

ONUS
Year-Out Booklet

50 Great Tips for Your Home and Shop

POPULAR MECHANICS

MAR. 1970
50 CENTS

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Say About the Duster**

**Dan Gurney Answers
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**A Submarine Icebreaker
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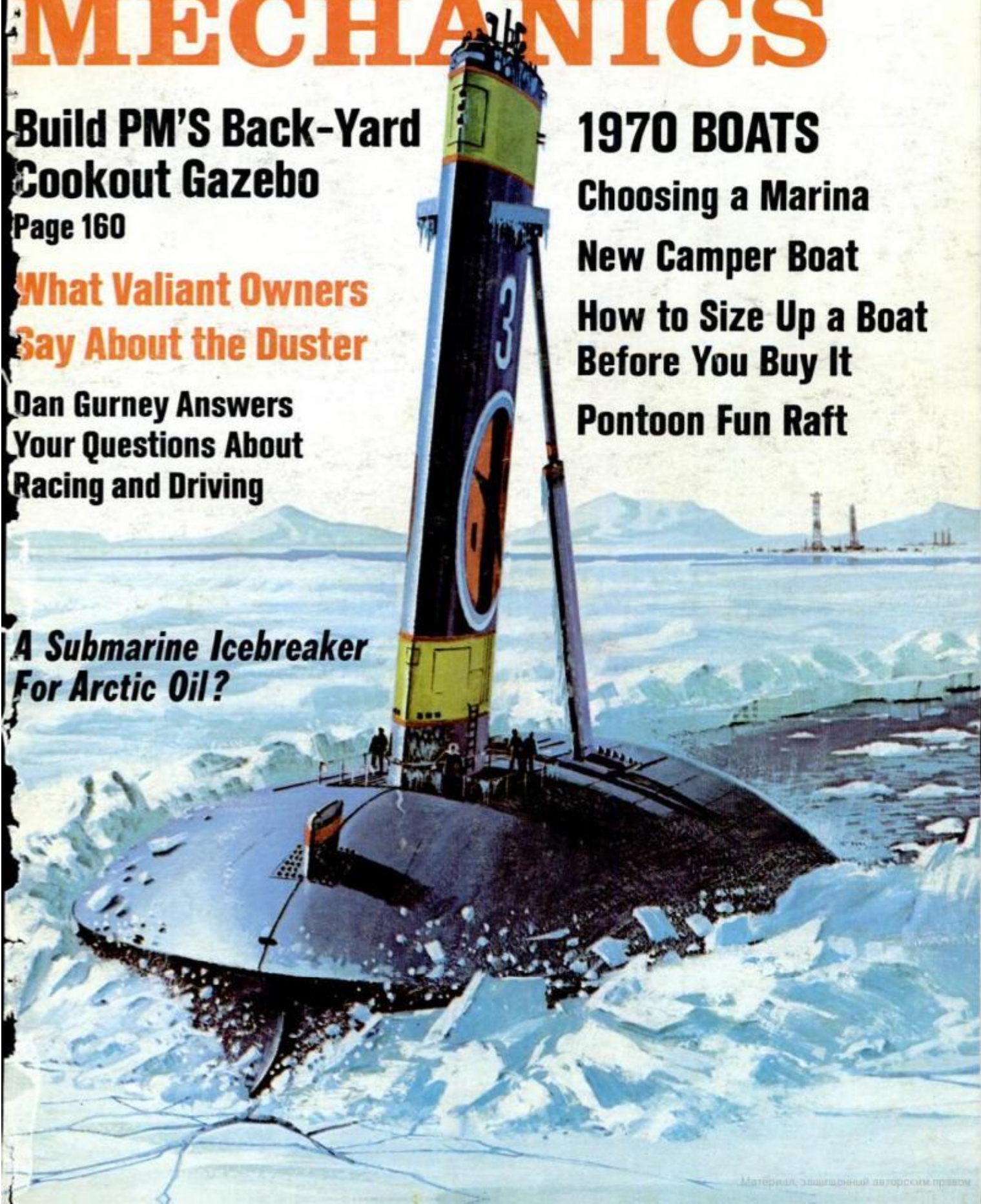
1970 BOATS

Choosing a Marina

New Camper Boat

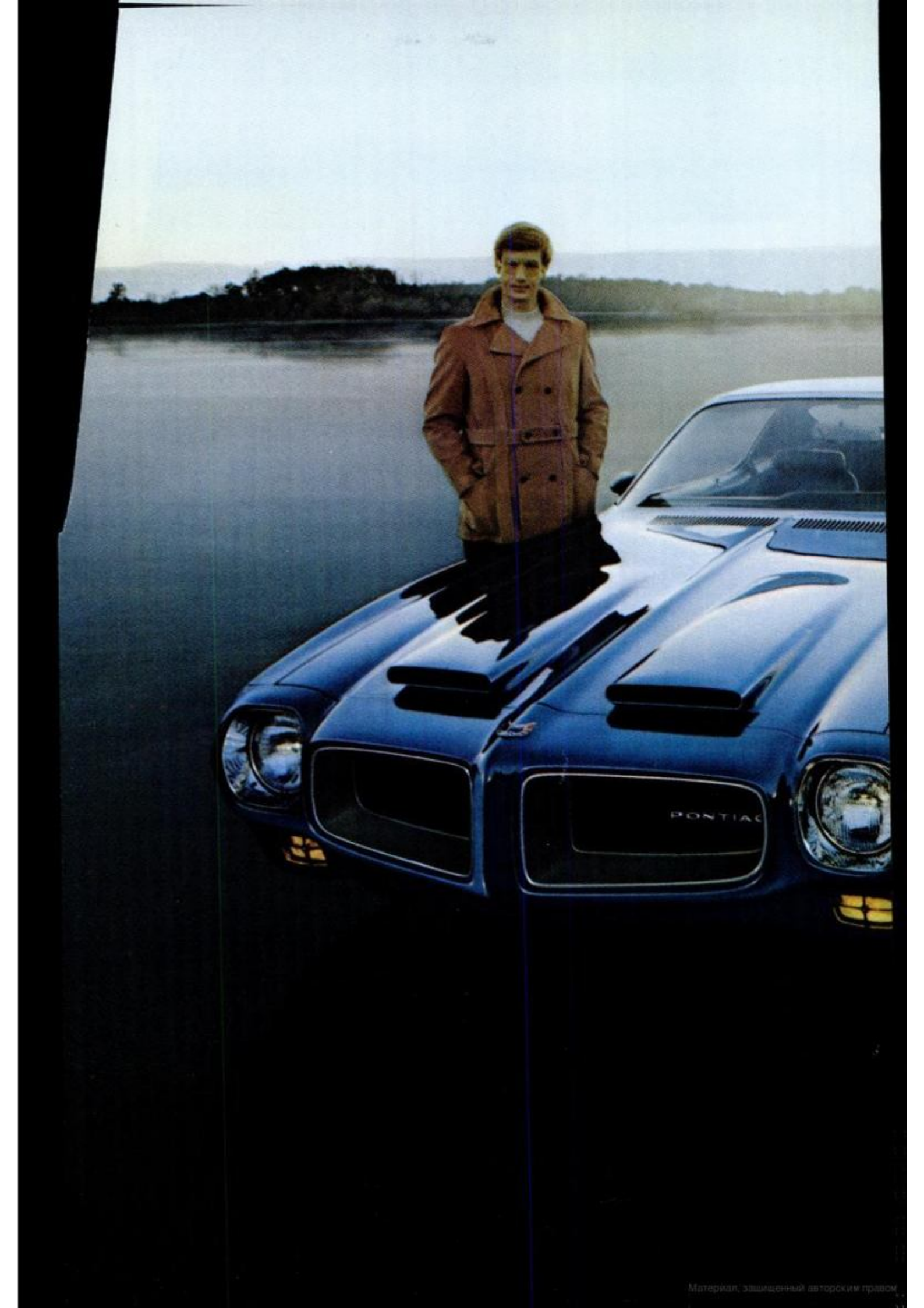
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(We take the fun of driving seriously.)



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Pontiac announces the beginning of tomorrow.

Gauges that gauge, spoilers that spoil, and scoops that scoop.

What's this? Detroit pushing functional styling? Wouldn't you know who. Pontiac.

We decided to give our designers and engineers their heads. And what they came up with is styling that works. Aerodynamically. In four totally new Firebirds. Two of which you just might find particularly stirring.

Firebird Formula 400 (the blue beauty shown left). We asked ourselves how many passengers we might seat comfortably. The answer was four. So Formula 400 has bucket seats front and rear.

Then, we raised the drive line tunnel between the seats to get more room for spring travel. And the result is a decided lack of the typical sports car jolts.

Formula 400 also has a bigger stabilizer bar up front. A brand-new stabilizer bar in the rear. And standard front disc brakes. For those roads that feature curves. The fastest variable-ratio power



steering around is available for such conditions, too.

The standard 330-hp 400-cubic-inch V-8 should be enough for about anyone. Just in case somebody disagrees, however, there's a 400 Ram Air V-8 you can order.

Should you do so, the scoops perched on that fiberglass hood will scoop. Really scoop. Take a glance at the available full complement of honest-to-gosh gauges if you doubt us.

Just remember who told whom about all that functional styling.

Firebird Trans Am (the one shown right that isn't blue).

Ah, what a little road testing can do. What it can do is help you come up with a front air dam and side air extractors that put a 50-lb. downward pressure on the front end. At turnpike speeds. It can show you how effective air dams are at the wheel wells. It can lead you into developing a rear spoiler that puts 50 lb. of pressure on the rear end. Also at turnpike speeds. And it can convince you that a shaker hood with a rear-facing inlet is effective indeed for providing air to a 345-hp, 400-cubic-inch Ram Air V-8.

It can also tell you how it all works with the Hurst-shifted wide- or close-ratio 4-speed transmission you can order.

Now you know why Trans Am is our most sophisticated Firebird. In fact, the only thing that doesn't function is the unsubtle stripe running the length of the car. But maybe it does something for you.



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The all-new Firebirds are here. New, even for Pontiac.



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You may never drive the Baja, but the AC Air and Oil Filters John Johnson used to win the "Mexican 1000" are the same AC Filters that are original equipment on all GM cars. When changed regularly, they virtually eliminate engine wear caused by dirt and sludge.

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Glutton.

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Be a glutton for mileage. Greater mileage saves you money. Get a set of Atlas Plycron 2 plus 2 tires today!

And remember, Atlas batteries and accessories as well as tires are sold at over 50,000 leading service stations.



This One



DOFB-SCB-UAOT

ATLAS
PLYCRON 2 PLUS 2

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How to Keep Your Tape Recorder Humming. Simple maintenance jobs you can do.
Union/Pure Oil Performance Trials. Do they discount Detroit's claims?
What Owners Think of Monte Carlo and Rebel. Two exclusive PM Owners Reports.
GE's Fantastic New Electric Garden Tractor. Ten pages on this and other startling developments covering nearly every outdoor job from tilling to trimming.

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MARCH 1970

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LETTERS

TO THE EDITOR

Racing Guide

Just a note to say thanks for the 1970 *Racing Guide* (Page S1, Jan. PM). It was great. I am glad to see that your magazine is taking a stronger interest in this fast-growing sport. The guide is very well put together and very complete. Keep up the good work; you are greatly surpassing your sister magazine both in quality and reader service.

FAIRVIEW PARK, OHIO JAMES STEFFNER

I enjoyed your *Racing Guide*. The track layouts and the brief section on rules were worth the price of the magazine. I'll look to PM for more racing information.

Being a dirt-track fan, I was disappointed that this exciting phase of the sport came in for only slight mention. Perhaps next year the sprint cars and the dirt-track championship cars will be awarded their rightful place in your informative little booklet.

T. D. BARCLAY

Easy to answer

My husband received as a gift PM's *Master Shop Guide*. We would like to order one for a son but don't know where to send for it or what the price is.

NEW GLOUCESTER, ME. MRS. M. STEVENS

Wish all questions were this easy to answer. It's \$3.95 from Popular Mechanics, Dept. JL, 224 West 57th St., New York, N.Y. 10019.

Faster than a speeding bullet . . .

Orbis is a real advance in highway safety and may prove effective in control of highway hot rodders (*Smile! You Just Got a Ticket*, page 73, Dec. PM). The flaw is that a simple cable attached to a hinged front license plate will allow the plate to fall forward and not be photographed.

NEW YORK KENNETH MILLER

If you can react faster than that strobe light, you deserve to get away.

Compare more snow tires

After reading the interesting article, *Studded Tires Take Hold* (page 112, Jan. PM), I wonder why you compared them only to standard snow tires. There are

[\(Please turn to page 8\)](#)

The Lazy Pipe Tobacco

Don't ever try to rush through a pipeful of Bond Street. It can't be done. Because this rich-tasting combination of plugs and flakes is specially blended to burn slow and even. You can do a good deal of sightseeing in a strange city while a single pipeful is burning its slow and lazy way to the bottom of the bowl. You'll enjoy the gentle taste of Bond Street (and chances are quite good that a passing cab driver or two will have a complimentary word for its incomparable aroma.




*Lights easy—
takes its own good
time about burning.*




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LETTERS

(Continued from page 6)

other modifications of tires for snow conditions: (1) sawdust or nutshell retreads, (2) tractionized snow treads, and (3) siped snow tires rear and summer tires in front.

A test comparing stud tires to these modifications would be very interesting. Studs give no help in new or deep snow or on wet pavement where others do, and you cannot combine the benefits of the others with studs.

TRAIL, B.C.

JAMES W. BROWN

Also looks good in wood

My 14-year-old son, Gary, decided to make the *Model 24-Pounder* (page 134, Feb. '69 PM) out of wood, since he doesn't have a metal lathe. He started at 2:00 p.m. on a Sunday and finished it the following night. The barrel was turned out of gum wood, and the other parts are black wal-



nut. All the brass hardware was made from nails and shim stock. To get the brass color on the barrel, he took dull gold radiator powder and mixed it with shellac and gave it two coats. All wood parts received two coats of varnish.

NORTH ROYALTON, OHIO K. J. RAUSCHKOLB

Clothesline anchor

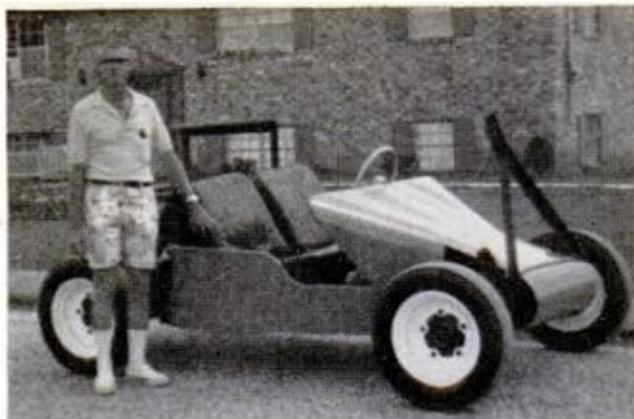
In *Good Way to Anchor* (page 159, Dec. PM) you state that "Bakelite solderless connectors" are good for anchoring wire clothesline to a post. I've always referred to them as split bolts, and they are copper.

RAIFORD, FLA.

BENNIE HOBBS SR.

41 hours with coffee breaks

I built the *Brush Buggy* (page 132, Nov. '68 PM) from plans in the magazine. As



you can see I added a little extra to the front and sides to give it class.

I purchased a VW complete and sold the body to a local body shop. Total amount invested, after sale of the body, is \$71.23. Time was 41 hours, including coffee breaks.

MORRISTOWN, TENN.

JERRY CHARLES

Electronic larynx a godsend

Lynn Daniel is quite right in pointing out that esophageal speech is preferable to the use of an electronic larynx (*Letters*, page 6, Dec. PM). Nevertheless there is a very important place for the artificial larynx in the total picture of rehabilitating laryngectomees.

Some 20 to 40 percent of the laryngectomees are unable to master esophageal speech, and, for these, the electronic larynx is a godsend. It's also needed by persons who can't take speech instruction because of age, ill health or other reasons.

Even a person who has a well-developed esophageal voice can use an electronic larynx in special situations. For example, when his voice level drops drastically from fatigue, or when telephoning police or fire department in an emergency.

AT&T Co.
NEW YORK

GALE M. SMITH
ASS'T ENGINEERING MGR.,
SERVICE FOR THE HANDICAPPED

Hey, pool-table builders

If you're building the *Bumper-Pool Table* (page 146, Jan. PM), make these changes in the specifications:

Cushion rail liner: Make it $\frac{3}{4} \times 1\frac{1}{16}$ in. (not $1\frac{15}{16}$). Consequently, disregard the $2\frac{13}{16}$ -in. dimension; it's self-determining.

Ball holes in the bed: Make them $2\frac{5}{8}$ in. (not $1\frac{5}{8}$).

Why the errors? We suspect that one of our typewriters is determined to have a confrontation with the Establishment. Its other January mischief included a wrong name for the maker of the *Drill-Stop* (page 76). The manufacturer is *Century Drill and Tool Co.*, 322 South Green St., Chicago, Ill. 60607. ★★★

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DETROIT

LISTENING POST

BY ROBERT LUND

FORD MAY BE FIRST on the street with a mid-engine car, but American Motors expects to be the first domestic automaker to produce a mid-engine in the United States. Ford hopes to whisk a couple of sample jobs produced by De Tomaso of Italy into the country by July. These will be for testing purposes and engineering evaluation, so don't get your checkbook out to place an order. Dearborn is pressuring for delivery of the for-sale version by late fall, but De Tomaso may have trouble meeting that deadline. American Motors has a mid-engine as one car on its something-new-every-six-months schedule. The present timetable calls for putting it in production early next year.

DODGE WILL POP with a performance version of Challenger within the next couple weeks. Named the Trans Am, it will carry a 305-CID plant as standard. This one's a surprise, because Chrysler's in the throes of a tight economy program. The company denies the clampdown on the cash register has led to cancellation of tooling for its '71 cars and says it will have the sharpest looking line of intermediates in the industry when it unwraps its '71s.

GRANTED THE PISTON ENGINE isn't going to be around forever, there's still a lot of life left in Old Faithful before electric cars, steam, turbines or whatever take over. How much? Nobody's saying, nobody knows, in terms of years. But as for getting more power out of present engines, engineers working on cars you'll drive in the mid-'70s see no obstacle to squeezing horsepower gains in the area of 40 to 50 percent out of current powerplants. That's working horsepower, not theoretical zip or the long count you get when power is measured in the lab. The gains will be achieved through use of lighter materials—primarily plastics and aluminum—and the introduction of fuel injection. Cutting car weight will boost horsepower 20 to 25 percent and fuel injection will add 15 to 25 percent on top of that.

SPEAKING OF FUEL INJECTION, you'll be able to order it as an option, possibly next fall, positively a year from then, providing you drive a big car with a big engine. Both GM and Ford are working on electronic fuel-injection systems. Ford and Shelby Automotive deny a report they'll install an experimental fuel-injection unit in the Shelby GT 350 and GT 500. The denial is on the level, as far as it goes, but Ford is known to have a couple of test cars equipped with fuel injection. Bendix is talking about tooling up to turn out 100,000 units a year. That's significant because Bendix doesn't bandy box-car numbers around unless it has fairly solid commitments from carmakers. If you want this as an option, it will set you back something like \$400 to \$500. Chevrolet charged \$484 for the item when it pioneered it back in 1957. While a lot of improvements have been made since then, both in the product and production techniques, the price will still be a whopper because of increases in materials and labor.

DON'T BET ON CHEVROLET SLUGGING IT OUT toe-to-toe against Maverick on price when XP 887 bows in August. Not at \$2000, anyway. Henry Ford himself says prices will be up on the coming crop of cars. That includes Maverick, the stripped version of which currently goes at \$1995. Ford sources admit the \$1995 tag was arrived at by seat-of-the-pants mathematics. It's a "bait" price and doesn't reflect all the production costs Ford normally takes into consideration in determining prices. XP 887 will be out ahead of both Maverick senior and the junior edition Ford will introduce in late summer. This will put GM in the position of pacesetter on pricing. GM adheres to a strict policy of basing prices on production costs, never mind what the

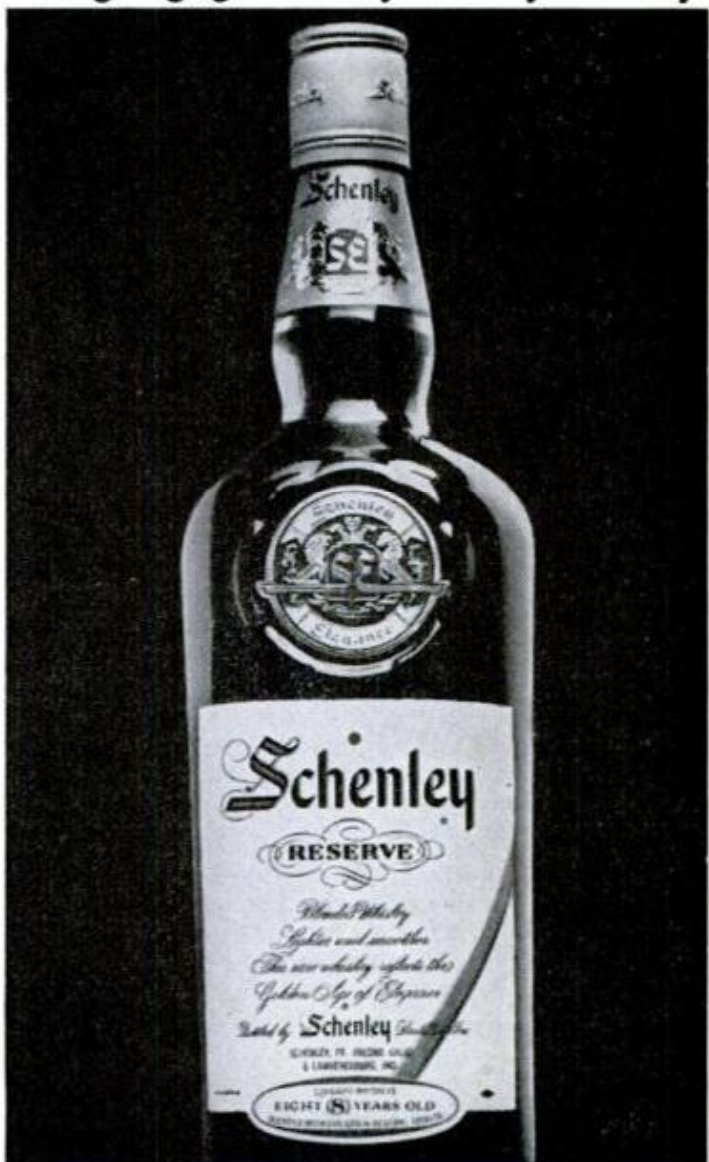
(Please turn to page 12)

8 years ago

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DETROIT LISTENING POST

(Continued from page 10)

competition does. Chevy is counting on two strong points to nip Maverick's heels: (1) Cadillac quality at a third of Cadillac's price, and (2) innovations, features, gimmicks and gadgetry not available on other small cars. You can also cool off on the idea that you'll be able to order an XP-by-the-numbers in a fastback, wagon and panel truck. They'll be along. But later. Chevy's immediate concern is getting an XP sedan launched. Other body styles will follow at the end of the year or in January, 1971.

IT'S ONLY A MATTER OF TIME, Detroit figures—five years at the outside—until Uncle will require car manufacturers to rate the life expectancy of most working, wearing parts of automobiles—electrical systems, shocks, batteries, windshield wipers, fan belts, you-name-it—as the industry is now required to rate brakes, passing ability and tires. Detroit may put up a halfhearted squawk when the time comes, but the auto companies view ratings for components as a blessing in disguise. For one thing, it will get manufacturers off the hook with slouches who neglect their cars and then charge the product was defective when they're involved in an accident. For another, part-by-part ratings should increase sales of replacement hardware. Now, most car owners replace parts only when a piece quits working. (Exceptions to that are items owners are required to change periodically to keep warranties in force.) But if car firms start spelling out the maximum number of months or miles each item is good for, there will be less of a tendency by owners to drive 'er to the last wheeze and more frequent replacement of parts on a regular schedule pegged to time or mileage.

WHAT PART of your car is most likely to conk out first and most frequently, requiring replacement? Most owners will say batteries, plugs or mufflers, because those are items they remember replacing. But a trade association that compiles a sort of hit parade of parts sold by wholesalers—the guys who supply replacement stock to dealers and repair shops—says that No. 1 on a list covering 34 items is ignition parts, which includes both generators and armatures.

What's last and least likely to give trouble? Brass fittings and fuel lines are lumped together in 34th place. If you have to replace those, you've got a lemon or an aging antique. ★★★

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THE TRACKER

GOODYEAR

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You've heard a lot about fiberglass belted passenger car tires, and the long mileage they deliver. Most 1970 cars come equipped with them.

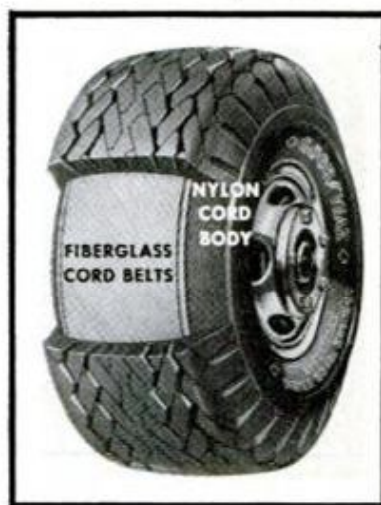
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See your Goodyear Dealer or Goodyear Service Store for The Tracker. Hi-Miler Wide Tred Nyloglas tire (shown) or Custom Xtra Grip Wide Tred Nyloglas tire for mud and snow. Available in the following sizes: 8.00-16.5, 8.75-16.5, 9.50-16.5.

Hi-Miler, Nyloglas, Tracker—T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



Nyloglas tire: Four nylon cord body plies and two fiberglass belts that extend around the tire to help hold the tread firm and fight squirm.



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2 A CAVE-IN PUT ME SIX FEET UNDER FOR SIX LONG MINUTES



3 IN THE HOSPITAL, I HAD PLENTY OF TIME TO THINK



4 I'D PASSED OVER DOZENS OF I C S ADS IN POPULAR MAGAZINES. BUT I SAW THIS ONE IN A NEW LIGHT



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HOW'S IT GOING, DARLING?

FAST! I'M INTO HYDRAULICS ALREADY. AND I THOUGHT I WAS TOO OLD TO LEARN

5 SIGNING UP FOR THAT I C S COURSE WAS THE SMARTEST THING I EVER DID

6 ONE MONTH LATER... GOOD TO SEE YOU BACK ON YOUR FEET, JIM. IT'LL BE AWHILE BEFORE YOU'RE BACK IN THE FIELD. SO WE'LL FIX A TEMPORARY DESK FOR YOU IN THE OFFICE WHEN YOU'RE READY

I'M READY NOW, MR. WALSH

7 THEY GAVE ME SOME SIMPLE ASSIGNMENTS... AND I SURE SURPRISED THEM!

SAY, WHERE DID YOU LEARN ABOUT PUMPS?

SAME PLACE YOU DID, JOE... I C S

8 THEN A FEW DAYS LATER, MR. WALSH CALLED ME IN...

JIM, I'M KEEPING YOU HERE AND PUTTING YOU ON SALARY. YOU'LL BE GETTING ABOUT \$20 MORE A WEEK. AND AT THE RATE YOU'RE GOING, I EXPECT I'LL HAVE TO RAISE THAT IN SIX MONTHS

9 THAT EVENING, JANE AND I WENT HOUSE HUNTING

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Temperature changes in parts of the body can be "willed." This has been demonstrated by two Stanford University coeds and a researcher—psychologist Philip G. Zimbardo—who were able to vary temperatures simultaneously in their right and left hands. They turned the trick while under hypnosis and in a constant-temperature room. Lying down, they were told to relax deeply, then to focus attention on their hands, which had thermocouples taped to them. Then the subjects "willed" their hands to become hotter or cooler. If further investigation can reveal how the changes are accomplished, says Prof. Zimbardo, this "will enable us to understand and, hopefully, to modify the behavior of human beings who somehow induce" such disorders as rapid heart action, ulcers, asthma and excessive sweating.

The recent discovery of a bed of fossil bones in the Antarctic "establishes beyond further question" that Antarctica once was part of a great southern land mass known as Gondwanaland. That's the opinion of experts who have inspected the bones—found by an Ohio State University team in the Trans-Antarctic Mountains, about 400 miles from the South Pole—and identified them as part of a skull of a small reptile that lived more than 200 million years ago in Asia and South Africa.

Bullets can't deflate a new tire made for the Air Force by the Goodyear Tire and Rubber Co. It doesn't collapse under punctures because it isn't filled with air but with a special foam rubber. The rubber has a controllable density that can be varied to simulate the inflation pressure of a pneumatic tire. Designed for military trucks and trailers, the tires could also be used on heavy construction and agricultural vehicles in situations where puncture damage is a problem.

Pigeons are good barometers of long-term effects of air pollution, says a Temple University (Philadelphia) physiologist who recently determined that lead levels in city pigeons are much higher than in their country cousins. Instruments now in use, says the scientist, measure pollutants in the air but do not indicate amounts absorbed by humans. And tests of human urine, saliva or blood show only acute levels of pollutants. So don't regard the pigeon as a pesky bird but as a feathery, long-range health gauge.

A transparent bubble will be used by the Navy to observe and direct underwater construction work by divers. Called NEMO (Naval Experimental Manned Observatory), the 66-inch sphere will be made of plexiglass two and a half inches thick and will be able to accommodate a crew of two. Designed to operate at depths up to 600 feet, the sphere will be lowered by cable and then anchored. NEMO is under construction at San Antonio's Southwest Research Institute and sea trials are slated for later this year.

How do you milk a polar bear? Dr. Bruce E. Baker of Montreal's McGill University will have a definitive answer to that question after he finishes an unusual investigation for the Atomic Energy Commission. His assignment: to collect and analyze the milk of arctic and subarctic animals such as wolves, bears, caribou, big horn sheep and whales. The object is to determine levels of radioactive substances in the milk. Dr. Baker's work is part of a broad AEC study of the effects of manmade and natural radioactivity on the environment and on the food chains on land and in the sea. He says he foresees no problems in getting his samples because the larger animals will be tranquilized with a dart gun. For further information about that, read *How to Catch a Hippopotamus*, page 102, Jan. PM. ★ ★ ★

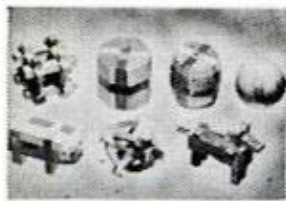
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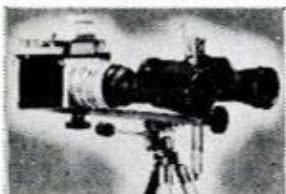
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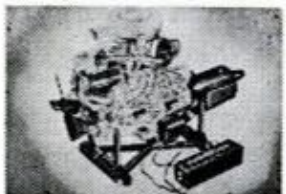
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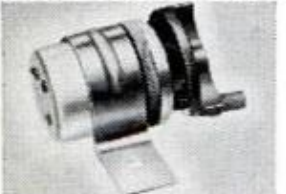
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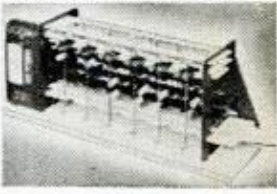
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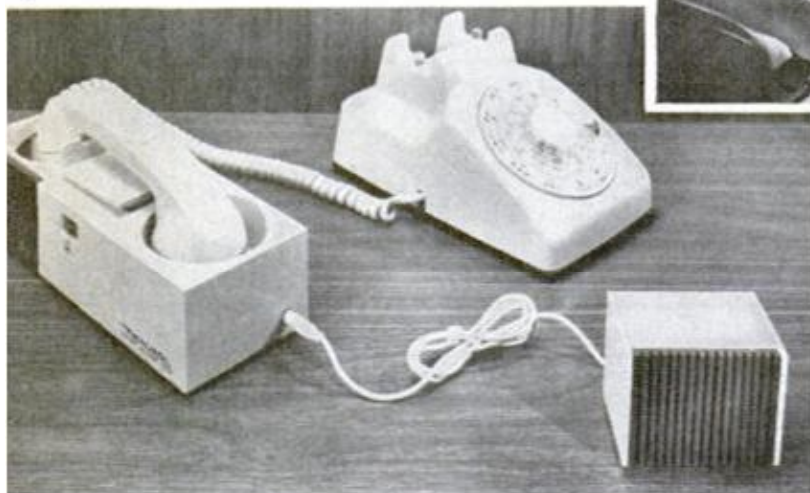
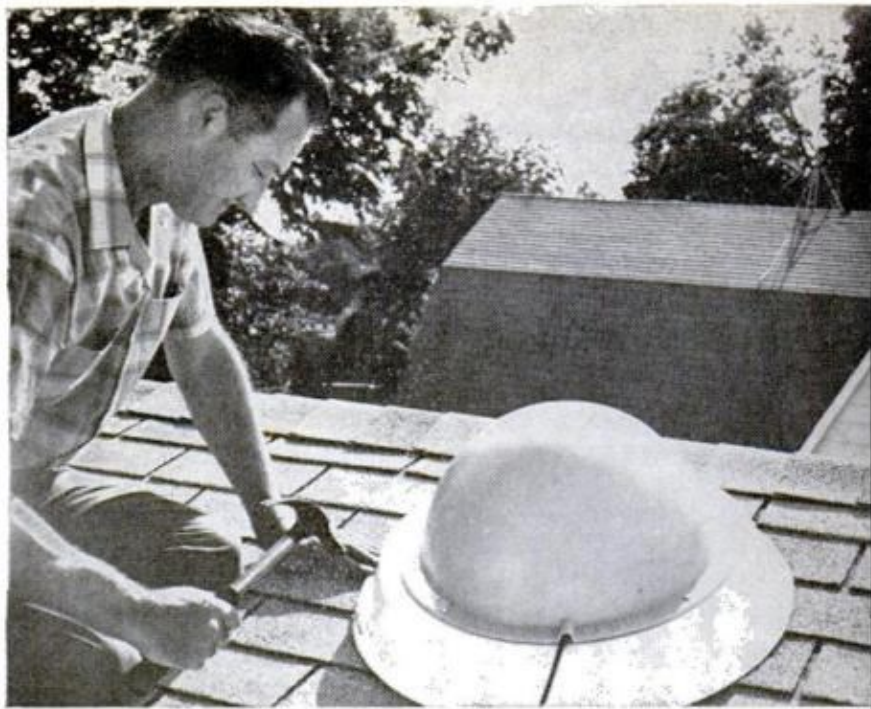
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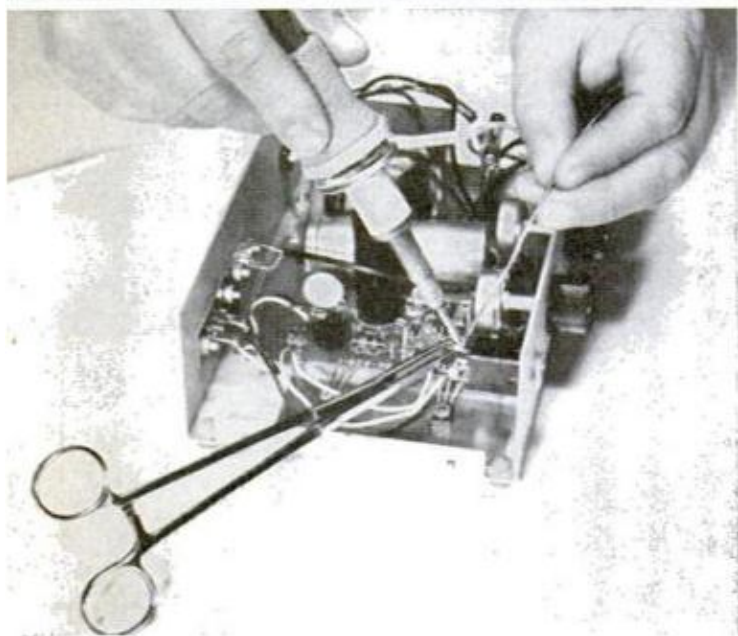
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New in Electronics

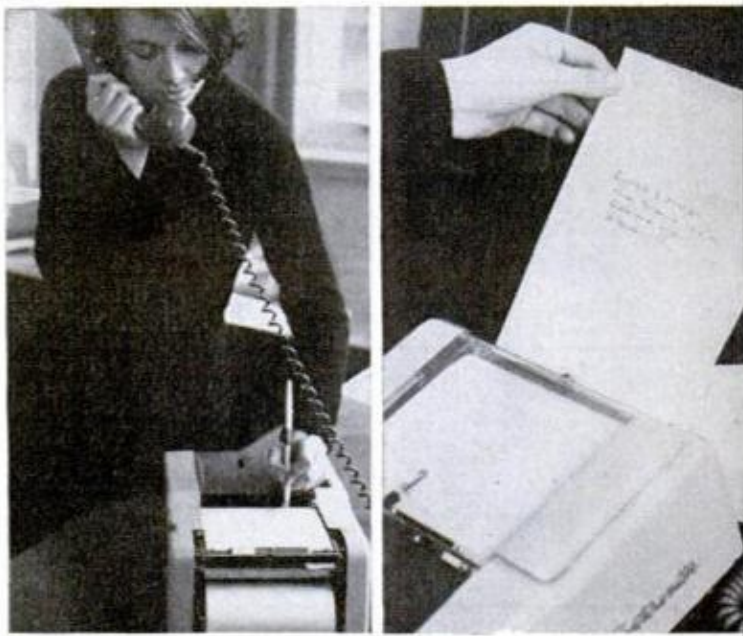
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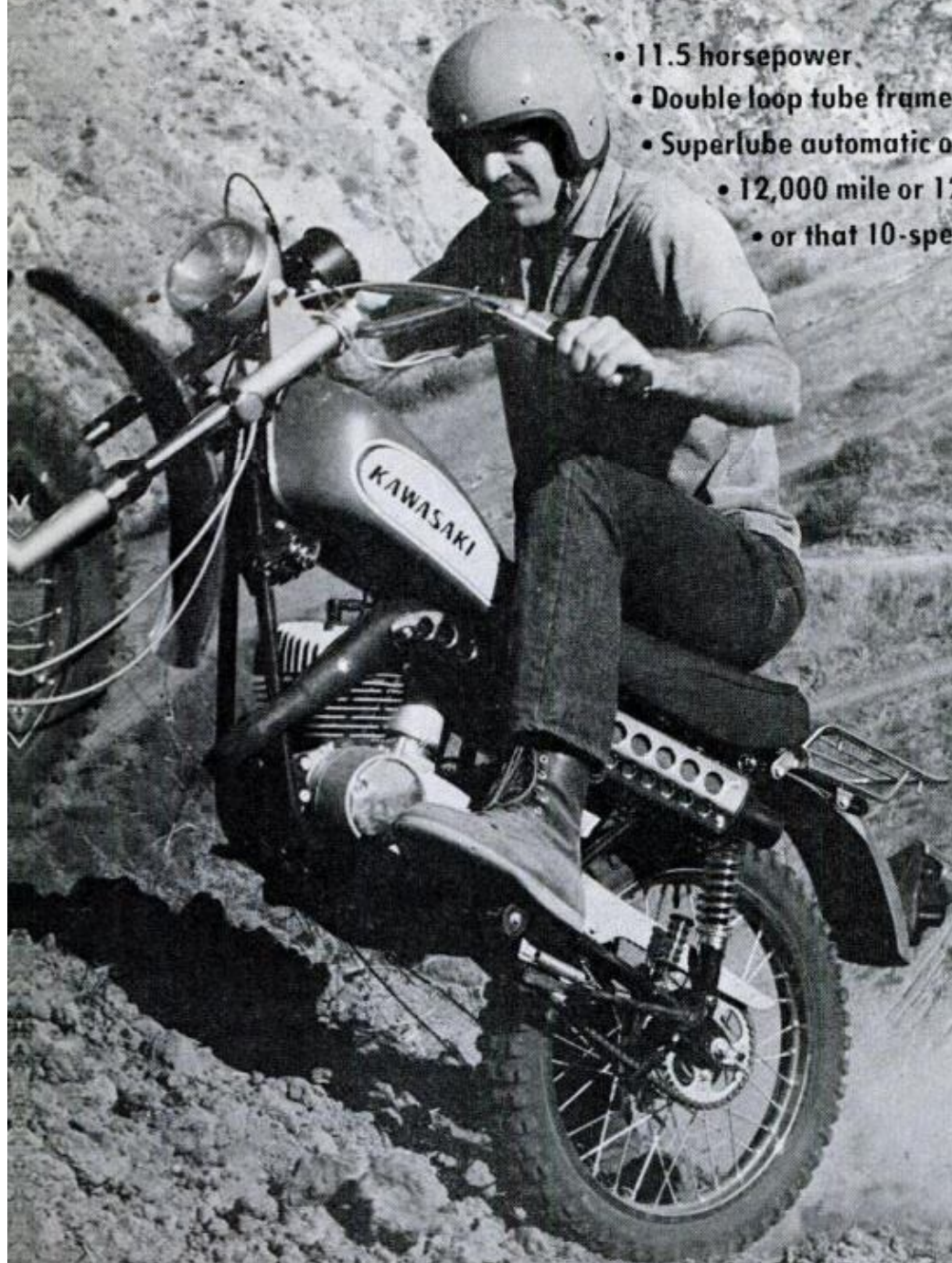
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Drivin' with Dan

What do the numbers in car names mean? What kind of racing will you be doing this year? What's the score with four-wheel drive in Formula 1 and Can-Am? Dan Gurney answers these and other automotive questions

Q. My boy friend says he is getting a Chevelle SS 454. I understand car names like "Chevelle" but I always hear him throw in those numbers. What do they mean?—Ellen Martin, Kansas City.

A. I am sure lots of people don't know the meaning of all the terms of identification that have been added to car names in recent years. "SS 454" means Super Sport with a 454-CID engine. Plymouth has a model called the "Hemi Cuda", which is a Barracuda with a "hemispherical-chambered" 426-CID engine. Ford has a "Boss 302" Mustang, which carries a 302-CID engine which they feel is "plenty boss." Generally, the numbers refer to cubic inches of engine size. European terminology usually expresses the same designation in liters, such as a 3.0 Ferrari (3 liters, or 183 cu. in.).

Q. I have been hearing big plans from something called March Engineering. What is it?—R. K. McAfee, San Diego, Calif.

A. March is a new organization in England which is building Formula 1, 2 and 3 cars, plus a Group 7 car, for 1970. It is headed

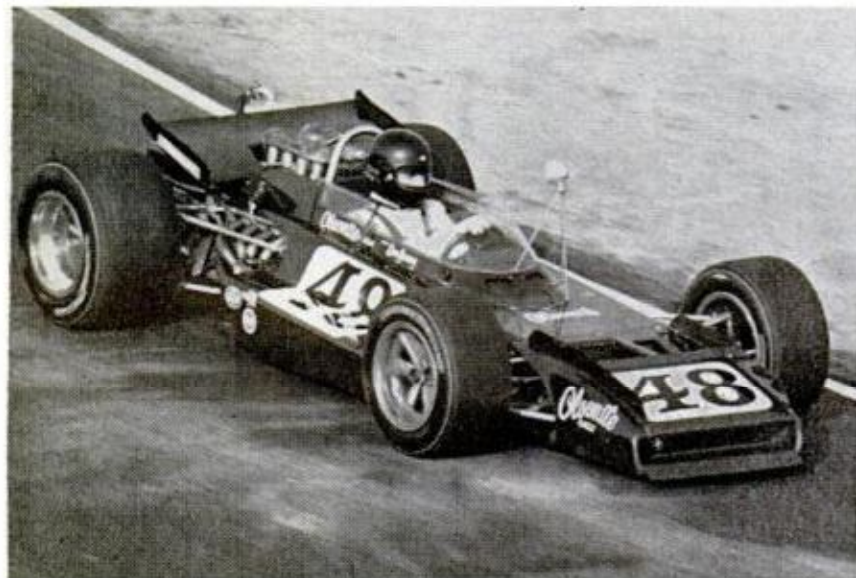
by Max Mosley, Sir Oswald Mosley, and Robin Herd, a designer who last worked for Bruce McLaren. I understand they have already signed Chris Amon for a team Formula 1 ride and that they will build a Formula 1 chassis for Jackie Stewart. If all their plans materialize, they should be a formidable new force in international racing.

Q. Will you be driving in the U.S. Grand Prix or any other Grand Prix races this year?—Billy Wells, Syracuse, N.Y.

A. I was offered several very flattering rides for the 1970 Grand Prix series, but my racing plans for Trans-Am and Indy cars made it impossible for me to accept. However, I do hope to secure a good car for the U.S. Grand Prix at Watkins Glen, N.Y., in October.

Q. I see most magazines are picking the Ford Mustangs to win the 1970 Trans-Am championship or possibly Jim Hall's Camaros; and Roger Penske was quoted as saying he expects to win seven races with the Javelins. Where does that

(Please turn to page 28)



THREE LAPS TO GO and it looked like Dan had another Rex Mays 300 wrapped up. On the 116th lap of the USAC Championship race at Riverside, Gurney's Olsonite Eagle broke a half shaft leaving him with one-wheel drive. After leading most of the race, he was forced to slow down, allowing Mario Andretti and Al Unser to pass him. Instead of a third consecutive Rex Mays 300, it was a finishing position of third

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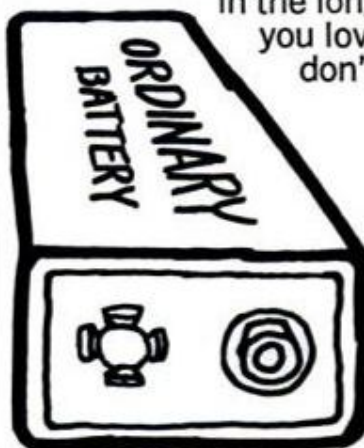
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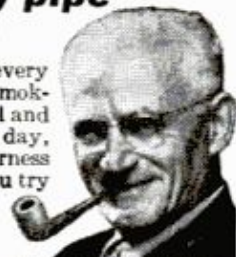
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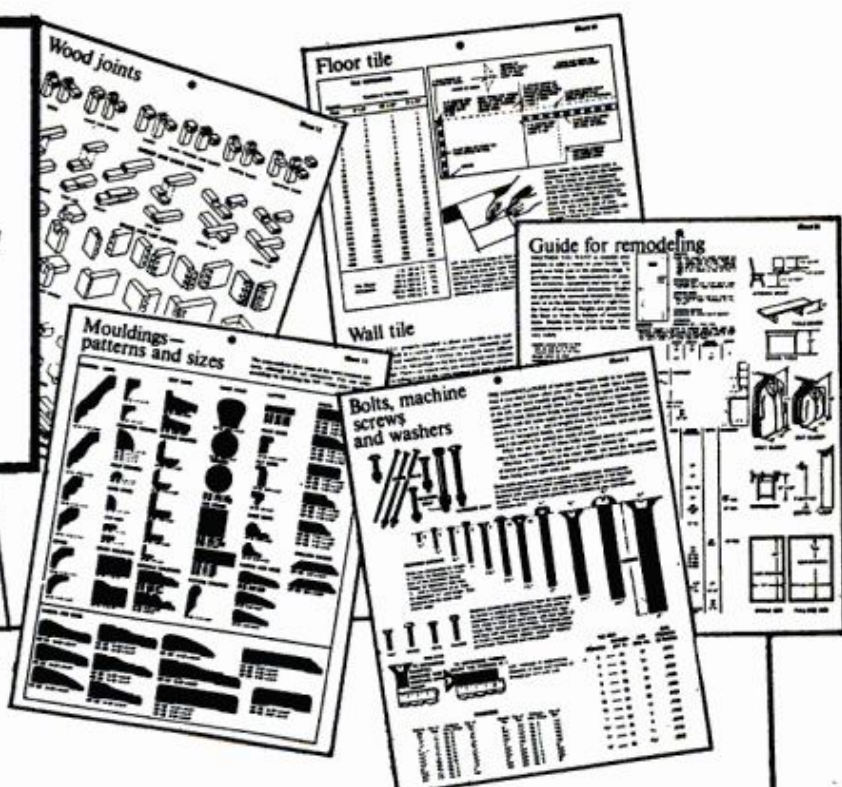
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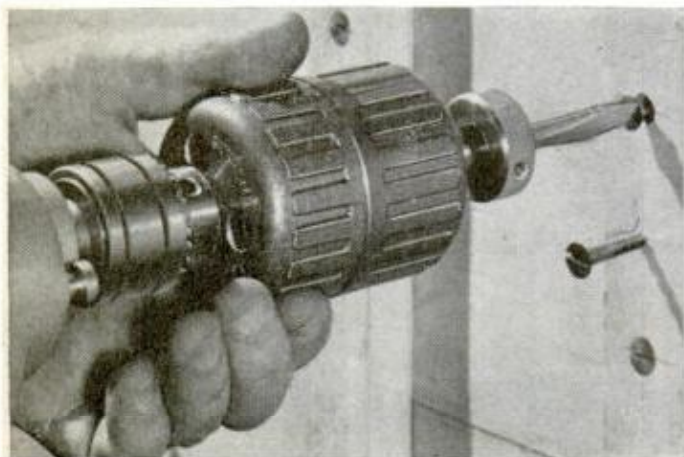
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DRIVIN' WITH DAN

(Continued from page 24)

leave you and the Barracudas?—Art Mulloy, Atlanta, Ga.

A. About where most football coaches would prefer to be before the season starts. There certainly is justification for high regard of the Ford, Camaro and Javelin teams because of their several years of battle testing in the Trans-Am, compared to the fact that it is the first effort for our company and, really, for the Barracuda. However, we plan to be in the thick of things and hope to cause some indigestion among the predictors before it's over.

Q. *What kind of racing will your All American Racers be doing in 1970?—Brian Davis, Chicago.*

A. We have decided to run the two big 500-mile races for Indy cars, at Indianapolis and Ontario, Calif., plus as many as possible of the Indy-type road races. Our other major effort will be fielding a two-car team, with Swede Savage and myself driving, of Plymouth Barracudas in the Trans-Am sedan championship series. We hope to run one or two Can-Am races in the California area, but at the moment, Indy and Trans-Am seem to be the best areas in 1970 for spectator appeal and good competition.

Q. *Whatever came of all the talk about four-wheel drive in Formula 1 and Can-Am racing?—Bill Maxwell, San Diego, Calif.*

A. Not much. It is generally felt, in both Can-Am and Formula 1 circles, that four-wheel drive does not provide enough improved performance to merit the difficulty and expense it requires. Rumor is that both Lotus and Matra, who tried it in Grand Prix racing last year, will not experiment with it any further in competition.

Q. *Is it true most stock-car drivers are also bootleggers?—Daryl Kline, Minneapolis, Minn.*

A. I presume you are talking about the legendary NASCAR southern variety. Although I have never lived in the South, I have many friends there who have been involved with stock-car racing virtually from its beginning. As I understand it, in the early days there were several drivers, including a few who

(Please turn to page 32)

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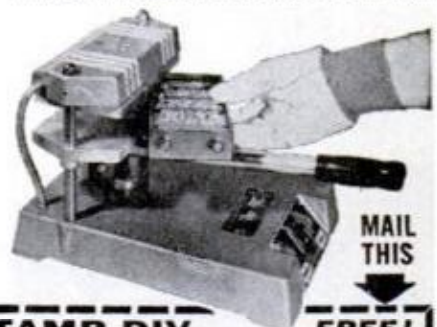
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DRIVIN' WITH DAN

(Continued from page 28)

became famous, who wore two hats. Today, however, late-model stock-car racing has become so professional that I doubt if there are many throwbacks to those "good old days."

Q. I have been trying to find out who won the American Motorcycle Assn. Grand National Championship in 1969. Do you know?—Bob Robinson, Tempe, Ariz.

A. The winner of the 1969 Grand National Championship was Mert Lawwill on a Harley-Davison.

Q. Some stories on the Sebring Formula A championship race had Mario Andretti on the pole in a Lotus and others said it was Swede Savage in an Eagle. Which was the case?—Rich Davis, Tallahassee, Fla.

A. It was Swede Savage. Mario, who was driving a new Ford-powered Lotus, held fast time until almost the end of the qualifying session when Swede turned his pole-winning time in a Plymouth-powered Eagle. I thought

it was a remarkably fine job by Swede, who, as you may know, is a team driver for our company. He was pretty much a last-minute entry. Mechanical troubles forced both Savage and Andretti out of the race which was won by David Hobbs.

Q. I heard you were working on an odd-size engine for Can-Am last year. What was it and will we ever see it?—Gary Haverson, Mobile, Ala.

A. When Ford was unable to deliver our 494 alloy engine we began work on an engine based on the alloy Ford 351 block which came out to 396 inches. We had available two and three-valve Eagle cylinder heads but were never able to get enough other parts necessary in time to field the engine. I imagine that in a proper state of development it could still comprise a competitive powerplant for Can-Am. We have it on the shelf and there is a possibility we may yet use it. ★ ★ ★

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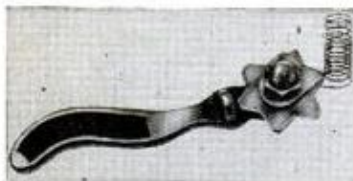


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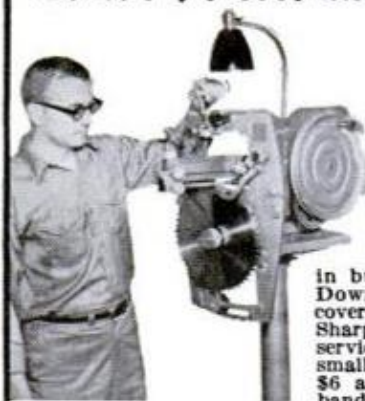
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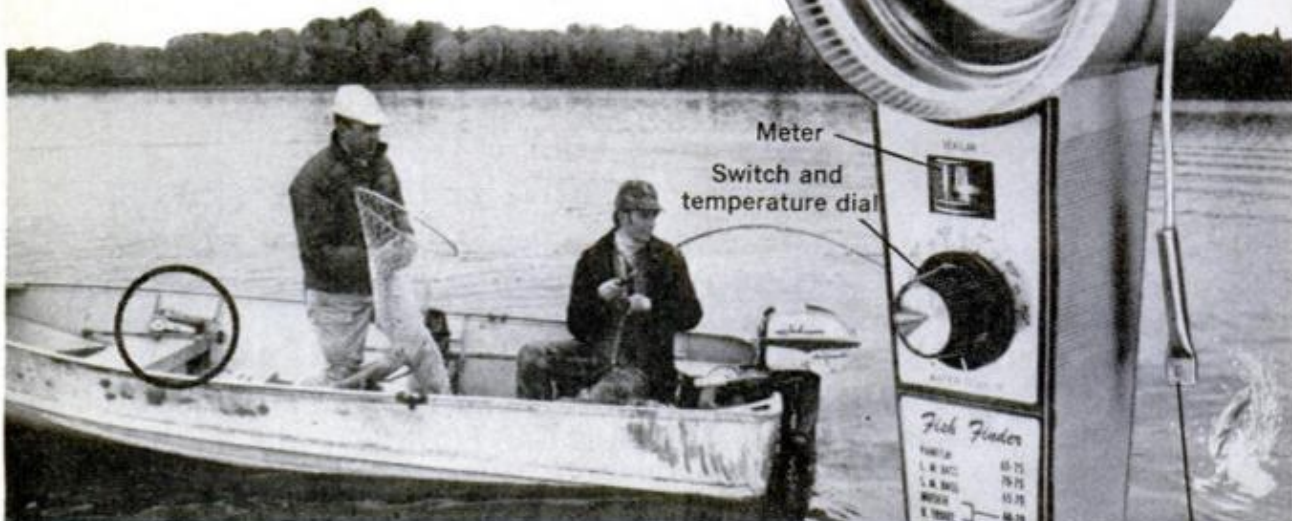
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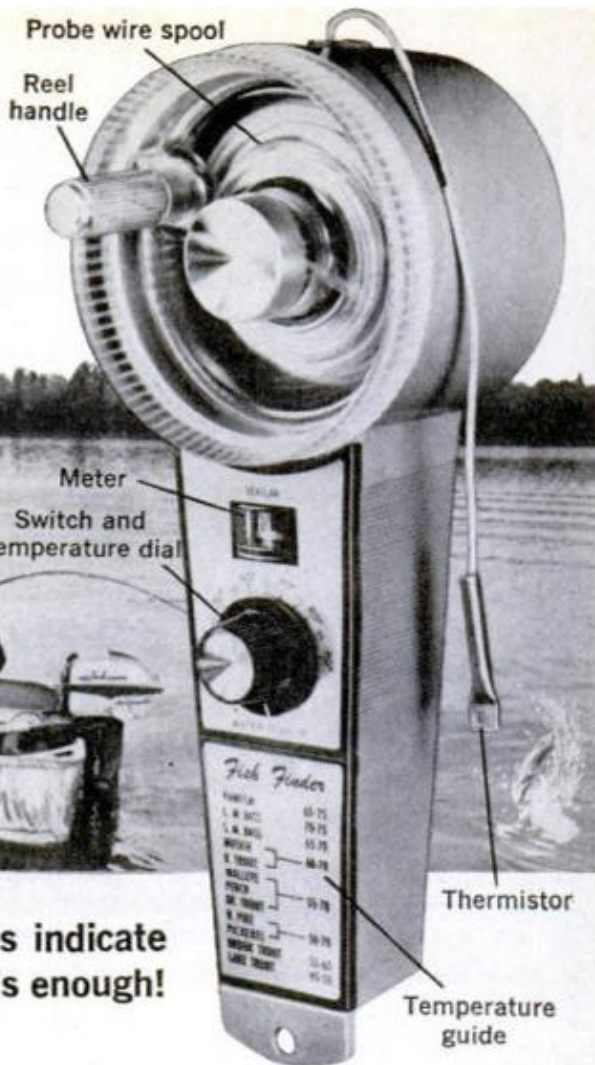
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By GEORGE REIGER



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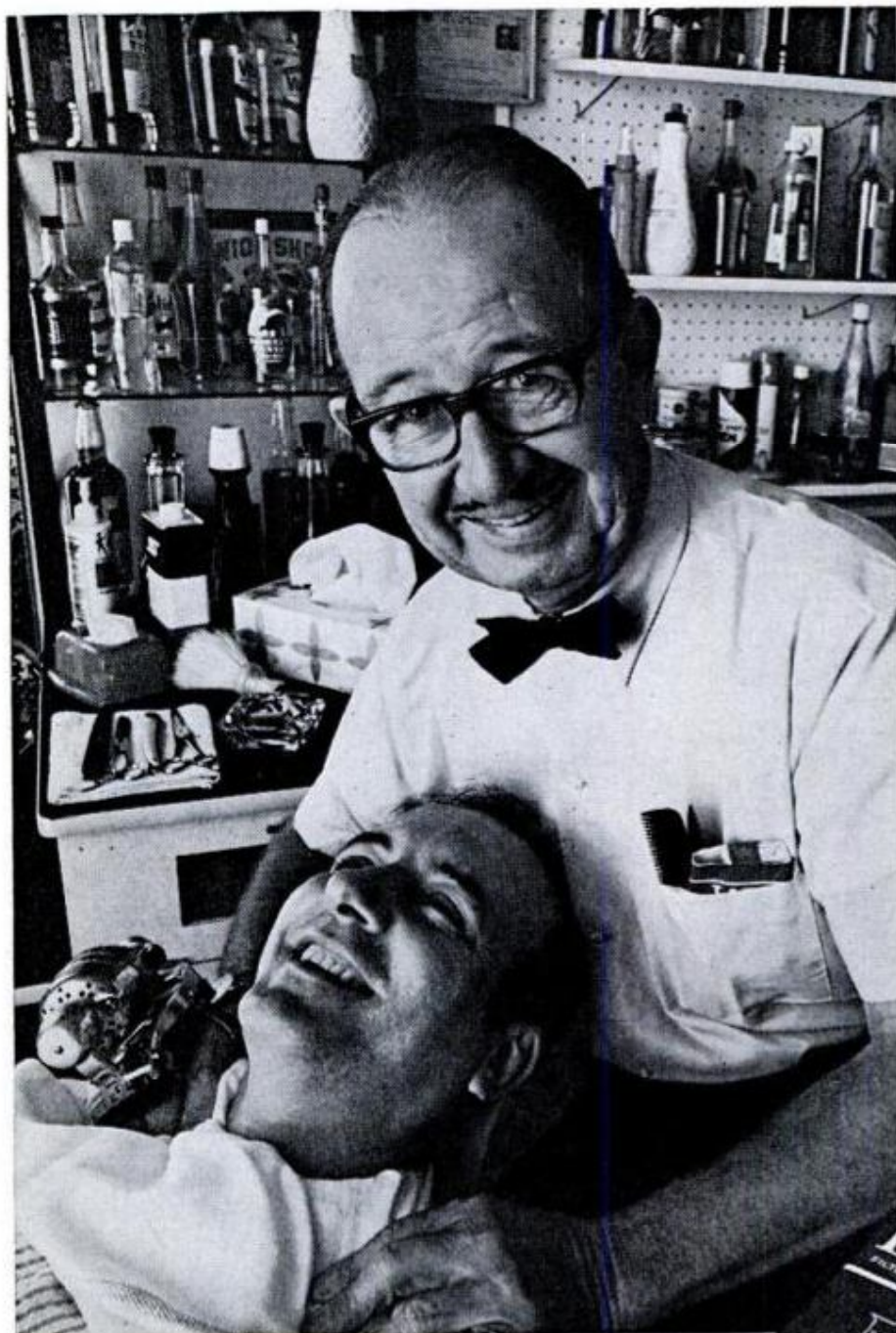
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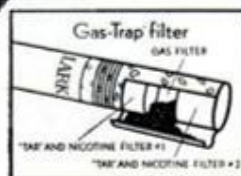
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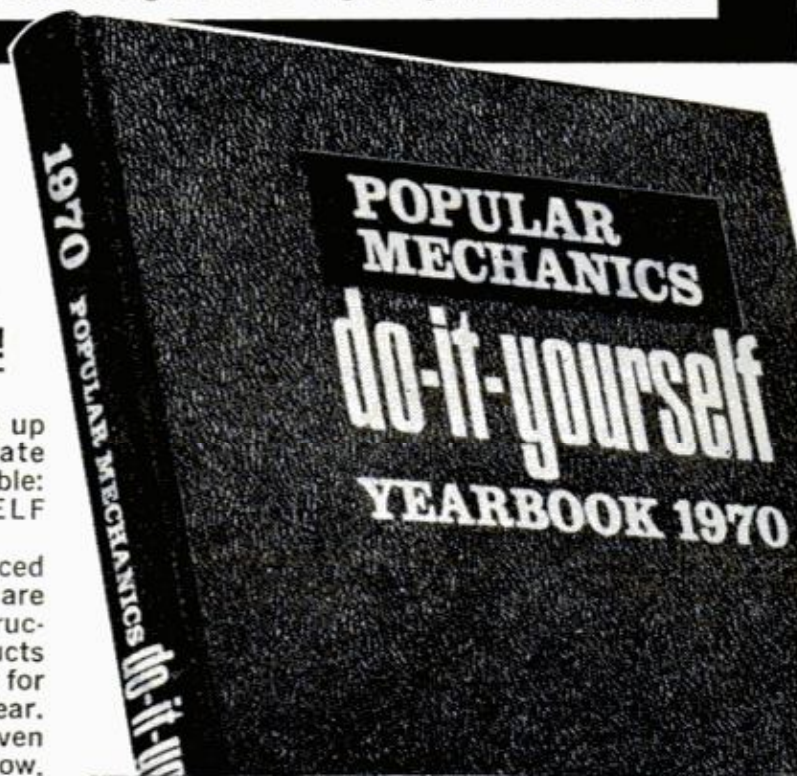
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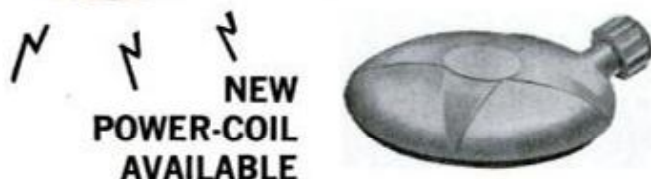


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The 1970 Camaro— Better for Being Late

The late debut gave the folks at Chevy time to shape some exciting new sheet metal and build in a lot more. Read on!

By MICHAEL LAMM
West Coast Auto Editor

PUTTING THE NEW CAMAROS through Riverside's esses proved their excellent overall performance and stability. The 1970 Z28, again with absolutely superb suspension and a new underrated 360-bhp V8 (up from 302 last year), held its own nicely in impromptu jousts against a 1970 460-bhp Corvette.

Camaros this year are no heavier than last, but power is up for all engines (see chart, page 48). Three-speed manual transmissions now come only with the standard Six and 307-CID V8; four-speeds only if you order an optional V8. Automatics—Powerglide and Turbo Hydra-Matic—are similarly segregated.

This is the Camaro's first major restyling since its introduction in 1967, and again it shares body basics with the Firebird (see page 50). New Camaros, though, borrow frontal flavor from the 1970 Monte Carlo and rear treatment from the Corvette. The pony car's wheelbase stays at 108 inches, but there are now two more inches in overhang. One of these is up front and, with the windshield moved back three, there's a four-inch increase in hood length. Yet Chevrolet engineers did manage to add almost two more inches of legroom (at the expense of trunk space).

Camaros go with semi-unit construction again in 1970. There's a redesigned front frame that bolts to the frameless main body section. The front frame, which carries engine, transmission, steering and front suspension, is heftier this year, having spring seats and skid plate welded in. Then, from the firewall back, the body takes the form of a single welded-up unit. These two sections bolt together through six big rubber doughnuts, an arrangement that helps keep weight down slightly, at the same time isolating road noise and shock.

Some owners of earlier Camaros had complained

(Please turn to page 46)



CAMARO SS front-end treatment features a full-width front bumper which divides the grille. Turn-signal/parking lights are below the bumper. Standard on all Camaro models for 1970 are front-wheel disc brakes



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Or maybe you make the wrong turn on an old logging road. And you find yourself on the rocky, rutty road to nowhere.

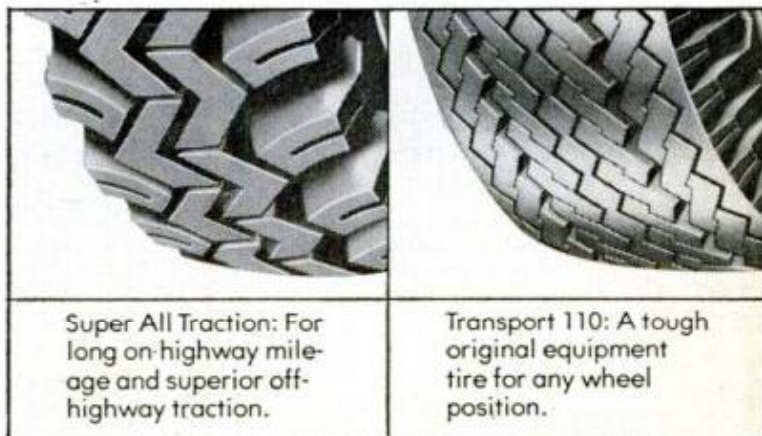
Unexpected? Sure. But isn't it nice to know that you're prepared for it? With reasonably priced tires that are built to take *unusual* punishment. Tires that will do a first-rate job of protecting the major investment you have in your camper.

For example, there's the Transport 110, an all-wheel tire from Firestone with quiet running and long mileage built right in. Moreover, a tire with remarkable impact resistance, and construction that minimizes flex damage.

And for a brawny tire that will really dig in and grab in mud, snow and deep ruts, Firestone makes the Super All Traction. This rear-wheel tire just plain eats up the unexpected!

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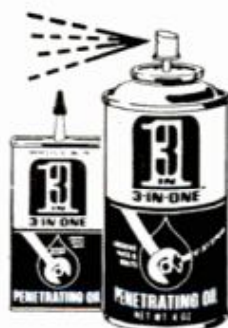


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REAR THREE-QUARTER VIEW of Z28 model shows car's Corvette-like rear end, emphasizes new styling



CAMARO DASHBOARD has been completely redesigned with a wraparound theme. Mirror bonded to windshield glass is new. Hidden wipers are optional

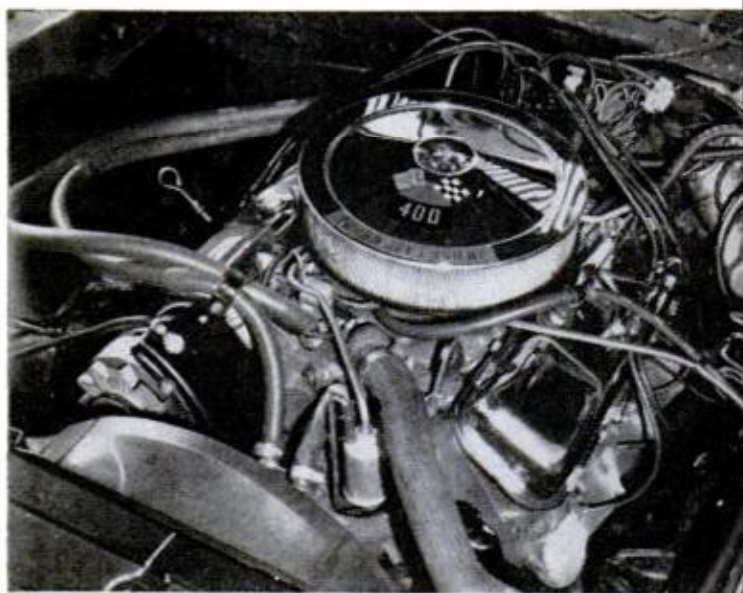
THE 1970 CAMARO

(Continued from page 40)

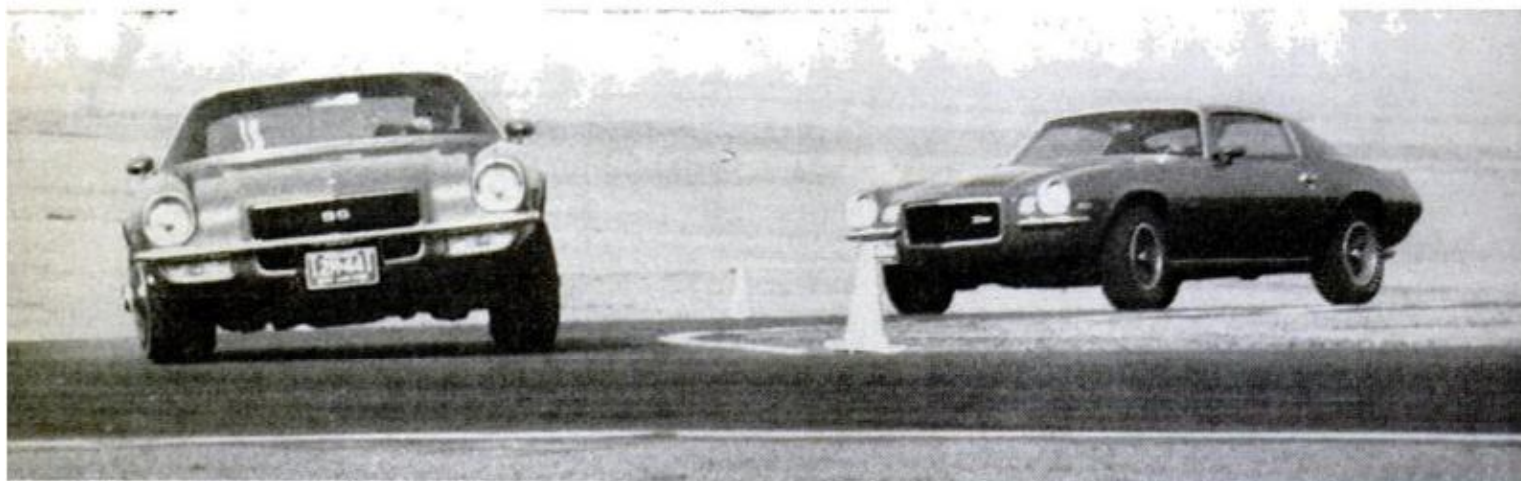
of undue body twisting and front-end shake resulting from this two-piece construction. So for 1970, Chevy engineers have increased sturdiness and silence by adding ribs in various areas, also box sections, and by reinforcing the chassis underbody. They've added a cargo barrier bulkhead between the rear seat and the trunk, and they've given the roof a double steel shell. Here, by using an inner steel roof just under the normal one—the inner full of tiny holes—then by putting a Mylar acoustical blanket beneath this double steel chamber, they added rollover strength to much better sound deadening.

Front disc brakes are now standard on all Camaros, but unhappily last year's four-wheel disc option for the Z28 has been dropped. "Too expensive," says

(Please turn to page 48)



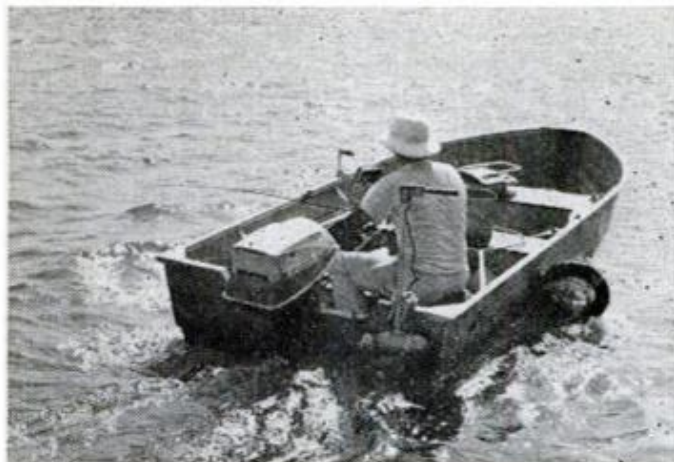
"TURBO-JET 396" V8 engine is plugged as "400" on the air cleaner. Specs give actual displacement as full 402-cu.-in. Brake horsepower at 5200 rpm is 350



SS AND Z28 CAMAROS joust on esses at Riverside International Raceway, site of press introduction last December. Chassis refinements for '70 improve excellent '69 set-up. Variable-ratio steering is option

TROLLING IS AN ART THAT CAN BE IMPROVED WITH SCIENCE

by Bob Cobb



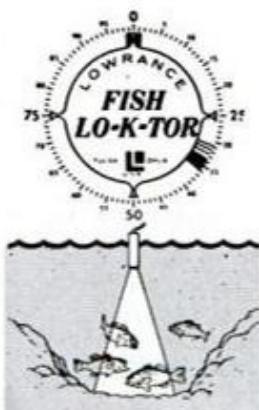
Trolling will often produce fish when no other method works.

You couldn't hold a boat to fish. The wind was howling. And, the temperature would boil a coffee pot. But to see Sam Jackson, Jr. struggling to haul a stringer of fish to the dock, you'd bet your fishing hat conditions were "A-Okay."

"Where did you have those fish staked out? You couldn't have caught them today," noted a wide-eyed skeptic who sauntered down to the dock.

The skepticism wasn't surprising; 22 white bass and five black bass add up to a respectable score. Sam and I had caught them all trolling.

The apparent simplicity of trolling dupes some observers into thinking this effective technique is a matter of dunking a lure overboard and revving up the motor.



Old creek channels are ideal trolling areas. Exact location and proper depth can be determined with Lo-K-Tor.



Increase fishing fun with a scientific Fish Lo-K-Tor

See how the Fish Lo-K-Tor finds fish. Your sporting goods dealer has a special demonstrator display you operate yourself! Portable and guaranteed. \$169.50

For installing on your boat!

New Depth Sounder and Fish Locator
Two instruments in one, with special high speed transducer. Gimbal mount. \$169.50



Trolling demands a measure of know-how for results. A successful troller has an understanding of the waters he fishes. With a sonar bird dog like the LO-K-TOR you can discover the "breaks" in underwater structure, as a sharp drop-off on a sloping ridge. You can follow more accurately the direction of underwater bars and reefs; areas where fish concentrate. You can find underwater weedbeds, brushpiles and treetops.

A successful troller is constantly experimenting with boat speeds, various fishing depths and an assortment of lures. Trolling can be just as scientific as you want to make it.

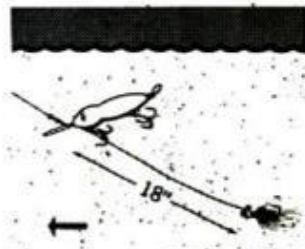
Here's a LO-K-TOR technique that helped us beat the summer slump. Sam used the sonar depth finder to follow an old creek channel in the lake, which evidently was cooler. The fish were using the deeper channel as their "air conditioner."

One of the key factors in selecting a lure for trolling is the depth it runs. I've used the LO-K-TOR to classify lures in my tackle box by the bottom-bumping level of each.

The LO-K-TOR showed fish at 18-feet deep in the channel. Diving plugs were used. Examination of the first white bass's stomach showed small shad. The score really picked up when we tied a 1/16-ounce white marabou jig on an 18-inch drop line tied to the plug's front treble hook. Attaching it to the forward hook digs the plug deeper.

"The thing that makes trolling successful is that you've always got your bait in the water," said Jackson. "You don't get many strikes with it in the bottom of the boat . . . running from one spot to another."

For a serious troller, a FISH LO-K-TOR ranks in importance with his boat and outboard motor.



Adding jig to deep diving lure puts bait at level of fish.

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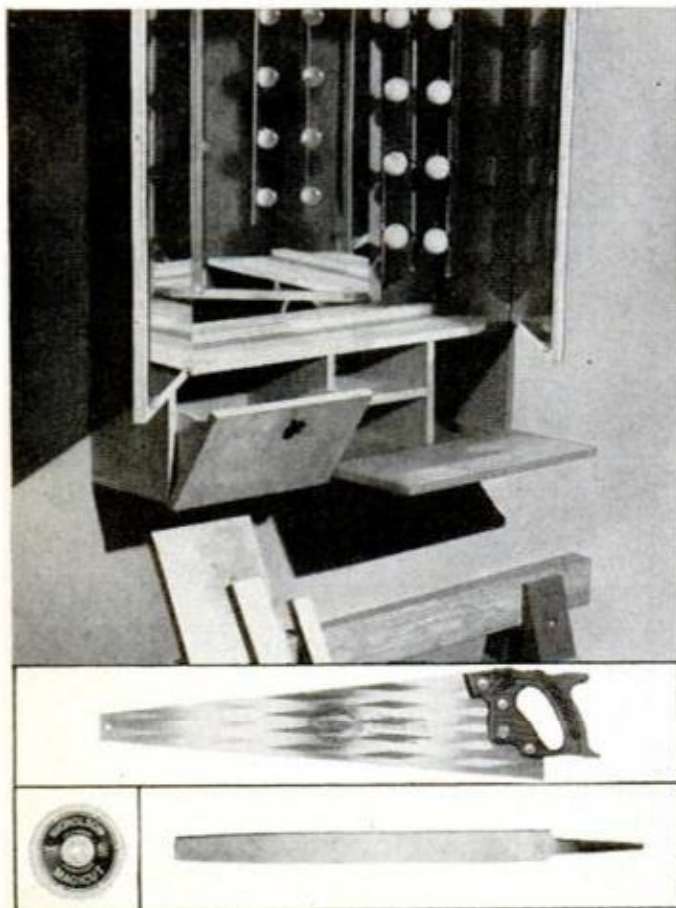
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Nicholson File Co., Providence, R. I.



THE 1970 CAMARO

(Continued from page 46)

Chevy. The new standard discs have an integral hub and rotor, both being cast in one piece.

The Camaro's general suspension layout hasn't changed, although stability and cornering have improved through a wider tread, heavier front stabilizer bar and staggered rear shocks in all series. On the hotter-engined models, suspensions are tuned to match power output and engine weight. These cars have bigger front anti-roll bars, the addition of rear stabilizers, heavier shock absorbers, plus different tires. Low-bhp Camaros get 14-inch wheels while the stormers use 15-inchers.

Pony car sales slipped in 1969, and some observers put the blame on uninspired styling face-lifts. Chevrolet hopes the 1970 Camaro's fresh new look will help bring back some of those lost sales. ★★

1970 CAMARO POWER TEAMS

Engine CID	Horsepower @ rpm	Torque @ rpm	Transmissions Available
250 Six	155 @ 4200	235 @ 1600	3-spd. manual 2-spd. Powerglide
307 V8	200 @ 4600	300 @ 2400	3-spd. manual 2-spd. Powerglide 4-spd. Turbo Hydra-Matic
350 V8	250 @ 4800	345 @ 2800	4-spd. manual 3-spd. Turbo Hydra-Matic
350 V8	300 @ 4800	380 @ 3200	4-spd. manual 2-spd. Powerglide 3-spd. Turbo Hydra-Matic
350 V8	360 @ 6000	380 @ 4000	4-spd. manual 3-spd. Turbo Hydra-Matic
396 V8	350 @ 5200	415 @ 3400	4-spd. manual 3-spd. Turbo Hydra-Matic
396 V8	375 @ n. a.	n. a.	4-spd. manual 3-spd. Turbo Hydra-Matic
454 V8	450 @ n. a.	n. a.	4-spd. manual 3-spd. Turbo Hydra-Matic

DIMENSIONS

Wheelbase	108 in.	Height	50.5 in.
Overall length	188	Tread (front)	61.3
Overall width	74.4	Tread (rear)	60.0

'Acoustic priming' dooms mice

Basing research on the fact that the loud sound of an electric bell can kill mice, University of Wisconsin psychologists are trying to learn what the effect of increasing noise levels will be on humans.

Kenneth R. Henry and Prof. Robert E. Bowman of the Wisconsin Regional Primate Research Center are using a new technique—acoustic priming—to study the effects of noise on body processes of mice.

A mouse can be primed by exposing it to an intense sound. When exposed to the same sound a few days later, the sensitized mouse is very likely to have a convulsion which can be fatal. Without priming, few seizures, and no lethal seizures, occur.

It is thought that the priming may result in some highly specific damage in the nervous tissue of the brain, a process that takes several days to complete.

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J. M. ROGERS, Pennsylvania • "Worked 7 hours yesterday, earned \$85.56. Part-time last week netted \$103.70."

ROY NELSON, No. Carolina • "I am doing real well with the Upholstery Deterger. I grossed \$204 in four days last week and have plenty more work. Everyone is very well satisfied."

BOB GREENBERG, California • "First month I made over \$800; now 80% to 90% are old customers."

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A Flock of Firebirds for 1970

They're all two-door hardtop coupes, but they're set up to suit your taste: five engine variations, spoilers, scoops—you name it!

By **BILL KILPATRICK**
Photos by Bill Morris



HOOD SCOOPS mark Formula 400 version, force cool air to carburetor. Car's only 50.4 in. high overall

DOING an effortless 100 mph on the flat, inside lane of the big oval test track at GM's Arizona proving grounds in Pontiac's new Firebird is a revelation:

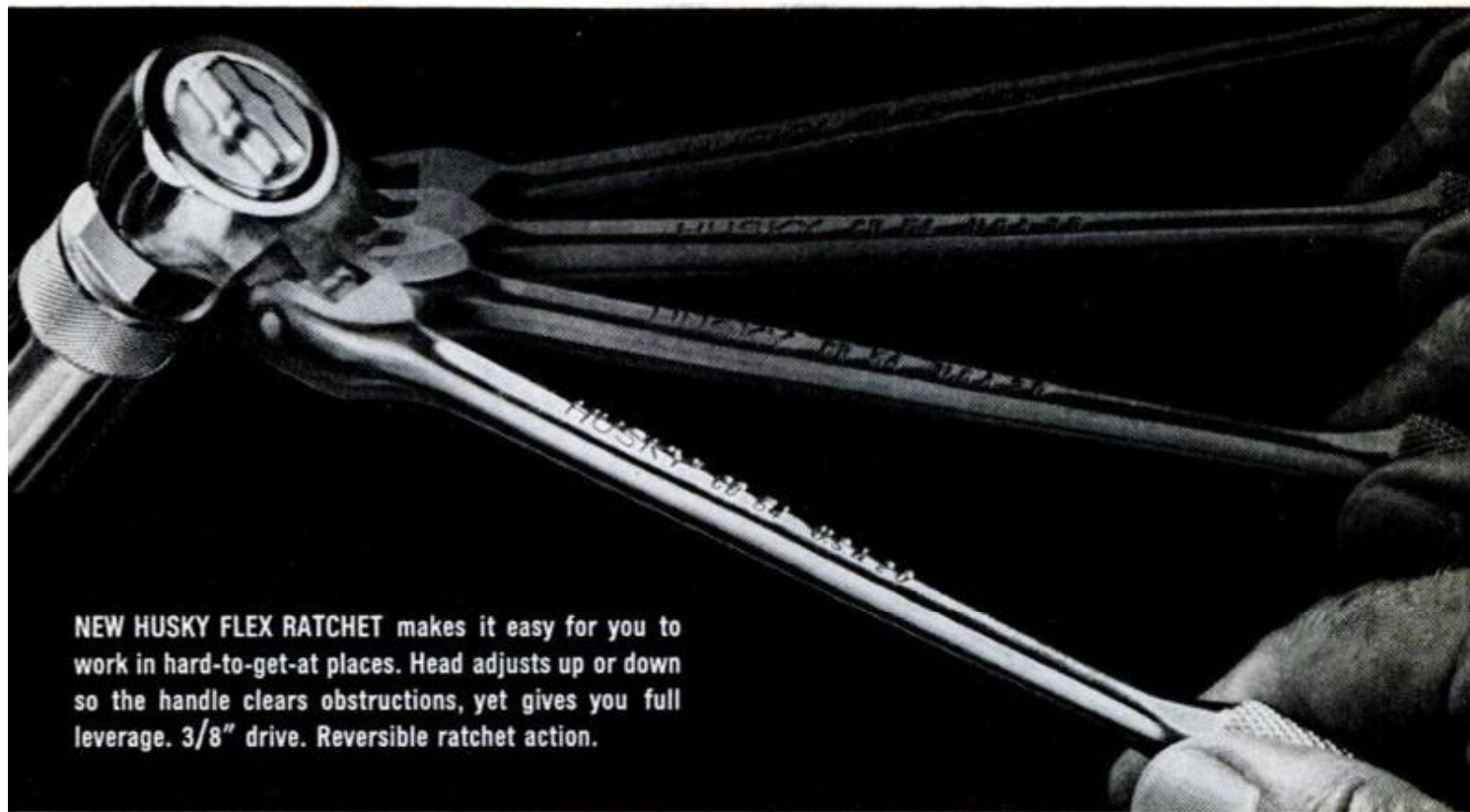
It indicates Detroit *can* mass produce a good, well-thought-out, straightforward car that will go like the hammers of you-know-where, quietly, without all the nonsense usually appended to so-called "super" cars. What's more, it indicates our guys can engineer a handling setup comparable to some of the finest European GTs.

I say "indicates" because I didn't get an opportunity to really wring things out or drive the car lots of miles over all types of roads under a variety of conditions. But what time I *did* get to spend in the new Firebird leads me to think the Pontiac people know what they are about. The new Firebird is a smart-looking, flexible package I would imagine will prove a big hit with "personal car" buyers.

The car is available only as a two-door hardtop coupe. However, the single model comes in four versions—a standard, a luxurious version called Esprit, and two high-performance versions dubbed Formula 400 and Trans Am.

In styling, the car—at least in the standard and Esprit versions—is happily free of tortured lines and afterthought gimcrackery. From the front rubberized-plastic "Endura" bumper to the recessed

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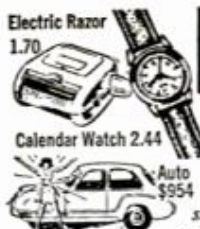
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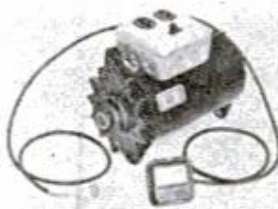
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I still have to pinch myself every week when I open my pay envelope—it seems too good to be true!

Especially when I remember how sorry everyone felt for me because I couldn't go on to college with the others in my high school class. "How are you ever going to make it now?" people kept asking me. "Without college, it's a losing battle. Everybody knows that!"

Well, the college boys left for school, and I got my first job. And it was tough going for a while, I'll admit that—one dull, routine thing after another. From pumping gas to driving a cab to working on an assembly line in a factory, I worked hard but never "struck it big."

Then I read an announcement like this one about the opportunities in Electronics.

I discovered that, with proper training, I could have my

pick of thousands of glamour jobs—in fields like radio and TV broadcasting, automation, computer servicing, or even the aerospace program.

And I found out that as you move up the ladder in this booming field of Electronics, you can earn the kind of money that even a college man could be proud of—up to \$5, \$6, \$7 an hour...\$200, \$250 a week...\$10,000, \$11,000, even \$12,000 a year!

And—most important—I realized how easy it would be to get the training I needed to break into this great field. The announcement said I could learn everything I needed to know, right at home in my spare time, with a home study course from the Cleveland Institute of Electronics.

Well, to make a long story short, I enrolled with CIE. I found that their courses had taken what seemed like a complicated subject and broken it down into easy steps. Sympathetic instructors sent me letters helping me over the rough spots. I really learned fast. And here I am now, a respected Electronics man—earning so much money I still have to pinch myself.

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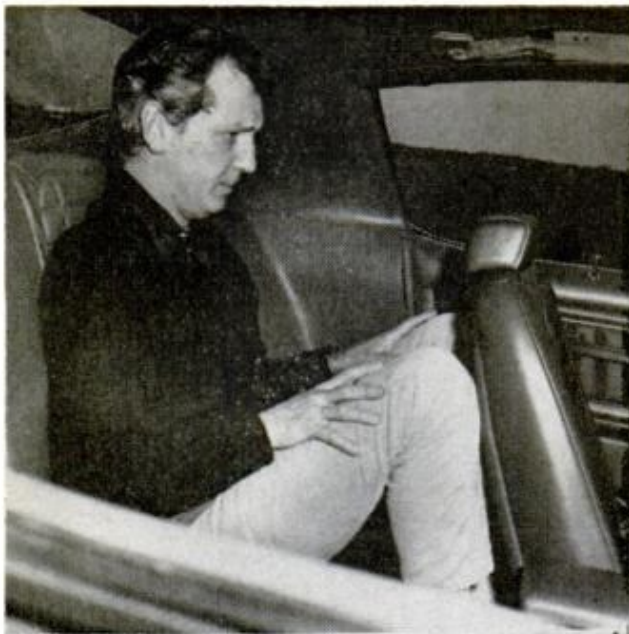
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PM-37



HEAD, KNEEROOM is small in back, like all "pony" cars, tight fit for six-footers. Rear seats are buckets

rear license plate bracket, the flow of line is clean and "of a piece." The theme is long hood, short rear deck—nothing new—but the execution is one of the best we've seen. This sort of thing is personal, of course, but even Pontiac-haters (assuming there are any) would have to admit it's a job well done.

It's when hp goes up that things tend to become tacky. I've never been a fan of hood scoops, spoilers and the like. To my eye such gimmicks look ridiculous. But you'll find 'em slapped on both the Formula 400 and the Trans Am. Too bad, because they clutter up a good design.

You'll like the new Firebird's doors. They're big and cut back far enough in the rear quarter so that access to the back seat isn't a contortionist's nightmare.

There's a lot to like inside—again, a clean, uncluttered look, an optional pad-



FIREBIRD CONSOLE is neat, uncluttered, as is dash panel. Seating is comfortable, driving position good

ded steering wheel, a *complete*, easy-to-read instrument panel, *rear* bucket seats, a tidy console, and so on, all of it evidence Pontiac has been paying attention.

The standard engine for the new Firebird is a 250-CID Six. Optional, depending upon what version of the car you might want, is a 350-CID V8 or one of three 400-CID V8s—a two or four-bbl. or a ram air. Transmissions include a three-speed manual, a two or three-speed automatic, and a four-speed floor-mounted manual.

The wheelbase of the new Firebird is 108 in. Overall length is 192.3 in., width 73.4, height 50.4. Track width is a shade over 61 in. up front, 60 and a fraction in back. Front disc brakes are standard, with drums to the rear, both heavy duty.

As I hope you can tell, I liked the car. I think you will, too. ★★★



FRONT BUMPER of rubberized plastic wraps around single headlamps, blends smoothly into hood, fenders



AIR SPOILER is featured on rear deck of Trans Am version of Firebird. Note "airdams" on wheel openings

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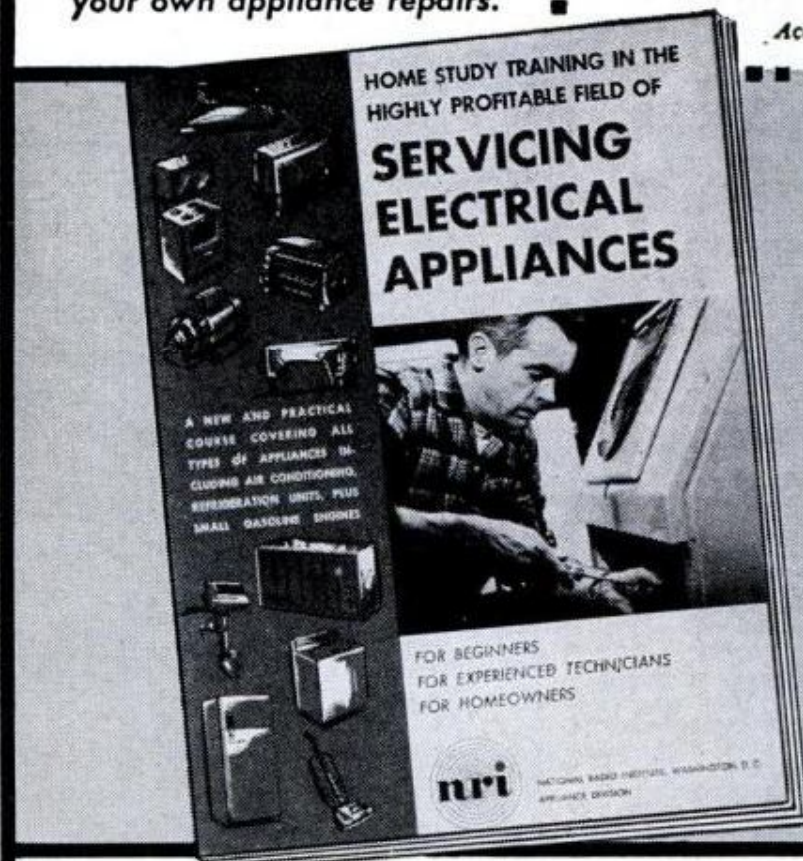
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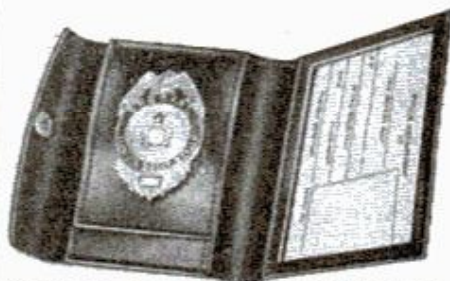
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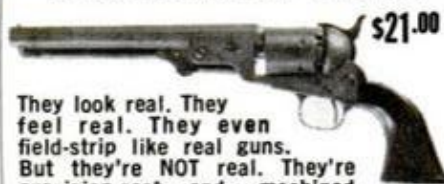


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(Continued from preceding page)

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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Don't cool it

My 1964 Pontiac Grand Prix operates at 240° F. In traffic on a hot day, it goes to 245°. I fear overheating. How can I get the engine to run cooler?—Harry A. Tallia, Garfield, N. J.

You don't. The engine is operating perfectly now. The ethylene glycol antifreeze you're using in that pressurized cooling system won't boil until it reaches 265° F. If you want a more thorough explanation, see *Hot Tips on Engine Cooling*, page 138, Aug. '69 PM.

Carburetor culprit

My 1963 Chevrolet Biscayne starts great when it's cold, but as soon as I accelerate the engine poops out. It stalls several times before catching. I've had the carburetor overhauled. What else can I do?—Harry Roccisano, Watkins Glen, N.Y.

It's got to be carburetion, specifically a choke problem or an accelerator pump that's not supplying enough fuel. Some V8s with Powerglide in this model year had a nasty habit of overchoking, causing rough idle and stalling during cold weather. A revised choke piston (part No. 7008937) was issued to correct the problem. This applies to carburetors that have the letter B stamped on their identification tags. If yours does not, you might want to try the new piston anyway. Keep the choke setting at "index."

Buck-passing

I bought a new 1968 Ford Country Squire station wagon equipped with Firestone tires. The rear tires wore unevenly and rapidly—Ford and Firestone agree to that. Yet, neither would admit his product was to blame. Each told me it was the other's fault. What's a guy to do when two manufacturers insist on passing the buck?—Shaun A. Seymour, Ephrata, Pa.

You use the term "manufacturer," but I'm wondering if you didn't mean to say that the two dealers have been passing the buck. The manufacturers have told me that if a customer has a complaint he should, as you have done, return to the dealer. But if you don't get satisfaction,

they say, you should then write to the customer relations department of the manufacturer. Your letter should outline the problem and give details such as the name of the dealer, the product identification, date of purchase, and dates that you brought the problem to the dealer.

Creeping crack

I've just purchased a used 1967 Oldsmobile with a small chip in the windshield that's beginning to crack. Can I do anything to stop this crack from spreading?—Miss G. Weber, Nashwaaksis, Canada.

Sorry, but no. This is tempered glass. Once its seal is violated, so to speak, vibration spreads the damage. You'll eventually have to replace the windshield.

Curing a surge

I have a 1968 Mercury Cyclone with 428-cu.-in. Cobra-Jet engine that surges under all conditions except acceleration. The dealer has yet to help. Can you?—Paul Hytinen, Groton, Conn.

I don't know what the dealer has done, but the cause of surging is to be found in the fuel system. A restriction in the carburetor, for example, could keep a full flow of fuel from reaching the cylinders. Before pulling the carburetor for overhaul, however, check the fuel lines and filter to make sure they're not obstructed. I'd also run a test on fuel-pump delivery to make sure it's sending the specified amount of fuel to the carburetor.

Bit of chatter

What would cause a six-cylinder Jeep to have clutch chatter in reverse gear?—Howard Becker, Geneva, N. Y.

The clutch linkage could be out of whack, of course. More likely, the rubber grommets used to mount the transfer case on the frame crossmember are worn or damaged. Have them replaced.

Whose tire pressure?

I recently purchased four new fiberglass-belted tires for my 1967 Volkswagen squareback. Embossed on the side-

(Please turn to page 84)

Over-protective.



This is peace of mind by the quart. Use it and you know you're giving your engine the best protection money can buy.

Quaker State DeLuxe 10W-40 Motor Oil is deliberately designed to exceed the motor oil requirements of every car maker in the world. Every drop of Quaker State is refined only from 100% Pure Pennsylvania Grade Crude Oil, the world's choicest. And fortified by oil specialists to protect your engine under all conditions.

Think over-protective thoughts for your car. Ask for Quaker State wherever they care about cars. It's America's most preferred motor oil.

Quaker State your car to keep it running young.



AUTOMOBILE CLINIC

(Continued from page 82)

walls is the information that the maximum pressure is 32 p.s.i., cold. This is far different from the inflation requirement for my original tires. They called for 17 p.s.i. in front and 26 p.s.i. in the rear tires when the car is unloaded, and 17 p.s.i. (front) and 37 p.s.i. (rear) loaded. Do I inflate my new tires according to the tire manufacturer's recommendation, or do I inflate according to the manual which was prepared by VW?—J. Scott Bechtel, Burlingame, Calif.

Follow the tiremaker's recommendations!

All or nothing

Why does my 1967 Dodge Polara's gas gauge still read only $\frac{3}{4}$ full with a full tank even though I've installed a new gas gauge?—Robert L. Cook, St. Paul, Minn.

Because the problem's not with the gauge. The filler tube leading to the fuel tank in this car is very short. When the fuel-pump nozzle is inserted into the filler tube, its tip is probably positioned at the $\frac{3}{4}$ -full mark. If the gas station attendant doesn't top the tank after the nozzle shuts off automatically, your tank will be only three-quarters full.

Gas attack

All instructions I've seen telling how to check for a refrigerant leak in an air-conditioning system, including yours in *How to Keep the Cool in Your Airconditioner* (page 142, July '69 PM), say to use a propane torch. Isn't it true that when Freon is subjected to heat it forms the phosgene that was used in World War I? If so, isn't this a dangerous practice?—Lewis Brook, Rapid City, S. D.

When Freon comes in contact with an open flame, it does form phosgene gas. However, the amount is insignificant and will cause no ill effect.

All fueled up

Since I bought my 1969 Buick Electra 18,000 miles ago, it's been difficult to start when cold. It starts easy enough, but begins to idle very rough after running for

30 seconds. It often stalls and then it is impossible to start again unless I keep the gas pedal depressed to the floor. After warming up, it's fine. My dealer shrugs.—Edward Cohen, Marblehead, Mass.

The engine is obviously loaded with fuel because of an incorrectly adjusted choke system. There are three adjustments to make: (1) the vacuum break, which establishes the position of the choke valve after the engine's started; (2) the choke coil rod, which controls the amount of thermostat spring tension that's applied to the choke valve, and (3) fast idle. A balance of these three is necessary for good cold starting and warm-up, and each should be set to specification. However, if the engine has a tendency to load up anyway, I'd change the vacuum break setting so that the choke opens slightly more than the specified .180 inch. Adjust it for an opening of .200-.210 inch.

Service Tips

● 1969 Fords and Mercurys with 429-cu.-in. engines and airconditioning may be sounding off with a loud squeal while the airconditioner is operating. Fault lies with the airconditioner clutch. Tell your dealer he's authorized to replace that clutch with a Pitts clutch and a field coil—parts Nos. C9AZ-2884-E and C9AZ-2987-A1, respectively.

● 1969 Dodges, Chryslers and Plymouths with 383 and 440-cu.-in. engines equipped with Holley four-barrel carburetors may be experiencing a surge between 30-40 mph. It's caused by an imbalance between the primary and secondary-idle fuel mixtures that can be corrected by drilling the secondary-idle air bleed to .078 in. The idle-mixture screw-limiter caps should then be removed and the air/fuel mixture reset to specification.

● Original equipment batteries of 1969 Corvair, Corvette and Chevy vans are unique in that the cable-attachment terminals are located on the side of the battery rather than on the top. Cable attachments are threaded-type bolts instead of the spring-type you've been used to. Keep in mind that when cables are to be reconnected following battery service, these bolts must be torqued to 6-8 ft.-lb., so that the cable tang "locks" into the battery terminal to prevent the cable from loosening. ★ ★ ★

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



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Fish in comfort. This swivel seat screws right into the boat's seat.

Hull and gunwales are one solid piece of fiber glass. No seams or rivets to leak.

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Fishing boats used to be pretty much alike. Then Sears and a marine engineer came up with "The Gamefisher."

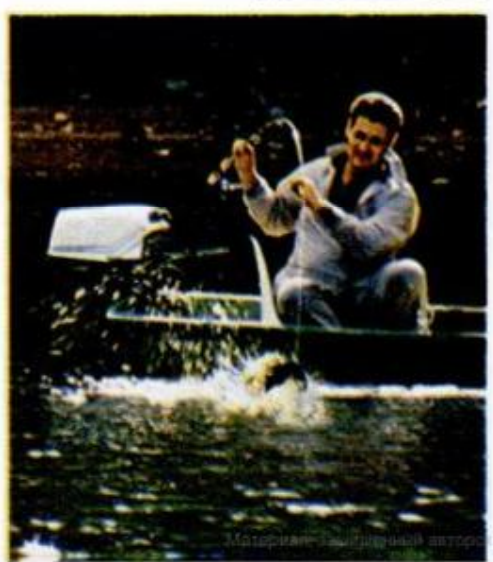
This check mark and signature certify Ted Williams, Chairman of the Sears Sports Advisory Staff, personally tested and approved "The Gamefisher."



Sears wanted to take a scientific approach to fishing boat design. So they asked a marine engineer to do something unusual: design a 12-foot boat—in fiber glass. It worked. He came up with a unique hull design that makes this boat ride steadier in any kind of water.

Then Sears had a boatload of extras built in—all the things a fisherman needs.

Tomorrow, see "The Gamefisher" in the Sears Sports Center. Or the Sears, Roebuck and Co. Catalog.





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

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

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

By Victor B. Mason

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

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

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

I Have All The Money I Need

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

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

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

A Fascinating and Peculiar Business

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

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

Are You Mechanically Inclined?

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

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

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

Does Happiness Hang on Your Decision?

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

VICTOR B. MASON
1512 Jarvis Ave., Suite M-2-C
CHICAGO, ILLINOIS 60626

A fast new way to blast carbon out of your car's engine.

What happens when carbon deposits build up in an engine? Power drops. Pickup slackens off. You start burning more gas and oil. Knocks and pings creep in. In some cases, you get "dieseling" or "after run" when red hot carbon particles on the piston head keep the engine turning over after the ignition switch is turned off.

You know all this. But sometimes it takes the jolting cost of an overhaul to make you really aware of the damage carbon deposits can do.

Carbon plus lead equals trouble. You get carbon deposits with everything you burn—logs in your fireplace or gasoline in your engine. But carbon deposits in your engine aren't like the soft soot that collects in a fireplace. Gasoline contains lead compounds and other non-combustible elements. These additives, under enormous heat of combustion, combine with carbon particles to form tough, flinty deposits that build up on pistons, valves and cylinder heads.

Some products promise to dissolve the carbon in your engine. Don't be taken in. This kind of carbon is almost indestructible. You can't *dissolve* these carbon deposits any more than you can dissolve diamonds.

But new, Fuel Mix Tune-up Concentrate will rid your engine of carbon deposits, quickly and easily. As easily as pouring a can of it into your fuel tank. Fuel Mix doesn't do a thing to carbon. But it's murder on the lead compounds that "cement" the carbon particles together. It reacts chemically with these compounds, breaks them down so effectively that carbon deposits flake off—and are blasted out through your exhaust system.



In the combustion chamber, hard, crusty carbon deposits build up on pistons, cylinder heads and valves to cause knock, ping, fuel waste.

protects your engine by lubricating the hot, oil-starved upper cylinder area to improve valve and ring action. Add a can to each tank of gas during the first 1,000 miles you drive a new car or rebuilt engine. It'll help prevent excess wear during those first critical miles of driving.

Use Fuel Mix regularly every 1,000 miles. You'll notice a big difference in engine performance almost immediately. Smoother, quieter running. Eager response. And power you forgot you had. But please don't take our word for it. Look for high potency Fuel Mix wherever fine automotive products are sold, and give it a try. Prove to yourself that it really works.



Before Fuel Mix is added to the fuel tank, piston heads are encrusted with layer upon layer of carbon and lead compounds.

After 4½ hours of driving, Fuel Mix has already removed most of the deposits, to improve engine performance and fuel economy.

GUMOUT Pennsylvania Refining Company
Cleveland, Ohio 44104

Also Available In Canada



A fast new way to
BLAST CARBON
out of your car's engine.
And it really works.

HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Wood "putty" beads

I have to reputty my window sashes every two years or so; the new putty loosens and falls out. I use a standard glazier's putty that can be painted immediately after application, or so it says on the label. Isn't there some substitute for putty that won't loosen and drop out, at least within a reasonable time?—D.A., Ala.

Do you clean the sash rabbets thoroughly—both wood and glass—before applying? Are you sure the wood and glass are thoroughly dry before knifing in the putty? Do you press the new putty firmly in place to force it under the edge of the pane as well as to fill the rabbet? Only affirmative answers to these questions indicate that you are carrying out the necessary steps to assure adhesion of new putty in what I assume are old sashes.

A substitute for putty? Well, yes, you can rip triangular strips of white pine to the size of the putty bead and brad these in place, mitering the strips at the corners to form a neat, tight joint. The strips should be painted on the unexposed faces before application, and must be painted immediately after application.

Walnut to fruitwood

The cabinet of my old sewing machine is made of solid black walnut and I'd like to give it one of the new fruitwood finishes. The old finish is in rather poor condition and must be removed. There also are a few minor nicks and dents but I do not care to correct them. How do I get the desired finish?—T.Y., Calif.

Any black-walnut cabinet in the solid wood is choice. Even if nicked, dented and worn it is still a first choice among the finest cabinet woods. For this reason I hesitate to go along with your suggestion of a fruitwood finish. It seems to me you would be better pleased in the long run to remove the old finish and refinish the wood in its natural color—about the simplest and easiest of all refinishing jobs.

However, if it must be a fruitwood finish, take off the old finish with a remover of the wash-off type. Permit the remover to work only through the old finish and not soften and remove the filler in the pores of the wood. Once the old finish has been softened to the wood, rinse thor-

oughly to remove all residues and then allow the wood to dry. Sand with a medium and fine abrasive to cut off any grain that may have been raised by washing off the remover. Then spray on the fruitwood finish (it's available in spray cans) and be careful to get it on uniformly without runs or sags. It is assumed you have first removed the sewing head, switch and all hinged parts.

Seedlings break through blacktop

Early last summer I had my driveway blacktopped. Within a month or so I noticed what appeared to be oak seedlings breaking through. I applied a weed killer and sealed what seemed to be a tiny opening. Now three other seedlings are coming through in different locations. What's the matter with the blacktopping? I thought it was impervious to any growth from underneath. Is there another way to prevent this?—G.B., S.C.

I don't know that anything is wrong with the blacktopping, provided it was properly put down over a tamped gravel fill. But seedlings can find their way through tiny openings or cracks. This leads me to suspect that the topping is settling due to inadequate fill or bedding, and that perhaps the topping is thin where the seedlings emerge. Or the topping may have been put down over earth, without a fill. Not an approved practice, this might lead to early breakup of the material, with fine cracks developing. Before you take other corrective steps, try an application of the asphalt-base coating especially made for resurfacing old blacktop. It's readily available, is relatively inexpensive and might well turn the trick without resorting to more heroic measures. Be sure to follow the instructions in all details.

Seepage or condensation?

I have slight seepage in a corner of my basement. Drops of water appear on the wall just above the floor during the summer months. Should I plaster the area with cement-and-lime mix, or what?—A.W., Minn.

A cement-and-lime mix is not a water-proofer comparable to those especially compounded for the purpose. I don't think this is seepage; rather it is moisture from the air condensing on the surface of the affected area, which has a slightly lower temperature than the basement air. Adequate ventilation (windows open during cool, dry days) should dispel the condensate and prevent a recurrence. ★★★

The 1970 GRAVELY Convertible Tractor.



Its toughest competitor is an old Gravelly.

Take a good look at that old red tractor. Remember how many of them you've seen still being used by neighbors, professionals, highway departments and industries. Proves Gravelly tractors last longer at the tough jobs, doesn't it? They last so long because we make them to last.

Old Gravelly tractors are tough competitors. But our new Gravelly Convertible Tractors are even better. They deliver the proved advantages of all-gear drive (no belts or chains) . . . instant

forward, neutral or reverse with a flip of one lever . . . a wide variety of quick-change attachments for mowing, plowing, gardening, hauling, snow removal, and a choice of 7.6, 10 or 12 horsepower . . . features like electric starting, a new transistorized ignition system on the 10 and 12 horsepower tractors.

Please let us send you a new catalog on Gravelly Convertible and Riding Tractors, and the name of your Gravelly dealer. Write now: Gravelly Corporation, 5703 Gravelly Lane, Clemmons, N.C. 27012.



GRAVELLY
CORPORATION
A SUBSIDIARY OF STUDEBAKER WORNINGTON INC.

ON-THE-GO

CAMPING

BY WADE MITCHELL

GOT A 1960 TO 1965 GMC OR CHEVROLET PICKUP? Then you are entitled to an exchange of wheels, courtesy of General Motors Corp. Owners of those vintage-year $\frac{3}{4}$ -ton trucks used to carry camper coaches are urged to contact their truck dealers for a free exchange of wheels. The original wheels have been declared unfit for coach duty, so don't risk it. The offer is good whether or not the present owner is the original buyer.

THREE-BEDROOM TENT TRAILER! That's right, the new Nimrod series has a three-compartment bedroom section in two side wings and one end wing providing three *separate* double beds. All this is in addition to the regular living area and kitchen facilities in the Nimrod Seventy. This model also features a drop-down rear deck and pull-out kitchen galley so that travelers can stop for a roadside meal without having to erect the unit completely. (Nimrod Seventy, Ward Manufacturing, Inc., 500 Ford Blvd., Hamilton, Ohio 45011.)

COMBINATION COACH AND CARGO TRAILER called the Trans-Por-Teer resembles a cross between a pickup truck and a travel trailer. Basically, it's a long flatbed trailer designed to haul a camper coach. The rear section has sleekly-styled, built-up sides and a storage area for a dune buggy, two snowmobiles, a boat, or six trail bikes. With a well-equipped four-sleeper camper coach, the Trans-Por-Teer costs about \$4500 complete and should be handy for families who indulge in many forms of recreation at the campsite. (Trans-Por-Teer Corp., Box 1341, 530 McDonald St., Elkhart, Ind. 46514.)

WINTERIZING KITS FOR RVs. A testing device and a special nontoxic, noncorrosive, antifreeze fluid for delicate coach tanks and toilets is available from Maritime Products Co. (21688 E. Nine Mile Rd., St. Clair Shores, Mich.). Ordinary antifreeze may damage certain sanitary fittings in a recreational vehicle. The new kits protect vital water lines down to minus 60°F.

SQUARE CONVEX SIDE MIRRORS are now available for pickups, vans and motor homes in a unique dual-unit installation. Instead of one large side-view mirror on each side, the new Velvac units consist of a set of twins: one conventional 6x10-inch mirror, and several inches below it, a 6-inch *square* convex mirror. The square design is a positive improvement over the round convex mirrors because it increases viewing area and reduces distortion. Since the flat and convex mirrors are mounted separately (instead of one upon the other), there is no danger of overlapping images. They call it the D-70 Mirror System. (Velvac, Inc., 2081 S. 56th St., Milwaukee, Wis. 53219.)

HUGE NEW VIEW WINDOWS SPARK 1970 MODELS. Glass area like you've never seen before will grace the sidewalls of many new motor-home models this season. Six by four-foot windows in the rear, with huge four-foot-high windshields that curve around corners are attracting attention everywhere. Advantages include better inside illumination when the camper's parked in forest areas and on gloomy days. Tremendously improved driving vision and scenic viewability also result. It is true that large windows make a coach harder to heat and cool. And the big glass is vulnerable to flying gravel and vandalism, too. Yet, experts agree that huge windows are here to stay.

WATCH THOSE JACKS! Several truck owners have learned the hard way that a standard truck jack (provided with a new standard pickup) isn't built to handle an extra 2000-pound camper coach. Buy yourself a good hydraulic lifter and carry it everywhere. A cheap jack might heft the load up just long enough for a wheel to be removed—then collapse!

★★★

Be a rat race dropout.



The Holiday-V, marine aluminum runabout I.O. & O.B.

Even if it's for just a few hours,
forsake the crowds in Grand Central
Station or the stacked-up cars on
highway 427. Open up a Starcraft
Great Escape Machine and let some
serenity seep into your bones.


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HANDON PUNTA'S WIDE WORLD OF BOATING
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**A touch of Turkish
turns on taste.
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Start walking.**



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A Submarine Icebreaker for Arctic Oil?



POLAR EXPERT Bud Waite employed knowledge of arctic ice in designing novel ship



CO-INVENTOR Marcel Golay, research physicist, handled system's theoretical aspects

The strike on Alaska's North Slope, biggest in North America's history, poses a whale of a problem: how to ship the oil to the Lower 48. This exclusive report describes a unique system that could do the job.

By JOHN F. PEARSON, Science Editor

THE SUBLIKE SHIP BUCKS ARCTIC ICE five feet thick, its powerful undershot bow plowing the creaking, groaning ice upward and spilling it in huge pieces on either side of the hull. Headway is slow but steady as the ship travels east toward Melville Sound, bound for a port in lower Greenland.

The ship has a huge cylindrical barge under tow, which rides low in the water about 150 feet back. Its cargo: crude oil from Prudhoe Bay, Alaska.

"Ice island ahead," the radarman calls out in the ship's control room. "Range, 6000 yards."

The island is at least 10 miles square and could be as much as 100 feet thick. Except for 12 feet or so, most of that thickness is below surface. The skipper considers his options and decides against going around the island. That would take too much time. "Prepare to dive," he commands.

The conning tower, which had been halfway up, is retracted to its full-down position. Then the ship, still headed directly for the island, quickly sinks below the surface of the two-mile deep water, pulling the barge after it like a huge harpooned whale...

This is a description of a voyage that has yet to happen. So far it's a reality only in the minds of the engineer and the scientist who conceived this submarine-icebreaker-barge system of oil transport in ice-choked waters. (The system is described on page 87.) The inventors bring an

(Text continues on page 88)

Waite-Golay System for Transporting Oil from Alaska's North Slope



DOCK

PUMP LINES

QUARTER BARGE

CONTROL HOUSE

HALF BARGE

BARGE

ENGINE ROOM

MOTOR

CARGO TANKS

PASSAGEWAY

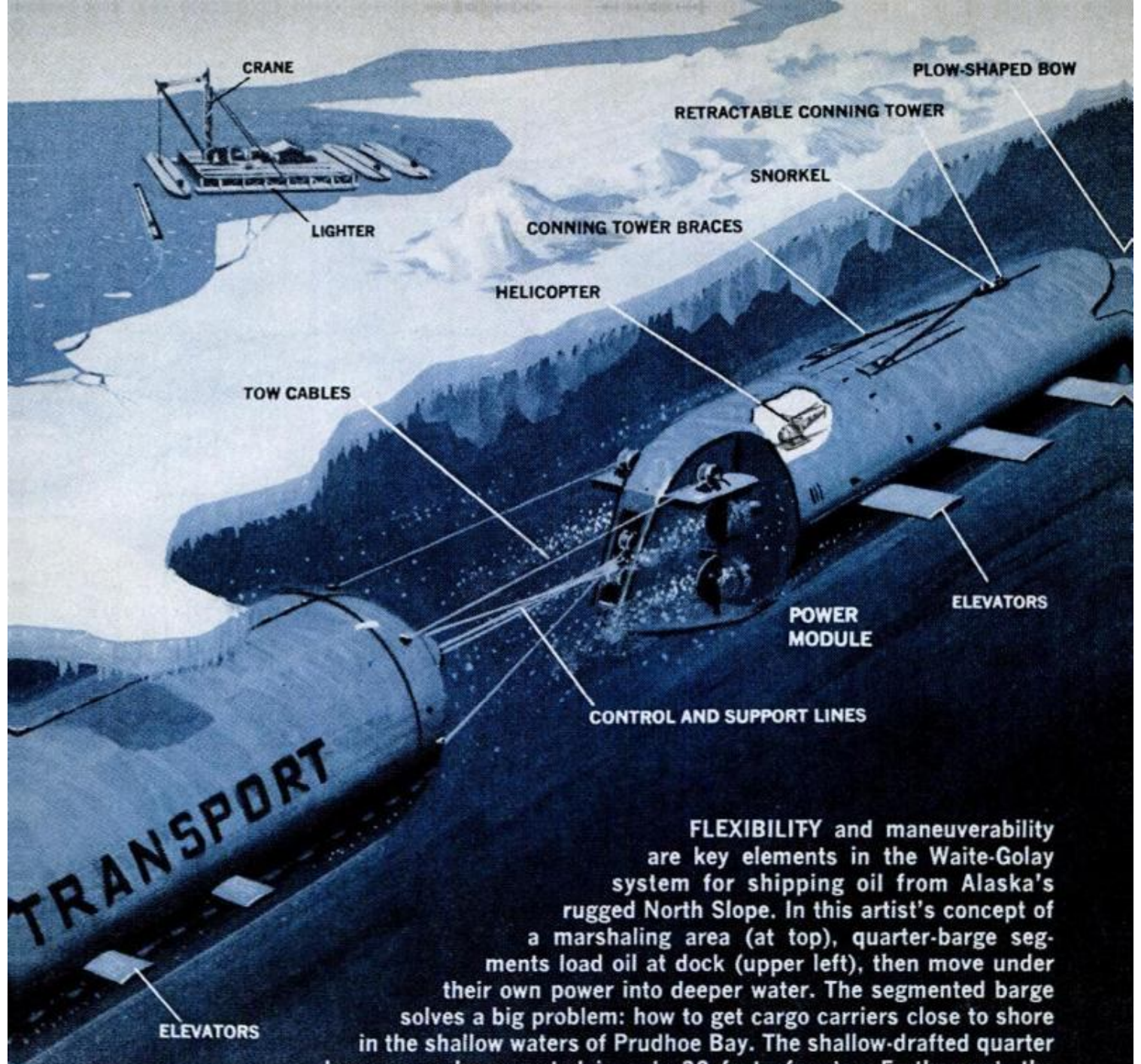
NACELLE

CREW'S QUARTERS

NACELLE BALANCING GEARS

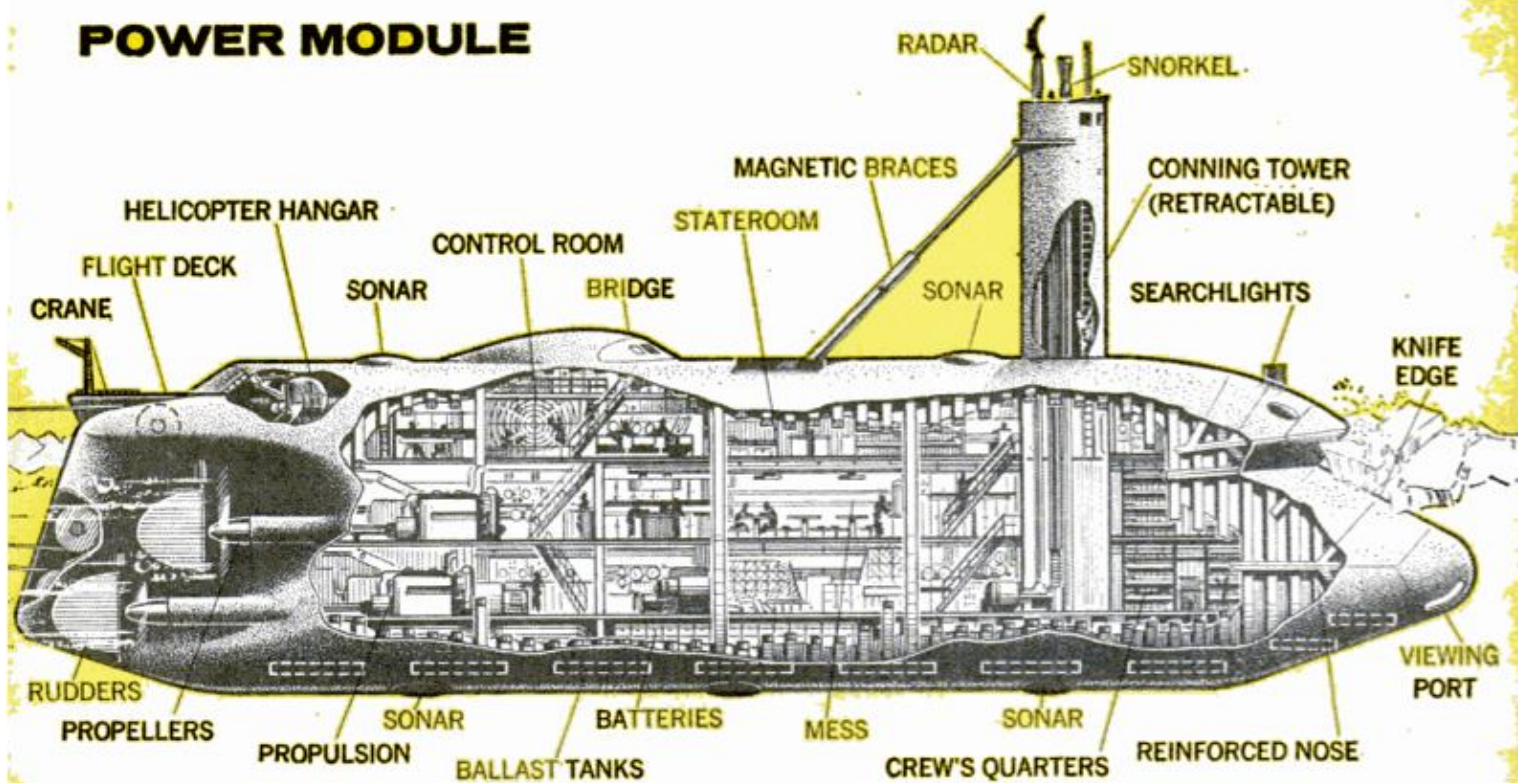
BATTERY COMPARTMENT

Art Concept by Ed Valigursky



FLEXIBILITY and maneuverability are key elements in the Waite-Golay system for shipping oil from Alaska's rugged North Slope. In this artist's concept of a marshaling area (at top), quarter-barge segments load oil at dock (upper left), then move under their own power into deeper water. The segmented barge solves a big problem: how to get cargo carriers close to shore in the shallow waters of Prudhoe Bay. The shallow-drafted quarter barges can be operated in only 30 feet of water. Farther out, the quarter segments are joined into half barges. At the lighter, a crane drops cubical control houses into position to provide the half barges with full maneuverability. Finally, the fully loaded half segments are mated to create cylindrical barges 900 feet long and 90 feet in diameter. Total cargo: 160,000 tons of crude. The 350-foot power module, which functions like a locomotive, takes the barge under tow in relatively deep water. In addition to tow cables, the two vessels are joined by control and other support lines. Thus, when under way the barge is controlled from the power module's command station. The vessels travel on the surface or under the water, as conditions dictate. In a heavy sea, for example, they'd make better time underwater, using the power module's snorkel and main engines. They run submerged under thick ice, with the power module's conning tower fully retracted. But for ice a foot or less thick, the conning tower would be up, its forward knife edge slicing through the ice. For ice up to five feet thick, the two vessels would normally be on the surface, with the power module's plow-shaped bow heaving the ice upward and out to clear a channel. In tougher situations, the barge could move under its own power, following the power module as it rammed its way forward. Leaving the North Slope, the module and barge are likely to head for a port in southern Greenland, where the cargo can be transferred to standard tankers for the final leg of the trip to an East Coast refinery. Then, the power module, towing a barge filled with water ballast, returns to Prudhoe Bay. The shuttle system is designed for year-round service.

POWER MODULE



unusual combination of field experience and expertise to the task.

The engineer is Amory H. (Bud) Waite Jr., a retired Army Signal Corps electronics and radio expert who may know more about polar ice than any man on earth. His specialty is devising systems and equipment for measuring ice with radio waves.

Over a span of 35 years, Waite traveled more than 100,000 miles on icebreakers and took part in 12 Arctic and 11 Antarctic expeditions. In 1934 he was one of three men to rescue Adm. Richard E. Byrd, who had become incapacitated while manning a lonely outpost south of Little America. Bud Waite was given a Congressional Medal for that heroic deed.

Co-inventor Dr. Marcel J.E. Golay is also a veteran of the Signal Corps. He is a physicist who can lay claim to many scientific achievements, among them the development of sound-ranging systems during World War II and the invention of the Golay infrared detector. Dr. Golay now serves as a senior scientist at Perkin-Elmer Corp., a leading maker of scientific instruments.

Though Bud Waite had done considerable thinking about the problems of moving ships in polar regions, it was

not until the oil strike on Alaska's North Slope, announced early in 1968, that he and his partner got down to serious work.

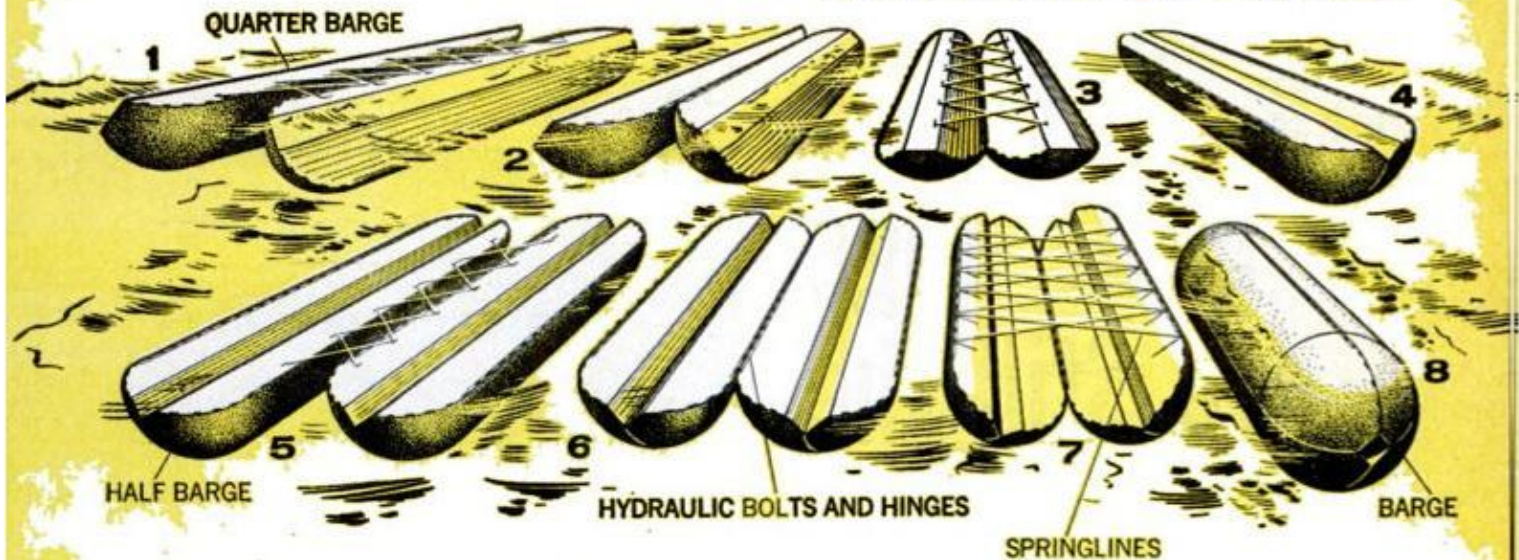
This biggest oil discovery in the history of North America also represents the toughest challenge ever faced by our oil industry. The big hurdle: how to ship oil from the frozen North to refineries and markets in the lower 48 states. Oil men are particularly interested in developing an economical method for transporting the oil to the populous East Coast.

So far, two standard approaches and one slightly offbeat method have come to light:

- *Pipeline.* According to present plans, an 800-mile pipeline will be built from Prudhoe Bay to a port on Alaska's southern coast. A tough, \$1 billion job—and it won't help to get Arctic oil to the East Coast.

- *Surface icebreaker-tanker.* It's unlikely that big-capacity ships like the SS *Manhattan*, which made headlines last fall by becoming the first commercial vessel to conquer the Northwest Passage, will ever be able to get through on a year-round basis, a requirement if their operation is to be commercially successful. A ship like

ASSEMBLY OF BARGE



BALANCING TANKS IN BARGE SEGMENTS are used to change attitude of segments during assembly operation. Segments are pulled close with springlines, then joined by means of a hydraulic bolting mechanism

TECHNICAL ART CONCEPT BY FRED WOLFF

the *Manhattan*, says Waite, has too broad a bow and too little power to smash through thick ice, and is too long to maneuver among big ice cakes. For the most part, the stuff the *Manhattan* went through was soft summer ice, perhaps little more than a foot thick in places. "Slush" is Waite's word for it. Even so, the big ship got stuck at times, requiring help from an icebreaker, and sustained a hole in her hull.

"What will a big tanker like that do with winter ice of five to seven feet?" Waite asks. "Not to mention ice that may run up to 15 feet thick in places and cakes that might be 40 feet thick."

- *Nuclear submarine tanker.* The General Dynamics Corp. proposes to build nuclear subs capable of carrying 170,000 tons of oil. They would operate only below the surface and would not be icebreakers.

Waite and Golay spell out the advantages of their system in this way:

- They say that the cost of the nuclear sub's powerplant would be twice that of their conventionally powered ship. Dr. Golay estimates that shipping costs would be about one-third higher for the nuclear vessel.

- The barge concept provides for a huge cargo capacity without cutting

down on maneuverability. In ice that would stop a big surface tanker, the power module could punch out a channel in which the barge could follow under its own power (enough to make a few knots). Or the two ships could dive under the ice.

- The water off Alaska's north coast tends to be shallow out to a distance of 40 to 50 miles. The barge can be loaded relatively close to shore because it breaks into four quarters, which individually can operate in shallow water. The surface tanker and the nuclear sub require deeper water for loading.

- The Waite-Golay system has a built-in growth factor. The power module would be capable of towing very large barges—over 1000 feet long—which would make for a very economical operation. Dr. Golay estimates these long jobs could carry 240,000 tons of oil.

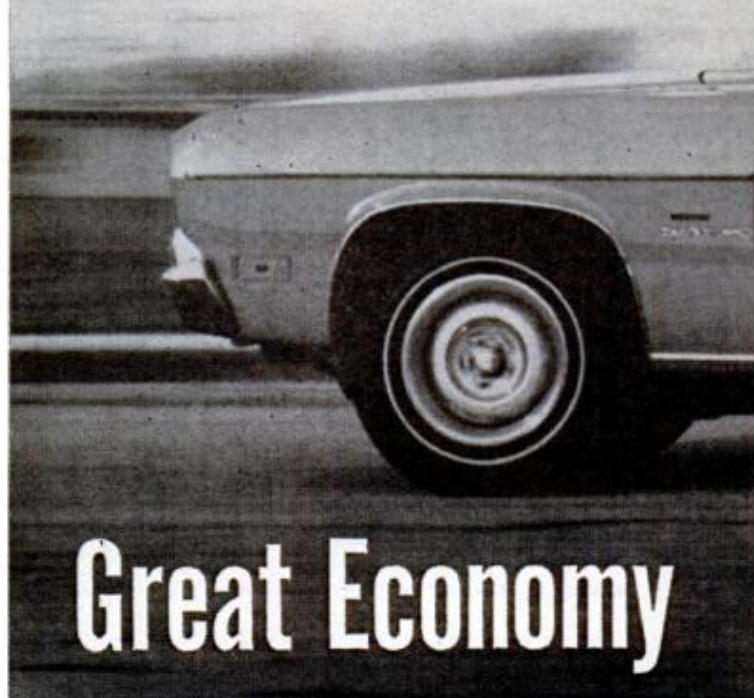
- If required, the power module could be adapted to nuclear power.

All in all, the submarine-icebreaker system is an imaginative piece of work. Whether it wins the North Slope transportation sweepstakes remains to be seen. Waite and Golay have made patent applications and, at this writing, are "talking" to several oil companies involved in the Arctic venture. ★★

**PM OWNERS REPORT
VALIANT AND DUSTER**

Little Bugs Are Still the Same, But This Year . . .

A Nationwide Survey Based on
230,000 Owner-Driven Miles



Great Economy

By **BILL HARTFORD**, Technical Auto Editor/Photos by Irv Dolin

"KEEP IT SMALL" is the sentiment of a good number of Plymouth Valiant owners. A retired New Jersey teacher who can't keep up with the ever-increasing length of cars says, "Make it smaller. Cars that start out as compacts keep getting bigger each year." At 188.4 inches the new Valiant Duster body style is not what many would call "compact," but it gives owners what they want from a car of that category: economy.

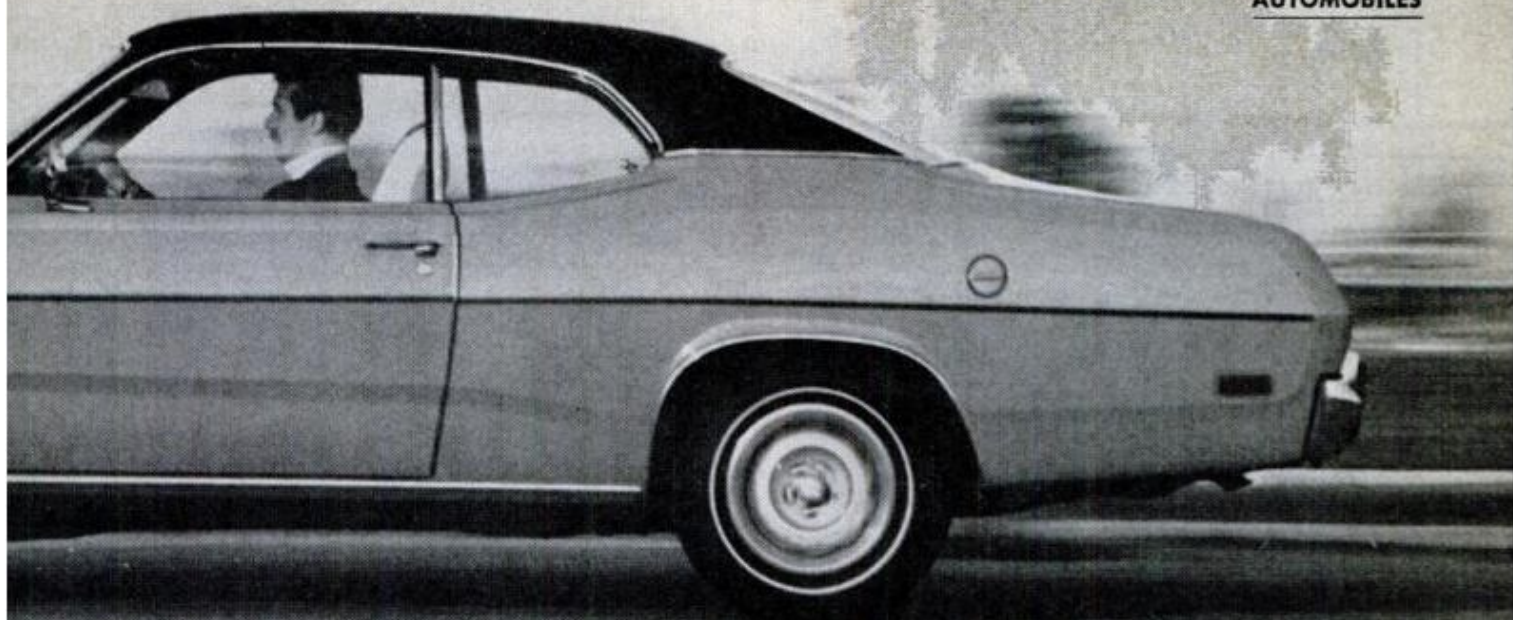
A retired Oregon woman's desire for

economy is implicit in her reply to the question of why she bought her Valiant: "For transportation." She has the four-door sedan which, unlike the Duster models, retains last year's austere, boxlike profile (1969 Valiant Owners Report, *Plain Jane With a Moneysaving Mill!*, page 96, Sept. '69 PM.) She is among the almost nine of ten owners in our survey who chose the four-door sedan. Interestingly, the age distribution of owners is heavy on the senior-citizen side: Over 50 percent are 50 years or older.

Owners of Dusters are generally younger. They are as equally concerned with economy (as indicated by the low percentage with V8 engines) but expressed a desire for "something a little sportier," as a Wisconsin engineer puts it. He's had two previous Valiant models "and was very satisfied." The 1970 Valiant line offers buyers a choice between two very different body styles. Owners with a Duster find it "really



DUSTER MODEL is a two-door hardtop; seats are nicely adjustable but are too low, say some owners



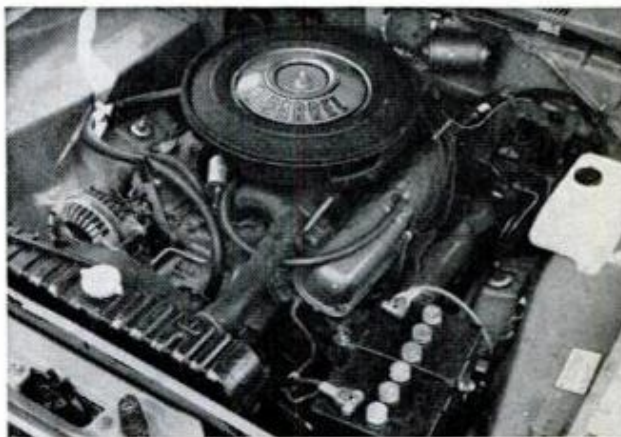
Teams Up With Style!

SLEEK STYLING of Duster is all new for '70. Basic, four-door Valiants keep "box" shape of '69, however

sharp," as a Louisiana underwriter expresses it. She has the 225-cu.-in. six-cylinder engine as do most owners.

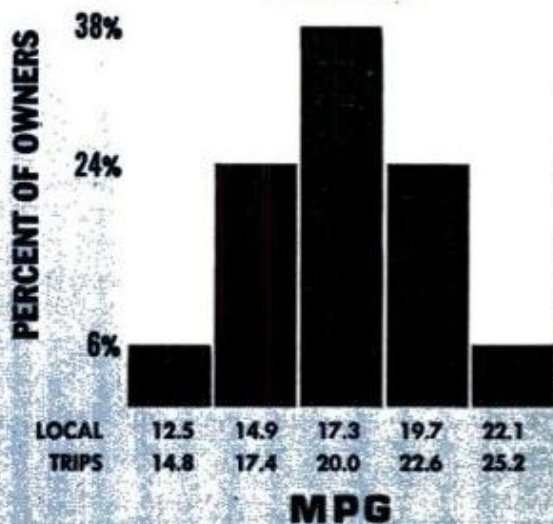
This engine is giving owners 17.3 mpg around town and an even 20 on long runs. A North Carolina cab driver has the 225 in his taxi; that's why he bought a Valiant: "I drive a Plymouth cab. The engine in the Duster is the same as the engine in my cab." He finds his car "smooth-running, good-handling, and good-looking." He would like more designed-in headroom and finds it "hard for a big man to get in and out." Part of the problem is in the low, sleek lines of the Duster which are both its appeal and its drawback in terms of comfort—very few owners complain of lack of headroom, however. This cab driver may be a big man, but he says his light foot gets him "26 mpg on the road!"

Equally significant a reason for buying a Valiant is past experience. A Nebraska minister says he has no complaints. He's "owned three before," and likes the "economy and reliability." A Vermont salesman, in fact, bought his four-door sedan because of his brother-



TOP ENGINE in Duster is 340-cu.-in. V8. It's got 4-bbl. carb, 10.5 compression, 275 hp at 5000 rpm

VALIANT FUEL MILEAGE CHART
225-cu.-in. Six





BACK-SEAT COMFORT in two-door Duster is average; head restraints integral to optional high-back seats



HANDLING is high on list of owner likes. For most owners handling is appreciated in traffic, parking



TAIL-END STYLING of Duster is distinctive. Some owners don't like style changes, want a VW approach

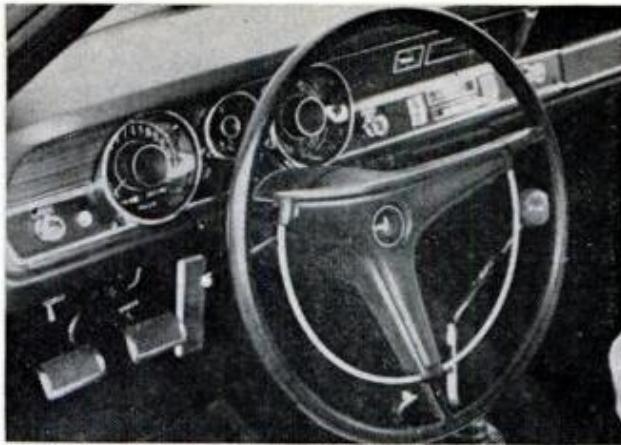


TRUNK ROOM isn't sufficient for some owners. None complained about position of spare under the floor

in-law's experience: "140,000 miles with no major repairs!" A Minnesota maintenance mechanic has "bought 15 Plymouths" from the same dealer: "As long as they keep their good policies, they keep me," he says. "Prior experience has been good," confides an Ohio engineer who's had six Valiants.

A gentleman in Minnesota—all of 81 years young—doesn't have much past experience with Valiants. He bought his because it's more compact than cars he's been used to driving. "I don't drive long trips anymore," he says. To him, as to other owners, the car combines all the desired qualities. Says a Virginia man: "Small enough to park almost anywhere, and large and heavy enough to be stable on long drives." "Easy to park and handle," says an Illinois accountant. "Economical to drive, well-built and nice size to handle," observes a retired Kansas man.

A Tennessee textile mechanic who has owned "four new Valiants: 1960, 1965, 1967 and 1970," is high on the car's economy and dependability. However, he speaks for other owners, too, when he says: "Improvements could be made on some of the parts such as loose screws and other small things." A retired South Carolina man sympathizes with his dealer on this point: "Dealer has to correct factory's lack of quality control." Some of these lapses include: "Sloppy door molding installation"—Massachusetts retail-store manager. "Weatherstrip missing on left rear door causing air and water leaks"—New



INSTRUMENT LAYOUT is well liked except for the position of windshield wiper/washer switch on right



STEERING COLUMN LOCK is anti-theft feature that requires a little getting used to, say a few owners

Jersey traffic analyst. "Faulty volume control on radio"—Ohio computer programmer. "Various rattles"—Louisiana office manager. "Doors, hood and trunk lid improperly fitted, rubber cement on glass, vinyl headliner overlapping door moldings"—Maine machine operator. "Glove compartment lock falls out"—Massachusetts clergyman.

A Massachusetts saleswoman would simply like to see "more snug fits all around." A New Hampshire nurse's small complaint is that "the windshield washer-wiper knob is in an inconvenient place to reach while driving." This is the second most mentioned

thing owners would like to see changed. Changes desired by a North Carolina mail carrier sum up buyer mood in this year of high compact economy-car sales: "Keep styling changes to a minimum, keep prices down and put a small station-wagon model on the market." He will have to wait for at least a year to see what the new second-generation compacts from Chrysler-Plymouth will be like and if there will be a much-needed, compact, domestic station wagon. In any event, any new car—as a retired college head now residing in Georgia says he likes about his '70 Valiant—"Smells good!" ★★★

Summary of 1970 Plymouth Valiant Owners Reports*

Total miles driven 231,408

Average miles per gallon:

198-cu.-in. Six,
 local driving 18.6
 long trips ... 20.9
 225-cu.-in. Six,
 local driving 17.3
 long trips ... 20.0
 318-cu.-in. V8 n.a.
 340-cu.-in. V8 n.a.

Specific likes:

Economy 53.3%
 Handling 44.0
 Comfort 17.3
 Size 17.3
 Styling 13.3
 Ride 13.3
 Performance 10.7

Specific dislikes:

Workmanship 13.9%
 Gas mileage 6.9
 Rattles 5.6
 Wind noise 4.2
 Quality 4.2
 Dash styling 4.2
 Cold start 4.2

What changes would you like?

Better workmanship 10.7%

Wiper-button location 8.9
 Gas mileage 7.1
 Trunk room 7.1

Body style:

4-door sedan 88.6%
 Duster 8.9
 Duster 340 2.5

Engine:

198-cu.-in. Six 21.6%
 225-cu.-in. Six 74.6
 318-cu.-in. V8 1.3
 340-cu.-in. V8 2.5

Transmission:

Automatic 87.8%
 3-speed manual 12.2
 4-speed manual 0.0

Had any mechanical trouble?

No 71.1%
 Yes 28.9

What kind of trouble?

Windshield wipers 17.4%
 Alternator 13.0
 Directional signals 13.0
 Transmission 13.0

Dealer repair satisfactory?

Yes 91.7%
 No 8.3

Why the Valiant?

Economy 31.2%
 Past experience 31.2
 Size 23.8
 Style 8.8
 Price 6.2
 Reputation 6.2

Is the Valiant your only car?

Yes 51.8%
 No 48.2

Other cars owned:

Plymouth 30.0%
 Valiant 22.5
 Chrysler 10.0
 Chevrolet 10.0
 Pontiac 10.0

What options/accessories?

Radio 68.4%
 Power steering 27.6
 Airconditioner 19.0
 Tinted glass 12.7
 Whitewalls 11.4
 Day/night mirror 7.6
 Remote side-view mirror... 7.6

Age distribution of owners:

15-29 16.0%
 30-49 32.1
 50 plus 51.8

*Where applicable, percentages may not equal 100 percent due to rounding and/or insufficient sample.

OUR SUPERSECRET, SUPERQUIET PLANE

By KEVIN V. BROWN

The Army is hush-hush about a craft that glides over enemy positions at treetop level as quietly as a "fluttering flock of birds" and sees all with new night observation devices.

ARMY YO-3A, now in limited production, has low-wing

EYEBROWS SHOT UP a few years ago, when James Bede, a Cleveland plane designer, put an engine on a standard sailplane and announced that he planned to fly it around the world—nonstop. Among those not particularly surprised were U.S. Army planners and Lockheed engineers who were working on way-out schemes of their own. By 1968 the Army also had put an engine on a sailplane, a development that was strictly hush-hush.

It has since been learned, however, that the Army's supersecret airplane is a supersilent airplane, and that it has flown, at night, over enemy positions in Vietnam.

What Bede had done was take ad-

POPULAR MECHANICS

SIX-BLADED WOODEN PROP was designed for YO-3A to reduce noise on sneak missions over enemy lines



configuration, conventional landing gear and tail wheel

vantage of the sailplane's exceptional ability to stay aloft. By putting a low-power engine on it, the plane's range was extended, possibly to globe-girdling distances.

To the Army, the plane's low power meant slower-than-usual speeds and quieter operation, ideal for certain observation missions. The Army is reluctant to say much about any of this. Officials simply admit that a test model has flown successfully in Vietnam and an advanced model has been ordered into limited production. It reportedly may ultimately be powered by a Wankel-type rotary engine, which is lighter and even quieter than a conventional aircraft engine.

The basic airframe is a standard Schweizer SGS 2-32 sailplane, which has the highest performance of any multiplace sailplane. In sailplane terminology, performance is measured in lift over drag. The 2-32 has an L/D of 34, meaning it will glide 34 feet forward for every foot it descends. A conventionally powered airplane has an L/D of around 10 or less.

More important, the Schweizer sailplanes have the reputation of being among the most heavily stressed of all aircraft. The 2-32 can handle crash loads of up to 25 Gs, four or five times the structural strength of conventional aircraft. The significance is that you can hang a lot of extra gear on the 2-32 without appreciably weakening its airframe.

This is what Bede had in mind when he went to Schweizer with his plans for hanging an engine on a 2-32. Before Bede was through, he had upped the gross weight from 1430 pounds to more than 6000, most of the added poundage resulting from electronic gear, navigational equipment and fuel. Besides the engine and propeller, the most noticeable modification is the extended wingtips, stretching the wingspan from 57 to 63 feet and providing extra fuel-storage space and stability.

With all of this the plane has a rated range of 28,500 miles, more than the circumference of the Earth, and a flight duration of 170 hours, or slightly more than seven days, without refueling. Bede has a 210-hp Continental engine on the sailplane, and uses a maximum of 55-percent power for cruise and may at times throttle down to 9-percent power. Normal aircraft use at least 65-percent power for cruise, and would stall at the bottom levels used by Bede.

Bede has made several test flights in his plane. He recently finished a 70-hour nonrefueled flight of almost 9000 miles over a closed-circuit course between Columbus, Ohio, and Kansas City, Kans. In the process he set several records, including an absolute distance mark for piston-powered planes. He

says he still has his sights set on a non-refueled, nonstop flight around the world.

After running eliminations, the Army chose a test model that qualifies for the Rube Goldberg award of the year. It had a conventional 100-hp aircraft engine, mounted behind the cockpit, with a V-belt drive running from the engine to an overhead driveshaft. The shaft ran over the pilot's head to the propeller braced above the plane's nose.

But there was logic in the screwy arrangement. If you put an engine up front on a sailplane, where no engine was ever intended, you make it nose-



DADDY OF 'EM ALL: Schweizer 2-32 sailplane provides



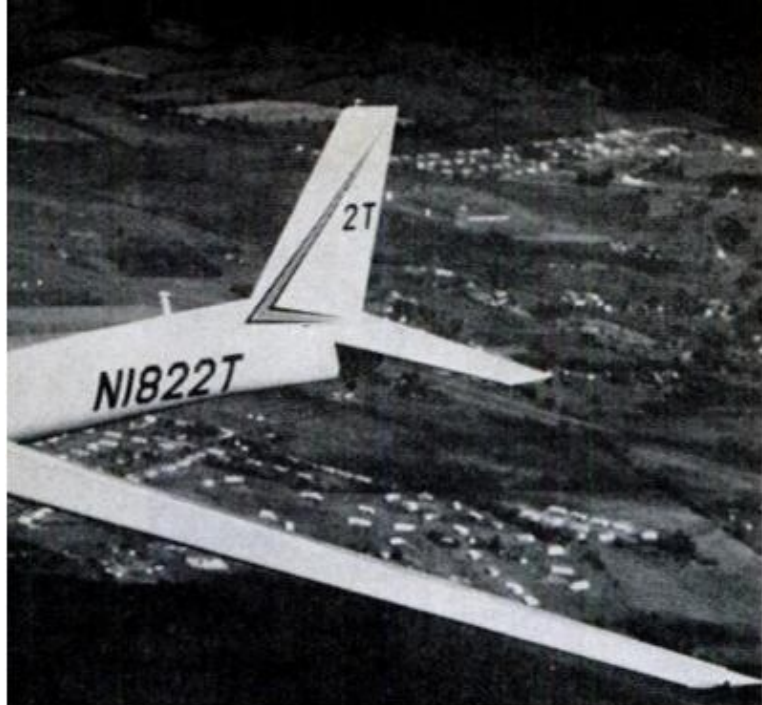
MONGREL CONFIGURATION of Q-Star resulted from center-of-gravity problem. Engine is behind cockpit

heavy. Bede solved this problem by putting enough weight (in equipment) behind the cockpit to balance the engine. The manufacturer for the Army, the Lockheed Missiles & Space Co., put the engine behind the cockpit where it was closer to the center of gravity. This spot was dictated by the need to put an observer and his equipment in one of the cockpits. If the engine were up front, the engine, the observation devices and the two crewmen would all be in the front half of the aircraft, magnifying the balance problem.

Also, the 2-32 is a low-slung plane,

with a single landing wheel. The wing-tips act as steadying points when the plane is landing or parked. If the propeller were placed in a normal position on the nose, it would scrape the ground. The overhead driveshaft gives it sufficient clearance. (In a later version, Lockheed installed a conventional landing gear.)

To minimize noise, the engine was insulated and the exhaust heavily muffled. The major noise in any propeller-driven aircraft, however, comes from the propeller itself, especially from the tips, which are traveling at the highest



the airframe for the low-noise, long-range airplanes

rate of speed. To cut down on prop noise, Lockheed cut down on prop size, reducing the propeller's diameter and increasing blade width and the number of blades (from two to four), and making them of wood instead of metal.

The result, according to one observer who heard the plane in flight, is like "the fluttering wings of a flock of birds."

The experimental model—called the Q-Star—eventually was sent to Vietnam. It proved itself during the Vietcong's Tet offensive, flying as low as 100 feet over enemy positions, without tipping off its presence to the VC.

Despite this success, it was obvious that the mongrel configuration would never be suitable for production. The

Army went to a new configuration.

The result is the YO-3A (Y for prototype, O for observation). The plane has a conventional configuration, with a 210-hp engine and stubby, six-bladed propeller up front, and a conventional landing gear and tail wheel underneath. The tail wheel configuration gives the propeller sufficient ground clearance, and the main gear retracts in flight to reduce drag.

Most significant, however, is that the 57-foot wing has been moved from a shoulder-high position near the rear cockpit to a low-wing configuration below the front cockpit, minimizing the center-of-gravity problem.

To achieve maximum quiet, the engine is heavily muffled; the exhaust runs through two mufflers that extend almost the full length of the fuselage.

A high-altitude version of the plane is on the drawing board. Rated for a service ceiling of between 40,000 and 50,000 feet, the plane would carry photographic, electronic and infrared detection devices to observe enemy activity. It could hold a flight pattern days at a time and be operated as a drone.

Whatever the final outcome of Bede's and the Army's efforts, sailplanes with engines have stirred up interest. Indications are the Air Force and the Navy may come up with their own versions. Army aviation experts must feel pretty good about that. ★ ★ ★

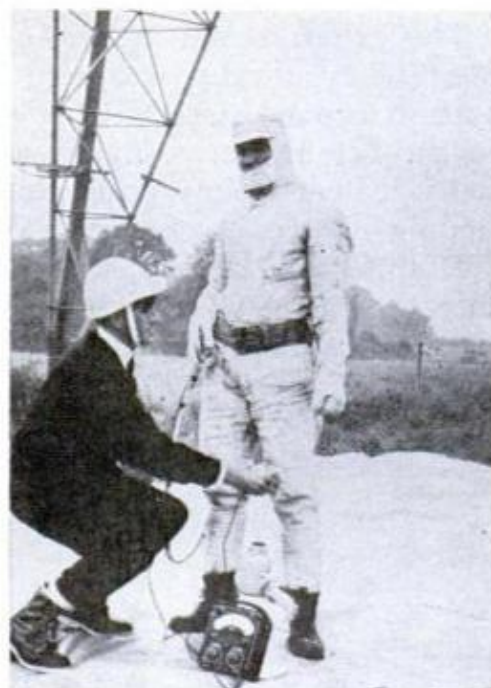
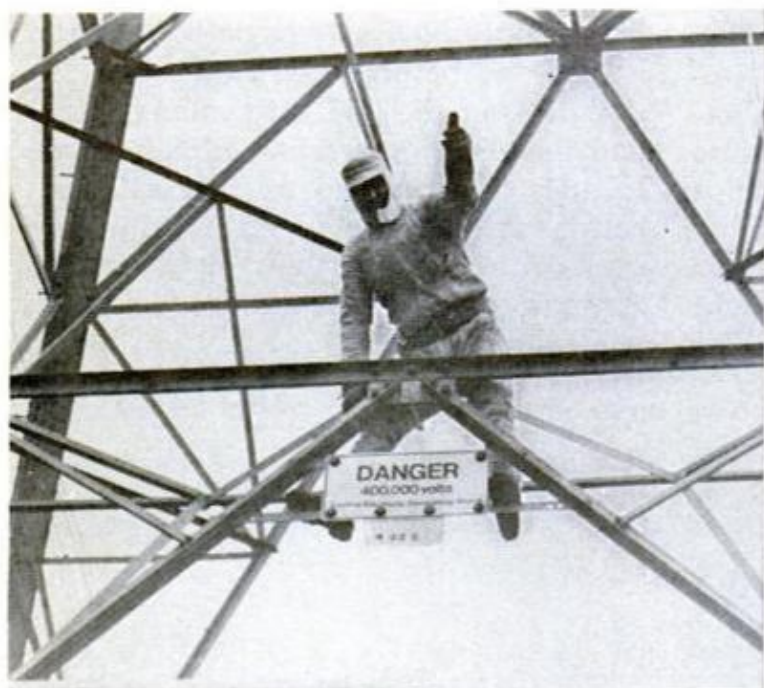
"BEDE'S "ROUND THE WORLD" PLANE has a 210-hp engine, wingtip extension for stability and fuel storage





Styrofoam 747 is real jet

A toy manufacturer has duplicated the giant Boeing 747 in Styrofoam. It's propelled by a CO₂ "jet engine" (right) attached to the underside of the fuselage. It's available from Dymo Products in New York.



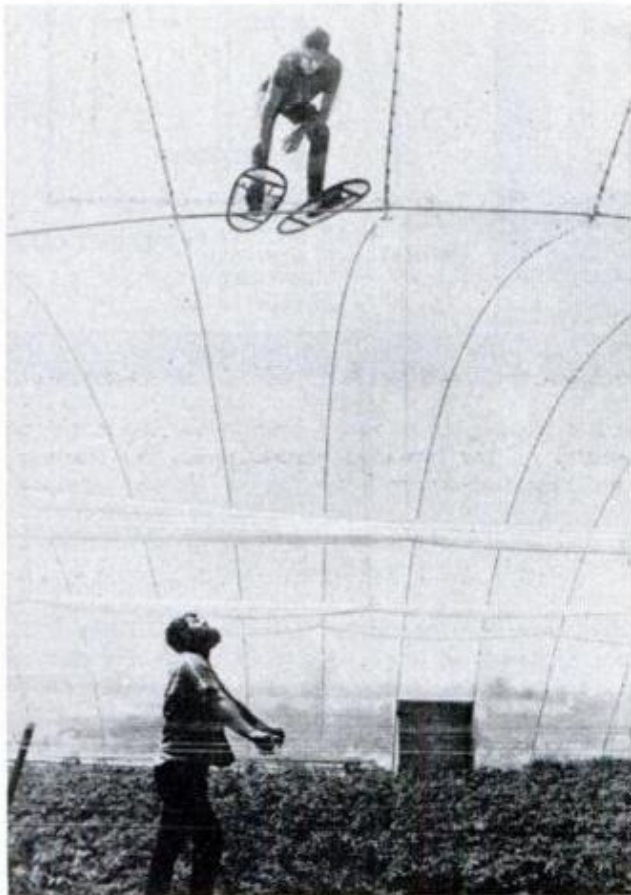
How to dress for 400,000 volts

Demonstrating a new protective suit for linemen who work on high-voltage cables, Harry New scampers about on 400,000-volt cables without harm. The suit is made of stainless-steel wire mesh woven into cotton fabric. The linemen also wear special boots of "conducting rubber" so that they're entirely surrounded by a protective cage. England's Central Electricity Generating Board has developed the suit so that linemen can carry on maintenance and repair work without having to shut off or reroute the electricity in the power lines. Engineers who designed the suit also had to take into account Britain's notoriously damp climate, which often makes conventional equipment unsafe.



Dornier tests prototype of tiny town car

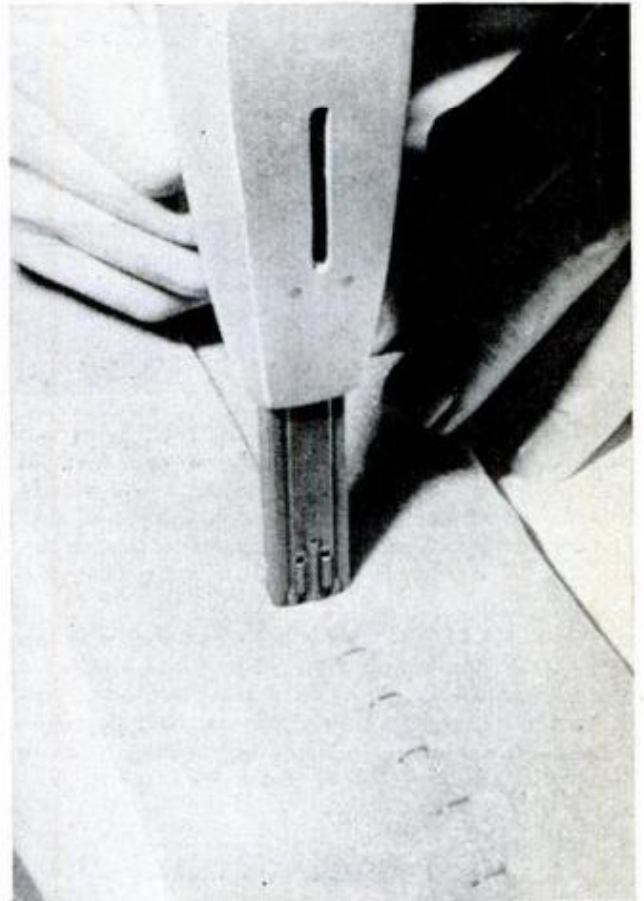
Dornier, the German manufacturer who built huge flying boats in the 1930s, has switched to a small-scale vehicle with this prototype urban car. The test model is equipped with a Steyr-Puch engine; other powerplants are being tried before the car goes into production.



Snowshoes on a greenhouse

An air-supported plastic greenhouse that covers an acre of land in Ohio is sturdy enough to support the snowshoer shown here walking over the dome. Air blowers keep the structure up by maintaining inside pressure just .01 percent higher than atmospheric pressure. The blow-up greenhouse, made by Goodyear, is 100 feet wide, 428 feet long and 20 feet high. Scientists believe whole communities could be housed under such domes.

MARCH 1970



Stapler for surgeons

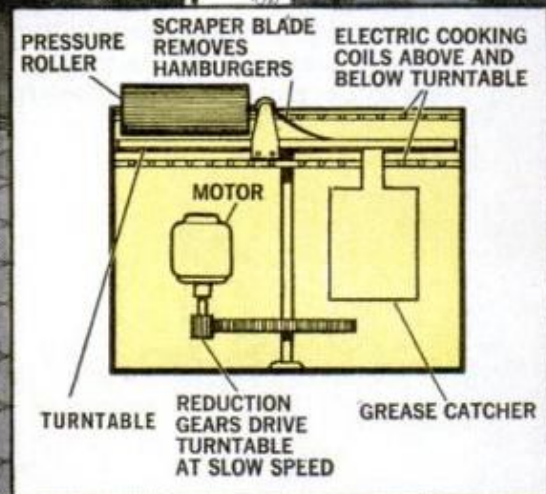
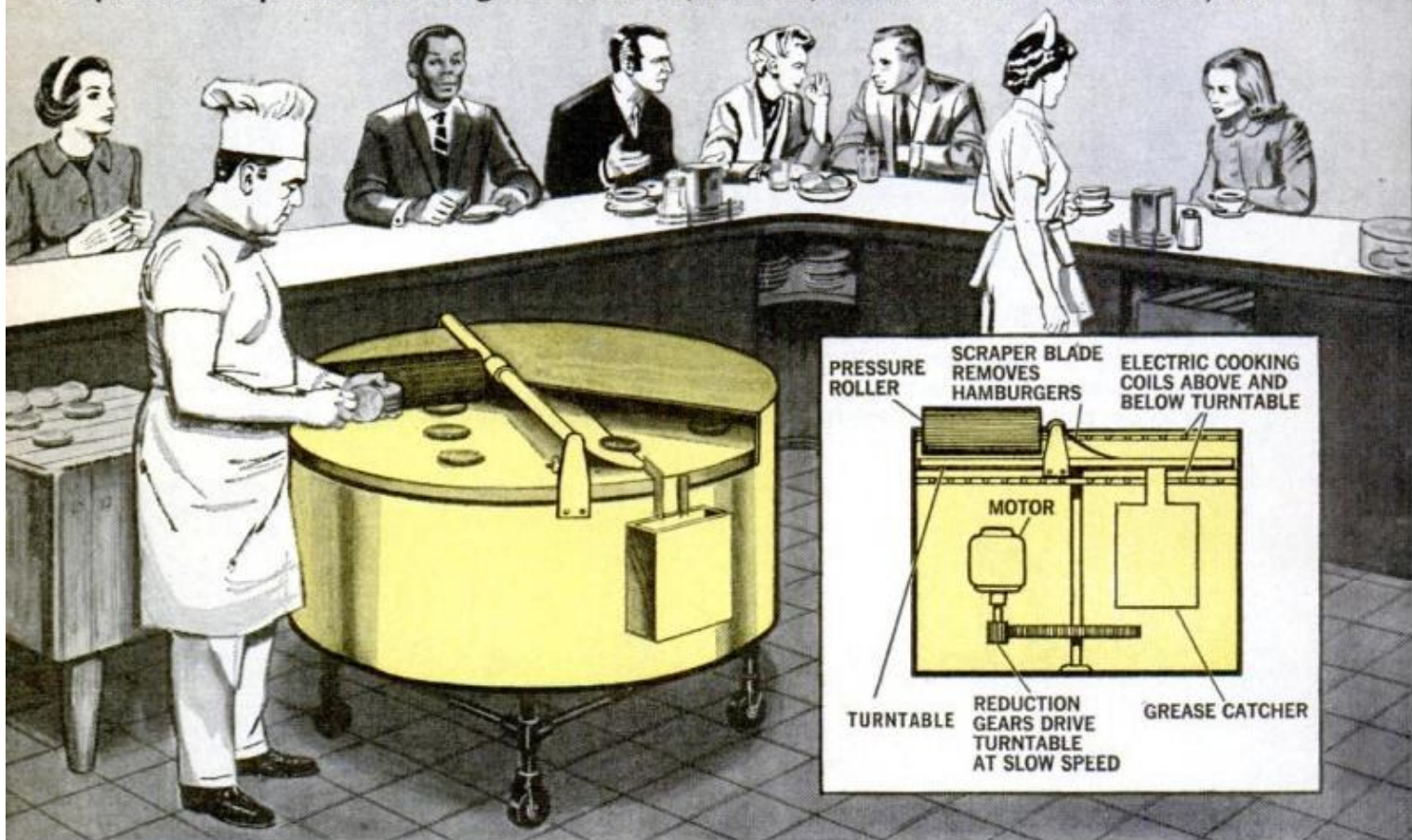
The Auto Suture surgical stapling set, recently shown at a meeting of the American College of Surgeons, enables a surgeon to suture or ligate in about 20 percent of the time taken by present methods. The unit employs fine, stainless-steel staples that come in sterile, preloaded disposable cartridges ready for operating-room use. The Auto Suture is a product of U.S. Surgical Corp. of New York City.

99

Just patented

PM'S PICK OF THE NEW INVENTIONS

Prepared in cooperation with Roger S. Shashoua, Director, International Inventors Assn., Inc.

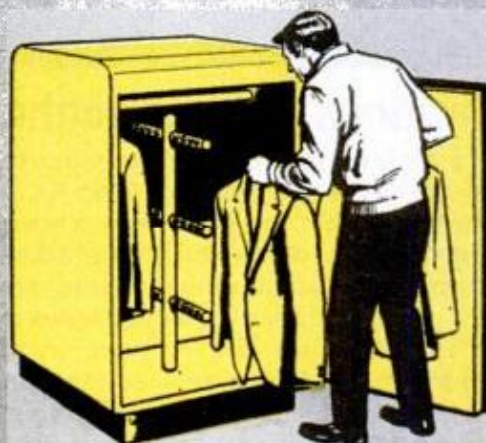
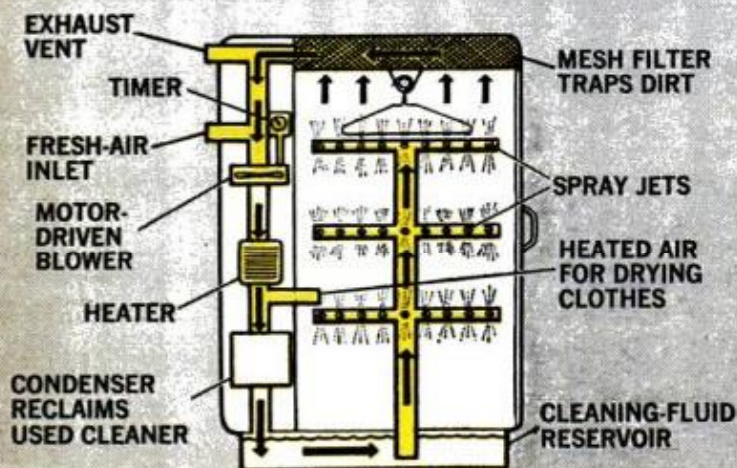


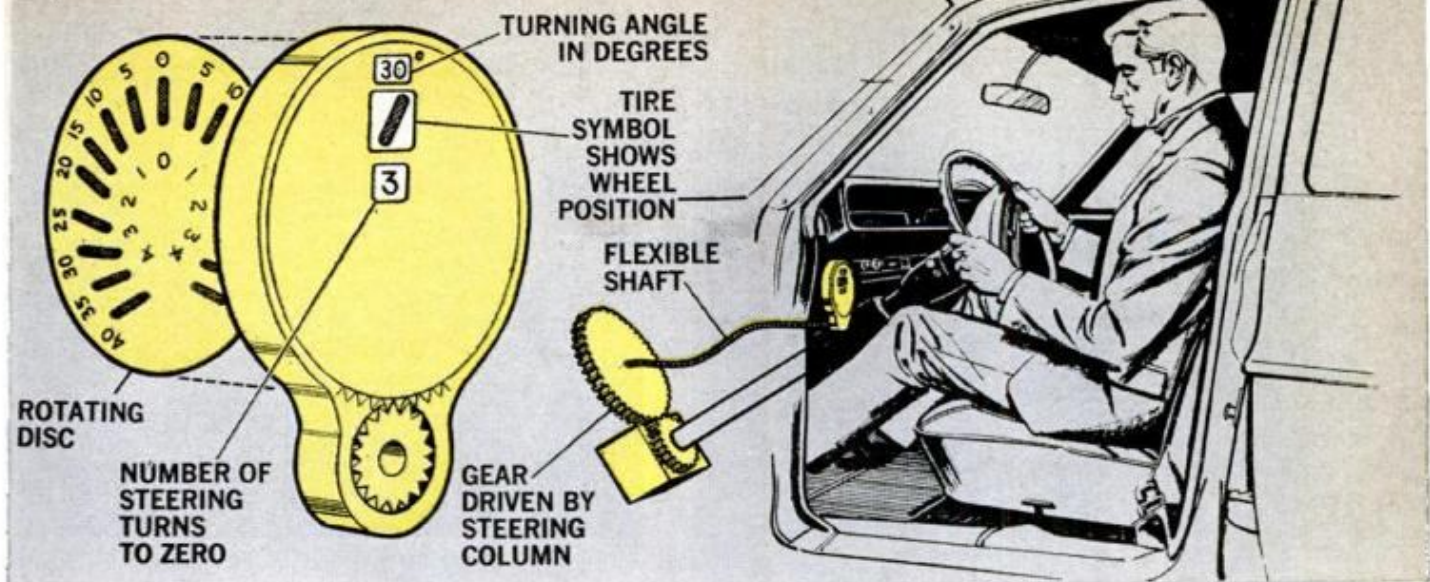
1. CONTINUOUS QUICK-ORDER COOKER turns out finished hamburgers as fast as you can feed in fresh patties of meat. As the patties move slowly around on a motor-driven turntable, they're first pressed flat by a revolving drum, then broiled by

electric heating coils above and below the cooking surface. As the browned patties reach the starting point, they're scooped up by a slanted scraper blade, all ready for serving. The excess grease is also scraped off by the blade into a waste receptacle

2. YOU CAN DRY-CLEAN your own clothes with this handy new home appliance. About the size of a small refrigerator, it holds suits, coats and other garments hung on a rod inside. As you shut the door, a motor-driven blower goes on, circulating cleaning fluid through the clothes from tiny spray jets.

After a preset period, a timer turns off the jets, and heated fresh air is circulated to dry the clothes and carry away fumes. At the end of this cycle, a buzzer sounds and the clothes are ready to be removed, clean and wrinkle-free. Vaporized cleaning fluid is reclaimed by a condenser for reuse later



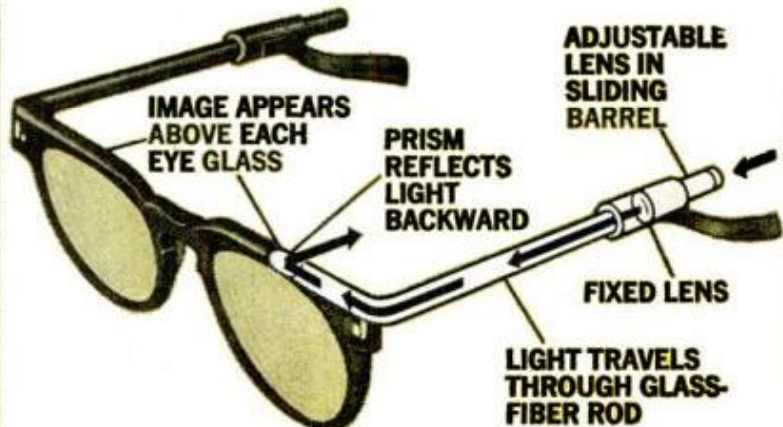


3. EASIER PARKING is the object of the steering indicator above. Geared to the steering column, it shows the position of your front wheels so you can tell how sharply you've turned or need to turn to maneuver. The steering wheel rotates a disc on

which are printed tire symbols at various angles. The symbol appearing in a small window indicates the angle of the wheels at that moment. Also shown are the angle in degrees and the number of steering-wheel turns required to straighten the wheels



4. YOU CAN SEE BEHIND YOU as well as in front with these novel spectacles. The earpieces are light-transmitting glass-fiber rods containing tiny telescopic lenses. Light from the rear is channeled through the rods to an angled prism above each eyeglass. By looking slightly upward, you can see



the view in back reflected in the prisms. An adjustable lens in a sliding barrel at the end of each rod lets you focus the image at the desired viewing distance. The two-way glasses are designed for detectives, secret agents, traffic-directing policemen and all others who need to see in all directions

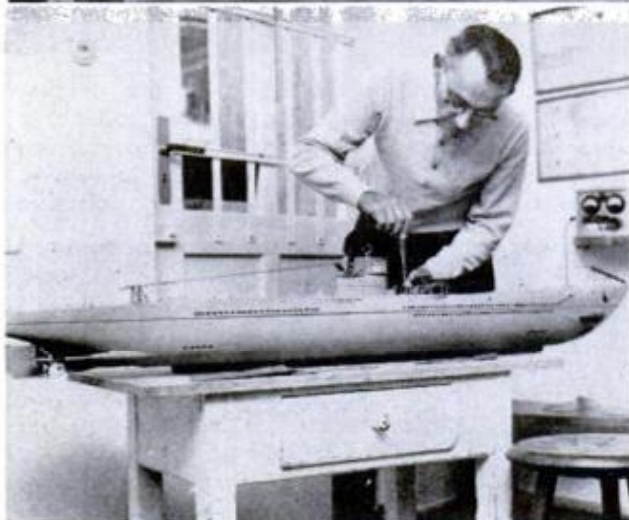
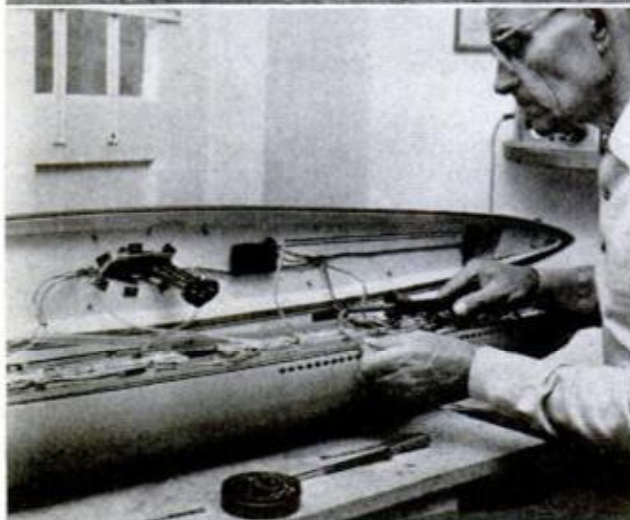
5. ENDLESS WASTE BASKET at right consists of a roll of plastic bags joined together like a strip of paper kitchen towels. You just drop a roll into the bottom of a basketlike frame and stretch the top of the first bag over the frame's rim so that the bag is held open. When the bag is filled with trash, you pull it out, tear it off along a perforated line and discard it without having to touch the contents. This automatically brings up the next bag into position, ready for use. The frame can be mounted on a wall or out of sight on the back of a cupboard door. Each roll contains 25 bags



Inventors of the items shown on these pages are as follows: 1. Fred W. Morley, 4515 N. Meridian St., Indianapolis, Ind. (No. 3,457,853); 2. Louis Zacks, Vancouver, British Columbia, Canada (No. 3,166,923); 3. James O. Hardy, Brooklyn, N. Y. (No. 2,934,035); 4. James R. Lang-

worthy, Clinton, N. J. (No. 3,410,638); 5. G. B. Enterprises, Groan Plein, Antwerp, Belgium. Readers wishing to bring new inventions to the attention of Roger S. Shashoua can reach him at International Inventors Assn., Inc., 680 Fifth Ave., New York, N. Y. 10019.

NEWS BRIEFS



Radio-controlled U-47 fires torpedoes and deck gun

Famed U-Boat 47, which penetrated Scapa Flow during World War II, has been recreated as a radio-controlled model by Gunther Lachmann of Munich. The model dives, surfaces, extends and retracts its periscope, fires torpedoes and shoots its deck gun by radio signal.



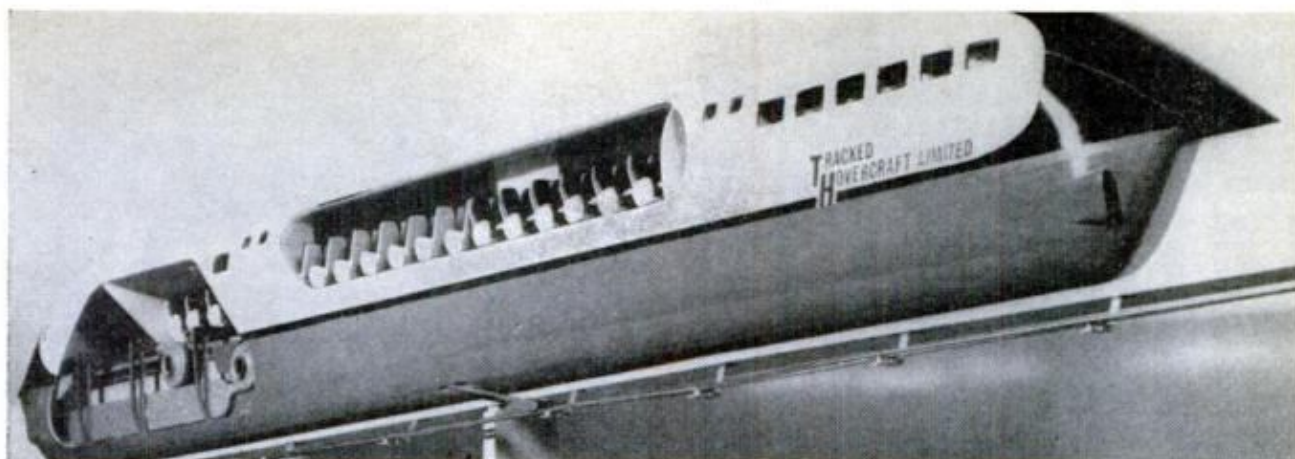
Homemade basement digger

Kermit Freewalt of Celina, Ohio, invented and built this powered excavator to speed the job of digging basements under standing buildings. A scoop shovel is filled with dirt in the excavation, then it's pulled by cable to the top of the slide where the dirt is emptied into a truck. A 25-hp gasoline engine provides the power.



Baby protector

Designed to foil would-be kidnapers, a British invention, the "Pram Alarm," buzzes if anyone tries to lift the baby from his carriage or cut or remove a slim waistband.



Tracked hovercraft may carry London air passengers

Proposed as a method of carrying passengers between London and a planned new airport is this 250-mph tracked hovercraft. According to studies, the hovercraft (shown here as a cutaway model) could carry passengers at about the same fare as first-class rail.



New fold-wing sports plane

The BO 209 Monsun is an all-metal, two-seat plane that can be toted off to the owner's garage with wings folded (right). Built by Messerschmitt-Bolkow-Blohm, the plane has wings that are held on by three bolts; wing folding takes just a few minutes.



130-mph go-karts prepare for international racing

Members of the British go-kart racing team are pictured during trial runs as they prepared for international competition. The 74-inch machines they drive are capable of 130-mph in fifth gear. One was clocked at 131 mph on a straightaway.

PM Tests: Dodge Corey Cruiser

The Livin' Is Easy



But first you have to get organized

By BILL KILPATRICK

WE STARTED OUT with light hearts and we finished with light hearts. But in between there were times that we were mighty low.

The idea of taking off on a week's trip in a camper has—on the surface, anyway—all the appeal such a trip is supposed to have—new places, sights, things, people. What comes out is a reaffirmation of something you should have known—the good and bad of such an outing is what you make of it.

Good is the two of you poking around in some seaside underbrush for beach plums. Bad is running out of bug spray in an area where mosquitos are like B-52s. Good is stumbling over an out-of-the-way bake shop run by a solitary man whose oatmeal cookies *have* to be manna. Bad is getting into a stupid argument with your wife as to just where to park the camper.

The conclusion would have to be that a camping trip—regardless of setting—is only an extension of what you are, not a new dimension of your being. If there's a lesson to be learned, it's that organization and geniality are musts.

First, there was our goal—the Cape Breton Peninsula of Nova Scotia. In our minds, at least, the area promised beautiful, rugged country, picturesque fishing villages, some Scottishness (a tip o' the tam to our forebears), a chance to dust off some long-neglected French, something other than New York City's fetid air in our lungs, and the opportunity to cast a fly or two at a passing Atlantic salmon.

Secondly, there was the camper itself—a trim, compact Dodge Corey Cruiser that appeared (again, on the surface) to offer just about all the comforts of home. My wife and I had in the

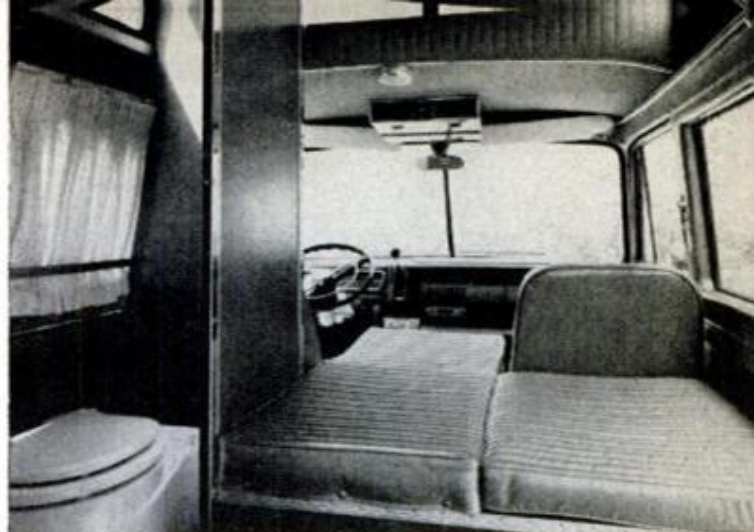


CAPE BRETON PENINSULA of Nova Scotia offers many magnificent views of rugged Atlantic seacoast

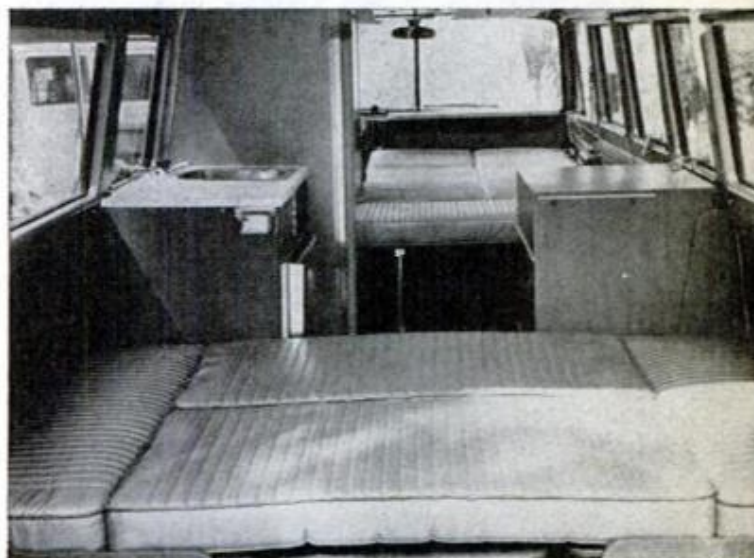
past made several trips in various borrowed campers; none, however, for more than a weekend. So this week-long outing looked like a good chance to plumb our imaginations and resourcefulness. Besides, *PM* Managing Editor John Linkletter and his family were off on a similar, though more ambitious trip in a different brand of motor home (see *Across Canada In a Motor Home*, page 122, Feb. *PM*) and it would be interesting to compare notes.

Finally, there was this thing of leaping off into the unknown, the adventure of going somewhere and doing something we had never done before. This, perhaps, is the piquancy of such a trip. It's also the trap.

How were we to know, for example, that outfitting with large, economy-sized packages or cans of any supply or staple would take up far too much



FORWARD SLEEPING BUNK in Corey Cruiser sets up double over the engine compartment, passenger seat



REAR BUNK, a dubious "double," sets up in dining area. The table lowers to level of bench-type seats

room? You say we should have realized that? Well, yes. Hindsight's a wonderful thing. Or how were we to know finding an appropriate toilet chemical would be a search worthy of the golden fleece? Should have thought of that, too, eh? Well, we didn't. Like Mark Twain, we were "Innocents Abroad." But we learned.

We learned that an icepick is an invaluable camping tool, that plastic trash bags and paper towels are gifts from the gods, that dragging along stuff on the theory you *might* use it is wearying delusion. (In my case it was golf clubs. I must have hefted and toted them a thousand times, not once on a links. In my wife's case it was a small sewing machine. She never used it.)

We learned that finding a source of butane in the boondocks—especially on a

(Please turn to page 198)



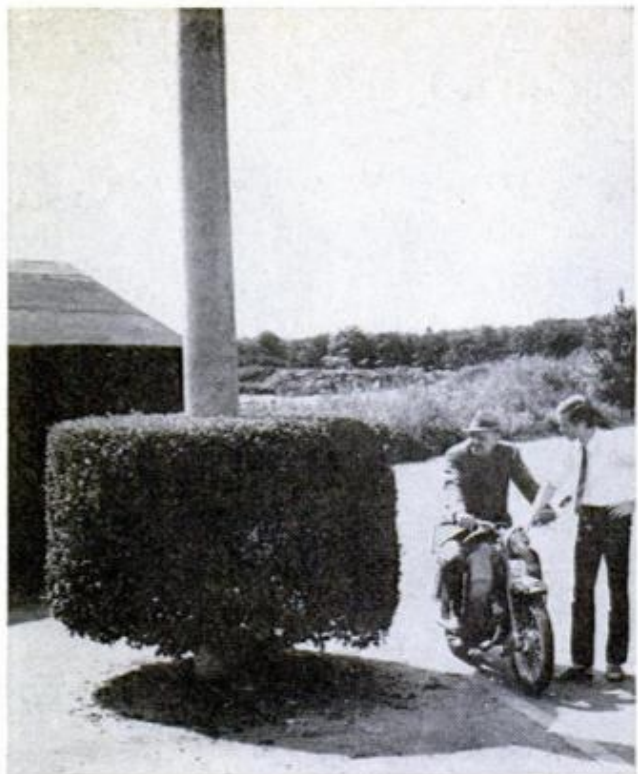
Pour-in helmet liner

Liquid polyurethane foam, poured into a mold on a pilot's head, hardens into a custom-fitted helmet liner in seven minutes. The technique was developed by Col. William Morton (shown) at Wright-Patterson AF Base.



Editors drink reclaimed waste

"It's very good water," reported Richard Dempewolf (left), editor of *Science Digest*, and Robert Crossley, editor of *PM*, after sampling reclaimed sewage on a recent trip to South Africa. Because of acute water shortages, South Africa has done extensive work in water reclamation; one city, Windhoek, South-West Africa, gets 30 percent of its municipal supply from reclaimed sewage.



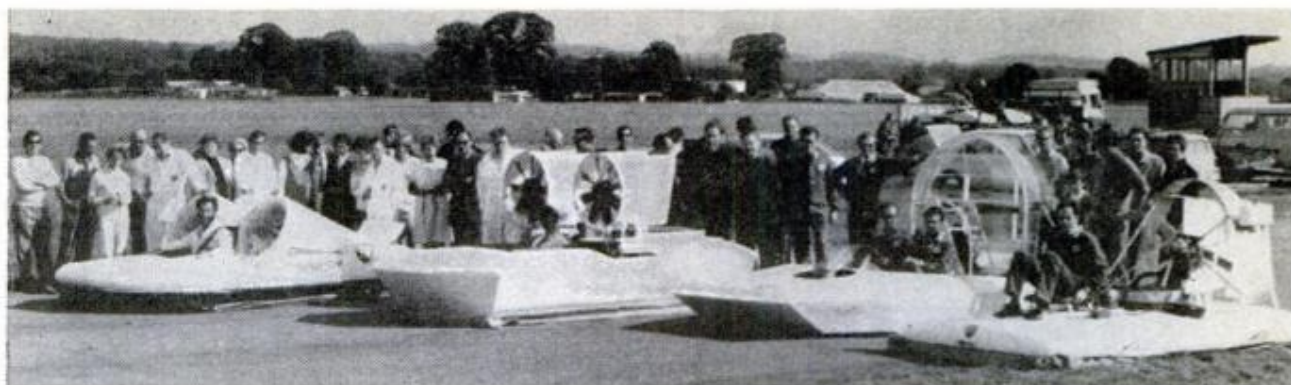
Hedge is real stopper

Standing at a bend in a German road, this sign pole was vulnerable to errant traffic—until police planted a hedge to protect it.



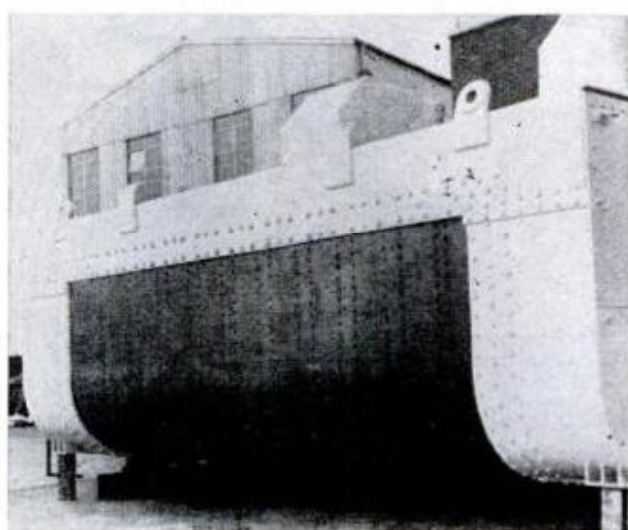
Walking aid for handicapped

The "Walk-About-Machine," invented by a 16-year-old British boy, enables physically handicapped children to learn to walk. The harness, attached to an overhead rail, is clipped to a spring-loaded drum that stops the child short if he starts to fall.



Auto club members switch from wheels to air cushions

Members of an automobile club at Goodwood, England, changed their mode of transportation for a recent rally. They drove nine air-cushion vehicles built by members of the club. The competition course took the vehicles over land and water.



Fiberglass warship

This is a two-thirds-scale center section of the world's first fiberglass warship. A 140-foot-long mine hunter, it will be built in Scotland for the Royal Navy.



Tube for living in

This house, shown being transported to an exposition, is a 50-foot-long plastic tube. Swiss architect Franz Dutler has outfitted it with a bath, living room, bedroom and balcony.



Helping hand

The Elastolift mechanical hand, developed by B.F. Goodrich, has gas-actuated rubber fingers that can grasp contoured objects.

MARCH 1970

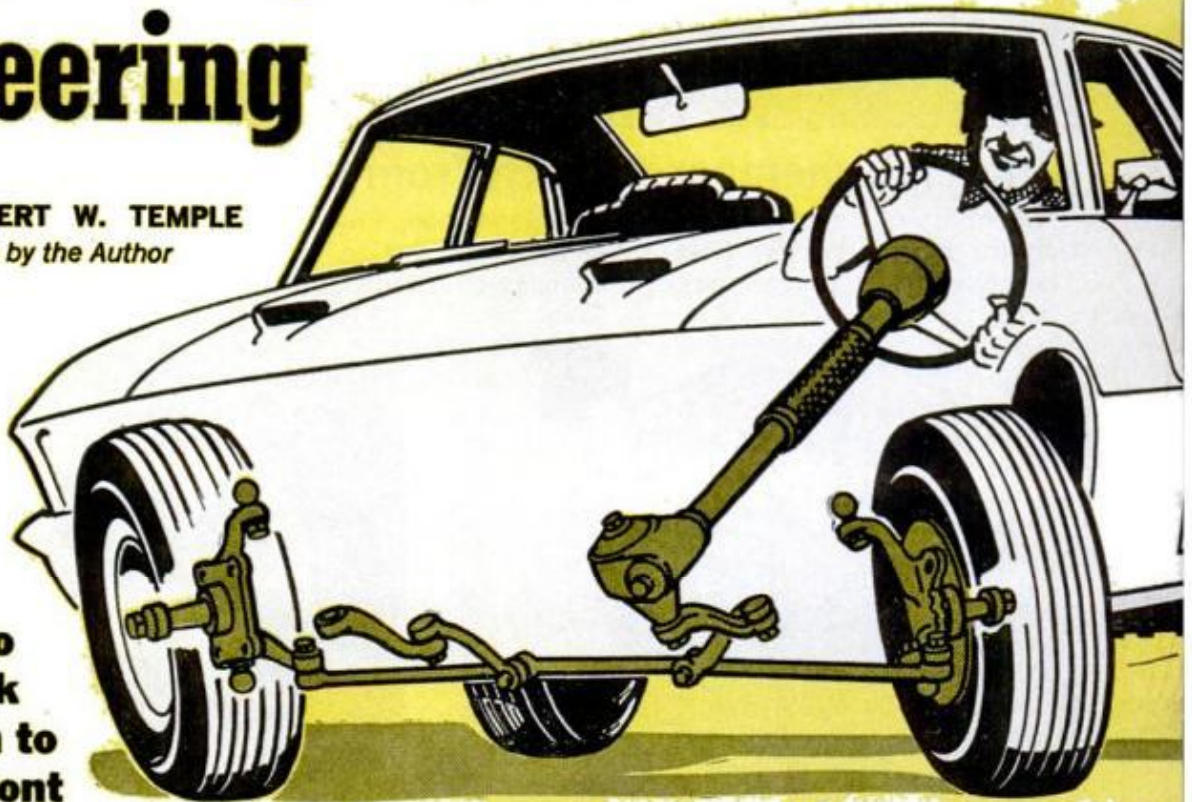


Coal-burning model

Rumbling along at $\frac{1}{4}$ mph, British businessman Peter Brandt pulls wagonloads of kids with his coal-burning steam engine.

The ABCs of Front Ends and Steering

By **ROBERT W. TEMPLE**
Drawings by the Author



You have to take a look underneath to see that front wheels are actually suspended at many different angles in an ingenious system that keeps your car going where you point it

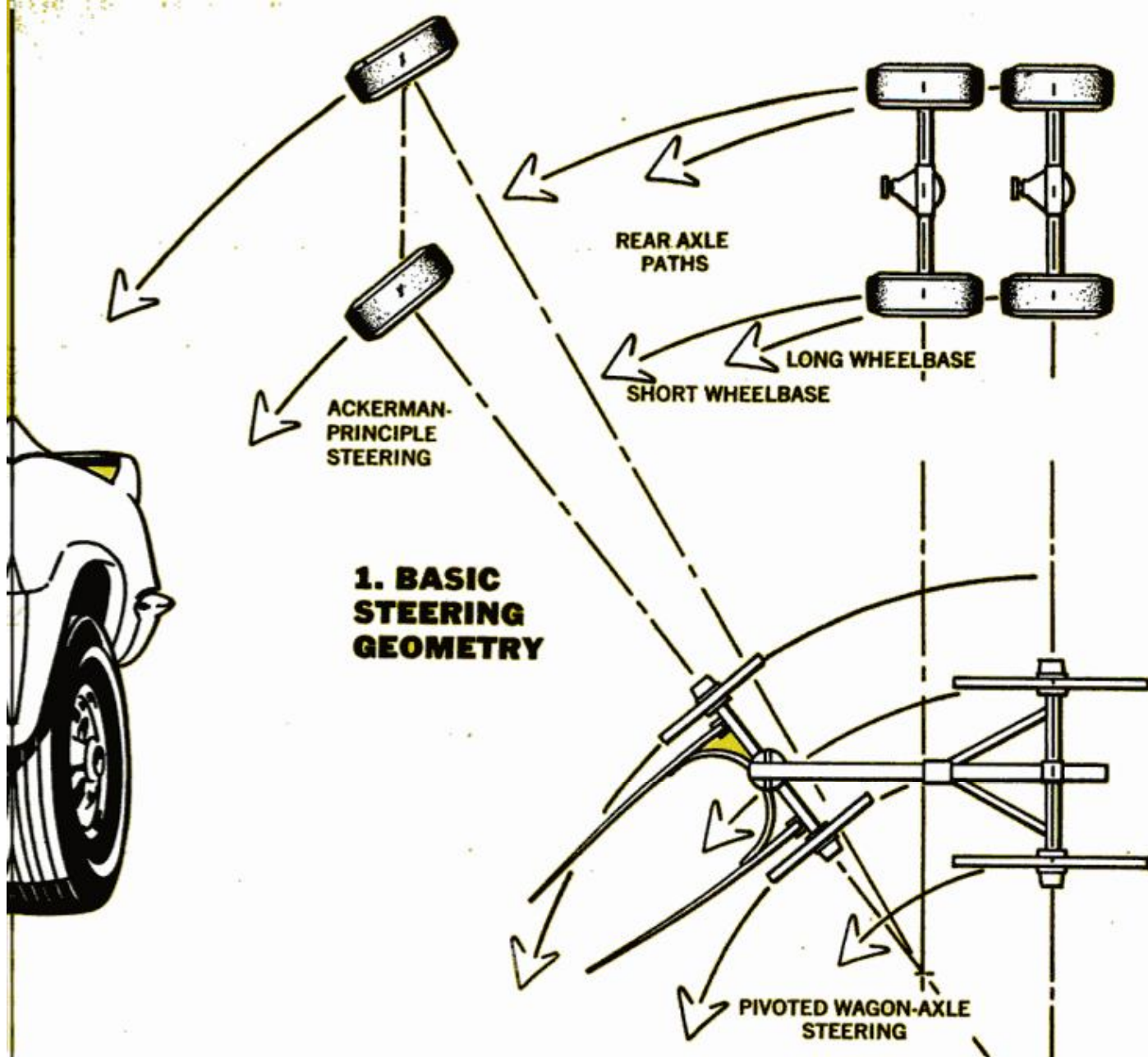
NEXT TIME you grasp the steering wheel of your car, think a bit about what happens between your applied effort at the wheel and the tire contact point at the road. The mechanism that you are activating is usually taken for granted. It shouldn't be, because the proper functioning of its components is what hopefully will guide you safely to your destination. A description of how an automotive steering system functions and how it can malfunction will help you to recognize impending troubles.

Major components of your steering system and front end are shown in the phantom view above. Working down from the steering wheel, the enlarged perforated section of the tube is the section of the steering column that telescopes to reduce crash injuries. As the

shaft telescopes, the outer jacket deforms to cushion impact. At the lower end of the column, the steering gear-box changes rotary motion of the steering shaft to linear motion of the linkage rods, an action we'll detail later.

The simplest type of steering is the center-pivoted straight axle, used on horse-drawn vehicles and tried on some of the earliest versions of automobiles. Shown in Fig. 1, this steering system isn't practical for modern automobiles because of limitations imposed by such things as engine and passenger compartments, suspension systems and a practical method of applying mechanical steering.

By mounting the front wheels with individual steering pivots, the limitations of the single-pivoted axle were overcome. But the spindle axles had to



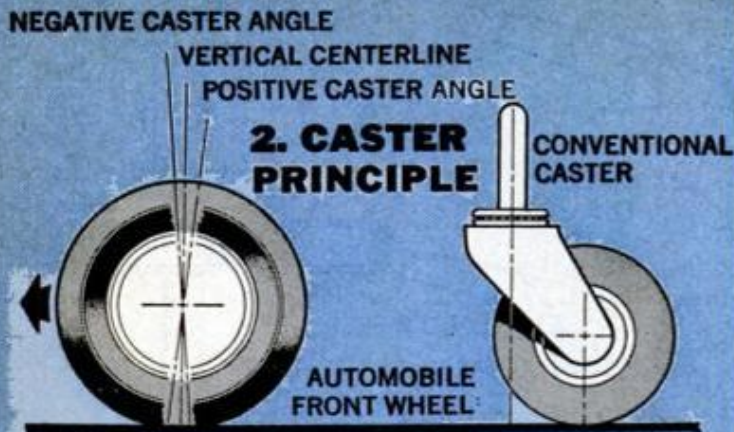
1. BASIC STEERING GEOMETRY

project at different angles with respect to the vehicle centerline when turning to achieve a common turning-radius center point, necessitated by different turning-circle diameters described by the inner and outer wheels. This is the Ackerman steering principle, also shown in Fig. 1. Inherent in any concept that steers on one end of the vehicle only, is rear-axle run-in. The rear end shortcuts the corner; the longer the wheelbase, the greater the problem. This is why big trucks swing into the center of the road to make a right turn. If they didn't, the rear end wouldn't make it.

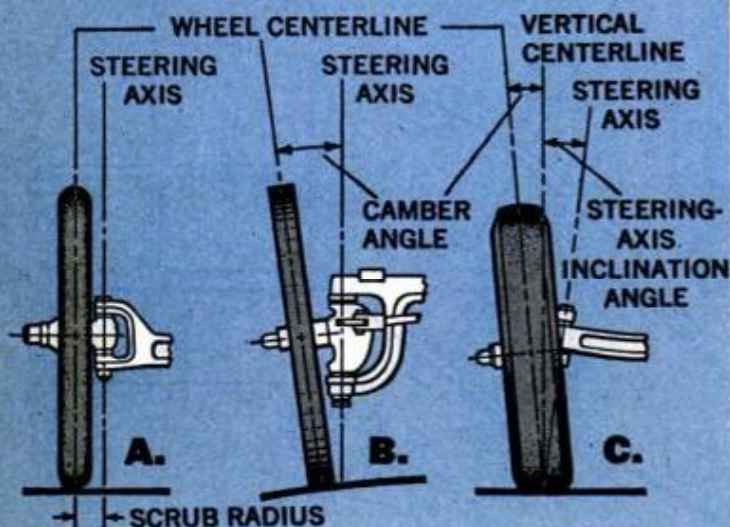
Getting down to rudiments of steering geometry, we have three basic factors to consider: caster, camber and toe-in, shown in Figs. 2 through 4. Caster is an application of the principle

used in furniture casters. The pivot, or steering axis, is offset ahead of the wheel contact point. When the castered object is pushed in a particular direction the pivot axis leads the wheel axis, resulting in automatic steering compliance. The projected centerline of the steering axis of an automobile is also offset from the wheel contact point. This angle between perpendicular and the line of the steering axis is the caster angle. If the axis leans rearward, you have positive caster; forward, negative caster. Both are used in automotive steering-system design, but if you find both on the same vehicle, head for the nearest front-end shop!

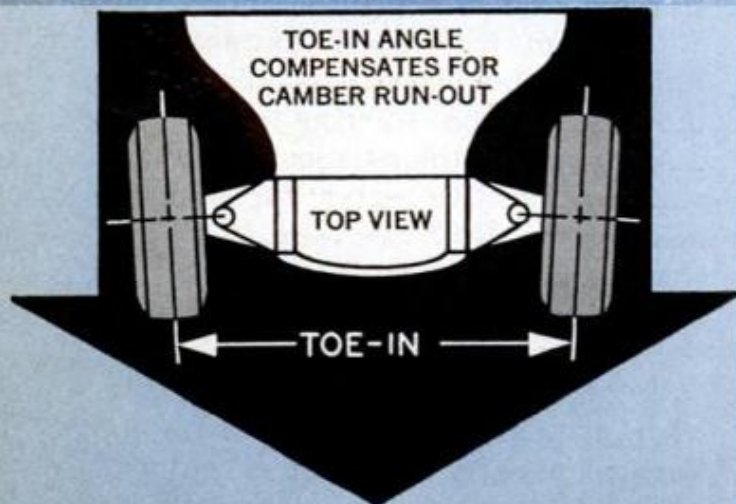
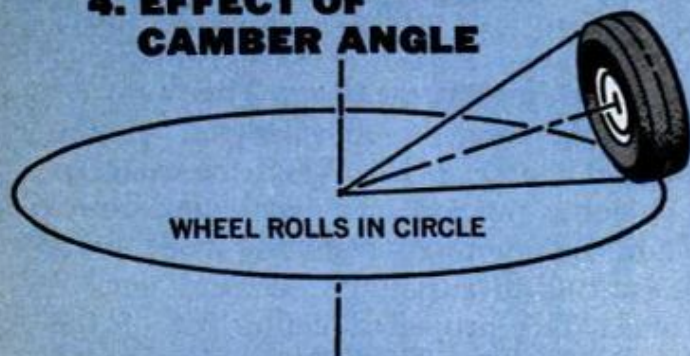
Some early applications of the Ackerman principle had the steering axis vertical, parallel to the wheel centerline (Fig. 3A). The offset distance between



3. STEERING GEOMETRY DEVELOPMENT



4. EFFECT OF CAMBER ANGLE



the two is known as the scrub radius. This discrepancy in centerlines means that any jolt to the wheel will be transmitted through the axle and telegraphed through the steering linkage to the driver.

As shown in Fig. 3B, camber is the tilting of the wheel outward. This brings the wheel centerline closer to the projected steering axis, to reduce the scrub radius. About 70 years ago, wheel camber was used mostly to help keep the vehicle on top of the high crowned roads of the era. In later years, however, the reason for camber angle, combined with inclination of the steering axis (Fig. 3C) was to help reduce the scrub radius without resorting to a radical angle away from perpendicular with either. Steering-axis inclination also provides a self-straightening characteristic to the vehicle after it makes a turn, because rotation of the spindle about the tilted axis is against the weight of the vehicle.

A leaning wheel (camber angle) will roll in a circle (Fig. 4). Imagine a paper cone on a flat surface. The apex of the cone represents the projected wheel centerline, and the open end of the cone represents the center periphery of the tire. To make the wheel roll straight down the road, a corrective angle is introduced into the steering system; this angle is called "toe-in" angle, because the wheels in plan or top view would appear to be rolling toward each other. The distance between the wheel-tread centerlines measured at the front is slightly less than the equivalent dimension measured at the rear of the wheels.

The sectional view of a typical independently sprung front end in Fig. 5 will help illustrate some factors which can adversely affect proper steering. One thing is tires. Just about any difference between

the conditions of the front tires can be felt at the steering wheel: Improper or uneven inflation pressures; mismatched tread patterns; a worn tire on one side, a high tread on the other; a tire that is out of balance or out of round, or a tire that has been flat-spotted in a panic stop.

A wheel that is bent or out of round will cause vibration in the steering system. If you've picked up some odd wheels for snow tires, be sure they have the same rim offset with respect to the bolting flange as your regular wheels. A different offset creates a different scrub radius. A "pull" to the side with the wider scrub radius will result, and the cause will be tough to spot.

Brakes should be in good shape, properly adjusted. There's a lot of difference in brake-lining materials. If you replace the lining on one front brake because of a wheel-cylinder leak or grease on the lining, replace *both* front-wheel brake linings.

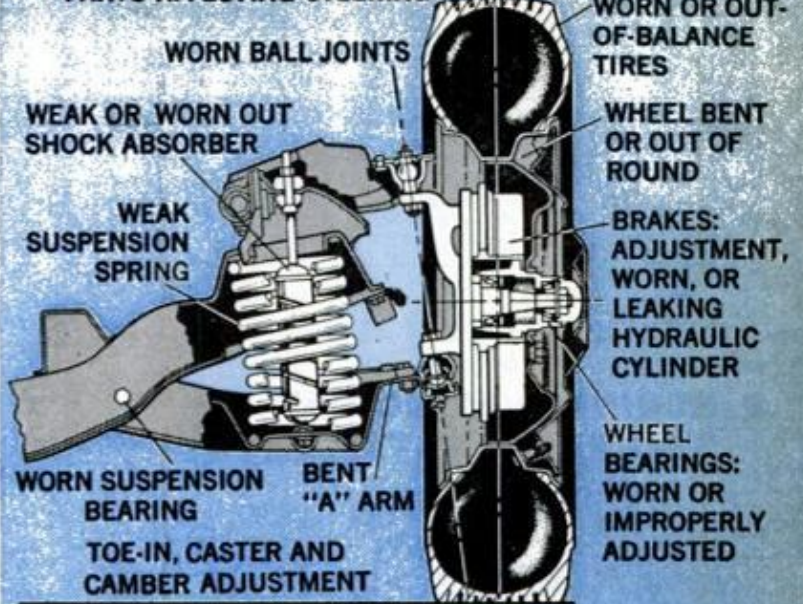
Wheel bearings worn or improperly adjusted will cause road wander. Bearings that are too tight will heat, throw lubricant into the brake, and the bearing will deteriorate rapidly. Remember that loose wheel nuts can let you down, literally. If you hear a noise from any wheel, check it or get it checked as soon as possible. The problem may be only a badly fitted wheel cover, but it could be a wheel in the early stages of working loose.

Toe-in, caster and camber adjustments are carefully engineered to impart proper steering and handling characteristics. An abnormal condition in any of these can affect steering and handling. Any working joint or pivot in a suspension system will affect steering action if worn. Bent or loose parts will also cause trouble; this in-

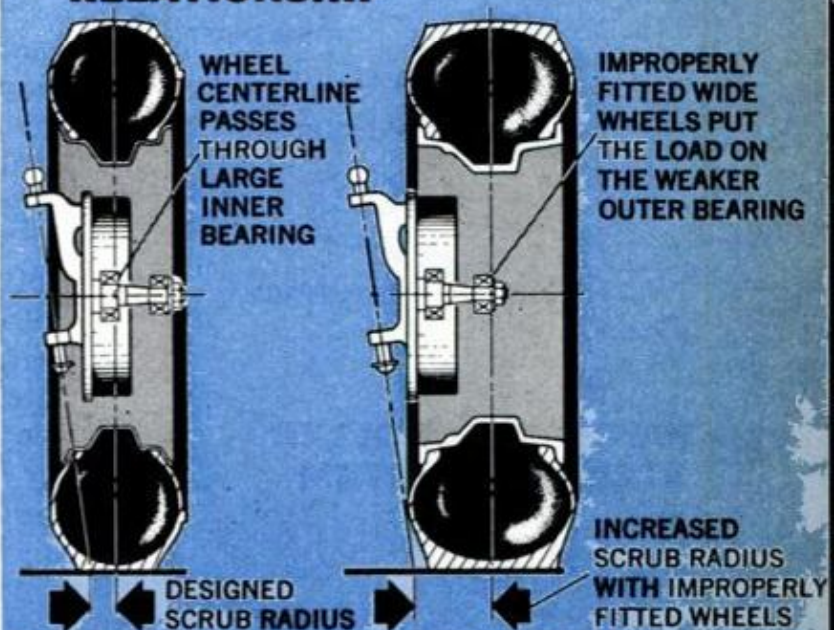
MARCH 1970

5. TYPICAL COIL SPRING IFS

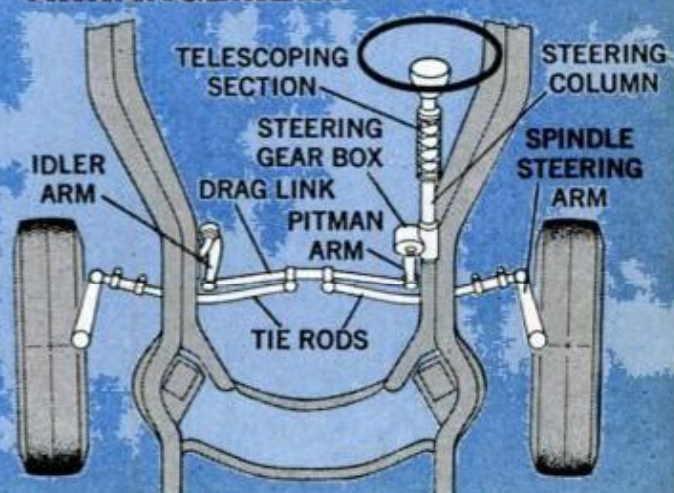
PARTS AFFECTING STEERING



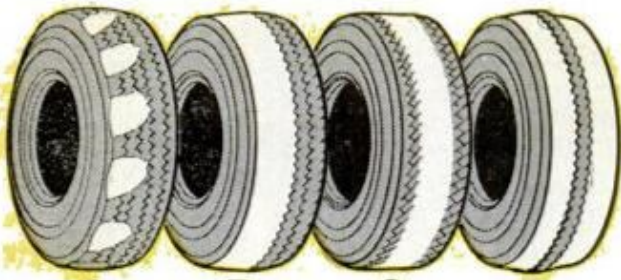
6. IMPORTANCE OF MAINTAINING PROPER WHEEL CENTERLINE RELATIONSHIP



7. TYPICAL STEERING-SYSTEM ARRANGEMENT

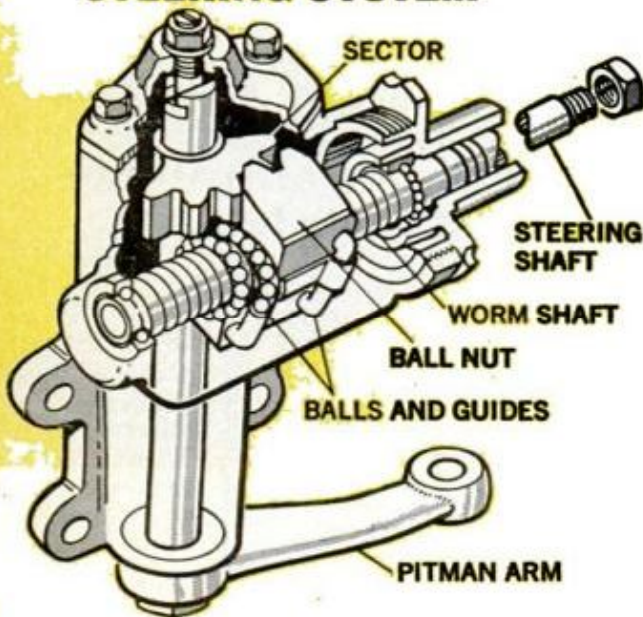


8. TELLTALE TIRES

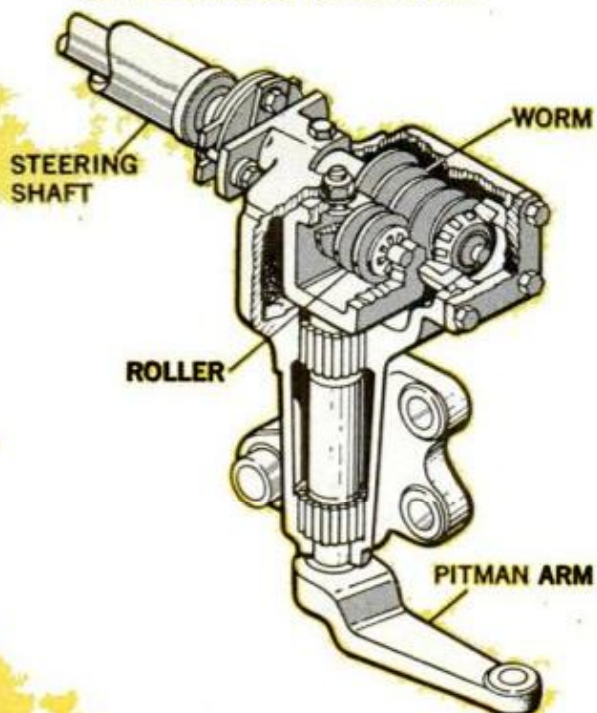


A. B. C. D.
TIRE-WEAR PATTERN INDICATES PROBLEMS

9. RECIRCULATING-BALL STEERING SYSTEM



10. WORM AND ROLLER STEERING SYSTEM



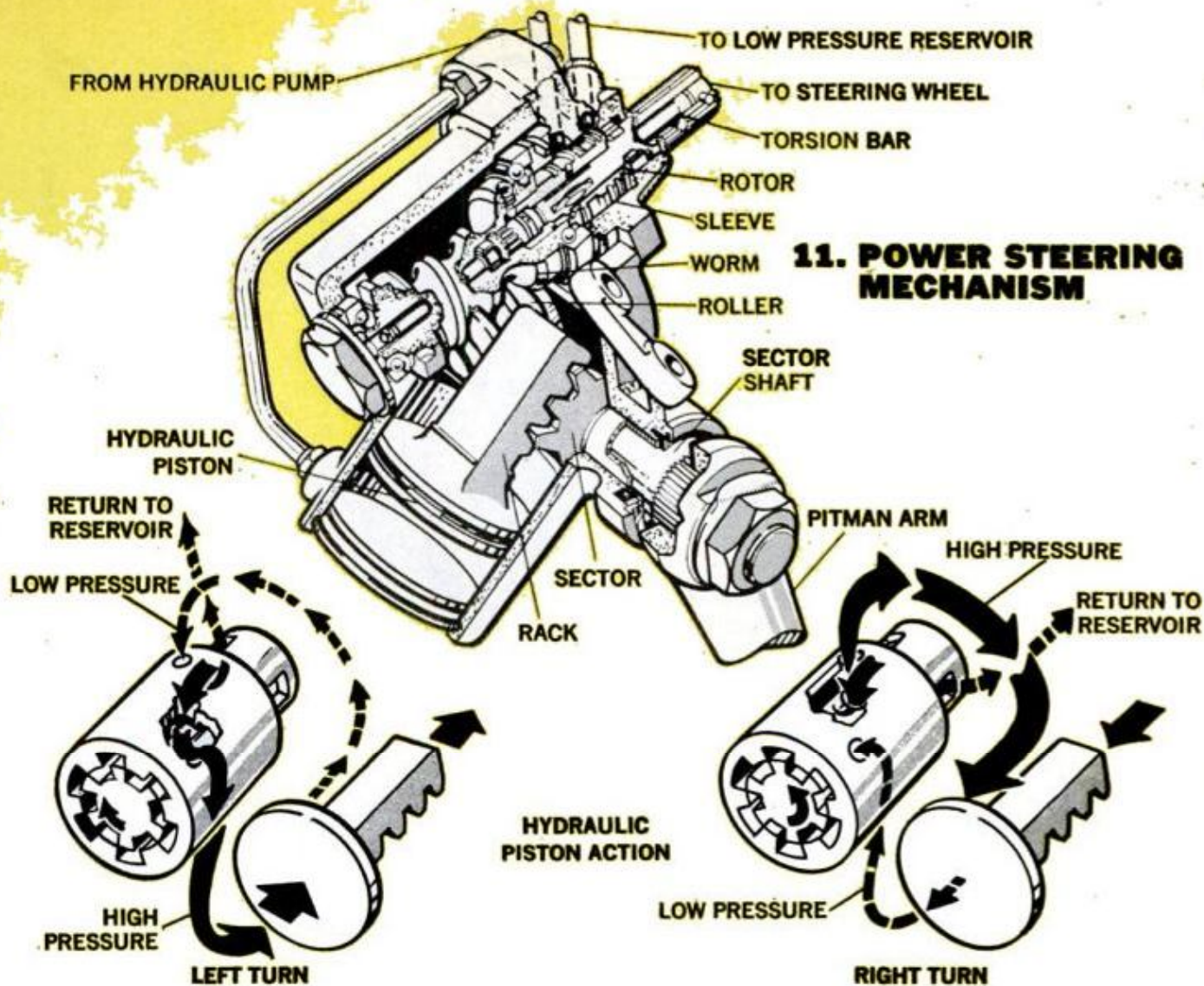
cludes tie rods, idler arms, drag links, Pitman arm and all mechanisms up to the steering wheel.

A weak suspension spring will cause a sag and pull on one side. Also important is the condition of your shock absorbers. A "shock absorber" is in reality a device which controls rebound in the suspension system. The purpose of rebound control is to keep the tire in contact with the road surface as much of the time as possible. If your tires aren't in contact with the road, you can't steer.

Wide wheels and tires are all the rage these days. Many are installed without regard to factory specifications. Let's take a look at what can happen. The problem gets down to the wheel-offset distance and the scrub radius. Manufacturers of accessory wheels are aware of the problem, and can furnish wheels on order to about any dimension. But it's asking for trouble to grab a set "off the shelf" and install them without regard to critical dimensions.

In Fig. 6, the factory wheel is on the left. The wheel centerline, which is also the direct-load-bearing line, passes through the inner wheel bearing, and at the strong base of the spindle shaft. Scrub radius is minimal. An improperly fitted wheel and tire having a wider centerline offset, as shown at the right in Fig. 6, will move the wheel centerline and consequent load-bearing line out to the small outer-wheel bearing and the weak end of the spindle shaft. This type of installation is often made by a performance enthusiast. It doesn't require a computer to reveal the increased risk of failure. The scrub radius has also been drastically increased, and the lever action of this factor will mean lots of steering effort at higher speeds.

There are many variations of steering-system linkages. Fig. 7 shows the type of system used with independent front-suspension systems. This is a straight mechanical lash-up. The Pitman arm is connected to the ball-joint-



11. POWER STEERING MECHANISM

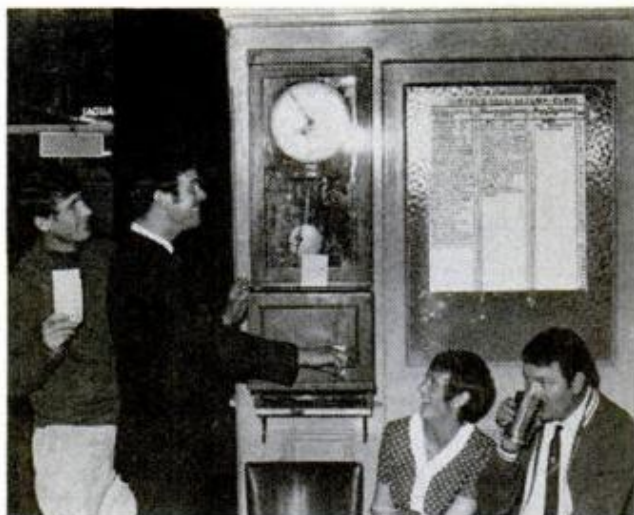
ed drag link. The drag link is suspended between the Pitman arm and an idler arm attached to the opposite side of the frame. Adjustable tie-rods are ball-jointed to the drag link near the center, and to their respective spindle steering arms at the other end. Ball joints on the spindle assemblies provide both steering-axis pivot points, and outer suspension pivots. Your safety hinges on the condition of all these.

Before we describe the operation of the steering system, let's look at some indications of malfunction which your tires can provide. See Fig. 8: (A) Intermittent cupping of the tread indicates loose, worn, or damaged parts in the steering and suspension systems. (B) Tread worn off on one side indicates an improper camber angle; wear on one half of the tread pattern with feather-edging of the other tread ribs

indicates excessive toe-in. (C) Center wear means inflation pressures are too high. (D) Wear at the outside, with a high center rib, is from underinflation.

Most automotive steering gearboxes are based on either the worm-and-nut, or worm-and-roller principle. The worm-and-nut-type is similar to a nut riding on a revolving bolt thread. Due to inherent sliding friction, such as you would have in a conventional machined thread, a spiral ball race is used for both the screw and the nut (Fig. 9). The ball bearings cannot escape from the nut as the screw revolves because the groove in the nut runs out to a return tube on the side of the nut, rather than out the end as with a conventional nut—thus the name "recirculating ball screw." The "nut" has a rack of gear teeth machined along one side,

(Please turn to page 222)



Punch in at the pub

Plagued by wives who didn't believe their husbands were really having a few with the boys, English bar owner Jack Williams bought a time-clock and now requires his patrons to punch in and out to prove they were there.



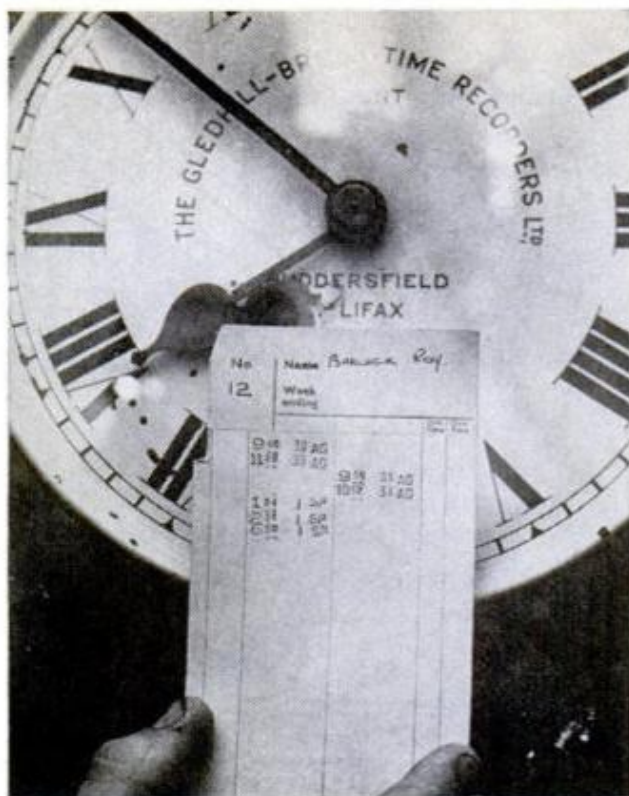
Quick repairs for runways

Sprays of special cement enable British crews to resurface a damaged—or bombed—runway so that planes can land within 20 minutes after the spray is applied.



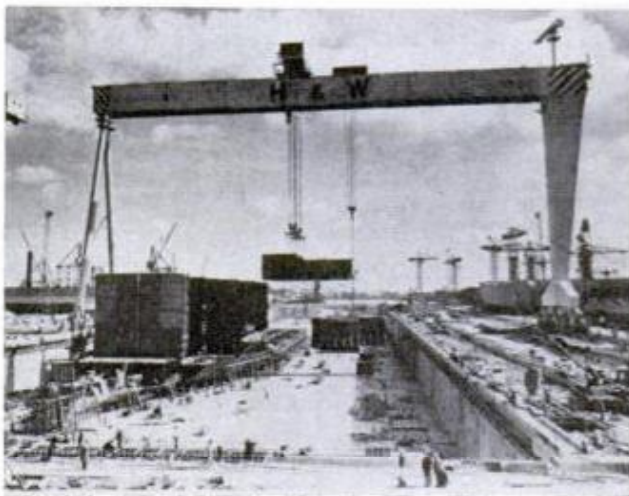
Undersea inspector

Hitachi Shipbuilding developed this 2-knot underwater scooter to inspect hulls of ships in its shipyard in Japan.



Japan Grand Prix winner

Japanese driver Motoharu Kurosawa, driving a Nissan R-382, won the 1969 Japan Grand Prix with an average speed of 194 kph over the 447-mile distance. He's shown here flashing along the Fuji Speedway.



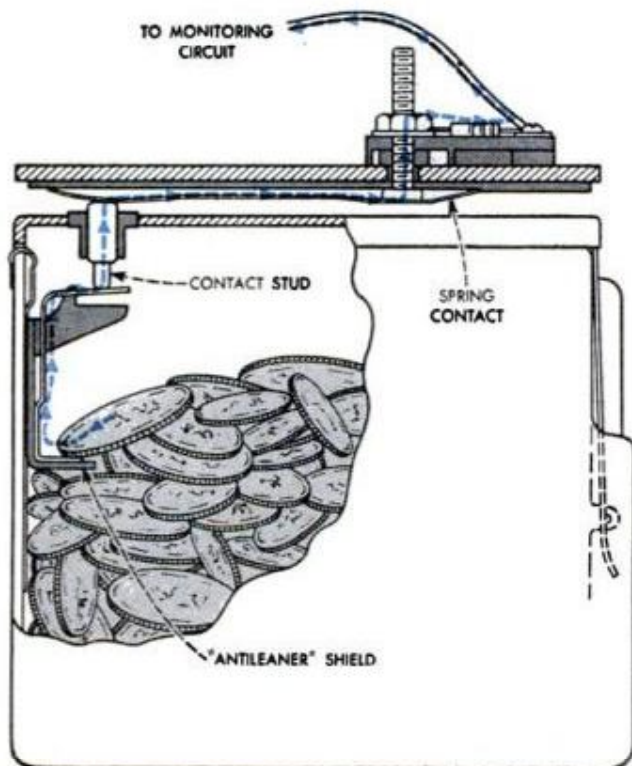
Supercrane for superships

Largest in the world, this 460-foot-wide crane operates at the Harland and Wolff shipbuilding dock in Belfast. The new dock will accommodate million-ton tankers.



Briefcase of the future

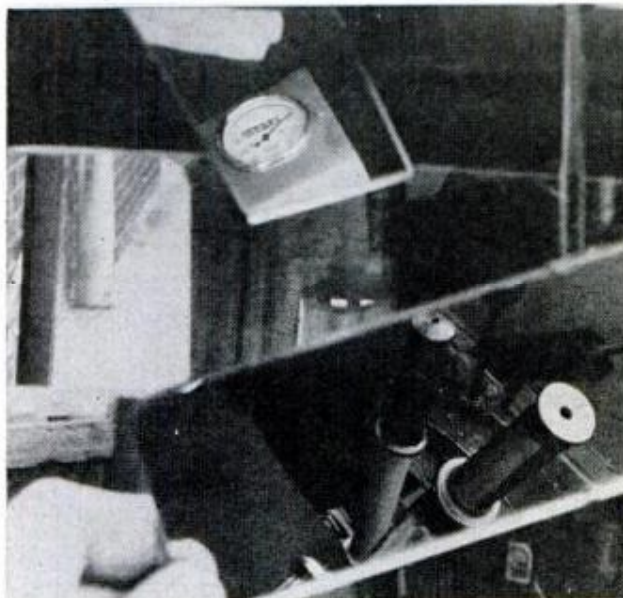
The "computer briefcase" is a prototype of one that may be made in 10 or 15 years. It contains a telephone, typewriter, calculator, TV screen, remote TV camera, microfilm filing system and a computer that helps run the entire operation.



The message is money

A new coin-level sensor that simply clips inside present coin receptacles in pay phones signals a central office when a box is 68 percent full of money. The coins come in contact with the sensor, which sends an electrical signal to a monitoring board.

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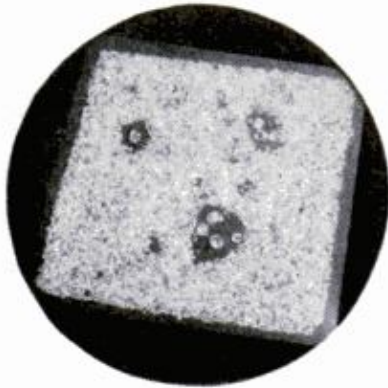
He drives standing up

Unable to bend main joints of his body, Harold Speakes of Manchester, England, is able to drive in a specially fitted car in which he stands upright. Mirrors (photo, center) enable him to see the controls.

Everything's Coming

Security-minded DeBeers doesn't encourage visits to its dredging operations off Southwest Africa. But last summer it gave PM this rare, first-hand look at its fantastic sea-bottom 'vacuum cleaner.'

By GRAHAM YOUNG



A SINGLE DAY'S dredge:
\$40,000 in raw diamonds

THE RAIN pelted my shoulders and ran down my neck as I stood on the tarmac of Cape Town's D.F. Malan Airport. It

was cold, not in the least like one expected in South Africa.

But nothing could dampen my spirits; I was about to embark on a personal inspection of the Sperrgebiet, the fabled Coast of Diamonds, locked away between a guardian desert and a guardian sea, closed to almost all visitors. Prohibited to all the world save mining personnel and those on company business of C.D.M. and M.D.C.

These two corporations, Consolidated Diamond Mines and Marine Diamond Corp., both parts of the famous DeBeers company, control the coast of the Namib Desert and the waters and, more important, the ocean floor and beaches of this treasure chest of gems.

So rich were the original finds that diamonds could be picked up in some areas without any digging whatsoever.

That was in 1908 when the desert and the treacherous coast were the only guardians of this newly discovered wealth. The desert is still almost impassable, and the rough seas off a coast almost without harbors are more than fortune seekers can face. In recent years desert patrols and other security measures have further isolated this already inaccessible area.

Now I was a guest of C.D.M. and M.D.C., about to be flown to the prohibited areas in a company plane. More, I was to be flown out to the world's only marine diamond dredge, the *Pomona*, at Hottentot's Bay up the coast.

Piet Albertyn, head pilot for the company, led me to a twin-engined Beechcraft. In shorts and safari shirt, Piet seemed oblivious to cold and rain other than how they might affect our flight.

Radio crackling with warnings of bad weather, Piet took us steeply up to clear the hills northwest of Cape Town and to climb above the overcast. But clouds went up beyond our ceiling; in the end he had to fly beneath them.

This gave us a superb panorama of the coast and the seemingly endless desert. Until we reached the mining areas I saw no sign of life in the red, yellow and gray sands below. Every few miles along the beach lay the rusting hulks of wrecked ships.

H. E. Milner, manager of M.D.C., whom I had interviewed in Cape Town, greeted us when we touched down at Oranjemund, the company's mining town built at the mouth of the Orange River. We picked up some company men, then took off for Hottentot's Bay.

By now the day had cleared. In place of the overcast, the sun shone fiercely through the plane's canopy, while down below a heavy fog rolled in from the sea. So thick was the fog, as we came in to land on the salt pan which served the camp at Hottentot's Bay as a landing strip, that I could see no sign of the diamond dredge.

Slit-eyed against the salt's blinding

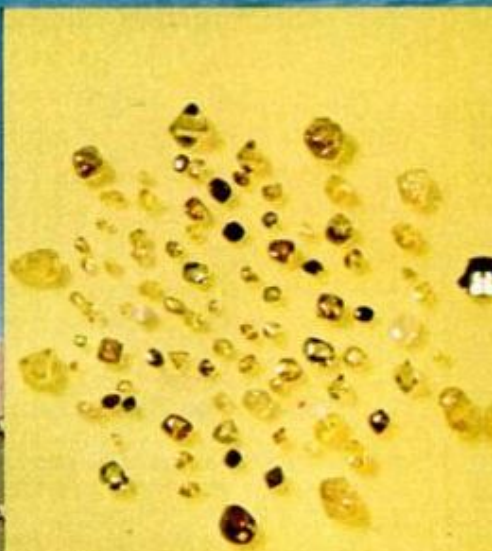
Up Diamonds!



THE FOG suddenly lifted over Hottentot's Bay. Minutes later we were hovering over the strangest craft ever to float on the South Atlantic. In one day Pomona sucks diamonds from 1000 square meters of sea bottom



WHILE POMONA SWEEPS ocean floor, the Vacuveyor, an enormous vacuum cleaner mounted on a Sherman tank chassis, goes after diamonds on beach



MARINE and beach mining recover highest percentage of gem stones of any diamond mining operation in Africa. Stones here are pick of the sorting tables, all rare colors and beyond price

glare, we stumbled across to the big cargo helicopter which flew us to the shore party's camp. There we sat drinking hot, strong tea and eating thick sandwiches while waiting for the fog to lift so the helicopter could take us to the dredge.

Miners are a rugged breed and warm hosts the world over, but I soon learned my first lesson. Although these men were full of tales of the coast and its diamonds, they sidestepped questions about company activities or details of the diamond dredge without giving anything away!

Piet Albertyn and the Beechcraft had to fly back to Oranjemund and on to Cape Town before nightfall, so our chances of getting out to the dredge lessened as the minutes ticked away.

But with less than an hour before time ran out, the fog suddenly lifted. We scrambled for the helicopter and minutes later were hovering above the most unusual craft that ever floated on the South Atlantic.

The *Pomona* was so huge and so crammed with derricks and gantries and gear that she looked like a vast barge carrying the Queensboro Bridge down New York's East River.

We landed atop the living quarters at the sharply pointed end of the monster, which turned out, surprisingly, to be its stern. Just as surprisingly, the bows, pointing shoreward and mounted with towering girder-work carrying the mining and suction heads were blunt and square.

I caught the name "... Kruger. . .," and a big man was shaking me by the hand and welcoming me onboard. But such was the racket of the helicopter engine and the diamond dredge in action that I watched his lips moving without hearing a word.

Besides, I was learning one of the dredge's secrets without even asking for it, for, as we flew onto the dredge, its mining heads were being lowered beneath the water. Now I watched them disappear slowly into the sea.

In Cape Town I had asked in vain for technical details of those heads. Did they cut with rotary teeth or with blades? Now, in the 30 or 40 seconds in which they had been visible, I could see they were armed with high-powered hydraulic jets to break up conglomerates on the sea bottom, while twin steel pipes sucked the diamond-rich debris onboard for processing.

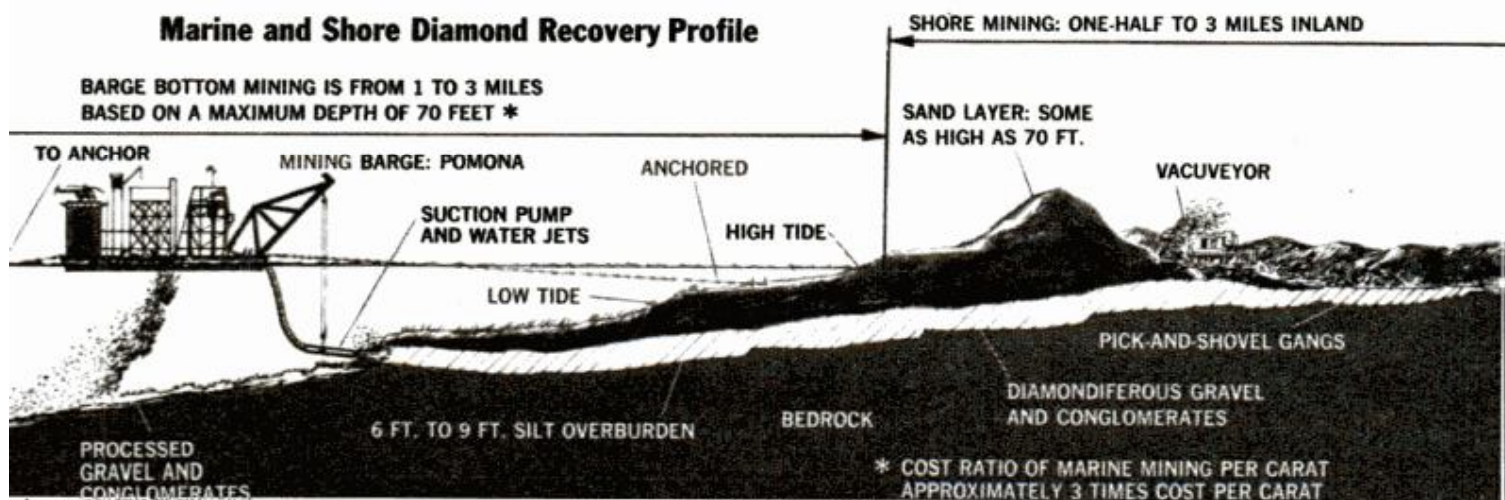
Immediately behind the jet heads, the pipes were rigid for some 30 feet, then flexible from there to back onboard to accommodate changes in depth and angle of cutting.

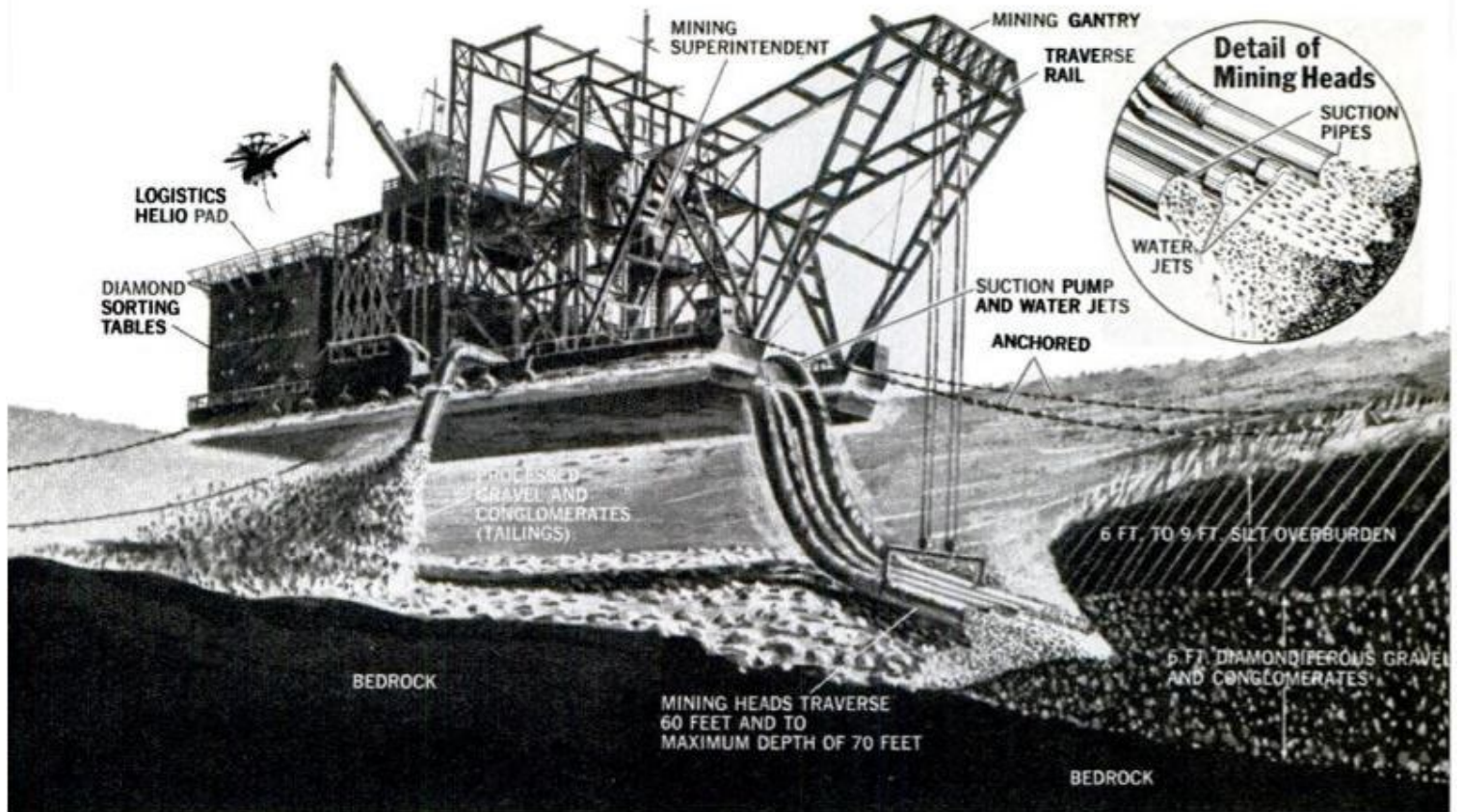
Mining was controlled by a single man sitting at a console in a centrally located observation post. There were two such dredging superintendents. Each worked a 12-hour shift.

Each shift had a port and starboard winchman, who moved the barge in an exact pattern between her mooring buoys. Four great anchors, parallel to the shore, held the bow. Another four, to seaward, held the stern into the pre-

SKETCH SHOWS how diamond-bearing stratum extends from shore to the sea bottom. One theory is that diamonds were washed down by rivers, some long since dry, from volcanic "pipes" near Pretoria and Kimberly

Marine and Shore Diamond Recovery Profile





HYDRAULIC JETS DIG through gravel to break up diamond-bearing conglomerate on the ocean floor. Parallel suction pipes, operated off the same 6000-gallons-per-minute pumps, siphon it aboard for sorting

vailing wind sweeping in across the South Atlantic.

Each winch-drum held 3500 feet of heavy cable. As the dredging superintendent swept the jet heads from side to side in a 60-foot arc, the winchmen inched the *Pomona* forward to keep the jets against the work-face.

The jets cut a trench some 70 meters long and 20 meters wide, before the heads were raised and the dredge winched back and seaward to start again. The dredge was then winched sideways 60 feet, heads lowered and a new trench begun. Three Amsco dredge-pumps handling 6000 gallons per minute gave power to break up the conglomerates and siphon them onboard.

The first layer uncovered is usually silt; the second, gravel mixed with shell and fine silt. Sometimes there is a third layer of gravel mixed with clay. It is in the gravel and conglomerates that the diamonds are found.

General sediment depth is 8 to 9 feet. The diamond-bearing gravels vary in thickness up to 30 feet or more. Those being worked were 6 to 9 feet thick.

Securely trapped in her network of mooring lines, the *Pomona* rose and fell as the long rollers swept shoreward beneath her. The jet heads were suspended in a system of counterweights which automatically kept the clusters of hydraulic jets positioned correctly.

Weather is the big enemy, salt corrosion second, isolation and loneliness third.

As mining superintendent Kruger and I carried on a shouted conversation he continually kept his eye on the weather out to sea. Although the *Pomona* had already ridden out 35-foot waves, all mining activities stop at the first sign of bad weather.

Waves up to 40 feet had been recorded when an earlier barge was torn from its moorings and swept ashore. The *Pomona* carried twin 1000-hp auxiliaries, and a powerful tug stood by night and day to pass her a towline if winds reached gale force.

In good weather, the *Pomona* mines about 1000 square meters of sea floor every 24 hours. It's responsible only

(Please turn to page 211)

NEW BOATS



A



B



E



C



F



D



G

FOR

'70

VARIATIONS along established lines will be the trend of boating for 1970. While more bowriders are on the scene and V-hulls are returning in popularity after the rage for trihull shapes in the '60s, the boating industry has concentrated on refining models already in production or created models competitive with designs produced elsewhere. What's *new* will have more to do with accessory outfitting as in Grumman's River Rogue, above-waterline innovations as in Bertram's "flip-top" or new water toys such as the AquaDart.

A—GLASTRON V-187 stern-drive "Fundeck" is popular with families wanting speedy party patio on water

B—PENN YAN 22½-foot Barracuda with cuddy cabin and two 80-inch berths offers options up to 225 hp

C—EVINRUDE Sportsman (foreground) and Explorer show squared bows of company's Gull Wing design

D—LARSON 18-foot Shark sleeps four, is available with a complete camper top. Outboard model: \$2277

E—STARCRAFT V-140 Modified is a windshieldless and distinctively marked ski boat for the under 25s

F—COBIA offers 22-foot Mobile Mini-Yacht with a 7x12 cabin and outdrive power options up to 155 hp

G—GLASSPAR 16-foot Cutlas Comboard ski boat run-about comes with 120-hp Mercruiser and power trim

H—DUO Mystery-17 is a flashy racer with 90-inch beam that takes up to 170 hp on the stern transom

I—MFG Westfield with a lapstrake hull is a fine 15½-foot all-purpose fun boat. Maximum hp is 70

J—NAUTA-LINE 34-foot fiberglass model strives for cruiser luxury on speedy houseboat hull and frame

K—CHRYSLER has unveiled the 19-foot aluminum Fin Runner with ample cockpit, storage space, fishwell

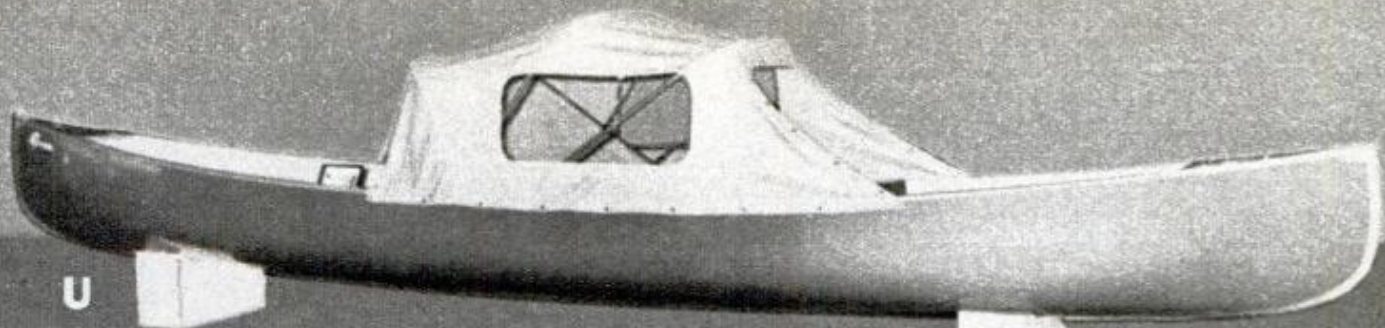
L—KENNER Ski Barges have double bottoms and positive foam flotation, are virtually unsinkable





'70 BOATS





U

M—WELLCRAFT's Dick Cole, inventor of the cathedral hull, has developed an "air-slot" design to cushion rides in choppy seas at high speeds. Price: \$1695

N—DELL QUAY in Britain presents the 14-foot Fisherman based on traditional Shetland hulls. Cruises four hours at six knots on a gallon of gas. \$3000

O—MID-FLORIDA Aluminum Corp. Air Gator boats feature an unusual type of "trip chine" hull construction that's designed for both speed and stability

P—LYMAN—23-foot Offshore Model is hand-built with company's usual concern for quality plywood construction. Speeds up to 37 mph. Price: \$7300

Q—FOLD-A-BOAT, increasingly popular with boaters having storage problems, is 12 feet long, can handle outboards up to 18 hp, folds flat to 4-inch thickness

R—LEISUREDYNE AquaDart, under Marine Corps test, weighs 190 pounds, speeds up to 25 mph. \$995

S—GALLEON 42-footer offers safety breakthrough in houseboating with positive foam flotation

T—KENNER Captain's Gig is a 12-foot dinghy powered by Palmer TW27 engine, draws only foot of water, and carries six comfortably

U—GRUMMAN River Rogue is standard 20-foot canoe outfitted with various luxury features

V—AERO CRAFT Tarpon Deluxe is 14½ feet of trihull, fiberglass construction weighing just 460 pounds. Recommended hp: 45. Price: \$759

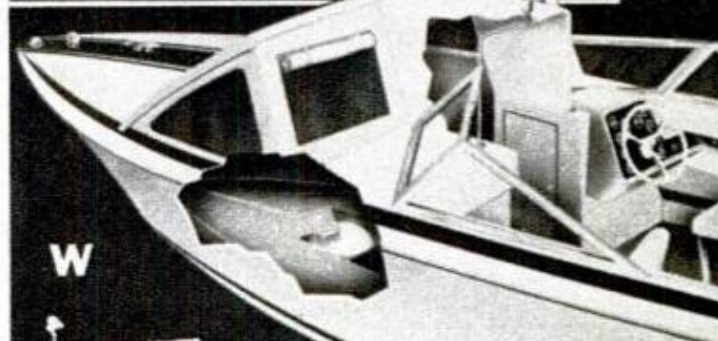
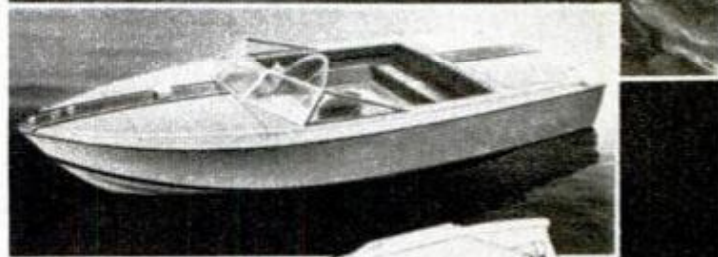
W—BERTRAM 24-foot trailerable flip-top boat offers camper convenience in a speedy runabout

X—JOHNSON Tide Rider is new addition to the Sea Foil line powered by 120-hp OMC stern-drive engine

Y—ALCORT 14-foot Flyingfish, popular with bathing-suit sailors, weighs 190 pounds with 120 sq.-ft. sail area. Price: \$1100



V



W

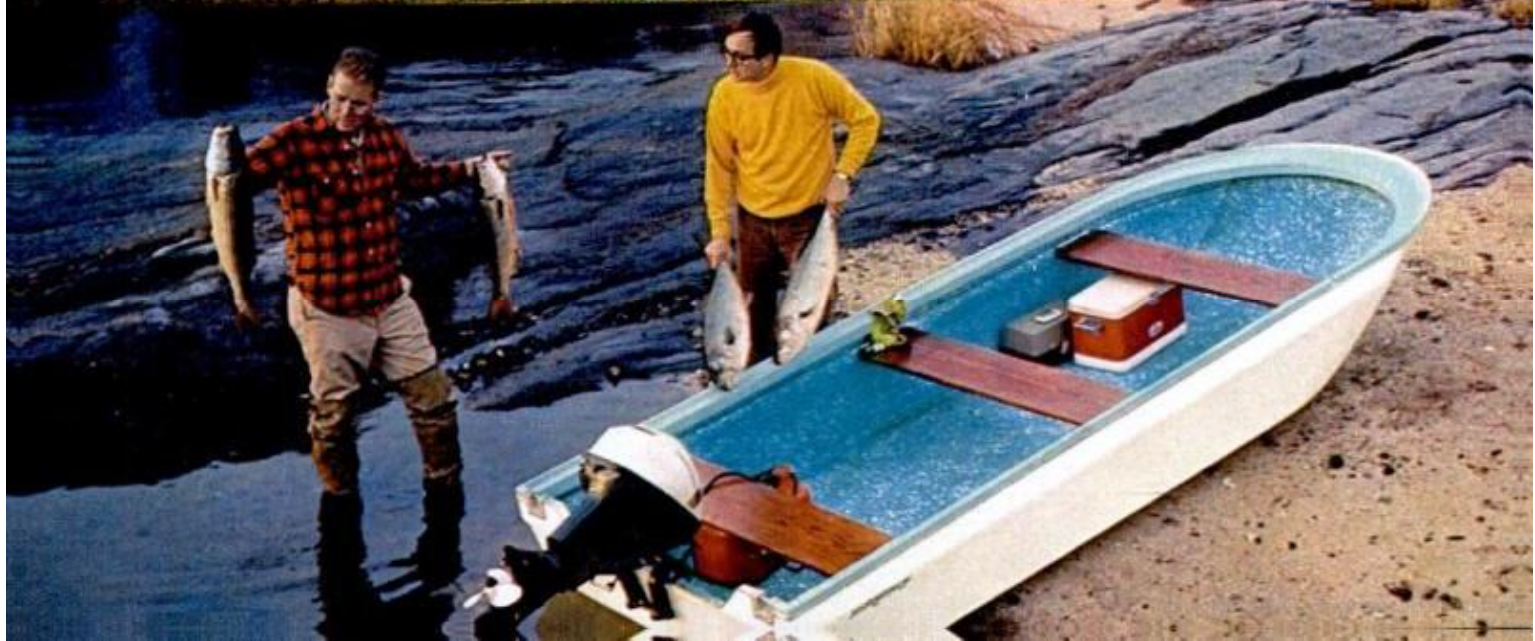
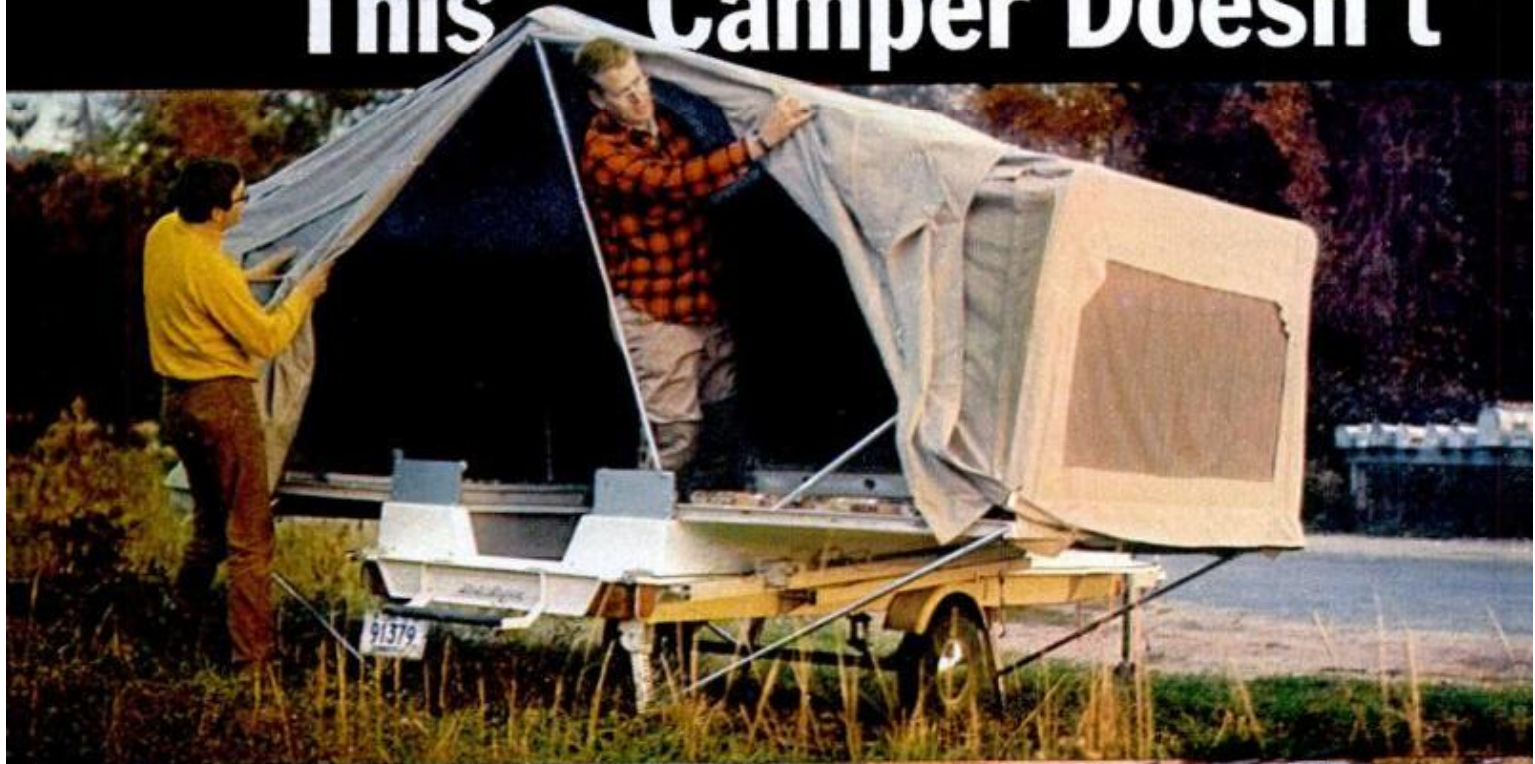


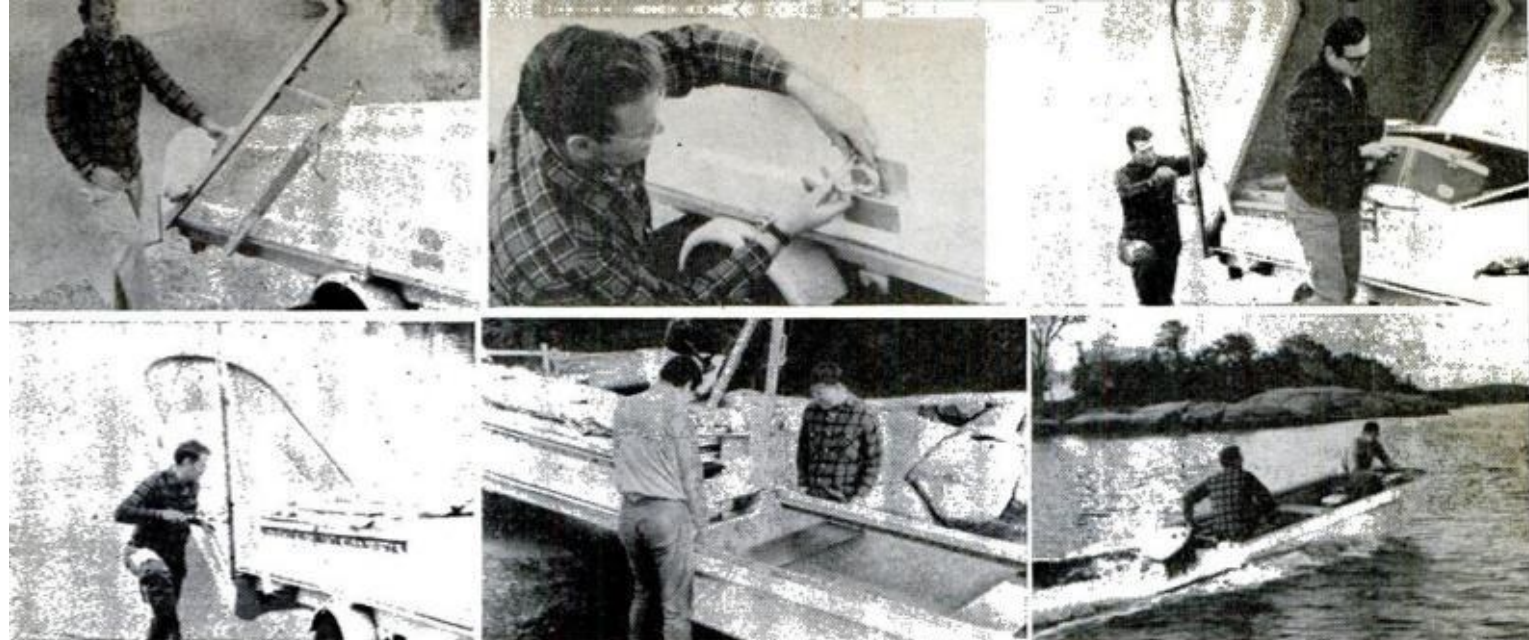
X





This Camper Doesn't





AUTHOR SETS UP TRAILER MAST, hooks in winch line, and cranks boat upright. Peter Dale unloads storage compartment while boat is lowered for launch. Transom unlocked, seats in—and off for a day of fishing

Miss The Boat

By **GEORGE REIGER**
Boating and Outdoors Editor

DO YOU TRAILER A CAMPER AND CARTOP A BOAT? Wish you could combine both and free your car roof for extra gear? Mossberg's Marine Camper slogan (and our title) may be corny, but this combination vehicle is sure to answer your needs. The Marine Camper doesn't sacrifice standards in either boat or camper to accommodate the combination, and you will be pleased by the ease with which the boat is launched and the camper set up.

We took our test rig to the Connecticut coast where we found bluefish and striped bass running. A 9½-hp outboard motor (transported in the trailer's 52-cu.-ft. storage space) easily pushed the 14-foot fiberglass utility hull with two bulky anglers. On the road the rig is just 16 feet long and 46 inches high, yet it can sleep four and house six at the campsite. Price: \$1495. For more data, write O. F. Mossberg & Sons, Inc., 7 Grasso Ave., North Haven, Conn. 06473. ★★

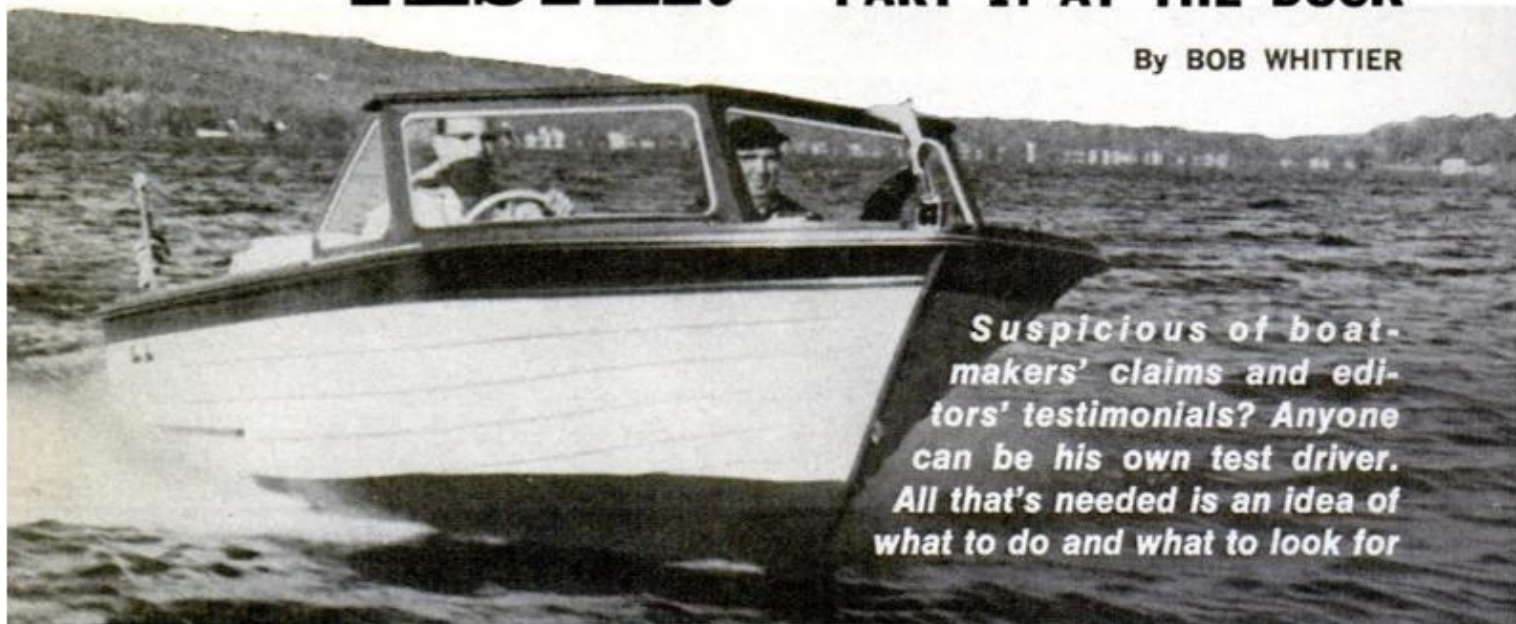
TO SET UP MOSSBERG'S HOME ON WHEELS, use tow-bar jack to level trailer and brace sides with fold-down legs. Pull out support rods and bed panels and raise tent. Within minutes you're all ready for bed



BE YOUR OWN BOAT TESTER

PART 1: AT THE DOCK

By BOB WHITTIER



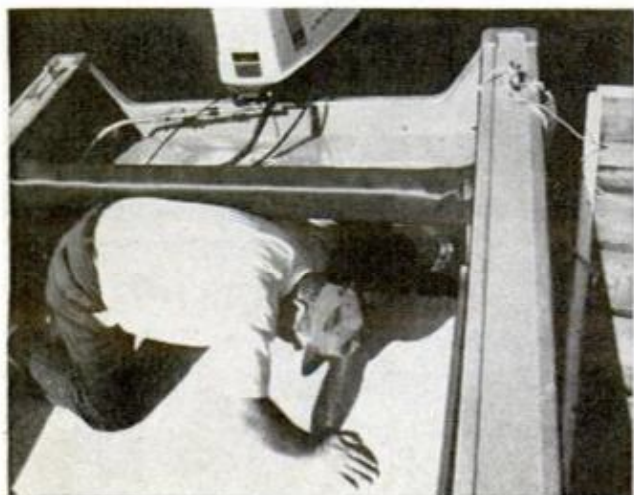
Suspicious of boat-makers' claims and editors' testimonials? Anyone can be his own test driver. All that's needed is an idea of what to do and what to look for

TESTING A BOAT is done in two stages. The first evaluation takes place in the showroom and at the dock; the second part, on the go in open water. You can learn a lot by being observant and making common-sense deductions during the first stage of evaluation. Don't just look—see.

For example, understand that boats are made to sell in *different price ranges*. An economy aluminum fishing hull may have no floorboards; passengers must walk around on exposed ribs and channels. A higher-priced boat of the same general type will have a level overlay floor. This difference doesn't make the first boat bad. It simply means that manufacturers are catering to various pocketbooks and needs.

Aluminum, fiberglass and resin are all sold in bulk by the pound. When confronted by one fiberglass runabout priced at \$595 and a similar one tagged for \$750, it's a good idea to compare weights. Basically, modern boats are sold by the pound, not by the foot. It's easy to arrive at the average price per pound for boats being sold in your area. Simply write down the prices and weights of several

MORE NUISANCE THAN LIABILITY is the fact that transom plugs in many runabouts are hard to reach

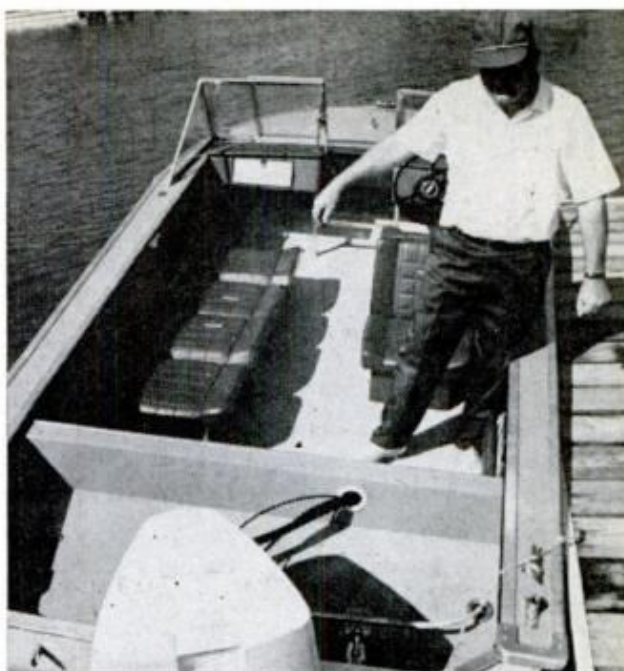


POOR RELATIONSHIP between seat back and dash puts wheel too far forward for comfortable grasp





HERE'S A STEERING WHEEL that's installed too close to cockpit side, causing interference between steering hand and motor-control hand when maneuvering



MUCH CAN BE LEARNED just by moving about a boat at dockside. Here the author feels out the static stability of a boat before taking it on a trial run

similar craft and average them out. With the average price per pound thus determined, it's easy to tell which boats are the cheapies and which are superior in construction. Take into account, however, the amount of trim and accessories.

Some boats are sparse in the matter of deck hardware; others are fully found, as sailors say. This difference sometimes means that builders are under dealer pressure to keep their list prices reasonably in line with the prices of competitive makes and models. More often, though, it reflects the fact that a manufacturer has no way of knowing how or under what conditions any given boat he sells will be put to use. Paint a red "X" on a utility skiff coming off the production line and follow it as it's shipped, put on display and finally sold. It may go 1000 miles east of the factory, or only 10 miles west of it. The buyer may use it for cruising, water skiing, fishing, diving, livery service, or as a workboat. The manufacturer logically goes easy on the hardware and lets each buyer outfit his boat to suit its use and his pocketbook.

To understand delivery charges, know that from a transportation stand-

A WELL-DESIGNED WINDSHIELD is high and comes around for genuine protection from wind and spray



PAIR OF STURDY BRACES reinforcing this windshield helps it to withstand inevitably rough handling





THIS WINDSHIELD HAS NO BRACING to resist strain caused by people grasping top or leaning against it



MANY DASHBOARDS are set so low as to cause bottom edge to press uncomfortably on driver's knees

point, boats are bulky but lightweight items. Trailer trucks work out to be the fastest, most flexible, and most economical means of delivery. Small boats must be crated for rail shipment, which costs extra money, and then shipping charges are based on the cubic footage of the crate. In addition, the "humping" of freight cars in railroad yards is brutal on boats; it jolts them back and forth in their crates.

In contrast, a boatbuilder can have his men carefully load uncrated boats onto tailored trailer racks and leave it to a good driver to give the boats a smooth ride to market.

Consider, too, that differences in delivery charges are based on the different sizes of the boats being carried. A tractor-trailer rig can leave a boat factory with 50 canoes stacked on it—or two stern-drive cruisers. Overhead and mileage is identical for both loads.

One way to size up a given boat's interior is to consider how difficult it will be to clean the boat. Some craft are clearly for the joyrider and definitely not for working boaters. At boat shows you tend to see a lot of "joyrider" craft and few fishing boats. Dealers know that most men bring their wives to shows and accordingly bring in boats likely to gain feminine approval. They figure the anglers will come around to their places anyway.

It's easy to spot a boat that was built

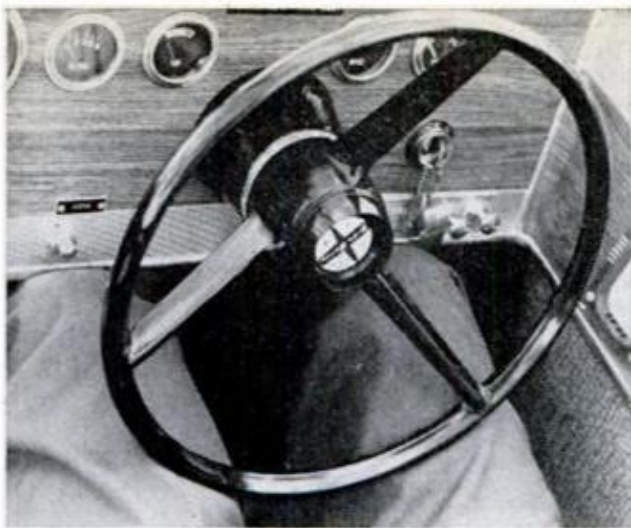
by fishermen for fishermen—its interior is almost as free of dirt-catching corners as the inside of a bathtub. There are other boats that would obviously be a chore to clean. *You* know what you'll do with the boat *you* select, so evaluate the problem accordingly.

Look at the transom drain plug. Often inboard of the transoms on larger outboard boats are "splash wells" which catch and return overboard water that slops aboard over the stern. A convenient place for gas tanks and battery is beneath the splash well, so this design is understandably popular.

But in order to allow for the full tilt of an outboard motor, wells tend to be of such a size as to make reaching the drain plug an awkward chore—especially if there's a long-range gas tank ahead of it. Don't damn the manufacturer for this fault—it's another reflection of his dilemma in designing boats for assorted buyers.

One way to solve the drain-plug problem for the owner who keeps his boat on a trailer is to put the plug in from the outside and keep a spare plug aboard in the unlikely event that the installed one drops out. Also on the market are drain plugs that work by remote control, that have extension handles, incorporate one-way check valves and operate automatically on the siphon principle.

Another solution to the drain prob-



UNLESS OPERATOR HAS SCRAWNY LEGS, this wheel rim will press down awkwardly on his thighs



NO FORWARD HATCH and one-piece windshield—try retrieving an anchor on this boat in a rough sea!

lem in big outboards and stern drives is to use the hard-to-reach plug only for cleaning and drainage ashore and to install a moderately-priced electric bilge pump. Since large boats carry storage batteries anyway, use is made of available current to operate the pump. Equipped with an automatic switch and located in a sump built into the floorboard aft, such a pump has the added merit of preventing a moored boat from sinking during heavy rains. At sea in rough weather, it will blast overboard water that splashes inboard considerably faster than water can trickle out a drain hole.

When you step aboard an unfamiliar boat for the first time, do so with care. Most are steady enough, but you never know for sure. Deep-vee hulls, for example, roll somewhat under one's weight. As soon as you're aboard and sure of your footing, a first impression of the solidity of the craft's build can be had by feeling the floorboard under your feet. Walk around, even jump up and down a little. Obviously a boat that's lightly constructed for portability won't be as solid as a workboat or an ocean racer, but allowing for the craft's purpose and material, any undue flexing or wobbling is worth noting.

Just sliding into the driver's seat may be enough to reveal the earmarks of a dog. Does the seat feel wobbly,

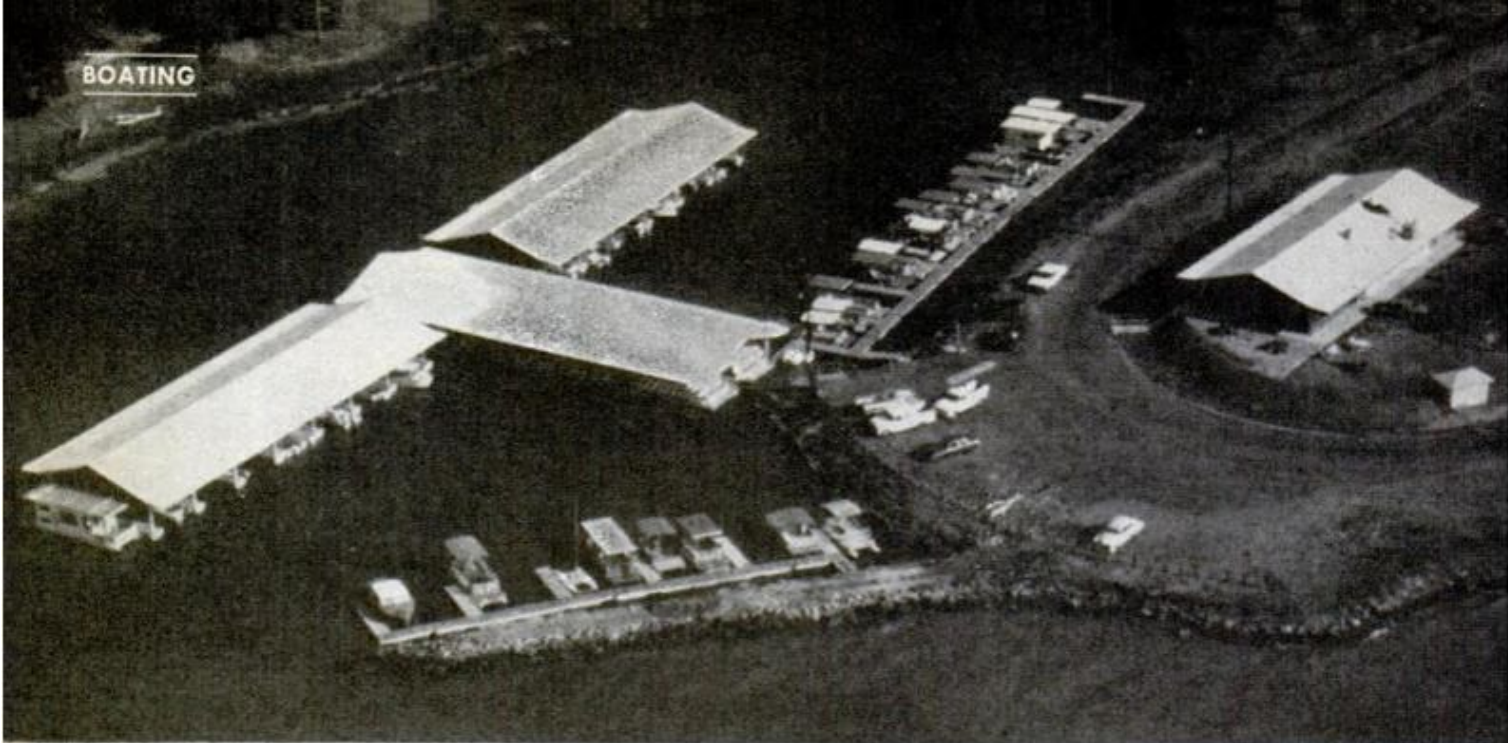
lightly built or poorly fastened to a thin floor? When you lean back seeking a comfortable position, is the steering wheel too far in front of you to be reached without eventual fatigue? Is there poor footroom, forcing you to crook your right leg behind your left for lack of space? Do your knees press uncomfortably against the lower edge of the dashboard? Does the steering-wheel rim press down on your thighs? When you operate the motor-control lever, does it pass so close to the steering-wheel rim that you jam a finger? Is there inadequate elbow and knuckle clearance fore and aft as the lever is operated through its full throw?

The designers of fishing boats and cruisers face a special problem. Often the boatman wants and needs to stand

(Please turn to page 202)

JUDGE BOAT'S CAPACITY by this plate, not by number of seats in it or what you think it should hold





WELL-PLANNED MARINA offers wind protection, ample parking, open and covered slips, easy access to docks

How to Pick a Marina

By GLENN HELGELAND

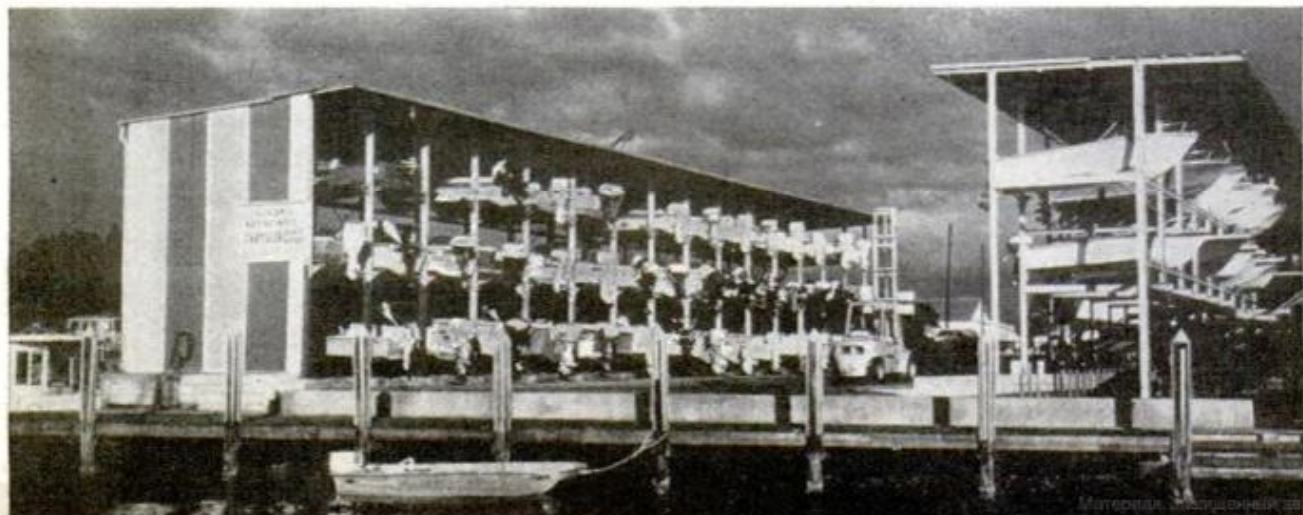
BASICALLY, there are two types of marinas: public and private. Publicly-owned marinas are generally municipally operated. Some are owned by the state, and the concessions may be leased to a private operator. They vary widely in facilities and services, but should have at least a gas dock, berths and moorings, launching ramps, dock electricity and water, snack bar, public telephones and toilets, ice machines and 24-hour security. Unfortunately, in many cases public marinas consist of nothing more than a handful of moorings: inexpensive and incon-

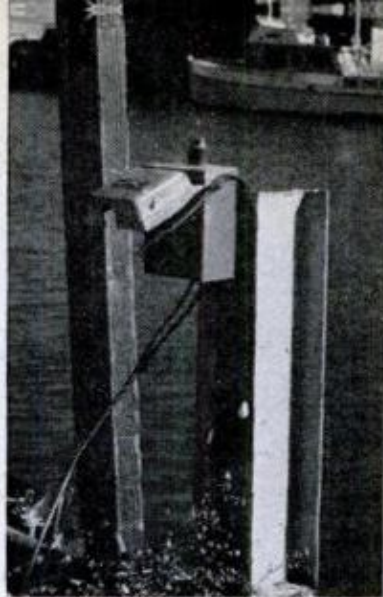
venient. Few such public facilities offer winter storage.

Private marinas and boatyards are sometimes found close by public marinas. They often profit by such proximity in picking up repairs. The additional facilities they provide draw boaters to their business.

Such private marinas vary widely from fishing camps to genuine yacht basins. Fishing camps are the "gas stations of the waterways." They usually provide a gas dock, launching ramp, some parking space, candy bars, maybe some minor accessories like sparkplugs

DRY-STORAGE FACILITIES make a marina of what otherwise would have been only a bait and fuel dock





AN OLD RUG works as a fender, but good marinas will offer more substantial protection. Exposed wires near the water are hazardous to docking boatmen

GOOD MARINAS provide protective handrails for their stairs, adequate maneuvering room near slips and strong, yet neat, fendering along the docks



TRY TO GET NEXT TO THIS DOCK without banging a boat or two! Either this marina has a special gas price, or many boaters don't care much about hulls

WELL-PLANNED GAS DOCK is one from which any boat can pull away without bothering others. Note overhead light for early risers, garbage can for litter

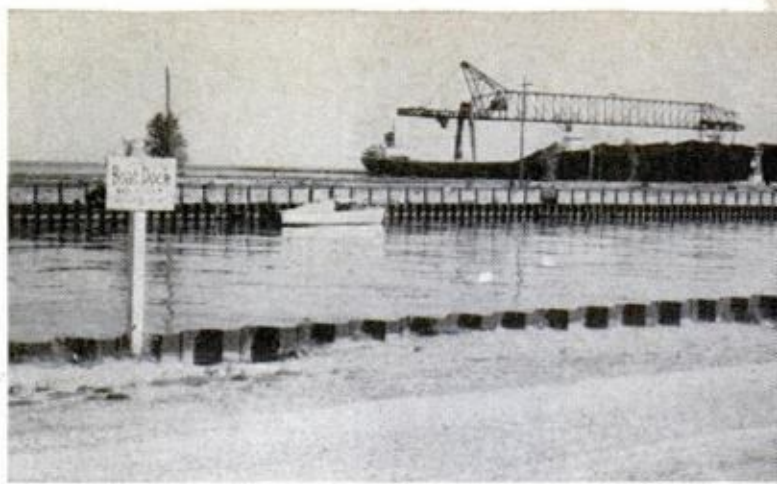


WOULD YOU TRUST a facility that maintained dock-side cleats like this one? Or allowed fuel lines to lie scattered on its docks for people to trip over?

WELL-FURNISHED MARINA will provide little extras like an electric hoist, to make easy work of launching small sailboats, and locking gate to the gas dock



A BREAKWATER that opens directly onto ocean or a big lake may be troubled by surges and heavy swells



SIGN SAYS BOATS DOCK HERE. But where? Public facilities sometimes offer nothing but lip service



WORST ASPECT of an overcrowded dock is the lack of safety for you and every member of your family



NO DOCK, NO FINGER PIER, no ladder and inadequate fendering—basically a miserable arrangement!

and shear pins, essential angling equipment, possibly an ice machine.

A more elaborate and increasingly popular type of marina, particularly in the South, is the dry-storage yard. It often offers little water frontage, but is able to launch and store great numbers of boats by the use of gigantic fork lifts modified and padded to protect hulls. As many as 300 outboard and stern-drive units may be kept on less than two acres of property. You merely call up and say when you want to use your boat. It will be in the water when you get there. When you finish with it, they take it out again.

Larger private facilities may include space for transients or boat rentals. The gas dock may offer diesel and ready-mixed outboard fuels in addition to regular gasoline. Electric boat hoists, carpenter shops for quick repairs, tele-

vision, phone and freshwater hookups along the dock, a sales office and display room for new and used boats and engines, motel, swimming pool, restaurant, picnic areas, campground security and surveillance, and even air for divers may all be seen as marina options.

Generally, the closer you are to high-density boating areas, the more facilities and services you'll find. Boating is an old sport on the coasts, so you'll generally find there a wide range of marinas and clubs to handle everything from small runabouts and dinghies to big yachts. But the boating boom in the Midwest and Inland West has outstripped facilities, and owners of large boats are sometimes hard-pressed to find what they need and want, particularly in winter-storage facilities. The first question to ask yourself is do you need a marina? You may not even

**REPRESENTATIVE MARINA PRICES
ACROSS THE UNITED STATES**

Long Island-New York City area

Slips: \$14 to \$20 per foot per season.
Outside winter storage: \$6.50 per foot for powerboats, \$7.00 per foot for sailboats.
Inside winter storage: \$10 to \$12 per foot if yard handles some work, \$15 per foot if no yard work.

Midwest Area

Slips: \$150 to \$200 for 25-foot boat—season.
Outside winter storage: \$2 to \$4 per foot.
Inside winter storage: \$5 and up per foot.
Overnight tie-up: \$.15 to .25 per foot.

Southeast Area

Dry storage: \$1 to \$1.50 per foot or \$20 per month.
Hauling: \$1 to \$1.25 per foot.
Overnight tie-up: \$.10 to .20 per foot.

Southwest Area

Dry storage: \$10 per month.
Slips: \$1.50 per day, \$10 to \$15 per month, \$100 and up per season.
Launching: \$1.50 to \$2.50.

Pacific Coast Area

Dry storage: \$2.25 to \$20 per month.
Slips: \$1 to \$2 per day, \$5 to \$20 month.
Launching: \$2.50 to \$5 (put in/take out).
Other general charges: Labor, \$7 to \$9 per hour; Launch ramp, \$1 to \$3; Seasonal launch pass, \$20; Seasonal locker, \$20.

Prices may vary considerably. The standard for most marina operators seems to be to charge all the traffic will bear. If there are many marinas in your area, costs will be held competitively low. Costs will also be generally lower away from population centers or high-density boating areas.

want a marina, particularly if you are a boating or fishing loner, and have access to public launch ramps.

Are you a Great Lakes coho fisherman, or a long-distance cruiser? If you don't have a marine radio, you may want to check in with a marina for a complete weather report. If you live 50 miles from Lake Michigan, will you prefer to trailer your boat to the lake every weekend or have it ready and waiting at a marina when you arrive?

If you live on the Gulf, do you have facilities to haul your boat every few weeks and scrub the bottom? A marina can usually do this quickly and for only a few dollars. Are you an apartment dweller in a megalopolis? If you own a boat, then you need a marina unless your apartment is larger than mine!

If you're a family man with a large runabout or small cruiser, you'll want more from a marina, because the kids get hungry and restless, and the wife usually craves conventional comforts. You'll need a snack shop or picnic area, certainly a grocery store nearby if you plan to make a weekend cruise. And if you plan to tie up at a strange marina for the night, you'll want transient docking space of adequate size, gas, a weather forecast and, perhaps, a navigation chart, shower and restaurant—all before leaving the next morning.

If you have a large sailboat or cruiser, you're best off making a seasonal contract with a marina. A good one will take expert care of you and your boat—and will probably require in its contract that it does most or all of the repair and service work. But by this stage, you've already spent so much money getting into boats that you might as well get as much out of it, boating and socially, as you can!

Ask yourself: Do you boat frequently enough to make a seasonal slip more economical than the cost of trailering? How far must you travel? Do you normally boat out of one area or like to launch from different locations?

If you like evening cruises, you'll save time and effort if you can call ahead and have your boat serviced and waiting in a slip when you arrive. Finally, if you want to combine the facilities and comfort of a country club with your marina needs, consider the more spacious yacht clubs. But they are expensive. And keep in mind that luxury marinas cater to luxury tastes. A salesman in a posh marina's boat showroom may look down his nose at you if you enter and ask for galvanized hardware!

Some modern mariners in their response to more service demands have established quasi-yacht clubs which provide the private facilities a member wants, but charge a minimum membership fee (for example, \$30 annually at Bay Haven, Holland, Mich.)

Marinas vary widely in who they want, and are able, to service. Opera-

tors make better profits from bigger boats with seasonal slip rentals, winter storage and servicing packages. But in some areas this specialization has spawned new marinas to handle the overlooked group of small boaters.

How do you decide what you want and need? Enroll in a U.S. Power Squadron or Coast Guard Auxiliary course of instruction. They're free. You'll learn safety afloat, seamanship, aids to navigation, charts and piloting, compass reading, government regulations, rules of the road and small-boat handling. Then start looking at marinas to see which ones will give you what you want and need. While you're doing this, question every seasoned boatman you know or can locate. Listen to their comments; they'll know the best marinas in your area. Next talk to the marina manager and his crew. Look around. They should be courteous, friendly, and will-

ing to explain their entire operation.

In checking out local marinas, you may need to be cleared at the gate. Some marinas issue seasonal passes to berth renters and restrict other entrants. A complete facility has a visitors' parking area and reserved parking for seasonal customers. Parking stalls for autos and trailers should be plentiful and long. There should be sufficient ramps to handle launch traffic without congestion. They should extend well out into the water, be clean, and have a nearby winch or other safety provision to help pull out trapped trailers.

Docks should be solid, resistant to decay and marine growth, well fendered to prevent scraping. In tidal areas or on inland lakes that have major water-level changes, docks should float or be on hinged struts. The gas dock should be at one end of the marina, easily reached, with several cleats for tie-



AN IDEAL MARINA will offer the following features and procedures for maximum security for you and your property: After showing your season's pass or paying a launching fee, you're cleared for entrance to the marina grounds. Large, well-marked auto and trailer parking spaces are plentiful and found close to the launch-ramp area. The marina should have 24-hour surveillance, and a night watchman will be available throughout the boating season. Visitors should park in a special zone outside the main marina area, while seasonal slip holders should have their own parking spaces close to the dock area. Few marinas offer all these features—but they should



up. Docks and finger piers between boat slips must be wide enough to keep boatmen from scrambling over each other. Several slips should be available for transient boatmen.

A good marina will be clean, with fire extinguishers and life rings provided at intervals around the docks. The entire area should be well lighted for security and safety. Garbage receptacles should be strategically placed.

There will be rules to protect the boaters and their property: no smoking on docks, observance of speed limits. Your family and friends will also be expected to behave decorously and offer help to fellow boatmen when needed.

Your marina should be properly insured and have competent employees, including a conscientious security force. One angry boatman told me the night watchman at his marina brought a tele-

worth the bother of using a dinghy each time you want to reach your boat.

An ideal marina will be located in a natural cove protected from winds and with a channel sufficient to handle most pleasure boats. Coastal marinas will have enough water beneath all docks at low tide (how much would you be willing to pay for a dry, mud-flat slip?), and there should be no swell nor surge of current on incoming tides or during high winds.

In all harbors check prevailing winds and breakwaters. Judge how the winds may affect boat handling in the harbor. Check bottom conditions, channel width and depth, ice flow, and current. There should be no stagnant water in a marina harbor. Polluted water backing up in water supply hoses is bad; standing water is worse.

When you place a boat in a yard,



LONG DOCKS in launching zone allow one boat to continue outfitting while another is launched in front of it

vision set to work, drove to the far end of the parking lot and plugged it into an electric outlet. This was the extent of his "surveillance."

A well-organized slip system will separate small boats from large boats, and sail from power. There should be moorings outside the harbor if there is no appropriate space within. Inside moorings will give you good protection in a big blow yet still be less expensive than a slip rental. On the other hand, you may decide that moorings aren't

check your contract. Most stipulate when your boat is to be hauled or put back in the water, and how much yardwork the marina will allow. Contracts are arranged to suit the marina or yard's work schedule, so if you want a specific day be sure to arrange this far in advance. Marinas have the right to fine boaters for missed dates.

As with nearly everything else, look around and find what you like at *your* prices. Then go ahead and enjoy your marina! ★★

NEW BOATING PRODUCTS

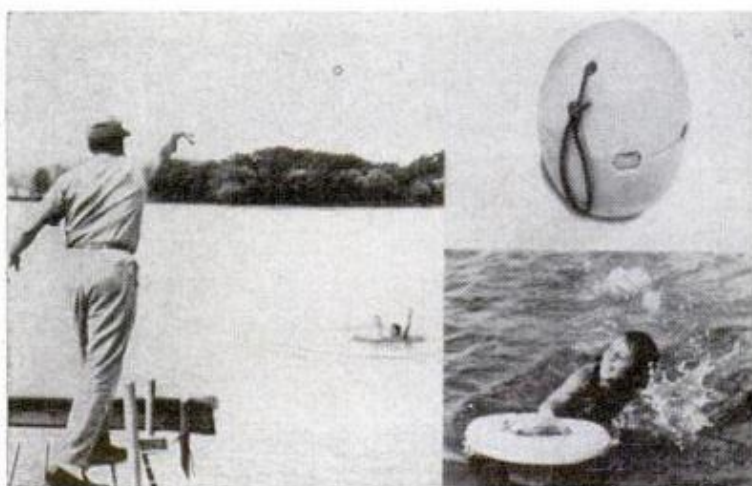


◀ **DINGHY PUMP** for a small boat and operator has easy 15-inch stroke to drain bilge water at six to eight gallons per minute. Priced at \$8 by Whale Pumps, 151 Mystic Ave., Medford, Mass.

SUPER BILGE PUMP for owners of something larger ▶ jettisons water in excess of 1200 gallons per hour. For more information, write Mayfair, 3700 N. Rose St., Schiller Park, Ill.

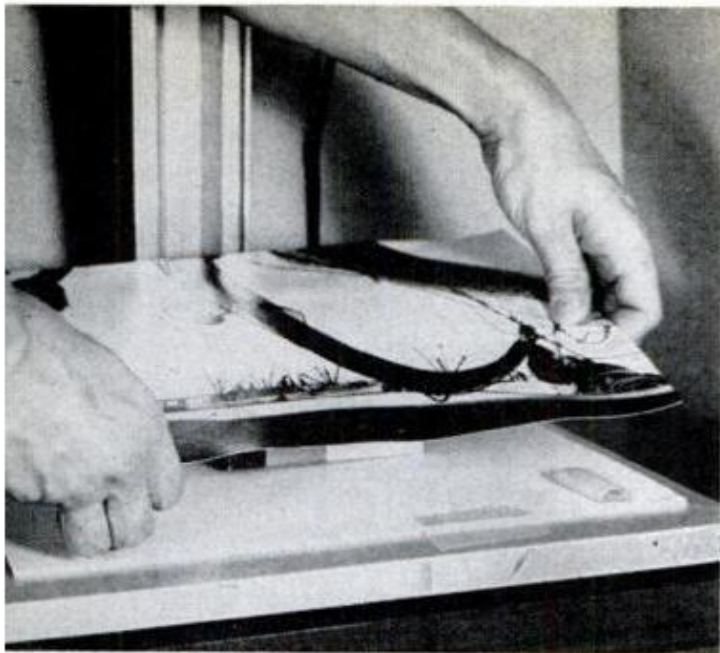


PORTABLE HIGH-PRESSURE WASHER to clean boat bottoms and other fouled surfaces costs \$385 from Goldenrod, Hastings, Neb. 68901. Or try a \$2.59 spray bottle of Fantastik made by Texize Chemicals, Greenville, S.C.



ICE BUOY (left) replaces standard mooring float during winter to keep anchor chain near surface for easy retrieval in spring. From Borg-Warner, Scottsburg, Ind. **Sav-A-Life Rescue Ball** (above), baseball-sized life preserver, can be hurled accurately up to 200 feet. Inventors Products Co., 541 W. 79th St., Minneapolis, Minn.

PHOTO HINTS



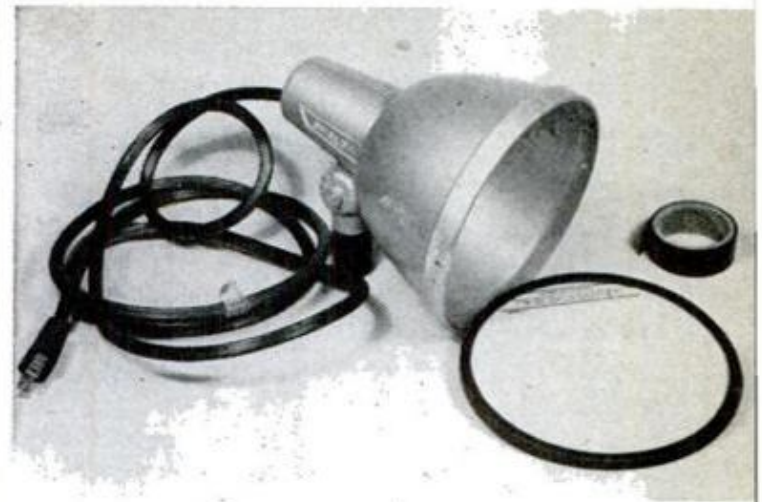
QUICK METHOD for making borderless prints requires only white cardboard and masking tape. Cut cardboard to size of your printing paper. Compose the image on the white surface, then tape cardboard down to keep it from moving. Make rings of tape and flatten them on top so part of each is sticky side up. Place printing paper over cardboard and expose it. Tape will hold the paper in place but let you peel it off easily after the print has been made

to Make Prints

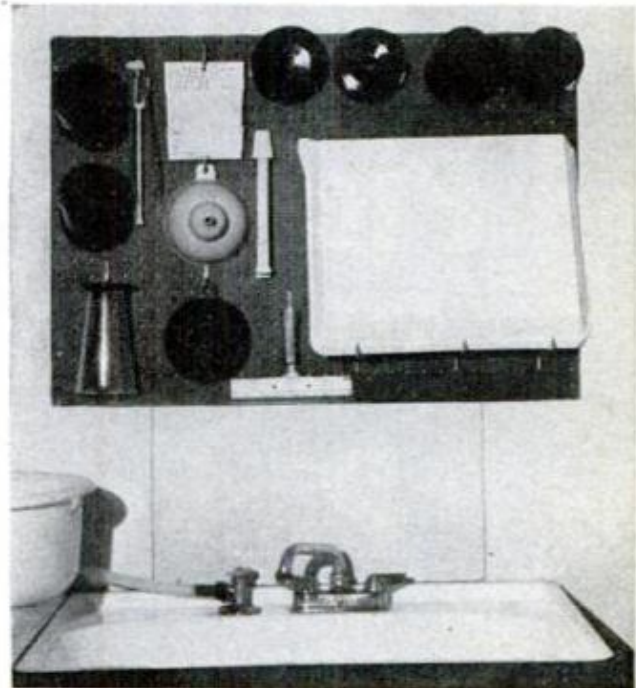
slots and is pressed inward by a section of screen-door spring mounted as shown in the drawing. The spring should be carefully positioned so the gripper exerts only the slightest bit of pressure against the printing paper. Too much pressure will cause the paper to bow up in the middle. The easel shown here is designed for 8x10 prints. For other paper sizes, adjust the dimensions accordingly.

For occasional borderless printing, you can use a simpler system devised by Raymond D. Johnson. With this method, shown at the top of the page, you cut a piece of white cardboard the same size as your print and compose the picture on it under the enlarger. When the image is properly cropped and focused, you place printing paper on top of the cardboard and expose it. Paper is held in place by tape, as shown in the photo. ★★★

MARCH 1970



A TRIM-LOOKING SAFELIGHT can be made from a die-cast reflector of the type used for outdoor yard lights. A standard round safe-light filter is a perfect fit for such reflectors. Run plastic electrical tape around the filter first to protect the edges, then tape the filter to the reflector's rim. You can hang the lamp by the cord or devise a mount using the built-in swivel bracket.—Arthur L. Ramos



SMALL PANEL of perforated hardboard mounted over a darkroom sink makes a handy rack for drying and storing trays, tanks, tongs and other supplies. Standard wire hangers will handle most darkroom equipment. Another helpful aid is a metallic stove-top hot pad, shown above cemented to the wall under the rack. Extremely smooth, it's a good surface to squeegee prints on before drying. The water just runs down into the sink.—D. E. Anderson


IF YOUR HI-FI SYSTEM is more than two or three years old, chances are you can upgrade its sound considerably just by changing the cartridge in your phonograph. Cartridge design has greatly improved in recent years, and nearly all of today's models offer performance levels unknown only a short time ago. Thus a new cartridge can be a worthwhile investment even if the one you're now using still sounds all right.

You don't have to spend a fortune, either. So much progress has been made in pickup quality that—surprisingly—the performance gap between the top and bottom of the price scale is rapidly narrowing. Some cartridges selling for \$25 or \$30 come amazingly close in performance characteristics to models costing two or three times as much. The accompanying chart lists pickups priced all the way from under \$10 to more than \$60. While there are obvious differences in specifications, all are basically good choices.

The chart, incidentally, is not intended to serve as a complete guide to stereo cartridges. It represents a selective sampling of current models that were actually tried and found to be excellent performers within their respective price groups. There are many other fine models to choose from. Knowing what to look for will help you make a wise selection.

Because a cartridge is small and hidden from view, its importance is sometimes underrated. Actually, as the gateway through which music enters your hi-fi system, it is one of the most vital links in the sound-reproducing chain. You depend on it to change mechanical energy imparted by the wiggles in the record grooves into corresponding electrical signals that can be fed into the amplifier. If it doesn't "read out" the sound correctly from the record, your music is messed up before it even gets started. No matter how fine your amplifier and speakers are, they can do nothing but magnify distortion introduced

How to Pick a Phono Pickup



Investing in a new phono cartridge can do a lot to improve hi-fi sound at little cost. Here's what to look for in choosing a good one.

By HANS FANTEL

by an inferior quality of stereo cartridge.

The fidelity of a cartridge depends on how accurately the stylus tracks the musical waveforms on the record. Suppose you have Al Hirt spinning on the turntable. What you hear as a smooth, bright trumpet solo is for your stylus a wild ride on a bumpy road. To pick up those rich 20,000-cycle overtones, it must swing through some 40,000 hairpin turns a second, each turn representing a half-cycle of a 20,000-cycle note. And in stereo, with two separate channels tracked by the same stylus, the frantic motion goes up and down as well as sideways.

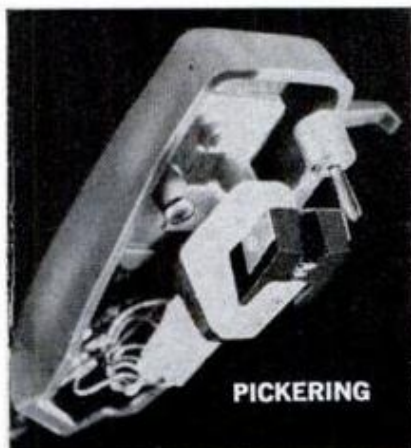
Throughout this harrowing journey, the stylus must never lose contact with the groove walls. If it doesn't follow the contours exactly, the result is ear-grating distortion. You can get a pretty good idea how well a cartridge tracks the groove from two of its specifications—dynamic mass and compliance.

Dynamic mass. This is the weight of a cartridge's moving parts—principally the

stylus. The lighter the stylus is, the more easily it swings through the sharp turns of the record groove, having less inertia to throw it off its track. If the dynamic mass is too great, the stylus can't keep up with the fast shuttle of the musical waveforms. Either it overshoots the curves, or it doesn't swing into them fully and cuts across them. In either case, the result is musical mayhem during loud passages where the stylus has to make wide and fast swings.

One way to reduce dynamic mass is to make the stylus shaft lighter. (You can't lighten the diamond tip. Its weight is fixed by its dimensions.) But if the shaft gets too light, another problem arises: The thin metal becomes too flexible and the motion of the diamond tip in the groove is not accurately transferred to the electrical parts of the cartridge. A compromise has to be made between low weight and adequate rigidity.

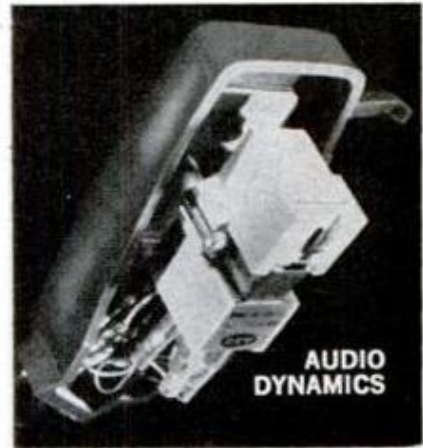
It is in this area that much recent progress has been made. Modern metallurgy



PICKERING



ELAC



AUDIO
DYNAMICS



EMPIRE



GRADO

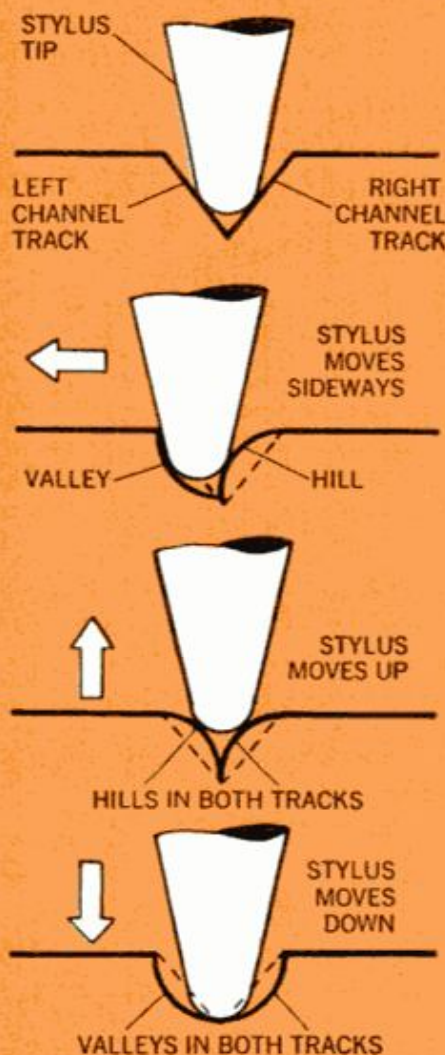


ORTOFON

PORTRAIT GALLERY of leading pickups shows some of many models available in a wide range of prices. Grado, for instance, while selling for less than \$10, has excellent characteristics for a modest investment. Other models range up to about \$75 for Empire's 999VE, a Cadillac among modern cartridges.

Note the unusual outrigger brush on the Pickering cartridge that rides ahead of the stylus to clean dust from the record grooves. Not shown here are also several fine Shure models from \$25 to \$67.50. Most pickups come with a choice of different types of mounting hardware to suit a variety of tone arms

HOW YOU GET TWO STEREO CHANNELS FROM ONE GROOVE



STYLUS TIP simultaneously rides two tracks in the record groove to produce the two signals needed for stereo. Tracks are at 45° angles, forming a V-shaped groove. The stylus does not respond to the impressions in each track individually but follows a path produced by both tracks combined. If there's a hill in one track and a valley in the other, the stylus is pushed sideways. Two hills coming together force it upward, and two valleys cause it to dip. The stylus is thus constantly being moved sideways and up and down. Inside the cartridge, these vertical and horizontal motions are separated to provide the two stereo channels, as you can see in the diagram appearing on the opposite page

—under stimulus from space research—has come up with very tough, lightweight alloys. Taking advantage of these, designers have been able to cut down dynamic mass without loss of high-frequency transmission along the shaft. In modern high-performance cartridges, dynamic mass is about one milligram (3/100,000ths of an ounce) or even less.

Compliance. Next to shrinking dynamic mass, the most important engineering advance in recent cartridge models is increased compliance. Basically, compliance tells you how readily the stylus yields to guidance from the record groove. If the stylus follows the grooves easily, it doesn't have to be pushed down so hard into them to follow the twists and turns.

Some cartridges now work at less than one gram downward pressure (so light you can move the tone arm by just blowing at it). Two grams is about tops. This makes record wear practically a thing of the past. At such featherweight pressures, the stylus does not permanently deform the groove walls. As long as you brush the dust off your discs before every play to prevent abrasion of the groove by dust particles, the new cartridges will make your records last almost indefinitely.

If you look at cartridge specs, you may find a typical compliance rating of something like 15×10^{-6} cm/dyne. This fancy figure tells you that if a force of one dyne (about 0.000002 pound) pushes on the stylus, the stylus has enough "give" to move a distance of 15 millionths of a centimeter. What really matters for purposes of comparison is just the first figure—in this case, the 15. The higher the figure, the greater the compliance. Today's better cartridges range from about 15×10^{-6} to 30×10^{-6} cm/dyne.

In addition to dynamic mass and compliance, check out the following cartridge specs before you make your choice:

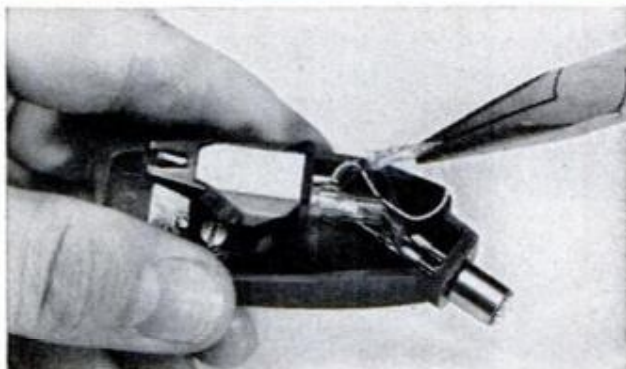
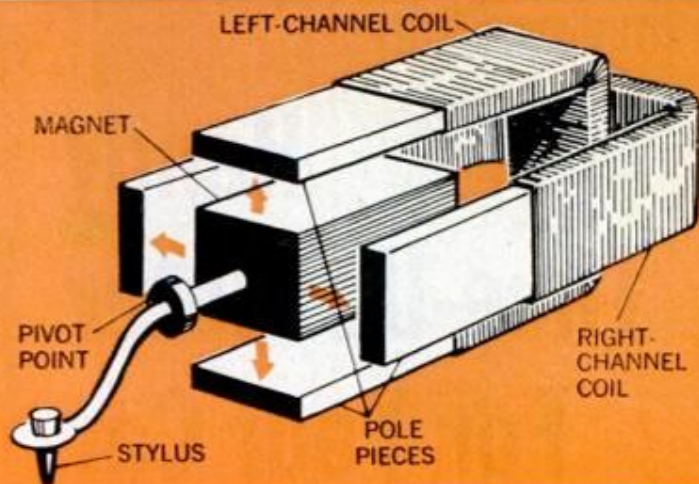
Tracking force. This figure tells how much weight must bear down on the stylus to make the cartridge track the groove properly. Tracking force is sometimes called stylus pressure. Both ex-

HOW SOME MODERN STEREO

MAKE	MODEL	TRACKING FORCE (in grams)	SEPARATION (in db.)	DISTORTION (in %)
AUDIO DYNAMICS	ADC 10 EMK II	1/2-1 1/2	30	1
	ADC 220	2-5	20	N.S.
ELAC	ST 244-17	1 1/2-3	27	1
EMPIRE	999 VE	1/2-1 1/2	N.S.	.1
GRADO	FTR	1 1/2-3 1/2	20	N.S.
ORTOFON	MF-15	1-2	30	N.S.
PICKERING	X-15/750E	1/2-1	20	2
	X-15 150	1-5	N.S.	1
SHURE	V-15 II	3/4-1	25	N.S.
	M-39E	1 1/2-3	25	N.S.
STANTON	681 SE	3/4-1 1/2	20	2

N.S.—This information not supplied by manufacturer.

MAGNETIC CARTRIDGES, most common type in use today, consist of a tiny magnet inside two coils, one for the right channel and one for the left. Magnet is attached to the stylus and moves up and down and sideways as the tip rides the record groove. As it swings back and forth inside the horizontal coil, it generates a small electric current in proportion to the movement of the stylus. This is the signal for one stereo channel. The magnet's up-and-down motion inside the vertical coil produces a second current in the same way, and this provides the signal for the other channel. In moving-coil pickups, this arrangement is reversed and a coil attached to the stylus moves inside two stationary magnets



CARTRIDGE LEADS should be carefully attached, using slip-on metal sleeves and long-nose pliers. Never solder leads directly to the pickup terminals as the heat can damage the delicate mechanism



CLEAN STYLUS REGULARLY with a soft-bristle brush, such as a small camel's-hair paintbrush or photographer's lens brush. Brush lengthwise along the stylus, never sideways, to avoid bending the tip

pressions mean the same. For a high-quality cartridge, tracking pressure should not exceed two grams. But there's a hitch. Such cartridges won't work in the ordinary kind of tone arm used on cheap changers and record players. The friction drag at the tone-arm pivot bends the sensitive stylus assembly out of its normal position. Besides, the high downward pressure needed to keep those arms in the groove limits vertical swing of the stylus, hampering stereo channel separation.

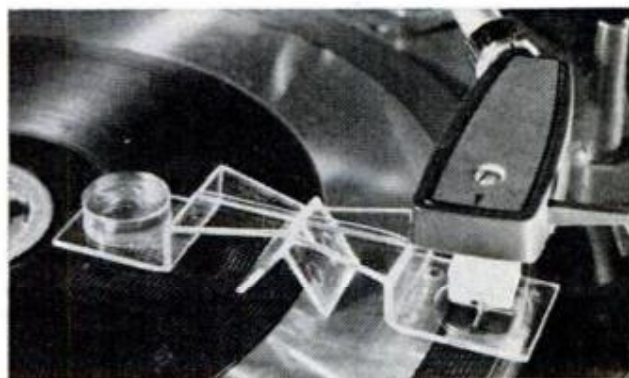
Cartridges with a tracking force of less than 2.5 grams should be used only in quality tone arms with low-friction pivots and precise stylus pressure adjustment. Fortunately, such arms are now supplied on nearly all component-grade record changers and turntables.

Light tracking force is the result of high compliance. If no compliance figures are listed in the specifications, you can guess at compliance from the figures for track-

(Please turn to page 200)

CARTRIDGES COMPARE

STYLUS TYPE	STYLUS DIMENSION (in mils)	COMPLIANCE (in 10^{-6} dyne/cm)	FREQUENCY RANGE (in cycles)	LIST PRICE
Elliptical	.3x.7	35	10-25,000	\$59.50
Round	.7	15	10-18,000	19.50
Round	.7	30	20-22,000	24.95
Elliptical	.2x.7	30	6-35,000	74.95
Round	.6	N.S.	10-35,000	9.95
Round	.7	N.S.	20-20,000	45.00
Elliptical	.2x.9	N.S.	10-25,000	60.00
Round	.7	N.S.	10-25,000	34.95
Elliptical	.2x.7	N.S.	20-25,000	67.50
Elliptical	.4x.7	N.S.	20-20,000	39.95
Elliptical	.4x.9	N.S.	10-20,000	55.00



USE A STYLUS-PRESSURE GAUGE to be sure your tone arm is adjusted to tracking force specified for the cartridge you buy. The AR balance scale above costs about \$1, is available at most hi-fi stores

KITBUILDERS' REPORT:

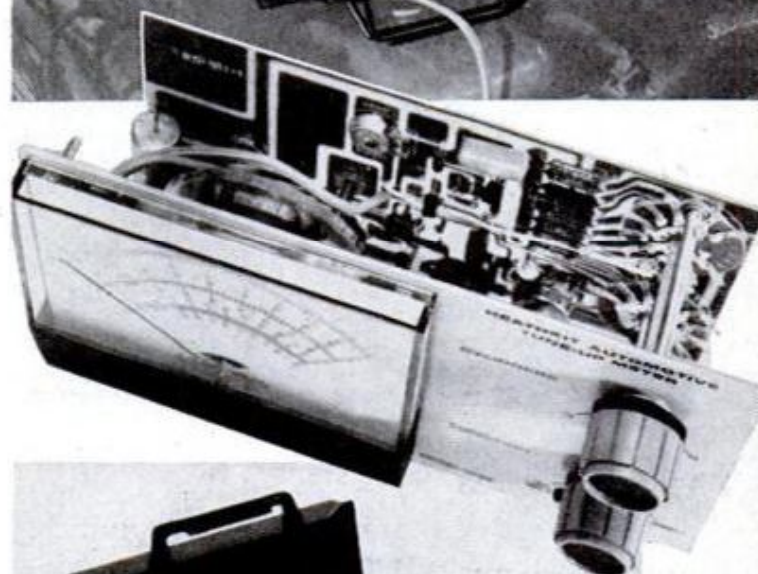
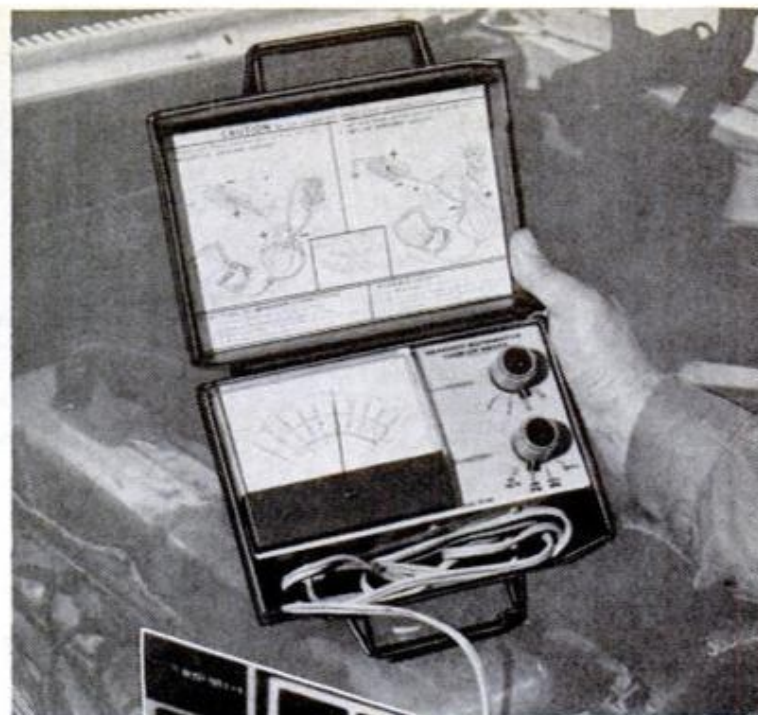
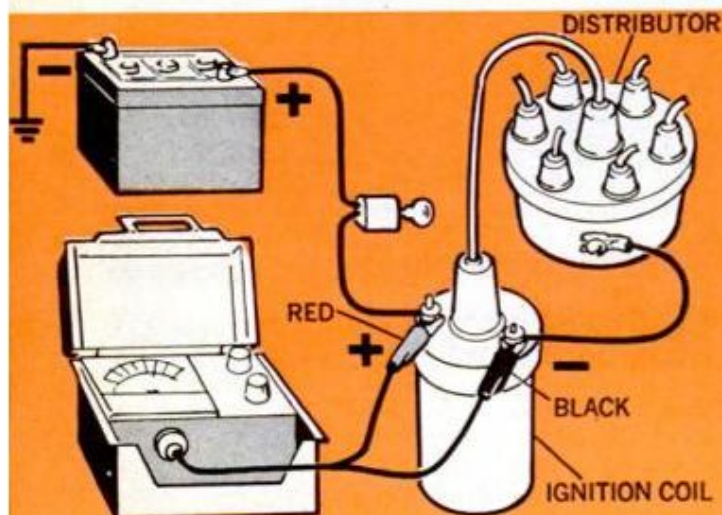
Handy Tune-Up Meter For Your Car

By SHELDON M. GALLAGER

IF YOU LIKE to keep your car running in top form, this new Heathkit tune-up meter can be a helpful aid. It lets you make several different performance checks merely by clipping two leads to your engine. The meter reads distributor dwell angle for proper setting of the breaker points and also serves as a tachometer, indicating engine rpm for making precise carburetor adjustments. In addition, it measures d.c. voltages for checking battery condition, starting drain and charging current.

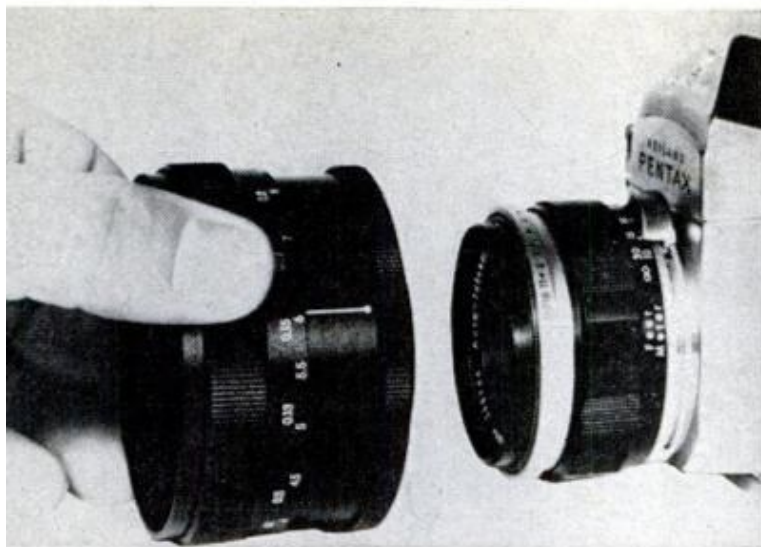
You can assemble the kit in four to five hours. The meter will work with any four-cycle engine of three, four, six or eight cylinders with a 6 or 12-v. electrical system. It is, however, recommended for use only with conventional ignition systems, not the solid-state type.

For making tests, the meter requires only two connections to your ignition coil, as shown in the diagram below. It needs no batteries or other power of its own since it works off the car's power. The Model ID-29 meter kit sells for \$29.95. Heath Co., Benton Harbor, Mich. ★★ ★



LARGE-FACE METER is easy to read, has scales for different numbers of cylinders, dwell angle, rpm, and d.c. voltages. Plastic case has lid that closes for safe storing and carrying. A handy compartment in front stows clip-on test leads. Simple two-connection test hookup is shown at the left

NEW IN PHOTOGRAPHY



YOU CAN MOVE IN REAL CLOSE with this zoom lens attachment designed to fit any 35-mm single-lens reflex camera. Screwed into the regular camera lens, it lets you shoot to within 3½ inches of a subject for ultra close-up and macrophotographic effects. The accessory threads into the filter mount on standard 49-mm, 52-mm and 59-mm lens barrels. It can also be fitted to other lens sizes with an adapter. Price is \$16.95. Luminos Photo Corp., 25 Wolfe St., Yonkers, N. Y. 10705.



SELF-POWERED SLAVE triggers remote electronic flashguns without needing current of its own. Made for Honeywell Strobolar units, it has a photocell that picks up light from the flash on the camera. This generates a tiny voltage, tripping a circuit that fires the remote flash at the same time. The small, batteryless device plugs into the flash in place of the regular tripper cord. Called the Honeywell Fotoeye, it sells for \$19.95.

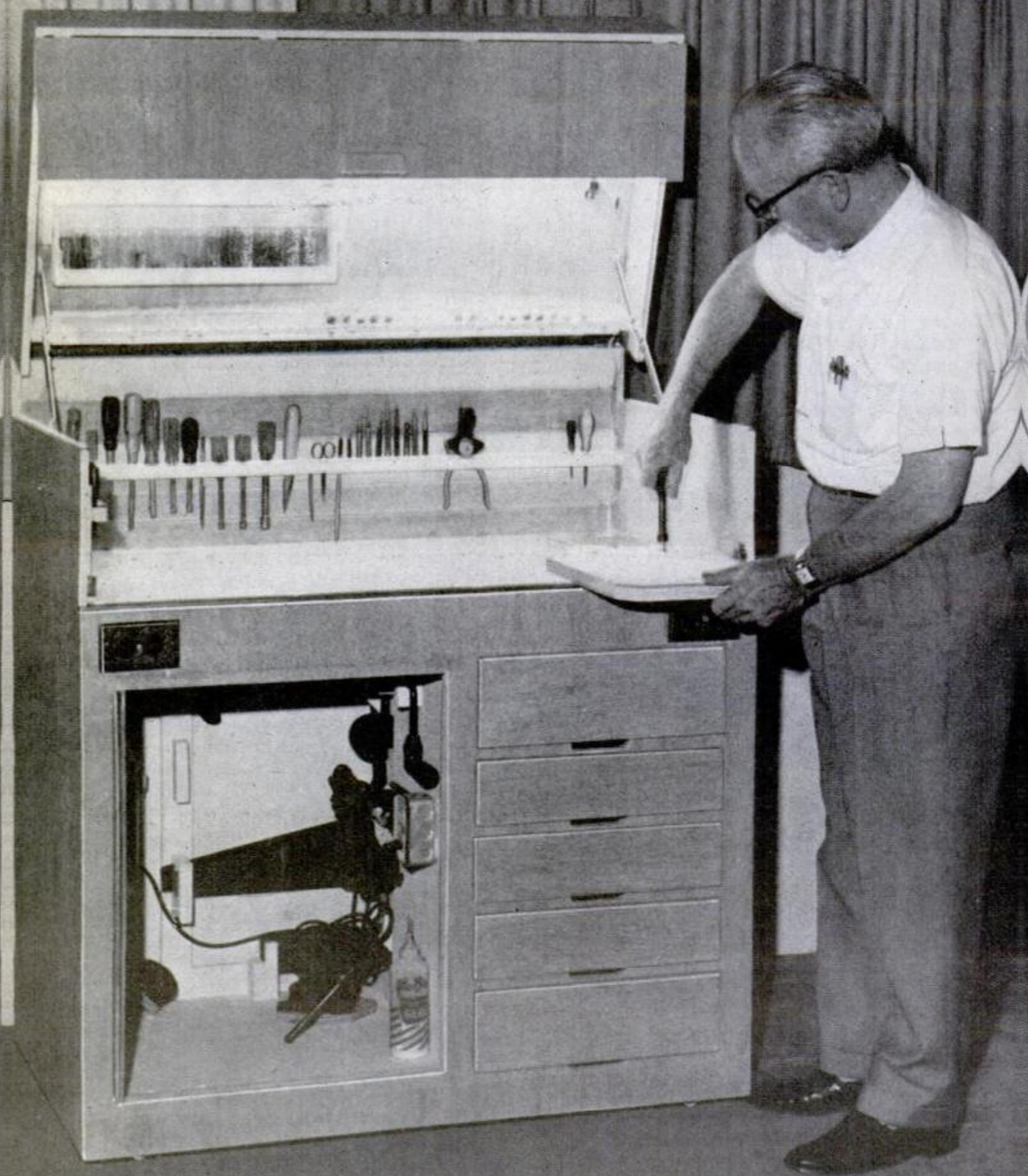


LOW-COST SLIDE-SOUND SYNCHRONIZER automatically keeps your pictures in step with accompanying commentary recorded on tape. It works with any stereo recorder and any slide projector having a remote slide-changing control. As you record your commentary, you press a button when you want to change to the next slide. This puts a cueing signal on the tape. On playback, the signal trips the projector, switching to a new picture. The control sells for \$20 from Edmund Scientific, 380 Edscorp Bldg., Barrington, N. J. Accessory connector cables are available for Kodak, Sawyer and Airequipt projectors.

CLEAR-PLASTIC FILM HOLDER at right makes it easy to view, sort and file strips of negatives without excessive handling. Once slipped into the sleeves, the strips can be studied over a light box and even contact-printed without your having to remove or touch them. The holders come in two models, one for 35-mm film and one for 120. They sell in packages of six for \$2.95. Vue-All, Inc., 49 W. 45th St., New York, N. Y. 10036, is the maker.



A LOT OF SHOP



GREAT FOR THE TINKERER, modelmaker or inventor, this shop in a chest is the perfect answer to the problem of where to work in a small home or apartment. Here a screw-on base is being attached to hold a vise.

IN 4 FEET OF SPACE

Complete 'apartment workshop' folds up into a piece of furniture when you quit work

By EARL STOWELL

Technical Art by Fred Wolff

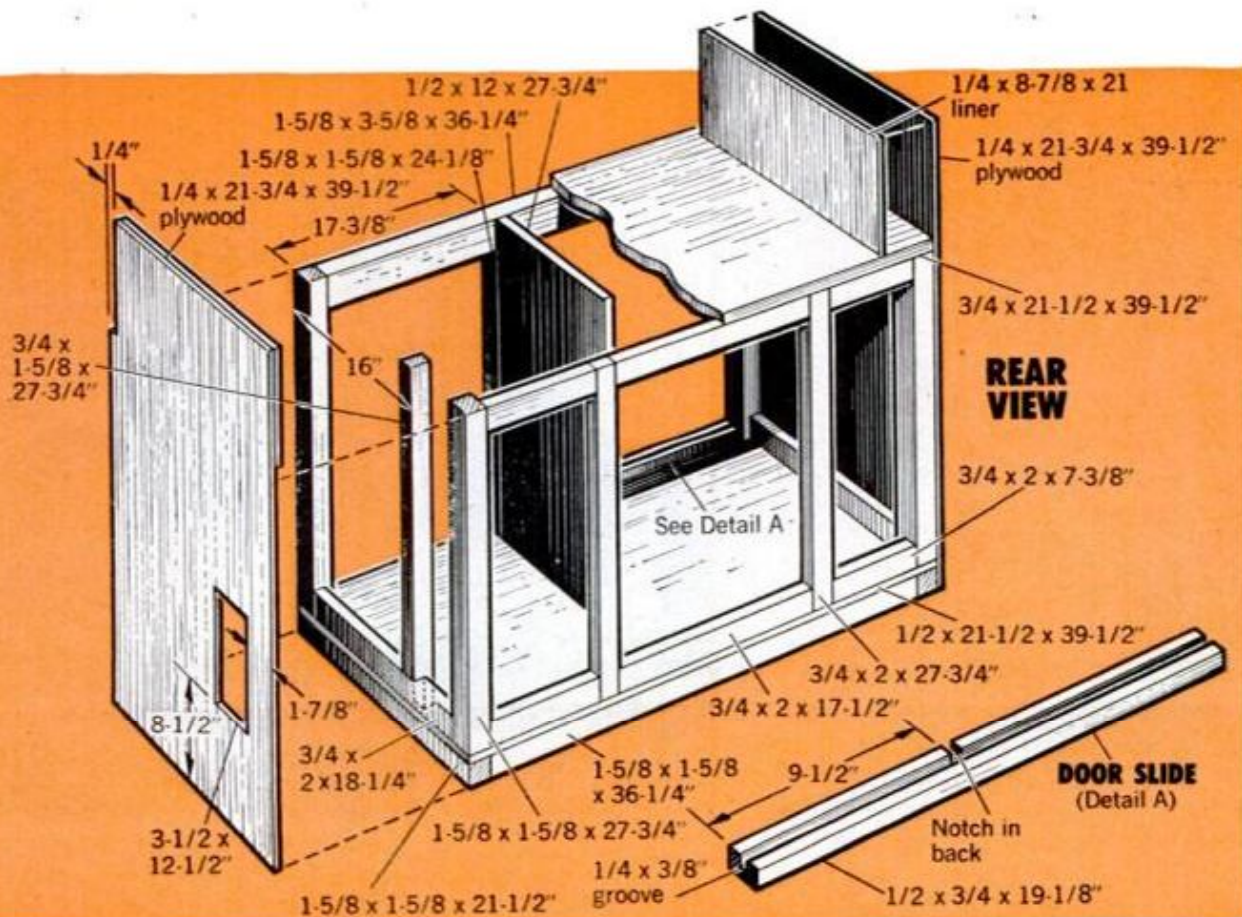


NO ONE WOULD SUSPECT that this attractive cabinet houses a complete hobby and fix-it shop in one unit

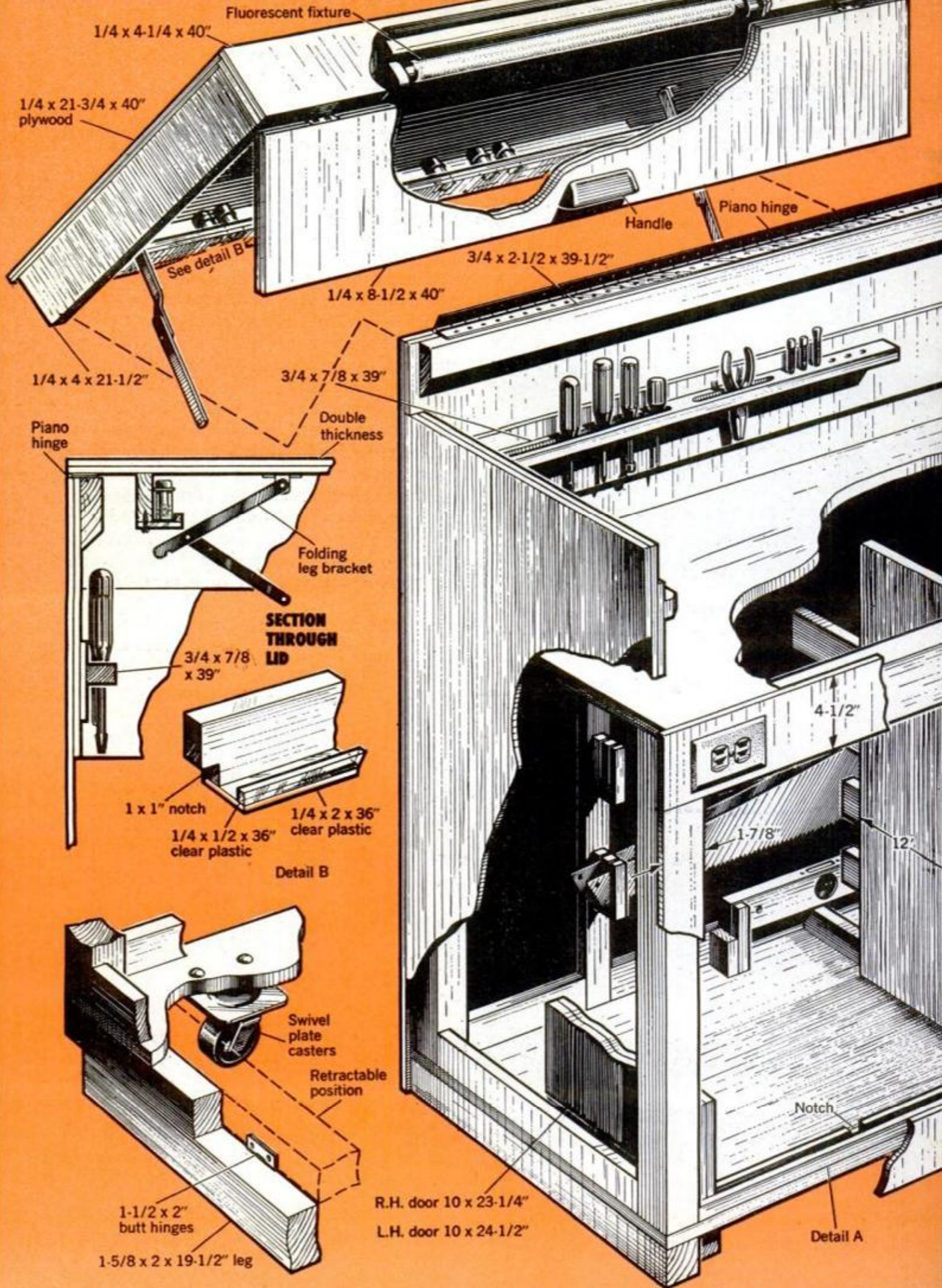
NO NEED TO PASS UP the enjoyment of making and fixing things just because you live in an apartment or a small home. Not when you have a "workshop" like this one!

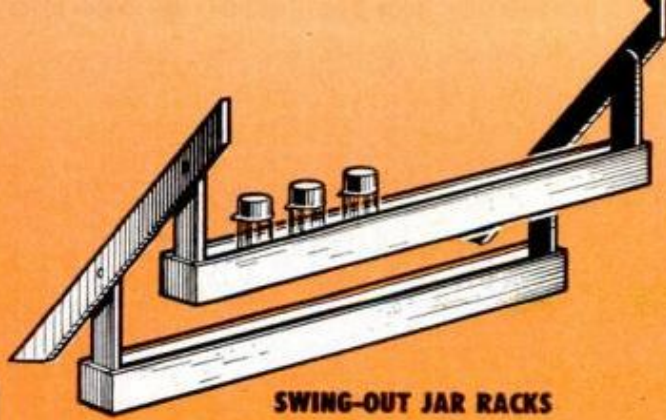
Closed up it looks like a piece of furniture, but raise the lid, flick the light and slide open the doors and you have a compact shop that will let you putter and tinker to your heart's content, all in the space of four feet.

There's a place for everything in this compact shop and you'll be surprised at what it holds. In addition to having five roomy drawers for holding a full complement of hand tools, there's storage below for a modelmaker's lathe, hand grinder, a small drill press, jigsaw, bench grinder and other tabletop machines. There's room for storing a couple of handsaws behind the drawers, you can have a vise when you want one, and the luxury of a small

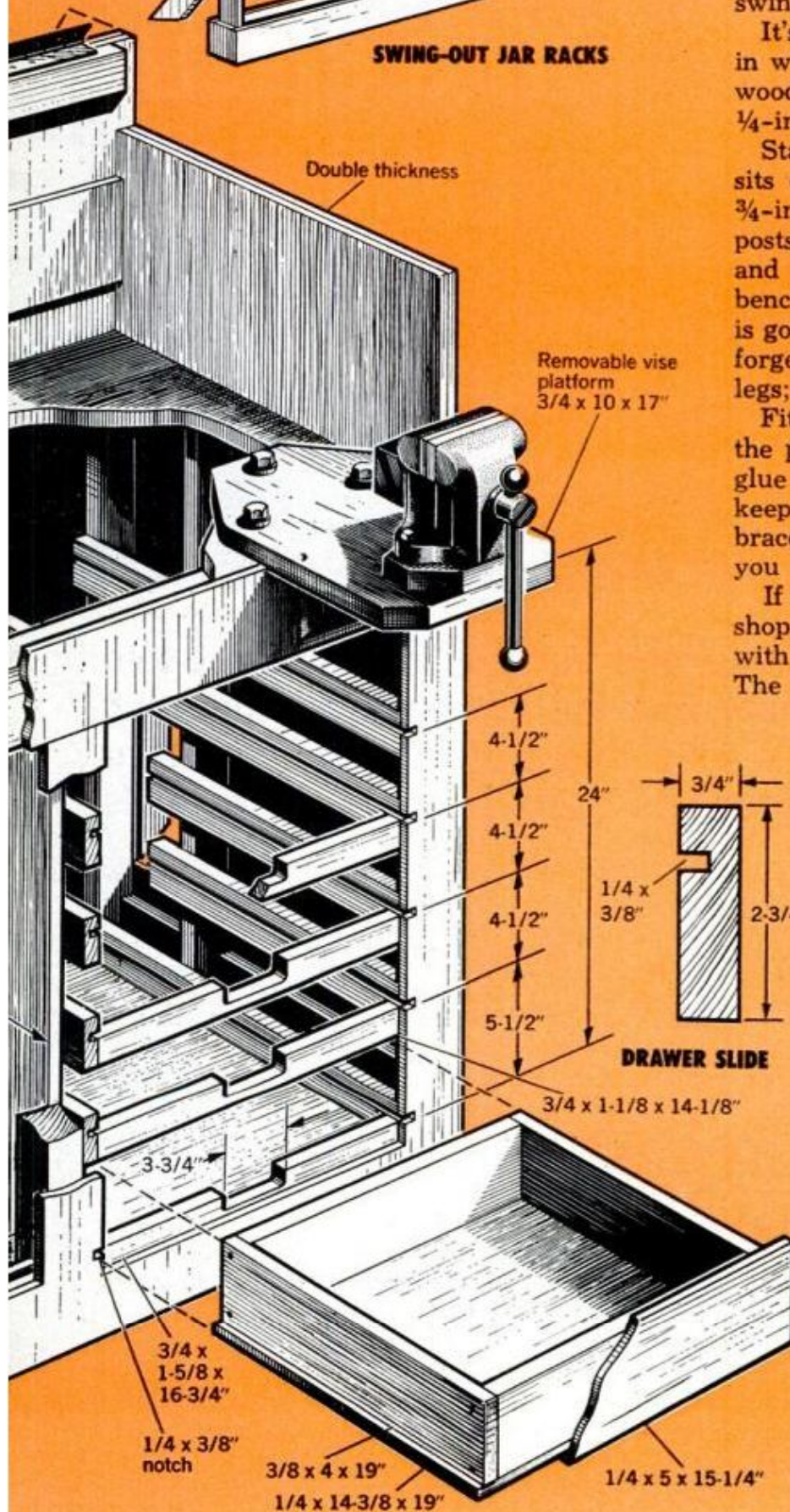


APARTMENT WORKSHOP





SWING-OUT JAR RACKS



tank-type vacuum cleaner will help you tidy up when you close up shop.

Rubber-tired casters let you roll it about, and swing-down "legs" make it stay put. You have two outlets for plug-in tools, and the two doors in the front not only slide but swing completely out of the way.

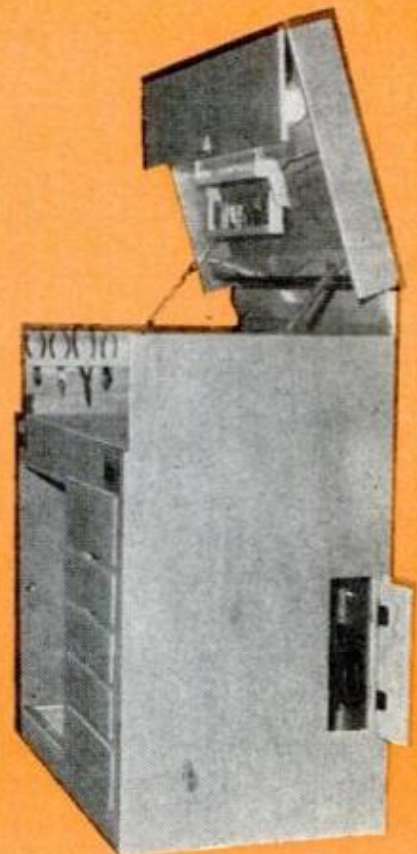
It's of "stressed-skin" construction in which a basic framework of plywood and lumber is covered with 1/4-in. hardwood-faced plywood.

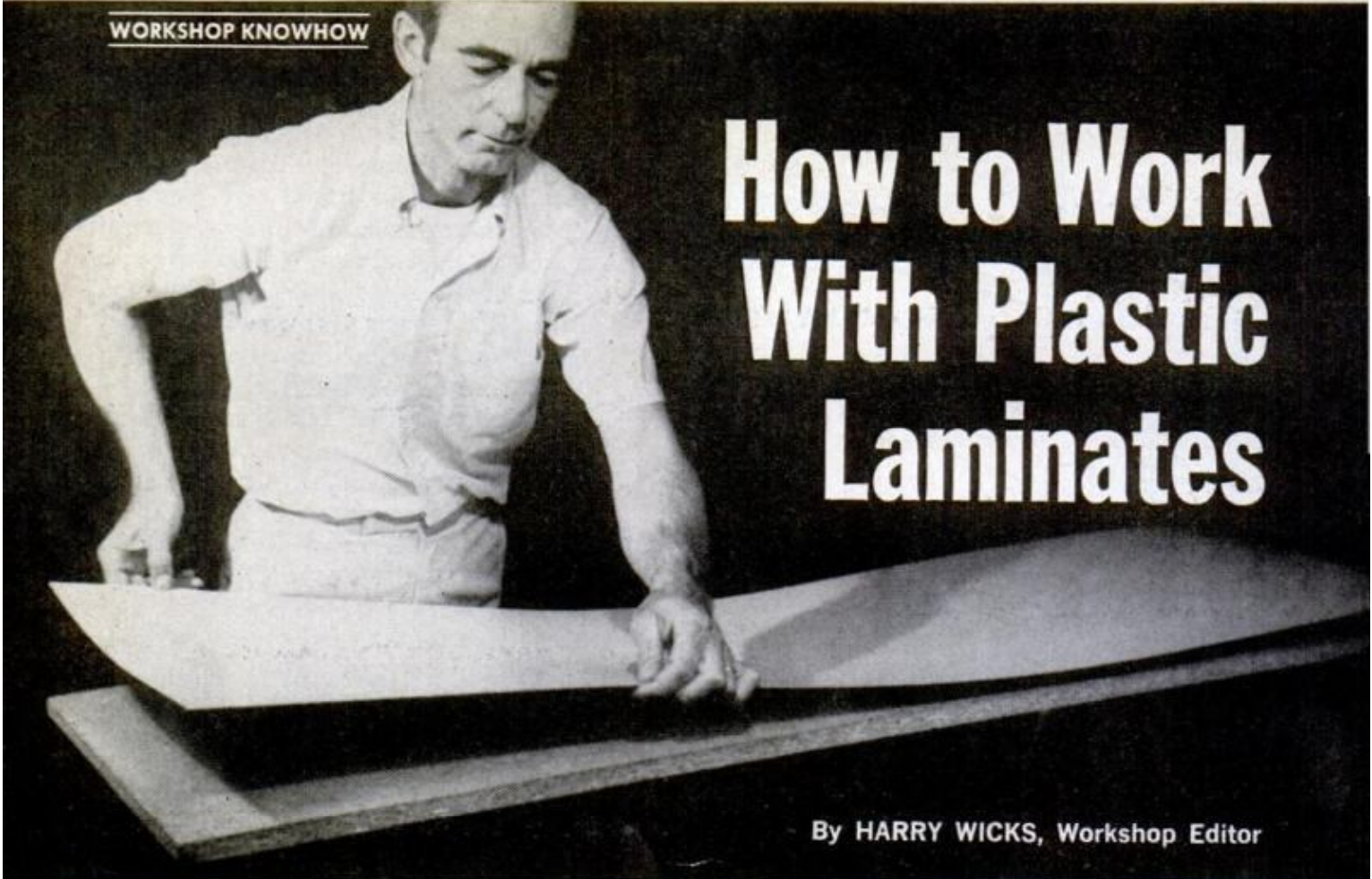
Start with the 2x2 frame which sits on the floor and cover it with 3/4-in. plywood. Then glue the four posts at the corners of the plywood and glue and nail the plywood benchtop to the posts. If your shop is going to stay in one spot, you can forget the casters and the retractable legs; otherwise, add these next.

Fit the joining crossrails between the posts as the drawing shows and glue them in place. Use a square to keep the assembly true and add a brace diagonally to hold it so until you start covering the outside.

If no one is to see the back of your shop, you can economize and face it with a piece of 1/4-in. fir plywood. The back panel is 43 in. high and is

(Please turn to page 223)





How to Work With Plastic Laminates

By HARRY WICKS, Workshop Editor

Photos by Robert Borst

Known as a good-looking and virtually maintenance-free surface, plastic laminate has the undeserved reputation of being hard to work with. The truth is, you can turn out elegant finished products using hand or power tools

IF YOU HAVE HAD THE URGE to re-surface your kitchen countertop, but felt that applying laminates was beyond your skills or knowledge, take heart. Actually, with special tools developed over the past 15 years, the task is well within your abilities. And, using the tricks shown on these pages, you'll find you can even do the job with ordinary handtools you probably already have on hand.

Obviously, you'll be able to do the job much faster and with less effort if you have a fully equipped power-tool workshop, but even without it the final result will be a good-looking finished project.

Not limited to countertops, plastic laminates are becoming a favorite with do-it-yourselfers because they permit the use of less expensive materials for basic construction. With proper preparation of the surface to be laminated, the end result will be attractive, just about maintenance-

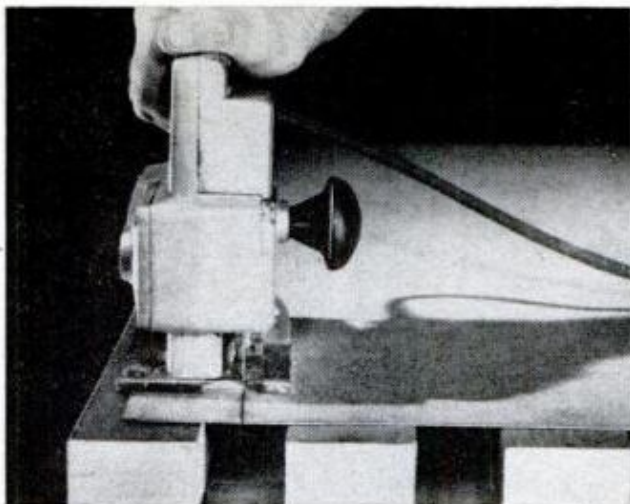
free and will last for years. Alternate work methods (depending on tools available) are shown on these pages for each step in the laminating operation.

Today, laminates are available in a great variety of dazzling decorator colors, attractive motifs and woodgrain finishes. Several makers offer up to five different finishes—gloss, textured, stone (dull), satin and one suitable for furniture projects. Thus, when you're planning a laminate project, a trip to the lumberyard for a first-hand look at what is available is time well spent.

Most manufacturers produce laminates in sheet sizes that range from 2x5 to 5x12 ft. You can generally select a sheet just slightly oversize for the project at hand. (Note: If you plan to apply self-edge rather than molding, be sure to add the extra widths to the piece you order.)

Tips on working with laminates:

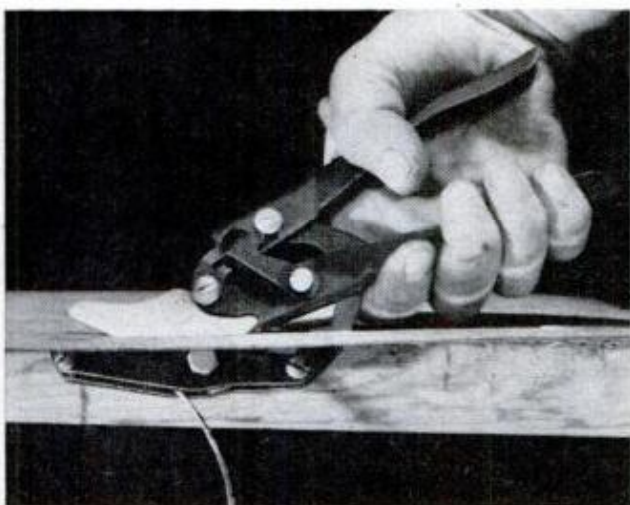
FOUR WAYS TO CUT PLASTIC LAMINATES



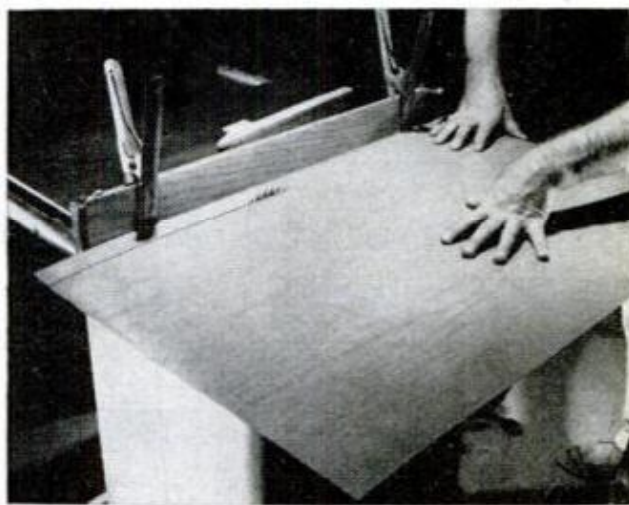
SABRE SAW chucked with fine-tooth hacksaw blade does good job. Cut laminate with the good side down



NEW CUTTER from BernzOmatic cuts plastic laminate quickly and neatly, and is an inexpensive tool



SHEARS USED BY PROS "walk through" the material because the blades take a good-sized bite each time



WOOD STRIP clamped to fence prevents thin material from slipping beneath. Use carbide-tipped blade

● **Adhesives.** It's a basic rule of thumb that the thicker the coat of adhesive, the harder it is to apply. High and low spots may occur, and that means uneven drying. Obviously, enough adhesive must be applied to the surfaces to be bonded, but it should be applied *evenly*. That sets up a rule: Coat the surfaces with as little adhesive as necessary for a good bond. Any more than that can cause a poor bond.

You can apply the cement with a brush, mohair roller or scrap of laminate. A good applicator—that is offered free by many makers with the cement purchase—is a disposable notched spreader. With it, you're sure to apply the glue evenly.

Caution: Since several types of contact cement are available, always read the label on the can before starting the job. The principal difference in adhesives is in the work time (the time span during which good bonding can be achieved). Some give

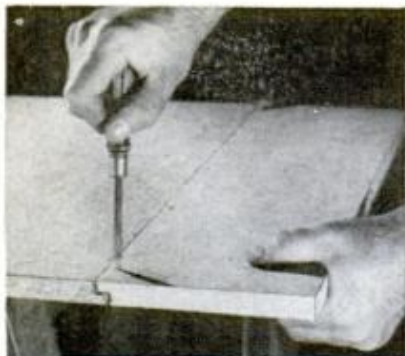
a greater work time than others. And, if you allow too much time to pass, both the laminate and core will need a second coat of glue. To test when the glue is dry enough for bonding, touch coated areas with a bit of brown paper; if no glue sticks to it, surfaces are ready for bonding.

● **Cutting.** Always cut the piece about $\frac{1}{4}$ in. larger in length and width than the core to which it will be bonded. For a perfect job, no matter what tools you have on hand, trimming is always done after the pieces have been bonded.

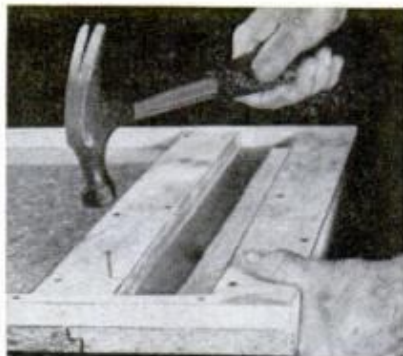
● **Temperature.** Ideally, temperature in the shop should be no lower than 70° F. But, keep in mind that humidity will also affect cement-drying time. If it becomes critical, hot lamps and fans can be brought into use to speed drying time.

● **Positioning large pieces.** Whether you use the brown paper method or $\frac{3}{4} \times \frac{3}{4} \times 30$ -in. sticks spaced 12 to 18 in. apart, always

HOW TO BUILD AND LAMINATE A COUNTERTOP



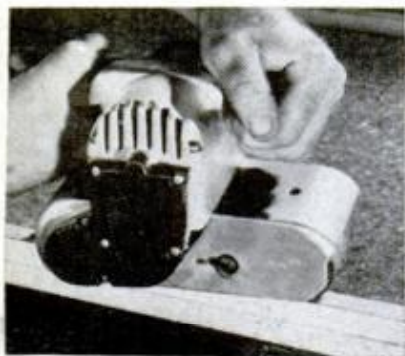
TO JOIN CORE-PIECES, edge-rabbit pieces of plywood or particleboard, fasten with screws



STRENGTHEN JOINT with cleat, then add edge-strips. Use glue and ringed nails to fasten both



ALL IMPERFECTIONS must be filled, or router will follow indent when cutting the plastic



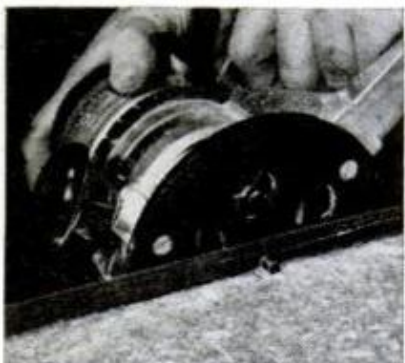
AFTER FILLING, entire edge is sanded smooth. Next, surface that receives laminate is sanded



FLOP TOP right-side-up and apply contact cement to strip of laminate and countertop self-edge



WHEN GLUE DRIES, strip is bonded. Pressure is applied by tapping with soft-face hammer



TRIM EXCESS PLASTIC with carbide cutter chucked in router. Block plane and smooth file do job too



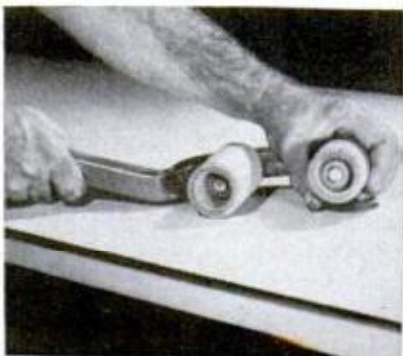
QUICK SANDING with belt sander insures self-edge is perfectly flush with countertop surface



MOHAIR ROLLER distributes glue quickly and evenly, is considered best method of applying adhesive



LAMINATE is lined up with top. As sticks are pulled, it is bonded to particleboard, core



DOUBLE ROLLER, used by pros, applies great pressure after bonding. Or, you can use rolling pin



LAMINATE TRIMMER cuts the top flush with self-edge. Special bit adjusts to make bevel-cut also



FORMICA CORP. PHOTO

BEAUTY OF PLASTIC LAMINATES is obvious in this attractive room. Modern kitchen cabinets show an imaginative use of contrasting colors and woodgrain with color inserts framed by matching woodgrain laminate



BEVEL CUTTER in router finishes edge. Apply Vaseline to edge to prevent bearing scorch marks

MARCH 1970

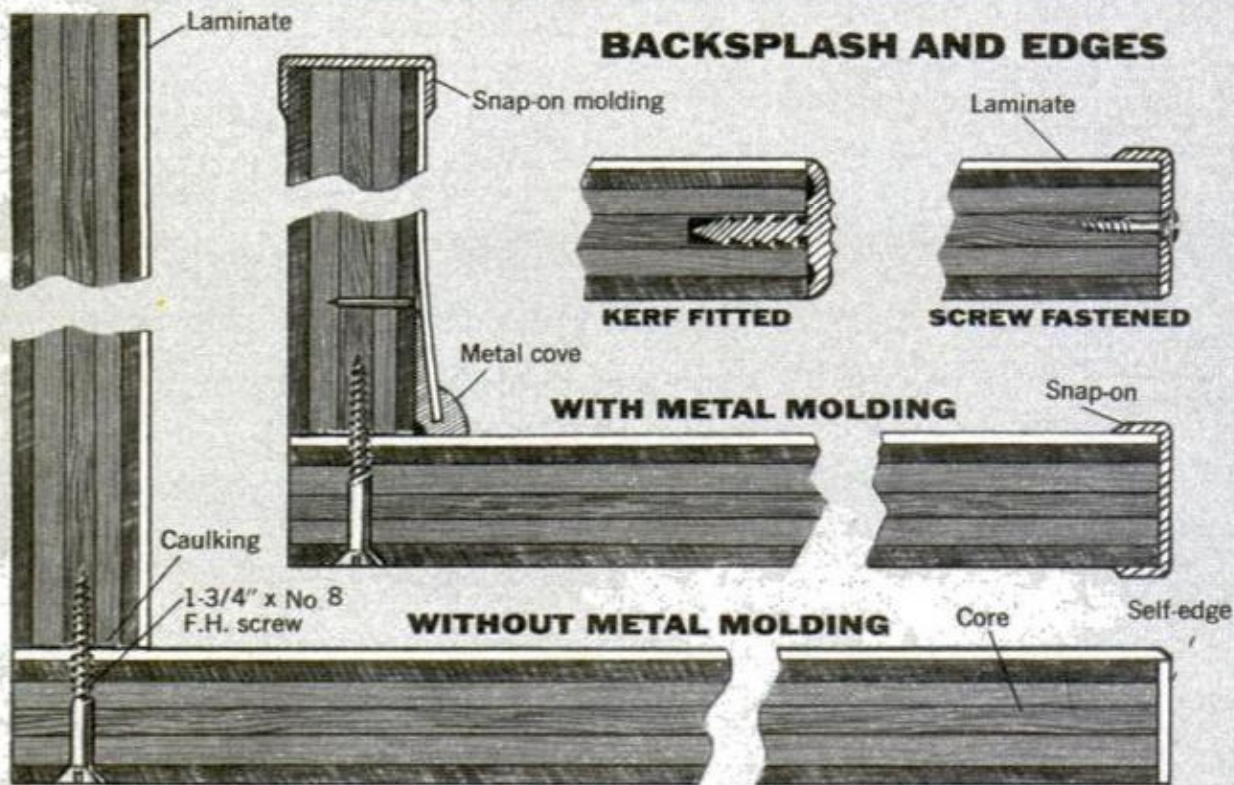
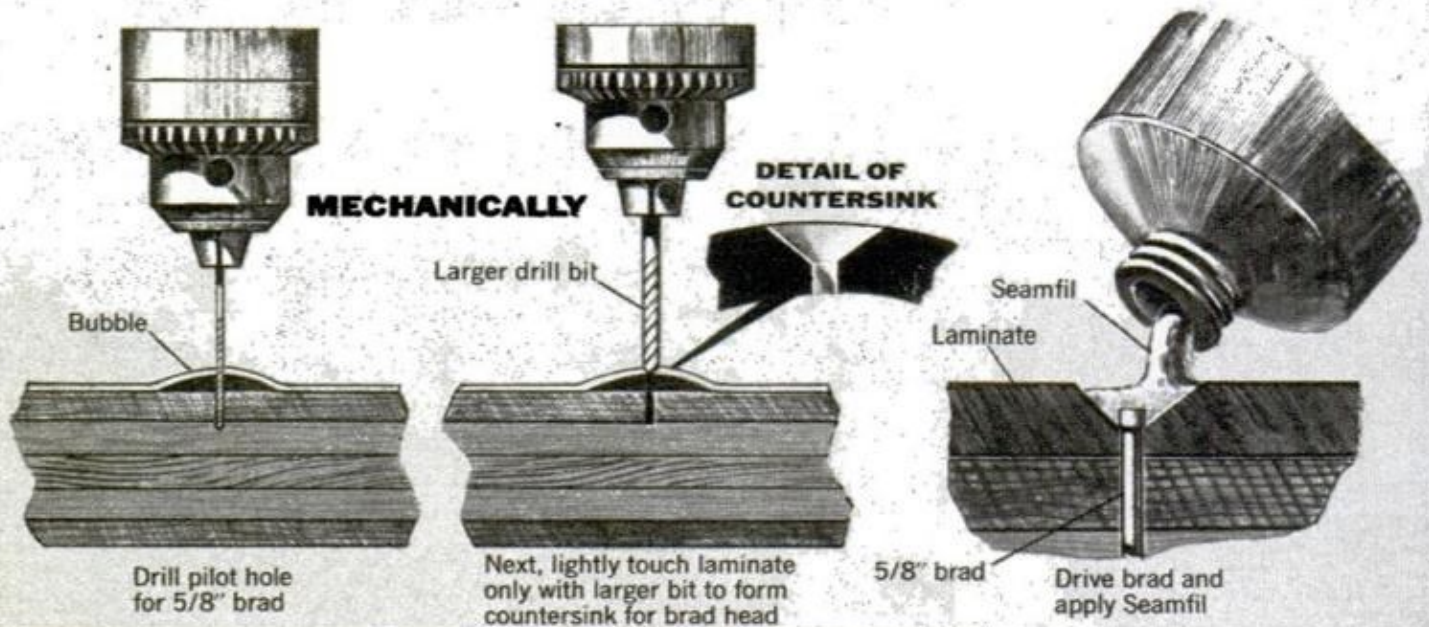


REMOVE EXCESS GLUE with scrap of laminate, a rag and lacquer thinner. Use the thinner sparingly



FINISH CLEANING with rag and thinner as needed. If desired, top can be polished with Jubilee

TWO SIMPLE METHODS OF CORRECTING COUNTERTOP



make certain that the spacer material is absolutely clean. Dirt, like moisture, is almost certain to cause delamination later.

● **Applying pressure.** Most contact adhesives need only momentary pressure after bonding. But don't mistake momentary for light. You *do* have to apply ample pressure. Actually, don't ever worry about applying too much pressure, and once it has been applied, move onto the next area of the work surface.

● **Cleanup.** Usually a small amount of contact cement will be spilled (or squeezed out) onto the finished surface. To dissolve and remove it, use lacquer

thinner and scraps of laminate (never metal) to get the heavy globs off, then finish with a rag. Or you can use naphtha. This type of solvent will dissolve only the resins in the adhesive and leave the rubber (in the cement) on the laminate. The rubber can then be rolled off the laminated surface with your fingertips.

● **Ventilation.** Since contact adhesives are highly combustible, always be sure your shop (or kitchen) is well ventilated. Matches, cigarets, open flames and equipment that sparks when turned on (oil burner, for example) do not belong in the room where you are applying the stuff.

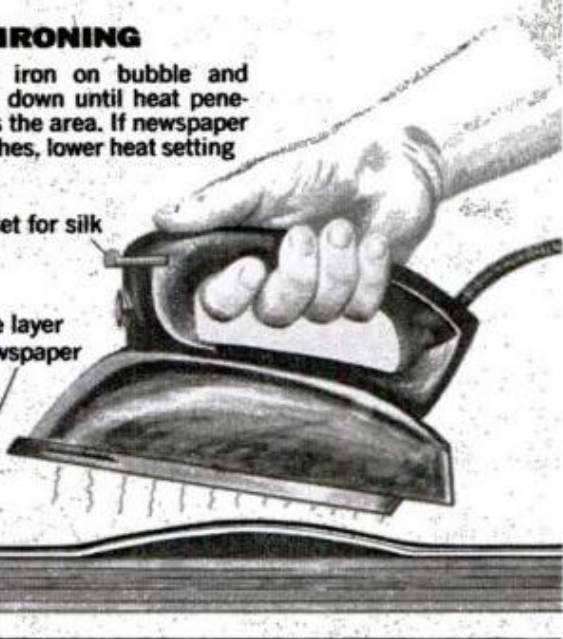
DELAMINATION (BUBBLES)

IRONING

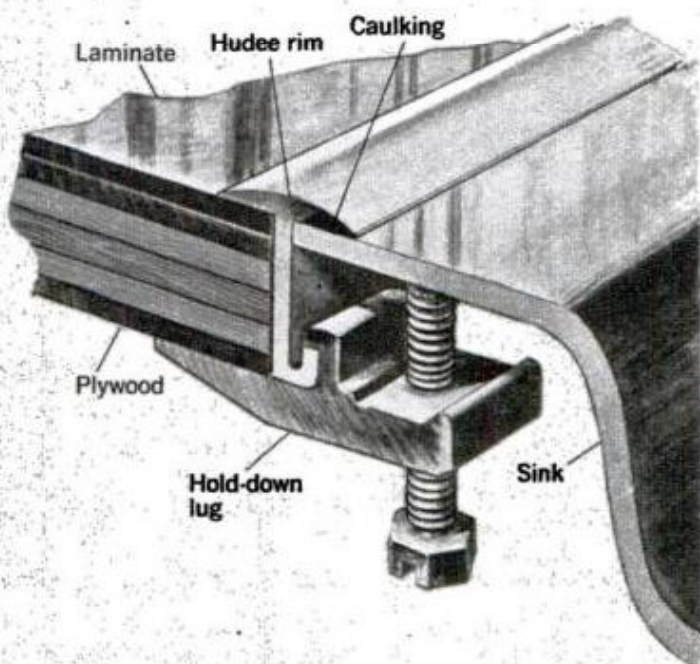
Place iron on bubble and press down until heat penetrates the area. If newspaper scorches, lower heat setting

Iron set for silk

Single layer of newspaper



INSTALLING A SINK



● *Special jobs.* Regular 1/16-in. plastic laminate has limited flexibility (bend radius); it can be safely bent around a 7-in. radius (approximate), provided the material is at least 70° F. To make tighter turns, the material must be heated. Cabinet shops use a flameless heater, but since that tool would have limited use in your shop, you can substitute a propane torch. To do it, heat the laminate from the back, holding the torch 6 to 8 in. away to prevent scorching. When the material softens, clamp it in a jig, simulating the radius you wish it to turn, and allow it to cool in that

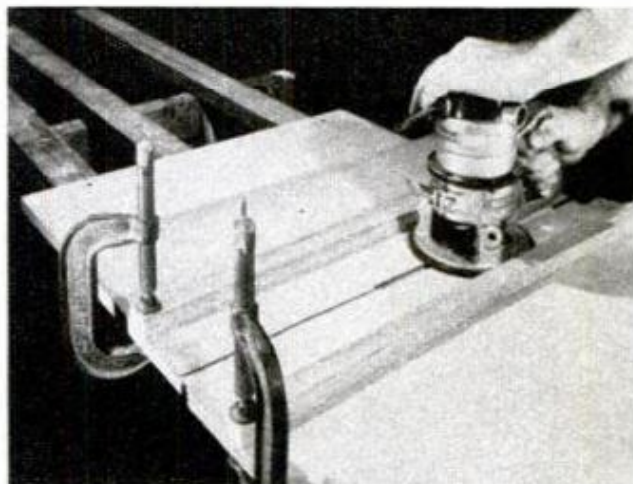
(Please turn to page 224)

MARCH 1970

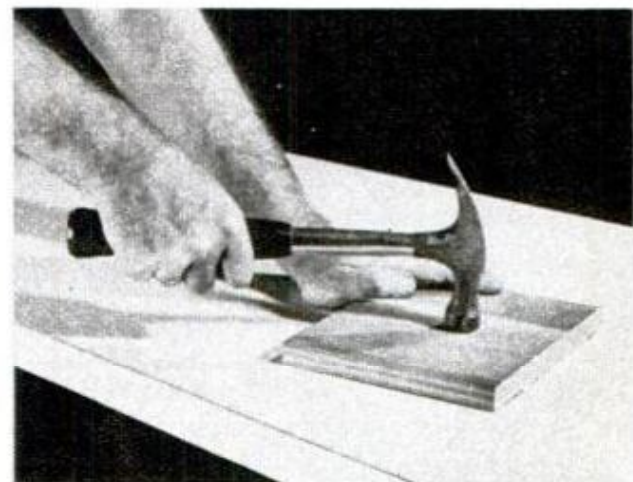
Other Laminating Tricks You Should Know About



TEMPLATE used with router gives accurate, fool-proof cutout for receptacle box. It's held on with double-faced tape. Consoweld also offers a template for routing rounded corners on the countertops



TO MAKE PERFECT BUTT JOINT, overlap two pieces of laminate and clamp two strips to serve as guide for router. Use a straight carbide cutter, cut material good side up. If router shoe is rough, cover bottom with masking tape to prevent scratches



WOOD BLOCK rapped with hammer provides ample pressure after laminate has been bonded. Make certain wood is clean and free of any metal (nails). Apply pressure working from middle toward the ends

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Build This



A THING OF BEAUTY, this distinctive entertainment center will add excitement to your outdoor living

Handsome Cookout Gazebo

It's an attractive back-yard entertainment center with its own built-in barbecue grill. You can build it yourself for less than \$700

By WAYNE C. LECKEY, Home and Shop Editor / Color Photos by Robert Borst

IF IT DID NOTHING MORE than just stand there, this charming back-yard gazebo would make your yard the prettiest one in the block.

But it does more than just look pretty. It features a built-in open grill to make outdoor entertaining twice the fun and half the gamble.

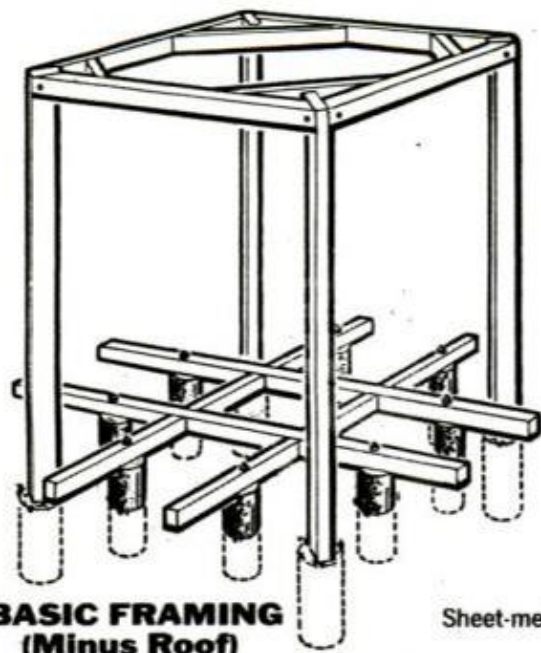
No longer need you worry about a cookout being rained out. The chef and his steaks are high and dry under the protection of a big umbrella roof. Wooden benches around three sides make the covered deck a natural eating place when a sudden shower tries to ruin everything. And as a shady retreat, its open design offers a delightful place to sit and sip and escape the noontime sun. When wired for lights and stereo and located at pool-side, this delightful lawn house will add a gay festive mood to after-dark swim parties.

The built-in grill occupies the center of the open deck and sits under a central flue which carries heat, smoke and cooking fumes out through the roof. Hanging from the sides, the grill has boxlike counters fitted with hinged lids to provide convenient storage for charcoal, barbecue tools and the like. To top it off, there's room under the grill to let you add a small refrigerator to save trips to the kitchen.

The grill itself sits in a metal-lined well that's filled with sand, and is raised and lowered by a handle at the side.

The gazebo you see here was adapted from an original plan developed by the Western Wood Products Assn. We modified it to simplify construction and





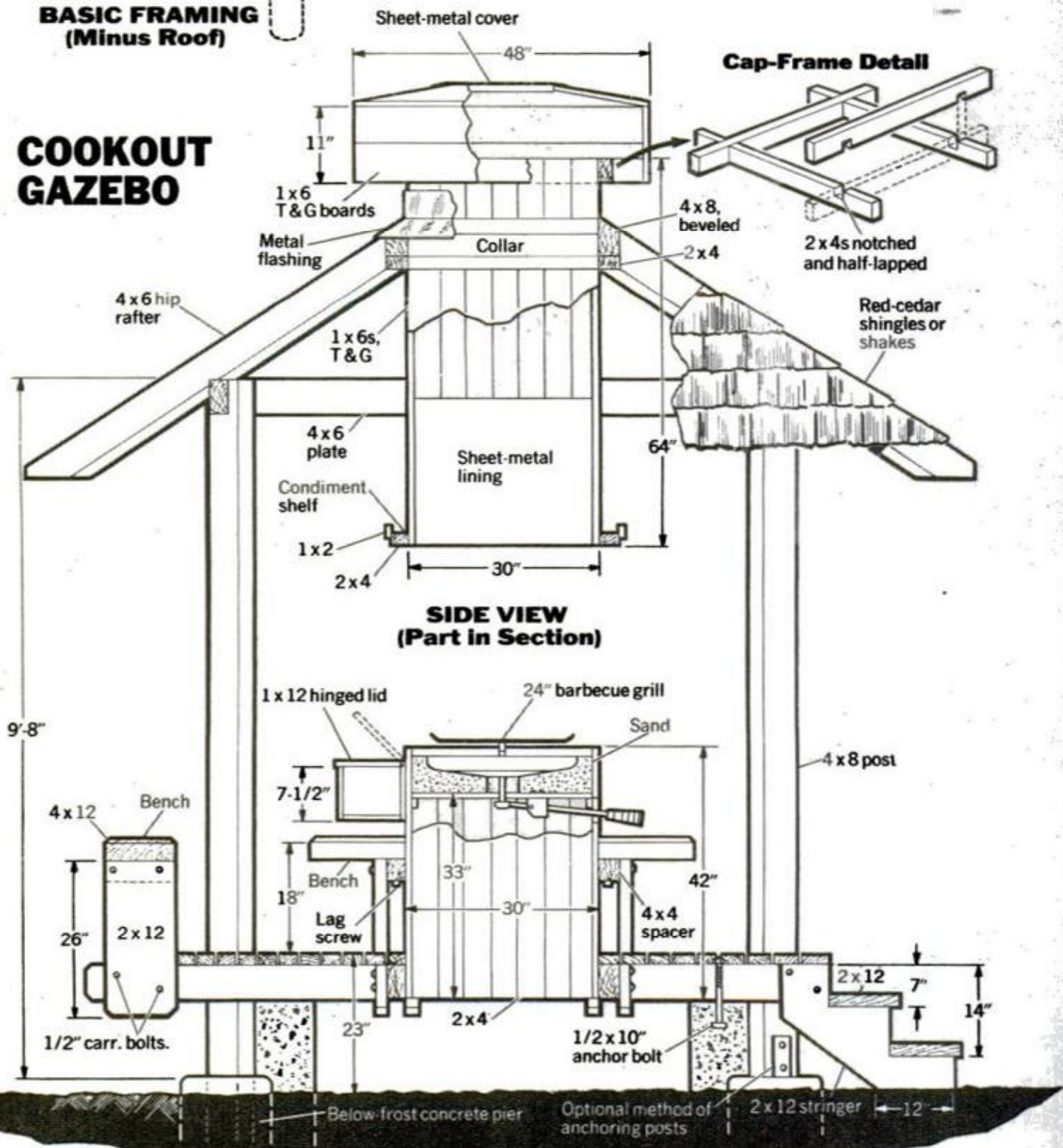
**BASIC FRAMING
(Minus Roof)**

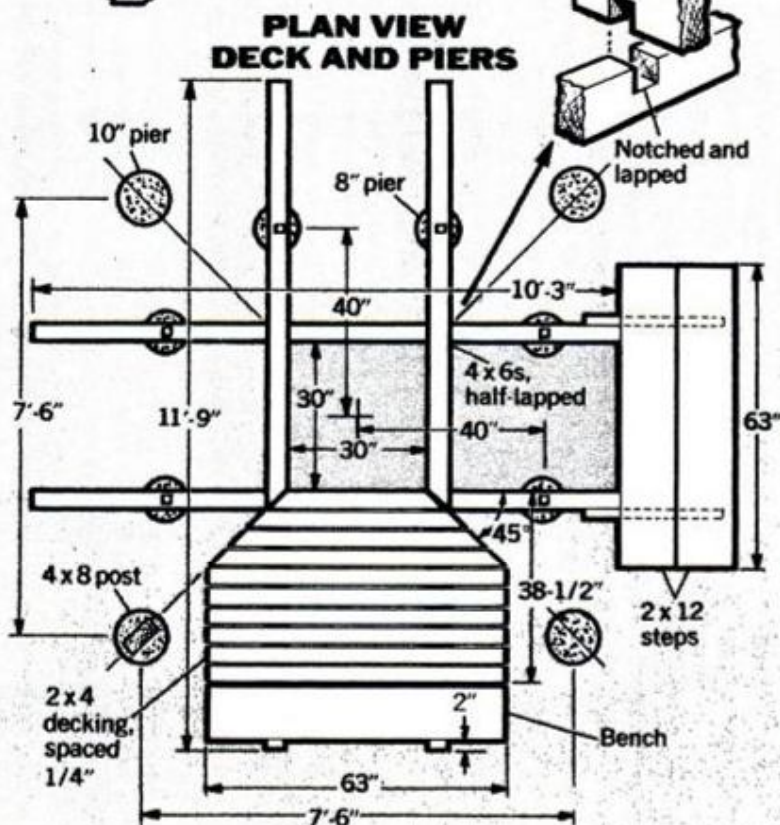
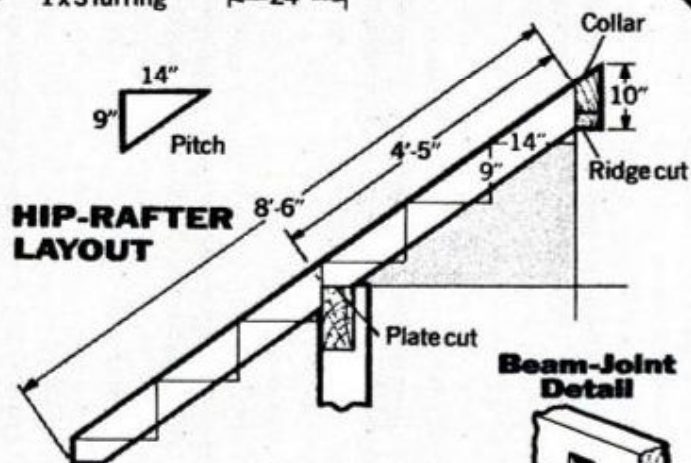
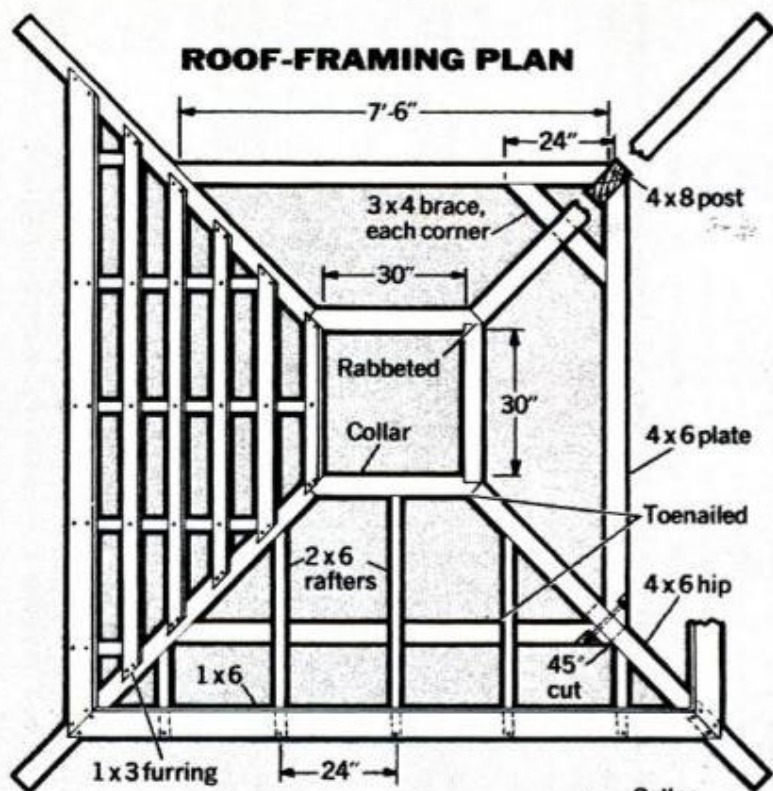
cut down its roof from 18 ft. square to 12 ft. square to fit the yard. The plans here are of our adaptation, but you can get an original one for 25 cents from WWP Assn., Dept. IP, Yeon Building, Portland, Ore. 97204. Ask for plan No. 7.

To build this gazebo we spent \$488.34 for lumber, \$54.74 for concrete and \$76.35 for hardware for a total cost of \$619.43. This was in a relatively high-cost area (southern Connecticut), and you may find you can build it for less.

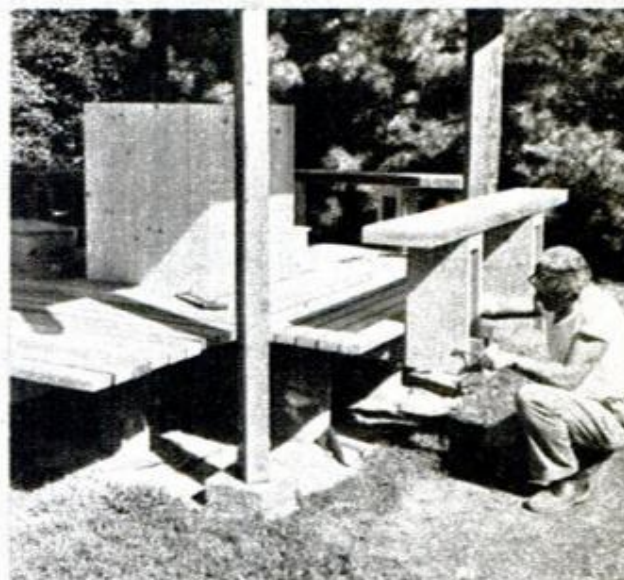
The supporting framework consists of heavy timbers, the posts being 4x8s, the deck beams, roof plates and hip rafters
(Please turn to page 230)

COOKOUT GAZEBO





Technical Art by Stanley Cohen



U-SHAPED LEGS of benches straddle outboard ends of 4x6 deck beams, are bolted to them



PIER-SUPPORTED BEAMS are decked with 2x4s placed flat and 1/4 in. apart. Use 12d nails



BOX-LIKE FLUE is made with 1x6 V-groove boards, shoved up through roof collar, nailed



THIS STORAGE FOOTSTOOL serves double duty by holding a pair of slippers, your pipe, tobacco and perhaps your favorite magazine

Color Photos by Robert Borst



A TOGETHERNESS STOOL—your wife can be making the needlepoint top while you are making the base in your shop



A FOUR-BOARD COLONIAL, this stool interlocks during assembly. Make it of pine and apply a suitable colonial stain

Great Projects to Keep Your Workshop Humming

We've rounded up a gaggle of handsome projects sure to enliven those dreary late-winter and early-spring weekends

ALL WOODWORKERS—professional and amateur alike—have one thing in common: They are constantly on the lookout for new and challenging projects. Recognizing this, *PM* collected a grab-bag-full of ideas to present in this 16-page section. Your wife can get in the act too; several projects call for needle-and-thread work.

You'll find instructions and drawings for building three footstools, a homework desk, sweetheart chair, mobile laundry counter, silverware tray, contemporary lamp and a ready-made coffee table.

THREE FOOTSTOOLS

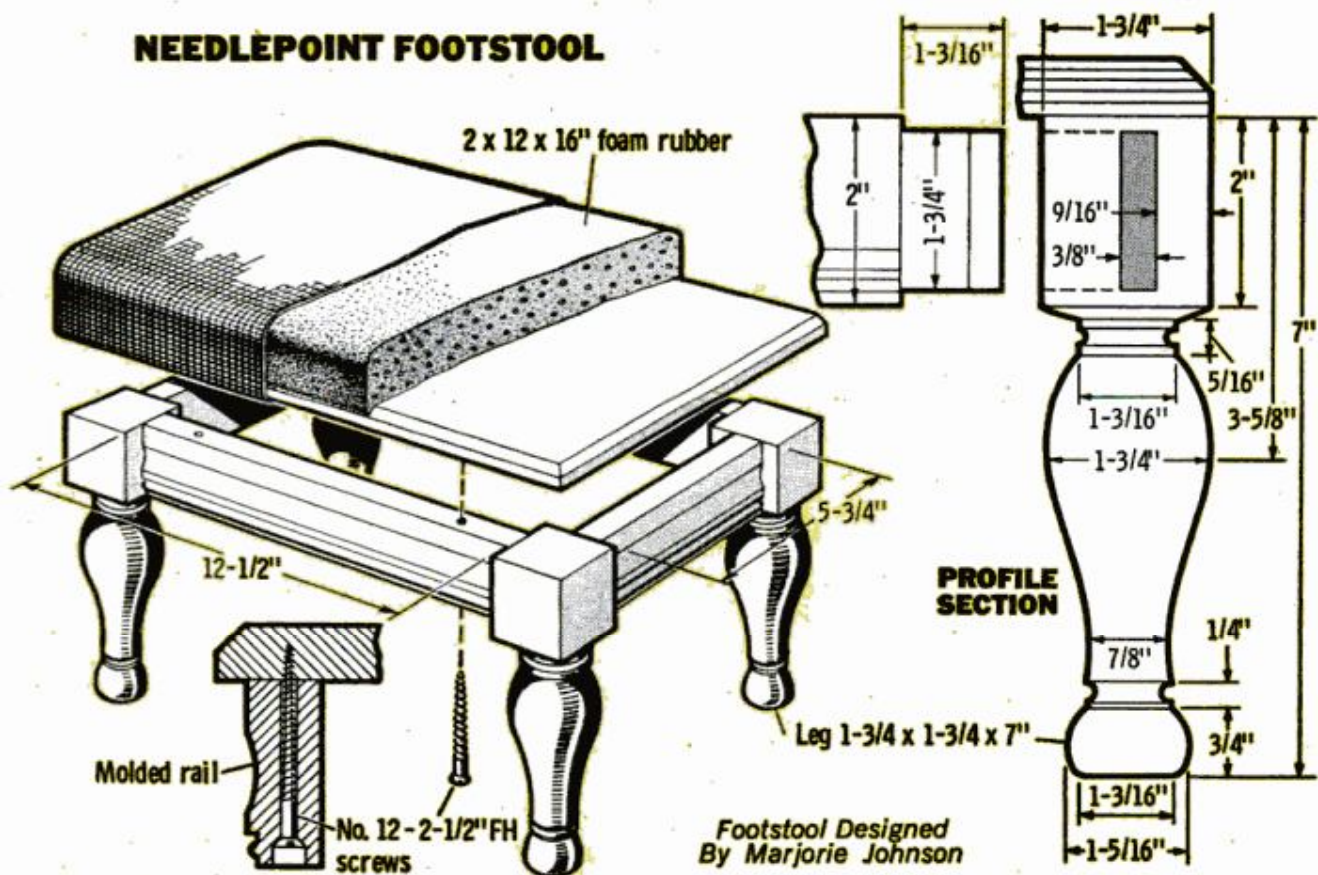
The needlepoint stool shown below can be made of scrap materials you probably

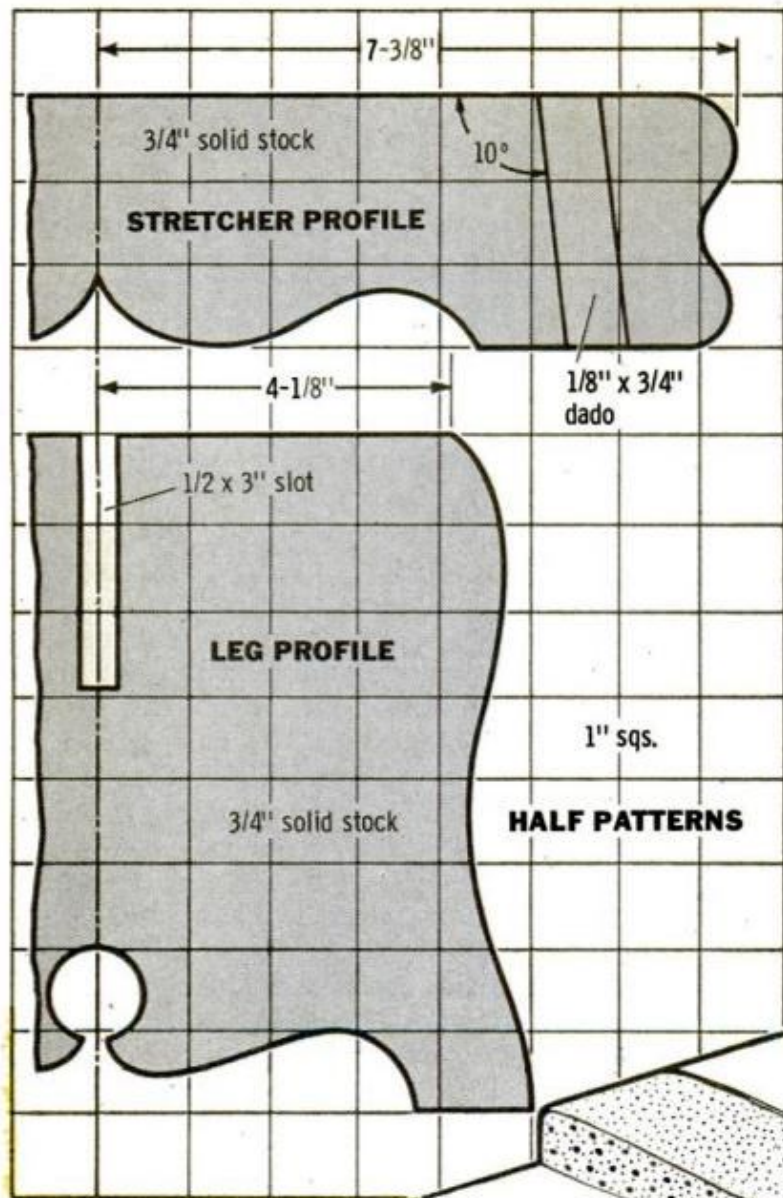
have lying about your shop. If you lack a lathe, you can purchase 6 or 8-in. ready-made legs at your local lumberyard or hardware store. The framework (stretchers) is of ornamental molding let into grooves ploughed in the legs.

While you build the frame, your wife can work on the needlepoint tapestry for the top. Tell her to buy a 16 x 20-in. piece with a design no more than 6 in. wide and 10 in. long. Two skeins of tapestry wool are required to fill in the background.

The colonial four-board footstool (on the following page) is an adaptation of the much older version built by the early colonists. If you plan to have the youngsters use it as a television viewing seat,

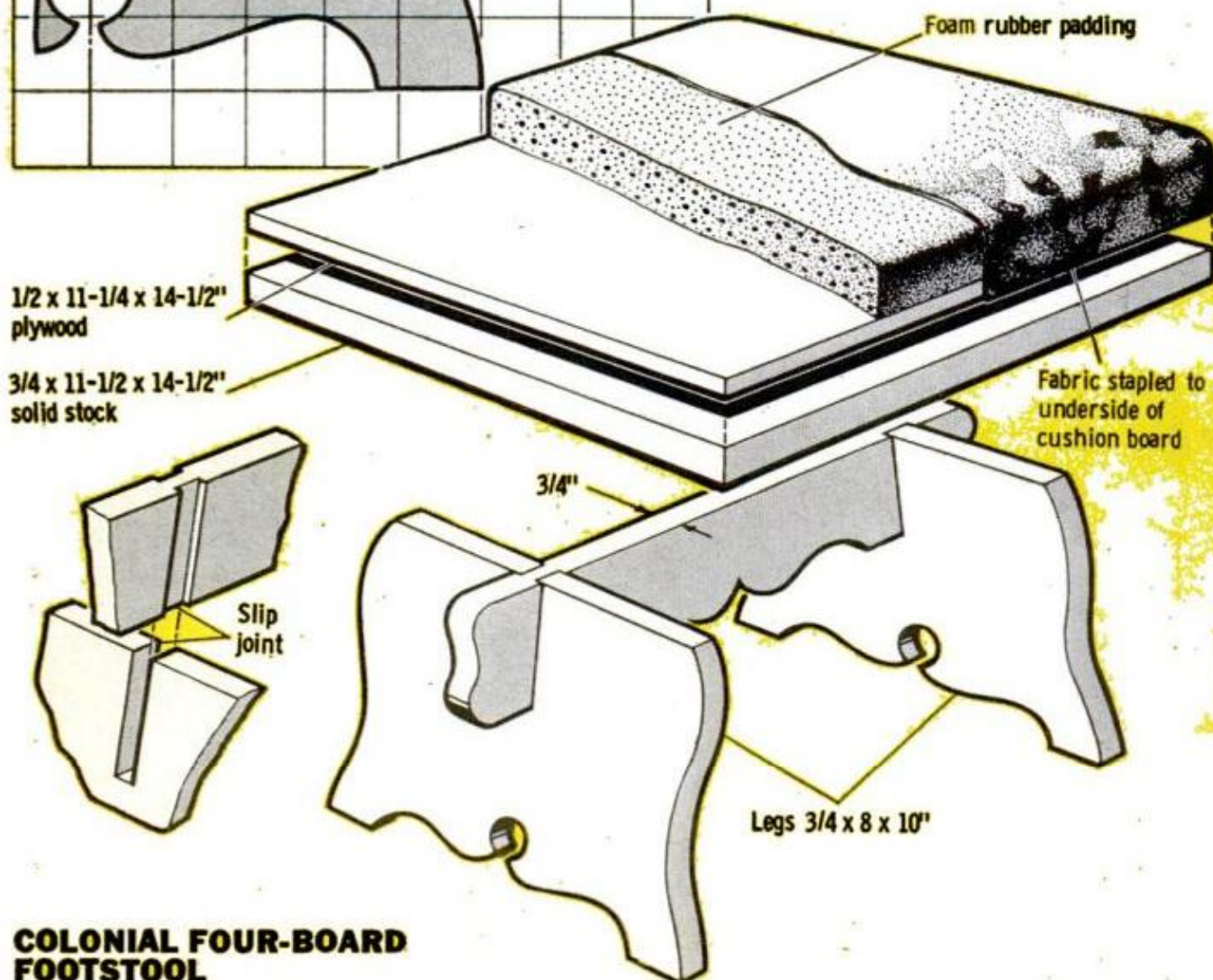
NEEDLEPOINT FOOTSTOOL





you can add a fifth board (slightly smaller than the stool top) and finish with a padded seat as shown. Originally these stools consisted of four pieces of lumber joined by various methods. The very early ones were strictly functional and lacked any ornamentation other than the V-shape cut in the legs. As woodworking techniques and tools improved, the stools became more sophisticated.

In this home-shop version, the legs are center-slotted to slide into the shallow grooves cut in the sides of the centerboard. The latter can also be cut at an angle of about 10° at the ends. The legs are then attached with glue and screws. Using the same basic construction, you could make the stool a bit longer and higher if desired. If you make it about 16 to 18 in. high, one board wide and 36 in. long, increase the centerboard (stretcher)



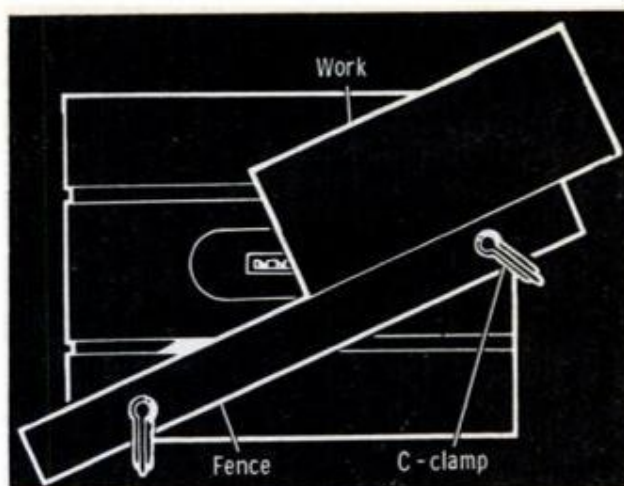
COLONIAL FOUR-BOARD FOOTSTOOL

width to at least 5 in. and you'll have a handsome fireside bench.

Though early settlers assembled their furniture without glue, you'll be wise to glue the legs to the stretcher for added rigidity and lateral strength. On the four-board stool, the top was glued to legs.

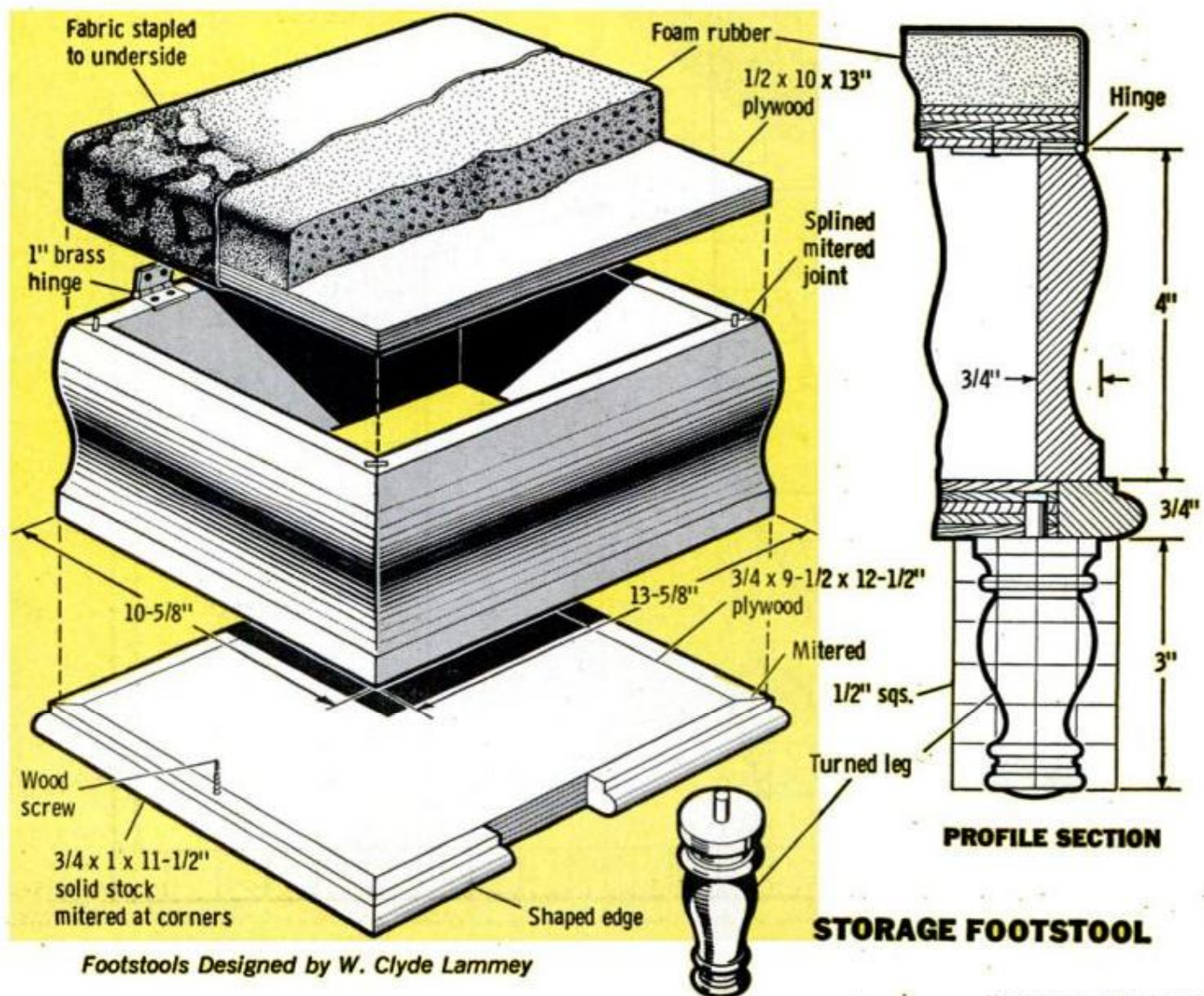
The third footstool is practical and useful—it gives storage as well as seating and foot comfort. Like the four-board stool it is an adaptation—not a copy—of early stools. Actually, the originals were generally larger and somewhat higher. Dimensions can, and should, be varied to keep the stool in scale with its chair.

Construction is quite simple. Start by turning the four legs (or select ready-made legs). Then edge the plywood base with solid wood strips mitered at the corners. Use glue to assemble. The edges can then be molded as shown or to a design suiting your fancy. Attach the legs to the underside with glue and dowel screws. Next, make the box. You can shape the cove molding as shown in the sketch above or use mill-made moldings. If you choose the latter method, buy the molding first as



COVE MOLDING is made on table saw using clamped guide. Work must be fed slowly and blade should be raised no more than $\frac{1}{16}$ in. after each pass. To shape the back, use a block plane and sandpaper

it will determine (and possibly change) the dimensions given. Notice that the molded sides are spline-mitered at the corners. Pine, mahogany, walnut or even plywood (if the finished product will be painted) are good choices. All stools shown utilize a 2-in.-thick block of foam rubber for comfort. To finish, sand well and stain.

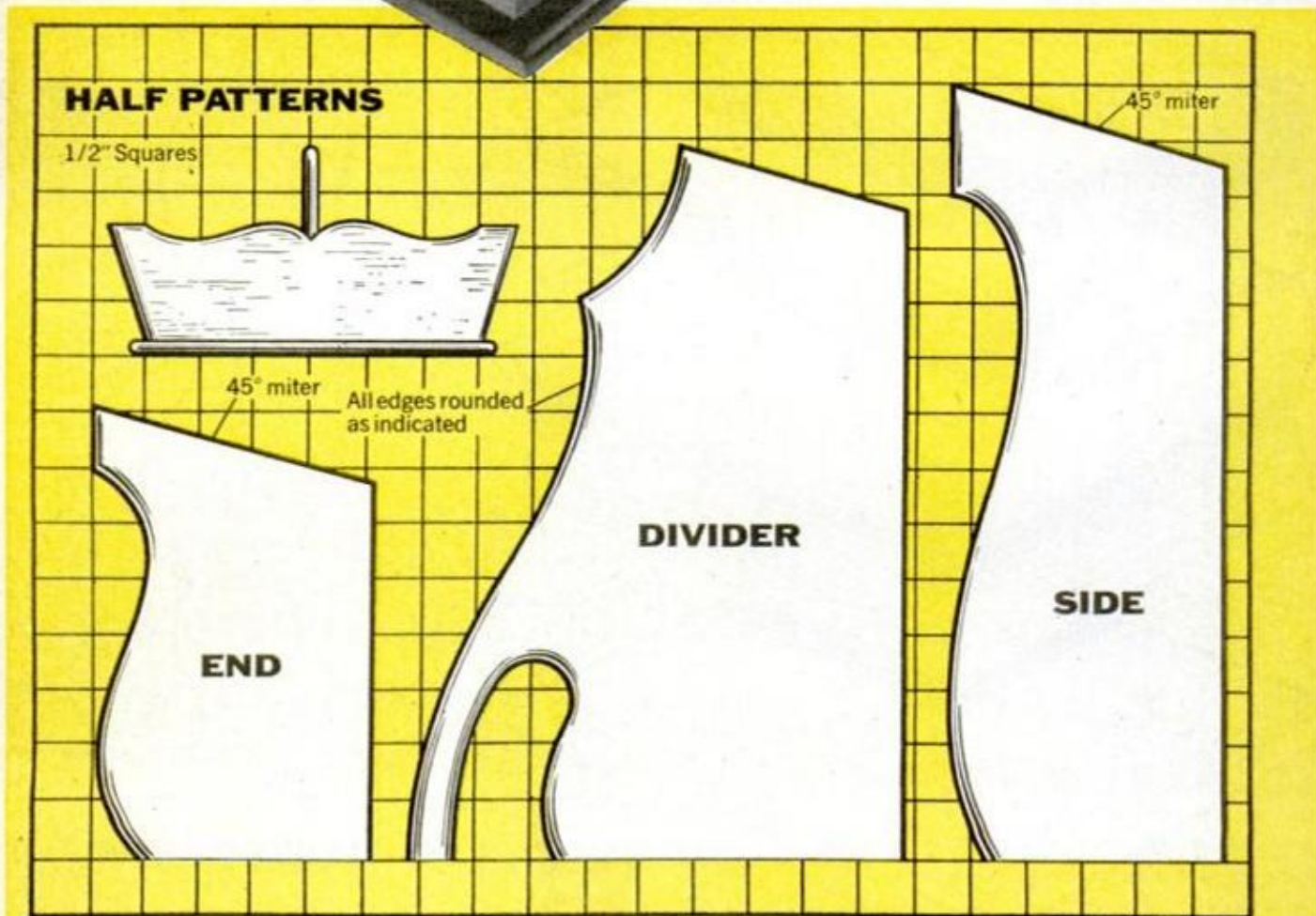


Handsome Tray For Your Best Silverware



BOTTOM of compart-
ments may be lined with
green felt glued in place

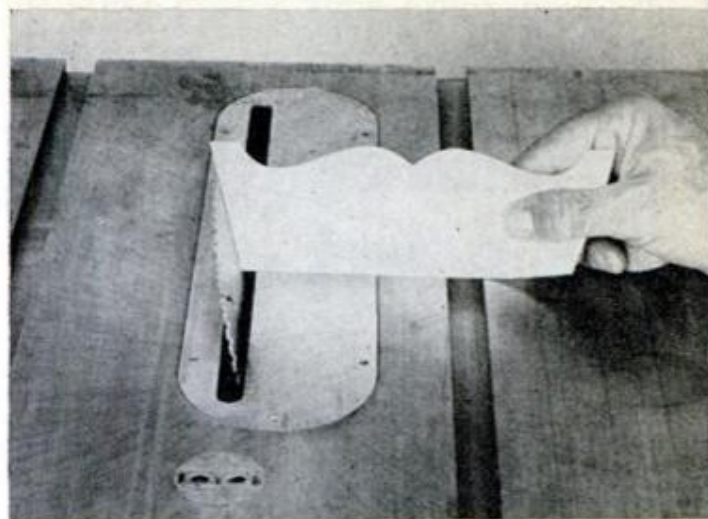
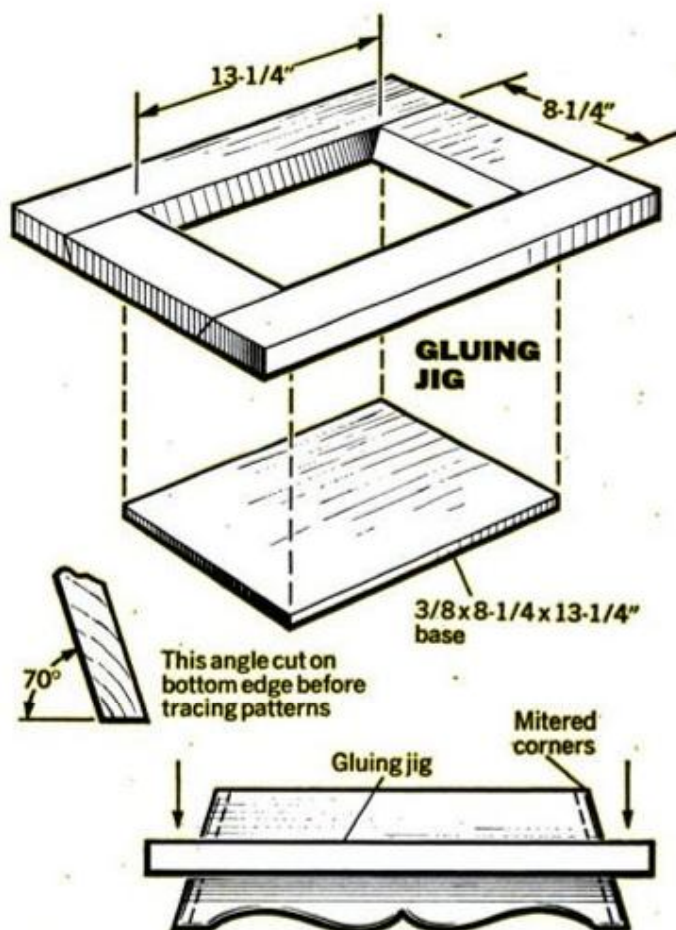
Designed by John Capotosto



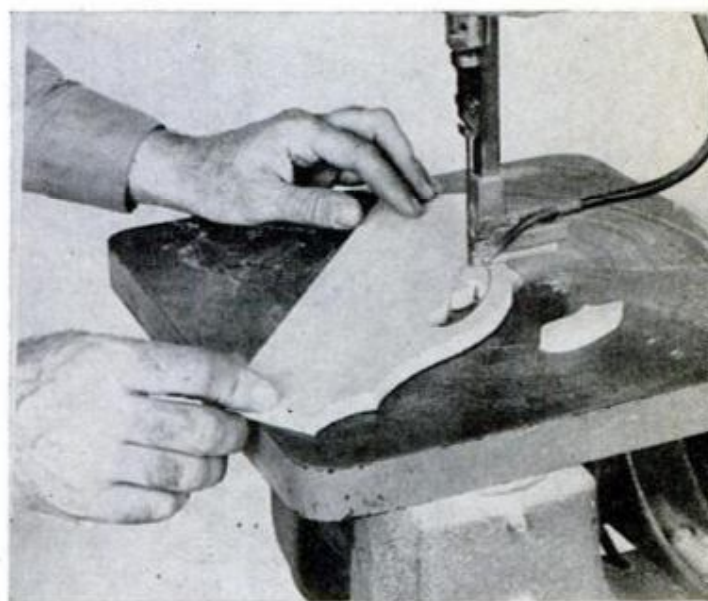
OF $\frac{3}{8}$ -IN. POPLAR, this attractive silverware holder is basically simple in design and construction. Though assembly ordinarily would be difficult (because of the tray's angular sides), it's a snap here because of a simple gluing jig that eliminates otherwise difficult clamping.

Start by laying out the patterns on a sheet of heavy paper, then cut them out with scissors or a razor blade. Using the templates as a blade-setting guide, set the table-saw blade to coincide with the angle of the patterns and rip one edge of lumber at this angle. Cut enough to make up the two sides and two end panels. After the bevel has been cut, return the blade to the 0° setting.

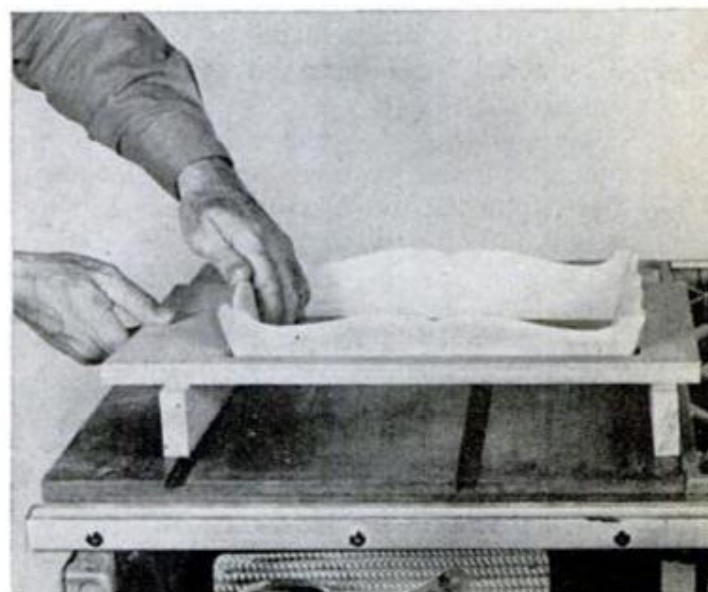
Align the bottom edge of the pattern with the beveled edge of the wood and trace the outline. Do this for ends and sides. The divider is traced onto a square piece of wood. All parts are cut on the jigsaw. The gluing jig, with its beveled cutout, simply slips over the assembled tray and holds the parts together until dry. After the glue has set, remove the piece from the jig and glue on the bottom. Finish the tray with stain and two coats of shellac.



MAKE CARDBOARD TEMPLATES, set bench-saw blade to correct angle for ripping edges of sides and ends



SCROLLS ARE CUT on jigsaw. For smooth cut use a very fine blade, high speed and a slow feed



GLUING JIG consists of piece of plywood with beveled cutout. No nails are used in the assembly

Saddle-Seat Homework Desk



SCHOOL HOMEWORK will be less of a drag when your youngster sits astride this saddle-seat desk. It has a slant top like the ones at school and a roomy compartment for pencils and paper under its lift-up lid. And it has a built-in blackboard to boot.

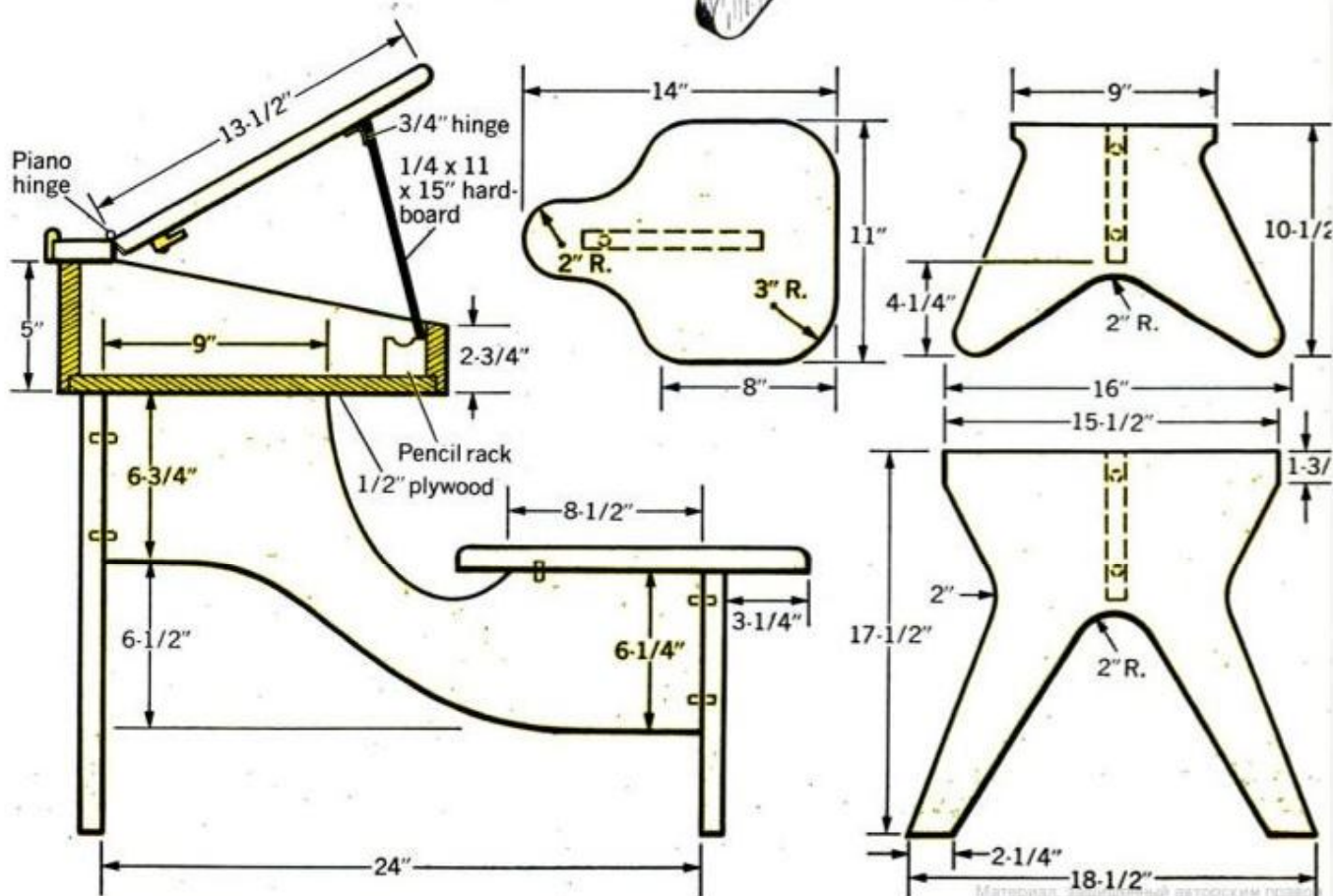
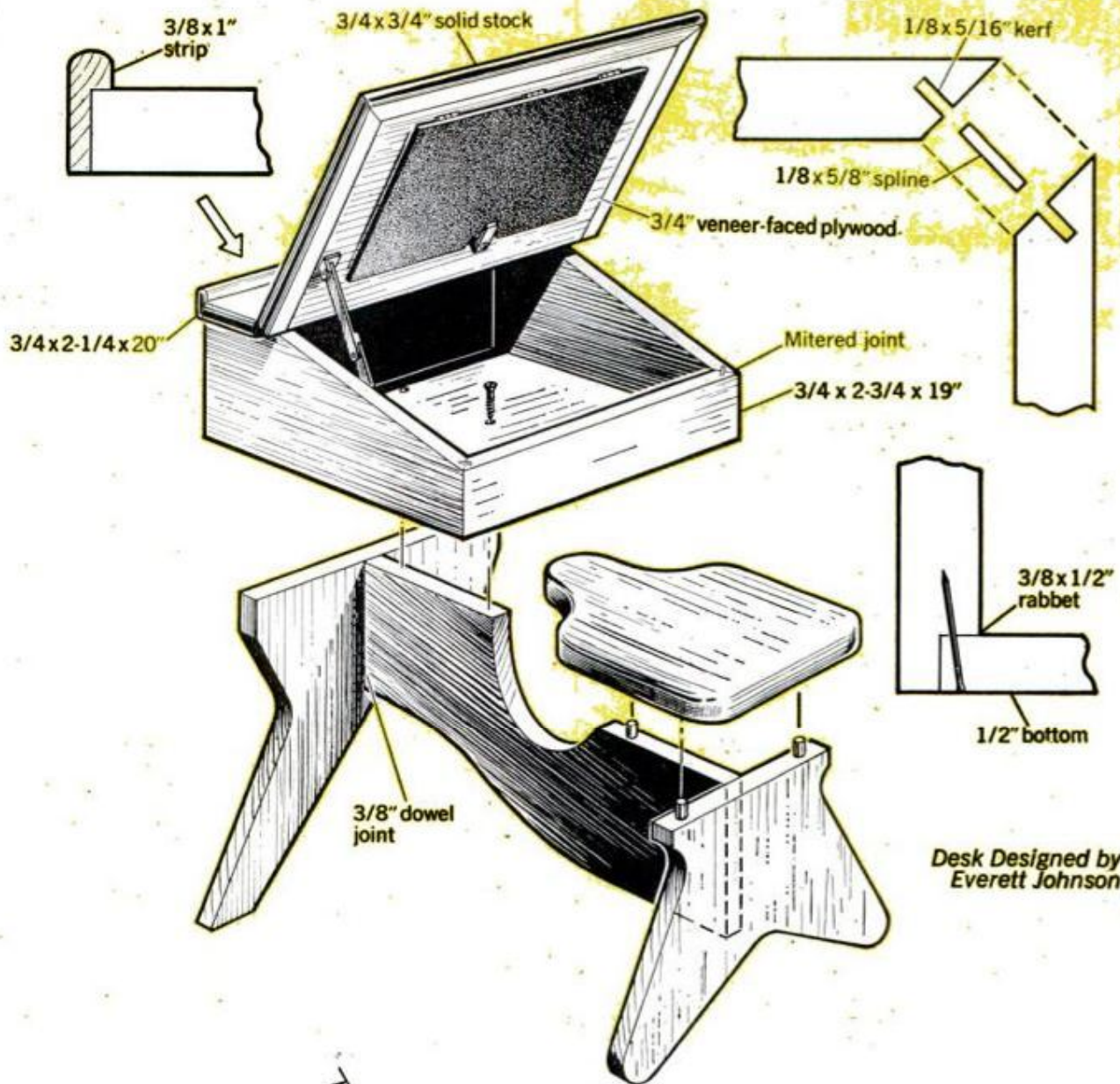
If you want to make the desk like a piece of fine furniture, pick solid walnut. For a painted finish, you can use less expensive fir plywood and tape the edges.

Patterns for the seat, legs and connecting stretcher are given on the opposite page. If working with solid stock, you'll have to edge-glue boards together for width. The plain sawed edges of the parts can be relieved by rounding them with a router. This is particularly important in the case of the seat edges to insure splinterfree seating. Regular blackboard paint, applied to hardboard, makes a fine "slate" surface. A regular support hinge should be attached to the top for positive stay-in-

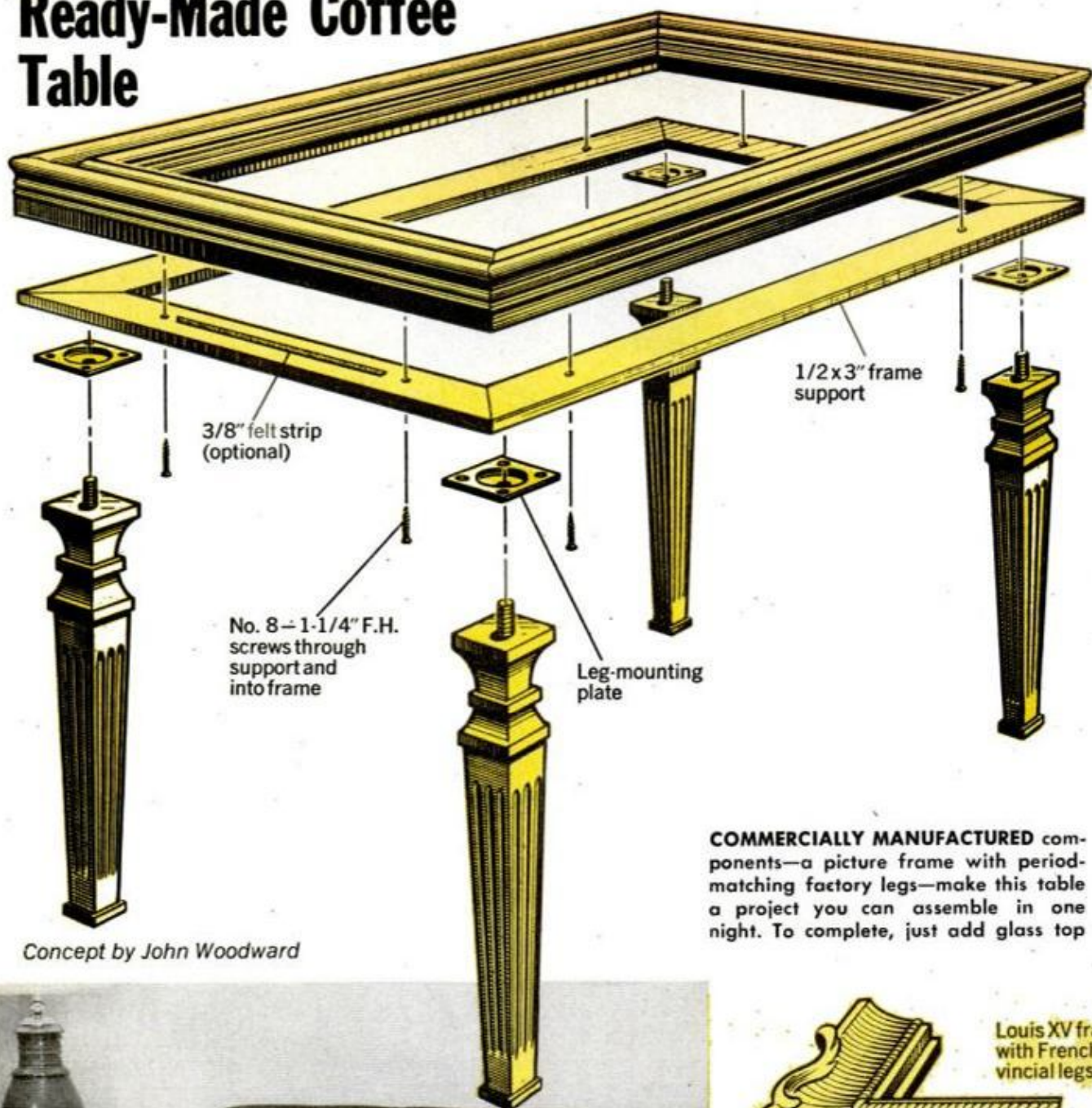
place action. If you build the desk of walnut, be sure to apply a coat of filler after the stain and before the sealer. If of plywood, make certain that you seal the wood before painting.

JUST THE RIGHT HEIGHT for drawing, coloring and reading, desk has its own built-in, saddle-type seat



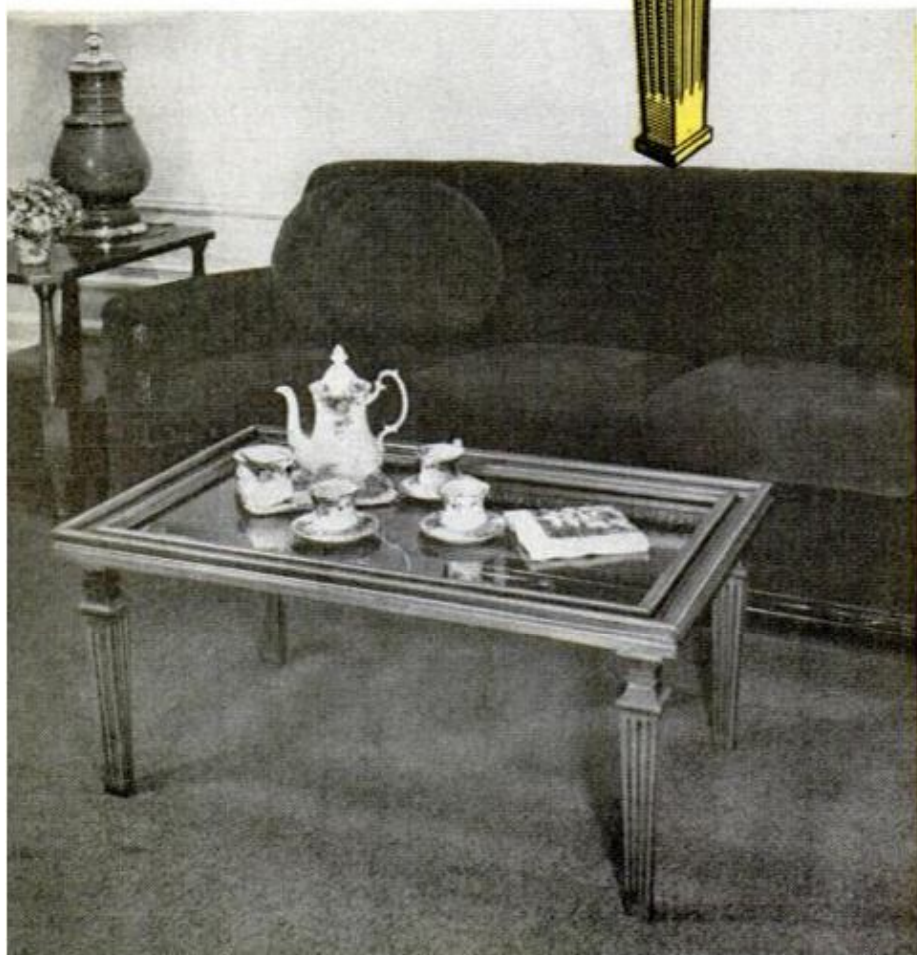


Ready-Made Coffee Table



Concept by John Woodward

COMMERCIALLY MANUFACTURED components—a picture frame with period-matching factory legs—make this table a project you can assemble in one night. To complete, just add glass top



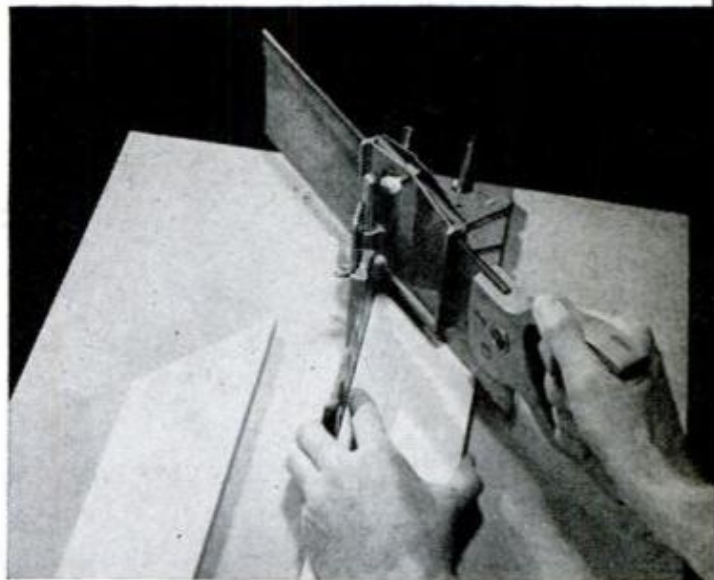
THE LEGS should be picked to suit the ornateness of the frame. A plain, turned leg would not go well with Louis XV picture frame

HERE'S A FAST WAY to make a handsome coffee table for your home: Simply add four ready-made legs to a picture frame. All you need in addition to the frame and legs are leg mounting-plates (which generally come with the legs), a glass top and a frame support.

The support becomes a solid base for the picture frame, holds the glass and also is the base for the leg mounting-plates. It's cut from $\frac{1}{2}$ x 3 or $\frac{1}{2}$ x 4-in. stock, depending upon the width of the frame you decide to use.

There are many varieties of picture frames and factory legs available. You can make all kinds of match-ups to suit your imagination. For example, you might combine a simple modern frame with a set of tapered contemporary legs. Or you might use one of the combinations shown on the facing page. There are also many metal legs in a wide assortment including wrought-iron legs in either stationary or fold-up designs.

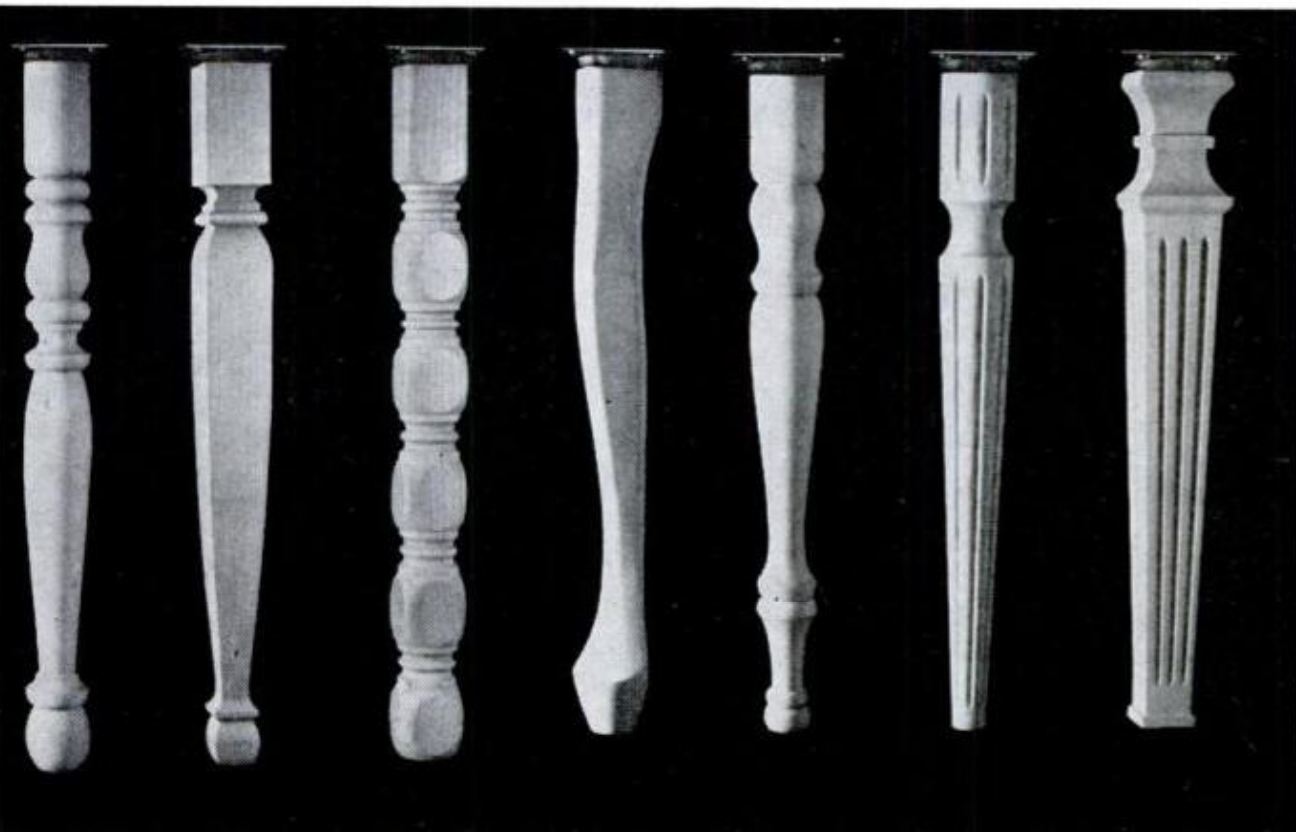
Make sure that the glass you select is at least $\frac{1}{4}$ in. thick to support any heavy objects that may be placed upon it. Your local glazier will cut it to size and smooth the edges for safe handling. Burnishing is unnecessary since the edges will be in the frame and not visible.



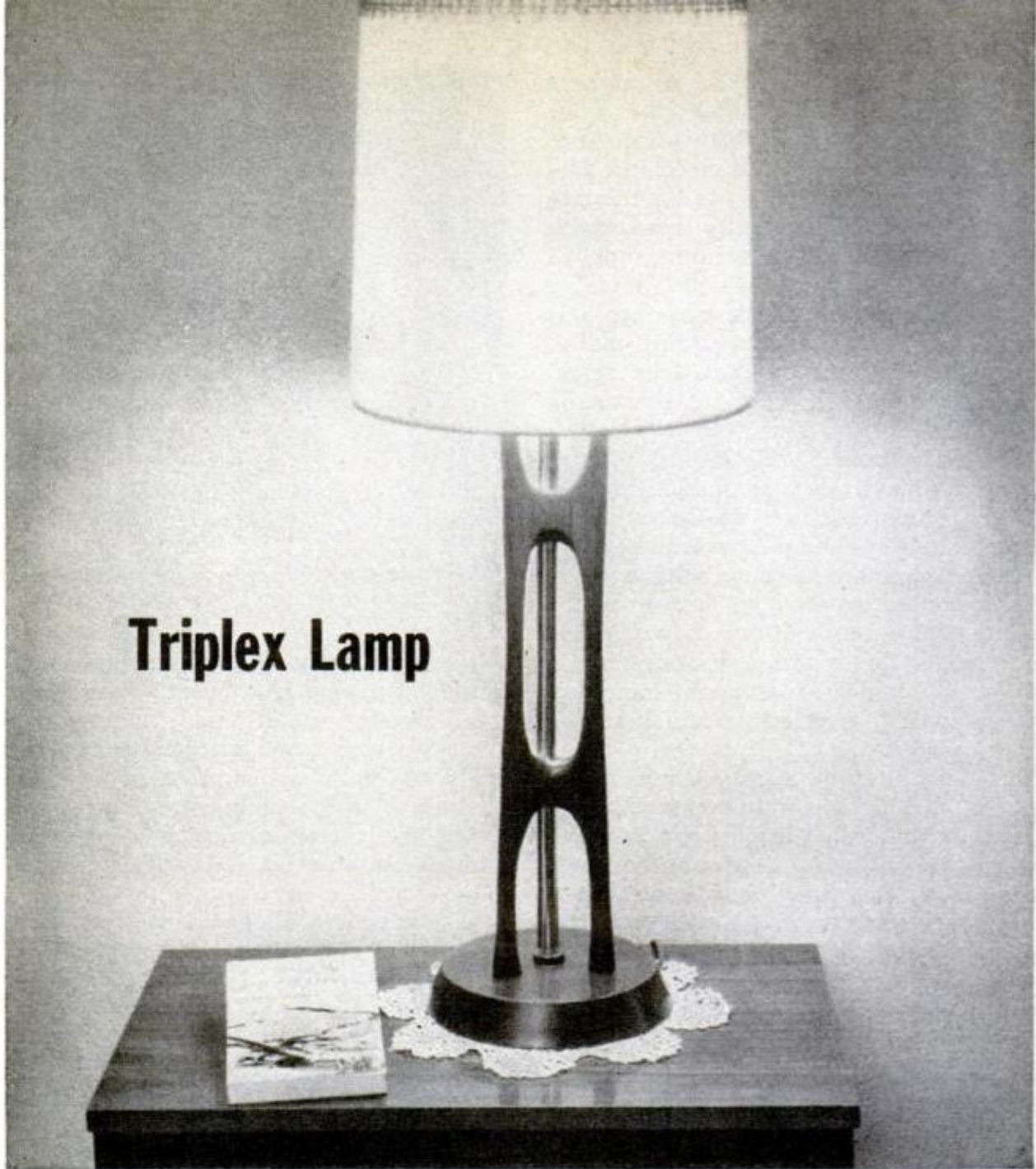
MAKE YOUR OWN frames from stock picture moldings to cut costs further. If you do, miter corners

Since the ready-made components come sanded, finishing is a snap. You can do a small amount of additional sanding, using a 180-grit (or finer) sandpaper and then apply the stain or paint of your choice. Because a coffee table is generally subjected to a certain amount of abuse, pick a tough, durable finish (such as polyurethane varnish) to complete the piece. Apply two coats, allow to cure for several weeks and buff with paste wax.

SEVERAL EXAMPLES of ready-made wood legs widely available in lumberyards and hardware stores. If you can't locate them locally, write to M. W. Wolchonok & Sons, 155 E. 52 St., New York, N. Y. 10017



Triplex Lamp



CAREFUL ATTENTION to construction detail makes this lamp give the illusion that it has been carved from a single block of wood. Actually, it consists of six separate wood members. The lamp shown is of walnut with the legs requiring $\frac{3}{4}$ -in. material, the center blocks 2-in. turning-square stock, and the base a 2x10-in. turning block. You will also need a 2-ft. length of $\frac{1}{2}$ -in.-dia. brass tubing.

To start, make a full-size paper or cardboard template of a typical leg section using the dimensions shown. Lay out the three legs on the $\frac{3}{4}$ -in. stock and cut to rough contour shape and sand. Next, make a template of the center-block end view and cut these two parts. But before cutting the center blocks, drill a $\frac{1}{2}$ -in.-dia. hole through the exact center of both

to receive the tubing that houses wiring.

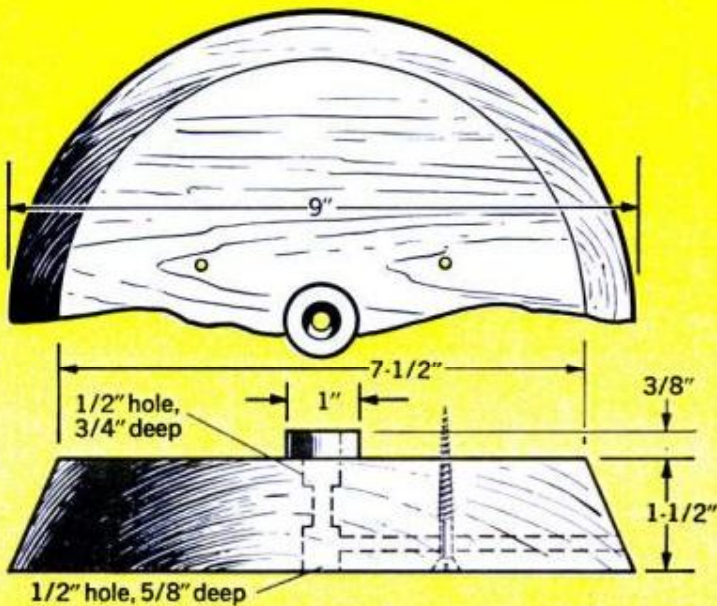
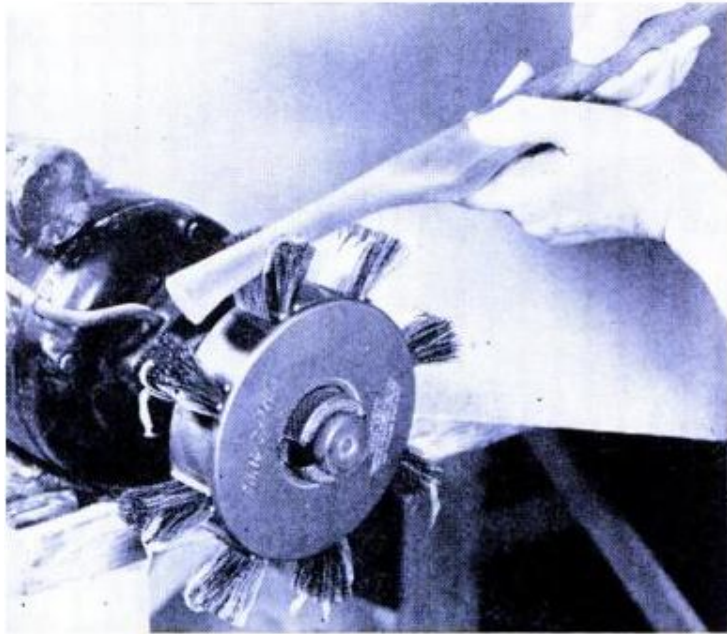
Next, cut the 2-in. base stocks to $9\frac{1}{4}$ -in.-dia. disc. Drill a $\frac{1}{2}$ -in.-dia. hole $\frac{3}{4}$ in. deep in the top of the base to accommodate the brass tube. Then, continue drilling through the base with a $\frac{1}{4}$ -in. drill. Enlarge the hole, from the bottom up, to $\frac{5}{8}$ -in.-dia. and a depth of $\frac{5}{8}$ in. Finally, turn the base to finished shape.

After you sand all wood parts, the base is ready for assembly. Lay a piece of wood across the shaped portion of the center block to serve as support for clamping. Glue one flat portion of each block to one leg, clamp and allow to dry. Then glue and clamp the second and third legs.

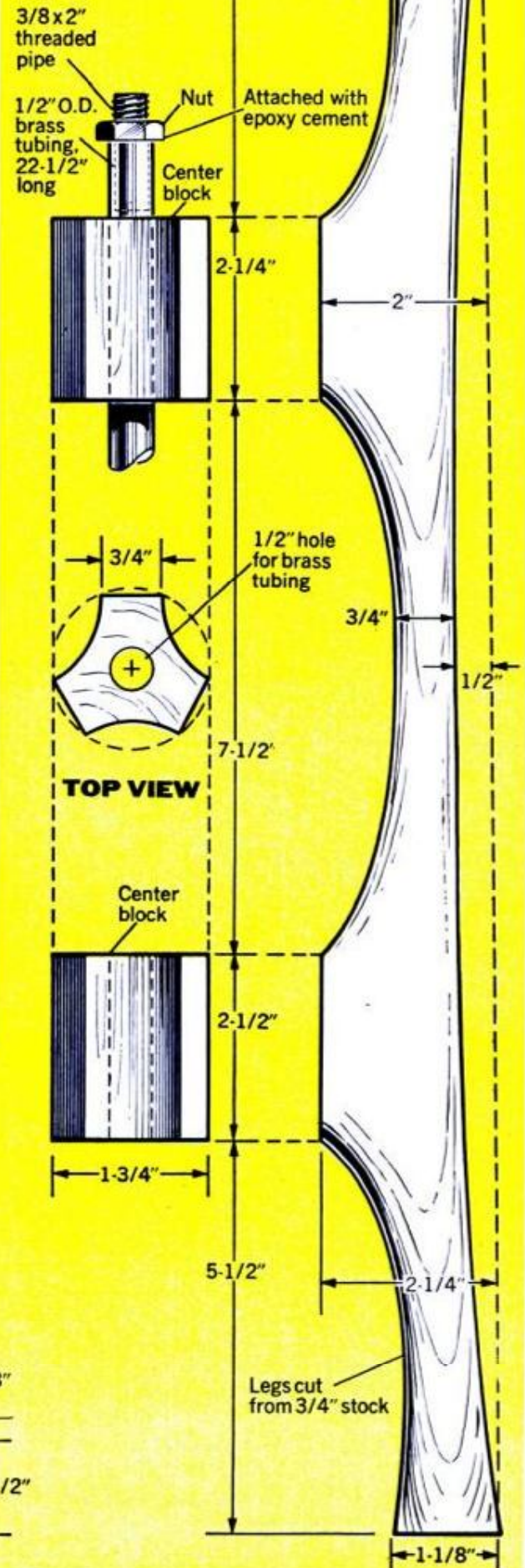
Cut the $\frac{1}{2}$ -in. tubing to an overall length of $22\frac{1}{2}$ in. Then cut a length of $\frac{1}{8}$ -in. running-thread fixture pipe ($\frac{3}{8}$ -in.



AFTER CUTTING THE LEGS, rough out shape using a rasp (either by hand or with power, above), then complete rounded shape with Sand-O-Flex wheel (below). Don't touch areas that fit against center blocks



Lamp Design by Elma Waltner

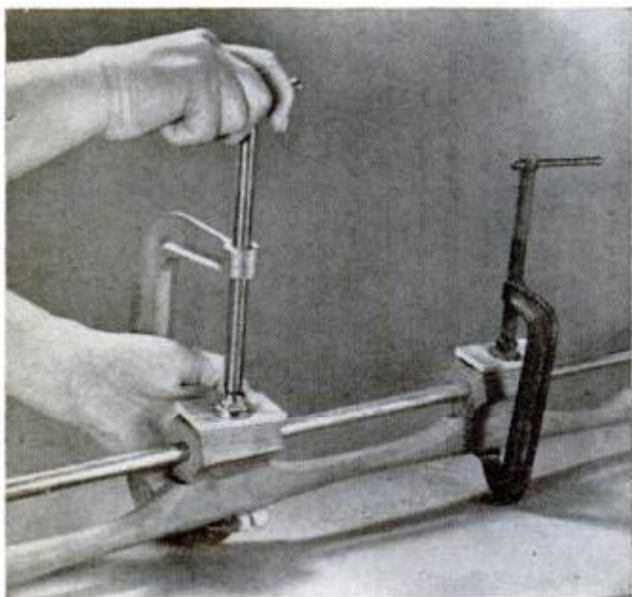


O.D.) 2 in. long. Turn on a brass hex nut until the pipe protrudes $\frac{1}{4}$ in. above it. Fit the longer length of the pipe inside the brass tube and glue the nut to the tube with epoxy cement. Slip the brass tubing through center holes of the leg assembly and push the tube into the "collar" in the base. Drill holes through the base up into each leg and secure with screws.

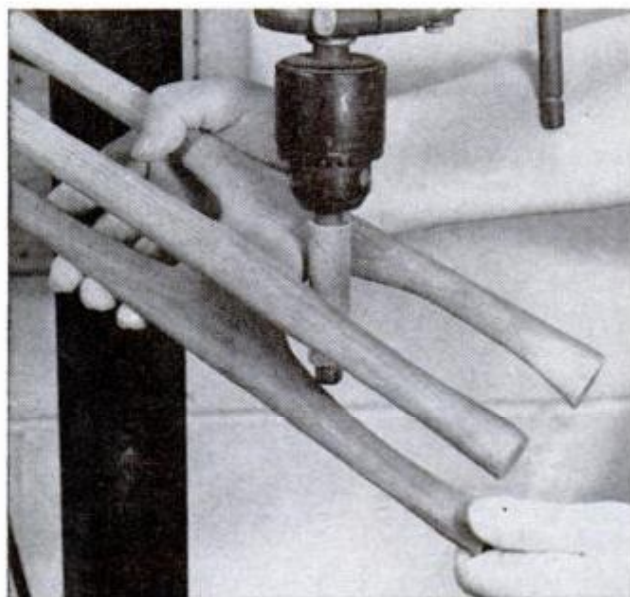
The cord is threaded through the hole on the base edge and pulled out the bottom hole. After double looping the end,

thread the cord back up through the hole and brass tube until it comes out the top. Attach the cord to a push-through-type socket and pull the cord back down to screw the socket to the threaded pipe above the hex nut.

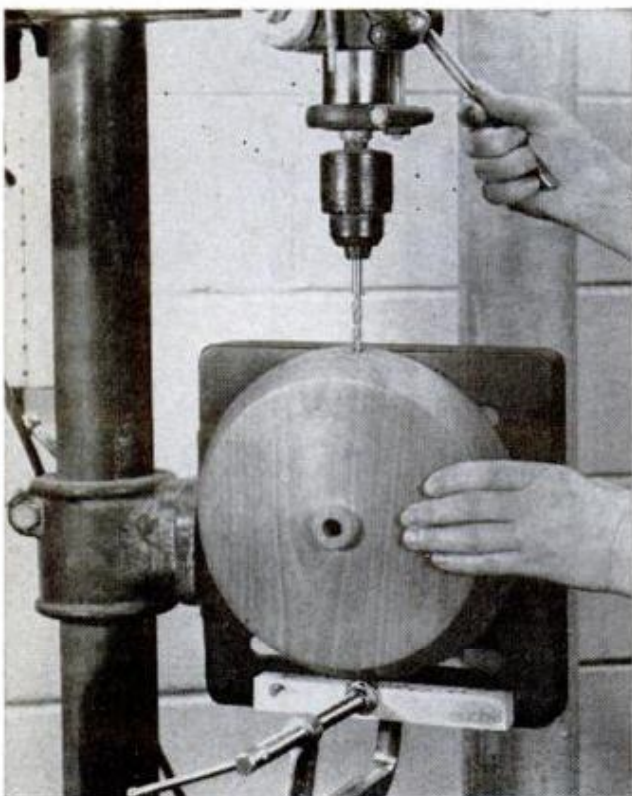
Finish the piece as desired; it goes a lot faster if done before final assembly. If not available locally, tubing and lamp parts can be ordered from Minnesota Woodworkers Supply Co., 925 Winnetka Ave. North, Minneapolis, Minn. 55427.



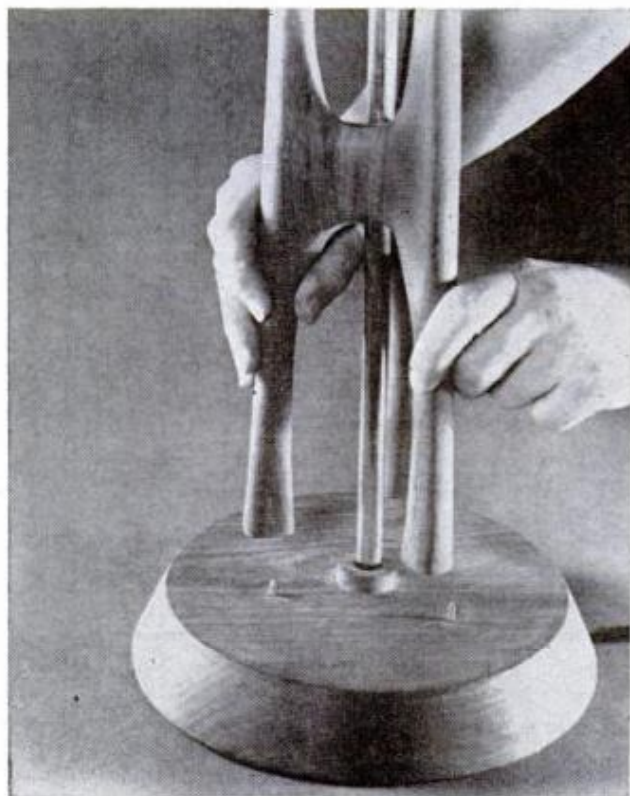
SLIP BRASS TUBE through holes in center blocks, glue blocks to flat surfaces of the legs and clamp



WITH LEGS ASSEMBLED, complete contour sanding between legs. Use sanding drum chucked in drill press



DRILL $\frac{1}{4}$ -IN.-DIA. HOLE, $\frac{1}{4}$ in. up from the bottom of base, from edge to centerhole for lamp cord



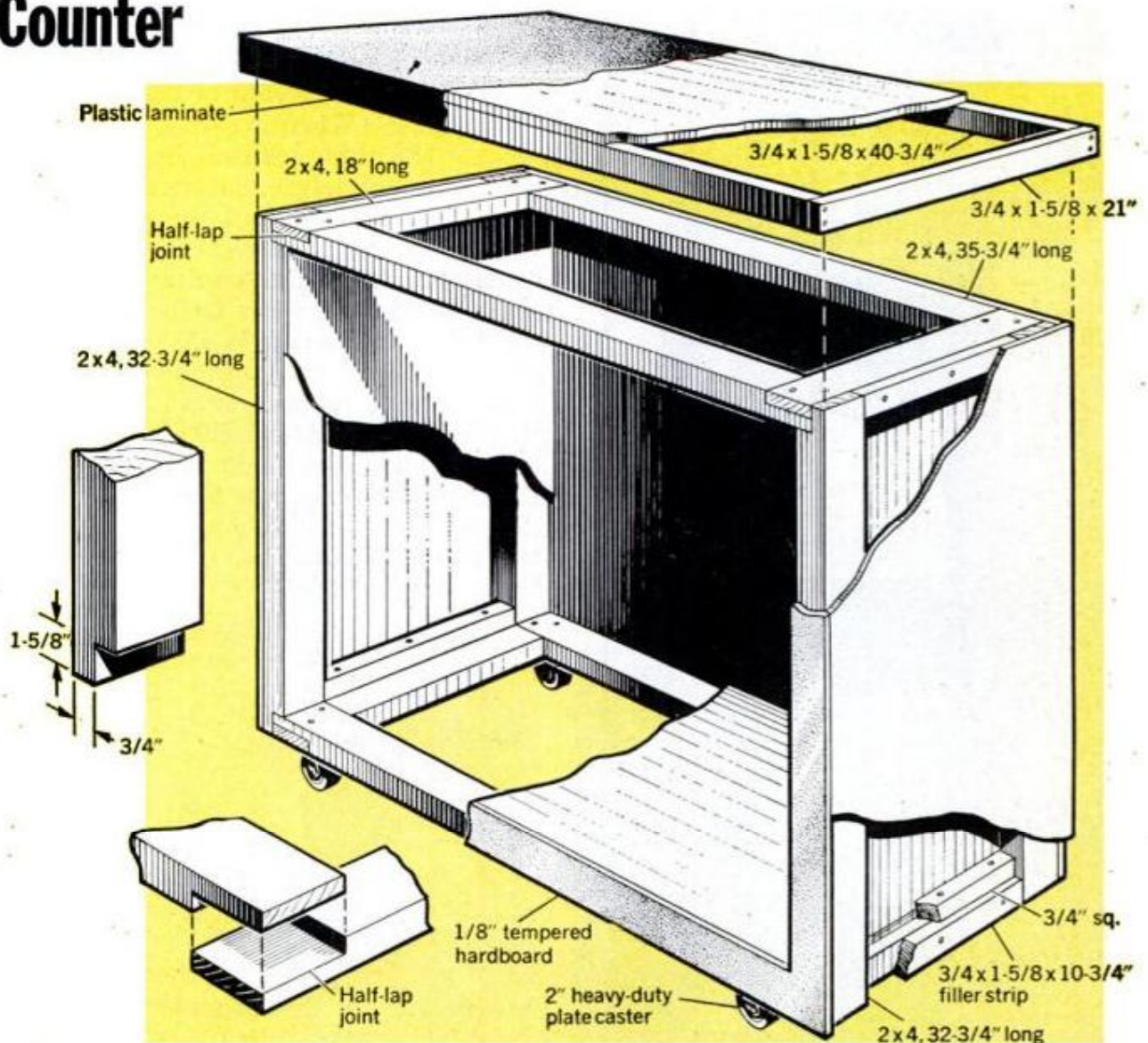
PILOT HOLES for screws are drilled up through base into legs; assembly is test-fitted before gluing



Design by Richard H. Harvey

SIMPLIFIED CONSTRUCTION techniques used on this project shouldn't lead you to believe that it's beneath your shop efforts. This practical laundry counter not only serves to keep soiled laundry sorted, the top can be used for folding clean clothes as well. Before starting actual construction, purchase the size and number of plastic wastebaskets that your family requires. The baskets, of course, determine the actual overall size. The version shown has a frame of 2x4-stock, lap-jointed and assembled with glue and nails. The frame is skinned with prefinished paneling but it can be of whatever 1/4-in. material you have on hand. For durability and ease of maintenance, make the top of 3/4-in. plywood and cover with plastic laminate. If you plan to use the rolling counter as a serving bar at parties in your finished basement, the exterior finish should blend with the party room rather than with the laundry.

Mobile Laundry Counter



Colonial-Style Sweetheart Chair

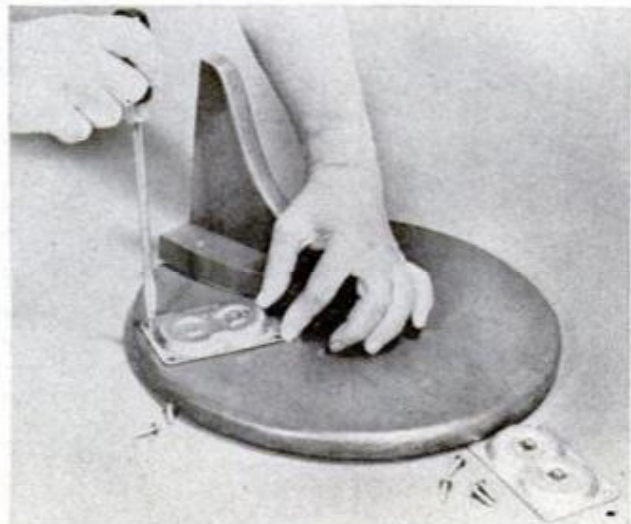
A QUICKIE PROJECT you can make using hand or power tools is this sweetheart chair, which gets its name from the heart-shaped cutout in its back. Our modification of the originals found in museums uses 16-in. factory-made legs and hardwood. Pine can be substituted, if desired.

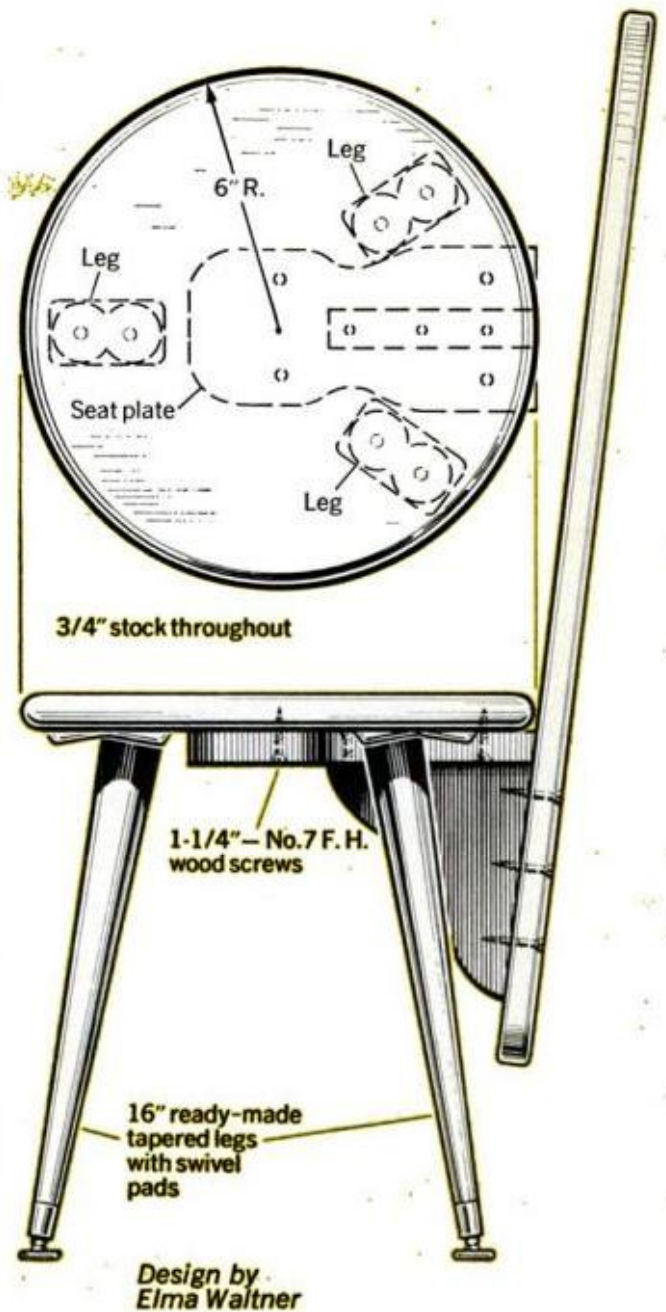
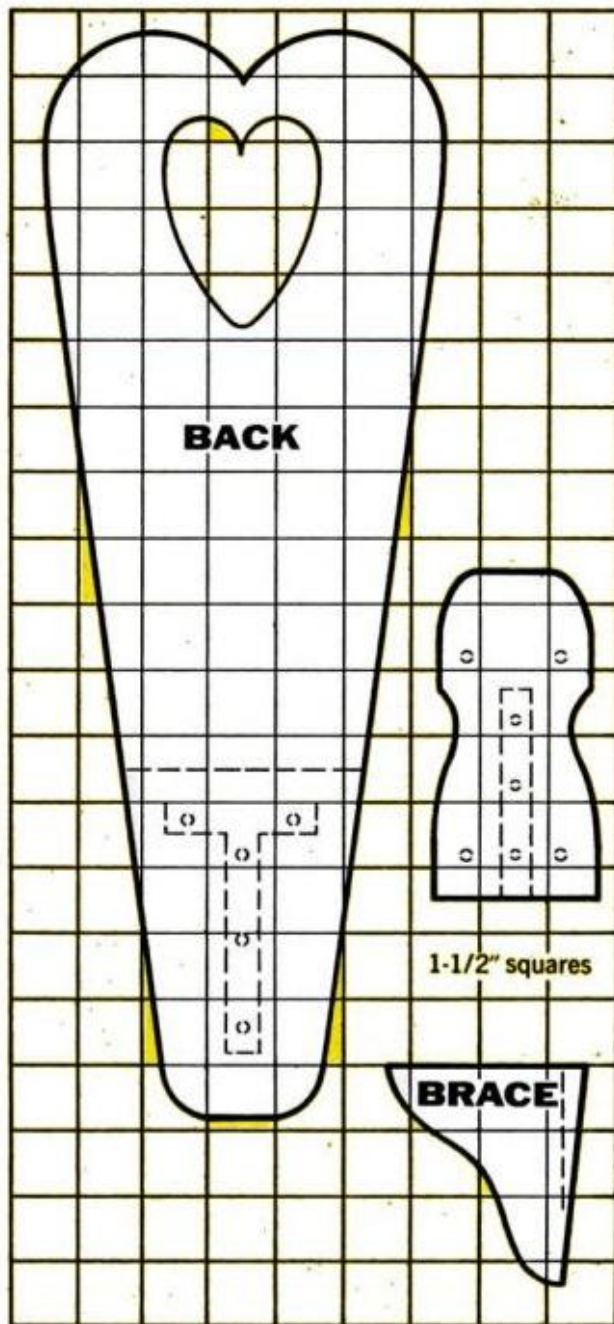
To start, make cardboard templates for all parts of the chair and cut them out. Next, round all parts except the seat-plate piece and the top and back of the brace pieces. Lacking power tools, you can do the rounding with rasp or sharp-pointed knife and finish up with sandpaper.

When you attach the leg mounting plates to the chair, center the front plate on the seat brace assembly. The remaining pair are mounted either side of, and butting, the assembly. After filling where needed, treat the chair with two coats of your favorite furniture finish. When it's dry, apply wax.

For the padded seat, choose a cushion fabric that harmonizes with the furnishings of the room where the chair will be used. Tell your wife to cut two 13-in.-dia. circles to make the cover. With right sides facing each other, the fabric is seamed $\frac{1}{4}$ in. deep, leaving about 4 in. unsewn. Pull the cushion cover right side out and stuff lightly with shredded foam. After stitching the opening shut, add two 12-in. sewing strips to the cushion to serve as ties. ★★★

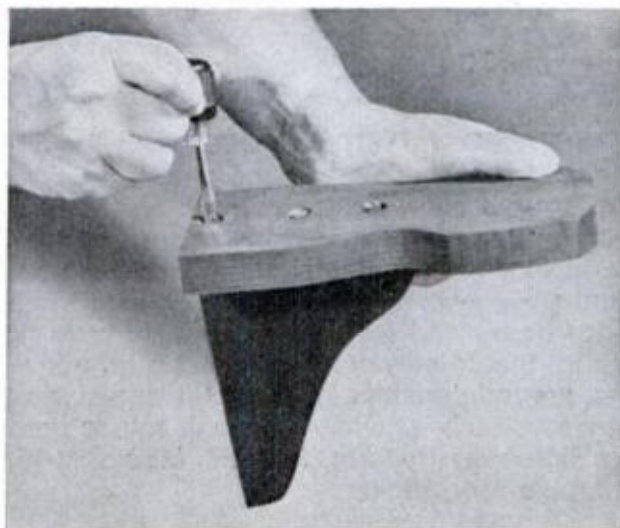
THE THREE LEG PLATES are screwed to the chair bottom even with edge. Use slant position for legs

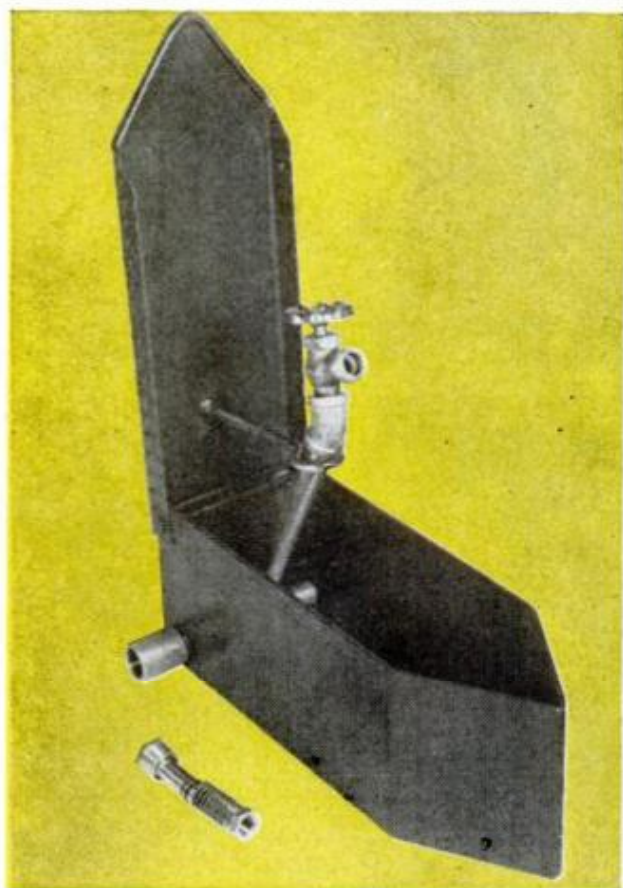




BRACE AND SEAT-PLATE are assembled with 1½-in. x No. 8 fh screws. Heads should be countersunk

BACK IS FASTENED to the seat-plate and brace with 1½-in. x No. 8 fh screws. Countersink the heads

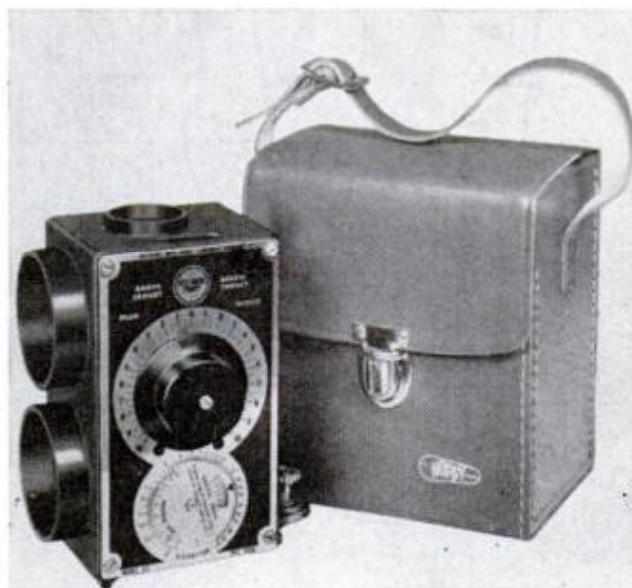




EXCITING NEW PRODUCTS

By CATHERINE BILSKI

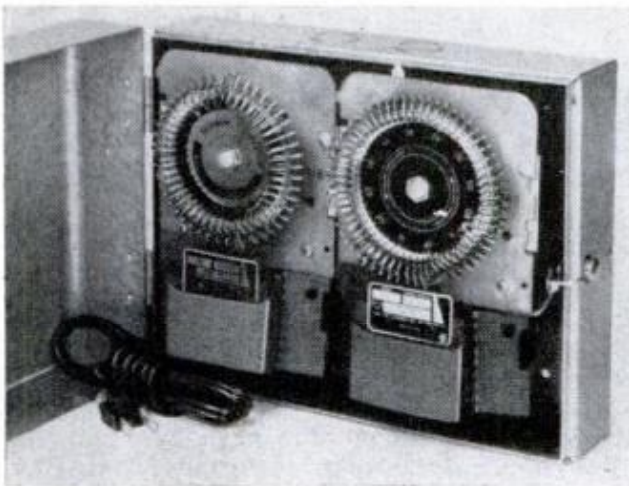
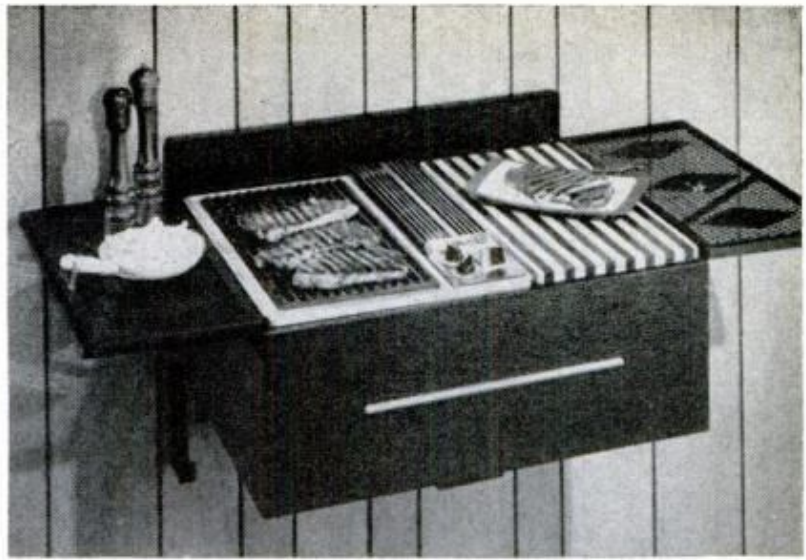
TRANSMIT RADIO SIGNALS to your furnace and airconditioner and get the exact temperature you want for any room in your house. Control unit shown at left is wireless and portable—just a flick of the dial gives you the temperature you want wherever you are. Easy to install, it operates on a 22½-v. power pack designed to last 18 months. Called Space-Temp 100, it sells for about \$90. Made by Kimco Laboratories, Inc., 5721-23 18th Ave., Brooklyn, N.Y. 11204.



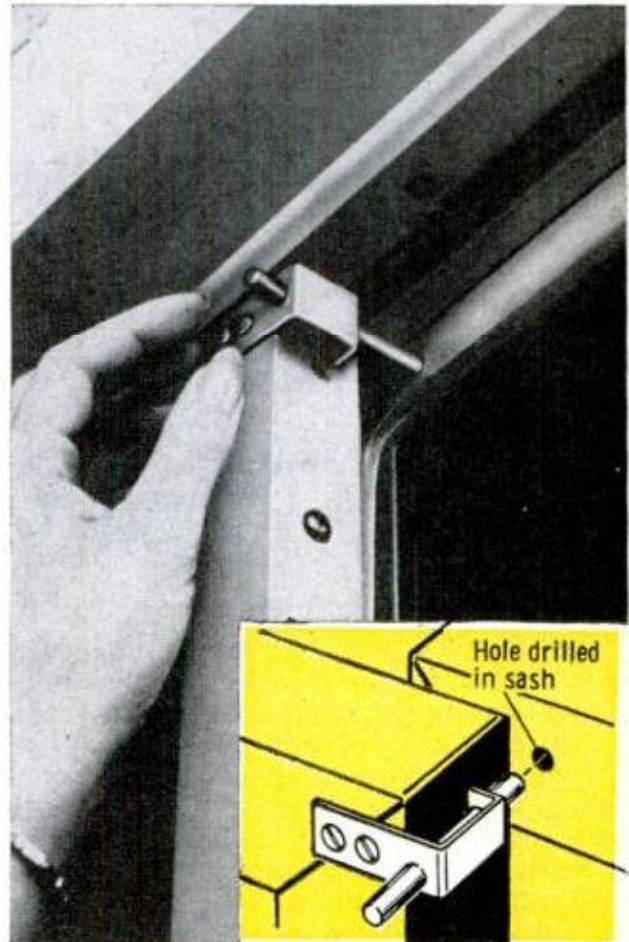
GETTING THINGS LEVEL can be quite a job, but the Split Image Transit (above) can be a great help to carpenters, land graders, farmers, bricklayers, builders—anyone whose work requires a level. Finely engineered to indicate level and measure inclines to a fraction of an inch, it also indicates how much correction is needed. Comes complete with handsome leatherette case. Sells for \$14.95 postpaid with money-back guarantee. Manufactured by Glen-Bel Enterprises, Route 5, Box 397, Crossville, Tenn.

CONCEALED OUTSIDE FAUCET can be installed in the middle of your yard. The Hide-A-Way Hydrant permits access to a faucet without disturbing flowerbeds or shrubs, does away with the usual unsightly faucet installation, gives a positive water control, eliminates extra hoses and lets you mow right over it. Lifting the lid elevates the faucet 6 in. above the ground, enables you to fill a watering can or attach a garden hose. Manufactured by Hide-Away Hydrant, Pickens, Miss. 39146, it retails for \$29.95.

BRING THE FUN and flavor of outdoor charbroiling indoors with a Shelv-A-Grill wall-suspended electric grill. It features a built-in ventilation system that eliminates smoke and odors. Available with either a single grill (which sells for \$2.31) or a twin grill (\$3.99), this compact unit includes a non-stick griddle and offers such accessories as a rotisserie, deep fryer and cutting board insert. It's ideal for installation wherever countertop space is limited. Jenn-Air Corp., 3035 Shadeland, Indianapolis, Ind. 46226, is the manufacturer.



SMALL GREENHOUSE owners can now benefit from automation with the Tork Time Control (above). The device features a mist propagation control that times infrequent intervals of mist or spray. No electrical installation is required; just plug it into an a.c. outlet. Available through electrical wholesalers or garden and nursery supply dealers, it's manufactured by Tork Time Controls, Inc., Mount Vernon, N.Y. 10551, and retails for \$69.



LOCK YOUR SLIDING DOORS and windows with Securlok (center, right). It's burglarproof, made of superstrong carbon-steel alloy, has a simple, positive operation and is easy to install with drill and screwdriver. Just close the door, mark position for Securlok, drill holes and mount. Priced at \$1 and manufactured by TC Industries, Inc., Box 71, Dayton, Ohio 45404.

AUTOMATIC TURN-OFF of any electrical appliance is assured with a Timed Extension Cord. Just plug it in and set the dial at a preset time interval (one minute to four hours). When time expires, switch turns off appliance. Handy for any home and ideal for radios, lights, fans, airconditioners, it's priced at \$8.55 postpaid from James House, 1714 Que St. N.W., Washington, D.C. 20009.

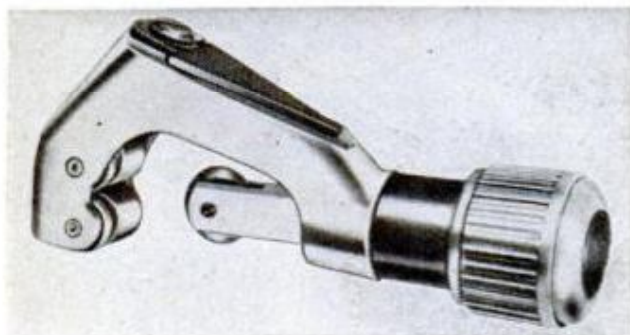


New tools you should know about



Low-priced circular saw

General-purpose circular saw introduced by the Black & Decker Manufacturing Co. is powered by a custom-built 1- $\frac{1}{2}$ -hp motor that drives the blade through cuts up to 2- $\frac{3}{8}$ in. deep. Priced under \$50, model No. 3009 7 $\frac{1}{4}$ -in. Saw-cat features a heavy-gauge, wraparound steel shoe that gives adequate support for any angle cut. Designed for safety, the unit's handle, trigger, switch and control knobs are fully insulated. It also boasts a big lift lever that permits the operator to lift the lower guard safely for plunge cuts.

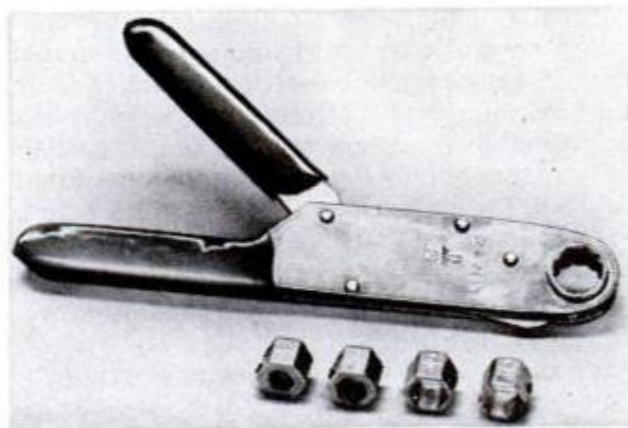


Easy action tube cutter

Designed to cut hard or soft copper, aluminum, brass, thinwall steel and other tubing, tube cutter 274-FC can be used for clean right-angle cuts on $\frac{1}{8}$ to 1- $\frac{1}{8}$ -in. O.D. tubing. Featuring a ball-bearing feed mechanism, steel feed bar and a wide cutting wheel, the tool cuts quickly and accurately. Imperial-Eastman, 6300 West Howard St., Chicago, Ill. 60648, makes it.

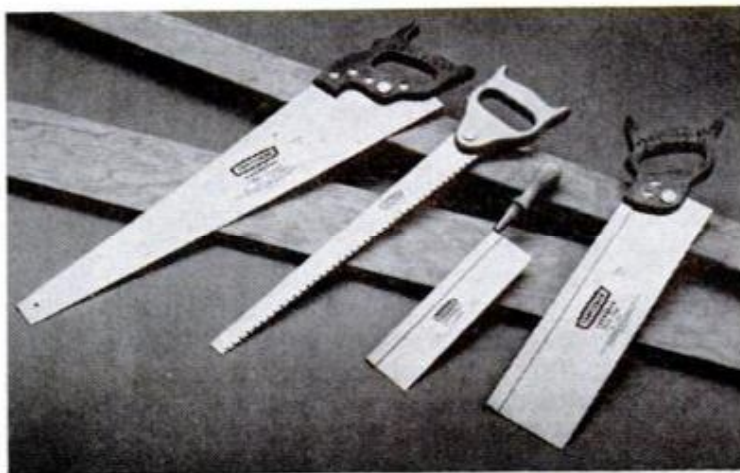
Squeeze-action ratchet-wrench

Designed for jobs in those hard-to-reach spots, this $\frac{1}{2}$ -in. box wrench comes complete with 12 inserts ranging from $\frac{1}{4}$ to $\frac{3}{8}$ in. and 6 mm to 11 mm. In tight places, turning is accomplished simply by squeezing the spring-loaded scissor-type handle. Where there is more room, this tool can be operated like a conventional ratchet box-wrench. For reverse action, the tool is turned over. At hardware and department stores, retail price is \$12.95. Made by the Jay-Thomas Co., 117 West Oxford St., Dept. PM-c Chula Vista, Calif. 92011.



Saws with chromed teeth

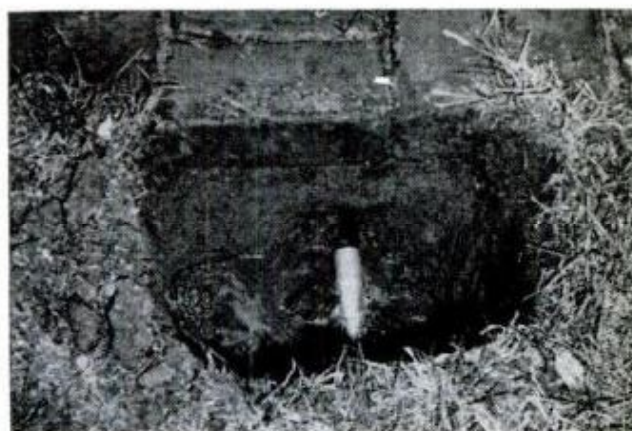
Latest model handsaws included in the Sears, Roebuck & Co. 1969 fall catalog are these models which feature chrome-coated cutting edges. Sears claims that the new, hard surface will resist rust, gum and pitch buildup and that it will stay sharp up to five times longer than that of an ordinary handsaw. Craftsman models shown—(from left) crosscut, double-edge pruner, dovetail and miter—available now at Sears retail stores or by catalog order.



Fast Way to Put Pipe Under Walks and Driveways



PLACED IN TRENCH, pipe (left), is forced through soil under walk using water pressure (above). Placement is completed (below) and nozzle is removed



Now you can put a pipe under a driveway or sidewalk as easily as you would sink a ground rod by using water pressure. That's the claim made for Plant-A-Pipe by the maker, Brite-Lite Enterprises, Inc., R.R. 2, Springfield, Ill. 62707. To do it, you simply attach the nozzle to one end of the pipe to be laid and a garden-hose adapter (which comes with the tool) to the other end to receive the garden hose. Designed to operate under normal house water pressure, the five orifices in the nozzle are shaped to minimize the chance of clogging by sand particles. The high-pressure water created and an easy back-and-forth manual motion allow you to bore the pipe through the earth quickly and easily. Available to fit three pipe sizes— $\frac{1}{2}$, $\frac{3}{4}$ and 1 in.—each nozzle and adapter set is priced at \$20. All three sizes are offered for \$50 if ordered at the same time.

Concealed nailing beautifies siding

Prefinished siding offers concealed nailing application without the aid of adhesives, splines or slots. Called Gold Bond Prefinished Woodrock, it features a high-quality acrylic coating baked on at the factory. The applicator can drive nails through the siding $1\frac{1}{2}$ in. from the top without danger of splitting it. The board above overlaps and conceals the nailhead. Highly resistant to mildew, Woodrock combines long-lasting cement and specially processed cellulose and mineral fibers to make it as noncombustible as masonry-type siding. National Gypsum Co., 325 Delaware Ave., Buffalo, N.Y. 14202.

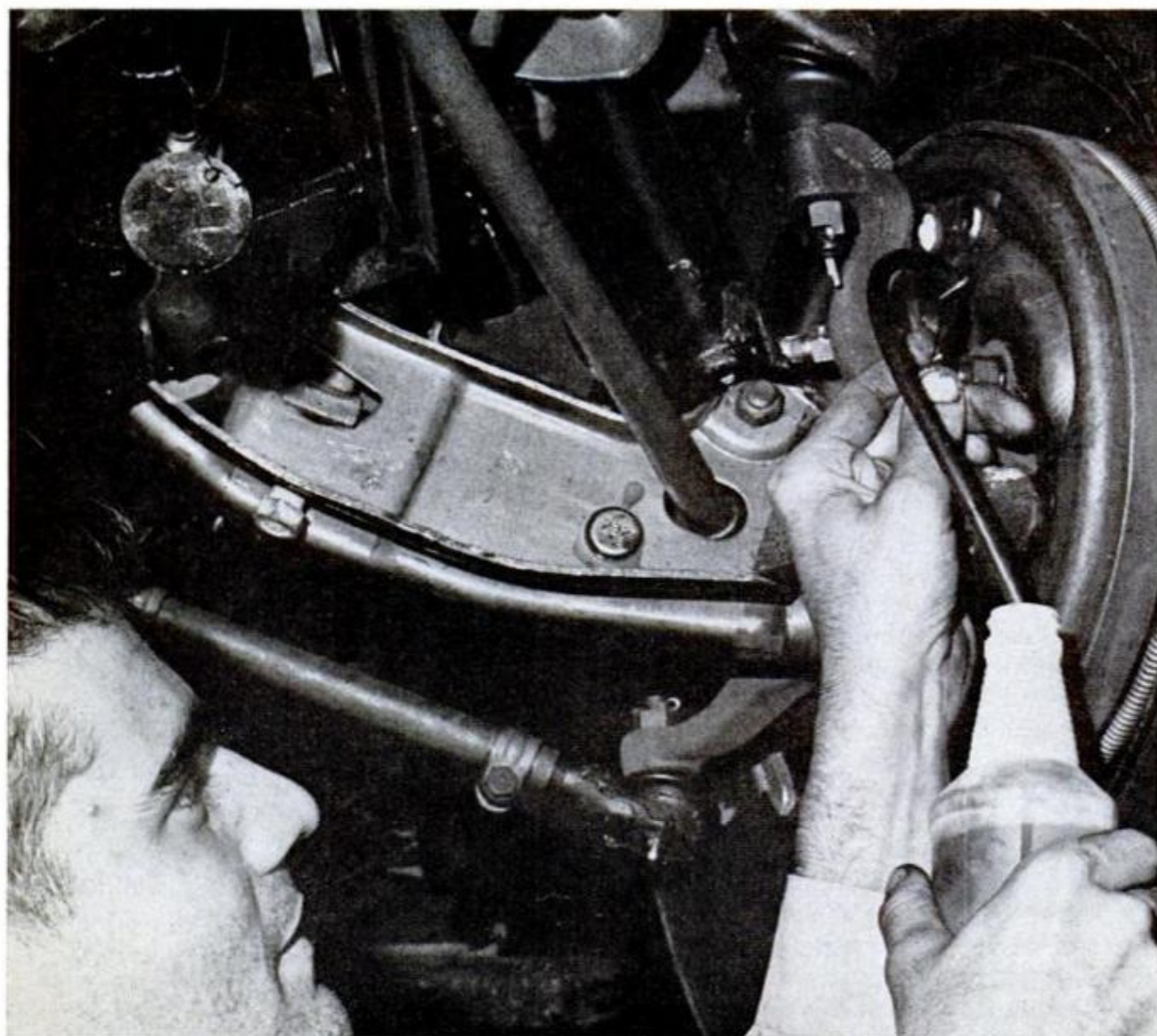


HOW TO DO A COMPLETE BRAKE SYSTEM CHECKOUT

An easy inspection and quick road test should reveal existing or potential problems and point to the cure

By MORT SCHULTZ

AIR IN HYDRAULIC SYSTEM bubbles out through fluid in container. Close bleed screw when bubbling stops



ONE OF THE MOST important things you can do for your car's brake system (and for yourself) is to conduct a thorough brake inspection every 10,000 miles.

It enables you to catch and fix a minor problem before it becomes a major safety hazard, and it can save you money by revealing if a problem is being caused by a relatively insignificant condition.

Brake inspection is done in two parts: an in-the-driveway check and a road test. The trouble these tests uncover will often have more than one cause. For example, there are four major reasons why a brake pedal will feel spongy, ranging in severity from air in the hydraulic system that has to be bled (easy enough) to drums that are worn too thin and have to be replaced (easy, but expensive). In tackling the problem, proceed from the easiest to the most difficult and/or more expensive. The chart at the end of this article provides a handy brake-diagnosis list which matches

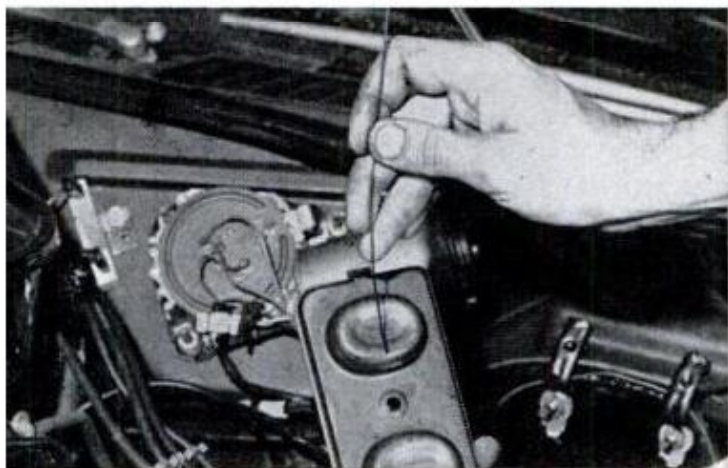
conditions with probable causes. The how-to for problems that require extensive work and time will be explained in next month's *Saturday Mechanic*.

In-the-driveway inspection. Apply heavy foot pressure to the brake pedal (idle the engine if you have a power brake). The pedal should feel firm, not spongy.

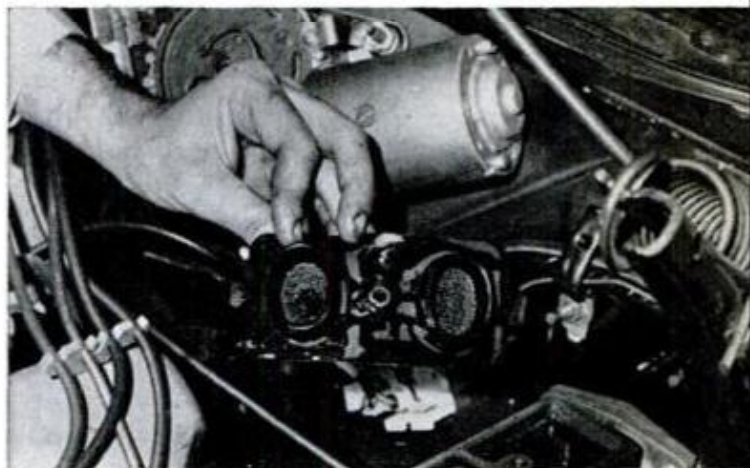
If it's spongy, make sure the vent hole in the master cylinder cover is not clogged. There are two holes in the cover of a dual-brake master cylinder. This cylinder has two outlets (one feeding the front, the other the rear), two fluid reservoirs and two hydraulic pistons which operate in tandem by a single push rod.

The usual cause of a spongy brake pedal is air trapped in the hydraulic system. Bleeding gets rid of this. Air can enter when the fluid level becomes low or if a brake part has been disconnected and then reinstalled.

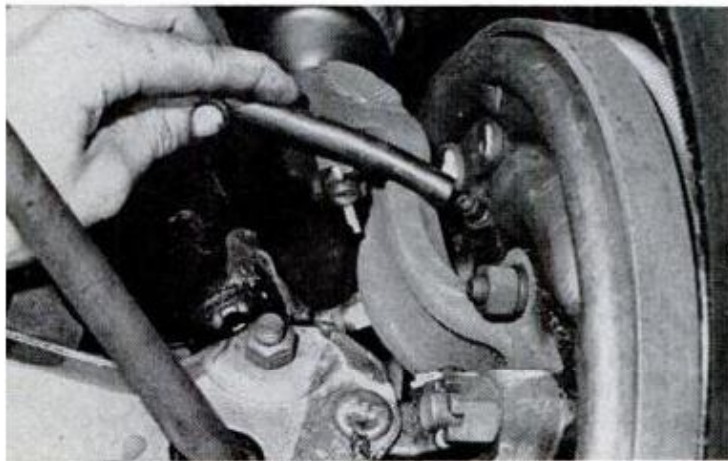
A bleed screw is provided at each wheel cylinder. The order in which wheel cylin-



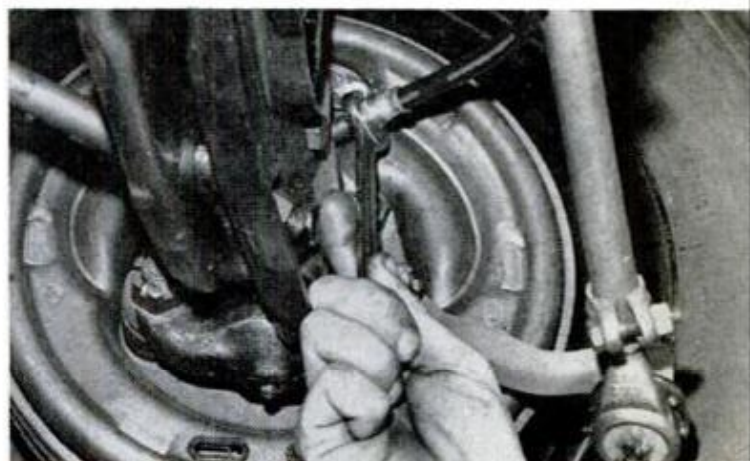
MASTER CYLINDER on newer cars with dual brake system has two reservoir covers. Make sure that vent holes are clear and be careful not to enlarge them



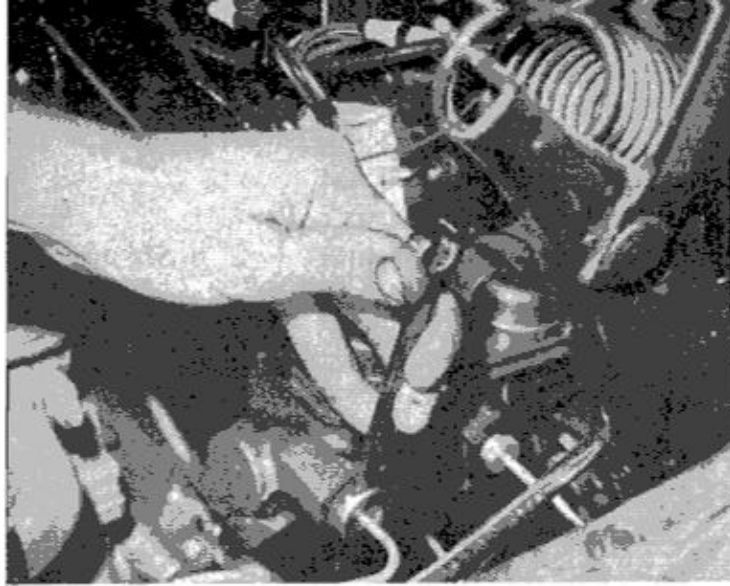
FLUID RESERVOIR of a dual master cylinder is covered by a diaphragm which is marked "fluid side" and "cover side." Be sure it is installed properly



PIECE OF HOSE about a foot and a half long should be kept as a bleeder hose for the hydraulic system. Just make sure it fits the bleed screw tightly.



RUBBER BRAKE HOSES should be inspected for tightness. Keep clean, check for softness, cuts, cracks or obvious leaks. Keep them clear of moving parts



CHECK CONNECTIONS at the master cylinder. Use a wrench to check for tightness. Look for any indications of leaks, inspect routing of hydraulic lines

ders are bled is of little importance, but be sure that you hit all four of them.

Before you bleed a power brake system, purge the vacuum by depressing and releasing the brake pedal five or six times with the engine off.

Here are the steps to follow in bleeding a hydraulic brake system:

1. If necessary, fill the master-cylinder fluid reservoir (both reservoirs if a dual system) with clean, good-quality brake fluid. After bleeding each cylinder, recheck the reservoir and replenish fluid if necessary. Keep the fluid level to within $\frac{1}{4}$ to $\frac{1}{2}$ in. of the top of the reservoir.

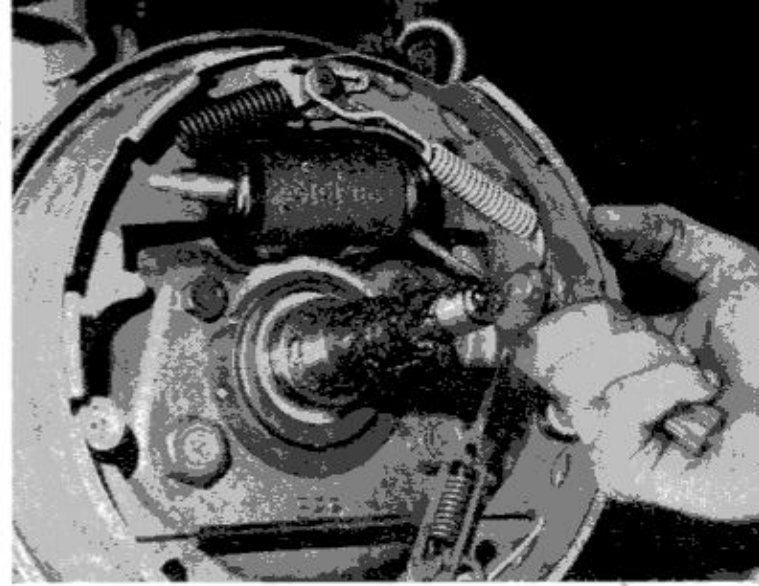
2. Attach the bleeder hose to the wheel-cylinder bleed screw. Use a piece of vacuum hose about 18 in. long. Submerge the other end into a container partially filled with hydraulic brake fluid. Glass or clear plastic is the best container to use since it's easy to see through.

3. Apply steady pressure to the brake pedal and open the bleed screw about $\frac{3}{4}$ turn. Pressure must be maintained until the screw is closed. When the fluid coming out of the hose stops bubbling, close the bleed screw. Repeat the procedure at other wheels.

Discard fluid that's been drained from the system. After the bleeding operation has been completed, make sure the fluid in the master cylinder is to level.

Another cause of a spongy brake is a soft or weak brake hose that expands under pressure. Feel hoses. They should be firm. If not, replace.

After checking for a spongy brake pedal, observe pedal reserve. If the pedal is low, brakes probably need adjusting.



WHEEL CYLINDERS that spring a leak ooze fluid onto the brake linings, ruining them. Always pull back both boots on the cylinders when you inspect them

Brakes in cars built since the early 1960s are self-adjusting. Make several forward and reverse stops. Be sure to make a complete stop after every forward and reverse movement. The pedal should come up. If not, the linings are probably too badly worn to be adjusted or there's another problem, such as the self-adjusting mechanism itself being in bad shape.

Now check for leaks in the hydraulic system by holding your foot lightly on the brake pedal for 15 seconds. There should be no pedal movement. Repeat the test, but this time use heavy foot pressure. Again, the pedal should not fall away. If the car has power brakes, repeat this procedure with the engine running.

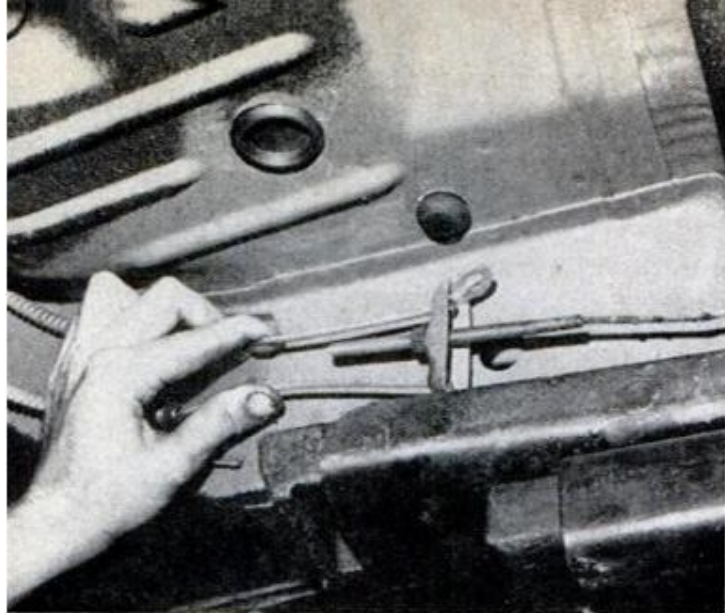
If the brake pedal gives way and heads toward the floor, there's a leak somewhere. Inspect the master cylinder first. Look for fluid around connections. See that they are tight.

Check all brake lines and hoses from the master cylinder to each wheel to see if there is a leak. If fluid is leaking from a connection, try to tighten it before replacing the hose. Make sure hoses and lines are free of dents, cracks and cuts.

Wheel cylinders can also leak. You'll have to pull the wheels to check them. Pull back both boots of each cylinder. If fluid leaks, the cylinder must be rebuilt.

If hoses, lines and wheel cylinders show no leaking, the reason for the fading brake pedal is damage inside the master cylinder. Fluid may be leaking from around a secondary cup into the boot where you can't see it, although you may be able to detect the odor inside the car.

It's not economically practical or 100-



PARKING BRAKE CABLE should be checked for a fair amount of play. Check out operation of hand lever and cable to ensure that there's no drag on brakes

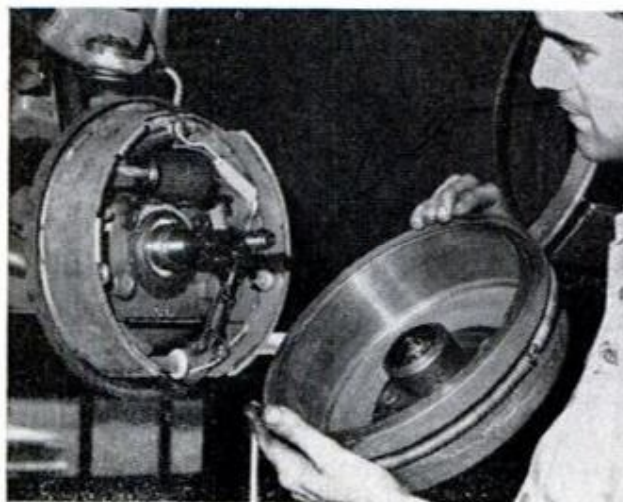
percent safe to rebuild a master cylinder, especially the newer dual type. In addition to the work involved, the kit needed for rebuilding adds up close to the \$20 or so you'd have to spend for a new cylinder. Wheel cylinders are something else. It pays to rebuild these yourself (we'll explain how next month).

Continue your driveway brake inspection by putting the car on jacks or on a lift (if you can get your local gas-station operator to let you borrow his for a few minutes). If you jack the car, test the front wheels; then the rear. Release the parking brake and make sure each wheel spins freely without drag.

Now, put light pressure on the brake pedal as you again turn wheels by hand. You should feel the same degree of drag from each wheel.

If wheels don't revolve properly during

BRAKE LININGS can be checked by pulling just one front wheel. Front brakes get more wear than the rear, and wear should be about same on left or right



this test, it usually means there's an inside problem involving linings or cylinders. However, if only the rear brakes are dragging, perhaps the parking brake is adjusted too tightly or is hung up. Release the lever. The cable should have some play. If not, adjust or lubricate, depending on the problem.

Finally, pull one of the front wheels and inspect brake linings. New linings are generally $\frac{3}{16}$ in. thick. Used linings should be no less than $\frac{1}{16}$ in. thick at the thinnest point. If you can't judge, use a gauge. If linings of one wheel are worn, replace linings on all wheels.

Road testing. Putting a brake through its paces on the road tells you how it's working under actual operating conditions. Tests should be conducted on a dry, clean, reasonably smooth and level road.

Be careful not to induce brake fade by overapplying brakes during tests. Heat causes fading, so if it should occur allow brakes to cool down for 10 minutes before proceeding.

Make the first test at 10 to 15 mph. Make several stops, alternating between light and medium-pedal applications. Bring the car to a complete stop each time.

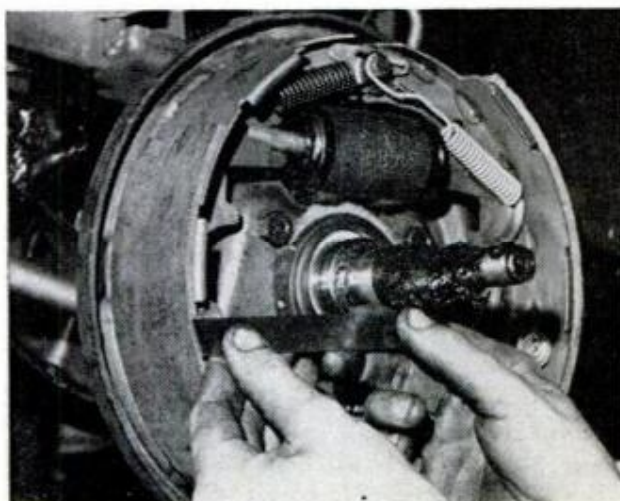
Notice the effort needed to make each stop. Do brakes grab? Does the car pull? Is too much effort needed to stop it? If so, a problem probably exists with the linings, master or wheel cylinder(s), or the drums.

If the car pulls, before doing anything else, however, make sure that tires are properly inflated. Uneven tread wear could also cause pulling.

Be aware that conditions other than

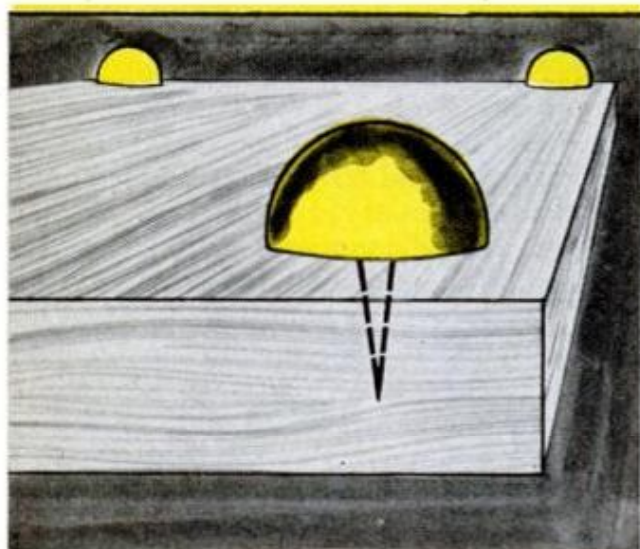
(Please turn to page 218)

AMOUNT OF LINING remaining is best checked with a gauge. Measure at thinnest point. If amount is less than $\frac{1}{16}$ inch, replace the linings on all four wheels

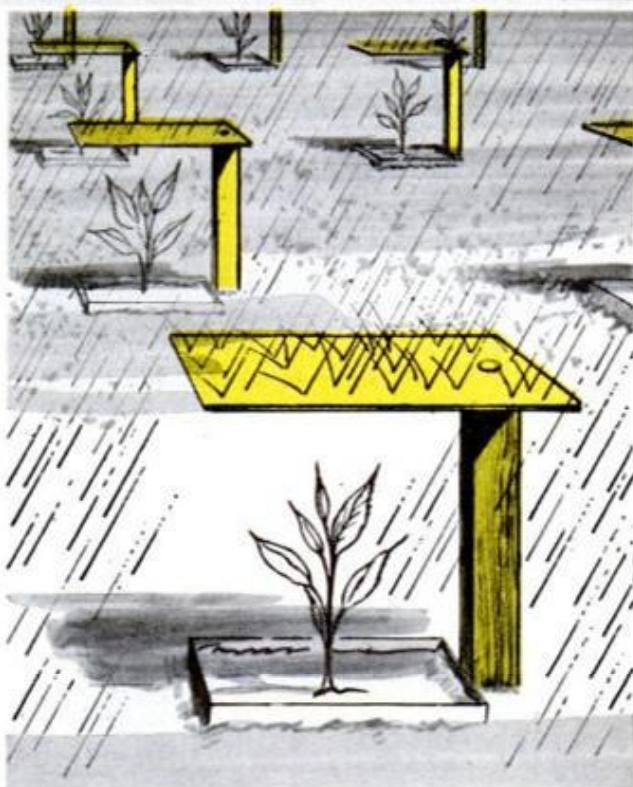




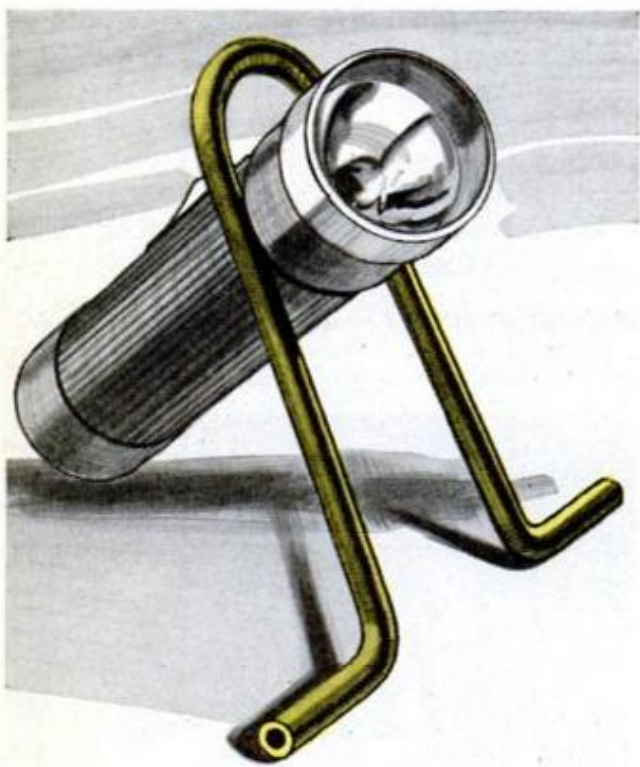
SOLVING



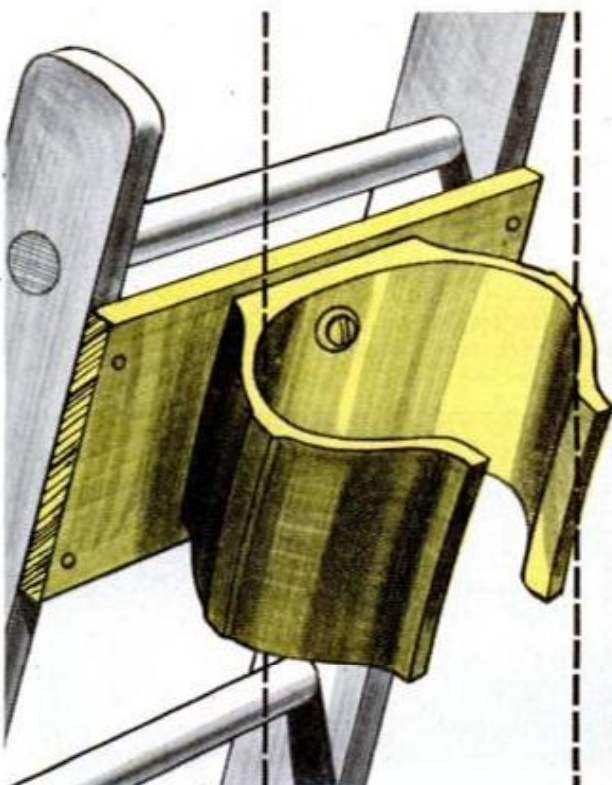
TO PREVENT A CUTTING BOARD from slipping about when in use, I fastened four rubber-head nails to the board's underside. I used the low-cost type that are sold for installation on toilet seats.—*Ken Patterson*



TO PROTECT YOUNG TOMATO PLANTS from heavy downpours or hail, I provide each seedling with a swingaround "hat"—a thin board fastened with a nail to a stake driven beside the plant.—*Annette Thompson*



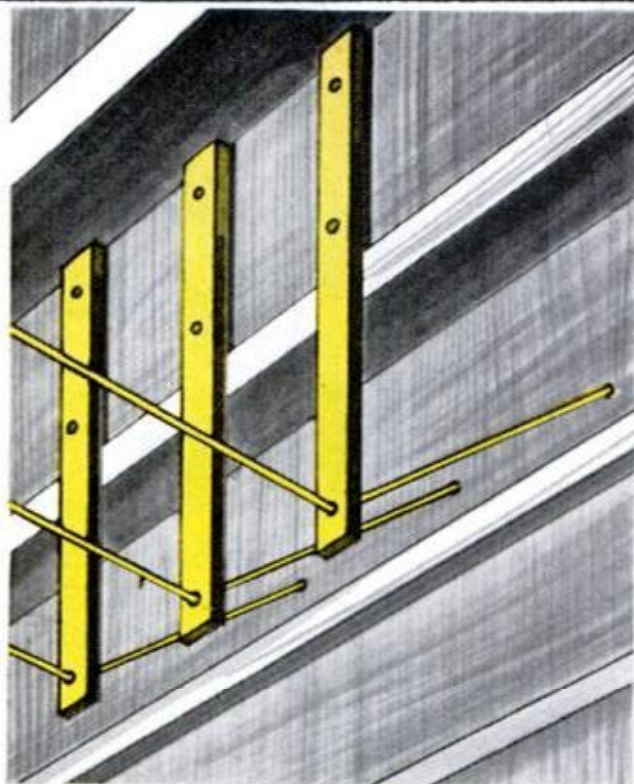
TIRE-CHANGING AT NIGHT, when there's no one to hold the flashlight, can be a lot easier with this simple light holder. It's improvised from a coat-hanger that's covered with rubber tubing.—*Ken Meade*



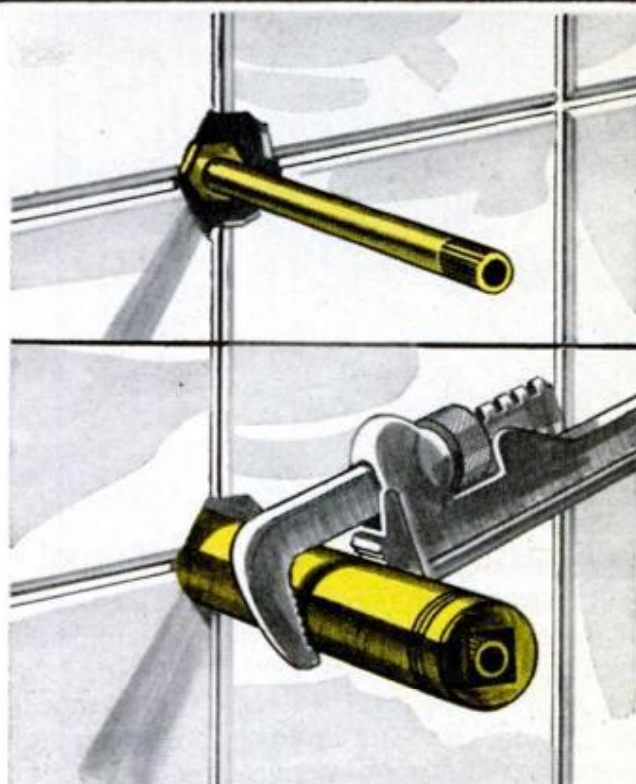
SECTION OF AN OLD TIRE CASING attached to a ladder serves as a collar and permits you to rest the ladder against odd-shaped structures such as a pole, tree or any other narrow upright.—*Wilfred Beaver*

HOME PROBLEMS

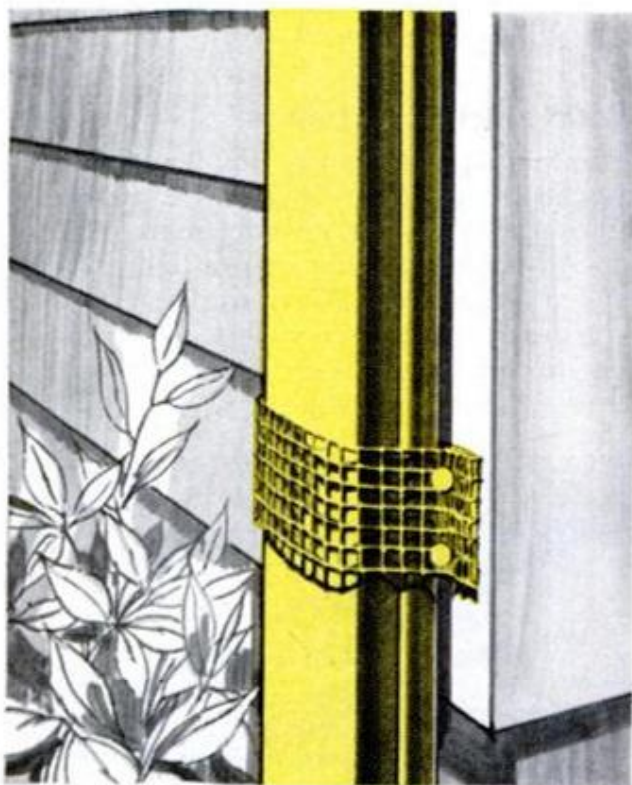
Illustrations by Adolph Brotman, Worman Associates



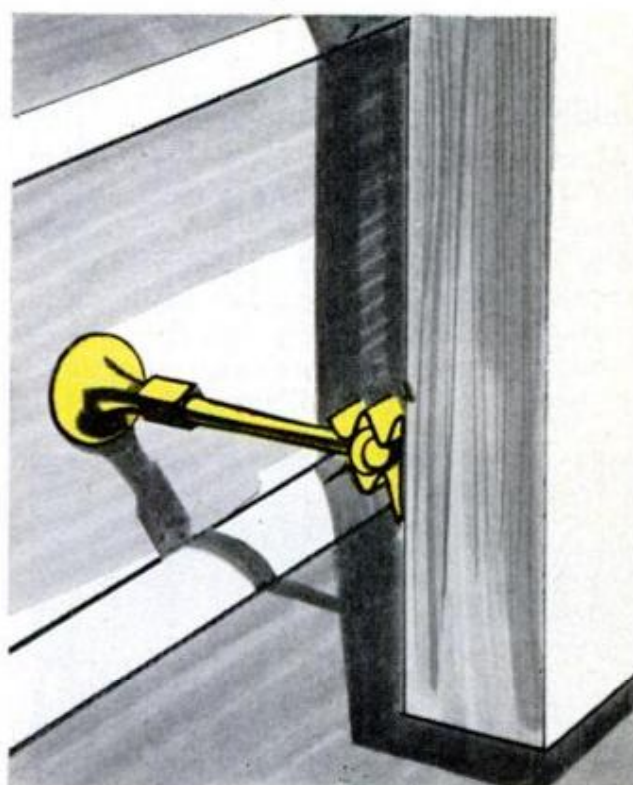
TO KEEP BASEMENT CLOTHESLINE from sagging without using brace-poles, try this trick. Simply nail 1x2s to the joists and thread line through. At end, pass line through the joist and tie knot.—*R. S. Tupper*



FAUCET FITTINGS BEHIND CERAMIC TILE in a bathroom are just about inaccessible with conventional wrenches. To replace washers, I use a deep-throated sparkplug socket wrench. It works fine.—*John Dinges*



WHEN DOING SOME SPRING CLEANUP, I came across a downspout that needed fastening. Since I lacked a conventional strap, I secured the loose pipe with a small piece of hardware cloth.—*Walter E. Burton*



TO HOLD DOORS OPEN, here's an inexpensive solution. Merely remove the rubber bumper from the door stop and mount a broom-holder clip on the door in position to receive the doorstop.—*David A. Graef*

HINTS

FROM READERS



Drilling to punch mark

One way to make a drill bit start precisely in a punch mark is to support the workpiece so that it can be shifted easily in any direction. The photo above shows a setup using two pairs of rollers about $\frac{1}{8}$ in. in dia. and long enough to provide adequate support for the workpiece.

—Walter E. Burton



Spillproof bit storage

Tired of chasing down various bits and burrs every time that I had a use for them, I hit upon the following idea. I turned a solid block of wood so that an aerosol spray-can top would turn on with a force-fit. Then, I simply drilled holes in the base to hold the bits in spillproof fashion.—Jay Wallace

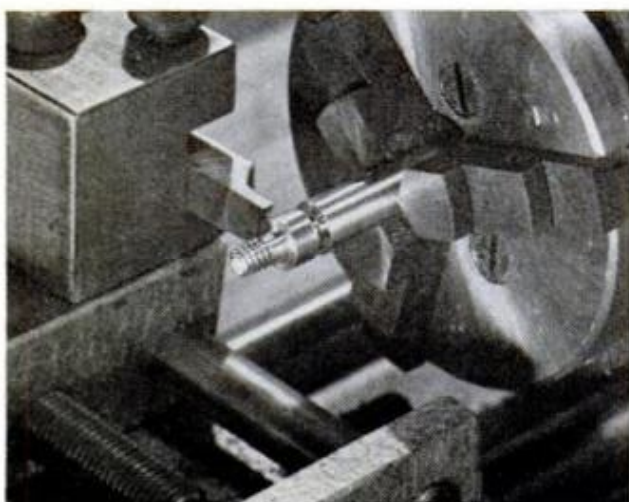


Foam strip blows chips

If you cut Styrofoam to form a strip resembling two wedges (base-to-base) and slip it over a drill bit, it serves as a fan to blow wood or metal chips from the surface being drilled and keep layout marks visible. Fan shown is about $\frac{1}{2} \times \frac{3}{4} \times 2\frac{1}{4}$ in., thick enough for the bit to be screwed through it.

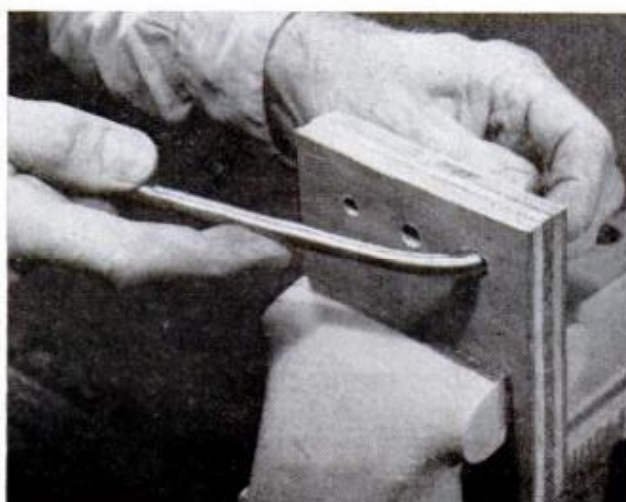
Welding rod for lathe work

Uncoated ferrous or nonferrous welding rods (or remnants) are a logical choice when picking small-diameter stock for lathe work. Rods with satisfactory machining properties can be made into screws, pins and other parts. Since machining properties vary, determine them by trial and error.—Walter E. Burton



Wood-block tube bender

So simple that you'll wonder why you haven't thought of this before, here's a tube-bender that is nothing more than a block of wood having one or more holes drilled through it. Wood can be fir, plywood or a tough-type such as birch, walnut or oak. Here, $\frac{3}{8}$ -in. copper tubing is bent—without kinking—in plywood block.



ADD AN ALUMINUM HAMMER TO YOUR TOOL RACK

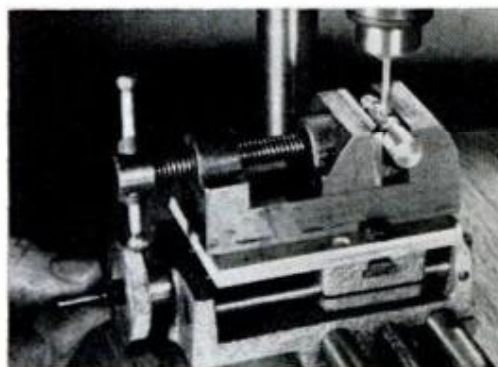
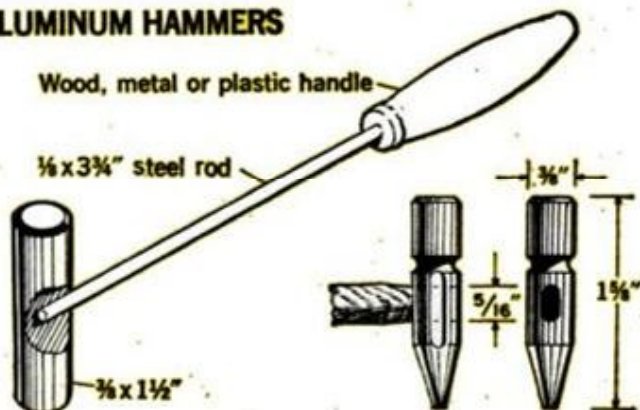
FREQUENTLY, there's a need in the shop for a hammer that can be used to tap softly to avoid denting or other damage. Using surplus aluminum and other scrap parts that you probably already have in your shop junkbox, you can easily fashion your own on a small lathe.

For example, the top hammer shown above was made from a piece of $\frac{3}{8}$ -in. aluminum rod (part of an aluminum bolt) into which a length of stiff wire equipped with a wooden grip salvaged from an old percolator cleaning brush was fitted to serve as a handle. Its shape is suitable for a wide variety of tappings and its size, of course, can be varied.

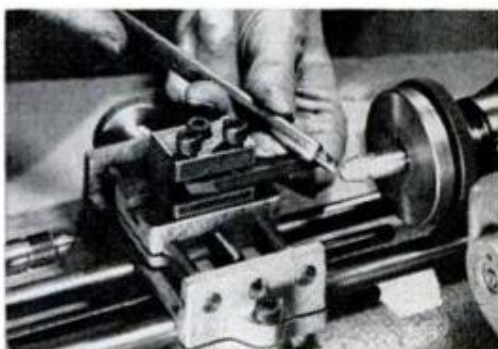
You can use conventional steel hammers as patterns or, you can shape the head to suit a special hammering need. For example, a long slender tip will reach deep into the innards of a mechanism from which you want to extract a stubborn pin or bolt. With continued use, you'll find that the business end of an aluminum hammer tends to pit and, in some cases, distort. In that event, a few quick passes with a file will restore the head.

—Walter E. Burton

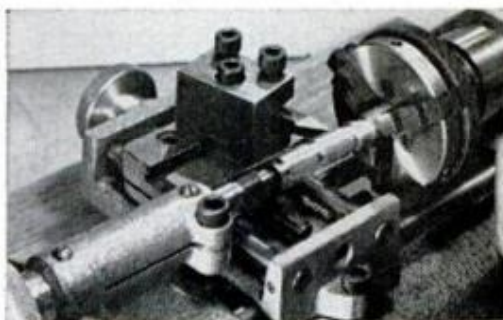
ALUMINUM HAMMERS



TYPICAL SETUP for roughing out aluminum hammerhead on a small lathe



HAND TURNING is often the easiest way to turn aluminum, if you use sharp tools



OVAL EYE is milled in the hammerhead. Use similar setup to make flat surfaces

Ornamental Scrollwork You Can Do at Home

Whether you want to build something 'way out' or to create a practical item, these three new tools will let you turn out professional-looking metal products

By JOHN BURROUGHS

BY HAMMERING STRAP IRON into S and C-shaped scrolls on the horn of an anvil, and then riveting the scrolls together, old-time blacksmiths could make anything from candlesticks to porch railings from wrought iron. The three unusual looking tools shown on the bottom of the facing page let you accomplish much the same sort of work (shown above) using a lot less effort than the blacksmiths did; you'll turn out ornamental metal scrollwork without lifting a hammer.

The scroll plate is a jig for bending the ends of strips of mild steel into uniform curls. The punch makes the necessary holes in the strips for riveting with $\frac{1}{8}$ -in.-dia. rivets. The riveting-forming tool sets rivets, rolls metal strip into circles or curves and makes neat right-angle bends.

Imported from England, the three tools are designed to work $\frac{1}{2}$ -in. wide low-carbon steel strip .065 in. thick, which

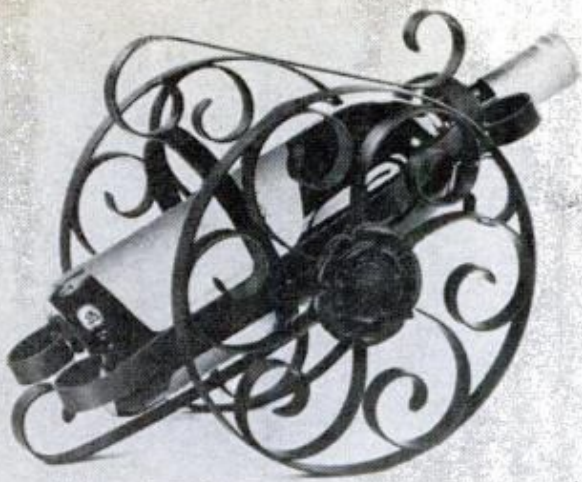


Candlestick

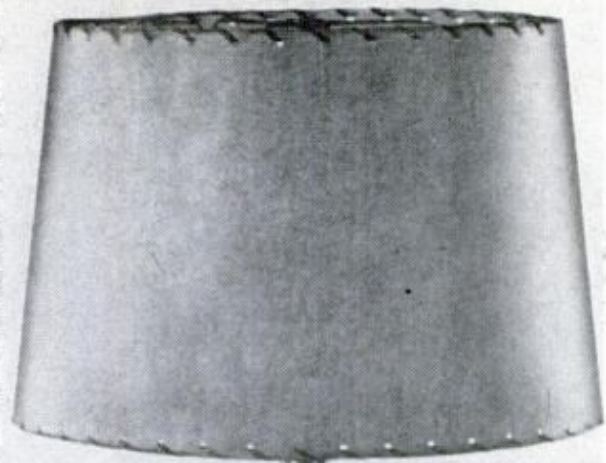
is dead-soft and easy to bend. Strips 3 ft. long, smooth-finished with rounded edges, are available from the importer for 37 cents per length, or you can use similar material obtained locally. The scroll plate and forming tool will also bend copper-plated mild-steel welding rod which you can get at welding supply houses by the pound. Scrolls bent from welding rod can be assembled by silver soldering.

All three tools are cleverly designed, ruggedly built and (like so many English tools) painted fire-engine red. Since they produce commercial-quality work, they're great for school shops or youth craft groups as well as for home-shop use. Handicapped workers can use all three without difficulty.

Making and riveting scrolls is really so easy that the biggest part of any scrollwork project is in the design of the piece. You can first work out sketches or simply



Wine bottle carrier



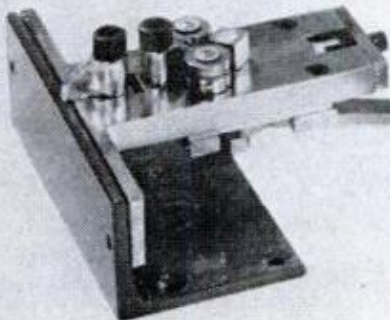
Lamp base



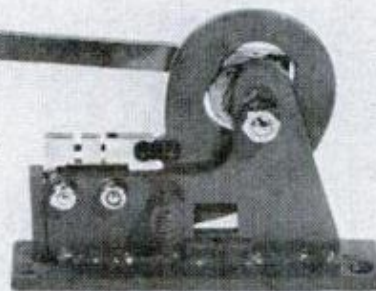
Book rack

TOOLS FOR MAKING SCROLLWORK

RIVETING-FORMING TOOL



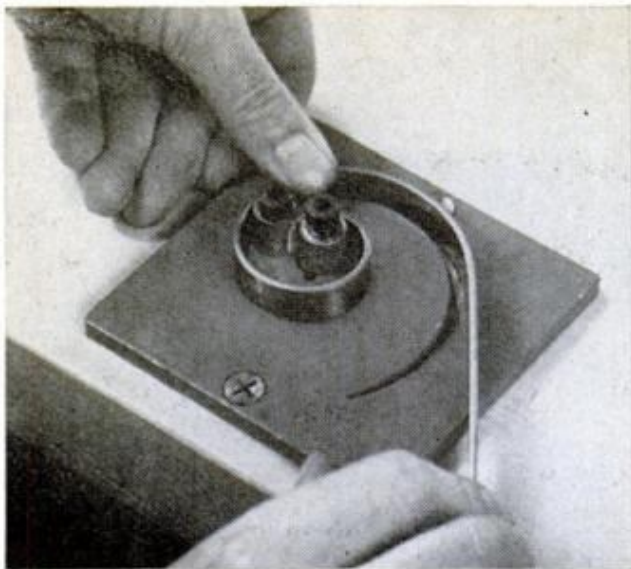
PUNCH



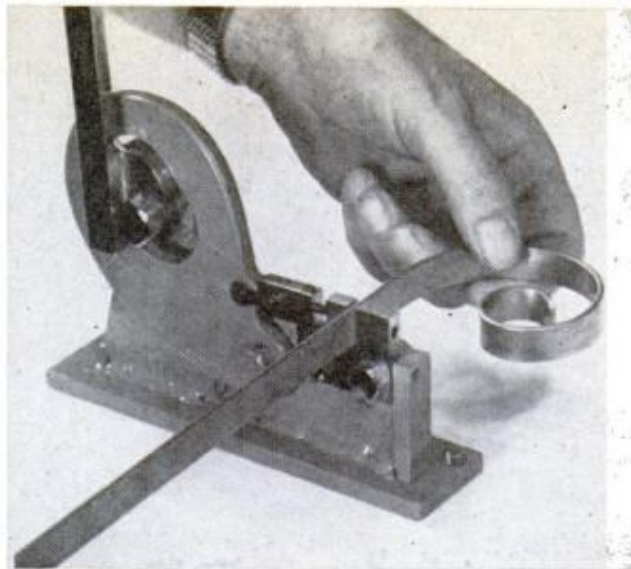
SCROLL PLATE



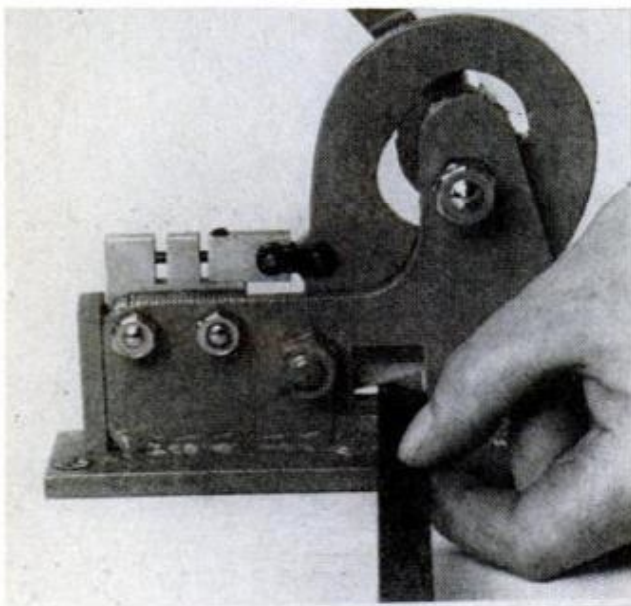
SCROLLWORK TOOLSET consists of these three basic components. Text tells where they can be purchased
MARCH 1970



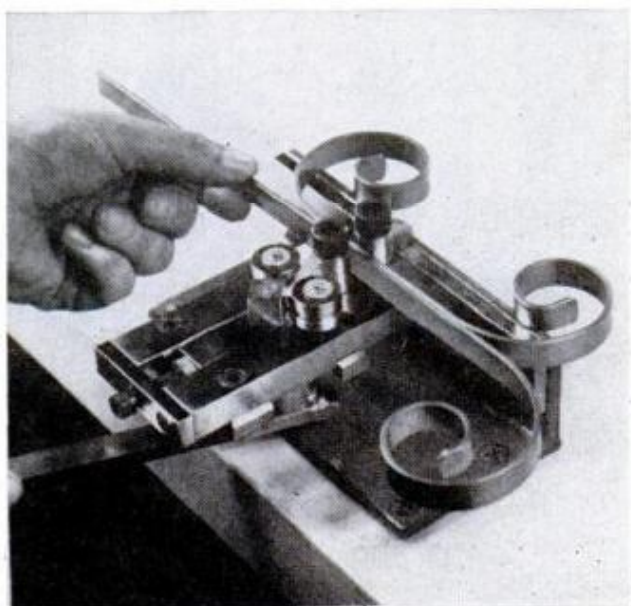
TO BEND MATCHING SCROLLS, end is gripped by studs, strip is wrapped around plate's raised spiral



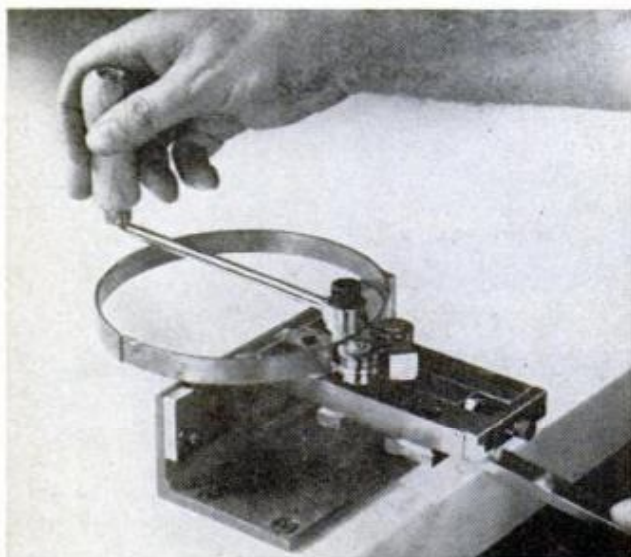
RIVET-HOLE PUNCH has rugged cam-lever action, delivers great leverage. Tool makes clean 1/8-in. holes



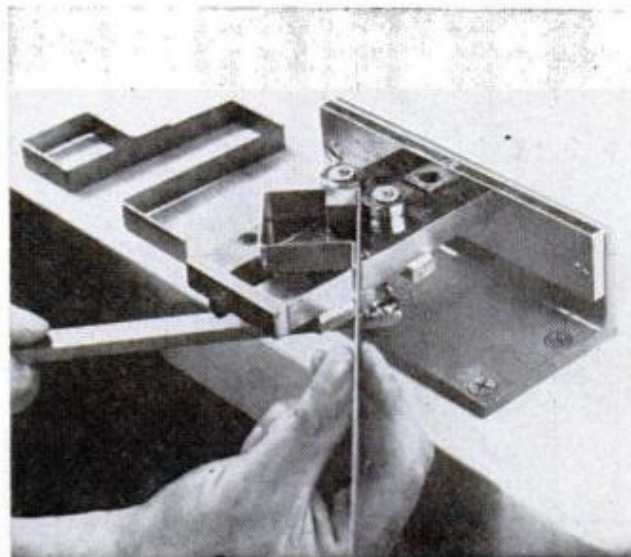
SHARPENED LOWER EDGE of punch's lever functions as guillotine for shearing strips to desired length



SCROLLS ARE JOINED with rivet-forming tool. Anvils (beneath Allen-head screws) squeeze-set rivets



TO ROLL RINGS, anvils are replaced with crank-operated roller. Lever-pressure determines radius



TOOL MAKES SQUARE BENDS when strip is squeezed between stud on slide and the two fixed rollers

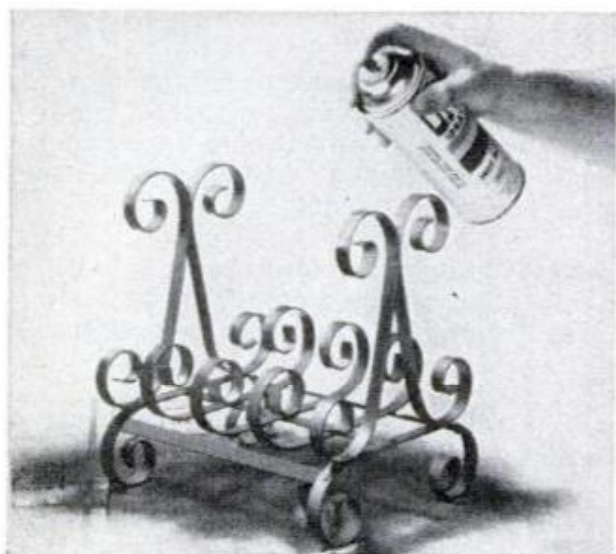


ORNAMENTS CAN BE INSERTED in scrollwork's riveted joints. Most have spot-welded angle brackets

make up batches of matching scrolls, lay them together in various combinations and see what you can make from them. Typical projects you can do in your first try are pictured. As your skill increases, you can advance to sophisticated projects of original design.

The completed scroll work can be sprayed flat black or flat white or, for a fancier finish, you can take the piece to a plating shop and have it copper or brass plated.

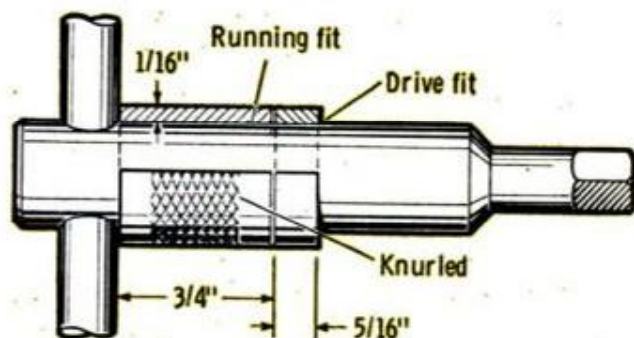
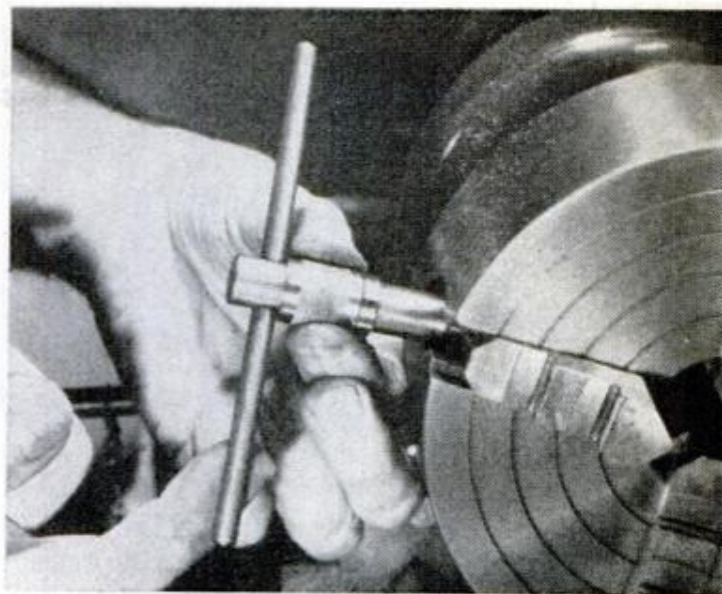
Sold as a set, the three tools are priced at \$79.50 plus shipping. For descriptive literature, write Creative Services Inc., 1280 Route 46, Parsippany, N.J. 07054. The company also offers two illustrated booklets of design ideas priced at 75 cents apiece. ★★



TWO-COAT SPRAY JOB—primer, then flat—provides a lasting finish. Clean metal well before painting

MARCH 1970

HINTS FROM READERS



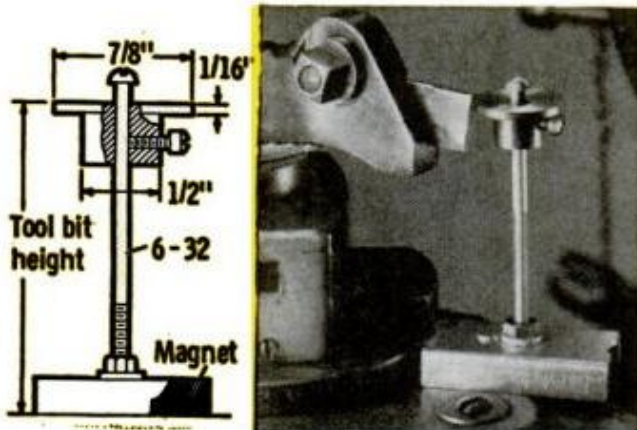
Chuck-wrench 'spinner'

The customary T-shaped wrench can adjust or change lathe-chuck jaws a lot faster if it is equipped with a simple "spinner." This consists of a knurled sleeve in which the wrench body, or shank, can turn freely. When this sleeve is grasped by one hand, the wrench tip can be held firmly in the chuck socket, while the wrench handle is spun rapidly with the other hand.

The drawing shows how the sleeve in the photo was made. Sleeve and retaining collar were machined from a round steel bar, the sleeve being bored for a running fit and that of the collar bored smaller for a drive fit on the wrench body. The time saved by this simple improvement to your lathe is particularly noticeable when the independent jaws of a four-jaw chuck are being reversed. Additionally, the wrench can be more firmly grasped when it has a spinner sleeve and is less likely to slip from your fingers in any situation thus increasing safety.

—Walter E. Burton

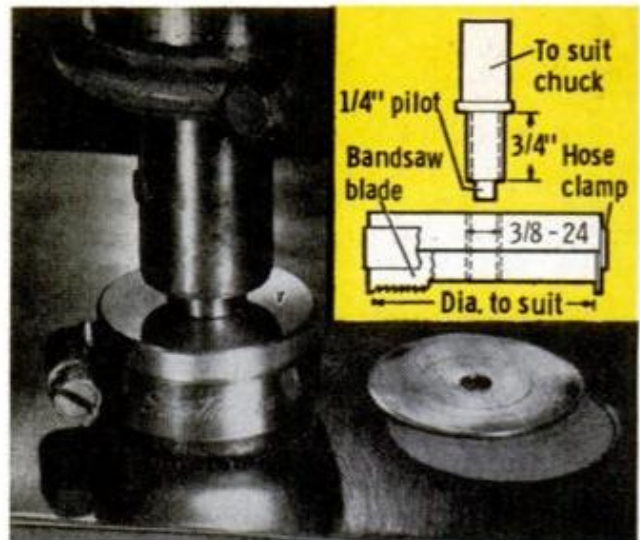
HINTS FROM READERS



Magnetic lathe-tool height gauge

You can speed up setting a lathe bit at proper height if you make the gauge shown above. The magnet, which anchors the gauge on a flat area of the cross slide, can be of the type used in door catches. To use the gauge, simply position it on the cross slide and adjust the tool so its cutting edge is on the same level as the disc top. With practice you'll find you can do this by feeling with a finger placed at the junction of disc and tool. The gauge makes adjustment easier than trying to align the tool with an index mark on the lathe's tailstock spindle. To store, stick the gauge on convenient part of the lathe.

—Walter E. Burton



Cup saw for special hole jobs

Recently I needed a special size cup-saw for a metalworking project. Unable to find a commercial version of what I needed, I hit upon the idea of making my own as shown above. Basically, the idea consists of holding a length of fine-toothed bandsaw blade on a recessed metal disc sized to give the needed diameter. A hose clamp was used to hold the blade and the setup was then screwed onto an arbor. (Threading permits interchanging saws at a later date if necessary.) To use it, the workpiece must rest on a flat surface perpendicular to the cutter, and the drill-press should be run at a slow speed.

—J. K. Becker

NEXT MONTH IN SHOP AND CRAFTS

BUILD THIS HANDSOME "CHALET" POOLHOUSE. Don't be fooled by its mini-size. It serves five practical functions to increase back-yard comfort and poolside fun. You'll find complete plans for it in the April issue of *PM*.

HOW TO PUT THE RIGHT FINISH ON LATHE PROJECTS. Since a craftsman's patience and skill are often judged by the way he finishes a piece of work, we asked lathe expert Walter E. Burton to pass along his expertise on just how finishing should be done. The result is an article that is jam-packed with information and must-reading for beginning and experienced lathe buffs. It's all in *PM* next month.

YOU CAN DRIVE YOUR OWN WELL. If the water-bearing sand formations in your area make it possible for you to obtain water at depths ranging from 15 to 40 feet, you can actually drive—rather than drill—a well. Learn all about this fascinating, little-known technique in *PM* next month.

YEAR-ROUND VACATION HOMES. *PM*'s annual selection of the best available in weekend and country homes. From simple A-frame to sophisticated structures, there's sure to be one for you in the April issue.

PLUS: A Pontoon Canoe You Can Build, Solving Home Problems, Hints From Readers, and more, much more.

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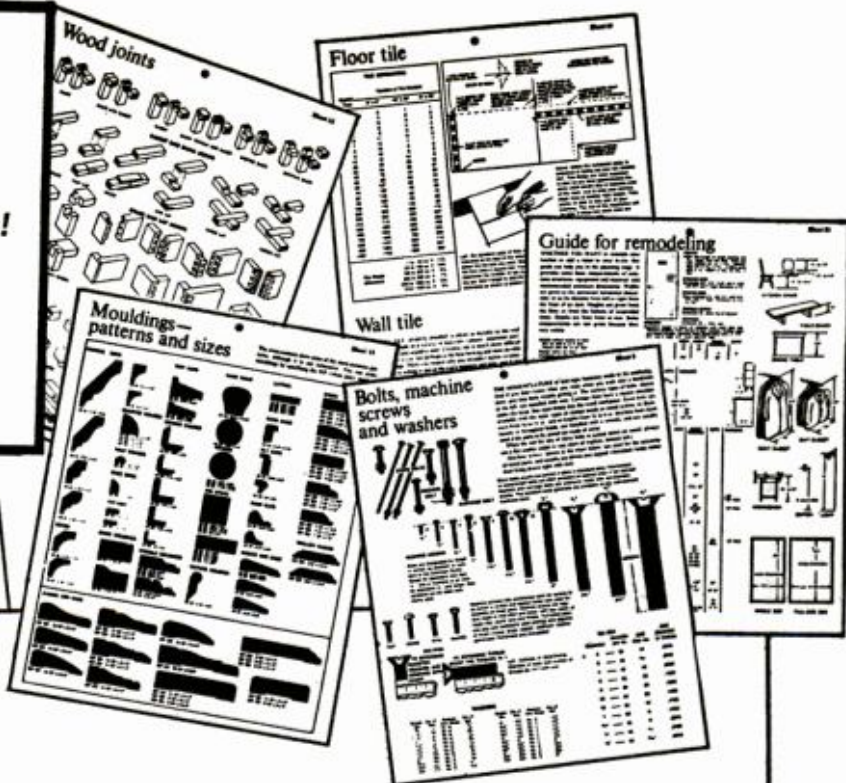
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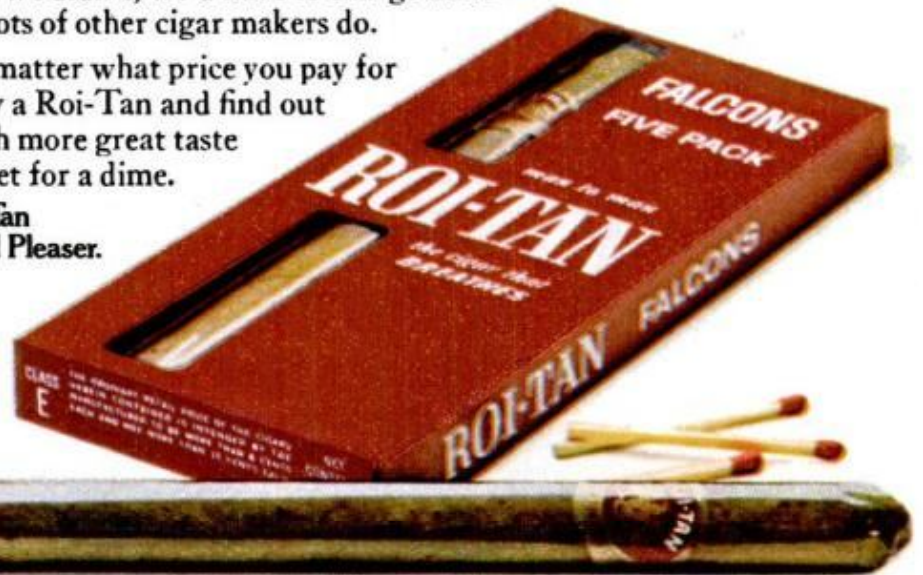
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THE LIVIN' IS EASY

(Continued from page 105)

weekend—is up hill all the way, that there are very real limits to how much refrigeration a camper refrigerator can put out, that a short-handled straw broom is the only housecleaning appliance you'll need.

We learned that buying a bottle of gin in the more remote corners of Canada can involve a half-day trek, that a length of garden hose is one of the best friends a camper ever had, that one's own estimate of "adequate camping facilities" is not necessarily consistent with that of the owner of a given campground.

We learned that coin laundries are pretty much universal, meaning we needn't have bothered packing all that linen and all those towels. We came to appreciate the therapeutic qualities of lots of fresh fruit. We learned that being off the road with overnight camping space reserved by 5:00 o'clock each afternoon is a wise move.

One thing we definitely learned is the wisdom of knowing your camper . . .

Personally, I learned that something billed as a "six-foot bed" can be a cruel hoax if one happens to be a six-footer, that loose-fitting clothing is a boon to the long-distance driver, that driving barefoot helped keep me alert, that packing supplies and staples—detergent, salt, sugar, and so on—in small boxes and jars can ease the chore burdens immeasurably.

One thing we definitely learned is the wisdom of knowing your camper—every inch of it. Whether it's yours, rented or borrowed, realize it has a personality all its own, complete with whims certain to drive a rational man up the wall. A plastic-pipe drain fitting, for example, can decide to go off on its own at the most inopportune times; like deciding to let go when you've got a sink full of dirty dishes and the family on the neighboring camping pad—all neat, tidy and terribly well organized—is looking your way and appears genuinely hostile as your waste spews out on the ground. Moral: Check all fittings, wiring, brackets, bolts and nuts, screws, what-have-you.

Also, make sure you know where things are—the oil dipstick, for example. In a Dodge van of the type we used, the dipstick is located under some radiator hoses at the upper right-hand corner of the engine. At our first oil check, it took the attendant and me 20 minutes to find it. Ob-

viously, it's a good idea to know how everything works. I must have read the instructions a dozen times, but never did learn how to work the oven.

The camper—"our" camper—cost \$6347 as it stood. About the only things missing were a shower and a stereo tape player, both of which can be ordered in the Corey Cruiser. We *did* have airconditioning, and a necessity it is, too; in a Dodge Van the engine is located between and just under the driver and passenger seats and I promise you it puts out an awesome amount of heat, particularly on a long, summer's day trip.

Fortunately, our camper was powered by Dodge's 318-CID V8. I say "fortunately" because we were able to maintain turnpike speeds. We ran into a couple whose Corey Cruiser was powered by the standard Dodge 107-CID Slant Six and they said that while power was adequate, they found themselves lagging behind on throughways.

Before you take off in a camper—particularly one of the smaller ones wherein everything seemingly converts into something else—it's a good idea to run through a couple of dry runs on setting up the bedding arrangements. In the Corey, the "dinette" area converts into what the literature says is a double bed. The key word is "double." We tried it the first night out, the result being that for the rest of the trip I slept forward over the engine. On the fourth night I figured out how the front bunk was *supposed* to set up. A lot of salty dialogue and discomfort could have been spared us if we had checked this out before taking off.

It seems obvious (and was, even to us) to take along such items as a good flashlight, complete with *fresh* batteries, and some form of outside lantern. We ate only one evening meal inside the camper, preferring instead the ubiquitous picnic tables found in every campground. Even with the screened windows of the camper open, it was too hot inside; remember that even parked, the engine continues to put out heat, requiring over an hour to cool off enough to be bearable.

Also obvious are raincoats and some form of "inside" slippers; the alternative is waiting for everything to dry, including tracked-in mud. Again, take along a lot of bug spray; it's not always stocked in out-of-the-way stores.

Pack carefully and *thoughtfully*. Be hardnosed about what you will and will not use. By the time we got home, we had worked out a dandy camping trip checklist tailored perfectly to our needs. We'll use it *first* next time. Like I said, we learned. ★ ★ ★

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HOW TO PICK A PHONO PICKUP

Continued from page 147

ing force. Anything below 2.5 grams is excellent.

Frequency response. The overall response should cover a range of at least 30 to 20,000 cycles. Some cartridges go to even higher frequencies. Even though such frequencies are inaudible, extending the response into that range is a sign the cartridge is free from false resonances in lower (audible) frequency regions.

Uniformity of frequency response is as important as overall range. This is why the range indication should be followed by a plus-or-minus figure to tell the maximum deviation from uniform response. Deviations up to plus or minus three decibels are almost undetectable by the human ear; a cartridge with less deviation can be considered excellent.

Stereo separation. This tells how well the cartridge keeps the right and left stereo channels apart. For instance, if the

Diamonds are the only type of stylus tip to be considered for high-quality sound

specs say "separation -20 db," it means that any signal leaking from the left channel over into the right (and vice versa) will be 20 decibels less loud than the signal rightfully belonging to that channel. The higher the figure, the better. Cross-channel leakage is usually more of a problem in the highs than in the low part of the frequency range. Channel separation of 15 decibels or more at 10,000 cycles is considered very good.

IM distortion. This is short for "intermodulation distortion"—the distortion produced when two or more frequencies are played simultaneously. In music, with many instruments playing together, this happens all the time. The figure indicates the amount of such distortion as a percentage of total output. Anything up to three percent is very good.

Output. This is the strength of the signal generated by the cartridge. A stronger signal is more likely to override any hum your amplifier may have. But since modern amplifiers are fairly hum-free, this is not a major problem and many fine cartridges nowadays have a low output. Anything above four millivolts is fine, unless you have a special hum problem. In that case, try a cartridge with higher output.

Cartridge types. To pick the right cartridge for your sound system, you have to

choose between two basic types: ceramic and magnetic. Because of their high output, ceramic cartridges are used mostly in simpler sound systems and in ordinary (non-hi-fi) record players that lack the extra amplifier gain needed to boost the signal of a magnetic cartridge. Such cartridges usually have a high output impedance (about one megohm) and must be plugged into the corresponding amplifier terminals (marked "CER" or "X-TAL").

Ceramic cartridges are very simple in principle. Two ceramic slabs, one for each channel, are linked to the stylus. Because of the so-called piezoelectric effect, they generate a voltage proportional to the stylus motion. This produces the audio signal.

The majority of top-rank cartridges work on the magnetic principle, and the inputs of all component-type amplifiers are designed for this type of pickup. Magnetic cartridges operate like miniature powerplants. A small magnet linked to the stylus moves inside tiny coils to generate a voltage proportional to the stylus motion. These are known as moving-magnet cartridges. In some designs, the process is reversed—the coils move and the magnet remains fixed. These are known as moving-coil cartridges.

A third type, using the motion of an iron shank to alter a magnetic field, is called a moving-iron cartridge. All these magnetic types are basically similar in their performance and differ only in mechanical structure.

Pointers on points. A diamond is the only material strong enough to endure the vast forces at the stylus tip without wearing down almost immediately. Diamonds, therefore, are the only type of stylus tip to be considered for high-quality sound. They come in various tip sizes. You can get a tip radius of 0.7 mil (7/1000ths of an inch) or 0.5 mil (5/1000ths of an inch). A few models have an 0.4-mil stylus. Generally, the smaller stylus (0.5 or 0.4 mil) has an advantage in tracing the inner grooves of a stereo disc where the waveforms get quite crowded in the tight circles near the label. But these fine points will rattle loosely in the wider grooves of old monaural records. The 0.7-mil stylus plays both mono and stereo records with good results. So if you still own mono records, the 0.7-mil models may be your best bet. If you play only stereo records, get an 0.5 or 0.4-mil model.

You can also get oval-shaped stylus tips, designed to reduce distortion at the innermost record grooves. Shaping and polishing a diamond to a precise oval contour is a tricky job, and the price of such cartridges usually shows it. The im-

(Please turn to page 202)

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HOW TO PICK A PHONO PICKUP

(Continued from page 200)

provement in sound is noticeable, but slight. If the rest of your equipment is good enough to show up the difference, a cartridge with an oval-tipped stylus may be worth the added cost.

When you mount your new pickup in the tone arm, remember these precautions: Remove the stylus or keep the guard on while you're working. Otherwise, you may bend the delicate tip. Don't solder the connecting wires directly to the terminal pins. The heat could damage the cartridge. Use the slip-on metal sleeves provided with either the cartridge or the tone arm, and make sure the sleeves grip tightly. Loose cartridge connections are a common cause of signal loss or hum.

Check your pickup's recommended tracking force carefully against the calibrated scale on your tone arm. If your arm lacks such a scale or if you want to be sure it's accurate, you can get an inexpensive stylus-pressure gauge for about a dollar at most audio dealers. ★★

BE YOUR OWN BOAT TESTER

(Continued from page 129)

while under way! It calls for some doing to arrange the seat and wheel so it's possible to stand behind the wheel, yet not have to strain to reach it when seated.

In a well-designed boat the dimensions of the steering-wheel assembly, the height and location of the deck and dashboard and the positioning of the seat are integrated from the outset to produce a comfortable seat.

A boat's windshield is something else that gives indication as to whether the boat was eyeball-engineered by an airbrush artist, or really designed by a boat-savvy naval architect.

Sheet plastic is readily cut by bandsaws and heat-formed into saucy curves. Windshields made this way crack from locked-in forming stresses, vibration and bumps, and eventually collect so many dust scratches from cleaning that it's hard to see through them under certain light conditions. All this explains why metal-framed, safety-glass windshields are found on the best boats.

However, even some of these windshields show poor design. A windshield that is low and rakishly angled can carry its upper metal edging just above the steering-wheel rim—where the bridge of your poor nose will hit should the boat jump a steep wave or slam into a piece of driftwood! Some have sharp corners in

the wrong places. Some lack center braces to stop vibration when underway or to hold them solid when, inevitably, someone grasps the top to pull himself up.

Windshield framing should not be so thick, or located at such a level, as to obstruct vision. Remember that a boat's attitude in the water changes with speed and load; framing that is close to your line of vision at one speed can block it at another speed.

Windshields should provide protection from wind and spray, but you'll encounter windshields so low that you can see over their tops. They might as well be made of wood as of glass or transparent plastic!

Or with no roof overhead, it's common to find blinding reflections in windshields from light-colored cabin tops and gaudy dashboards. This is a definite hazard on a fast boat used about busy waterways.

Finally, consider how a particular windshield will affect your ability to gain the foredeck to handle anchor or mooring lines. Step-through windshields are increasingly common, and they make a lot of sense. One-piece or rigid windshields are sturdy and have no joints to leak or rattle. But on a boat of any size such a windshield has to be complemented by a hatch for access to the foredeck.

The number of seats vs. the carrying capacity can be confusing. An aluminum fishing skiff might have five wooden thwarts on which 10 people could sit—but that would obviously overload the craft. Many runabouts have only two back-to-back seats for four people, even though their hull volumes could support more. Sometimes this is because the popular back-to-back seat unit folds down to form a couch, and on some models needs so much room to do so that there isn't space for more seating! Other times, it's because a manufacturer feels that a majority of his purchasers want a cockpit that is reasonably open and clear for diving or water skiing. Thus it's not possible to judge a boat's capacity by counting seats.

Your best aid in determining a boat's capacity is the capacity plate installed usually on or near the transom. It tells you how much in pounds the boat will safely carry under *average* conditions. You can divvy up the capacity in pounds between people, motors, gas tanks and equipment, but never forget that all the little items you inevitably take aboard add up to a significant amount of weight.

By now, you have absorbed a fair idea of what to look for on a boat before taking it on a trial spin. Next month, we'll consider problems of stability and then shove off for an on-the-water evaluation. ★★

This reel's geared for power. Its ball-bearing mounted helical gear system handles the biggest fish.

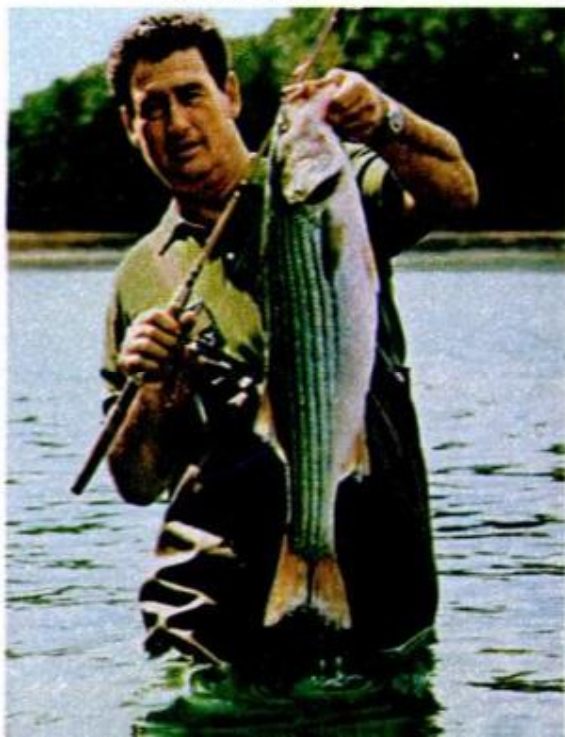
There's less line wear and smoother pick up with this stainless steel line guide. It revolves as you retrieve.

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COMING UP DIAMONDS!

(Continued from page 119)

for mining, processing and sorting gravels.

Prospecting is carried out by the survey tug *Rockeater* which works her way up and down the coast putting down a six-inch drill pipe for core-samples through the diamondiferous gravels to bedrock.

A chart of the ocean floor and the richest diamond area is then prepared with the aid of a Telurometer, a surveying and measuring device operating on radar principles, mounted onshore. It can position the barge over her mining area to an accuracy within inches. Such precision is essential if patches of rich gravel are not to be missed.

Diamonds from the sea are mostly beautiful gemstones. Almost none are of industrial quality. Though beautiful, the sea-stones are also uniformly small, so that of the gravels brought to the surface only the minus half-inch go for further treatment while the plus half-inch are pumped back into the empty, worked-out trenches along with the other tailings. Accurate disposal of the tailings is important to prevent contamination of unworked conglomerates by processed gravels.

Superintendent Kruger was still shouting answers to my questions as we took off in the helicopter. As we circled the dredge and headed in across the surf to the desert, I could well believe one crewman who said it would be at least two years before the *Pomona* had mined all the diamonds from Hottentot's Bay.

As to how the diamonds got there on the sea bed or on the beaches and terraces ashore, no two groups of experts seem to agree. One theory is that great rivers, such as the Orange and others long dry, carried diamonds from inland volcanic "pipes," such as those at Kimberly and Pretoria, to the sea. Then current and wave action spread them along the coast.

One man who disagrees with this theory is Sam Collins. Sam is an American whose approach to diamond mining resembles a wildcatter's approach to oil drilling. Sam believes there are diamond pipes beneath the sea off the West African Coast and perhaps all the way to Brazil.

No one believed there were diamonds on the sea bottom until Sam built a crude barge and mined them successfully. A second and larger barge followed, the one washed ashore, and then the *Pomona*, now operated by C.D.M., as is Sam's old company, Marine Diamond Corp.

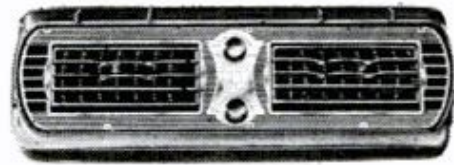
Sam's theories about where the diamonds came from were still not widely accepted at the time of my visit last year,

(Please turn to page 214)

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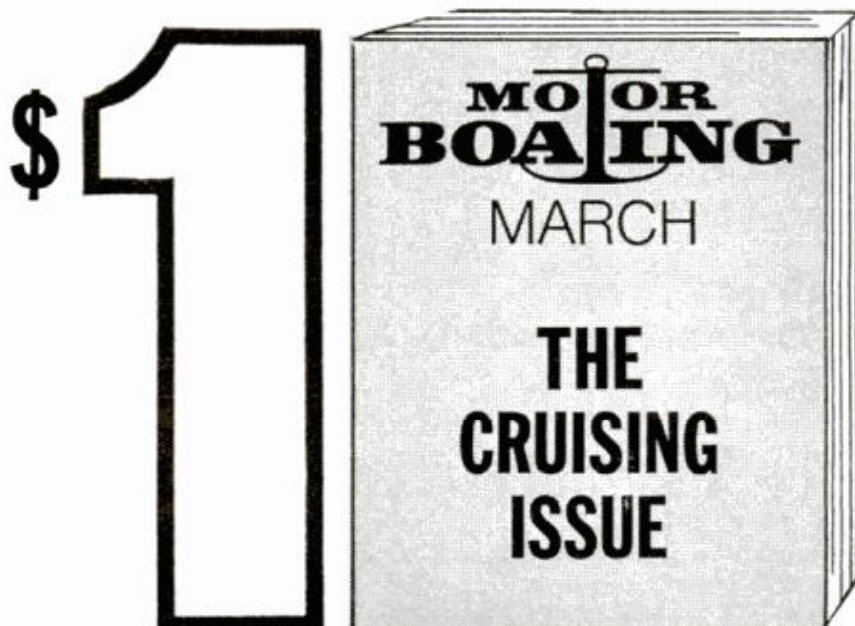
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COMING UP DIAMONDS!

(Continued from page 211)

but since then there is talk of a specially designed submarine to be used in mineral prospecting off the West and East African coasts. Perhaps such a craft could pinpoint the source of marine and beach diamonds and decide their origin.

By late afternoon we were back in Oranjemund with all facilities of a modern city at our disposal. The main base for all C.D.M. and M.D.C. operations, it is just north of the Orange River mouth in the prohibited area. It is solely for miners, their families, offices and plant.

From the Orange River the C.D.M. beach mine runs 60 miles up the coast toward the towns of Pomona and Luderitz. It extends back from the beach from half a mile to two miles. There is not a shaft anywhere; it is essentially strip mining carried right down to the surf.

Diamonds of incredible beauty and quality are found in this narrow coastal strip on terraces cut into the bedrock by three different ocean levels which existed in prehistoric times and which were many feet above present sea level. A fourth terrace lies below today's beach.

Prospecting is done by sinking transverse trenches down to bedrock at regular intervals all up the coast. These trenches are numbered, their position plotted on a field map and the diamond content of their samplings recorded. Later, the areas of highest yield are opened as desired.

Mining is largely by earthmoving equipment which first removes an overburden of sand 30 to 70 feet thick, plus another 5 or 6 feet of harder materials, before diamondiferous gravel and conglomerates are uncovered. In this last stage pick-and-shovel gangs take the clearing process on deeper to bedrock three to six feet farther down.

The residue or lashings found amongst crevices in the bedrock are often the richest in diamonds. An enormous vacuum cleaner mounted on a Sherman tank chassis, the Vacuveyor, is the newest device to mechanize recovery of the lashings. An American named Meade designed it.

Beach diggings are carried on behind 15-to-20-foot dikes thrown up at the very edge of the surf. The sea is continually cutting them away while bulldozers are constantly pushing more sand into place.

Cross walls and pumps control saltwater seepage in the work areas so bedrock-cleaning gangs can recover the lashings with only occasional aid of rubber boots.

The mine's workforce is recruited in

(Please turn to page 216)

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COMING UP DIAMONDS!

(Continued from page 214)

the main from Ovambo tribesmen. Some have acquired such skills as punch-card operators, mine assistants, control-panel operators and drivers of earthmoving equipment. I was pleasantly surprised to find dormitories for the Ovambos on the mine set amongst flowers and palm trees, served by nonprofit stores and a vast kitchen which served a varied menu. Bunks, quarters, lockers and shower and washing facilities were hospital-clean. The senior Ovambos were housed two to a bungalow, provided with telephones, radios and bathrooms.

Processing of gravels and conglomerates is aimed primarily at separating the large sterile rocks from the diamond-bearing residue with a minimum of expensive crushing and treatment. Waste is dumped straight into the sea, while the mixture of shell, gravel and diamonds is further reduced and screened.

The secondary stage comes when the concentrates are shipped to the final plant from the field processing areas. Further milling and screening take place before the concentrate of diamonds, gravel and some shell goes into a clean solution of ferrosilicon and drops straight into a cyclone separator. Centrifugal force separates the heavier material, which includes the diamonds, from the bulk of the lighter shell and gravel, which is floated off in the dense ferrosilicon, then pumped back into the sea. The ferrosilicon is recovered magnetically and recycled.

From the cyclone the diamonds go to the grease tables after a final washing and preparing. Diamonds, being then unwettable, adhere to the inch-thick layer of grease while all other debris, being thoroughly wet on all surfaces, rolls off the grease tables as waste without adhering. The diamonds are then scraped off the grease, cleaned and go to the sorting tables. The final sort is by hand.

And here all likeness to a commercial operation ends, for suddenly there is an Aladdin's Cave of sparkling diamonds. Ninety-five percent of them are gemstones of clarity and beauty, and there are 300,000 rands (\$420,000) worth of them coming in every day!

Since my return to the States a spectacular new marine diamond find has been made off the coast between Hottentot's Bay and Oranjemund. This find, near a group of small islands exotically named Roast Beef, Plumpudding and Guano, is the richest yet and, with new and improved methods of dredging, should return profits exceeding \$1,000,000 a year. ★★



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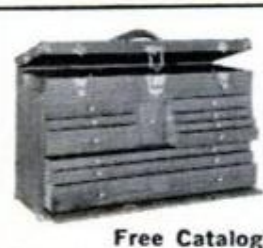
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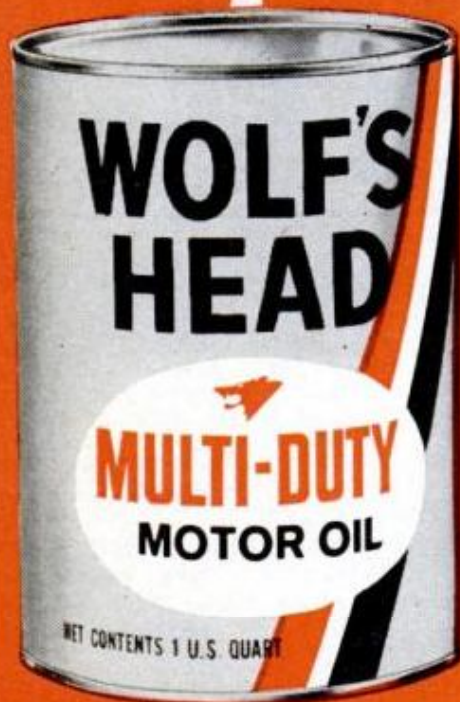
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BRAKE SYSTEM CHECKOUT

(Continued from page 187)

brakes could cause a car to pull. They are loose or worn wheel bearings, loose steering and misadjusted camber. Check them.

Open the windows, turn off all accessories and listen for noise. Try to determine from which wheel a squeal, click or scraping noise comes. Driving alongside a wall, such as a concrete highway center barrier, as you conduct this test will make noises more audible.

Speed up to 60 mph and make a few light-pedal stops. Is there chatter or shudder? If so, check for worn or loose wheel bearings. If bearings are okay, suspect out-of-round brake drums.

From 60 mph, make several hard-pedal stops. Apply the brakes as hard as you can without throwing the car into a skid. Be sure to bring the car to a complete stop after each application, but don't repeat stops within two miles of each other to avoid high temperature and fading. Listen for unusual noise and check for any undue effort in stopping. ★★★

BRAKE DIAGNOSIS CHART

CONDITION	CAUSE
Low pedal (excessive pedal travel needed to apply brakes)	D E G K
Spongy pedal (a springy sensation of the pedal upon application)	G I J K
Hard pedal (excessive pedal pressure needed to stop the car)	D E H J K L
Fading pedal (pedal falls away under foot pressure)	G I J K L
Grabbing or pulling	B C E F G H J L M
Noise (squeal, click, scrape)	D E F G H
Chatter or shudder	B E G H
Dragging brakes	A D E F H J K L

KEY:

- A—Parking brake improperly adjusted or sticking.
- B—Loose wheel bearings.
- C—Front-end misalignment or uneven tire tread.
- D—Brake shoes improperly adjusted; automatic adjuster out of commission.
- E—Worn, contaminated or distorted brake linings.
- F—Weak or broken shoe return spring.
- G—Cracked, thin, scored or out-of-round drums.
- H—Brake support plate rusted, loose or worn.
- I—Air in hydraulic system fluid.
- J—Hoses and lines soft or weak, kinked, collapsed, dented, clogged, loosely connected, or leaking.
- K—Damaged master cylinders.
- L—Damaged wheel cylinder.
- M—Check tire pressure.

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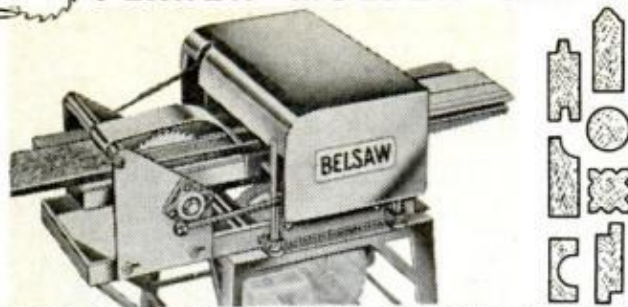
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FRONT ENDS AND STEERING

(Continued from page 113)

which engages the teeth of a sector gear that operates the Pitman arm through the sector shaft.

Worm-and-nut steering gearboxes were once used almost universally, but the problem with these is the same as with a machined-thread bolt and nut if it were used for the purpose: too much sliding friction, resulting in hard steering. To overcome this, the sector gear was replaced by a bearing-mounted, worm-gear-type roller which meshes with the steering-shaft worm gear (Fig. 10). The roller profile is on a radius from the Pitman-shaft center, and the steering-shaft worm has a compatible concave profile. The roller is offset from the center of the Pitman shaft so motion of the roller along the steering-shaft worm produces a rotary motion of Pitman shaft and Pitman arm.

The mechanics of power-assisted steering are identical in concept and actuation to the straight mechanical type. The "assist" comes from a hydraulic cylinder geared into the works. Hydraulic power for the cylinder comes from a belt-driven pump which operates off a pulley at the front of the crankshaft. There are several methods of accomplishing the same result, so configuration will vary, but the operating principle is the same. The one shown in Fig. 11 happens to be British, if you're curious about the left-side Pitman arm.

Proportional control of steering action is accomplished by means of a rotary valve at the base of the steering shaft. The valve has a series of lands and grooves in both rotor and outer sleeve, the lands on the rotor being somewhat narrower than the grooves in the sleeve. A torsion bar is pinned to the steering shaft at the input end, and to the worm at the other. The worm is allowed to rotate a few degrees in each direction with respect to the rotor.

In the lower diagrams, oil under pressure is introduced through ports in the valve sleeve, and into the grooves in the valve. With no turning pressure on the steering wheel, the rotor lands are centered in the sleeve grooves and hydraulic pressure is applied equally to both sides of the piston. When the steering wheel is turned, the wheels on the ground provide resistance to the worm through the steering linkage, resulting in a twisting action in the torsion bar. The rotor, linked to the input end of the torsion bar, moves with respect to the worm-attached sleeve, diminishing clearance between groove and land along one side. The high-pressure oil goes through the open side of the

groove while the restricted side allows passage of only a trickle of oil at lower pressure. High-pressure oil works against one side of the piston; low-pressure oil from the "starved" side of the piston is returned to the reservoir.

A gear rack attached to the piston actuates a sector gear on the Pitman arm shaft in this particular style of gearbox to assist the mechanical worm and roller which is mounted alongside. Application of pressure to the piston is progressively controlled, because any motion of the piston assisting the steering also rotates the worm-actuated valve sleeve, cutting down the supply of high-pressure oil and cancelling the assisting action. ★★

SHOP IN 4 FEET OF SPACE

(Continued from page 153)

kept even with the back posts. You can use contact cement to glue it in place or just plain glue. The hardwood plywood ends, which are 4 in. shorter than the back, lap the back panel and are kept even with the front posts. Notice that the ends are cut back 1/2 in. at the front to accommodate the hinged front panel of the lid. The small door in the right-hand end piece may be cut before or after the plywood is glued in place. The door gives access to handsaws kept behind the drawers. Attach the door with a couple of offset cabinet hinges; you can add a magnetic catch if you wish.

If you don't want any joints in the front facing, cut it from a single piece of plywood. Let it lap the ends, the benchtop and the sliding-door track. Make it 2 5/8 in. wide where it covers the divider post so it will lap the 3/4-in. thickness of the grooved drawer rails.

The drawer bottoms project on each side to form their own runners which slide in the grooved rails. The left-hand rails are fastened to the divider panel, while two right-hand ones are screwed to front and back corner posts. Notice that three drawers and their rails are made shorter than the others so as not to block the handsaw passage.

The two doors swing and pivot inward to provide legroom when you sit at the bench on a stool. The left door is merely hinged to the corner post. The right-hand door slides in a track, top and bottom, on a pair of nylon-covered studs. The studs are made by sawing off the heads from four 3/4-in. No. 6 wood screws. Two are put in the top and two in the bottom edge of the door. To swing the door inward you slide it until a pair of studs align with notches in the track. ★★

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PLASTIC LAMINATES

(Continued from page 159)

position. *Caution:* Heating and bending can be a little tricky, so wear gloves and practice the technique on scrap first.

Or, if the pattern you are using is available in 1/32 in. thickness, use the thinner material for tight turns.

● *Wall (vertical) applications.* Laminates can be successfully applied to unpainted walls of 1/2-in. plywood, hardboard, plasterboard or plaster that are clean, firm and free of cracks or holes. Regardless of the type surface, the walls should be sanded smooth to insure that the laminate comes in contact with the entire wall surface. A thinner, less expensive laminate can be used on vertical surfaces. Walls and cabinets are generally skinned with 1/32-in. material, half as thick as material used on horizontal surfaces.

When doing wall applications, all wall cutouts—windows, switches, receptacles—should be cut before you install the panels. An easy way to locate them on the laminate is to mark the edges of the wall cutouts with a black crayon. Then, after placing the panel in exact position, tap with a rubber mallet or your fist around the area which is marked. The crayon will be transferred to the panel back. After cutting the laminate, be sure to clean off all crayon thoroughly prior to bonding.

Bonding on a vertical surface is done exactly the same as on a horizontal surface except that (for large panels) it is best to use two coats of cement on the vertical surface and one coat on the laminate. Be sure the first coat is dry before

applying the second. If plywood is used as a backing, allow for expansion when you position the laminate panels. Do not butt them too tightly. For a moistureproof job, make all joints with channel moldings.

● *Laminating hints.* I've found that the contact cement seems to dry faster on the plywood (or particleboard) core than it does on the laminate. Thus—since the closer the drying times are to each other, the better the bond—I always apply the cement to the laminate first and then to the plywood so that both are dry and ready for bonding at about the same time.

If you do trimming with a carbide cutter in your router, make certain you keep the work-contacting bearing clean. Unless the guide is free moving, it will spin at the same speed as the cutter and leave unre-movable scorch marks on the self-edge. To keep your cutters clean, store them in covered jars filled with lacquer thinner.

To make sink cutouts, position the

(Please turn to page 228)



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		PJ31	15.50	10 1/2 x 11 1/2
		PJ30	15.50	10 1/2 x 12 1/2
		PJ32	15.50	10 1/2 x 12
		PJ35	15.50	10 1/2 x 13 1/4
		PJ40	15.50	10 1/2 x 14
60 - 90 HP	60-68	PJ74	16.00	10 x 9 1/4
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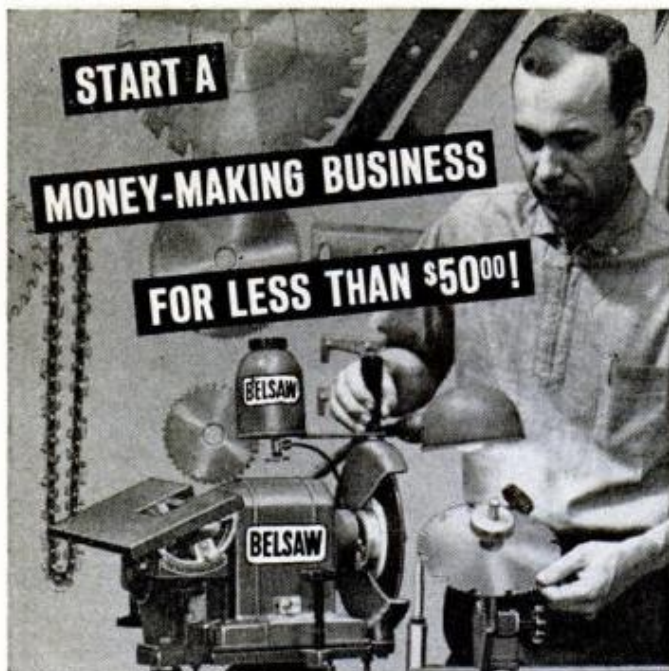
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PLASTIC LAMINATES

(Continued from page 225)

Hudee rim (or the template for the sink if it's self-rimming) on the countertop and draw the outline in pencil. Drill holes in the four corners and complete the cut with a sabre saw. To prevent scratches, it's a good idea to cover the sabre-saw shoe with masking tape.

Which surface to bond first? Before applying any cement, size up the job. The order in which to apply the various panels is determined by the edge that is most visible to the eye and to abuse. Thus, for example, self-edge always goes on before the top. Conversely, if your backsplash has an end return, the 3/4-in. vertical strip goes on after the splash panel and before the top horizontal strip. ★★★

PM's HANDY PLASTIC LAMINATE GUIDE

For quick reference, here's a roundup of major plastic laminate manufacturers, plus companies producing tools and related products shown in this article—you can clip it out and tack it up on your shop wall. If you have difficulty locating a particular product locally, write the maker directly.

PLASTIC LAMINATE MANUFACTURERS

American Cyanamid (Formica), Formica Corp., 4614 Spring Grove Ave., Cincinnati, Ohio 45232.

Consoweld Corp. (Consoweld), Wisconsin Rapids, Wis. 54494.

General Electric Corp. (Textolite), Construction Materials Div., Coshocton, Ohio 43812.

Johns-Manville (Melamite), Richard Marcoux, 22 E. 40th St., New York, N. Y. 10016.

Pioneer Plastic Corp. (Pionite), 205 Lexington Ave., New York, N.Y. 10016.

Westinghouse (Micarta), Decorative Micarta Div., Hampton, S.C. 29924.

LAMINATE CUTTERS

Bernzomatic Corp. (BernzCutter), Driving Park and Reich, Rochester, N.Y. 14600.

Karl Klenk, Inc., 20 Germay Drive Industrial Park, Wilmington, Del. 19804.

LAMINATE FILLER

Kampel Enterprises, Inc. (SeamFil), Dillsburg, Pa. 17019.

DOUBLE ROLLER

Diverso Products Div., Misceramic Tile Co., Box 1070, Cleveland, Miss. 38732.

LAMINATE TRIMMER

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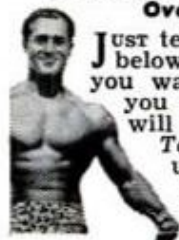
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BUILD THIS COOKOUT GAZEBO

(Continued from page 162)

4x6s. The deck is covered with 2x4s, the roof framed with 2x6 common rafters, the three benches assembled from 2x12s, 4x4s and 4x12s. All members are standard, nominal-size timbers which most lumberyards stock in Douglas fir, ponderosa pine, western hemlock, spruce or western larch.

In studying the floor plan, notice that the crisscrossed deck beams are supported by eight 8-in.-dia. piers, while the four corner posts are supported by 10-in.-dia. poured footings. The holes for these are dug below the frost line and located from a center point of the structure. We found that regular clay flue tile made neat ready-made forms for the eight piers and forms which remain as part of the pier. All forms must be leveled in both directions, which can be done with a long straight-edge and level or, more professionally, with a builder's transit.

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corner posts right in the footings or bolting them to steel anchor plates embedded in the concrete. The former method will make a more sturdy structure, but poses a replacement problem if a post should ever rot off at the footing. However, if first treated with a wood preservative, the posts could last 20 years or more. If the posts are to stand in the footings, they must be plumbed and braced prior to pouring the concrete and be longer than otherwise.

You'll save a lot of time and aching muscles by ordering premixed concrete. The depth of the holes will determine how much concrete is required. We used 1½ cu. yds. of 1/2/4 mix. Strike off the concrete flush with the tops of the tile forms and then place a ½ x 10-in. bolt in the center of each one.

Notch the supporting deck beams to form a 30-in.-sq. opening in the center when the four members are half lapped. The grill box later sits inside this opening. Holes are bored in the timbers so they will sit down over the bolts. Before drawing up the nuts, check the beams with a level. You may have to shim them. Draw the nuts only moderately tight.

The four posts are joined at the top with 4x6 members (plates) kept even with the tops of the posts and flush with the front

edges. Ends of the plates are mitered 45° and tied to the faces of the posts with long bolts. These pass through holes bored through both post and plates, one bolt for each post. Inside corner braces (3x4s) are required when the corner posts are bolted to the footings.

Make the supporting collar for the flue next. In studying the rafter plan, note that its inside opening is 30 in. sq. and that the members are rabbeted at the corners. The corners of the collar are trimmed 45° to provide a flat face against which the hip rafters butt and toenail. Also, you'll see that 2x4s are added to the bottom of the 4x6s to increase their width. Finally, the top edges of the collar are beveled to match the roof pitch.

The hip rafters are laid out to a 9 and 14 pitch. To determine their length and the location of the plate cut, you step off the 9-in. rise in a 14-in. run with a framing square. Here you first mark the ridge cut which butts against the corner of the collar, and then pace off the required number of steps as indicated. The hip rafters actually rest on top of the posts to which they are toenailed.

You'll need help to lift these heavy rafters and set them in position. Long supports nailed to the deck beams will temporarily elevate the collar at the right height so you can toenail the hips to it. Once you have the hips nailed, it's less of a job to continue to fill the space between with common rafters which are spaced 24 in. on centers. For laying out the 2x6 common rafters, use 9 and 12 in. on the framing square.

Both the grill and the flue are built up of 1x6 vee, tongue-and-groove boards. They are nothing more than square, open-end boxes having an outside dimension of 30 in. The flue box is shoved up through the collar from inside the gazebo. It projects 10 in. and is nailed securely to the collar from inside. A 2x4 shelf circles the bottom of the flue to provide a place to keep salt and pepper handy. Four pieces of sheet metal line the flue for a height of 24 in.

The grill box has a loose, wood bottom which rests on cleats placed 6 in. down from the top. We made use of the bowl of an inexpensive 24-in. patio grill (brazier) and brought the raising and lowering handle out through a slot in the side of the box. This works fine when the original center post is replaced with a longer one of ½-in. copper tubing. The grill we used was made by Crestline, Division of Federal Steel Corp., Raritan, N. J. It's placed in a bed of sand, and a tuna fish can, minus its bottom, is used as a ring to keep the

(Please turn to page 232)

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BUILD THIS COOKOUT GAZEBO

(Continued from page 230)

sand from sifting through the center hole in the bottom board. The grill box is mounted flush with the bottom of the deck opening and nailed securely to the beams from the inside.

You can hang the storage counters on three sides of the grill; we added them to only two. They're simple boxes about 29 in. long and fitted with hinged lids.


The deck consists of 2x4s placed flat and spaced 1/4 in. apart. You'll notice in the floor plan that they extend out from the grill in four directions and run as far as the benches. The ends of the first four pieces are mitered. Steps to the deck are added along one side. If your gazebo is located near a pool like ours, a ramp can be used in place of steps and decked with 2x4s to match the rest. Use two 12d galvanized nails at each nailing point. If you take time to chamfer the rough-cut ends of all the 2x4s with a hand plane before you nail them in place, the deck will have a more finished look.

The flue is topped off with a 4-ft.-sq. cap which is assembled around a half-lapped framework of 2x4s which slips over the top. The sides are 1x6 vee tongue-and-groove boards, butted and nailed together at the corners. You can build the cap in place on the flue or make it up separately and add it as complete unit. A long ladder placed on the shingled roof will let you slide the preassembled cap up the ladder rails and give adequate footing for lifting the cap over the top of the flue. Sheet metal is used to seal off the opening in top of the flue; fumes and smoke actually escape through side openings.

We used red cedar shingles on the roof. (Shakes look better but will cost you more.) Furring strips spaced 6 in. apart and nailed to the rafters support and provide nailing for the shingles. Lay the latter about 5 in. to the weather, and when you reach the flue, add flashing. Overlapping shingles cover the hip ridges. To avoid having nail points poke through the furring and be noticeable, pick 3/4-in. large-head nails to fasten the shingles.

All three benches are made alike, each having two pairs of legs which straddle the ends of the deck beams. Spacers of 4x4, lagscrewed to the underside of the benches, provide blocks to which the legs are cross-bolted. Bolts are used to fasten the benches to the beams.

The completed gazebo looks best when given a rustic look with dark stain. Plastic laminate could be added to the counters. We made a plastic cover to slip over the grill between cookouts. ★★




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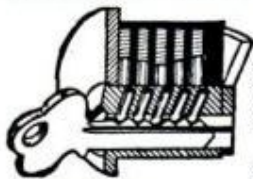
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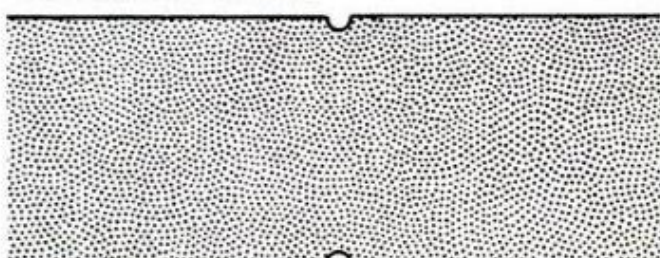
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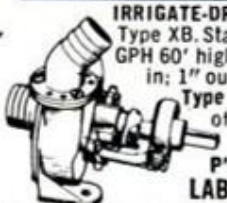
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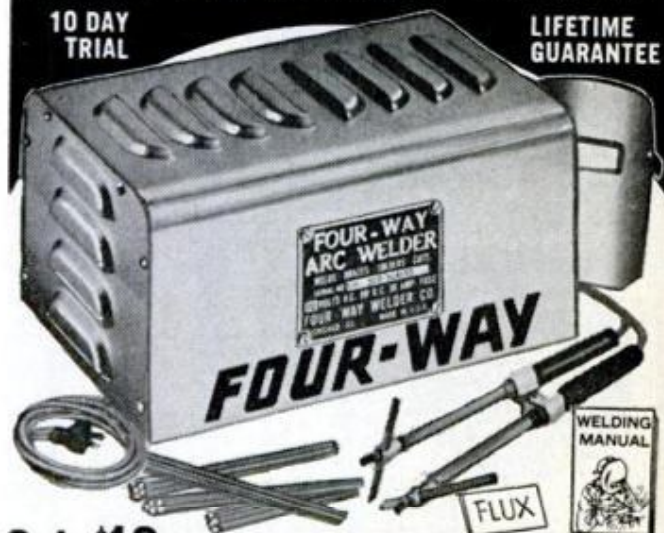
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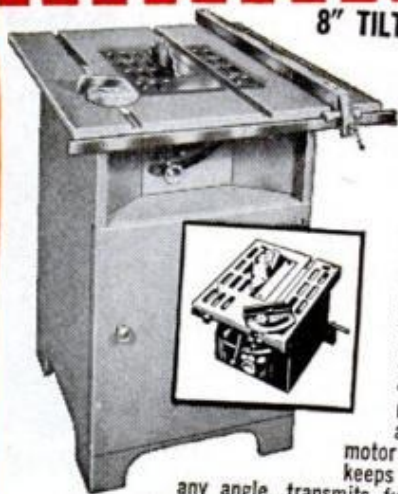
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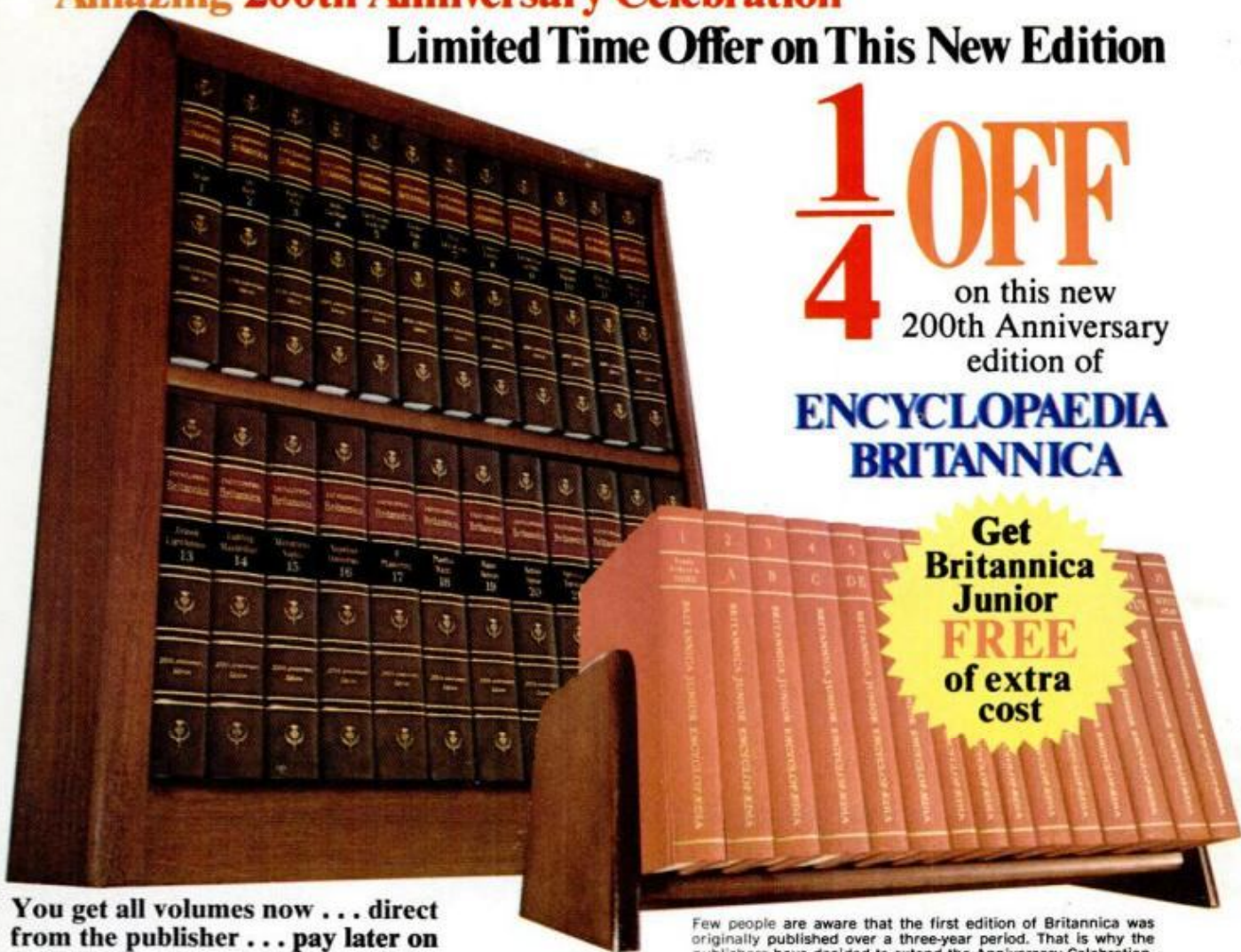
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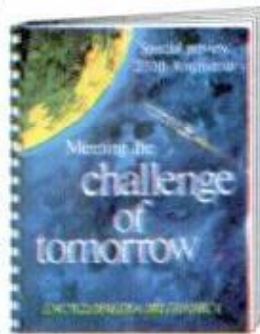
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