

POPULAR MECHANICS

DEC. 1967
35 CENTS

**ARTIFICIAL
GILLS**
They Let
You Breathe
Like a Fish



**Through Yellowstone
On a Snowmobile**

**The Real Scoop
On Gun Scopes**

**Rodger Ward Tests
The '68 Charger**

**All About Those
Tiny TVs**

**Workshop In a Closet
Complete Plans Page 138**

IDEAS to Make Your Christmas Lighting a Success

**How to Put a
Fireplace
In Your Home**

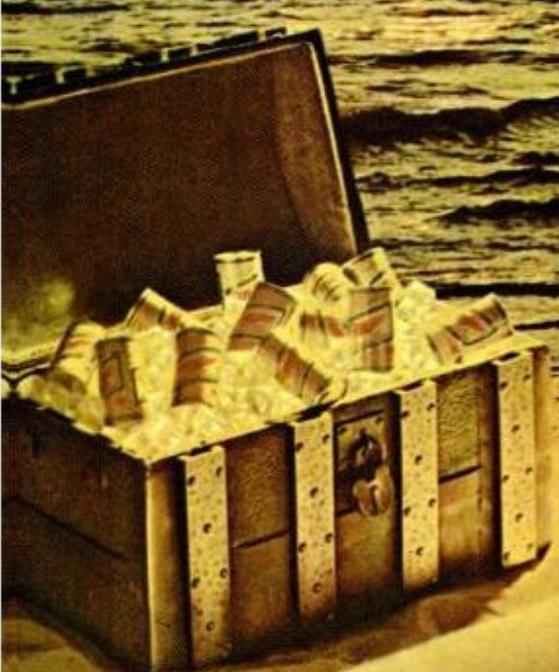
**In COLOR: Tiny
Railroads Half
The Size of HO**

**Saturday Mechanic:
Checking Out
Your Driveline**

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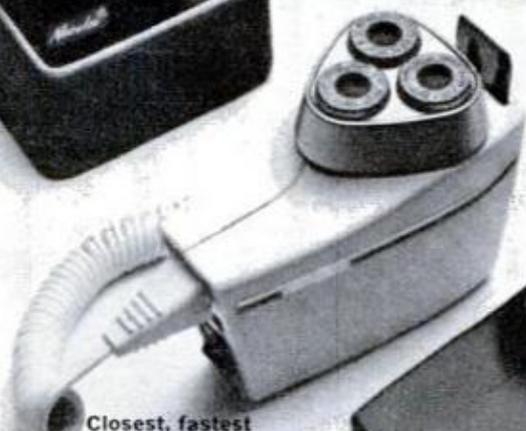
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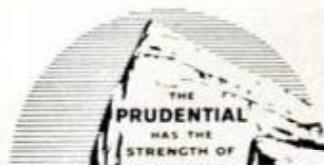
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Cover Photograph by Joe Munroe

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World's Fastest School. Bill Kilpatrick, auto editor, tells how he learned high-speed driving from veteran stock-car ace Curtis Turner.

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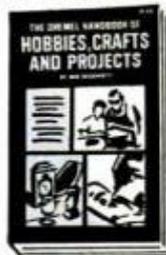
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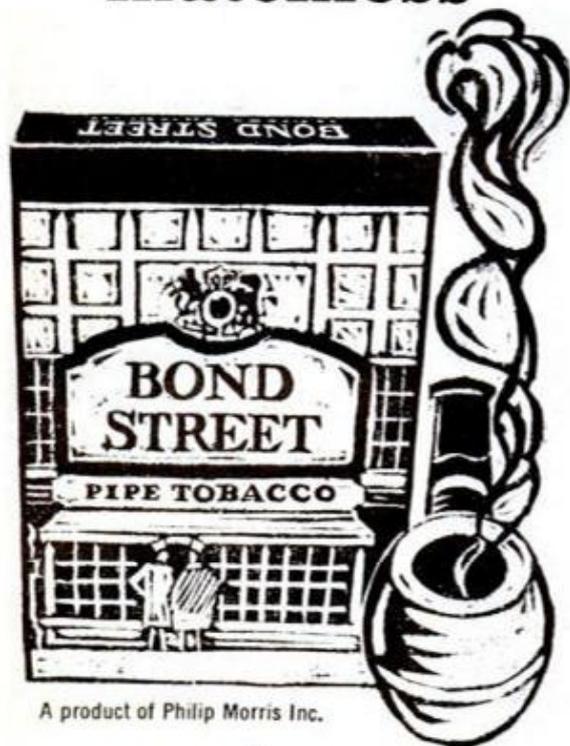
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LETTERS TO THE EDITOR

Too young?

I read with considerable interest *How Young Is Too Young?* (page 132, Oct. PM). I think everyone agrees that the accident rate of the teen-age driver is much higher than that of any other age group. However, there is one thing that bothers me—that is, whether this is due to age or to lack of experience. Perhaps 40-year-old drivers with only a year or two of experience may have as bad a record as the 17-year-old boy with only one or two years experience. I'm wondering if we aren't giving the wrong cause and blaming it on age rather than experience.

AMER. AUTOMOBILE EARL ALLGAIER,
ASSN. MANAGER, DRIVER
WASHINGTON, D.C. EDUCATION DIV.

Phooey! If the author is so intent on saving lives, why doesn't he advocate the end of licensing for anybody but qualified public transportation drivers? This would cause many inconveniences and would probably ruin the auto industry, but it would save many lives.

Why weren't statistics about teen-age driving after driver education reported?

PEORIA, ILL. MIKE WATERS

Contrary to popular opinion among adults, a car is very important to a teen-ager. Consider not only those who drive to high schools, night schools and even colleges but also those who drive to work. Also consider dating. Can you see a 20-year-old boy and his date getting on a bus to go to a movie, walking to a party, bicycling to a football game, or, worst of all, sitting as passengers while the boy's father drives them to a social gathering?

PROVIDENCE, R.I. WENDY HEMENWAY

Land sakes, child, we have seen it. Ask your father if he didn't get around on foot or on bus occasionally during his dating days. Matter of fact, it kept us all well and strong in the Olden Days so we could go fly planes and all that in World War II.

I'll be darned if I'm going to fight for a country that won't let me drive.

SPRINGFIELD, OHIO G. Cox

I think it was terrible to say such a thing about teen-agers because I am a grandmother of one, and he has to drive

(Please turn to page 8)

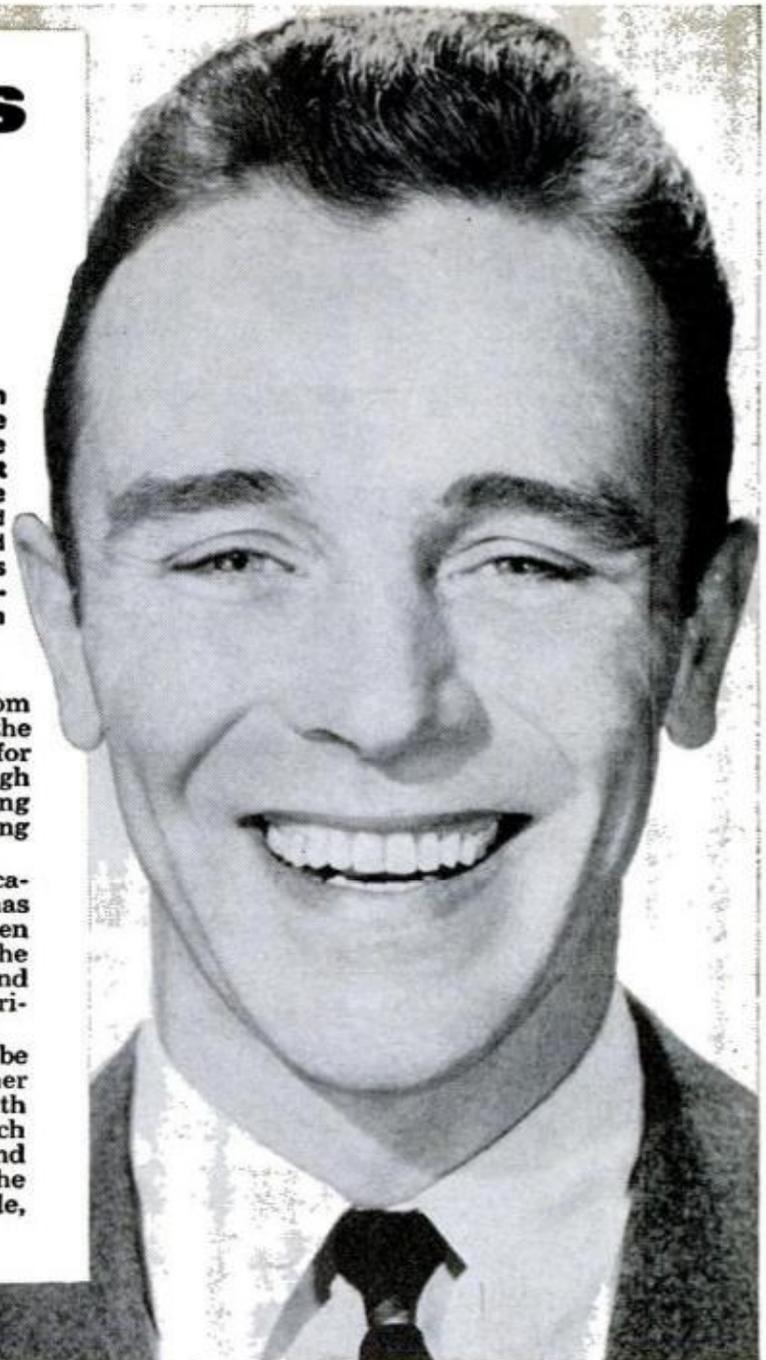
"Look who's smiling now!"

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City & State..... Zip No.....

Occupation..... Working Hours..... A.M. P.M.

LETTERS

(Continued from page 6)

every day to earn his living. I bet Tom Stimson who wrote the article was just like all teen-agers when he was one and I bet he had plenty of narrow escapes.

VERONA, N.J. MRS. LOUISE BARNES

Probably so, but nothing he's done in the past was as risky as writing about teen-age drivers. (And remember, Tom was reporting on Stanford Research Institute findings, which don't necessarily reflect either his opinion or ours.)

I have had my driver's license a little over one year and had two accidents—one on snow and one in the rain. Given just one-third the space it took Mr. Stimson to downgrade us young drivers, I'm sure anyone could give an entirely different side.

FOWLerville, MICH. NELSON MONROE

We-l-l-l, maybe . . . but try something else for openers.

Tires don't matter

The fact that a car is on rubber tires has absolutely nothing to do with safety in a

car during an electrical storm (*Letters*, page 6, Oct. PM). The car body forms a closed cage capable of carrying a huge electric current around anything inside.

WATERTOWN, WIS. EDWARD H. STUEBE

You are safer because you are inside a "Faraday cage" which conducts the current without allowing it to get inside. But it would be very dangerous in an open car.

LYME, N.H. ROBERT DESME

Meter retriever

Your article on constructing a continuity meter from an old exposure meter (page 181, Sept. PM) is a great idea for our use. It seems to me that Joseph Braunstein's name has appeared on many very clever items over the last few years.

NBC NEWS DAVID KLEIN, SUPERVISOR,
NEW YORK NEWSFILM CAMERA LIGHTS
AND SOUND EQUIPMENT

'Answer is simple'

The answer to *How Fast Is Too Fast?* (page 71, Sept. PM) is simple: The car is going too fast when the speed controls the driver instead of the other way around.

HUNTINGTON BEACH, CALIF. LOUIS MULLER



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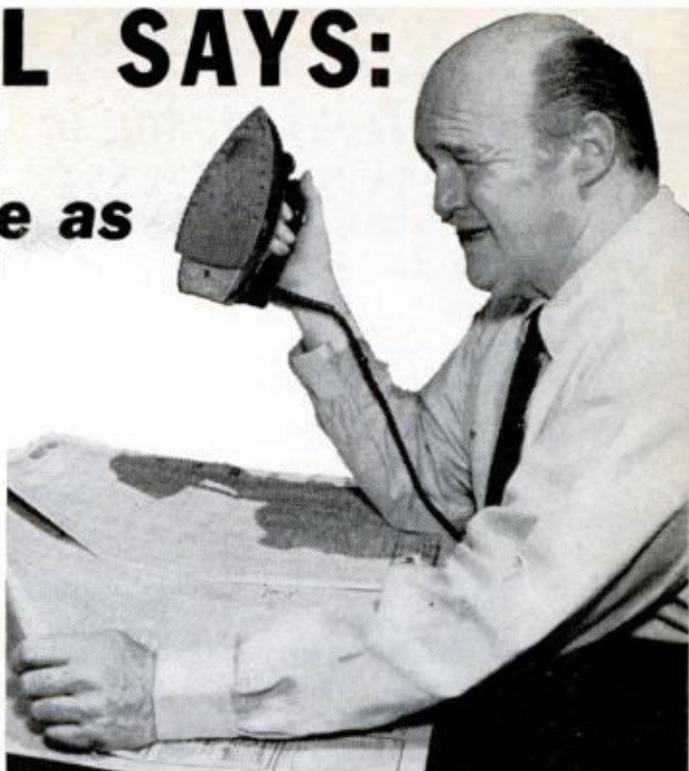
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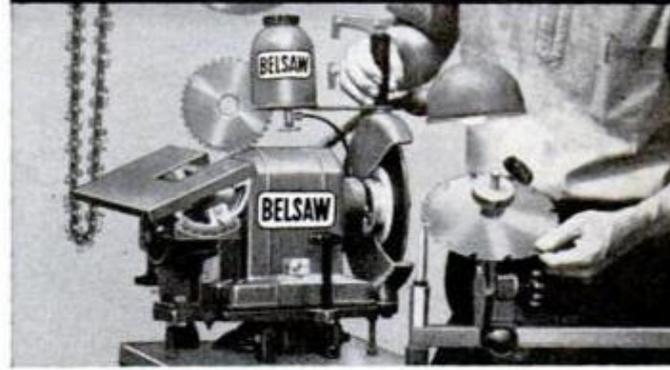
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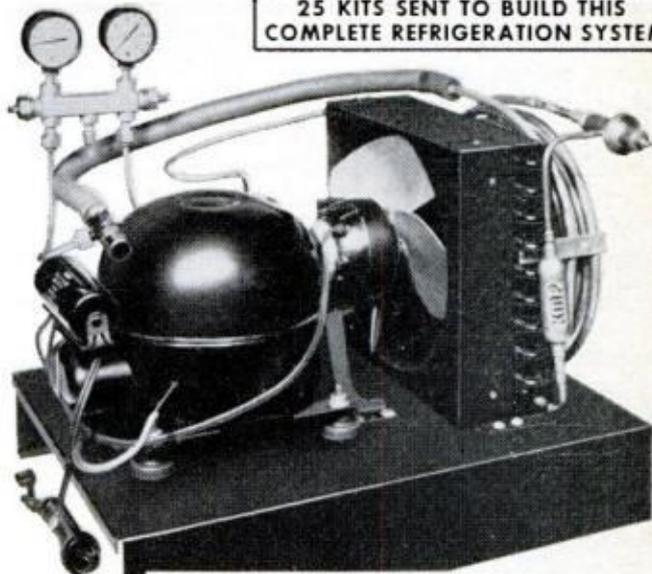
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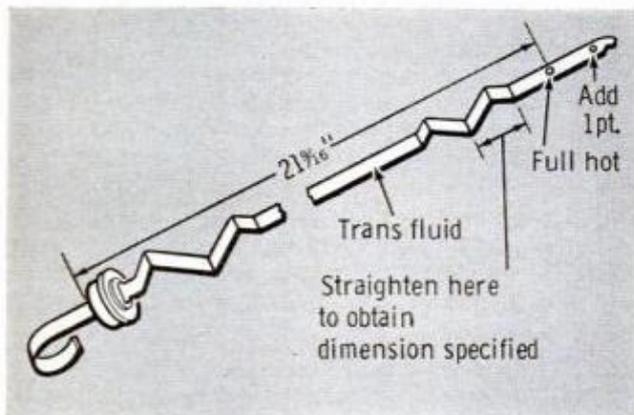
BY MORT SCHULTZ

Short stick—big trouble

I'm losing transmission fluid out of the vent of my 1965 Corvair with Powerglide. A pressure test of the transmission reveals that all is within limits. So why the loss?—Jack Hyman, Sacramento, Calif.

One good reason may be that you're overfilling the transmission without knowing it. Some early production 1965 Corvairs had fouled-up Powerglide dipsticks that gave a normal "full" reading when the transmission was actually overfilled. The stick was too short.

I'd measure the distance of the dipstick between the full mark and the top surface of the vent cap. It should be $21\frac{9}{16}$ inches. If your measurement shows the stick to be $\frac{1}{8}$ inch or more short, straighten out the lower accordion fold to get the correct dimension as shown below.



Stopping squeals

Here's a beaut. I get a loud squealing noise on hard turns with my 1965 Pontiac. I've been advised to get new tires, but I don't buy that. Do you?—John Wachtel, Roanoke, Va.

No sale, John. Some of those 1965 Pontiacs with 8.55 x 14 tires squealed like mad on hard turns because the front tires jumped the stop and contacted the frame. Check this by getting beneath the car and inspecting the frame adjacent to the tires. A shiny area where the frame has been rubbed clean indicates the trouble.

The problem is solved by installing a new wheel stop (part No. 9777335), which you can get from a Pontiac dealer. It has a more pronounced lip that will keep tire and frame from rubbing shoulders.

Put out about throw-out

I'm at my wit's end. I can't keep clutch throw-out bearings in my 1963 Dodge Dart. I've replaced five within the last six months. Even a complete new clutch assembly hasn't helped. I'd appreciate your comments on this.—N.E. Sinamark, Oakland, N.J.

There are two malfunctions that can ruin throw-out bearings. Check for misalignment of the transmission and bad motor mounts.

Sometime power windows

The power windows of my 1965 Cadillac operate on a catch-as-catch-can basis. It's a toss-up whether they'll work when I press the button. Does this indicate a major repair or something real simple?—Sid Lane, Phoenix, Ariz.

A poor electrical ground between the door and the car's body could be at the root of this problem. Why not try installing a ground wire (12-gauge standard about $8\frac{1}{2}$ inches long) between the door-hinge pillar and the body-hinge pillar. Prepare it with a terminal on each end and install with self-tapping screws. Make sure the wire won't be pinched or chafed when the door's opened and closed.

Riding high

I have just bought a used 1963 Comet. It seems to me that this car is riding awfully high in the front. My gas station mechanic can't figure it out—neither can I. Can you?—Pat Fountain, Kansas City, Mo.

The previous owner may have had the front coil springs replaced. In doing the job, the springs may have been installed in a position that allowed them to ride on top of the spring stops. This will result in cocked springs and increased riding height. If I were you, I'd remove the springs and reset them. Bet that will clear up the problem.

All choked up

My friends and I have 1965 Oldsmobiles and the same trouble—cars that are tough
(Please turn to page 20)



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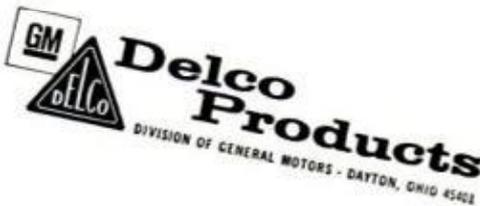
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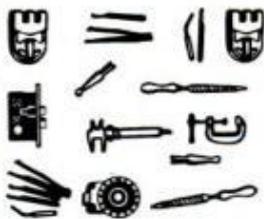
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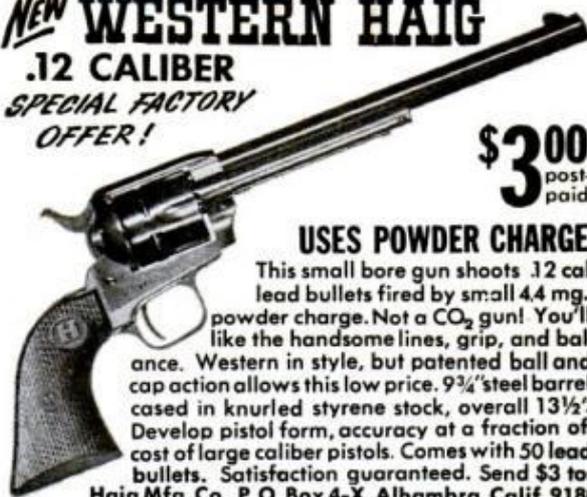
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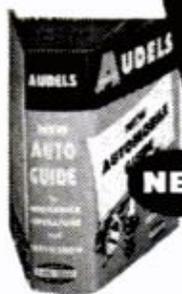
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AUTOMOBILE CLINIC

(Continued from page 14)

to start when cold. Both vehicles are tuned to perfection and receive frequent maintenance. Is this an inherent bug?—Louis Hopewell, Concord, Mass.

This problem is not new with owners of this model. It's been traced to a binding choke coil spring which is easy enough to fix. Blow dirt out of the choke housing and choke piston with compressed air while actuating the choke valve by hand to loosen dirt. Inspect the contact area of the choke coil spring and choke actuating lever for burrs or sharp edges that could be impeding action. Polish down any you find. Check and set the choke piston flush with the bore. Finally, set the choke at the index notch for two-barrel carburetors and at one notch rich for four-barrel carburetors.

Make sure the choke linkage operates freely, too.

Service Tips

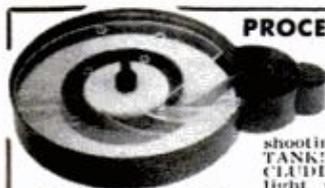
● **The engine oil dipstick** used in some early 1967 Darts with 170 or 225-cu.-in. engines is giving an improper oil level reading, Dodge tells us. With the correct amount of oil (four quarts), the stick shows a quart overfilled. You have the wrong stick, if it has a black handle. The right one (part No. 2463443) comes with a red handle.

● **A no-drive-in-any-range problem** could turn up in 1965 and 1966 Plymouth, Chrysler, Imperial and Dodge cars with A-727 automatic transmissions. If you are so troubled, the cause is probably a turbine that has failed inside the torque converter. Have your service chief check it out according to service bulletin 66-92 (8/3/66).

At the worst, the torque converter will have to be replaced with a new assembly (part No. 2801305).

● **Oldsmobile tells us** that in some 1967 F-85s water could be following the chassis harness through the cowl to the hazard warning flasher. To offset this possibility apply sealer around the area where the wiring harness enters the car's interior. ★★

Each month Auto Clinic answers questions on car repair. For a personal reply, send 50 cents in coin to cover mailing and handling. Write Auto Clinic, Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022. One question per letter, please.



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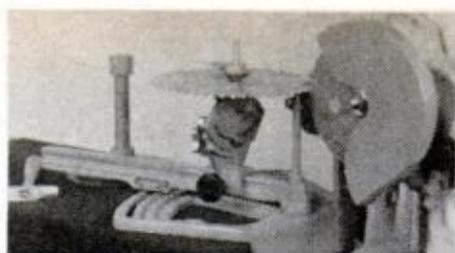


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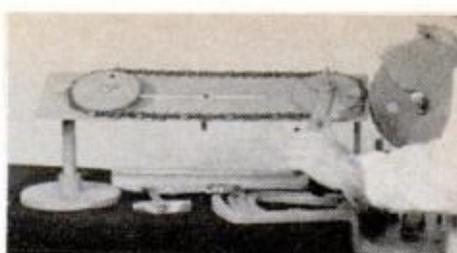
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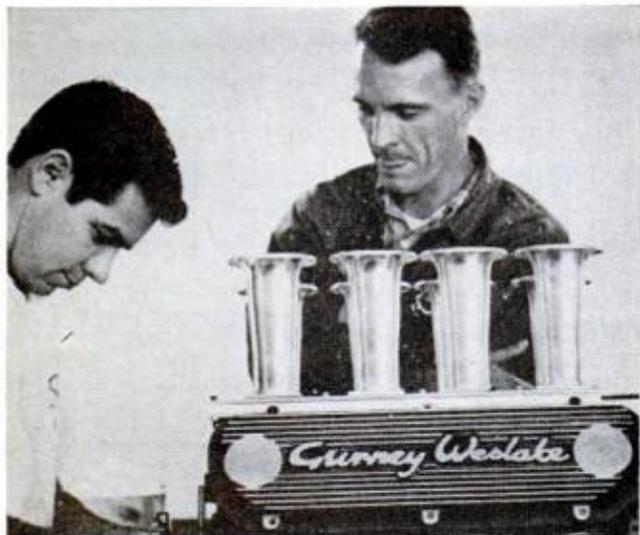
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Drivin' with Dan

Do you plan to compete in more stock-car races? Can I use an enlarged 390 Ford engine on the street? What's the most beautiful GT-type racing car? Dan Gurney answers these and other provocative questions



DAN WATCHES as John Miller, chief engine builder for All-American Racers, assembles Gurney-Weslake Ford sports-car powerplant in the AAR engine room

Q. If Ford doesn't race its big prototype cars in the Daytona Continental and at Sebring, will you compete in more stock-car races—the Daytona 500 maybe?—M. M. Frederick, Waterloo, Iowa.

A. That is not the plan right now. I expect to be devoting more time to our Indy car testing and developing, and our new Formula 1 car work. We at AAR have homework to do. We want to win more of the races that we do enter, and that requires "homework."

Q. I read that the reason your Eagles didn't do well in the British Grand Prix is because they didn't corner well enough. I thought chassis and suspension was supposed to be their strong point. —George Lawrence, Albany, N.Y.

A. We have never been satisfied with the Eagle's handling, although it has shown lots of ability on many occasions. At the British G.P. it was poor in several areas. Since then we've made considerable progress. Next year's Eagles should be very hard to beat.

Q. Bobby Allison is supposed to have said that Lee Petty is "the only one of the Chrysler gang who really knows how to make a hemi handle well on the big tracks." Do you think this is true? Also, what has the kind of engine got to do with handling?—Jim Frawley, Athens, Ga.

A. The Pettys have certainly proven their ability by winning so many races. I'm sure others know how to make a hemi handle as well, or almost as well, but there is more to winning. The hemi engine is heavy. The engine is up front, and this makes it tougher to get it handling. The rear wheels spin easier when you have a bigger percentage of the total car weight on the front wheels.

Q. Have you seen Bill Vukovich Jr. drive? Is he going to be as good as his daddy?—Andy Garelli, Flint, Mich.

A. Yes, I have seen him drive. A lot of people believe that he will eventually be as good as his dad was. I hope that he will be. That would be great for racing. Only time will tell. I don't know him personally, but I see his name often, and it seems that he is rapidly climbing the ladder.

Q. What is the most beautiful GT-type racing car in the world?—Lozell Broom, Petersburg, Va.

A. Recently, GT racing cars have been styled more by aerodynamic considerations rather than having the aerodynamic characteristics dictated by styling. Since they all must conform to certain dimensional rules set down by the FIA in Paris, they bear a resemblance to each other. To answer your question I'll pick the Le Mans Ferrari of 1967.

Q. Four of us are considering buying a wrecked '67 or '68 Corvette, modify it and enter it at [\(Please turn to page 26\)](#)



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DRIVIN' WITH DAN

(Continued from page 24)

Sebring. What class would we be in, who could we get to sponsor us, and what do you think of our chances?—Charles Hoh, New Richmond, Ohio.

A. You would race against other Corvettes, Mustangs, Porsches, Ferraris and some slower cars. I'm not up-to-date on Sebring regulations because we can't afford to race there (heavy on investment, light on prize money). You must get regulations. Try writing the ARCF, Sebring, Fla. I suggest that you attempt to get a small amount of sponsorship each, from as many Chevy dealers in your area as you can round up. You could win your class, even the race. You'll need good luck, a well prepared and engineered car, good driving, and so forth. Good luck to you!

Q. What do you think of oil additives?—Mike Fritz, West Des Moines, Iowa.

A. I have seen racing men whose judgment I respect use additives even though they were not paid to use them. I feel they are sure that they help. These men were top stock-car racers at Riverside, Daytona and Atlanta. I'm not sure of all the benefits of additives, but I believe that they will beef up the strength of oil under severe racing conditions. I believe that additives cling to parts much longer and give more protection to an engine started after sitting in a garage for a long time.

Q. I understand Gordon Cooper, the astronaut, drove 25 laps at Indianapolis last summer and expressed a desire to compete in a championship race. How do you think he'd do?—Fred Morgan, San Antonio, Tex.

A. I would guess that Gordon Cooper would be the best judge of that. I know that he loves racing. He probably has more of what it takes than most racing drivers. I doubt if he really has the time required to develop fully all of his natural skills. The only way to find out is to get in there, do it and see. Lots of racing drivers have taken written psychology and aptitude and coordination tests such as astronauts must take. It would be very interesting to see how they stack up in various categories. It still wouldn't tell us what sort of astronaut J. M. Fangio would have been!

Q. I would like to enlarge a 390 Ford to 428 or

even 450 or 460 cu. in. Can I be sure of winding up with an engine I can use on the street? I don't plan to race it.—James Wilson, Collierville, Tenn.

A. Yes, you can be sure that it will be a usable street engine. The camshaft, carburetion and exhaust system, and compression ratio govern the personality of an engine, provided other things are satisfactory. Naturally, you will not get something for nothing; chances are the engine will not be as reliable over a long period.

Q. What did Ford do to its Mark IV cars after Daytona to make them so much better at Le Mans? And which car did you feel was the toughest to beat there?—Doug Kresse, Spokane, Wash.

A. Ford corrected the fault in the gearbox, which was the big weak link at Daytona. It also made body shape changes which improved lap times. The Fords were the toughest to beat. Next, of course, would have been the second-place Ferrari. It was a very tough car and it ran hard all the way. It averaged less than one mph slower over the distance.

Q. I understand Carrol Shelby is pulling out of All-American Racers and will build Formula 1 and Indianapolis cars on his own. How come?—Hank Fletcher, Canton, Ohio.

A. You really should ask Carrol. We are still friends. He is always welcome here and we continue to cooperate in many areas. Carrol's first responsibilities are naturally to Shelby American, and as his business expands he has to pull out of some of his lower priority commitments. Even Carrol can only be in one place at a time.

Q. Is Mario Andretti as hairy as the other drivers say?—Bill Hayes, Johnstown, Pa.

A. I've never seen him with his shirt off. He's not hairless, though, I'll guarantee you that, sight unseen. Let's say most drivers are bald in comparison, how's that? ★ ★ ★

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 14).

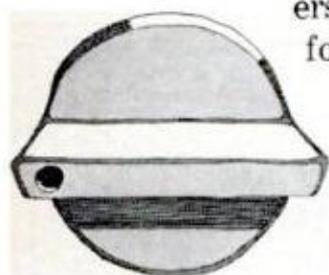
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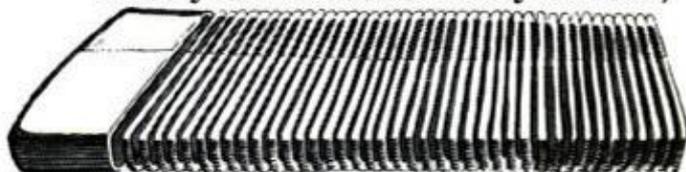
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DETROIT

LISTENING POST

BY BOB IRVIN

MAJOR CHANGES ARE PLANNED IN 1969 for many of the industry's full-size cars. The Ford and General Motors standard models will have all-new bodies. In the case of Ford, there will be new frames, too. These will be energy absorbing, designed to collapse under controlled conditions in an accident. Chrysler, which put all-new sheet metal on Plymouths and Dodges in 1967, will defer the next big change until 1970.

OTHER CHANGES PLANNED FOR 1969 include an all-new Mustang, first since the original "sporty" car was introduced in 1964. The long-hood, short-deck theme will remain, though. Also coming will be a two-door Lincoln Continental convertible. It will replace the four-door softtop Lincoln dropped a couple of years ago, a car much in demand since its discontinuance. Another softtop expected to be out in 1969 is a convertible version of American Motors' Javelin.

MICROCIRCUITS WILL MAKE THEIR LONG-AWAITED BREAKTHROUGH in the 1969 automobiles. The only use on the 1968s is a voltage regulator with integrated circuits made by GM's Delco Radio Div. and offered as an option by Pontiac. Some outside electronics makers accuse the auto industry of being too cost-conscious and refusing to use microcircuits until the price drops to "almost zero." But, says one West Coast manufacturer, next year will see an increasing use of the tiny circuits.

A NEW COMPUTER-CONTROLLED, FUEL-INJECTION SYSTEM on the 1968 Volkswagen squareback and fastback sedans surprised some Detroit auto men, who had trouble making some conventional F.I. systems work in the past. VW claims the gadget is the first of its kind ever installed in a car and is "truly a computer because it makes decisions. It takes seven pieces of information and puts out one—how much fuel to give the engine." It measures such things as engine speed, intake manifold pressure and cylinder-head temperature and maintains the proper voltage for the electrical system. The device is about the size of a two-pound box of candy and fits into the left rear fender. VW dealers won't have to worry about repairing it. If there is a malfunction, the unit is simply removed and another one installed.

GM'S ELECTRONIC TRANSMISSION has a target date of 1971. Like VW's fuel injection system, GM's new transmission is computer-controlled. It's said to be a simplified version of the one tested in the Chevrolet-powered Chaparral sports car. The electronic device measures such things as torque, engine rpm and manifold pressure to determine optimum gearshift conditions. It would be the biggest change in transmissions since GM introduced the first Hydramatic almost 30 years ago.

ANOTHER GAS-TURBINE ENGINE has been designed by Chrysler. The experimental powerplant will be considerably smaller and weigh less than earlier models. It will offer better mileage in city driving, yet provide for improved performance. However, Chrysler has shifted the whole turbine program into low gear. It now agrees with Ford and GM that the first use of turbines in motor vehicles will be in trucks, but apparently Chrysler is willing to let its competitors do the pioneering. A far cry from its 50-car consumer test program conducted on turbines a few years back.

SATELLITES may be used by 1970 to make highway studies for the federal government. The equipment's now available, and officials feel it may be both cheaper and more efficient than the on-the-ground studies now being made at a cost of more than \$10 million each year. In mid-1968, General Electric is expected to recommend whether

(Please turn to page 26F)

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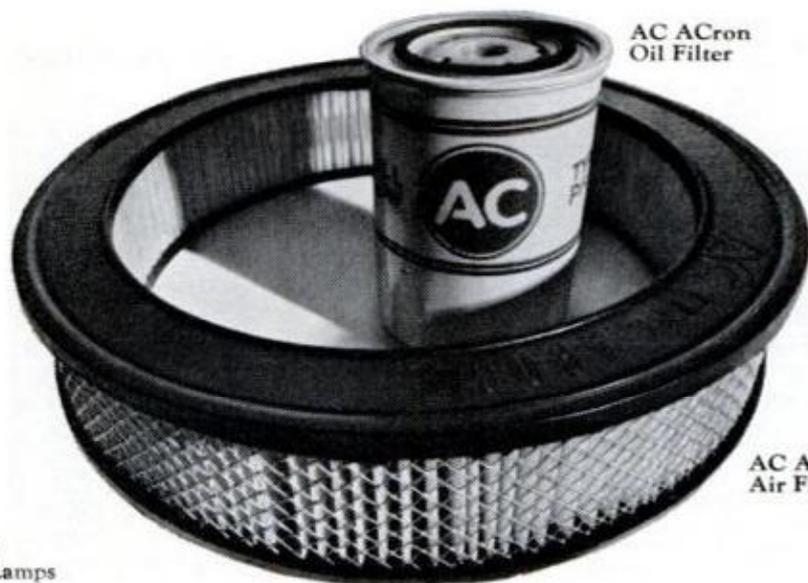
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(Continued from page 26D)

to use satellites or high-flying aircraft—such as the U-2—for traffic research. It's doing the preliminary work under a federal contract. The satellites or planes would first be used for photographic studies, later would be part of a master highway control system for a whole section of the country. This would make those helicopters used by metropolitan radio stations for traffic surveillance of expressways look like the horse and buggy era.

NEW-CAR WARRANTIES were restricted with the 1968 models because of mounting problems encountered by the manufacturers and dealers. The guarantees still last for five years or 50,000 miles on the power train and 24 months or 24,000 miles on the rest of the car. But restrictions have been placed on the number of successive owners for whom the guarantees are valid. This is because Chrysler, which pioneered the 5-50 in 1962, found that after a car had been sold two or three times it was almost impossible to prove that all the owners had followed recommended maintenance procedures. So Chrysler, followed by AMC, limited the warranty to the first two owners. GM and Ford put the clamps on even tighter. Their restrictions are such that only the original buyer can count on the full 5-50 guarantee. Despite the rollback, the present warranties are still far better than the old 90-day, 4000-mile guarantee.

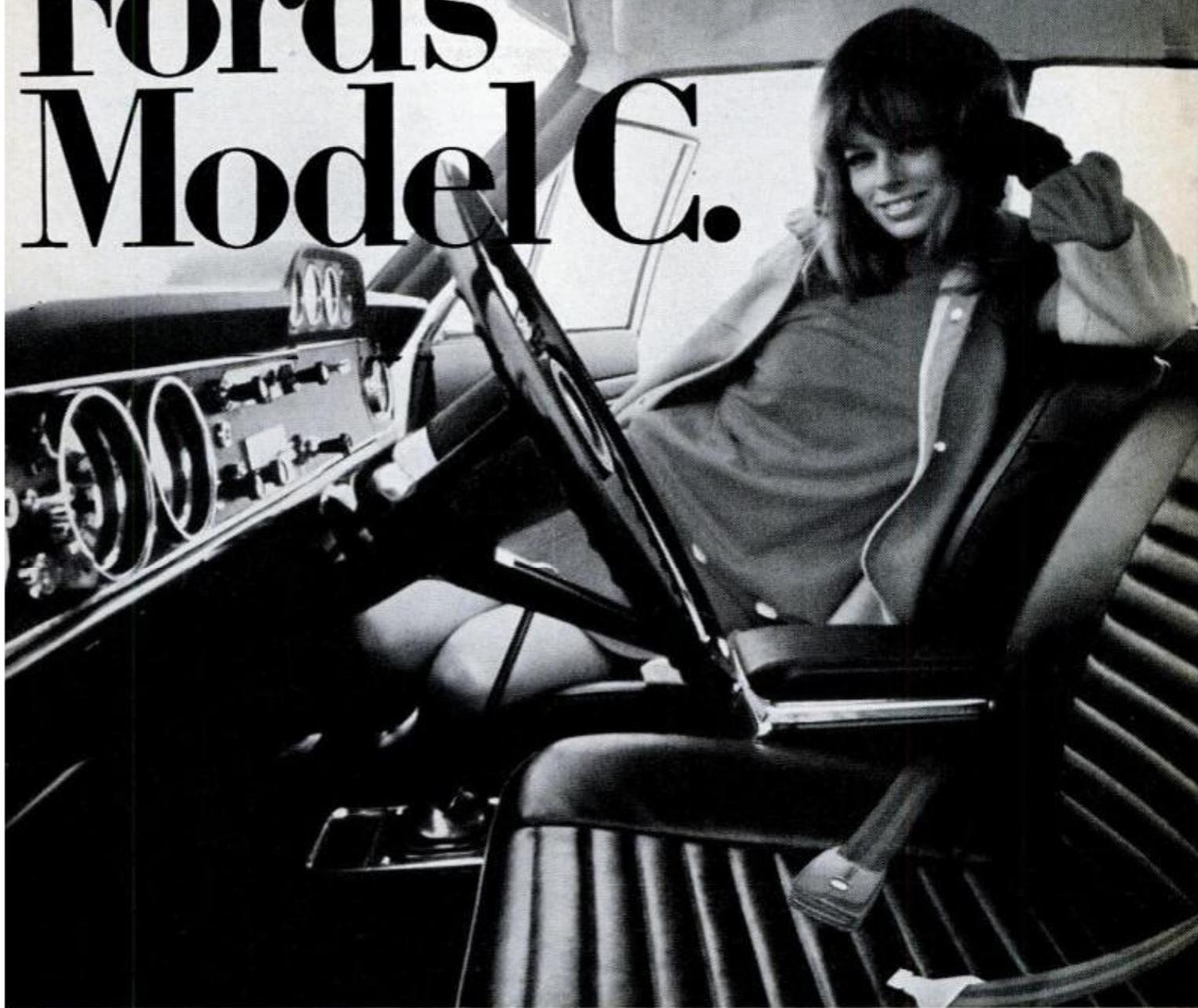
PRICES OF THE 1968 MODELS may go up even more. Automakers are considering a January increase to cover costs of adding shoulder belts to cars. And they hint they may raise prices because of the high cost of labor peace. It would be the fourth sticker price rise in three years.

MAPLESS DRIVING? Yep, and here's how it would work: At the start of a trip a driver hops in his car and dials a code number representing his destination. The number is read by route guidance equipment inside the car. The equipment automatically transmits the code to key roadside equipment, which then transmits—either by voice or visual display in the car—routing instructions to the driver.

Sounds crazy? GM is working on just such a gadget under federal contract. The company in recent years has devised other experimental systems for automatic driving and one day soon hopes to offer future motorists the pleasant prospect of being able to drive anywhere without using either road maps or signs. ★★★

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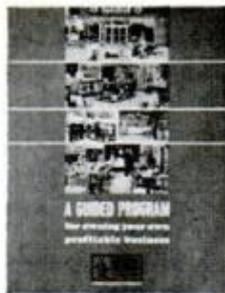
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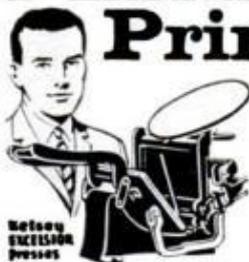
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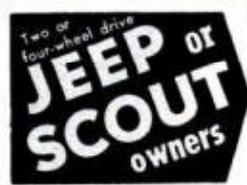
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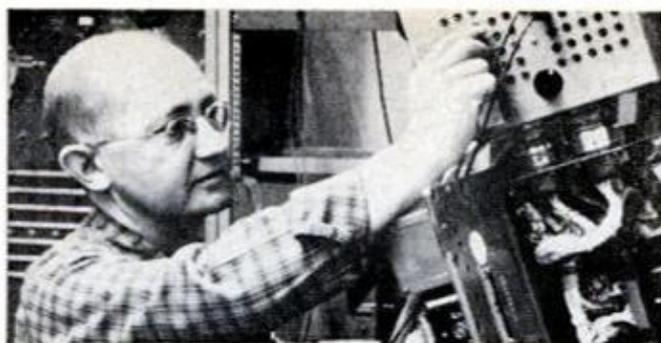
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The chances are you can't buy new pegs. You'll have to make them yourself, or have them made if the turnings are detailed (especially if they have complex beaded or fluted surfaces). If the pegs are straight tapers, however, you can make them from short lengths of dowel with the same diameter as the originals. Just whittle them down with a sharp pocket-knife and sand to a uniform taper. Stain and finish to match.

To remove the broken portions of the pegs, use one of two methods: drill out the waste with a twist drill slightly smaller in diameter than that of the peg (measure this at the point of the break so that you do not enlarge the tapered hole). Then break away the waste, fit the new pegs and glue them in place. If you can't drill out the waste because an irregular break makes it difficult to start the drill, then drill through from the back and drive out the broken pieces with a pin punch or a short length of steel rod.

Getting ready to paint

I have two questions:

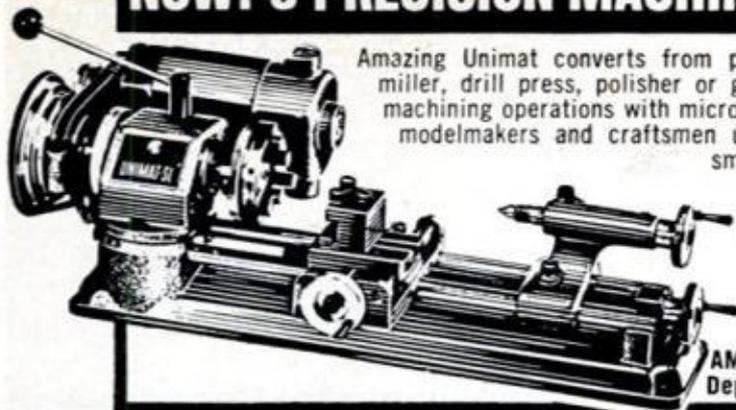
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2. How do you cover red paint with white and not get a bleed-through?—G.H., Tex.

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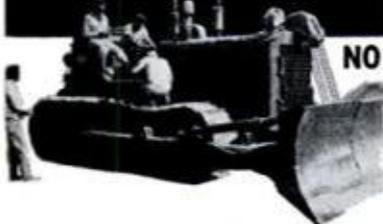
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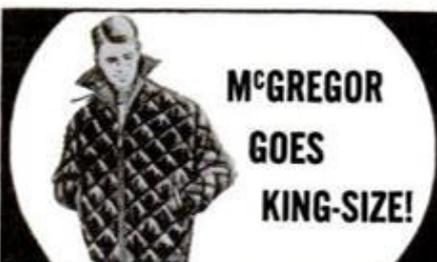
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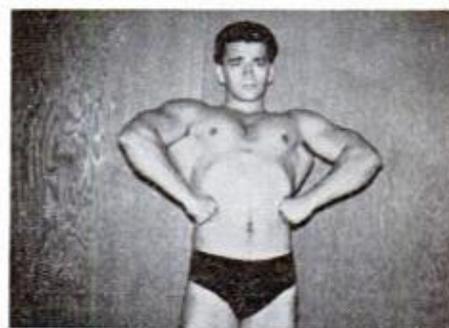
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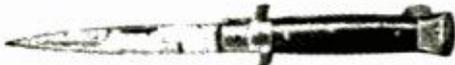
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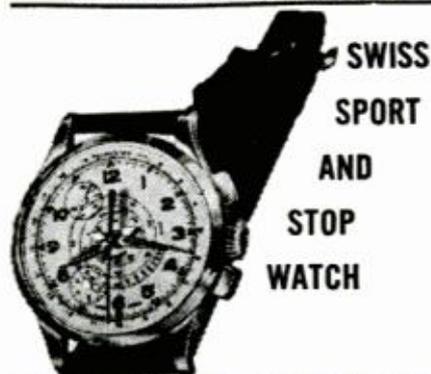
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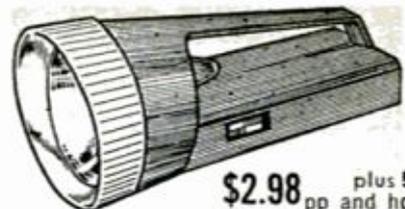


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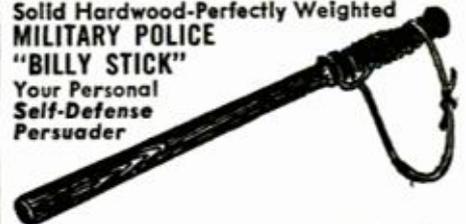
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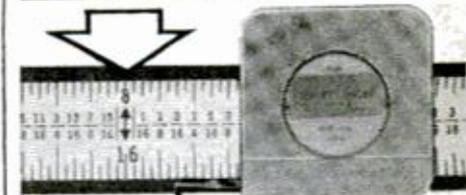
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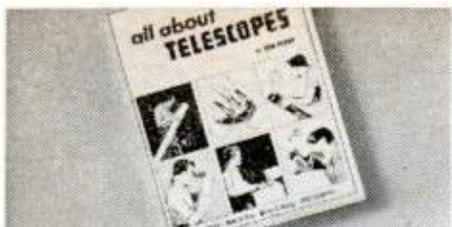
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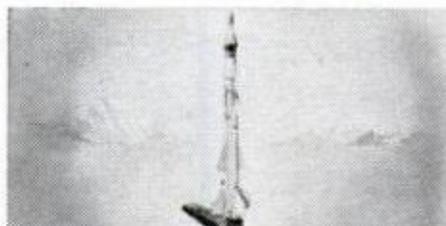
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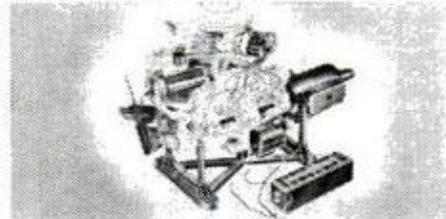
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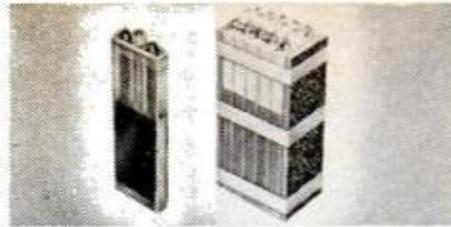
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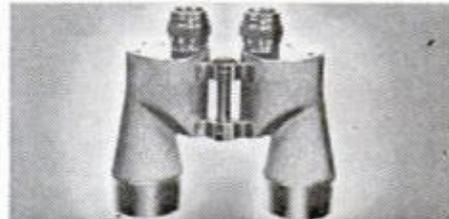
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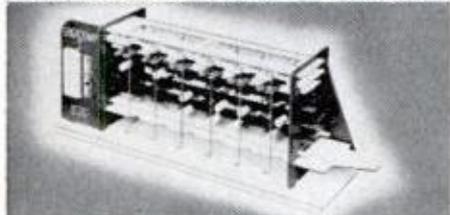
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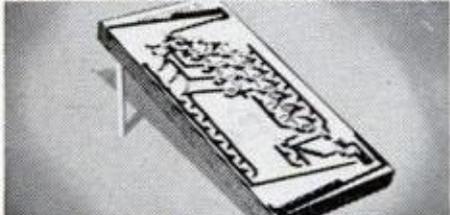
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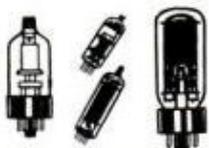
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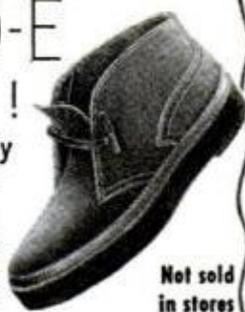
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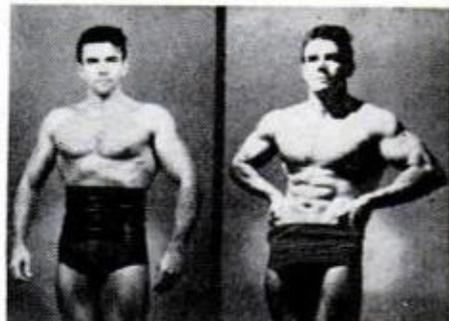
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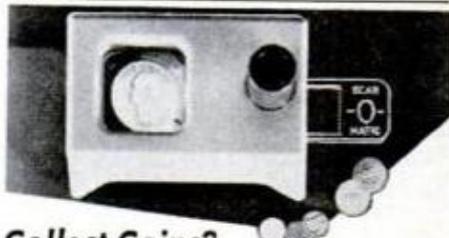
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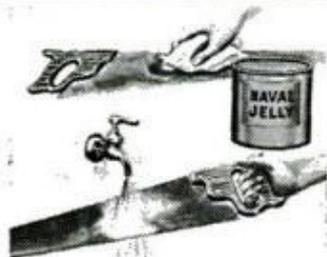
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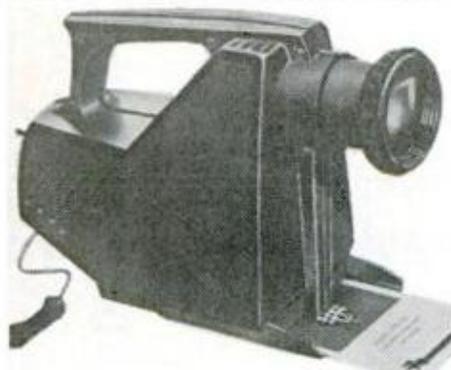
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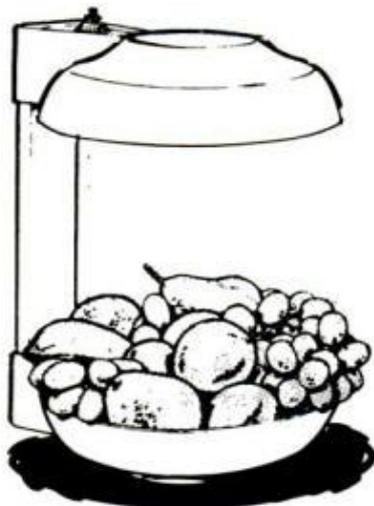
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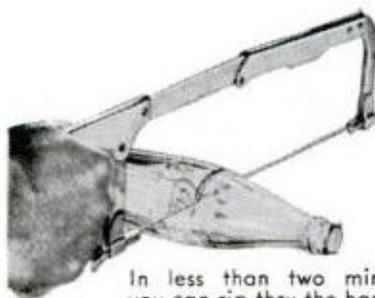
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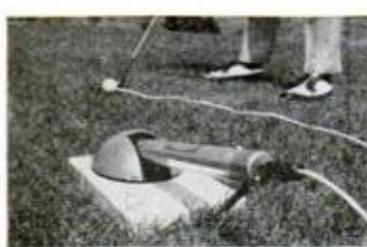
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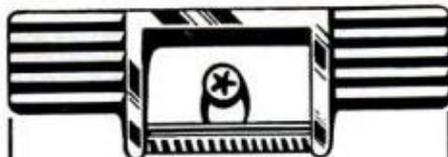



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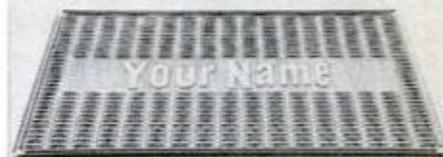
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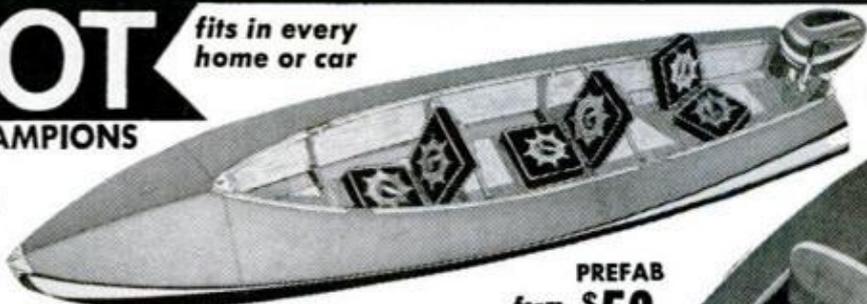
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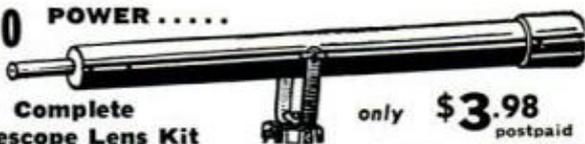
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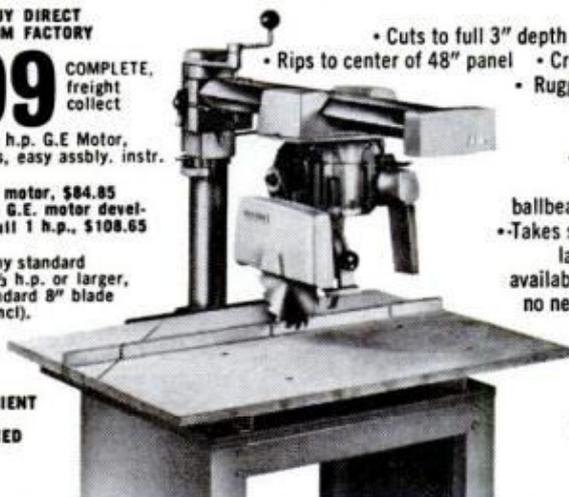
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OFFSET Printing. Varga Quick Copy, 350 State Street, Rochester, N.Y. 14608.

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PRINTING Presses, type, supplies, Lists, 5¢. Turnbaugh Service, Mechanicsburg, Pennsylvania 17055.

TYPE Cases, cabinets, Manufacturer, Catalog. King McKay Company, 23179 Telegraph, Southfield, Michigan 48075.

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FROM THE PATENT OFFICE **NEW INVENTIONS** BY M. J. PEDERSEN

ELECTRIC STEERING for cars has earned patent 3,330,372 for Antoine Brueder, who assigned rights to the French auto firm of Andre Citroen. The wheels are turned by a system of servo motors. To prevent a car from being flipped by too sharp a turn, the system automatically makes the steering wheel harder to turn as the car's speed is increased.

TRACKING MISSILES is no simple matter when the missiles are shrouded in a cloud of chaff—radar-reflecting material released into the surrounding sky to confuse enemy radar. But chaff floats and falls erratically, while a missile tends to gyrate around its center of gravity at a fairly regular rate. A tracking system that detects this difference, responding only to a target with a "wobble frequency," has earned patent 3,341,850 for Leonard Kings and Donald Reiser.

A MOON VEHICLE consisting of a series of huge metal hoops with a cabin suspended within them has received patent 3,327,801 for Dr. Arthur Ezra. The hoops form a sphere that can roll in any direction, while the cabin remains upright at all times. Power is supplied by a small rocket or jet engine that can be aimed to steer the craft.

GARDEN MULCH may be made from sugar cane stalks whose sugar has been pressed out. Such stalks, called bagasse, are compressed in bales and left to weather for 60 days. Nitrogen is then added and the bales are chopped up into uniform size. If mixed with wood fibers, the bagasse serves as an effective anti-erosion material. Patent 3,337,326 was awarded Harry May of Jackson, Miss., and Harry Nadler Jr. of Thibodaux, La.

CONVERSION OF RAW SEWAGE into relatively harmless digested sludge may be accomplished much faster if a weak alternating current is passed through the bacteria-containing sewage in a digestion tank. After the sewage is completely digested, the current can be increased sufficiently to kill off the bacteria, thereby producing sterilized sludge that can be used as fertilizer. George Neidl received patent 3,336,220. ★★

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What a difference a name makes

BY JOHN F. PEARSON
SCIENCE
WORLDWIDE

AUSSIE CIGARETS are much more dangerous than American, according to a survey by the Anti-Cancer Council of Victoria, Australia. Popular Australian smokes issue up to 40 percent more tar and nicotine than normal in U.S. brands.

HUGE JET PLANES may get a big boost in takeoff lift from rotating cylinders built into their wings, according to results of experiments at Ames Research Center, Moffet Field, Calif. The purpose of the research is to cut down the distance it takes for big jets to get off the ground. The bigger planes get, the longer runways must be. The work at Ames, a branch of the National Aeronautics and Space Administration, involves converting into lift capacity some of the enormous initial power required by planes to reach takeoff speed. The cylinders on the leading edges of a plane's wing flaps increase lift by as much as 50 percent.

DANGER LURKS IN THE POP of a champagne cork, say British physicians. An increase in eye injuries caused by flying corks led researchers to test the power that is contained in bottles of the bubbly liquid. They found that a champagne cork travels at 45 feet per second on release and can reach a height of 40 feet when "shot" from an upright bottle.

RABIES IS A SERIOUS THREAT to American forces in Thailand, according to a recent report in *Medical World News*, a professional journal. Thousands of stray dogs roam free because of a Buddhist prescription against killing of animals. Tests indicate that 4 percent of such dogs are infected with rabies.

AN OLD LIBERTY SHIP purposely scuttled in the Pacific south of the Aleutian Islands has finally been found. The ship was loaded with 2000 tons of obsolete bombs, mines and torpedo warheads—a cargo set to go off when the ship reached a depth of 4000 feet. But the explosion, designed to help Defense Department scientists evaluate a worldwide nuclear test detection network, didn't come off. Precise location of the hulk defied all efforts until the Navy oceanographic ship, the *Silas Bent* (my old friend, whose operations I was first to report on in the April '67

PM), was sent to the scene. A deep-towed magnetometer detected the hulk and a camera brought up photos pinpointing the ship at a depth of 2800 feet.

PLASTIC HORSESHOES are beginning to replace the old-fashioned metal jobs. Now researchers at Virginia Tech in Blacksburg, Va., are trying to find a glue to substitute for nails in attaching them.

HIGH ALTITUDES affect men and women in different ways. That was recently established in a 10-week study made at 14,110-foot Pikes Peak, according to a report from Fitzsimmons General Hospital at Denver. Eight coeds reported suffering from headaches, fatigue, insomnia and menstrual changes. Eight men in the study complained of palpitations, shortness of breath and chest pains.

FACTS, THEORIES AND DEFINITIONS normally scattered throughout a score of texts can now be found in a handy one-volume reference. It's the *Cowles Encyclopedia of Science, Industry and Technology*. Written in nontechnical language, the 910-page book offers information on technical and scientific processes, food and agricultural developments, industrial procedures, the mechanics of transportation and space exploration. Cost: \$9.95.

HEAVIEST SPECK OF MATTER ever definitely identified was recently created by physicists at the University of California. It's an isotope of mendelevium, has an atomic weight of 258, contains 101 protons and 157 neutrons and has a half life of two months. Mendelevium 258 was created by bombarding a target of einsteinium with helium atoms. The "gun" was the heavy ion linear accelerator in the Lawrence Radiation Laboratory at Berkeley.

GULF OF MEXICO OYSTERS are concentrating DDT and other pesticide residues in their tissues, report biologists at the Bureau of Commercial Fisheries laboratory in Gulf Breeze, Fla. Although the oysters may stay alive, many fish that eat them in lab tests die within 48 hours. Reason: Pesticide residues are transmitted at ever-increasing concentrations as they pass up the food web from simple to complex animals. ★★

The how-to-glue chart.

Type of Material	Glue For General Usage (In Order of Preference)	Glue For Maximum Waterproof Durability (Boats, Exterior Construction, etc.)
All general gluing of hard and softwoods	Elmer's Plastic Resin Glue Elmer's Casein Glue Elmer's Glue-All	Elmer's Waterproof Glue
Particle and chip boards to wood	Elmer's Plastic Resin Glue Elmer's Casein Glue Elmer's Contact Cement Elmer's Glue-All	Elmer's Waterproof Glue
Plywood to decorative plastic laminates	Elmer's Casein Glue Elmer's Contact Cement Elmer's Plastic Resin Glue	Elmer's Waterproof Glue
Laminating heavy framing members	Elmer's Casein Glue	Elmer's Waterproof Glue
Veneering, inlays, cabinetwork	Elmer's Plastic Resin Glue (extended) Elmer's Glue-All (small jobs)	Elmer's Plastic Resin Glue
Bonding oily woods (teak, pitch pine, osage, yew, etc.)	Elmer's Casein Glue—sponge surface with dilute caustic soda one hour before gluing	Elmer's Waterproof Glue
End-wood joints, mitered joints, scarf joints	Elmer's Glue-All Elmer's Plastic Resin Glue (heavy mix)	Elmer's Waterproof Glue
Loose-fitting joints, relatively rough surfaces	Elmer's Glue-All Elmer's Casein Glue (heavy mix)	Elmer's Waterproof Glue
Doweling	Elmer's Plastic Resin Glue Elmer's Glue-All	Elmer's Waterproof Glue
Hardboard to ply- wood, wood or itself	Elmer's Plastic Resin Glue Elmer's Casein Glue Elmer's Glue-All Elmer's Contact Cement	Elmer's Waterproof Glue
Gluing porous mate- rials—linoleum, can- vas, etc. to wood	Elmer's Plastic Resin Glue Elmer's Casein Glue Elmer's Contact Cement	Elmer's Waterproof Glue
Gluing plastics, metal foil, etc. to wood	Elmer's Casein Glue (sand both surfaces)	Elmer's Contact Cement
Gluing non-porous materials— glass, metal, iron, aluminum, bronze, brass, etc.	Elmer's Epoxy Glue	Elmer's Epoxy Glue

There's an ELMER'S Glue for every job you do.

Here's a handy guide for making sure you're using the right glue. Stick-it on your workshop wall. (With Elmer's, of course.) And you'll never have a sticky problem.



Pontiac Firebird 400. The top end. Heavyweight of Pontiac's Magnificent Five Firebirds for 1968.

The credentials below are the powers behind our Heavy. You'll find them all set smugly atop 400's extra-firm but obliging suspension, with new asymmetrically mounted, multiple rear springs and wide-ovals. And you can order knitted (the

better to breathe with) vinyl upholstery.

And, with every Firebird, the kind of safety that comes from seat belts and side mounted marker lights. And that's just the beginning.

Now, any guesses why we call the 400 the Heavyweight of our Magnificent Five? We didn't think there'd be any confusion. Pontiac Motor Division

**400 cu. in.
Quadra-jet 4-bbl.
H.D. suspension.
330 hp.
Hurst.**



The end.



MARK OF EXCELLENCE
WEEK OF EXCELLENCE

No Snorkel, No Scuba

ARTIFICIAL GILLS:

They'll Let You Breathe Like a Fish

Newest underwater breakthrough 'filters' oxygen from water

By WALLACE CLOUD

Illustration by Dale Gustafson

CAN MAN BREATHE like a fish? Why not? Talk to a few of the people who are working on the problem, and what once seemed incredible suddenly seems obvious: A diver doesn't have to carry air tanks—he can get oxygen from the water around him.

Like other science writers, I was a bit skeptical a few years ago when Commandant Jacques-Yves Cousteau, co-inventor of the aqualung, predicted divers would become "men-fish," *breathing water*. He claimed, also, that it would soon be possible to plug an "artificial gill" into man's bloodstream. Today, this is what's happening:

- Two American inventors have patented artificial gills that let a diver breathe into his lungs the oxygen that is dissolved in the water, and get rid of exhaled carbon dioxide by the same route.

- These gill systems promise to eliminate or minimize diving problems: the bends, nitrogen narcosis, oxygen poisoning. Conceivably divers will move up and down in the ocean as freely as fish, without decompression stops.

- Scientists now talk seriously of circulating the diver's bloodstream through a gill unit, bypassing the lungs. Two divers for an undersea-engineering firm have volunteered to undergo surgery necessary to implant such a device.

- The same kind of gill system can be used to supply fresh air in submarines and undersea stations.

When Cousteau, in 1962 predicted gills for men, he could not have known that one kind of gill had already been tested. The turning point came on Aug. 6 that year, when a Rutherford, N.J., research engineer named Waldemar A. Ayres and his wife went on a secret mission to Jones Beach, N. Y.

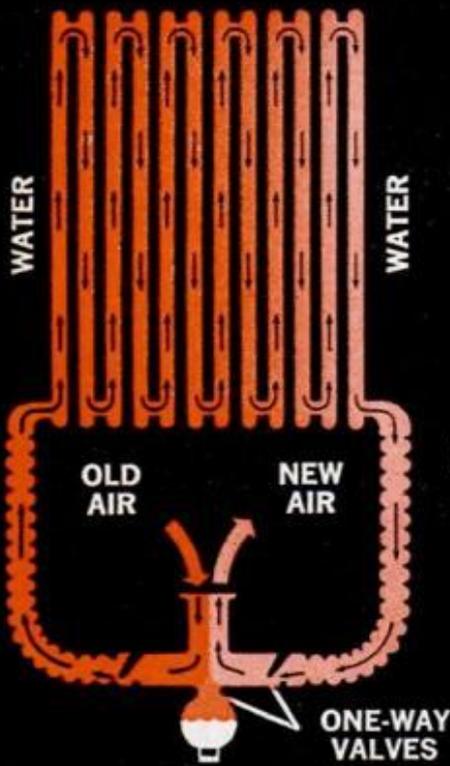
Ayres unrolled four foot-wide strips—actually flat plastic tubes, each 25 feet long—and carefully inspected them. (One side of each tube was made of fragile material.) He interconnected them with short lengths of garden hose and hooked up a scuba diver's mouthpiece. Valves at the mouthpiece were arranged so his exhaled breath would travel the entire combined length of the tubes, then be reinhaled.

He floated the tubes on the water, fragile side down. Then he sat down in the water, clamped his nostrils shut with a clip, put the mouthpiece in his mouth and proceeded to inhale and exhale through the apparatus for an hour and a half as it bobbed up and down on the waves. He stopped only when water leaking in made it hard to force his breath through the tubes.

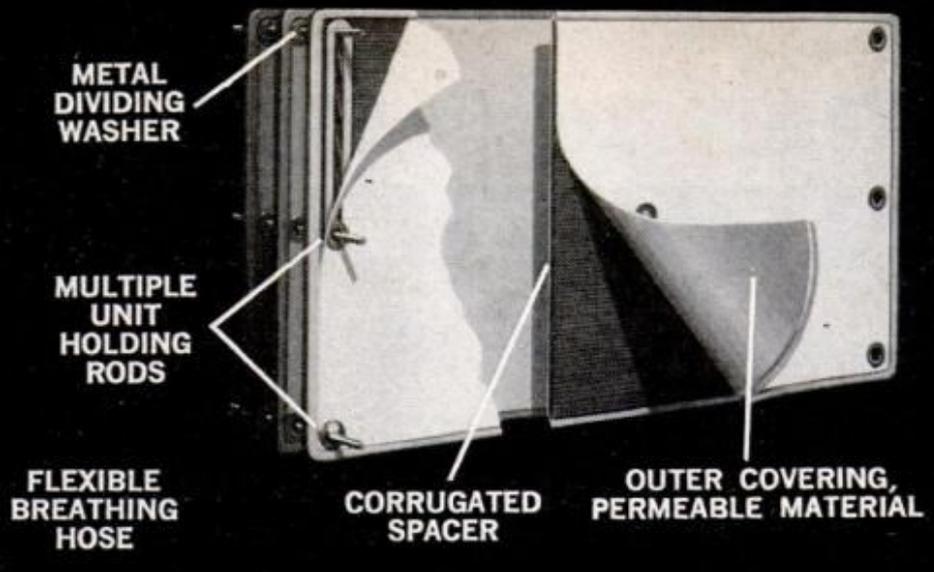
Wally Ayres thus became the first human to successfully breathe dissolved oxygen from the water like a fish.

How could he be sure? The top side of each tube was made of tough, airtight upholstery vinyl. No oxygen could get in from that side. But the side immersed in water was a spongy polyethylene

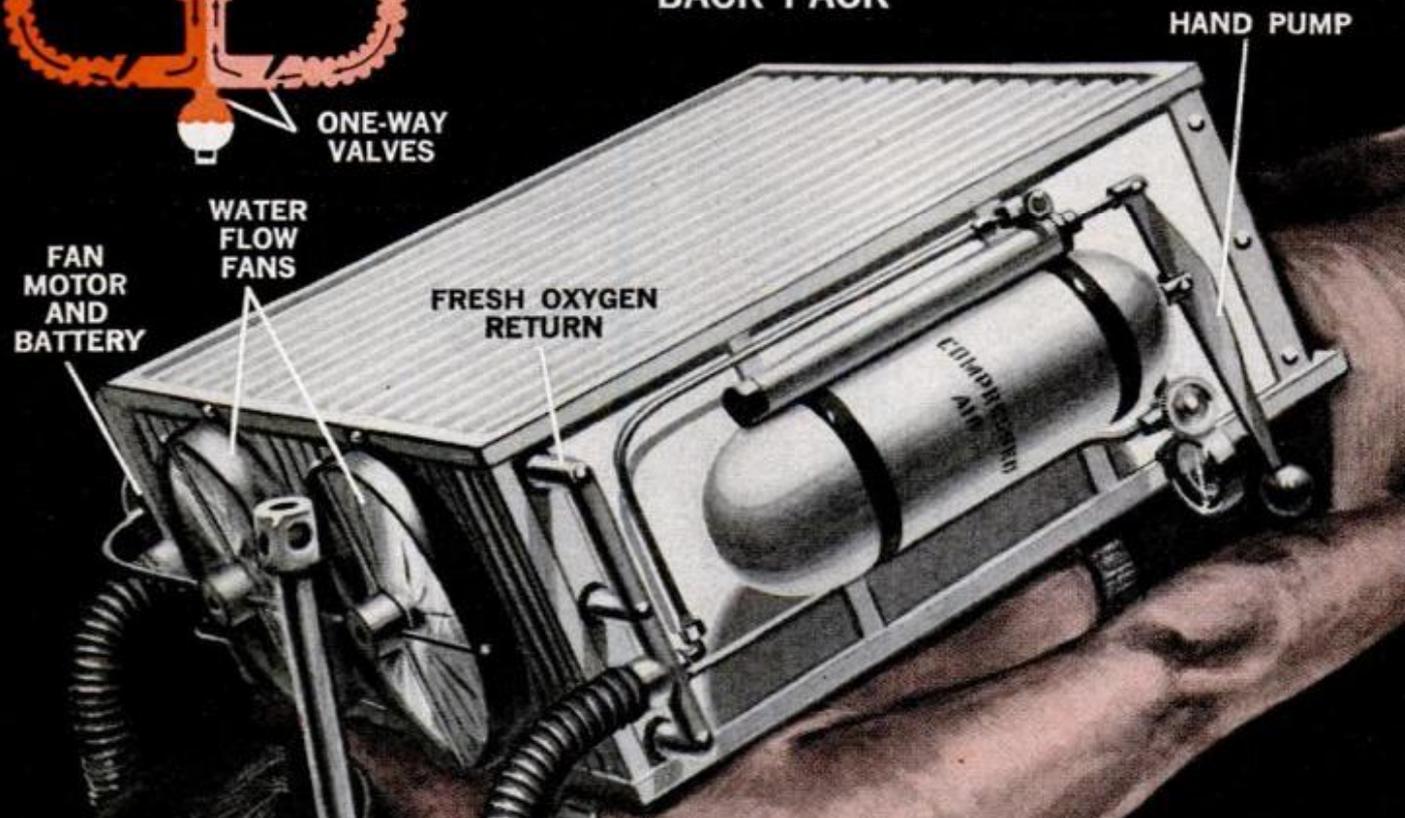
OXYGEN-CO₂ EXCHANGE CYCLE



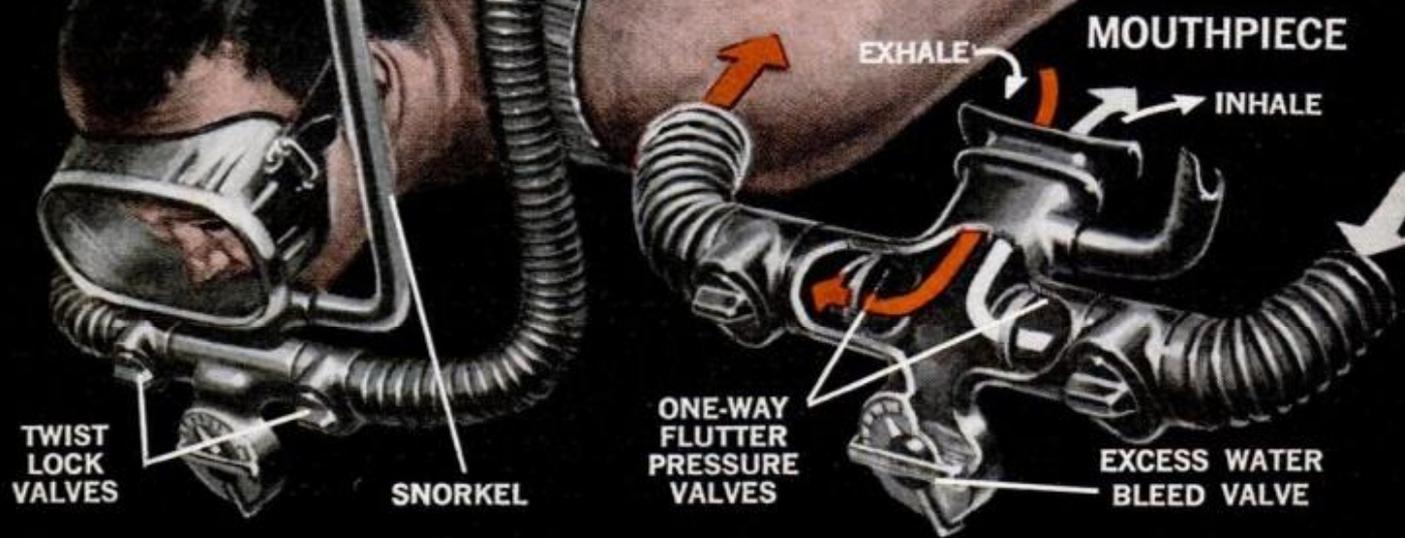
GILL MEMBRANE



BACK PACK

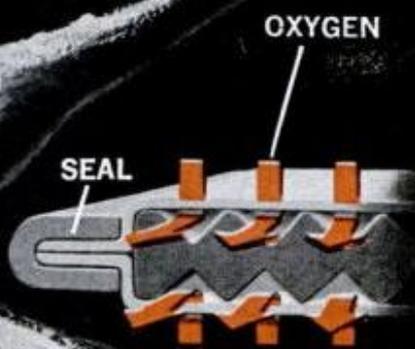


MOUTHPIECE



TWIST LOCK VALVES
SNORKEL

CROSS SECTION OF GILL



TWO-WAY STREET: Molecules of gas can go in either direction between larger molecules of the membrane; which way they go depends on "partial pressure"—a larger supply of molecules on one side of the membrane.

Oxygen molecules, more numerous in water than in diver's exhaled air, diffuse into gill through the membrane. There is a larger "population" of carbon dioxide molecules inside the gill than there is dissolved in water, so CO₂ travels out.

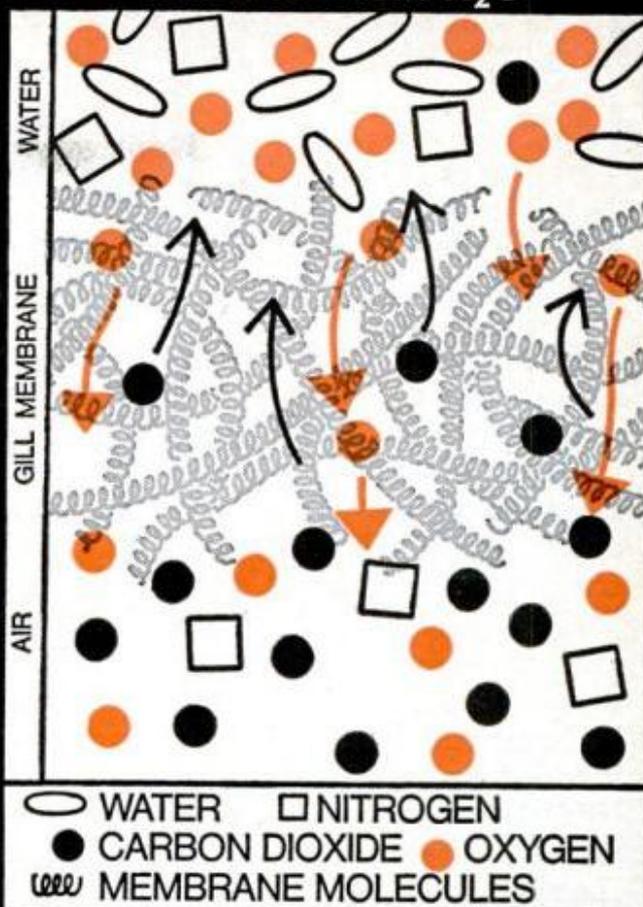
material—containing millions of microscopic pores—designed originally for baby pants. Through this membrane, his breath was in contact with the water; oxygen diffused from the water into the air in the plastic tubes, and carbon dioxide diffused from the air into the water.

If it hadn't worked, Ayres would have experienced the symptoms of anoxia and carbon dioxide excess: flushed face, difficulty in breathing. Or he could have passed out in minutes.

The next day Ayres repeated the performance while a friend observed, took pictures, and recorded the time. The information was then incorporated into an affidavit. Ayres was in the middle of a 10-year struggle to get the U.S. Patent Office to recognize his invention.

That's the way Ayres told me the story, which he had kept secret during the touch-and-go process of getting the basic patent (No. 3,228,394) on all underwater breathing systems using the gill principle.

HOW GILL SEPARATES OXYGEN FROM H₂O

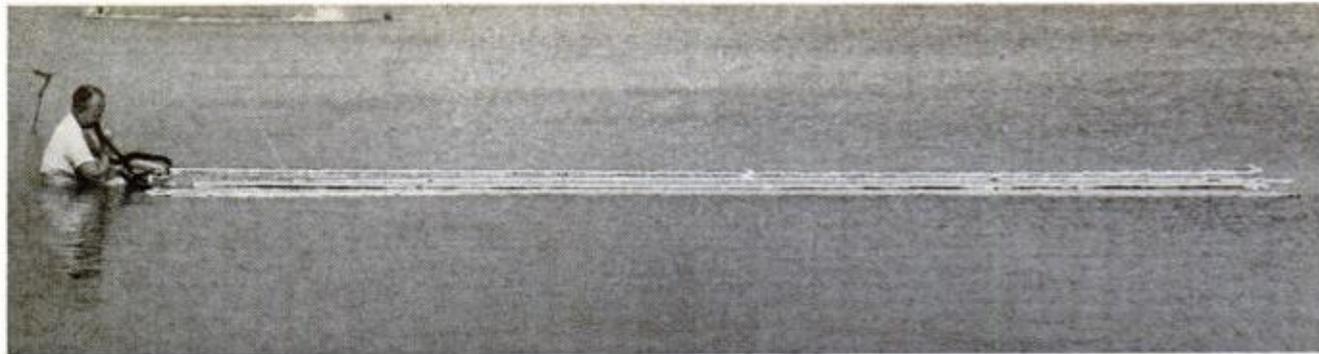


He had conceived the idea in 1955, while scuba diving in the Bahamas. After all, he reasoned, there isn't a vast difference between a fish's gill and the human lung. In both cases blood moves past one side of a membrane; on the other side is the oxygen-bearing medium—air or water.

Both gills and lungs work because of "partial pressure." This means that in a mixture of gases, the pressure of each gas is a fraction of the total pressure of the mixture. That fraction—the partial pressure of a single gas—is proportional to the percentage of the gas in the mixture.

For example: Air consists of about 78 percent nitrogen, 21 percent oxygen and small amounts of other gases including carbon dioxide. Atmospheric pressure at sea level is 14.7 pounds per square inch, so the partial pressure of oxygen in the air is 21 percent of 14.7 p.s.i.

In water exposed to the air, the gases are dissolved in the same proportions;



BREATHING 'LIKE A FISH,' Wally Ayres inhales oxygen diffused from water by 25-foot-long plastic tubes

while the *concentration* of the dissolved gases is less—about 1/30 as much as in an equal volume of air—their partial pressures are the same as in the air, with slight variations influenced mainly by temperature. This is true however deep in the sea you go.

If the partial pressure of a gas in *one* medium—air or water—happens to be greater than it is in the *other* medium, it tends to diffuse into the medium where its partial pressure is lower until equilibrium is reached. But that doesn't affect the behavior of any other gas in the system.

Blood, entering the fine blood vessels of your lungs, is depleted in oxygen, overloaded with carbon dioxide. It is separated from the air you inhale only by the thin membrane lining the lung, which keeps the blood in but is permeable to gases. Since partial pressure of oxygen in the air is greater than in the blood, oxygen molecules diffuse through the membrane into the blood. Similarly, the partial pressure of carbon dioxide is higher in the blood than in the air, so carbon dioxide passes out through the membrane.

Exactly the same process takes place between blood and water instead of between blood and air.

Ayres studied these processes in great detail. He satisfied himself that an artificial gill was practical. But he didn't reckon with the patent examiners—even though he has over a hundred patents. When he broached the subject at the Patent Office in 1955, said Ayres, "a look of horror came over the official's face. It said plainly, 'I've got a nut on my hands.'"

Ayres managed to get his application accepted, but the examiners rejected his broad claims. They boggled, for instance, at the key phrase, "extracting dissolved oxygen from seawater." In 1962 a patent examiner insisted on "proof of operability." That meant Ayres had to build working test equipment. He experimented, came up with the Jones Beach prototype. He submitted his affidavit of proof of operability. But the Patent Office refused to believe it!

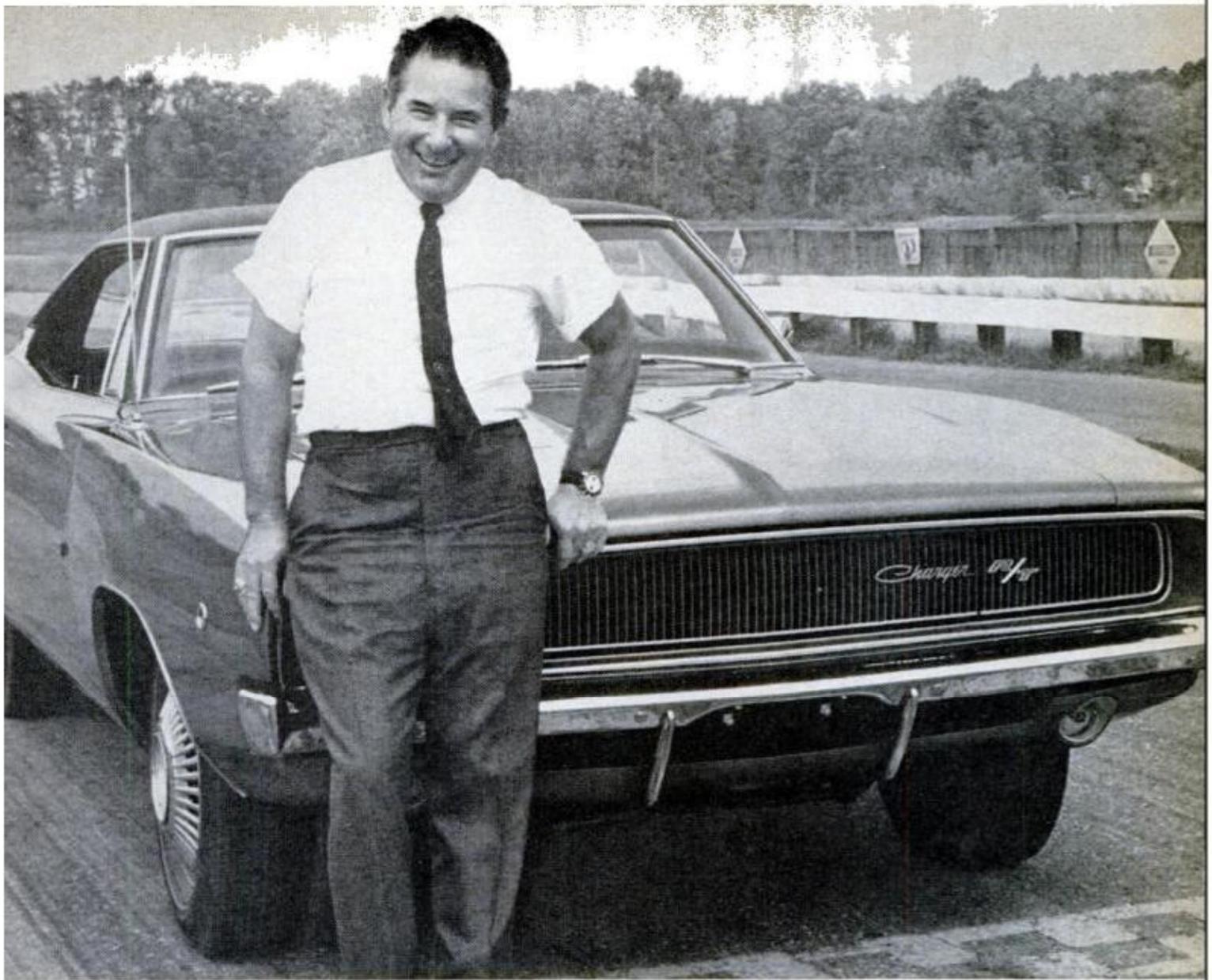
In 1964, help came from an unexpected quarter. At General Electric's Research and Development Center in Schenectady, N.Y., Dr. Walter L. Robb had been working on silicone-rubber membranes, unaware of Ayres's gill. He developed a method of making pinhole-free membranes only 1/1000-inch thick.

To publicize these leak-free membranes, GE released photos of an "aqua-hamster" living in an underwater cage covered with sheets of membrane. GE said the hamster was getting oxygen from the surrounding water via the membrane, and that carbon dioxide went out the same way.

Ayres collected clippings on the GE development and took them to the Patent Office. "They could laugh me off," he said, "but they couldn't laugh off General Electric." Last year his patent was issued.

Ironically, Ayres says, the membrane isn't really necessary for certain kinds of gill systems. His patent includes *membraneless* air-supply systems for submarines and undersea installations. At any depth, seawater would be piped

(Please turn to page 189)



I TOOK TO THE CHARGER R/T like a duck to water. It offers what I like—good handling, performance, looks

Rodger Ward Tests the CHARGER R/T

PM pries the Squire of Indianapolis off the golf course for a few hours to flail away at Dodge's ultimate Scat Pack offering. His verdict? 'An awesome amount of car!'

By **RODGER WARD**, *Indianapolis winner, 1959, 1962*

Photos by Jeannie Weaver

HERE'S THE WAY IT IS with Dodge's new Charger R/T, particularly one powered by the eye-popping 425-hp Hemi engine:

At a traffic light on Detroit's Telegraph Road, a car—what has to be a classic example of the sort of thing

with which owners of the R/T have to contend—pulled up next to me. You know what I mean—mag wheels, wide tires, an engine cammed to the nines, radio blaring Bobbie Gentry; the driver young, needing a haircut, stabbing the throttle every few seconds. The



CAR GOES where it's steered, provides outstanding "on-the-line" handling, thanks to heavy-duty suspension

decal on his front fender identified him as Slug . . . and Slug wanted to race.

But when the light turned green, I let him go—roaring off in a cloud of tire and exhaust smoke. Why?

Well, for one thing, I like to think I outgrew that sort of nonsense years ago. Two, the picture of Rodger Ward trying to explain to a cop why he was dragging with a kid down a main public thoroughfare is enough to keep me awake nights. And three, I didn't want to break poor Slug's heart—I'm certain that Hemi-powered R/T would have cleaned his clock.

Make no mistake, a Charger with a Hemi in it is an awesome amount of car; not the sort of thing I'd buy Mother to run back and forth to the grocery store. The car just cries out for running room and skilled, high-performance driving. You *can* order a more docile version of the car, powered by either the 318 or 383-cu.-in. engines. But when you order the 440-cu.-in. Magnum or the 426-cu.-in. Hemi, you're in a sort of automotive never-never land.

I drove the Hemi-powered Charger at a small road-racing course in Mil-

ford, Mich., just north of Detroit. It's a pity the track wasn't bigger, because at no point could I really let the car out all the way. Still, I was able to give it a pretty thorough workout.

From a driving point of view, one of the first things that impressed me was the car's handling. It was equipped with heavy-duty torsion bars, rear springs (an extra leaf had been added to the right rear spring to handle wheel torque and hop), shocks and sway bar. What this adds up to is a car that will go exactly where it's driven.

Only once did the rear end start to hang out. I barreled into a tight corner a bit too fast and felt the rear wheels start to let go. But a simple steering correction, coupled with taking my foot off the gas, straightened me out easily. So I'd have say the Charger is more than willing to meet a reasonably skilled driver at least halfway.

Power steering would help, however, even on a car of this type. As is, the beefy standard steering and the extra inches of tread on the wide tires make, say, parking a bit of a chore.

As you've gathered by now, acceleration is amazing. Depending upon how

quickly you can get through the four-on-the-floor, all-synchromesh gearbox, 0-60 times can be startling. In three runs, I averaged 6.6 seconds. Although I didn't time it, I went from 70 to 100 mph in what seemed like the bat of an eye. Obviously, there's a penalty involved in such performance: You can almost see the fuel-gauge needle drop as you drive. An economy car it ain't.

Inside, things are simple and well thought out. The dash is quite plain and features instruments (all gauges, no "idiot lights") canted toward the driver. As a result, they're easy to read. I think I'd like the steering wheel a bit lower and farther away, however. I'm about average in height and I found myself reaching up for the wheel. Also, I like plenty of elbow room for the type of handling I think this car requires.

Foot-pedal height and tension are about right for most drivers. The clutch pedal takes a little muscle, but then it should—lagging pedal response could mean missed shifts, and a missed shift at a critical time can be a moment

of chilling truth, you can take it from me.

The front bucket seats are comfortable, although I imagine they could get a bit hard toward the end of a long trip; they're pretty substantial. Leg-room is good, and there's plenty of clearance overhead. In back, things get a bit more cramped, but not uncomfortably so. On a long trip it might be different.

Visibility is good all around. However, the Charger—like most cars—has blind spots on both sides back where the roof slopes down to join the tops of the fenders. I should think designers and engineers would be able to lick this problem . . . maybe with some sort of rollbar, which I think all cars should have.

Finally, I think the new Charger has to be one of the best-looking cars on the road. The styling is distinctive, yet you don't get the impression the Dodge Boys were straining for effect. Driving along, you accept admiring glances as a matter of course.

In all, a handsome, gummy package I really liked. ★★★

CHARGER FEATURES simple, uncluttered styling around rear end and deck. Spoiler should be a racing plus



The Coast Guard's

It didn't happen upon a midnight clear or even in December or, for that matter, in a manger. It was a foggy afternoon in July, and a newborn babe was fighting for his life on a Russian fishing ship.

By Ch. Journalist William R. Brantley, USCG
and Lt. Commander John R. Butler, USCG

Illustration by Ed Valigursky

ALL THE ODDS were against the survival of Slava Perminov. He was born at the wrong time—in his mother's sixth month of pregnancy. Modern hospitals keep premature babies on the danger list until they weigh five pounds; Slava weighed two pounds, two ounces. He was born in the wrong place—on a fishing ship 168 miles ESE of Cape Cod—far from the nearest hospital—so far at sea that he was beyond the range of a Coast Guard helicopter.

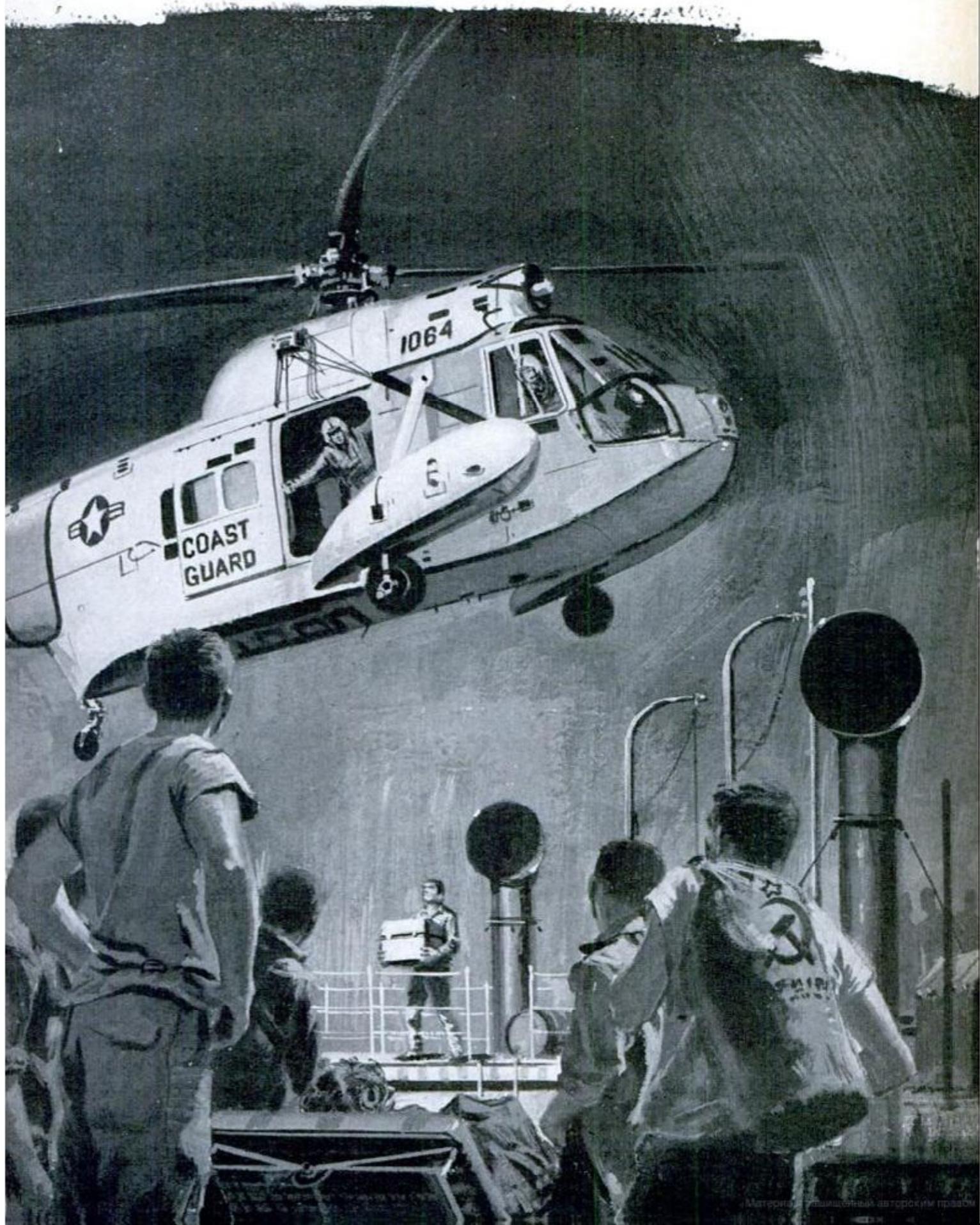
He was born under the wrong weather conditions—with heavy fog blanketing the seas, making a mercy flight even more improbable. He was born off the shores of the wrong country—the United States, which requires special clearances before citizens of his mother's native Russia can enter.

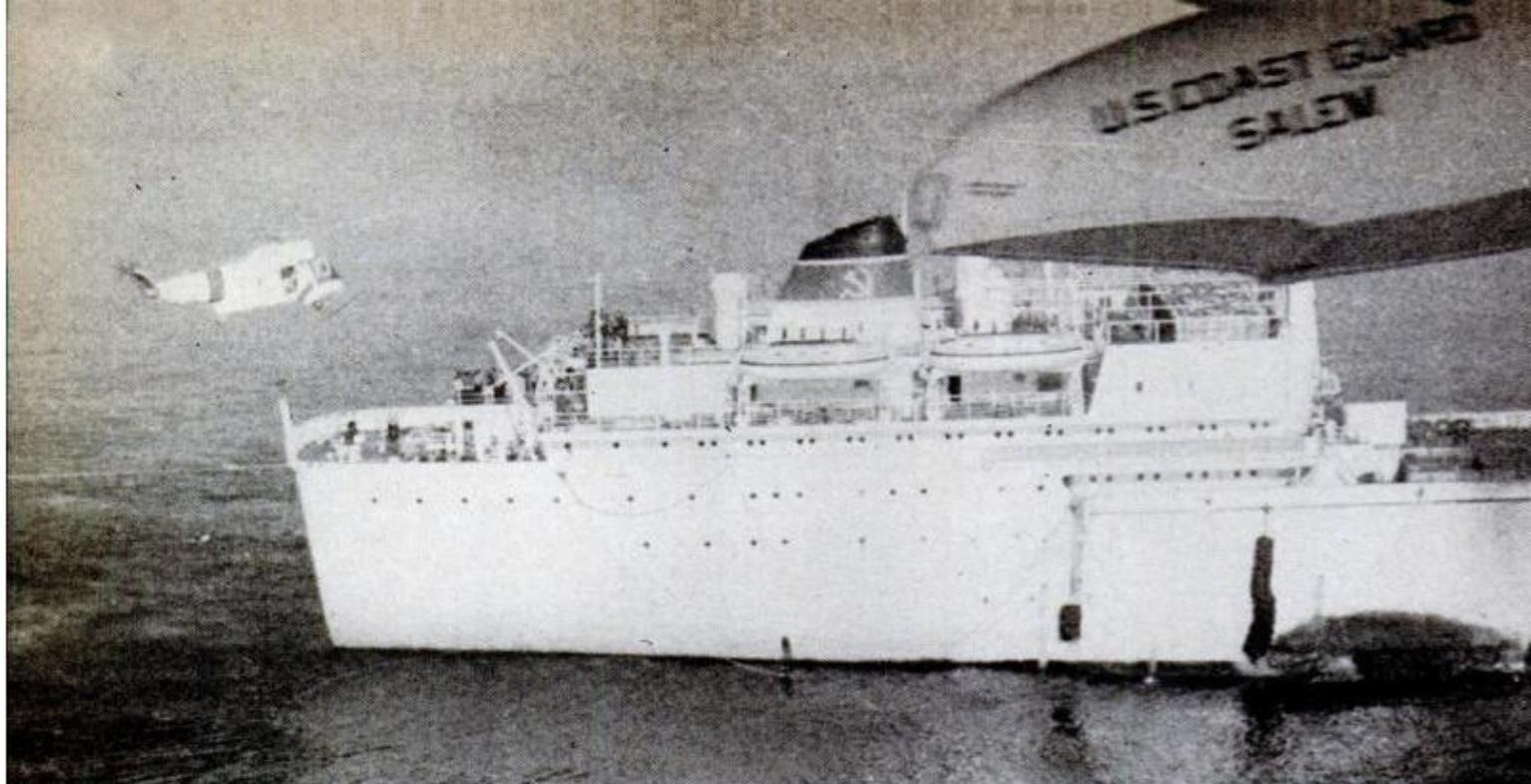
These were the odds against Slava. But he also had odds in his favor. He had a captain interested enough in his welfare to radio for help. He had the U. S. Coast Guard, with 177 years' experience in saving lives at sea. He had the U. S. Public Health Service, with a doctor ready to board an aircraft for any destination where a human being in need of medical attention waited. He had Boston City Hospital waiting to give him the finest in care if only he could be brought to them. Best of all, he had Lt. William H. Solley, a Coast Guard aviator willing to attempt the most difficult and dangerous landing in his life.

Slava's mother, 24-year-old Mrs. Alexandra Minaslowna Panko Perminov of



Christmas Carol





HOVERING AT STERN of Russian ship, Lt. Solley's helicopter was photographed from Coast Guard plane

Riga, U.S.S.R., worked as a waitress for the officers of the *Trubovaja Slava*, a "factory base ship" for the Russian fishing fleet. She had taken the job to be near her husband, Nicolai, who was aboard one of the fishing trawlers whose catch is processed at sea by the *Trubovaja Slava*. Both were scheduled to return home before the birth of their baby. But Slava, named after his mother's ship, arrived three months early.

His mother felt the first pains of childbirth on the evening of Friday, July 14, but the ship's woman doctor diagnosed them as an aching muscle, pulled by lifting a heavy pot. Throughout Saturday the pains got worse, but not until Sunday morning did they become recognizable for what they were. By then, there was no longer any doubt; the baby was born at 9:00 a.m.

The doctor realized at once the frailty of the two-pound, two-ounce child, whose condition was made even more perilous by a respiratory ailment. She explained to the captain that her limited sickbay equipment would not be sufficient to keep the baby alive.

At 9:33 a.m. the captain sent this urgent message: "ON BOARD HAVE PREMATURE CHILDBIRTH MUST HAVE MEDICAL HELP PLEASE HELICOPTER." Radioman 3.C. Patrick Carey of the Coast Guard

radio station in Marshfield, Mass., copied the Morse-code message and gave it to Radioman 1.C. Ralph A. Hemenway, who phoned it to the Search and Rescue Center in Boston. The problem, with all its ramifications, became the responsibility of the controller, Lt. (j.g.) Stanley Kruszewski and his assistant controller, Chief Quartermaster James E. Andrews.

Before they could act, they had to radio for the exact location, size, type, speed and course of the ship. They learned the vessel was 541 feet long, had a helicopter landing pad and was anchored at 41° 12' N, 66° 45' W, 188 miles ESE of Provincetown.

At 9:48 a.m. Lt. Kruszewski ordered the cutter *Vigilant* to get under way from Provincetown. He knew it could never reach the Russian ship in time to save the baby, but he also knew the *Trubovaja Slava* was far out of range of a Coast Guard helicopter. The only solution was to send the *Vigilant* as far east as possible. Then a helicopter from Salem could use its deck as a stepping stone, landing to refuel on both the outbound and return trips.

However, the *Vigilant* would have to get under way fast and make good speed. Lt. Cmdr. Earl E. Martin, acting commanding officer, had it steaming out

"Landing seemed out of the question. . . . Turbulence was extreme, and the ship was rolling."

of Provincetown at 10:00 a.m., 12 minutes after receiving the word. Rounding Cape Cod, he sailed east at 16 knots.

Meanwhile, Lt. Kruszewski and Chief Andrews were still busy. One instructed the Salem Coast Guard Air Station to get a helicopter airborne; the other explained the situation to Dr. Abraham J. Benyunes, a 28-year-old pediatrician at Public Health Hospital, Brighton, Mass.

Dr. Benyunes notified Boston City Hospital and arranged to borrow oxygen and a portable incubator. When he arrived at Boston Coast Guard Base with the equipment, a helicopter from Salem was waiting. Dr. Benyunes doesn't like to fly, even in a commercial plane. He had never flown in a helicopter but he boarded the "flying lifeboat" without hesitation. It left Boston at 12:14 p.m., manned by Lt. William H. Solley, 33, of Ashland, N.J., pilot; Lt. (j.g.) George E. Ellis, 30, of Fairfield, Me., co-pilot, and Aviation Ordnance-man 2.C. Richard E. Martin of Danvers, Mass., crewman.

It was soon joined by a Grumman Albatross amphibian, also from Salem Air Station. Piloted by Lt. Cmdr. Robert J. Imbrie and co-piloted by Lt. (j.g.) Merrill R. Menlove, it was to fly escort and lead the helicopter through the fog to its destination.

The helicopter landed aboard the *Vigilant* at 12:54 p.m., eight miles ENE of Cape Cod Light. Rendezvous would have been farther to sea, but the *Vigilant* had slowed down to keep from penetrating a dense fog bank. Refueling required only a few minutes, but the helicopter did not take off immediately. The Russian ship was still too far away for a round trip by the chopper. So the *Vigilant* steamed for more than two and a half hours toward its goal, reducing the distance to 124 miles.

At 3:33 p.m. the helicopter left the *Vigilant*, arriving at the *Trubovaja*

Slava at 5:03. As he approached from the stern, Lt. Solley could see only the masts sticking up out of the fog. Not until he was within 50 yards could he see the ship itself. More than 200 men and women crowded the decks. Many pointed amidships to a helicopter pad, but Lt. Solley saw at once that it had been designed for a much smaller helicopter. It was only 50 feet square. Barrels were piled in one corner. Cables hung from booms surrounding the landing area. A high steel rim ran around the ship. Loose objects cluttered the pad.

Though landing seemed out of the question, Lt. Solley approached from the port side for a possible set-down. Turbulence was extreme, and the ship was rolling in the swells. Within five or ten feet of the deck, he decided landing would be too hazardous. It would not only endanger himself and the others in the helicopter, but also bystanders on the deck. Even if there were no deaths or injuries, any accident which put the aircraft out of commission would mean failure of the mission.

Backing off, then hovering over the stern, the Coastguardsmen lowered the rescue basket with the portable incubator. First they could lift the baby, then lower again for the mother.

The Russians unhooked the basket from the steel cable. They took it and the incubator below decks. Fifteen minutes later they brought the basket back—empty. One Russian was holding a note. Crewman Martin lowered a hook and brought it up. It was unintelligible, but Lt. Ellis managed to make out "middle." The Russians still wanted them to land in the midships area. Obviously they still underestimated the span of the helicopter's rotors.

On the same note, Lt. Ellis wrote, "Not enough room, baby first, mother second." The Russians read it, but again pointed to the pad.

Time was running out. Lt. Solley knew he had enough fuel for the round trip from the *Vigilant* plus 30 minutes' hovering time. Twenty-two minutes had

already been used over the ship, but the Russians did not seem to realize the urgency of the situation.

One possibility was to lower the crewman to the deck to supervise hoisting—but he probably would not be able to overcome the language barrier in the eight remaining minutes. Another was to lower the doctor and leave him on board—but he would not be able to keep the baby alive without the hospital facilities.

There were really only two choices open to Lt. Solley: land or abandon the mission. He chose the former. The Russians had cleared much of the pad, but a stack of barrels remained in a corner, and the booms and cables were still there. The ship was still rolling.

Once he made his decision, Lt. Solley wasted no time. He landed safely, stopped the rotors and engine to conserve fuel, then looked to see how close he had come to disaster.

The distance from rotor blade to superstructure was two feet, a small percentage of the blade's 53-foot diameter. Such clearance is considered too small when a helicopter is being towed behind a tractor, with blades stopped. It is unthought of for in-flight obstacle clearance. It was a moment of truth Solley will relive many times.

The Russians closed in, greeting the men warmly, shaking their hands, many taking photos of the helicopter crew. To the Americans the family-like atmosphere of the ship was a surprise. Wives, children, pets and clotheslines made it resemble a Russian village. But the sight of people swimming in the cold North Atlantic brought back the reality of being far at sea.

The Russians took Dr. Benyunes to the baby, who was close to death. "He was practically black," the doctor said. "He had poor respiration and did stop breathing once."

In the incubator, receiving medication and oxygen, Slava began to improve. His mother, Alexandra, was in excellent condition.

Eighteen minutes after landing, the



AT FIVE POUNDS, little Slava Perminov had gained sufficient weight to go home to Russia with mother

helicopter departed. Again, the two-foot clearance required skillful maneuvering. Immediately after takeoff, visibility dropped to 50 yards again as the fog moved back over the ship.

Once they were on top of the fog, a new problem arose. To maintain a 90° temperature in the incubator, the heater in the chopper had to be set on maximum. Cabin temperature soared to 110. The flyers sweat profusely in their flight suits and Mae West jackets. The oxygen bottle got so hot that Dr. Benyunes feared it might explode. To cool it, the men took turns holding it against the window.

By now the *Vigilant* had sailed nearer, but even with his radio and the escort plane's radar, Lt. Solley had trouble finding her in the fog.

Lt. Theodore Brandsma, operations officer on the cutter, heard the chopper, but couldn't see it. The men on the helicopter looked down as the direction finder indicated they had just passed over the cutter; all they could see was a shadowy outline. Contrary to belief, you don't just stop a helicopter

(Please turn to page 184)

The Biggest Blast Before the A-Bomb

It was just 50 years ago this month. A city was blown off the map because two ships disputed the right-of-way

Based on *The Town That Died* by Michael J. Bird. Used by permission of G. P. Putnam's Sons. © by Michael J. Bird.

GUN COTTON

PICRIC ACID

BENZOLE GASOLINE

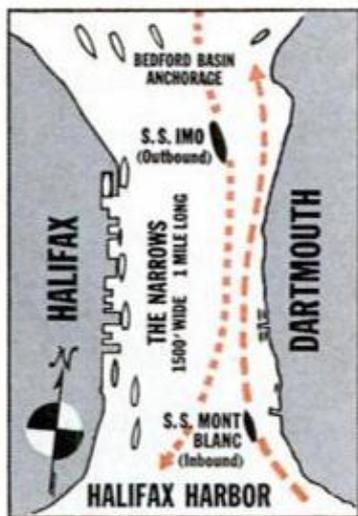
TNT



CAPT. AIME LE MEDEC was worried. With 2500 tons of explosives aboard, his ship was floating bomb

OLD-TIMERS still speak of it in clichés—"Go to Halifax" or "I'll blow you to Halifax"—and for youngsters it's a legend. For either, the reference is to the biggest man-made explosion in the history of the human race until the development of the atomic bomb. One grim morning in December, 1917, two ships, one loaded with more than 2500 tons of explosives bound for the war in Europe, collided in Halifax Harbor.

The resulting explosion killed nearly 2000 persons, injured 9000 and blinded 200. This is the story of that tragic, and easily avoidable, collision, and why it happened.



HALIFAX HARBOR, on fateful morning, was peaceful. It could have remained so if *Mont Blanc*, inbound to anchorage, had been allowed to follow normal right-hand traffic, and *Imo*, outbound to Atlantic, had done the same. Instead, stubborn insistence on right-of-way put both ships on a collision course near Dartmouth shore and set scene for the terrific explosion

SS MONT BLANC (right) arrived at dusk the night before from New York with perilous cargo, anchoring for night in Halifax Harbor, south of Narrows. In morning she would move into Halifax to pick up coal



SS IMO (left), Norwegian liner, also docked in Halifax to pick up coal, was en route to New York to collect relief supplies for war-stricken Belgium. Her captain was angry because ship had been forced to spend night in Bedford Basin when coal loading was delayed. So, early next morning, when she finally started south into the Narrows, she accelerated until she was doing a brisk seven knots. Meanwhile, the *Mont Blanc* had also started up, proceeding northward cautiously because of deadly cargo, hugging the right shore. Tragedy was minutes away



Illustrations by Jack Mitchell



8:35 A. M.: On northbound explosives ship, men on bridge were appalled to see southbound *Imo* fail to take normal course (dotted line) out to sea. "That fool is aiming to come down in our water," the harbor pilot said to Captain Le Medec. "Better give him a whistle." One signal was blown, which demanded same reply—acknowledging port-to-port passing—but to disbelief of men on *Mont Blanc*, *Imo* gave two blasts, indicating starboard passing

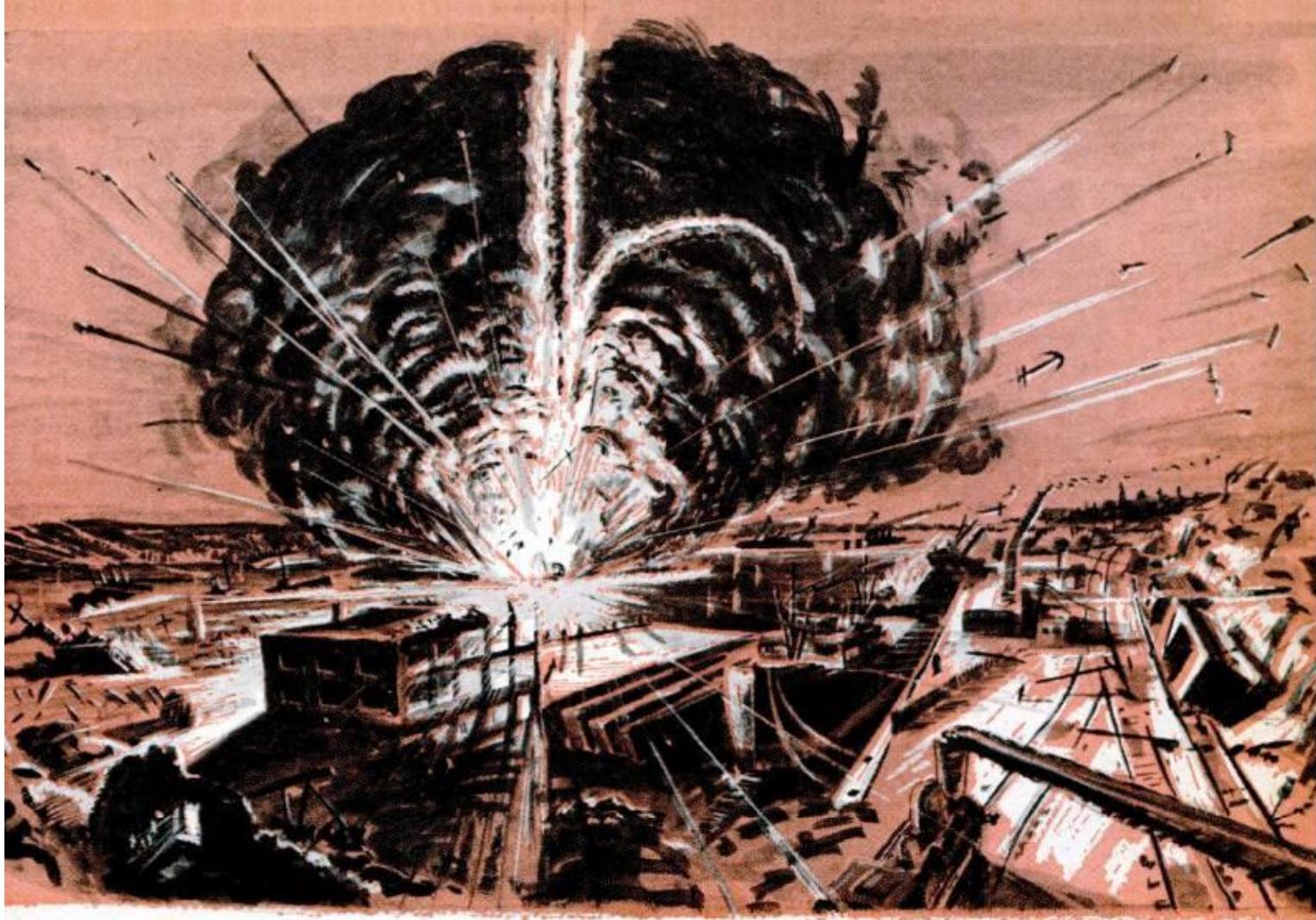
8:42 A. M.: When *Mont Blanc* pilot realized *Imo* was going to try to squeeze between them and Dartmouth shore, he shouted, "Stop our engines!" Then, in desperate maneuver, he had *Mont Blanc* swing hard left. Too late! *Imo*, instead of continuing on course, blew three blasts which meant, "I have reversed my engines." But reversed engines now threw her own bow to her right. She continued drifting close and collision now seemed sure. Through all of this, *Mont Blanc* was not flying red "explosives" flag. Such flag was only required when loading



8:45 A. M.: Bow of *Imo* sliced 10 feet into bow of *Mont Blanc*. Barrels of gasoline smashed open and flooded deck. Some fell overboard. Then *Imo*, with engines still in reverse, backed away and sparks from rent metal ignited the spilled flammable fuel. *Mont Blanc*, now on fire, continued drifting to port and came to rest near downtown Halifax docks



8:55 A. M.: As thousands lined shore to watch, unaware of impending catastrophe, cowards and martyrs played out grisly scene. Crew of *Mont Blanc*, who knew of ship's deadly cargo, fled in lifeboats to Dartmouth shore, hiding in nearby woods. Meanwhile, tugboat crews and others from nearby vessels, who only saw ship in distress, tried valiantly to tow it away from docks and prevent further spread of flames. Some intrepid seamen even climbed aboard stricken *Mont Blanc* to help quench fire. Most inevitably perished in disaster, because drifting ship was now greatest time bomb mankind had ever assembled. Worse, factory windows filled with spectators. Tram cars slowed down so passengers could get better look



9:06 A. M. Twenty-one minutes after collision, *Mont Blanc* blew up, devastating Halifax, its citizenry and surrounding territory. Explosion blew bottom right out of harbor, huge rocks landing on shore. Part of *Mont Blanc's* heavy iron anchor, weighing half a ton, came down two miles away. Officer on one nearby ship, was blown from deck and landed on Fort Needham Hill, a half mile away, bruised and naked. Water blown out of harbor hit a ship at sea so hard her crew thought she had been struck by a mine. Whole blocks of Halifax and Dartmouth were knocked flat. Much of what was left was on fire. Many not dead were dying. And it was still not over. The explosion, which happened almost in the middle of Narrows, blew so much water out of slim channel that, when it went out to sea and started in again, it came back in waves 30 feet high, rushing up on the shores two block deep into both towns

9:30 A. M.: When survivors dared lift their heads, Halifax was a shambles, a horrible sight to behold. City had been laid waste. Thousands of homes, factories and office buildings were utterly destroyed without trace. Trains had been blown off their tracks. Fires were everywhere. A few ships, including *Imo*, were badly damaged but still floated, their crews dead or dazed. Both *Imo's* captain and harbor pilot aboard were killed instantly. Later, charges were brought against Captain Le Medec and his pilot but, after lengthy legal maneuvering, charges were dropped. So, to this day, blame for tragedy has never been placed





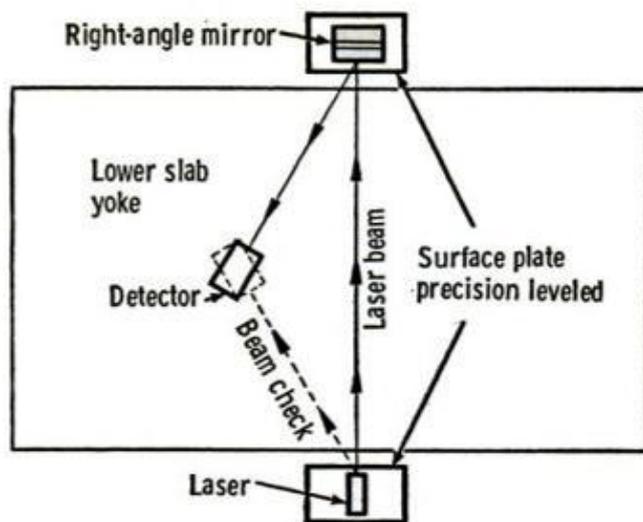
Abraham's foot trouble is a rerun of a fable

It was almost like *Androcles and the Lion*: The Lion (named Abraham) had a thorn in his paw and was limping—but no one could get close enough to remove it. The wardens at the English lion reserve called in a vet, who shot three drugged darts at the beast with a crossbow. Four hours later, the lion fell unconscious, the thorn was removed and he got a shot for infection.



PM editor and art director present painting to President

A painting commissioned by *PM* for the article, *The Stupendous Saturn V* (page 96, July *PM*), was presented to President Lyndon Johnson in a recent ceremony at the White House. In the photo, the President is shown accepting the picture from Editor Robert Crossley (center) and Art Director Tom Dauer. Howard Schafer, prominent space artist, did the painting.



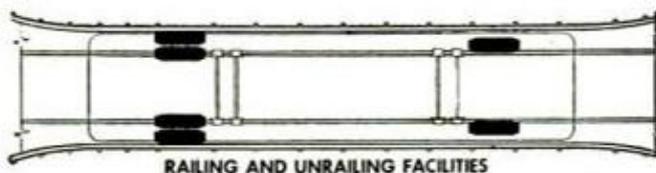
Cyclotron is leveled by laser

Using a laser in the manner of a surveyor's level, technicians constructing the University of Maryland's new cyclotron bolted together 16-ton steel slabs to a variation in alignment of less than 1/1000th of an inch. The slabs form the "yoke"—a 500-ton magnet that is the heart of the particle accelerator. As each slab went into place, a detector placed on it revealed variations when a laser beam was aimed at it from the laser itself and from a mirror.



If the shoe pinches . . .

As a child stands, kneels, leans and crouches on this electronic foot scale, the machine notes changes in foot size and calculates an index number for correct shoe shape and size.



Rail and road bus

Flanged, retractable wheels mounted on airport buses could enable those buses to travel on railroad tracks and thus avoid congested freeways. An experimental bus was demonstrated recently on the Long Island Rail Road tracks outside of New York City. The bus ran a quarter of a mile on the tracks (with its inside rear tires resting on the tracks to drive it), stopped at a crossing, retracted its steel rail wheels and drove off on a street. The rail-bus is being considered for the New York City to Kennedy Airport run; it's estimated that it would cut the rush-hour trip to 40 minutes from the present 90 minutes.

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Tiniest flattop

A detachable landing platform installed on a Navy armored troop carrier in Vietnam enables a UH-1-D "Huey" helicopter to land and take off and thus serve with river forces.

New Electronic War On Burglars

Light beams, sound waves, radar are all being used to protect business and home from prowlers

BY JAMES R. BERRY

Illustration by ZIK Associates, Ltd.

BEAM OF LIGHT guards drug cabinets in a pharmacy. Anyone passing through it instantly triggers an alarm

THE BURGLAR ALARM, I knew, was supposed to be triggered by my motion. I was out to beat it. Cautiously, I eased forward in the darkened room, sliding across the carpet in slow, six-inch steps. Suddenly, a dazzling light flooded the room. I forgetfully raised my hand to my eyes.

Before my palm moved two inches, there came the screeching wail of a siren. The alarm had won.

"You can imagine how a burglar feels when he hears *that*," chuckled Bill Brackley, husky security director at the Pinkerton's detective agency in New York. "Just the light goes on when the alarm first senses motion. That's to avoid false alarms from a falling box or other one-time motion. Any movement within 60 seconds after that, and the

siren sounds and a buzzer goes off in a police station or guard room."

The alarm I just tested—which used radar to spot my movements—is simply one of dozens of ingenious electronic weapons that law enforcement agencies have drafted in their war against burglars. A common method of protecting windows is taping metal foil around the edge of the glass. Smashing the window tears the foil, interrupts a circuit, and sounds the alarm. But the system no longer works for experienced thieves.

"Today, burglars draw a circle in the center of a pane with special glass cutters, then use a suction cup to yank out the disc, explains John Heyrman, assistant director of security at Pinkerton's.

Security men still put foil around

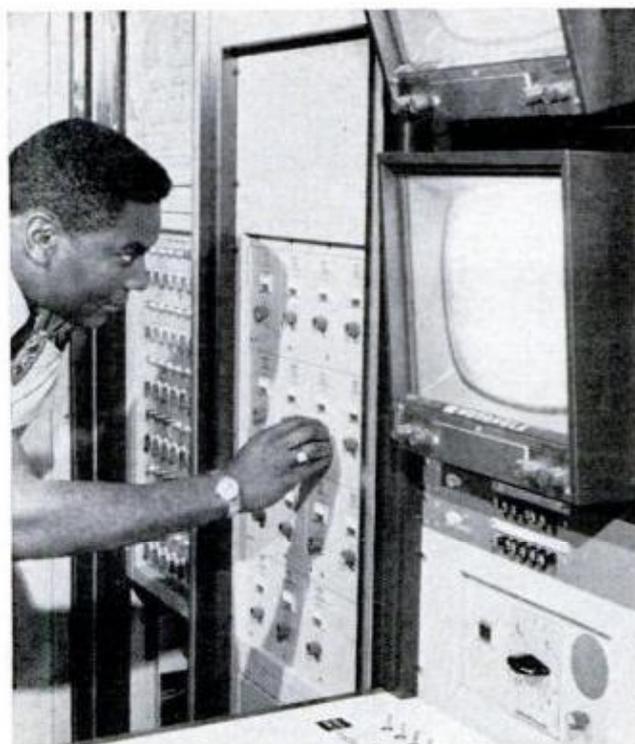
windows as a deterrent to amateurs and vandals, but they count on vibration detectors to spot break-ins by seasoned yeggs. One such detector is no larger than a wristwatch and is glued to a corner of a window. Noises such as sonic booms, car backfires or rumbling trucks are electronically filtered out. But the device instantly spots the high-pitched shudders glass makes when it's about to shatter or when being cut.

Another skirmish between burglars and security experts took place over doors. In yesteryear, a tiny switch in the jamb was supposed to sound an alarm when the door opened. Burglars laughed and slyly taped the switch down.

Electronics men hit back with a tamperproof magnetic switch. Clever. But burglars beat it by supplying their own magnets to hold the switch open and keep the alarm from sounding while they blithely broke down the door.

Security experts counterpunched this play with a balanced magnetic switch. "This switch is matched to the door's magnet," explains William Boyle, security expert at Honeywell, Inc. "A sub-

GIANT CONSOLE at Los Angeles' new art museum gives guards electronic ears and TV eyes through the entire building. TV camera at right is one of 24



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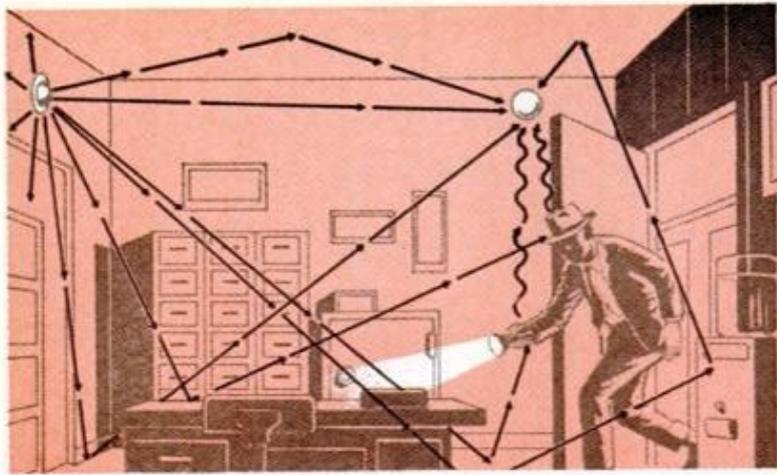
AN ESCAPING BANK ROBBER is caught by a hidden camera for quick identification and capture later

stitute will pull the contacts too much or not enough. In either case, the alarm goes off."

A New Jersey firm, Bagno Alertronics, uses tiny laboratory strain gauges as stress alarms that are glued to such locations as window sills, roof beams, fire escapes, fences and shelves. The slightest change in stress—the theft of a single man's shirt from a rack holding 99 others, for example—changes the



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SLIGHTEST MOVEMENT of a burglar in a room flooded with high-pitched sound waves disturbs the waves and trips alarm



WAVY, GHOSTLIKE LINES on TV screen tip off a guard that something has moved

electrical resistance of the gauges and sounds the alert.

Burglars don't always oblige by entering through a door or window, though. One night last April, a well-rehearsed team of crooks backed a truck up to a brick wall of a Minneapolis fur storage company. Working from within the truck, they broke through the wall with crowbars and sledgehammers. Then they methodically jammed the vehicle with valuable furs and drove off.

Internal alert systems

Since many break-in men bypass doors and windows, alarm experts combat thieves with a family of internal alert systems, such as the motion detector that Pinkerton's uses. This alarm, called Radar-Eye, is about the size of a large shoebox and works on the same principle as a highway radar trap.

The device beams out high-frequency radio waves. When these waves hit stationary objects, they bounce back at the same frequency at which they left. But a moving object causes reflected waves to change frequency slightly—a phenomenon known as the Doppler effect. The faster the movement, the greater the frequency change. Radar traps translate this frequency shift into miles per hour; Radar-Eye interprets it as a burglary attempt—and sounds off. The motion of a twitching finger is enough to trip the device.

Closed-circuit TV monitoring—a rap-

idly expanding security measure in large plants—is another system that electronics experts have improved. The obvious weak spot of closed-circuit TV is boredom. Guards just can't stare at a bank of motionless TV screens with full attention during their eight-hour shift. Now, thanks to a development by Sperry Rand, they don't have to.

As soon as an intruder hits an area monitored by closed-circuit TV cameras, a radar motion detector alerts a guard and activates a video recorder that stores reference pictures of the scene. These reference pictures are automatically compared with the camera picture 30 times a second. Any movement causes a difference between the two images, which is flashed on a TV monitoring screen as a ghostly, white halo that outlines the shape of what moved.

Two winters ago in Syracuse, N. Y., a crack team of thieves calmly broke into the headquarters of Brink's, lugged in a 20-mm antitank cannon, and bombarded a two-foot hole through the foot-thick steel and concrete vault with 31 armor-piercing shells. Unhurried, the crooks then carted off \$316,000 in cash and securities.

Not one of the multiple alarms protecting the firm made a peep—and for good reason. Signals from the Brink's alarms—as with most large firms—are transmitted over leased telephone wires. In this instance, the Brink's burglars had skillfully bridged the alarm cables

where they joined the telephone wires in an outside junction box. The alarms went off, but gave as much notice of a robbery as a muffled cowbell.

Electronics specialists at Walter Kidde & Co., a security firm, plugged this gap with a transmitter that, when attached to an alarm, generates three different tone signals in a certain sequence. A receiver at a central station tunes in these three signals, sounding off if the right tones aren't heard in the right order. The sequence and tone of the signals automatically change periodically. Duplication of the signals is virtually impossible since there are millions of possible combinations.

Home alarm dials police

Home alarms have come in for some innovation, too. Security Associates, a Maryland firm, sells an alarm that calls for help on a customer's home phone. Various sensors, ranging from vibration and noise detectors to magnetic door locks, lead to a console. When this console receives a warning from a detector, it alerts the occupant with a light or buzzer and electronically dials the cops. Then a prerecorded message tells the name and address and asks for help.

To foil bank robbers who operate in broad daylight, security men have perfected automatic cameras that film a holdup when a hidden button is pressed by a teller. Usually, someone spots the thief shortly after his picture has appeared on TV or in newspapers.

As good as today's alarms are, security firms aren't content. Several companies are now working on a device that will spot an intruder from his odor—just such an instrument is now used in Vietnam to detect enemy troops. Still another burglar alarm under study would detect the decrease in air pressure when a door is opened or a window broken. The pressure in a room is first raised artificially by a blower, then a pressure-sensitive device detects any drop in that pressure if a burglar attempts to enter the room, letting air escape.

Perhaps the most ambitious new alarm is being developed by Honeywell. This device will use heat detectors to sound an alert and get a profile of a burglar's size, shape and type of clothing. Even if the thief escapes, police will have a rough description to work from.

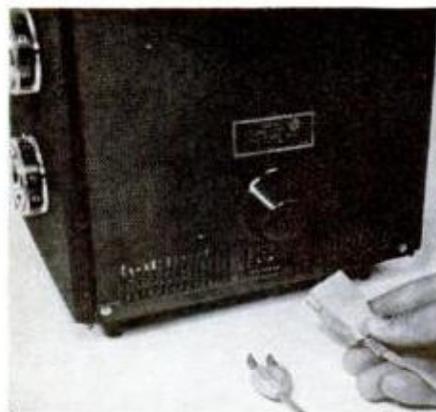
Still, the *ideal* alarm isn't yet on the drawing boards. "What we really need is a brain-wave detector that spots the *desire* to steal property as a thief enters the protected area," jokes William Carl- sen of Central Station Signals. ★★ ★



ULTRASONIC WAVES are beamed through a museum, above, from a speakerlike device (to left of spot-light on balcony). Below, radar antenna can be seen hanging under garage roof to prevent theft of cars



What to look for in a Miniscreen TV



THREE-WAY OPERATION on 115-v. house current, 12-v.d.c. or self-contained battery pack gives miniscreens versatility. You can run them in car or boat or tote them where there's no power

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DARK GLARE SHIELD that's built-in or snaps on is a must for outdoor viewing. It causes screen to appear black when set's off, cuts reflections and picture wash-out when the set's in sunlight



ANTENNA OPTION allows you to use built-in telescoping whip outdoors, but connections are provided for home rooftop antenna. Here, twin-lead runs to Westinghouse Jet Set transformer adapter

POPULAR MECHANICS

SMALL-SCREEN TV gets bigger as it gets smaller. More and more three to eight-inch pixie-sized sets are on the move—from bedroom, to beach to boat and beyond. Just yank the plug and off you go on batteries without missing a commercial.

It's convenient to classify a miniscreen TV as one under 50 square inches of viewable area. Any set at or below that figure is probably a true portable that operates on batteries. The most popular today is the eight-inch diagonal, or about 37 square inches. The smallest size to be demonstrated to date is a one-square-inch model.

Almost all miniscreen sets are solid state: Transistors have replaced all tubes except the picture tube. Tallying the number of transistors in a set, though, is no sure indicator of quality. One manufacturer boasts 45 solid-state devices, a figure that breaks down to about half for transistors, half for common diodes. Another producer claims a piddling 21 transistors, but he also adds an integrated circuit (IC). This micro-miniature chip often contains the equivalent of a dozen transistors. So judge a set on clarity and brightness and the ability to pull in weak signals and display steady images. Counting transistors doesn't tell the whole story.

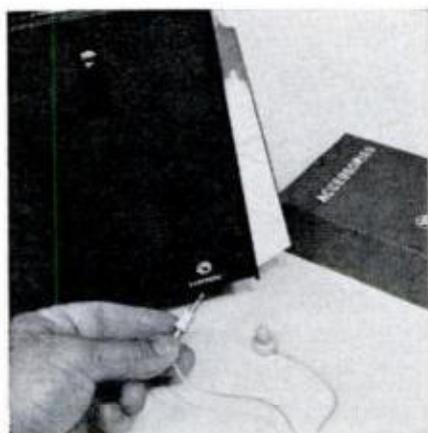
Since those ICs will soon sweep into the design of all radio and TV, is it wise to delay purchase of today's mini-

screen set? Probably not. Sony's experimental set, which has a one-inch screen, uses the IC to show how far engineers can shrink TV. Nevertheless, that set still uses a conventional, though small, picture tube. Until picture tubes go solid state, there'll be little change in overall size and weight of today's miniscreen models.

Solid-state design in today's sets makes possible three-way power operation. You can carry the set from room to room, or even run an extension cord outdoors to operate the TV on 115-v.a.c. The sets can also be powered directly by 12 volts supplied by an automobile or boat electrical system. Most manufacturers offer a cord that connects directly into a cigaret lighter socket for the power pickup or a cable for connection directly to the battery.

The third way is truly portable. It's the use of a battery pack that makes the set completely independent of any other power source. Manufacturers select their packs from a number of battery types. Some favor the nickel-cadmium cell; others go for the alkaline type. In any case, both types can be recharged with a charger plugged into ordinary house current. Usual charging time is overnight. The pack operates the receiver for about four hours or more.

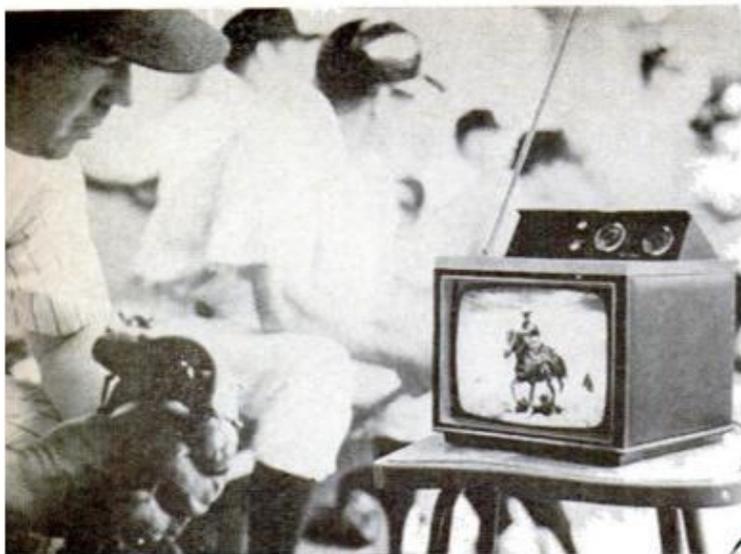
For convenience, a "pack" usually consists of both batteries and charger



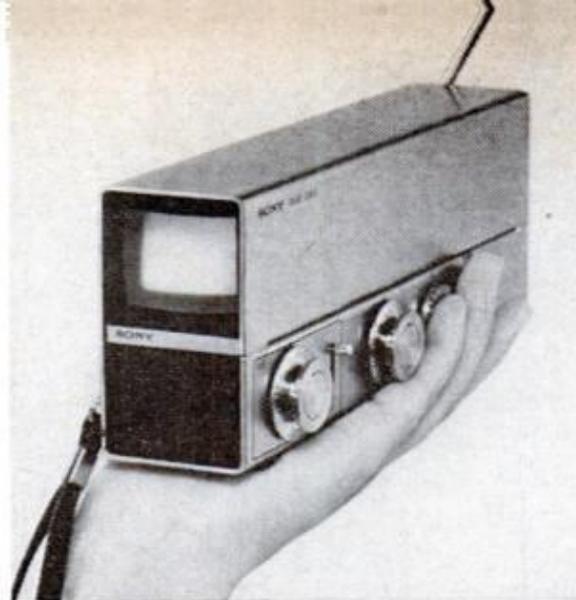
ACCESSORY EARPHONE, which plugs into jack on set, makes for convenient private or late-night listening. Other accessories include battery rechargers, car or boat antennas and mounting brackets.

Good pictures come in the smallest and lightest packages yet. Just take a close look and size up one that'll go everywhere you go . . . at your price

By **LEN BUCKWALTER**



CONTROL PANEL on RCA's Petite, above, pops up and turns the set on. Sony's one-inch set above right, is an experimental model with smallest practical screen size to date. Panasonic's Starstream model, right, has a 16 sq.-in. screen in a cabinet of unusual design; it's 7½ in. (H) x 8¾ in. (W) x 10¼ in. (D)



in one case. Weight of the package adds about six pounds to that of the receiver. And it may be available in one of three formats. First is the completely separate pack that connects to the set through a cord. Second is the pack that clips to the bottom of the receiver and also serves as a base. The third system signals a recent trend in miniscreen TV. It's the completely built-in pack that inserts directly into the TV cabinet.

Most manufacturers offer the battery pack as an optional extra, and the cost runs about \$20 over the basic price of the set. If you're going to use the set only on house current or on the 12-volt battery of a car or boat, you can delay the purchase of the pack until you need actual hand-carried portable operation.

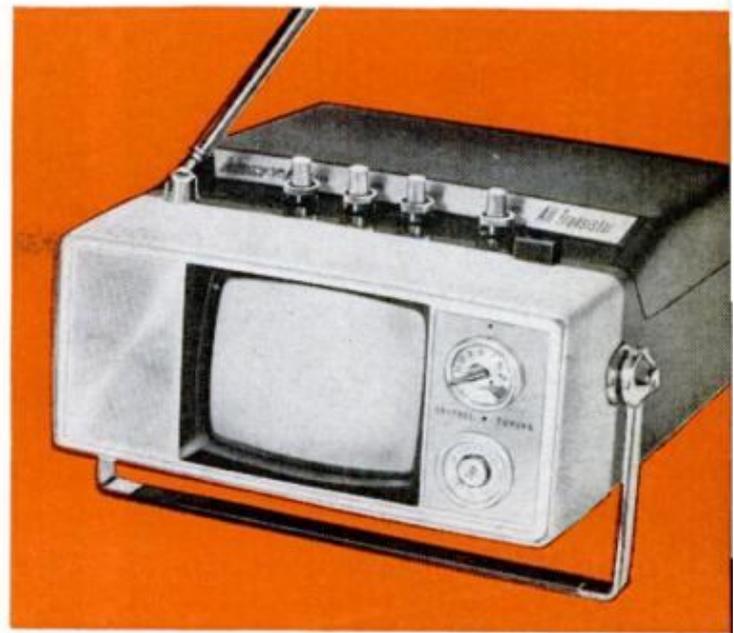
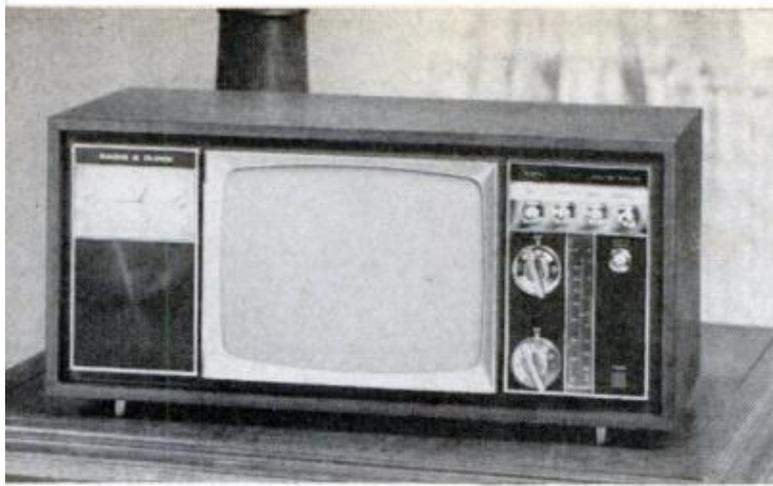
Batteries in the pack won't last forever. Despite the designation "rechargeable," they may start to give out after about 40 charge cycles in some sets. This means a new battery must be periodically purchased for the pack. Cost is about \$10. Some simple arithmetic reveals that average battery cost for operating a set on the pack is about six cents an hour. (Cost for recharging on house current will hardly affect your electric bill.)

The antenna on most miniscreen sets



is a single, telescoping rod called a "monopole." It serves for most outdoor viewing. I pulled in satisfactory images on one set at a distance of 50 miles from several TV stations. Some judicious angling of the rod (which is really one rabbit ear) reduces ghosting and improves the signal. But in some viewing situations, the monopole could prove inadequate. The deficiency of a simple antenna shows up in deep-fringe areas or large cities where ghosts prevail. Manufacturers anticipate the problem—you can also attach an outdoor or rooftop antenna to miniscreen sets.

You can beef up the signals when reception is planned in a car or boat. The problem here is that metal in these vehicles tends to shield the signal from the simple monopole antenna. It also aggravates sparkplug interference from the ignition system. With special out-



ENTERTAINMENT CENTER, typical of miniscreen combination models, is Sears' 8-in. TV with AM/FM radio and clock-timer, above left. Delmonico's 4-in. model, above, has battery pack and charger built into its roughly 4x8x9-in. case. The 5-in. screen of Sony's new model, lower left, hides behind sun shield

side antennas for cars or boats, the TV signal is picked up in the clear, then ducted through a coaxial cable to the set inside.

Special boat mountings even keep a set stable in a rolling sea. Some manufacturers also offer a mounting that fits over a car's front seat. This permits the set to be viewed by people in the rear of the automobile. You should be aware, however, that reflecting signals, which cause ghosts and unsteady images, can be a problem on the road.

All sets receive UHF (Channels 14-83), most on their own wire loops, or you can attach an outdoor antenna to the same terminals for better reception of weak signals. A feature growing in popularity in these portables is a specially tinted, dark glass shield that reduces annoying reflections when the screen is viewed outdoors.

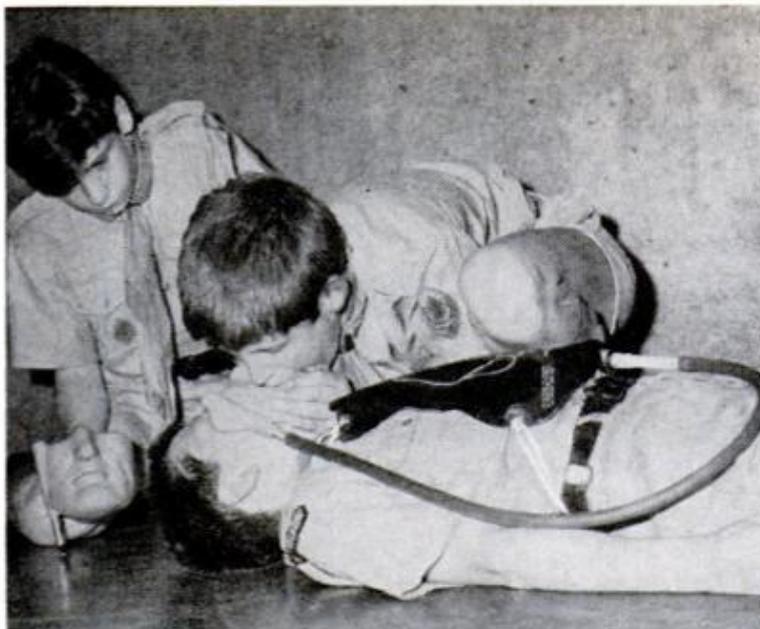
Nearly all sets have an earphone for private or late-night listening. When the earphone is plugged in, the loudspeaker is automatically silenced. Another feature for night people is a built-in clock timer on some models.

A new breed of tiny TV has joined the ranks of miniscreen models. One manufacturer aptly calls it the "consol-ette." These are like the large TV-radio-phono combinations except that they can sit on a tabletop. They are fully portable with 12-volt battery packs. The small combo idea is carried forward in models that contain not only TV and AM/FM radio, but a complete phonograph as well.

The next big thrust of miniscreen TV is easy to predict. It's color. Until recently, the closest thing to portable color has been GE's 10-inch, 60-square-inch tube-type Porta Color, which operates on house current. Sony, however, has developed a seven-inch color set weighing about 18 pounds. Transistorized and a.c. or battery-operated, it should be available in a few months for \$350 or less.

Sony's set will not use the "shadow-mask" picture tube found in all U.S.

(Please turn to page 202)



Going to a Halloween party? Nope, just out for a breath of air

Although the lad with the mask looks as if he's on the way to a masquerade party, he's really about some serious business. The false face is part of a new mouth-to-mouth resuscitation trainer. It provides realism for students, while preventing direct contact. The mouth on the mask is connected by a rubber tube to an artificial lung strapped to the "patient's" chest. The "rescuer" simply blows into the mask to inflate the lung while learning the technique.



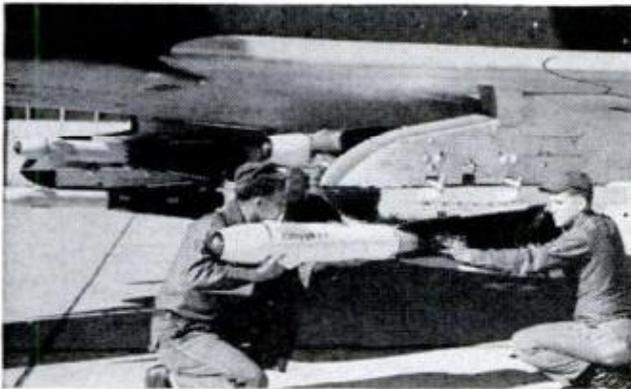
The coach peers in and sees the target

The new M-2 Aiming Device gives Army rifle instructors a firer's-eye view of the gunsight and the target. The device is based on a two-way mirror mounted behind the rear aperture of the rifle's sight. The rifleman aims (peering *through* the mirror) and fires as he normally would. The instructor, off to the side, looks into another mirror—set at a 45° angle—and sees the same sight picture that the trainee sees. The instructor can then point out any error he may make.



Flower power in the business jungle

After laying half an acre of grass-green carpet tiles and replacing all partitions with living plants, a British manufacturer says he has achieved all objectives of office remodeling: efficiency, humanizing the environment and saving space. The 200 employees call it "the jungle."



Deadly new heat-seeker

Newest of the Air Force's infrared air-to-air missiles is the AIM-4D Falcon, shown here being loaded on the wing pylon of an F-4. The Hughes missile, designed for use against high-speed, maneuvering targets, has been successfully tested at Holloman AFB.



Easy on tires, too

John Brush of Cincinnati combines boating and motoring with his "automaran," a set of twin aluminum hulls driven by a propeller that connects to his car's engine. Top speed on water is 25 mph. Once he docks, Brush drives the car off and uses it on land.



'Hey, I caught it. Now what do I do?'

It looks as if a tadpole was the inspiration for this "test shape body" by North American. It's actually an aerospace design adapted to water—and tested by vertical drops into the sea.

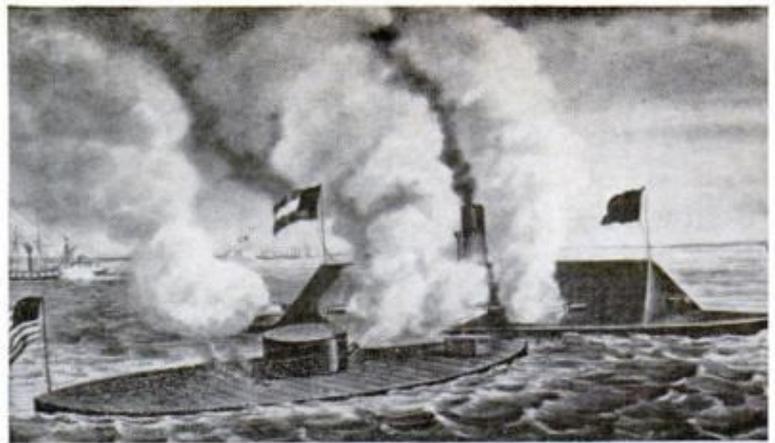
The Ironclads Rise Again!

They died a natural death after the Civil War, but 'river battleships' have been resurrected for Vietnam duty

By ROBERT ZIMMERMAN

A NEW "RIVER BATTLESHIP" that looks like the famous *Monitor* of the Civil War—and goes by the same name—is making its debut in Vietnam. The first U.S. Navy River Assault Force to be commissioned in more than a century has started using armored, turreted "ironclads" to flush Vietcong guerrillas out of swampy hideaways.

The modern *Monitors* bring tremen-



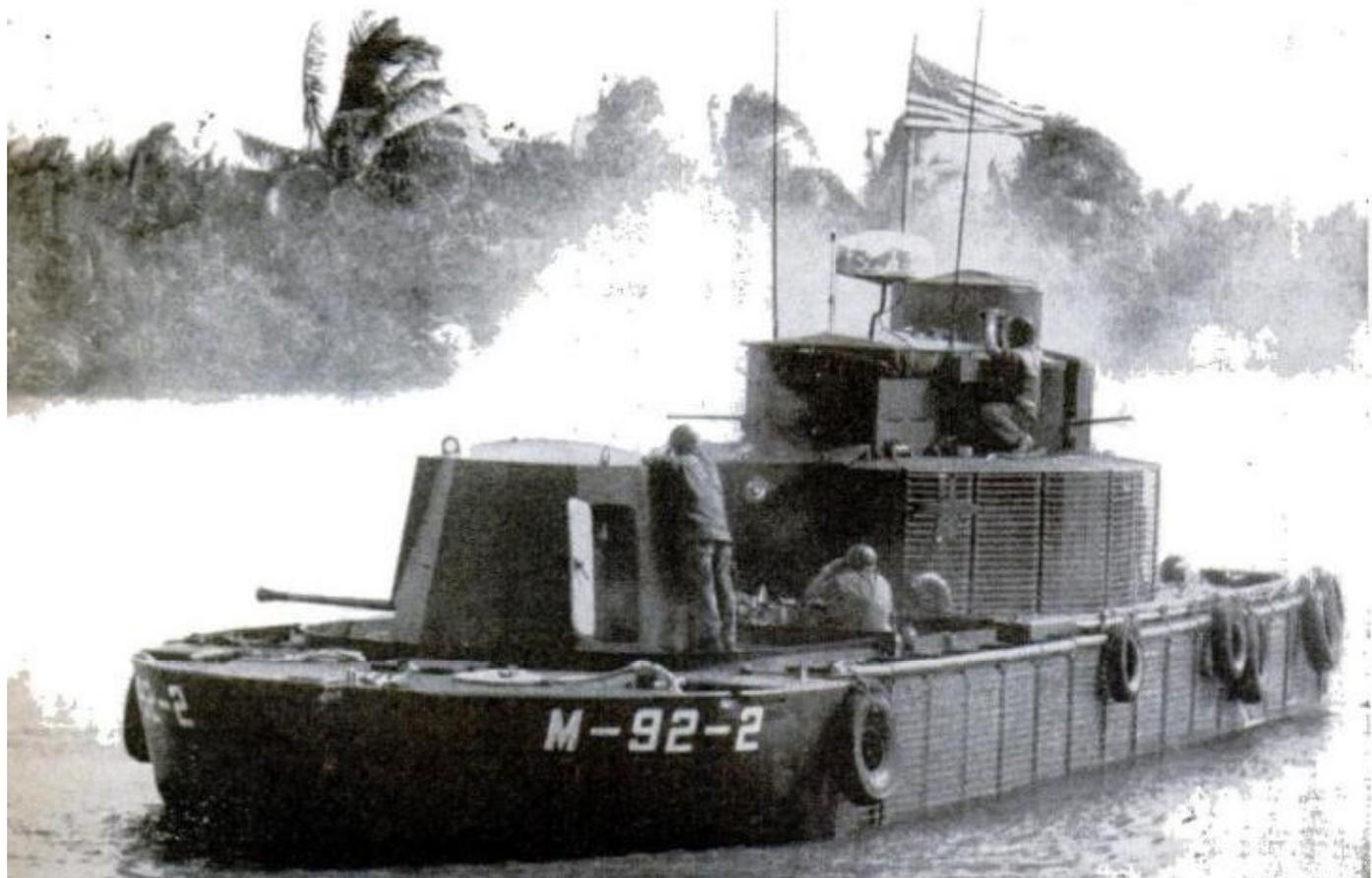
BETTMANN ARCHIVE

ORIGINAL MONITOR (foreground) more or less won first ironclad battle with Confederate *Merrimac*

dous firepower to bear on an enemy that has long held the upper hand among the meandering streams of the Vietnamese delta country. They have chewed up VC units hidden in mangrove thickets on the river banks, firing 40-mm cannons at point-blank range into slits of river-bank bunkers.

"We're using them like tanks in a ground war," says Capt. Wade C. Wells, the river force commander. The biggest shells the surprised VC have sent back—Russian-made, armor-piercing anti-

MODERN MONITOR, built on a landing-craft hull, has heavily armored superstructure and gun turrets



tank rounds—have exploded harmlessly against the *Monitor's* sides. Teaming up with Army infantry, borne into battle aboard low-slung armored boats, the river force has pushed as much as 100 miles inland seeking out the VC.

With the formal commissioning of River Assault Flotilla 1, a cycle of U.S. naval history has come full swing. It was on March 9, 1862, that the *Monitor* and *Merrimac* fought a noisy four-hour duel at Hampton Roads, Va., ushering in the age of ironclad warships. But after Appomattox, this kind of river warfare ended until Vietnam.

River Assault Flotilla 1 includes not only *Monitor* gunboats but armored troop carriers that open up to send waves of infantry ashore and armored command and communications boats to coordinate assaults.

Under the unusual silhouette of each craft is a familiar hull and power plant—the diesel-driven M6 landing craft known to every GI who has slogged ashore in an amphibious operation since World War II. Last fall and winter dozens of them were hauled out of naval storage, moved into shipyards and refitted with designs and weapons supplied by the Navy.

What emerged were three basic assault boats for the new flotilla:

The Monitor. Considered the battleship of the river force, the *Monitor* has a 40-mm cannon in its forward turret, a 20-mm cannon in a high turret at the

COMMAND BOAT, also heavily armored, has most of communication gear and directs flotilla attacks

stern, .50-cal. machine guns poking through turrets on either side, an 81-mm mortar to fire out of a well amidships, and four .30-cal. machine guns and two M-18 grenade launchers to fire from protected deck positions.

The Command and Communications Boat. A floating command post, the CCB mounts 40-mm and 20-mm cannon and .50-cal. machine guns in the same positions as on the *Monitor*, and carries two .30-cal. machine guns and both M-18 and M-79 grenade launchers. Bristling with antennas, its nerve center is a pack-type field radio and nine short-range radios that can maintain contact with other assault craft and field positions during an operation. It can also call in and direct air support.

The Armored Troop Carrier. Performing a role like that of a tank landing ship in a seagoing amphibious force, the ATC has most of the same armament except the 40-mm cannon. In place of the forward turret, there is space for troops or a heavy vehicle, such as a 2½-ton prime mover or armored personnel carrier, or an artillery piece as large as the 105-mm howitzer. Unlike the *Monitor* and CCB, which have shaped bows, the troop carrier is fitted with a ramp that can be lowered against a river bank so its troops or vehicles can move ashore.

With assault boats and crews arriving in Vietnam, one step remained to round out the new river force. More than

TROOP CARRIER, third craft in flotilla, carries Army infantrymen or artillery right up to shoreline



DECEMBER 1967



2000 troops of the U.S. Army's 9th Infantry Div. moved aboard two Navy barracks ships pulled out of reserve to serve as floating bases. By spring of this year, the new Army-Navy strike force was ready for business in two areas where "Charlie" has been calling the signals for years—the Mekong Delta and the notorious Rung Sat Special Zone, a swamp that lies like a green booby trap threatening ship channels between Saigon and the sea.

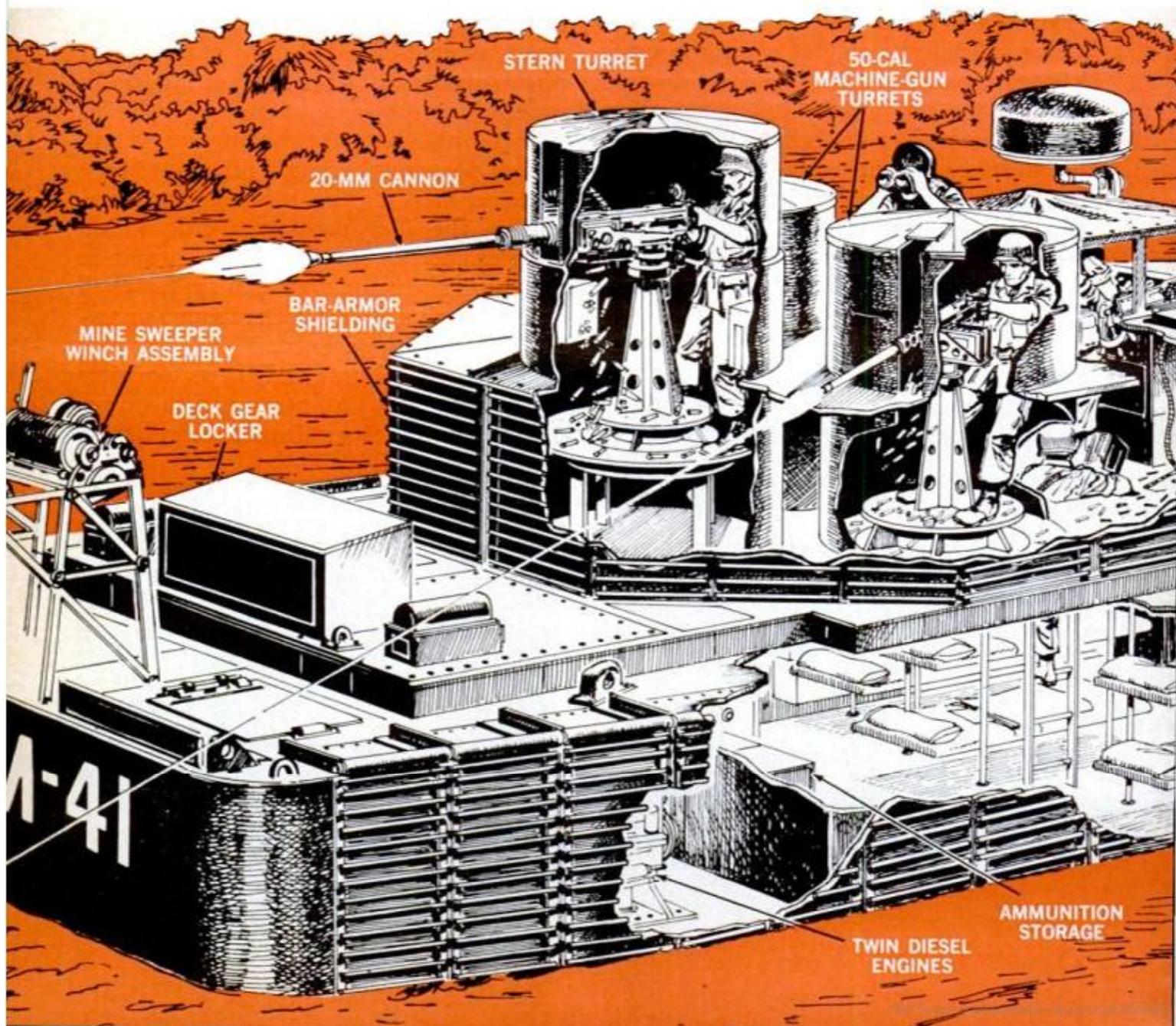
Captain Wells, a tough, burly veteran of World War II and Korea who was picked to be the first commander of the river force, says the new strategy is paying off against the VC. "We're finally able to bottle them up, keep them in the middle and chop them down."

The river force has moved a step beyond modern amphibious warfare. As

Wells explains: "In a regular amphibious operation, the job of the boats is to deliver the troops to shore. With the river force, the boats keep fighting along with the troops."

Until now commanders could not fight a "ground war" in the deltas. Tanks, artillery and trucks would sink out of sight in the mud. The river force deploys its *Monitors* like tanks, its ATCs like armored personnel carriers. And to beef up their firepower, the assault boats have towed barges into battle—mounted with Army artillery!

Monitors have proved themselves almost impregnable in combat. The 57-mm recoilless rifle, the primary VC artillery piece, can't stop them. Some VC units have hauled up Russian-made B-40 antitank weapons to return their fire, and while these rocket-propelled



rounds have wounded *Monitor* crewmen, they can't sink the boat.

The Vietcong have traditionally lured their foe into "prepared battlefields"—open spaces ringed with booby traps and concealed gun emplacements and bunkers. Foot soldiers take a beating when they move into such a setup with the weapons they can carry. In such a move the river force had its baptism of fire—*Monitors* turned the tide.

In this Mekong Delta operation last spring, ATCs moved up the Soi Rap River, led by *Monitors*, to the sanctuary of a Vietcong battalion. The ATCs nuzzled up to the river bank and let down their ramps. Infantrymen scrambled ashore. The VC let the GIs fill the area before they opened up.

The initial fire was intense and the Americans took heavy casualties before

they could scramble for cover. But once the VC had disclosed their position, the *Monitors* could swing through the nearby channels and pound them from the side with their weapons. Entire palm trees crashed to the ground under the onslaught. The VC were routed, leaving an estimated 250 dead.

Split into two squadrons, each with barracks ship and other support vessels, the river force has racked up a 10-to-1 "kill ratio" against the VC.

While armor and firepower give the river force its punch, mobility of the force is what gives U.S. commanders in the deltas hope that the pendulum may be swinging in their favor. "The main thing is that we can contain the enemy now," Wells explains. "Charlie likes to fight as long as he's winning. When he's outmatched he slips away." ★★★



RIVER BATTLESHIP

Illustrated by Charles Kramer of Zik Assoc., Ltd.

MONITOR CUTAWAY emphasizes its firepower and protective armor. It carries two cannons, six machine guns, a mortar and (not shown) two grenade launchers. Hull is protected by bar armor, armor plate and foam.

Underwater Hot Rod

By JOHN FIX

You ride it like a motorbike and control it like an airplane. Pegasus will perform acrobatics or help find sunken treasure.

BECAUSE AN AMATEUR DIVER had trouble taking underwater photographs, a new, highly maneuverable underseas vehicle was created.

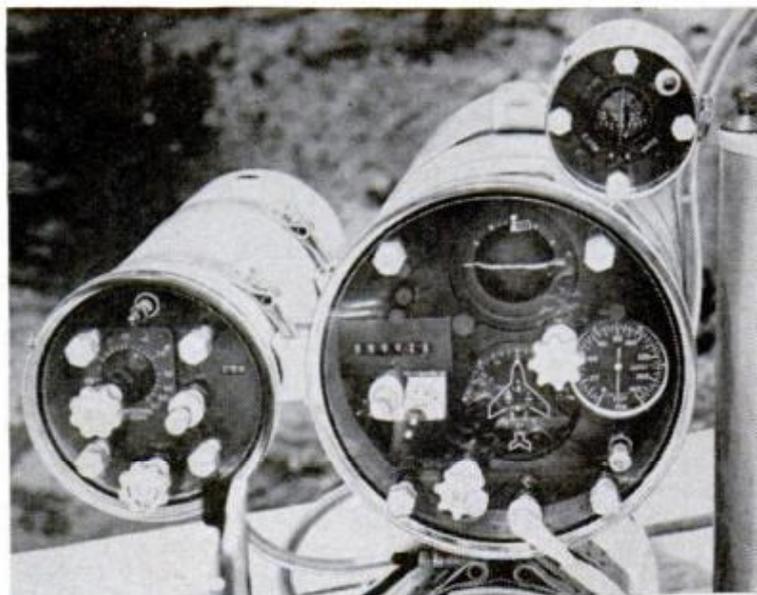
It all began in the 1940s, when Dimi- tri Rebikoff was a young reporter-pho- tographer in Paris. A friend, an ama- teur diver, complained about the im- possibility of taking pictures at depths greater than 130 feet. Rebikoff, who had invented a strobe light, thought it could be adapted for water, so he took off for Cannes to try it.

It worked fine; the color fidelity was great, but the distortion caused by the glass on the camera housing led Rebi- koff to another discovery. With Dr. A. Ivanoff, he perfected a no-distortion glass housing for his camera.

Again, it worked fine, but it led to still further creations. The hand-held camera was cumbersome and the un- wieldy breathing tanks of the day were awkward, so the man on the ocean floor was too busy just surviving to take great pictures.

Rebikoff wanted something he could put the camera on, then mount himself and ride around on in the ocean. That was the beginning of Pegasus, a cross between a torpedo and an airplane.

The latest version is capable of great maneuverability and of speeds up to 100 yards a minute, about 10 times fast-



PEGASUS INSTRUMENTS look like this to diver. Cam- era housing is at left; film cameras can be operated automatically. Magnetic compass is small housing at upper right. Large housing includes (clockwise) artificial horizon, fathometer, gyro compass, volt- meter and chronometer. Underwater color shots (right) show various configurations of Pegasus in use. Bottom photo shows the strobe lights, camera lens

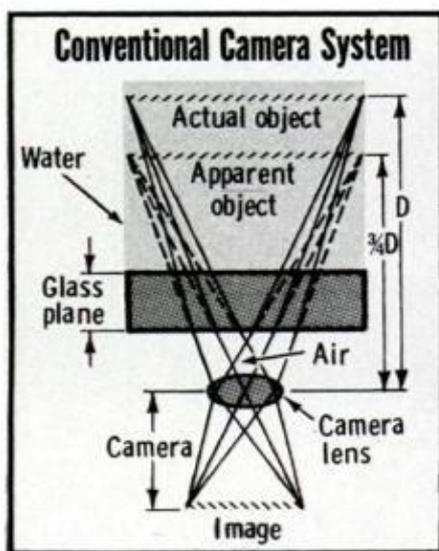
er than an unaided scuba diver can do.

Also, Pegasus can descend 400 feet or more and remain as long as two hours.

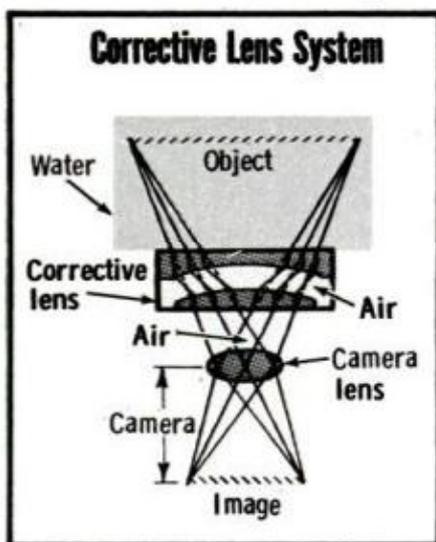
For diving, Pegasus is ballasted to maintain a neutral buoyancy, adjust- able to different densities of water. There is no change in buoyancy with a live load, since a man in scuba gear is also ballasted for neutral buoyancy, and with new helium-oxygen breathing mixtures he can return safely from these deep dives. Navy divers have done it with Pegasus to at least 200 feet.

Pegasus is driven by a 1.5-hp electric motor geared to an 11.5-inch-diameter, three-bladed shrouded propeller. The shroud gives the prop a 90-percent ef- ficiency ratio. Power, for propulsion





CAMERA LENS improves underwater photography. Old glass porthole on camera (above) distorted image, giving "pillow" effect to lines, bending them out at sides, and also falsely making the object appear closer than it was, affecting the focus. Corrective lens (below) improves clarity, contrast and accuracy



and all other equipment including camera and lights, is supplied by a single 100-ampere, 24-volt, 18-cell battery.

Elements of Pegasus's units are enclosed by watertight, streamlined pods, including an instrument pod, a navigation pod, a camera pod and twin strobe-light pods. Navigational instruments include an artificial horizon, directional gyro, fathometer, shaft revolutions log, voltmeter and water-leak detectors.

Because of the precision navigation equipment, dives are possible in murky waters or in total darkness.

To ride it, the diver straddles Pegasus and controls its movements with his hands and feet. In its latest version the feet are placed on a swing bar which controls the directional rudder, and the left hand operates a "joy stick" which controls the differential ailerons

for pitch and roll, the rear diving rudder and the motor-control switch.

The camera, which started the whole thing, now takes amazingly clear underwater photos, and it can be any kind—movie, still or television. The secret is a corrective lens which replaces the glass porthole, becoming an integral part of the optical system. The glass, with water on one side and air on the other, distorted the image. The corrective lens, with air in between its two elements, retains the true image as if the picture were taken above water.

Rebikoff sees a variety of applications for his combination underwater airplane and high-fidelity camera, including commercial exploration, oceanographic expeditions, treasure hunts, military use and plain fun. Price? About \$15,000 for the military version. ★ ★ ★



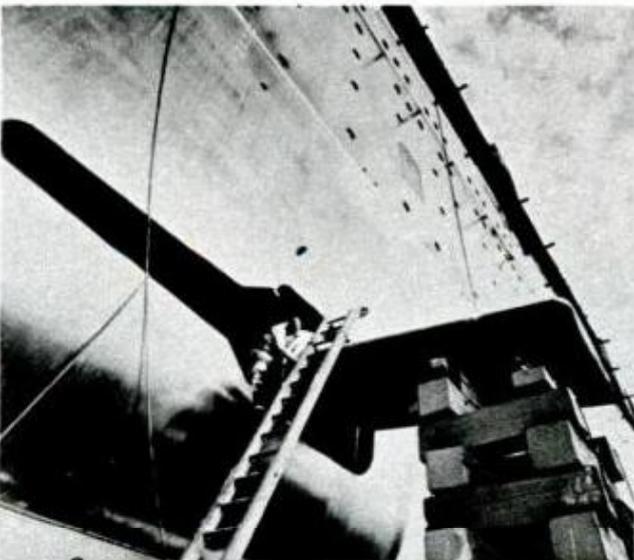
Nuclear carrier to be named after Admiral Nimitz

This is an artist's conception of the 94,000-ton nuclear-powered aircraft carrier soon to be constructed and named in honor of the late Fleet Adm. Chester W. Nimitz. Advance planning and design of the huge \$427.5 million carrier is now under way.



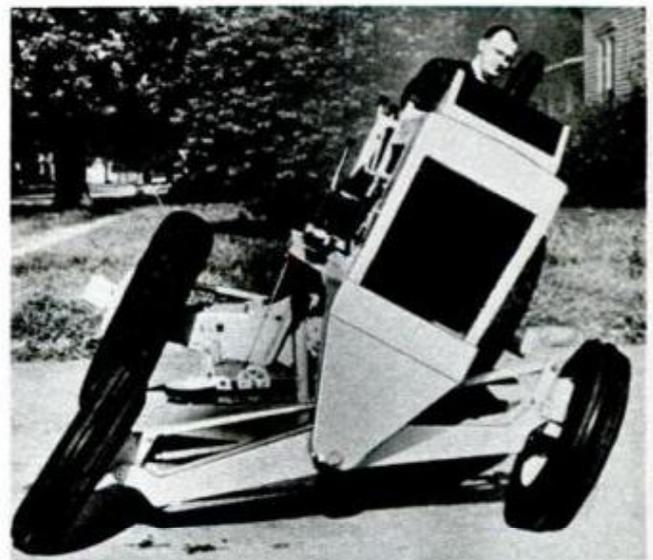
Now the French are swinging wings

The United States has the F-111, Russia has the Mikoyan and the French have the Mirage 3G—and all have wings that sweep back while they are in flight, enabling them to achieve extremely high speeds. The French plane weighs 16 tons.



New Queen swings, too

Cunard's newly launched *Queen Elizabeth II* (see page 106, Sept. *PM*) has four "swing-wing" stabilizers that fold forward into the ship's hull when they are not being used.



He's got an angle

The driver of this loose-jointed tractor-mower demonstrates on level ground how the machine can shift its center of gravity so it can be used on steep highway slopes.

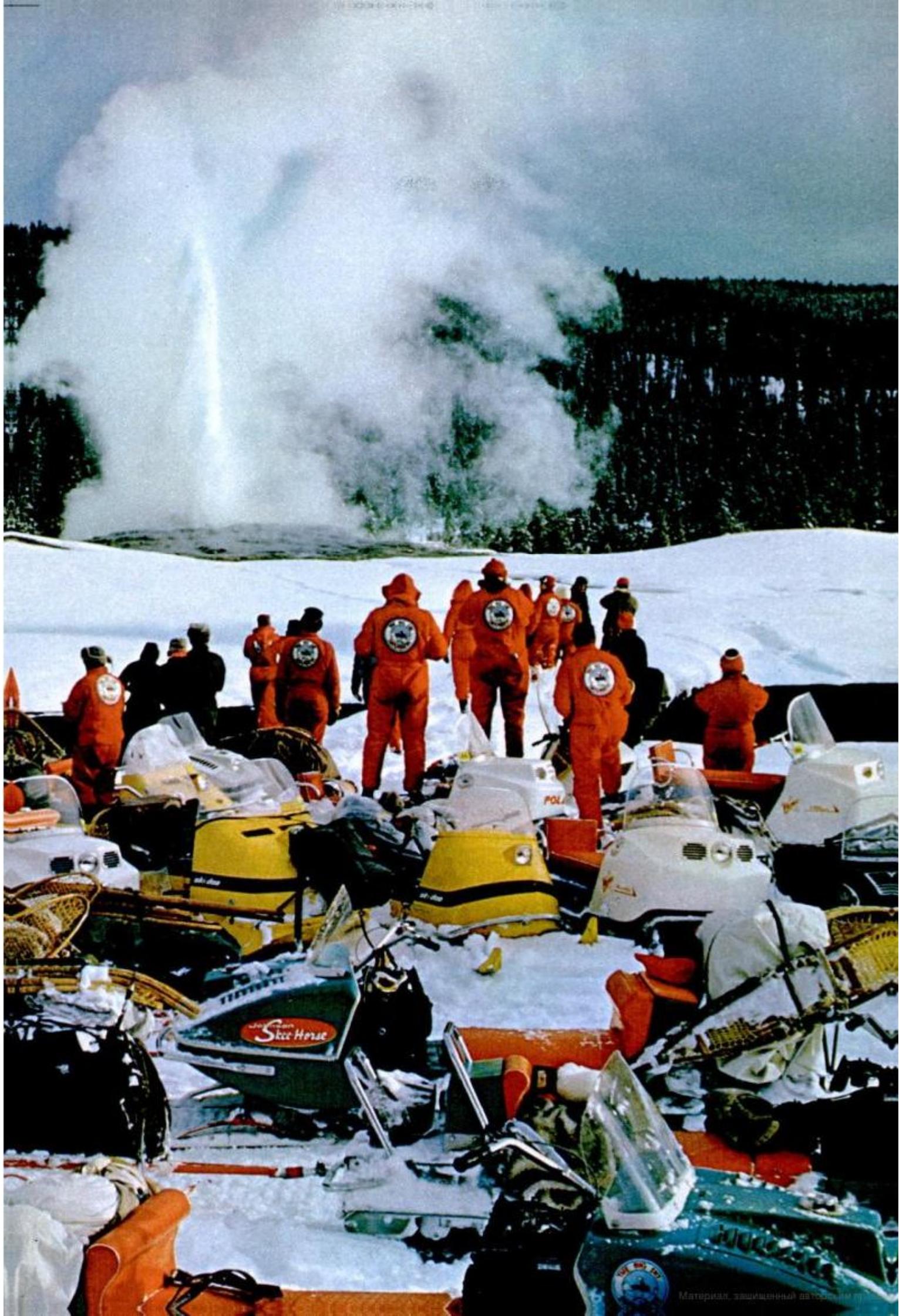
Through Yellowstone on a Snowmobile

By DANIEL C. FALES

Photos by Joe Munroe

MILLIONS OF AMERICANS visit Yellowstone every summer. Up to now, though, only a handful of snowshoeing rangers and a few hearty explorers have ever seen the park in winter. But now you can take a look at this winter wonderland, as I did. It's all







CARAVAN STOPS to take in the view as we break out of the woods just above ice-covered Yellowstone

possible through the wizardry of snowmobiles . . . but let's go back to the early-winter start of my trip . . .

This run is going to be a humdinger for two reasons. For one, 38 experienced snowmobilers on 25 "machines" (they call them that) are going to try to make the first long (135-mile) run *around* the snow-buried park—a rugged challenge even for experts. And here am I, certainly no expert yet, hoping to keep up with them for three days.

Like you, of course, I know how popular the swift little machines suddenly have become. Right now they're whistling through the woods of New England, racing over the North Central Plains, busting through deep powder in the Northwest.

There are, you see, three *kinds* of snowmobiling: (1) trail-work, (2) racing and (3) drift-busting. On this run we'll be doing all three. I'm worried about this fast company. Members of the Big Sky Riders, a typical snowmobile club, live around Livingston, Mont. Nothing scares them.

Our starting point is sprawling Mammoth Motor Lodge near the north end of the park. I'm here early. My mentor, a square-jawed man in a parka, comes over and shakes hands. He's John Dietz, retired Air Force officer who manages the lodge operated by the Yellowstone Park Company (YPCo).

"Your first job," he says, "is to learn to throw your weight around." My machine is waiting in a stable of snowmobiles anyone can rent for \$6 an hour. It's a heavyweight, 15-horse job.

I've come here thinking I'll need a lot of trail training. I was wrong.

My first surprise is when John explains that in cross-country work you kneel as much as you sit—for two reasons: You see better over the shield, and it's easier to shift your weight. He leads the way on a brief test run, after checking me out. In two hours I have enough confidence to begin throwing my weight on turns.

Then at dinner hour club members start driving in from Livingston, each trailing a snowmobile. Some unload not



Lake. Some take this opportunity to adjust gear

only machines but sleds and toboggans. These, full of food and gear, will be trailed behind the snowmobiles.

Going over plans tonight, there's talk of blizzards, killer avalanches, sleeping bags, extra clothes, dry socks (there's nothing like dry socks for cold feet), snowshoes, gloves, head masks, goggles. We talk, too, of extra sparkplugs, drive belts, tools, oil to mix with gas and walkie-talkies. Then we sleep.

It's 8:00 a.m. and 10 below zero as we rev up amid clouds of smoke. We rock our machines so they don't stick to the snow.

Twenty-five machines in line and ready are quite a sight. Engines pop. I'm in third place. Up front, John Dietz is making a walkie-talkie check with the last driver—Tail-End Charlie, we call him.

Then a hand waves, and we're off. The trouble comes almost right away.

We're heading south. It's a 50-mile leg. We start up a range of hills. The column twists and moves up slowly.

The trouble, when it comes, is odd.

We're following a summer road, long since closed by snows 30 feet deep in drifts. But suddenly the runners throw sparks. They're running on bare road. No snow! The hot springs for which Yellowstone is famous have left dry spots. One is 1000 feet long.

How do you run on bare pavement? Runners no longer steer. So we get off, run alongside, pushing, coaxing, hauling, sweating. All the time we have to keep the belt going for traction, and that's hard when there's a dead-man's throttle to work while you're pushing the 400-pound machine away from a cliff.

But we all make it, and at the summit we rest.

Now comes the real ride! We go on, a beautiful column, every machine throwing a white squirrel tail. Up ahead John is up on the seat and kneeling. Our speed is 15 mph. He's swaying side to side as he takes the turns. I follow suit. But on the first turn my machine tries to tip over and throw me—not *away* from the turn as you'd expect but toward the *inside*. Then I remember: John had shouted, "Lean right when you turn left!" This does it. We go on twisting, turning, climbing, descending through a world of great beauty. Far back I see Tail-End Charlie. He's the guy with the extra gas;

TAIL-END CHARLIE checks the extra gas supply before taking up his position at the end of the column





SNOWBALL FIGHTS at 15 mph. John Dietz and wife Ann are in the front machine leading the merriment. Author is driving snowmobile just behind the Dietzes'

YOU MUST LEAN together when going around turns. Bruce Sigrist and his wife zip along the trail. Note the perky gal snowmobiler on fast-moving machine at left

ICE BALLS develop within track system when temperature gets above 30°. These can jam the bogies, stopping machine. Ice balls must be removed before you go on.



though each of us carries an extra five-gallon can, Charlie's there if any of us runs out. We figure on five miles per gallon. We'll refuel tonight.

Until now I've been horsing my machine. Now I'm learning to take it easier.

Then suddenly, a blizzard.

We're on a long plain. The wind comes wild. The column vanishes: a whiteout. I turn on my light—hoping to be seen. I can't see a thing. Only shadows. Surely, Dietz will stop. Then I realize, we've got to keep going.

I suddenly know what it is like to be lost in a blizzard. When I lose sight of Dietz and the No. 2 man only 30 feet ahead, I slow, unsnap my brown glare-goggles, replace them with yellow lenses for brightness.

I wonder how Dietz can see. Only long training will help. We're still following buried roads. Even the tops of guide sticks become invisible, and there

BUFFALO are among many kinds of wildlife roaming free in the park. Every day there's something to see



are canyons along edges of the roads. And then, suddenly, the blizzard ends. Now at last we can open out in a clear track. We go pelting westward through Alice-in-Wonderland country. All around us are great gaping steam holes and snowy pines. We go under arched trees of snow. A lunch stop.

Now Old Faithful is not far ahead. Two big YPCo snowcats come blasting

DECEMBER 1967

toward us like Army tanks, each hauling a dozen tourists in warm comfort on a day's run from West Yellowstone to the big geyser. And then we come chugging down to Old Faithful.

We unroll our sleeping bags in the cabins. After a hearty dinner, a bit of singing and a few jokes, we sack out early. Before I fall asleep (feeling good that I spilled only three times), I go over the spills, trying to remember what I did wrong. Each time the machine had rocked past the balance point. I'd felt it sinking to one side. I'd let go the dead-man throttle and I'd been tossed into soft snow.

It's a late breakfast. We're ready to leave when Old Faithful fires off—spectacularly—on schedule. It's 9:05 a.m. and time to hit the trail.

The next two days are great sport. We turn 40 miles east. I'm sore all over, but I'm getting the hang of it. And

(Please turn to page 182)



OUR YELLOWSTONE ROUTE: We start at Mammoth, spend the first night at Old Faithful, the second night at Lake

109



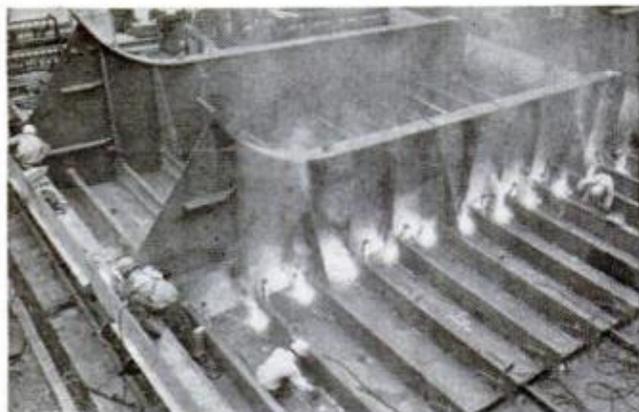
Thief bar

Locked to the steering wheel of a car, a new British antitheft device is simply a long steel bar that prevents the wheel from being turned more than a few degrees. The maker says that, since the gadget is visible from outside, few thieves even bother to break in car.



Ready, aim, talk

Army units can talk to one another via satellite by using a new collapsible "stovepipe" antenna. Within 30 minutes, two men can extend the unit from an 8-inch package to its full 13 feet, locate the satellite and be ready to handle voice and teletype communications.



Fast operator

One operator can manage six welding units simultaneously in the gravity weld system developed at the Kawasaki Dockyard Co. in Japan. This is one of several methods used to improve and speed up the building of ships.



Nongardening gardener

Charles Walder's flower garden in England is filled with 5000 colorful blossoms all year round—and he never has to plant, plow, spray or weed. He's saved himself all that work by filling the garden with plastic plants.



Minijet

The smallest jet engine ever built in France powers a new flying wing that will carry its occupant at speeds of more than 120 mph for several hours. The engine weighs a little over 80 pounds, develops 176 pounds of thrust.



Light side of the Army

Targets more than 1½ miles away can be illuminated in darkness by the Army's new xenon searchlights, shown here at Fort Sill, Okla., where operators—two per unit—are training to work the new lamps in Vietnam.



Next: Drag racing to the water cooler?

One advantage of an electric motor scooter, a London secretary finds, is that she can take the quiet, fumeless machine up the elevator into her office and recharge it there. The two-wheeler is a City Bike, powered by two six-volt batteries. It'll travel up to 20 miles at 30 mph.



Not afraid of the water

Special skid gear on this Bell 206A Jet-Ranger carries floats that can be inflated while the helicopter is in flight (shown in sequence, top to bottom), enabling the craft to alight on water and stay afloat. Either air or a gas may be used to inflate the pontoons.



On call anywhere

Talking to her boss 3000 miles away, this girl is using the Portable Executive Telephone, which requires no connections to phone lines or power sources. The radio device permits phoning almost anywhere in the world via the phone company's mobile-telephone operator.

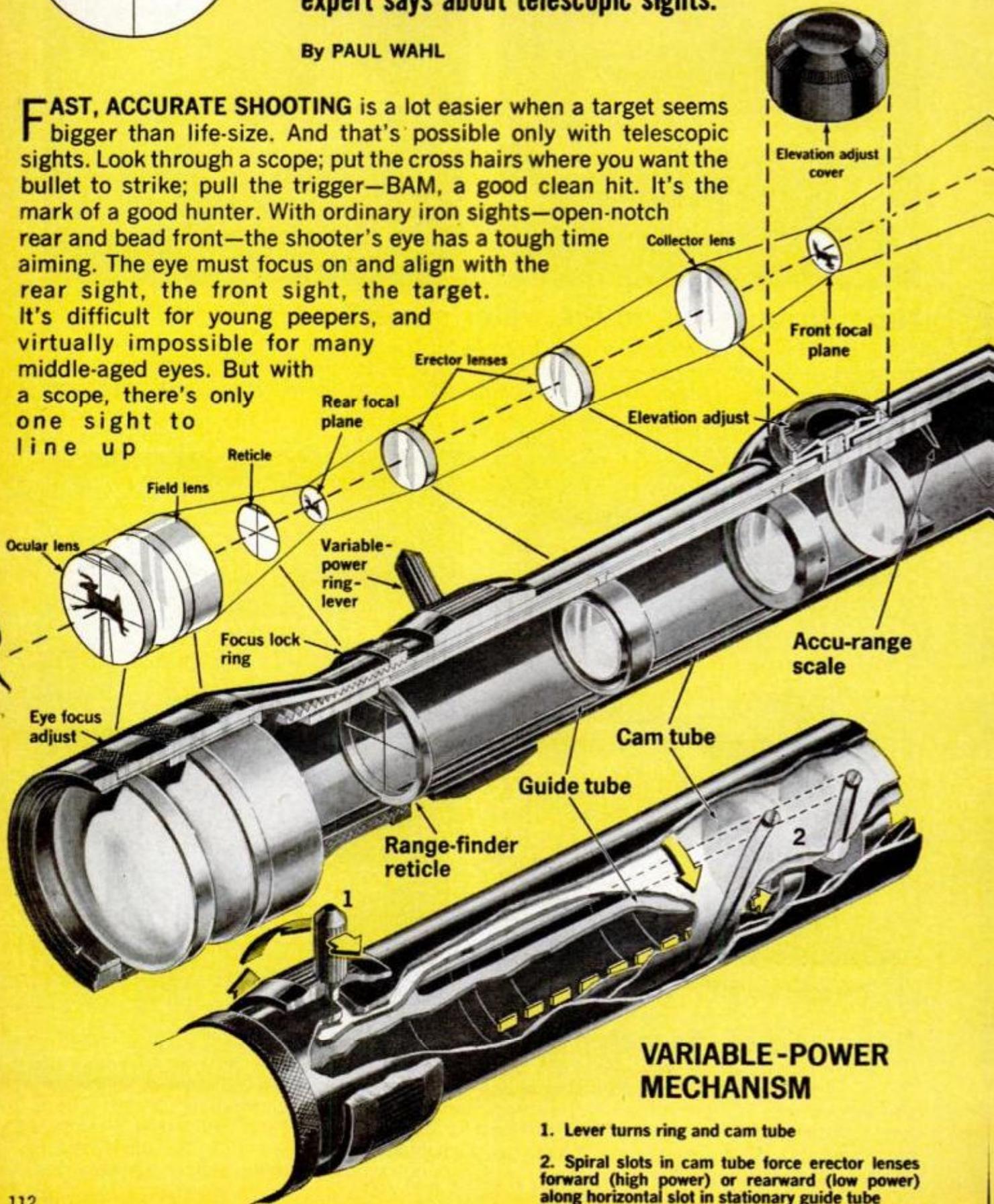


The Real Scoop

Mass confusion surrounds purposes, terms, prices of the No. 1 shooting accessory. Read what an expert says about telescopic sights.

By PAUL WAHL

FAST, ACCURATE SHOOTING is a lot easier when a target seems bigger than life-size. And that's possible only with telescopic sights. Look through a scope; put the cross hairs where you want the bullet to strike; pull the trigger—BAM, a good clean hit. It's the mark of a good hunter. With ordinary iron sights—open-notch rear and bead front—the shooter's eye has a tough time aiming. The eye must focus on and align with the rear sight, the front sight, the target. It's difficult for young peepers, and virtually impossible for many middle-aged eyes. But with a scope, there's only one sight to line up

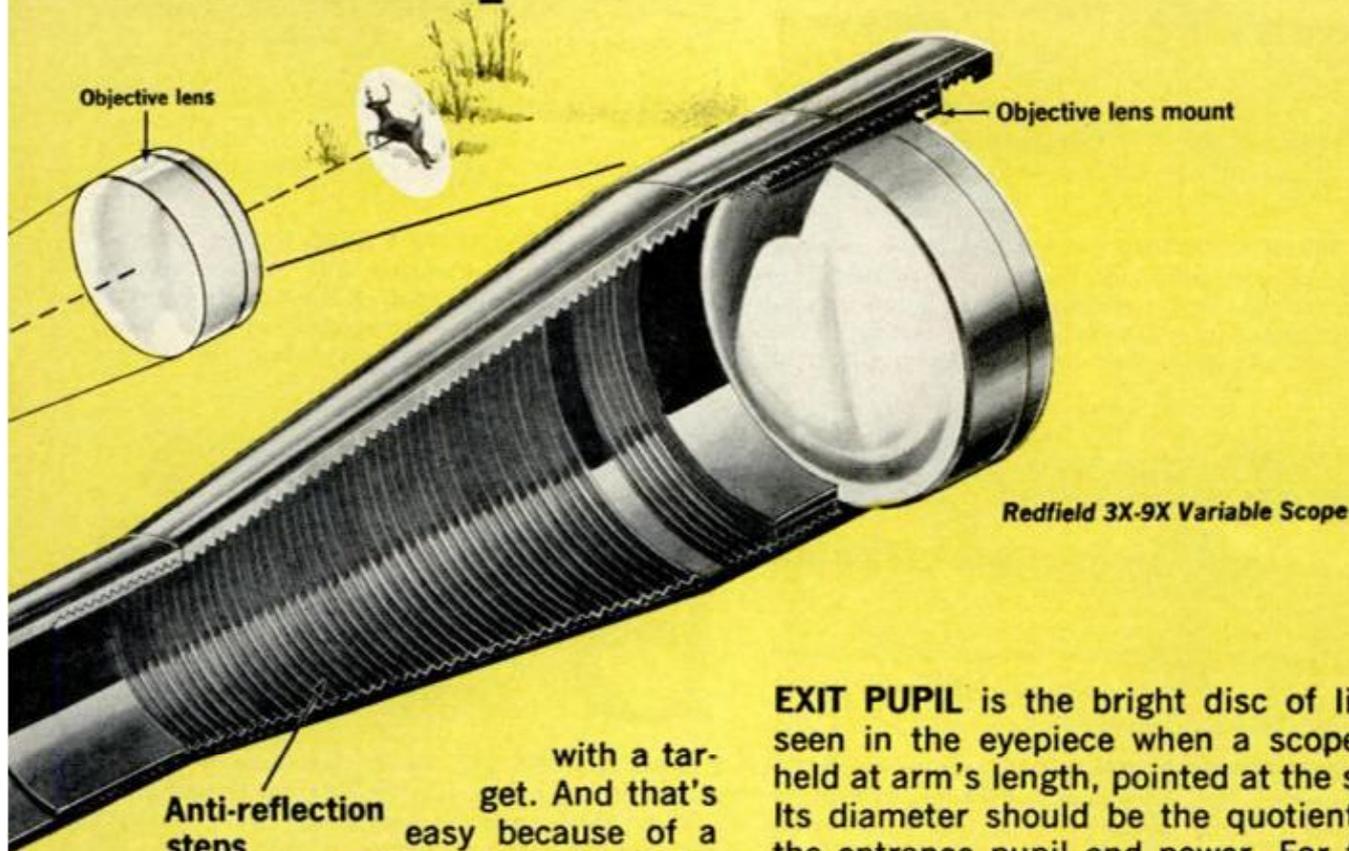


VARIABLE-POWER MECHANISM

1. Lever turns ring and cam tube
2. Spiral slots in cam tube force erector lenses forward (high power) or rearward (low power) along horizontal slot in stationary guide tube

on Scopes

Art Concept by ZIK Associates, Ltd.



Redfield 3X-9X Variable Scope

with a target. And that's easy because of a scope's ability to make a target seem brighter and closer. But before going off half-cocked to buy, you should know the different scopes used for different targets. There are several important facts and definitions you need know, too. Scope types are on the next page—terms used with telescopic sights start here.

MAGNIFICATION is given in terms of "X." It means the detail you can see at 100 yards. The unaided eye seldom sees objects of less than one inch at that range—thus the norm, 1X. But with a 4X (four-power) scope, you can see 1/4-inch objects at 100 yards—6X, 1/6-inch objects, and on up to 36X. Don't buy more power than you need. A 4X scope is standard.

ENTRANCE PUPIL is the diameter, in millimeters, of the clear aperture of the objective lens. This determines light-gathering ability in relation to magnification. If the objective lens is too small for the power, a scope lacks the brightness needed to perform effectively under a normal range of light conditions.

EXIT PUPIL is the bright disc of light seen in the eyepiece when a scope is held at arm's length, pointed at the sky. Its diameter should be the quotient of the entrance pupil and power. For fast shooting, it is desirable that the exit pupil be somewhat larger than the eye (5-mm) for more freedom of eye position on the scope axis.

RELATIVE BRIGHTNESS is an index to the amount of light put out by a scope. It is the square of the diameter of the exit pupil. Don't be too impressed by a high relative-brightness index—anything over 25 is wasted because this represents the most light the pupil of the human eye can admit under any hunting conditions.

FIELD OF VIEW is the diameter of the picture seen through a scope, usually given in feet-at-100 yards. So, a 30-foot FV means you can see a 30-foot section of territory, 100 yards away. Generally, as magnification increases, field of view decreases. Construction of variable-power scopes slightly restricts the field of view.

EYE RELIEF is the distance behind the ocular lens at which the eye must be held to get the full field of view. "Eyebrow relief" can be more important. To



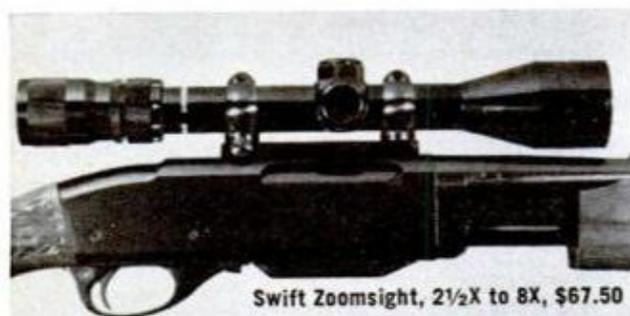
Weaver K2.5 scope, 2½X, \$37.50

FOR BRUSH SHOOTING, where fast shots at close range are often called for, magnification is a lot less important than the wide field of view of a low-power scope—from 1X to 3X. Best selling brush scope is 2½X with a field of view of about 43 feet



Realist Brush, 1½X to 4½X, \$59.95

VARIABLE-POWER BRUSH SCOPES are probably the most useful for short-to-medium-range hunting in the woods. Power varies from 1½X, for fast shooting at point-blank range in thick cover, to 4½X—all you need for the longest shot you're likely to get at a deer



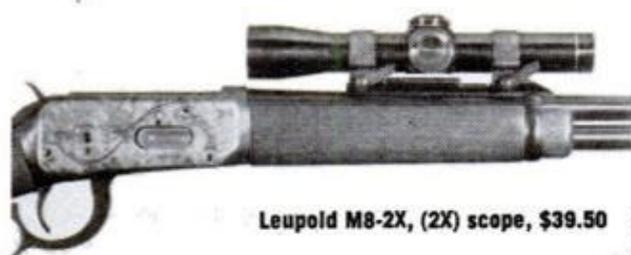
Swift Zoomsight, 2½X to 8X, \$67.50

VERSATILE VARIABLE SCOPES have broad magnification ranging from 2½X to 8X. With one of these scopes, needs of virtually any hunting condition can be met by instant change of power. It's a good choice when you want to hunt varmints with big-game gear



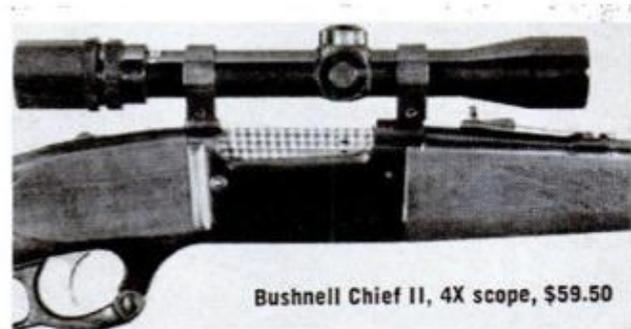
Redfield Variable, 4X to 12X, \$124.50

LONG-RANGE VARIABLE SCOPES run from 4X to 12X in power. This is perfect for any type of shooting from big game to varmint at all ranges. These scopes also have parallax-focus adjustments from 50 yards to infinity on the front bell housing



Leupold M8-2X, (2X) scope, \$39.50

SCOPING A TOP-EJECTION RIFLE is now possible because of low-power scopes with long, noncritical eye relief. Scope is mounted on the barrel ahead of receiver and out of way of ejected cartridge cases. This rifle was usually scopeless before this design



Bushnell Chief II, 4X scope, \$59.50

FOR ALL-AROUND USE, the 4X is excellent for medium and most long-range shooting. It gives enough magnification for a good enlarged view, yet is not too much for the average hunter to hold steady, off-hand. It's the best fixed-power scope for general use



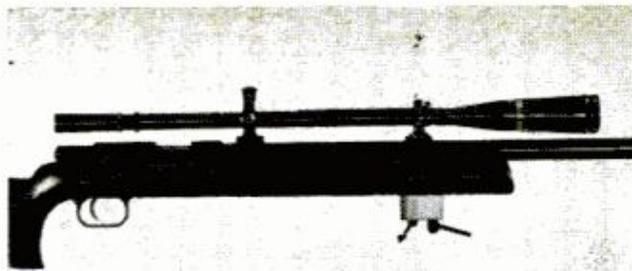
Leupold M8-7.5X (7½X), \$69.50

FOR LONG-RANGE SHOOTING, most expert riflemen choose 6X to 8X scopes for big-game hunting in open country, where most shots are fired from rest position. Though magnification is harder to handle, some old hands use 10X to 15X for varmint shooting



Pacific 4X28, 4X scope, \$24.95

FOR THE .22 RIFLE the 4X is most popular, but there are also modestly priced 6X, and even variable-power scopes made especially for .22s. To get most out of yours, put a scope on it. Installation is easy: most have mounts to fit dovetail receiver grooves



Lyman Super-Targetspot, 34mm 20X, \$125

TARGET SCOPES range from 6X to 36X. They have long tubes, large objective lenses and high-precision mounts. Higher power scopes require large objectives for adequate brightness. The most popular for outdoor matches is the 20X with a 34-mm objective

avoid injury, be sure that your eyebrow is at least 3 inches from the eyepiece rim of any scope used on a high-power rifle. Heavy recoil can drive the rim of the eyepiece into your face.

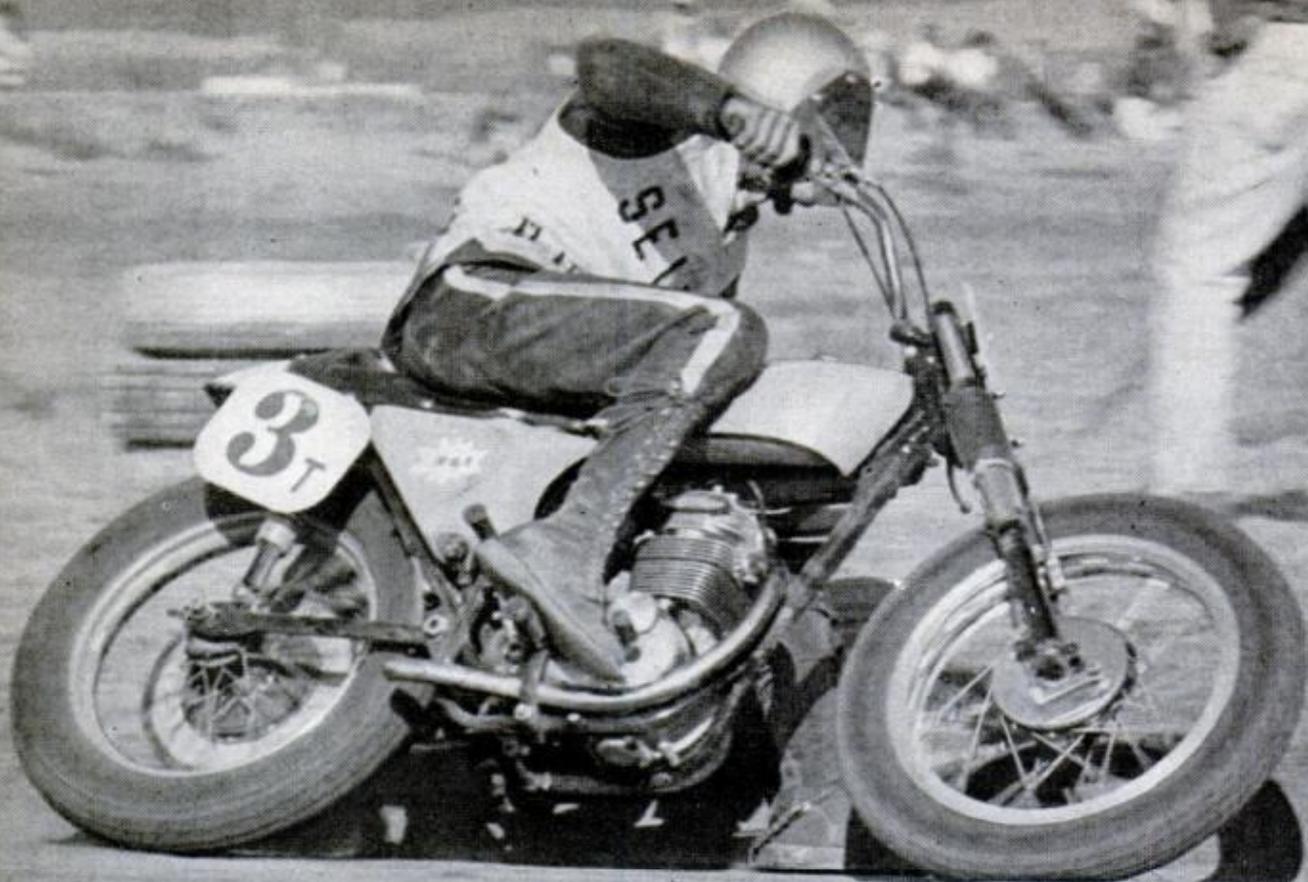
RETICLE is the "sight" by which a scope is aimed. Standard types are: cross hairs, post and cross hair, cross hairs and dot. The cross hairs—medium for general use, fine for long-range hunting—are most widely used. The post and cross hair, easier to see in dim light or against a dark background, is ideal in woods. The dot gives a more definite aiming point than just cross hairs.

LATERAL AND VERTICAL MOVEMENTS of point-of-impact are called "windage" and "elevation." Nearly all hunting scopes have internal adjustments, accomplished by moving the erector system. The reticle should remain centered. In the low-power scopes, one

(Please turn to page 186)

BUYER'S GUIDE TO RIFLE SCOPES

Manufacturer or Importer	Brush Scopes	Long Eye-Relief Scopes	Variable-Power Brush Scopes	All-Around Scopes	Variable-Power Scopes	Long-Range Scopes	.22 Scopes	Target Scopes
BAUSCH & LOMB	\$49.95	—	—	\$49.95	\$79.95-99.95	—	—	—
BROWNING	—	—	—	59.95	94.95	—	\$32.95	—
BUSHNELL	29.50-49.50	\$24.50-34.50	—	37.50-59.50	94.50-99.50	\$39.50-69.50	14.95-19.95	—
FIREARMS INT'NAT'L	35.00	—	—	39.95	69.50	43.50	—	—
LEUPOLD	59.50	39.50	—	59.50	79.50-89.50	69.50	—	—
LYMAN	45.50-47.50	—	—	54.50	—	64.50-84.50	—	\$125.00
MARBLE	47.50	—	—	57.50	89.50	59.95	13.25	—
MARLIN	39.95	—	—	49.95	79.95	59.95	14.95	—
PACIFIC	27.95	—	—	30.95-36.95	52.95	33.95	24.95	—
REALIST	49.75	—	\$59.95	57.50	89.50	59.50	9.95-14.95	—
REDFIELD	34.95-49.95	39.95-49.95	—	59.95	89.95-124.95	79.95-109.95	—	—
SAVAGE	31.50	—	—	37.50-59.50	59.75	—	9.75-14.95	—
STOEGER	—	—	—	24.95	46.95	29.95	11.25-11.95	—
SWIFT	24.00	—	—	24.50-36.00	67.50	25.00	—	—
TASCO	24.95	—	—	24.95-29.95	29.95-39.95	27.95-39.95	7.95-14.95	—
TRADEWINDS	—	—	72.00	—	—	—	—	—
UNERTL	50.00	—	—	54.00	—	68.00-132.00	—	69.00-192.00
WEATHERBY	69.50	—	—	79.50	99.50-109.50	89.50	29.50	—
WEAVER	16.95-37.50	—	55.00	16.75-45.00	62.50-69.50	48.50-72.50	9.75-14.95	—
ZEISS	—	—	199.00	135.00	—	147.00	—	—



"FASTEST TURNING 250-cc pushrod engine I've seen"

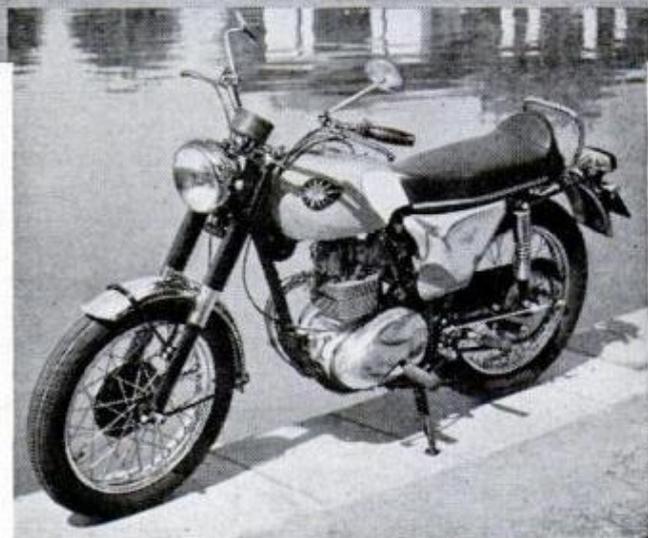
PM Tests BSA's 250-cc Starfire

Maximum 'Go' in a Minimum Package

By DOUG RICHMOND

BSA'S 250-CC SQUARE-BARREL is a pretty bike. Everywhere I went people stopped to admire it. The black seat and frame, the chrome of the lower fork bars and brake backing plates "go with" the light blue off-white color of the fiberglass gas tank, oil tank and battery-and-tool cover.

The square-barrel BSA Starfire differs from its 250-cc predecessor in more than just superficial appearance, for it is actually a hybrid, a 250-cc cylinder and head grafted to the lower unit of the very successful 441-cc Victor, which in turn is de-



IT'S A PRETTY BIKE," says the author, who found people stopped to admire it everywhere he went

veloped from the out-and-out competition trials model that has met with such fine results in European meets. The brakes, frame and so on are similar to the Victor, with most parts being interchangeable.

The biggest improvement over the preceding 250-cc BSAs is in the breathing—right off the floor the Starfire has the sort of induction tract the lads tried to get in years past by hearty applications of rotary files and elbow grease—and almost never achieved!

The free-breathing characteristics, plus a massive lower unit, give the engine the

ability to really wind out without running out of breath, and the oversize clutch and gearbox provide the beef necessary to handle the strain. This is the fastest turning 250-cc pushrod engine I've ever seen; without a tach I'm unable to state just exactly how fast it turned, but frankly, I lost my nerve and shifted up long before the engine ran out of steam!

Unfortunately, the free-winding engine is harnessed to the rear wheel with ridiculously tall gearing—so help me, this machine ran just about as fast in third as it did in fourth, and to prove it we ran the quarter mile through the traps with all four gears, then with only three, and could detect no appreciable difference—the standing quarter-mile elapsed times were consistently from 18.19 to 18.80, with speeds at the quarter of 71 to 74 mph.

Running on the freeway in fourth gear, 70 mph was held with no difficulty, although the tall gearing caused a loss of speed at every little hill.

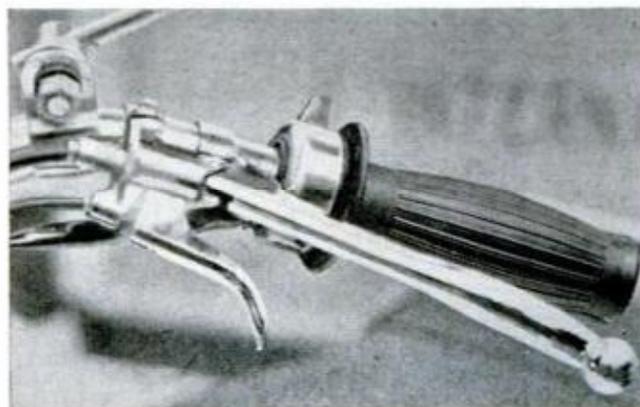
The stock rear sprocket has 49 teeth, so when I discovered Charley Storm was running a 59-tooth rear on his 650-cc scrambler I persuaded him to lend me his sprocket and chain after the main event at Hayward one night.

The interchangeability among current BSA models is high nowadays, so the sprocket fitted perfectly. The larger machine uses a wider chain with the same pitch, so all we had to do was install the bigger chain.

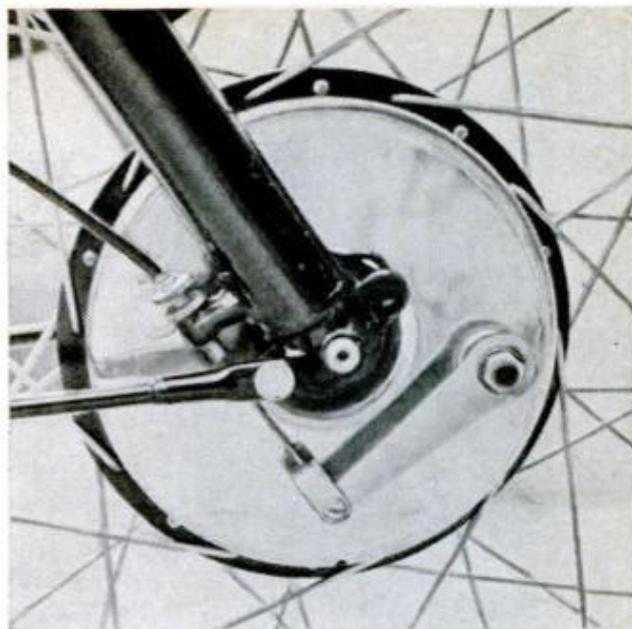
Although the swap was made specifically in order to make it possible to ride up in the mountains, the improvement in the bike's characteristics for all-around town riding was fantastic.

No longer was it necessary to drop a gear to climb the spans of the San Francisco Bay Bridge, and 65-to-75 mph was

BIG, SOFT GRIPS are easy on rider's hands; small "trigger" below the bar is a compression release



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STARFIRE OFFERS extra adjusting nuts for front brakes in addition to the regular bar adjustment

maintained on the freeways regardless of hills and headwinds.

We were greatly impressed by a number of little touches that are so often neglected by bike designers.

For instance, there was the big cast aluminum heat sink for the Zener diode mounted between the front forks. The Zener serves as a voltage regulator, preventing the output of the permanent-magnet alternator from cooking the life's juice out of the battery when running without lighting load. This is one reason why many bike riders run with their lights on during daylight.

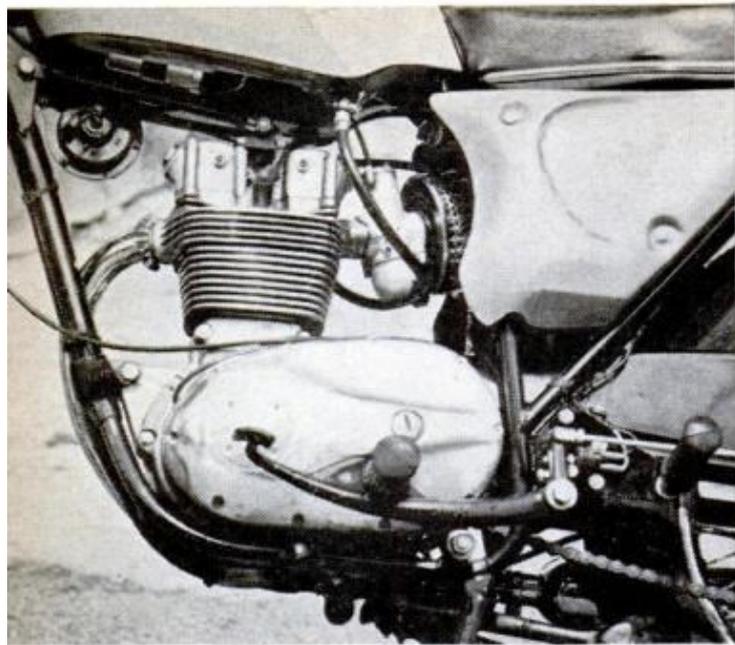
Another thing that goes well is the illuminated high-beam indicator. Although the high-low beam switch position under the motorcyclist's thumb is a highly efficient beam indicator, California law requires an idiot light on bikes.

Another thing is the balance of the bike when on the center stand. Ordinarily, the bike on the center stand has its rear wheel touching the ground; if the rear wheel is removed the bike tilts forward onto the front tire. A small thing, but anyone who has ever wound up with a motorcycle in his lap when pulling a rear wheel will appreciate it deeply!

Vibration is not a problem for the rider, perhaps because of the high speed of the little engine, but still and all the speedo (Smiths) is mounted in rubber, and the grips are the big, fat, soft kind. Even after hard hours of fast riding I had no sore hands.

The odometer, by the way, has a trip

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ENGINE IS WELL FINNED and seemingly impossible to overheat; but fins produced odd sound at idle

indicator, a very handy item indeed on a bike with a two-gallon gas tank and no reserve!

For general riding—around town, freeway, up in the hills—mileage averaged 52 mpg. This was quite hard-riding, on the average, and I expect an “easier” rider, on a well broken-in machine, will get better mileage. But 52 mpg is pretty good in my book!

The engine is well-finned, and I don't believe it would be possible to overheat it as long as it isn't completely covered with mud or something, but the fins produce an odd engine sound at idle simply because they act like little sounding boards. But the effect is only there on tickover, not when under way.

This bike is equipped with the latest Amal concentric carb—28-mm—and wonder of wonders, it doesn't leak! In fact, I finally wound up getting a bit on the careless side and usually neglected to shut the gas off when parking the bike. Even overnight I had no trouble, a far cry from the day (recent day) when a few minutes parked with the gas tap on left the rider with a crankcase full of gas and none in the tank.

Perhaps the new Amal is part of the reason for the generally good starting, but even when it was unloaded in the dark in front of my house I was able to start it without difficulty, quite a trick for a British thumper any time, and downright rare for a totally unfamiliar machine.

Suspension is conventional, with a swing

arm and a couple of adjustable-for-load units in the rear, and a telescopic fork in the front.

For road use or TT-type dirt the suspension is just about right, with the slightly stiff suspension contributing to the excellent road-holding.

For rough dirt and trail riding the machine seems a little stiff, although I'll have to admit that the bike never put me off in the dust. The times I fell off it were absolutely my own fault.

Although the Starfire is an out-and-out street machine, with no racing pretensions whatsoever, several of the local lads, notably Bill Bailey (3T), campaign it with considerable success, running against bona fide competition two-strokes that were designed specifically for our TT scrambling.

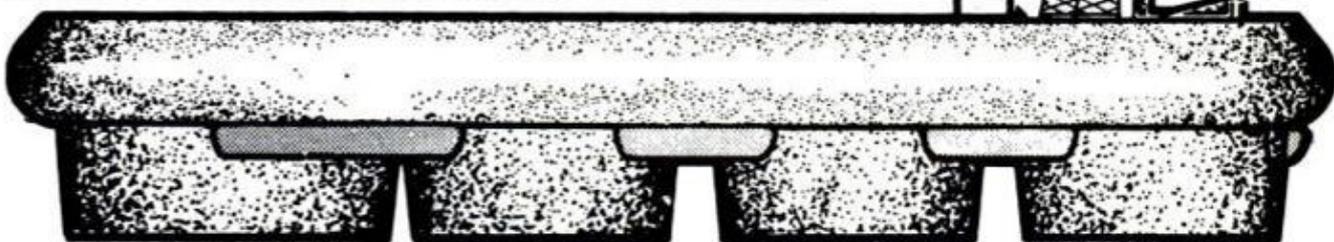
I wound up my testing by accompanying the Oakland Motorcycle Club on its annual run in the High Sierras. I was traveling in clouds of dust or in rain most of the time—but wet or dry, the Starfire ran like a watch. At the end of the run, another rider paid the 250 square-barrel the ultimate compliment: “That new bike sure goes pretty good.”

It does, too!

★★★

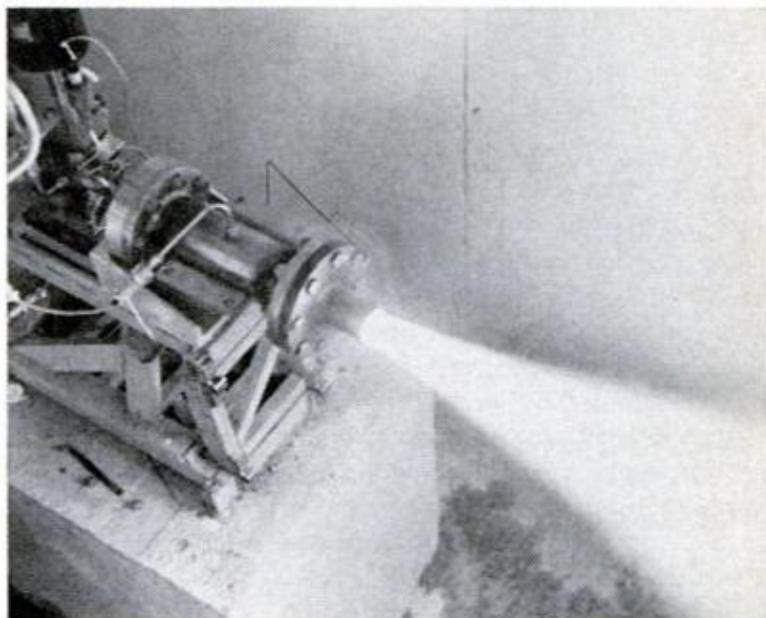
BSA STARFIRE 250-CC SINGLE VITAL STATISTICS

Recommended base price	\$745
Engine	
Bore and stroke67mmx70mm
Piston displacement	249cc
Compression ratio	10:1
Carburetor	Amal concentric 28mm
Fuel	Premium
Ignition	Battery and coil
Gearbox—4-speed	
1st gear	18.3:1
2nd gear	11.4:1
3rd gear	8.6:1
4th gear	6.92:1
Countershaft sprocket (std)	16t.
Rear sprocket (std)	49t.
Frame & suspension	
Wheelbase	53 inches
Ground clearance	8 inches
Weight	315 lbs.
Fork travel	5.75 inches
Rear suspension movement	2.75 inches
Seat height	32 inches
Tire sizes	3.50x18 r; 3.25x18 f.
Electrics	
Battery	12 volt
Charging	Alternator/rectifier
Voltage control	Zener diode
Headlight	50/40 watt
Other lighting: stop/tail, instrument, high beam.	
Fuel tank	2 gals., fiberglass
Engine oil	2 quarts
Gearbox	½ pint
Primary chaincase	¼ pint



Four skirts for this air-cushion vehicle

Multiple skirts, rather than the usual single skirt, are used on a new French air-cushion vehicle to give it more stability on rough terrain. The air cushion is supplied by a turbojet engine, while forward propulsion comes from two propellers driven by a turboshaft powerplant.



Fuel from space waste

Monex W, a new rocket fuel containing human wastes and sewage, has been used to test fire a liquid injection-type rocket by Rocket Research Corp. The propellant, nearly 40 percent waste, is shown at left, above; the test firing is at right. The developers say the fuel could be used on a spacecraft to operate rockets for velocity correction, attitude control and the like.

Who's the mightiest mouse?

The strongest mouse was the one on the right; he was last to drop off the Mouse Fatigue Tester as it rotated. The machine is used to test the effects of pep drugs and tranquilizers.



130 MPH ON THESE TIRES?

You may never drive that fast, but what the Florida Highway Patrol learned at Daytona could save your life at 80

By KEITH VINING

Photos by Taylor Warren

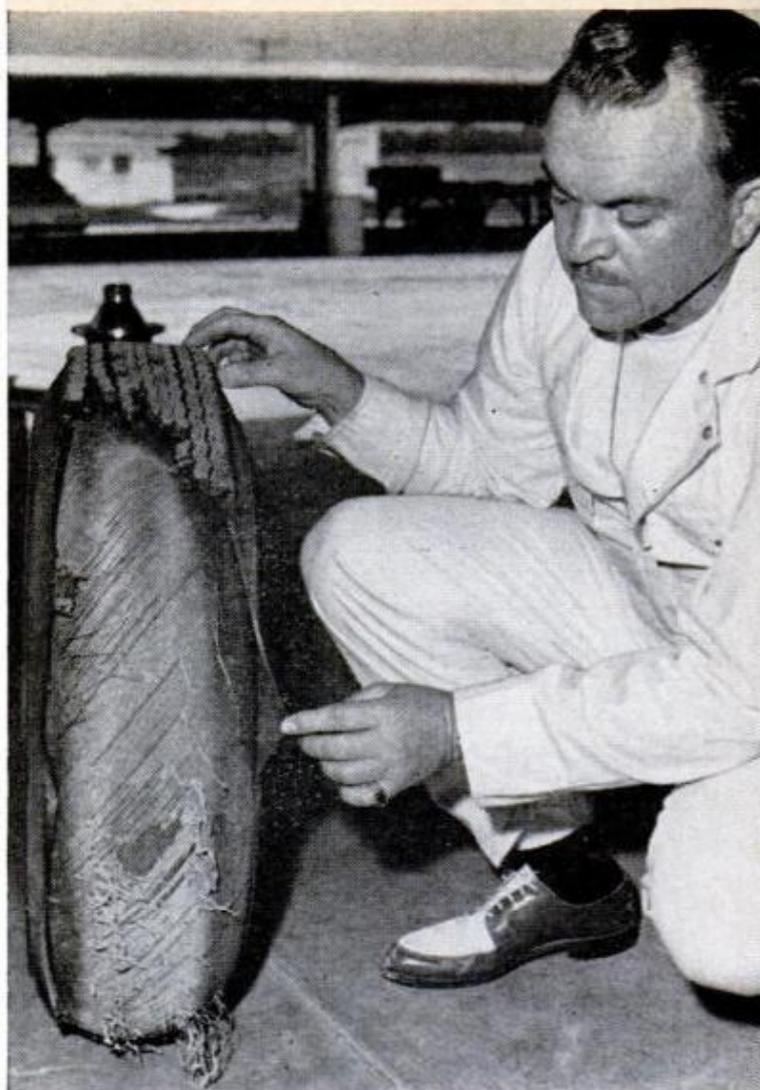
LAST SPRING a trooper of the Florida Highway Patrol U-turned his cruiser out of the northbound lane of a new superhighway and chased a speeder heading south. He poured the coal to his hungry V8, for his quarry had opened a wide lead while he was turning.

How fast the speeder *was* going will never be known; the trooper never caught him. Soon after his speedometer hit 120 mph, a tire threw its tread. Only his skill and Lady Luck stopped him safely by the time the tire blew completely.

What the trooper said is not recorded, but what Gov. Claude R. Kirk Jr. told the next meeting of the Florida State Cabinet is. He said this was the 14th cruiser tire to fail that month.

All were from the same batch, recently purchased. All met the state specifications for pursuit tires. The trouble was, someone pointed out, that Florida's pursuit-tire standards had been set up in 1957. They had never been updated to meet the tougher requirements of the high-speed highways now stretching across the state. Even the Federal Government standards were eight years old, and no other state had really adequate standards.

This fall the Federal Highway Administration finally got around to issuing some



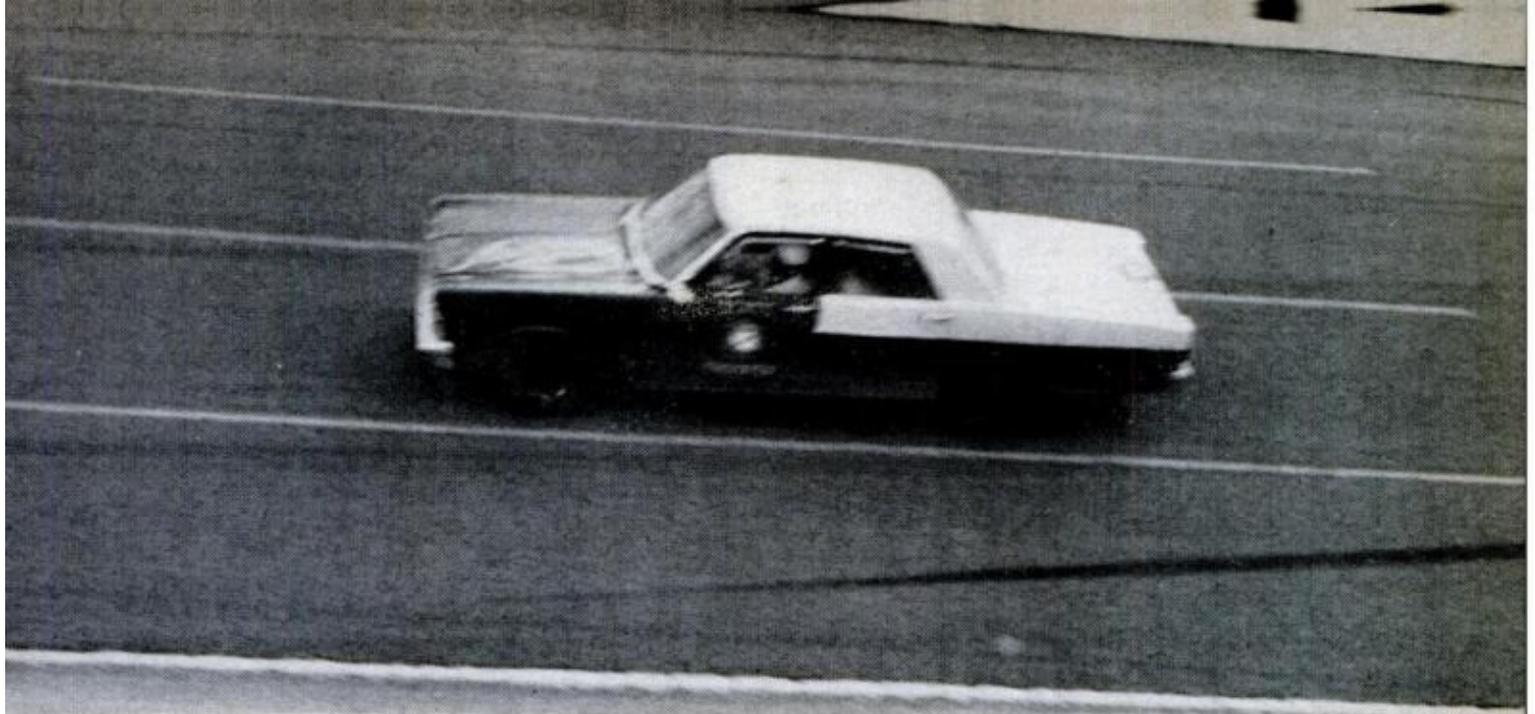
FONTY FLOCK, chief test driver for NASCAR's Automotive Research Bureau, points to a "pursuit-type" tire that threw its tread during high-speed tests

minimum standards for 1968, but its idea of high-speed driving is 60 mph.

As Florida's state treasurer Broward Williams put it: "Our patrol cars will travel at more than 130 mph, but none of our tire specs required tires to withstand such speeds." On recommendation of a committee headed by Williams, the Florida cabinet voted to hire NASCAR's Automotive Research Bureau, Inc., to test various brands and types of so-called pursuit tires at the Daytona International Speedway. Sensing the importance of these tests, editor Bob Crossley arranged for me to witness them and report to *PM* readers.

I watched former stock-car star Fonty Flock, now chief test driver for NASCAR, put the tires through the most punishing tests ever given nonracing rubber.

One might wonder just how necessary it is to have tires capable of such high speed. Frankly, I did until I watched a mock chase at the Speedway late in May. NASCAR's



TIRES WERE TESTED for 100 miles at 100, 110, 120 mph on Speedway. Only three sets survived 50 miles at 130

president, Bill France, driving at 110 mph with a fair lead was the "speeder." Fonty Flock, driving a patrol car at 120 was the "trooper." The chase went on for 18 miles before it was ended when the patrol car threw the entire tread off one tire.

TREAD SEPARATION (left) starts with chunking (right). The thicker the rubber, the more likely tire is to chunk



A little arithmetic indicates it would have taken Fonty eight miles, and four minutes, to catch France had the latter been driving at only 90 mph with a two-mile lead. A lot can happen in that time and distance on a crowded highway.

Florida officials learned a lot from these tests about what can happen to tires—and why—in high-speed driving. The knowledge will save troopers' lives. It can save yours too, if you do much fast driving.

A standard patrol cruiser was used for the tests. NASCAR safety equipment was added, including special door locks and a roll bar. Flock wore full racing harness with a quick-release bar. No alterations were necessary; the cruisers carry heavy-duty road equipment and were powerful enough when purchased to exceed needed speeds. Joe Epton, trial director of A.R.B., Inc., set up test equipment and supervised the runs. Tires designated "Pursuit" were bought in sets from various dealers, so makers would have no chance to run in specially selected tires. All identifying marks were ground off the tires, leaving only a number for record-keeping.

Four tires of a given make and grade were carefully inspected for visible flaws and out-of-roundness, then mounted and balanced. Each set then got a 50-mile break-in at 55 to 60 mph. Flock made a big point of this:

"Tires should never be run at turnpike speeds until they have been inspected (*after break-in*). This flexes them and reveals weaknesses that might develop."

A good point to remember when you

buy tires: Arrange with your dealer for reinspection after break-in. The chance of finding a faulty tire of a good name brand is admittedly slim, but it takes only one bad shoe out on the Interstate to spell trouble.

When cold, tires were reinflated to pressure and mounted two at a time on the left side of the test car. On the right, or "high," side ARB mounted special "inner-liner" racing tires, like those used by stock cars circling the track at 180 mph. Epton explained that centrifugal force built up around the 31°-banked turns piles weight on the outside tires many times above normal.

Actual test runs went like this: 100 miles at 100 mph; 100 at 110; 100 at 120. Tires that held up this far were then run 50 miles at 130 mph. Very few made it.

The track surface at Daytona resembles that of most superhighways in Florida and many other states. Air temperatures during the trials were between 80 and 90° F., a typical range when most long trips are taken.

Tire temperatures were taken after each segment of the run. Like a badly fevered human's, they kept rising. After 100 miles at 120 mph, they often recorded between 200 and 250°—almost three times air temperature. After it failed at 130 mph, one tire registered 270!

Significantly, while many tires failed at 130 mph, all failures but one were due to tread separation. The carcasses did not blow. The one blowout came at 120 mph in a tire not having four-ply nylon or polyester cord like the others.

Along long, straight stretches of new high-speed roads you can spot little pieces



TEST TIRES were run only on left. Big racing tires were used on right side where pressure is greatest

of rubber. This is caused by what tire men call "chunking." The chunks are pieces of the fancy tread pattern. Their throw-out is the first warning of complete tread failure. The cause of chunking is heat from friction. The thicker the tread, the sooner it may come apart at high speed.

Fonty Flock says, "More rubber, more heat: more speed, more centrifugal force trying to throw off the tread."

Joe Epton adds: "When a tube-type tire fails, it usually blows out. A tubeless tire is more apt to lose pressure gradually, even after it throws its tread. At legal speeds that gives you time to slow down safely and pull off the road." Note Joe said "at legal speeds."

That the 14,000-plus miles of tests on 68 tires of 14 makes and types did not damage the cruiser, was due largely to Fonty

(Please turn to page 210)

Tips on tire safety from Fonty Flock

- If you drive a lot of long stretches at maximum speed, make sure your tires have been inspected after break-in.
- Examine your tires carefully—at least once a week—for signs of chunking. On a sustained trip do this every morning.
- When you buy your next set of tires, go to a dealer who keeps a checklist indicating the right tires for your kind of driving. Most major manufacturers issue such a list.
- If you plan a long superhighway trip, consider getting the new wide-oval tires if they will fit your car. Otherwise, stick to four-ply, standard-size nylon or polyester cord tubeless tires and get a careful inspection after break-in.
- Don't mix wide-oval and standard tires. This can lead to real trouble.
- Get familiar with the feel of your wheel while driving on balanced, properly inflated good tires at maximum legal speeds. There's a different vibration when a tire begins to throw bits of tread. Any different feel should be investigated promptly.
- On long trips, check cold tires each morning for pressure recommended by the maker.

New Instant Printer Makes Pictures Right Before Your Eyes

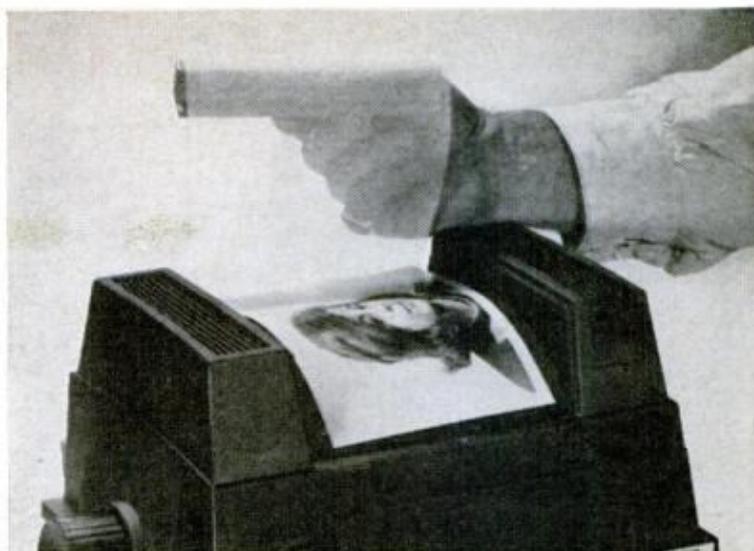


IMAGE SUDDENLY APPEARS as exposed paper is placed on top of warm projector housing. Heat starts chemical development

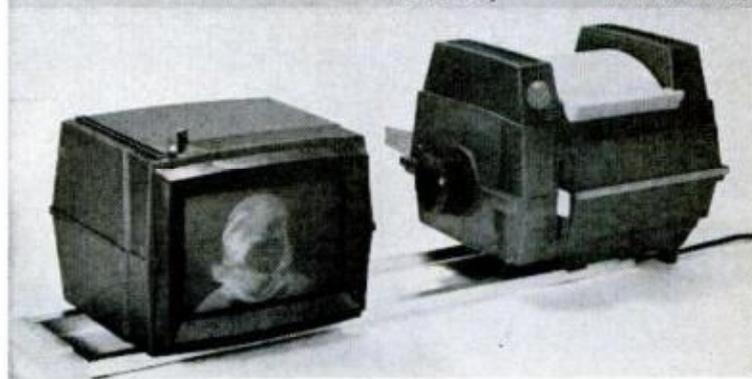
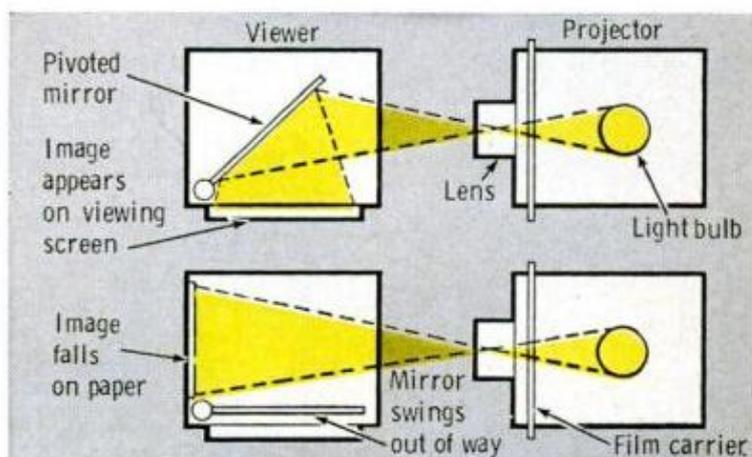
LIKE TO MAKE your own photo enlargements of favorite negatives in a minute's time with no processing? With this ingenious printer, called PhotoMate, you can do just that. It uses a special dry-process printing paper that requires no chemicals, no darkroom and no waiting.

The outfit consists of a simple projector and a viewing box that slides on rails. By moving the viewer back and forth, you can make the image any size you like and crop out unwanted portions to improve the picture. To make a print, you just flip a knob. This swings aside a mirror, auto-

matically exposing the special paper (see diagram below). The paper is then placed on top of the projector. Heat from the lamp starts a chemical reaction and in a few seconds the picture appears magically before your eyes.

PhotoMate makes blowups up to 5x7 and takes black-and-white negatives from 35 mm to 2 1/4x2 1/4. Priced at \$29.95, it's not intended to replace a standard enlarger, but is designed for family fun. It can also be used as a conventional slide projector or viewer. Maker is Graphic Products, 200 Fifth Ave., New York, N.Y.

PRINTING PAPER is slipped into viewing box after image has been focused on screen. It can be handled in ordinary room light with no harm. Holder accommodates either 4x5 or 5x7 sheets depending on which side is used. Diagram at right shows how mirror directs the image onto the viewing screen for editing, then swings out of way to expose the paper



The RIGHT way



to run a snowblower

THESE TIPS CUT MANEUVERING TIME TO A MINIMUM

Illustration by Harold Johns
Technical Art by Don Evans

THE TACTICS of farm or street plowing just don't work when you're clearing your property with a snowblower. You have to consider many more things.

First is the snow-removal area itself—a conventional walk, side drive close by the house, two-car garage ramp or a long, exposed drive are typical. Other factors are:

Type of surface. A smooth, hard surface is easiest; just set the blower height low. Crushed rock and gravel take a higher setting; rocks and pebbles thrown far and wide create a safety hazard.

Grades, slopes. A level-running speed may suddenly become too fast for a steep downgrade. A runaway snowblower pursued by a frantic householder isn't funny.

Targets to avoid. A neighbor's picture window, windshield, children and dogs are vulnerable to hard-flung stones or ice.

Property or machine damage. Stones along flowerbeds, buried survey stakes, shrubs, flowers and ditches should be cased and marked before starting. It's easy to tear up both blower and obstacle.

Wind direction. If you have a smooth, more-or-less even depth of snow, try starting the cut so the wind will cross your path at an angle, thus blowing snow to right or left. If a building is a factor, make a first cut close to it and cast the snow away.

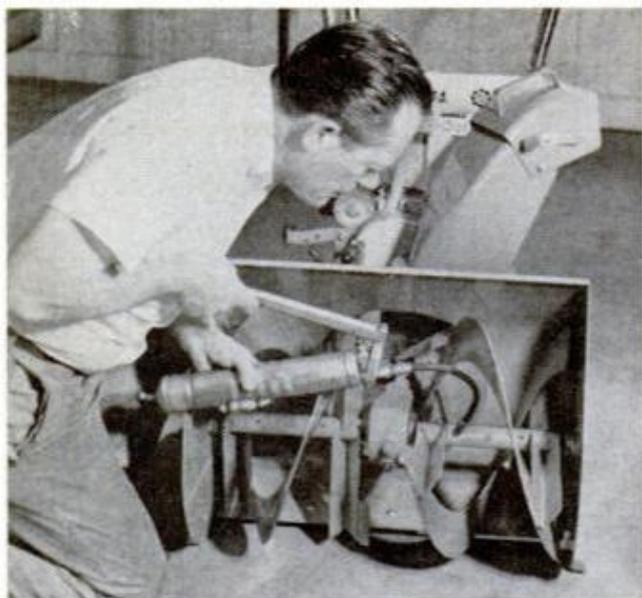
Two mistakes often beset the beginner. First, he has seen television ads of blowers throwing snow 40 ft. or more, so he turns the chute discharge high. This rooster tail may be impressive, but it's seldom necessary or practical. Sooner or later it will lash back and leave you gasping. There's a chance that the blower will pick up something you didn't know was there and fling it into a target you don't want to hit.

The second mistake is assuming that unless the snow is thrown far away it will be handled a second time, doubling the work. A few trials with the chute aimed down will convince you this isn't true. Chewed-up snow redeposited in an uncleaned area just isn't a problem.

Another tactical error is based on the

HOW TO TURN A SNOWBLOWER

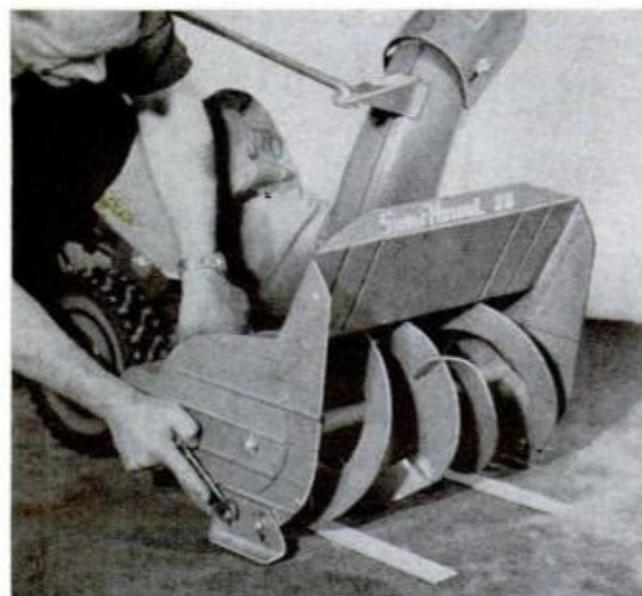




CHECK OWNER'S MANUAL for lube points. This unit was accidentally delivered with a dry, auger gearbox



PLASTIC PADDLES on lightweight blower are easily replaced. Be sure to check for the proper clearance



WOODEN SHIMS give adequate adjustment when the blower is to be used on a smooth, even surface

farmer's plowing method. You may feel that the most efficient approach is to make a constant circle or loop pattern.

It's better to make a pass close to your starting point, reverse the blower and back up for another pass; then repeat until you have a cleaned area that allows a nice easy turnaround and realignment for the next cut. Some time is lost in backing, but the cleaned area lets you reverse and turn the chute at the same time without throwing snow over the cleaned portion.

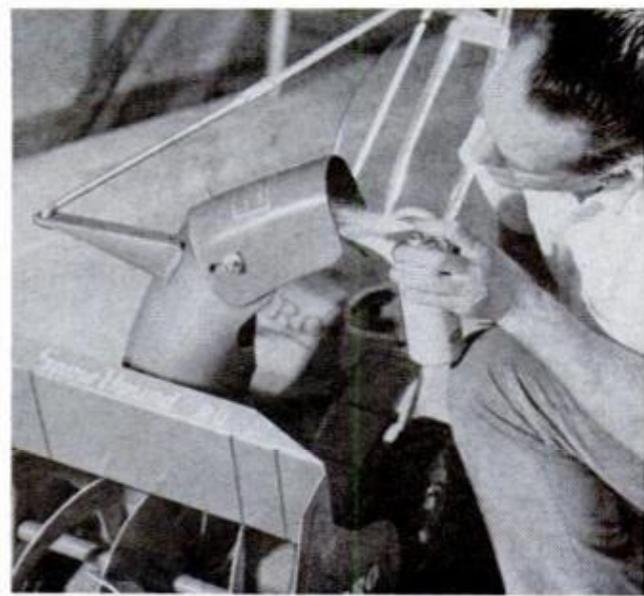
Sometimes this forward-and-reverse method is best for the whole job—especially on a bitterly cold day with a high wind. Just turn your back to the wind and keep it there. Generally, however, it's practical to do this for three or four passes at each end of your work area.

With room to turn at each end you just start a series of loop passes at the windward side and work towards the downwind finish point.

Learning how to turn a blower around properly takes practice. One good method is to declutch the hand clutch just as you come to the end of the loop. This disconnects the power from the drive wheels. At the same time, bear down on the hand grips and elevate the scoop a few inches so the auger doesn't start picking up snow until you're headed into your new pass.

Always turn so your body goes into any side or quartering wind. Turning the other way places the chute discharge between you and the wind.

On a straight walk or drive, usually you start to the windward and work to the



SPRAY WAX applied to inside of chute and discharge area will prevent snow from sticking to the metal

lee with up-and-down passes. If working quarters are tight, such as a driveway between two houses, it is often practical to discharge the snow into a central windrow by working from both sides. This narrow heap of snow can then be cleaned up by starting at the garage and working toward the street with chute discharging straight ahead. A street plow throws it on your drive, so you might as well throw some back.

Hardened drifts, always tough to clear, are formed by heavy snow and howling winds. Often they are preceded by rain so that lower layers are soaked and well glued to the surface. When followed by below-zero weather, the drifts become almost solid and lower snow layers are rock hard. The usual snow blower doesn't have the weight and ripping power of a commercial plow to get under this type of drift. Instead, it rides up over the drift and trims a little off the top. A number of techniques can help:

- Remove the little skids on the snow scoop to get the sharp scoop edge down into the snow as much as possible.
- Place a sack of sand or salt on the scoop to hold it down.
- Put chains on blower drive wheels.
- As the auger bites into the hard, deep snow, declutch drive wheels so the blower can digest and clear the material. This lets all the engine power feed the blower and doesn't crowd the machine faster than it can work. By clutching and declutching with a rhythmic pattern, the blower will dig in and back off in a series of bucking actions, like the rocking of a stuck car.



LOW DISCHARGE is less dramatic than high rooster tail, but it's more practical setting for the chute

DECEMBER 1967

● Break up the worst areas with a shovel jammed downward at intervals or use a small paddle-type blower to chop up the hard spots, then clear with the big machine. Amazingly, these lightweights will tear into snow the big augers can't touch. Small machines, gas or electric-powered, can be scooted all over like a vacuum cleaner or picked up in a two-hand grip like a shovel. They will clean steps and tough spots easily.

Regard the paddles as expendable. Made of a tough, durable plastic, they will take all sorts of arm-jarring beatings and come up smiling. Replace them after the season to be ready for next year.

If you don't already have a snowblower, check the kind of snow-removal problem you have before you buy. No blower is ideal for all jobs. Often a small paddle-wheel type and a larger auger model may do the work faster and easier than a single blower. Here are other considerations:

Slopes and grades. Dragging a heavy blower back uphill is dangerous. If you have a slope, be sure to buy a machine with power reverse. If the area is small, a superlight job without reverse is good.

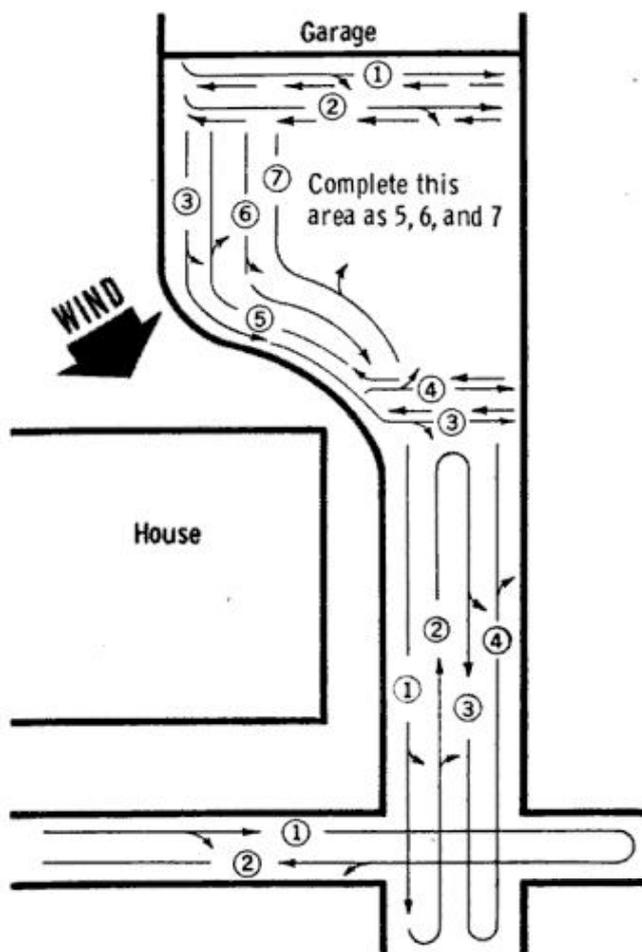
Steps, porches and patios. A big auger job is practically useless for cleaning small areas or a series of steps. A light gas or electric paddle-wheeler can be handled like a shovel.

Long runs. Clearing long drives and walks can get tedious, especially when snow cover is moderate, unless the blower has three or four forward speeds. A good one travels at a peppy walk. Fixed-speed

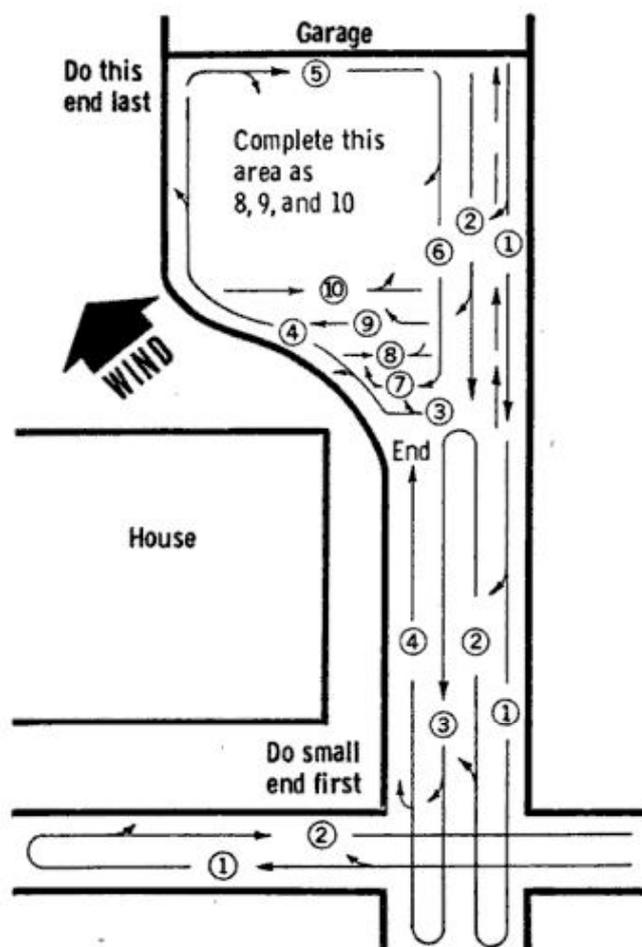


LIGHTWEIGHT paddle-type blower is best for steps and small areas, can also break up large drifts

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WIND DIRECTION is one of most important factors to consider when planning your attack. Here are two methods of handling more-or-less typical layout that demonstrate how pattern is varied to suit the wind



types will merely prolong your exposure.

Storage. If you can wheel the blower into a garage or shed, size and weight are no problem. If you'll store it in a basement or elevated porch, think light.

Special uses. Maybe you want to take your blower to a hunting cabin or carry it in your car's trunk in case you get stuck. The small jobs are wonderfully convenient and transportable for such purposes.

Snowblower design and construction is not quite so standardized as that of automobiles. With a new blower, give yourself an hour of unhurried study to read the instructions and examine the guts of your machine. Search out the lubrication points, and if you don't have the grease guns, oil cans and lubricants, spend a bit to set up for quick servicing during the heavy-use season. Time spent now and an occasional lubrication and chain and belt adjustment will save hours of future trouble.

Before you take your new blower out for a trial spin, keep these points in mind:

Panic stop. Know the quickest and safest way to cut the engine in case you should run into an unexpected obstacle.

Blower declutch. With a dog-clutch drive to the blower you can tear things up by trying to engage a dead blower shaft with a spinning, main-drive shaft. Your instructions will give the proper sequence. You can also play hob with your blower by driving it into a garage or storage shed with the auger spinning.

Fuel shutoff. Some engines have none; others have a manual shutoff valve and a few have carburetor drains that dump a trickle of gas when stopping. Leaking gas in a closed, heated garage can spell danger. If you have a gas valve, get in the habit of closing it.

When spring finally arrives, take an hour or so to prepare your snow blower for summer storage. Be sure to:

- Get rid of all old gas in tank and carburetor. Run it dry, if necessary.
- Drain the oil; replace it with fresh.
- Grease and oil all bearings, chains.
- Replace the vee belts if they look worn.
- Replace the sparkplug.
- Oil the control linkages and Bowden wire cables.
- Clean and dry your blower, retouch the bare metal areas, and wax.

Finally, if it was a hard season, have your repair agency look over the clutch and drive train before next fall's rush. ★ ★ ★

How to 'Glass' a Boat

All you need to know about fabrics, resins and application techniques to turn out a perfect job

By **GEORGE EMORY**

Technical Art by Roger Chapin

A NEW FABRIC-RESIN SKIN will not only strengthen your wood hull and improve its appearance, but also cut your seasonal maintenance to a mere sponge-and-water rinse.

Strictly speaking, "glassing" means covering a hull with fiberglass fabric and resin. However, other fabrics having different characteristics are often used to cover boat hulls (people speak of "fiberglassing with Dynel"), so the first step is picking a fabric with the quality you need most. This could be maximum strength or minimum weight. Or, you might want a flexible, abrasion-resistant skin, or decking with a built-in nonskid surface.

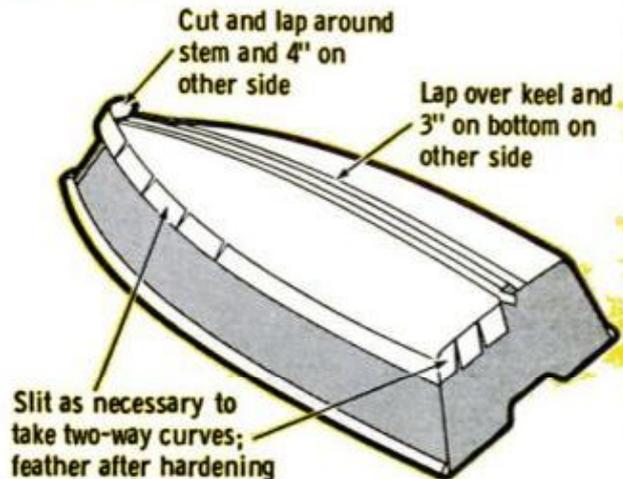
The fabrics that lead the field (many others have been tried) are fiberglass, Dynel, Vectra and canvas.

Fiberglass is the strongest and heaviest, also has the least "give" so it needs more tailoring to the hull. It's made from glass fibers so fine that up to 90 miles of it comes from an olive-sized marble.

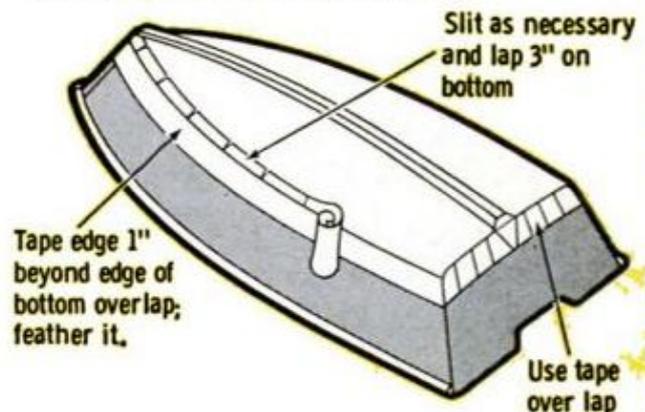
High strength and low "give" make fiberglass the only fabric widely used for boat construction as well as covering. If you want your covering job to add the most all-out strength for a given amount of work, it's your best bet. Ten and 7½-oz. (per sq. yd.) fabric weights are the most popular for boats of trailering size. Favor the lighter grade where weight saving as well as strength is important.

Vectra, lightest of the fabrics, is so light it actually floats on water. (Actually, Vectra is the fiber, and Versatex is the fabric made from it.) Technically it's polypropylene, made from propylene gas. Extruded through very small holes in a spinnerette, the fibers are almost as fine as fiberglass and have much more give, so the fabric can flex with a hull. This quality gives it a cushioning effect against surface impacts, hence high abrasion re-

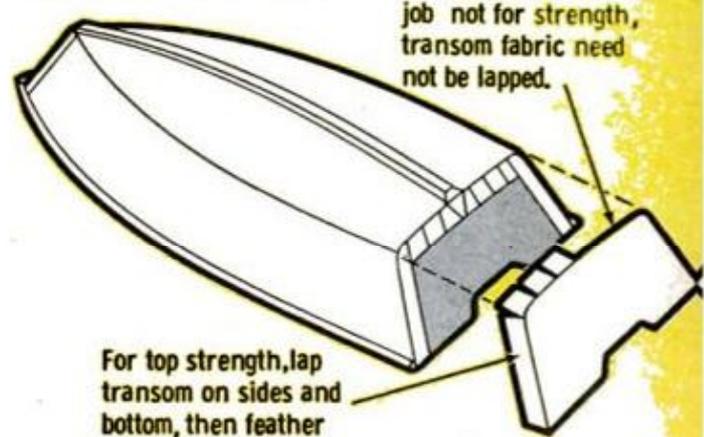
COVER BOTTOM FIRST



GLASSED BELOW WATERLINE



FULL COVERING JOB



How to Pick the Right Materials for Your Particular Covering Job

FOR THE QUALITIES LISTED BELOW . . .	USE THE MATERIALS INDICATED	
	FIBERGLASS	POLYPROPYLENE (Vectra)
Maximum hull reinforcement for given work	Highest tensile beefs up frail hulls	Multi-layers or "sandwich" lay-up for strength
Minimum weight	No (Heaviest)	Lightest of common covering fabrics
Maximum "give" to take dimensional changes	No (Minimum give)	Ample give, but should be used with flexible resin
Abrasion resistance	Moderate	High with flexible resin; can be used over fiberglass
Minimum tailoring	Low stretch; requires tailoring	Greater stretch than fiberglass, less tailoring required
Nonskid surface	Use nonskid paint	Comparable to fiberglass

ABOUT RESINS: Either standard polyester or epoxy resin may be used with fiberglass. Flexible polyester or epoxy should be used with the more elastic fabrics, polypropylene and Dynel. Some resin manufacturers provide additives to be combined with their regular polyester resin to provide elasticity. Others offer a ready-mixed elastic-type resin. Both require addition of hardener before application. Epoxy resins are formulated in varying degrees of flexibility, can be further varied by mixing proportions. Follow manufacturer's directions.

ABOUT CANVAS CEMENTS AND FILLERS. Where canvas is to be cemented to wood, as in deck work, use a cement made specifically for the purpose. The reason: These cements are made to provide a good wood-canvas bond during the life of the canvas, but they permit "peel" removal of the fabric when replacement is necessary. Check on this before buying your cement.

sistance. But because of its flexibility, it can't stiffen thin planking.

Where you want the advantages of a slick, abrasion-resistant skin, and where minimum weight is more important than peak strength, as in a camping canoe, this is your fabric. You can also use Vectra over fiberglass as a resilient outer skin over chines, skids or keel.

Vectra doesn't produce "fly" in the air or dust in the working area. But its "give" requires a flexible bonding resin, and its

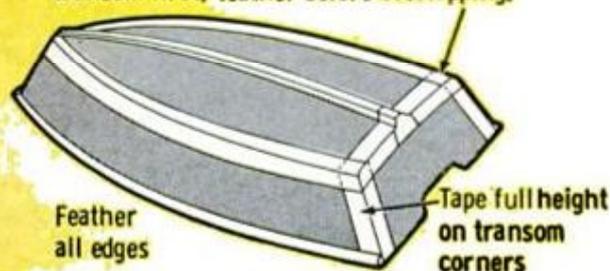
light weight and "memory" (it remembers creases even after they're flattened) mean you'll need a few application tricks that are described later. The popular weight for trailering-size boats is 4-oz. which closely resembles 10-oz. fiberglass.

Dynel, most form-fitting of the fabrics, can be snugged over compound hull curves in sweater-girl fashion with a minimum of tailoring. Technically, it's a modacrylic made from a gas called vinyl chloride and a clear liquid called acrylo-

TAPE JOB

Sand off paint where tape will be; remainder of hull need not be sanded; feather all edges.

Chine tape laps transom tape; tape transom first; feather before overlapping.



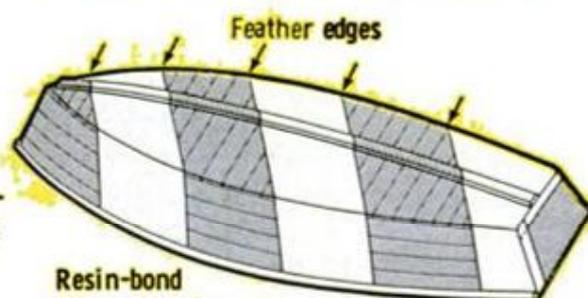
45° overlay—20 fabric strands cross seam



Parallel overlay—10 fabric strands cross seam.



45° STRIP FOR PEAK STRENGTH



Resin-bond alternate strips and feather edges, then resin-bond intermediate strips. If second layer is used, angle it in opposite direction

BELOW . . .

	DYNEL	CANVAS
	A covering, not a structural material	Comparable to Dynel, but not bonded
	Medium weight	Depends on weight-grade of fabric
	Comparable to polypropylene in general terms	Ample give on small boats if properly applied
	Comparable to polypropylene	Varies with finish
	High stretch; form-fitting; minimum tailoring	Moderate; lighter weights need less tailoring
	Fibers form natural nonskid surface if no gloss resin coat used	Forms nonskid surface if not heavily painted

GENERAL TIPS: Mix a small amount of your resin and test it for hardening time at the temperature of your work area. Pick a shady rather than sunlit area for your resin job, as sunlight speeds hardening greatly, cuts your working time seriously. Humid weather has the reverse effect, slows hardening. If you must work in sunny area start in early morning before sunlight reaches daytime brilliance, quit before it shortens working time, finish late in day when sun is lower (or wait until next morning).

nitrile. Powdered resin is dissolved in acetone and forced through spinnerettes to make the fibers.

Unlike fiberglass or Vectra, the fibers are not continuous but are chopped into short pieces, crimped and spun into "staple" fibers like cotton. This helps produce the form-fitting quality, and also gives Dynel a natural nonskid deck surface, if you omit the final flow coat of resin.

Where you face complex variations in contour, or where you want a nonskid

deck, this is your fabric. It's lighter than fiberglass, heavier than Vectra and has exceptional resistance to acids and other chemicals. But it's a covering, not a structural material. And it must be used with a flexible form of resin, preferably an epoxy. (You can strengthen a hull with fiberglass, deck it with Dynel.) For average covering jobs use the 3 $\frac{3}{4}$ -oz. weight; for heavy duty, 6 $\frac{1}{2}$ -oz.

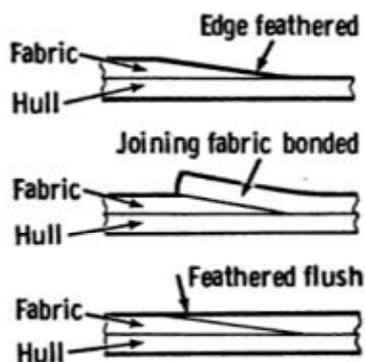
Canvas for boat covering is really cotton duck. It doesn't increase hull strength measurably because it's edge-tacked, not resin-bonded to the planking. But after finishing it forms a slick, watertight skin on which minor repairs are easy.

Canvas is used mainly on small boats that are removed from the water when not in use. The usual weights are 8-oz. (per running yard 38 in. wide) or No. 12 "numbered duck" (about 11 $\frac{1}{2}$ -oz. per sq. yd.). The latter is handiest as it's usually available in widths up to 6 ft. This lets you cover a canoe or small dinghy with a single piece seamed only at ends.

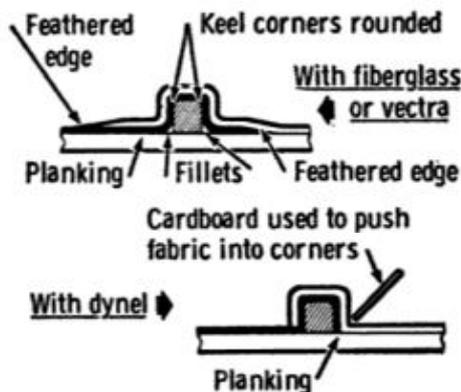
All these fabrics except canvas also come in tape form for sealing chines and similar seams without completely covering the hull. This can cut costs, weight and work, but first let's cover the two standard resins used with these fabrics.

Polyester resin is the most popular type because of its easy working consistency (about like maple syrup) and relatively low price—one-half to one-third the price of epoxy. You can use it as-is with fiberglass. For Vectra or Dynel pick a flexible type or one for which a flex-increasing additive is available. The maker of the resin you use can tell you if such an additive is available for it, or if the unmodified resin has enough flexibility for your

SCARFING FABRIC SEAMS



STRENGTHENING KEEL



FIBERGLASS TIPS





MEDICINE DROPPER is fine for measuring small dose of hardener



SIMPLE SQUEEGEE with rubber blade spreads resin efficiently



FINGERS ARE HANDY for working fabric into inside corners

fabric. A mismatch of fabric and resin flex can cause poor adhesion, cracking and crazing. Incidentally, don't use polyester over styrene-type foam like Styrofoam. It breaks down the foam on contact.

Epoxy resin is stronger than polyester and more flexible, especially in "polyamide" types formulated for flexibility. It's compatible with styrene foams.

This is the best resin to use with high-give fabrics or wherever the resin may find its way between nonporous materials, as between metal plates. Undiluted in "100 percent solids" form, epoxy has no solvents to evaporate and can harden fully, even in sealed spaces. Polyester usually has a shelf life of about two years, but many epoxies last indefinitely when stored unmixed.

Both polyester and epoxy must be mixed with a chemical hardener before use. After that, working time depends on the temperature, amount of hardener, total amount of resin mixed, even the container's shape.

With polyester, more hardener is used to shorten hardening time or to harden the resin in cool weather. Since too much hardener can cause brittleness, a "promoter" solution usually takes the place of excess hardener in really cold weather. Hardener and promoter must be mixed with the resin separately. *Mixing them together can cause an explosive reaction.*

The MEK (methyl ethyl ketone) hardener is used in amounts as small as $\frac{1}{8}$ -oz. per gallon. Follow the maker's directions and be sure to get his temperature-mixture-proportion-setting-time chart.

As the hardening process generates heat, large batches of mix harden faster than small ones. (Heat can't escape from the center of the mix as fast.) So mix a quart or less at a time—in a shallow tray.

Epoxy hardener works on a different

principle and is used in much larger amounts, often on a 50-50 basis.

Preparing for the covering. On sound hulls, plan to lay your fabric for the greatest economy, usually in lengthwise panels. On weak hulls (especially planked boats), lay the fabric at a 45° angle to the hull seams. This way all strands in the fabric cross the seam, and none run parallel to it, so you get twice the cross-seam tensile strength, plus a trussing effect that resists hull twisting. To rough-estimate the amount of resin you'll need, figure 1 qt. will provide three coats for 14 sq. ft. of 7½-oz. fiberglass or 11 sq. ft. of 10-oz.

On plywood boats up to 16 ft. long, a single layer of fabric is enough. On those longer than 16 ft., and on planked hulls, especially if there's structural weakness, use two layers.

Sand off all paint with 12 to 16-grit open-coat aluminum-oxide abrasive after removing all metal.

Do the same kind of sanding on a new, unpainted hull. The rough surface produced is essential to a good resin bond.

Do not use a blow torch or heat-type tool for paint removal. Heat will drive paint oils into the wood and cause a poor resin bond later. If you use a liquid paint remover use *only* one recommended by the resin maker. Other types may leave a wax or oil residue.

Fill all seams and holes with a plastic filler compatible with the resin you'll use. You can also make your own by mixing a filler powder like Cab-O-Sil or Union Carbide's microballoons with your regular resin. Buy the filler where you buy the resin. Let it harden, then sand it off flush.

Round sharp corners, slightly along chines, keel and rub strips. Most fabrics can take sharp bends, but sharp edges chip much more easily than rounded ones.

(To do the job quickly, you can use an inexpensive Stanley cornering tool.)

It's wise to round inside corners with a fillet; fabric worked into a sharp corner doesn't always reach all the way in. The fillet may be a narrow triangular wood strip bradded and resin-bonded into the corner, or simply formed from a soft resin and powder-filler mix.

Fabric fitting. Tailoring hull fabric over chines and most hull curves is relatively easy. If you're using Vectra, however, look out for sharp creases. Plastic "memory" makes them pop up, so keep flattening them until the resin holds them.

Although each fabric must be custom-tailored to the hull, the basic method is the same. For smoothness, seams that are merely overlapped during the fitting job, are "scarfed" when the resin goes on.

PRICES AND SOURCES

NOTE: Buy all the materials you'll need for a job in a single batch to get the best bargain, as prices often decrease with quantity. A gallon can of resin costs considerably less than four quart cans. At many outlets, too, fabric prices drop noticeably in amounts greater than 25 yards. Others base their prices on a full roll (about 125 yards) and add a percentage for smaller amounts. If you can't get the material you want at your local boatyard you can obtain most types from mail-order houses like Sears or from the sources listed.

FIBERGLASS CLOTH: typical prices, widths, weights

Weight per square yard	Price per yard for common widths		
	38-inch	44-inch	60-inch
4 oz.	72¢	80¢	\$1.04
7½ oz.	85¢	\$1.34	\$1.48
10 oz.	\$1.03	\$1.44	\$1.57

DYNEL (standard weight): Prices drop sharply after 25 yards at some sources.

	38-inch	48-inch	60-inch
	\$1.25	\$1.39	\$1.69

Versatex (4.3 oz.)

	44-inch	50-inch	60-inch
	\$1.33	\$1.43	\$1.59

RESIN PRICES (typical) plus delivery charges, which means you'll pay a little more when you buy from a local source.

POLYESTER
Quart, \$2.20; Gallon, \$8.20

EPOXY
Quart, \$4.60; Gallon, \$18

Sources of Dynel and Versatex (Vectra), if not available locally: Astrup Co., 2937 W. 25th St., Cleveland, Ohio; Defender Industries, 384 Broadway, New York, N.Y. (Same concerns handle variety of resin types.)
Source of wide range of fiberglass weights and widths: (Also resins).

Berton Plastics, 170 Wesley, South Hackensack, N.J.; Fibre Glass-Evercoat Company, Inc., 6600 Cornell Rd., Cincinnati, Ohio.

On a diagonal-strip covering job, for instance, first cut and tailor all the fabric strips, and hand-smooth them onto the hull dry. The strip at the stern should be lapped onto the transom. Remove alternate strips and lightly pencil the outlines of those remaining. Remove the remaining strips, rolling them up on battens, so they can be unrolled again onto the hull. Coat the first pencil-lined hull area with resin. If dry spots appear, apply more resin so the entire area is shiny wet.

Allow the resin to become tacky, following directions as to time allowance. Roll the fabric out on the resin-coated area, smoothing off wrinkles and blisters by working them outward and off the fabric edges. Feel for unstuck areas with your hand. Press them down hard and they'll stick. Allow hardening time for this bonding coat. If you apply a second coat too soon it may loosen the fabric from the first coat. Apply the second coat and let it harden. Use a flexible disc sander to feather out the edge of the fabric down to the hull surface. If you discover an unstuck spot at this stage sand through it to the wood. Feather edges of the area and bond on a fabric patch. Bond on the next strip, letting its joining edge overlap the feathered edge of the first strip.

When the second resin coat on the new strip has hardened, sand the overlapping edge flush with the surface. Repeat the procedure for successive strips.

When all overlaps have been sanded flush, lightly hand-sand the entire fabric surface with medium-fine open-coat aluminum oxide paper to smooth off protruding hairlike fibers and remove the waxy film that forms on resin.

After this, apply a final flow coat of resin to fill completely the fabric weave and produce a smooth, glossy surface. If a second fabric layer is to be applied, this third coat is its bonding coat. Don't let seams fall on top of those in the first layer.

If the weave still shows in spots brush on a local touch-up coat of resin. A brush gives the final coat the smoothest finish.

If the fibers of Vectra or Dynel tend to catch or pull during feather-out sanding, ease up pressure on the sander to increase its rpm. If fibers still pull, add another coat of resin.

Two-resin systems provide a separate bonding resin that stays tacky much longer before hardening. This gives you more

(Please turn to page 196)

How to light up your

Stringing and rigging temporary outdoor lights can be a shocking experience if not done safely

By **WAYNE C. LECKEY**, Home and Shop Editor

Technical Art by ZIK Associates

LIGHTING THE YARD and exterior of the house has become as much fun as decorating the tree inside, but in their eagerness to string lights outdoors many holiday electricians don't give a thought to the fact that wet ground and exposed plugs can be as hazardous as an electric chair.

Approved methods which are considered safe indoors are *not* safe outdoors. Only when precautions are taken against

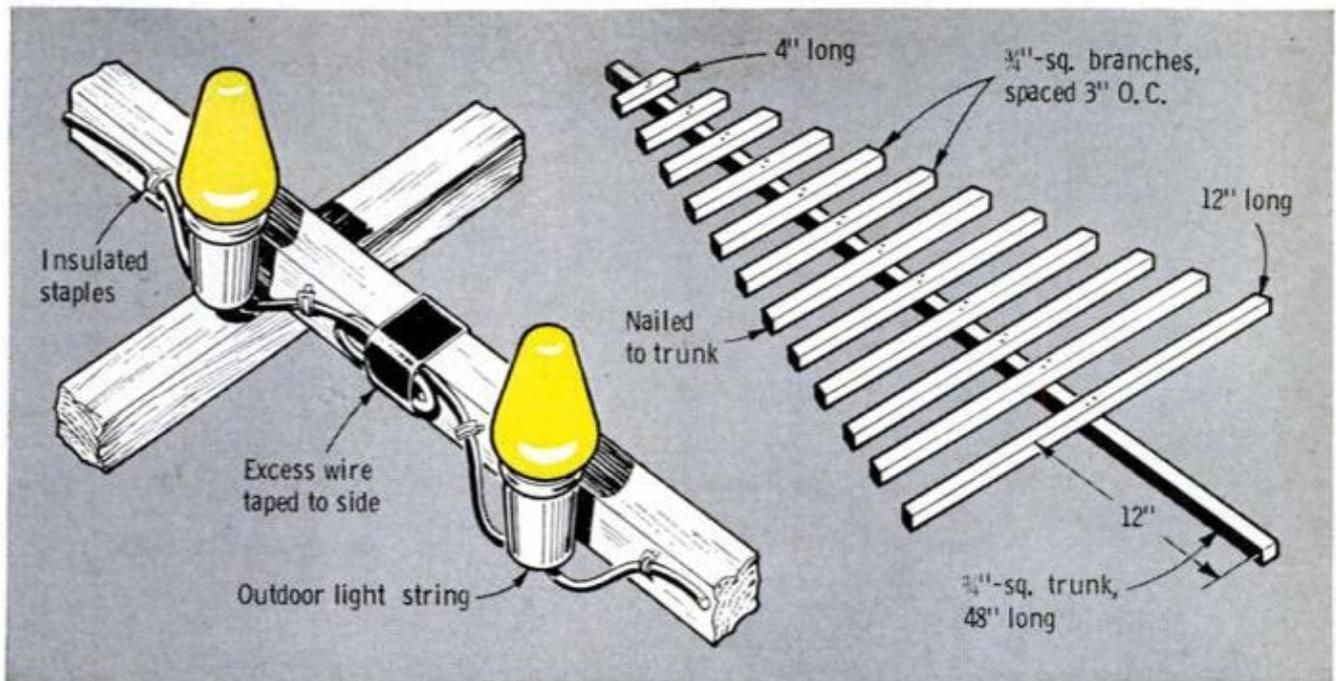
shorted wiring can you have a truly safe and merry Christmas.

One of the most foolhardy things people do when bringing power outdoors is to use extension wiring of common light-weight lamp cord to connect a lighted tree or rooftop display. All it takes is the smallest break in the light rubber covering to make it deadly when touched.

The danger of electrical shock occurs when a person contacts the "hot" side of a



home for Christmas



WALL TREES

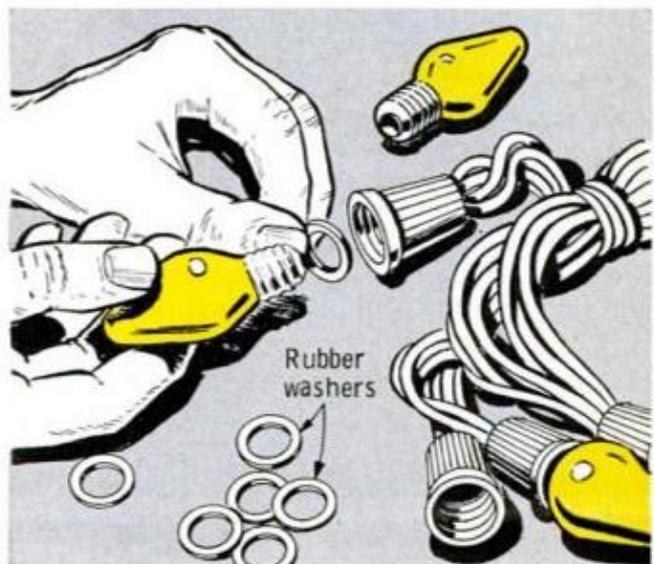
USED SINGLY or in groups of three as shown at the left, these wooden trees provide a most attractive display when mounted on the front of the house or door and spotlighted. Bulbs of one color or different colors in string sets attached to the trees will give a striking effect. The lights are stapled to the cross "branches" in a conical pattern and the excess wire is then held in tow with electrical tape

120-v. circuit while also in contact with an electrical ground such as water or the earth. The conventional fuse or circuit breaker found in the home is little protection during such a mishap since a fuse is designed primarily to prevent fires caused by overloaded circuits.

Outdoor extension cords should be No. 14 wire, contain three wires and be fitted with a three-prong plug for proper grounding. Current to outdoor lighting systems should be supplied from weatherproof receptacles placed outside the house. A three-prong grounding-type receptacle permits use of a cord having a grounding wire, so that metal parts of floodlights can be grounded for safety.

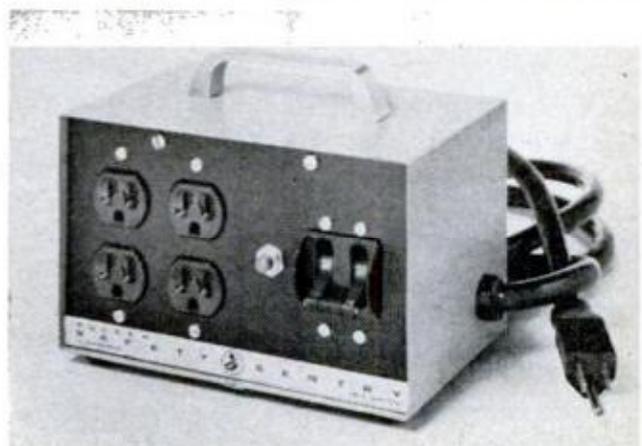
But even with a third-wire ground you can't be sure of safe power since three-wire systems depend on ground integrity. Many older homes do not have a grounded system; thus, a three-wire cord used in it is no better than a two-wire cord.

Perhaps your best protection against



SOCKETS OF STRING SETS can be made waterproof by first inserting the bulbs through rubber washers

PORTABLE CIRCUIT BREAKER such as this provides fail-safe protection against a fatal electrical shock

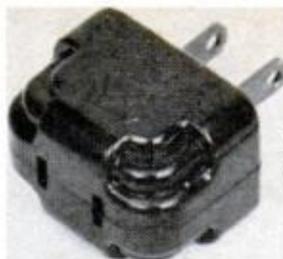


Standard Electrical Fittings



ADAPTER
SOCKET

BUTTON
WINKER



OUTLET
WINKER



SOCKET
WINKER



TAP-A-LITE



CUBE TAP

THESE ELECTRICAL DEVICES are a few of many fixtures your dealer has to help you rig special outdoor lighting effects. They include several winkers, for example, that make strings of lights flash intermittently

dangerous line-to-ground shock is a portable circuit interrupter such as the Rucker Safety Sentry (shown at the bottom of page 135) since it is not dependent on a three-wire ground. Where fuses generally do not respond to currents under 15 amperes and take a full second or more to trip out, the portable circuit breaker disconnects power in 30 milliseconds after detecting the slightest ground fault.

Such a protective device is useful not only at Christmas time, but at any time you're using power tools and yard equipment outside—there's always the danger of electrical shock. Simply plug its cord into a house receptacle and the outdoor lights, or tool, into the protected socket.

Where two or more extension cords are joined together to reach a remote tree, it's important that their plugs and connectors be made waterproof too. This can be done by wrapping them well with friction tape. Remember that cords which are strung when the ground is dry can be buried in snow before the holidays end.

If you do not have a weatherproof receptacle outside the house, the running of cords through doors and windows is not

good practice. Wires can get pinched, break and cause a short. You'll do better to plug into your protected porch fixture.

Special decorating effects can be achieved with winkers, electrical devices which make your outdoor lights flash intermittently. You'll find three types (button, socket and outlet) at your electrical store. Button and socket winkers are limited to conventional sockets for regular bulbs. Outlet winkers have prongs which can be plugged into a receptacle. By plugging a cube tap into the winker, it will handle up to three light sets.

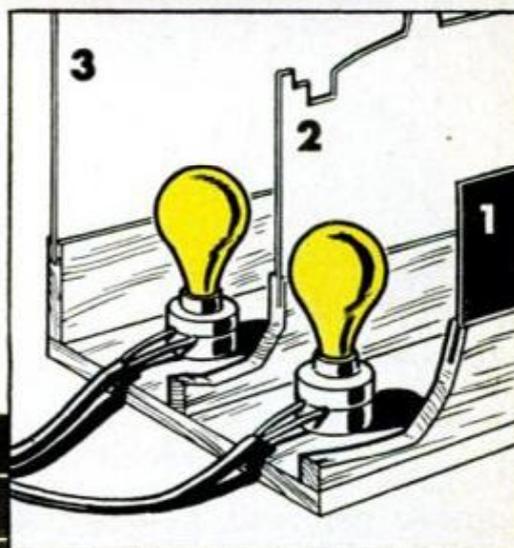
One of the handiest gadgets for making up your own soffit and gable string lights are little devices called Tap-a-lites. They're tiny receptacles which clamp over parallel conductor cord. They bite into the conductors to make contact, so they can be placed anywhere along the cord. Adapter sockets plug into the tiny receptacles to accept 7½-w. or larger colored bulbs.

In more protected areas like the roof soffit, typical Christmas-lamp string sets can be made waterproof by slipping rubber washers over the bases of the bulbs before screwing them into sockets. ★★



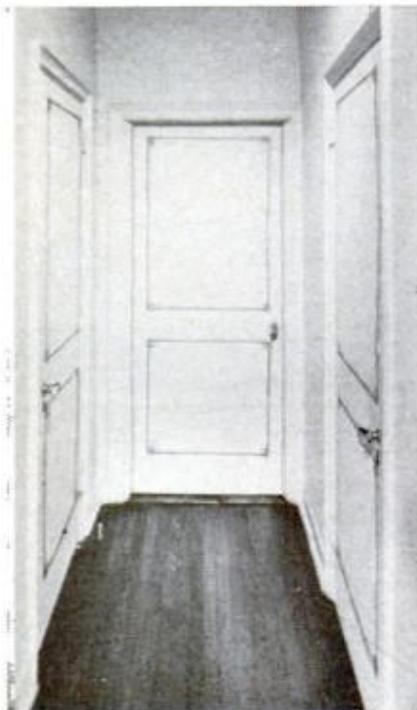
3-D SILHOUETTES

SPOTLIGHTED SILHOUETTES have always made popular displays, but they're twice as effective when multiply lighted. Here, instead of being lighted from the front, rows of hidden bulbs at the base of three jigsawed cutouts backlight the triple scenes to produce a pleasing 3-D effect. Each cutout is placed upright in the edge of a grooved board which is first nailed to a baseboard as shown at right. A series of sign sockets wired in parallel and fitted with colored bulbs—blue for cut-out No. 3 and yellow for cutout No. 2—will make cutout No. 1 stand out in silhouette. The latter cutout is painted flat black



PM takes a cue from THE WORLD'S MOST

So impressed was PM by Bill Crane's unusual brainchild that we arranged to borrow his idea, in a somewhat simplified version, for your own use



LONG HALLWAY converts to a working area when two doors are open. Third door leads to a den

WILLIAM B. CRANE Jr. is the type of person Hollywood scriptwriters dream about. Viewing New York from his penthouse apartment, Crane is likely to be thinking about a pneumatic-hydraulic bumper for automobiles or a self-watering flowerpot, his most recent invention. Although he holds some two dozen patents and is one of America's most successful inventors, his ingenuity takes many forms. Take, for example, his Christmas trees. His apartment is on the 18th floor. Every other year he has a contractor hoist a 20-ft.-tall tree up the outside of the building to his floor (yes, he has a 20-ft. ceiling). This is an alternating year, so Crane and his family make do with a tiny 2-ft. tree.

A prolific inventor must have facilities to transform ideas into practical, working systems. The necessary tools and machinery ordinarily require more space than you'd ever find in an apartment—so Crane imaginatively produced what may well be the world's most compact workshop. Intrigued? Then turn the page to view PM's adaptation of his in-a-closet tinkerer's bench.

Admittedly not as complex as Crane's brainchild, PM's simplified version nevertheless should hold all the tools

OPENING ONE DOOR, Crane reveals a portion of his collection of tools, machinery, accessories

OPEN OTHER DOOR and as many tools appear. Door can be opened manually or by pushbutton

PUSH A BUTTON and a spring-loaded bench unfolds automatically. Hidden is another tool panel

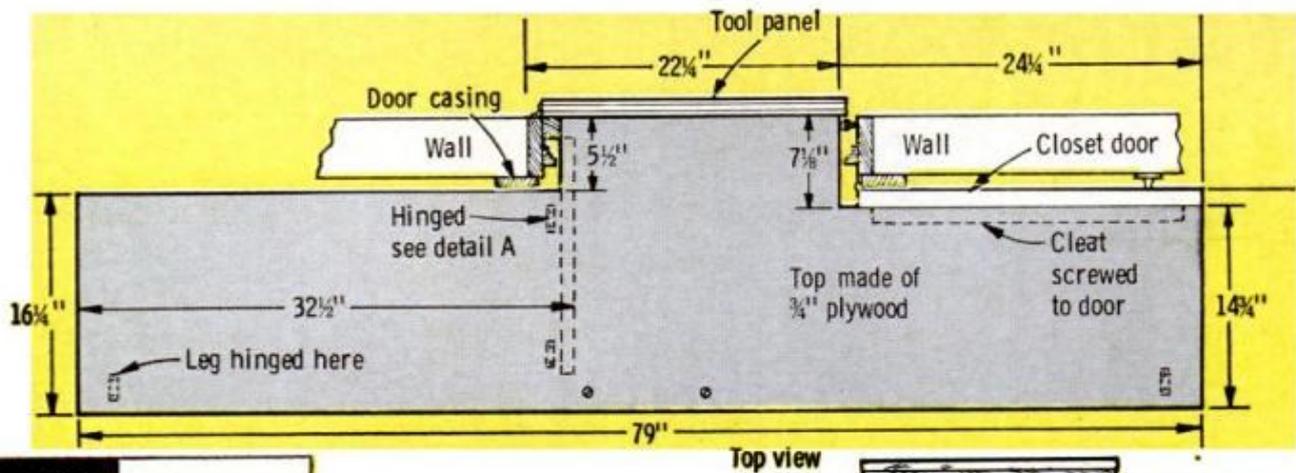


a successful inventor...

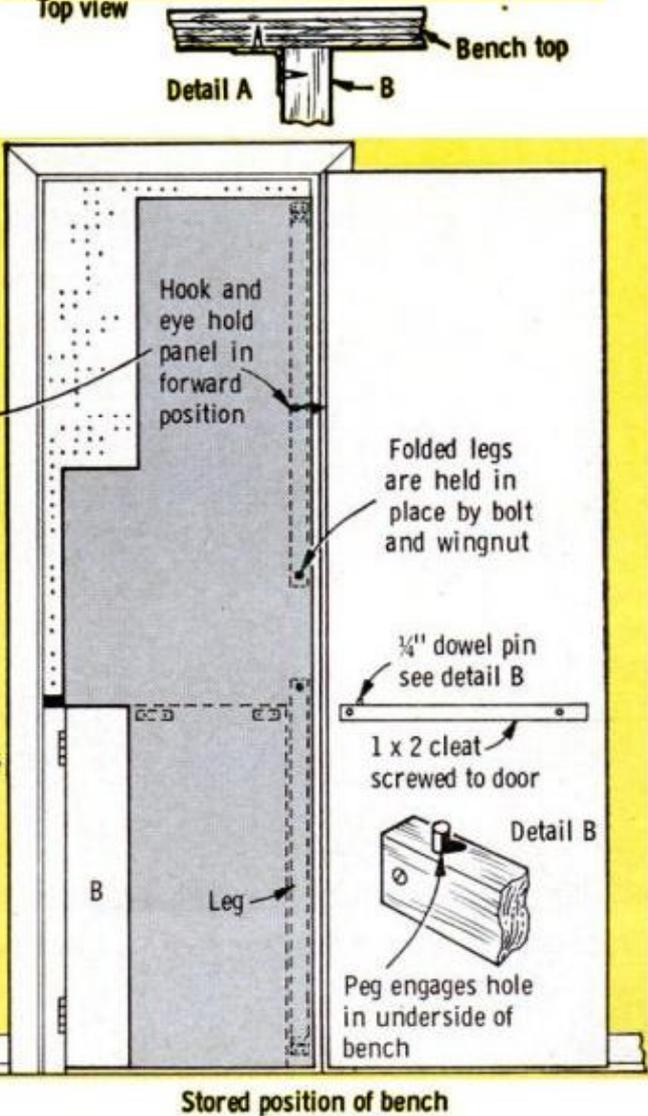
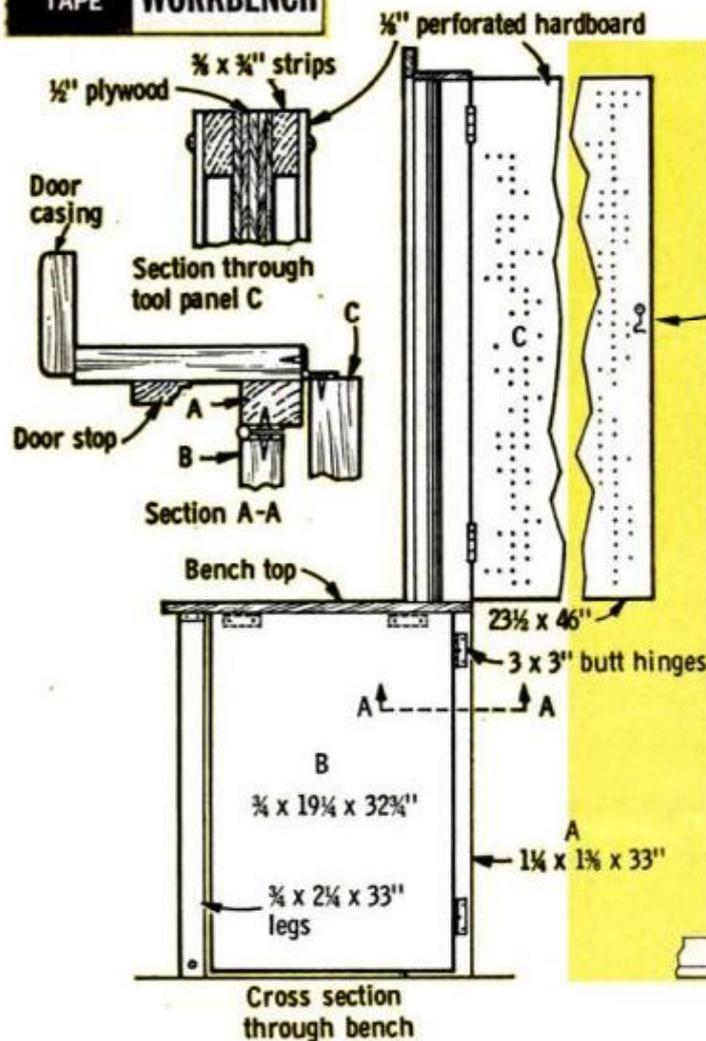
COMPACT WORKSHOP



READY FOR ALMOST ANY JOB, designer has hundreds of tools just a step away



CUT FOLD TAPE
IN-A-DOOR WORKBENCH



you commonly need when working on hi-fi equipment, household appliances and the like. In fact, the unit pictured on the opposite page accepts so many tools that it actually doubles as a father-and-son workbench for constructing electronic kits, as well as wooden ship and airplane models.

Study the detailed construction drawings above, and you'll find that the idea can be adapted to any size closet merely

by varying the width of the section of benchtop that fits in the door opening. The only other dimension you may need to modify accordingly is the width of the hinged tool panel.

Once the basic bench has been assembled, you can make it as fancy as you please. This particular closet, for example, wasn't really needed, so it was lined with shelves for the storage of additional tools and supplies.



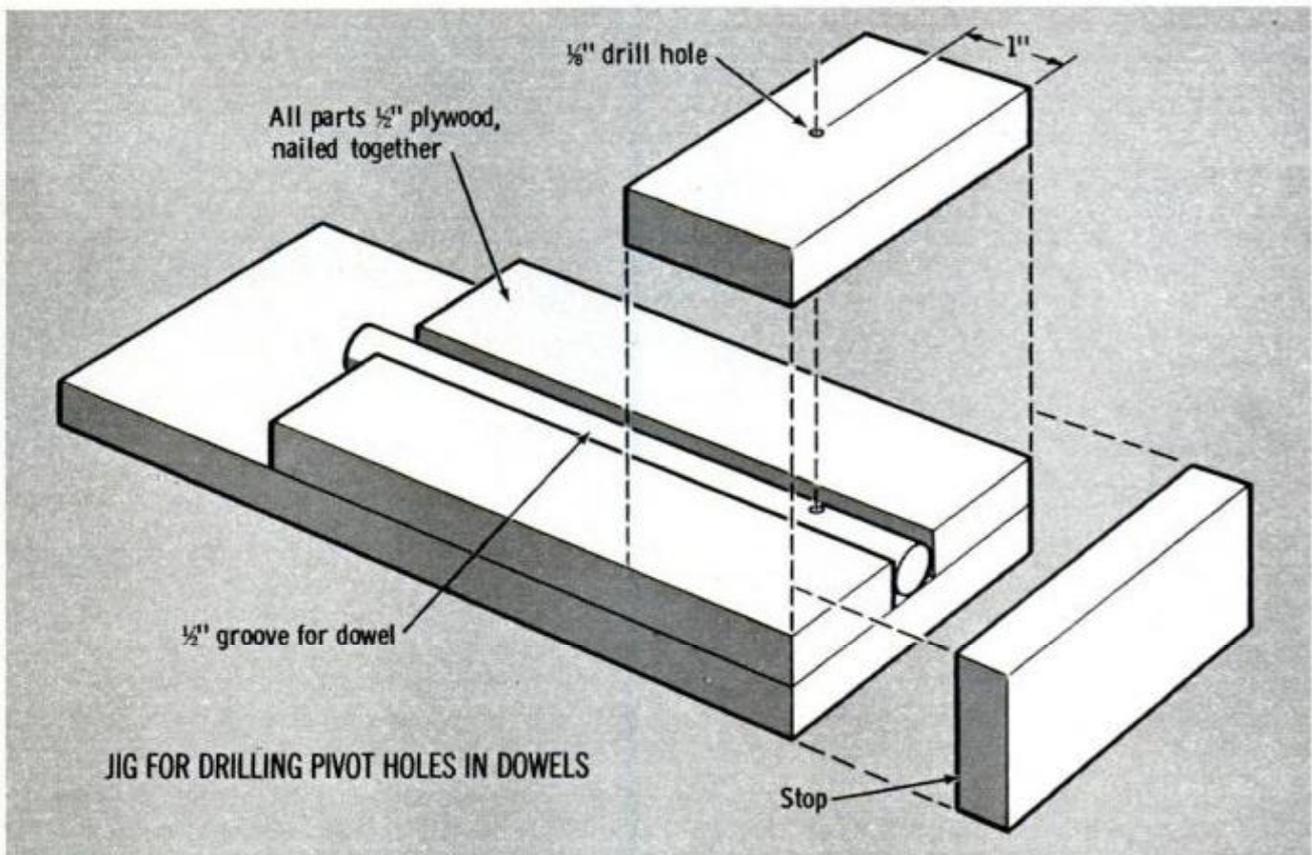
However, if you find closets too scarce to sacrifice, you can *still* assemble the bench as shown. Referring to the drawings once more, you'll note in Section A-A that the tool panel is hinged to the inside edge of the closet frame. But the forward movement of the panel is not restricted by bottom strip (A) as may appear at first glance. Thus, you swing the panel out to gain access to items stored on the rear side. Not having to swing the

panel *into* the closet means that you can still retain full use of the closet for clothes and other items.

One final note: If you cut the top exactly as shown, you may find it necessary to replace the regular doorknob with a slimmer wooden knob or drawer pull. As an alternative, you could cut that end of the top at a slight angle, so that when unfolded, it slips over the dowel and holds the door away from the wall. ★★★



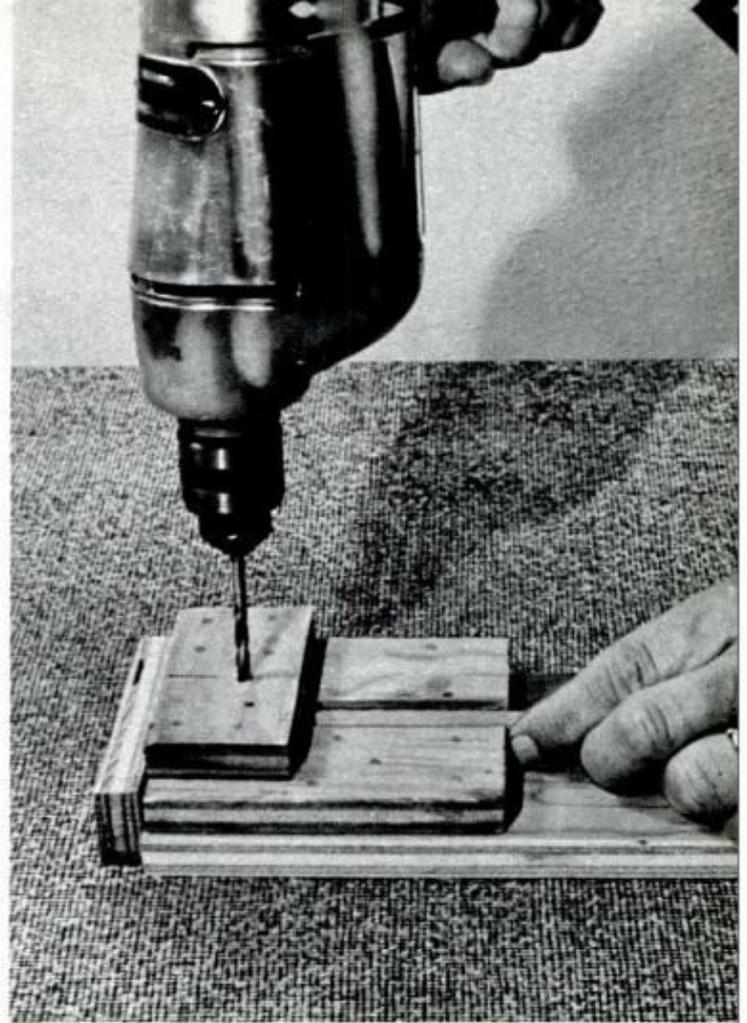
How good is your coordination? If you walk the ball across the keys, you're a real whiz!



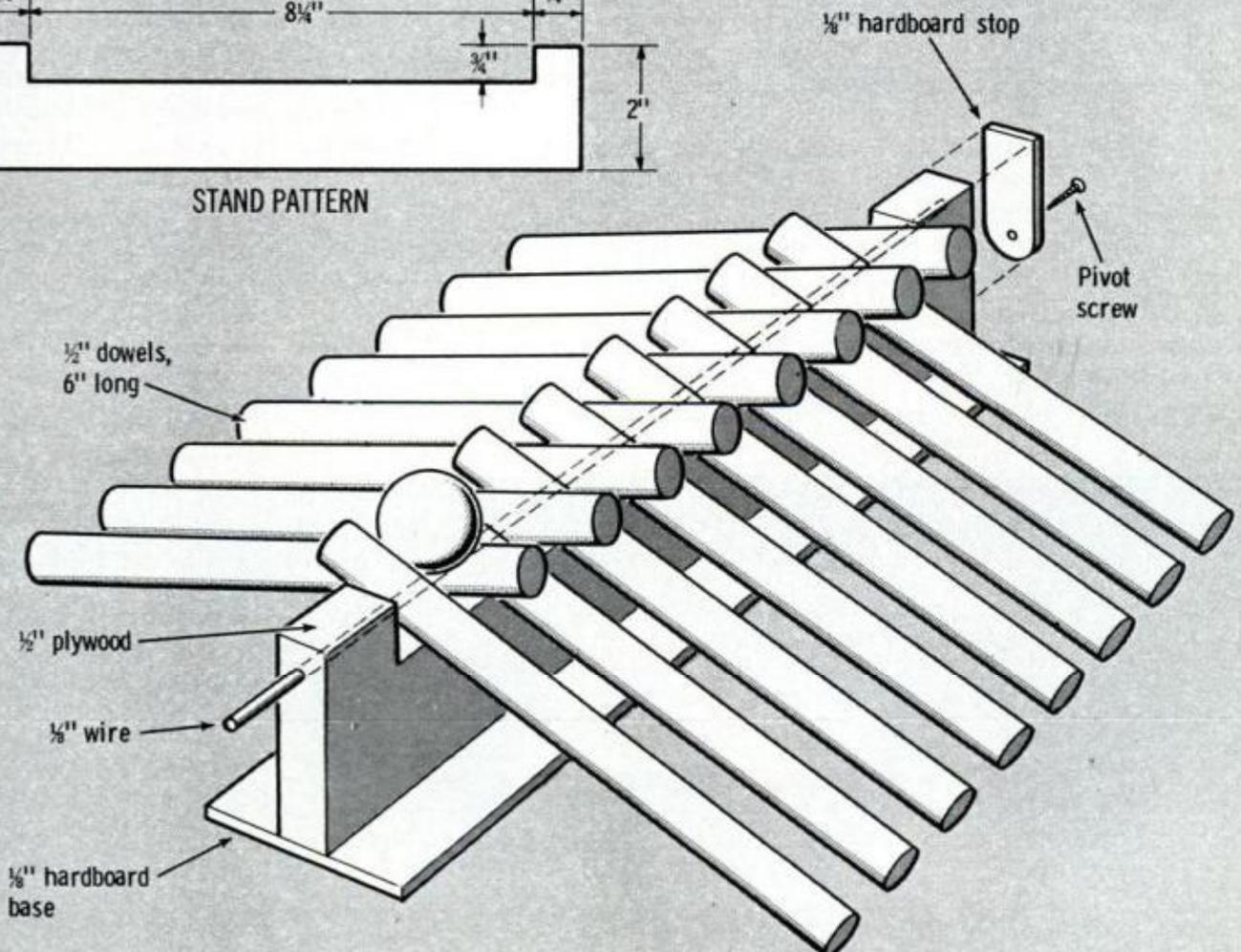
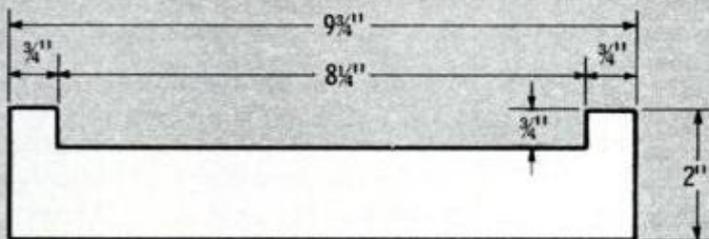
SIMPLE, YOU SAY? Wait till you try it. You'll find it takes real coordination to "walk" a Ping-Pong ball from one end of the keyboard to the other and back without the ball rolling off. If you can do it you're a whiz, for it generally takes considerable practice.

The ball is manipulated by 16 half-in. dowel keys which are loosely pivoted on a stiff wire stretching across an upright stand. By raising or lowering one, two or more keys, the ball can be coaxed to roll between the cradles formed by the dovetailing dowels.

You can follow the dimensions given below or build a longer keyboard to make the trip across an even greater feat. It's important that the pivot holes in the dowels be centered exactly and drilled at a point one in. from the end. You can't miss if you take time to make the jig detailed on the opposite page. Used in conjunction with your portable drill or drill press, the jig automatically positions each dowel under a drilling hole so that all will be drilled alike. A coat hanger will do for the wire. Sand the parts smooth, then paint the base black, eight keys red and the others white.—*Merton H. Slutz*



INSERTING DOWEL in groove of the jig automatically positions it for drilling a hole one in. from the end



New Mini-Trains: Built Like a Watch!

Exactly 1/160th the scale of real trains, new "N" gauge models are miniature packages full of precision machinery

By ROBERT SCHLEICHER

THIS CHRISTMAS, another generation of youngsters will be looking under the tree for their first set of model trains. Only this year, they'll have an eye out for a diminutive package—one that would be dwarfed by the bulky carton of trains that we remember.

So diminutive are the packages, in fact, that the tiny train and the track shown below both fit into a book-size box that's ingeniously hinged to open like a book and display its contents. Such space-saving features are sure to usher in a new era for hobbyists. Just imagine—you can have a complete railroading empire set up on a board the size of a Ping-Pong table. If even that's too much space to sacrifice, you can rig a complete set in an area the size of a desk drawer—or in the desk drawer itself.

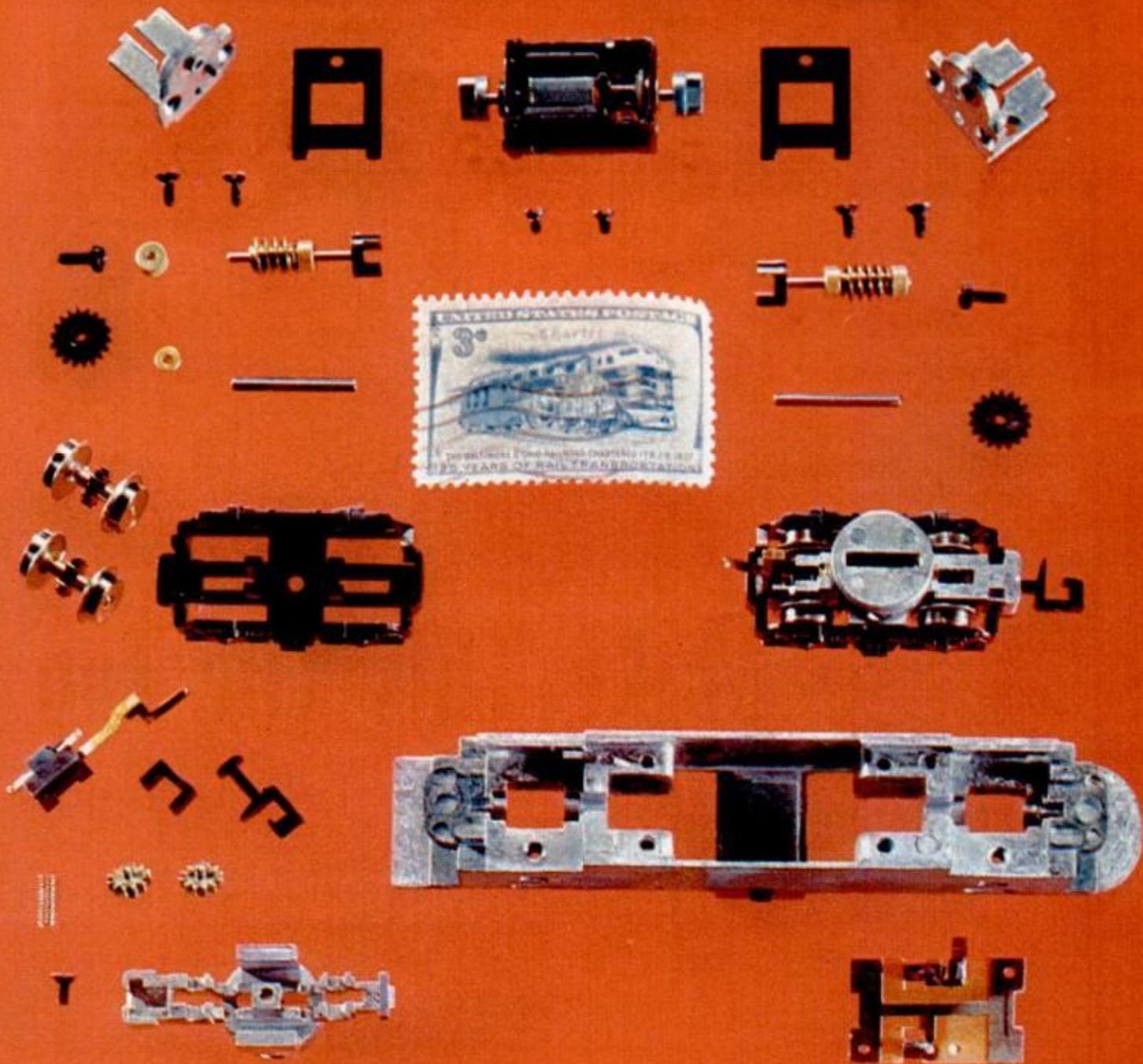
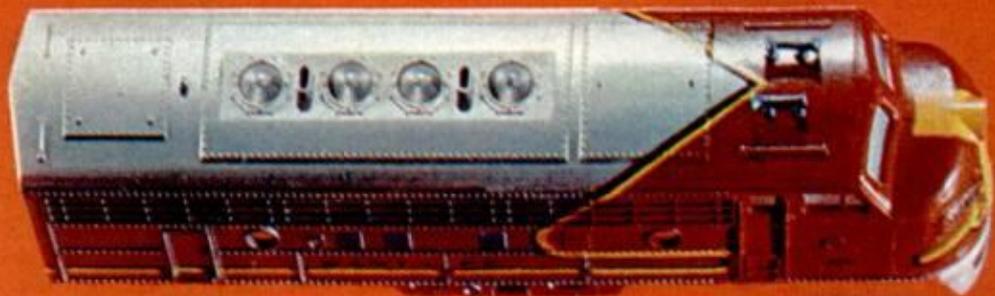
One quality that isn't proportionately sacrificed is realism, for as can be seen in the actual-size photo of a partially disassembled locomotive, the body markings, ventilation openings and even the windows are surprisingly detailed. Indeed,

when you consider that the N-gauge models are just half the size of HO trains, or only 1/160th scale of real rail-runners, the design and performance of a miniature eight-wheel-drive engine is impressive.

The locomotive and the set shown are from Aurora Plastics and constitute one of four basic outfits, each of which is available with Union Pacific, Santa Fe, Pennsylvania or Baltimore & Ohio markings. Known as Postage Stamp trains, Aurora's "book"-packaged sets cost from about \$25 for the set shown, to \$30 for a seven-car set with a dummy diesel. All can be powered by any 12 to 16-v.d.c. power supply used for model railroading.

Revell is another supplier of N-gauge trains and accessories, and, like Aurora, is marketing models made in West Germany. Other major companies engaged in trains and accessories include Atlas, Kemtron, Lima and Lone Star. In most cases, accessories as well as rolling stock are interchangeable. All share one point in common, however—their tiny size is the big news in model railroading. ★★★



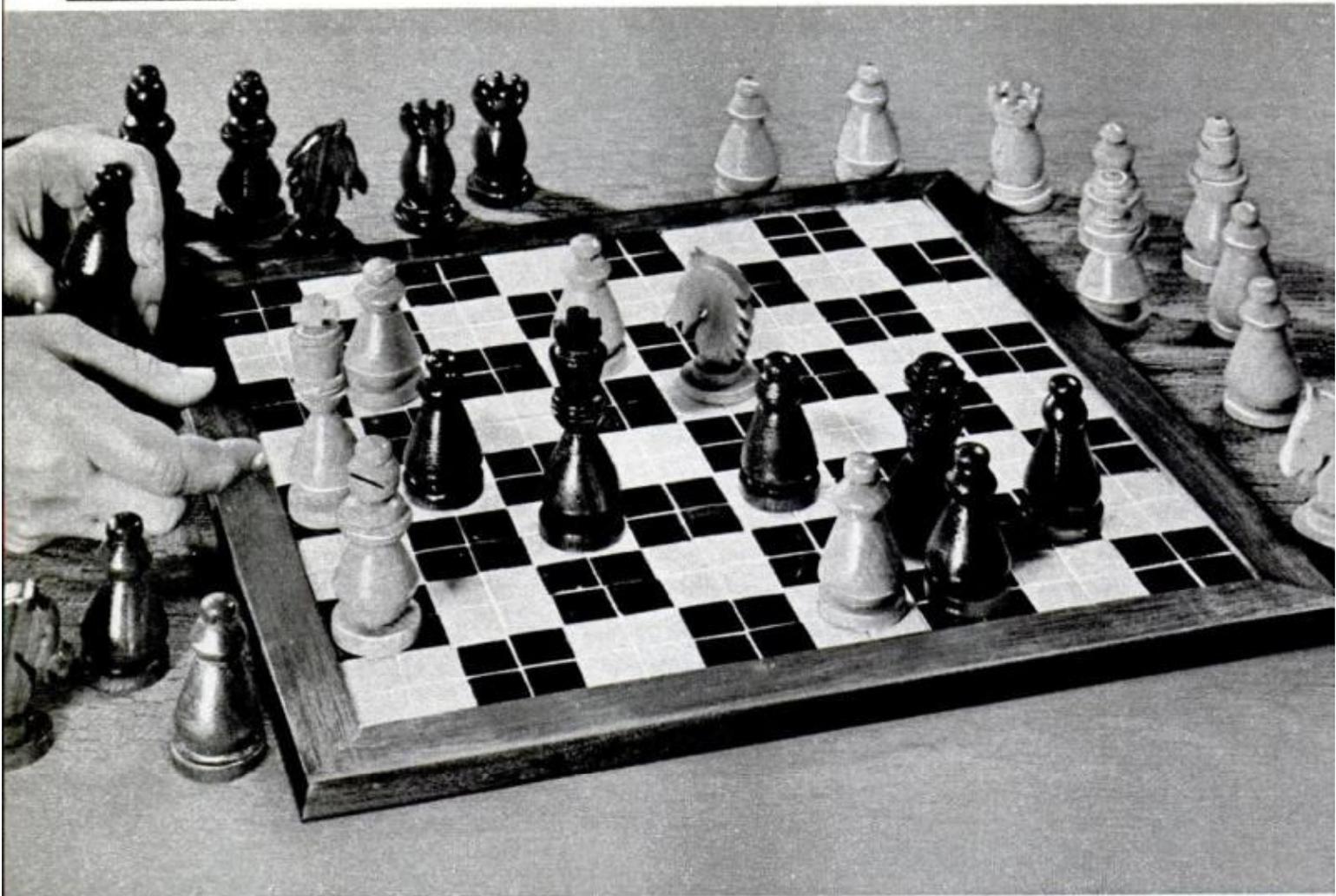


← **CHRONOLOGICAL LINEUP** best illustrates development of model trains down through the years. At far left is old standard-gauge electric, the 318E. Next is an O-gauge, followed by S-gauge model. Small locomotive encircled by the N-gauge track is familiar HO diesel. Large models courtesy Polk's Hobby Center

DECEMBER 1967

↑ **SHOWN FULL SIZE**, a partially disassembled locomotive yields a myriad of tiny, precisely machined components. Still intact is the front truck assembly which essentially is the same as disassembled rear truck. The one-piece chassis is made of metal, while the body is formed of sturdy plastic. Tiny motor is centered near top

145

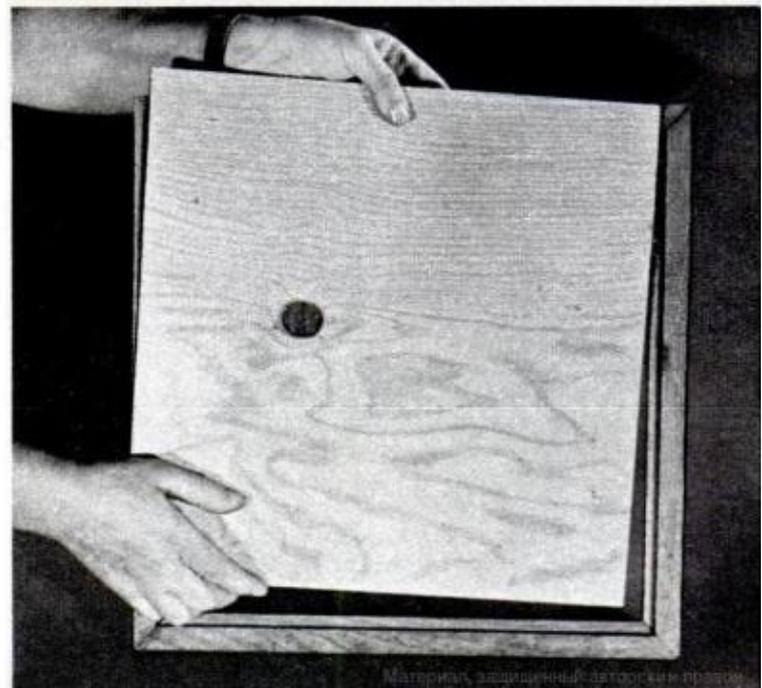
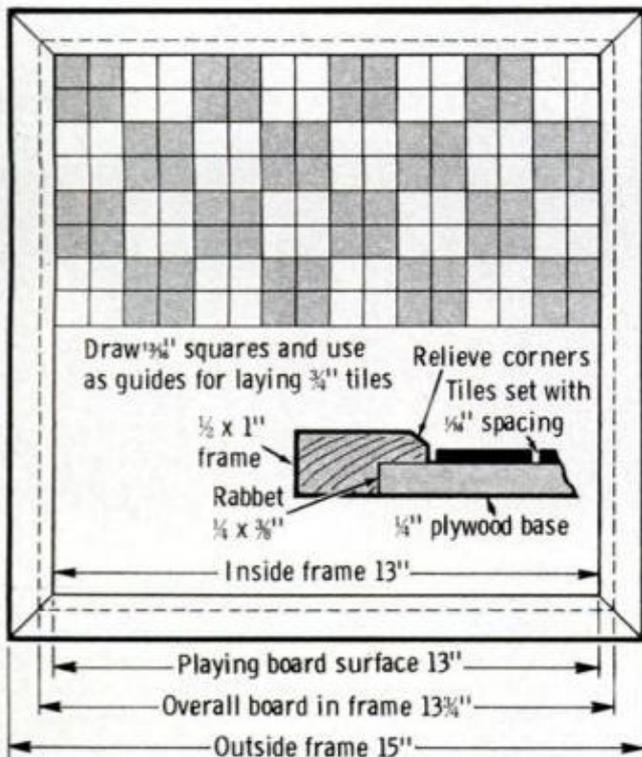


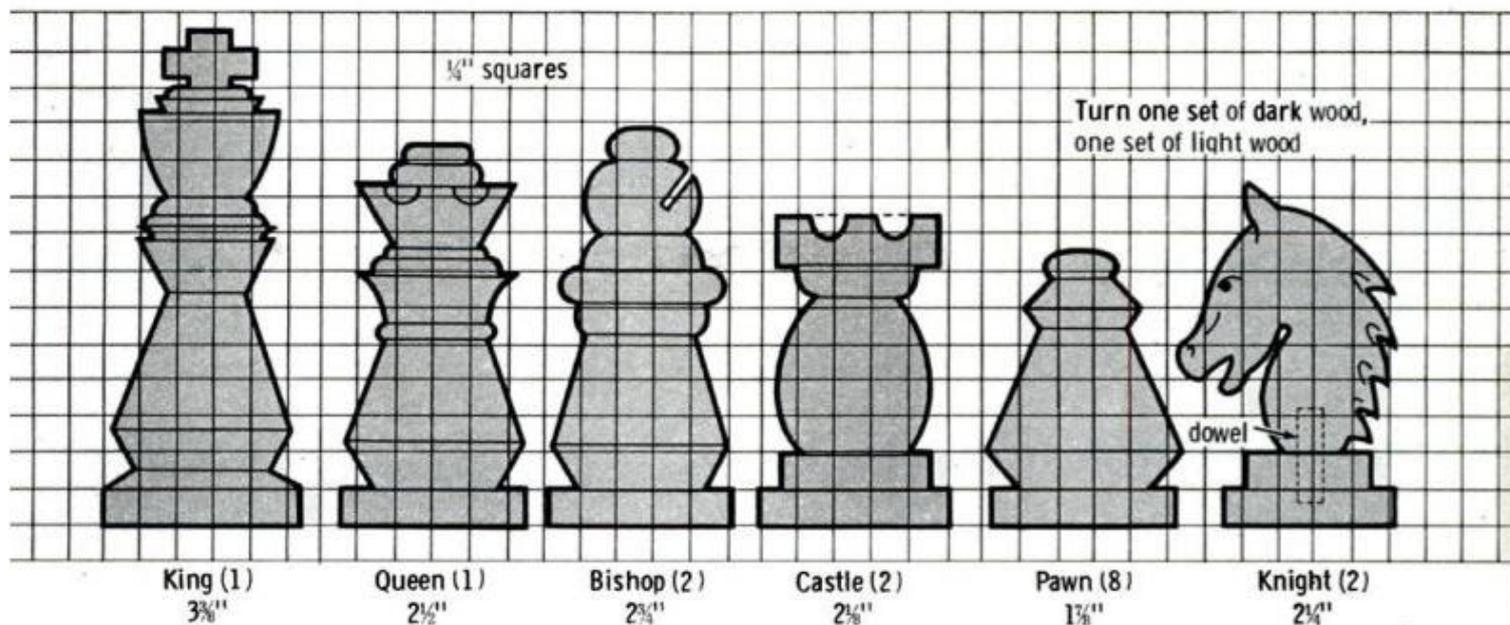
By **ELMA and WILLARD WALTNER**
 Technical Art by
 ZIK Associates, Ltd.

Make This Tile-Top

Then turn out

PLYWOOD BOTTOM is set in a frame as if it were a picture, but it's glued and toenailed in position





ANYONE CAN PLAY chess or checkers on a common checkerboard, but to wage "war" on an elegant tile-top battlefield such as this—that's really something!

If you already have a chess set and just want to update it with this classy board, you can forget about the men. But if you want to make the complete set, the patterns at the top of the page give you the shapes to follow in turning them from walnut and maple or other contrasting

woods. Carefully turned and "carved" with a jigsaw, you'll have a chess set you'll always be proud to display.

The board is little more than a square of plywood ruled off in thirty-two $\frac{13}{16}$ in. squares and set in a picture frame of walnut molding. The individual ceramic tiles are cemented to the board. Space them $\frac{1}{16}$ in. apart. Then when the cement has dried, the spaces between the tiles are

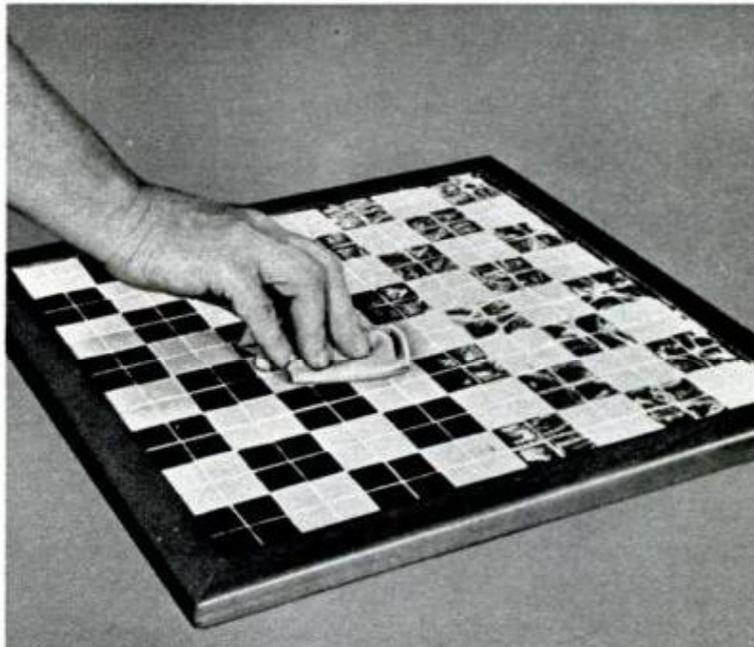
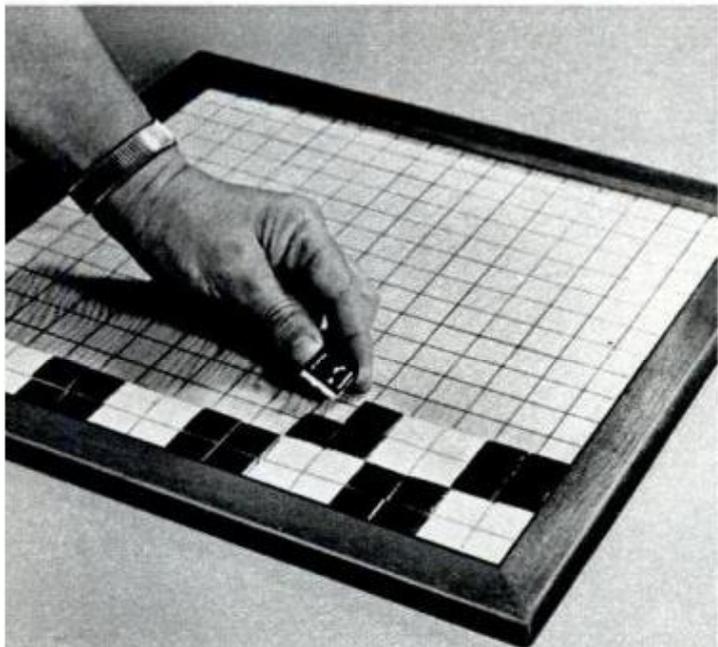
(Please turn to page 190)

Chess and Checkerboard

the men at your leisure

FOUR $\frac{3}{4}$ -IN. CERAMIC TILES make up each white or black square, spaced and cemented $\frac{1}{16}$ -in. apart

AFTER GROUTING TILE, wipe the white sludge clean with a sponge, which leaves the joints filled level



You, too, can build a

Packaged steel units make it a cinch to build your own fireplace

By WAYNE C. LECKEY



fireplace

PART 1

Technical Art by
Graphic Presentations
Color Photo by Robert Borst

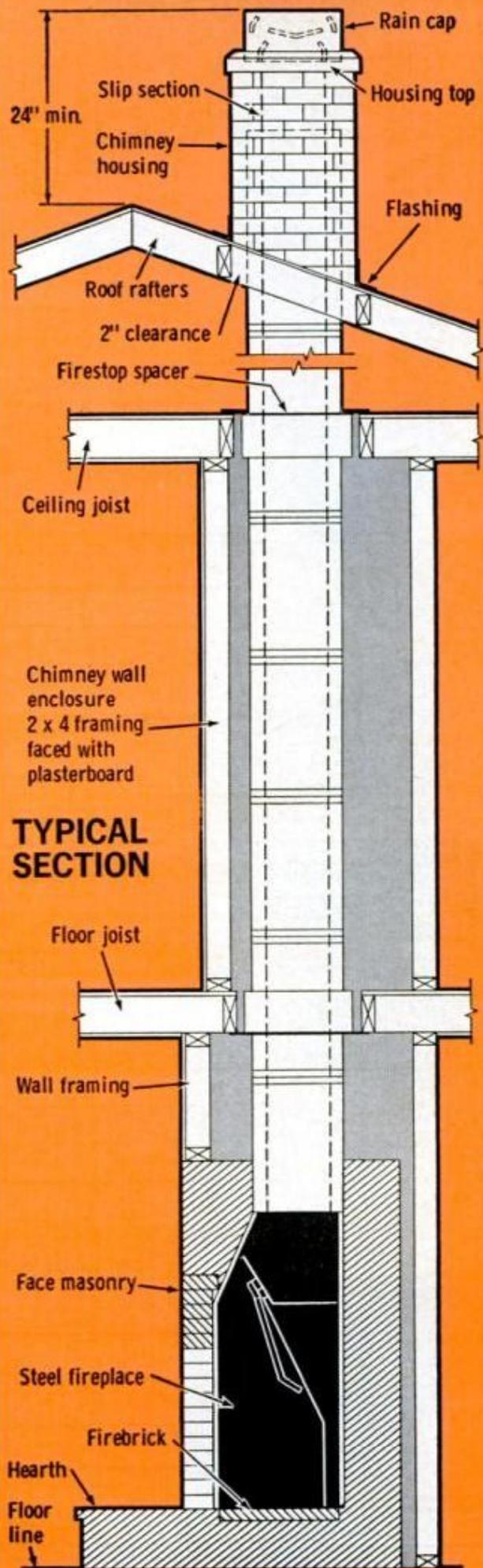
WHAT'S SO DIFFICULT about building your own fireplace? Nothing—if you build it around a factory-made steel form.

It takes an experienced bricklayer to build a fireplace from scratch, but with a kit that comes complete from hearth to chimney top, the hard part is made easy for the handy homeowner. The critical downdraft shelf, the damper and the smoke dome are already properly installed to guarantee a smoke-free unit.

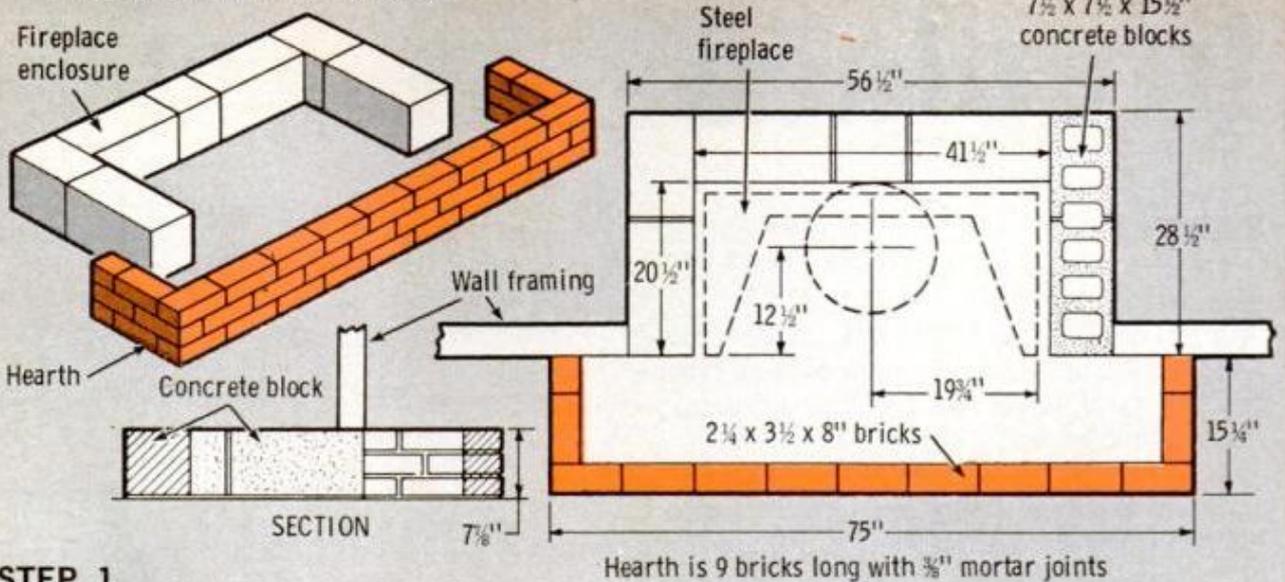
Just where you are able to locate your fireplace will be determined largely by the structural framing of your house.

In both one and two-story dwellings, you're wise to locate your fireplace on an inside wall. However, where you have a low-pitch roof you may consider locating it on an outside wall. But where the house has a fairly steep roof, you run into a

THE CAVITY for the steel form is laid eight blocks high, with brick ties placed in first three courses

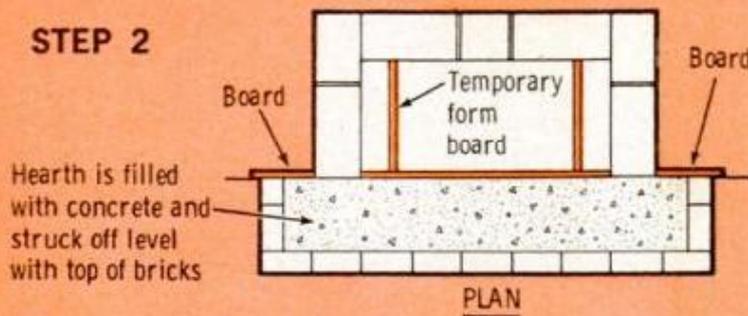


FIREPLACE LAYOUT



STEP 1

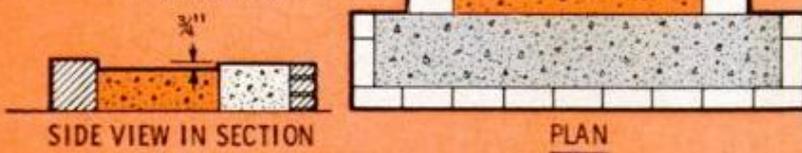
STEP 2



CUT FOLD TAPE BUILD A FIREPLACE

STEP 3

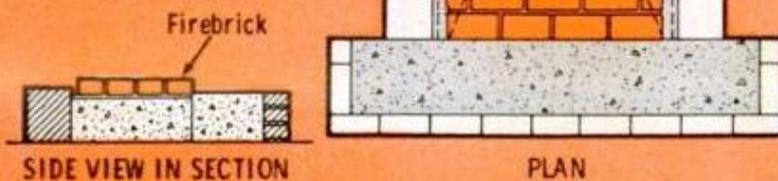
Firepit area is filled with concrete next, but is kept 3/8" below level of hearth concrete



STEP 4

Firepit area can be covered now, or after enclosure is completed, with firebrick bedded in mortar

15 firebrick, 2 1/2 x 4 1/4 x 8 1/4"



chimney-height problem inasmuch as the top of it must be a minimum of 2 ft. above the roof's ridge to assure proper draft. Then, too, you can't get a chimney housing that's taller than 6 ft. So, in most cases, you are better off sticking to an inside wall.

In the case of a two-story house, you have to keep in mind where the chimney will come out upstairs. Ideally, it should emerge in a corner of a bedroom, through a closet, or at least close to a wall, where it can later be boxed in with 2x4s and plasterboard.

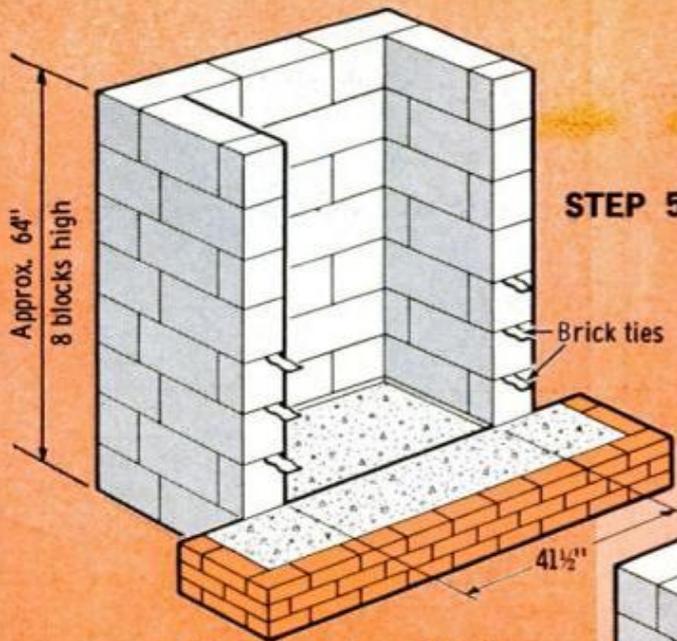
The floor hole for the chimney can't be too near a wall. With the pipe sections measuring 15 in. in diameter and requiring a 2-in. airspace all around, a minimum distance of 19 in. must be figured.

In a one-story house you don't

WALL OF BRICK, three courses high, forms hearth which is later filled with concrete



LAYING UP ENCLOSURE



STEP 5

Brick ties

41 1/2"

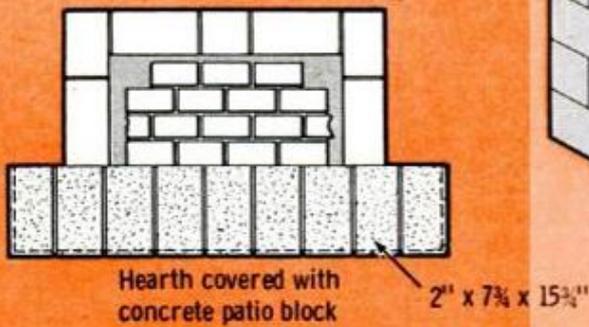
Approx. 64"
8 blocks high

CAVITY FLOOR is filled with concrete too, but is troweled 3/4 in. below hearth level

How fireplace enclosure is built up

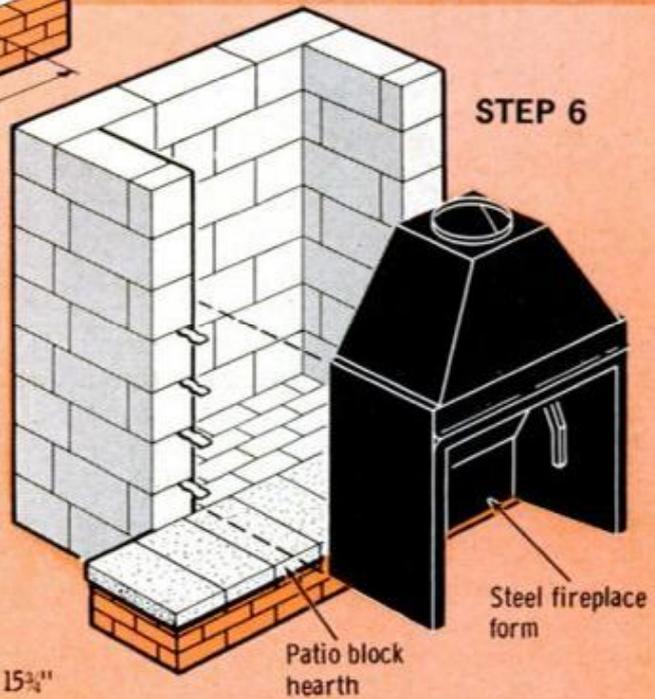


End view in section



Hearth covered with concrete patio block

2" x 7 3/4" x 15 1/2"



STEP 6

Steel fireplace form

Patio block hearth

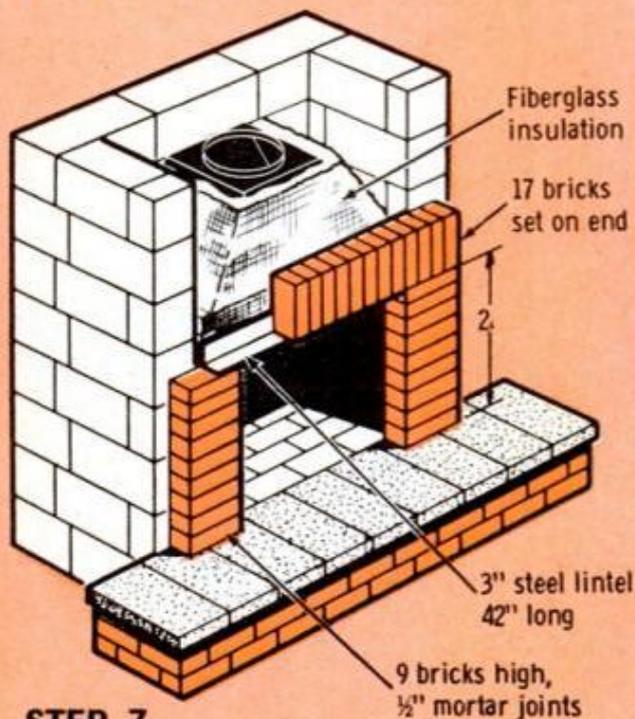


SOUP MORTAR MIX, applied with brush, is used to cement fiberglass insulation to outside of steel form



THE BLANKET INSULATION, which comes in a roll, is cut to fit form and patted in place in the cement

HOW FACE IS LAID



STEP 7

have to worry about the chimney; it merely passes unseen through the attic on its way to the roof. I wasn't so lucky. Mine is a two-story split level.

Besides the front-open model that I installed, you also have a choice of a side-open one, as well as a circulating model.

As for location, I chose a wall between garage and family room. To have the chimney come up in a bedroom corner I had to straddle the wall, letting the fireplace



CHIMNEY OPENING is cut through ceiling and upper floor boards prior to setting steel form in cavity

project 6 in. into the garage and 2 ft. into the family room. As it worked out, it created much needed storage areas at each side of the fireplace, and I found myself lucky, too, in meeting the 2-ft.-above-the-ridge requirement with a maximum 6-ft. chimney.

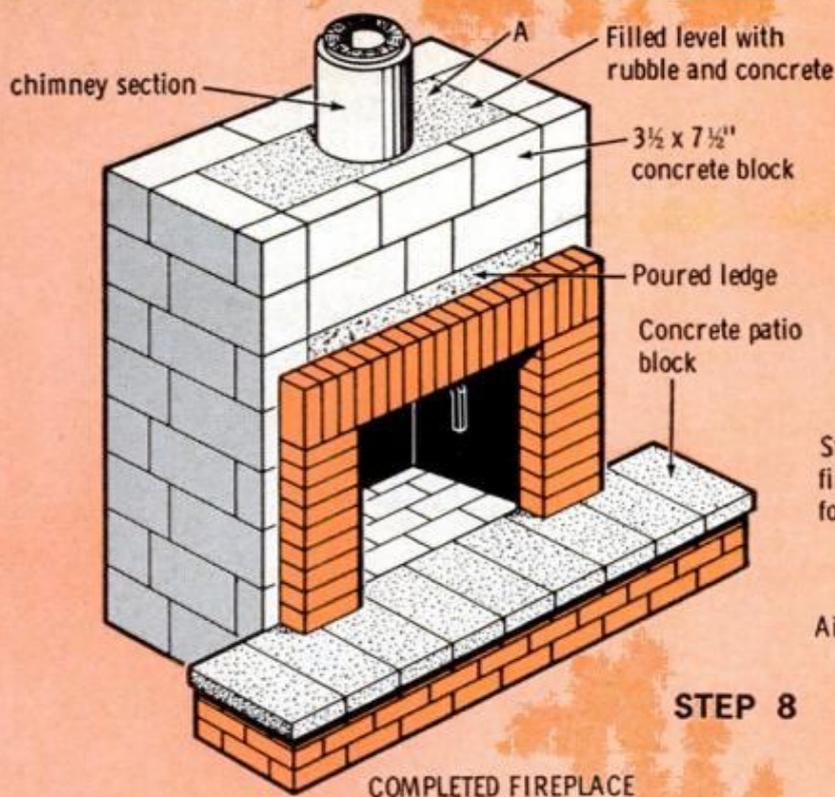
There are several kit fireplaces on the market which are designed to be built in and are offered in a choice of sizes. I picked a Mark 534 Heatilator made by Vega Industries of Syracuse, N. Y., which has a firebox opening of 24x32 in. It comes with insulated chimney sections, 15 in. in diameter and 2 and 3-ft. lengths, which simply stack and lock together with a twist. From the ground it's hard to tell that the chimney housing is sheet metal



TIERS OF BRICK on each side of fire-pit opening are plumbed with level as they're mortared in place

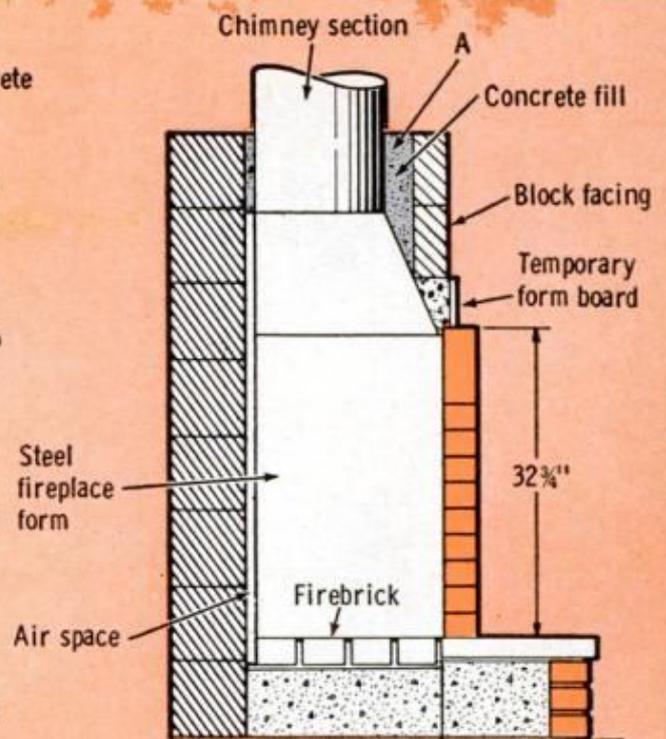


STEEL LINTEL rests on top of brick tiers to provide ledge for brick mortared on end across the top



STEP 8

COMPLETED FIREPLACE



SIDE VIEW IN SECTION

and not real brick. The housing, plus its stonelike cap and buff-colored flue, takes on even more realism as its textured finish weathers. You can get white or red brick and single and double-flue models.

Each installation will vary somewhat, but the steps involving the kit are basically the same. For example, you might not want to face your fireplace with paneling as I did. You may prefer to brick (or stone) the whole front. Or you may want

to surround it on three sides with plasterboard walls and add a mantel. Again, you may not want a raised hearth. It's up to you.

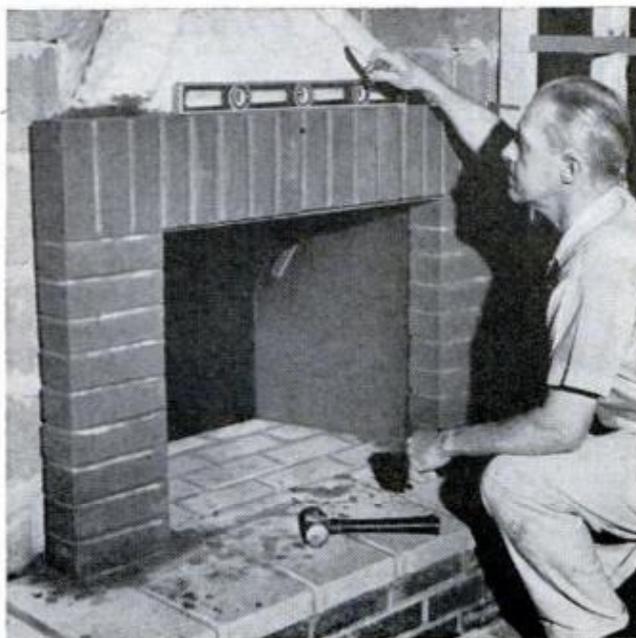
I was lucky in having a concrete floor. Where the floor is wood, you can't build your fireplace directly on top of it. *There must be no combustible material under the fireplace.* This means that you must cut, at least, a 3x4-ft. hole through the floor and fill it with concrete. This requires lining the hole with a boxlike plywood form (later removed) and supporting it from below with either a pier of concrete blocks or steel lally columns.

Now to begin

Once you have roughly plotted the location, your first step is to spot the center of the chimney pipe. Here the locating measurements differ with each size of steel form, but in each case the center point is measured from the outside and the front of the form. The amount the fireplace will jut out from the wall will differ, too, with the size of the form. A plumb line dropped from the bedroom, or attic, as the case may be, will accurately establish and align the center of the square chimney hole—to be cut in the ceiling later.

You don't have to touch the wall against which the fireplace is located, but I had to

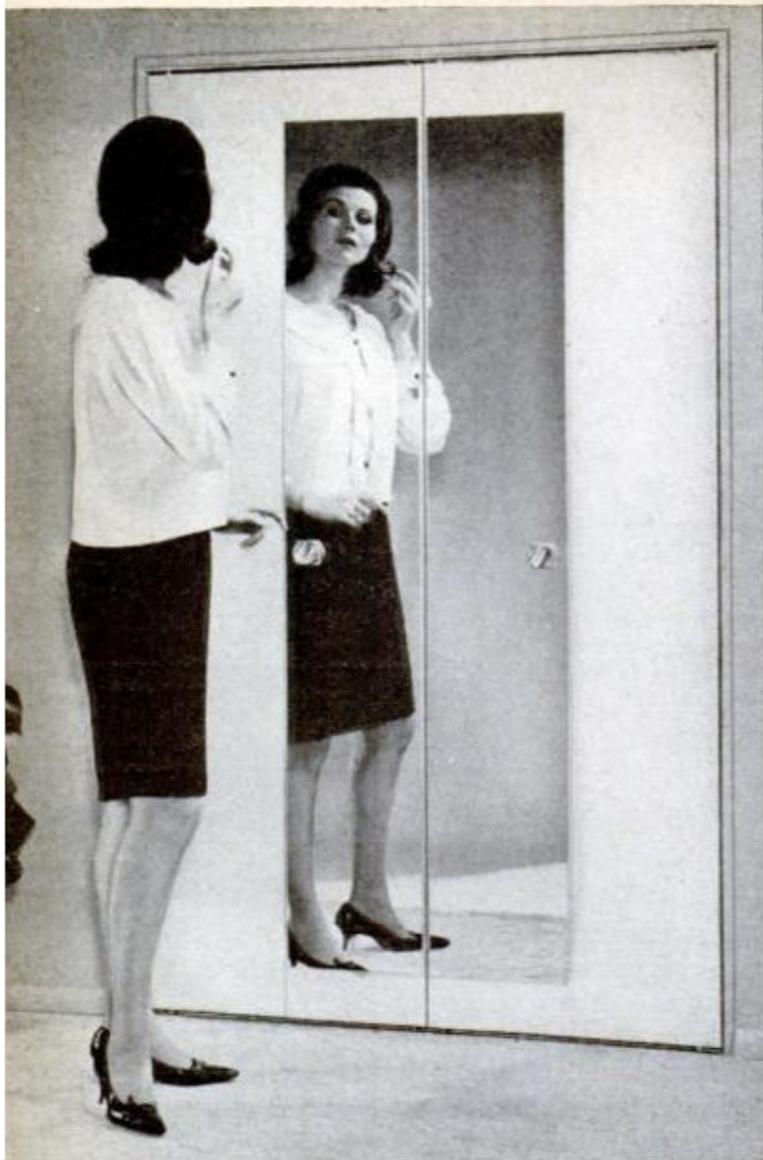
(Please turn to page 200)



NINETEEN FACE BRICKS space out evenly across top. Use level frequently to check for perfect alignment

EXCITING NEW PRODUCTS

By CAROL SCHULTZ



METAL BIFOLD DOORS have two first-quality, double-strength mirrors held permanently in place on four-panel "Full-Vu" doors to add appearance, utility and convenience. The twin mirrors provide front and back views; you simply open the doors to the desired position. Each mirror is 70 inches long. Made by Leigh Products, Inc., Coopersville, Mich.



ADJUSTABLE METAL CLOSET SHELVING has "goof-proof" wall supports, designed to catch studs where they are. Available in various sizes. Shelves (with rod) priced from \$5.47. By Stanley Hardware, New Britain, Conn.



TOTE-SEAT is a compact red-canvas pack sack that holds all incidentals you need for a day afield. It's also a portable chair to attach to any convenient tree. Priced under \$20. By Sportsgear, Inc., Minneapolis, Minn.



FURNITURE RESTORER removes alcohol rings, food stains, even minor cigaret burns. Not an abrasive; will not harm varnish. Four ounces sell for \$2.50 postpaid from Albion Distributors, 927 Long Beach Blvd., Long Beach, Calif.



SOAP HOLDER with tiny suction cups will adhere to any hard surface. Save soap by hanging vertically to dry—no mess. Ideal for side of tub, basin or shower. 39 cents. Quikey Mfg. Co., 1500 Industrial Pkwy., Akron, Ohio

BLACK TIRE AND MAT DRESSING quickly restores "like new" appearance of automotive tires, floor mats, brake and accelerator pedals, trunk mats and kick pads. Quick-drying aerosol spray quickly seals and protects with a new low-sheen finish. \$1.95. By Tempo Products Co., 6200 Cochran Rd., Cleveland, Ohio

WINE THERMOMETER takes guesswork out of serving wine at proper temperature. \$8.45 postpaid. Sidney Corn, 1317 Third Ave., Los Angeles



Think you can't draw?
Try these

'INSTANT' SKETCHES

FROM PHOTO PRINTS

This ingenious trick of tracing a photo and making the image vanish produces professional-looking pen-and-ink drawings almost magically

By BOB CORLEY

IF YOU WANT to have some fun and surprise your friends, try this dodge: Trace over the image on a photographic print in ink, then bleach out the original image, leaving just your ink tracing. The result looks amazingly like a freehand pen-and-ink sketch made by an artist.

The method requires only standard darkroom supplies. Any print can be used, but one without a high-gloss finish works best. Use a black, waterproof India ink and a fine-point drawing pen. Start by roughing in the main outlines, then fill in the details. The finer your strokes, the more professional-looking the results will be. When the ink has dried, soak the print in water for a few minutes.

The bleaching agent is potassium ferricyanide, available at photo stores. Mix three tablespoons in a quart of water. Immerse the print in the solution and gently rock the tray to insure even bleaching. In several minutes, the image will turn brownish and disappear. When the image is no longer visible, immerse the print in ordinary hypo for two or three minutes until the background turns pure white, then wash in the usual manner. ★★★



1 ALL YOU NEED for instant sketches is a clear, sharp photographic print, preferably 5x7 or larger, a fine-point sketch pen, waterproof India ink and a jar of potassium ferricyanide, a bleaching agent

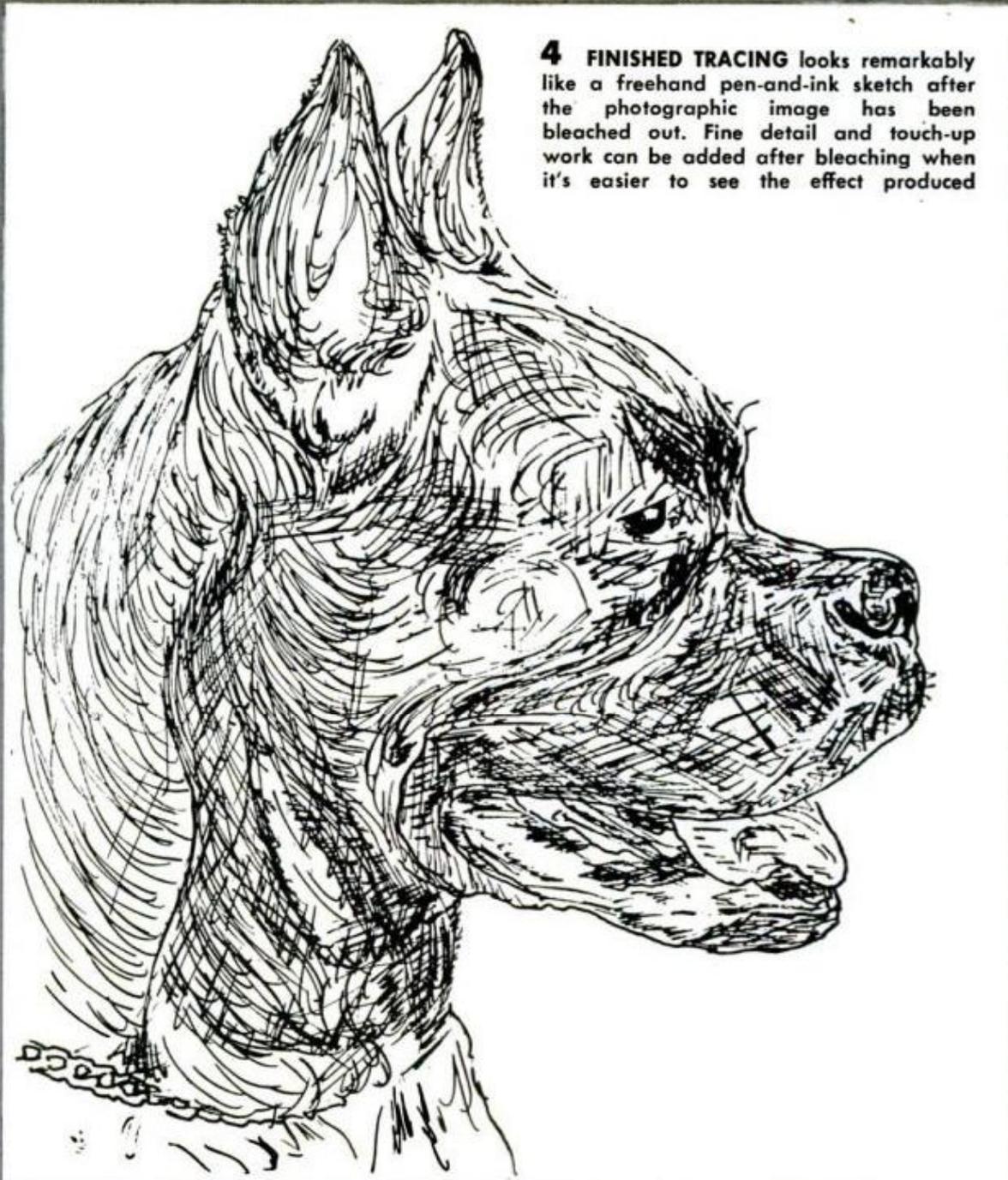


2 TRACING THE IMAGE directly on the print gives you an inked outline of the subject. Use short, quick strokes for a freehand effect. Closely spaced cross-hatching adds darker shadow areas and contours



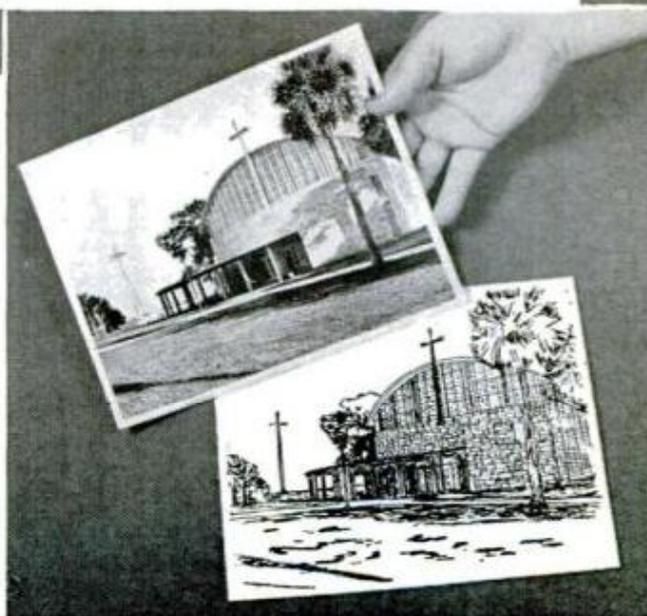
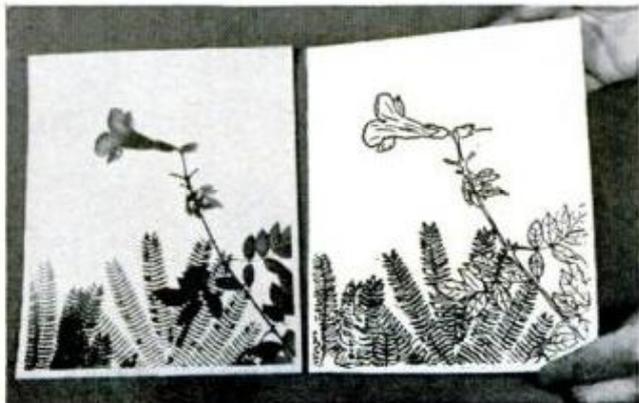
3 ONLY THE INK REMAINS when the print is bathed in a solution of potassium ferricyanide. The chemical acts as a bleach, completely removing the photographic image and leaving the tracing

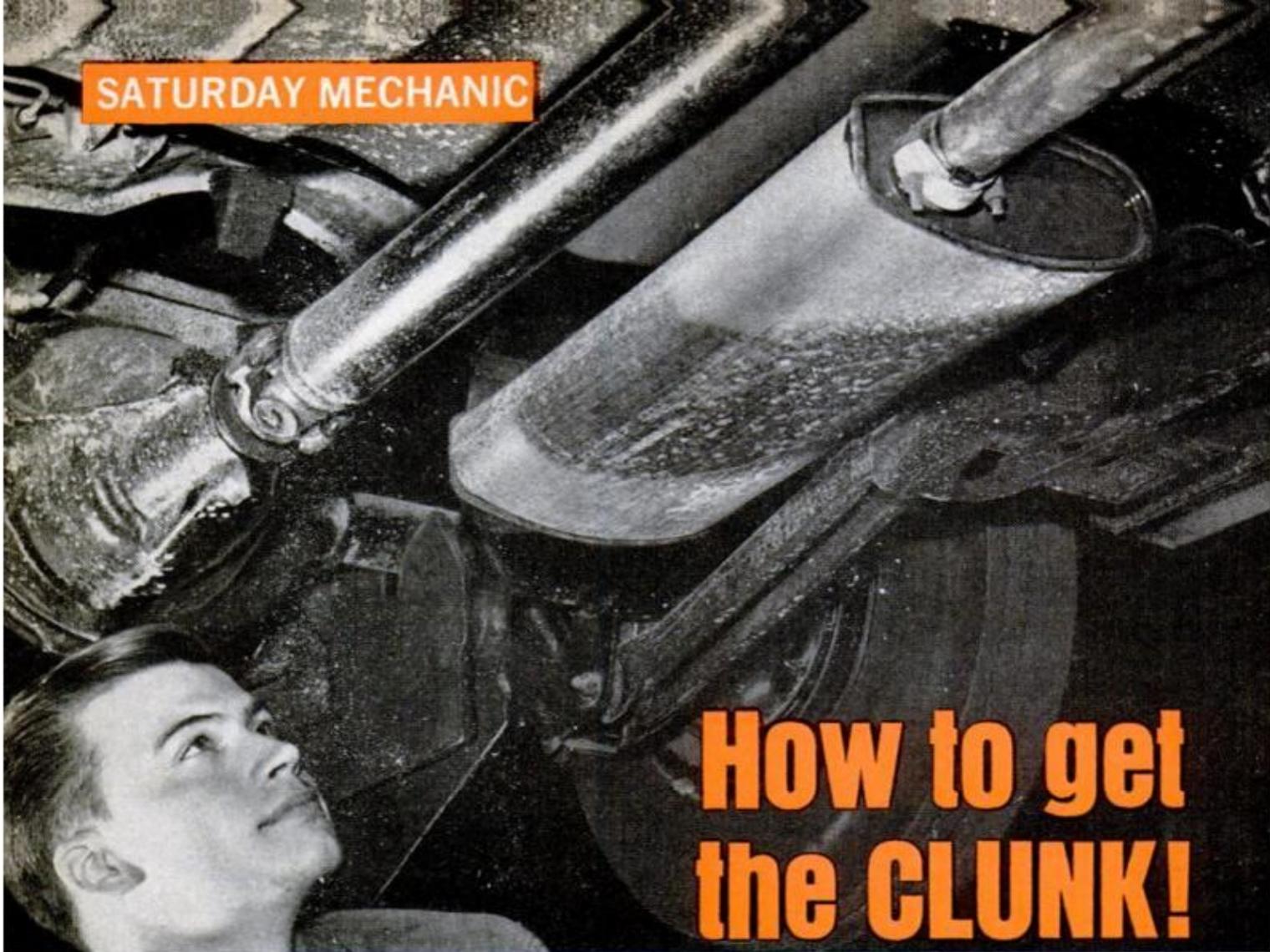
POPULAR MECHANICS



4 FINISHED TRACING looks remarkably like a freehand pen-and-ink sketch after the photographic image has been bleached out. Fine detail and touch-up work can be added after bleaching when it's easier to see the effect produced

ALMOST ANY SUBJECT can make a good ink tracing. Here, the method adds a touch of quaint charm to a modern church (at right) and a flower (below)





How to get the CLUNK!

THOROUGH DRIVESHAFT EXAMINATION when vibration occurs could save much front-end trouble shooting

IT'S EASY TO KNOW when you've got trouble in your driveline: It telegraphs a message of vibration and noise. I'd say you have about 5000 miles from the time a universal joint starts to "clunk" to the time it fails, but I wouldn't push my luck. There's really no need to, either. It's easy to check out suspected driveline trouble in a few minutes—it's that simple.

First let's ask a question. Did that vibration start right after you had the car undercoated? If it did, I'll bet that's the trouble.

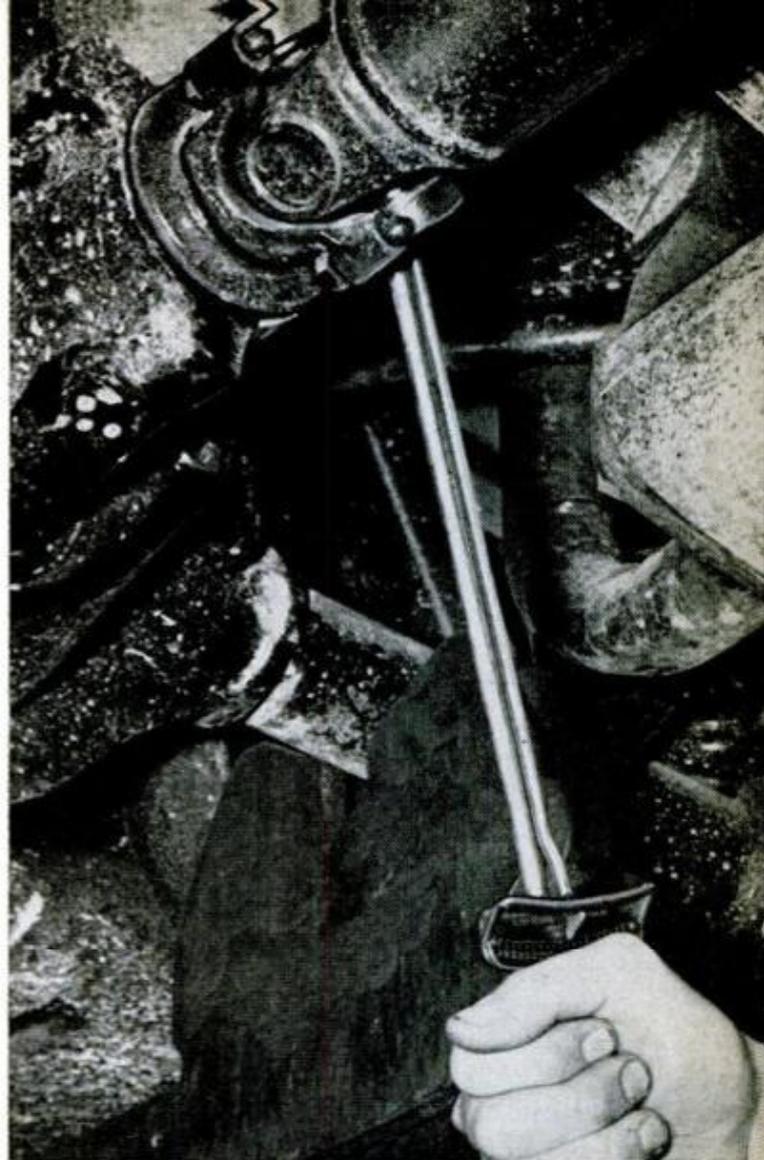
Driveshafts are carefully balanced at the factory; undercoating that runs and cakes on a shaft can be enough to upset this critical balance. The shaft will whip, creating vibration that you feel throughout the car. You can get the same effect if a glob of mud sticks on the shaft.

If you're going to have the car undercoated, make sure they first cover the driveshaft with an even coat.

out of your Driveline

Here's the easy approach to fixing the trouble you're likely to find when you get out and get under to inspect your driveshaft.

By MORT SCHULTZ



DON'T TAKE ANYTHING APART until you've wiped down the driveshaft to be sure it's free of any accumulations that could cause vibration, and until you've torqued U-joint flange bolts to specifications

However, undercoating and mud aren't the only things that can cause a whipping driveshaft. The shaft may have been smacked with a rock and dented. Or the U-joint bearings may be shot, knocking the angularity of the shaft off keel. Or universal-joint flange bolts could be loose.

In any event, here's a tip if vibration develops in your car. Before you spend money on front-end alignment, wheel balance, motor mounts and new tires, check the driveshaft.

Get the car up in the air so at least the rear wheels hang free and the driveline is unobstructed. If you're chummy with the guy at the gas station, ask to use his lift.

If you can't beg a lift, you can use any kind of jack. A center-lift chassis type is safer than two bumper jacks.

With the rear end up and wheels free, have someone start the engine, put the transmission into gear and rev up the

motor as you examine the shaft. You're looking for blurriness.

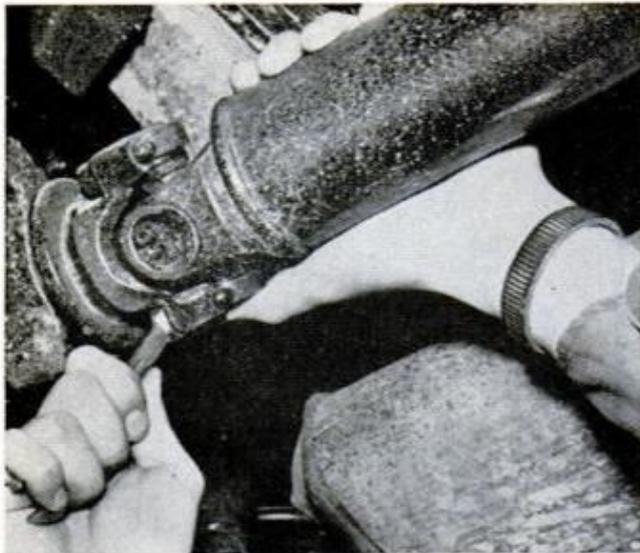
If the shaft is out of kilter and whipping, it will be blurred along the edge. A true shaft revolves smoothly and reveals a smooth edge as if it were motionless. If you detect blurring, any one of several problems could be causing it. Follow our checkout procedure in the given order and you'll narrow down the possibilities.

- Assuming undercoating or foreign matter is adhering to the tube, wash it down with solvent and make the blur test again.

- A universal-joint flange bolt may have loosened. Tighten the bolts to the manufacturer's specification. You can check specifications in the manufacturer's service manual or consult an auto repair manual, such as *Motor's Auto Repair Manual*, at your library.

This tightening must be done with a torque wrench. Indiscriminate tightening, resulting in overtightness, can distort

Dropping the Driveshaft



FIRST, remove the universal-joint flange bolts that hold the rear (differential) U-joint securely in place

U-joint bearings.

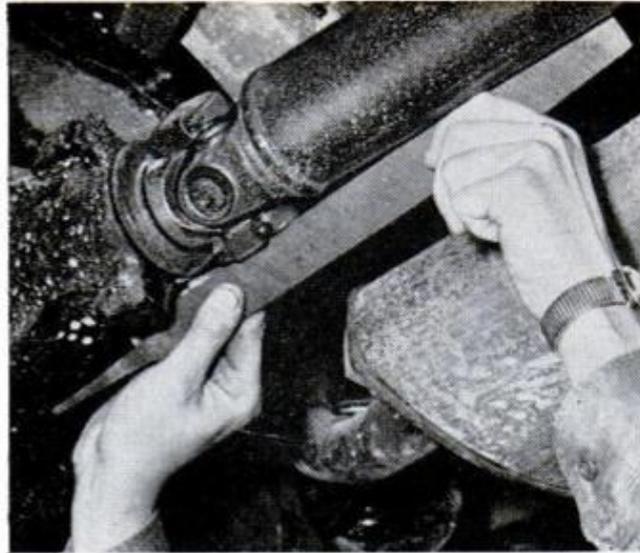
A torque wrench is a basic tool you'll use for more than just U-joint flange bolts, so it's a worthwhile investment. One calibrated to 150 foot-pounds will let you tackle practically any parts on your car that require precise tightening, such as sparkplugs, water-pump bolts, exhaust-manifold nuts, and a score of other things.

A fairly good torque wrench will cost you from \$13 to \$18, without sockets. You can probably use the same sockets you already have.

- There may be something wrong with your rear springs. They could be broken or improperly matched, which could cause your car to sag to one side. In any event, check them out. Problems with rear leaf springs can throw a shaft off even keel. If you have coil springs, there's no problem.

- Driveshaft out of alignment. This is more likely to happen with a new car fresh from the factory where shaft alignment between transmission and differential was either set wrong or somehow became misaligned. If this is the case, it should be checked and repaired under your warranty.

It's very rare that a shaft becomes misaligned unless it was set wrong to begin with. But there's no sense taking a chance, because it's easily checked. However, although it takes only a minute, I doubt if a local gas station can do it for you. Checking angularity requires a



SCRIBE A MARK across U-joint and differential flanges for proper alignment when reinstalling

prop-shaft alignment gauge that a dealer's shop or independent garage is more likely to have.

When angularity is checked, the car should be level without extra weight except for a full tank of gas. If the angle is not to specification, it can be changed. On some models, for instance, the engine angle can be changed by installing shims under the rear engine mount, thereby bringing driveshaft angle into proper plane. With other cars, the angle of the shaft is changed by readjusting the rear axle.

- Driveshaft bent, dented or out of balance. If your driveshaft is damaged,

Replacing the U-joint

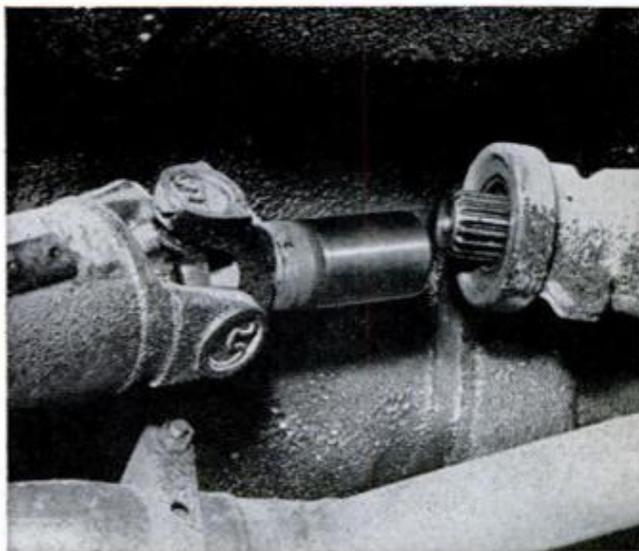


BEARING-CAP RETAINERS can be pulled with needle pliers. Remove caps, pull cross assembly from yoke

POPULAR MECHANICS



DROP THE REAR END of the driveshaft away from the differential carefully—just enough to clear it



FINALLY, slide the shaft back, pulling it off the splined transmission output shaft as shown here

you'll have to replace it at a cost that's usually between \$30 and \$40.

● **Worn or damaged U-joint.** If you suspect a universal joint, there are two ways to confirm your suspicions. First, if you hear a clunking noise when the car is driven at about 10 mph in high gear or rolling in neutral, chances are good that the problem's a worn joint.

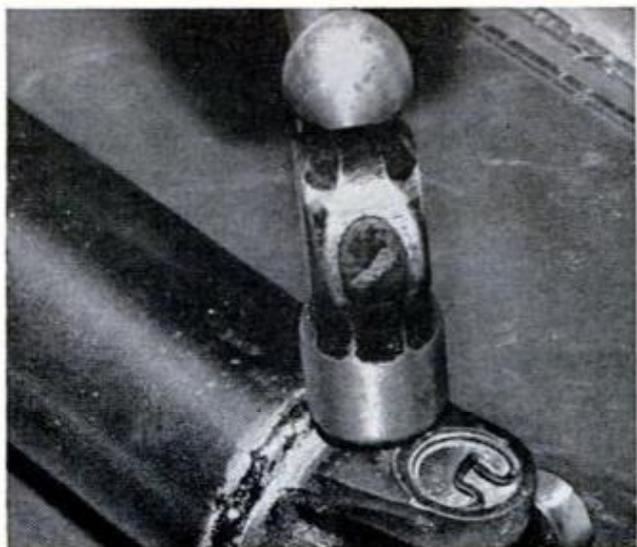
However, to be sure, grab the shaft near each joint and try to rock it back and forth, sideways, and up and down. Putting the car up on a lift or on jacks makes this easier. You shouldn't be able to feel or see any play in the joint. Sometimes, play results from a loose flange

bolt, so torque them. If the play is still there, the joint should be replaced.

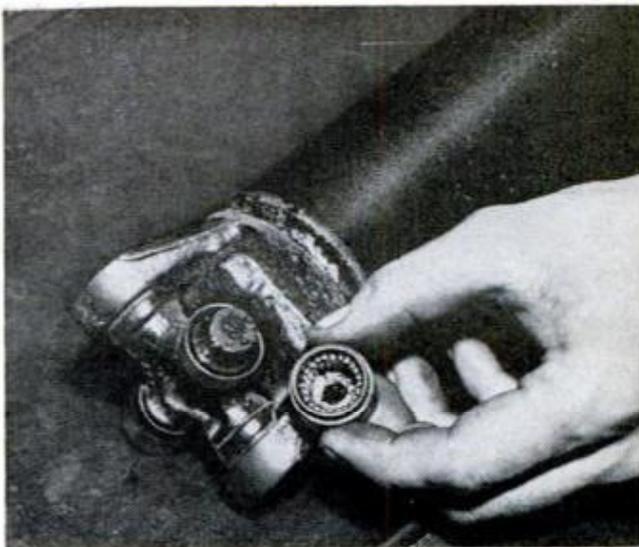
There have been, and still are, several types of universal joints in use. None is particularly tough to replace, although in some cars there are more joints used than in others. Throughout the years, for example, some General Motors cars (Cadillacs and Oldsmobiles, for instance) have used split driveshafts. Instead of only two U-joints that are employed with a single driveshaft, you may have as many as four.

Probably the most common type of joint is a cross-and-yoke unit. You

(Please turn to page 198)



TAPPING THE YOKE should cause bearing caps to pop off. If it doesn't, you'll have to pry them off

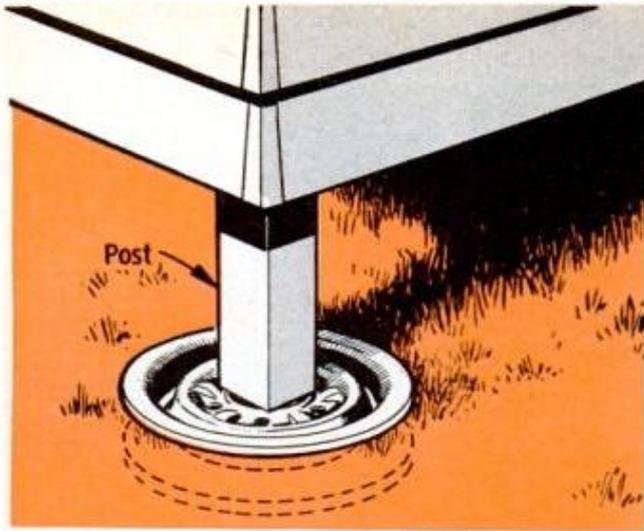


INSIDE PERIPHERY of bearing cap is lined with a large number of small "needle" or roller bearings

HINTS FROM READERS

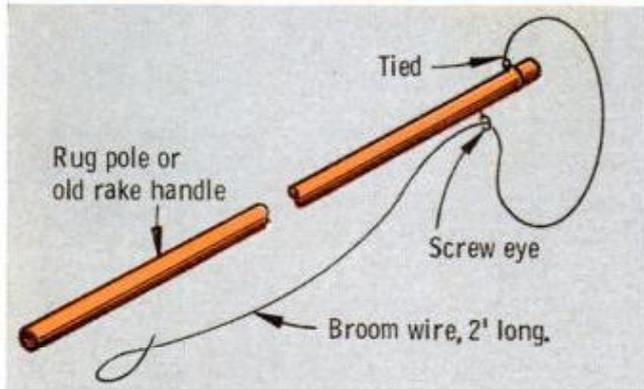
Wheels for post footings

Old automobile rims can serve as footings or bases for posts under outbuildings, toolsheds and other storage structures. The rims will last indefinitely due to their good corrosion resistance and also will not sink into the ground because of the large surface area covered. The post, of course, must be wider than the opening in the center of the rim.—*Vincent Plesko*



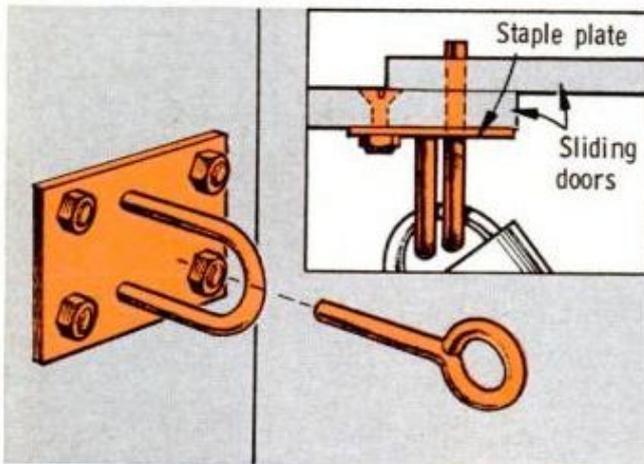
Pole, wire form long arm

To take down a hornet's nest, catch a dangerous reptile or reach a similarly uninviting object, use this remote control arm that can be assembled in a jiffy. All you need is a long pole, a screw eye and a length of flexible wire. Secure one end of the wire to the pole, thread it back through the eye and tie a smaller, hand-size loop at the other end.—*C. Shaw Miller*



Simple lock for sliding doors

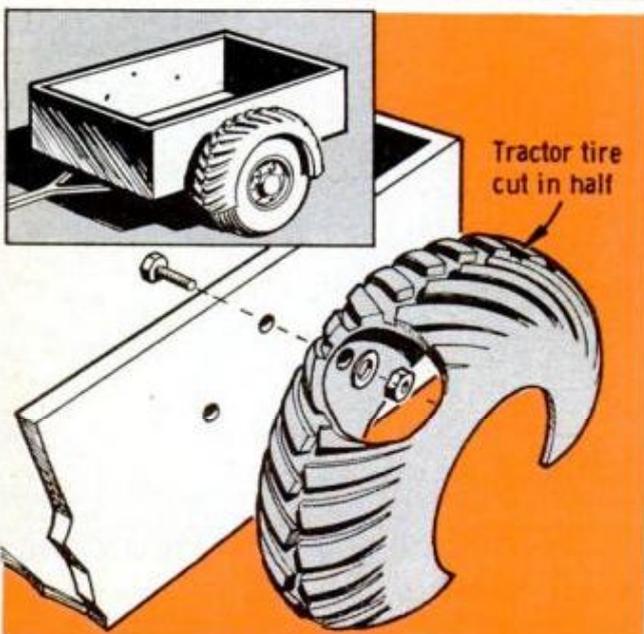
The staple plate from a hasp-and-staple combination and an eyebolt or large screw eye can be combined to produce a simple but quite effective lock on sliding doors. The staple plate is mounted on the outer door with countersunk flathead bolts and a clearance hole for the eyebolt is then drilled through both the plate and the inner door. Insert the eyebolt and trim it so it extends about $\frac{1}{2}$ in. beyond the inner door.—*R.C. Roetger*



Tractor tire for trailer fenders

On homemade trailers, what to use for fenders can pose a problem. A neat and easy solution is to cut an old tractor tire in two and simply fasten the sections to the trailer by using three to five bolts. The rubber fenders are rattleproof, dent-proof and also will not dent or scratch anything they bump against. The degree to which the treads have worn off is of little consequence—in fact, smooth tires look better than those with treads. Select a tractor tire that fits neatly over the wheels of your trailer. Use roundhead carriage bolts with the heads inside the trailer and the washers and nuts inside the fenders.

—*Morris G. Hults*



WALL HAMPER STOWS CLOTHES AND SOAP



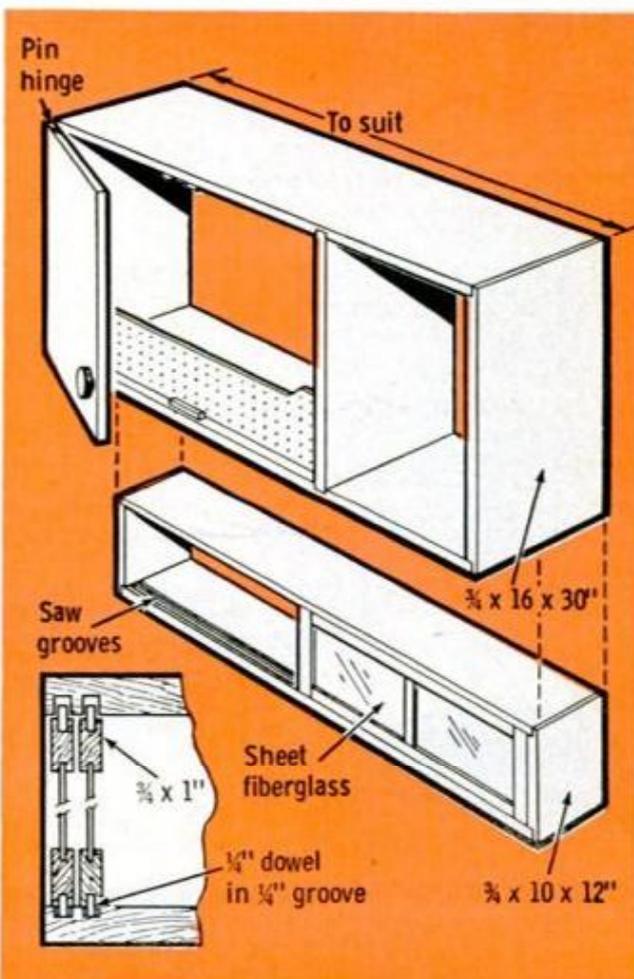
ROOMY CLOTHES BIN in upper half keeps clothes corraled for washday. Lower half holds soap, towels

HANDY IS THE WORD that best describes this home-laundry convenience. Hung above washer and dryer, it puts everything within arm's reach. Behind twin doors there's a roomy bin for soiled clothes. There's a place behind sliding doors for freshly laundered towels, and there's storage galore for soaps and detergents. What a Christmas gift it would make for your wife!

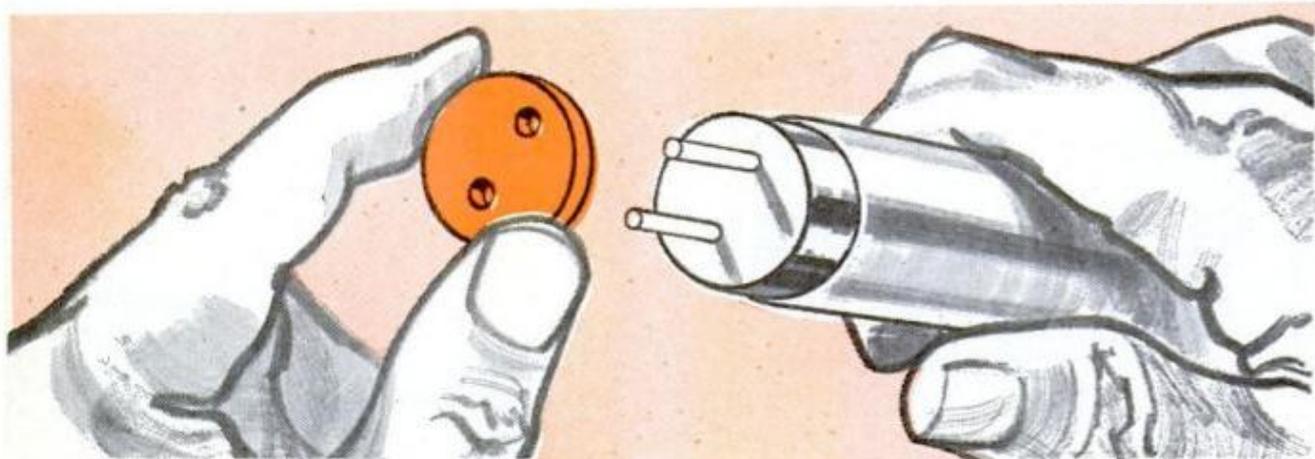
There's no trick to making it if you have a power saw. As you see, the upper part is little more than an open box with a partition and doors fitted across the front. Magnetic catches keep them shut, and a fence of perforated hardboard forms a bin.

The lower assembly is even simpler. Pegs in the top and bottom edges of the doors engage $\frac{1}{4}$ -in. grooves which are cut before the parts are assembled. Remember that the grooves in the upper member must be made twice as deep as the ones in the lower member so that you'll be able to lift the doors in and out. Colorful fiberglass was used as inserts in the original, but panels of $\frac{1}{8}$ -in. perforated hardboard would be equally attractive. Saw kerfs are run in the edges of the door members to house the inserts, after which they're assembled as a unit. Each door is made 1 in. longer than midpoint of the cabinet to lap the other at the center when closed. A little wax in the grooves will make the doors slide freely.

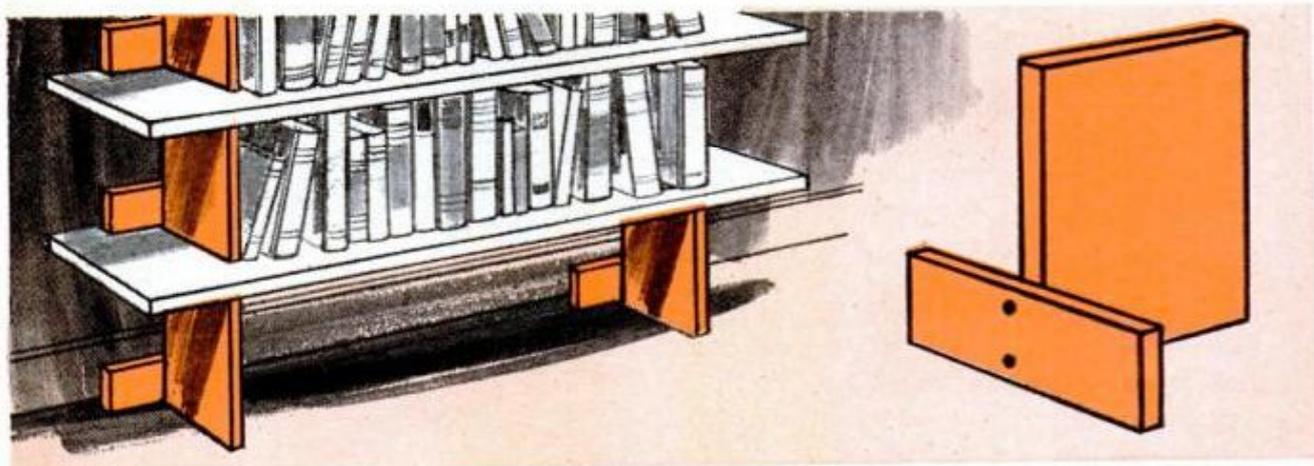
Plywood is the best material to use, particularly for the upper cabinet since it requires stock wider than lumber. Concealed-type hinges made for full-lap doors are recommended.—*Robert Fish*



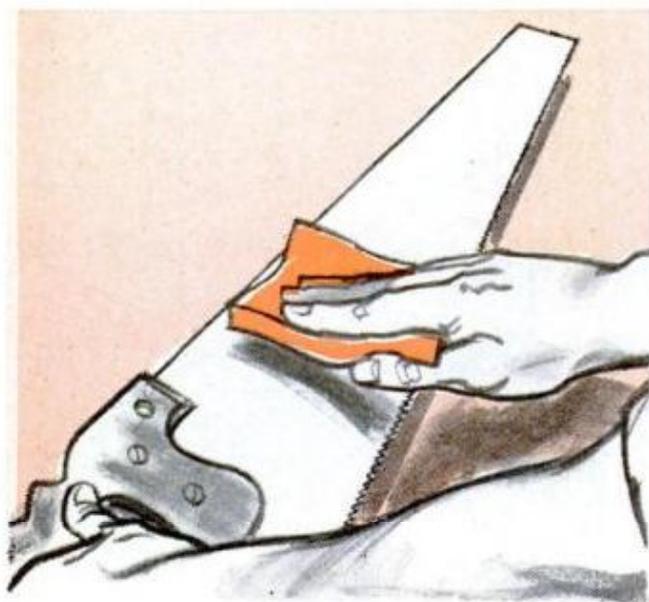
Solving home problems



RUBBER WASHER cut from an old inner tube will hold a loose fluorescent lamp securely in its fixture. When installing lamp, insert washer end first so you can compress washer as necessary to take up looseness



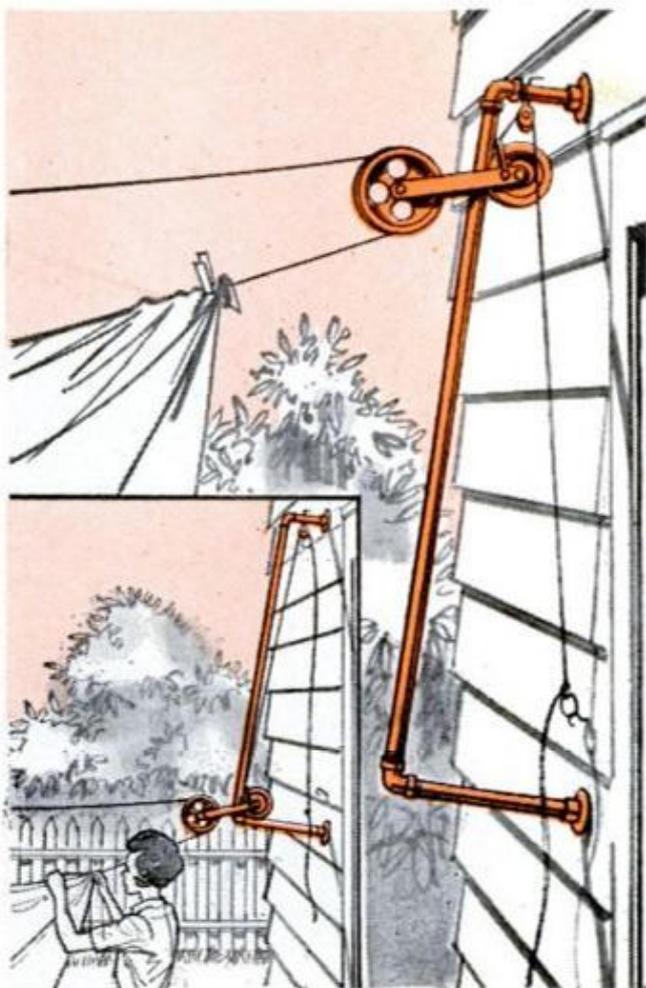
INSTANT SHELVES to fit almost any space are possible with simple T-shaped support brackets, above right. Dimensions and materials depend entirely on needs, since the idea works equally well in shop or rec room



INDOOR-OUTDOOR CARPET, such as Ozite, makes excellent scouring pad which won't scratch or rust. Used with soap, it's safe for chrome and bathroom porcelain. With cleanser, it works like steel wool



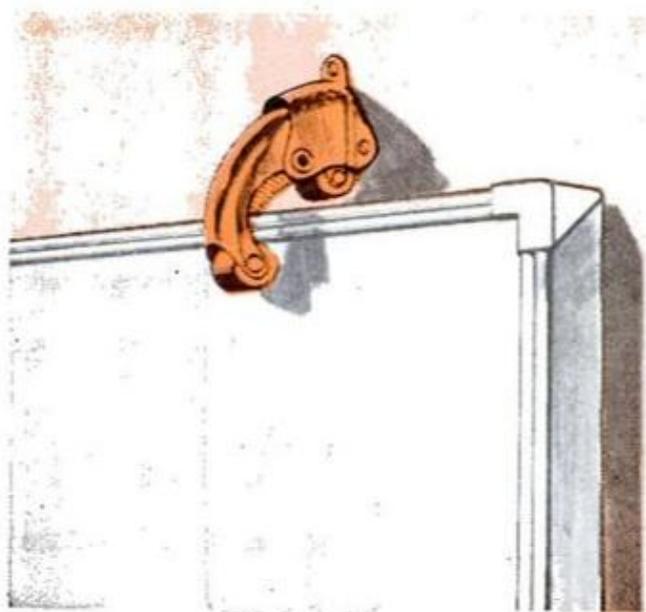
IF YOU FIND that the brush applicator is missing from a jar of paste, cut a finger from an old rubber glove and slip it over your index finger. It makes a fine substitute spreader, and is reusable



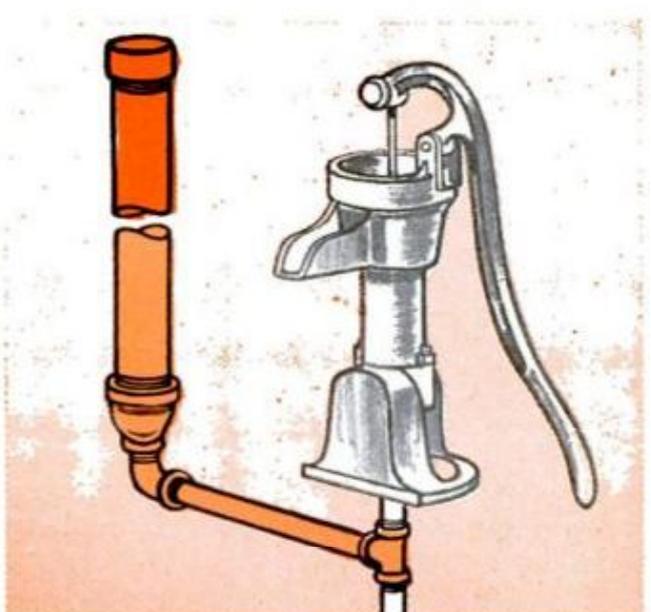
ELEVATED CLOTHESLINE is strung from a pair of pulleys which ride up and down on a pipe bracket mounted on the house or garage. It's raised or lowered by means of third pulley at top of the bracket



LONG-ARM TOOL for carrying windows, doors or plywood panels is just an old metal towel rack—one of those with metal mounting plates on each end. The plates will keep the load from slipping off holder

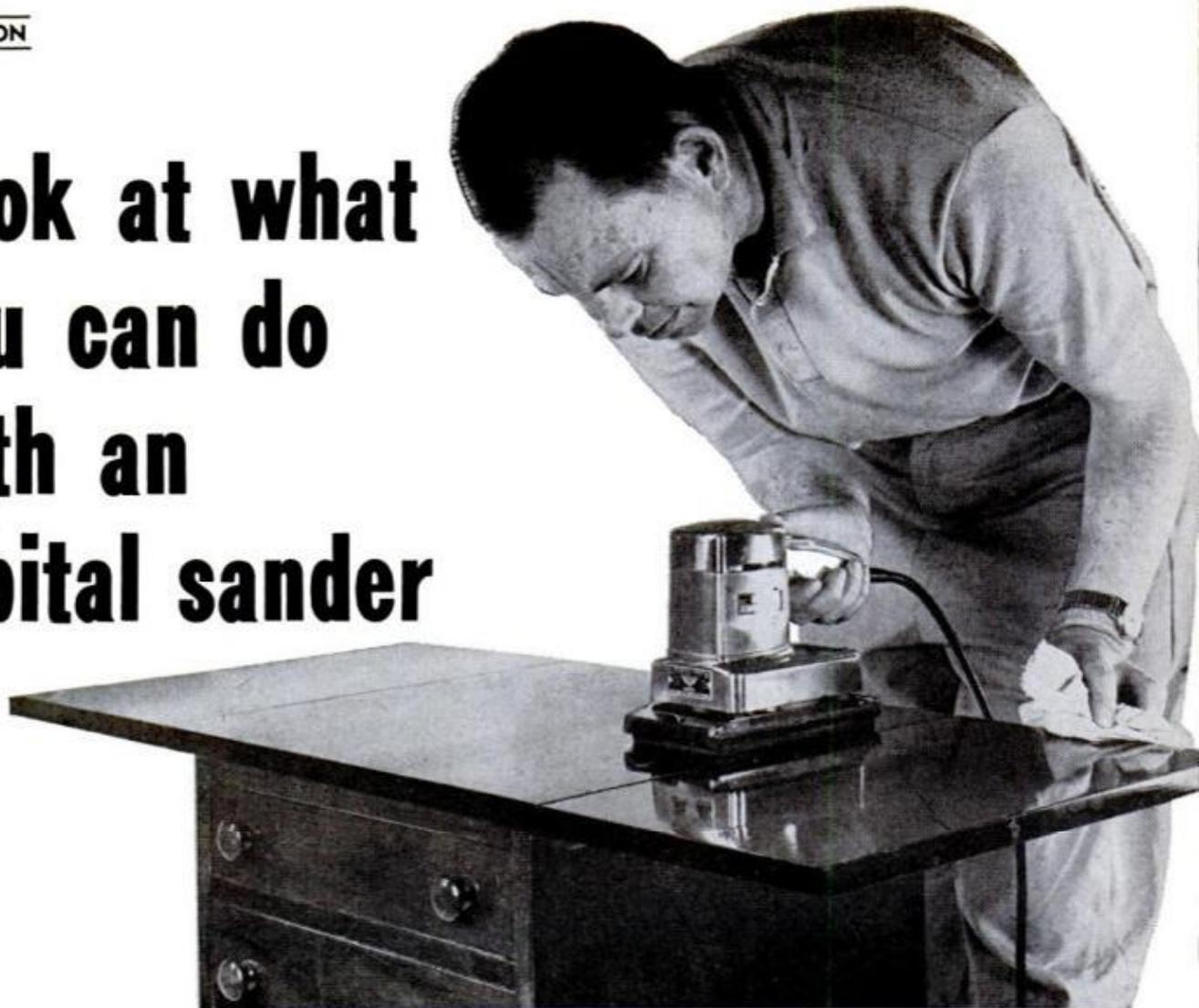


HANDY HOLDER for a bridge table stored in a closet can be made by mounting a door catch on the wall so that you can slip the table under it. The spring section of catch will hold the table flat against wall



YOU CAN IMPROVE performance of a cottage pitcher pump by installing an air chamber to prevent a vacuum from forming at top of water column. Make it from a 2-ft. length of 2-in. pipe and cap the top

Look at what you can do with an orbital sander



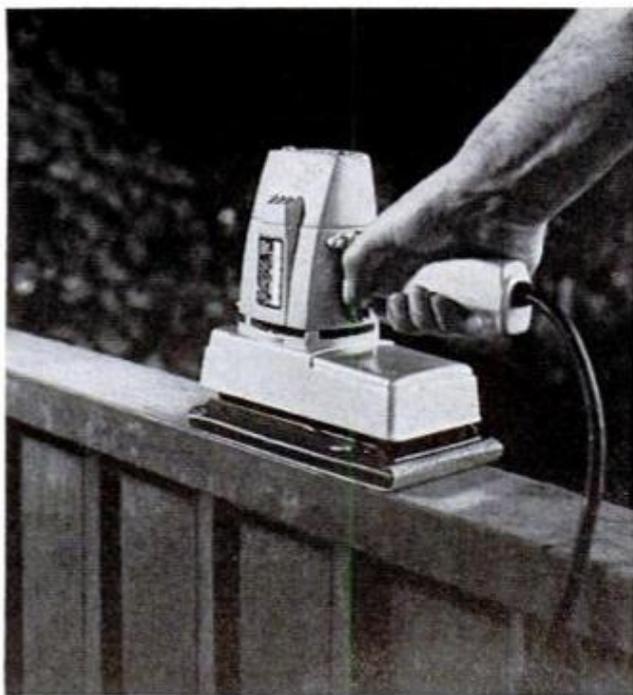
VARNISHED SURFACE will gleam if you fit orbital felt pad; use soupy paste of rottenstone, paraffin oil

By **JOHN BURROUGHS**

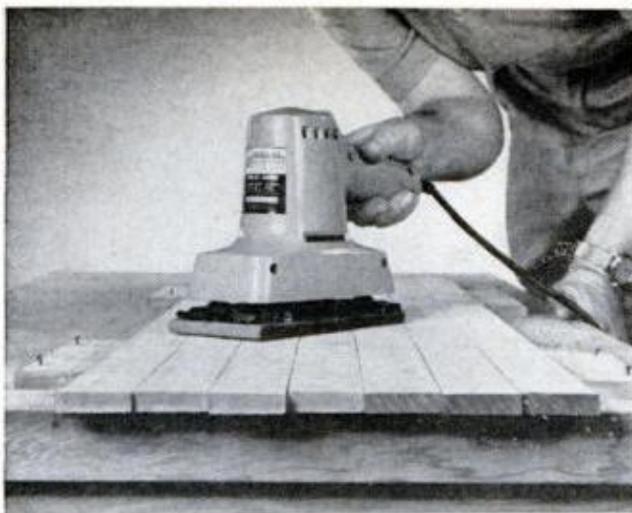
FOR THE BROAD RANGE of everyday sanding jobs, the oft-neglected orbital sander has no equal.

As the orbital swirls its abrasive paper in precise little circles, the individual grains of abrasive make their own circular cuts through the material. With coarse-grit paper on the tool, this cutting action becomes fast enough to sand out deep scratches or dents quickly. Yet the same tool, when fitted with fine-grit paper, will finish a piece of work smoothly without leaving objectionable swirl marks.

As with most power tools, orbitals can be divided into light and heavy-duty categories. The larger orbitals made for use in professional cabinet and carpentry shops require a 4½ x 11-in. sheet of abrasive (half a standard 9x11-in. sheet), and usually are equipped with built-in dust-collecting systems. Nearly all of the smaller (and less expensive) models sold for home-workshop use will accept sheets of



EXTERIOR WOODWORK can be sanded with 40-grit paper after you scrape off any peeling or blistered paint. Brush grit frequently to minimize loading



FINISH STRIPS by blocking them side-by-side on a smooth surface and then gang-sanding. Flop the strips and sand all four sides to same dimensions



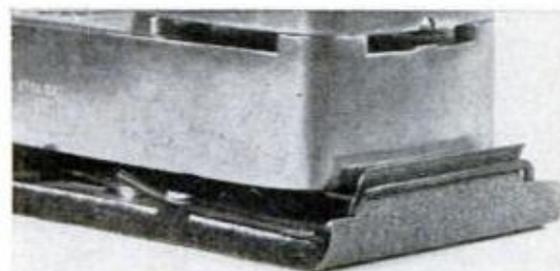
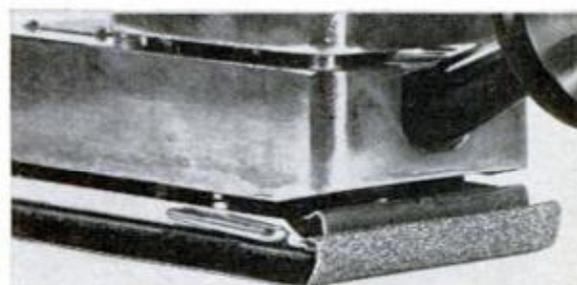
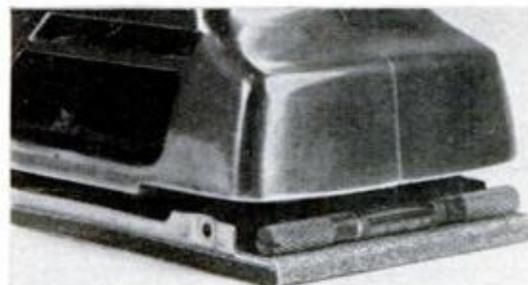
INTERIOR WOODWORK can be prepared for repainting with 220-grit open-coat paper. This levels off the surface and cuts gloss. Never bear down on sander

$3\frac{5}{8}$ x 9-in., or only one third of a standard sheet.

Essentially, however, models in both categories are similar in that all use a universal motor (except one unit shown on the next page) to drive a counterbalanced eccentric mechanism through gears, belts or other means. The eccentric, in turn, swirls a platen, mounted on four neoprene trunnions, at about 4000 orbits per minute.

Some models in the home-workshop category incorporate special features: One is a provision that enables you to attach your shop vacuum; another is a dual-

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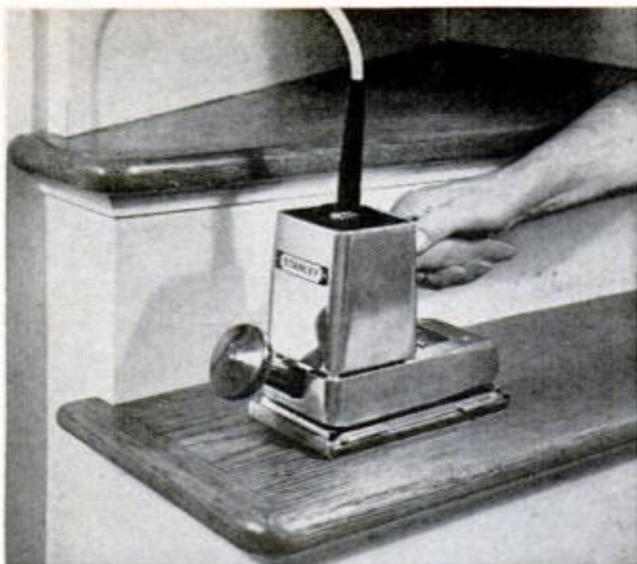
HOLDING MECHANISM for the paper may be roller-type (top two photos) or clip-type (lower photos). Both work well, but be sure to align paper properly

action mechanism that can be shifted from orbital to straight-line sanding.

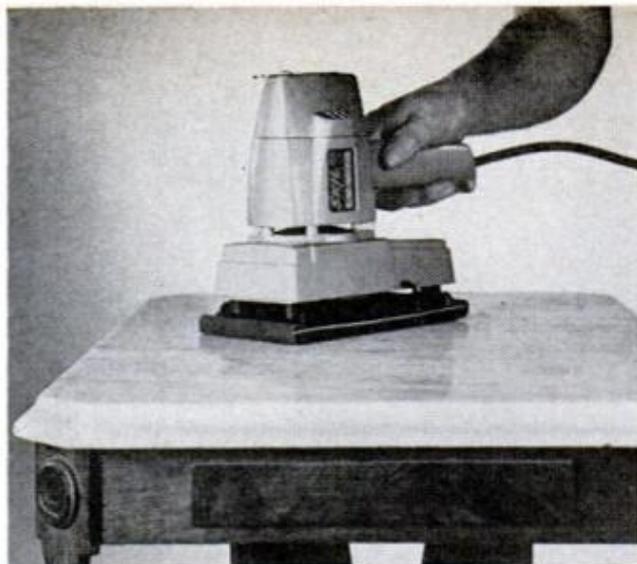
Regardless of which machine you choose, obtaining the optimum from an orbital depends primarily on the selection of the right paper for the job. To determine the type paper you need, first classify the job by one of the two most common uses; sanding *off* (removing material), and sanding *down* (smoothing a surface).

When it's necessary to remove paint, varnish or other excess material, a coarse, fast-cutting abrasive should be used. About the coarsest abrasive you can use practically is a 40-grit paper. Either open-coat

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WORN SPOTS such as those found on stair treads should be sanded with 80-grit to remove ground-in dirt. Then smooth with 120 and feather out with 220



MARBLE SLABS can also be polished with an orbital. Remove scratches with 220, wet-sand with 320, finish with 600. Shine with felt pad, tin oxide paste



ALUMINUM OR BRASS takes on a lustrous satin-mat finish when sanded with an orbital. Numeral was cut from $\frac{1}{8}$ -in. aluminum, soldered to mounting flange

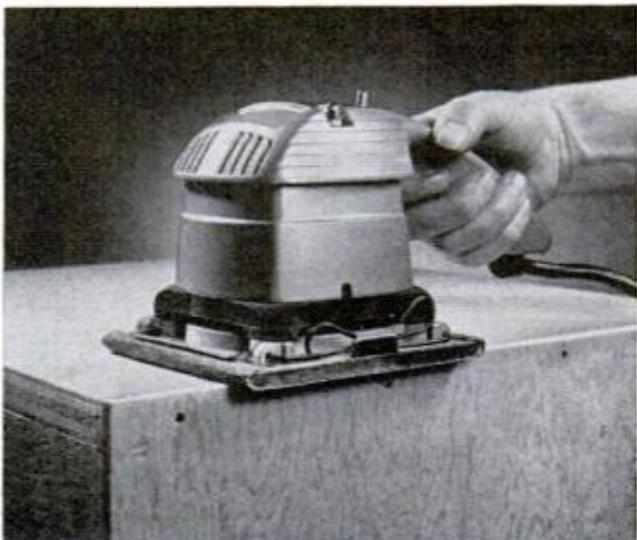
(preferable) or closed-coat (easier to find) paper will work satisfactorily. Garnet paper is sharper and cheaper initially, but aluminum oxide paper lasts longer.

Common flint paper (actually quartz) wears so rapidly that it really isn't suitable for machine sanding. On the other hand, it can be a money-saver when it comes to sanding resinous wood or other materials that quickly load the paper.

When the job calls for smoothing a surface to a fine finish, it isn't necessary to use every grade in progressive steps. This would mean you'd be working with 100, 120, 150, 180 and 220-grit papers. If in doubt as to what papers to use, just follow this rule of thumb: Never skip more than two grades at a time, and always finish up with 220.



UNUSUAL MODEL is Rockwell's Speed-Bloc with a 2-amp. universal motor that direct-drives the $4\frac{1}{2}$ x $4\frac{1}{2}$ -in. sanding pad about 12,000 orbits per minute



BRUSHLESS MOTOR drives $4\frac{1}{2}$ x $5\frac{1}{8}$ -in. sponge pad on Thor's induction model in $\frac{1}{8}$ -in. orbits. Three $4\frac{1}{2}$ x $6\frac{1}{2}$ -in. pieces can be cut from standard sheet



PRIME OR SEAL fir plywood before sanding. If you don't, the abrasive will cut out the soft woods between the hard grain and leave the surface wavy

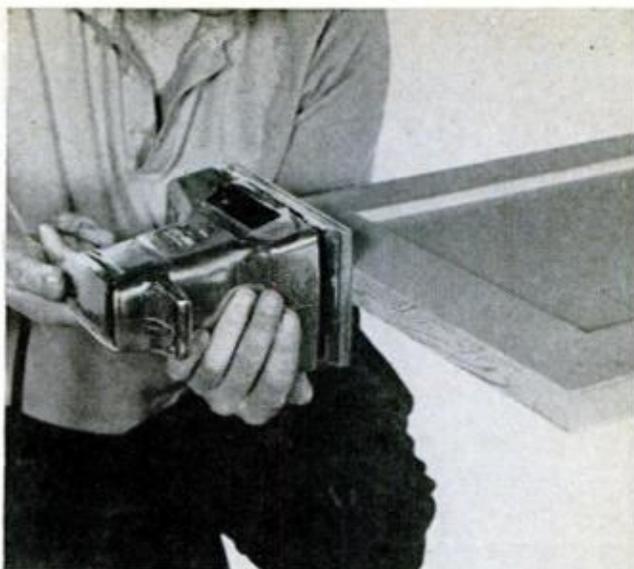
Softwood thoroughly sanded with a 220-grit paper is smooth enough for painting—in fact, a finer grit paper will merely raise fuzz. Open-coat 220-grit paper also should be used for sanding down coats of enamel. Be sure that it has a coating of white zinc stearate however, as this helps to prevent loading. Also avoid bearing down on the sander. The tool's weight is sufficient—additional pressure just generates friction, loads the grit and marks the finish.

Ultrafine silicon-carbide papers in grades of 320, 360, 400 and 600-grit are waterproof and should be used with plenty of water. If an even finer finish is desired, fit your orbital with a felt polishing pad and use either rottenstone or tin oxide (mixed with water to form a thin paste) as an abrasive. ★★★

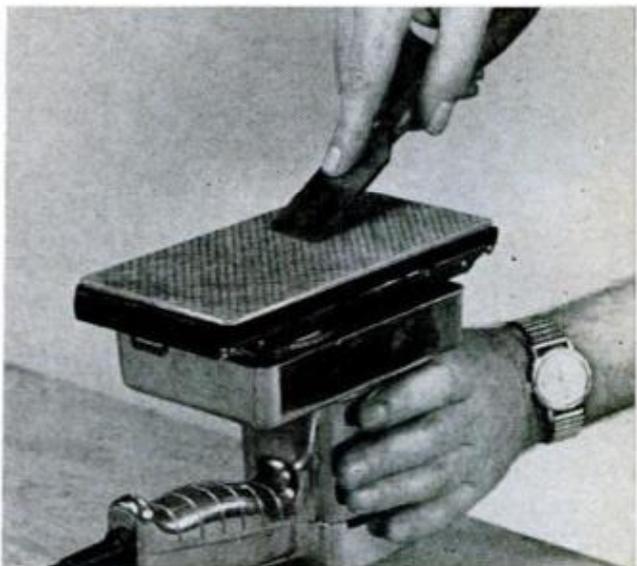


COARSE GARNET PAPER will quickly clean up second-hand lumber for re-use. Not only is old seasoned lumber better than the new stuff, but it's cheaper

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FREE STICKING DOORS without splintering the edges. Use a medium grit to remove any high spots, then switch to a finer grit and smooth off sticking areas

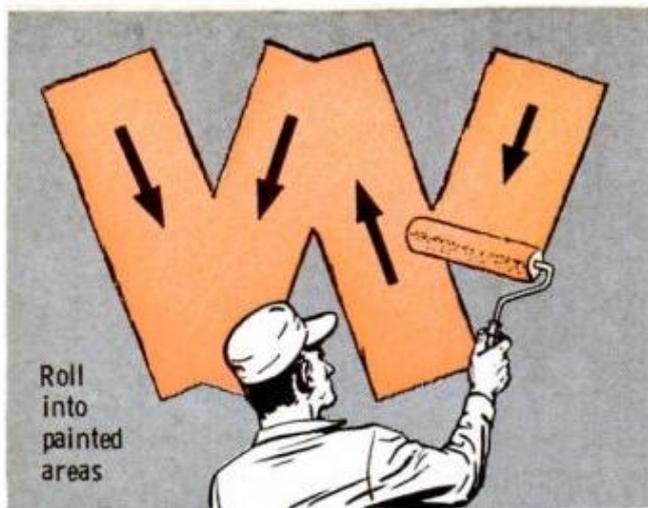


HONING ATTACHMENT is simply an aluminum plate cemented to thin leather. Cross-scribe scratches on the plate, fill them with red rouge buffing compound



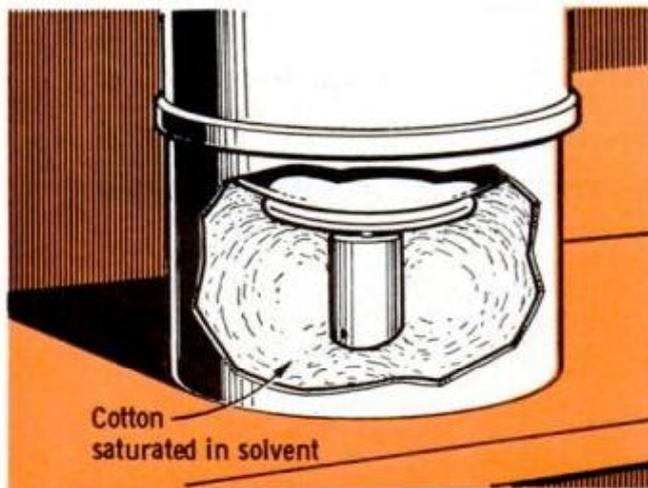
TUNGSTEN CARBIDE sanding sheet has grit brazed to thin sheet steel and offers long life. You can clean one with a wire brush or even paint remover

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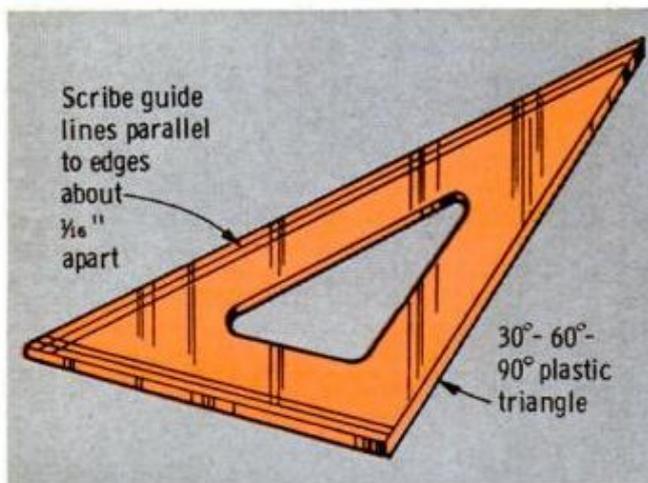
'W-roll' on paint

You'll get more even coverage from a roller if you start at the top of a wall with a big W. Roll out the W and go back and fill in between the gaps. Repeat in the next section, always rolling into wet areas as arrows indicate.—*William Hartman*



Keeping nozzles clear

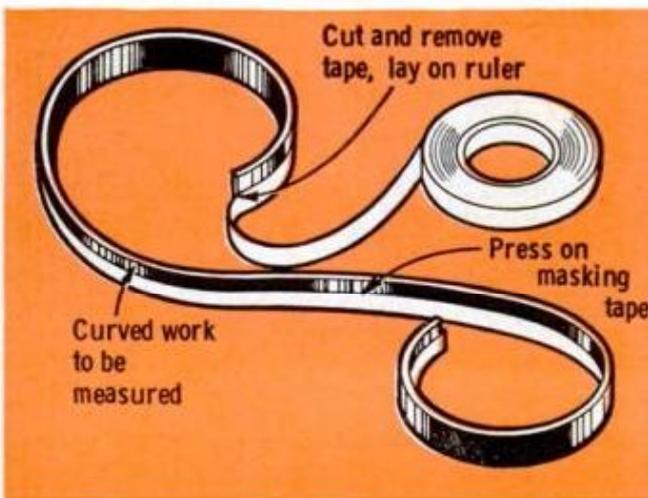
To prevent the nozzle of a pressurized paint can from drying out and clogging, try this simple trick. After the can is used, fill the cap with absorbent cotton and saturate it with the solvent recommended by the instructions on the label. Store the can upside down and you should never be caught with a full can that you can't use, just because the nozzle has become clogged.—*Andrew Vena*



Cross-sectioning aid

A neater and faster job of drawing cross-section lines can be done if you scribe a few lines parallel to the edges of your plastic triangles. In use, draw the first cross-section line, then move the triangle until the scribed guide line coincides with the line on the paper. Then draw the second line, move the triangle to coincide with this, and repeat the process.

—*Walter Hastings Jr.*



Tape-measure odd pieces

The next time you find it necessary to measure the precise length of irregularly shaped pieces of work, use *masking tape*. Just press on the tape along the entire length of the piece, then trim it off at both ends. Peel off the tape, lay it along a regular steel rule, and you have the exact length. It's especially useful when duplicating wrought-iron scrollwork.

—*Daniel Bousha*

Rear-windows mailbox save you steps

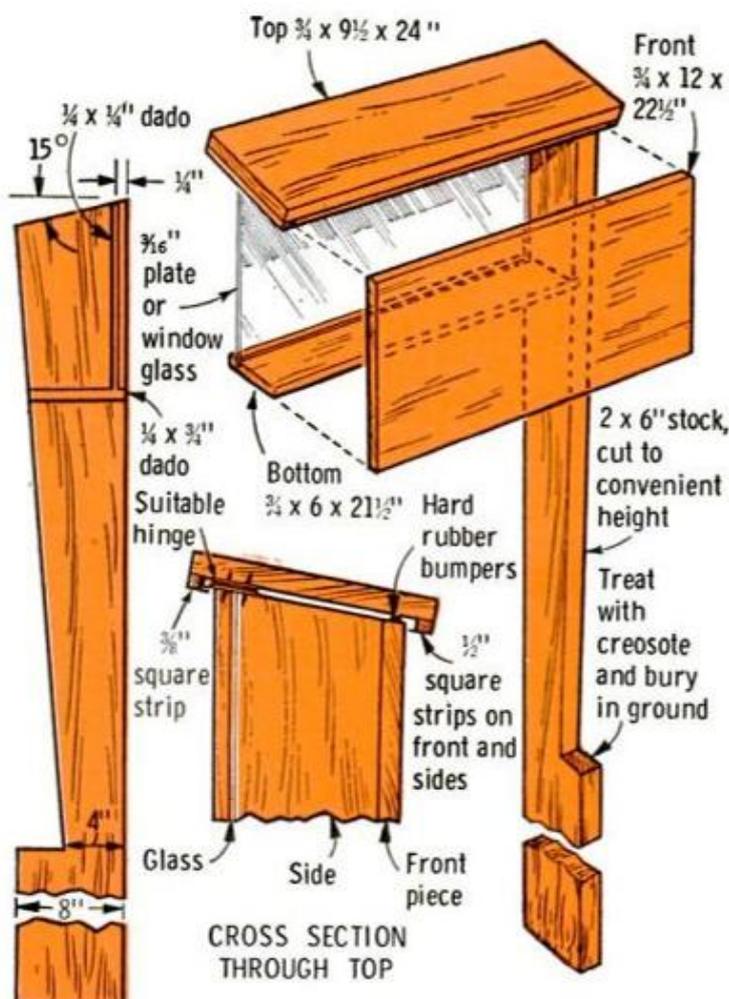


SEE-THROUGH GLASS BACK lets you see from the house whether there's mail in the box. It's handy in bad weather

HOW OFTEN have you gone to the window, gazed out at your "rural" mailbox and wondered if that important letter arrived? Some mailmen will tip you off by raising the flag, others won't. You hate to go out in the rain and cold to find out—if only you could see into the box from the house. That's when I decided to make a mailbox with a rear window.

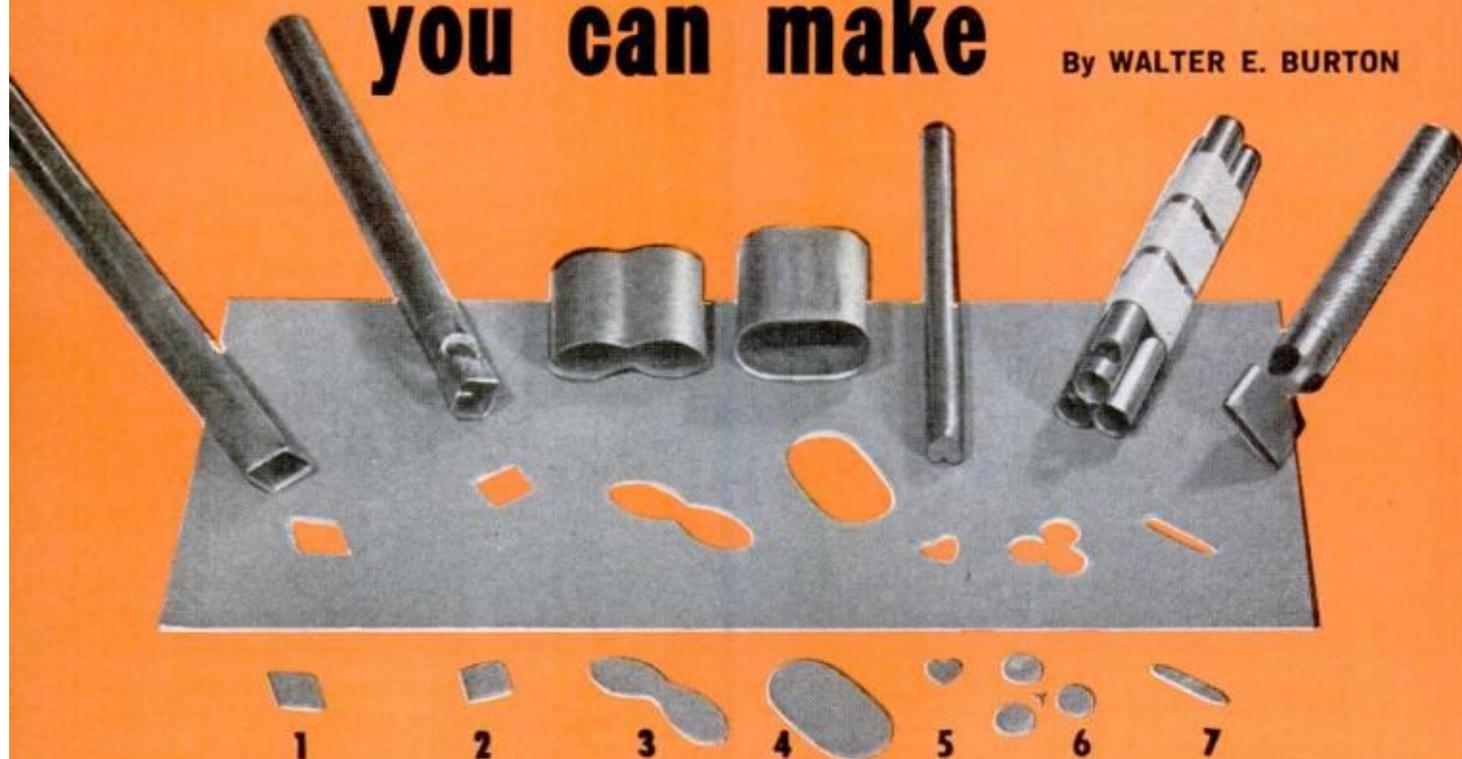
The drawing below shows how I made it. I used a piece of Texture One-Eleven plywood to dress up the front and applied jigsawed letters and numbers to it. The hinged lid has a square strip around the underside to keep out rain and snow. This is $\frac{3}{8}$ in. across the back. Note that the hinges screwed to the top of the legs are set out to allow the strip to clear and permit the lid to open. It's a good idea to add a preservative to buried ends of the legs.—*Andy Winn*

JIGSAWED LETTERS applied to grooved front give box eye appeal. Paint contrasting color



Special-shaped punches you can make

By WALTER E. BURTON



DECORATIVE INLAY work for table-tops, cabinets and other pieces of finely crafted furniture will be a snap when you use inexpensive, shaped punches like these. With just a whack of a hammer, or a squeeze of a press or vise, the punches will cleanly cut through thin wood veneers, as well as metal foil, cardboard, plastics, paper, rubber, fabric and even leather.

Shapes that are easy to produce include slots, squares, ovals, rectangles, diamonds, hearts, spades, clubs, triangles and polygons—and in almost any size desired. What's more, while a lathe may be helpful, you can make these punches with just a hacksaw, drill and files.

The seven punches shown above can be divided into three basic groups:

- Punches 3 and 4 are made of thinwall steel tubing and are short so they can be used in a press or vise. Such punches are often called cutting dies and are similar to the steel-rule dies used industrially.

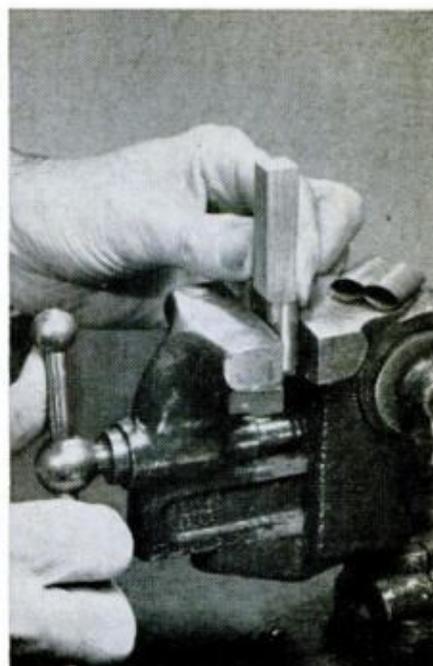
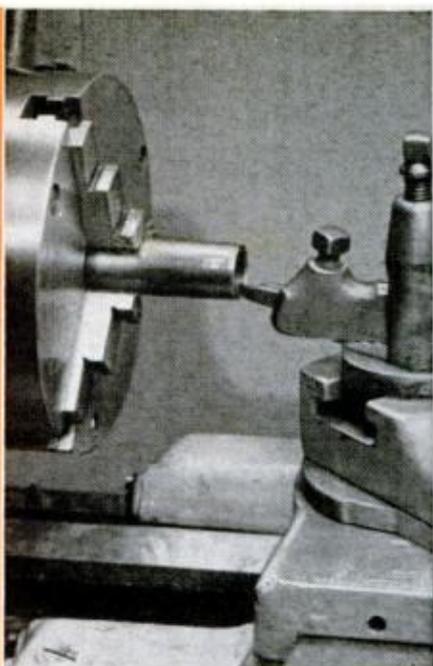
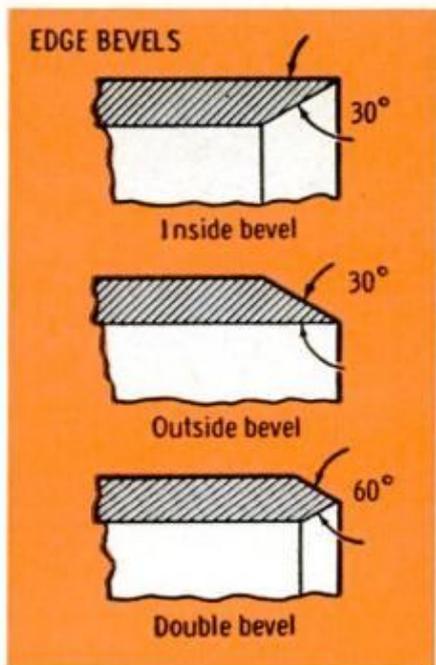
- Punches 1, 2, 6 and 7 are hollow-drive punches. No. 1 was made from steel tubing, No. 2 machined from cold-rolled steel rod, and Nos. 6 and 7 from drill rod.

- Punch No. 5 was formed from a solid steel rod, shaped by filing and finished with an oilstone.

All of these punches have one thing in common: they start out as simple round shapes. Subsequently, they are squeezed, bent, filed, flared or otherwise processed to produce the desired cutting contours.

To make a hollow punch from a solid rod, first chuck the rod in a lathe (or drill) and machine one end square. Then convert a short length of the rod (usually a half inch or so) to a thinwall tube by drilling out the center of the rod. Using a round file, form one or two openings in the side of the tube to permit easy removal of the cutout pieces.

Bevel the outer end of the tube to form a sharp cutting edge and then anneal the beveled edge by heating it to redness and



THREE BASIC BEVELS will equip you with the right punch for almost any job. For common shop uses, double bevel is best

CUTTING BEVELS is a cinch if you have the use of a lathe. If not, you can duplicate results with a drill secured in a vise

SQUEEZING TUBES requires both practice and the use of a spacer block. Otherwise, flat center surfaces could bend inward

letting it air-cool. Finally, shape the cutting edge to the desired configuration.

Punch No. 7, for example, can be shaped by squeezing the tube in a vise or a pair of pliers. Use this method with caution, however, as the simple squeezing of a tube in a vise often results in unwanted curves, much as in punch No. 3.

To make a square punch, heat the hollow end of the tube to a glowing red and immediately drive it over the square shank of a brace bit or some other square, tapered form. Tap the sides of the edges with a hammer to produce a true square.

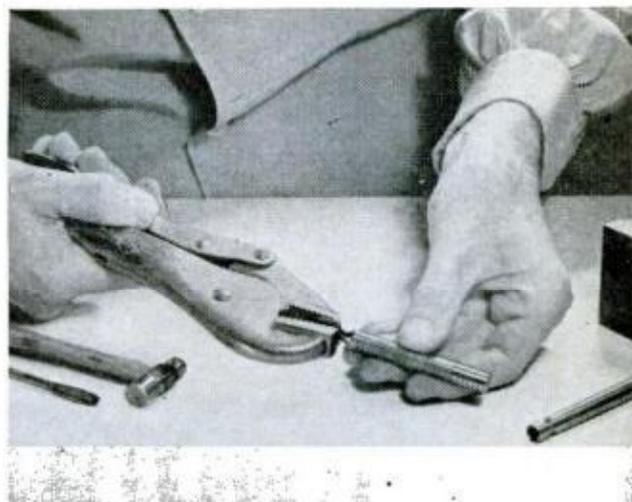
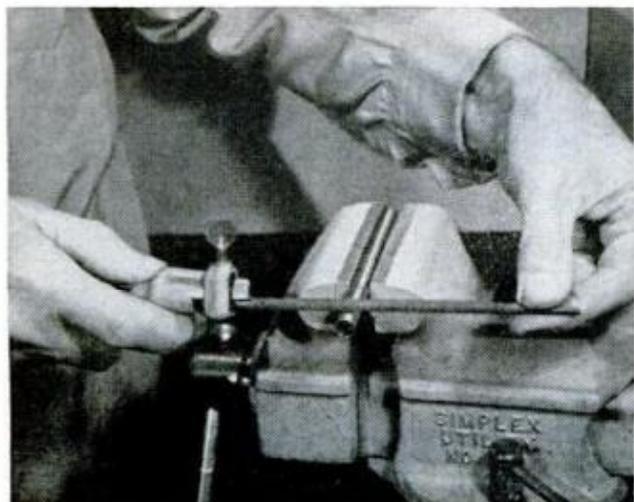
No side opening is required for punches made of steel tubing (like that used for

automobile fuel lines) because you can run a rod through the length of the tube to eject the cut pieces. When using seamed tubing, be careful not to open the seam when forming the cutting edge. If you should accidentally do this, however, you can try closing the seam by hammering or squeezing it in a vise.

The sharp edge-bevels on a hollow punch can be formed with an inside bevel, an outside bevel, or both (see drawings above, left). An inside bevel produces clean-cut openings, while an outside bevel produces clean cutouts. A double bevel places the cutting edge in the middle of the wall and therefore produces a slight-

FILE ROUND NOTCHES in side of tubular portion cut in a solid rod. Depending on final shape, one or two notches may be needed for removal of the pieces

NARROW SLOTS will be cut by this particular type of punch. After annealing, flatten the hollow end to desired degree. Vise or vise pliers do equally well



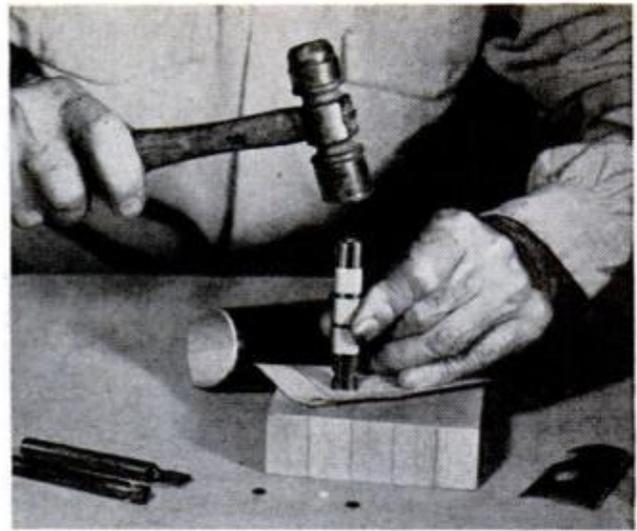


THREE ROUND PUNCHES, when taped together, will produce a cutout shaped similar to a cloverleaf. Each ganged punch must be provided with an inside bevel

ly distorted opening and cutout. For most uses, however, this slight distortion is of little consequence. Ganged punches (simply two or more punches bonded together by tape or other means) must always be provided with inside bevels.

When forming a punch of drill rod or any other hardenable steel, remember to harden and temper the cutting end. If in doubt as to the specific directions for working with a particular alloy, try heating the cutting end to a deep red color (in a dimly lighted room) and then plunge it into cold water. Clean off the punch so the actual color of the steel is visible and then heat it again. When it

SQUARE PUNCHES are simply round tubes heated and then tapped over the square, tapered end of a brace bit. Tap all four sides gently for a true square



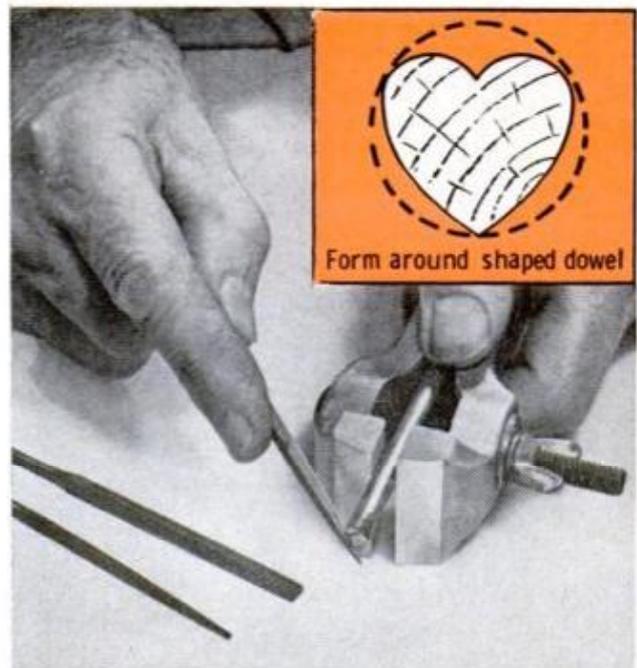
SCRAP WOOD is the most common material used to support the work being cut. Be sure, however, to have only the end grain of the wood facing the punch

turns to a reddish-brown or purple color, plunge it into the water for a final quenching.

Punches of soft steel, such as ordinary tubing or cold-rolled rods, must be treated by case-hardening the edges, and often the head as well. After using any of the common hardening compounds (follow the directions on the package implicitly), temper the punch in the same manner as other hardenable steels.

When using any of the punches, be sure to back the material being cut with a support of wood, cardboard or hardboard. Wood should always be placed with the end grain facing the cutting edge. ★ ★ ★

ODD-SHAPED PUNCHES can be made in many ways. A heart shape, for example, can be solid rod filed to shape, or a tube formed around shaped dowel (inset)



Christmas Gifts for yourself

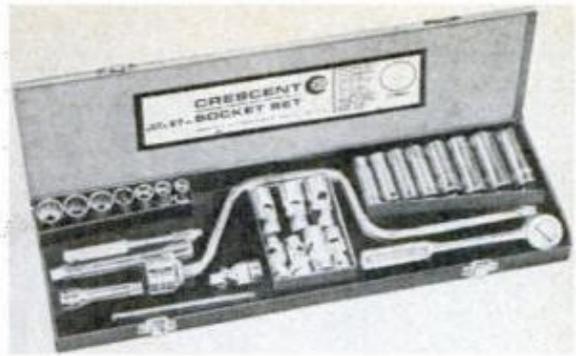


VACUUM BASE grips with amazing strength, yet lets go instantly when lever is released. Ideal for anchoring portable tools to bench or nonporous surface. Mounts horizontally, vertically. \$3 postpaid form Edmund Scientific Co., 107 E. Gloucester Pike, Barrington, N. J.

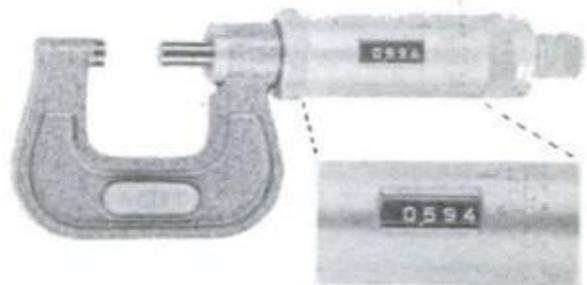


EXTRA-COMPACT ELECTRIC WRENCH weighs only 6¼ lbs., has full ½-in. capacity, with roller and ball bearings throughout. Automatic one-speed shift switches from forward to reverse in an instant. Accepts three-jaw drill chuck and right-angle head. \$95 from Black & Decker Mfg. Co., Towson, Md.

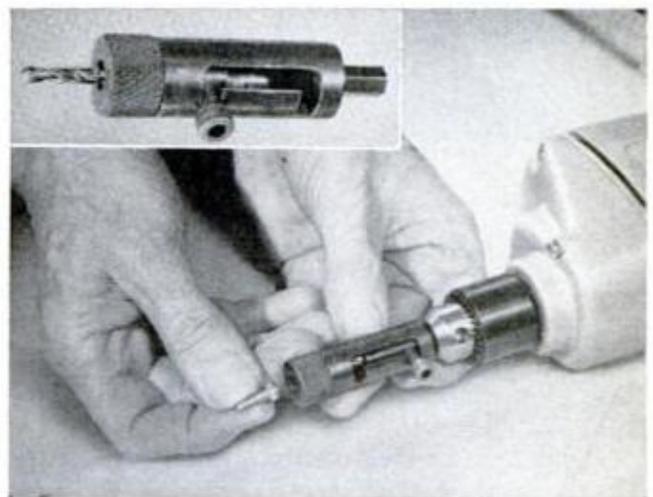
DECEMBER 1967



MASTER SOCKET-WRENCH SET contains 27 pieces, precision-machined from polished alloy steel. Sockets feature unique ratchet, with only seven working parts. Other sets range from 9-piece basic set to 81-piece mechanic's set. Crescent Tool Co., 70 Niagara St., Buffalo, N. Y.



HIGH-ACCURACY MICROMETERS featuring direct digital read-out to 1/1000 of an inch, reduce chance of error. Twelve models available, all featuring sensitive ratchet operation with nonrotating measuring spindles and carbide tips. Dyer Co., Oberlin, Ohio.



DRILL AND HEX-HEAD DRIVER is two-in-one tool that chucks in portable drill to save time when driving screws in sheet metal. Drill bit first locks in place to drill hole, then retracts to let driver attachment grip hex-head screw. Manufactured by the Crane Co., Depot Ave., Windsor, Vt.

175

Make an inclinometer — and get those angles straight!

BY WALTER BURTON

Indispensable once you've used it, an inclinometer will measure the angle, or angular movement, of your saw table, lathe chuck or any other tilting surface

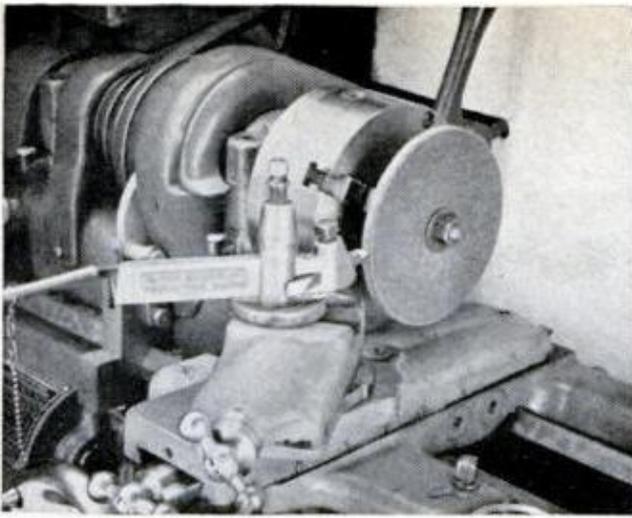
BASICALLY AN INSTRUMENT that measures how much a line or surface varies from a horizontal reference, an inclinometer is a somewhat exotic industrial tool that will also make a useful addition to your shop.

It will indicate, for example, the angle of tilt on a saw table with remarkable precision. By measuring the angular movement of your lathe chuck, it will enable you to index work or cut equidistant holes around pipes or tubes.

Similarly, it will help you when you need to form flats or cut slots in round stock. Other uses might include setting up

milling equipment, assembling machinery framework, assisting with building construction (as in determining the pitch of a roof) and many other jobs involving either the measuring or fabrication of angled members.

Essentially, the inclinometer detailed here consists of a free-swinging pendulum bearing a pointer, and a disc edged with a scale to indicate pointer movement, usually in degrees. A magnetic base enables the instrument to cling to lathe chucks, saw tables and other steel or iron machinery. For use on nonmagnetic surfaces, the magnetic base is attached to a steel or iron



TURN HARDBOARD DISC to the required diameter. Use washers and a 1/4-in. bolt for an arbor as the center 3/8-in. hole, drilled later, must be precise



SECURE METRIC TAPE to the edges of the disc with epoxy cement. The four large holes cut in the disc reduce the weight and help to improve the response

plate, which then functions as the base of the instrument.

The diameter of the disc (A in photo below and drawing on page 179) is dependent on the common millimeter scale used as a degree scale. The scale came from a steel metric tape about 1/4-in. wide. The diameter of a circle is equal to the circumference divided by pi (3.1416+); therefore, dividing a 360-mm tape by 3.1416 results in a diameter of 114.5 mm, which is then converted to about 4 1/2 in. To determine the precise diameter of the disc, subtract two times the thickness of the scale from the calculated diameter.

Make the disc from 1/4-in. tempered hardboard, drilled as shown on page 179 to decrease overall weight. Fasten the

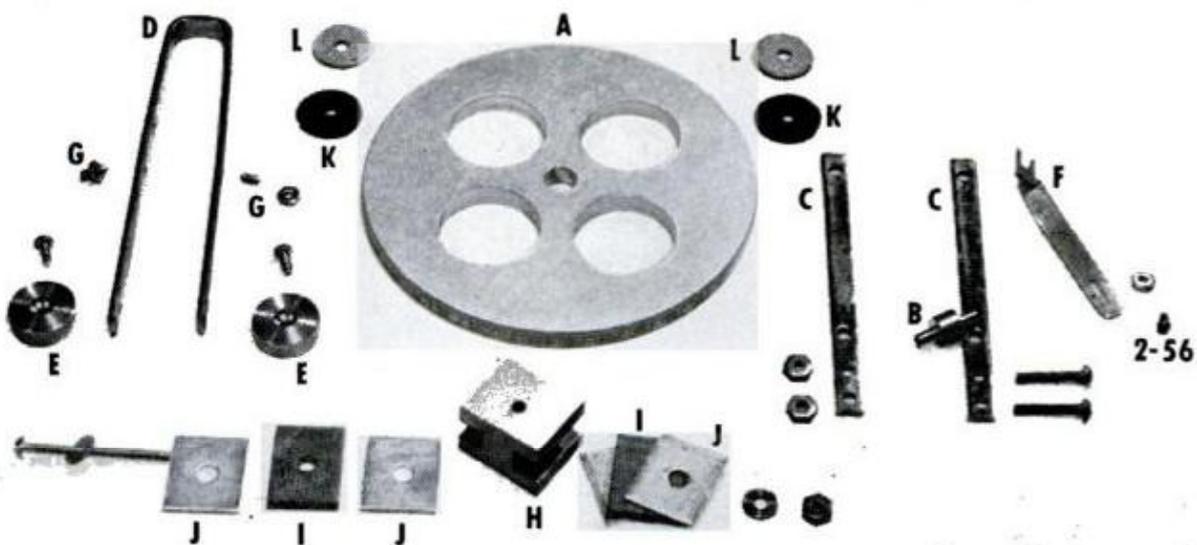
tape to the edge of the disc with epoxy cement and allow it to dry thoroughly before drilling the center 3/8-in. hole for the hub (B).

Machine the hub from brass or stainless steel so it fits tightly in the center hole. The diameter of the projecting ends, although indicated as 3/2 in., really isn't too critical. Each end must, however, have a smooth conical recess or depression of about 60°.

The two uprights (C) can be brass, steel or aluminum. Their lower ends fit in the slots cut into a hardwood or plastic block (H). The holes in the other end of the uprights accommodate the ends of the hub snugly, without binding.

Between the disc and each upright are

COMPLETED PARTS OF THE INCLINOMETER





ASSEMBLED WITHOUT THE DISC, the pendulum and uprights above at left are flanked by wood block, felt and metal washers, and sheet-metal pointer. In photo at right, block is mated to magnets, which in turn, are sandwiched between two steel plates. Only one of the uprights is shown attached to the wood block

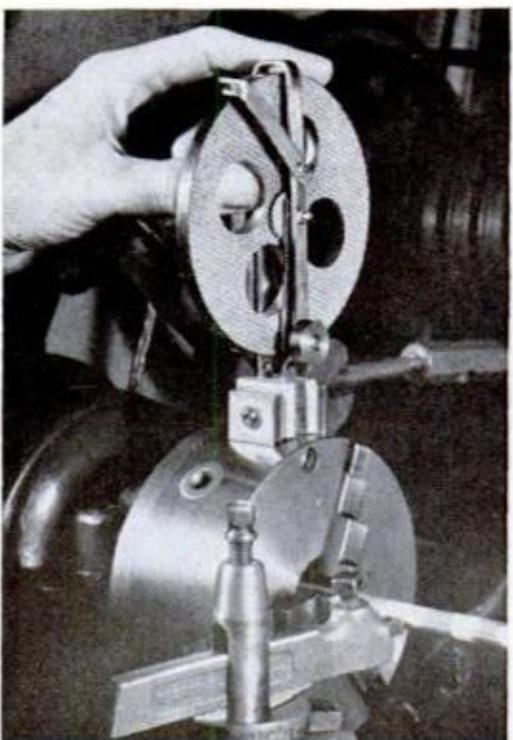
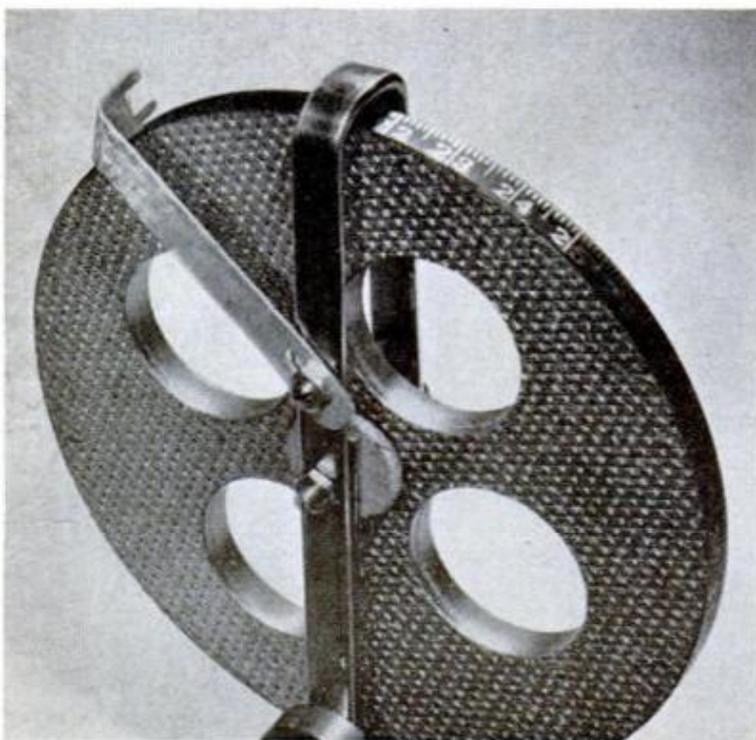
felt washers (K) and metal washers (L). The pressure of the uprights against these washers creates a dragging action that holds the disc in position, yet permits it to be turned easily to "zero" the reading. The holes marked "optional" on the uprights (C) will accept a bolt that you can use to regulate this pressure in the event the disc spins too freely.

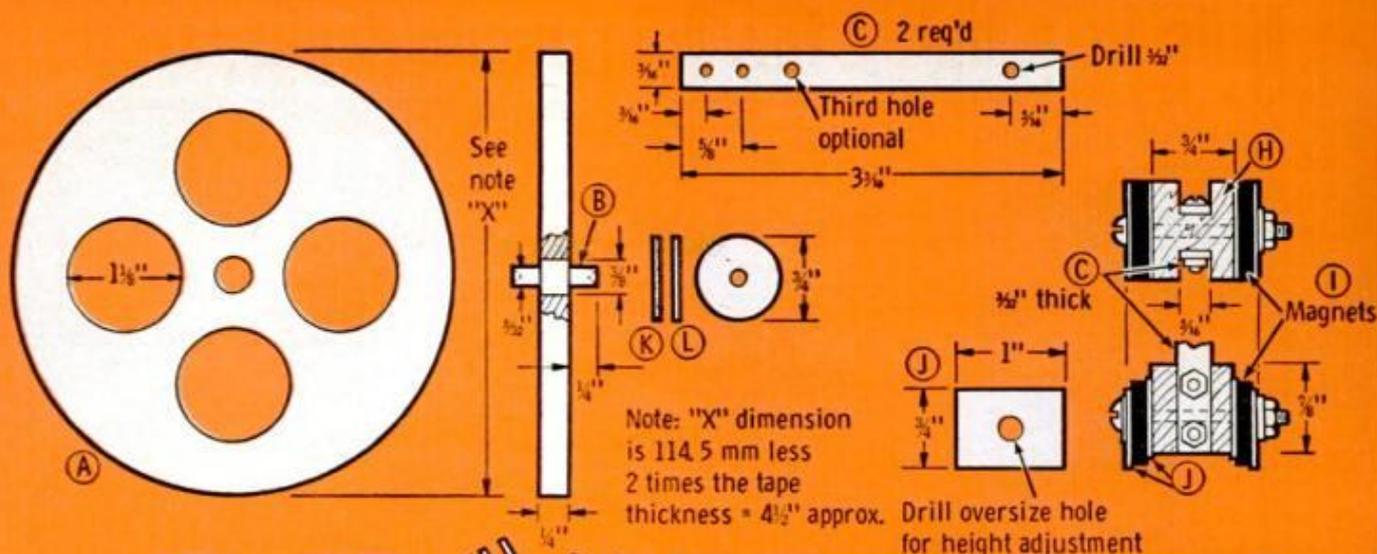
The pendulum (D) is bent from the same stock used for the uprights and fitted with two cone-tipped screws (G) in the conical holes in the hub. In use, adjust

these screws until the pendulum is held securely in position, yet is free enough to swing without appreciable resistance. Secure the cone-tipped screws in place with locknuts. Form two weights (E) from brass, stainless steel or lead, then fasten one to each of the lower ends of the pendulum, using 6-32 bolts. (With the exception of a single 2-56 screw identified in the photo of the completed parts, all screws and bolts are 6-32.)

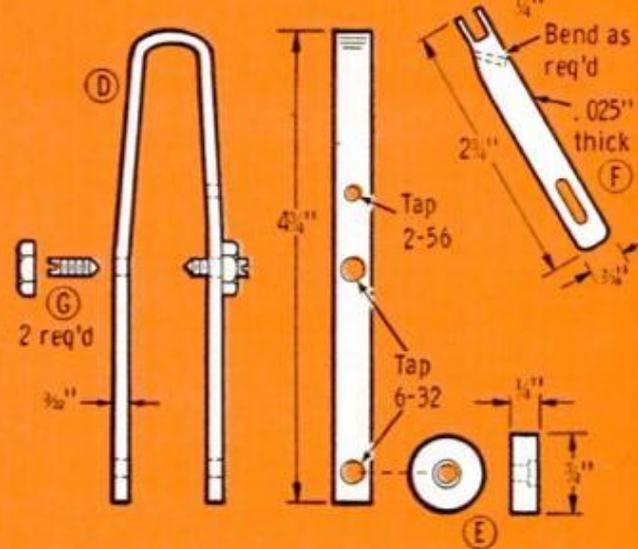
Make the pointer (F) from thin sheet aluminum or tin and mount it on one side

BEFORE USING THE INSTRUMENT, position pointer so you can comfortably view down through the tines of the fork and see only one division. In the bottom right photo, the operator is setting the disc at zero after cutting the first of six grooves in a piece of stock. Six equidistant grooves must be exactly 60° apart

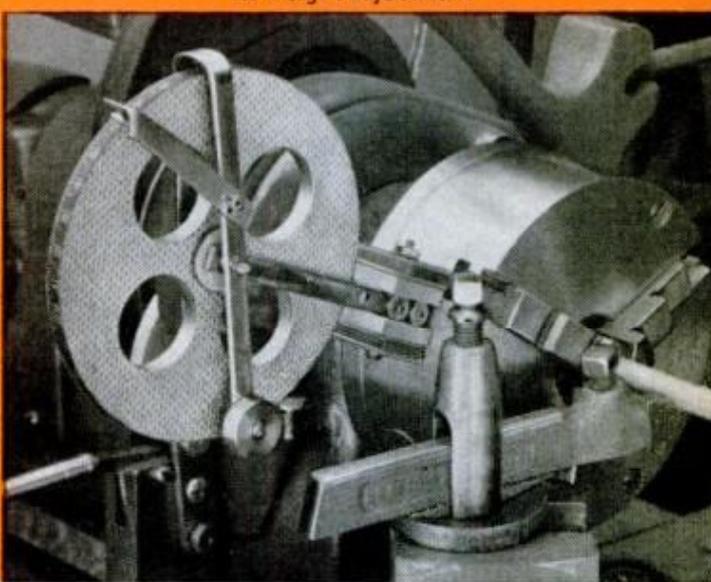




Note: "X" dimension is 114.5 mm less 2 times the tape thickness = 4 1/2" approx. Drill oversize hole for height adjustment



CONSTRUCTION DETAILS



of the pendulum with the 2-56 screw and a washer (or, as shown, a larger nut can double as a washer). Bend the forked end of the pointer so that when you look directly at the edge of the disc, only one division falls between the two tines.

Form the base block (H), cutting the two grooves so the space between the two uprights is the same as the spacing at the top of the uprights where the hub and the washers meet. Attach the magnets to the block with a single 6-32 brass bolt. The magnets shown were taken from cupboard catches, and then placed between two steel plates or armatures. Drill the holes through the magnet and armature slightly oversize so the latter can be shifted to conform to the curvature of a lathe chuck or other curved surface. If the instrument is to be used only on flat surfaces, the magnets and armatures can be mounted in line with the bottom of the block.

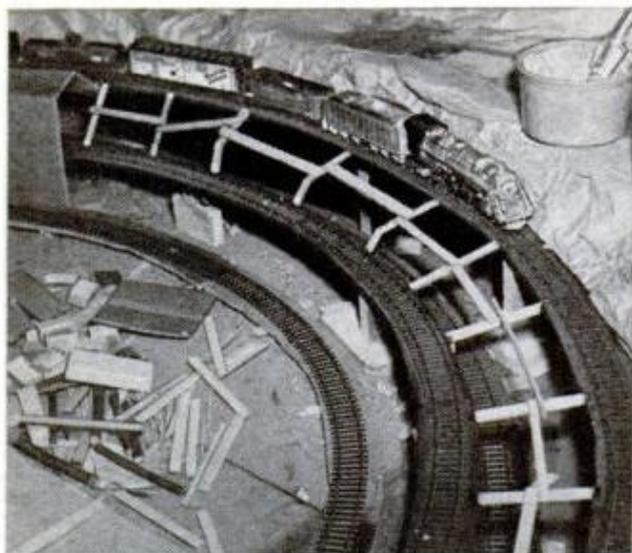
To use the inclinometer for measuring the angular displacement or motion of a lathe chuck (for example, to drill six holes

ROTATE THE CHUCK and the pointer on instrument indicates the angular movement. Remember that the pointer and pendulum move, but disc is stationary

around a piece of work), drill the first hole and then clamp the inclinometer to the top of the chuck. With the pendulum at rest, rotate the disc until the pointer is aligned with the 0° or 360° mark on the scale. Then rotate the chuck until the pointer is aligned with the 60° mark. Clamp the chuck in place, drill the second hole, and reset the inclinometer at the top of the chuck. Zero the instrument, rotate the chuck to 60° and drill the third hole. Repeat each step until all six holes have been drilled.

If the pointed screws and the conical depressions have been formed carefully, the pendulum should swing freely, without overshoot beyond the final resting point. Should the pendulum continue to oscillate back and forth, tighten up a bit on the cone-tipped screw. Just be sure to keep the points and their corresponding holes in the hub free of dirt. ★ ★ ★

Hills in a hurry for your model-train layout



HO RAILROAD MODELERS don't have to wade through gallons of plaster and yards of screening just to produce hills and mountains for their layouts. A much easier alternative is to use small scraps of wood and some old paper shopping bags, thoughtfully provided by any supermarket.

As shown in the photo, above left, first arrange the sticks to rough out the basic shape of the terrain. Any quick-drying glue or cement will secure the strips to one another. Then lay large sections of the paper bag over the wooden framework and press in some tacks to keep it in place.

At this point, apply a generous coat of wallpaper wheat paste to the paper so that

it's completely saturated and pliable. Now form gullies, bluffs and other landmarks simply by shaping the paper with your fingers. Allow everything to dry thoroughly and finish with a coat of water colors.

To fill smaller areas, use sheets of newspaper instead of the heavy brown paper bags. This time, saturate the newspaper before laying it out. Allow it to dry, add another coat of wallpaper paste, and when this is dry, finish with water colors.

If you're like most HO modelers and reroute your tracks each year, you'll appreciate that these hills can be torn out with your fingers—not a crowbar.

—Hank Clark

NEXT MONTH IN SHOP AND CRAFTS

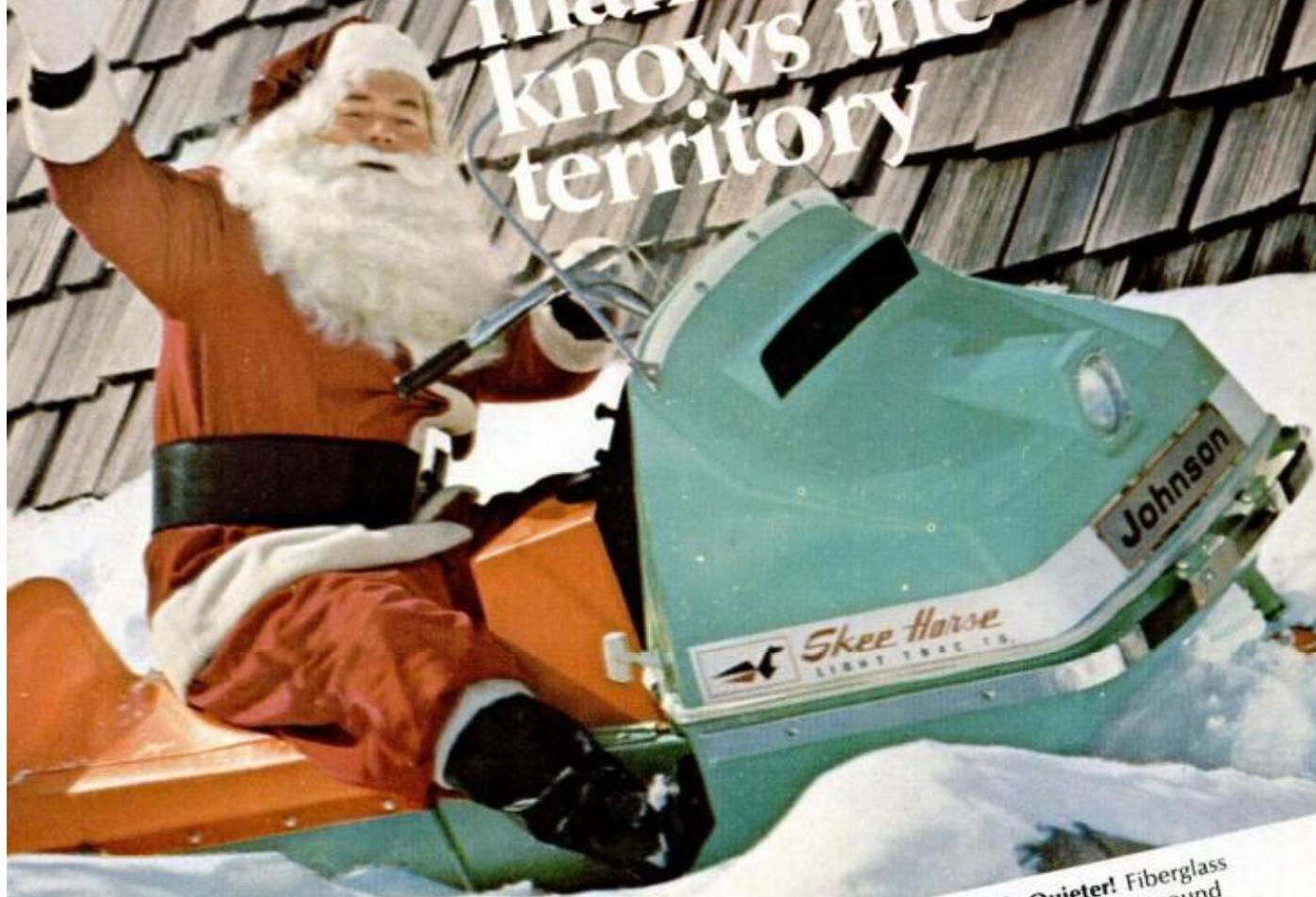
HOW TO TROUBLESHOOT FURNACE FAILURE. It's a bitter, windy, 15°-below-night and the dawn is hours away—when suddenly you awake and realize that something has gone wrong with the furnace. Do you anxiously begin calling every repairman in town, hoping to find an emergency shift on duty? Or—better—do you dig out the January issue of *PM*, remembering that 95 percent of furnace failures can usually be fixed by a homeowner?

THREE WALL-HUNG CURIO CABINETS. Actually, it's a bit improper to group the three units into a single category, for each is different and unique. The first is a clock-and-planter affair, the second a shelves-and-planter unit, and the third a neat corner-hung cabinet. Presented in full color and with detailed plans.

EIGHT WAYS TO SOUP UP YOUR SLOT CARS. After you've set up the track you're giving the kids for Christmas, surprise them by wringing top performance from their "stock" cars. All it really takes, you'll learn, is a screwdriver, some sandpaper and the tuning techniques detailed in next month's *PM*.

BUILD A SPLIT-LEVEL TYPING DESK. It's a sleekly styled desk that, on one side, features a typewriter table placed at just the right height and, on the other side, houses two roomy drawers and a pull-out writing board. Complete plans in the January issue make this modern piece a cinch to construct.

Ask the
man who
knows the
territory



When you've got to get around in snow, pick a Johnson Skee-Horse snowmobile! Now you have 16 horsepower pulling for you — in an arctic-tuned, American-built two-cylinder power plant (Johnson dependable!) . . . with new reverse gear for maneuverability . . . Torque-Sensor Drive that gears automatically to hill and load. Really rugged! And quiet? With my new Johnson Skee-Horse, I can sneak up on the most wideawake kid in town!"



Quieter! Fiberglass hood, new sound baffles, tuned exhaust make Skee-Horse whisper where others roar!

Ask the man who knows the product. Your nearby Johnson dealer invites you to compare — with any other brand — these first "second generation" snowmobiles on the winter scene! Three Skee-Horse models for 1968 — electric or manual starting Wide-Trac 20's or Light-Trac 15 with new self-cleaning plastic track. For catalog and "Fun Guide to Snowmobiling," both free, write Johnson Motors, Dept. PM-S81 Waukegan, Illinois 60085.



Lighter! Faster! New Skee-Horse packs less weight and more action! New sleeker styling, too!

Johnson
Skee-Horse

First in dependability • Sea-Horse motors • Sea-Foil boats • Air-Buoy dive gear • Division Outboard Marine Corporation

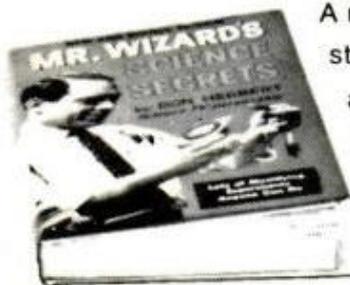


Reverse Shift! In its class, only our Wide-Trac 20 offers forward-neutral-REVERSE gear for complete mobility!

It's going to rain today

A can, a cork and a straw can predict the weather if you know what to do with them. Your daily newspaper is great for boiling water if you're caught without a pot. And a needle and a cork make a darn good compass.

These are some of the amazing experiments you can do with household items. Why don't you try some of them yourself? Just ask Mr. Wizard, he'll show you how.



A new edition of "Mr. Wizard's Science Secrets" by Don Herbert, creator and star of the award-winning television show "Meet Mr. Wizard" is now available from Popular Mechanics Press.

Whether you have a lab or work on the kitchen table, this big handbook for the home scientist offers step-by-step instructions for experiments with the basic principles of such things as sound, light, weather and gravity. Each experiment can be done with the everyday things you find around your home.

Incidentally, if you're planning on giving Mr. Wizard's Science Secrets as a gift you'd better buy two... people who see the book just can't seem to give it away.

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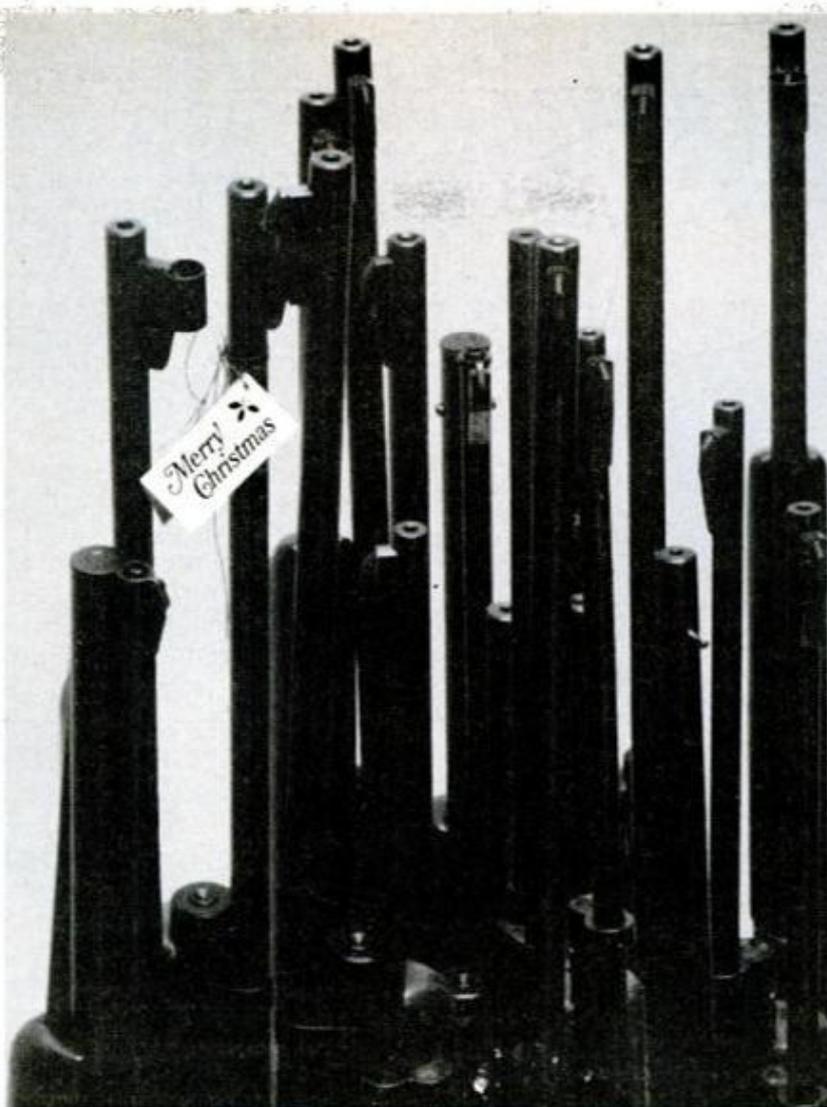
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My can told me so





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POWERMASTER 760. BB and .177 cal. Pellet Air Rifle. Power ranges from low for indoors to high velocity of over 500 feet per second for field shooting. Genuine hardwood stock, solid steel barrel. Short-stroke, high-compression pump. Holds over 180 BB's. Carries the symbol of fine gun craftsmanship . . . the gold-finished trigger. Less than \$22.



MODEL 140. Air-powered Pelgun Rifle, .22 Cal. Crosman quality and performance is built into this economical, high powered, single shot pump gun. All steel button-rifled barrel, polished hardwood stock, self-cocking mechanism, selective power, adjustable sights. Less than \$33.



MODEL 99. CO₂ Powered Pelgun, Lever Action Repeater. Looks, feels, handles like a big-game rifle. Lifetime valve for increased power and efficiency. Power selection gives choice of normal or high power. Self-feeding magazine holds 10 Super Pells. .22 Cal. About \$36.

You can add a Master mount and scope to any of these rifles; optional \$9.98. See these and all the fine models at your Crosman dealer. Send for free "More Shooting Fun" brochure. Write Dept. PM 127.



MARK I AND MARK II. Target pistols for .22 Pellet, or .177 Pellet and BB. They feel, look, handle like—and are—fine match target pistols. The most accurate Crosman has ever designed for Pellet and BB shooting. Fully adjustable sights, trigger adjustment for conventional or fine shooting. Up to 120 shots per single CO₂ Powerlet. Single shot action for accuracy. Under \$25.



MODEL 38-C. Combat "38", CO₂ Pelgun Revolver. Here's a pistol that's easily mistaken for a .38 caliber firearm. It offers single and double action and revolving cylinder which holds six .22 caliber Crosman Super Pells for slow or rapid firing; (38-T target model with 6" barrel), either model less than \$33.

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Crosman Arms Co., Inc., Fairport, N. Y. 14450
Crosman Arms (Canada) Ltd., Dunnville, Ont.

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NEW! DREMEL MOTO-TOOL with constant-torque permanent-magnet motor

This new space-age miracle motor is super powered. For its size, the fastest, most powerful electric hand grinder ever built. Compact — weighs only 11 oz. Has shockproof Lexan housing. Has more than twice the power of previous models. Collet sizes; $\frac{1}{8}$ ", $\frac{3}{32}$ ", $\frac{1}{16}$ " and $\frac{1}{32}$ ". Three models available — \$22.95 to \$39.95. See your dealer or write direct.

No. 270 with bronze bearings \$29.95
No. 280, ball bearing construction . . \$39.95



No. 271 Moto-Tool
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Complete with No. 270
Moto-Tool and 34 accessories
for grinding, polishing,
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Name.....
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City..... State..... Zip.....

YELLOWSTONE ON A SNOWMOBILE

(Continued from page 109)

I'm impressed. We've had only one major breakdown. In this run we have five mechanics.

But one job we couldn't handle. The rugged beating has split one man's motor mounts and he's out of business. Luckily this happened close to Old Faithful and John Dietz arranged to have the busted machine towed to West Yellowstone by one of the YPCo cats. Its driver now rides tandem on another machine.

Otherwise our bug list has included only these: a broken throttle cable (we installed another); two slipping clutches (we lost 30 minutes tightening them) and a broken spindle on a front ski. The latter was not easily repairable. Someone solved it by a clever jury-rig of guide ropes so the good ski steered its partner too.

All day we break trail. At dark, tired

PARK RULES FOR YOUR TRIP

1. Rent a snowmobile or bring your own.
2. No less than two are allowed to operate (if one breaks down, the other can go for help).
3. You must take snowshoes, one pair for each group. We carried one pair per machine. Reason: It's all but impossible to walk in deep snow. In fact we even needed snowshoes to get from snowmobiles to outhouses.
4. You'll need proper sleeping bag gear for overnight stays. There are no accommodations in winter, except at the Lodge. We used the cabins at Old Faithful by special permission.
5. Get a park permit. You must check with rangers before hitting the trail. File a trip plan.
6. Take food to last at least an extra day. It's easy to get stranded—and that's tough.
7. You can only travel roads used in summer. Most are under many feet of snow, marked only by plow-guide poles.

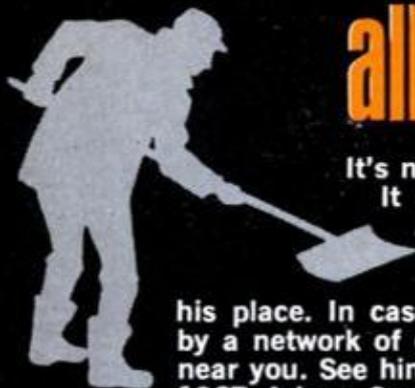
but cheerful, we put into the settlement of Lake for hot food and good cheer.

We had planned to go north through Tower Junction the third day. Rangers warn us of avalanche danger ahead so we'll detour through Norris Junction, hoping conditions will be better.

They are—somewhat. No avalanches. But all day we battle enormous drifts. There's a deep drift behind every half-buried tree. But the little machines hold out, and after dark we clatter back, at last, to our starting point—the lodge.

Breaking trail through untarnished snow; seeing elk and moose, deer and buffalo; "hearing" the silence of a snow-covered valley when all engines have stopped: this is what you get when you go snowmobiling in Yellowstone. ★ ★ ★

Ariens takes the Lifting out of Drifting all over America



It's no secret, an Ariens Sno-Thro costs more than a snow shovel. It should. It does a whole lot more. For one thing, a 2-stage Ariens Sno-Thro cuts through after-blizzard drifts quickly, conveniently, dependably. An Ariens Sno-Thro gives you a feeling of power — a way of putting Old Man Winter in his place. In case you're wondering, Ariens Sno-Thros are sold and serviced by a network of dealers across America's snowbelt. In fact, there's one right near you. See him today, or over the weekend. Get a lift out of life with a new 1967 Ariens Sno-Thro.

All Ariens Sno-Thros are equipped with four forward speeds, power reverse and a directional discharge chute. The Ezee-Start 4 hp, 5 hp, 6 hp and 7 hp engines have been winterized for dependable get-up-and-go performance. NEW! LOCK-OUT DIFFERENTIAL! Standard on Models 10M-6D, 10M-7D. Available for Models 10M-6 and 10M-5. Optional attachments turn some models of the Ariens Sno-Thro into a lawn vacuum, reel or rotary lawn mower. Ask about them, too, whatever the weather.

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Ariens Company, 547-A W. Ryan Street, Brillion, Wisconsin 54110

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If the tiller you've been using has its revolving blades in **FRONT** (See 'Torture!' at right), you won't ever be happy with it again, once you try the **TROJAN HORSE** which has its revolving blades in the **REAR**—and is **SO EASY** to handle you guide it with just **ONE HAND!** (See 'Joy!' at right). You do **NOT** have to walk **behind** it, leaving footprints! It leaves **NO** wheelmarks! The **TROJAN HORSE** is now in its 7th great year. Built by the makers of the famous **ROTO-TILLERS**. If you want Tilling to be a **JOY** instead of **TORTURE** from now on, please mail the coupon below right now for the **whole** story of this wonderfully better design in Tillers! Trojan Horse Tillers, Troy, N.Y. 12182



Torture!



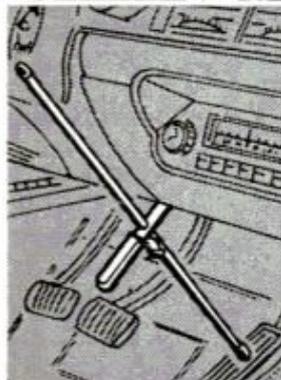
Joy!

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Please send the whole wonderful story of **TROJAN HORSE** tillers, including prices, name of nearest dealer where we can see, buy or rent a **TROJAN HORSE**.

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Keeps motor running to warm parked cars & trucks in winter; cool in summer; recharge rundown batteries. Also for engine tuneups. Metal rod 21" long. Sliding bar adjusts to fit under dash of all models. Rubber foot grips pedal; plastic tips protect finish. \$2.50 postpaid. Deflecto-O Corp., 2901 E. 46th St., Indianapolis, Ind. 46205.

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 or 504 Victoria Ave., Windsor, Ontario, Canada

CHRISTMAS CAROL

(Continued from page 80)

and descend to the deck like an elevator.

Now, as the low-fuel light warned the tanks would be dry in 15 minutes, they had to start a "beep to the hover," a maneuver similar to a conventional aircraft's instrument approach to a weathered-in field. But there was no GCA controller talking them in, no crossed ILS needles to indicate on course and glide path, no lighted runway appearing out of the soup.

Flying downwind over the cutter, which was on a course and speed to keep a 15-knot breeze over the port bow, the chopper pilot began the often practiced pattern—straight and level for 15 seconds, then turn 40° to the right, 25 more seconds of straight and level flight, then a 220° turn to the left, followed by a precision descent and slowing of airspeed until the aircraft was but 10 feet overhead—hovering with a slight forward motion.

Lt. Solley never moved the "cyclic" control stick, but trimmed it by small actuations of its beeper trim button; thus, the name "beep to a hover." The *Vigilant* loomed out of the fog as the helicopter eased forward over the ship's wake.

At 6:43 p.m. the helicopter landed. Seventeen minutes later, fully fueled and airborne, it took off again. Puffy cumulus clouds spawned over the comparatively warm water, forcing the chopper up to 4500 feet until it was inside the Cape.

At 8:39 it landed at Logan International Airport. Baby and mother were cleared in two minutes and sped to Boston City Hospital. Slava Perminov was not 12 hours old, but odds for his survival soared.

For the Coast Guard it was "case closed" for Search and Rescue Case 403—the 403rd for July 1967 in the New England district. For Slava Perminov it was the beginning of weeks on the danger list. For Mrs. Perminov it was the beginning of a remarkable interlude. An unplanned guest in a country she had been taught to distrust, she gradually relaxed and enjoyed her stay.

By Sept. 5, little Slava's original weight of one kilogram—two pounds, two ounces—had increased to three pounds, fourteen ounces. Three weeks later, he passed the five-pound goal of premature babies. On the 28th Slava and his mother flew to New York and on to Moscow.

Will Slava grow up in peace, return to the United States in friendship, and look up his rescuer to thank him, perhaps to admire the Distinguished Flying Cross for which Lt. Solley has been recommended? Of all who wish him well, not the least is the U.S. Coast Guard. ★★★

Remember when tools were built to take it year after year?



Ours still are.

There was a time when a man could use the same set of tools all his life, then leave them to his son.

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THE REAL SCOOP ON SCOPES

(Continued from page 115)

click or graduation moves bullet strike at 100 yards 1/2 inch or 1 inch; in higher power scopes, 1/4 inch. There are click adjustments for both elevation—up and down aim—and windage—side to side aim. Windage adjustments are used to correct for crosswind effects on a bullet's path.

COATED LENSES now are available on all scopes, regardless of price. This anti-reflection coating usually is a microscopically fine film of magnesium fluoride, readily recognized by a "color" from straw to purple on the surface of a coated lens. Coating increases light transmission 50 percent and greatly improves image contrast.

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When a scope is assembled and sealed in normal atmosphere, the tube may be filled with dry nitrogen to drive out atmospheric air. Gas-filling isn't needed if scopes are assembled under controlled atmospheric conditions. If a scope is free of moisture inside and sealed tight, it won't fog internally, whether gas-filled or not.

VARIABLE-POWER SCOPES change magnifications by axial movement of the erector system. Generally, no impact-point change accompanies power change. The reticle, if located at rear focal plane, remains the same size regardless of magnification changes. In some scopes, the reticle at front focal plane is magnified along with the image, an undesirable condition.

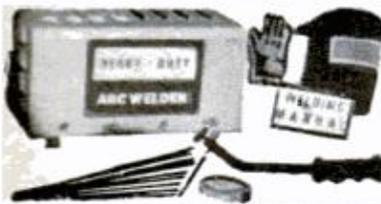
SCOPE MOUNTS. Nearly all current-model high-power rifles are factory drilled and tapped for standard top mounts—scope installation is an easy, do-it-yourself job. Most of today's .22 rifles have standard 3/8-inch dovetail receiver grooves for the low-cost tip-off mounts available for the various .22 scopes. Most older rifles can be mounted with scopes by a gunsmith.

FOCUSING. Here's how to check: With a white handkerchief over the objective lens (for a diffuse image), point the scope at the sky. Look at a distant scene for a few seconds, then glance into the eyepiece. The reticle should appear instantly sharp and clear if the ocular is properly focused. If not, focus by turning the eyepiece to make correction. ★★★

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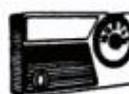
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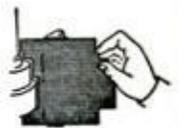


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130 MPH ON THESE TIRES?

(Continued from page 122)

Flock's acute sensitivity to any unusual vibration. Repeatedly, he brought the powerful car to a safe stop, with sections of tread banging around, and only the cord carcass left to control. Fonty says he can feel the very first chunking beginning and is ready for the tread failure that inevitably follows. How long does that take?

"At high speeds," Fonty says, "the tread can throw almost immediately, though a few last 10 miles. At 120 mph, that's only five minutes! If the last tire temperature registered near 250°, I know it'll throw fast."

According to NASCAR experts, the wider the "footprint" of a tire, in relation to thickness of the rubber, the better it is able to withstand high speeds without building heat up to a destructive level. As proof, the tread depth of one lot of 8:15x15 tires was shaved from 1½/32 to 9/32 inches. Some performed well at 130 mph for runs of 25 miles. There was no sign of tread failure, and much lower temperatures developed than in unshaved tires. Obviously, the tread would wear through sooner, but that's not the same as tread failure.

New highways are a challenge

Bill France says "These new long, straight state and federal roads represent a big challenge to the tire industry. Few present tires will hold up for 10,000 miles at 70 mph. Even those that will, would throw their tread in a short distance at 120 mph. Tire heat goes up with the weight of a vehicle. It goes down as the outside tire circumference increases. And it goes much farther down with increased width of the footprint." In tests for Florida, wide-oval or wide-tread type tires proved much the best for sustained high speeds.

In its report ARB recommended either nylon or polyester cord for pursuit tires, also that the state "red-line" the speedometer on patrol cars at 120 mph if it continued to equip them with 8:15x15 tires. For speeds over 120, the report urged the state to specify wide-oval or wide-tread type tires.

How can these tire failures at 130 mph have anything to do with the kind of driving you do? On thousands of miles of fast roads you can drive the limit for hundreds of miles without stop. If the limit is 70, the highway patrol will usually excuse 75. To get around some 65 mph "creepers," you will be hitting 80 to 85 mph to pass. If your tires have already heated up and begun chunking, just one such passing may be all it takes. ★★★

ARTIFICIAL GILLS

(Continued from page 72)

in through the hull, its pressure reduced to that of the breathing atmosphere. It would be circulated through a gas-exchange tank where the breathing air would bubble through it vigorously. Then the water would be pumped back into the sea. There's no limit to how much oxygen such a system could supply, Ayres claims.

On a small scale, the Navy is testing that system. Researchers at the Naval Civil Engineering Laboratory, Port Hueneme, Calif., have shown that animals can live indefinitely in air rehabilitated by bubbling through seawater.

The Ayres gill, in its simplest form, has one important limitation. A diver using it could stay under water indefinitely, but not go very deep. Air in the gill remains at atmospheric pressure—since the pressure of gases dissolved in the water is the same as at the surface, no matter how deep you go. However, *water pressure* increases by the equivalent of one atmosphere for every 33 feet of depth.

A diver simply can't breathe air at atmospheric pressure if he gets more than a few feet below the surface. His chest muscles aren't strong enough to work against the water pressure. Below 100 feet it will crush a man's rib cage. Scuba gear takes care of this by supplying air at the pressure of the surrounding water.

The Ayres patent, similarly, provides for a pressurizing tank of air attached to the gill. The diver would pump air into this tank, using a simple hand pump, at the surface. Air would then be released into the gill to offset the water pressure.

Some people doubt the workability of this approach. With compressed air in the gill, they say, partial pressures of oxygen and nitrogen inside the system would be higher than in surrounding water, and gases would diffuse out through the gill.

Ayres thinks otherwise. There will be an initial loss of oxygen, he says, but very rapidly equilibrium will be reached and oxygen begin diffusing in from the water to meet the diver's needs. An excess of nitrogen will remain in the gill as a pressurizing gas for useful periods. This, too, will diffuse out into the water, slowly. Ayres has tested the rate of nitrogen loss through various membrane materials. He says a diver should be able to remain at 50 feet for half an hour—then can surface, refill the tank and repeat the procedure.

Ayres told me he has also worked out a method—still secret—of going down several hundred feet and staying indefinitely.

The second inventor to secure a patent

(Please turn to page 192)

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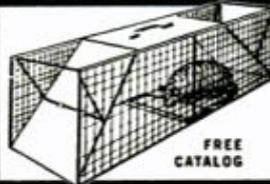
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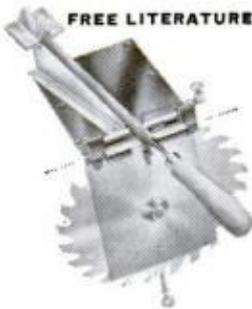
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CHESS AND CHECKERBOARD

(Continued from page 147)

filled with a white grout and the surface is wiped clean with a cloth. All the "men" are lathe-turned, excepting knights. These have turned bases, but the horse heads are jigsawed out of 3/8-in. solid stock, shaped with a knife and pegged to the bases.

In the case of the kings, the arms of the crosses on the crowns are made flat by jigsawing off the surplus on two sides.

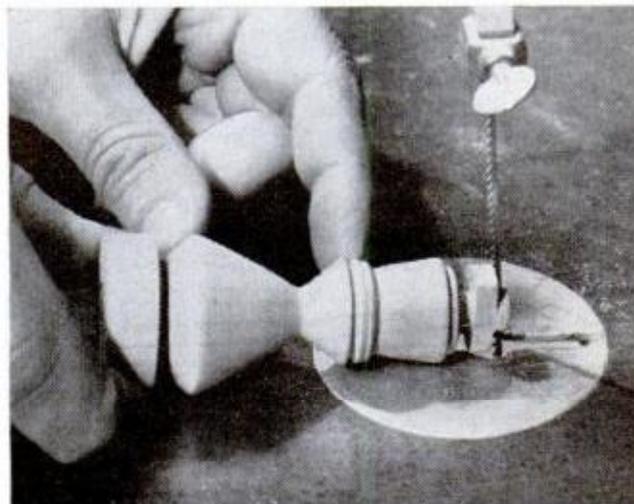
As for the queens, the crown depressions may be hollowed out with a carving knife or with a burr cutter in a hand grinder. The knights have a slanting slot cut in their helmets with a jigsaw.

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ARTIFICIAL GILLS

(Continued from page 189)

for an artificial gill system has another way of coping with depth limitation. He is Lewis H. Strauss, a Washington, D.C., physician and son of Lewis L. Strauss, a former Atomic Energy Commission member.

The Strauss gill (his children call it the "Artifish") is essentially an improvement on the Ayres gill. It uses a type of Freon as a pressurizing gas.

Called Freon C-318, it's a DuPont development but is unlike Freon used in refrigerating equipment. It was developed as a pressurizing gas for whipped-cream dispensers and other pushbutton foods. Its molecule is composed of carbon and fluorine (fluorine replacing the chlorine of other Freons). It's odorless and, DuPont says, nontoxic. Animals have lived for months in an atmosphere of 80 percent Freon C-318 and 20 percent oxygen.

Freon C-318 is virtually insoluble in blood and water. Similarly, it won't diffuse through a membrane—molecules passing through a membrane are viewed by physicists as being "in solution" in the membrane material. Thus the Freon will not diffuse out of a gill system. The diver simply carries a small cylinder of liquefied Freon and valves Freon into the gill to equalize pressure. When he swims back to the surface, excess Freon is released.

Freon C-318 is a gas at pressure up to 45 pounds per square inch, equivalent to a depth of about 66 feet in water. Below that, the Freon would liquefy, imposing a depth limit on the Strauss gill. Eventually other inert, heavy gases that can remain gaseous at lower depths may be developed.

Some design problems remain before artificial gills can be placed on the market. Ayres recently tested a backpack model of his gill in a Long Island swimming pool. It had more total area of membrane than the cumbersome Jones Beach version—100 square feet compared to 64—but it was less efficient, and he could breathe underwater for only 10 minutes.

Apparently, a somewhat restricted flow of water in the spaces between the membrane sheets cut the amount of gas exchange below tolerable limits. To correct this, it may be necessary to add a propeller to push water through the gill, or increase membrane area. But such problems seem minor now that it has been shown that man can, indeed, breathe like a fish. Once perfected, the gill will lessen major risks: oxygen poisoning, nitrogen narcosis, bends.

These result from excess gas dissolving in the diver's blood and then dispersing through his body. With a gill, dissolved

(Please turn to page 193)

gases tend to reach equilibrium with partial pressures of the same gases in water. Since these pressures are essentially like partial pressures in the air, diving with a gill should be safer than with scuba gear.

Even such a simple device as Ayres's gill seems unnecessarily complicated to some far-out thinkers, since oxygen must pass from water into air, then from air into the blood. At GE, bio-engineers talk of another approach—direct gas exchange between blood and seawater.

The diver's blood would be circulated through membrane passages, with seawater flowing past the other side of the membrane. His lungs wouldn't play a part in the process—he would breathe an inert gas in and out.

There are a few harrowing problems. A large volume of blood would have to circulate through the gill; this might require open-heart surgery to insert connections in the pulmonary artery. Formation of blood clots would be a risk.

Then there is osmosis: Gas-exchange membranes are to some extent permeable to other things; water molecules would migrate from blood to seawater, dehydrating the diver, and some chemicals dissolved in the water might travel in the other direction, contaminating the blood.

Angelo Dounoucos, membrane project engineer at GE, told me he thought these problems could be solved. GE is now working with doctors to perfect a membrane-type blood oxygenator for use in heart-lung machines. The object is to prevent damage to blood cells that now occurs when oxygen is bubbled through blood in such devices. Excellent results are being obtained in the experimental blood oxygen generator, he said.

Dounoucos discounted the hazard of osmosis. The diver's water loss can easily be made up, and the membranes can be made *selectively* permeable, he said, so they will pass only desired substances.

Among professional divers, interest in artificial gills runs high. Robert Stenuit and Frank Palejczyk, who work for Ocean Systems, Inc., a leading undersea-engineering firm, have volunteered to have water-to-blood gills implanted.

Ocean Systems physiologists say there's no immediate prospect the offer will be accepted; they still regard the water-to-blood gill as very far out. Nevertheless, the company takes the gill seriously, said Dr. Heinz Schreiner.

Wally Ayres remains the only experimenter to have successfully tested an artificial gill with which humans can breathe like fish. "Ayres certainly deserves full credit for pioneering the gill," declared GE's Dounoucos. ★★★

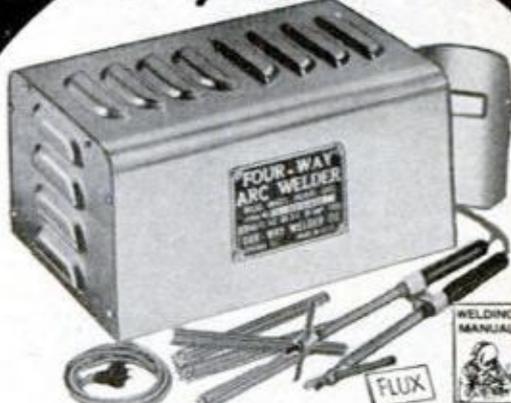
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says David K. Price of Redlands, California.

"When we needed a new pick-up for our citrus farms, we looked carefully at all makes... I kept coming back to the 4-wheel drive 'Jeep' Gladiator and finally decided it might be worth the extra dough. So I bought it. A couple of months later, it became one of the best investments I ever made.

"It had been fairly warm, but by mid-afternoon the temperature started to slide. At 6:00 P.M., I called the

weather bureau—"Riverside... 32°... Bloomington... 30°... Redlands... 33°..." WOW! Down 10° in an hour! We didn't have one wind machine on.

"I loaded drums of fuel for the wind machines into the Gladiator and took off for our biggest farm—30 miles away. There was a ton of it in the back, but the Gladiator really barreled down the highway.

"When I got there, I still had a hun-

dred yards of deep sand bottom between the road and the machines. I flipped the lever into 4-wheel drive, and stepped on the gas. All 4 wheels started to churn. We sank right to the hub caps in the soft sand, but then the 'Jeep' Gladiator began to grind its way—fuel drums and all—right across the bottom and up to the grove.

"The wind machines were all fueled up and on by 9:15. Not a moment too



"I called the weather bureau. It was nearly freezing."



"I had to get over a ton of fuel to our wind machines...in a hurry!"



"In between the road and the wind machines was 100 yards of deep sand...uphill!"



"An ordinary truck gets stuck automatically when you try to turn in the sand. But even with that load in the back, my 4-wheel drive Gladiator kept churning along."



"When the temperature hit freezing, nine wind machines were on. Only one still had to be filled."



"We didn't lose a single orange. And that crop was worth \$36,000."



"My whole family enjoys our Gladiator. Especially when we're camping. We love going to places 2-wheel drive trucks could never reach."

soon. At 10:30 it went well below freezing.

"Next day we found we hadn't lost a single orange. That crop was worth \$36,000.

"Everyone likes to drive that Gladiator—including my wife. With Turbo Hydra-Matic* automatic transmission, it's a cinch to drive. She also takes advantage of 4-wheel drive...flips it on when the roads turn slippery, for

instance (even at 60 m.p.h. it's almost as easy as turning on the lights).

"On days off, we put on the camper and head for the hills. The kids love it, because we push back to places we couldn't go before. I don't worry about getting stuck... not with this baby!"

"Sure, we paid a little extra to get this 'Jeep'

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HOW TO 'GLASS' A BOAT

(Continued from page 133)

time to roll on and smooth the fabric, so you can cover much larger areas.

The "brush-through" method of resin-bonding is another trouble-saver for use on small boats that you can tilt for a horizontal work surface. Simply lay the prepared fabric on the hull dry, stapling edges for tautness, if necessary, then paint the resin through it.

Don't pigment this coat; it's much easier to spot unstuck areas in clear resin. Use a spreading tool with light pressure.

This system is not advisable with Vectra, which tends to float in the resin.

Resin mixing tips. The proportion of polyester hardener mixed with resin is sometimes as small as 1/6 oz. per gallon.

If you buy resin by the gallon for economy, the container of hardener or setting agent will usually have four division marks so you can mix the resin a quart at a time. (The hardener vial with a quart container has half-pint marks)

For smaller mixes from either size, empty the hardener into a small straight-sided bottle. Then simply measure the fluid height and divide it into whatever fractions you want.

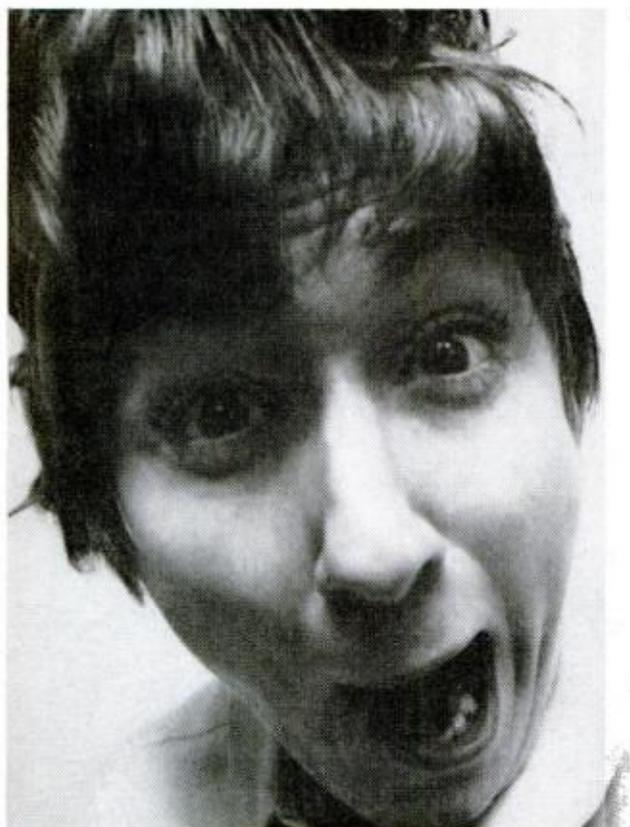
Be sure to get the manufacturer's chart of hardener mixing proportions for various working temperatures. The amount of hardener for use at 70° F. may, at 90° cause your resin to set too quickly.

Pigmenting. Follow instructions, and use the same make of pigment, if available. Buy pigment for the type resin you're using—epoxy or polyester—and *don't intermix*. Generally, polyester pigments are mixed with the resin before adding hardener. Because of the larger proportion of hardener in epoxy mixes, the pigment and the two resin parts are usually mixed simultaneously.

In all resin work, be sure to heed the maker's ventilation and fire warnings.

Canvas covering. To recanvas a hull, remove *all* old canvas first. Stretch the new canvas—a single, wide piece—over the hull dry, tacking it at wide spacing at gunwales. Wet the canvas to shrink it to hull shape. It will loosen but hold contour stretch when dry. Then retack at short spacing at gunwales after retightening against hull and lap both sides of canvas 1 1/2 in. over stem, after tailoring. Bed laps in canvas cement and tack. Replace rub strips, keel, skids and so on, then fill canvas weave with waterproof filler (from makers like Old Town Canoe Co., Old Town, Me.) Allow full drying time for filler, sand smooth (but not into canvas fibers) and finish with boat paint. ★★

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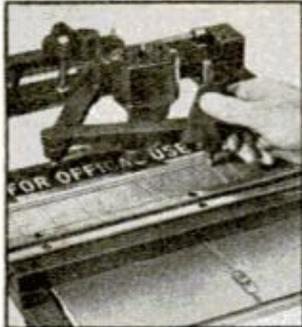
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I certify that the statements made by me above are correct and complete. Joseph F. Kern, (Signature of business manager).

HOW TO GET THE CLUNK!

(Continued from page 161)

shouldn't have any trouble replacing it.

Start by dropping the shaft. Again, your job is made easier by getting the car off the ground or, if you're lucky, finding a grease pit. The shaft is held to the car by means of the rear (differential) U-joint only. That means that removing hardware from around the rear joint allows you to remove the shaft. The front (transmission side) joint is part of the prop-shaft tube that slides over the splined transmission output shaft. Once the rear joint is unbolted, the shaft can be slid from place.

Shaft alignment critical

This is important: To insure proper shaft alignment when reinstalling, scribe a mark across the rear joint flange and its companion flange before dropping the shaft. When you put the shaft back into the car, make certain that these two marks line up.

After the shaft has been removed, support it so the entire tube is level and place the U-joint end in a vise. Do not tighten—just use it to hold the shaft steady.

In some cases, you'll have to use a piece of pipe that has a diameter large enough to encircle the bearing cap to remove it. Apply enough force (with a hammer) to break the bearing cap retainer and force it out of the yoke. Rotate the shaft and do the same with the opposite bearing cap. In other cases, you'll be able to remove snap-ring-type retainers with a long-nose pliers.

Now, tap around the circumference until you can remove the cross assembly from the yoke. To reassemble the U-joint, install the cross assembly into the shaft yoke and press on the bearing caps. The caps are seated by tapping them into place with a soft-faced hammer.

While doing this, make sure the bearing rollers don't get jammed on the cross assembly. Test for free movement. To finish it up, install the snap-ring type of bearing cap retainers with their gaps toward the yoke.

This is the procedure used to replace one type of U-joint. There are numerous variations. If you have a variation that you can't figure out, the best bet is to seek more specific instructions about the installation in the appropriate manufacturer's service manual.

At first, you may have thought that it would be a monumental job to get at the source of that annoying "clunk," but as you see it's not that tough after all. ★★

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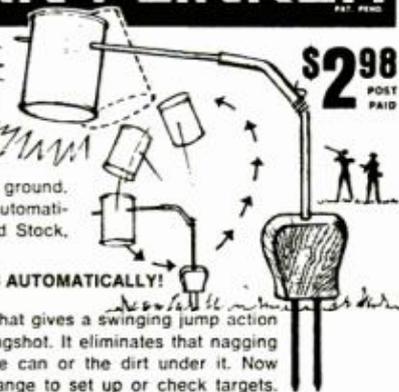


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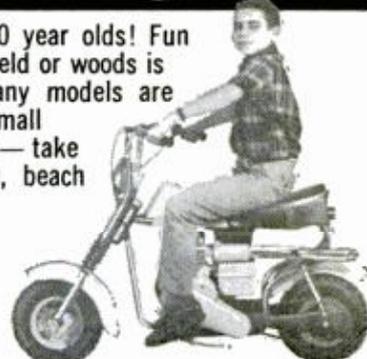
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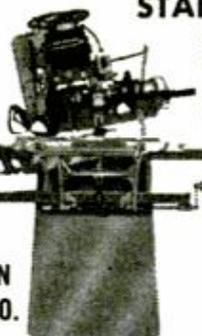
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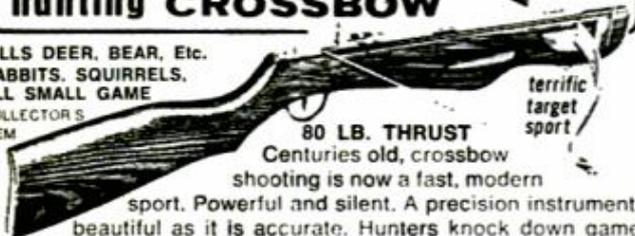
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YOU CAN BUILD A FIREPLACE

(Continued from page 153)

since the fireplace stuck through the wall. Where you prefer to have only the hearth and facing brickwork project at the front as I did, you'll have to put up a second wall flush with the fireplace and make use of the space behind it for storage or built-in bookshelves.

The steel form sits in a three-sided cavity of concrete blocks, so your first step is to mortar in place the first course of the U-shape enclosure as shown in step 1. The instructions you receive with your kit will provide the interior dimensions of the cavity.

Next you build up the hearth with a wall of brick three courses high. This is centered in front of the cavity. In planning the size of the hearth, I arrived at a length that would avoid the cutting of bricks across the front and one that would accept nine concrete patio blocks which I placed on top. Packaged mortar mixes are convenient when laying brick and block.

Next, the space inside the hearth is filled with concrete after temporary form boards are installed as shown in step 2. Strike off the fill even with the top of the brick and wood forms and leave the surface rough. Let the concrete stand overnight before removing the form boards.

The next step is to fill the area in the cavity. You'll notice here (step 3) that the concrete is kept 3/4 in. below the hearth. This was done so that the firebrick, which is thicker than patio block, would be level with the latter when both were mortared in place. If you go to a different kind of hearth, you may find that you can pour both the hearth and cavity level in one operation.

Now you continue to complete the cavity. This is laid up eight courses high (64 in.), using standard 8x8x16-in. hollow-core concrete blocks.

Before the steel fireplace form can be lifted into the cavity, firebrick must be in place. Note that firebrick is required only on the floor of the cavity. I got by with 15 firebricks, but here, again, it depends on the size unit you use. Tap the fire bricks down evenly in a bed of mortar and space them with 1/2-in. joints.

The outside of the steel form is completely covered with a 2-in. layer of fiberglass which comes with it. This is done before the form is lifted into the cavity. A soupy mixture of mortar is used to cement the fiberglass to the metal. Center the form in the cavity; keep the front even with the blocks.

At this time I covered the hearth with
(Please turn to page 202)



The 8-second woodcutter

That's how fast the new Homelite XL-101 chain saw cuts through a 12-inch log. Eight easy seconds that start with a gentle 2-finger pull. It's the perfect helper for pruning trees, repairing storm damage, cutting logs for your fireplace. Yet it weighs only

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It's the RIDGID No. 15 tube cutter, and it's one of the handiest tools ever invented!

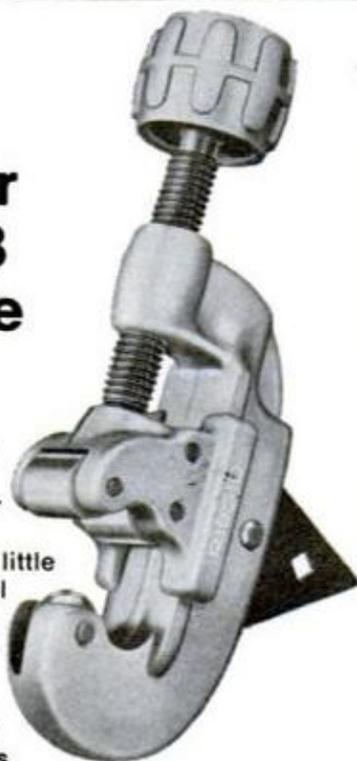
One. It's the smoothest little tube cutter available for all $\frac{3}{16}$ " through $1\frac{1}{4}$ " copper, brass and aluminum tube, also thin-wall conduit.

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RIDGID



YOU CAN BUILD A FIREPLACE

(Continued from page 200)

the patio blocks, bedding them in mortar to be even with the firebrick and letting them overhang sides and front about $\frac{1}{2}$ in.

Now the firepit is framed with face brick. Nine bricks on each side brought me to the top of the firebox opening at which point I bridged them with a lintel of angle iron to support the bricks across the top. Here the ties in the concrete blocks anchor the brick. Half-inch mortar joints are struck between the brick and tooled with a regular $\frac{1}{2}$ -in. mortar-joint iron. As shown in step 7, the upper brick are bedded on end and spaced to produce uniform joints.

All that remains to complete the fireplace itself is to fill in above the brick with 4-in.-thick concrete blocks. In my installation I found it necessary to pour a ledge across the top of the brick for the block to rest on. This required a simple form board about 5 in. high, placed across the front of the cavity, to hold the concrete which was poured behind it.

When the front is filled-in with block even with the top of the cavity, a 3-ft. section of chimney pipe is locked to the smoke dome with a twist. Then the whole top of the fireplace is filled level with concrete and rubble as shown in step 8.

(To be concluded next month)

MINISCREEN TV

(Continued from page 93)

makes of sets. Instead it will use the "Chromatron" tube originally developed here by Paramount Pictures. Though offered to U. S. manufacturers, the tube was dropped mostly because of difficulties in mass production. With the production problems tamed, the tube should unleash a barrage of portable color sets. Its bright images hold up well for outdoor viewing.

Black-and-white, of course, has the appeal of lower price. Cost of a typical eight-inch set is in the \$125 range. There are sets for less than \$100, however. Notable are Symphonic, Sears, and Airline (Montgomery Ward) models. The Symphonic set is an eight-inch, tube-type, 115-v.a.c.-only model, but the others operate on 12 volts. Symphonic also has a \$160 Minni-3—a three-inch, $5\frac{1}{2}$ -pound lightweight a.c. and 12 volt model.

Prices go all the way up to the \$200 range where Delmonico offers a combo unit with AM/FM radio and a four-speed stereo record changer. For a bit less than \$200, there are several AM/FM, clock-timer models in Panasonic's line. ★★

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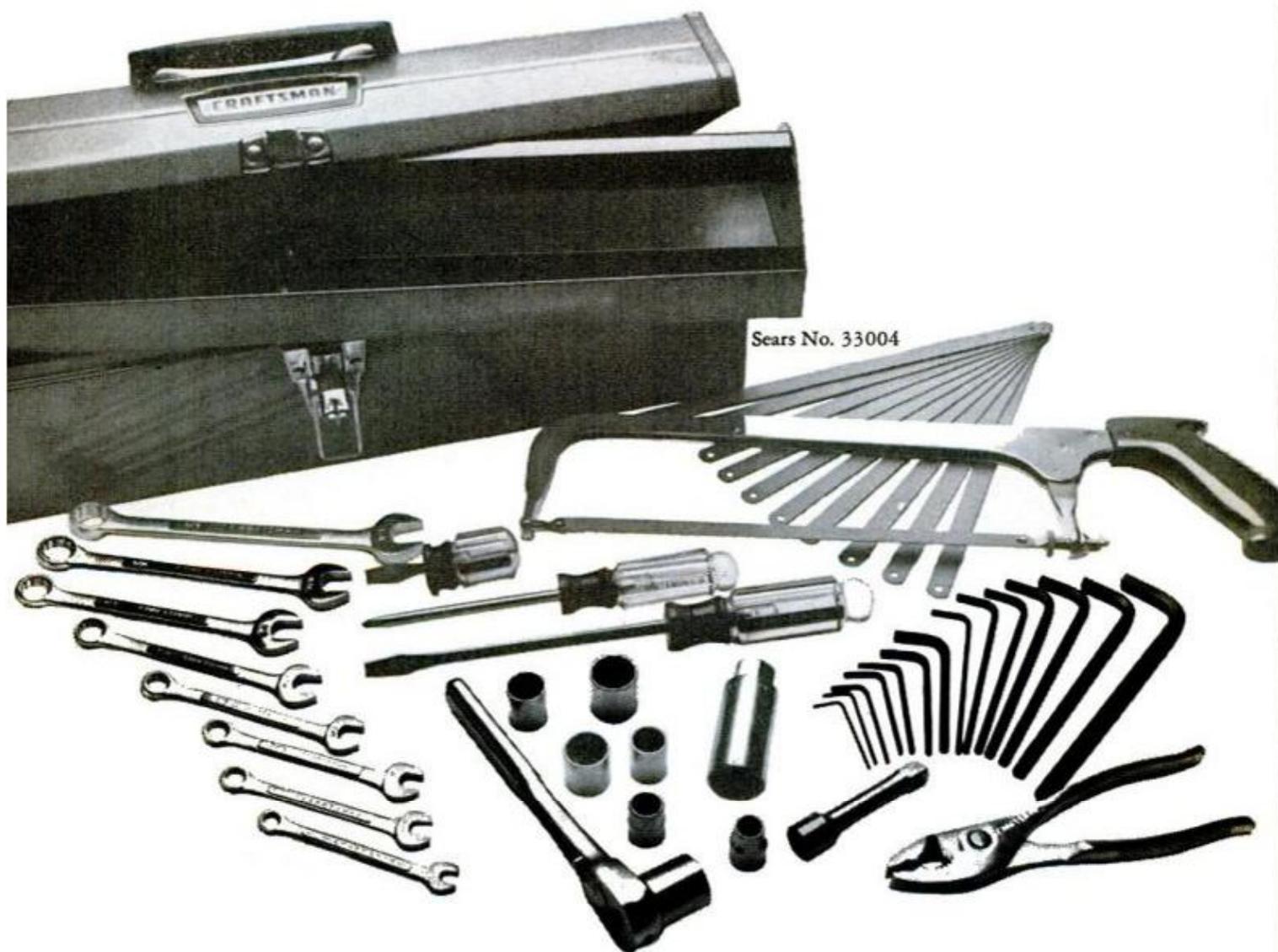
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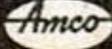
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<input type="checkbox"/> 8" Power Saw at \$14.95	<input type="checkbox"/> Jointer-Planer at \$19.95
<input type="checkbox"/> Standard Rip Fence #354 at \$3.50	<input type="checkbox"/> Lathe at \$9.85
<input type="checkbox"/> Long Rip Fence #354C at \$4.50	<input type="checkbox"/> Set of 3 High Speed Turning Chisels at \$4.95
<input type="checkbox"/> Belt Sander at \$14.95	<input type="checkbox"/> Drill Press at \$29.95
<input type="checkbox"/> Mitre gage for Sander at \$1.95	<input type="checkbox"/> Disc Sander at \$7.95

1/2 hp GE Motor } \$14.80 (purchased with other item)
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SAW BLADE TILTS... TABLE STAYS LEVEL

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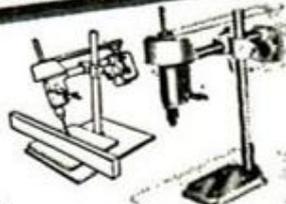
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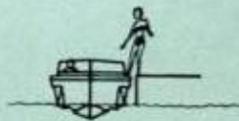
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