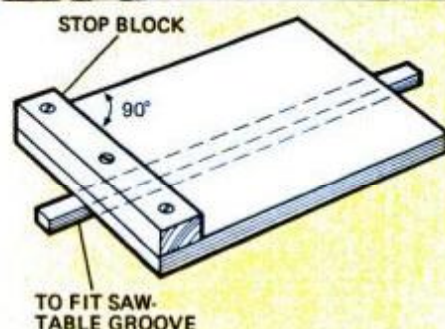
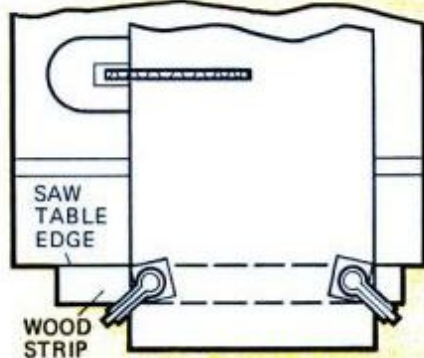
Two ways to rip tapers

Taper ripping requires a jig to hold the work at the required angle as it goes through the saw. Details below show two jigs; one a two-leg hinged affair, the other a stepped block. The hinged jig is set by measuring across the legs at a point 12 in. from the end. By opening the legs 1 in., you set the angle for a 1-in.-per-ft. taper. The non-adjustable stepped jig is good for work tapered on four sides, such as table legs. The work rests in the first notch for the first pass, then in the second notch.



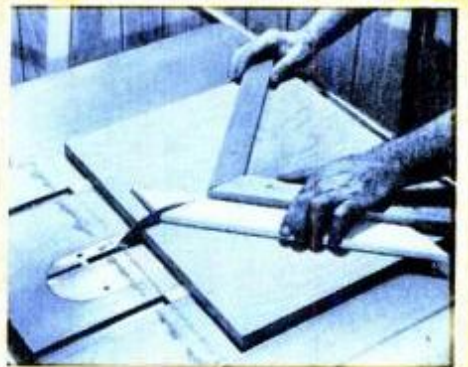
Board for squaring odd pieces

A squaring board comes in handy for cutting a straight edge along irregularly shaped plywood leftovers from your jigsaw and bandsaw. It's nothing more than a sliding platform fitted with a runner that rides in the table groove. The squaring board is used to support and guide the work as it passes through the blade. The rip fence should never be used to make such cuts. A squaring board is especially good for small pieces. When you want to square-up the edge of a large piece, a strip is clamped to the underside and then it is guided along the edge of the saw table itself. Placement of the strip is dictated by the size of your saw table, plus what is required to true up the ragged edge. If your saw is small in size it may be difficult to guide the work along the table edge without a helper.



Mass-produce identical work

Pattern sawing is a fast way of duplicating straight-sided work in quantity on your table saw. The setup requires an overhanging wood fence which is clamped or screwed to the saw's fence, and a master pattern of the part to be duplicated. The points of two brads in the master pattern embed in the wood to anchor the work. As the detail shows, the wood fence is aligned flush with the outer face of the blade and the blade is raised just high enough to handle the thickness of the work. Clearance under the overhanging fence must suit the thickness of the work, and the pattern must be thick enough to ride the edge of the fence. The work, of course, must be cut up beforehand to the approximate (and slightly larger) size and shape of the master pattern.



Miter molding faster with a jig

A miter jig is faster and more accurate than your saw's miter gauge for cutting right and left-hand miters. Runners are added to the underside of a plywood platform and the saw is used to make its own kerf. A plywood fence is positioned and screwed to the platform so it forms a perfect 90° angle at an exact 45° angle to the kerf. A strip of sandpaper glued to the face of each fence of the jig will help keep molding from shifting as it's being cut.

An expert's 23 best woodworking tips



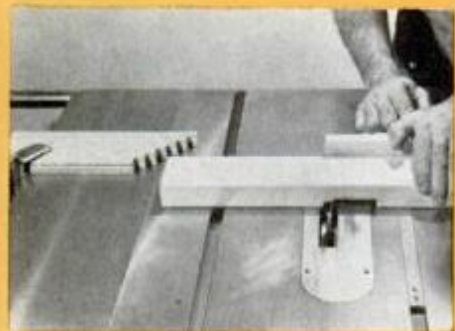
Crosscut wide boards

Place the miter gauge backwards in the table groove when crosscutting a wide board on a small saw. This utilizes all of the table in front of the blade and provides maximum support to the work. After you are halfway through turn off the saw and reverse the gauge in the groove to complete the cut.



Cut duplicates safely with block

Never use the fence itself as a stop when crosscutting duplicate pieces. The work will wedge between the fence and the blade and be thrown with force. Always butt the work against a stop block clamped to the table. This way there is no chance of the pieces getting caught and thrown by the saw.

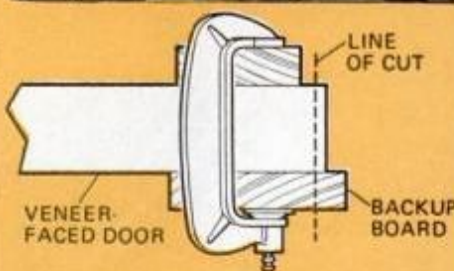
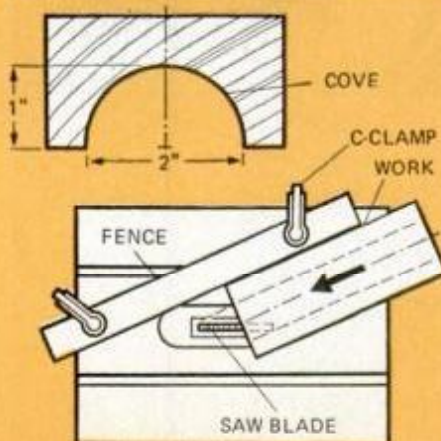
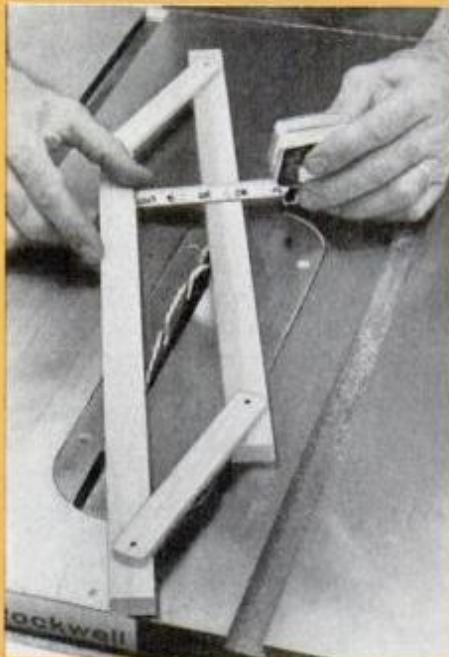
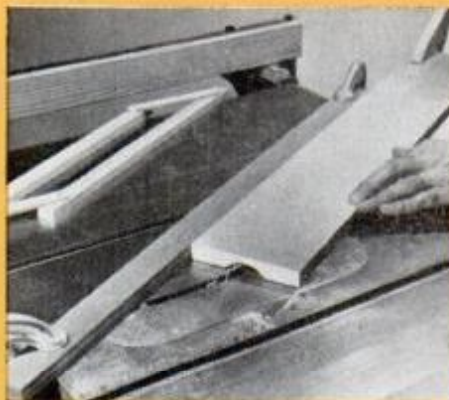


Duplicate identical dados

Extra-wide dados in duplicate work come out exactly the same length each time if you clamp a stepped block to the left corner of the saw table. Pre-cut to suit the width of the dado blade and the length of the dado, the block determines each successive pass by resting work in the steps. The last step automatically sets the width. You can't miss since the block does the measuring.

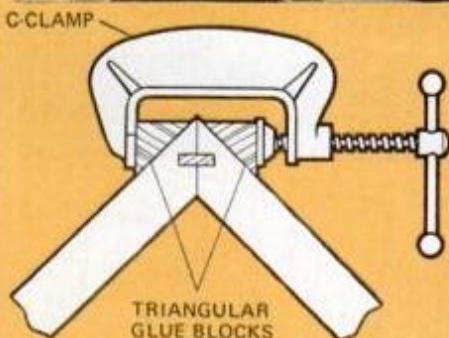
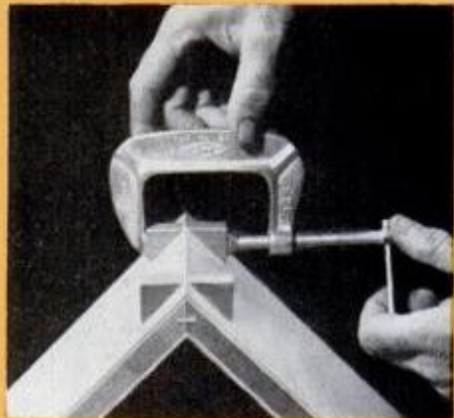
Forming cove molding

Making cove molding on your saw is possible by passing the workpiece repeatedly across the blade at an angle. The auxiliary fence is positioned to form the cove down the middle of the work, then clamped to the saw table. Stock is cut away by successive passes over the blade, cutting no more than 1/16 in. each pass. A combination blade works best and produces a smooth cut. Width of the cove establishes fence angle and is found with an adjustable parallel gauge as shown in the lower photo. Work is finally ripped down the center to produce two strips of cove molding.



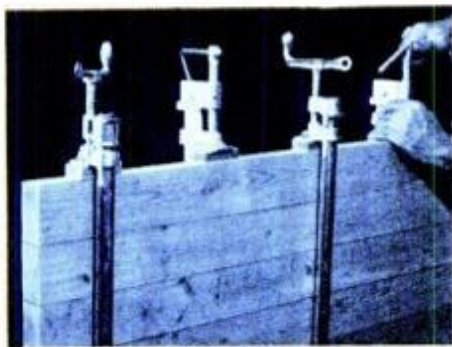
Trim bottom of door with backup

Sawing off a narrow strip from the bottom of a door with a handsaw presents two problems; guiding the saw so it won't run off and keeping it from splintering the opposite side. Both problems are solved by clamping a scrap board to the underside. With the board backing the cut, the saw can't chip or scar the veneer.



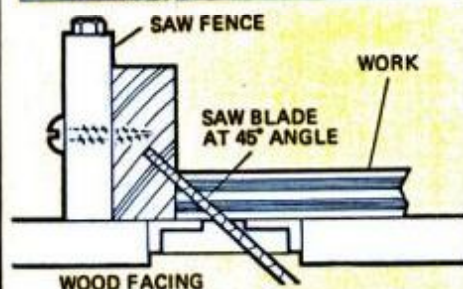
Clamp mitered joints

While there are special "clothespin"-type clamps with swivel barbed jaws for holding mitered joints when gluing, you can make your regular C-clamps do by gluing several triangular clamping ears to each side of the joint. The ears are later chiseled off flush and the surface sanded.



Avoid cupping by alternating

When tabletops and other wide panels are built up of random-width boards, the heart grain of the boards should change direction from board to board and the bar clamps should be placed on alternate sides of the work.



Miter wide boards

How do you rig your bench saw to cut a perfect miter along the edge of a wide board or plywood panel? First you add a wood facing to the rip fence, then with the blade tilted 45° and raised 3/4 in., you ease the fence into the rotating blade enough to just bury the tip of the blade in the wood facing. Fence will support miter.

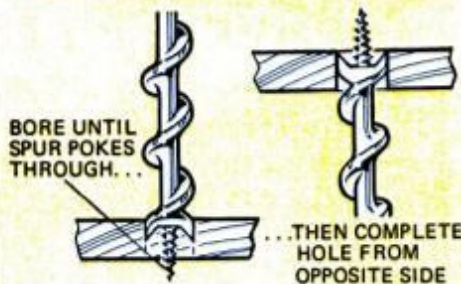
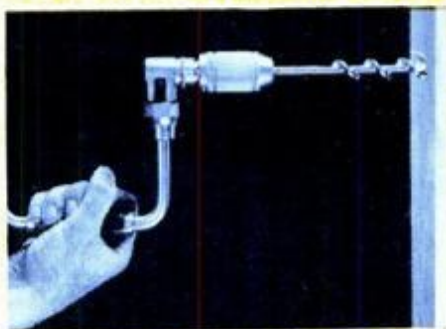


Contour legs with a sanding drum

For a perfect fit when doweling legs to a central turning such as the post of a lamp table, use a sanding drum. It works best when both the diameter of the drum and turning are equal. Notch a board to fit around the drum as shown and support it horizontally so its surface is at the very axis of the drum.

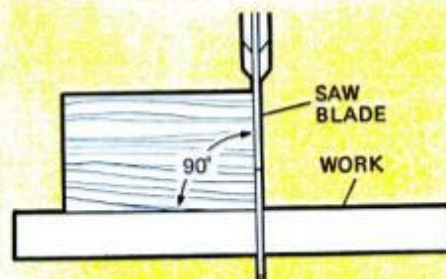
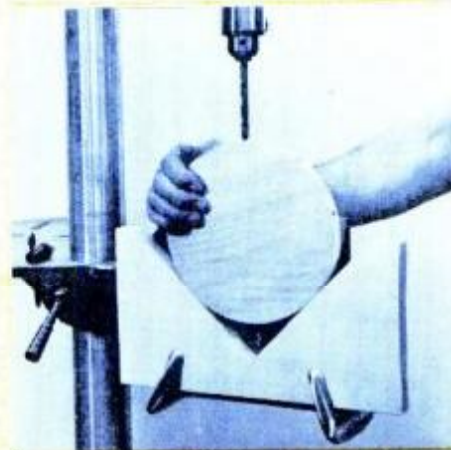
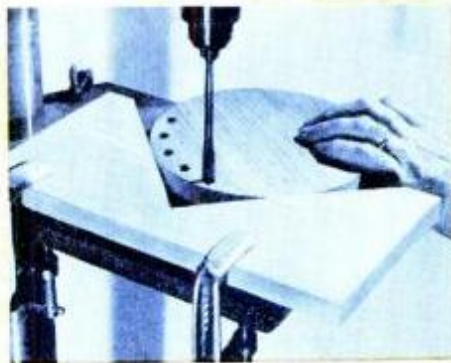
Bore clean-cut holes

Boring a hole from both sides is not always possible but when it is, remember this stunt for producing a clean-cut hole. Start boring from one side until the bit's spur pokes through the other side. Then back out, turn the work around and finish the hole by boring to meet the first. You'll have a clean hole and no splinters.



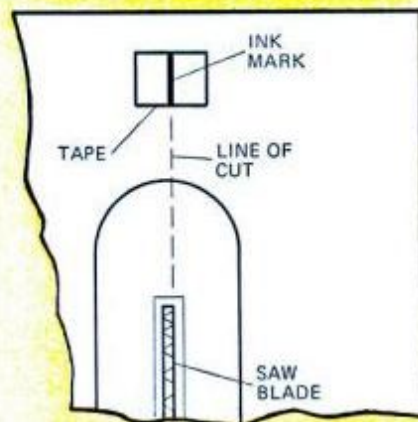
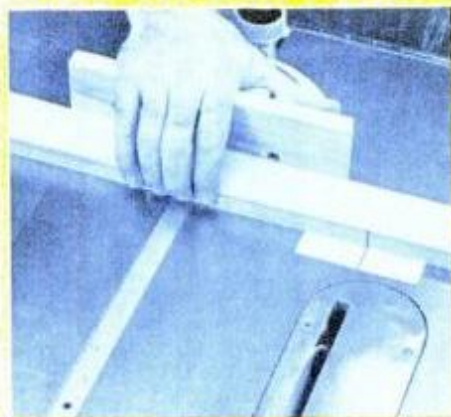
Two ways to drill a disc

A V-notched board clamped to your drill-press table will uniformly space holes around the circumference of a disc. To bore them in the face, the table is kept horizontal. To bore them in the edge, the table is tilted 90°. The board must be positioned so the V-notch is in line with the bit and at a point to suit the distance you want the holes from the edge.



Block keeps handsaw vertical

With practice and a sharp handsaw it's no great feat to follow a line when sawing a wide board. The trick is holding the saw vertically the full length of the cut. When it's important that the cut be 90°, simply hold a square-cut scrap of 2x4 against the saw blade as you continue to saw.



Saw precisely to line

Lining up the mark on the work with the saw blade is easy if you stick a piece of white tape to the saw table and make an ink mark on it directly in line with the inner face of the blade. You'll be right on target when you push the work across the table and into the blade.

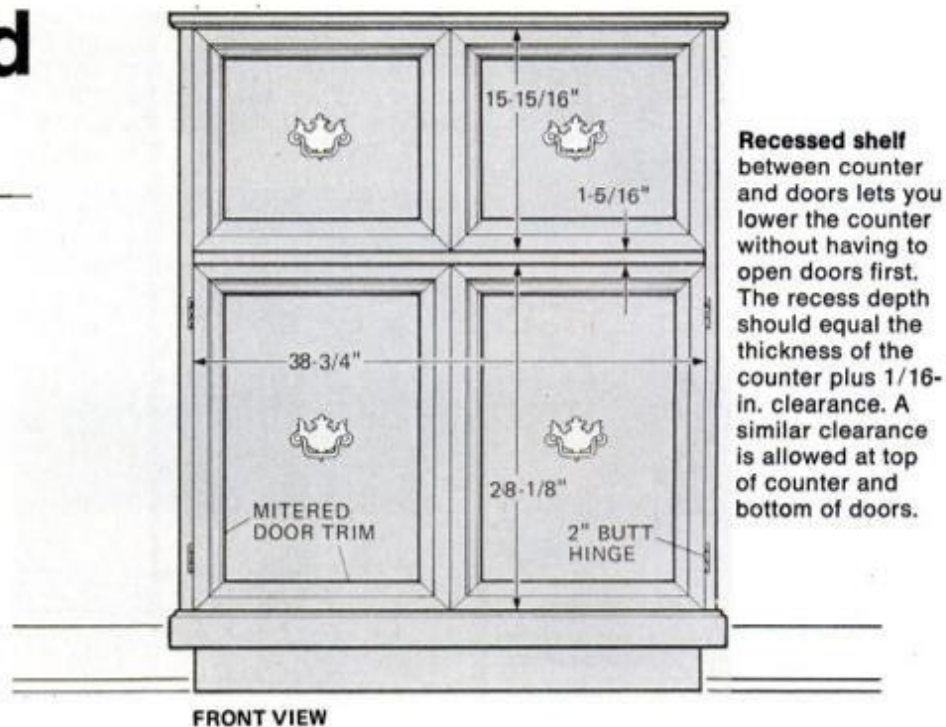
Build this one-of-a-kind home bar

by Wayne C. Leckey
HOME AND SHOP EDITOR

Open or closed it's a beauty. It's a bar your guests will admire every time the drinks are on the house.

True, you'll have to be able to tie the sink into a drain pipe and connect it to hot and cold-water lines, but you'll have the ultimate in a home bar. It offers a roomy storage compartment for beverages, a handy drawer for napkins, stirrers, jiggers, a colorful bar-type sink and a built-in mini-size refrigerator.

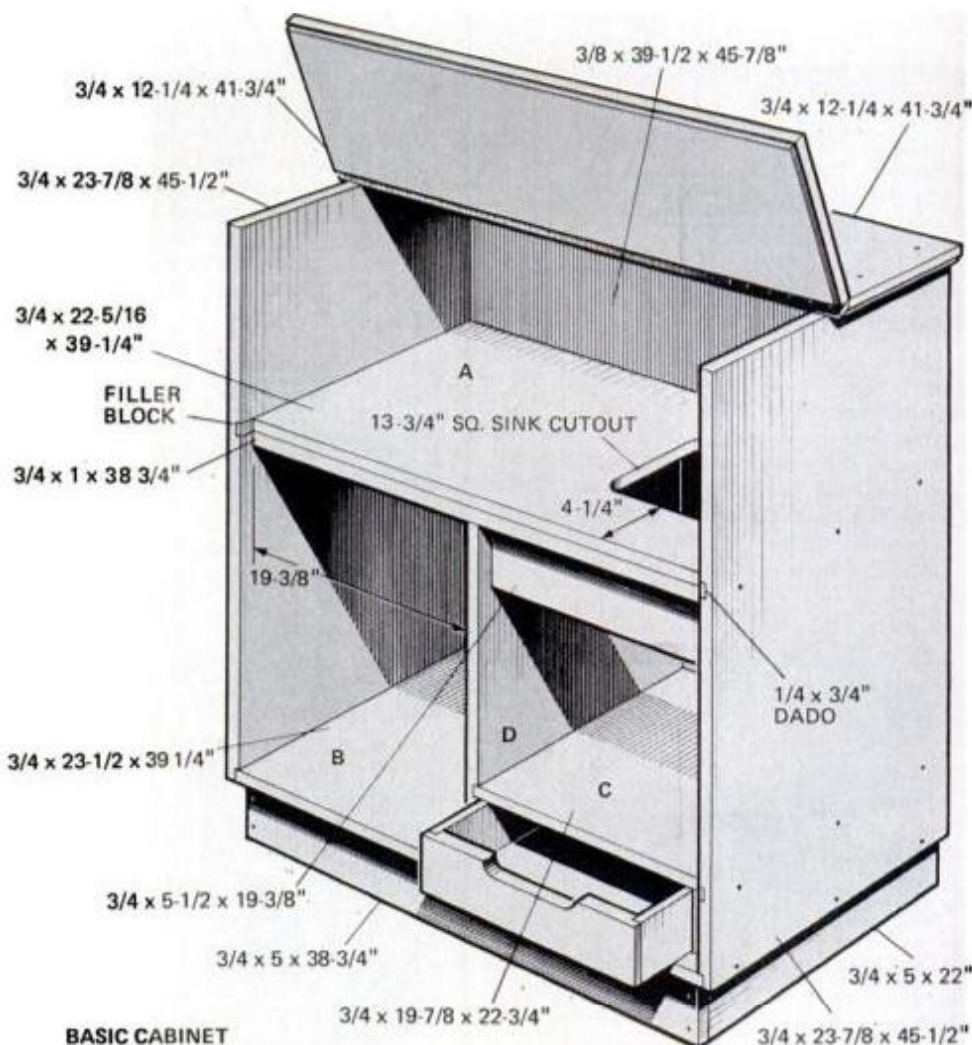
Its cost depends on materials used. We built ours from lumbercore plywood, better plywood than common



Bar's refrigerator compartment is dimensioned to accept this Norcold RV unit. The refrigerator has walnut-finish door, runs on battery or 110-v. current and is available from Sears for \$239.95.



Acrylic bar sink called Gimlet comes in red, black and sunflower colors with gold or chrome faucets, measures 15 x 15 in., is self-rimming for easy installation. From Kohler Co., Kohler, Wis.



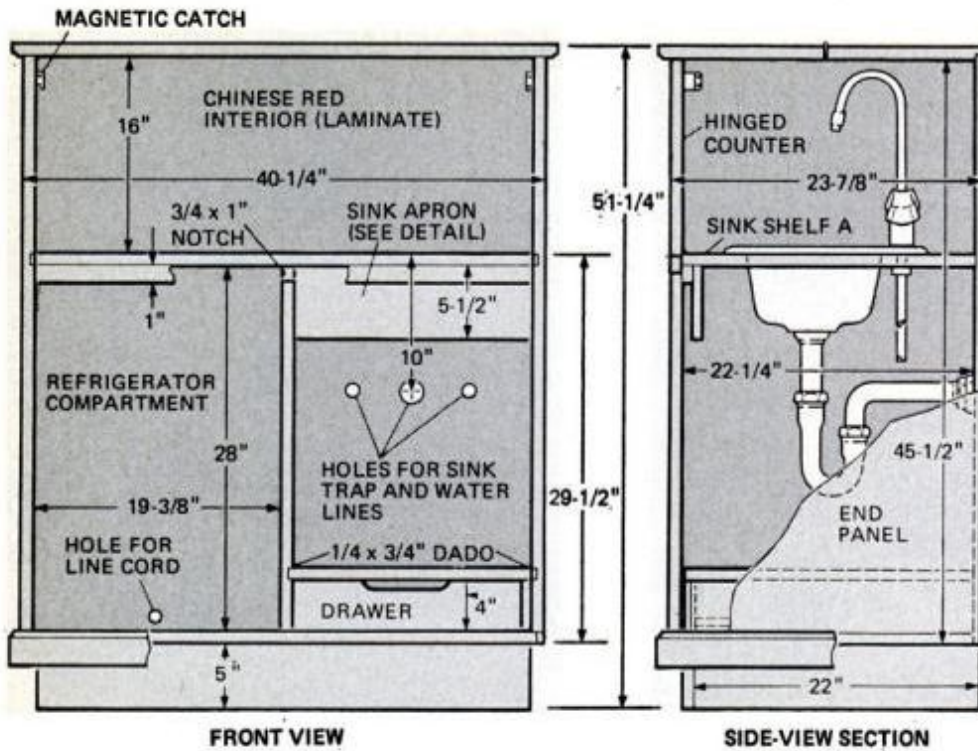
Photos: George Ratkai
 Art: Fred L. Wolff
 Cabinetry: Everett Johnson
 Design: Tom Fung



Don't throw just another party. Instead, make a memorable impression with PM's one-of-a-kind bar that has everything—sink, refrigerator and storage—all in one neat and handsome cabinet. It's elegant for any room in the house, and you can build it yourself.

When it's closed, no one would guess this handsome cabinet is a home bar in disguise. You'd be more apt to think it a stereo console with speakers behind the doors. When open, it's a party center with all you need to add cheers to entertaining fun.





fir but it costs more. We covered the plywood with plastic laminate to add a handsome, durable finish. It, too, added to cost. We used piano-type hinges for the drop-down counter and the flip-back top. Again plain butts would cost less.

If you skip the laminate and finish your cabinet with stain and varnish, you can't get by with less than cabinet-grade, veneer-face plywood for it to have a furniture-store finish. However, if a simulated wood-grain finish will do, you can build your bar from less expensive fir plywood.

Building the cabinet

The basic cabinet is a simple structure. A 3/8-in. plywood back sits in a rabbet; shelves A, B and C, plus partition D, rest in rabbets and dados. Note that the 1/4 x 3/4-in. blind dados for shelf A and partition D are cut to full panel width and later filled at the front with filler blocks. A 13 3/4-in.-sq. cutout is made for the sink with a sabre saw before shelf A is installed.

If you cover the plywood with laminate, it's best, and easiest, to apply it to the interior surfaces before the parts are glued and nailed. We used a decorative laminate called Nevamar, made by Exxon Chemical Corp., Odenton, Md. 21113. We lined the three sink-compartment walls with Chinese red and faced the counter with black slate. If you have not applied laminate before, see *How to work With Plastic Laminate*, page 100, Feb. '75.

To assemble your cabinet, first glue shelf C to partition D, then the partition to shelf B. Add shelf A, then the ends and the back last. Add the back temporarily for now to help brace and square-up the assembly.

Build kickboard separately

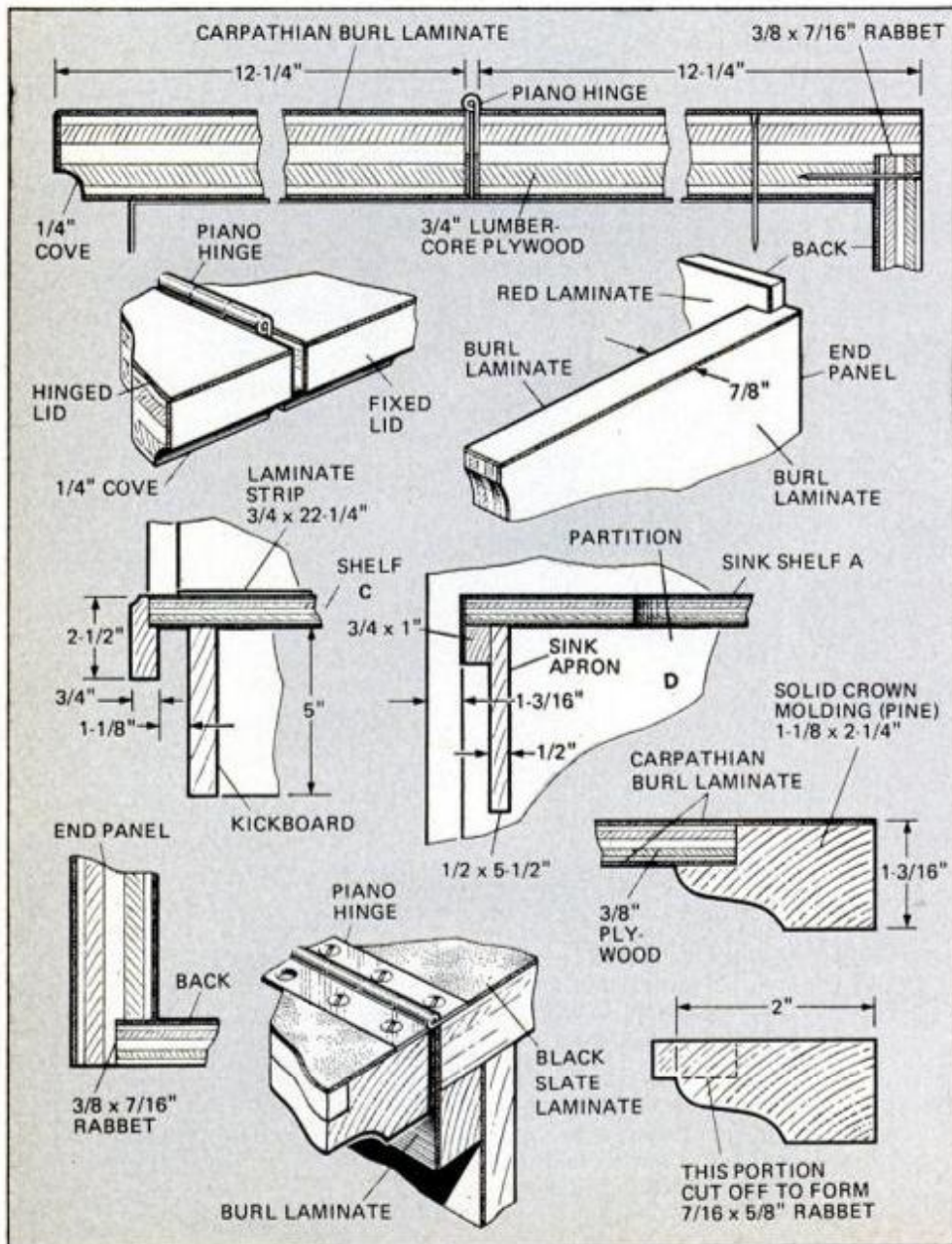
The three-piece, butt-joined kickboard is assembled separately, covered with laminate, glued to the bottom of shelf B and nailed from the top. We picked carpathian burl laminate and used it for a rich look on kickboard, ends, doors and top.

Rip the 2 1/2-in.-wide skirt from 3/4-in. hardwood, rabbet the back and run a cove along the top edge. Miter the front corners and glue it in place. The skirt is later antiqued and varnished, as is door molding.

Add laminate before hinges

To laminate exterior surfaces: First, edge-band top and front edges of end panels before the two-piece hinged top is in place. Then face the ends. As when edge-banding, cut the laminate 1/8 in. oversize and later trim it flush with your router and a

(Please turn to page 142)

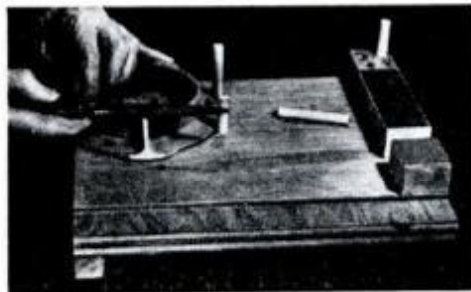


Two for your shop

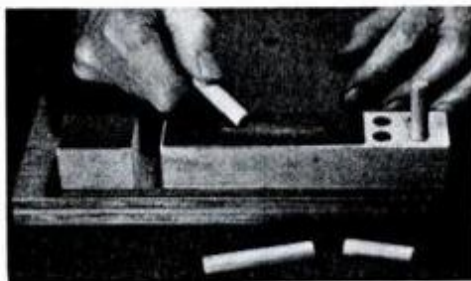
- Deluxe bench hook
- Lathe dividing attachment



When sawed through gap in a cleat, both parts of workpiece are firmly supported.

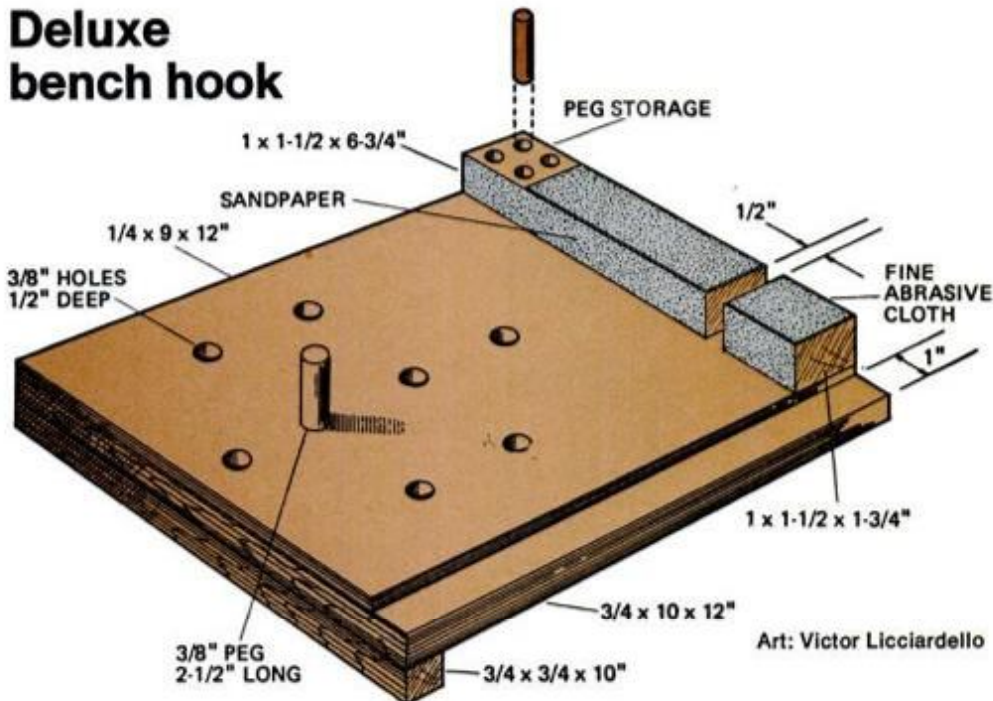


Removable wood pegs hold irregular-shape work securely for filing or carving.



Sandpaper surface is handy for chamfering the ends of dowel pins when gluing.

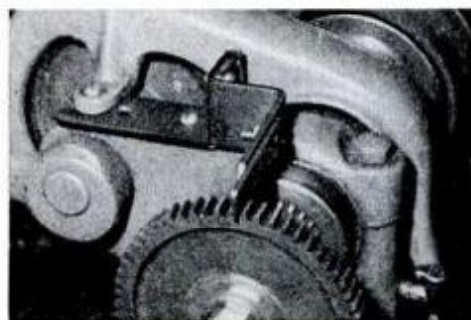
Deluxe bench hook



The common bench hook, basically a board with a cleat at each end and designed to hook over a table edge, has always been a handy fixture for benchwork. With the added innovations you see here it becomes twice as useful. For example, when a step-down surface is added, you can cut dowels, molding and other work without sawing into the surface. When the top stop cleat has a gap in it, the work is supported better for sawing or filing a notch in it.

When the cleat is covered with sandpaper, the work not only is less apt to move, but the abrasive provides a handy surface for chamfering the ends of dowel pins to be used for gluing. Finally, a series of 3/8-in. holes randomly spaced and bored in the surface of the hook for dowel pins will help steady the workpiece for filing. Holes at the far end of the cleat provide a place to park the pegs and keep them handy.—Walter E. Burton

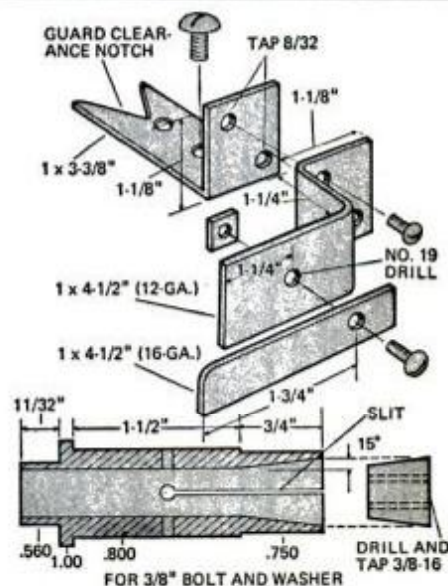
Lathe dividing attachment




Gear rides end of holder; hex-head bolt locks holder in spindle when tightened.

I made this simple headstock dividing attachment for my 9-in. South Bend lathe, but it can easily be made to suit other makes. You use the standard change gears to provide the divisions generally used. The 60-tooth gear, for example, will make divisions 1, 2, 3, 4, 5, 6, 10 and 12. The 56-tooth gear will serve for 7 and 8.

The 54-tooth gear is suitable for 9 and the 44 tooth for 11. I turned the gear holder from cold-rolled steel and used drill rod for the expander to provide a hard-wearing surface. When not needed, the pivoting indicator finger of the attachment can be removed and the rest left in place.—Carl A. Traub







Parquet floors: Careful preparation is the key to a good- looking job



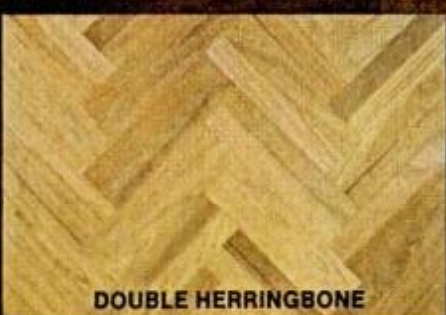
BASKET WEAVE PARALLEL



FOUR SQUARE FINGER



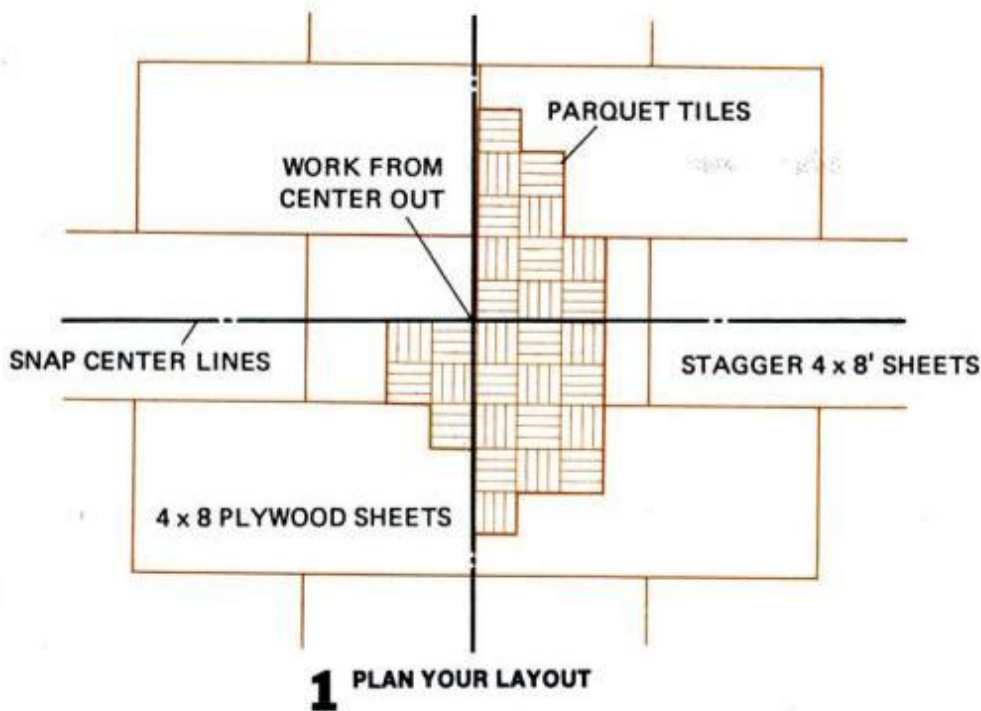
FOUR SQUARE DIAGONAL



DOUBLE HERRINGBONE

Laying a parquet floor used to be a job for a master craftsman—but not any more. With industry innovations like pre-finished surfaces and self-adhering backs, this job can now be tackled by homeowners. There is a wide variety of woods and patterns and a range in cost from raw wood, which must be set in paste, up to self-sticking tiles with stained, sealed and polished surfaces.

If you think it sounds too easy—you're right—there is a catch. You must start with a strong, clean, level surface. Putting your floor in shape might take only a layer of 1/4-in. hardboard across old floorboards. We've outlined the most complete job you might have to do. Here's how.



1. Prepare the surface

Whatever room and tile design you're working with, you must provide a smooth, strong and level surface to lay the tile on. It's also important to stagger the plywood end joints in order to distribute the load evenly across the floor. Any material, ranging from hardboard to 1x6 tongue-and-groove subflooring, should lap the end joints from one support to another.

In general, you should follow the same layout rules for tile floors as for tile ceilings: Snap center lines and work with the edges of the tiles along the lines, filling in from the middle of the room toward the walls. This way, if your room is not square, you stand a chance to make up the discrepancy behind furniture or under the baseboard where it won't be noticed.

2. Most durable installation

Laying a new subfloor is the way to get the most complete and durable installation. It gives you a chance to level up bad spots, to provide a new, strong surface and to allow for a ventilated air space in between the 2x4s that will keep the tiles warm and dry.

This will also make the floor more comfortable to walk on because a wood subfloor is more resilient than concrete.

3. Bridge the low spots

The best way to handle low spots is to bridge them with 2x4 sleepers and then support the bridge with shingle points. You can drive one in from each side and let them overlap

as much as needed to make the 2x4 level. You should check for level along the length of the board and across from one to another. Note that adhesive is used along with screws and anchors to make sure this floor won't shift or squeak or start popping the tiles loose after it's in use.

4. Combine nails and glue

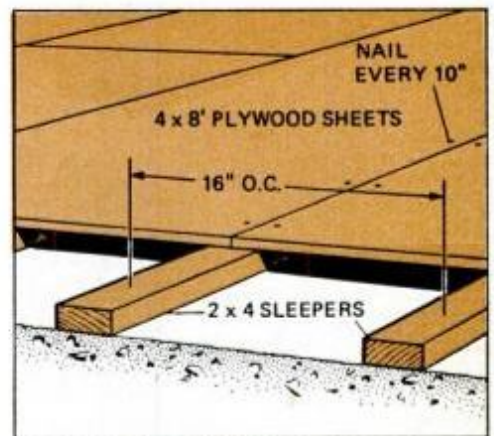
A thin bead of construction adhesive between the sleepers and the concrete will give you the permanent and professional results you're looking for. Nails, on their own, may work loose and the joints may separate, but if you combine the force of the nails with that of the adhesive bond you will make this job true and tight.

5. Check for flush surface

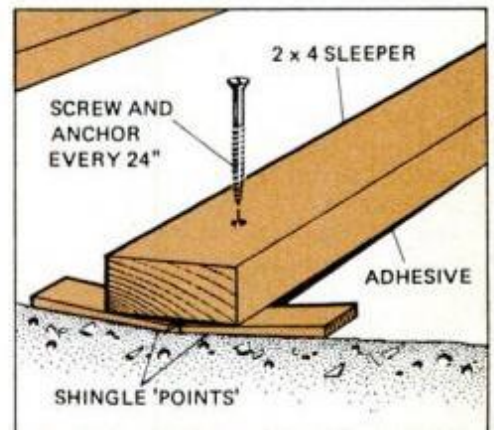
You're almost ready to lay the tiles—but give your floor one last check. Make sure the nailheads are driven down flush to the plywood. You don't want to discover protruding nails as you're spreading paste or laying tiles. If some of the plywood seams are uneven, now is the time to plane or sand them down and fill in any voids in the surface skin with water putty.

Any loose material on the plywood will prevent the tiles from adhering properly, so all good craftsmen will invest a little extra time in this last step to clean up the sawdust and double check their preparations.

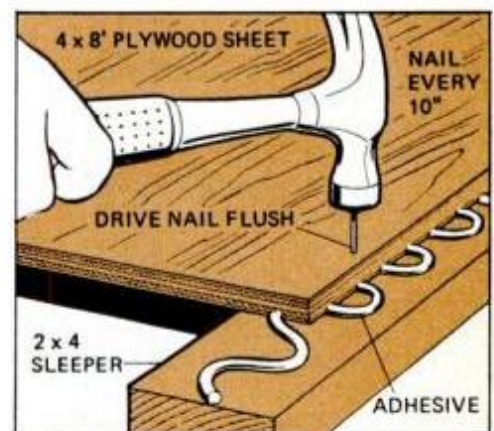
Now you're ready for the easy part of the job—laying one tile next to another for a beautiful parquet floor. —Mike McClintock, Associate Home and Shop Editor



2 LAY 2x4 SLEEPERS



3 LEVEL UP WITH SHIMS



4 GLUE AND NAIL PLYWOOD



5 PLANE DOWN UNEVEN SEAMS

Color photos: Bangkok Industries



3 ways to use a one-car garage and still get the car in

by Ray Gill

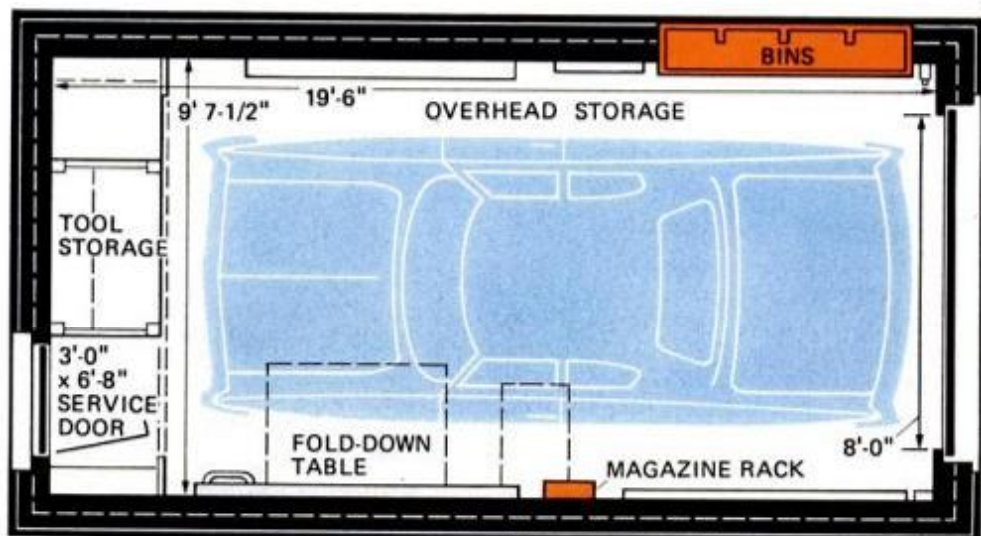
Even the smallest one-car garage can add an unbelievable amount of living and working space to your home. This can be done on a surprisingly low budget without moving walls or building extensions. The trick is to build in well-organized and flexible units that can be of service when you need them, and be out of the way when you don't. The garage I worked with is attached, with a utility room, to a small Cape Cod-style house and has inside measurements of 9 ft. 7½ in. x 19½ ft. I developed this area into:

- a versatile shop,
- a gardening center and
- a flexible storage facility.

As you can see in the picture, I am still able to get the car in.

Since no neglected garage is ever in very good shape, I started by repairing the Sheetrock ceilings and walls. This called for a thorough spackling job (filling holes and sanding down bumps) and a new coat of textured wall paint.

The floor needed work too. So after a good cleaning I flash-patched the bad spots and then laid down a liquid vinyl floor. To do this I spread a thick water-based epoxy, sprinkled on multi-colored vinyl chips and finished with three coats of clear sealer. This turned out to be the best solution to the problem because of three advan-



PLAN VIEW

Built-in versatility

The Homosote panel can be hung with eye hooks on the side wall (above) or over the storage area (right). With the bull's-eye showing it's decorative and functional as a target for darts. The reverse side doubles as a screen for slides and movies. With foldaway shop benches, the garage can be set up for many uses.





Gardening center

The trestle table is totally demountable. The 4x8 plywood top is stored in normally "dead" space above the garage door tracks and sawhorse brackets are removable. Space-saving shelves were cut into the stud wall where plastic containers and ConTact-covered coffee cans provide storage for cuttings and small tools. Bins underneath will hold large bags of fertilizer and grass seed. A section of the rear wall has dowel pegs to hold tools and the grass bag, and a wide shelf notched for a rake.

Storage area

Main storage units are 25 in. deep, a dimension I got by pulling the car into the garage and measuring exactly the room I needed for passage. This wall holds large gardening equipment, a radial-arm saw (on casters), large power tools, and every kind of leftover from closets in the house. Good planning is the key here; careful measurement for the lawnmower and saw, and a same-size system of storage containers.



Workshop wall

Activity here is centered around two worktables and a 4x8 pegboard sheet for tool storage. We mounted the ¼-in. board on heavy-duty spacers with holding screws into each stud (16 in. on center). The main workbench is secured with four 3½-in. butt hinges to a 2x4 ledger lagscrewed to the wall. The legs are also on hinges so the unit can fold out of the way. A smaller surface to the left is built for heavy-duty use with a 2x6 ledger and 4x6-in. T-hinges instead of butts.



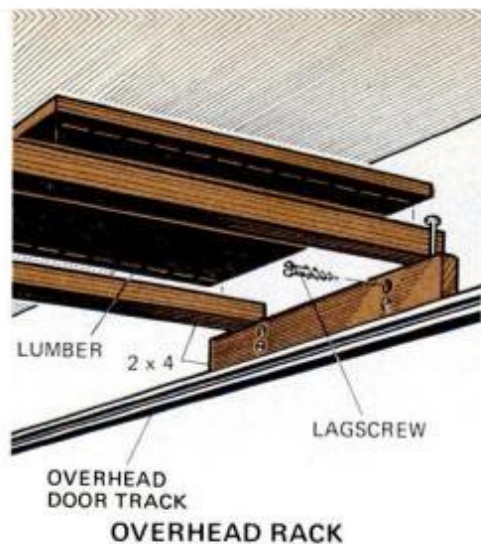
tages: easy installation, low maintenance and durability.

After refinishing all interior surfaces, I started "building in" the variety of uses wanted. First I built the rack above the garage-door tracks. A 2x4 lagscrewed to the wall on each side, with two 2x4s on edge bridging the span, can support plywood tabletops, sawhorse legs, heavy metal pipe clamps, loose lumber and moldings. Almost every room has some "dead" space, but with a little ingenuity you can design a simple structure like this to take advantage of all available space.

More storage

As mentioned earlier, the main storage unit (for outsized items) is on the back wall. But I wanted to avoid as much clutter as possible. A room like this, that can be used in so many ways, is bound to collect the remnants of all kinds of projects. So I needed another storage area that could hold odds and ends like art supplies, ball and bat and paint cans.

Art: Peter Trojan



A simple rack placed over the garage door uses "dead" space effectively.

Following the same idea of reclaiming unused space, I literally built in a storage unit by recessing the shelves into the wall. After removing the Sheetrock, I framed the opening with 1x10s. By cutting 1x8 boards to fit around the studs, I was able to gain 4½ in. of shelf space. Use of colorful plastic containers to organize the shelves gave a uniform and attractive appearance. Labeling each bin made it easy to identify stored items.

Useful and colorful

As functional as this room is, remember that it should be attractive and pleasant. One of the simplest built-in units was the magazine rack. The 1x2 frame was routed to accept the edges of the red Plexiglas sheets, then toenailed to the studs and painted to match the wall. It didn't get in the way like a bookshelf and was very useful in storing instruction books and repair manuals.

Once you start a project like this you'll come up with space-saving ideas that suit your needs best. Hopefully, my project will get you thinking about reclaiming some garage space. You might find you'll be adding a versatile and useful room to your house. ★★★

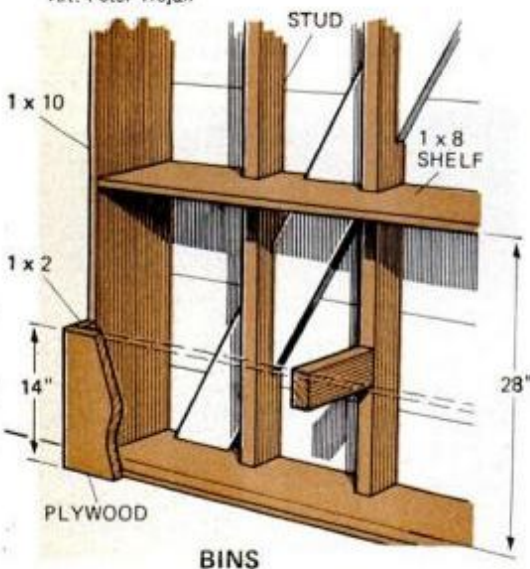


MAGAZINE RACK



A magazine rack is handy for reference and adds a touch of color. Shallow, it takes but little space.

Материал, защищенный авторским правом



BINS



Shelves are recessed into the wall studs for neat and efficient storage.

Your wife will love its cozy, textured look.

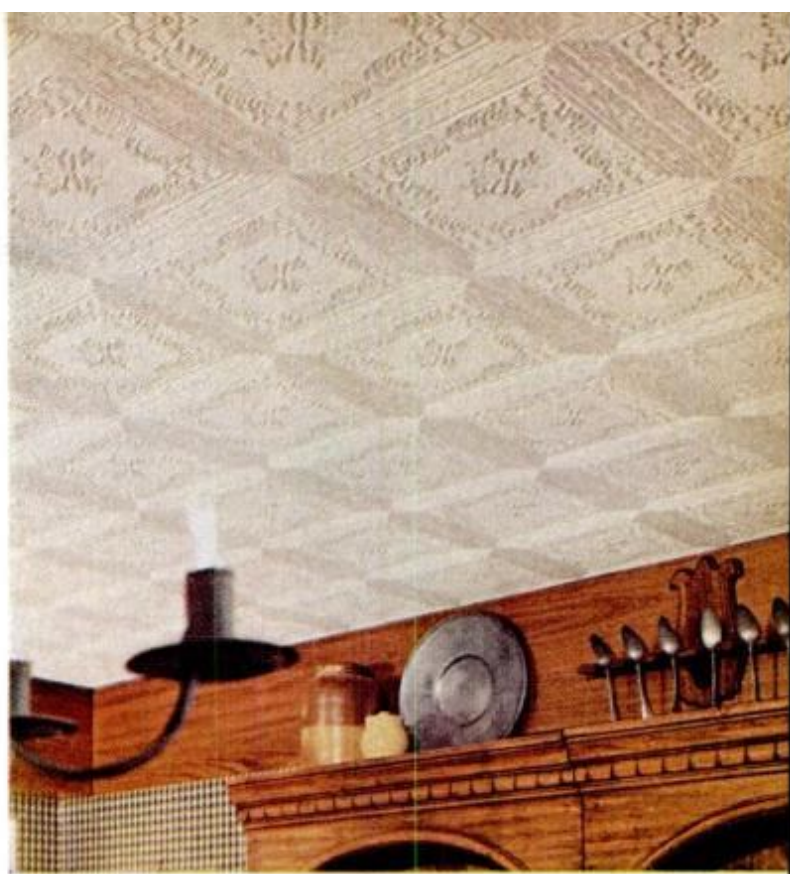
The Armstrong Integrid® System. As easy as

3-2-1

3 steps. 2 days. 1 man.

If you've put up a tile ceiling, you know what a hassle it can be. Nailing up all those furring strips—two nails every 16 inches. Stapling up every tile—four staples each tile. A long, hard job. But no more. Not with the Armstrong Integrid Installation System. It's a lightweight interlocking metal system that goes up quickly and easily with a minimum of nailing and no stapling. Best of all, the metal never shows!

You can buy Integrid in convenient premeasured packages. They include everything but the nails. There's practically no waste, and no special tools are required.



Here's how the Integrid Installation System works.

Step 1.

Install the metal furring channels directly to your old ceiling. (Or you can suspend Integrid on hanger wires to lower the ceiling.) The metal won't warp and rack like wood furring strips, so you won't have to worry about joints pulling apart. Only 12 nails for a 12' x 12' room, not 260.



Step 2.

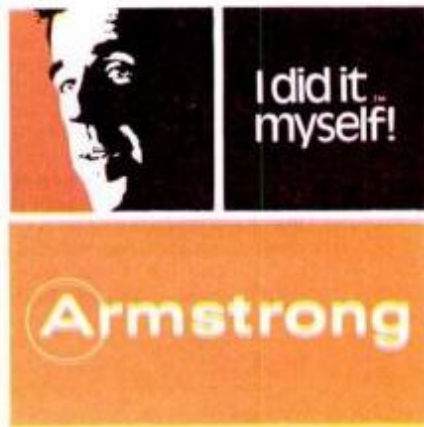
Slide the tiles into place. Choose from a wide assortment of designs, from formal Victorian to casual rough-plaster effects, including the Early American sampler design shown above. With this system, each tile interlocks with the others for a tight fit that minimizes joints. The old beveled edges and block look are gone. Now the design flows uninterrupted wall to wall.



Step 3.

Snap each metal cross tee onto the metal channel, and slide it into the groove on the side of each tile. Each tee supports four 12" x 12" tiles, and the metal "disappears." The interlocking ends of each tee are slotted to help compensate for common installation errors, like leveling. Integrid—fast, reliable, and as easy as 3-2-1!

For more information, see your Armstrong retailer—listed under "Ceilings" in the Yellow Pages—or mail in this coupon.



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myself!

Please send me color brochures on the Integrid Installation System and the names of my nearest Armstrong Ceiling Center™ retailers.

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Keep your house snug

Seal-up cracks and joints inside and outside your home with DAP Latex Caulk. Keeps heat in—cold out. Guns easily, sets fast for painting in 2 hours. Won't stain, bleed or show through latex or any other paint.



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DAP Inc., General Offices: Dayton, Ohio 45401
Subsidiary of Plough, Inc.

THE ACCIDENT YOU'D NEVER FORGET (Continued from page 70)

execute this avoidance maneuver without error—and all other maneuvers required by the course—two expert drivers from General Motors Proving Ground and one from Calspan drove the course several times at close to the limit of the cars' capabilities. It was soon evident (instrument tapes proved it) that when drivers failed to execute a maneuver successfully it was because they were squeamish about using the full cornering ability of their car, even at 30 to 40 mph. When cornering, drivers were willing to take only .35 Gs—about half of the car's capability. At one G, a driver feels a side pull equal to his own weight.

Wet-surface handling

Barreling down the straightaway again, drivers came to a stretch of blacktop under an inch of water. The lane veered to the right at a 45° angle, then back 45°, then straight ahead. Intent on making up time on this stretch, drivers went into it at nearly 50, saw the lane angle and hit their brakes. If they stayed on them, they went into spectacular skids.

Those who didn't brake did better but found their steering had to be carefully timed. Even some professionals "lost it" here. Those who did get through the wet stretches without skidding didn't simply "sling-shot" through with luck. They did it by driving with a precise, delicate touch. Still, 47 percent had at least one failure in this part of the course and Richard Rasmussen, GM Proving Grounds engineer concludes: "People do not readily adapt to changing road friction; they do not slow down enough for these conditions."

There were more failures by drivers in the wet—and elsewhere—on their fifth run than on their first. Researchers can only speculate why. Speeds went up on the later runs; was it because familiarity with the course was breeding contempt for "risk"? Or had earlier success at lower speeds made drivers overconfident? Under 30 mph, on the wet stretch, there were practically no failures. At 35 to 40 mph, about one-fourth of the runs met with failure. Over 40 there was almost twice as much failure as success. As speed went up, accuracy went down.

It's easy to recognize the real-life parallel of this situation. A driver returning home from work on a route he knows well—he drives it twice a day—is in a bit of a hurry; it's his bowling night. Like the drivers on the test-course straightaways, he guns it whenever he can. He'll be okay—if the unexpected doesn't hap-

pen. A little rain and a slick spot right where he has to avoid a truck and a concrete abutment; a driver who suddenly darts over to his lane to make a left turn and stops; a driver who forgot to turn on his headlights blundering out of a parking lot in front of him—he copes with things like this every day. But tonight he's pushing—and as speed goes up, accuracy goes down.

Most people overrate their ability as drivers. Of the 100 volunteers, only one considered his ability less than average; 74 percent rated themselves as above-average drivers. This overly optimistic opinion of their skill leads them to believe they're capable of driving aggressively when they're not. (Had they been, they would have pulled more Gs, used more of the car's capability. Yet 75 percent of the drivers said they had never driven a car harder at such speeds.) And an exaggerated estimation of their skill leads them to drive unfamiliar cars as aggressively as their own. Roy Rice was eager to learn what effect switching from the standard to the modified Chevelle had on the way test subjects drove. Drivers "pushed" the less familiar car harder. At many points on the course this caused them to make mistakes, particularly when they tried to maneuver on wet pavement and not spin out.

"Anyone driving a new car, or one who frequently drives rental cars, might well conclude from this that

(Please turn to page 126)

Using the brakes

One readily apparent finding of the GM study is that drivers need more training in the use of their brakes.

"They're not aware of 'squeeze' braking techniques that apply steadily increasing pressure without locking up their wheels," says Roy Rice. "However, our instruments showed people seemed to be aware when they locked up and when they released their brakes."

"Many drivers seemed to have a preferred pedal pressure, something that feels comfortable to them and they vary the slowing process more by how long they keep their foot on the brake than by how much pressure they use at any given time."

"Our longitudinal accelerometers showed some left-foot brakers had a foot on the brake and a foot on the throttle at the same time—probably because they had gotten into the bad habit of not getting off the brake. In stop-and-go traffic, left-foot braking is a great advantage—it reduces overall reaction time. But the driver who rides the pedal is certainly hard on brake linings."

"We saw all kinds of braking. One driver was so intent on stopping that she used both feet on the brake—one on top of the other."



If you ask your pickup to be more than a pickup, ask for a GMC.

The days of the good ol' hard-nosed no-nonsense pickup are numbered. Because today's pickups are being asked to do more than just an honest day's work.

They're being asked to do what the family car does.

They're also becoming involved in more and more purely recreational pursuits. And they're even becoming motorized works of art.

Well, if you're not already part of this trend, we suggest you drop by your GMC dealer. He's a truck expert. Which

means he can do a lot more than just sell you a pickup.

He can help you set up your GMC any way you want it.

He'll help you select the right engine, tires, axle ratio, and springs. He'll help you prepare your GMC for any special trailer-towing chores. Or to carry a camper.

But no matter how you equip your pickup, the important thing is that your GMC dealer is giving you such a solid truck to begin with. One with double-wall construction in the cab and pickup box.

Independent front suspension. High-Energy Ignition. And a roomy, comfortable cab, either 2- or 4-door, with lots of glass area and little niceties like padded armrests and visors and a continuous flow-through ventilation system.

Yes, a GMC is a fine pickup. It should be. Because it comes from people who've specialized in trucks for over 70 years. In other words, if you're itching to get in on America's growing love affair with the pickup, your GMC dealer is the logical place to go.

(The rather special pickup shown here includes some equipment not available from GMC.)

GMC. The Truck People from General Motors.



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If you're on your feet all day, you can't afford less than the best. That's just what you get in every pair of Hermans. The best fit. The best shoes for your work. The best boots for your sport. Herman Uniform Shoes come in 99 individual fittings: 6D through 6EEE to 14A through 14EEE. Plus 15 and 16C, D & E. Pictured are styles #5230 dress leather oxford and #7230 chukka boot featuring non-marking, oil resistant crepe soles; and, #5225 moccasin toe oxford featuring



non-marking, oil resistant Goodyear Chemi-gum® soles. Their perfect fit and fully cushioned insole guarantee great comfort. Top quality materials and workmanship guarantee great wear.

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EARN WHILE YOU LEARN

ACCIDENT YOU'D NEVER FORGET

(Continued from page 124)

a little extra caution—not aggressiveness—is in order when they get behind the wheel of a strange car," says Rice. "There's a big difference between a safe driver and a skillful driver. Many skillful drivers got themselves into trouble on the course. The safe driver does a nice job of combining caution with skill."

Volunteer drivers were 60 percent male, 40 percent female. "The male drivers were clearly more aggressive than the females," says Rice. "They drove at higher speeds on both the straightaways and in the corners. And they made more errors."

"I'm not keen about having my wife see those results," Rasmussen adds, "but you can't deny that they made fewer errors in this test."

Does this confirm other studies indicating women are safer drivers?

Women allow margin for error

"I always have trouble with such comparisons as 'safer' and 'less safe,'" says Rice, "but our results would certainly suggest that women are involved in fewer single-vehicle accidents (not involving another car) because they are allowing themselves more margin for error."

Volunteers in the experiment were enthusiastic about what they claimed they had "learned" in their five runs over the course—although they were given no instruction. Many were interested in getting further training in handling emergency situations.

The Calspan research was, in fact, further work by General Motors aimed at improving just such a course in driver training. After researching and analyzing the principal causes of single-vehicle accidents, GM developed and introduced in 1969 an Advanced Driver Education program. The course consists of exercises that stress skid control, evasive maneuvers, off-road recovery and proper braking.

To expedite the spread of ADE, the company set up courses in many universities where high school driving instructors are trained. Over two dozen universities have built driving ranges and are teaching hundreds of high school instructors the emergency procedures. Meanwhile, service clubs and other groups seem to be the best hope of getting their communities to build the driving range needed and employ the qualified instructor. To help them, GM supplies specifications for the driving range (a minimum of 450 by 250 feet) and a 16-mm sound movie.

Did any of the drivers tested on

(Please turn to page 128)

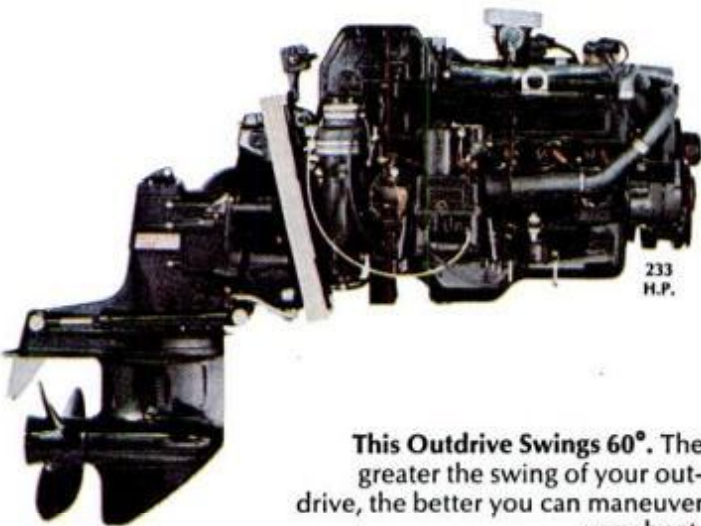


Can you spot the VW in this picture?

Hidden beneath the smooth, sleek lines of the Invader GT5 is a VW bug. This fun and easy to build sports car kit results in a low cost, exotic GT machine. Send \$2.00 for a 20 page, color catalog. Autokit, 2725 Magnolia St., Oakland, CA 94607. (415) 832-7737.

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This Outdrive Swings 60°. The greater the swing of your outdrive, the better you can maneuver your boat.

This Outdrive Tilts 60°. Tilting the outdrive is essential for launching, beaching and trailering.

The Trim* on this Stern Drive is Part of the Tilt System. It has hydraulic cylinders outside the boat.

The Steering System on this Stern Drive Uses a Tiller Arm. The wheel should be held firmly or it may spin to port or starboard during a trim angle change... especially in a hard turn.

This Outdrive is Bolted Directly to the Transom. Drive unit vibration and noise are transmitted to the transom and the hull.



This Outdrive Swings 90°. That's 50% more. You can literally turn your boat in *half* the distance required by any other stern drive.

This Outdrive Tilts 75°. OMC tilts so high you can change a prop without getting into the water, or hauling your boat out of the water.

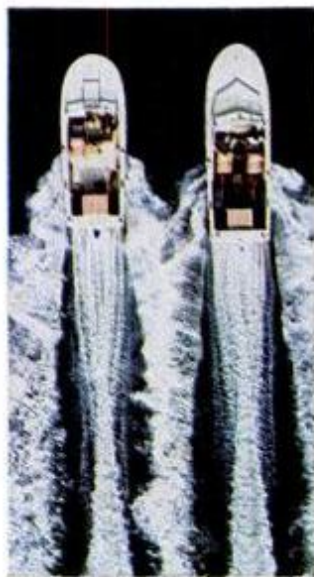
The Trim System* on this Stern Drive is Separate from the Tilt System. By being separate, it is easier to "fine tune" your ride with independently controlled precision. And it is mounted inside the boat, away from corrosion.

The Standard Steering on this Stern Drive Uses a Worm and Sector Gear. This helps keep you on course in a turn, straight ahead, at trolling speed or at any speed. And, should you lose your grip on the wheel, it stays put until you turn it.

This Outdrive is Mounted Directly to the Engine. The OMC outdrive doesn't touch the transom, minimizing vibration and noise.

Ask your OMC Stern Drive Dealer for more information on OMC exclusive features such as 90° turning, 75° Hi-Tilt™, SelecTrim™, Tru-Course™ steering, Uni-Mount™ and Power Shift.

If you would like more facts and figures (like competitive V-8 speed and fuel economy test comparisons), write direct to: Chuck Marcussen, Director of Marketing, OMC Stern Drive Division, 3145 Central Avenue, Waukegan, Illinois 60085.



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ACCIDENT YOU'D NEVER FORGET

(Continued from page 126)

the Calspan course profit from the experience?

"Most of them told us they learned a lot," says Roy Rice, "even though our figures show that most of them made more mistakes the fifth time around. Still, they couldn't avoid learning one big lesson and that was: The worst thing to do is give up—freeze. Hang in there; keep on trying to save the situation, even when it seems too late—whether you're in a skid, pulling the wheel hard over in a desperate effort to avoid an obstacle, a pedestrian or another car.

"Remember: The people in our tests didn't wring out the car hard enough in evasive maneuvers. If they had, there wouldn't have been so many 'accidents.'" ★★★

NEW PLUSH POWER

(Continued from page 97)

165-hp Six. MerCruiser V8s include 170, 188, 233, 255, 280 and 395, with 233, 255 and 350-hp inboards and a 375-hp jet package.

■ **OMC Stern Drive** in Waukegan, Ill., will have a broad selection of 13 sterndrive models with power options up to its new 235 V8 with SelecTrim or fixed mount. Others include 175, 190 and 225 V8s, four-cylinder inline 120s and 140s and a 165-hp Six. OMC jet packages include a 140 Little Squirt for boats to 18 feet, the JX-245 Honker and JX-290 Stomper with Corvette power to spare. OMC inboards and vee-drives come in 230 and 260-hp engines with five different gear ratios.

■ **Scientific Engineering's Turbo-Marine**, Salina, Kans., is packaging jet drives with Ford V4 104-cu.-in. engines, or the 302 or 351 Fords. **Volvo Penta** has the standard 280 sterndrive for all powerplants, or a smaller model for 7.5 to 23-hp sail auxiliaries. ★★★

'MACHINE-GUN' LIGHT KITS

(Continued from page 101)

sible, or it will be overexposed and wash out any objects in front. Studio photographers use black velvet; you can get the same effect by shooting outdoors at night, keeping well away from any background object that could reflect light.

Some cautions to observe when using these lights: Never look directly at the light when it's flashing; turn the light off at once if you feel dizzy or ill at ease, and never use it in the presence of an epileptic. The Archer-Kit manual spells out these cautions in detail; Graymark's just tells you not to look directly in the light. ★★★

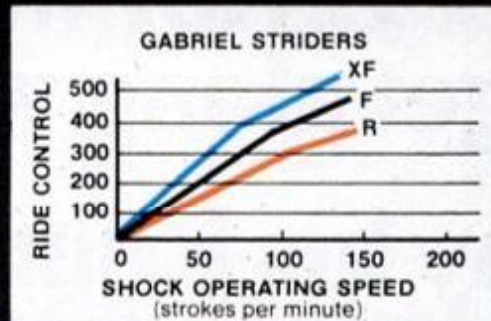
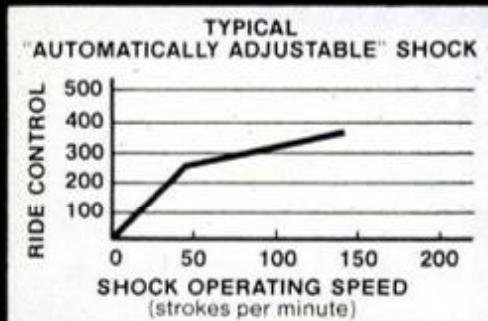
Don't let those "Automatically Adjustable" shocks take you for a ride.

You hear a lot of big talk about some shock absorbers being "automatically adjustable." But put 'em next to Gabriel Striders, and they don't sound so adjustable any more.

Striders give three completely different ranges of riding comfort and driving control—Regular, Firm and Extra Firm. When you "twist 'n click" Striders to the ride you want, you actually change the valve settings inside.

The other shocks have one, fixed valve setting. They can only give one range of control, one kind of ride. And while they talk about "automatically adjusting to changing speeds and road conditions," the fact is, that's what *all* shock absorbers do.

Get *real* adjustability for your car. Custom tune your suspension to the ride you want with Gabriel Striders. America's best selling adjustable shock. We won't take you for a ride. But we will give you three of them.

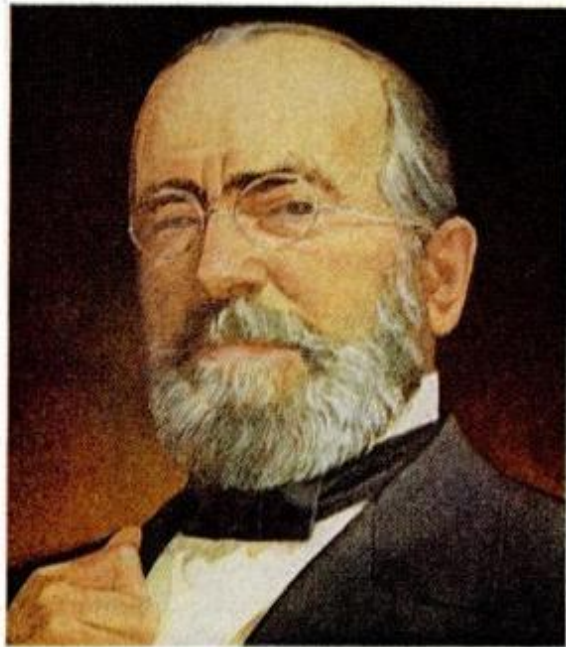


The ride control of all shocks varies according to operating speed. "Automatically adjustable" shocks, with one, fixed valve setting, have only one range of ride control. Striders have three valve settings, three completely different ranges of ride control.

Gabriel® Striders®

King of the Road





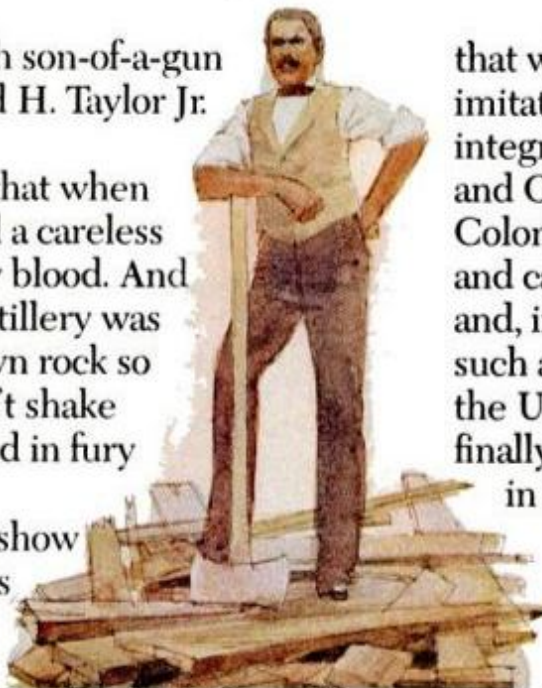
Colonel Taylor was hard to get along with.

That's why his Bourbon isn't.

What a tough son-of-a-gun Colonel Edmund H. Taylor Jr. could be!

People said that when he tongue-lashed a careless supplier, he drew blood. And that his castle distillery was built of thick-hewn rock so the walls wouldn't shake when he exploded in fury at shoddiness.

The records show that even after his Old Taylor was famous, he smashed all his wooden stills to splinters and built new stills of copper because copper — and damn the expense! — produced better Bourbon. And they show



Even after Old Taylor was famous, the Colonel tore down his wooden stills and rebuilt them of copper.

that when cheap-jack imitators threatened the integrity of Bourbon and Old Taylor, the Colonel badgered and cajoled and, in all, raised such a ruckus that the U.S. Congress finally intervened — in his favor.



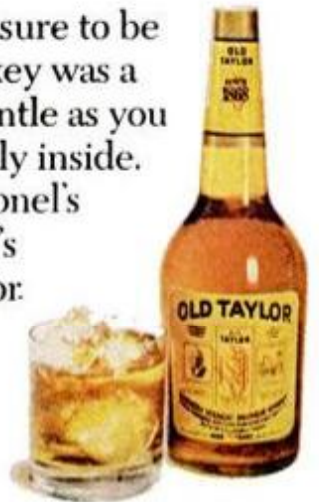
The Colonel even badgered Congressmen to protect the integrity of his Bourbon.

No, the old man wasn't always a pleasure to be with. But his whiskey was a constant delight: gentle as you sipped it, warm and friendly inside.

We still make the Colonel's Bourbon with the Colonel's painstaking care. Old Taylor: *His* Bourbon. Try it.

Old Taylor. It's easy to get along with.

Kentucky Straight Bourbon Whiskey, 86 and 80 Proofs. The Old Taylor Distillery Co., Frankfort & Louisville, Kentucky



Материал, защищенный авторским правом

Morse code. Many conversations go on at the same time.

Since the satellites are at altitudes of 900 miles, an Earth station can be up to 2450 miles away from an OSCAR and receive signals from it when it comes over the horizon. Communication is possible with another ham up to 4900 miles away when the satellite is in view of his station at the same time. The satellite is constantly moving along its orbital path so stations in different parts of the world come in and go out of view of the satellite. A very large portion of the globe is available for communication for the ham operator who waits for OSCAR to be in just the right spot. It's amazing too that this coverage is possible with rigs that are small in size, power and cost.

Simple antennas

Fancy equipment is not needed to hear OSCAR. All I use is the short-wave receiver and a wire antenna strung between two chimneys on my house. My antenna is a simple dipole constructed with 8 feet of wire attached to each end of a center insulator. The lead-in attaches to each "branch" at the center insulator.

Bob Peters, operator of amateur radio station K3EZZ in State College, Pa., listens to OSCAR with a 25-year-old shortwave radio and a single long-wire antenna running from his ham shack out to a tree.

Once in a while a radio will sound dead on 10 meters and need some extra pep. To give their radios a boost, hams add small preamplifiers between antenna and receiver. They are available from radio stores in kits for \$6 or ready-made for \$12. Adding such a preamp would give a basic OSCAR Earth-station Cadillac quality. A preamp usually is not needed to hear the stronger signals passing through OSCAR.

One feature needed in the receiver is a "BFO" (beat frequency oscillator) or other means of detecting single sideband (SSB) voice communications and the beep-beep of Morse code. OSCAR can hear and retransmit AM, FM, SSB and code. But AM and FM transmissions suck too much current from OSCAR's batteries. So SSB and code are the hams' favorite modes of operation.

Here comes OSCAR

It was exciting when I first fired up my own Earth station. The 10-meter band was silent as the satellite crossed the equator and moved north toward the United States. Suddenly, as the satellite came over my horizon some 2450 miles southwest of my sta-

tion, the band came alive with signals. There was the Morse-code telemetry beacon on 29.502 MHz. Morse code and SSB voice conversations were everywhere between 29.400-29.500 MHz. OSCAR 7 was out over the Rocky Mountains streaking north at four miles per second.

I knew my signal should be in the area of 29.480 MHz so I tuned there and transmitted a long string of "dits," the letter "E" in the dit-dah of Morse code. And there it was. My own dits coming back to me from 900 miles above the Rocky Mountains. Quickly I sent a simple "CQ de K3RXK," meaning, "Hey, you guys, how about somebody talking to me." Immediately Gordy Wightman, operator of ham station VE5XU who had been listening by coincidence on my frequency, came right back to me, "K3RXK de VE5XU." I got goosebumps from the excitement.

Here I was. A licensed ham for 21 years. Eighteen years after Sputnik. I was freely using an orbiting satellite floating across the sky out west more than 1000 miles from my central Pennsylvania home, working another fellow all the way up in Regina, Sask.!

Gordy and I talked for about five minutes, exchanging signal reports while the satellite raced 1200 miles farther north. OSCAR 7 was in view of my Earth station only 20 minutes on that pass. Listening for the satellite and for my own signals, and talking to Gordy, I used up the time.

Next evening, OSCAR 7 came over again and Ed Bizub, WA2CBB of Clark, N.J., came back to my call. And yet another thrill was coming. My first "DX" distance contact came on the third night. OSCAR 7 was over the North Atlantic when G3IOR in Norfolk, England, came back to my CQ. Again the rush of excitement was overwhelming.

My first use of OSCAR 6 came shortly after I talked with G3IOR. OSCARs 6 and 7 are in similar orbits, one trailing the other. After a satellite crosses the equator, it passes over the United States from south to north.

The Earth is moving under the satellite so OSCAR seems to be moving to the west. If the satellite comes up over the Southeastern United States one hour, it will come northward over the Rocky Mountains two hours later. And two hours after that it will come north over the Pacific Coast. And so on, around the Earth in a corkscrew pattern, daily covering the United States and the world.

Because of the spinning Earth, a satellite half the time ends up looping across the equator south-to-north

(Please turn to page 132)

How to get rich

**START YOUR OWN BUSINESS
RIGHT FROM YOUR HOME—
AND MAKE A FORTUNE
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Mail Order Beginners Get Cash by Mail!

Have you ever thought of operating a little mail order business of your own? Something you could start on a shoestring right from home in your spare time. It's a fabulous business!

Bob Carter of Newark, N.J. ran his first small mail order ad in House Beautiful magazine—offering an auto clothes rack. Business Week reported that his ad brought in \$5,000 in orders. By the end of his first year in Mail Order, he had grossed over \$100,000!

Another beginner—a lawyer from the mid-west, sold a mail order item to fishermen. Specialty Salesman magazine reveals, "he made \$70,000 the first three months!"

There is no other business where you can make a fortune so fast. Come up with a 'hot' new item . . . and WHAM!

It strikes like a bolt of lightning!

Millions of people read your ad and suddenly, you are swamped with cash orders from all over the country . . . MORE MONEY in 60 days than you could earn in a lifetime!

Like the Vermont dealer who ran one ad in Sports Afield magazine. His ad pulled 22,000 orders—over A HALF MILLION DOLLARS IN CASH!

Yes, Mail Order is the fastest-growing, most profitable business in America! And now with the population explosion . . . the huge teenage market . . . and more people moving to the suburbs—we are on the verge of the BIGGEST BOOM in Mail Order history!

Free

If you are sincerely interested in starting a lucrative business of your own ACT NOW! We can help you get rich in Mail Order just as we've helped others. Mail the coupon or send a postcard. We'll send you a free book, catalog, ads and complete facts about our offer. No salesman will call. No obligation. You don't need previous experience but you must be over 21. Write to:

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SATELLITES MAKE HAM LISTENING MORE FUN (Continued from page 131)

on the far side of the globe. When this happens, OSCAR comes up over top of the North Pole and down over the United States from north to south. A new orbit starts whenever and wherever OSCAR passes across the equator south-to-north.

Talk to each other

Since OSCARs 6 and 7 are in slightly different orbits, they are not overhead at the same time. The distance apart varies. Twice a year they are so close hams can talk to each other through both at the same time. A signal goes up to OSCAR 7 and is retransmitted to OSCAR 6 which retransmits the signal to Earth.

A half-hour after I chatted with G3IOR in England, OSCAR 6 came over my horizon. My first contact through that satellite was with Dick Smith, W1FTX of Winsted, Conn.

Contacts through both satellites in the weeks following were with amateurs in California, Florida, Illinois, Kansas, Maine, Maryland, Massachusetts, Michigan, New Hampshire, New York, Ohio, Pennsylvania, Tennessee, Texas, Virginia, Wisconsin and Washington. Hams are on in all states and everybody has an equal chance to hear the satellite.

Like OSCAR 7 signals from OSCAR 6 come down on the 10-meter band at frequencies between 29.450-29.550 MHz. Its beacon is at 29.450 MHz. Telemetry beacons from the satellites are strings of numbers in Morse code that can be deciphered easily to find out temperatures, voltages and current drain in the satellites. OSCAR has an alarm clock on board to remind when internal house-keeping chores are to be done. It's easy to find out what time OSCAR thinks it is from the telemetry.

Emergency communications

The satellites are being tested in several serious experiments. Medical electrocardiograms (EKGs) have been sent via OSCAR 7 from George Dillon, W6ELT at Santa Ana, Calif., to Len Aberbach, K3ATA, at the National Institutes of Health in Washington, D.C.

Miami hams maintain a hurricane watch and weather bulletins are transmitted via satellites. Techniques are being worked out to use the satellites to find downed aircraft. Portable Earth stations in suitcases are being built to provide emergency communications at earthquake and other natural-disaster sites on short notice anywhere on the globe.

The American Radio Relay League (ARRL), national organization of radio amateurs, makes available free

to interested teachers a curriculum book for classroom use of OSCAR in teaching math, physics, astronomy, communications, electronics and space science. The book explains in elementary language how to use a simple shortwave receiver to teach and learn what keeps a satellite up, what governs its speed and how to use OSCAR for many math and science classroom activities. Hundreds of school students already have participated in the program.

Students using the educational package learn how to determine the satellite's period, how long it takes to go once around the globe; its increment, how many degrees farther west it will be when it crosses the equator next time; and its inclination, the angle at which the satellite path crosses the equator.

OSCAR 6 has a period of 114.99449 minutes, an increment of 28.7486° per orbit, and an inclination of 101.6015°. OSCAR 7 has a period of 114.94478 minutes, an increment of 28.7362° per orbit, and an inclination of 101.7010°.

For more information about the educational program write the ARRL at 225 Main St., Newington, Conn. 06111. For more about when, where and how to listen to OSCAR, write the Radio Amateur Satellite Corp. (AMSAT), Box 27, Washington, D.C. 20044. AMSAT is an international organization of hams and listeners interested in amateur satellite work. It sponsors the satellites and coordinates activities.

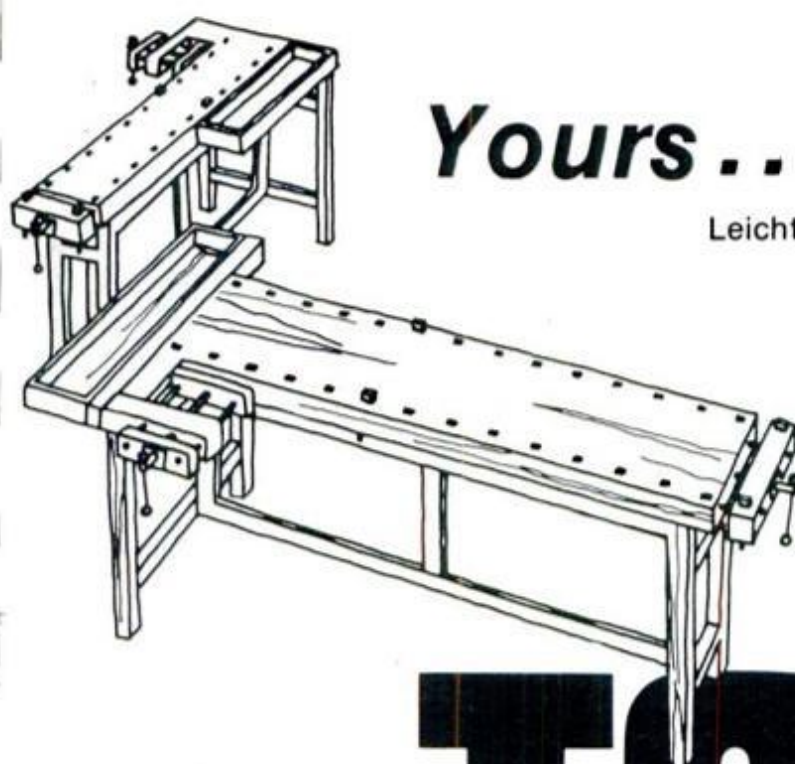
OSCAR Earth stations need not be in houses. Fred Merry, W2GN of East Greenbush, N.Y., makes contacts through OSCAR while driving his car. Dick Long, WA4JID of Plantation, Fla., talked with hams from on board his sailboat while on an ocean trip down through the Florida Keys.

Sun-revitalized batteries

OSCARs are powered by rechargeable nickel-cadmium (nicad) batteries, revitalized by the sun through solar cells on the satellite skins. OSCAR 7 has many more cells so its power supply is stronger. OSCAR 6, with fewer solar cells, is turned off periodically to conserve energy.

OSCAR 6 has only one rebroadcaster on board. It is only capable of hearing signals in the two-meter ham band and retransmitting them on the 10-meter amateur band. OSCAR 7, on the other hand, has two repeaters aboard. One day it hears the two-meter band and retransmits on 10 meters. The next day it hears signals

(Please turn to page 134)



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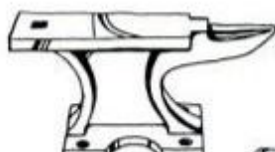
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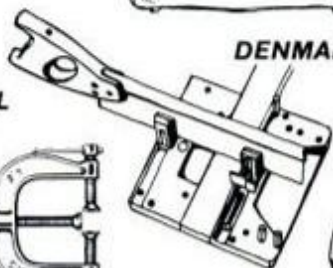


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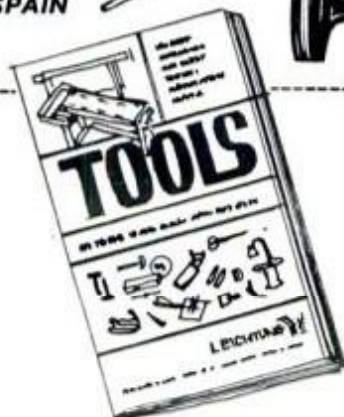
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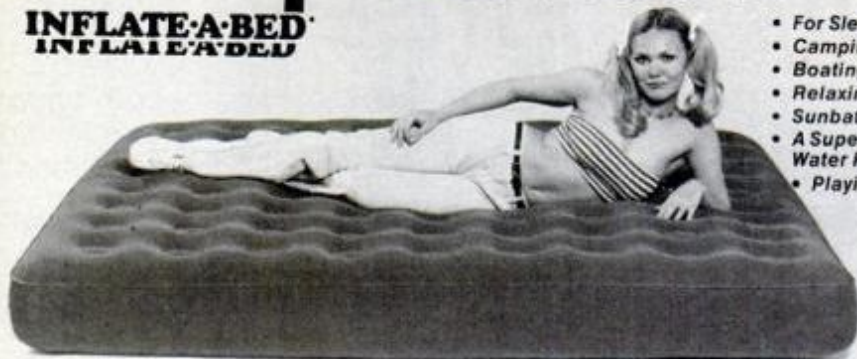
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HAM LISTENING

(Continued from page 132)

at 432 MHz in the 70-centimeter band, and retransmits them to Earth in the two-meter band. Shortwave receivers hear only the 10-meter band, not two meters, so OSCAR 7 can be heard with a simple receiver only every other day. OSCAR 7 signals on alternate days coming down on two meters can be heard by hooking a converter between antenna and receiver. Converters start at \$40.

When to listen

A sure-fire way to hear OSCAR is to turn on a shortwave receiver any night except Tuesday. OSCARs pass overhead at least twice during an evening. OSCAR 6 will be turned on for hams to communicate through on Sunday, Wednesday and Friday night local time in the United States. OSCAR 7 will transmit on 10 meters on odd-numbered days of the year.

A pass over eastern North America will take place between 7:00 and 9:00 p.m. Eastern Standard Time. A pass over western North America will take place between 9:00 and 11:00 p.m. EST (6:00 to 8:00 p.m. PST).

Select the band on the receiver for coverage of the 10-meter ham band. Set the dial at about 29.5 MHz. Turn on the receiver's "BFO" or turn a "mode" switch to "CW" or "code" or "SSB" position. When an OSCAR satellite passes overhead or near your location you'll be able to hear at least the stronger signals coming through.

OSCAR 6 was designed for one year of life. However, last fall hams around the world celebrated its third birthday. OSCAR 7 also will be in orbit for years. And AMSAT is building a new generation of OSCARs to extend communications time to hours. They will have kick motors to push the satellites into elliptical orbits taking OSCAR as far out as 20,000 miles over the Northern Hemisphere. These satellites will be in view of Northern Hemisphere Earth stations up to 12 hours and out of sight behind the Earth only about one hour. The ability of hams to help out in emergencies and natural disasters, transmit medical data or locate downed aircraft will be even greater.

So dust off your shortwave receiver. Hang out a wire antenna. Cock an ear toward OSCAR. You might hear WA4JID on the ocean, W2GN in his car, EKGs from California, hurricane bulletins from Florida, G3IOR completing an extraordinary 6000-mile conversation with W6CG, or even my station, K3RXX, as I talk with new states and countries. There's plenty of excitement when you ride along with the ham satellites. ★★

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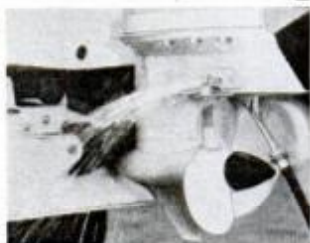


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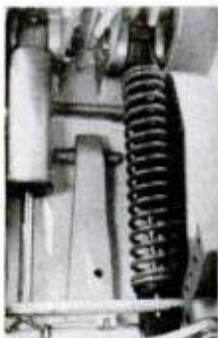
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boats '76



Sport Convertible 25-footer, the new AMF Slickcraft 255 has inboard power for family cruising and fishing, with four berths and a flush-deck self-bailing cockpit.



Pioneer from Kayot is called the first do-it-yourself cabin deckboat. Assembly is reported to take two workers four hours. Built on 28-foot pontoons, the 8x24 deck supports a prefab 8x12-foot cabin built with standard tools for budget boating.



Flotation pontoons turn a tippy canoe, like this 13-foot Michi-Craft aluminum model, into stable base for fishing. Michi pontoons attach to other canoes as well.

THE CLASSY PERFORMERS

(Continued from page 93)

storage compartments. Large models have broad bow and stern casting platforms, and the biggest open offshore machines are seaworthy enough to challenge the fancy sport-fishing models out where the game-fish swim.

Almost any boat bigger than the smallest inflatables can be rigged now with a convertible top to keep off the sun. Add side curtains and an open cockpit can be enclosed into a cabin for your mini-cruiser. Though few boatmen find enough time for extended cruising, cabins and overnight accommodations show new popularity and are featured in many models being introduced for 1976. Placement of the cockpit amidships in larger power and sail craft allows fore and aft cabins with privacy for two couples, another arrangement that is appearing on more and more models.

High performance leaders include the hot shallow-draft ski boats of the West Coast. And, again, the most outstanding machines of all come from Don Aronow of North Miami Beach, Fla., builder of the amazing offshore racing Cigarettes. ★★★



Inflatables are often light enough now for backpacking, big enough for long inland passages. Ten-foot, 21-pound Pyrawa-5, from Leisure Imports, is one of 13 models.



For high-performance sailing, MiniSprint Mark II, imported by KMS Marine Ltd., has open self-bailing transom, sliding seat.



Cruiser that can sleep six in 28 feet, new Mega sedan from Uniflite has dual flying bridge and cabin controls, twin inboard power through V-drives, full galley with electric refrigeration, hull of fire-retardant fiberglass, is priced around \$34,000.



Family comfort when cruising is design goal of SS245 Sedan by AMF Slickcraft. In forward cuddy cabin are twin V-berths, head, hanging locker, while hardtop-covered forward cockpit has helm, galley, dining area. Price of 24-footer is \$16,400.



Large cockpit and small cuddy cabin combine in new 26-foot Sport Convertible from Bertram Yacht. Range is 230 miles with speeds to 40 mph using twin stern-drives. Galley/dinette, top and curtains are among options for 84-sq.-ft. cockpit space.



Trailer cruiser trend has a new addition from MFG with the Morrison 25. Though it's 25 feet long, beam has been kept to 8 feet for trailering. Single or twin stern-drives are supplied from 100-gal. fuel system. Camper curtains are optional.

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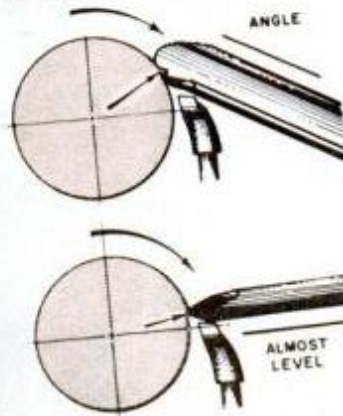
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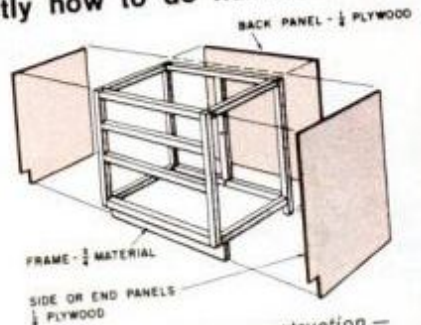
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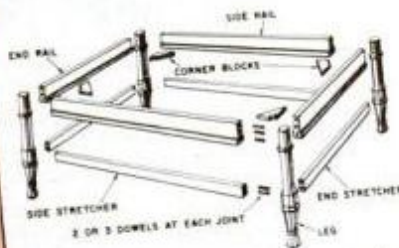
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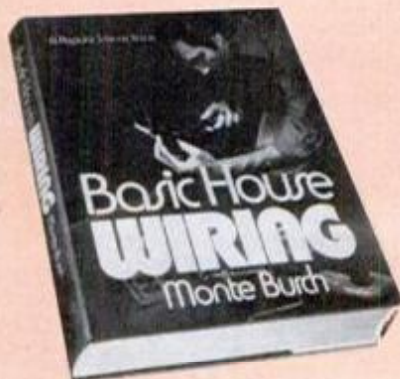
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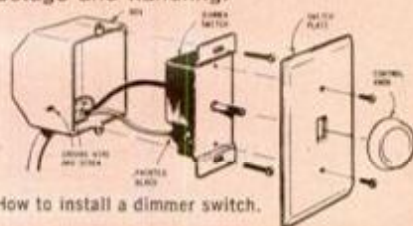
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ONE-OF-A-KIND HOME BAR

(Continued from page 116)

special laminate cutter or by plane and file. In positioning laminate, butt the lower edge against the skirt and place the laminate just where you want it; once the cement-coated surfaces touch, you can't shift it. Contact cement bonds instantly. The edges of partition D and shelf C are painted along with the rest of the interior.

Next comes the two-piece hinged top: The front half has a cove around three edges; the rear half has one on outside edges only. A $\frac{3}{8}$ x $\frac{7}{16}$ -in. blind rabbet is cut along the back edge for the cabinet back. Band the edges with laminate first. Keep the strips even with the cove and trim them flush at the bottom. Cover top and bottom surfaces with laminate, but do not face the top of the rear half until it has been installed with finishing nails driven through the top into top edges of the end members. The nails will go through the banding previously cemented to the edges.

You now can cover the top surface. Try to buy a $1\frac{1}{2}$ -in.-wide piano hinge to join the two halves; the hinge leaves will cover the full thickness of

the plywood. If you have to settle for a $\frac{3}{4}$ -in. hinge, you'll need to stain the exposed wood.

Doors are like picture frames

Doors and the drop counter are $\frac{3}{8}$ -in. plywood, covered both sides with carpathian burl laminate and framed like pictures. The $1\frac{1}{8}$ -in.-thick pine molding is stocked at lumberyards as solid crown. You have to rabbet it and miter the corners. Cut the rabbet $\frac{7}{16}$ in. deep to take the added $\frac{1}{16}$ -in. laminate thickness. Make your frames first, insert the covered panels in the rabbets and then apply laminate to the entire backs.

The drop counter is built up quite similarly; while the frames start as two separate assemblies with inserts, they become one when glued and butted end to end. Install a drop pull in the center of each frame, with bolt heads set flush. Then cover the backs of the two frames with one piece of black slate laminate so the drop-pull screws are concealed below the surface. The counter is hinged to shelf A with a brass piano hinge, and an 18-in.-long brass support chain is attached at each end with screws. Magnetic door catches keep the counter and doors closed. The

doors are hinged with 3-in. brass butts and fitted with Amerock's T-871 drop pulls in antique brass. The drawer rides smoothly on two $\frac{3}{4}$ -in.-wide strips of scrap laminate cemented to the bottom of the compartment along the sides.

The refrigerator compartment accommodates an RV unit which requires a 2-in. air space in back and 4 in. above. The cabinet back is permanently attached after boring holes for water and drain lines and the refrigerator cord.

We used an antiquing kit called La Patique to add a chateau-walnut finish to the pine skirt and door molding. It's made by Salmon Products, Div. of Rub 'N Buff, American Art Clay Co., Indianapolis, Ind. 46268, and is a simple two-step process.

Here's how it's applied: Prime the bare wood with an enamel undercoater. When dry, brush on base latex (first coat in kit) and let this dry about 3 hours. Following the kit's instructions, wipe on sparingly a finish glaze with a lint-free cloth. For a realistic wood-grain effect, stroke the wet glaze lightly with cheesecloth. When glaze is thoroughly dry, you can apply clear urethane for a more durable finish. ★★

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ALL ABOUT BATTERIES (Continued from page 82)

retailers. For example, J.C. Penney's lifetime battery, which also happens to be maintenance-free, sells for \$45 outright (no exchange). This is less than the price of "48s" from many other stores.

■ **And you get a replacement battery** if the lifetime battery fails while you still own the car.

Before leaving the topic of warranties, take a look at a few unusual clauses. Mobil's batteries guarantee free replacement for the first eight to 12 months, depending on total warranty. After that, the warranty suddenly drops to 50 percent and 25 percent credit in specific 9 to 60-month increments. K-Mart, on the other hand, gives 12 to 18-month free exchanges before prorating its 36 and 48-month batteries. And Firestone adds one full year to the warranties of its 24, 36, and 48-month batteries on the West Coast.

Be sure to read all warranties, because some do have rather unusual clauses.

Maintenance-free batteries

One of the newer wrinkles in car batteries are those that never need attention. So-called maintenance-free

(MF) batteries have no filler caps and never need water or servicing.

What, you ask, is the catch? Do they work and, if so, how do they work?

The traditional car battery uses plate grids made of an alloy of lead and antimony. The antimony stiffens the soft lead. Antimony is fairly expensive, and about 30 percent of it comes from China, even today. Another 30 percent comes from South Africa and Bolivia.

MF batteries substitute calcium for the antimony, sometimes with a trace of tin. Lead-calcium grids cost less than lead-antimony, but lead-calcium is also harder to cast and less consistent in structure.

At least one of the big battery manufacturers—Delco—has developed a system of rolling and stamping lead-calcium grids instead of casting them. Slots are cut into the lead-calcium sheets, and they're then stretched so they resemble the perforated steps on metal fire escapes. Gould, Globe-Union, Prestolite, Electric Storage Battery, and General Battery Corp. also make MF batteries, but these have grids cast by conventional methods instead of roll-

ing, stamping and extending the grid metal as Delco does it.

Unlike batteries with lead-antimony grids, those with lead-calcium normally don't "gas"—the discharge of hydrogen and oxygen. When you charge a standard lead-antimony battery, and especially when you *overcharge* it, each cell gives off hydrogen and oxygen which explodes when sparked or exposed to a flame. Escaping gas in a conventional battery also takes some of the electrolyte with it, which is why you have to refill each cell periodically. A constantly thirsty battery means its being overcharged—and that's a dangerous and harmful (to the battery) situation.

MF batteries, though, don't give off gas unless they're grossly overcharged. Thus they don't use up water and never need refilling. Some don't even use an aqueous electrolyte. Rather, a few MF batteries use a gel as their electrolyte—a substance with the consistency of aspic or cold consommé. There are no filler caps, but MF batteries do have tiny vent holes in each end to help equalize atmospheric and internal pressures.

If MF batteries are overcharged, though—and it can happen through a defective voltage regulator—gassing *can* occur, and you have a potentially dangerous situation. It's very important with an MF battery to have your charging system checked periodically. If you notice high charging on your dashboard ammeter (assuming you have one), have the system looked at immediately.

Detroit's automakers like MF batteries for one reason in particular. They can place them anywhere in a new car. Smog restrictions make underhood temperatures so high nowadays that heat becomes one of the battery's major enemies. But with no need to service an MF battery and no gassing, carmakers can hide it anywhere—inside a console, under a seat and so forth.

General Motors made MF batteries standard equipment in some Pontiacs in 1970, and today they're used in all new Cadillacs, Chevettes and Vegas. Many aftermarket retailers (chain stores, filling stations, and auto dealers) sell MF batteries as replacements for original equipment. These are usually no more expensive than comparable conventional batteries, and hold a charge for long periods. Most battery engineers see MF units as the wave of the future.

Dry-charged batteries

Today, approximately half of all replacement car batteries are sold *dry-charged*. Dry-charged means you have to add electrolyte before you

Six ways to make your battery live longer

Lengthen the life of your car battery by following these simple tips:

1. Have your car's charging system checked periodically. Too-high and too-low charging rates are primary causes of battery failure. A mechanic should test your alternator and voltage regulator at every tune-up, also when you buy that replacement battery (very important). Most shops and retailers conduct such tests free.

2. Be sure your battery is securely bolted down. Vibration is a major cause of plates rubbing through separators. Once two plates touch, it's all over for the battery.

3. Check your battery's water level regularly. Always use distilled rather than tap water. Tap water in many areas contains harmful minerals. Never use softened water.

4. Keep your battery clean and dry. Wash dirt from the top of the battery. Use baking soda to get rid of whitish deposits on connections and hold-downs. Slather axle grease over connections to make an airtight seal, then cover the grease with plastic wrap. Corrosion-inhibiting felt pads under terminals also help.

5. Don't let the battery run down accidentally. Big drops in charge (such as headlights left on overnight) are hard on a battery, can cause plates to buckle and rub through separators.

6. Never add acid or any additive (except distilled water) to a battery. So-called "rejuvenators" and "life extenders" can be harmful to cells and usually void a battery's warranty.

can use the battery. The electrolyte (25 percent sulfuric acid and 75 percent pure water) usually comes in a separate plastic container. Either you or the mechanic pours this electrolyte into the battery before you install it in your car.

Except for a few which are vacuum sealed or come with premoistened plates, dry-charged batteries should be slow-charged before use. Most, though, aren't. The mechanic puts in the electrolyte, installs the battery, and if there's enough energy to start



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your car, that's it. If your engine doesn't start immediately, he hooks up a fast charger and gives the battery a quick boost. This isn't too healthy for the new battery.

The proper way to activate a conventional dry-charged battery is this. Fill it with electrolyte. Let it stand for 12 to 24 hours. Charge it on a slow charger. Then install and use it. The battery will last a lot longer that way.

Major battery makers

Seven major manufacturers produce 90 percent of the car batteries on today's market. These Big Seven, as they're called, are: Delco, Gould, Electric Storage Battery, Globe-Union, Prestolite, General Battery Corp. and Chloride, Inc.

These big companies supply private-label brands to many different accounts. Atlas brand batteries as sold by Exxon, for example, are made by both Prestolite and General. Sears gets most of its batteries from Globe-Union. J.C. Penney buys from Gould.

Delco is owned by General Motors and makes original-equipment (o.e.) batteries for all GM's new cars and trucks. Delco sells aftermarket batteries only under its own name, but it does this through new-car dealers,

some auto-parts stores and some filling stations.

Gould supplies private-label-brand batteries not only to Penney but also to Montgomery-Ward, Gemco, K-Mart, Union 76 and Motorcraft. Ford buys some 46 percent of its Motorcraft o.e. batteries from Gould.

Globe-Union, in addition to its Sears account, also makes batteries for Ford—plus AMC, Caterpillar, Gulf Oil, Sunoco and NAPA.

General Battery Corp. makes private labels for Pep Boys, Atlas, Grand Auto, Checker Stores, Schucks and others. Electric Storage Battery supplies Chrysler Corp., and markets its own units under the Exide and Willard names. Prestolite and Chloride were reluctant to give names of their private-label customers, so I can't include them here.

The important thing to remember, though, when the time comes to buy a new battery for your car: Ask about cranking amps, first. If the salesman doesn't have the figures handy, have him look them up in his sales and data literature. Then once you've established the battery that'll match your cold-cranking and reserve needs, the rest—warranty and price—will pretty much take care of themselves. ★★

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BACK-YARD FISH FARMING

(Continued from page 83)

series of three tanks or pools, each stepped slightly lower than the preceding one and covered with a sloping glass roof to let in sunlight. The upper pool is a purification filter to detoxify waste materials from the fish in the bottom pool. Here water passes through a bed of clam and oyster shells where bacteria change fish excrement into useful compounds like nitrates and nitrites, which serve as nutrients for algae. After further filtering through rich soil and oxygenating plants, the water flows down by gravity into the second or middle pool. Here algae and tiny freshwater animals like daphnia are cultured. The daphnia feed on the algae and, in turn, become food for the fish.

Periodically, this food-rich water is flushed down into the bottom pool where the fish are bred. Some species grow to almost a pound within about 12 weeks. As the fish mature, they're removed from the pool by nets, cleaned, then frozen for future use. As the water in the lower pool gets dirty, it is fed by a windmill-powered pump back up to the purification pool, and the whole process starts over again in a continuous cycle. The water also passes through a solar collector and is heated. The structure surrounding the bottom pool doubles as a greenhouse for growing plants and vegetables—no opportunity is overlooked in this clever high-yield food system.

Build-it-yourself Ark

"Anybody can build an Ark," says marine biologist John Todd, one of the institute's founders. For people living in warm climates, Todd suggests a simplified two-pool system that eliminates the need for a water heater and windmill pump. The tanks can be small plastic swimming pools of the above-ground type. Algae and daphnia are grown in the upper pool, feeding on a few ounces of roasted soybeans added every few days. Fish live in the lower pool. Periodically, dirty water is manually drained from the lower pool and fresh water added to the upper pool, thus also eliminating the need for a purification filter.

Extensive information on fish-culture systems and how they work can be found in the 132-page *Journal of the New Alchemists* for 1974, available for \$6 postpaid from the New Alchemy Institute, Box 432, Woods Hole, Mass. 02543. Growing your own fish—like home vegetable gardening—can not only save money in these days of high food prices; it can also be a lot of fun. ★★★

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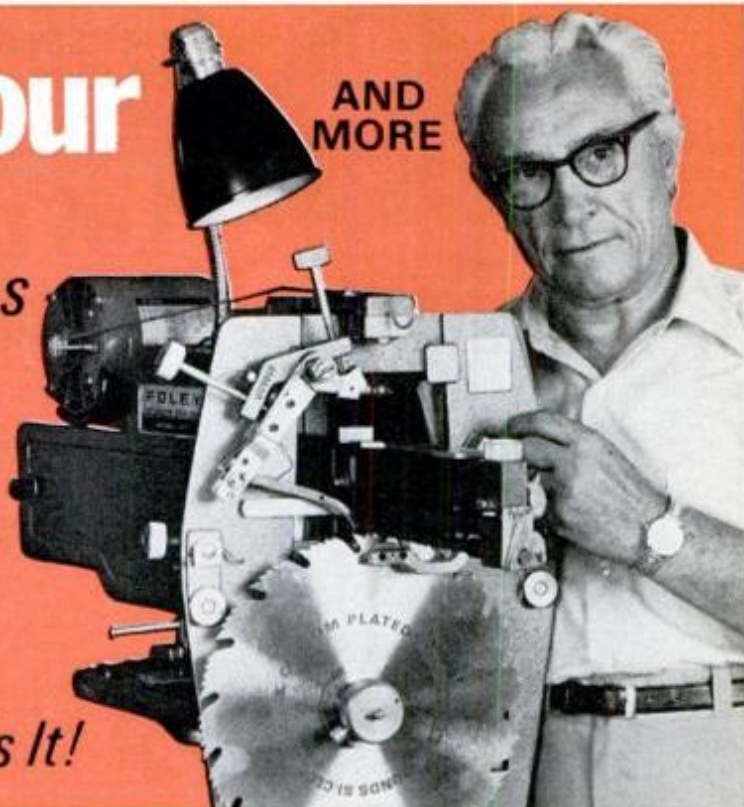
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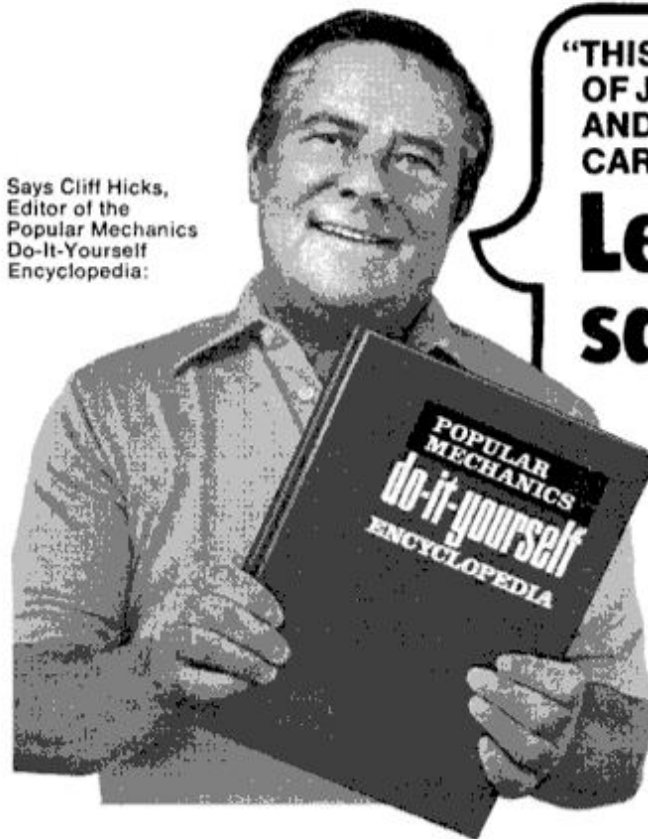
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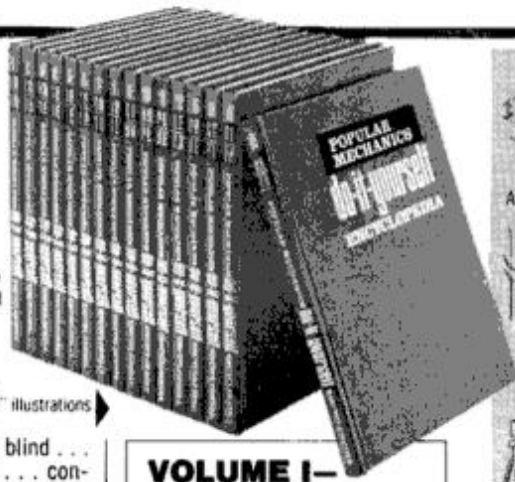
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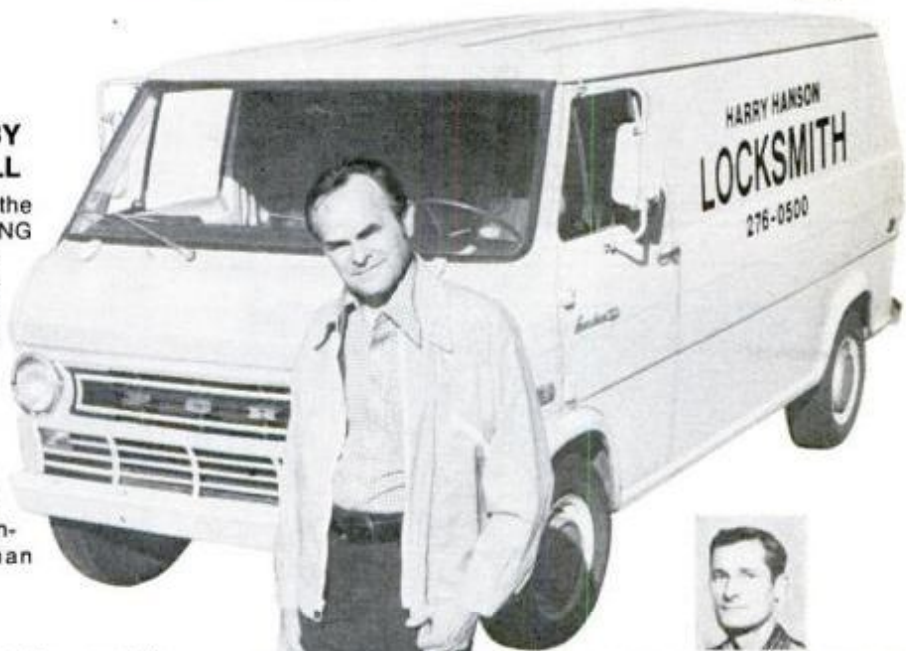
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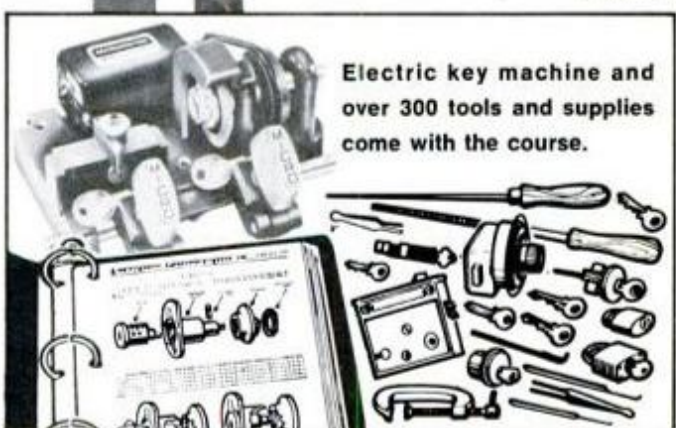
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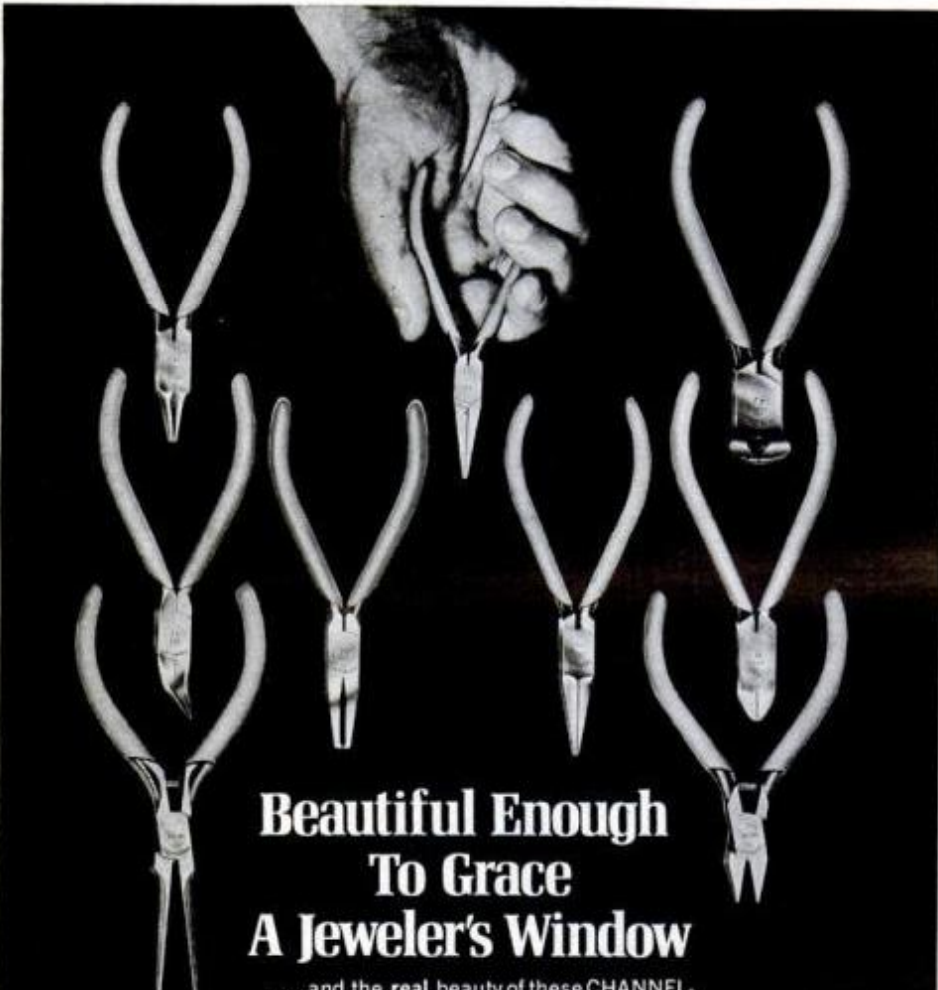
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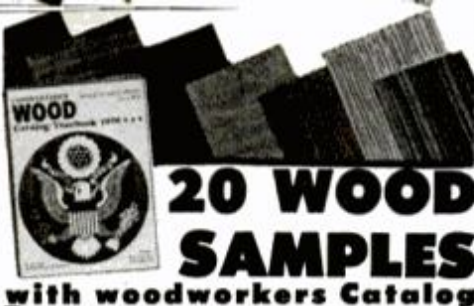
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STRANGE WARS BY OUR GULLIVER FORCE (Continued from page 86)

waves generated by the worst imaginable storm that could occur in 1000 years.

"Routinely we would set up tests to determine what would happen during the worst storm in 50 or 100 years," says project engineer C.E. Chatham. "But because of the importance of this project it was decided to test for the 1000-year storm."

That would be a double hurricane passing right over the site. A double hurricane occurs when one storm passes and then doubles back to the site while a second hurricane has already established residency.

And what would be the height of the waves? "We figure about 48 feet," says Chatham. "The project is planned in water that's 40 feet deep. This depth can only sustain waves up to 31 feet high. But during this double hurricane, we estimate that the storm might pump an additional 23 feet of water into the area, thus supporting a 48-foot wave."

He'll build the model, set up scale waves and crash them against different breakwater designs built with different breakwater materials such as concrete or rocks. He'll have an answer soon for the people who want to know: "Will it hold during the worst possible storm?" And he'll have an answer too for the cost people who want to know how wide, how high and how much.

He's done this before—building models and testing designs to lessen the effects of wave action on sandy beaches, at harbor entrances and on the harbors themselves.

Who pays?

"When you spend \$200,000 to work up models that might show you a way to save \$2 million in real project construction costs—that's worth it," Chatham says, referring to a simple design change in a proposed Saudi Arabian harbor that saved millions in building costs.

That's what the Corps' experimental station is all about.

"We are self-supporting," says Col. Harry Hilt, WES's commander. "We bill the various agencies that ask us to study projects and give them results and environmental impact statements." WES does this work for the Corps and the rest of the military, and for state, local and other government agencies, as well as private and foreign groups. It's all done on a fee basis.

Models are built and tested with the results determined by expert engineers. Some people believe that these are unfeeling engineers—engi-

neers who have only an interest in numbers and structural stresses and strains with little sensitivity to the stresses on people and the impact of their work on the environment.

Understanding is growing

"In the past, we battled all the time," says Frank Kelly, a Corps public information officer who works directly with conservation groups.

"But now there is some understanding. We are expert engineers and we know our field. But we need to work with the conservationists who are expert in their field," Kelly says.

And getting more sensitive to public pressure is certainly one of the overriding concerns of the engineers at WES. During a recent visit to the Vicksburg facility, I noticed two things—one of them was a great enthusiasm by each engineer for his project; the other was a concern for the project's impact on the environment.

To get its feet wet in the conservation field, the Corps at WES has opened a new department—Environmental Effects Laboratories. It is here that two fascinating projects are underway. The first is modeling the complete ecosystem of DeGray Lake, Ark. A new building is used to house massive tanks that represent the DeGray Reservoir. A greenhouse is attached too in which flora grows in soil taken from the reservoir's watershed.

What they want to do is drop rain on this garden and then see how the runoff affects water quality in the lake. "We are really pushing the state of the art on this one," says Dr. John Keeley who hopes that by changing the composition of watershed runoff he can influence the lake. He believes the working model will show him how.

But raining on a watershed model is not the main project at EEL. The second project is bigger. Actually it's the project with the largest funding—\$30 million. In the real world, the Corps of Engineers handles some of the largest and continuous dredging operations in the world. It is constantly clearing channels in the navigable waters of the United States. With just-granted Congressional power, the Corps will be extending its responsibilities to protecting water quality in these navigable waters plus looking after water quality in adjacent wetland, in lakes larger than five acres and in streams up to the headwaters.

This means the Corps is charged

(Please turn to page 156)

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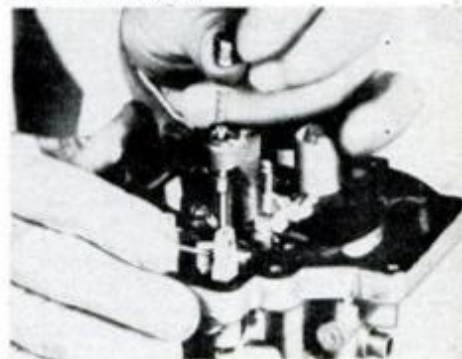
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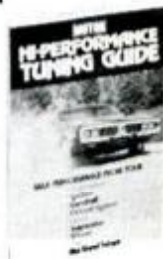
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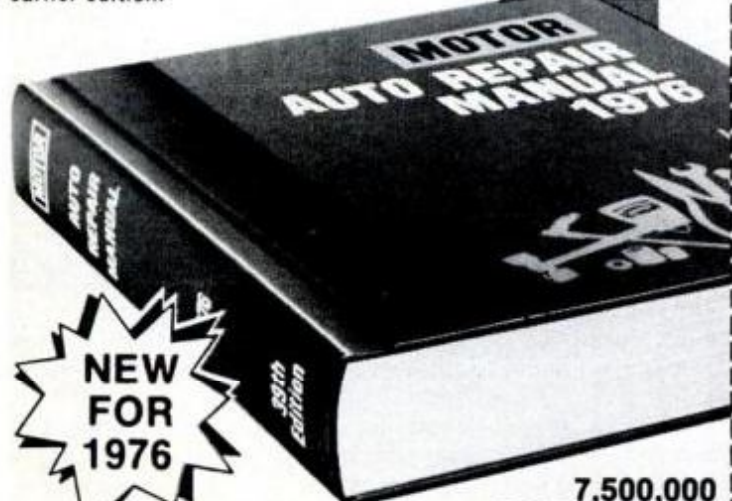
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STRANGE WARS BY OUR GULLIVER FORCE (Continued from page 154)

with protecting the water from discharge of harmful dredge, fill or other materials. Now, not only must the Corps watch over the discharge of others through a permit-issuing system, but it must adhere to the old phrase, "Physician heal thyself"—it must mind what it does with its own tailings.

So the Corps' labs at WES have mounted this \$30 million effort to find out what can be done with materials from dredging operations.

Heaping up sludge and making barren, ugly islands along dredge channels used to be the common practice.

"Now we have classified dredge materials as a natural resource," says Keeley. "We are studying what can be done with this material to develop new marsh lands."

So the Corps is now in the marsh-building business. But before you can build one, you have to know what will grow in it to support wildlife. So there's another experiment at WES that's taking place in another greenhouse. A dozen timers are lined up in a row controlling simulated tidal effects in a dozen giant growing bins. Here different marsh grasses are tested in different quality dredge materials—sand or clay, polluted or nonpolluted. The grasses are also tested for heavy-metal content to be sure a good growing grass in one marsh won't be a toxic grass for local ducks that feed in the new marsh.

Attacking the dredge material problem is the job of EEL, but attacking weeds that are choking our southern lakes is the job of Lewis Decell who heads the Aquatic Plant research project.

"You know weeds are just plants that grow where you don't want them," says Decell. "Now our job is to get weeds viewed as just plants again." But one of the biggest weed problems is occurring in the lakes and rivers of the nation's southeast quadrant. Water hyacinths and hydrilla plague boatmen, fishermen and naturalists in these regions. Waterways are being strangled to death by these weeds, which are not native to this land.

The water hyacinth and hydrilla are glaring examples of foreign vegetations that have gotten loose in an extremely hospitable environment with no local enemies.

The hyacinth was brought from South America by a man who wanted to beautify his pond at home. That was years ago. Now the South is up to its lakes in hyacinths. The same is true of hydrilla. This plant was im-

ported for beautification of aquariums. Someone dumped his aquarium into a local lake, and bang.

So how do you attack this enemy? One of the first weapons was a biggy—laser beams.

"We tried lasers," said Decell, "but it proved too expensive to generate enough electricity to get enough laser power to do the job." So with that idea abandoned, WES lab engineers thought of other approaches such as mechanical harvesters to cut down the weeds. However, this led to high decay rates in the water which sucked up all the oxygen—results, fish kills. So then they tried finding a commercial use for the weeds. But it cost too much to dry the harvest. Then they thought of chemicals to kill them, but that was immediately rejected. And finally they thought to introduce a vegetarian fish—a fish that eats hydrilla and hyacinths for breakfast, lunch and dinner.

Such a fish was found. Called the white amur that is a native of China. So now the WES lab has thousands of white amur, which have been raised to plant in a test lake. Ah, you say, but what if they don't work or what if they capture the lake with their number, or what if there is something unknown now about letting the amur loose in this country? Decell says he'll test one answer. Make the fish you let loose of one sex. Only put out monosex fish so if the program busts you just wait for the fish to die. So that's what's going to happen to Lake Conway in Florida this year.

The white amur apparently has another asset besides its appetite for hydrilla and other water plants. The fish will grow to 80 pounds in some cases, making it a good candidate for sportfishing. Some experimenters have filleted, broiled and eaten the fish. This unscientific experiment was extremely successful and tasty, according to reports.

Decell is also testing the use of a local beetle that attacks the hyacinth, too.

Concrete mysteries

Both the beetles and the fish can be seen and counted. But in another section of WES seeing and counting things is impossible without special glasses. And in the concrete lab the special glasses are in reality an amazing electronic microscope that can practically look into the future.

Bryant Mather is the master of the concrete section and has been looking into the future for years. One of his division's jobs is to come



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up with some concrete solutions to strange mysteries. Ask him sometime about the strange case of the holey concrete. It seems that while building an airfield, the strength of the hardened concrete was only half of that called for by the specs. Close examination revealed that infinitesimal bits of aluminum were the problem. The aluminum was reacting in the cement mixture, creating hydrogen gas. This gas caused the holey concrete.

Tracing back to the sources of all the ingredients in the concrete, investigators found that rock for aggregate was hauled from quarry to job site in huge trucks with aluminum beds. As the trucks bounced over rough roads, and as the rock slid out of the raised beds at destination, the rocks would scrape shavings of aluminum from the beds. Solution—iron-bedded trucks.

While the concrete lab solves construction problems, the real heavies of the Gulliver force are those who blow things up. How explosives react in both military and civilian applications is the job of the Weapons Effect lab. It's here that men devise methods of accomplishing giant tasks. It is here, too, that the effects of nuclear explosions are tested by using simulated, nonnuclear devices.

One of those devices is the world's largest blast load generator. In this contraption the effects of mammoth explosions on underground structures are investigated. The generator can develop dynamic pressures up to 500 psi. with a minimum rise time of 2 milliseconds for about 2 seconds.

Explosive excavation

Though testing underground effects is important, equally important is removing ground. This is the job of the Explosive Excavation Research Laboratory. EERL has developed special techniques for excavating highway and railway cuts, spillways and quarries, and has developed special underwater explosives to dredge small harbors.

When the sea level canal through Central America was discussed several years ago, it was EERL that said it could be done.

How anything can be done is what the Gulliver force is all about: how structures can be protected from earthquakes; how chimney smoke can be cleaned; how a river will react to channeling or damming; how trucks can float across marshes; how giant cargo planes can land on membrane-thin runways; and how the wheel should be designed for a lunar rover. It's all being done in the land of the big and the little. ★★

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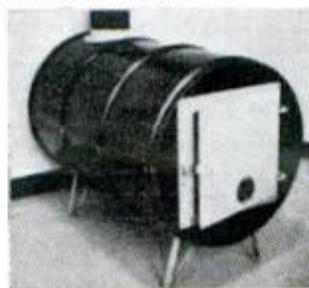
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VARIEZE PLANE

(Continued from page 75)

automatically by a return spring in each tail.

Elevator and aileron control are equally simple and ingenious. These are combined into dual-function "elevons" in the nose-wing canards. For climbing and diving, they operate collectively, moving up or down together. For banking, they work differentially—one up, one down—like conventional ailerons. Both functions are coordinated by a modern military-type side-stick controller.

High maneuverability

Because the canard control surfaces are set far forward, they provide extremely responsive control, improved climb and turn-on-a-pin-head maneuverability—they literally pull the nose in the direction you want to go just as if you put a rudder on the bow of a boat instead of the stern. The canards also add lift at high angles of attack, making the plane virtually stall and spinproof.

The nose wheel retracts, but only partly to lessen drag in flight. Its other advantages are even more clever. Retracting the wheel on the ground allows the plane to "kneel" like a camel, resting on its nose. This makes it easier to climb in and out and compensates for the tail-heavy effect that occurs with no pilot aboard to counterbalance the weight of the rear-mounted engine. Parking the plane on its nose keeps it from tipping over backward.

The main gear is fixed to eliminate the added weight and complexity of a retract-gear system. A single, continuous bow-shaped strut supports both wheels and runs clear through the fuselage to simplify attachment and lessen impact strain on the airframe—another ingenious touch. Individual toe brakes are used for steering and stopping.

Simple construction

Construction is almost entirely of fiberglass-covered foam. This not only accounts for the craft's unusually low weight, but actually speeds building time—there's little welding, machining or metal forming.

Despite its small size, the VariEze can carry more than its own weight, or a gross of 890 pounds. Climb rate with one aboard is a brisk 2000 feet per minute; with two, 1200 fpm. Estimated construction cost is \$1500, plus \$1200 for a converted VW engine. Burt expects to have plans and/or kits available by early summer. An information kit is \$5 from Rutan Aircraft Factory, Box 656, Mojave, Calif. 93501. ★★★

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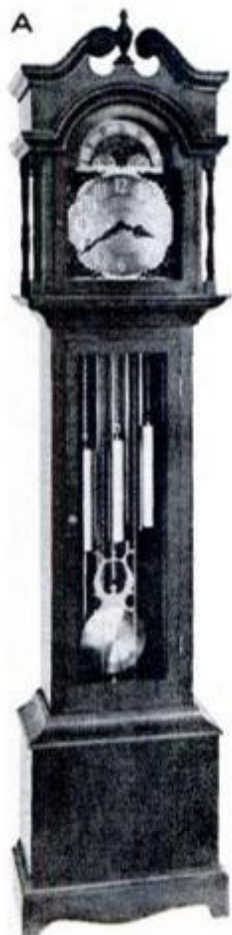
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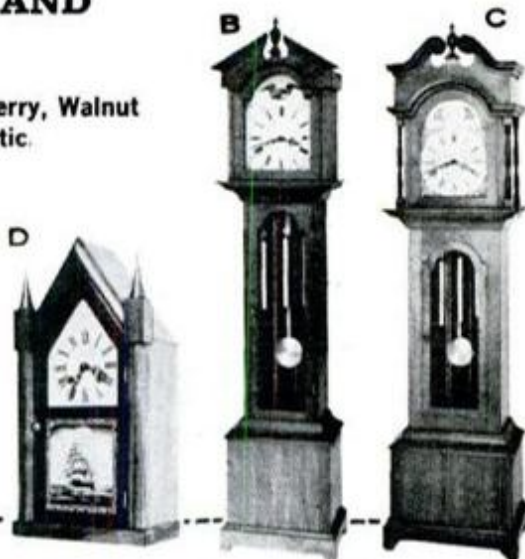
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WHEN YOU NEED A BETTER CAMERA (Continued from page 88)

fast speeds only when the light is very bright. More sophisticated cameras let you pick either a shutter speed to match the action or a lens aperture that will force your camera to give you the shutter speed you want.

The less time the light has to reach the film, the more rapidly you should let it in. So a wide aperture (at least f/2.8) is advisable for any camera you intend to use for action photography.

■ **Selective focus** is another trick

eras, in addition, tend to be compact, quiet and inexpensive.

■ **Reflex focusing** is closer to what actually takes place on the film: The image will be sharp when and where it looks sharp in the finder, fuzzy when and where it doesn't. Some people find this easier to use and understand than a rangefinder. Others find it harder because it forces them to judge small differences between the sharp and not-quite-sharp. For them, most single-lens reflexes have either a "microprism" spot that



Portrait with normal lens makes nose balloon toward camera, unless you move away till subject no longer fills frame.



Portrait with mild telephoto has subject filling frame, even though shot from far enough away for pleasing perspective.

that better cameras will let you try. A simple camera's f/8 or f/11 lens keeps everything in focus from about five feet to the far horizon. That's fine when you want both near and far objects in focus; but if you want to throw a background out of focus while keeping the nearby subject sharp, you'll need a camera with a fast lens again. At apertures of f/2.8 or faster, only a narrow zone is in sharp focus.

Since focusing gets more critical with faster lenses, better cameras have some means of checking focus accurately. On cameras list-priced from about \$125 or \$150 up, this is usually a rangefinder; on reflex cameras, it's a ground-glass or similar focusing screen.

■ **Rangefinder cameras** show your subject through a window with a fuzzy image in its center. That fuzzy spot is actually two images, slightly out of register; when the two images overlap exactly, the fuzziness will disappear and the lens is in focus.

Rangefinder focusing is easy after a few minutes spent getting the hang of it, and is quick. Rangefinder cam-

slightly exaggerates the difference between clear and slightly fuzzy, a "rangefinder" spot that breaks up out-of-focus lines or both. Twin-lens reflexes, with bigger ground-glass images, tend not to have these extras.

■ **Visualizing your image** is important. If you can't relate what you see in the finder to what you'll see on your print or slide, you can't expect good pictures. For many people, reflex finders look more like a picture, less like a peephole on the world, and make this visualization easier.

This effect is especially true of the big ground-glass screen or a twin-lens reflex. That screen is big because the film is big, and the bigger the negative, the higher the potential print quality. Twin-lens cameras are easily used at waist level or below, which makes them great for child photography from the child's eye-level and viewpoint.

The single-lens reflex or SLR for short, is far more popular, because it can do just about everything, and do some things uniquely well. The key to its versatility is its viewing system, which lets you look through

the camera lens to see just what the film is seeing (when you shoot, the viewfinder mirror flips up to let light through to the film).

That makes the SLR exceptionally good for close-up work, or for use with interchangeable lenses.

No matter how close you get with an SLR, you don't have to worry about cutting off part of your subject because your viewfinder is in one place and your lens in another, as is the case with a twin-lens reflex (see page 78, Nov. '75). And you can see whether focus is correct or not.

For the same reason, no matter how long a telephoto lens or how wide a wide-angle you use, you will see what the lens and film see, and be able to focus without cumbersome auxiliary equipment.

Being able to take off one lens and mount another makes a vast difference in what a camera can do for you. Wide-angle lenses, for example, don't just let you get more in the picture, important as that is when shooting in cramped places; they also let you exaggerate perspective and dramatize space.

Long telephotos, on the other hand, compress space, making cars spread over a mile of freeway look bumper-to-bumper; and long teles give you "close-ups" of subjects too far away to reach (or altogether inaccessible, like the helicopter on page 89).

Medium teles, from 85 to 105-mm, let you shoot portraits from the distance that gives the most flattering perspective, yet still fill the frame with your subject.

So should you buy an SLR? Yes—if you want to use its versatility and are willing to pay the SLR's high cost and the cost of additional lenses or close-up accessories. You might even want one just because you like its viewfinder system better than that of other camera types. On the other hand, realize before deciding that the SLR is noisier, more complex, more expensive, and usually heavier than other types, and the viewfinder blacks out for an instant every time you shoot (it's that flipping mirror).

■ **Buying a new camera** won't make you a better photographer if you just stick to your old habits. It won't even make you a more versatile photographer unless you make sure you make use of your new camera's inherent versatility. But if you're trying to take pictures now that your old camera can't handle, a new camera can be the answer if you know what you want. ★★★

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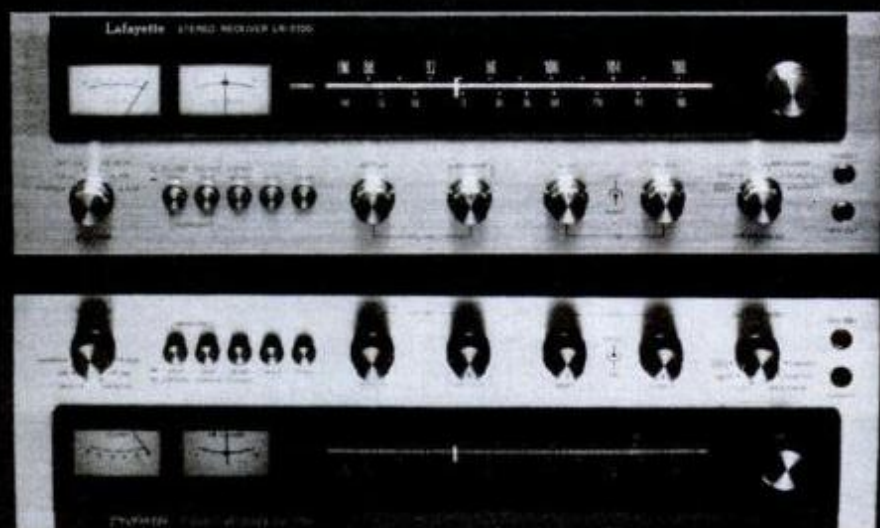
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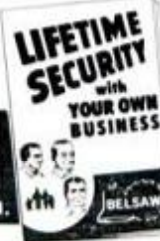
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LOW-COST CUTOFF SAW YOU CAN MAKE *(Continued from page 109)*

gather your materials first and use the exploded view (page 109) to clarify step-by-step instructions. For detail sizes, see the facing page.

Step 1. Start by drilling and tapping the holes in the 3-in. channel base (see parts list). Do the same with the vertical support arm. Then scribe two lines forming the 3/8-in.-wide slot in the vertical support arm. This is the tightener for the V-belt driving the crankshaft arm.

When you mount the support arm to the edge of the channel, tighten the bolts, then check alignment. You may have to shim slightly in order to produce an accurate 90° angle that you can check with a square. Do this carefully since the rolling process of steel is not always accurate and you must have a perfect angle when you tighten bolts.

Step 2. Press-fit the two bronze bushings into the two 7/8 x 7/8 x 2 1/4-in. bearing blocks. These standard-length bushings will be somewhat longer and extend beyond the edge of the blocks. Either cut them flush or let them extend toward the inside.

Step 3. Drill and tap the threaded-rod block for the 5/8-11 machine screw and insert the rod in the block (this should be done before attaching the block to the base). Place the 1/2-in. nut with the counterbore onto the 7/16-in. end of the rod. Then clamp it between two pieces of soft wood (to protect the threads) and peen over the edges of the last thread to keep the nut from coming off. Check that the nut will still turn freely and then mount the block.

Step 4. Attach the trip lever to the slide bar with the 1/4-20 x 1-in.-long hex-head machine screw but, leave it just loose enough to move into position automatically when the slide bar is raised. This will hold the bar up and out of the way for loading, and a simple flip of the rod on the trip lever will lower it.

Step 5. Insert the 1/2 x 5 7/8-in. driveshaft into the bearing blocks (you may have to loosen them slightly for proper alignment) and install the 6-in. V-pulley with the hub portion against the block. The 5-in. crankshaft pulley is attached to the vertical support arm using the 3/8 x 2 3/4-in. bolt, each piece separated by 3/8-in. nuts and washers.

Step 6. Assemble the saw head frame by loosely bolting together the two 16-ga. side plates and the two 1/2 x 1/2 x 9-in.-square spacing bars using the 10-24 x 1-in. long screws. Then insert the 1/2 x 1/2 x 3 in. front and rear spacing bars and place the assembled unit onto the slide bar. Oversize bolt holes pro-

vide space for a good sliding fit between spacers and slide bar.

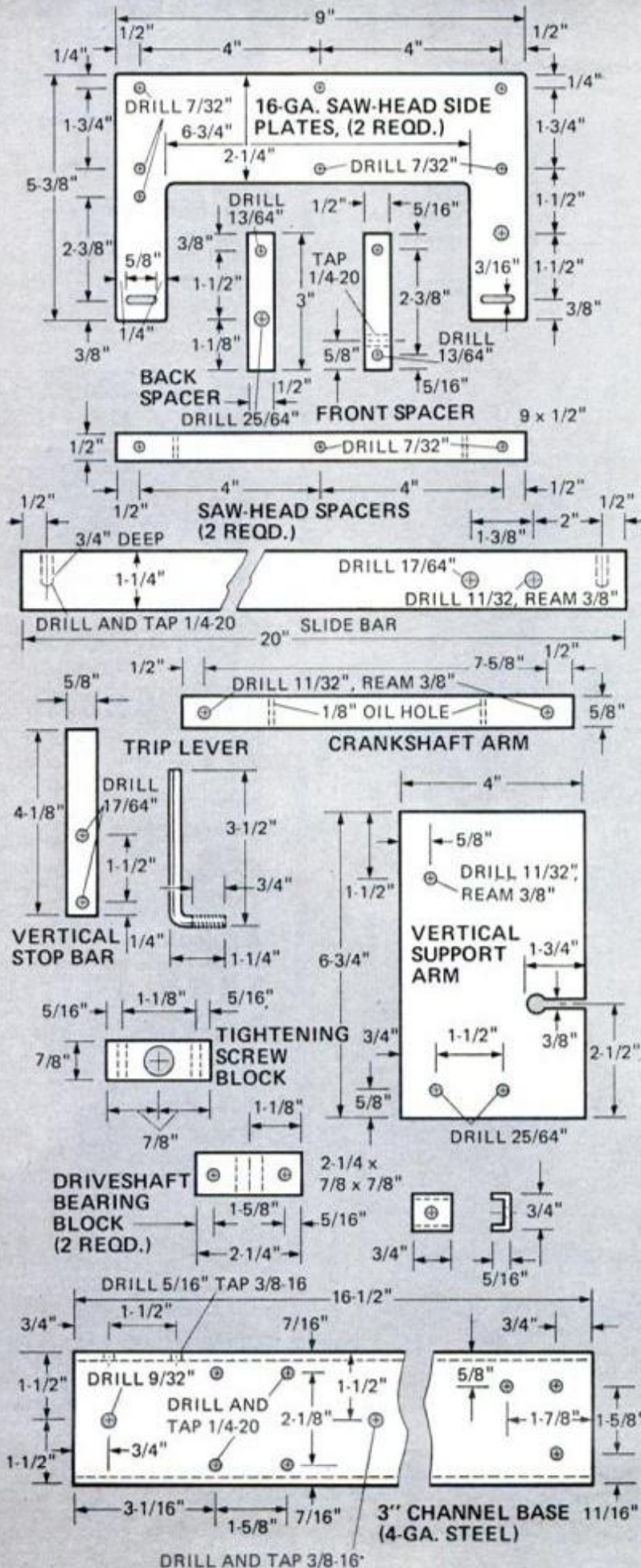
Step 7. Attach the crankshaft to the 5-in. pulley, leaving enough space so the arm won't bind when in use. Follow the same process with the 3/8 x 1 1/2-in. bolt, separating the units with 3/8-in. nuts and washers. Insert the 20-in. 3L V-belt and attach the crankshaft arm to the saw head assembly using the 3/8 x 2 3/4-in. bolt (through the spacer bushing) with the same type of 3/8-in. nut and washer assembly. At the top rear of the slide bar, insert a 1/4-20 x 1 1/2-in. hex-head machine screw to adjust height of the saw head for depth of cut. At the top front of the slide bar, insert the 1/4 x 3 1/2-in. load weight arm.

Make sure you check the assembly for tight connections and easy movement of the slide bar before trying to operate it. The saw will do a better job if you take care adjusting the depth of cut and vary the load weights to suit the job. You'll need more weight for longer cuts and harder metals to help the blade bite into the work. Finally, wear safety goggles while cutting, and install an off-on switch not easily accessible to children. ★★

BILL OF MATERIALS

Amt.	Size and Description
1	3 x 16 1/2" steel channel (4.1)
1	2 x 6—18" wood base
1	3/4 x 4 x 6 3/4" hot or cold-rolled steel
1	3/16 x 3 x 5 1/4" hot or cold-rolled steel
1	1/2 x 1 1/4 x 20" hot or cold-rolled steel
1	1/4 x 5/8 x 4 1/2" hot or cold-rolled steel
1	1/4 x 5" round
3	1 x 2" steel
1	5/8-11 x 8" threaded rod (steel)
1	1 1/2" heavy nut (steel)
1	3/8 x 7/8 x 8" hot or cold-rolled steel
1	1/4 x 3" hex-head bolt (steel)
1	1/2 x 6" steel shafting
2	1/2 x 3/8 x 1 1/8" bronze bushing
1	3/8"-dia. x 1" black pipe
1	1/4"-dia. x 3/4" black pipe
1	6"-dia., 1/2" bore V-pulley for 4L belt
1	1 1/2" motor pulley (1/2" bore) 4L belt
1	2" (1/2" bore) pulley for 3L belt
1	5" (1/2" bore) 'O'-sec. V-pulley 3L belt
1	3/8 x 5/8 x 8 1/2" hot or cold-rolled steel
1	3/8 x 1/2 x 1" bronze bushing
2	5 3/8 x 9" 16-ga. steel
1	1/2 x 1/2 x 25" cold-finished steel
1	2 x 2 x 3"-long 3/16" steel angle
1	20" 3L belt
1	30" 4L belt (for motor)
1	1/6-hp motor (No. 48 frame)
1	3/8-16 x 1 1/2" hex-head capscrew
2	3/8-16 x 2 3/4" hex-head capscrews
1	3/8-16 x 1/2" hex-head capscrew
1	3/8-16 x 3/4" hex-head capscrew
2	7/8-16 x 3/4" hex-head capscrews
2	1/4-20 x 1" hex-head capscrews
7	10-24 x 1" pan or RH screws
2	8-32 x 1"
2	8-32 wingnuts
20	3/8" washers
8	3/8-16 hex nuts
8	10-24 hex nuts
6	1/4-20 hex-head capscrews

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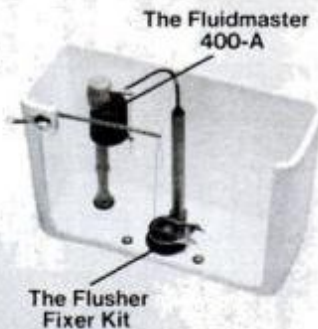
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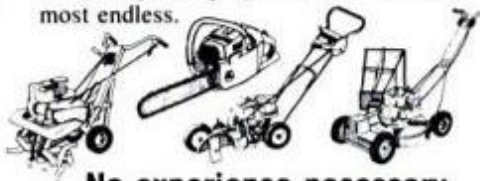
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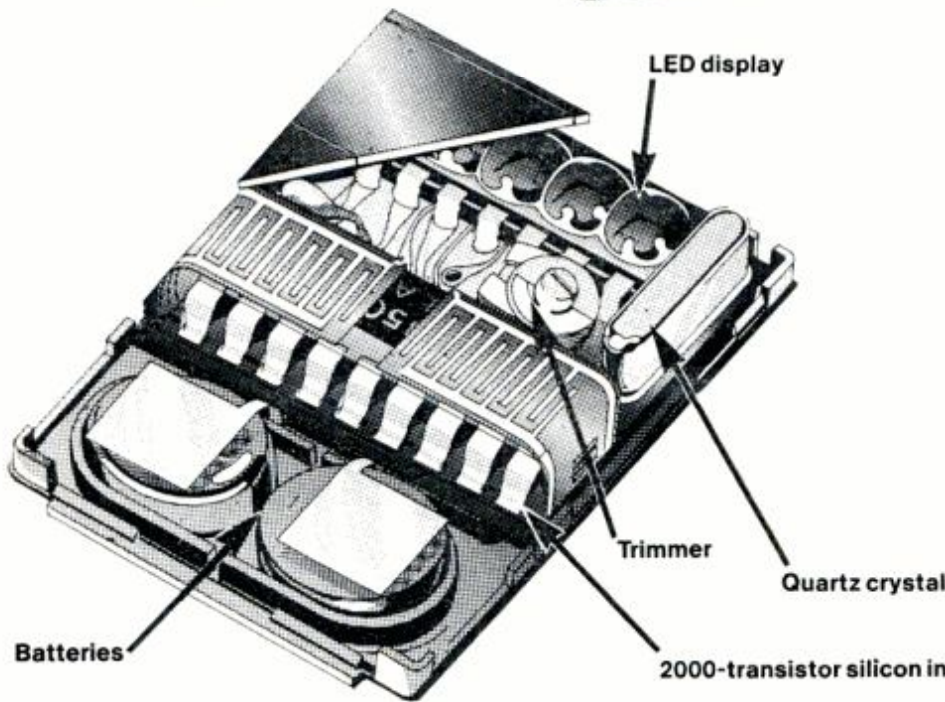
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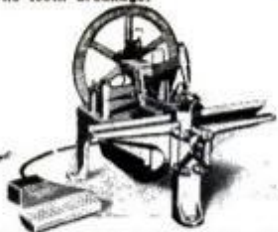
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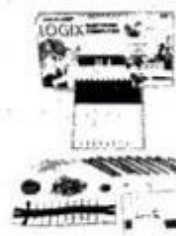
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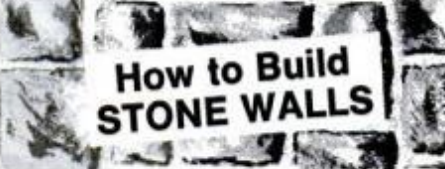
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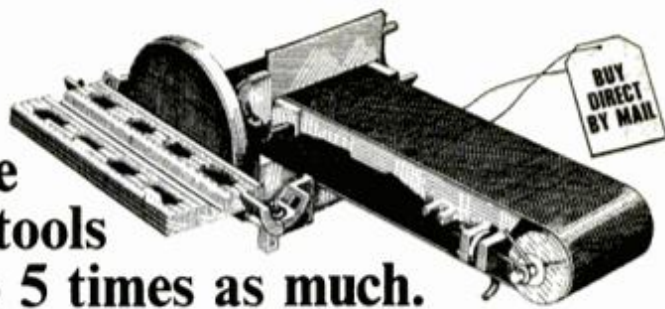
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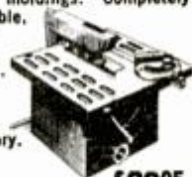
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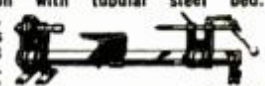
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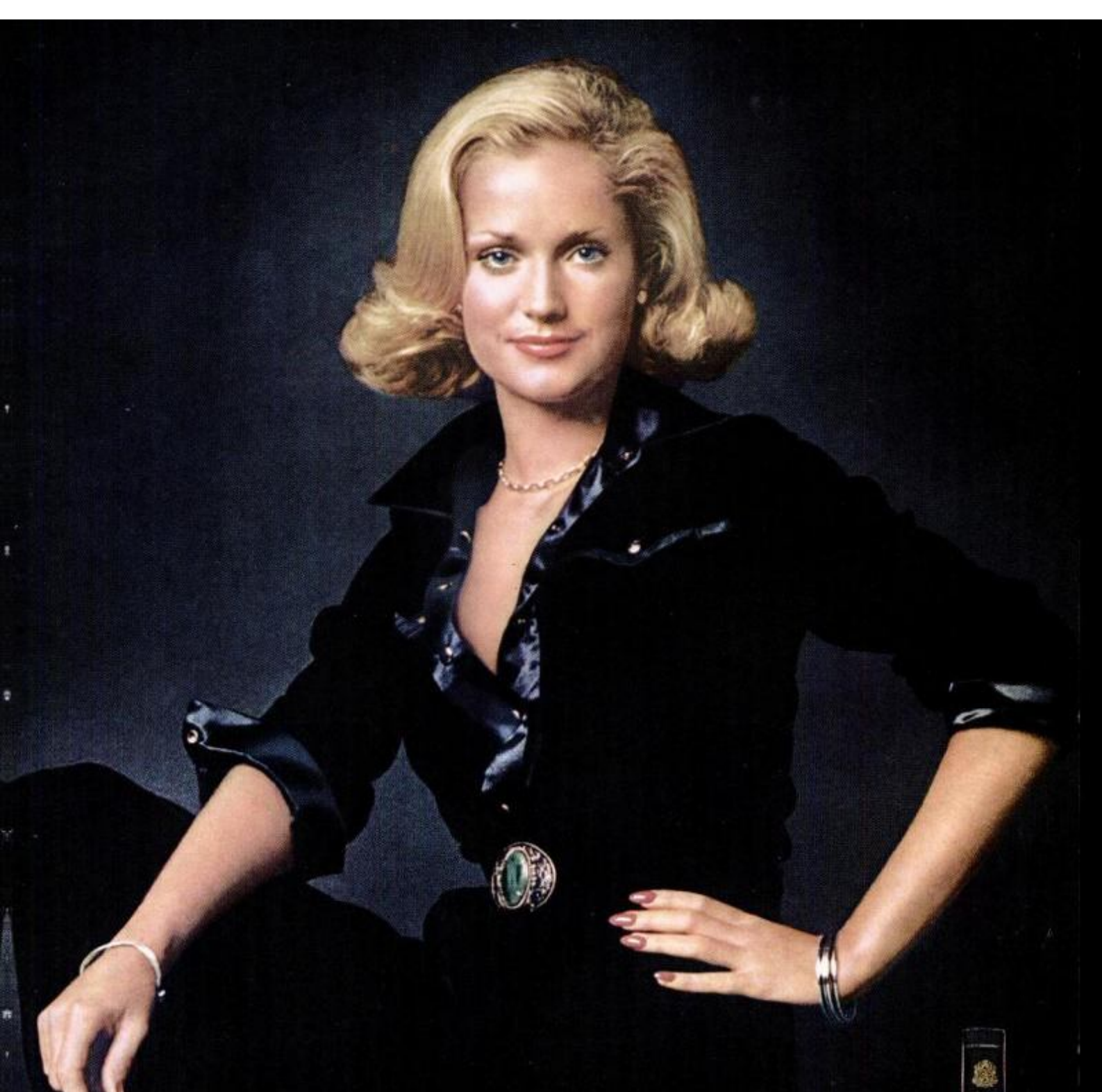
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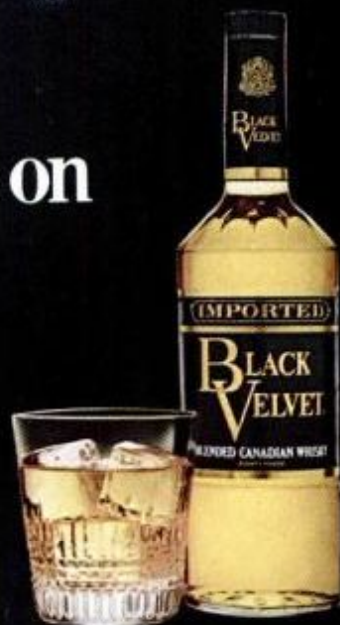
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