

Russia's 'Unbeatable' MiG-23

HOW IT WORKS:
Football's Instant
Replay Page 108

POPULAR MECHANICS

NOV. 1971
50 CENTS

Snowmobile Ordeal at 10,000 Feet

Eyewitness account of a tragedy that almost wiped out two Viking linemen

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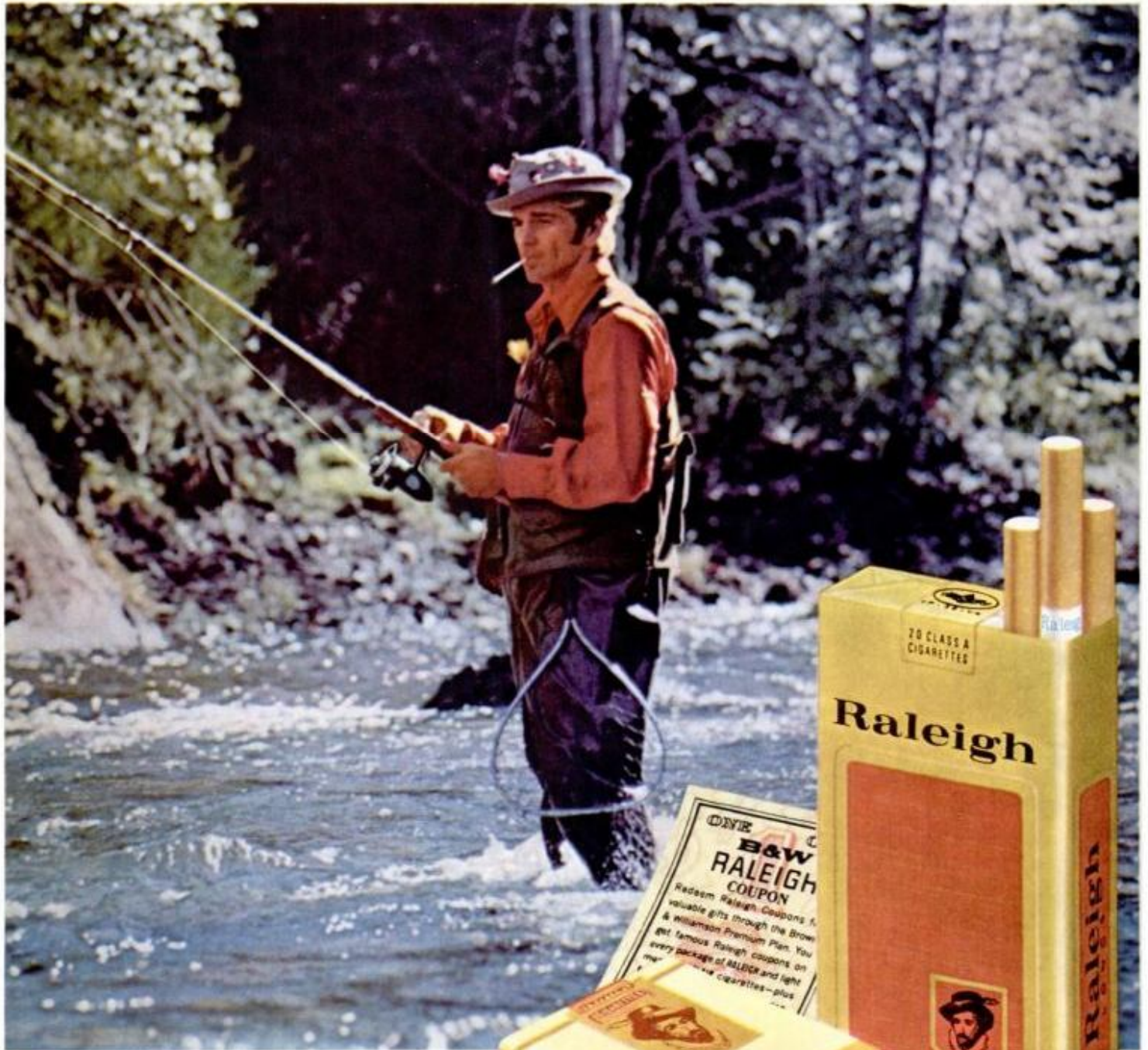
300-MPH MONORAIL Page 81



**Electric
'Greeting Card'
For Your Yard** Page 152

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Filter Kings, 17 mg. "tar," 1.2 mg. nicotine; Longs, 18 mg. "tar,"
1.3 mg. nicotine, av. per cigarette, FTC Report Aug. '71

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This Christmas go back to tradition

Golden 39A

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Zane Grey Century

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Can a hunter learn anything from a skeet shooter?

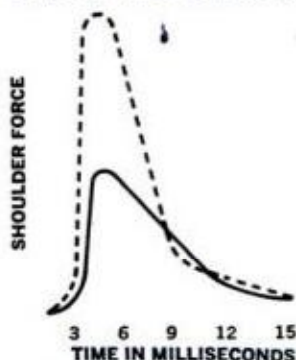
"Yes", say Remington experts . . . including why our Model 1100 Automatic Shotgun—the top gun in skeet—is tops in the field!

It's said some hunters don't shoot skeet because they can't eat clay pigeons. But, if you don't count taste and plumage, there is virtually no difference between a clay bird and a game bird. As far as a wing shooter is concerned, both are moving targets with the same problems of pointing, swing and lead.

If you go hunting with a skeet shooter, don't bet against him. Because skeet actually came from the field. It was developed about 50 years ago by the late Charles E. Davies, at Andover, Mass. He was an avid upland game hunter and wanted to practice shots he had missed while hunting. And don't forget that a dedicated skeet shooter may shoot at *thousands* of clay birds a year, each one simulating a game bird in flight. So it would take a really tricky bird to fool him. Naturally, like the hunter, the skeet shooter wants a shotgun that points naturally, patterns consistently and is reliable. That's why you'll find so many Model 1100's in the hands of so many skeet shooters, especially at championship events.

When you hold an 1100, you can tell it's different. The 1100 is designed with "muzzle preponderance" . . . balanced so there's weight at the muzzle. We believe this helps you hold an 1100 steadier than a shotgun without it. And we think it helps you point easier and faster and swing more smoothly, too.

Remington designers have given the 1100 a rate of fire they feel is optimum. Pull the trigger, and the 1100 ejects the empty hull and chambers a fresh shell automatically. You can fire again as soon as this cycle is complete. But, if the cycle takes too long, you may lose the chance for a quick second shot. And if the cycle is too fast, you're apt to shoot too soon . . . and miss. Remington's designers believe that the 1100's rate of fire is an ideal compromise between those two extremes.



The dotted line shows the recoil force from a typical fixed breech shotgun action (Shotgun weight: 7 lbs. 2 oz.). The solid line shows the recoil force delivered by a Model 1100 (Weight: 7 lbs. 12 oz.). Checked and proved by computer, the Model 1100 delivered 55% less force than the fixed breech gun. Each gun tested with a 12 ga. magnum load.

The 1100 really reduces recoil sensation. Remington has found a way to "soften" recoil sensation by distribut-

ing it. The chart shows how the Remington Recoil Reduction System works by plotting shoulder force against time. The dotted line shows what happens when a 12 gauge magnum load is fired in a fixed breech shotgun of approximately the same weight as the model 1100. The recoil quickly rises to a high peak. The solid line shows the recoil when the same load is fired in an 1100. The line starts to rise but the system traps some of the recoil force, releasing it later. Thus you feel a "push" instead of the usual jolt you can get from a competitive gun.

If you like good-looking shotguns, you'll like the looks of an 1100. Those looks are functional, too. Our RK-W wood finish does more than dress up the stock. It's tough and scratch-resistant. Our "vibra-honing" metal finish not only permits a deeper, richer blueing . . . but it also makes the working parts smoother so there's more glide and less friction.

The Model 1100 comes in 12, 16, 20, 28 and 410 gauges. And there are optional interchangeable barrels within each gauge. In addition to the standard models, there are three-inch magnum 12 gauge, two lightweight 20 gauge models (one a magnum), deer models with rifle sights, and trap and skeet versions. Prices start at \$184.95*.

Use the shells we test the 1100 with. The champions do. Here's something else you can learn from skeet shooters: use Remington-Peters shells. That's what both the High Overall World's Champion and the runner-up did in *all* events at the 1970 World Skeet Championships. Skeet shooters know their ammo as well as their shotguns.



The Model 1100 is available in these 5 gauges.

Remington Reports are based on information direct from the men who design and engineer our products. If you'd like a free folder to keep them in and a free 1971 color catalog, send a postcard to: Remington Arms Company, Inc., Dept. 321, Bridgeport, Conn. 06602.

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Model 1100,
12 Gauge,
Vent. Rib

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Cover Illustration by Ed Valigursky

300-MPH Monorail—An idea developed from a futuristic toy that may revolutionize mass transit

NEXT MONTH IN PM

Race your own radio-controlled car.
PM builds and tests three trailbikes.
Men against the sea: a salvage team.
Kawasaki's hot new 350.

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LETTERS

TO THE EDITOR

Saturday Mechanic

Do All of Your Own Routine Service and Maintenance (page 122, Sept. PM) by Mort Schultz is a slap in the face to all service stations and owners. Aren't the service stations and garages entitled to a living? Why don't you attack your magazine industry? I will not renew my subscription or ever buy another PM.
MASSENA, N.Y. P. W. SKARLOW

There are at least a dozen magazines running home improvement, woodworking and furniture articles. There are just as many running auto and auto-repair articles. Mort Schultz is probably the publisher's son-in-law so you have to run his woman's-magazine-type auto articles. Why not run some honest-to-God mechanical articles like projects for a 9 or 10-inch engine lathe?
BERKELEY, CALIF. M. V. CONN

For several years I have read and enjoyed Mort Schultz's *Automobile Clinic* and articles on car repair and maintenance. I knew nothing about cars and engines until I received PM some years back. Now I service and repair my own cars and sometimes those of my friends.
MERRICK, N.Y. J. HENRY JONQUIERE

See here, male chauvinists

I was thoroughly enjoying the September issue until the caption on page 143, "... even your wife can tile a floor" (*Tiling is Now Easier Than Ever*) hit me square in the face. What you do not seem to realize is that women can sometimes even outdo their husbands.

My husband is marvelous at growing a bountiful garden, but he cannot drive a nail straight. So please take back that ill-advised statement or I'll bet I won't be the only woman cancelling.
TOPEKA, KANS. MRS. A. SIEFERT

The price of a nine-tile package of Place 'n Press tiles was incorrectly quoted at \$16. Correct price is \$3.75.
ARMSTRONG CORK CO. ROBERT K. MARKER
LANCASTER, PA.

New—each quarter century

A Lifejacket for Torpedoes (page 71, Aug. PM) certainly is not new. It was de-
[\(Please turn to page 8\)](#)

POPULAR MECHANICS

Материал, защищенный авторским правом

Do you have the makings for a career in Computer Programming?

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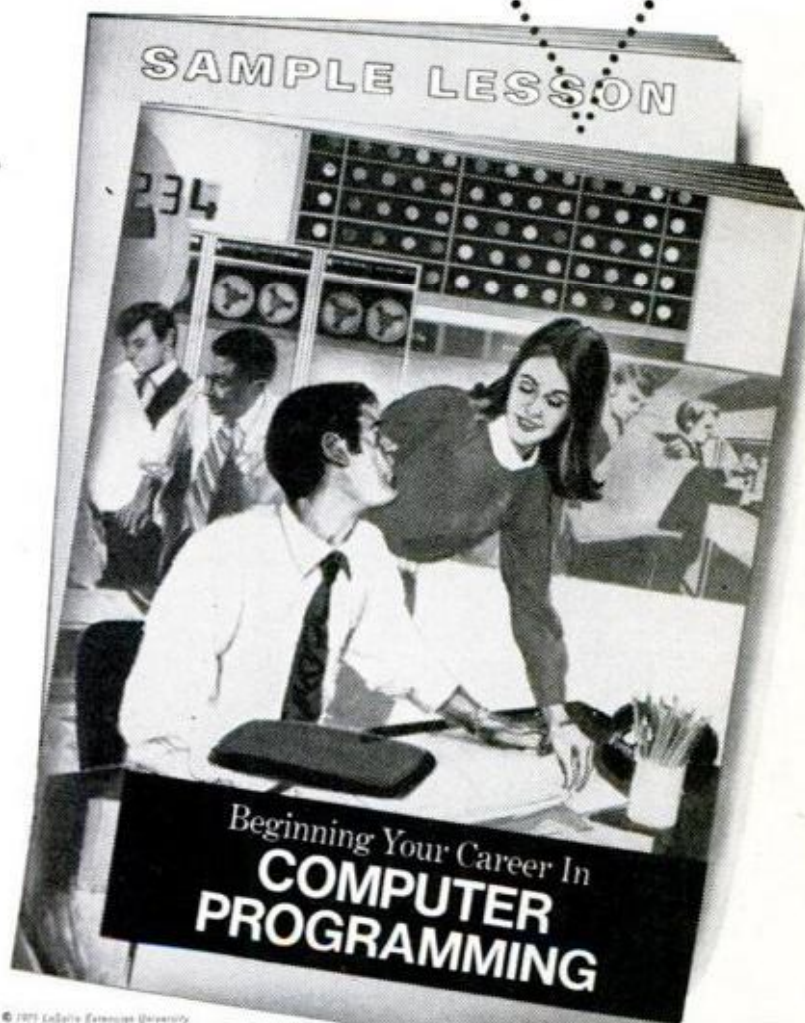
Newcomers begin at good pay and with experience there are many opportunities for advancement and really fine earnings. Employers consider education and a logical mind, as well as prior job background (including any in a related field) when hiring trainees. Once started, it's up to you. Programmers are employed in many types of business—in banks, utilities, department stores, manufacturing.

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LETTERS

(Continued from page 6)

veloped under a Navy contract at General Electric; the tirelike inflatable tube was developed by Goodyear. This was done in 1948, and the exercise head was used by the Navy on test firings at Newport that year. Maybe after nearly 24 years, something old is new again.

LAFAYETTE HILL, PA.

P. H. ALSPACH

Backward Houston

Reading *Nature's Secrets From the Sky* (page 68, Sept. PM) is informative and interesting. However, the MSA photo of Houston on page 71 was printed from a negative that was obviously reversed. Houston is northwest—not northeast—of the main body of Galveston Bay.

CORPUS CHRISTI, TEX.

J. R. COKER

Our atlas bears out reader Coker: We printed Houston backwards.

Trireme from the 30s

I think the new generation should see the *Grecian Trireme War Galley* you published in 1938 in your February issue (page 280).



I am over 75 years old, and work like this keeps my mind sharp. It took three winters to make. The hull is pine and the rest is maple.

RIVERSIDE, ILL.

ERNEST ASCHBURNER

Guns without the maze

The facts in *Is There Really an All-Around Rifle* (page 106, Sept. PM) were presented in such a way that the average person (who isn't a gunsmith) can easily understand them without going through the usual maze of ballistics tables. I'd like to commend the author.

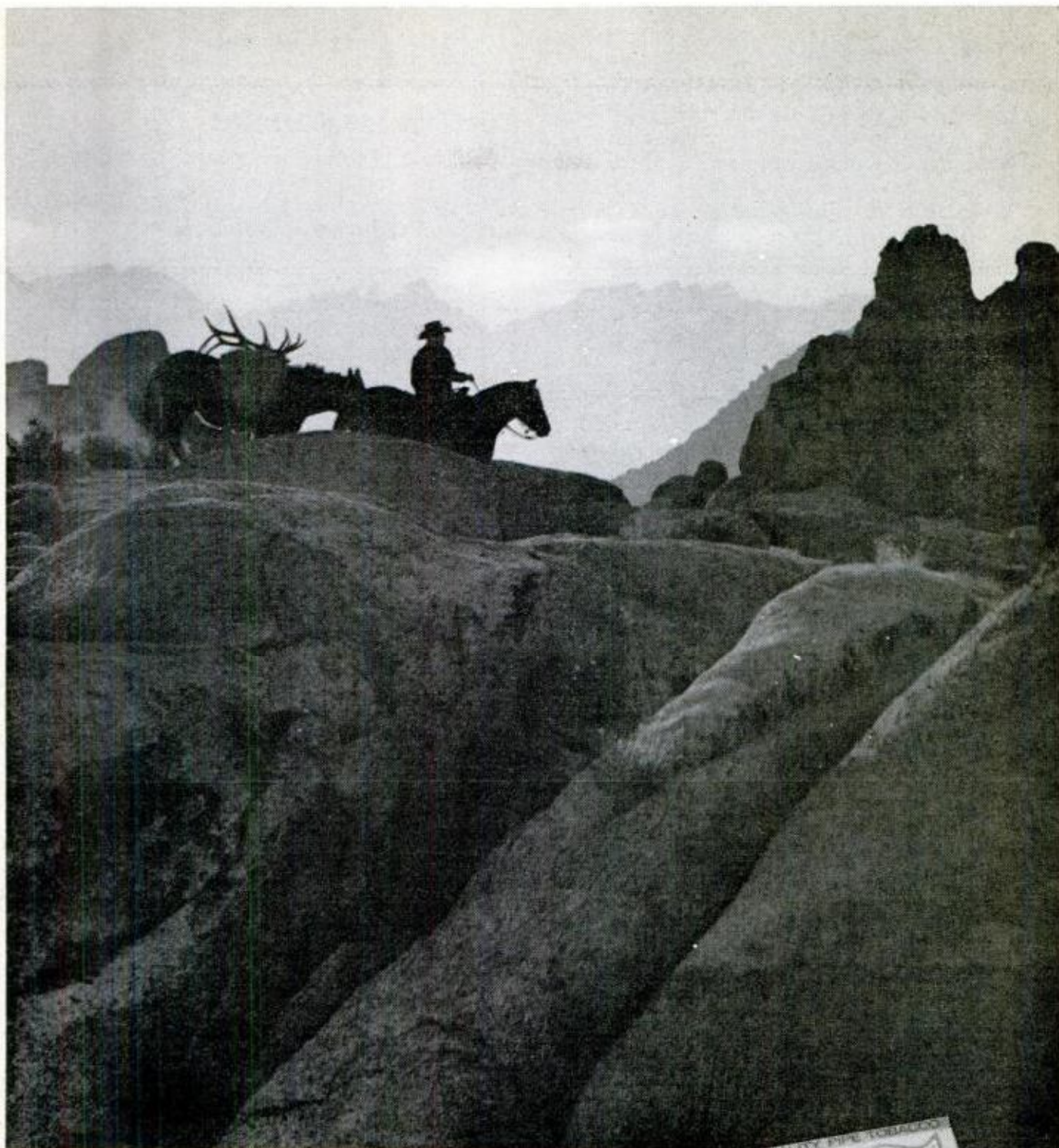
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MICHAEL COUSINO

New formula for Grand National

Right after going to press with Jake

(Please turn to page 10)



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A quality product of Philip Morris U.S.A.



LETTERS

(Continued from page 8)

Reichert's question about NASCAR carburetor plates in last month's *Drivin' With Dan* (page 48), the rules were changed! Replacing the plate requirement is a new formula for carburetor base openings. Carburetor discharge-bore size is now specified for each type and make engine competing on the Grand National circuit.
SANTA ANA, CALIF. DAN GURNEY

Tic-tac-toe

I always enjoy making those small projects such as *Tic-Tac-Toe You Can Play Anywhere* (page 153, April PM). Your



author stated that it is a one-session project; it is—about a week long.

LEONIA, N.J.

CARL STEUER

Multicolored taillights?

Why can't car manufacturers install taillights that shine green when the car is accelerating, yellow when it's not accelerating and red when it's braking?

I know of several instances in which near-accidents could have been avoided had there been this kind of warning light to alert an oncoming driver.

In 1969 I read of a University of Indiana engineering instructor whose experiments indicated the multicolored taillight is a cure for many rear-end collisions. Yet no manufacturer has put the light on his car. What's wrong with the idea?

BURLINGTON, IOWA

KEITH FOLEY

Christmas lawn display

Thank you very much for the unusual Christmas display plans you have printed in PM. I built the *Two-Way Season's Greeter* (page 136, Nov. '68 PM) and put it on display this past Christmas. I hope you don't mind that I added some ideas of my own. The candles "burn" continuously,

(Please turn to page 12)



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Each time a buddy of mine moans about the lousy repair job he got on his refrigerator or toaster or washing machine, I'm reminded of the fact that a good Appliance repairman is a mighty rare breed these days.

This neighbor of mine had refrigerator trouble just last month, and needed some speedy repair service. After phoning half a dozen repairmen who were booked solid for days, he finally had to settle for a bum job from a guy who had no business calling himself an Appliance repairman. This brings me to an important point. No one who wants to earn money in Appliance repair needs to learn by trial and error. There's a great, low-cost home study plan on the market that covers every type of Appliance repair in detail. The course was prepared by the Appliance Division of the National Radio Institute, one of the biggest and best schools in the field. Thousands of guys like yourself have studied with NRI, and many of them have more than paid for the low tuition fee within their first couple months servicing Electric Appliances.

If you want to make money (and who doesn't) in a field that's crying for good talent, make certain you send for a free NRI catalog. Get the details on the well-illustrated lessons that teach you how to repair home, farm and commercial Appliances, and small gasoline engines. You'll be amazed at how little the training costs. And you'll even get a professional Appliance Tester without extra cost.

NRI has been in the home study field since 1914, and they have a staff of 150 experts in Washington, D.C., who guide you through the course with more personal attention than you'd find in some classrooms. If you're really out to learn, they can furnish a



special course in air-conditioning and refrigeration repair, too.

Even if you've never tried to put a toaster in working order, even if your schooling never went beyond the tenth grade, I'm as certain as my name is McCahill that you can make money in the Appliance repair field with the help of this NRI course.

Do yourself a favor right now. Send off the coupon below and NRI will send you a free catalog. If you don't like the looks of this material, you can forget the entire deal, and you'll be out only one postage stamp. But remember, the Appliance repair field needs qualified men *now*. And you can qualify with NRI training.

Tom McCahill

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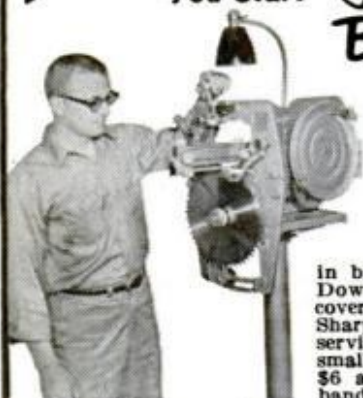
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LETTERS

(Continued from page 10)

and I included a stop-and-go feature. The candles turn 180° and, when they're in perfect alignment, they remain stationary for 10 seconds while they display their message. Then they turn 180° and remain stationary another 10 seconds.

TONKAWA, OKLA.

JOHN P. FISHER



Any other readers who'd like to build the rotating candle display can order Xerox copies of the article. Just send \$1.05 to Popular Mechanics, Dept JL, 224 West 57th St., New York, N.Y. 10019. (And don't overlook the brand-new project on page 152 of this issue.)

Hi Sibley

We were saddened to learn recently of the death early this year of Hi Sibley, whose name many of you will recognize as a long-time contributor to PM. If there is such a title as "dean of do-it-yourself writers," we feel that over the years Hi surely earned it. His first contribution to this magazine was in 1918. ★★

POPULAR MECHANICS

Материал, защищенный авторским правом



The master midget builder.

For 35 years Leonard Gonsalves has been building racing machinery.

"When I got out of school somebody sold me a bandsaw for \$7.00. So I built a racing boat. It went real well, so I built some more and sold them.

"Then I started building

midget race cars. I guess that's what I always wanted to do. I've got a real beauty down at the shop now. It'll be the fastest one I've ever seen.

"I bought the Ford Ranchero to take my racers to the track. And I switched it over to Champions first

chance I got. Well, you know, I've always raced with Champions and I guess I know what's best for an engine."



Toledo, Ohio 43601

**6 million Ford owners have switched to Champion Spark Plugs.
This has been one of them.**



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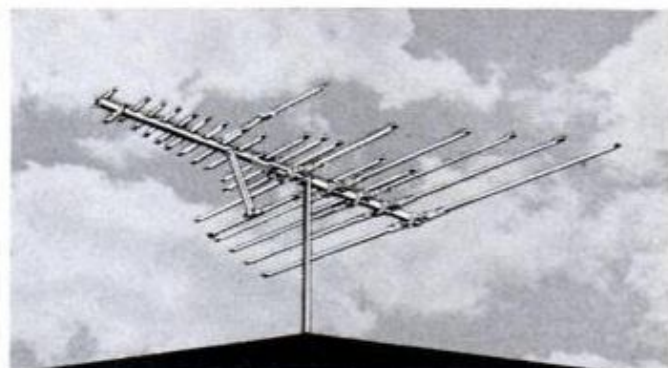
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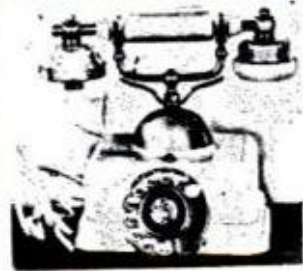
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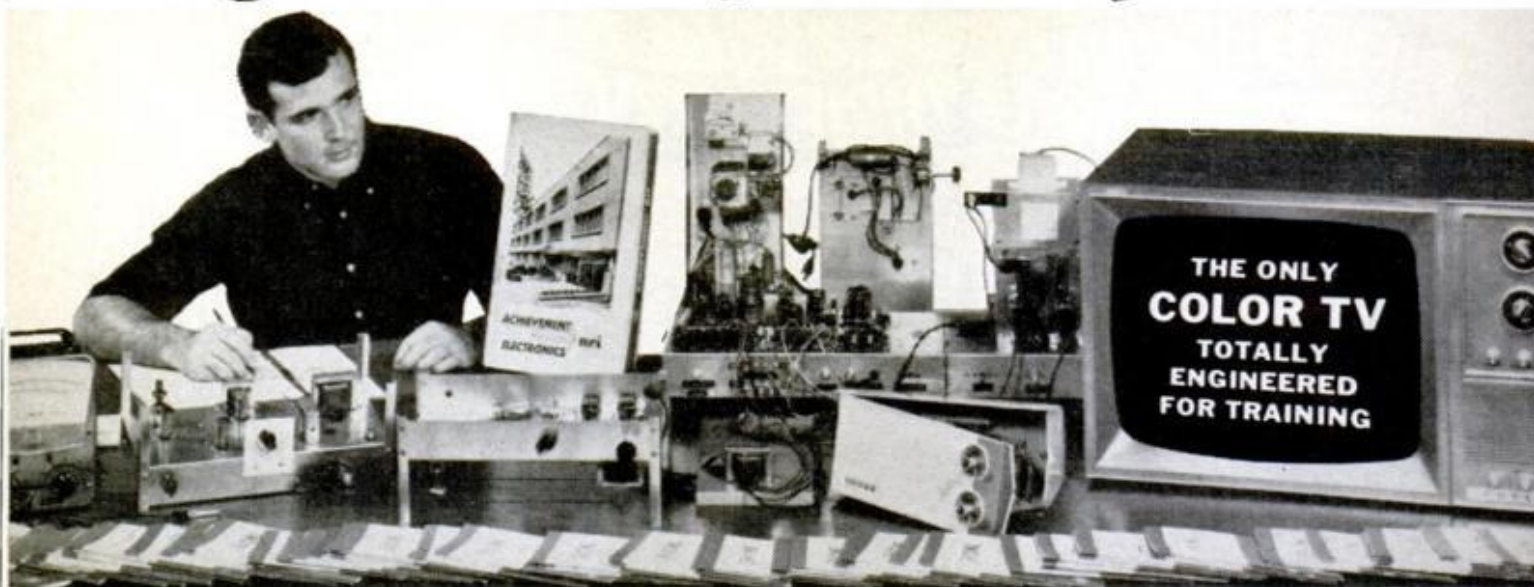
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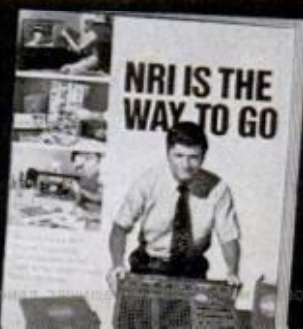
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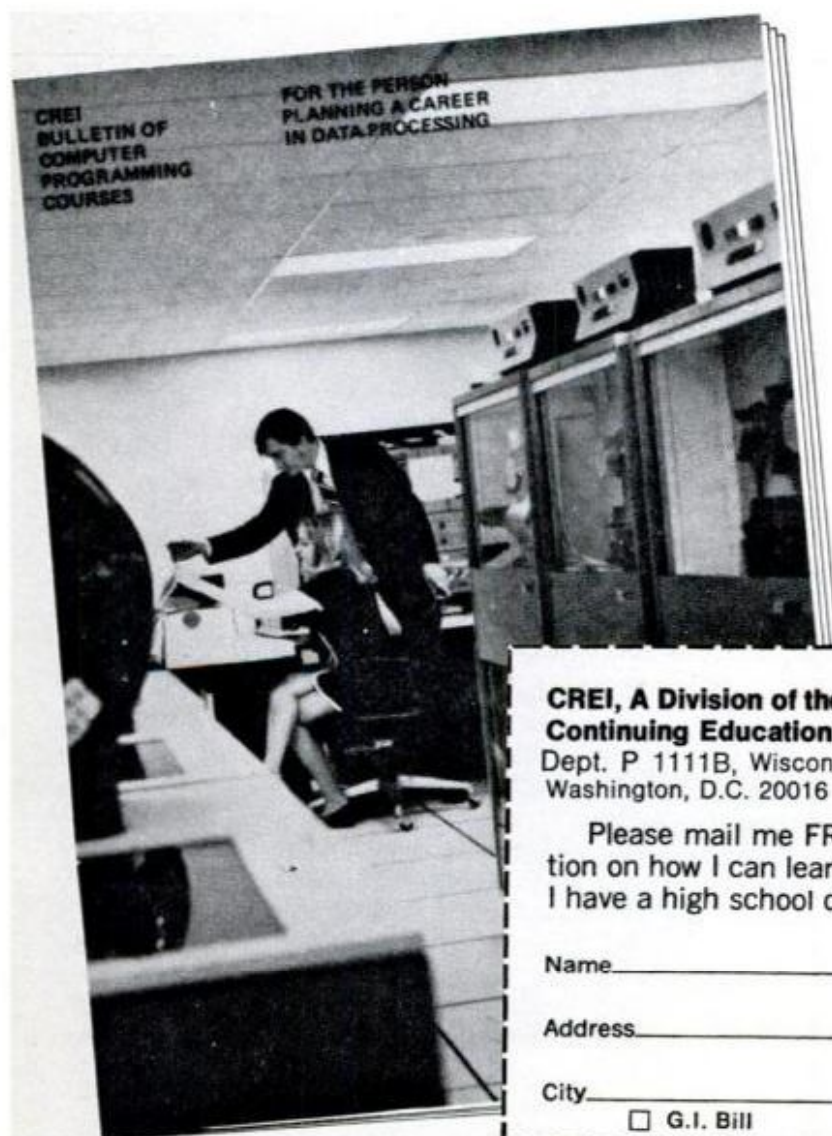
Please mail me FREE booklet with complete information on how I can learn computer programming at home. I have a high school diploma or the equivalent.

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SOLUTIONS FOR MECHANICAL HEADACHES

AUTOMOBILE CLINIC

BY MORT SCHULTZ

Cups and sources

Our car, a 1969 Pontiac Catalina with standard suspension, wears front tires rapidly in a pattern of repeated cupping (flat-spotting) around the circumference of both the inner and outer rows of treads. This has occurred despite numerous wheel alignments, balance, tire rotations, proper tire pressure and conservative driving. The dealer denies there is anything mechanically wrong with the car. Can you help?—Elmer R. White, Grand Lodge, Mich.

Cupping all around tires indicates out-of-round brake drums, uneven brake adjustment, loose suspension bushings or weak shock absorbers.

A knock in the head

Almost since the day of purchase of a 1969 Ford LTD with 429-cu.-in. four-barrel engine, the oil-pressure light remains on and the engine knocks for a few seconds until the light goes off. This occurs only if the car has sat for an hour or more. If the engine is restarted within the hour, this does not happen. I am on my third oil pump, and no one here (Ford or independent garage) has the answer. Can you help?—William P. Morris, Athens, Ala.

This is a tough one, but I'm convinced the trouble is not the oil pump. It is most unlikely you would get three faulty pumps in a row. Maybe you are using a viscosity of oil that isn't suited for your car and area. For example, if as suggested by your owner's manual for the temperature in your part of the country you are using an SAE 30 motor oil, perhaps it gets too thick as it sits. Maybe that's why you have the trouble after the car has been idle and the oil has had time to thicken, and don't have it when oil is warm and thinner. Your problem might be cleared up by switching to a multi-viscosity SAE 10W-40 motor oil.

Filler tube spills gas

I have a problem with a 1969 Chevrolet Nova that is both dangerous and costly. Gas spills out of the filler tube, and not only when the car has been sitting in the

sun. I have had a new gas cap put on, but this hasn't helped. I have seen other Novas do this as they have taken off from a stoplight. Is there a fix?—Michael Nichols, South San Francisco, Calif.

Make sure the car is equipped with the right gas cap. If it's right, check the gas-tank filler neck for damage. Furthermore, it should be angled. If it comes straight out of the gas tank, it should be bent up. Make sure, too, that the filler-neck cap sealing surface is free of dents that may be preventing the cap gasket from sealing.

Where'd the compression go?

My 1969 Volkswagen sedan has suddenly shown up without compression in the No. 2 cylinder, less than 5000 miles after the engine was analyzed and the valves adjusted by a VW agency. At that time No. 2 showed 125 pounds. The car has 33,000 miles and I use regular-grade Standard Oil of California gasoline only. Where did the compression go so suddenly?—Rachel Hamlin, Berkeley, Calif.

It could be that the head came loose, allowing loss of compression. If so, perhaps the head will have to come off for refacing or replacing. However, I think it's more likely that the fellow adjusting the valves tightened those in No. 2 too much, causing a burnout. I'd take the car back to the dealer. If he can't solve the problem, then contact the VW customer relations manager, Volkswagen of America, Englewood Cliffs, N.J. 07632.

Word from the far north

Recently while doing a job on my 1969 ¾-ton Ford pickup, I pulled the pan to clean it out and found a glob of gray sticky matter with the consistency of putty. I use Chevron Supreme 10-30 motor oil, and change it and the oil filter every 2500 miles, if not sooner. The temperature here averages only 40° and we have only 16 miles of blacktop road. Runs with the truck are short—it has only 16,000 miles on it. Can you settle my apprehension?—Marvin Kinberg, Sitka, Alaska.

Most times a gray color would denote
(Please turn to page 22)



Her first pair of skis. And he wants them just right. The right length. The right feel. He won't have it any other way. Their cigarette? Viceroy. They won't settle for less. It's a matter of taste.



Viceroy gives you all the taste, all the time.

AUTOMOBILE CLINIC

(Continued from page 20)

a moisture content, perhaps caused by condensation. To get a clearer picture of this, why not put some of that gray stuff in a vial and send it to the director of customer relations, Standard Oil of California, 225 Bush St., San Francisco, 94120. Ask if he would have it analyzed for you and what he suggests.

Hesitation problem

Several of us have the same size engine in our 1969 Chrysler-produced cars—a 318-cu.-in. with two-barrel Carter carburetor. We all have the same hesitation problem between start and warmup. When you step on the accelerator, the engine dies way down and almost stops. You have to feather the accelerator to keep the engine from stalling, but after warmup, it runs smoothly. Timing has been advanced from TDC to $2\frac{1}{2}^\circ$ to 7° advance, and also back to $2\frac{1}{2}^\circ$ retard. Carburetors have been adjusted and rebuilt, automatic chokes adjusted and re-adjusted. The vacuum advance is okay. Our last hope is you.—Lois Smith, Jackson, Mich.

This has been a problem for some time, but the solution may be as easy as directing your mechanic's attention to the carburetor section of the service manual. Have him adjust the vacuum-kick exactly as directed. This adjustment controls the fuel delivery while the engine is running. If it is made perfectly but the problem continues, try these other things. Have the accelerator-pump spring and metering-rod spring stretched about $\frac{1}{4}$ inch. Have the float level set a trifle higher than specification and have the metering rod jet drilled out to .051 inch.

Changing the numbers

Elmer Denis of Green Bay, Wis., asked if there was a way to keep his 1966 Oldsmobile Delta 88 from hesitating on acceleration during warmup (Automobile Clinic, page 48, May '71 PM). I recommended that a new accelerator pump be installed and inadvertently cited factory numbers that won't do you any good. The numbers you need to order this part (they apply to 1965, 1966 and 1967 models) are: for 425-cu.-in. two-barrel engines, part

No. 7032562; for 330-cu.-in. two-barrel engines, part No. 7032829; and for 330-cu.-in. two-barrel engines (HD), part No. 7038413.

Tough talk about tires

I would like to equip my 1968 Pontiac GTO convertible with steel radial tires. If I bought four, would I have to take all four off in order to use my regular bias-ply snow tires?—Fred D. Peckham, San Francisco.

Absolutely! The Department of Transportation advises you not to mix different types of tires. It says you may be able to get away with mixing regular bias and belted bias tires, providing each type is used in pairs on the same axle. However, the industry states unequivocally the vehicle will be tough to control.

Service Tips

● 1971 VWs, of all things, are being bugged by bad gas mileage. These cars have to be timed just right because of the effect of emission control devices or they will burn gas excessively. Dealerships now have a 12-point tune-up procedure to follow. If the shop chief looks at you crazy-like when you tell him this, refer him to page 7 of the June 1971 issue of the *Weathervane*, which is an official VW publication.

● If your 1971 Chrysler Corp. car with 225-cu.-in. engine is leaking oil, could be that the oil-pump-to-cylinder block joint face is slightly out of flat. Have the oil pump removed and then reinstalled using two gaskets (part No. 2121404).

● FoMoCo has spelled out what it means in owners manuals when it says that "more frequent service" is required if your car or light truck is operated in dusty or low-temperature areas. Change the oil and oil filter every 3000 miles or three months, whichever comes first, if operation includes periods of idling or low speed operation of the variety done by taxis and door-to-door delivery trucks; if you tow a trailer with over 2000 pounds gross weight for long distances; or if outside temperature remains below 10°F . for 60 days or more and most trips are less than 10 miles. Basic oil and filter change interval for normal operation stays at 6000 miles or six months. ★★ ★

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



Now Ford gives you a choice of swinging or sliding doors.



Sales leader for 11 straight years.

Only Ford vans have so many better ideas that make vans easier to drive, to service, to use.

New Econolines now offer a choice of swinging doors or a new gliding side door for cargo handling in cramped quarters. Three tracks, at top, bottom and center, give solid support for smooth operation.



Wider at top for built-ins. Body sides are more vertical, wider apart at top than other vans. Built-in units fit better and leave more aisle.

Shorter outside, easier to park. Compared to other makes of

similar loadspace, Econolines have significantly less overall length, for better maneuverability.



Easy, out-front servicing. Routine service points are right at hand under convenient outside hood: water, oil, battery, wiper motor, many others.

Strong, Twin-I-Beam Independent Front Suspension—Ford's exclusive design smooths the going for both load and driver. Two forged steel I-beam axles provide strength and durability; wide wheel stance means stability in cross winds.



Engine clear forward. In Ford's clear-deck design, engine is all the way out of cargo area. Over 8½ ft. clear floor space behind driver's seat... over 10 ft. in the SuperVan. Maximum payload over two tons.



**FORD
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VANS**





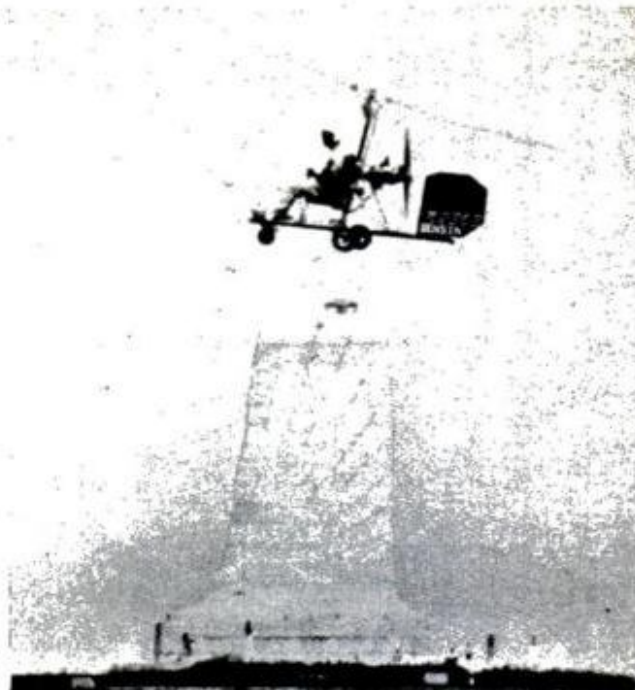
Basketball on ice skates

They play basketball on ice skates in the West Suburban YMCA, LaGrange, Ill. Covered with $\frac{1}{4}$ -inch-thick Slick, a product of Vinyl Plastics, Inc., of Sheboygan, Wis., the gym floor is the largest iceless ice-skating rink in the world. The material is removable.



Skiing on plastic 'snow'

Heini Messner (top), a leading Austrian skier, zips down a plastic "snow" ski trail at Bergamo, Italy. The year-round slope is surfaced with Ultrathene, an ethylene-vinyl acetate copolymer that rivals real snow for softness and slip characteristics.



Cross country by gyrocopter

Flying past the Wright Brothers monument at Kitty Hawk, N.C., Ken Brock completes a 3400-mile gyrocopter flight from Los Angeles. Covering 350 to 400 miles per day, Brock navigated by ordinary road maps; his only instrument was an airspeed indicator.



Racing on milk cartons

A 50-foot-long boat whose flotation consisted of 2600 empty milk cartons (top) was the longest boat in the First Annual Milk Carton Boat Race during the Minneapolis Aquatennial. One heat of the unusual contest is shown in the bottom photo.

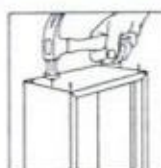
Mellow Old Crow Bourbon begins with men who love to work with their hands.



Many a morning, Cecil Goins warms up for his Master Cooper's job by turning out clock cabinets. By the time he arrives at Old Crow, he can repair a barrel with such skill, the Bourbon mellowing inside never knows its long sleep has been disturbed.

Craftsmen made Old Crow famous. Back in 1835, our people figured out the formula that made Bourbon taste good, bottle after bottle, and later they handmade the first sour mash Bourbon. We still use our hands in making Old Crow.

Like to try your hand at cabinet making? We'll send you the same plans Cecil Goins used. Write: Old Crow, Box 675, Frankfort, Kentucky 40601.



Glue, then nail cabinet joints with blunted finishing nails.



Hinge door. Use 1 screw in each hinge leaf for trial fit.



Put clock close to door for best visibility. For plans, see address at left.

Old Crow
The Bourbon Made
By Good Kentucky Hands



HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

Paint failure

Why does paint fail earlier on the south and west sides of my house?—S.M., Iowa.

What you describe is not so much paint "failure" as ordinary day-to-day exposure to the elements. Paint on all houses, in any climate, will always have a shorter life on the sides exposed to the sun. If you take a good look at your roof, you will find the same holds true for asphalt shingles. If you are trying to cut down on the painting chore, your best bets are to use a high-quality paint and to give some thought to applying an extra coat to the south and west walls.

Paint-stained concrete

I accidentally spilled about a pint of green paint on the concrete floor of my breezeway. Of course, I mopped it up but that green stain won't come off. What to do?—E.H., Tenn.

A wash-off type of paint remover just might do it. Here you have to watch the remover closely after applying it to see that it does not evaporate to the point where it won't wash off readily. After rinsing with clean water you may need a second and possibly a third application.

Or, you can make a thin paste by adding trisodium phosphate (about a double handful to the gallon of water), spread and cover with a cloth. Scrub away just before the stuff dries completely and rinse thoroughly.

As another alternative, you might use a wire brush or masonry abrasive disc chucked in your electric drill.

Insurer's imprint

I have an oval-shaped object of lead or other soft metal and about 3 inches long. It's somewhat damaged, but what appears to be the imprint of a fireman is on one face, plus traces of red and white enamel. From this description, can you tell me what this object might be and what it was used for?—A.O., R.I.

I'm guessing it's what was known as a "fire mark," which used to be provided by an insurer for an owner to attach to his house in a conspicuous place. Its

purpose was to alert local firemen and others called in the event of a fire that the home was insured and assure them that they would be paid for their smoke-eating efforts.

If genuine, such an imprint might have some value as an antique.

Blistered tile floor

There are two blisters in my asphalt-tile basement floor. These are at the point where the corners of four tiles meet, the raised portions being only about 3/8 in. high and perhaps 2 in. in diameter. When pressed down, they spring up again. How can I remedy this?—D.F., Utah.

First, I'd dampen a washcloth, fold it double, place it over a blister and hold a household iron on the cloth while the iron's switch is set at the silk setting. The trick is to apply just the right degree of heat—and no more—to soften the cement. Then lift the iron and cloth, and place a weighted block over the blister. If this doesn't do the trick, remove the tile and old mastic and apply new adhesive.

Concrete floor slant

I'm replacing a wooden porch floor with concrete and disagree with my contractor when he says 1/2-in. pitch, or slant, of the floor, will be sufficient for drainage. I think it should be at least 1 1/4 in. Who's right?—O.T., Mass.

Standard pitch for water runoff is 1/4 in. per running foot. Thus, if your porch is 8 ft. wide, the high end—at the house—should be about 2 in. higher than the outboard edge. If your personal taste rules out this much pitch, I would not recommend a pitch of less than 1 in. For your peace of mind, "positive" water runoff is a must.

Don't shake that varnish!

Recently I was told never to shake a can containing varnish, but my informant did not know why. There must be a reason. What is it?—Y.M., Wash.

In a can containing varnish from which some of the contents have been used, air is entrapped when you replace the lid. If you shake the can prior to use, tiny air bubbles will form in the varnish and these will be picked up by the brush and laid on the surface being finished. As the varnish dries these form tiny flecks you can feel when you pass a finger over the surface. Always stir—never shake—varnish.

★★★

Get away from the crowd.
Get all the flavor you want in
Old Gold Filters.



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



15 mg. "tar," 1.2 mg. nicotine av. per cigarette, FTC Report Nov. '70.

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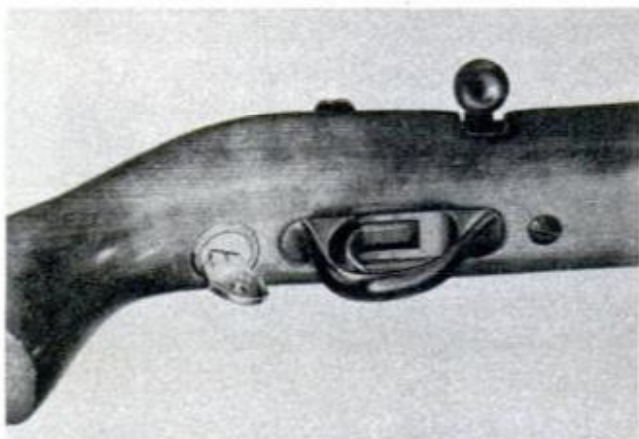
ALL BY GEORGE REIGER OUTDOORS



MOST DOG-TRAINING DEVICES use short-lived model airplane control components in a heavy metal case. Jetco Electronics has "built a better mousetrap" using 40-hour batteries in a plastic pack.



ONE WAY TO WARD OFF antigun feeling is to introduce the entire family to the pleasure of plinking. Smith & Wesson brings its long experience in making quality handguns to the manufacture of a pellet pistol patterned after its successful Model 41 .22-cal. target automatic. Ideal for basement target practice or for training your wife and kids to shoot, the CO₂ unit retails for \$35.



A LOCK IN A RIFLE is one way to keep the kids from using your firearms. And a Model 63-K (for key) lock gun from Savage Arms provides a smart solution for the growing problem of theft, too.

(All Outdoors [continues on page 30](#))

DIVERSIFICATION IS THE NEW NAME OF THE GUNNING GAME—1971 is the centennial year of Harrington & Richardson, a venerable firearms firm in Worcester, Mass. It's also the year H&R became exclusive U.S. distributor for Hardy rods, reels and angling accessories imported from England. This linking of flyrods and firearms is symbolic of change throughout the gunning industry.

For years gun manufacturers presumed a kind of invulnerability. Americans showed an everlasting interest in firearms, and a growing population seemed to promise profits for years to come. Then President Kennedy was shot, and waves of antigun sentiment gave the gunmakers second thoughts about the value of specialization.

The result is that today Mossberg makes campers, Colt sells knives, Winchester markets boots and books, Sturm Ruger is in industrial hardware, and Browning and Garcia make or market just about anything for the outdoors. And the trend is growing. Don't be surprised to hear of Savage fishing reels or Remington snowshoes in the not-too-distant future!

A good friend is now easy to come by.

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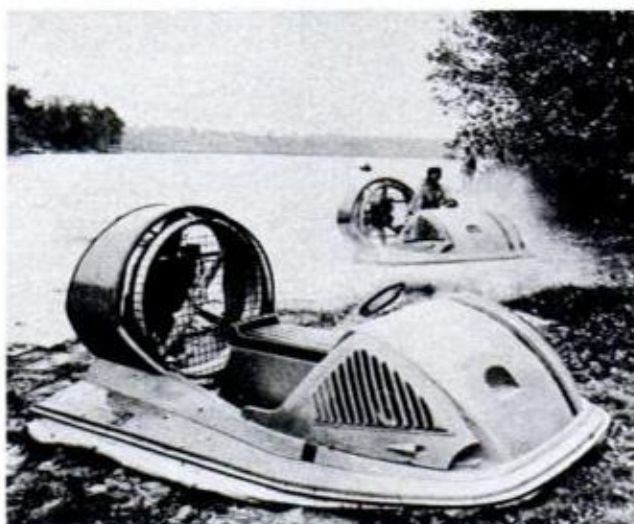
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ALL OUTDOORS

(Continued from page 28)



MINI-BASS BOATS are becoming popular. The Basshopper made by Jac-Raft in Ardmore, Okla., is a variation of the Water Wagon (see *Boats with a Purpose*, page 102, Sept. '71 PM) Its chief advantage over the Wagon seems to be that the caster has a higher seat off the water. But there's no place to mount a little gas-powered engine to move you quickly between hotspots, and the Basshopper weighs about 65 pounds more while supporting some 250 pounds less weight.



A COUPLE OF YEARS AGO, when E. Carl Kiekhaefer retired as president of Mercury Outboards, everyone wondered what this energetic pioneer of small engines would do next. Recently, this question had a partial answer. Carl has been named director of Canada's MHV Industries which makes recreational hovercraft (above.) He also produces a line of snowmobile engines and conversion units. In fact, he seems to be bringing his talents to all areas of recreation he missed during the first 30 years of his career! ★★★

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 Commercial Art
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 Illustrating
 — Advertising Layout
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Math and Physics for Engineers

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 Heating & Air Conditioning with Drawing
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 Paper Making
 Pulp Making
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 Secretary, Private
 Sec'y, Legal
 Sec'y, Med.
 Secretary, Executive

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 Stationary Fireman
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science worldwide

By JOHN PEARSON



Backpack for flying around lab

A BACKPACK MANEUVERING UNIT will be tested when Skylab, NASA's orbiting laboratory, is launched in 1973. Hand-controlled nitrogen jets will propel the astronauts within the confines of the big, 10,000-cu.-ft. lab. The experiment is part of a study of the feasibility of using maneuvering systems in free space. Skylab will orbit Earth at a 270-mile altitude.

A NEW TYPE OF THERMOMETER that can measure changes as minute as two-thousandths of a degree has been developed by University of Illinois scientists. It was designed to measure in the range from minus 457.69° to minus 459.13°F., where very small temperature changes are important in cryogenic phenomena. The thermometer consists of an aluminum wire, a solenoid whose magnetic field affects the aluminum's superconductivity, and detection coils to reveal the superconducting condition of the aluminum. Its operation is based on the fact that at extremely low temperatures certain materials lose all resistance to electricity and that this state of superconductivity can be affected by a magnetic field.

SPACE-AGE MEDICINE. With a new IBM system, a patient records his medical history by answering a filmed questionnaire presented on the screen of an optical image unit. In answer to a question about where pain is felt, the patient indicates the exact spot on a drawing by touching the screen with a "light pen." The system also automatically records results of medical tests. A computer compares these findings with norms established by the examining physician. When the last test is completed, the computer prints a detailed summary of each patient's medical history and test results for the doctor to analyze.

SAFER FOOTBALL MAY RESULT from a computer study recently launched by a group of physicians who have a professional interest in the sport. Data on injuries are fed into a computer and the printouts analyzed. According to Dr. Herbert W. Virgin, physician for the Miami Dolphins, the study could lead to a number of changes in football training schedules, rules and equipment.

FLY ASH—A POLLUTANT produced when coal is burned —isn't all bad. In it are glass bubbles that, according to a researcher at the Polytechnic Institute of Brooklyn, N.Y., can be used to make artificial wood, and insulating and buoyancy materials. Even at the ocean's lowest depths, says the scientist, few of the bubbles collapse. Under a microscope, they appear tiny when compared with grains of salt. ★ ★ ★



"Here's where it hurts the most"



The big ones are grains of salt

KEEP PACE WITH SPACE AGE! SEE MOON SHOTS—LANDINGS, SPACE FLIGHTS, CLOSE-UP!

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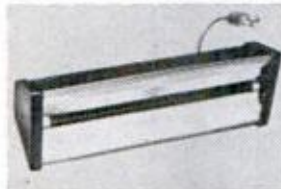
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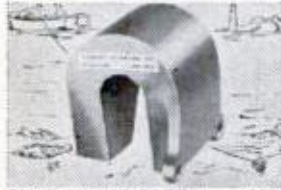
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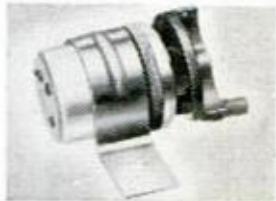
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This year your studded snow tires may be illegal!

By MORT SCHULTZ

STUDED SNOW TIRES, which have never been allowed in Mississippi and Louisiana, are now illegal in Minnesota, Hawaii and Ontario, Canada. In April, 1972, they will be banned in Utah. As this was written, Wisconsin, Pennsylvania, Ohio, Michigan and Iowa were considering a ban. In each case, the prohibition applies to out-of-state cars traveling through a state as well as to those of state residents.

A spokesman for the Illinois Department of Public Works and Bridges says, "I believe that by 1973 or 1974, most states will have made the use of studded snows illegal." And a Federal Highway Administration report to a U.S. congressional appropriations committee last April concludes that "damage from the use of studded tires is not compensated for by any reputed safety benefits."

The administration, however, is powerless to act in banning snow tires. So is Congress, except in the case of government-owned land, such as national parks and military reservations. Prohibition on all other roads within a state is left to that state.

Practically every state has had a law for many years forbidding the use of metal lugs on tires. Studs are considered as metal lugs, so when they first came into vogue in 1965 states had to pass "enabling acts" to make them legal. Such an act is good for a specific time and has to be renewed if what it permits is to remain legal. Mississippi and Louisiana never passed enabling acts permitting studs. Studs are therefore illegal in those states.

In Minnesota, the enabling act came up for renewal last May, but the legislature

didn't act. The law expired, making studs again illegal in Minnesota. This reversal was based primarily on a study made by the state's department of highways, which pointed out:

"Studded tires have damaged pavement surfaces, particularly on those highways with high traffic volume. Continued use of studded tires will necessitate substantial repairs in addition to those expected during the normal service life of the pavement."

By 1980, it will cost the taxpayers of Minnesota \$55 million to repair road damage caused by studded snow tires, according to the report, which added: "It seems reasonable to conclude . . . that if studded tires were discontinued there would be little appreciable change in traffic safety in Minnesota."

The advantage of studded tires, the study said, lies in their ability to aid vehicle performance on "warm, clean glare ice." As the temperature drops, however, and ice becomes colder and harder, the contribution of studded tires becomes "significantly smaller"—as it also does on rough or sanded ice and in snow and slush. "Improvements in vehicle performance through use of studded tires on ice are much smaller than improvements obtained by sanding, deicing chemicals and chains," the report says.

The report also states that road wear caused by studs could be contributing to such safety hazards as premature loss of pavement lane markings, loss of pavement grooving that aids in skid prevention, reduction in driving visibility due to increased splash and spray from water that accumulates in rutted wheel tracks, and adverse steering effects caused by rutted wheel tracks. Thus, studded tires may contribute to more accidents than they prevent!

Where does all this leave you? If you are thinking of equipping your snow tires with studs, you had better check first. And even though studs in your state may still be legal, most states ban their use for part of the year. In Delaware, for example, you can have studded tires on your car only from Oct. 15 to April 15.

Check the dates in your state with the highway department, a state vehicle inspection station, the highway patrol or a tire dealer. ★★★



PULL OUT STUDS WITH PLIERS if they violate your state law. Check before you have new tires studded

Jeep[®] guts pick up where others leave off.



Jeep Truck. The 4-wheel drive pick-up that hauls bigger payloads more places.

Pound for pound, this is one tough truck. It's built to work hard for you. And that goes for every single model up to the 8000 GVW model, with its whopping 3500 lb. payload capacity.

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the rocks seem softer.

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What are you waiting for? Saddle up and test drive a Jeep Truck today.

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Jeep

Drive your Jeep vehicle with care and keep America the Beautiful.

DETROIT

LISTENING POST

BY ROBERT LUND

LINCOLN-MERCURY'S DENIAL that it has any "definite plans" to produce a car smaller than Comet is accurate as far as it goes. But Ford Motor decides what L-M's product line will be, and the parent company is working on a sub-Pinto-size car. The new mini, when ready, will be marketed by the Ford Div. Then, if Ford follows past practice, L-M will get a Pinto-size car. With GM working on a minnow-size Cadillac, you can bet Ford's going to have whatever chips it takes to stay in the game.

GM HAS INSTALLED A COUPLE OF DIESELS in test cars as part of its all-out program to (1) lick the emissions problem or (2) develop a replacement for the conventional piston engine if it can't be cleaned up enough to meet anti-pollution standards. "But don't make a big thing out of the diesel jobs," a company source cautions, "because chances of our going that route are practically nil."

AMC ON A WANKEL ENGINE PROGRAM? While there may be no official announcement, that's the way the map reads. When GM was the only company working on a Wankel, American Motors could ignore it. But with Ford and Chrysler breathing on GM's heels, AMC can't afford to be left out.

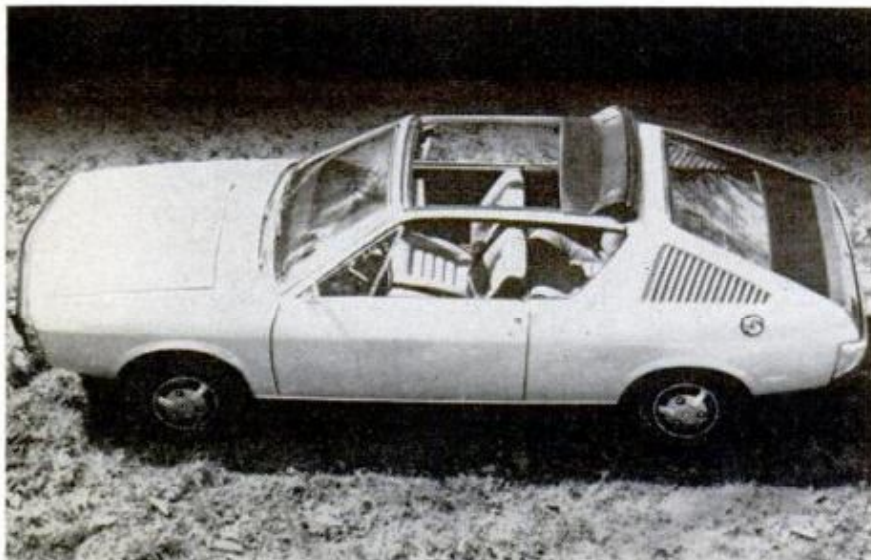
RENAULT'S NEW SPORTS CAR, the front-wheel-drive Model 17 (below), will make its U.S. debut next summer. The \$4000 two-door fastback is powered by a four-cylinder, ohv,

1565-cc, fuel-injected, aluminum engine that produces 120 hp at 6250 rpm. Luxuriously appointed, the car is 168 inches long overall on a 96-inch wheelbase and is good for 100 mph plus.

Scheduled to arrive next spring before the 17 is another fwd sports car, the Renault 15. It's only slightly different from the 17 with slightly less power and is expected to sell for about \$3300.—B.H.

DON'T LOSE ANY SLEEP over GM becoming another Penn Central or Lockheed if the big daddy of Detroit discontinues production of four-door hardtops a year or two down the road. GM's worked up a design with a pencil-thin center (B) pillar that's as attractive as any hardtop on the road now. In some mock-up versions, windows back of the B post are fixed permanently, but this could change if and when the cars go into production. GM hasn't said it's going to drop pillarless hardtops, but it's considering the idea because the addition of a B pillar makes for a safer car than a non-pillar in a rollover.

IF YOU'RE DISAPPOINTED in the '72 cars because they don't show much change from the '71s, you've got a lot of company. The guys who designed and engineered them feel pretty much the same way. Not that they're ashamed of their work, but they admit the cars don't show much in the way of innovation and imagination. Detroit's working under the most severe restrictions it's ever experienced. On one hand, cars must be built within limitations imposed by government regulations. That puts the screws on any flight-of-fancy designing and engineering. Carmakers are pushing greater interchangeability of parts and sheet metal—using the same item or pattern in several cars—as a means of reducing costs. That puts the clamp on individuality. But things will get better, cars will improve in looks and mechanically. It's just a matter of engineering. (Please turn to page 40)



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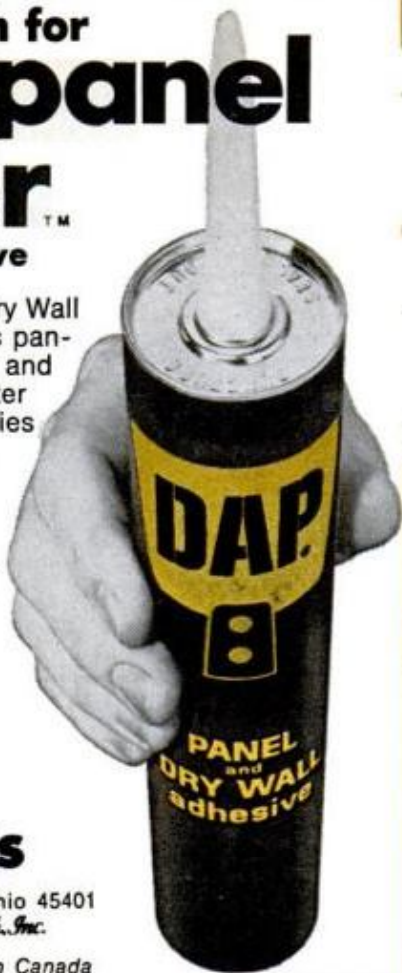
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DETROIT LISTENING POST

(Continued from page 38)

neers and designers learning how to operate within the confines of the situation, getting used to the handcuffs and shackles. The spirit of adventure isn't dead in Detroit. It's just in a state of catalepsy.

THE AUTOMAKERS—Chrysler in particular—are subtly trying to create greater distinction between cars in different price brackets: low, medium and high. There was a time when you could peg the approximate price of a car just by looking at it. But not in recent years. Some marketing men now believe the lack of distinction undercuts the sale of expensive cars. At least in the case of buyers who still fall for the "keeping up with the Joneses" flim-flam. Why put out \$3500 or \$4000, the theory goes, if the more expensive machine can't be distinguished from a \$2500 car? The auto firms want to bring back some of the snob element, but without offending buyers of low-price cars. Read the ads and you'll see how they're trying to psyche you to go for the big ticket.

MUSTANG WILL UNDERGO a major change in 1974, become a smaller car and probably lower priced. How? For one thing, beginning with the '74 version it will be built on the Pinto frame. Mustang's original appeal was to young buyers. Not only from the standpoint of looks, but because it was priced right—in the area of \$2500. Now it's over \$3000 and if you take a few extras it can top \$3500. The company wants to bring the price down where it can pitch the car at the young buyers who made the first of the Ford horse machines a success.

STEEL OR ALUMINUM? Plastic or metal? What difference does it make as long as the part does the job? But it could make a difference in what you pay for license plates and other fees in 1973-74 if you live in an area that charges for plates or operating stickers on the basis of vehicle weight. On impact-absorbing bumpers, for example, two steel bumpers will weigh 70 to 80 pounds more than two aluminum bumpers.

The auto companies are trying to sweat cars down weightwise by using lighter materials wherever possible. With all the new gear coming over the next couple years—safety equipment, antipollution devices, innovations in hardware, structural changes—the industry will have to move into aluminum, plastic and other lightweight materials in a big way just to stay even. ★★★

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Drivin' with Dan

If your son wanted to be a race driver, what would you say? Which are faster: Formula 1 or Indy cars? What compression do Indy and stock cars have? Dan Gurney answers these and other automotive questions

Q. *If you had a son who wanted to become a race driver, would you feel good or nervous about it? Also, what advice would you give him?—Jerry Bonner, Norman, Okla.*

A. Nervous. I would suggest that he be absolutely honest with himself about being a driver. Find out as much as he possibly can about it. Read as much as possible. Study the various statistics. Most important, he should also study engineering courses that relate to auto racing. This is a very demanding sort of competition. The more knowledgeable he is, the better his judgment is apt to be.

Q. *Does the color of a racing car make any difference? I've heard that black, since it absorbs heat, is better because air flows faster over a hot surface. Am I right?—Joe Thier, Hamilton, Ohio.*

A. I think white is the best because it remains cooler in the sunlight. I don't know about the aerodynamic effect of hotter or cooler skin temperature. The "temp" of the fuel and other components should be kept as low as possible.

Q. *Which do you think is faster: Formula 1 or Indy cars?—Russell Candell, Ashland, Ky.*

A. In my estimation, Indy cars are potentially faster, even on road circuits. In actual practice, however, F-1 cars have usually been faster on road circuits. On an oval track, there is absolutely no contest. The Indy cars are much faster.

Q. *I have a 301-c.i.d., four-speed, 3390-pound '63 Chevy. What would you say is the maximum speed my car could take a 90° corner without crashing into parked cars on a one-way street: 50 or 60 mph? I need an honest answer.—Gerald Kaye, Brooklyn.*

A. This depends on your tires, chassis, handling, road and weather conditions, body shape, weight distribution, springs, wheel width, ride height, shocks and other suspension adjustments. However, Gerald, you are restricted to something far below 50 mph by your local speed laws which I—and, I suspect, all the car parkers in your vicinity—trust you'll never deliberately violate.

Q. *What are "Nomex suits"?—G. S., Springfield, Ill.*

A. Nomex is a trade name for a fabric that does not burn as easily as most other fabrics. It resists burning and gives better protection



PACE CAR DRIVER: Dan accepts keys to a Datsun 510, official pace car for California 500 at Ontario Speedway last September. Handing keys to Dan is Mr. Y. Katayama, president of Nissan Motor Corp. in U.S.A., while Debbie Presto, Miss Ontario Motor Speedway, stands by. Joe Leonard won the contest with 152.354 mph his average speed. Bobby Unser, in Dan's Eagle, escaped injury when the rear spoiler came loose, causing him to spin and hit the first-turn wall

in a fire. It will not give complete protection, by any means, but it does give a man a few more seconds of safety in most fires.

Q. What is the compression ratio of the engines on Indy and stock cars?—Armand Bucci, West Berlin, N.J.

A. Stock cars have approximately 10.5 to 11.5 compression ratio. Indy engines are mostly supercharged now and they run on lower compression—approximately 8.5 to 9.5.

Q. Is there any chance the Russians might compete with cars or drivers in motor racing? What a race that would be!—Tom Cass, Dover, Del.

A. There is always a chance. I'd like to see it also.

Q. Must you have 20-20 vision or better to be a race driver?—Chris Kotowski, Covina, Calif.

A. No. But good vision is certainly advantageous.

Q. I have heard a Chevy Z28 Camaro with a 302-c.i.d. V8 turns 450+ hp for '71. Is this true? And what would top speed of such a car be?—John Robertson, Red Springs, N.C.

A. In Trans-Am racing trim this is true; in fact, it is on the conservative side. I'd say the top speed is a bit over 160 mph.

Q. Have you ever had a speeding ticket you didn't feel you deserved? What did you do about it?—Allen Sullivan, Tallahassee, Fla.

A. Yes. I paid it and felt bad about it. I realized we can't very well have laws which cover all circumstances. The main things are to continue to exercise good judgment and keep safety for yourself and others uppermost in your mind at all times. You won't get many tickets this way.

Q. Are there any drivers' schools or books you could suggest to help get me started as a race-car driver?—Bill Luttrell, Hurst, Tex.

A. Read everything you can get your hands on. Check your library for titles. Go to as many races as you can. Become a student of the sport. When you are old enough and can afford it, you can go to one of the schools for

(Please turn to page 46)

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DRIVIN' WITH DAN

(Continued from page 45)

race drivers. You might want to read Auto Editor Bill Hartford's story, *How I Became a Racing Driver in Three "Easy" Lessons* (page 86, Jan. '71 PM).

Q. *Is Don Prudhomme's new Indy racer considered a rail or funny car?—Terry Hawkins, Stockbridge, Ga.*

A. *I'd call it a "funny rail."*

Q. *I have a 1971 383-c.i.d. Dodge engine. If I were to put headers on it would I get any increase in gas mileage? If so, about how much? Would a racing cam increase this gas mileage?—Harold Mack, Austin, Tex.*

A. *I'd guess it would increase the mileage, together with the headers, if it is a mild grind. But, one usually changes driving technique with these modifications, and the net result is poorer mileage together with better E.T. from A to B.*

Q. *Are McLaren cars allowed to race at Le Mans? If not, why not?—Corrie Byrd, Livonia, Mich.*

A. *The McLarens do not manufacture a car that qualifies under existing Le Mans rules.*

Q. *On the STP March 711s the front spoiler sticks out and above the nose of the car. What is the advantage? Would this sort of spoiler be good for an Indy-type car?—Doug Huffines, Atlanta.*

A. *There are many theories on front and rear wings. I personally think the March concept is excellent. It enables the car to have more wing area and less angle of attack for a given amount of down force, which pays off with less total drag. It does require a more complicated structure to support it though. I think it would be good on an Indy car.*

Q. *What would you say is the fastest American-made car on the road today? My guess is the 454 Corvette.—Neil Kermings, Detroit.*

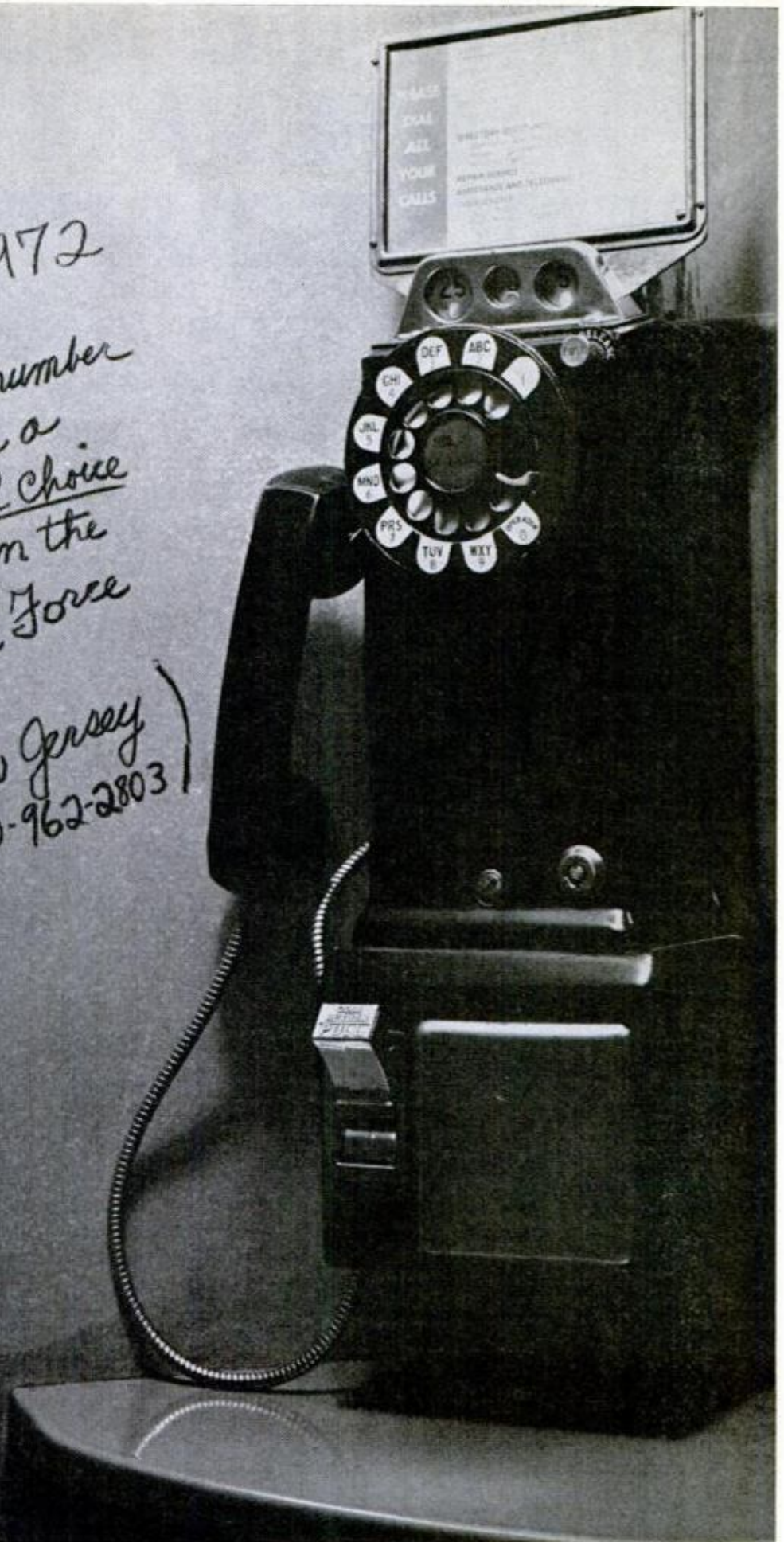
A. *I would agree with you.*

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 224 West 57th St., New York, N.Y. 10019. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 20).

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Snowthrowers: 'winter fun' machines

By GERALD KRATSCH

YOU MAY LIVE in an area of the country that has only two or three heavy snowfalls a season, along with intermittent snow showers. Or you may live where it's not uncommon to record 100 or more inches in a winter.

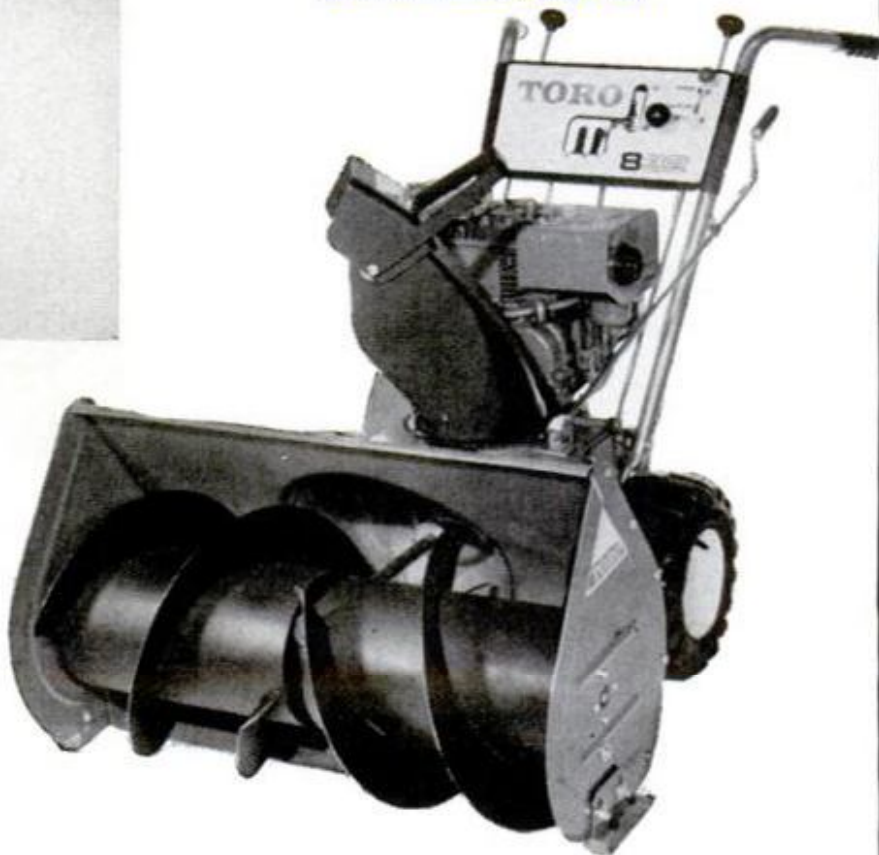
But wherever you are in the snowbelt, getting rid of the white stuff as quickly as possible, with the least amount of time, effort and energy is the object of the game.

In the last year or two, manufacturers have gone to greater horsepower on their snow-removal units. In our 1968 survey, makers reported some 16 7-hp snowthrowers and no 8-hp machines. This year, a half-dozen or more 8-hp units have been added.

Prices are up, generally across the board, for snowthrowers this season:

(Please turn to page 52)

STOPPING "DRIVEWAY BACKACHE" prompts most of the snowthrower sales. Latest Gilson Brothers Co. model (above, \$270) is compact—it's only 18 inches wide—and is powered by 4-hp motor. For heavy drifts, Toro's top-of-the-line 8-hp two-stage model (right, \$509.95) cuts a swath fully 32 inches wide and tosses the snow 30 feet. Toro now offers seven different models



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See the local Texaco Representative or write to: Manager—Retail Sales, Texaco Inc., 135 East 42nd Street, New York, New York 10017.



SNOWTHROWERS

(Continued from page 50)

There are price tags of \$460 to \$500 on the 7 and 8-hp units that cut a 26 to 30-inch swath. But this won't stop buyers who prefer power to backaches. Snowthrower sales increase every year.

The new throwers are almost evenly divided between dual and single-stage models. A dual-stage machine has a slow-speed auger feeding into a high-speed fan to blow (or throw) snow. A single-stage unit has a single high-speed auger or high-speed fan to throw snow out the chute. A three-stage machine has a smaller

"drift-breaker" auger at the top above the front main auger.

Most important is to fit the snowthrower to the job—the size of your sidewalk, driveway area, the types of snow in your area and average snowfall.

Study the specifications listed in the accompanying chart. The maximum discharge distance reported for a machine represents what it will do with "average" snow (meaning the light, fluffy stuff). If a major part of your drive is hemmed in on both sides, figure how far you have to throw snow ahead before you get in the clear. Note the degrees that the chute will

(Please turn to page 54)



HAHN-ECLIPSE Snow Giant (above, \$385) weighs 272 pounds, flings snow 40 feet from a 24-inch-wide cut

LAMBERT 3-hp model (A, right, \$169.95) must be pushed, but it's not all that heavy—only 112 pounds

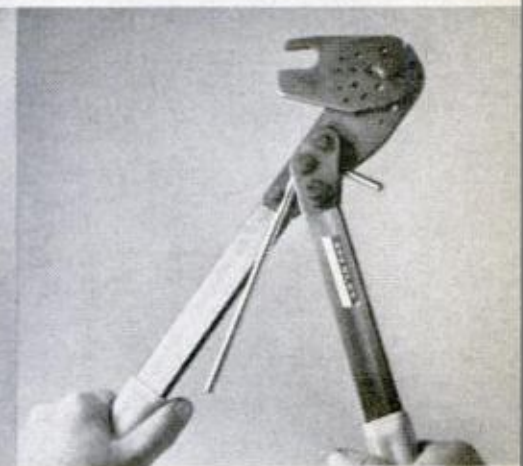
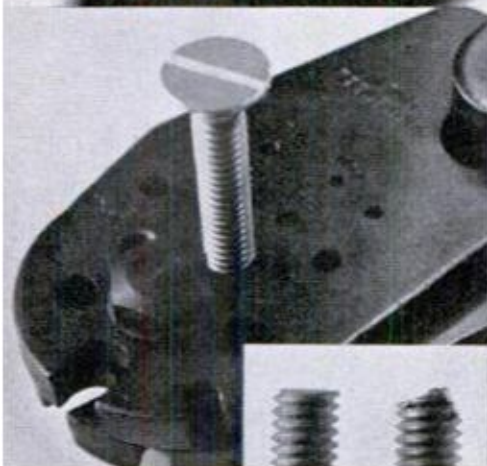
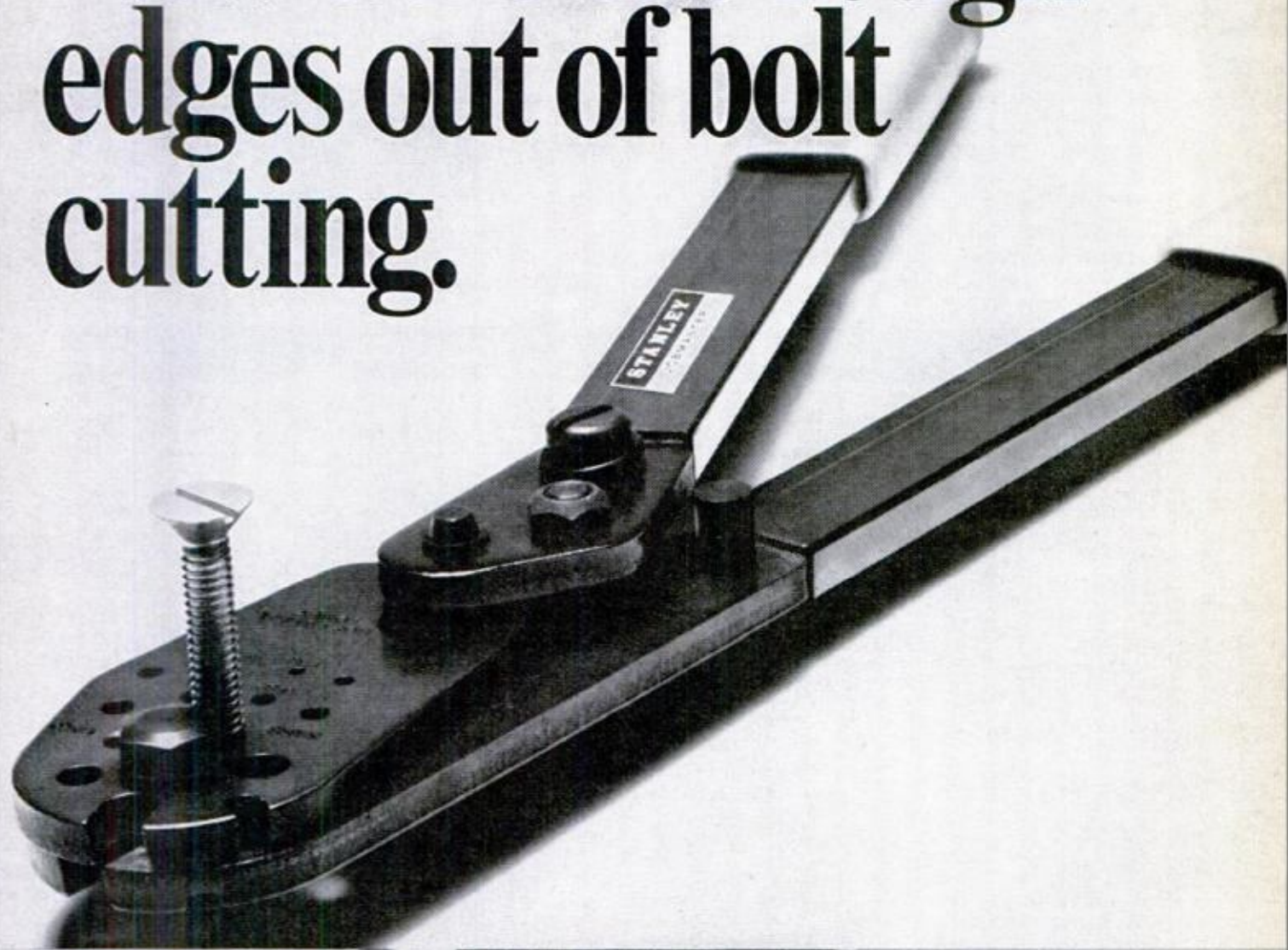
TORO 14-inch gas-power Snow Pup (B, right, \$119.95) has a new drum auger and paddle assembly this year

JACOBSEN's largest snowthrower (C, right, \$460) is powered by an 8-hp motor, weighs in at 275 pounds

AMF POLAR BEAR (below, \$449.95) has 8-hp engine, sports a third stage to break ice-encrusted drifts



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Stanley puts shearing action into its new Jobmaster™ Bolt Cutter. You cut threaded bolts or rod stock *smooth* – have no mashed threads or rough edges to file down.

NOVEMBER 1971

The holes, by the way, take bolts or rods up to $\frac{5}{16}$ " diam. For open end cutting of chain, fence or long wire, use the nose cutters. But it does still more jobs.

Stanley's Bolt Cutter easily bends steel rods (up to $\frac{1}{4}$ " diam.). Quite a tool, for around \$13.95.

STANLEY
helps you do things right

SNOWTHROWERS

(Continued from page 52)

rotate as well. Virtually all turn 180° permitting discharge to either side as well as ahead of you.

There's still a place for the small, lightweight thrower. If you're concerned only with clearing porch and steps plus a small walk area, one of the gas or electric paddle-type units will do the job. These lightweights are popular in areas where snowfalls are medium, but they're also used in the big snow country for clearing porches and even short driveways, particularly after a "snow shower."

Homeowners with compact tractors
(Please turn to page 56)



ARIENS tractor takes 32-inch-wide snow attachment

SNOWTHROWERS AT A GLANCE

Make and Model	Type	Stages	Swath Width (in.)	Discharge Chute		Engine			Sugg. Retail
				Distance (ft.)	Rotation (degrees)	Make	Cycle	Hp	
Allis-Chalmers									
4-Hp Tracker	SP	1	21	5-40	180	B&S	4	4	\$290
7-Hp Tracker	SP	2	26	5-40	180	B&S	4	7	\$440
AMF Western Tool Div.									
1360-06	SP	2	26	30	180	Tecumseh	4	5	\$359.95
1361-05	SP	2	26	30	180	Tecumseh	4	8	\$419.95
1362-04	SP	3	26	30	180	Tecumseh	4	8	\$449.95
Ariens Co.									
922002 Sno-Thro	SP	2	20	30	240	Lauson	4	4	\$290
910002 Sno-Thro	SP	2	24	30	240	Lauson	4	6	\$360
910962 Sno-Thro	SP	2	24	30	240	Lauson	4	7	\$400
910954 Sno-Thro	SP	2	32	30	240	Lauson	4	7	\$430
Atlas Tool & Mfg. Co.									
SN420B	SP	1	20	20	180	B&S	4	4	\$189
SN728	SP	2	28	30	210	Tecumseh	4	7	\$419
Bolens Div., FMC Corp.									
Arctic 55	SP	2	24	30	280	Tecumseh	4	5	\$379
Arctic 75	SP	2	26	30	280	Tecumseh	4	7	\$425
Eska Co.									
944 Sno-Flyr	SP	1	20	25	180	Lauson	4	5	\$249.95
945 Sno-Flyr (ES)	SP	1	20	25	180	Lauson	4	5	\$299.95
946 Sno-Flyr (ES)	SP	1	26	25	180	Lauson	4	7	\$499.95
Gilson Bros. Co.									
55008	SP	2	18	10-30	180	B&S	4	4	\$269.95
55001	SP	2	26	20-40	180	B&S	4	5	\$334.95
55006	SP	2	26	20-40	180	B&S	4	8	\$409.95
55002	SP	2	26	20-40	180	B&S	4	8	\$429.95
Hahn-Eclipse Co.									
CH-584-5	SP	2	24	40	180	B&S	4	5	\$340
PH-584-6	SP	2	24	40	180	Tecumseh	4	6	\$370
CH-584-6	SP	2	24	40	180	Tecumseh	4	6	\$385
PH-586-7	SP	2	26	40	180	Tecumseh	4	7	\$399
CH-588-7	SP	2	28	40	180	Tecumseh	4	7	\$420
Jacobsen Mfg. Co.									
51604 Sno-Blitz	Push	1	17	10-20	180	Tecumseh	2	2	\$129.95
51614 Sno-Blitz	Push	1	17	10-20	180	B&D(elec.)	—	2	\$139.95
52003 Snow Jet	SP	1	20	30	200	Jacobsen	2	3 1/2	\$249.95
52612 Imperial	SP	2	26	40	200	Tecumseh	4	5	\$374.95
52625 Imperial	SP	2	26	40	200	Tecumseh	4	7	\$409.95
52630 Imperial	SP	2	30	40	200	Tecumseh	4	8	\$459.95
Lambert Corp.									
HS-130B	Push	1	21	20-30	180	B&S	4	3	\$169.95
HS-140	SP	1	21	20-30	180	B&S	4	4	\$199.95
HS-1440	SP	1	24	20-30	210	Tecumseh	4	4	\$264.95
HS-1540	SP	1	24	20-30	210	Tecumseh	4	5	\$294.95
HS-2540	SP	2	24	20-30	210	Tecumseh	4	5	\$379.95
HS-2780	SP	2	28	20-30	210	Tecumseh	4	7	\$419.95
Lazy Boy Lawn Mower Co.									
RE 19-71	Push	1	19	40	180	B&S	4	3	\$150
DLB 71	SP	1	22	40	180	B&S	4	4	\$190
Montgomery Ward									
496	Push	1	16	25	220	Electric	—	—	\$ 99.99
485	Push	1	18	25	220	Tecumseh	2	3	\$124.99
495	Push	1	18	25	220	Electric	—	—	\$159.99

Table continues on page 56

Any man with style enough to drink Old Taylor deserves his own bar.

(We'll show you how to build it.)

Haven't you always wanted a great home bar? Old Taylor is offering a free 24-page booklet that shows you step by step how to build six different home bars. A corner bar. A closet bar. A rolling patio bar. All kinds of bars for practically any room of the house. These plans were prepared by the editors of Popular Mechanics magazine. Mail the coupon today. Offer void in states where prohibited by law. Offer expires June 30, 1972.



Old Taylor, Box 4865, Grand Central Station, N.Y., N.Y. 10017
Please send me the free booklet "Build Your Own Bar."

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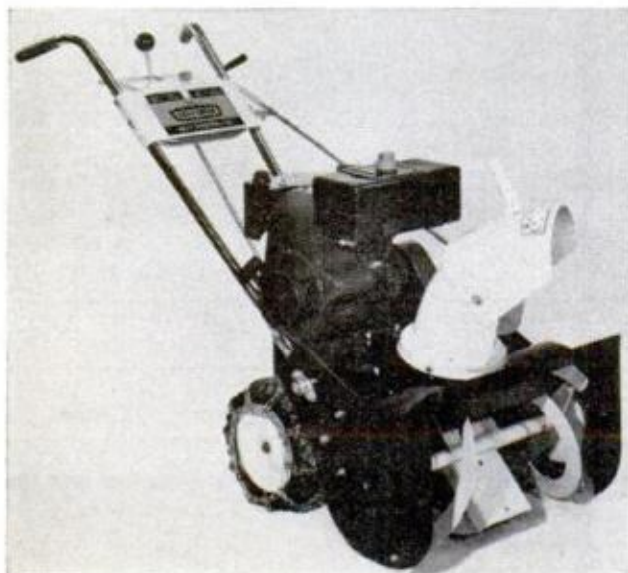
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Make and Model	Type	Stages	Swath Width (in.)	Discharge Chute		Engine			Sugg. Retail
				Distance (ft.)	Rotation (degrees)	Make	Cycle	Hp	
Montgomery Ward (cont.)									
470	SP	2	18	25	180	B&S	2	4	\$259.99
472	SP	2	26	25	180	B&S	4	5	\$359.99
490	SP	2	26	25	180	B&S	4	7	\$399.99
471 (ES)	SP	2	26	25	180	B&S	4	5	\$409.99
476	SP	2	26	25	180	B&S	4	8	\$419.99
479 (ES)	SP	2	26	25	180	B&S	4	8	\$474.99
MTD Products Inc.									
311-100	Push	1	18	30	90	Tecumseh	2	3	\$129.95
311-210	SP	1	20	50	180	Tecumseh	4	4	\$219.95
311-220	SP	1	20	50	180	Tecumseh	4	5	\$229.95
311-300	SP	1	21	50	240	Tecumseh	4	4	\$259.95
311-250 (ES)	SP	1	20	50	180	Tecumseh	4	5	\$289.95
311-400	SP	1	21	50	240	Tecumseh	4	5	\$289.95
311-450 (ES)	SP	1	21	50	240	Tecumseh	4	5	\$349.95
311-600	SP	2	26	60	240	Tecumseh	4	5	\$349.95
311-700	SP	2	26	60	240	Tecumseh	4	7	\$379.95
311-750 (ES)	SP	2	26	60	240	Tecumseh	4	7	\$449.95
Sears, Roebuck									
81959	Push	1	14	15	100	Electric	—	—	\$130
81972	Push	1	18	15	100	Craftsman	2	2½	\$130
8248	SP	1	20	15	160	Craftsman	4	4	\$200
8249	SP	1	20	20	160	Craftsman	4	5	\$270
82559	SP	1	24	25	160	Craftsman	4	6	\$330
82567	SP	3	26	30	180	Craftsman	4	7	\$430
Simplicity Mfg. Co.									
558	SP	1	21	20-30	280	B&S	4	4	\$269.95
652	SP	2	24	20-30	280	B&S	4	5	\$354.95
656	SP	2	26	20-30	280	B&S	4	6	\$399.95
742	SP	2	24	20-30	280	B&S	4	5	\$404.95
643	SP	2	28	20-30	280	B&S	4	7	\$419.95
Toro Mfg. Co.									
31412 Snow-Pup	Push	1	14	15	180	Tecumseh	2	2	\$119.95
31453 Snow-Pup	Push	1	14	15	180	Howard(elec.)	—	—	\$139.95
31502 Snow-Pup	Push	1	21	15	180	Tecumseh	2	2.5	\$139.95
31302 Snow-Hound	SP	1	20	20	270	Tecumseh	4	3.5	\$219.95
31660 Snow-Mill	SP	2	26	25-30	200	Tecumseh	4	5	\$389.95
31760 Snow-Mill	SP	2	26	25-30	200	B&S	4	7	\$449.95
31820 Snow-Mill	SP	2	32	25-30	200	B&S	4	8	\$509.95
Wheel-Horse Products Inc.									
Pathmaker 4	SP	1	20	20	240	B&S	4	4	\$199
Trailblazer 5	SP	2	26	35	240	Tecumseh	4	5	\$359
Trailblazer 7	SP	2	26	35	250	Tecumseh	4	7	\$409
Wisconsin Marine Co.									
820 Bob-Cat	SP	2	20	30	180	B&S	4	5	\$380.50
820-A Bob-Cat	SP	2	20	30	180	B&S	4	5	\$403.50
1824 Bob-Cat	SP	2	24	30	180	B&S	4	7	\$456.50
1824-A Bob-Cat	SP	2	24	30	180	B&S	4	7	\$479.50
1628 Bob-Cat	SP	2	28	30	180	B&S	4	8	\$620
Yard-Man, Inc.									
7160 Snowbird	SP	2	22	20	180	Tecumseh	4	4	\$260
7090 Snowbird	SP	2	24	40	240	Tecumseh	4	5	\$350
7100 Snowbird	SP	2	26	40	240	Tecumseh	4	6	\$400

Key: ES, Electric Start; SP, Self-Propelled; B&S, Briggs & Stratton; B&D, Black & Decker

SEARS 5-hp Craftsman (\$270) throws snow 20 feet



SNOWTHROWERS

(Continued from page 54)

have a choice of plow or snowthrower attachment. The plow will handle most light snows faster, but won't do the job in heavy drifts or confined areas. At least a 6-hp tractor is needed for a snowthrower attachment; 8-hp or more is preferable. Don't expect a riding mower, or "lawn tractor" (one that can't operate tilling attachments) to handle the big snows with a plow attachment.

Starting, even on below-zero days, isn't a problem any more. Winterized engines and electric starters have licked that.

Self-propelled units have several forward speeds and, usually, reverse. Be sure you get reverse on a heavy machine—you'll need it.

★★★

If TV seems to have lost a little of its pazzazz, try watching on one of these new black and white Panasonics.

The TR-005 is straight from the Space Age. With technology to match. The 5" (diag. meas.) picture is so detailed, it'll turn your head. While the set turns a full 180° on its swivel-tripod base.

Moving in another direction is the world's only TV picture that pops out of a portable cassette tape recorder. The TR-003 gives you a neat 3" (diag. meas.) of viewing or terrific entertainment on tape.

Or if you'd rather have the only FM/AM radio with TV tucked inside, that's the TR-425R. It comes up with a 5" (diag. meas.)

picture and the same portability as the tape unit. Because it also works on AC or its own self-contained batteries.

But if big picture portability is what you're after, pick up the TR-449BA. It gives you a full 9" (diag. meas.) picture. That's beautiful from clear across the boat. Or bench.

And last and least, is the world's tiniest TV. The TR-001 has a super-sharp 1½" (diag. meas.) picture that will keep you enthralled for over 800 hours before you need new batteries.

So if TV has you yawning long before bedtime, get one of the exciting new Panasonics. And have something to watch when you don't want to watch TV.

Maybe you'd find TV more exciting if your set was.

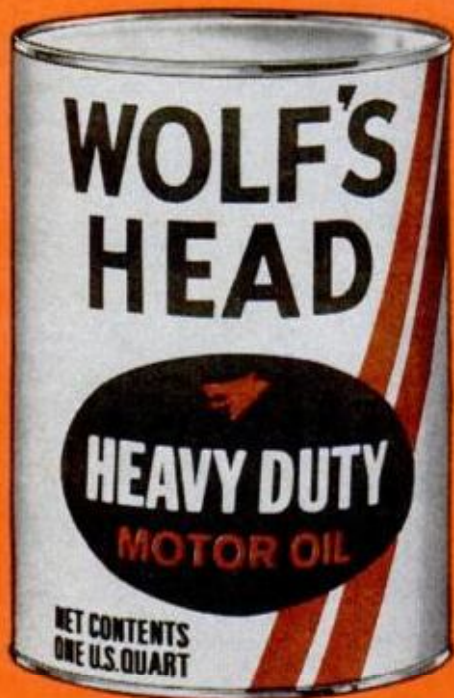


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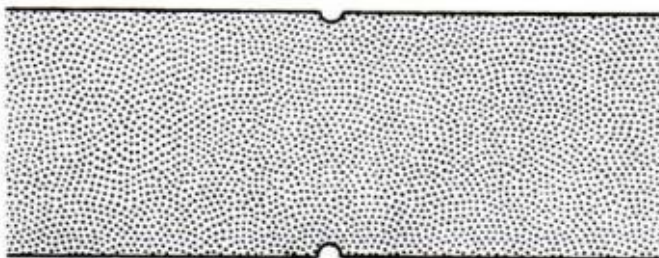


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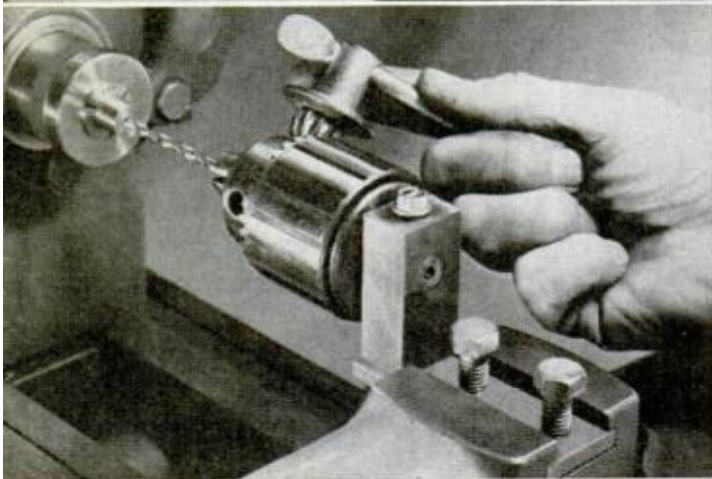
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A Carriage Chuck Mount For Your Lathe

By WALTER E. BURTON



FIVE OF SEVEN attachment parts are short bolts. An optional eighth part is indicated as "C"

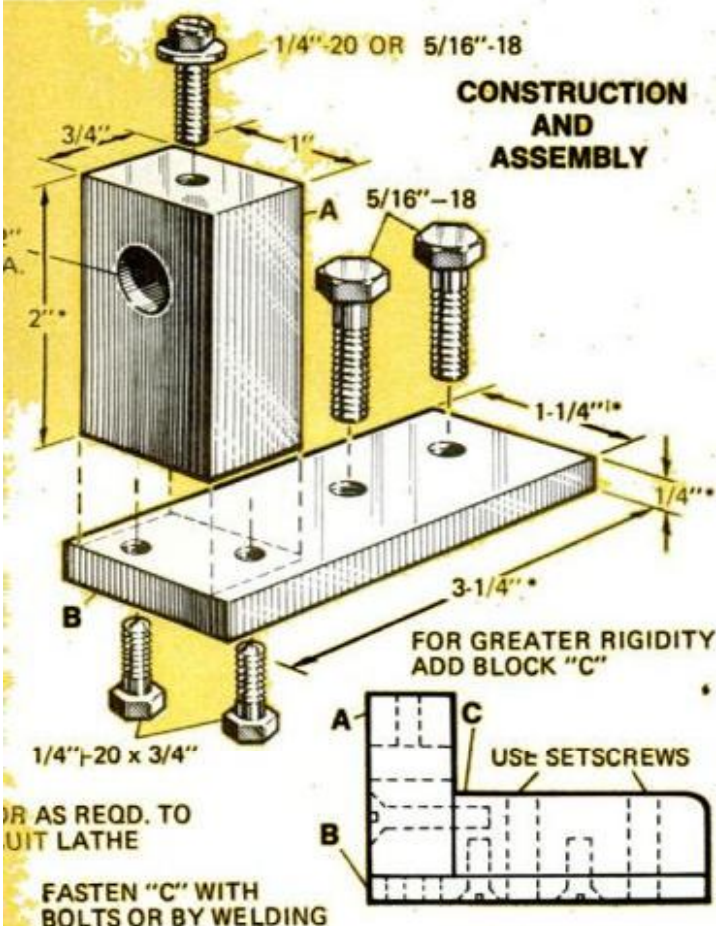
A DRILL CHUCK on a lathe carriage can be useful when your tailstock spindle is occupied by some other tool, or when you want to avoid juggling bits and chucks for certain operations. Or perhaps your only good drill chuck available has a straight arbor that cannot be readily adapted to the tapered hole in the tailstock spindle.

The horizontal part, "B" in the drawing, fits the toolpost slot of the compound slide and is clamped there by two $\frac{5}{16}$ -18 bolts passing through it and bearing against the slot bottom. Moderate tightening of the bolts to force the bar up against the undercut parts of the T-slot locks it securely. Bar "B" projects beyond the slot enough to support the vertical piece "A." In the model, two $\frac{1}{4}$ -in. bolts, running upward through "B" and engaging threaded holes in "A," hold the pieces together. Dimensions on the drawings are for an attachment to fit a 9-in. bench lathe. Vertical block "A" extends about $\frac{3}{4}$ in. above the lathe centerline. The $\frac{1}{2}$ -in. hole in this block accepts the $\frac{1}{2}$ -in.-diameter stub arbor of the drill chuck used. This hole coincides with the lathe axis. To position it properly, the assembly was clamped in the T-slot, with an edge of bar "B" pressed firmly against one side of the slot, and "A" (or the head of one of the bolts below it) tight against the side of the compound slide. The slide was set at exactly 90° to the lathe axis.

The attachment shown is intended for drilling, reaming, countersinking and similar operations using bits aligned with the lathe centerline and having opposed, or "balanced," cutting edges. Light boring can be attempted with a boring bar or tool having offcenter action.

No chatter trouble should be had using the chuck to hold a marker for scribing circles on faceplate-mounted work, or for cutting circles in cardboard with a knife-edge bit (the material being on a faceplate perhaps turned by hand). ★★★

CONSTRUCTION AND ASSEMBLY



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"I'm very pleased to find that someone has finally developed a home training program for mechanics that's right up with the times. The new NRI Master Automotive Technician course for mechanics is amazingly complete and seems to cover all major aspects of today's complex cars. Certainly, a man with an NRI diploma in automotive mechanics is well on his way to a solid career in a field where his knowledge is in demand. The texts are great, and the equipment you get is top-quality — and essential. This program promises to make real mechanics out of men seeking a solid profession."

Tom McCahill is equally enthusiastic:

"This baldheaded bearcat has been worrying for years about the condition of our automotive repair industry, so it's a great relief to see a highly qualified school like NRI come up with home training that should do much to help ambitious guys become top mechanics. It either takes a lot of years of dirty hands or a comprehensive training program to come to grips with car repair and know what you're doing. NRI has done it. I particularly like the way the use of essential equipment is worked into 'bite-sized' lesson texts. After over a quarter of a century in this business, I'm beginning to have some hope about finding good mechanics again — I'll just look for an NRI diploma on the repair shop wall."

*William H. Crouse, author of NRI mechanics training, has written nearly two dozen outstanding books on automotive subjects, and has been Editor of Technical Education Books for McGraw-Hill Book Co., including *The McGraw-Hill Automotive Mechanics Series*.

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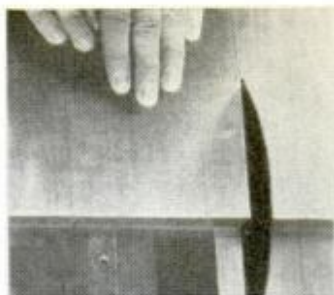
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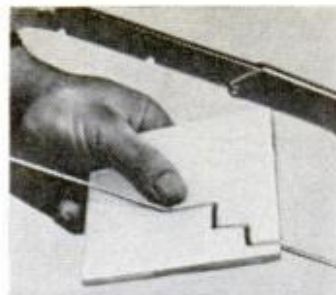
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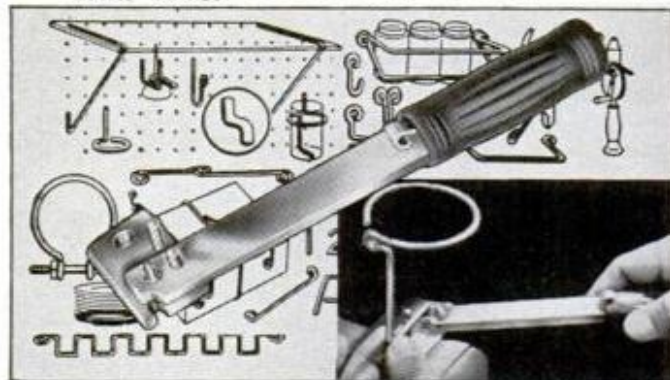


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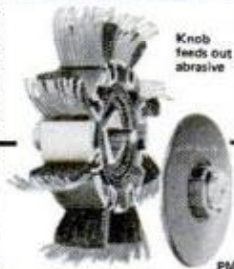
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NEWS BRIEFS



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New downhill racer

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**Mini Cinemas - a big
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Jerry Lewis started the operations of Network Cinema Corporation in September, 1969 in order to develop his automated mini theatre chain throughout the United States and Europe. Since that time, Jerry Lewis mini cinemas has become the fastest growing theatre chain in the world. This phenomenal record is a strong endorsement of the Jerry Lewis Cinema concept.

Before the end of 1971, over 100 Jerry Lewis Cinemas are scheduled to be opened and operating. The very near future should see the company meeting its projection of 2,500 theatres throughout the United States and Canada.

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INVESTMENT INFORMATION

Minimum cash investment for an Area Director is \$50,000, which includes the cash we require for your own Jerry Lewis Cinema. Your Cinema will be used as your Showcase and in addition will return a substantial profit to you. A portion of the above investment refundable upon performance.

For ONE Jerry Lewis Cinema—Cash investment required by us is \$10,000 to \$15,000, depending upon seating capacity of theatre. Additional working capital needed. Balance may be financed.



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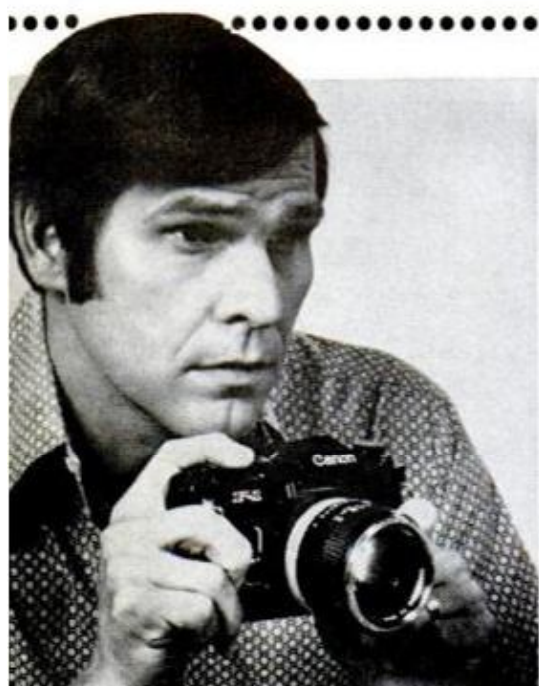
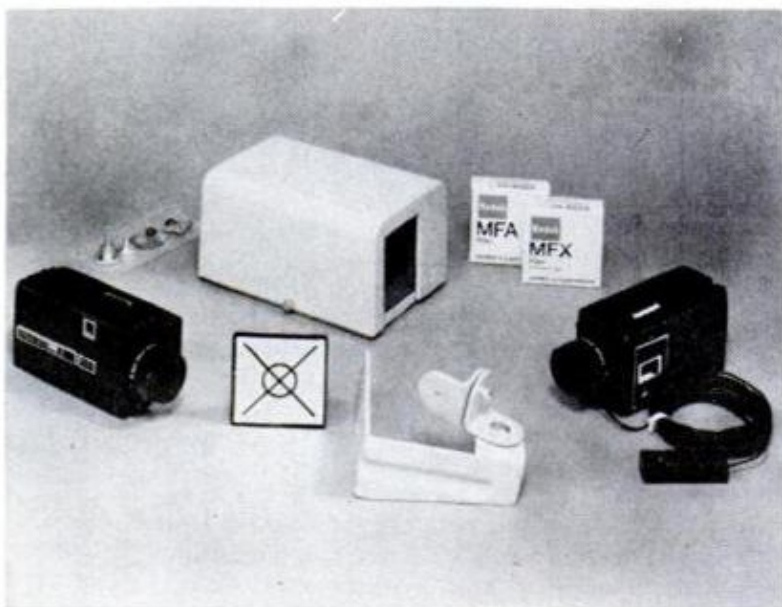
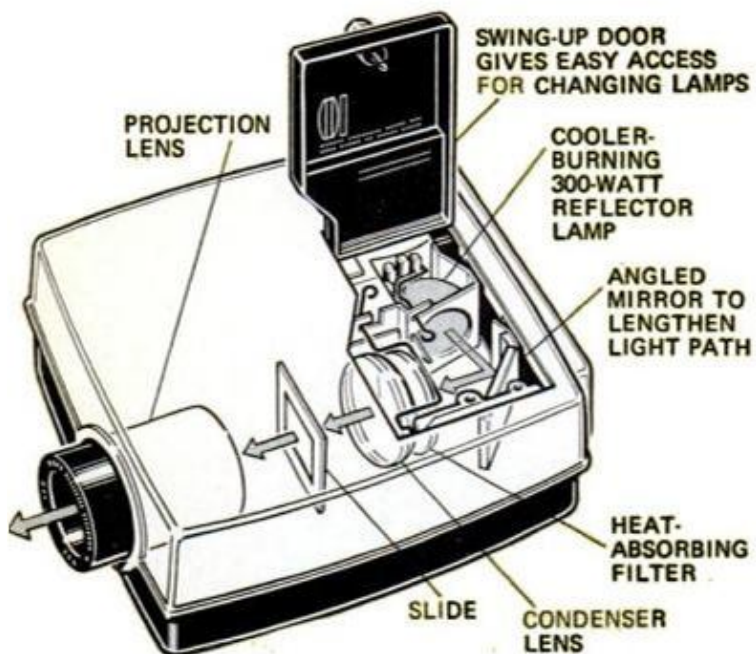
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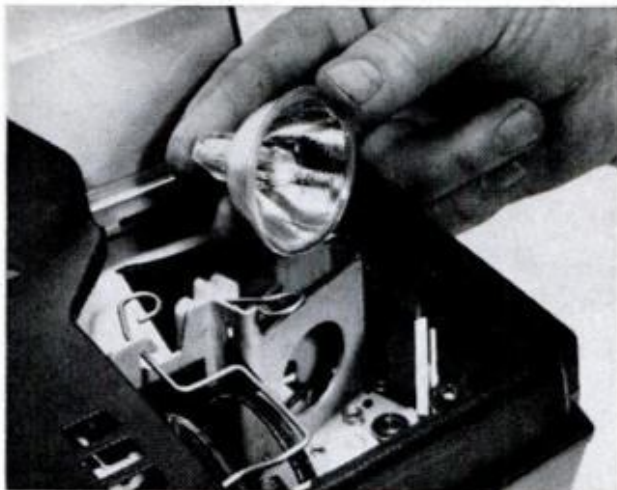
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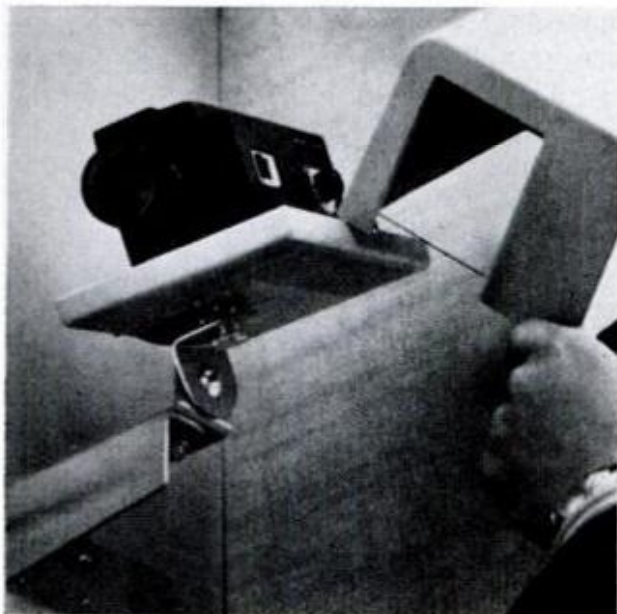
NEW IN



PHOTOGRAPHY



COOLER, QUIETER SLIDE PROJECTORS from Kodak are made possible by a new high-intensity projection lamp that puts out as much light as older bulbs on almost half as much power. Made by GE, they have their own built-in reflector (photo at near left) and are equal to 500-watt lamps while drawing only 300 watts. The result is they burn much cooler and permit the use of a slower-speed fan to dissipate heat. The reduction in blower speed in turn eliminates the high-pitched whirring sound characteristic of earlier projectors. To provide a longer light path for the new bulb without increasing projector size, the beam is reflected around a corner by an angled mirror, as shown in drawing at far left on opposite page. The virtually silent Carousel projectors come in seven models, ranging from \$79.50 for the simplest to about \$220 for those with such features as remote control, self-focusing and automatic slide sequencing.



LOW-COST "WATCHDOG" CAMERA, developed by Kodak, uses inexpensive Super-8 movie film and is cheap enough—less than \$200—to give small businesses and even private homes protection against burglars and other intruders. The special time-lapse camera, shown being mounted in a hidden, soundproof housing at near left, can be set to take stop-motion pictures at rates of one every $1\frac{1}{4}$ seconds to one every 90 seconds. For example, exposing one frame every 12 seconds compresses 24 hours of surveillance time into one 100-foot reel of Super-8 film. In addition to programmed time-lapse intervals, the camera can be triggered remotely by self-tripping detection devices. Two models—the Monitor for 50-foot film cartridges; the Analyst for 100-footers—can also be used for hobby and research time-lapse photography.



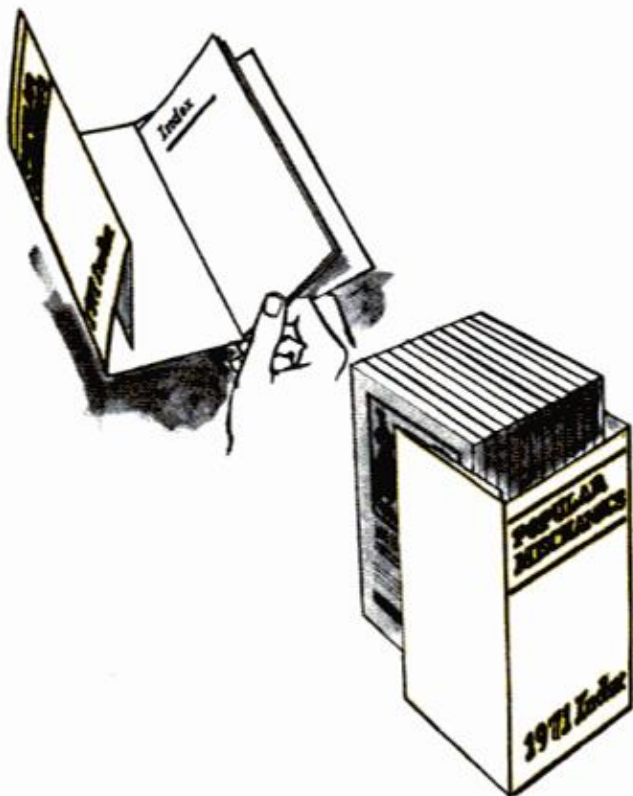
VERSATILE NEW CAMERA from Canon can take 40 different kinds of interchangeable lenses and more than 180 accessories. The F-1 35-mm single-lens reflex has shutter speeds up to $1/10000$ th of a second and comes with a 50-mm, f/1.4 lens. Fitted with a motorized drive and a 250-exposure film magazine (center photo at left), it can make rapid-fire sequence shots at the rate of up to three a second. The motor is powered by a small, portable battery pack. A special servo-operated clip-on prism head, also powered by battery pack (near left), provides fully automatic exposure control, even during rapid-fire shooting. Camera with standard lens is \$500. Motorized drive, film magazine and exposure control are \$345, \$250 and \$280 respectively. The Canon F-1 is sold by Bell & Howell, 7235 North Linder Ave., Skokie, Ill. (New in Photography [continues on page 74](#))

Announcing — The Popular Mechanics Index and Shelf Wrapper

Here's a great idea that will multiply the value of your back issues of PM. Reserve your copy now!



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Wall-to-wall carpeting, upholstery, walls: 3 great needs for on-location cleaning

Nothing enriches a room like wall-to-wall carpeting. Every year you find it in more homes at every income level. Then there are all the public places with this carpeting. Places like motels, hotels, restaurants, banks, offices, theaters, stores, cocktail lounges, hospitals, reception rooms, etc.

Since this carpeting can't be sent out for cleaning there's a real opportunity for on-location cleaning services. It's faster, easier and inexpensive to clean carpeting on the customers' premises.

This same opportunity exists for upholstered furniture. It's faster, easier and costs less to clean upholstery on-location.

Now, consider wall and ceilings. Cleaning them with a bucket and sponge is slow, tiring and messy. People will welcome a service that does a professional job of cleaning quickly and without mess.

3 Von Schrader Detergers: each does on-location cleaning at its best

With Von Schrader Detergers—professional cleaning equipment—you'll do on-location cleaning that wins repeat customers . . . make as much money part time as many people earn full time . . . enjoy a steady, dependable business of your own . . . watch your income grow to where you are financially independent. Every home, every building, are a potential source of income.

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Von Schrader Carpet Deterger. Cleans so completely it helps restore natural beauty. Fast drying.



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bucket-and-sponge method. Cleans easily without any mess.

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As a Von Schrader Associate you are your own boss. There's no contract to sign. You pay no fees, dues or royalties. Work out of your home part time or full time. Hire help as your customer list grows. (Many men start by working evenings or weekends while retaining their regular jobs.)

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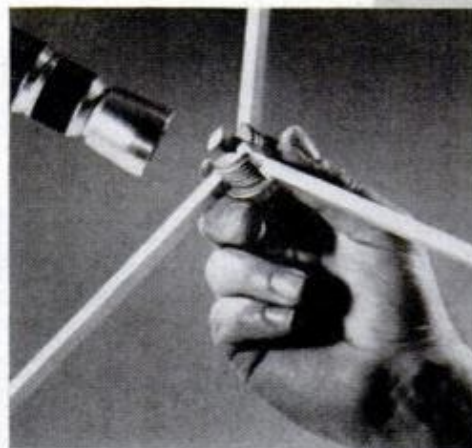
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New in Photography

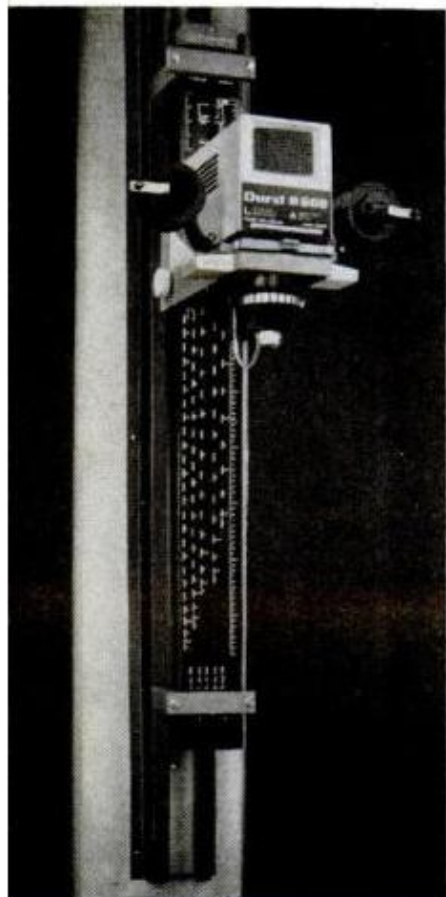
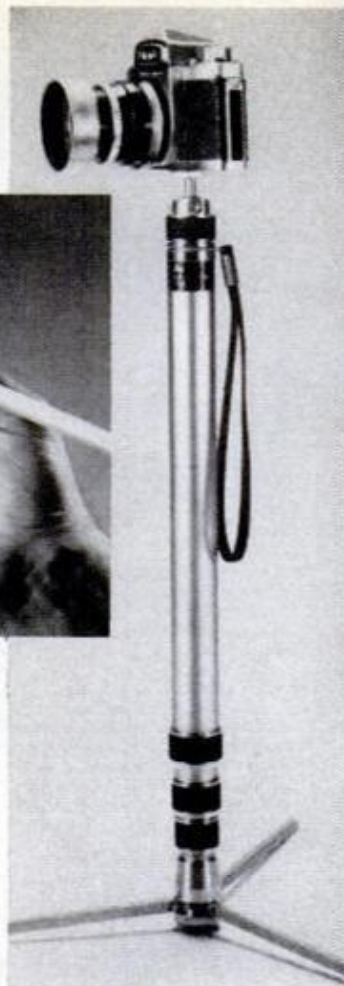
(Continued from page 71)



DOUBLE-DECKER CAMERA BAG solves the old problem of trying to find small accessories that get all mixed up with larger equipment at the bottom. The bag is divided into two compartments. On top is a shallow one for film, filters and other small items. Underneath is deeper section with lift-out tray for cameras and lenses. Either one can be opened without disturbing other. \$29.95, Spiratone, Inc., 135-06 Northern Blvd., Flushing, N.Y.



TWO-WAY MONOPOD turns magically into a tripod when you need steady support. Collapsible legs store in lower-most section and fold out to form a tripod base. Handy for working in tight places, the slim support doubles as light or mike stand. Made by Miida, a 60-inch three-section model is \$16.50; 66-inch four section model, \$19.50. Ace Photographic Supply, 132 Ipswich, Boston.



◆ **WALL-MOUNT COLUMN** for Durst enlargers is designed to give added rigidity for sharper prints. It also simplifies the making of bigger-than-normal blowups since the easel can be lowered to the floor without disturbing the enlarger. Called Uniwall, it fits Durst A600, DA900 and L1000 enlargers. Another accessory, called Danoroll, is a roll-type negative carrier for strips to 100 feet long and 70 mm in format. Crank moves negatives through enlarger. Uniwall mount is \$80, Danoroll carrier, \$110. They're sold by Ehrenreich Photo-Optical Industries, 623 Stewart Ave., Garden City, N.Y.

◆ **YOU GET AUTOMATIC FLASH CONTROL** with the new 35-mm Canon camera at right. As you focus on your subject, the lens-coupled diaphragm opens or closes to give you the correct flash opening for the particular distance you're focused at. Ingenious system eliminates your having to make calculations and set diaphragm manually. Called Canonet 28, the rangefinder-type camera has 40-mm, f/2.8 lens and hot shoe contact that does away with flash sync cord. Sold by Bell & Howell, for \$124.50 with clip-on electronic flash, \$89.50 without flash.



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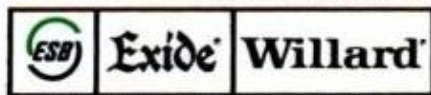
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POLLUTION FIGHTERS'

NEWSLETTER BY SUSAN MAZUR

RECYCLED CANS AND FIBERGLASS are being combined to make a honeycomb-type panel to roof a section of the world's largest atom smasher at the National Accelerator Laboratory in Batavia, Ill. Cans were collected from youth organizations, schools and can manufacturers in the vicinity, then sent to the laboratory's machine shop. Here each panel is made by removing the lids from approximately 1000 cans and placing them upright between two 10-foot equilateral triangles of fiberglass. These 'sandwiches' are being used to form a geodesic dome over the lab's neutrino building. The cans are also functional in preventing glare since their shiny interiors collimate sunlight.

GREAT LAKES POLLUTION CONTROL and elimination of pollution there by 1975 will be sought by the United States and Canada through a formal pact. The signing is expected by the end of this year.

Objectives are: common water quality standards for boundary waters; construction of treatment facilities for municipal, industrial and other wastes; prevention of oil spills in the Great Lakes and establishment of a joint response center which will be alerted in case of a spill; reduction of phosphorus discharges; elimination of mercury and other toxic metals; control of thermal pollution; restriction of radioactive discharge and pesticide wastes; compatible regulations in both countries governing the types of ships using the lakes and controlling their potential pollution activities.

Cost of the program will be shared, with the United States absorbing most of the financial burden since industrial development on the Canadian side of the lakes is far less than on the U.S. side—90 percent of the pollution in Canadian waters drifts in from the United States.

"GRASS" FROM TIRES? The Goodyear Tire & Rubber Co. of Akron, Ohio, is developing a way to convert old tires into artificial grass. First, it strips wire beads from tires, then shreds the tires into thin strands less than an inch long, blends these with a rubber-base binder in a concrete mixer, and pours the mix on the ground or onto a slab. Goodyear researchers say the

material hardens overnight, is fungus and rot-proof and can be pigmented any color during or after mixing. Some suggested uses are highway median strips, playgrounds, patios, poolsides and paneling (the material has a noise-deadening quality).

STYROFOAM-LIKE CERAMIC, said to be producible at 3 cents per board foot, is being made from recycled glass bottles and cow dung. Professor John D. Mackenzie of the University of California, Los Angeles, originator of the as yet unnamed product, claims it is a heat and noise insulator, impermeable to water and gas, nonflammable, odorless; also that it can be painted, glazed, drilled, sawed, glued or nailed. He says the ceramic can be used for shingle, cinder-block and brick replacement; roof and wall insulation, water pipes, lightweight containers, acoustical tiles and wall partitions. The ceramic is a mixture of 5-10 percent powdered dung; 90-95 percent powdered glass.

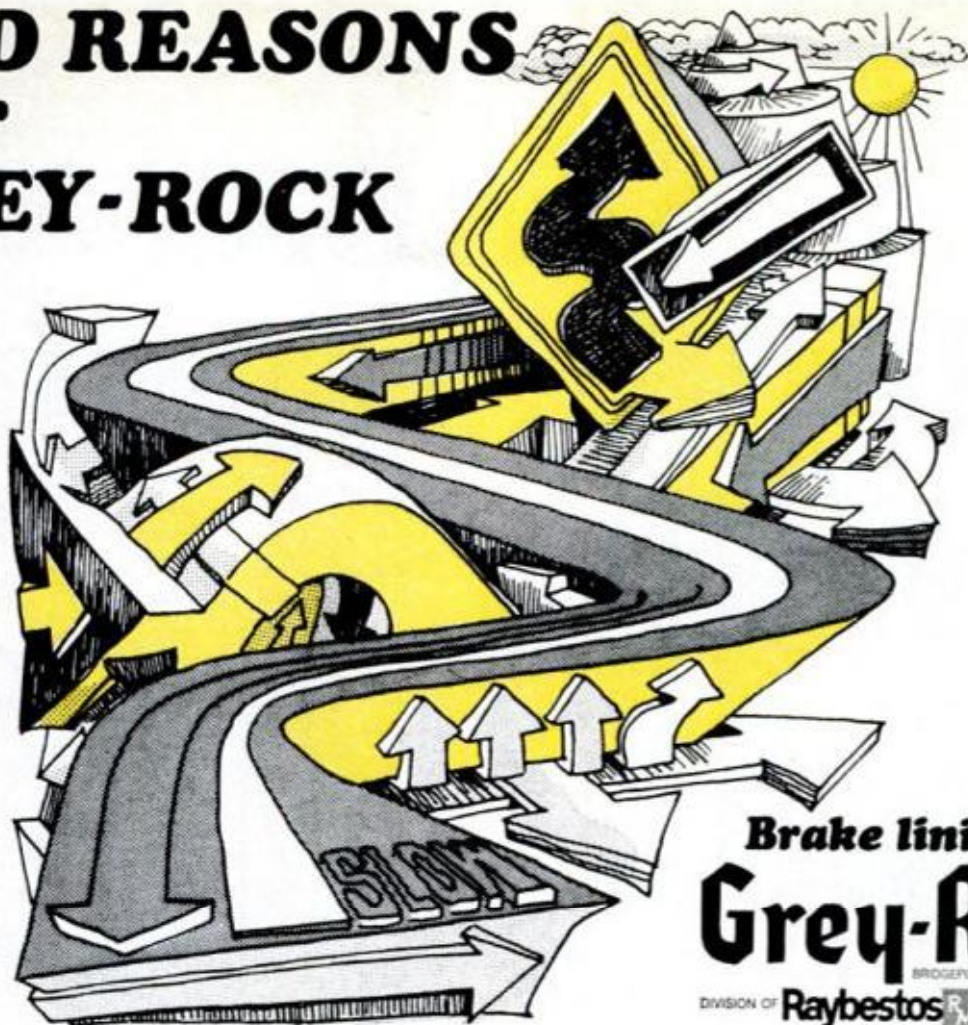
A POLLUTION TEST KIT for young people eight to fourteen years old is available from Envirco, Inc., Northbrook, Ill. Equipment includes test tubes, dropping bottles, funnel, magnifying glass, microscope slides, parts for assembling a smoke trap, a Ringleman smoke chart, nonharmful chemicals and an instruction manual with suggestions for doing experiments with materials found around the home. Envirco has even included report forms for mailing observations to government officials. The price is \$9.95.

AIR POLLUTION MONITORING in New York State is being done completely automatically by the Department of Environmental Conservation. Data from electronic measuring equipment in eleven unmanned vans is scanned by a central computer in Albany to plot the course of contaminants and local variations in air quality.

THE OIL SPILL INFORMATION CENTER at Santa Barbara, Calif., has broadened its scope from its original concern with local oil pollution of the sea to a global concern for our marine environment. Documentation and bibliographic materials are available: write the University of California, Santa Barbara, Calif., 93106.

DO YOU KNOW about some action being taken to fight pollution that we don't know about? In your community? On the job? Tell us about it. Write Environmental Editor, *Popular Mechanics*, 224 West 57th St., New York, N.Y. 10019. ★ ★ ★

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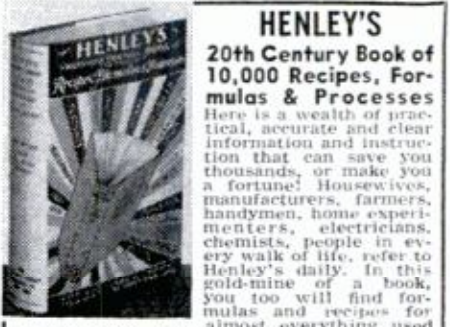
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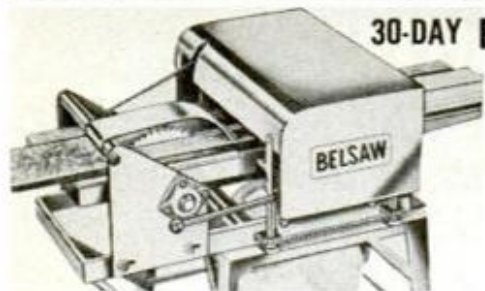
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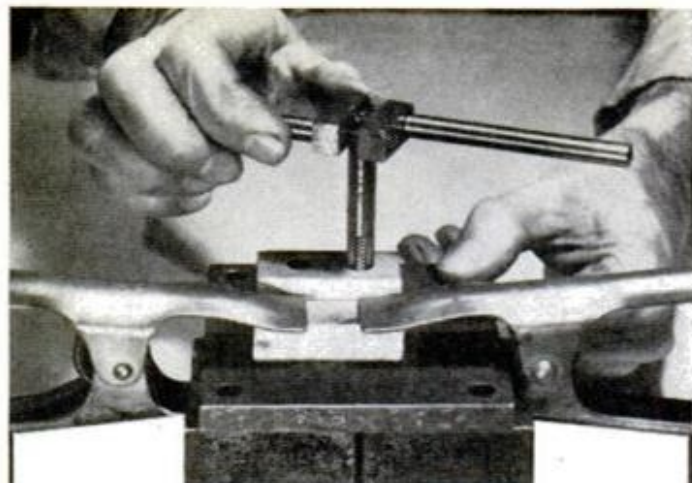
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BY CATHERINE BILSKI

ANYONE INTERESTED in purchasing or using recreational vehicles or trailers will be interested in this eight-page illustrated booklet, *Guidelines to Safe and Carefree Camping*. The booklet provides information on maximum payloads for trucks with a given gross vehicle weight, the type of equipment to order, the type of hitch that is best—and legal—for the various types of trailers, and how to balance all the gear that campers like to cram into their recreational vehicles. It's available free at Dodge dealerships, or by writing to Harold Connell, Sales Promotion Manager for Dodge Trucks and Recreational Vehicles, Box 1261A, Detroit, Mich. 48232.

WHETHER A MAJOR REMODELING or the most modest redecorating job, home improvement should always provide solutions to problems created by a family

growing in size or affluence. To help homeowners create a living environment in harmony with family needs, Masonite Corp. is offering a 16-page brochure entitled *Living Ideas for Your World at Home*. It features design and decorating ideas to blend into four environmental settings; a true live-in room, an elegant dine-in room, a room to grow in and a versatile play-in room. It's free; you'll get it by sending a postcard to the Masonite Home Service Bureau, Box B, Chicago, Ill. 60690.

KODAK is offering two great guides—*America's National Parks* and *Guide to Colonial America*. The first covers 34 national parks, and for each park the author gives descriptions of unique features and how best to photograph them. The latter covers 36 historical areas within the U.S. National Park System that played exciting and important roles in the founding of our nation. The book contains picture-taking tips as well as maps of some areas to aid in locating the best photographic spots. Available for \$1.50 each plus tax from Dept. 454, Eastman Kodak Co., 343 State St., Rochester, N.Y. 14650. ★★

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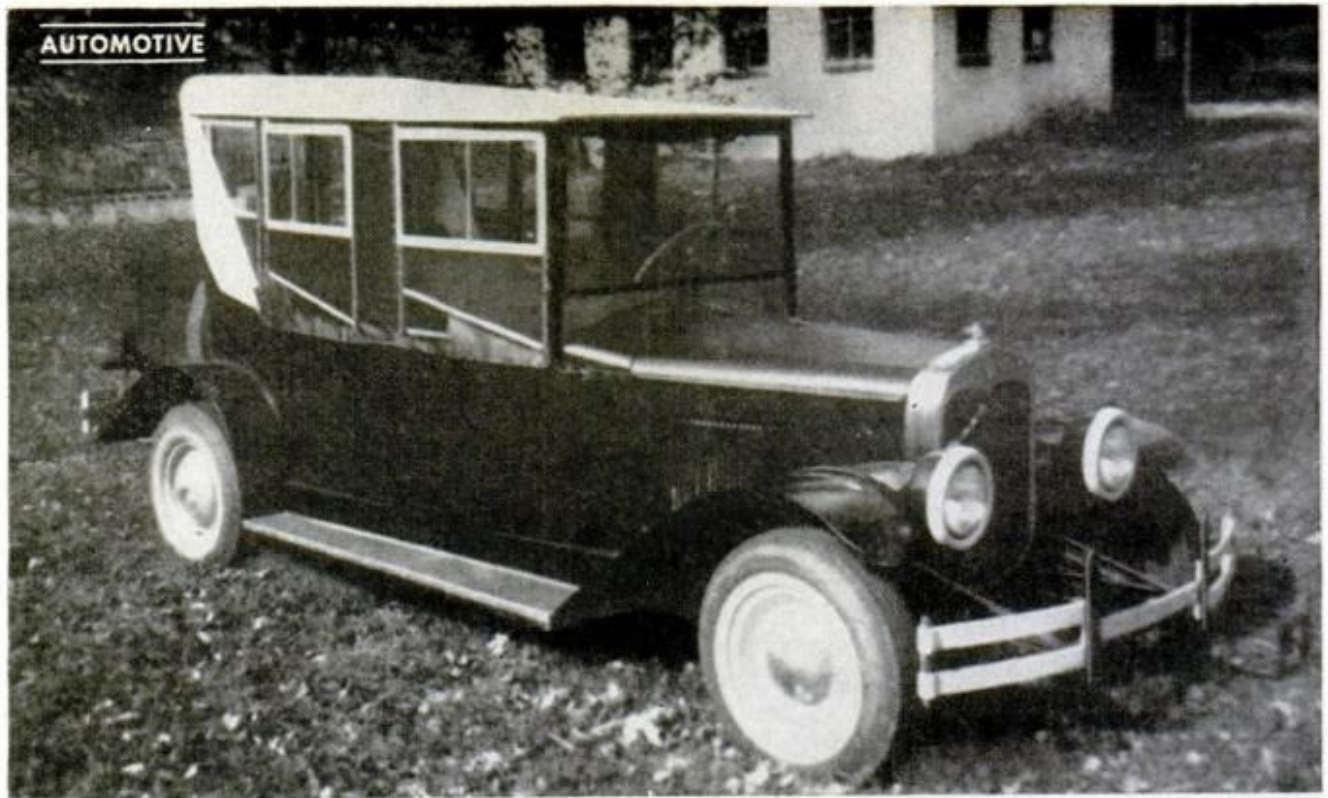
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Right Out of The Roaring Twenties

This homebuilt sedan captures the nostalgia of a bygone era—with real pickup and pizzazz under the hood

By DAVID S. POWELL

IT'S REMINISCENT of the roaring 20s, but the handcrafted construction of this handsome touring car has resulted in a rugged, comfortable, thoroughly practical vehicle for today's highways. It began with a wrecked 1962 Mercury Comet station wagon, which contributed a 170-cu.-in. six-cylinder engine, automatic transmission and rear end. From an early '50 Dodge came a frame that was cut to a 105-inch wheelbase.

In keeping with his car's personality, builder Benny Powell of Danville, Ky., incorporated the radiator shell from a 1930 Model A Ford, hood from a 1929 Chevy, and cowl lights, headlights and rear bumpers from a 1927 Dodge (headlights are converted to conventional 7-inch sealed beams). Unlikely as it seems, angle iron and sheet steel form the body structure from firewall back. Fenders were made from old oil drums and the front bumper consists of spring leaves from a truck.

The interior is designed for comfort and convenience. A stainless dash with Stewart-Warner instruments and radio plus vinyl seats make a handsome interior. A heater under the front seat warms the car. All doors are hand-made, even to latches.

Sitting back to enjoy the smooth ride and the scenery, Powell couldn't be more pleased. The car may not fly like Chitty Bang-Bang, but it is impressive testimony to the skill of an inventor-mechanic who lost his right arm in World War II. ★★



TOURING-CAR TOP of fiberglass fits over a frame of electrical conduit. Side curtains, with sliding plexiglass windows, keep out weather. Fenders were shaped from 55-gallon oil drums



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

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

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

By Victor B. Mason

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

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

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

I Have All The Money I Need

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

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

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

A Fascinating and Peculiar Business

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

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

Are You Mechanically Inclined?

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

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

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

Does Happiness Hang on Your Decision?

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

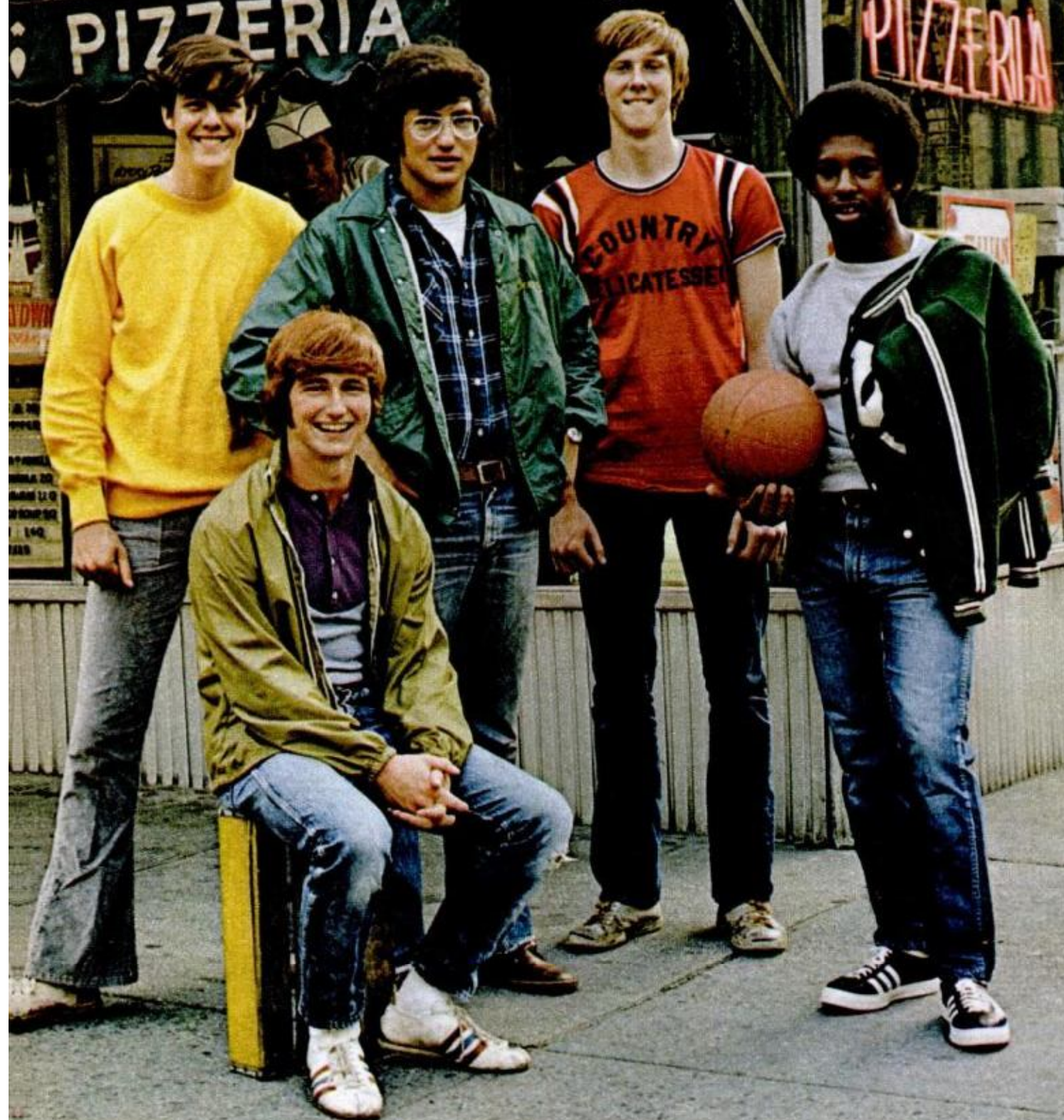
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Mike, Leroy, Rocky, Vince and Bunts are taking the Army's 16-month tour of Europe. Together.

Bunts first mentioned the Army's 16-month tour of Europe. Rocky chimed in about enlisting together, training together.

It sounded like such a good idea, the guys decided to put it together. The training. The tour.

Here's how it works. When you and the guys enlist as a group for Armor, Artillery or Infantry, you can choose to take your first duty assignment in Europe. Together.

The group gets to take basic and advanced training together in the States. Which takes about four months.

Then, after successfully completing the training, the group's off for a minimum of 16 months in Europe. You'll be assigned to the same unit or to units in the same general area.

Or the group can decide to go to Hawaii, Alaska or Panama.

Talk it over with your local Army Representative. Ask about the Buddy Option. Or use the coupon for free folder.

Talk it over with the guys. Tell them that the gang that enlists together, stays together.

Today's Army wants to join you.

Army Opportunities	Date _____
Dept 200, Hampton, Va 23369	2PM 11-71
We're interested in enlisting together, training together, touring together. Please send us your free folder.	
Name _____	Date of birth _____
Address _____	
City _____	County _____
State _____	Zip _____ Phone _____
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It's only natural.

NATURAL MENTHOL...
not the artificial kind. That's what
gives Salem Super Kings
a taste that's never harsh or hot.
You always get an extra long
taste of Springtime.

Extra long.



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

20 mg. "tar", 1.3 mg. nicotine av. per cigarette, FTC Report AUG. '71.

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300 MPH Monorail... Started With a Broomstick

Tri-Mono-Trans was designed for a child. But it's the right answer for every adult ever caught in a traffic jam

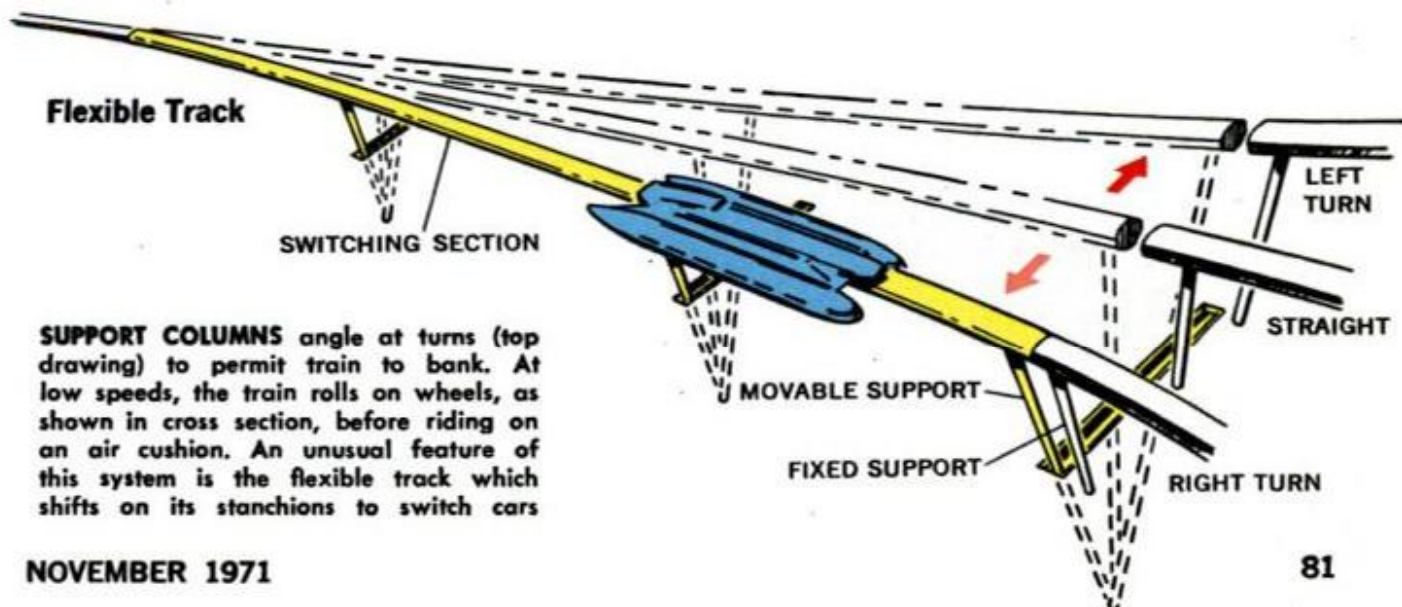
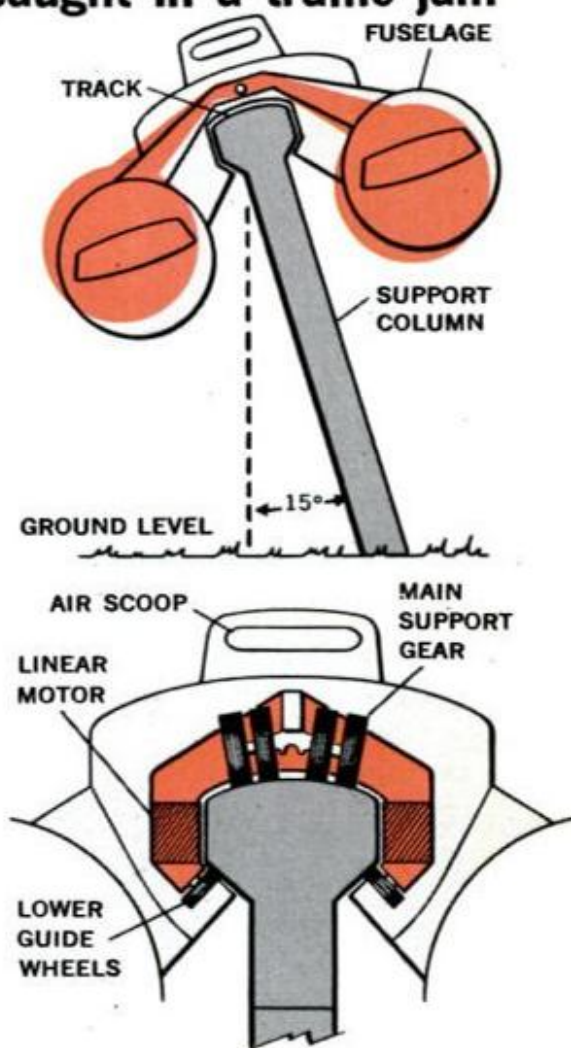
By MIKE LAMM, West Coast Editor

IT BEGAN AS A TOY—a possible replacement for the popular electric train set. It was a futuristic monorail that could run from room to room.

Marty Trent, who developed the idea, is like most who tinker with toys. He dreams of coming up with another "Hula Hoop" or "Hot Wheels" to captivate the children's world. What the 44-year-old project engineer finally did create is something that might be a hit in the adult world instead.

His toy monorail turned into a design for a 300-mph rapid transit system. (It is one of several being investigated as a possible answer to mass transit problems, particularly for interurban movement.)

Eight years ago Trent put together a broom-and-stick-and-molding-strip mockup of the toy and showed it to his project manager at North American Rockwell in Los Angeles. Howard Evans was impressed and suggested Trent work up a full-scale proposal. Then the company became interested and ordered a feasibility study. Out of it came the Tri-Mono-Trans System. What



300 MPH Monorail...



made the "toy" so impressive were design features different from other monorail systems.

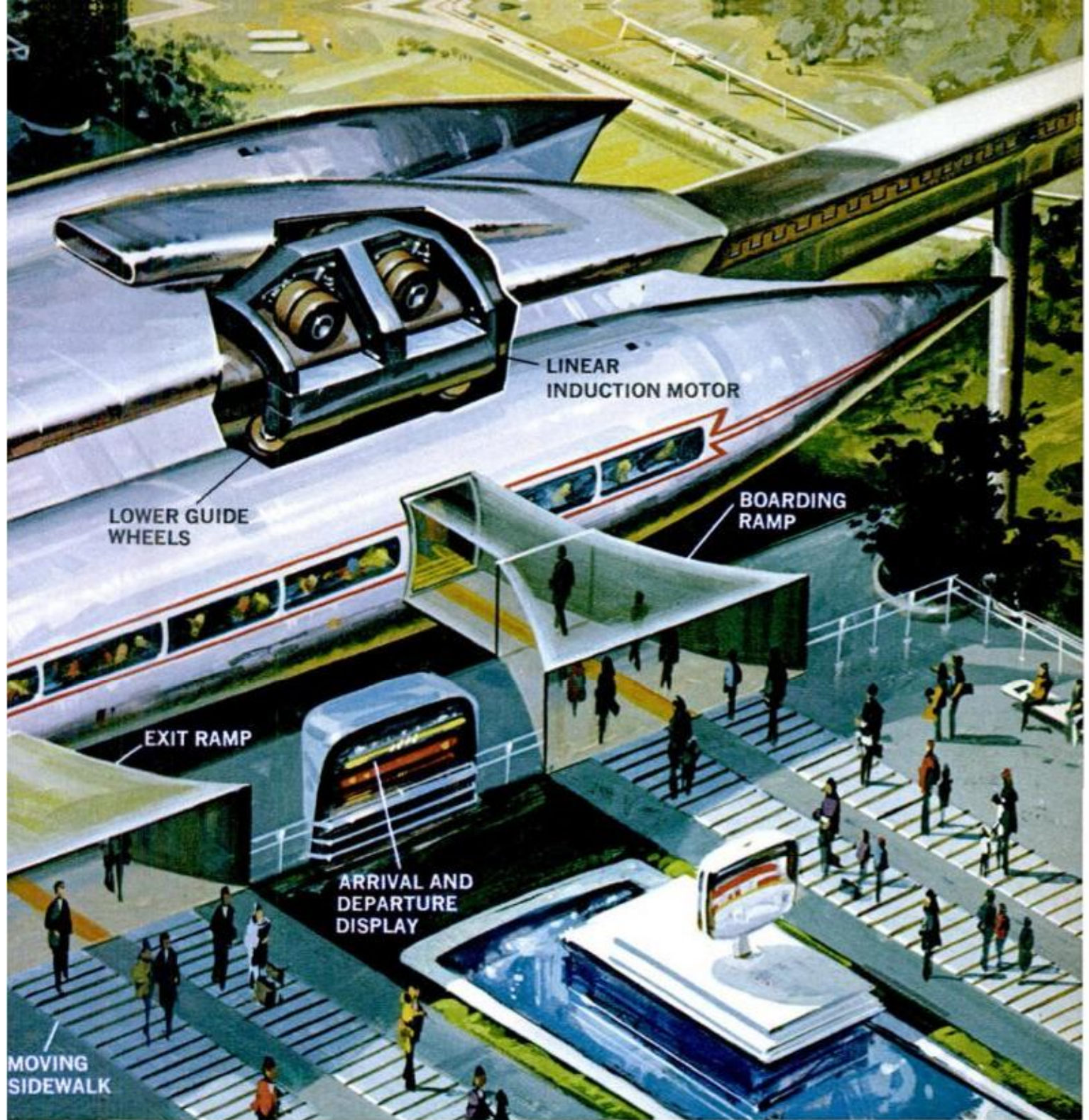
Most systems have passenger compartments hanging down from the rail. This means supporting structures and rail must be strong, big—and expensive. With such suspended monorails, the gondola swings and sways, which at high speeds causes nausea in riders.

And most monorail gondolas can bank freely only in one direction, away from the support structure. At high

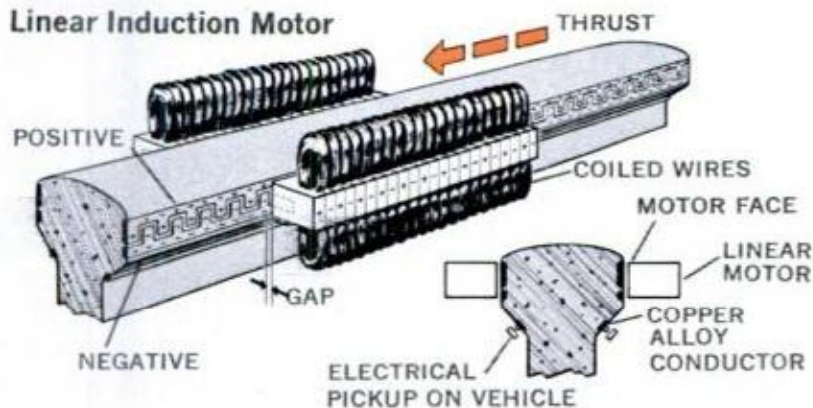
speeds, the support arms have to be cantilevered way out over their base so that banking gondolas don't hit the columns.

Trent's train has passenger fuselages that hang on either side of the track to get a low center of gravity and low roll center.

The supporting structure can therefore be relatively light and inexpensive. Stanchions can be cylinders of prestressed concrete, as is used in many bridges. Also the rail would take up



Linear Induction Motor



5000-HP ELECTRIC MOTOR uses track as armature, while field coils are built into the train. Track and train must not touch. Insulation is provided by rubber wheels and pressurized air cushion

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little space by being built above existing superhighways.

For switching trains, Trent devised and patented a system in which the long-legged track itself bends the way prestressed concrete buildings do in the wind.

This same "give" would be used in the monorail track. At switching points, tracks

(Please turn to page 198)

ADVENTURE

Ordeal on

The trek was strictly for sport and fun. But when the 16 snowmobilers reached the summit, they were hit by the full fury of a mountain blizzard

By **JIM KLOBUCHAR**
Minneapolis Star Columnist

LIKE HIS COMPANIONS, the author wore frozen face mask for much of trip. Below, party members try to right Marshall's machine after the football player plunged over the rail



Beartooth Mountain

THE MARKER came at us through the dim light of a dying day in January. It read: "West Summit, Beartooth Mountain—10,942 feet." I had seen it some 30 or 40 times before, usually in the easy breeze and unfiltered sunlight of a July morning. But now the marker had an alien look.

This was nightfall in the Beartooth. The wind charged and screamed over the tundra, driving crystal darts and snow debris before it at speeds of 75 mph. The mountain weather had gone berserk. I'll bet that more than one of us wondered why in hell he wasn't home in front of a warm fire . . .

I had organized wilderness snowmo-

bile trips for the past four years. They were intended as light-hearted cavalades for people with a fondness for the big country and a feeling for the fellowship of the trail. The pull of the mountains is strong, especially in winter when the snow, the granite walls and the sweep of firs are sculptured beauty, and the solitude is overwhelming.

We had made up the party months before. Some of the members were experienced hands, but some were novices to mountain snowmobiling.

Hugh Galusha had called me back in November. "Care to sign on a capitalist and wandering Montana boy?" he'd asked. That was Hugh all over. Though he was president of the Ninth Federal Reserve Bank in Minneapolis and a man of enormous intellectual gifts, he was not self-important. At 51, the wry Montanan was as much at home in an art salon as on a Yellowstone Park backtrail. Though an experienced outdoorsman, Hugh was new to the snowmobile and had never experienced Yellowstone in winter.

Including Hugh and myself, there were 16 of us in the party:

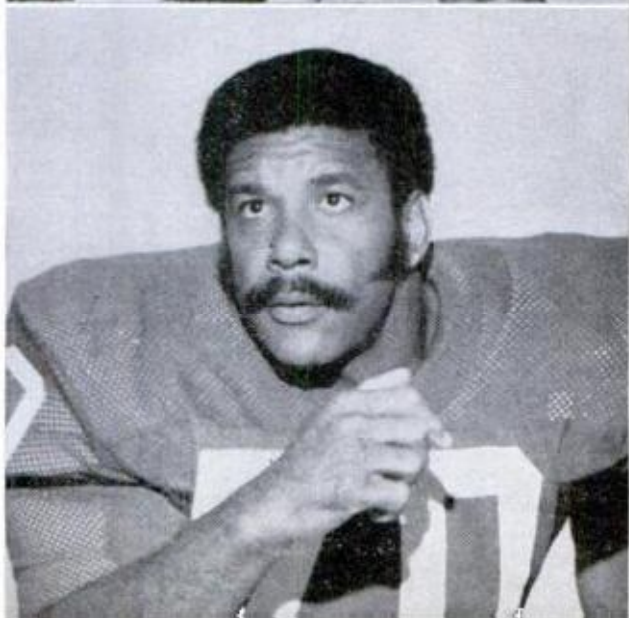
Jim Marshall and Paul Dickson, Minnesota Viking linemen, big guys with a yen to see the big horizons;

Bob Leiviska, a Minneapolis insurance man and former basketball star at Hamline University, and his 15-year-old son, Bob Jr;

Vern Hennessy, a Yellowstone Park ranger;

Les Rucker, director of an Idaho school for problem boys, an enormously strong and self-sufficient guy;

Monte Later, a calm, big-shouldered



TWO BIG MEN drawn to the Beartooth by a sense of adventure—Minnesota Viking stars Paul Dickson (top) and Jim Marshall—were novice snowmobilers

grocer from St. Anthony, Idaho, and an amateur botanist and photographer;

Wallace Dayton, member of a Minneapolis department store family;

Dave Boe, Minneapolis photographer;

Averill Kronick, Minneapolis photographer;

Loren Miller, Polaris Co. mechanic, Roseau, Minn.;

Dee Street, Ski-Doo mechanic, Red Lodge, Mont.;

Marilyn and Vern Waples, Red Lodge.

A special word about the Waples couple. Marilyn, a slim and pretty chatterbox, had handled the Ski-Doo dealership in Red Lodge for several years. With her husband she had traversed Beartooth Pass many times.

Vern was perhaps the most important member of the party. A state game warden, he was a mountaineer in the classic Western tradition—steady, self-reliant, quiet but forceful. He understood the high country's furies and he would not, as our guide, take us where we should not reasonably go. But he had no control over the weather.

In brief, this was the plan: A semitrailer would carry us and our Polaris and Ski-Doo machines from Red Lodge to the third switchback on Beartooth, at the 8500-foot level. Weather permitting, we'd snowmobile over the pass to Cooke City, Mont., where the truck would pick us up again. We'd go by

truck from Cooke to Gardiner, Mont., and spend Saturday night there.

On Sunday, we planned to snowmobile in the park, bed down at West Yellowstone Sunday night, then run through the park into the Grand Teton country on Monday, meeting the truck again Monday night at Jackson, Wyo. In short, a fairly demanding trip through some darn pretty country.

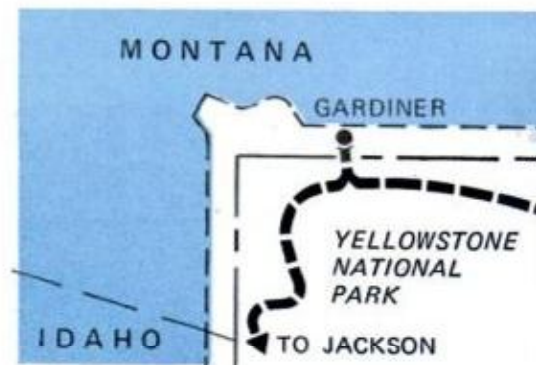
We got started right on schedule: 7:00 a.m., Saturday Jan. 30, 1971. After breakfast in Red Lodge, we piled into the semitrailer with our machines. It was a raw day—a mix of rain and snow. Halfway to the starting point, Vern Waples said to me: "Lousy weather. But I think we might as well machine around for an hour or so past the third switchback to let the guys experience some high-altitude snowmobiling. I'm sure we'll be heading back after that."

But at 8:00 a.m., when we unloaded the machines, the wind was slack and the sky had begun yellowing above the timbered ridges that floated beyond us to the west.

The change surprised even Waples. "No man ever broke the bank betting on Beartooth weather," he said with a grin.

If the weather held, we'd make a run for the "Top of the World," a rustic souvenir shop 10 miles beyond the summit pass. If it didn't, we'd settle for a truck ride back to Red Lodge.

We wore conventional polar outfits—



THE 35-MILE RUN from Red Lodge to Cooke City should have taken about five hours. Weather made the difference. Left: Vern Hennessy needs help at the 9500-foot level

goggles, heavy mittens, insulated parkas, boots. But we had no tents or paraphernalia needed for a full-scale expedition. We packed about \$20 worth of grub on the machines, some extra fuel and emergency gear like Vern Hennessy's walkie-talkie.

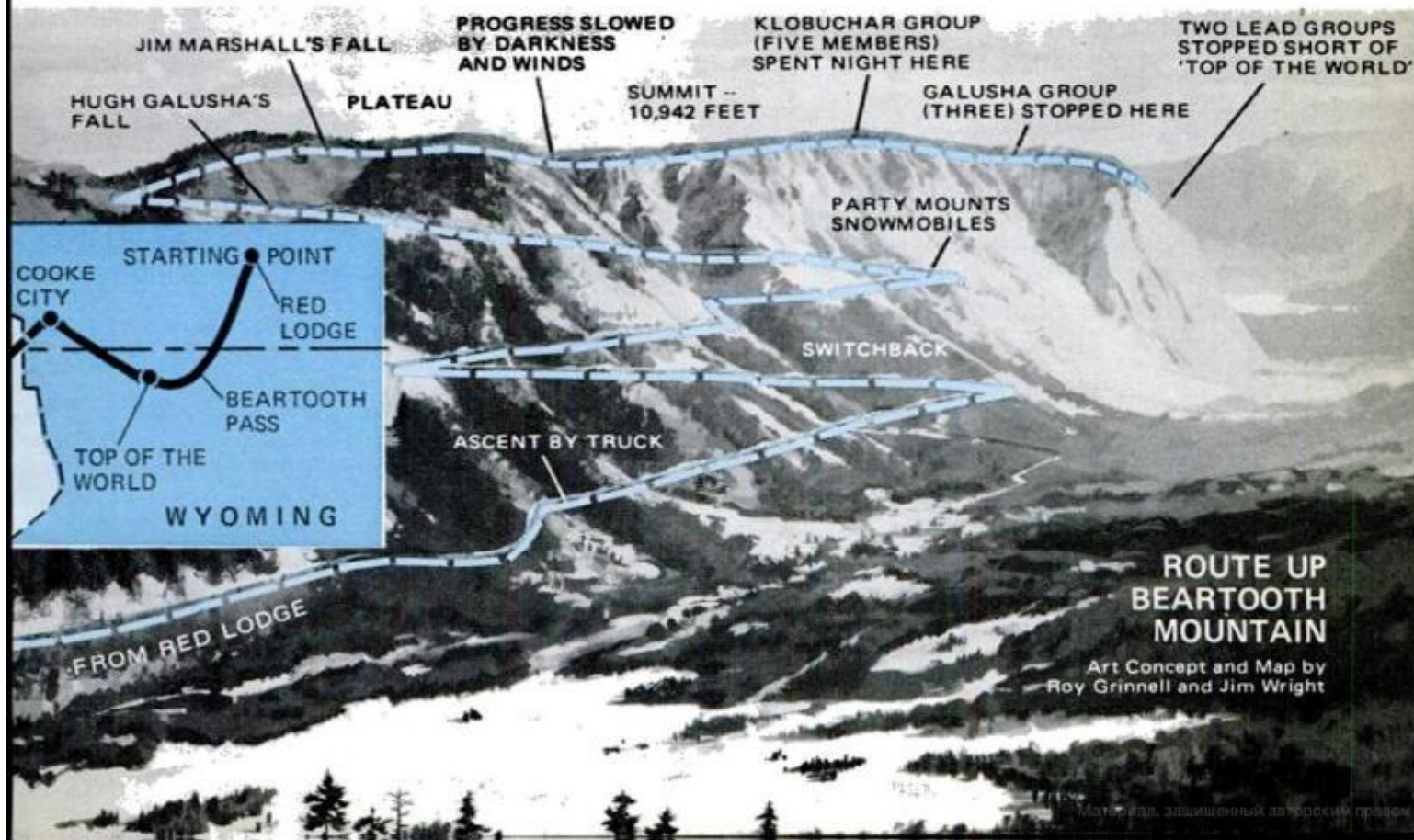
Waples usually took snowshoes with him. But his old set was shot and a new pair, a gift from his wife, hadn't arrived in time for the trip. Later, he would have cause to ponder this quirk of fate.

We got underway soon after 8:00, and by 10:00 we were moving at a good rate. The route follows the snaking Beartooth Highway, which lifts 5000 feet in a series of spectacular zigzags from the valley floor at Red Lodge. In summer it is an alpine drive of splendid airiness, carrying the tourist onto the windy plateau above the timberline, the realm of the wildflower and the rockchuck. Until two years ago, when the Montana highway department began plowing the route from Red Lodge to the high switchbacks, the Beartooth road in winter was left largely to the drifts, the gales, a few snowshoers and a random snowmobile party. But now it's an easily accessible playground for scores of snowmachine rompers.

Sixteen machines was a sizable squadron. Even under the best of circumstances, things were bound to happen. Jim Marshall was the first to come unhorsed. His accident was relatively harmless and not altogether unexpected. Though a great athlete, he's an impish guy with a gift for creating small disasters. One time during his career with the Vikings—he's a bruising defensive end—he ran 66 yards into the wrong end zone after recovering a fumble. Later, he mistakenly took a plane to Chicago instead of Dallas, where he was to be presented with a gag award for his wrong-way run.

He has a penchant for role-playing and striking the heroic pose. But his fondness for adventure is genuine. He was not an experienced snowmobiler, but a predictably eager one.

Somewhere close to the Vista Point switchback, Jim went charging over one of the windrows in the middle of the snowroad and crashed into the guard rail. The machine toppled but remained on the road. Momentum carried Jim over the rail. He slid down the 30° slope that angled to the lower switchback 800 feet below. Fortunately, all 260 pounds of him came to rest about 30 feet below the roadway. He'd



ROUTE UP BEARTOOTH MOUNTAIN

Art Concept and Map by Roy Grinnell and Jim Wright



LAST TIME ENTIRE PARTY WAS TOGETHER was at 1:30 p.m., at spot above timberline at 10,000 feet. After this photo was shot weather worsened and machines began to break down. The ordeal was in the making

stopped himself by digging in with his fingers and toes of his boots.

Monte Later and I scrambled down to him. We had no rope. I don't think we could have done more than wave if he had resumed the slide.

"James," I said, "so far nobody's laid a glove on you. You haven't far to go to get back up."

Marshall assessed the geography. "It ain't what's up that's worrying me," he said, casting a downward glance.

The three of us made it back to the road and we resumed the run under a more aggressive sun and in relatively calm air. We had a few stoppages here and there. The route led through forest, where the wind had whipped the highway snow into long, thin coxcombs.

The less experienced among us were having trouble now.

Hugh Galusha jumped a guard rail. Like Jim, he had miscalculated one of the narrow-spined windrows and plunged off the highway, disappearing into a grove of spruce. Vern Waples supplied a rope and we managed to haul the machine back to the road. Hugh appeared more embarrassed than hurt. "Greenhorn stunt," he said.

An hour passed. Another. The summit was still miles away, and it was getting colder and a bit snowy. Breakdowns began to mount. Someone would lose a spare gas can. Time to find it and refasten it. Time to find some plugs for

Bob's machine, then for mine. Time to unstick a throttle. Time was beginning to run with the wind.

Now it was near 4:00 p.m., and the party had accorded out. Vern Waples was aware of the danger in that. He also knew that some of the machines might not make it to the Top of the World. If the lead machines made it, there at least would be a rescue base should real trouble develop on the mountain.

Marshall's machine was the first to give out. He doubled up with Dickson, a husky Viking from Texas. My snowmobile conked out 15 minutes later and I got a ride with Hugh Galusha. He looked comical with an iceball goiter

SNOWED-IN SOUVENIR SHOP became goal of party after breakdowns multiplied. But no one reached it



POPULAR MECHANICS

hanging from his face mask. But he also looked tired.

Breakdowns multiplied. It was twilight—an all-too-brief twilight—and the wind was picking up. Whorls of snow began to obscure riders in front of you. Soon the whole mountainscape was blurred by the intensifying storm and descending night.

Our machine got sluggish. When it was apparent that it could pull only one rider, Hugh said he'd rather walk. I watched him as he and a couple of others vanished over a ridge.

It was past 5:00 p.m. when I and Dave Boe, who'd been running ahead of me, spent 20 minutes working on his Ski-Doo. When you have to horse a machine around at 10,000 feet, yank its skis and dig your shoulder into its rear frame to get it moving, the effort can drain you physically and leave you prostrate in the snow. That's how it was with us. But we got the darned thing moving again.

The machines were not really at fault. It was the foul weather. The wonder was that so many of the snowmobiles had even reached the summit.

It was a bit later that my headlight picked out the summit marker. I wanted to smile at the incongruity of a tourist sign marking the way for us in the middle of a fully orchestrated bliz-

MARILYN WAPLES smiles up at husband Vern before start of run. A game warden, he was party's guide



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zard. I might have smiled, except that my lips were welded to my face mask by frozen moisture.

I fumbled with the quilted sleeve of the snowmobile jacket to look at my watch. The mittens made it a clumsy, maddening chore. I removed a mitten. It fell to the ground and nearly blew away. I lunged at it in the snow and grabbed it. At the moment, the tumbling, soggy mitten seemed to me the most important single thing on Earth.

Not long after that my machine keeled over and slid off the trail cut by Les Rucker in the lead machine. I tried to get the snowmobile back on the track. But two men on a pitching snowmobile—on a slope of uncertain grade and riding a night storm—can't shift weight with the synchronized finesse described in the manual.

Les Rucker, Wally Dayton and Vern Hennessy came to help me and Dave Boe. After we got my machine back on the track, we did some talking. To make ourselves understood, we had to get nose-to-nose and shout. The power of the wind was awesome. Wally Dayton was knocked to his knees by a gust and sent tumbling across the highway.

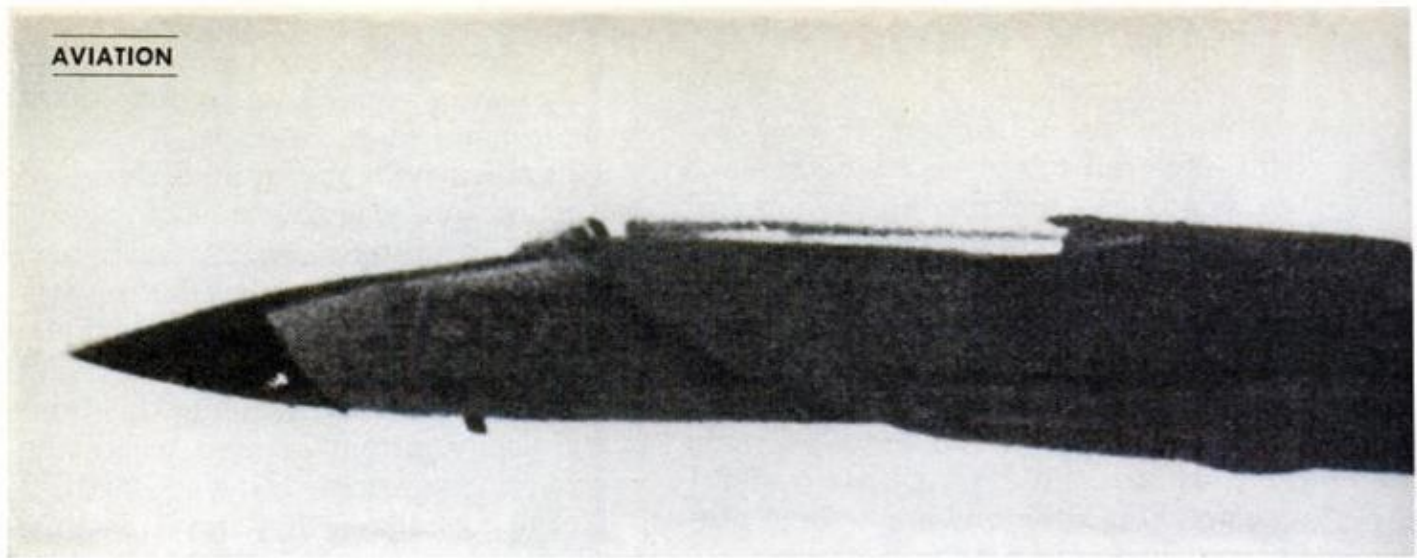
Rucker spelled it out for us. We could try to continue on the three machines among us, go it on foot, or dig in and wait for morning.

We decided to walk. We moved out, holding on to a length of rope to prevent getting separated. We'd gone about 100 feet in the darkness when Hennessy staggered in the wind and fell. Dayton walked into him without seeing him.

We'd had enough. We returned to our machines and broke out a hunk of salami, an orange and some candy. We all were dehydrated. The only problem was jamming the food through the frozen mouth slit in our masks.

Near a rock formation that we figured might slow the wind a little, we turned one of our machines on its side for a windbreak. Then we lay down next to it, one against the other, shar-

(Please turn to page 194)



Russia's MiG-23:

The Soviets' newest fighter—called Foxbat—has posted great performance figures. Some Americans think it can rule the sky. Others claim our F-14 and F-15 will prove its match

By D. J. HOLFORD

N EITHER THE F-14 OR F-15 can handle the Foxbat threat."

That statement was made in a recent report that raised the hackles of some of our military men. The report was issued by the House of Representatives Appropriations Defense Subcommittee as part of an evaluation of the Navy's F-14 and the Air Force's F-15, both of which are supposed to be able to take on any fighter in the world.

But the subcommittee did not agree. Its members came to the conclusion that Foxbat will be in control of the combat situation.

Foxbat is the NATO code name for the Soviet MiG-23, a fighter reportedly capable of flight at altitudes above 80,000 feet and speeds in excess of 2000 mph (better than Mach 3).

Foxbat has been flying since 1967 and has been supplied to the Egyptians. The Grumman F-14 (*A Hot New Fighter for the Navy*, page 83, Jan. '70 PM) is still in the test stage. The first prototype

crashed last December when its hydraulically operated control systems failed.

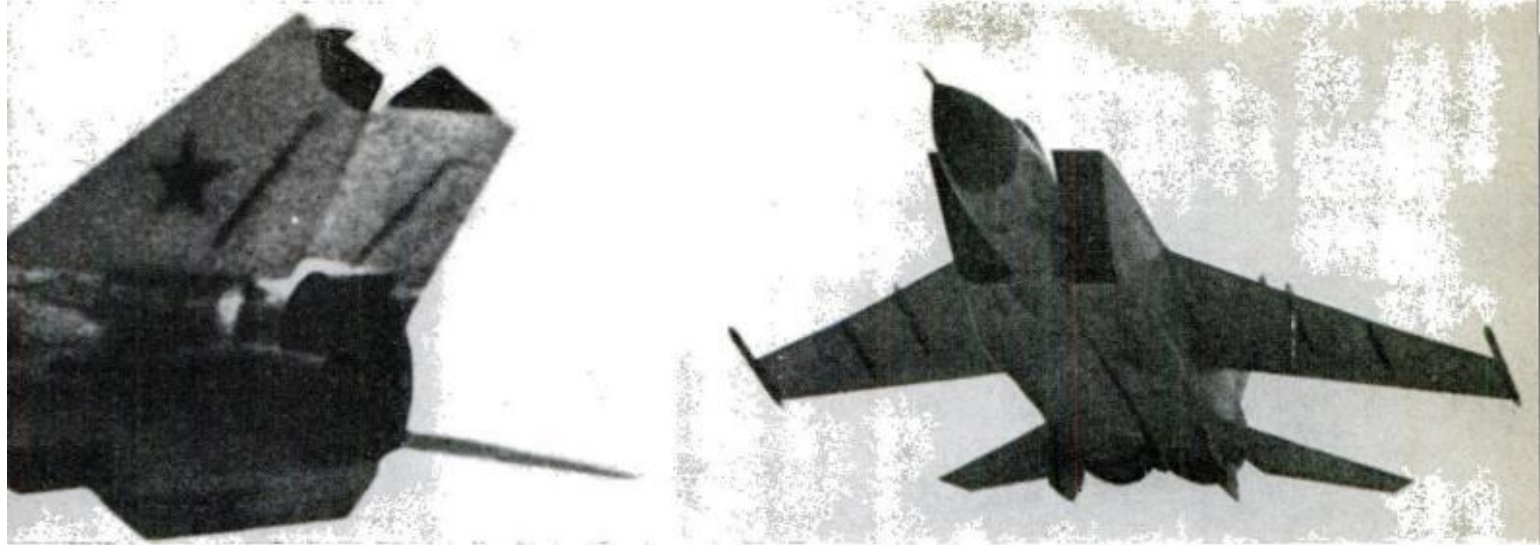
The McDonnell-Douglas F-15 (*A Fighter Pilot's Fighter Plane*, page 73, Dec. '70 PM) has yet to fly.

The F-14 is expected to enter Navy service in 1973, if no further delays are met. The F-15 will not see service until 1975. What the Soviets will be flying then is anybody's guess.

Foxbat is the interceptor version of the original MiG-23 unveiled in 1965. The twin-engine jet reportedly weighs 64,200 pounds at takeoff, has a wing span of 44 feet and a 65-foot-long fuselage, and can be armed with air-to-air missiles, rockets and bombs. Its primary mission in Egypt is air superior-

STILL IN THE TEST STAGE, the sharp-looking F-14 was designed as an air-superiority fighter. It's slated to enter service in '73





Unbeatable?

ity (tactical control of a given air space), but it can also handle reconnaissance and fighter-bomber roles. Foxbat is said to have a combat radius of about 600 nautical miles.

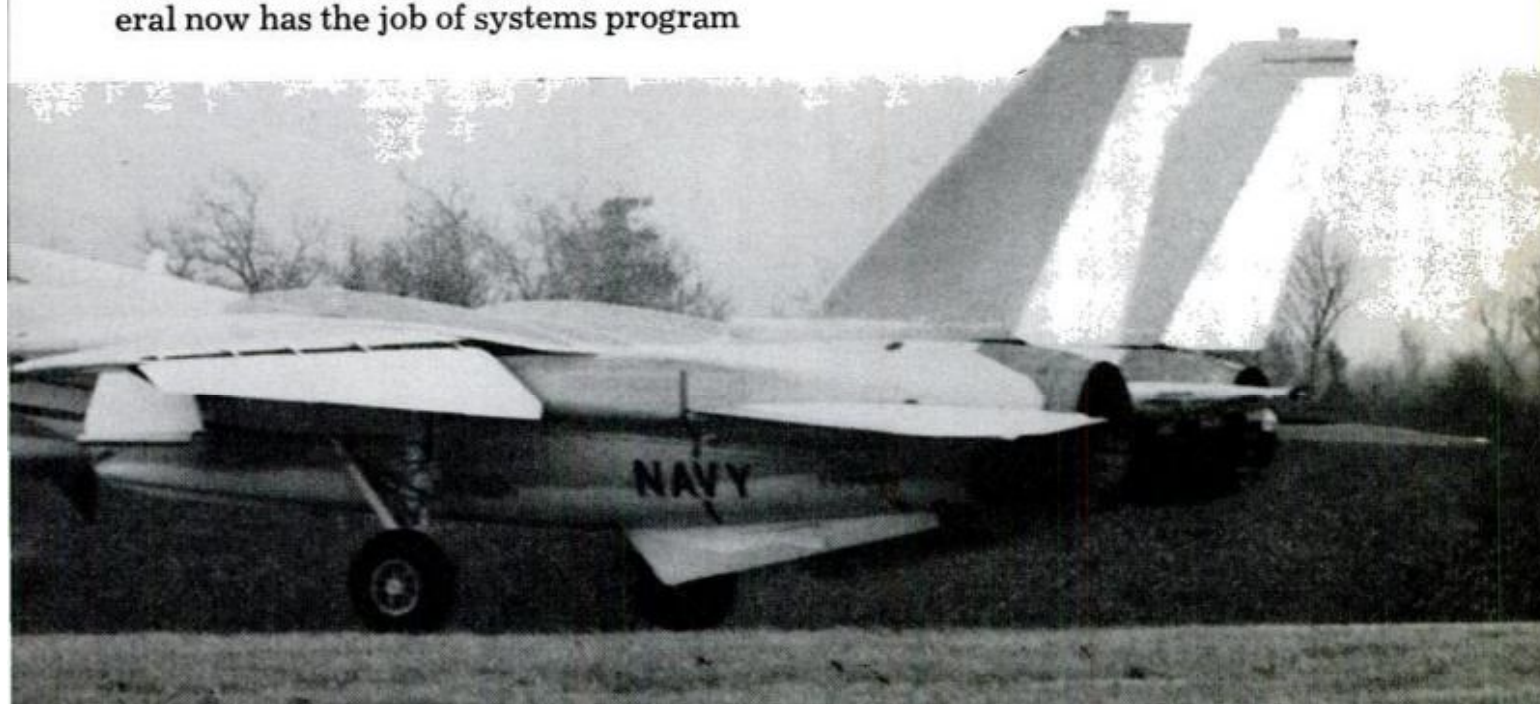
Performance figures are hard to come by. But Foxbats over Egypt have been tracked by radar at altitudes of 73,000 feet and speeds up to 2140 mph. It's considered doubtful if either the F-14 or F-15 will be able to match that performance.

But are speed and high-altitude capabilities key factors in the effectiveness of an air-superiority fighter? Brig. Gen. Benjamin N. Bellis of the Air Force doesn't think so. With long experience in research and development, the general now has the job of systems program

director for the F-15. He made his views clear in a recent issue of *Air Force Magazine*:

"The F-15 is the best air-superiority fighter the United States can build at this time. Nothing has happened since contract go-ahead that justifies doubt. To the contrary, the great volume of wind-tunnel data accumulated so far indicates that the design does indeed represent the very best attainable for the air-superiority mission.

"But the F-15 can't do everything for everybody. It is not a strategic bomber, nor a competitor of the SR-71 (a high-flying American reconnaissance plane). Rather, it is an air-superiority fighter



for the tactical environment. And for this role, it is the very best that present technology makes possible in terms of airframe, engines and avionics.

"The Mach 2.5 capability is no handicap. In fact, excessive speed can handicap you in the air-superiority role. If you want to fly at Mach 3 plus, you have to go to altitudes where dogfighting is not possible. Secondly, every time you turn at such speeds, you swing around a territory the size of Wyoming and fly completely out of the battle zone. In other words, at best you get one pass at your opponent and this makes no sense for an air-superiority fighter."

These views are echoed by the former commander of the Israeli Air Force, retired Maj. Gen. Ezer Weizman. The high ceiling of the Foxbat is more useful for reconnaissance than for air-to-air combat, according to the general.

"If war breaks out again," he says, "we shall down the MiG-23s as we downed the others." He refers to the fact that Israeli planes have shot down a number of Soviet-manned MiG-21s in the Middle East.

One of the highly touted advances in American combat technology is the development of "downward looking radar" and "snap down missiles" for use against targets at lower altitudes. The idea is that you can cruise at a high altitude, perhaps out of reach of the

enemy, and still be able to knock him down.

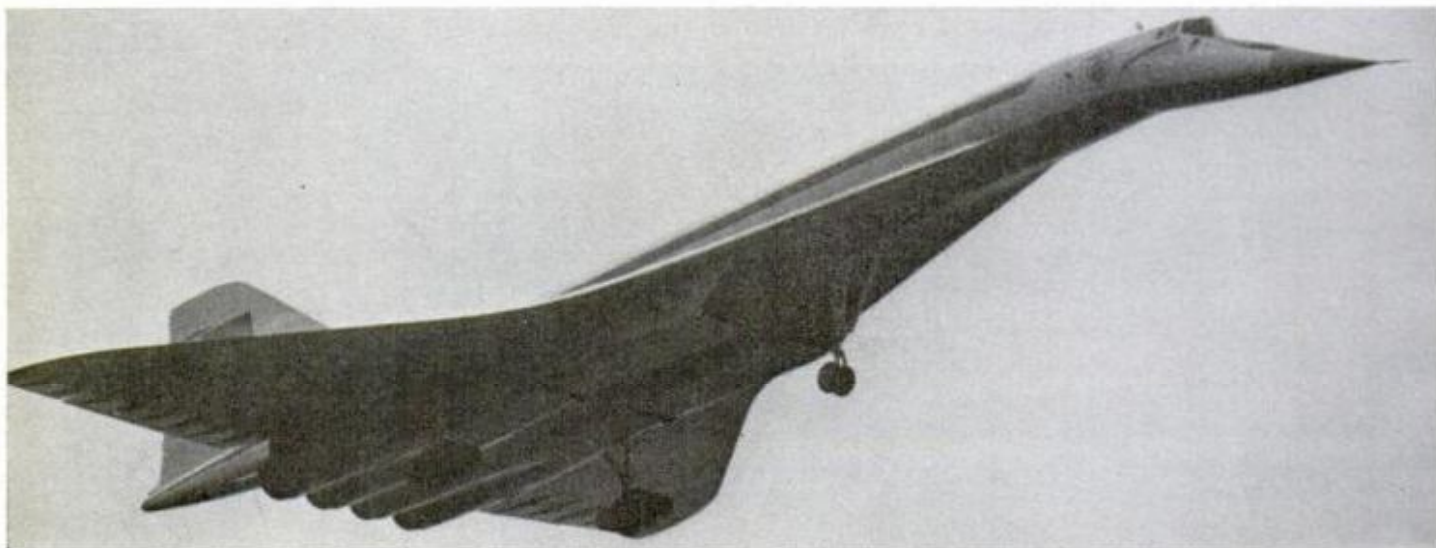
A great idea. The only trouble is that there are reports that Foxbat has similar equipment. Since Foxbat can fly higher than either of the American planes, it would seem to have the advantage.

But maybe not. Computer studies by the Air Force, according to Gen. Bellis, indicate that a Foxbat-type plane operating at high altitudes (where its ability to maneuver is minimal) would be vulnerable to missiles from a lower flying aircraft.

Air Force experts also say that the F-15's great maneuverability and sophisticated radar should enable it to dodge any missiles fired at it from above. At this point in time it's impossible for the layman to judge the validity of this line of thinking.

As a nation, we tend to put a lot of faith in the superiority of our technology and of our pilots. So far, that faith certainly has been justified. But that doesn't mean we should close our ears to warnings from knowledgeable people.

One such person is Col. Jack Broughton, who chalked up 216 combat missions as a fighter pilot before retiring from the Air Force. He has flown almost every American fighter from the P-47 to the F-106. He is a former leader of the USAF Thunderbird aerobatic demonstration team and achieved an





AIR FORCE has high hopes for the F-15 (shown in the painting) as an effective air-superiority fighter

enviable record as commander of a fighter-bomber wing in Vietnam.

In his book, *Thud Ridge*,* dealing with the air war over North Vietnam, Col. Broughton describes an encounter with a MiG-21. (The MiG-21 was first revealed to the West in 1956. Col. Broughton was flying a Republic F-105 Thunderchief, the first production model of which flew in the same year, so the planes were of about the same vintage.)

Col. Broughton recounts the battle: "He went by me so fast I could have

* From the book *Thud Ridge* by Col. Jack Broughton, USAF (Ret.). Copyright © 1969 by Jacksel M. Broughton. Reprinted by permission of the J. B. Lippincott Co.

imagined that my engine had quit and that it was time to eject. . . . This guy was different; he was no run-of-the-mill North Vietnamese trainee. I couldn't see his eyeballs, but I'm willing to bet that they were both round and blue. . . . I certainly hope that our management of statistics and stories does not delude us into believing that we have met and conquered the best of the world's airmen. It just is not so, and the 10-to-1 kill ratio racked up by the MiG-21s a bit later ought to make somebody do a bit of thinking."

Later in the dogfight Col. Broughton managed to get into a firing position behind the MiG. He describes what happened next: "It was time for him to disengage and get out of there, and he wrapped his little beauty into a vertical 180° turn to the left and was gone. Just like that. I couldn't come close to staying with him, and he was gone. It must be great to call the shots like that."

Col. Broughton is speaking as an American fighter pilot, remember, not as someone with political or ideological axes to grind. He continues:

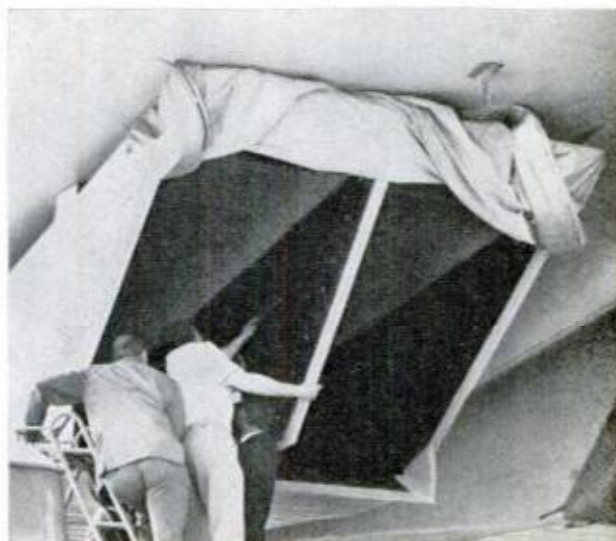
"Anyone who reads the air-to-air results and feels that American technology has scored another victory over the competition of the world is sadly misled. . . . I scream caution at the top of my lungs that we have not yet met the first team of MiG drivers. . . ."

No doubt about it—the MiG-21s have proved themselves. But other experts

Soviet entry in supersonic race

With our Boeing SST in limbo, Russia's entry remains the only one in active competition with the British-French Concorde. The Tu-144 was first test flown in 1968 and reportedly became the first passenger plane to exceed Mach 2 during a 1970 flight. According to the Soviets, the plane can speed up to 1550 mph and has a range of about 4000 miles. It gets its push from four turbofan engines, each rated at 38,580 pounds thrust and requiring a giant air intake (photo at right). When flying at low altitudes, the SST's nose is in "droop" position (left) to provide pilot with better visibility. The Tu-144 will have a maximum passenger capacity of 120, compared with 144 for the British-French Concorde.

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would argue with Col. Broughton, pointing out that in Vietnam the Republic Thunderchief was forced into an air-to-air combat role it never was intended for. It is a type of fighter-bomber—designed to pour ordnance on a target—not an air-superiority fighter. The Phantom F-4, however, is an air-superiority fighter that's downed its share of MiG-21s in Vietnam, especially below 15,000 feet.

Since Col. Broughton's encounter in Vietnam the Soviets have built new combat aircraft. We've built the F-111, which did not work out as a fighter. The Navy version of it was abandoned, and the only future left for it is as a low-level bomber—just the type of threat that the Foxbat was designed to handle.

What next? One possible ray of hope is the RPV (Remote Piloted Vehicle). RPVs are radio-controlled fighters flown by a pilot who is far removed from the scene of battle. The pilot views the action on a television screen and flies the fighter just as if he were sitting in the cockpit.

RPVs promise a number of advantages over manned aircraft. They can have supermaneuverability since they aren't restricted by the physical limitations of a human pilot. Because they do not carry a pilot they do not need the complex safety and life-support systems a manned plane requires. Therefore they can be smaller and made



MIG-21 HAS SEEN SERVICE in Egypt and Vietnam. This plane sports colors of the Indian air force

more cheaply and in larger numbers.

The Navy recently carried out trials with an RPV and F-4 Phantoms, the hottest fighters in the American inventory right now. Though few official details have yet been released to the public, it is reported that the RPV flew rings around the Phantoms. It escaped from missiles that were fired by the manned fighters and succeeded in shooting them down (with a camera) several times.

The Foxbat controversy is in its early stages. We are sure to hear a lot more about it as time goes on. But if the F-15 ultimately proves inferior to the Foxbat—as the Congressional subcommittee has warned—then perhaps the RPV will be the aircraft that we will look to to provide us with air superiority. ★ ★ ★



A 'biggest' for the USSR

Offering a cargo hold 90 feet long, 14 feet wide and 14 high, the new Mil V-12 chopper rates as the world's biggest. It's powered by four turbine engines and has two five-bladed rotors. It reportedly was designed for use in remote areas and for hauling bulky engineering gear and large vehicles. The copter won a special Sikorsky prize, sponsored by the American Helicopter Society, for the feat of lifting a load of 88,449 pounds 7335 feet. The chopper cruises at 149 mph and has a ceiling of 11,610 feet.



New bowling aids

Among the features of Brunswick's new Astroline bowling equipment are the Pin Finder (top) and a solid-state foul detector, called Tel-E-Foul. The pin locator lights up when the ball hits the pins, then continues to show the pin leave where it can be seen easily by the bowler.



Kingfisher comes back

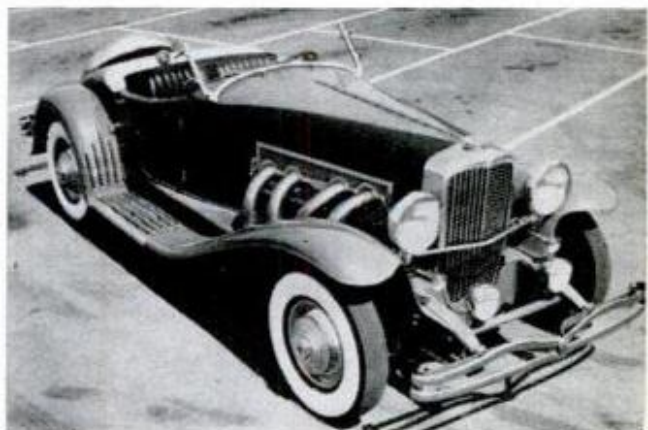
An OS2U-2 Kingfisher, which crashed in British Columbia in 1942, has been restored to display condition by retirees of Vought Aeronautics Co., original builder of the plane.

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Patient can stand in chair

The Stand-Up Wheelchair, which may be used in normal fashion by a handicapped person, enables the patient to stand upright with the aid of springs built into the chair. Locks hold him up until he releases them, then springs assist him to a sitting position. The chair was designed by Peter Bressler under Alcoa's Ventures in Design program.



Duesie is a Dodge

Using a 128-inch Dodge truck frame and a 383-cu.-in.-Dodge V8 engine, Bernard Miller is turning out replicas of the Duesenberg boat-tailed Speedster. Body is of aluminum panels on ash wood frames. Price: \$24,500; Duesenberg Motor Corp., Gardena, Calif.

No Gas Pains, but Oh! That Crunchy Gearbox!

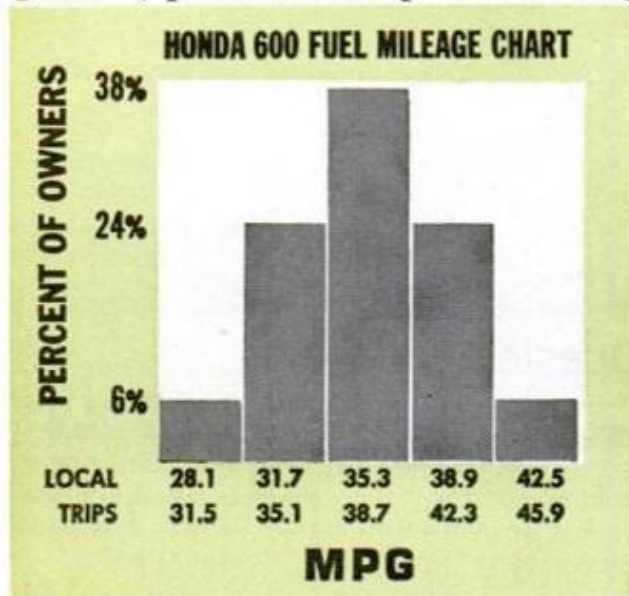


By **MICHAEL LAMM**, West Coast Editor/Photos by the Author

THE HONDA 600 is an unusual car, not only in looks but in its basic engineering (See *Handy Little Honda*, page 88, March '68 PM).

It uses front-wheel drive, with a two-cylinder, in-line, aircooled, overhead-cam, four-cycle engine delivering 36 bhp from 36.5 cu. in. For you math fans, that's just under one horse per inch—quite an admirable squeezing.

The Honda boasts a unit body/chassis, independent coil-spring front suspension, a beam axle behind with leaf springs, vac-assisted front disc brakes, four-speed gearbox, plus rack-and-pinion steering. It's the shortest, lightest car currently



FRONT-WHEEL DRIVE, quick rack-and-pinion steering put Honda's handling on par with some sports cars
 96



MOST HONDA OWNERS are young, rather impoverished, consider the car cute, and appreciate its stinginess with gas. Workmanship gets good marks, but transmission, brakes and noise come in for most of gripes

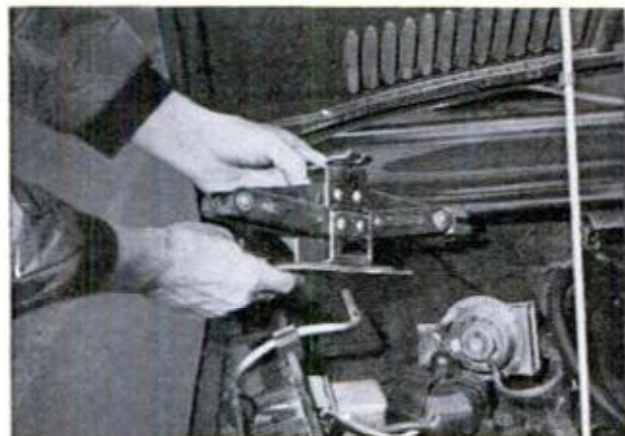
being brought into this country: 125-inch overall length, 1355-pound curb weight. (The 600 was introduced initially in the "test market" of California, Oregon and Washington where our owners report was conducted. The car is now "going national," however, and by newsstand time dealerships should be opening nationwide.)

Those are the Hondas raw statistics, but owners point to more than that. They're pleased with gas mileage (up to 40 mpg), reliability, workmanship, a raft of clever and thoughtful innovations, big-car spaciousness (almost) in the front seat, plus the usual Honda eagerness to please.

Says an Oxnard, Calif., grocery manager, "My wife likes the way it rides, and I like the way it handles on the highway—am very proud to drive it. A Long Beach housewife: "If everyone

drove a Honda to work, we'd have less smog. It takes up less space on the freeway and in parking." A Hollywood airlines controller: "I drive 40 miles a day to work and back and got sick of spending \$7.50 a week on gas. Now I spend \$2 a week and am able to park closer to my job." A Bellflower, Calif., salesman says he gets a \$50 monthly car allowance and, with his Honda, pockets half.

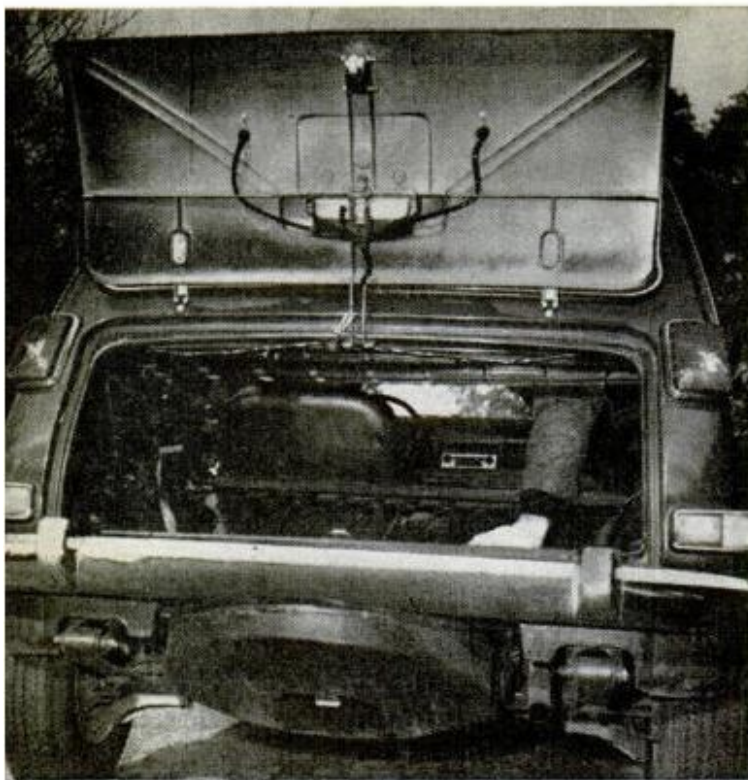
Here are other random phrases of praise: "My front passengers can't believe the amount of room this car offers." "Workmanship is commendable." "Fun to drive in the city." "One test drive convinced me." "The car is very easy to tune, and since it has no smog plumbing, it stays in tune and you get all the power undiluted. My service manual cost \$15.95 but it was well worth it." "I don't plan to trade mine for eight years."



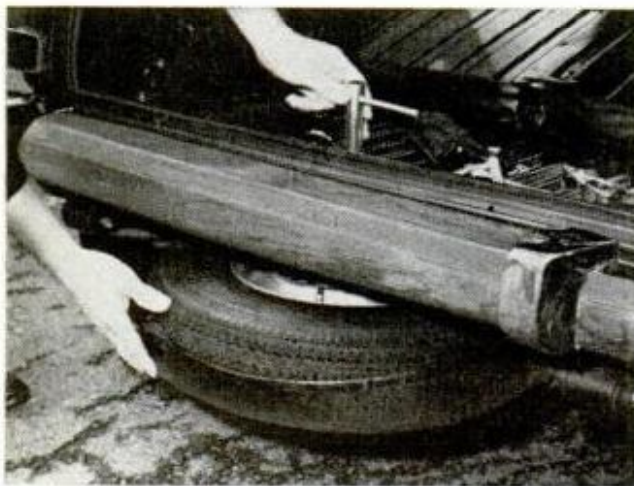
TOOLS store under hood. Engine compartment looks crowded, although owners say it's easy to work in
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RELEASE BUTTON in door pillar opens filler door, so when you lock the car, you also lock the gas tank



REAR SEAT unbolts with four wingnuts, gives lot of luggage capacity. Decklid is unreinforced plastic



SPARE TIRE hangs down under trunk floor, unscrews from above. Frequent tire rotations are advisable



BOXY LINES make maximum use of space, and though the rear seat is cramped, there's plenty of headroom

The Honda's most griped-about feature is its transmission: hard-shifting, cantankerous, noisy and totally void of synchromesh. (Since our survey was conducted, Honda has added synchromesh on the current N600B models. Suggested price is now \$1495.)

Brakes got a few black marks, too. They apparently don't pull down the car quickly enough in panic situations. Also, since the rear end is light, the rear wheels sometimes lock up, causing skids.

Owners say the back seat is "a little tight," but they realized this when they bought their cars, thus it's not a complaint. Quite a few reported removing their rear seats to give more cargo capacity. One gent even said he'd turned his Honda into a mini-camper "... with no body modifications."

On so petite a wheelbase (78.7 inches) and with such small tires, the ride tends to be choppy, but we got few complaints on that score. "Ride is firm and comfortable," said a letter carrier. And a Los Angeles student: "My Honda has done well on several 3000-mile trips—good roadholding, good stability, comfortable." Owners like the way the car handles; several admitted flogging it harder than an ordinary car simply because of "... quick steering, good cornering, and fast pickup around town."

Front-wheel drive and small tires mean lots of front tread wear. Front tires seem to average 10,000-13,000 miles. "Standard tires are poor and the dealer wants \$26 each for replacements. I went down the street and bought radials for \$23 each." To forestall tire replacement, the factory suggests frequent rotations.

One-third (32.2 percent) of our respondents said they'd like a bit more horsepower. "Mine doesn't pull long hills well in fourth gear." "In freeway driving, where there is a wide difference between speeds, I would like to be able to move out of dangerous bunching situations. Entering a crowded freeway can be a problem, too, because cars behind me want to go faster but can't pass

Summary of 1971 Honda 600 Owners Reports*

Total miles driven1,981,089

Average miles per gallon:

Local driving35.3
Long trips38.7

Why the Honda?

Economy80.3%
Price28.0
Style11.3
Size10.0
Handling7.5

Specific likes:

Economy81.7%
Handling64.7
Styling22.0
Performance13.3
Comfort10.8
Price9.5

Specific dislikes:

Hard shifting29.8%
Rattles16.7
Lack of power14.6
Poor brakes8.0

What changes would you like?

More power32.2%
Easier shifting18.3
Change seat belts11.3
More left-foot room8.3
Better styling6.5

Had any mechanical trouble?

Yes51.2%
No49.8

What kind of trouble?

Carburetor17.9%
Exhaust manifold10.6
Electrical9.8
Shift mechanism/trans7.3
Horn7.3

Did you repair it yourself?

No84.2%
Yes15.8

Dealer repairs satisfactory?

Yes74.5%
No25.5

Is the Honda your only car?

No61.2%
Yes38.8

Other makes of cars owned:

Chevrolet15.4%
Volkswagen12.6
Ford10.1
Dodge8.1
Pontiac7.4
Oldsmobile6.7

Number of cars owned:

2 cars49.6%
1 car38.1
3 cars9.3
4 cars2.5
5 or more cars0.8

Age distribution of owners:

15-29 years58.9%
30-49 years32.4
50-plus8.7

Would you buy another Honda?

Yes78.3%
No21.7

*Percentages might not total 100% due to rounding and/or insufficient data.

even when I'm at peak acceleration." "It cruises nicely at 65 mph, but passing from that speed takes some nerve."

A few expressed fear of accidents. "The only worry I have is getting hit by a bigger car." "I would like to see a bit more reinforcement in doors and roof; perhaps also a rollbar." An Oakland, Calif., oilworker: "Ours was totaled in a relatively minor accident. Considering the damage to the outside, though, the inside held up extremely well."

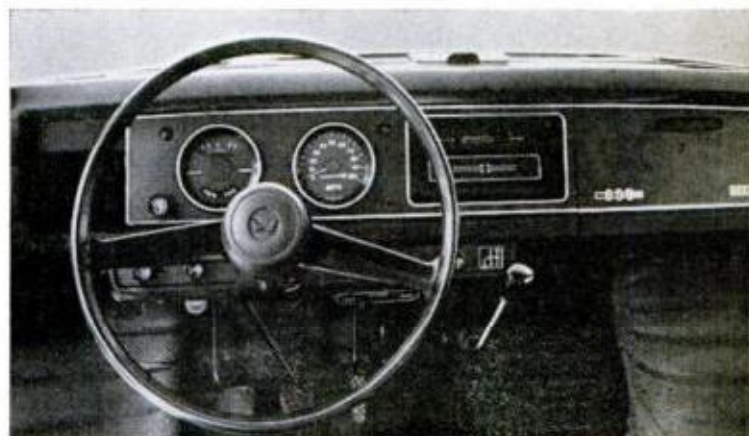
Dealers usually sell Hondas alongside other lines, mostly American. Generally, Honda owners rate their dealers "good to excellent," with only 35 percent marking them "below average." Half said service was above average and half said below. These are loose ratings, not included in our data panel.

A significant number of owners feel they're paying too much for service. Figures mentioned: \$24.50 for a 3000-mile warranty check; \$18 for an oil change or \$26 with filter replacement; and six sets of plugs (albeit only two to a set) in 12,000 miles.

Noise is another complaint. "The heater sounds like it's about to eat you up," says a commercial artist. "Can't hear the radio with the windows rolled down at 60 mph." "The engine sets up quite a racket."

Among the Honda's clever touches: "Radio antenna, roof-mounted, is in a good place—you can put it up or down from inside." "I like the removable headrests because we can take them out at drive-in movies so the kids can see." "Every square inch of this car is used for something."

Summing up, a San Simeon (Calif.) park ranger observed: "I bought my Honda to save money. My last three cars depreciated more in 1½ years than the Honda's total cost. With approximately 50,000 miles on each previous car when traded, I couldn't lose on the Honda even if it's worth nothing in 1½ years. And it just happens that I'm very happy with my Honda."



FRONT COMPARTMENT boasts as much space as big car, but some say there isn't room for the left foot

Slick New Scout



Sitting in looking out, you'd hardly guess you were driving an off-road vehicle. It's another of those two-car cars

By MICHAEL LAMM, West Coast Editor / Photos by the Author

INTERNATIONAL HARVESTER assumes that the typical off-roader still spends most of his time on the road. Thus the new Scout II, while it's perfectly at home in the wilds and woollies, is as much so on the freeway or carting the kids to music lessons.

In 1961, the original Scout became the first recreational workhorse to give the Jeep Universal a run for its money. Soon, with the Scout selling so well,

Ford jumped in with its Bronco, then Chevy with the Blazer, and several imports also entered the field—the British Land Rover, Toyota's Land Cruiser, and the like.

Now I-H feels it's time for a second generation of Scouts. Styling differences aren't drastic, but the changes inside and underneath are quite thorough. The key word is *refinement*. The Scout II has been greatly refined, and by doing so, I-H is trying to make this vehicle the Cadillac of its class.

You can order it any of 1000 ways—from spartan to ultraluxurious. Airconditioning, power steering, power drum brakes, automatic transmission, two big V8s, All-Wheel drive with power take-off, Trac-Lok limited-slip differentials, locking hubs and fancy interiors are only the beginning. And if you think it's sissy to drive through the



TAILGATE opens with one hand, thanks to spare tire being moved inside. Cargo deck is 5 inches longer



WIDE CHOICE of colors and trim brighten Scout II, and luxuries include airconditioning, power options

boonies with power steering and air-conditioning, you ought to try it sometime. The thing is, these luxuries don't impede the Scout II's ability to go odd places—they just make it more flexible and comfortable, and they also make this the car you and your wife can use *willingly* for daily transport. So again, this is one of those two-car cars.

The Scout II in its underwear comes as a roadster, but with doors this time (it used to be available without doors). Since almost no one ever bought a roadster, you can now get one only via special dealer order, and since there's not yet a folding cloth top available, these little impediments add up to I-H's way of discouraging the roadster's sale.

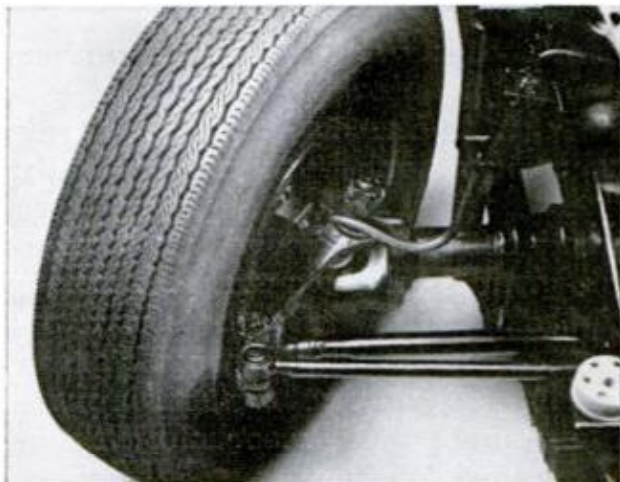
Next rung up the ladder is a Scout II pickup, which is merely the roadster with a cab top. But for more general use, a full-length Traveltop transforms the Scout II into a small wagon, with plenty of room for a family of five plus all their camping gear.

Available engines, transmissions, and general specifications are given on page 102, so we won't repeat those here except to say that one of the V8s—either the 193 or the 197-bhp—is recommended if you're planning to load yours down with options and trailers. The bigger V8 is new to the Scout this year, although it's been available in Travelalls for some time.

The Scout II gives you a choice of

BUCKETS or 30/70 split bench may be trimmed in a variety of styles. Instruments include full gauges

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ALL-WHEEL-DRIVE Scout II uses open Cardon joints to give a 38° turn angle. Brakes have 11-in. drums



WITH 4WD, power takeoff is standard. Gearbox options include four-speed manual, three-speed auto





SCOUT II stands lower, longer; gets re-engineered suspension for a greater on or off-highway comfort

front bucket seats or a bench with a 30/70 split. Gauges are just that—no idiot lights. The 19-gallon gas tank nestles between the rear (and fully boxed) frame rails. Optional skidplates are a must for rough country, because the Scout II has longer leaf springs than before, thus more suspension travel. This means the body dips lower on hard bumps, but it also means a more comfortable, softer ride both on and off the road. We recommend skidplates both front and rear.

Other differences between the old and the new Scout are briefly these: The new body stands 3 inches lower and nearly 11 inches longer, giving half a foot more passenger space and a 5-inch longer cargo bed. Doors are wider and now use flat sills so you don't have to step over them. The doors have check straps and better insulation to cut wind noise at higher speeds. Pedals are suspended for the first time to eliminate the chance of

toeboard leaks, and the trans hump is now smaller even though the floor stands lower.

The Scout II's ventilation system has been redesigned, with a remote-controlled vent on the driver's side and an easy-to-reach lever for the front passenger. The tailgate may be opened with one hand, because the spare tire now rests inside the car, not continental-style as before, and doesn't hamper tailgate operation. The hood now has an inside lock. It hinges from the front and opens almost vertical to give better engine access.

The Scout II's All-Wheel drive system, made by Dana, can be ordered in the same package with automatic transmission. A separate lever controls the transfer case, and on Scouts equipped with locking front hubs, four-wheel drive can't be engaged except after turning the hubs.

We drove several Scout IIs briefly at I-H's Chandler, Ariz., proving grounds and found them amazingly comfortable and easy to drive. It's impossible to give detailed impressions in so short a space, but we will say we were extremely impressed with the performances the new Scouts turned in.

The base Traveltop wagon with the standard 111-bhp Four sells for \$2622. All-Wheel drive adds \$822, and from there the sky's the limit. With most of the luxury options, the tab can easily top \$5000. ★★★

1972 SCOUT II SPECIFICATIONS

Available engines: ohv 4, 196 c.i.d. (std.); ohv 6, 232 c.i.d.; ohv V8, 304 c.i.d.; ohv V8, 345 c.i.d.

Available transmissions: three-speed manual, floor shift (std.); four-speed manual, floor shift; three-speed automatic, floor shift.

Differential types and ratios: All-Wheel drive with power takeoff (opt.); Trac-Lok no-spin differential; manual locking hubs; ratios 3.31, 3.73, 4.27:1.

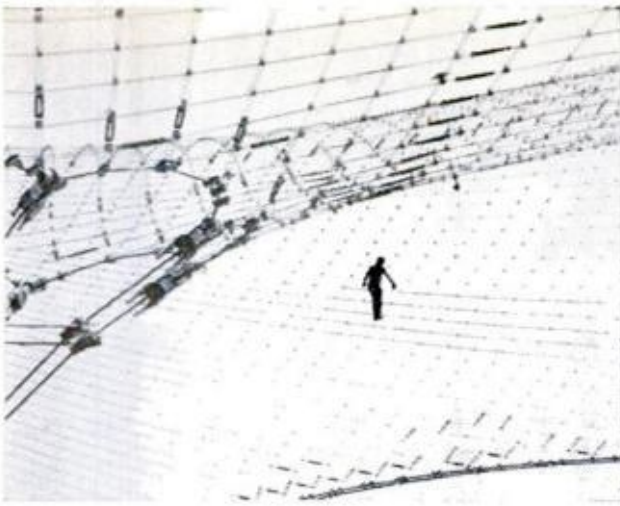
Brakes: hydraulic drums, 11-in. dia.; 175.7-sq.-in. total lining area; opt. vacuum assist.

Steering: worm and roller; power steering opt.; All-Wheel drive has open front Cardon joints, ball-joint kingpins.

Suspension: Solid front axle, longitudinal semielliptic leaf springs, double-acting, tubular hydraulic shock absorbers, torsional front stabilizer bar; rear is same but without stabilizer bar.

Frame: ladder type, fully boxed side rails, three cross members.

Dimensions: Wheelbase, 100 in.; overall length, 165.7 in.; width, 70.0 in.; overall height, 66.4 in.; front and rear tread, 57.1 in.; curb weight, 3569 lbs.



Circus? No—the Olympics

The 1972 Olympics arena near Munich is taking on the look of a circus with a huge "net" overhead. Plastic panels in the net will protect athletes and audience from weather.



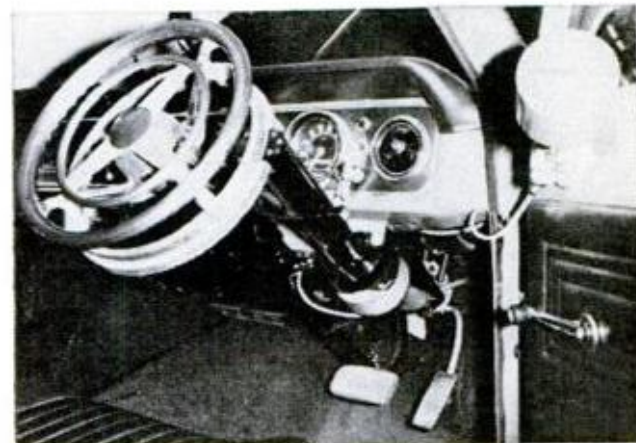
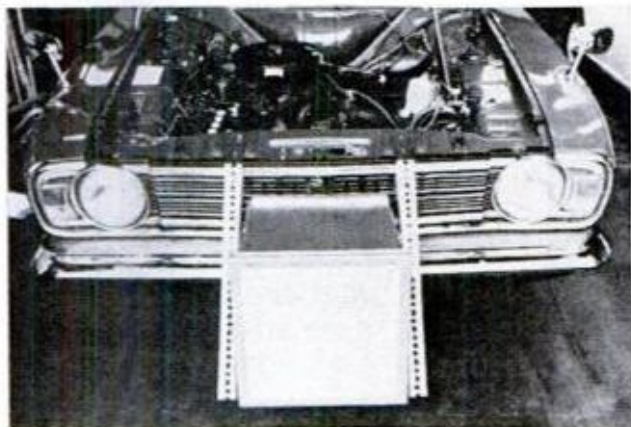
Tiny but noisy

Super Sound, a three-ounce, aerosol-type warning device, yields 100 loud blasts before needing refill. Here, a young sailor calls for a landing launch. The unit sells for \$2.98; Thorpe Industries, Mountainside, N.J.



Fine crop of umbrellas

To protect his dahlias from heavy rain, an English gardener gathered dozens of old umbrellas and rigged them over the flowers.



Driverless car

A remotely-guided, driverless car (left) has been operating at the Road Research Laboratory, Crowthorne, England. Buried just below the road surface is a cable energized by alternating current. Two sensors on the front of the car (upper left) pick up the signal, determining by signal strength whether the car is veering right or left. Corrections are made via an electric motor that turns the steering wheel (upper right).



One Million

MAMMOTH CAVE—with more floor area than football field and 10 stories high—was needed for four generators



By MARK WALKER

NORTHFIELD MOUNTAIN in Western Massachusetts is more than a pretty view. Deep inside its granite mass men and machines have carved a huge cavern and installed massive generators that will pour out 1 million kilowatts of power daily for the customers of Northeast Utilities.

Northfield Mountain Pumped Storage Hydroelectric Project is the biggest powerplant of its kind in the na-

tion—and the first to be built entirely underground. It's scheduled to begin operation in June, 1972.

Pumped storage? That's a method of pumping water up to a reservoir and keeping it there "on tap" for peak demand periods, when it is released in a surge to spin the turbines of the generators. Thus, although alternating current cannot be stored, water can—and it adds up to the same thing.

Northfield Mountain was chosen for its 1000-foot summit, which is crowned by a 300-acre natural basin—large enough to hold 5.5 billion gallons of water. The mountain slopes gently to the Connecticut River, the source of water for the power station. To give the water a steep fall the powerplant had to be built underground (see cross-sectional drawing).

A half-mile-long access tunnel leads into the power plant chamber that is longer than a football field and 10 stories high. The 1130-foot, angled pressure shaft from

the upper reservoir, the 565-foot vertical ventilation shaft, the access tunnel and the tailrace tunnel—they all connect with the cavern.

Dominating the cavern are four reversible pump-generators. They can pump the water up the pressure shaft to the reservoir, or spin and generate power as the water flows down.

By itself, a pumped powerplant is inefficient. It takes three kilowatts of

Kilowatts From a Mountain Cave



BIG TRAILER TRUCKS HAULING POWERPLANT PARTS have direct access to cavern through this two-lane, half-mile-long tunnel. Drilling and blasting this tunnel was first step in creating the mountain powerhouse

pumping to produce two kilowatts of power. But the Northfield Mountain Project will tie in with nuclear-power thermal plants supplying basic power needs for the area. In off hours, when there is little demand from the nuclear plants, they will run the Northfield pumps to fill the upper reservoir.

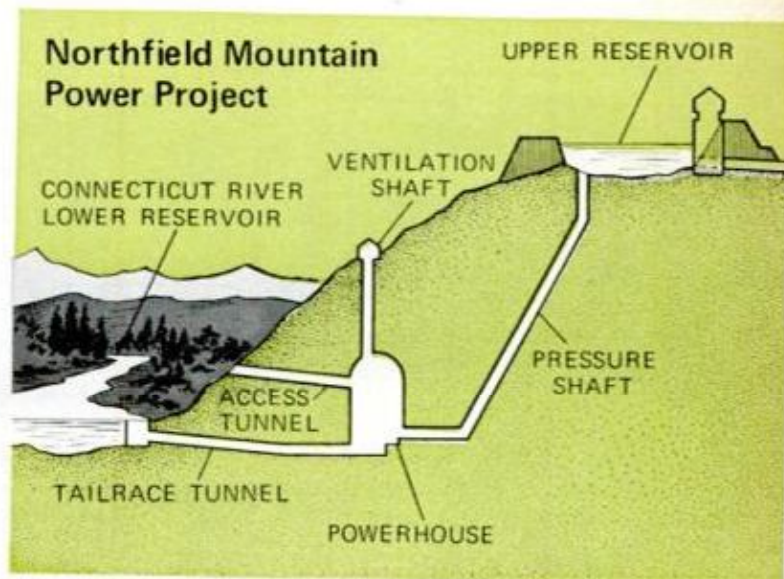
This arrangement benefits the nuclear plants, too. They must be kept at top heat constantly to prevent thermal stress and insulation damage.

These days, when the demand for electrical power is continually outpacing the available supply, pumped storage plants seem to be an idea whose time has come. The first such plant in this country was built in 1928 in Connecticut. It took until 1954 for the next one to be built, but now there are 15 in operation, 7 under construction and 18 in planning stages.

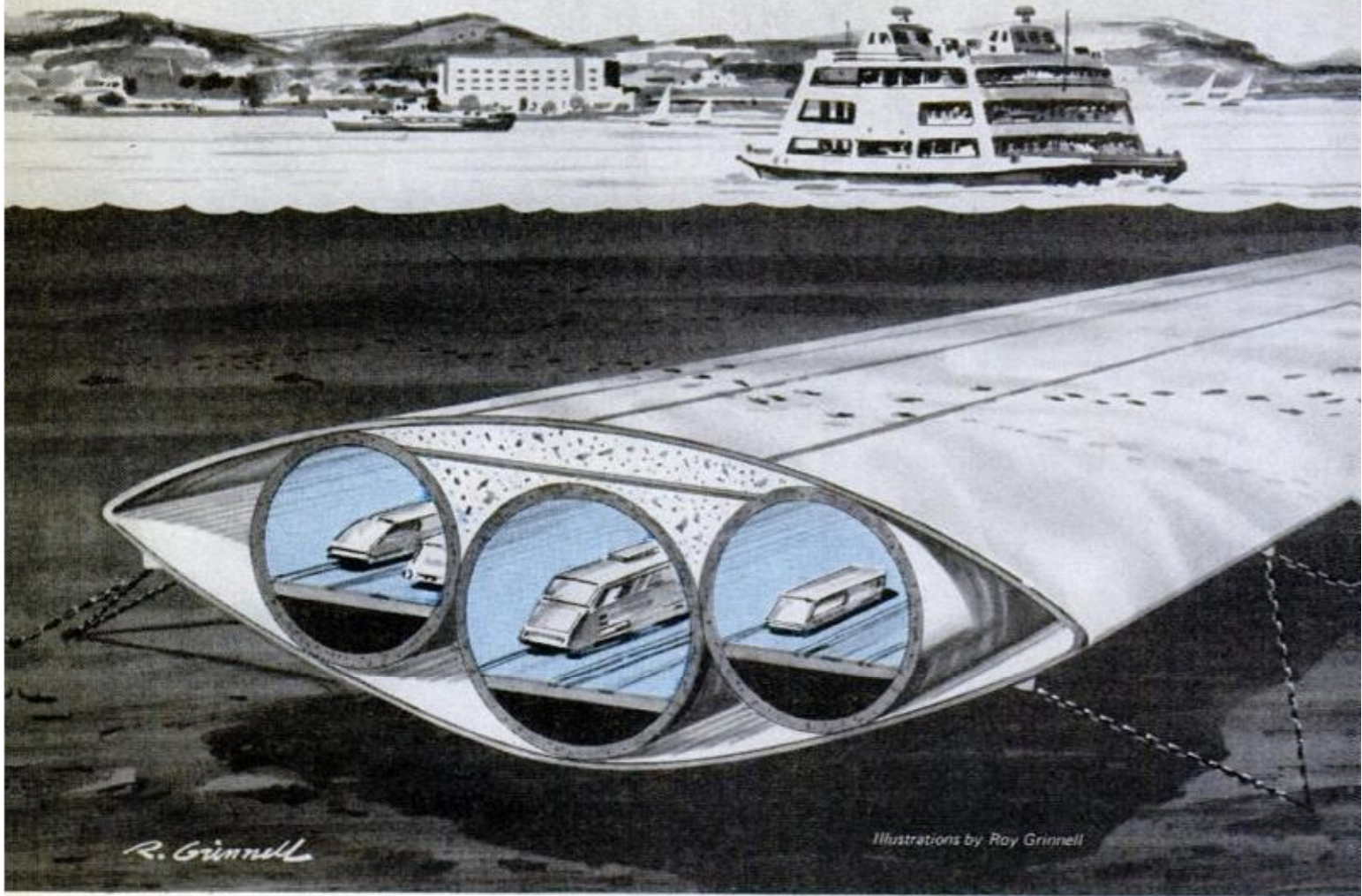
The price tag on the Northfield Mountain project is \$90 million. Another \$4 million will be spent on nine

new recreation areas, including 100 miles of trails surrounding the project.

Next June, when millions of airconditioners in the Northeast put a stress on sources of electricity the powerhouse hidden deep inside the Massachusetts mountain will come through—like a giant storage battery—with an additional million kilowatts. ★★★



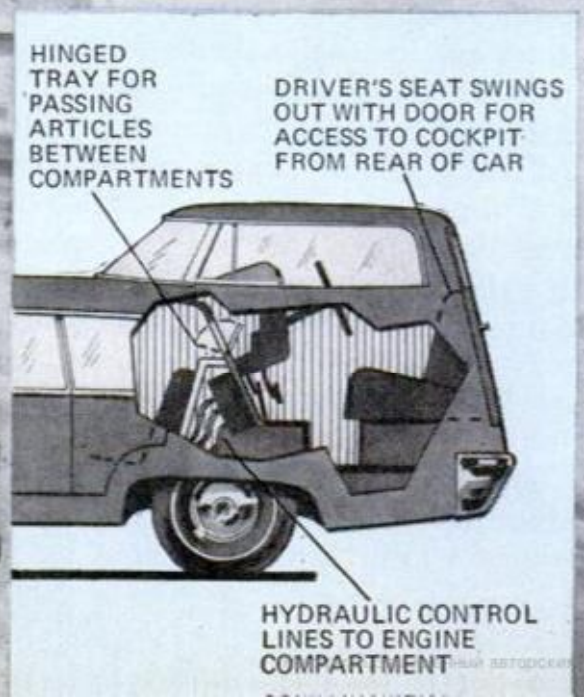
Half Bridge, Half Tunnel



A 'Flying Bridge' for Cars Yet?

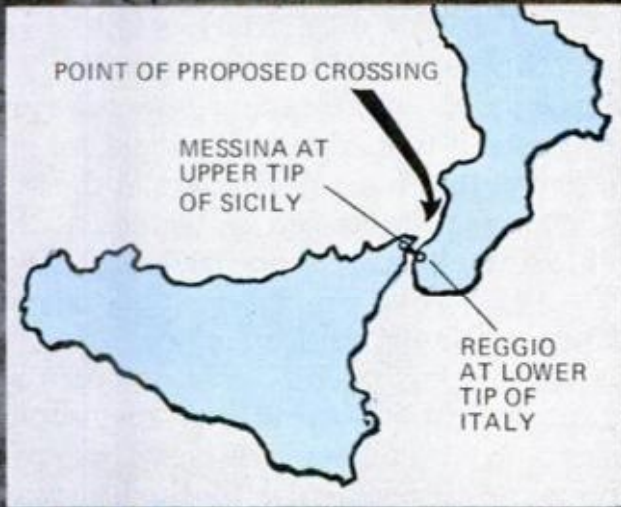
You get a clear view of the road from this raised driver's cab patterned after flying-bridge cockpits on cruisers. The idea: safer driving and easier maneuvering in tight spaces. Located above and behind the

passenger compartment, the cab isolates the driver from distractions, could foil hold-up attempts in taxicabs and frees the front seat for sightseers. It's the brainchild of Walter W. Arakelian, North Billerica, Mass.



...and It Floats!

JUST PATENTED

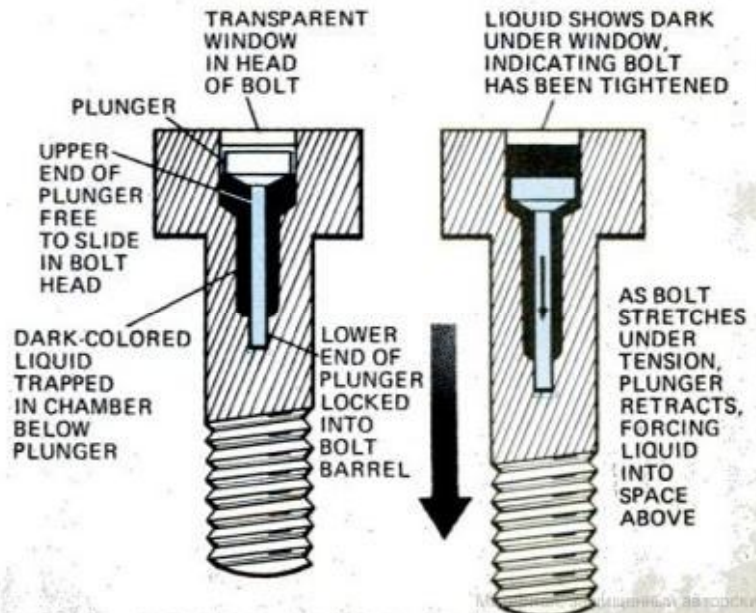
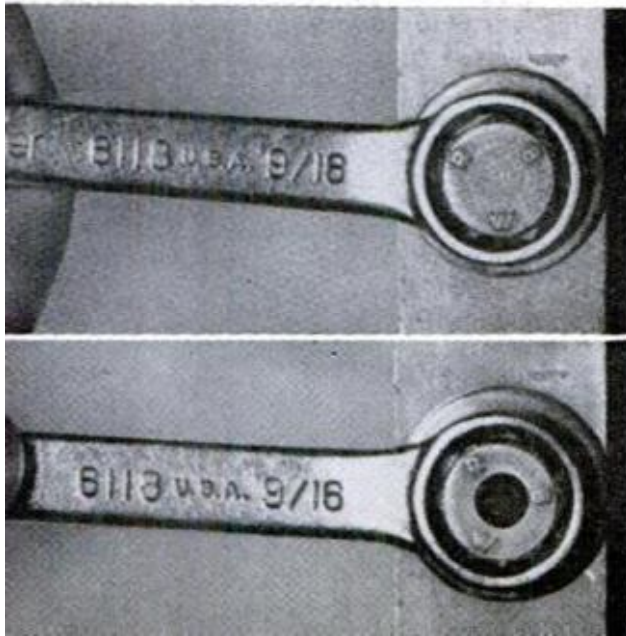


How do you cross a gap that's too wide for an overhead bridge and too deep for an underground tunnel? Right—you go half-way in between. That's exactly what British engineers have proposed for a high-speed road-and-rail link joining the southern tip of Italy with the island of Sicily several miles across the treacherous Messina Straits. They plan to span the channel with a floating underwater tunnel anchored to the seabed by cables. It will consist of oval-shaped concrete sections made buoyant after assembly by pumping out water and filling inside spaces with air. Like a giant skyscraper, the rigid tube is designed to sway slightly without harm, but will be far enough down—150 feet deep—to avoid passing ships and surface storms. How soon the mighty project will be tried is still uncertain.

This Bolt Tells You When It's Tight

Bolts tightened to precise pressures, such as on an engine head, require careful checking with a special torque wrench—but not this one. It changes color, telling you at a glance when it's tight. The secret: As the shank stretches under pressure, a

tiny plunger pulls away from a plastic window in the head. This forces a dark liquid to show up in the window, indicating proper torque (lower photo at left, below). Made by Gyrafalcon, Inc., Camp Hill, Pa., the bolts can be preset for various pressures.



INSTANT REPLAY: TV's Electronic Magic



SPLIT-SCREEN TRICK (above) shows quarterback about to pass with receiver running downfield. As receiver makes spectacular shoestring catch, screen shifts to full view of play (below). To capture such action, isolated cameras follow possible receivers whether they get ball or not



It's not done the way you may think. Rerunning a spectacular play seconds after the live action requires fantastic teamwork and some fancy equipment few people have seen. Here are secrets of this exciting electronic process

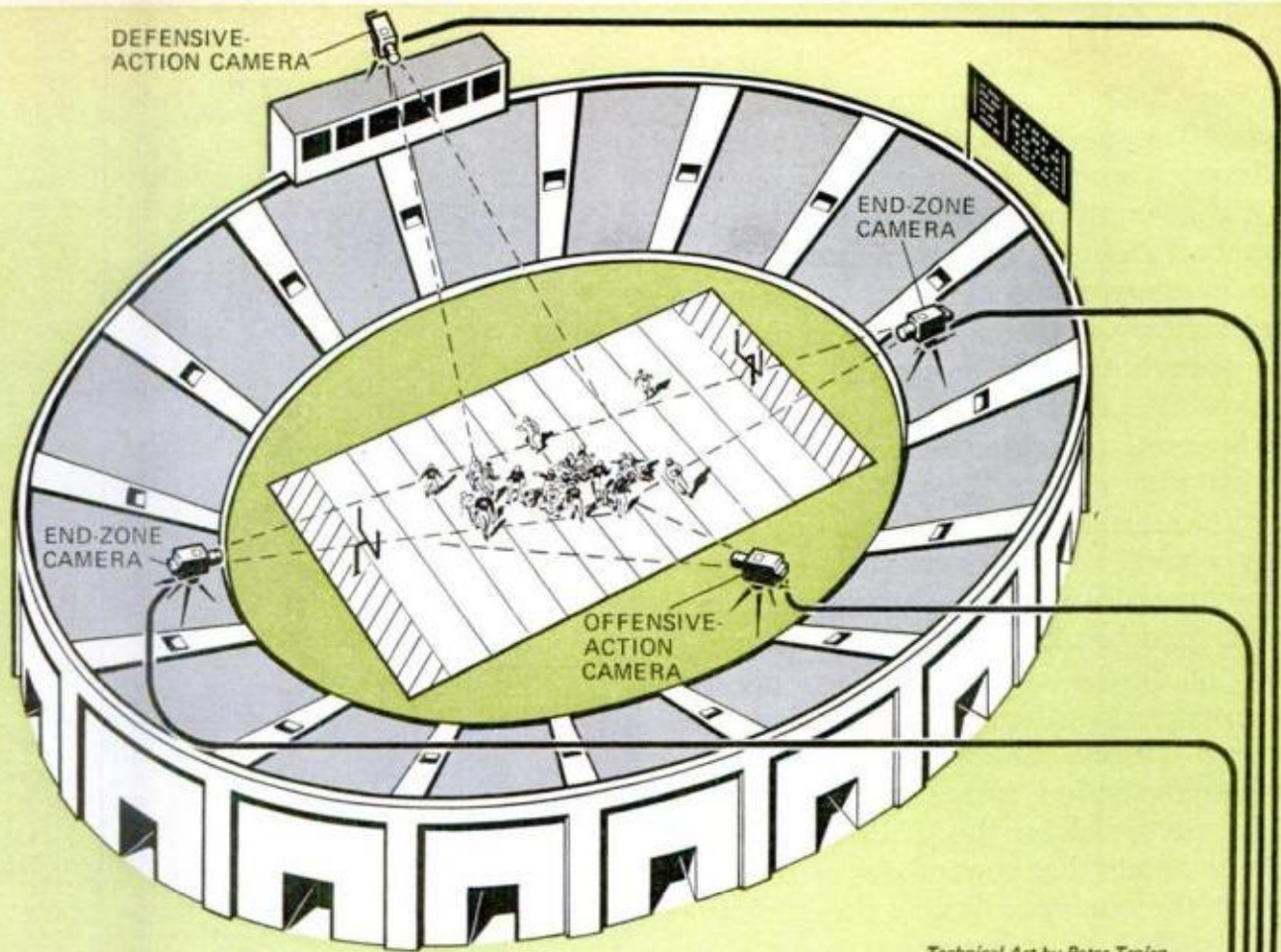
By RICHARD DUNLOP

YOU'RE WATCHING a kick returner streaking across the TV screen in a breathtaking 98-yard run-back for a touchdown. How did he get through that mass of tacklers at the 50? Did he really step out of bounds at the 20 as the picture appeared to show? You wish you could see it all again. Then suddenly, as if by magic, there he is again, starting his twisting, turning run. At the 50-yard line, the action slows to a molasses-like crawl, revealing several spectacular blocks by teammates that helped to clear the way. At the 20, the motion freezes and you see the runner's feet clearly within the sideline. Finally, the action returns to normal speed as the player triumphantly crosses the goal line.

This modern TV marvel of instant replay is now treating home-screen sports fans to sights that not even

WATCHING MONITOR SCREENS, director in main van decides which of several camera views will be sent out live and which will be recorded for replay. Replay scenes are not usually the same as live ones





Technical Art by Peter Trojan



DIRECTOR'S VAN.



INSTANT-REPLAY VAN



MASTER VIDEOTAPE RECORDING VAN

IN REPLAY VAN, operator punching buttons on control consoles can back recorder up to any point for immediate rerunning of live action that just took place. He can also add stop action or slow motion

MASTER RECORDING VAN puts game on regular reel-to-reel videotape for editing and reuse at later time. These tapes can include both live and replay action—whatever was actually broadcast to viewers

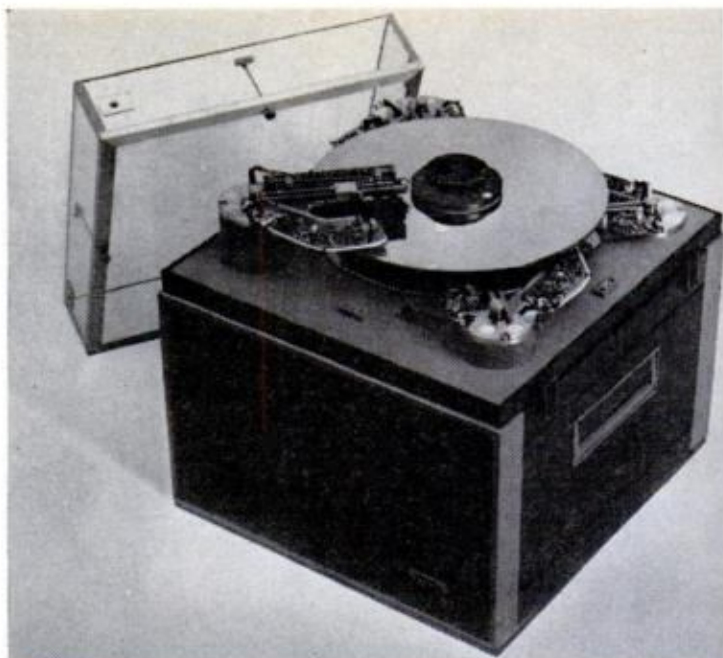


ticket holders on the 50-yard line ever get to see. Thrilling runs and circus catches flash back on the screen seconds after the live action, often from a different camera angle, so you can relive the excitement and study the action more closely. Controversial plays can be shown and reshowed from several vantage points so you get a clearer view of what really happened.

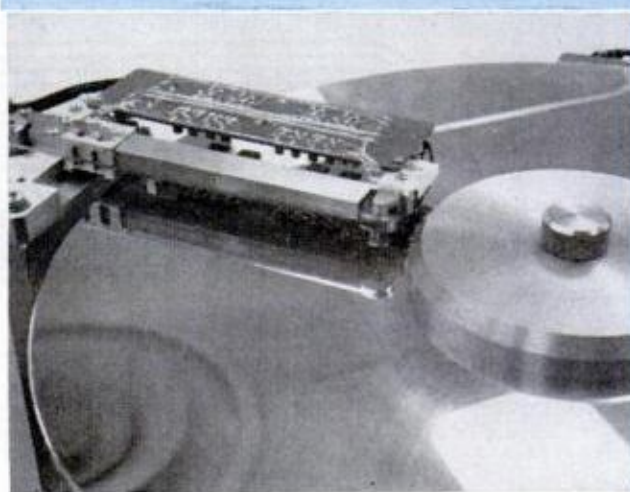
How do they do it? Two special tricks make possible the amazing antics of instant replay. First, the recorder used to store video images for later replay is radically different from conventional reel-to-reel videotape machines. Developed by Ampex in 1967, the odd-looking device consists of two highly polished metal discs, about the size of a large pizza pie, that spin at high speed. Full-color video images are magnetically recorded on the discs by motor-driven heads that move back and forth across the surfaces, laying down circular "tracks" of information something like the grooves in a phonograph record.

In the early days of football telecasts, engineers using standard videotape recorders would frantically try to rewind the tape, find the start of the desired action sequence, then rerun the play. The process was maddeningly clumsy and slow, and TV viewers rarely got a chance to see the rerun until considerably later in the game, if at all. With the Ampex machine, called the HS-100, an engineer can rerun a play within four seconds of the original live action. The reason is that the spinning discs never stop turning and thus do not have to be reversed to get back to the start of action recorded earlier. To rerun a play, the operator merely presses a button and the motor-driven recording heads automatically move back to the beginning and replay the action. During the process, the operator can slow the motion to a snail's pace, stop it dead at a critical point in the play or split the screen and show two different views simultaneously side by side.

The Ampex HS-100 recorders cost



SPINNING METAL DISCS—not tape—are secret of Ampex HS-100 instant-replay recorder. Discs never stop turning, thus do not have to be stopped and reversed. Motor-driven heads move back and forth across discs to play different tracks like grooves in a record. To rerun a sequence, all operator has to do is press a button; heads automatically go back to start of action

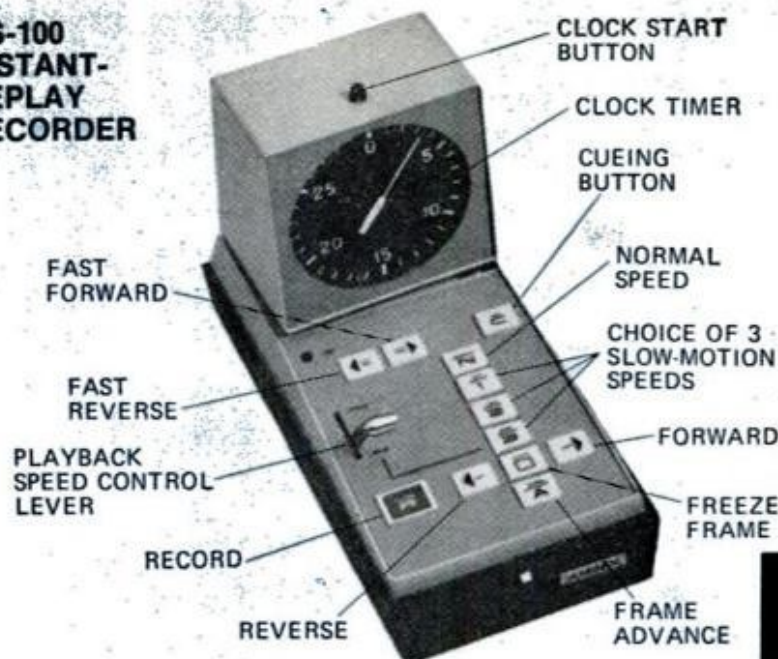


\$100,000 apiece and are a miracle of electronic ingenuity. More than 100 are now in use by every major TV network in the United States and in many foreign countries. Besides football, they're bringing added excitement to such other sports as baseball, basketball, soccer and Olympic contests.

The second secret of instant replay is that the TV cameras used for it are generally not the same as those that pick up live action for direct telecasting. Usually, there are as many as three or four cameras devoted solely to recording action for later replay. These

POPULAR MECHANICS

HS-100 INSTANT- REPLAY RECORDER



CLOCK START
BUTTON

CLOCK TIMER

CUEING
BUTTON

NORMAL
SPEED

CHOICE OF 3
SLOW-MOTION
SPEEDS

FORWARD

FREEZE
FRAME

FAST
FORWARD

FAST
REVERSE

PLAYBACK
SPEED CONTROL
LEVER

RECORD

REVERSE

FRAME
ADVANCE

UNUSUAL INSTANT-REPLAY RECORDER

consists of two spinning discs with four separate record/playback heads, each moving over one of four sides. Diagram, here simplified for clarity, shows how image frames are successively recorded on different sides to form smooth-flowing sequence of action. Actually, each frame occupies two sides of a disc because half of trace is recorded on top and other half on underside. The two traces are then interlaced in playback to provide one complete frame. Buttons on console (left) control forward, reverse, slow motion, freeze frame, other functions

HEAD NO. 1 RECORDS AND
PLAYS TOP SIDE UPPER DISC

HEAD NO. 2 RECORDS
AND PLAYS UNDERSIDE
UPPER DISC

HEAD NO. 4
RECORDS
AND PLAYS
UNDERSIDE
LOWER DISC

RECORDING HEADS
MOVE BACK AND FORTH
ACROSS DISCS TO PLAY
DIFFERENT TRACKS

HIGHLY POLISHED
METAL DISCS SPIN
AT 3600 RPM

MOTOR

HEAD NO. 3 RECORDS
AND PLAYS TOP SIDE
LOWER DISC



1.



2.



3.



4.

are isolated from the live cameras and thus have given rise to the strange term that has mystified many TV viewers listening to announcers referring exuberantly to replay action on the "isolated camera." The isolated what?

Each replay camera feeds an Ampex HS-100 recorder in a van parked outside the stadium. Usually, one camera is assigned to cover the offensive team, another to cover the defensive team and a third in the end zone to pick up downfield action. This is why you frequently see views on replay different from, and often more dramatic than,

those shown during the live telecast.

The end-zone camera focuses on the split end or wide receiver and follows his evasive action against the defensive corner back. Since he is often the target for the quarterback's passes on long "bombs," you get, on replay, an exciting view of the receiver's movements long before the ball arrives. By contrast, the live cameras must concentrate on the play as it unfolds from the line of scrimmage and rarely are able to pick up downfield action at the same time. The live cameras must also follow the ball carrier or passer, ignoring



SEVERAL TYPES OF TV CAMERAS are used to cover action during game. Above, roving cameraman with portable back-pack rig catches dramatic ground-level shots from sidelines, can move quickly to follow direction of play. At times, mobile cameras on vans also roam sidelines. At right, fixed camera higher in stands covers broader areas of the field



side action out of their field of view. But an important block thrown by an interior lineman, overlooked by the live cameras, can be caught by a replay camera. Often a replay camera has saved the day, capturing a key play missed by a fooled live camera.

Putting it all together for the TV viewer is a complex job of precision teamwork headed by the director in his own van outside the stadium. Watching a huge bank of monitor screens, he is able to tell exactly what each live and replay camera is picking up. From this, he must decide instantly which camera view is to be sent out live and which are to be stored on the replay recorders for use later. Orders are given over an elaborate network of intercom lines linking all cameras with the director's van, replay van and numerous other vans containing conventional videotaping and transmitting equipment.

The director not only has a choice of several replay views to show from different cameras, but he can also select the most appropriate rerun mode—normal speed, slow motion, stop action or split screen. The spinning discs on the HS-100 recorder turn at the rate of 60

revolutions a second or 3600 rpm. Each image frame is recorded separately in a track representing one revolution of the discs. Actually, it takes two tracks to form a complete frame. One half of the scanning trace is recorded on the upper surface of the top disc, and the other half is recorded on the underside. On playback, the two traces are interlaced to form the full image frame.

The next frame in the sequence is recorded in the same way on the upper and lower surfaces of the bottom disc. The third frame is recorded back up on the top disc, the fourth frame on the bottom disc and so on. Thus successive frames are alternately recorded on the top and bottom discs, then put together in a smooth flow in playback.

The speed of the playback action depends on the speed that the motor-driven heads move across the discs. To switch from normal speed to slow motion, the operator simply slows down the rate of head travel. To stop the action, the discs keep spinning, but the heads remain stationary, replaying the same track repeatedly. Since each track represents one frame, the effect is to

(Please turn to page 182)



Dressed up for the riots

Noting that policemen's helmets are often knocked off in riots, a British design student devised this new headgear that's fitted with gas seals and filters, a two-way radio and a chin guard that has a crushable foam casing with hard inner shell.



Truck with a staircase

The driver must use a staircase to get to the cab of this 16½-foot-high, 84½-ton truck when he wants to drive. Capable of carrying 120 tons of iron ore, the giant vehicle is one of 36 being built by WABCO Australia for Hammersley Iron Limited.



Four-wheeled flower box

When you buy a new car and can't quite bear to part with the old one, what do you do with the aging hulk? A German farmer found this solution: He turned his favorite runabout into a flower box in his front yard. He's Adalbert Hofmann, who continues to feel he's taken a positive step in the interest of beautification despite some contrary comments from neighbors.

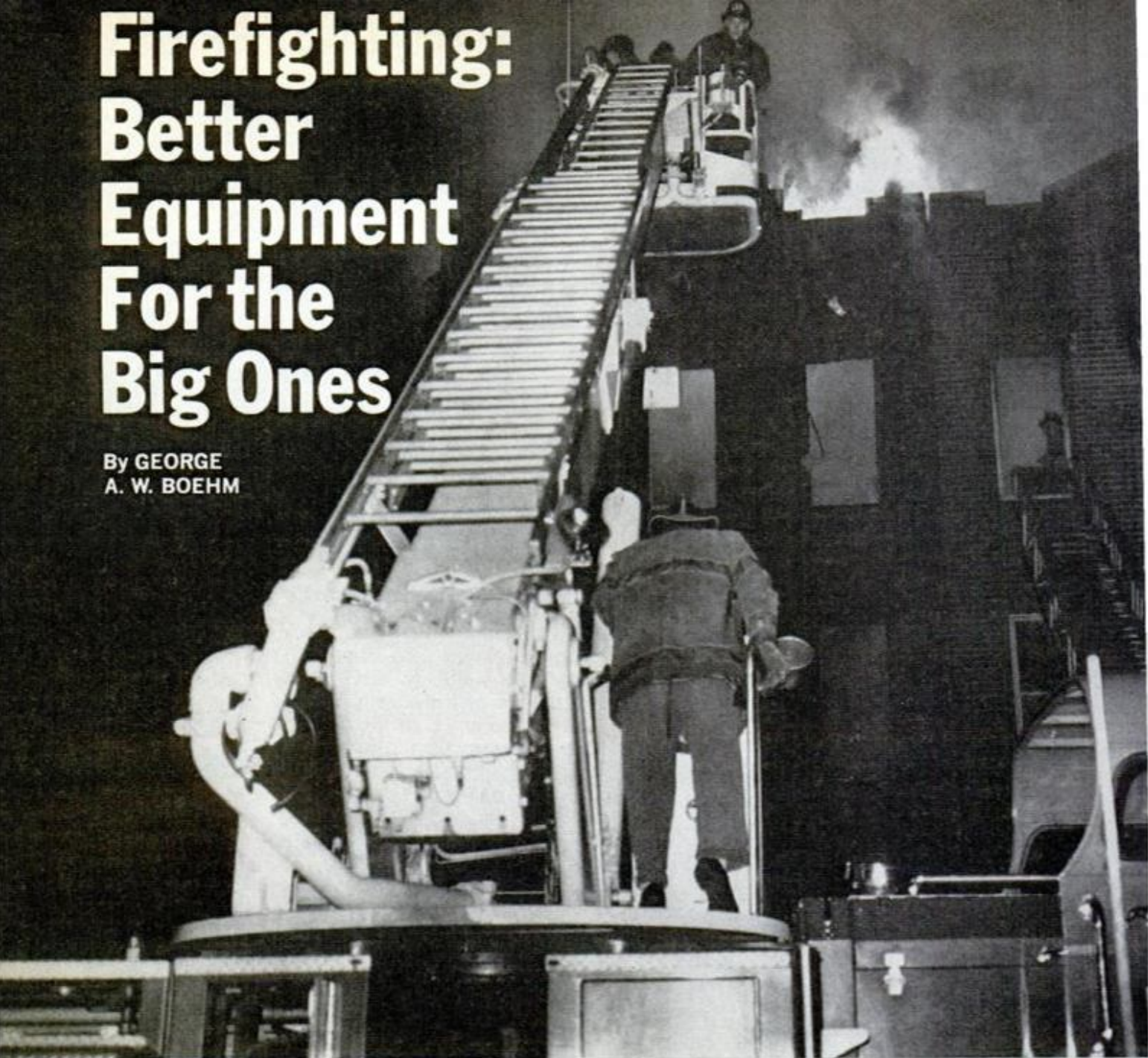
Israeli STOL

The Arava, a 20-passenger, twin-turboprop STOL aircraft built by Israel Aircraft Industries, is now undergoing final testing for commercial and military use. The craft can clear a 50-foot obstacle in a 900-foot takeoff and land within 1000 feet. The maximum cruise speed is 205 mph. With passengers, its range is 845 miles.



Firefighting: Better Equipment For the Big Ones

By GEORGE
A. W. BOEHM



Firemen are catching up with technology. They're using helicopters, tower ladders and elbow cranes. And they're experimenting with 'slippery' water

THE U. S. COAST GUARD ice-breaker *Staten Island* seemed doomed when Seattle firemen rolled up to the drydock where she lay one evening in March 1970. An electrical fire had broken out below decks in a compartment that could be reached only through a narrow passageway. Acrid smoke and intense heat kept the firemen from getting near the blaze. Nor could they chop down through the steel deck; the metal plates were glowing and had begun to buckle.

Fortunately, the Seattle Fire Dept. had just bought an unusual new tool never before used in fighting an actual fire. With nothing to lose, the officer in command decided to try it. A lemon-yellow box the size of a small suitcase was placed on the deck directly above the burning electrical room. Then a fireman about 30 feet away flicked a switch at the end of a red electrical cord attached to the box. There was a muffled explosion, no louder than a pistol shot, and where the box had lain, a

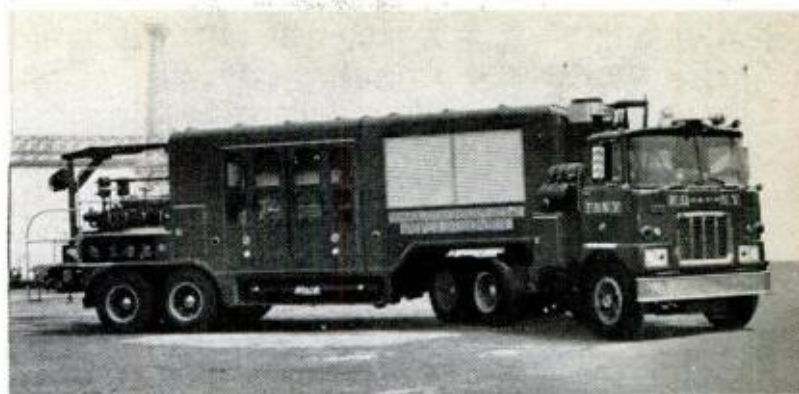
neat circular hole a foot in diameter had been punched through the deck. Into this hole the firemen shoved a hose with a rotating nozzle and quickly extinguished the blaze.

The yellow box that saved the *Staten Island* is an offshoot of space-age ingenuity. Called Jet-Axe, it is made by a small California company specializing in the manufacture of the explosive cord that forcibly separates the first and second stages of the Saturn rocket. Jet-Axe focuses the entire force of an ounce or two of high explosive in one direction. The rest of the box is filled with granular insulation to protect the explosive from any handling damage. Jet-Axe is, in fact, impervious to fire and gunshot, and is, in fact, safe enough to ship through the U.S. mails. Price: less than \$100.

Jet-Axe is typical of the fresh ideas now being used to make cities safer and to save the lives of firemen. For half a century, fire departments did little to modernize their tactics and equipment—aside from replacing the horse with the internal combustion engine. A few years ago a speaker at a fire chiefs' convention remarked sarcastically: "In the 1870s we had 97-foot aerial ladders. Now we have 100-foot aerial ladders. Boys, that's progress."

Today almost every major fire de-

PERCHED HIGH on tower ladder platform, New York City firemen fight a third-floor blaze above store



SUPERPUMPER (top) gives New York City firefighters extra punch with its capacity to pour 8000 gallons per minute on a blaze. The mobile fireplug is operated from a control panel (center) carried in the tractor-trailer rig. For smaller fires in tight quarters, firemen are using Sqrts, a unit with an elbow-like crane (bottom) that can shoot water around a building corner too hot to approach



partment is rushing to catch up with the times—of necessity, for in the last dozen years the fire alarm rate in most cities has doubled; in New York and some others it has quadrupled. Everywhere fire damage is mounting, and according to the latest figures compiled by the National Safety Council and the U.S. Bureau of Labor Statistics, firefighting has become one of the most hazardous occupations.

Besides, morale has been sagging. Not so long ago, firefighting was a pleasant way of life: puttering around the firehouse, raising geraniums, polishing brass, playing a little pinochle, and occasionally dashing out to extinguish a blaze or rescue a kitten from a tree. The hours were long, but the pace was relaxed, and the fireman was a neighborhood hero.

In the troubled cities of today, firefighting is fraught with hazard. Engines on their way to fires are frequently targets for snipers. Firemen wrestling with hose often have to dodge bricks and bottles. False alarms

and maliciously started fires account for the major part of the increase in the alarm rate. In New York alone, where false alarms are rising at a rate of more than 25 percent annually, the total is expected to exceed 115,000 this year.

Even their friends are doing little to help the firemen. Municipal budgets, already strained, include no funds for trying out new techniques and equipment. The Fire Research and Safety Act, which became law in 1968, provides for research in many areas: statistics, the cause and nature of fires, fire prevention, improved building codes, training and public education. But last year Congress voted only about \$1 million to carry the program out—hardly enough to continue routine testing of the flammability of children's clothing, draperies and other household articles.

Somehow, though, with scanty funds and little public support, a number of enterprising fire departments around the country are harnessing modern sci-



FIREFIGHTING ATTIRE is taking on the spaceman look with the help of NASA research. Houston firemen are experimenting with plastic helmets, and light fiber coats and boots to replace their heavy rubber gear

ence and technology to solve their problems. Almost everything that a fireman wears, handles, rides in or does has been restudied. Even water has been improved.

Back in 1968 New York City hired Rand Corp., a leading research organization, to help streamline several of the city's operations. Dr. Edward H. Blum, a Rand scientist assigned to the fire department, was aware of a good deal of advanced military technology in firefighting. He recalled that a certain slippery liquid plastic, a long-chain polymer, lessens the friction of flowing water. Perhaps adding a little of this plastic might so increase water flow through a hose that a smaller, lighter fire hose than was traditional could be used.

Subsequent tests showed that Blum's hunch was even better than he had hoped. "Slippery water," made by adding the merest trace of the plastic at the pump, not only flowed 70 percent more swiftly but shot out in a stream that was 100 percent longer, thus enabling firemen to fight blazes from safer distances. The smaller hose that evolved allows firemen to climb stairs and reach remote areas much more quickly and easily than before. Also it decreases the danger of back strain among firefighters, a common occupational ailment.

The Union Carbide Co., which makes



FLYING FIRE ENGINES with belly tanks water-bomb brush fires on remote Los Angeles mountain peaks

the plastic under the name Polyox, has invested about a million dollars perfecting a way of feeding just the right amounts into a hose stream. The New York Fire Dept. is currently fitting its pumpers to dispense slippery water, and other departments across the country are planning to do the same.

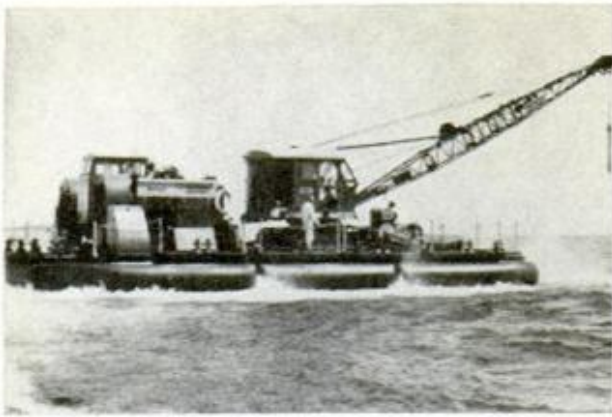
Another water additive was developed especially to fight harbor fires by the Naval Research Laboratory near Washington. It is a chemically modified protein that mixes with water to make a cohesive foam, known as "light wa-

(Please turn to page 200)



PUFF THE MAGIC DRAGON smothers Seattle fires by first firing a 1500-pound charge of dry chemical extinguisher, then follows up with a tremendous blast of light foam. "Puff" specializes in gasoline fires

NEWS BRIEFS



Crane on an air cushion

A 20-ton crane and auxiliary equipment can be carried on a new 51-foot-long hover platform developed in England. The rig is used for excavating, dredging, salvage and other marine work. It was developed by Mackley and Air Cushion Equipment of England.



Ship rescuer

Built to free ships that are icebound in rivers, this unusual vehicle was developed by the Soviet Experimental Designing Office. Unsinkable and capable of traveling 12 mph on snow, the vehicle carries a milling device that can cut ice at the rate of about 300 yards per hour.



Scaled-down Niagara helps in facelifting study

Mighty Niagara became a mini when it was reproduced in scale by the U.S. and Canadian governments in a study aimed at improving the appearance of the famous waterfall. The 22-foot-wide model of the American Falls (shown in both the above photos) was built at the hydraulic laboratory of the Ontario Hydro Service Center in Toronto. Several hundred tests have been conducted and some 40 plans made for improving the look of the falls.

Build This Low-Cost Winter Home For Your Boat

By DAMAN G. FENWICK

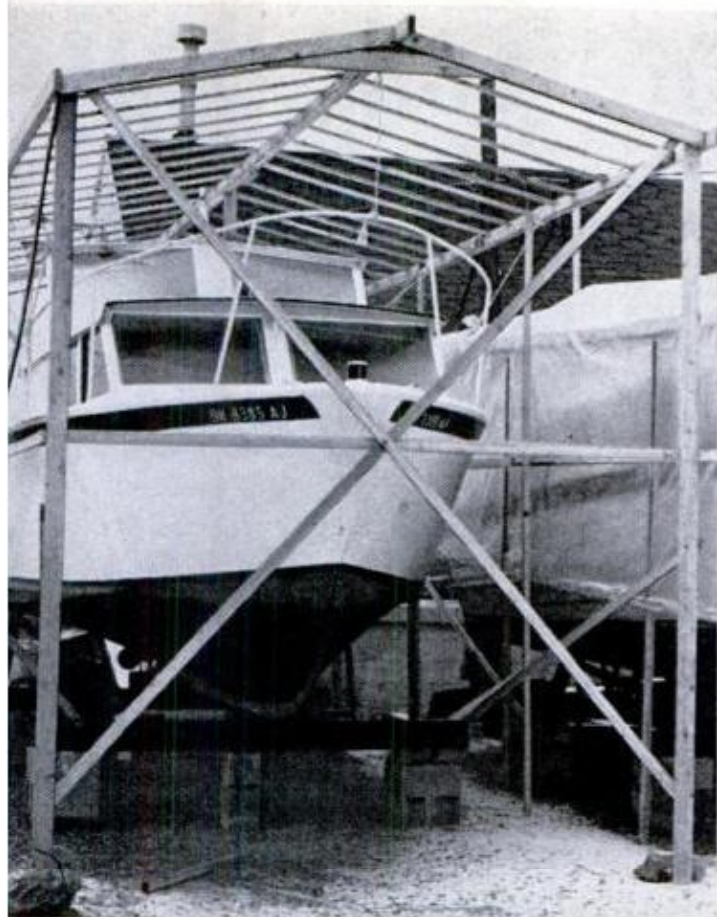
ONE COURAGEOUS BOATER in our Toledo (Ohio) Yacht Club dared store his boat under plastic during the winter of 1969-70. A lot of us laughed and predicted that the first winter wind would rip his shelter to pieces. It didn't—our innovative yachtsman was first to launch his boat in spring. He had been able to sand, paint and tend to winter maintenance details; others had to wait for dry weather.

When spring came, he simply tore off his plastic cover and knocked down the timber frame. He discarded the plastic, but saved the timber for next season. The entire job took two hours, about half as long as it took to put up his "plastic boathouse" in the first place.

Last season all he had to do was buy another 100-foot roll of 4 or 6-mil clear polyethylene for around \$10. But it seems there was something of a run on our local supply: our innovator suddenly had a lot of imitators!

Plastic storage has several advantages: the clear plastic permits light to get through the cover to the work area; the frame permits adequate ventilation and work space; and materials for the housing are incredibly cheap. In fact, most of us scrounged our lumber, but a visit to your local lumberyard won't break your budget.

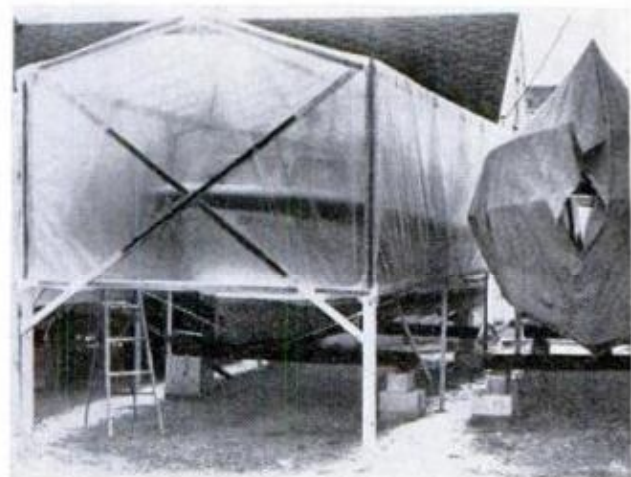
With a stapling gun and your choice of 4 to 20-foot-wide rolls, construction takes little longer than an afternoon. Small-boat shelters can be made permanent for years of use. ★★★



SPACIOUS FRAMING allows ample air circulation. A smaller "boathouse," like that shown below, can be left assembled and lifted on and off by just two men

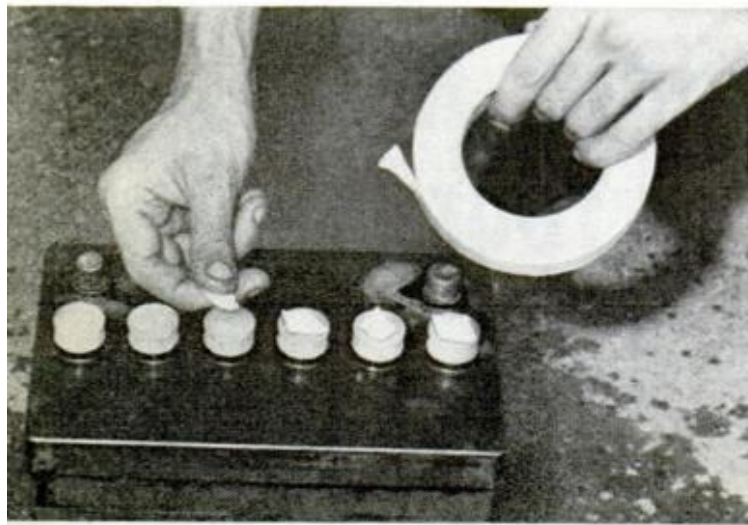


PLASTIC-COVERED BOAT (below) is better ventilated and easier to work with than tarp-wrapped neighbor



How to Store Your Boat

By MORT SCHULTZ



SMALL STRIPS OF TAPE over the battery-cap vents keep baking soda solution from running into the cells



WASH ENTIRE BATTERY with baking soda solution, paying particular attention to top vents and posts



FLUSH BATTERY with clear water; make sure that your cleaning solution is thoroughly washed away

FIND COOL STORAGE for your battery—the cooler the better. Don't worry about freezing. If a battery has a specific gravity of 1.200 (50 percent charged), it will withstand a temperature of minus 16° F. Specific gravity is a measure of the battery's state of charge, and if you bring a battery to full charge (1.260 specific gravity), it won't start to freeze until the temperature reaches minus 62°. Warmth, on the other hand, causes a battery to self-discharge by activating chemicals. At 80°, for example, a battery will lose an average of .001 specific gravity per day. This means that a battery with a specific gravity of 1.240 (75 percent charged) at storage time will have a specific gravity of 1.210 after 30 days, or 1.180 after 60 days, which borders on lifelessness.

Dirt in the form of electrolytic salts also causes rapid self-discharge by establishing a conductive path through which energy is drawn from the battery. Wash the battery before storing it with a mixture of baking soda and water (1 tablespoon to 1 quart respectively). Baking soda neutralizes salts which gather on the battery during the boating season.

Battery caps covering cells must be screwed down tightly when baking soda is applied. Also apply a small piece of adhesive or masking tape over each cap vent hole to keep out the solution.

Apply the baking soda solution with a sponge. When it stops fizzing, rinse the battery thoroughly with water. Keep applying the baking soda solution and hosing down the battery until an application of baking soda no longer bubbles. This means the acid has been neutralized.

Polish battery terminal posts with a small wire brush or a swatch of sandpaper. Apply a thin layer of petroleum jelly to protect posts from moisture in the air during storage.

Battery for the Winter

According to the U.S. Coast Guard, battery failure is a major reason why many pleasure boaters are towed ashore in the spring. Save yourself embarrassment next year by servicing your battery now.



GIVE YOUR BATTERY a little prewinter maintenance and it's less likely to let you down next boating season

Now, determine the battery's state of charge (specific gravity) with a battery hydrometer, which costs a couple of dollars but is one of the most important service tools you can own. Throughout the boating season a hydrometer can be used to indicate trouble in the boat's electrical system. If an electrical system is operating properly, the battery will maintain its specific gravity. However, when the hydrometer shows that specific gravity has fallen, you know you have some kind of problem in which quick detection usually permits quick, and inexpensive, repair. (Also keep tabs on electrolyte level. If you have to add

water once a week, it means that the electrical system is causing the battery to overcharge. Find and fix the problem immediately.)

During the boating season, your battery should be checked with a hydrometer once a week. It should also be regularly checked during storage. If specific gravity falls, bring it back up by charging the battery.

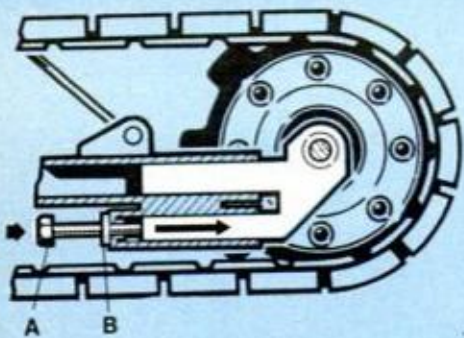
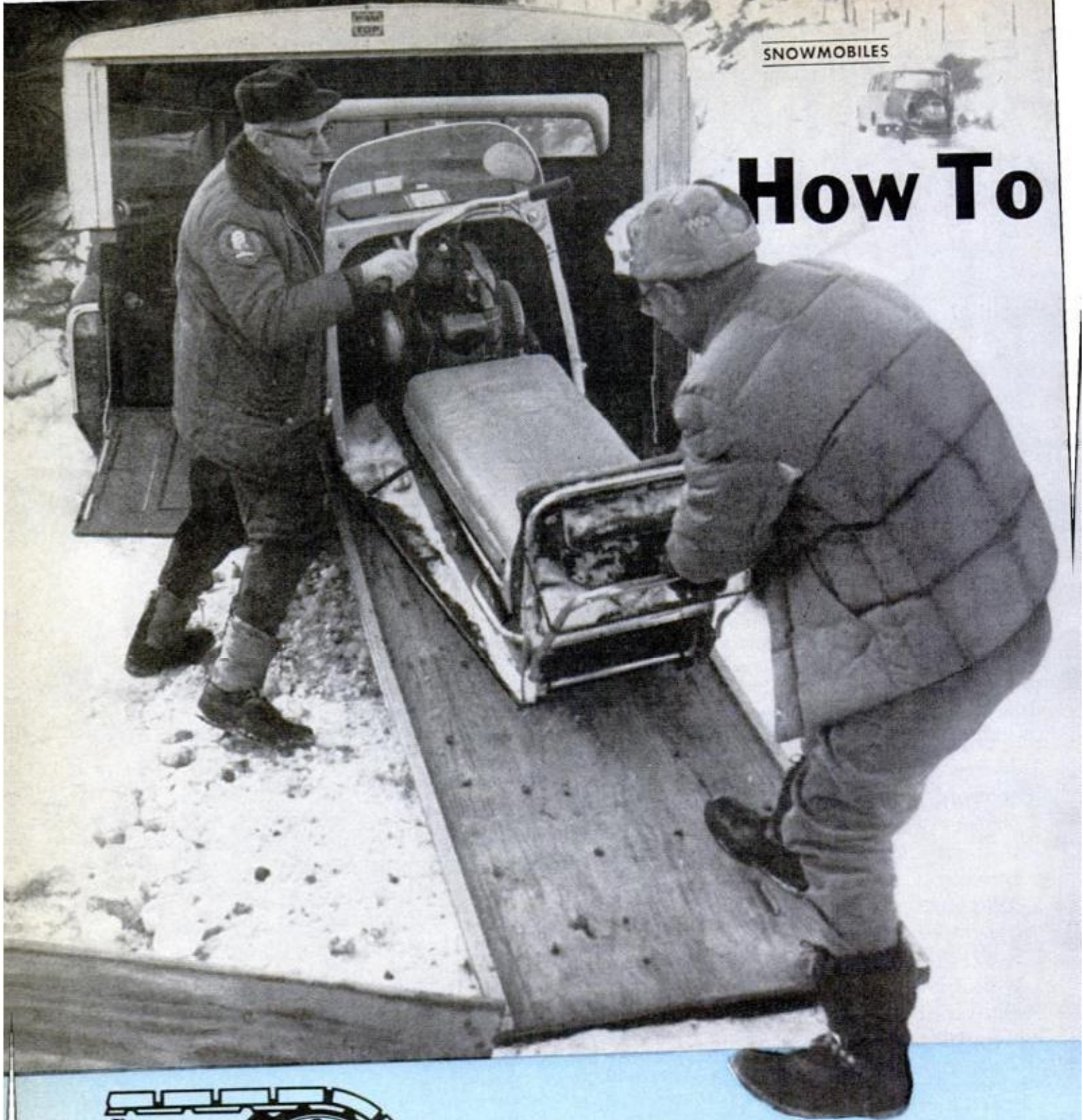
To check specific gravity, draw electrolyte from one cell at a time. Be sure that the hydrometer's float rides free, hold the tool at eye level, and read the specific gravity. If one cell shows a reading .050 less than the others, that

(Please turn to page 205)

CLEAN POSTS with wire brush, sandpaper or a special battery-cleaning tool sold in auto supply stores. Check specific gravity with a hydrometer. Then charge battery, making sure that caps are removed from cell openings. This prevents possible damage should interior pressure develop during charging operation



How To



EVERY SNOWMOBILE has a means of aligning the track. This one has a track-adjusting screw (A) which is held by a locknut (B)



You promised you'd get to your snowmobile before next season. With the first snowfall you'll want the machine in a hurry. Here's a quick home checkout for a snowmobile that hasn't been run since last winter.

Get Your Snowmobile Ready For Snow

By HENRY B. NOTROM

MAINTENANCE CHECKS you can make to get your snowmobile in top condition would cost \$25 if done by a professional mechanic. Here they are:

- *Service suspension and adjust track.* Some makers recommend that bogie wheels be removed for special treatment. If this was not done when you stored the machine, do it now. The procedure is simple: To remove bogies from a Ski-Doo, for example, take off capscrews and star washers that hold the cross shaft to the frame and slide wheels off the frame. Wheels come off in sets.

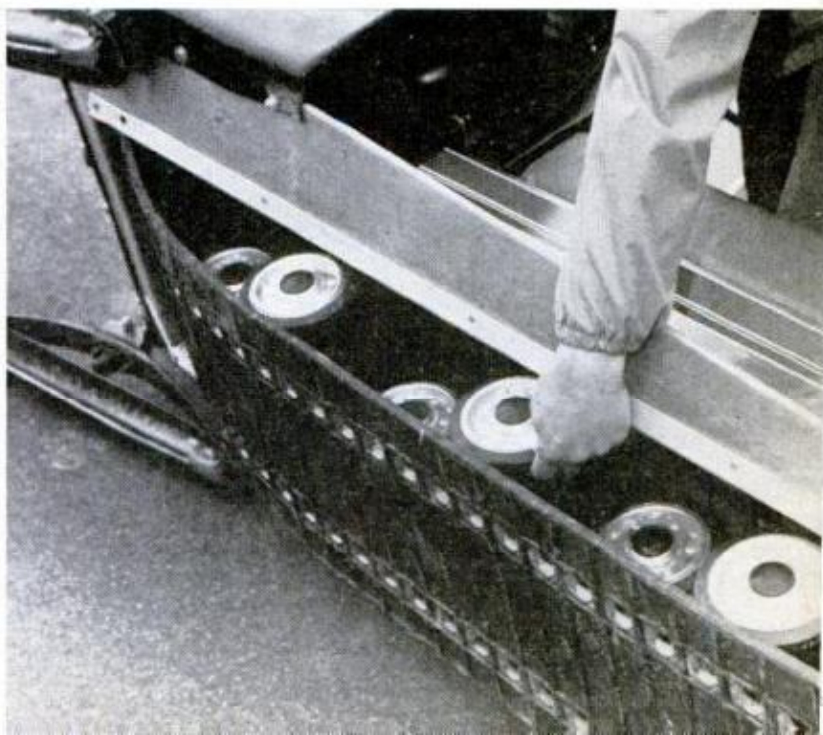
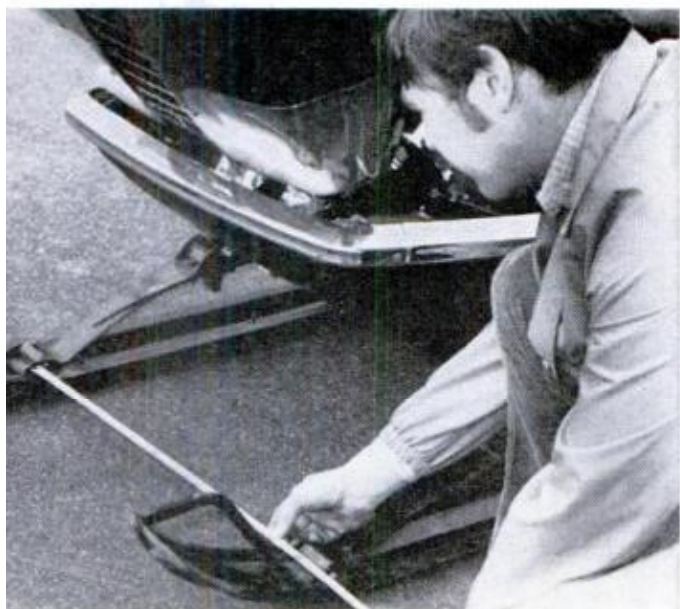
- *Remove cross shaft from each set and check to see it's not bent or worn.* Clean dirt off all parts and apply a metal protector to bogie wheel springs. Coat each cross shaft with a thin layer of low-temperature grease.

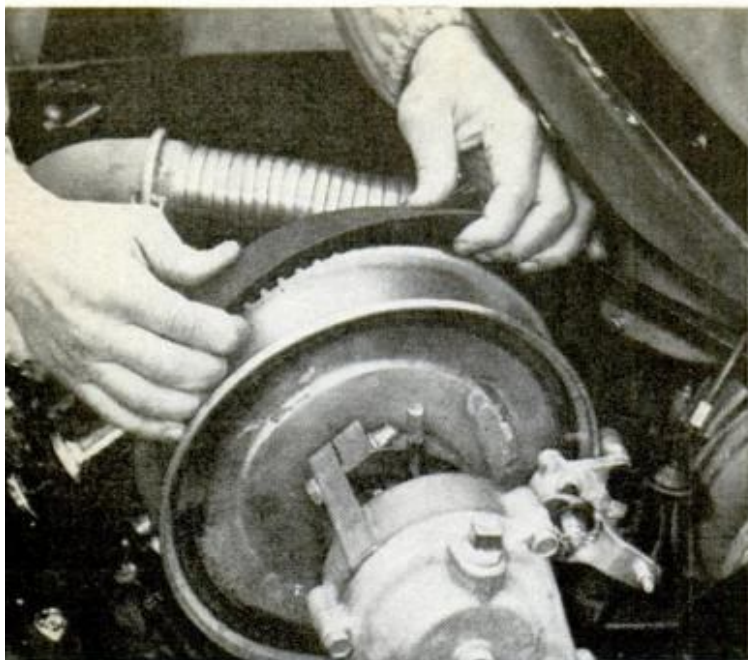
No matter what make machine you own, raise and support the rear of the vehicle, release tension on the track and spin each bogie wheel to check for seized bearings. If a wheel "clatters" or binds, have the entire system checked.

- *Check and adjust track tension.* This is done differently, according to make and model. Yamaha and Evinrude tracks must be raised so they don't support the machine. But Mercury and Polaris tracks must support the vehicle as you make the adjustment. Checking and adjusting track tension is one service outlined in all owners manuals. If you've lost yours, write the company for another.

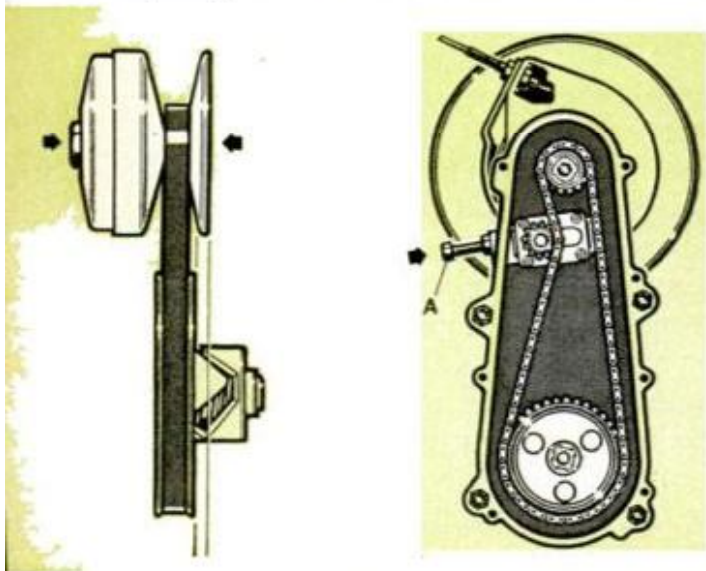
- *Check track alignment.* Lift the rear of the machine off the ground and block the front end for stability. Start engine and run the drive mechanism to see if the

CHECK SKI ALIGNMENT by measuring distances between skis at both their heels and toes. They should be equal. To check for bad bogie bearings (right), spin each wheel by hand and listen for a vibration noise





DRIVE BELT should be in good condition. Loosen it for best inspection. Diagrams show (arrows) where chain-adjusting nut is located on most model chain cases



track is centering squarely between the sides of the chassis and if the teeth on the sprocket wheel are entering the drive slots evenly. Track alignment is usually made by adjusting screws.

- *Check ski alignment and adjust if necessary.* Skis should parallel each other and the vehicle's body while the steering bar is in a straight-ahead driving position. If you don't trust your eye, measure the distance across the skis, front and rear, with a metal tape.

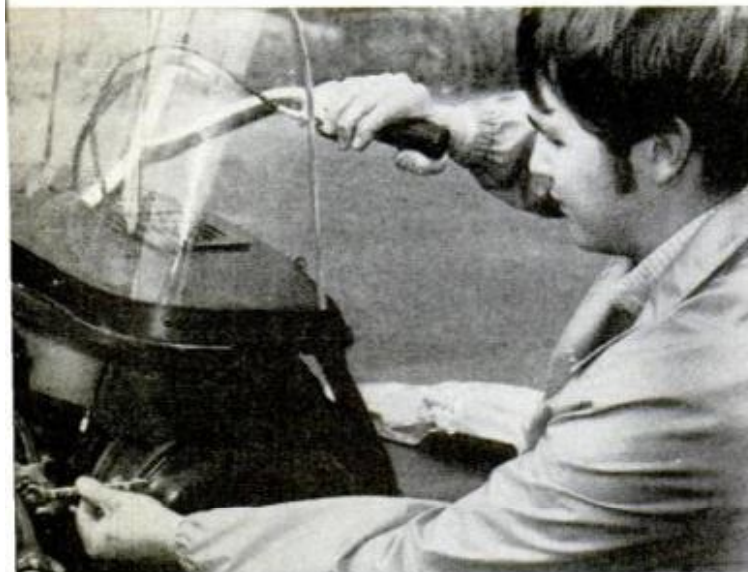
Ski adjustment varies. With some machines, such as Yamaha and Bombardier, loosen tie-rod nuts and turn tie rods to move skis in or out. With Mercury, loosen the mounting bolts of one ski spring pivot plate until it parallels the other. With Evinrude, loosen the jam nuts at outer ends of the tie rods, remove locknuts from the outer ball joints, and turn ball joints to align the skis. Polaris models are adjusted by turning the rod and bearings.

If you can't figure how to align your machine's skis (in many cases, the procedure isn't in the owners manual), ask a dealer or write to the maker.

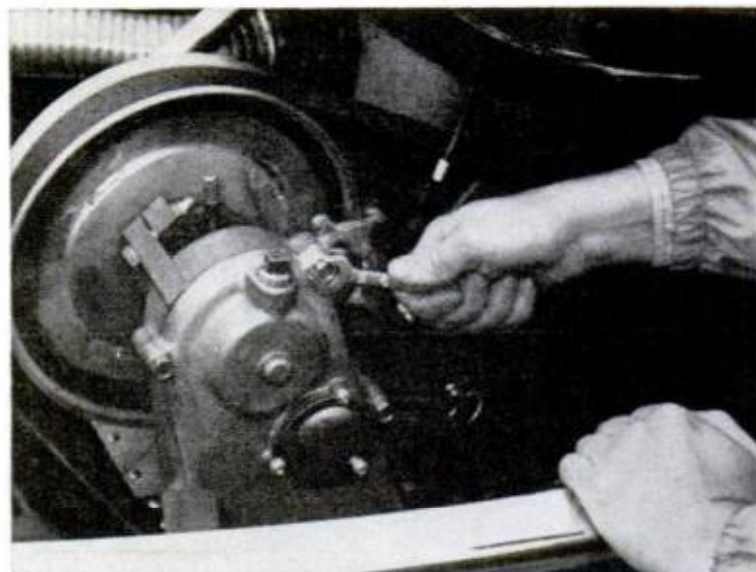
Examine skis carefully. If runners are worn excessively, replace them.

- *Check drive belt for wear.* If it's cracked, frayed or worn, replace it. If it's unevenly worn, your drive and driven pulleys are out of adjustment.

Pulley offset—the relative position of



TAKE UP SLACK on brake cable so brake lever is ¼ inch or more from handlebar when activated. You can't afford to have "soft" snowmobile brakes!



MODERN SNOWMOBILES are built to stand rough treatment. However, vibration causes nuts and bolts to loosen. Tighten these parts before season starts

one pulley sheave to the other—is generally about ½ inch; the exact dimension differs from machine to machine. If pulleys are misaligned, usually they must be removed, and shims added or damaged parts replaced. This job is best done by your servicing center.

● *Adjust drive train if too slack.* The drive chain connects the driven pulley to the drive axle. To check tension, remove the inspection cover and press in on the side of the chain. There should be a slight deflection. A chain that's too slack will jump on the sprocket, damaging the chain or sprocket. Adjustment usually is made by loosening a locknut and turning an adjustment mechanism, though some chains are self-adjusting.

Make sure the drive-chain case is filled with lubricant. If it isn't, add chain case oil available at your local snowmobile dealer.

● *Adjust brakes if brake lever is less than ¼ inch from the handlebar when brakes are engaged.* Adjustment usually involves loosening the brake cable at the brake-shoe mounting and taking up the slack cable.

● *Tighten all bolts and nuts and lubricate all appropriate points.* A lube chart should be in your owners manual. Remember: grease and oil are cheap compared to damage their nonuse causes.

● *Check the battery.* If your machine has electric start, make sure the battery

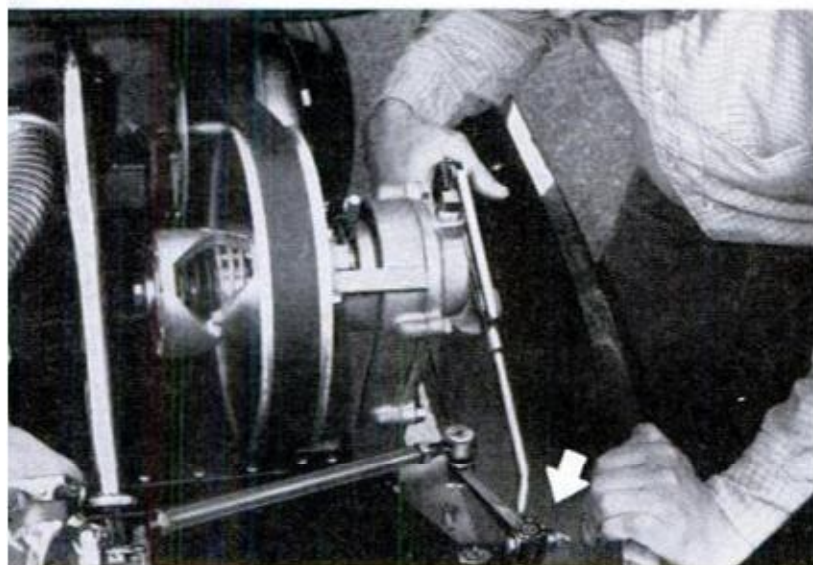
electrolyte is up to level, terminal connections are tight and free of corrosion, and the battery is clean. If battery is dirty, remove it from the machine and wash with a baking soda solution or ammonia, taking care not to get any inside the unit. Rinse the battery thoroughly with water. Reconnect terminals tightly and coat them with a light layer of petroleum jelly to retard corrosion.

Start the engine and listen for "wrong" sounds. Small-engine maintenance and repair articles appeared in the March and April '71 issues of *PM*. Much of the data given applies to snowmobile engines.

● *Examine the machine's exterior.* For any scarred areas, use a touch-up paint you can usually get at your snowmobile dealer's. Wet-sand damaged area with No. 320 sandpaper, using a circular motion. If damage is deep and you have to sand to base metal, apply a zinc chromate primer before painting.

For a minimum of engine work at the start of a season, you should clean or replace the fuel filter; check the fuel line (replace if it's dried out); replace sparkplug(s) if damaged or worn; clean and regap old plugs if reusable and adjust the carburetor.

Don't assume the carburetor is set properly because the machine ran okay when you stored it. A change in temperature may affect adjustment. ★★★



MOST IMPORTANT SERVICE you can give your machine is lubrication—before and throughout the season. Follow the lube chart found in owners manual
NOVEMBER 1971



CARBURETOR ADJUSTMENT may be required. Proper fuel flow to your power system is especially critical with machinery that's likely to see a lot of hard use

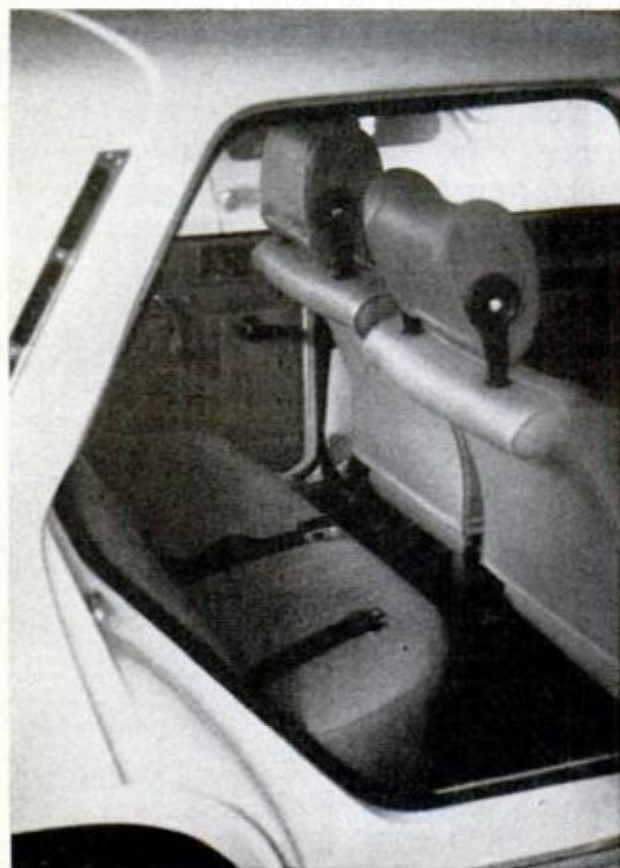
BALMETTE
(TALLOIRES)

Front- Wheel Drive to The Fore!

The new Renault 12
joins the growing number of front-wheel drive imports



By BILL HARTFORD, Auto Editor



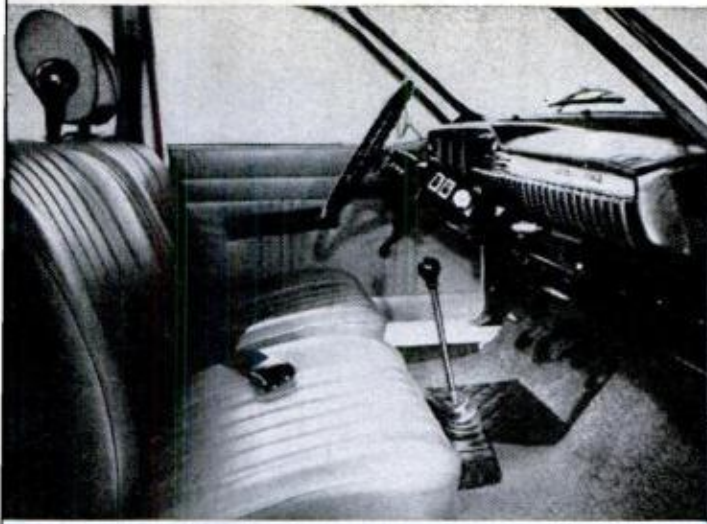
REAR-PASSENGER COMFORT is result of fwd layout and Renault's care in designing of seats for the 12

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FOOT TO THE FLOOR, speeding south from Paris on the autoroute last May seemed no different to me than being on the New York State Thruway. It was familiar and fast. But after a quick switch onto two-lane blacktop for the run between Mâcon and Talloires on Lake Annecy the driving experience suddenly became very French—like running head on into a travel poster. The narrow road knifed between two, ram-rod straight and regularly spaced rows of plane trees. They beat by in a blur that gave the effect of being in a tunnel—but without the “safety” of a smooth tunnel wall!

Later, farther into the French Alps, the challenge was still to cling to the right-hand side of a narrow, crowned road, but now to do it as it rhythmically wound, and sometimes violently hooked, left and right. This driving quickly rehonored what is so essential to survival and what too easily rusts from

POPULAR MECHANICS



IMPORTS WITH FRONT-WHEEL DRIVE

Audi—Super 90 2 and 4-door sedans and station wagon; 100 LS 2 and 4-door sedans.
 Austin—America 2-door sedan.
 Citroen—Mehari 2+2; D Special 4-door sedan; DS-21 4-door sedan, station wagon.
 Fiat—128 2-door sedan.
 Honda—600 2-door sedan.
 Lancia—Fulvia coupe and 4-door sedan; Flavia coupe and 4-door sedan.
 Peugeot—304 2 and 4-door sedan and station wagon; 504 4-door sedan.
 Renault—16 4-door sedan/wagon; 12 4-door sedan and station wagon.
 Saab—96 2-door sedan; 95 2-door station wagon; 99 2 and 4-door sedan; Sonett III sports car.
 Subaru—1100 2 and 4-door sedan, station wagon; 1300 2 and 4-door sedan.



FLAT FRONT FLOOR, mark of fwd, contributes to high level of driver, passenger comfort. Car is recognized easily by more-than-average slope of rear deck

driving too-big cars on too-big roads: concentration!

If I wasn't quite in my natural habitat, the car I was driving was. The Renault 12 was introduced in Europe in 1969 and is now available here in a four-door sedan model and—a first for Renault—a four-door station wagon. I drove the U.S. version which has a 1565-cc Four—one up on the European version with its 1289 cubic centimeters.

What *all* 12s have in common, of course, is front-wheel drive—a feature that made my trip from Paris, through the Alps and ultimately to Monaco, both swift and safe, but certainly not unique—not in Europe anyway. A hundred different front-wheel-drive models are made in Europe (vs. just Toronado and Eldorado here) and the number is increasing as Fiat and even VW join the ranks. Not all European fwd models are exported to the U.S. but there's quite

a bumper crop (see the list above).

Of these manufacturers, Renault is the No. 1 producer of fwd cars—with the five-million production mark having just been passed. Renault's fwd production began in 1959 with a small commercial vehicle and continued with the 4, 6, 16 (see *Test Driving the New Renault 16 Automatic*, page 38, June '70 PM) and 12. Also, it's no secret that Renault will begin importing two fwd cars—the 15 and 17—next year (See *Detroit Listening Post*, page 38).

The advantages and desirability of fwd are severalfold, especially in smaller cars ("smaller" meaning more sensibly sized in overall dimensions than most domestic models). Packaging and comfort are two such bonuses. With all driveline components under the hood there's no transmission hump, drive-shaft tunnel or rear-axle differential. The result is a flat floor up front, more



RENAULT 12 STATION WAGON has top-hinged tailgate and 58 cu. ft. of cargo space with rear seat folded. In profile, wedge shape is approached by downward slope of hood and high degree of rake of windshield

rear-seat room and seats that can be lower for more headroom. Trunk space benefits, too, when there's no bulky rear axle. Noise and vibration are confined under the hood, and center of gravity of the car can be kept lower for greater resistance to rollover. All these advantages are evident in the 12.

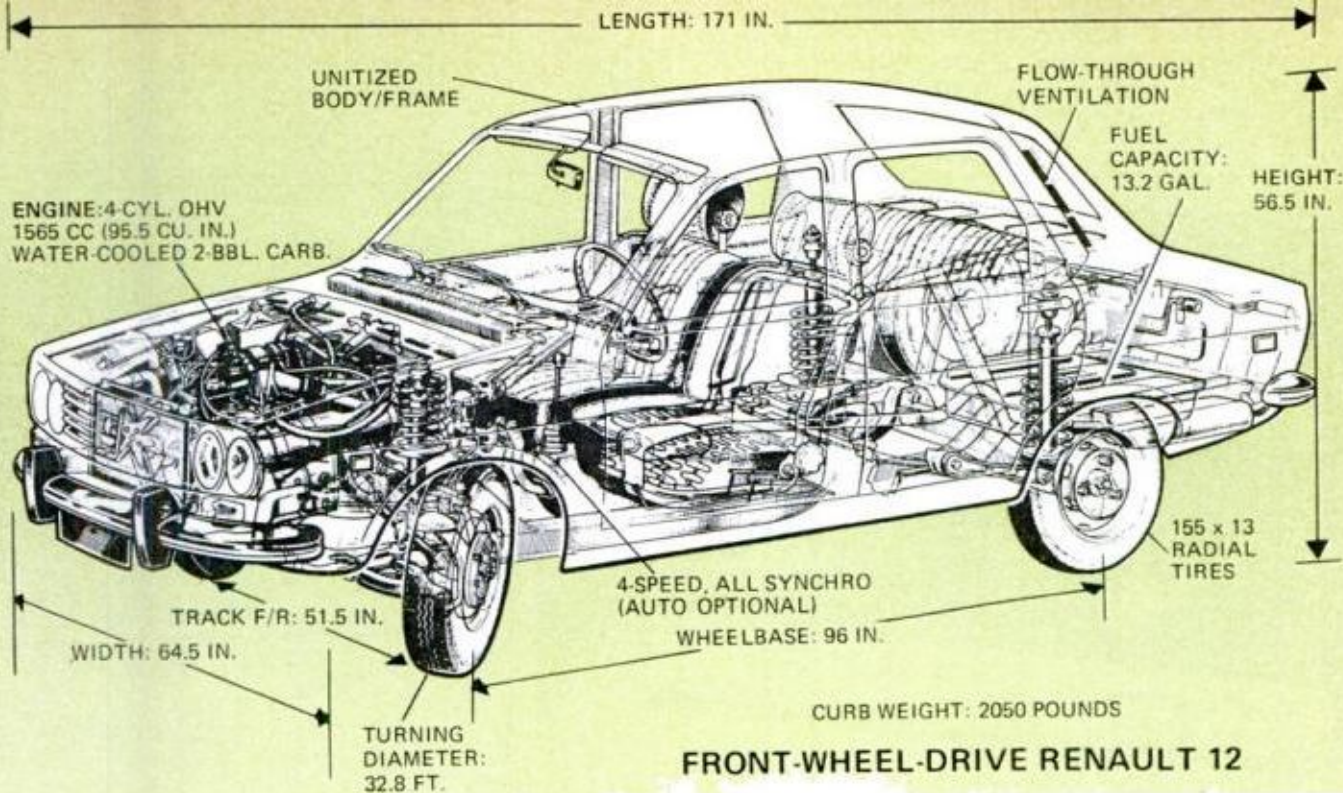
As appealing as these fwd advantages are by themselves, it is still the unique *handling* that is the biggest bonus. Superior traction and stability are the handling characteristics most readily noticed by having the front wheels pulling the car rather than the rear wheels pushing. Fwd takes a better bite of the road because of distribution of weight over the driving wheels (about 60/40 front/rear in the 12). Wheelspin under acceleration is minimized, and even if you do spin your wheels you won't skid sideways as with a rear-drive car. (This was borne out by some very fast starts in notorious Paris traffic, which confused some knowledgeable French drivers who were puzzled at the brisk acceleration of what appeared to be just a mild 1289-cc Renault 12!)

In sand, snow and slush the going is easier, too, since the front wheels make a path for the rears to follow. Front-wheel-drive stability in crosswinds is

evident while you drive the 12 flat out on the autoroute on a gusty day. The claimed top speed of 91 mph is easily achieved (even at that speed, the big, luxurious, fwd Citroens closed fast, quietly passed and slowly disappeared ahead). A cruising speed between 70 and 80 mph proved most comfortable, however, and the experience would dispel anyone's holdover notion from the early days of imports that "small" cars are not up to the demands of American freeway driving.

Stability in hard turns is another handling characteristic of fwd. A morning drive through Grenoble—of 1968 Winter Olympics fame—to the little mountain village of St. Julien provided the opportunity to confirm that in the Renault 12. Following the "do as the Romans do" philosophy, we drove as the Frenchmen do—with *elan*. And so we quickly mastered what we had observed: the downhill-racer technique of getting past slow cars on left-hand hairpins by passing on the inside. *C'est magnifique* when you can see the road below you, but don't try it uphill! And, of course, don't do it until you know the car.

In such hard driving, with fwd you have the advantage of being able to



FRONT AND REAR SUSPENSIONS allowing high degree of wheel travel are among features under skin

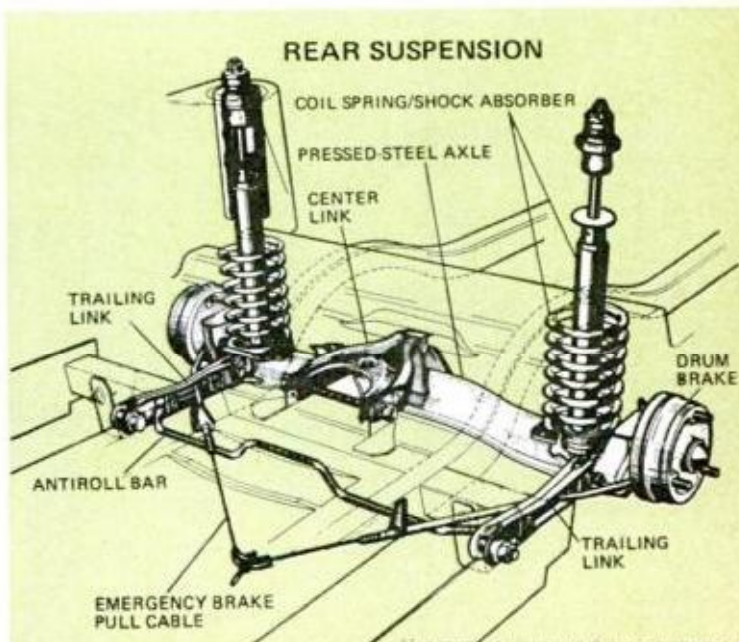
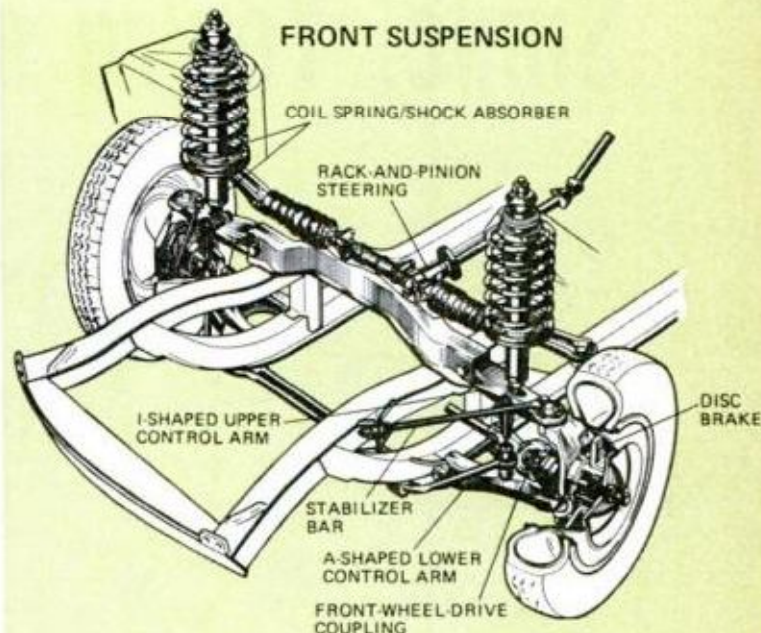
simply *steer* through a very fast curve. With front engine/rear drive, and even more so with rear engine/rear drive, at the same speed, you would need a great deal more driving experience and skill for correcting slides and adding opposite lock for oversteer, for example. The 12 exhibited the familiar understeer (tendency to run wide in a turn) common to fwd cars and designed into Detroit front-engine/rear drive cars to make them easier to control for the average driver. The 12 didn't abruptly oversteer (rear end slide out) when power was backed off in a turn.

What we didn't like about the 12 right off the bat, and disliked even more after driving the length of France, was the sloppy, rubbery, four-speed shift linkage (automatic transmission is optional). Otherwise, Renault has for the American market a very smooth, comfortable, roomy and carefully assembled car.

The sedan is very competitive at the (prefreeze) price of \$2195. The \$2595 sticker for the wagon seems too much more, but it does have as standard the comfort, convenience and appearance afforded by the TL Decor Group that's a \$150 option with the sedan. ★★★

NOVEMBER 1971

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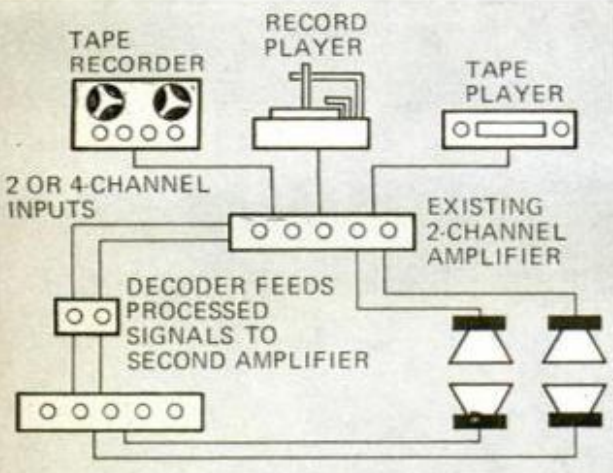


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THREE INEXPENSIVE ADAPTERS you can buy to convert to four-channel sound are (from left) Lafayette, Dynaco and Electro-Voice. Lafayette and Dynaco are about \$30; Electro-Voice, \$60



Smile, You're on Four Channels



4-CHANNEL DECODERS REQUIRING



HEATHKIT

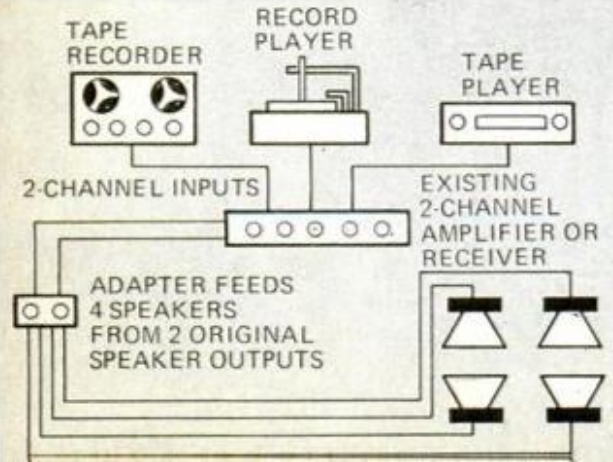


IT'S ONLY A SMALL BOX with two knobs on the front, but it can produce four-channel sound from your present stereo system if you have a second am-

plifier available. Pioneered by Electro-Voice, it connects between the two stereo amplifiers and decodes standard or matrixed two-channel sources in-

ADD-ON ADAPTERS are simpler than decoders, but require no additional stereo amplifier. They connect to your existing stereo system and produce

four speaker outputs for synthesized four-channel effects. Dynaco's, shown below and in parts on facing page, is styled to match Dynaco amplifiers and



4-CHANNEL ADAPTERS REQUIRING NO



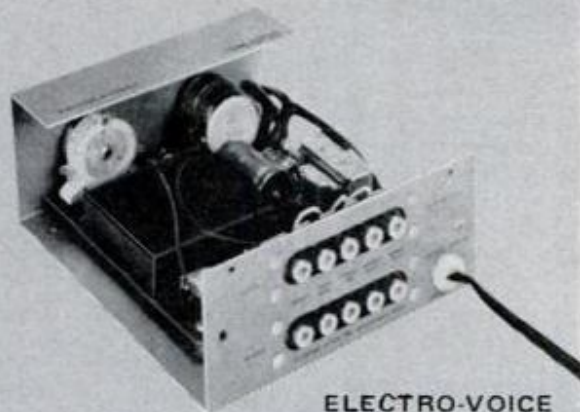
Like it or not, you're going to have to face an ever-growing number of choices in today's rush to get quadraphonic sound into American homes. Here's a rundown on the current entries in the race with tips on choosing the right equipment to suit your needs



Now!

By SHELDON M. GALLAGER

SECOND STEREO AMPLIFIER



to two additional channels and feeds these to rear speakers. E-V's and Realistic's are both \$59.95. Heath sells a similar model in kit form for \$29.95

tuners. It's \$29.95 assembled, \$19.95 in kit form. Similar Lafayette model at top of the opposite page is \$29.95. Realistic's at right, below, is \$24.95

THREE MONTHS AGO, in the August issue, PM published what was then the "last word" on four-channel stereo—the latest and most exciting developments in this brand-new form of home entertainment. In the short period since then, so much has happened that it's time again to take another look at this galloping trend in hi-fi listening, called quadraphonic sound.

If you're a little confused, you're not alone. So many different four-channel systems have hit the market so fast that even store clerks are having difficulty keeping them straight. This has led some frustrated cynics to call the situation the "multi-channel muddle."

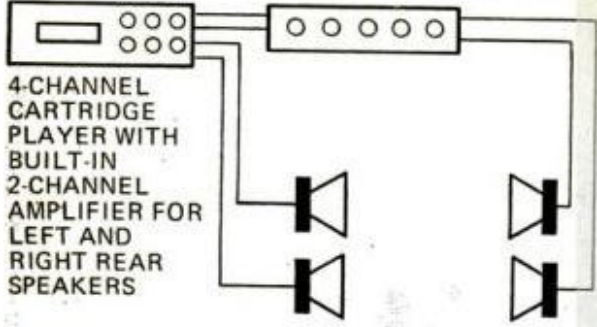
This needn't be, however. There's no muddle if you know who's doing what and why. First, four-channel stereo is not just a gimmick, as some have implied. It's for real. I've listened to demonstrations of all major systems and the sound represents an impressive improvement over conventional two-channel stereo. It is, in fact, to stereo what stereo was to early monaural. The two additional speakers placed at the rear of the listening area combine with the regular speakers at the front to produce a rich, room-filling "surround" effect

ADDED AMPLIFIER



REALISTIC

EXISTING 2-CHANNEL
AMPLIFIER FOR
LEFT AND RIGHT
FRONT SPEAKERS



4-CHANNEL
CARTRIDGE
PLAYER WITH
BUILT-IN
2-CHANNEL
AMPLIFIER FOR
LEFT AND
RIGHT REAR
SPEAKERS

4-CHANNEL "ADD-ON" CARTRIDGE



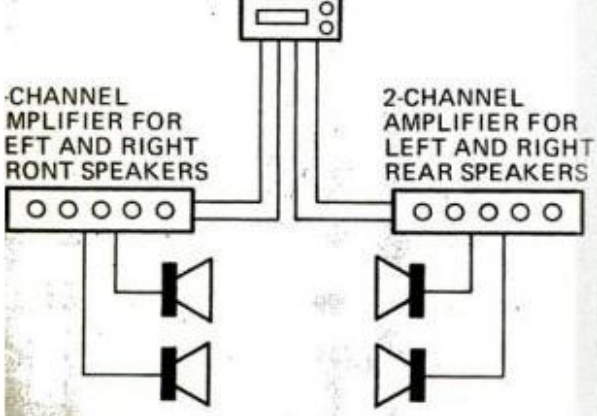
BELL & HOWELL

FISHER

YOU CAN TAKE YOUR CHOICE of four-channel cartridge tape players in three forms. The add-on or slave-type units shown above incorporate their own

built-in two channel amplifiers and are designed for use with an existing stereo amplifier to provide the two added channels. They also play regular

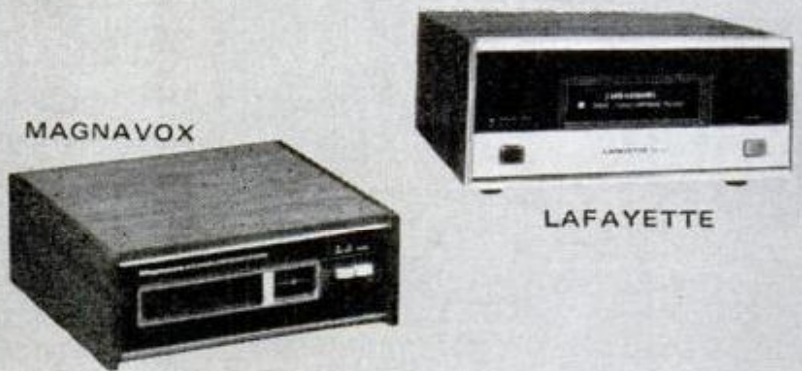
4-CHANNEL CARTRIDGE DECK



2-CHANNEL
AMPLIFIER FOR
LEFT AND RIGHT
FRONT SPEAKERS

2-CHANNEL
AMPLIFIER FOR
LEFT AND RIGHT
REAR SPEAKERS

4-CHANNEL CARTRIDGE PLAYER DECKS

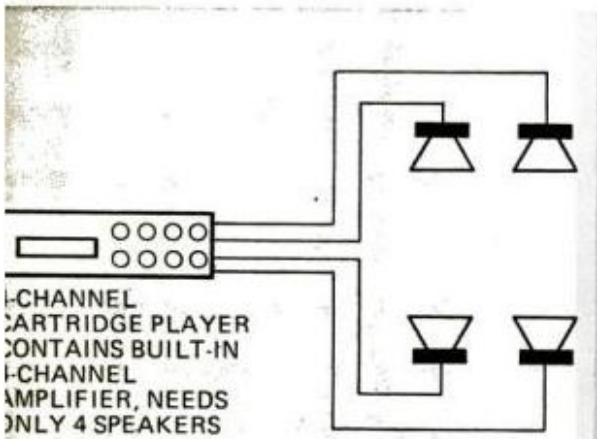


MAGNAVOX

LAFAYETTE

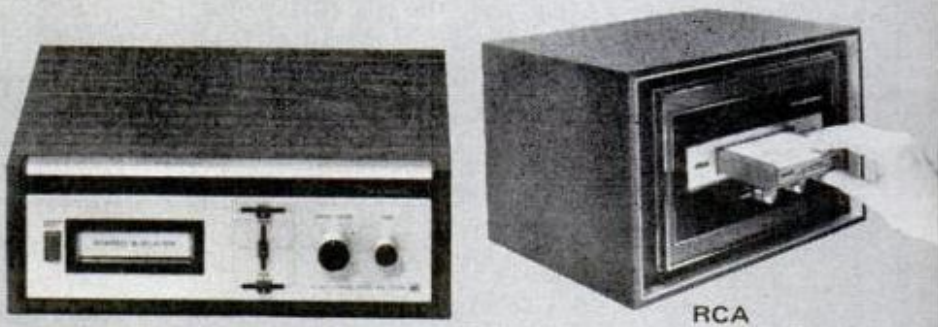
FOUR-CHANNEL CARTRIDGE DECKS are least expensive type, but contain no amplification of their own. They require two two-channel stereo amplifiers or

a single four-channel amplifier. They will, however, play regular two-channel cartridges through your present stereo system now, and you can add a



4-CHANNEL
CARTRIDGE PLAYER
CONTAINS BUILT-IN
4-CHANNEL
AMPLIFIER, NEEDS
ONLY 4 SPEAKERS

COMPLETE SELF-CONTAINED



REALISTIC

RCA

YOU NEED NOTHING EXTRA with these self-contained four-channel cartridge players. They have complete built-in four-channel amplification and most

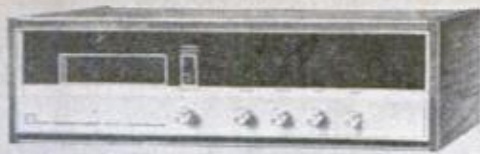
even include four speakers in price. Realistic is \$189.95; RCA, \$249.95; GE, \$199.95; Teledyne (not announced); Toyo, \$169.95; Motorola, \$399.95. Mo-

that gives the feeling of listening to live music in a huge concert hall. The walls expand magically outward and the music floods over you from all directions. At it's best, it's magnificent.

trying not to obsolete your present hi-fi equipment. Most of the new systems represent "add-on" units that can be used with your existing stereo amplifier or receiver. Also, different four-channel units can be purchased a piece at a time without

Secondly, manufacturers are sincerely

PLAYERS



MOTOROLA



AMPEX

eight-track, two-channel cartridges. Prices are: Fisher, \$299.95; Bell & Howell, \$169.95; Motorola, \$229.95 (includes two speakers); Ampex, about \$230



FISHER

PANASONIC

second stereo amplifier later for four-channel cartridges. Prices are: Magnavox, \$119.95; Lafayette, \$89.95; Panasonic, \$129.95; and Fisher, \$169.95



CRAIG

4-CHANNEL CAR PLAYERS



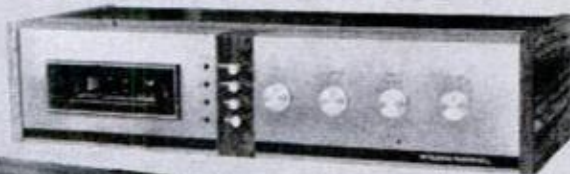
MOTOROLA



TOYO

EVEN CAR PLAYERS have gone quadraphonic. These new four-channel under-dash cartridge models are: Craig, \$139.95; Motorola, \$159.95; Toyo, \$129.95

4-CHANNEL CARTRIDGE PLAYERS



TELEDYNE



TOYO



GENERAL ELECTRIC

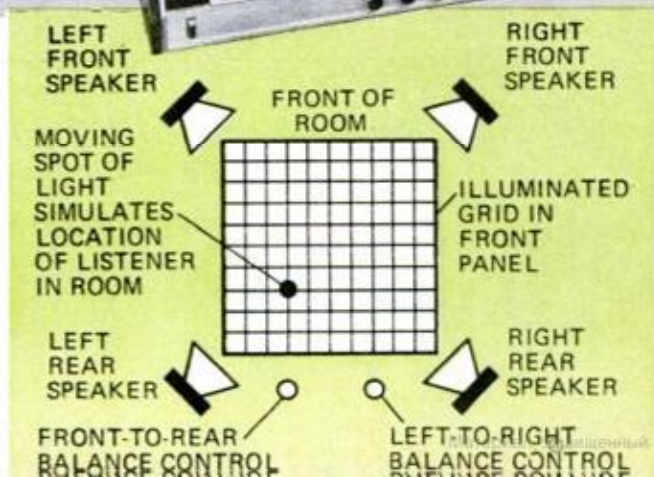


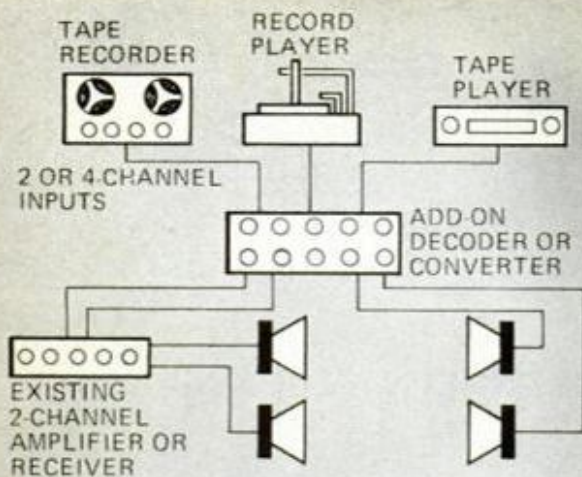
MOTOROLA

Motorola has novel balancing system (right) that lets you adjust speakers by moving a spot of light on a grid until it matches your listening area in room

disturbing or outmoding your present setup.

Some inexpensive quadraphonic adapters start out at as little as \$30 and require only two extra speakers. Those sold by Dynaco, Lafayette and Realistic (Allied



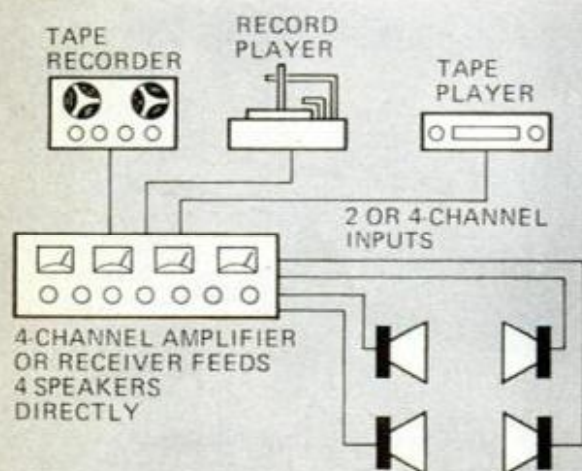


DECODERS, CONVERTERS



CONVERTERS ARE BASICALLY two-channel amplifiers with added circuitry for creating a wide variety of special effects. Used in combination with your

existing stereo amplifier or receiver, they can produce discrete four-channel sound, such as from four-channel tapes, or they can decode matrixed



4-CHANNEL AMPLIFIERS AND RECEIVERS



FOUR-CHANNEL AMPLIFIERS contain everything you need for quadrasonic sound in a single unit. Like decoders and converters, they'll play either dis-

crete or matrixed four-channel sources, except that no second stereo amplifier is required to supply the additional two channels. Of those shown here,

Radio Shack) cleverly extract "difference" signals from the two conventional stereo channels and use these to feed two rear speakers. This simulates the effect of four-channel sound without requiring an additional stereo amplifier, and the result is remarkably good. Since four speakers are the heart of any quadrasonic sys-

tem, an investment now in extra speakers is not wasted if you should decide later to enlarge your system to incorporate four separate or "discrete" channels.

Actually, the possibilities are so numerous and fascinating that four-channel sound can become an exciting hobby regardless of which system you elect to

FOUR-CHANNEL EARPHONES? Well, no, but Toshiba's newest model at left uses unique cross field to enhance regular stereo. Part of left channel is fed

to right ear and vice versa to simulate "surround" effect. Price is \$24.95. At right is Panasonic's four-channel cassette recorder, first of its kind



AND SYNTHESIZERS



PANASONIC



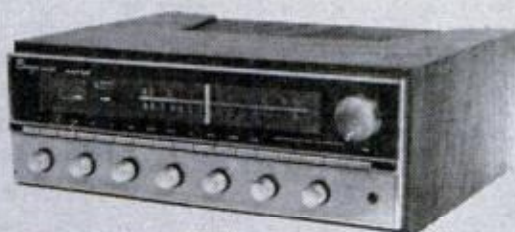
SANSUI



SANYO

two-channel sources into four channels. They can also derive simulated four-channel effects from regular two-channel sources. Sophisticated controls

let you vary tone, reverb, speaker balance and other functions. Prices are: Toshiba, about \$200; Sanyo, \$79.95; Panasonic, \$309.95; and Sansui, about \$200



BENJAMIN

LAFAYETTE



FISHER



SCOTT

the Panasonic, Fisher and Benjamin models also incorporate AM/FM/FM stereo tuners that will receive standard stereo or matrixed four-channel radio

broadcasts. Prices range from \$219.95 for Lafayette's basic four-channel amplifier to about \$600 for Fisher's four-channel AM/FM/FM stereo receiver

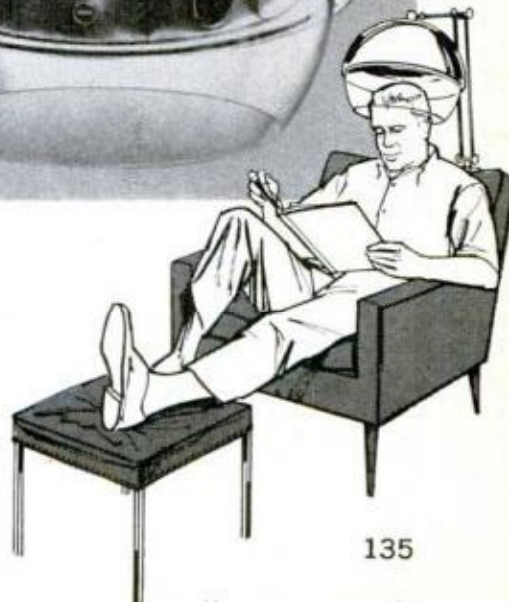
start with. In so-called true or discrete four-channel sound, the once-dying eight-track cartridge tape has clearly emerged as king. Already containing four tracks in each direction, it offers manufacturers a quick and easy way of converting to quadraphonic sound. Instead of recording four two-channel programs, they simply record two four-channel programs—one in each direction. In effect, you get half as much program time, but you get it in glorious four-channel sound.

As a result of the cartridge's sudden rise in popularity, you can choose from dozens of four-channel players in any of three basic forms. Some are "decks" only, with no built-in amplification. These require two two-channel amplifiers or a single four-channel amplifier. Other players have a built-in two-channel amplifier and are designed for use with your pres-

(Please turn to page 204)



WELL-DRESSED hi-fi fans may soon sport this four-speaker headgear resembling a hair dryer. It's an idea from Panasonic for the ultimate in private quadraphonic listening



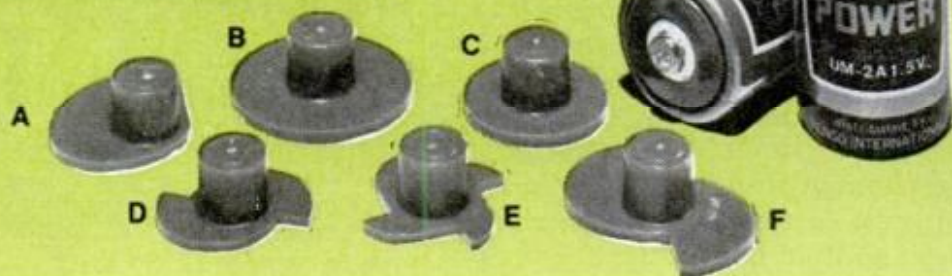
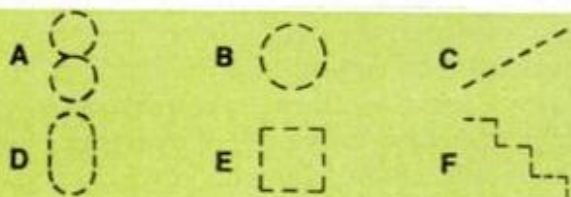
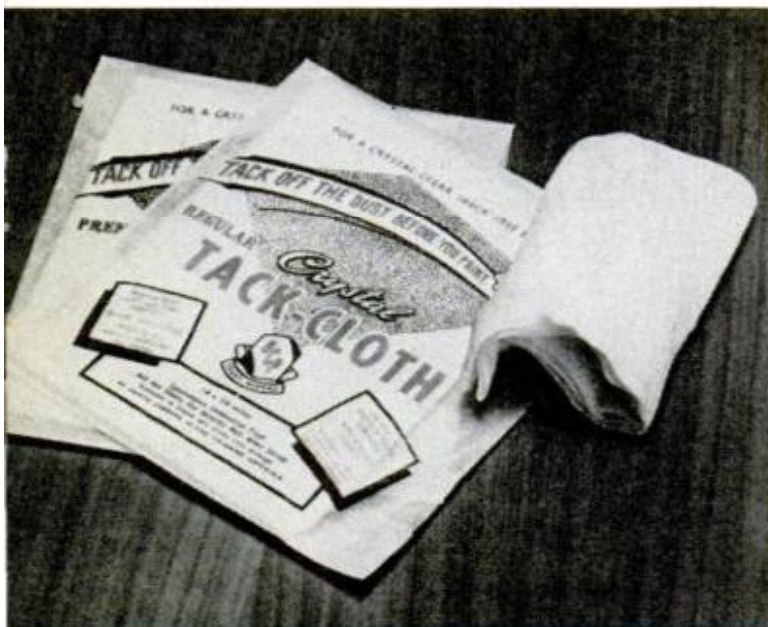
EXCITING NEW PRODUCTS

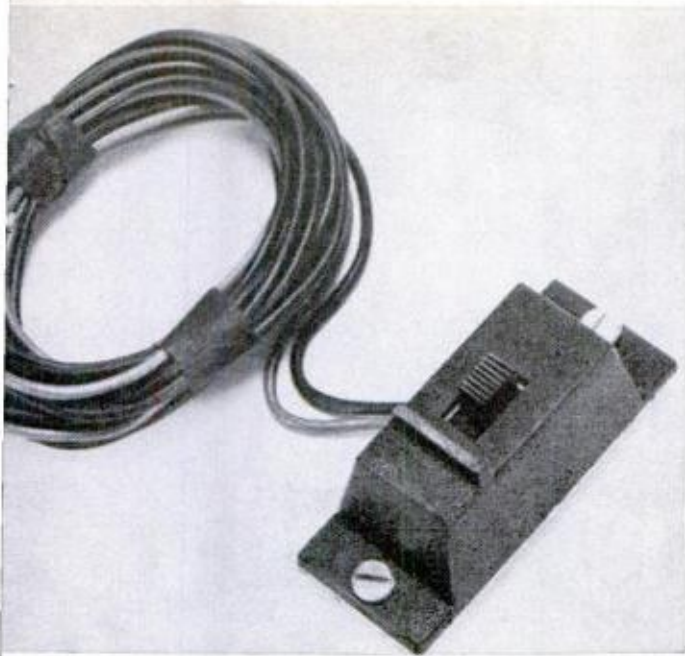
BY CATHERINE BILSKI

FUTURE DRIVERS, new drivers, experienced drivers—just about anyone will enjoy playing the exciting, competitive and educational game of Driver Ed. It's authentic and actually based on the real rules of the road. Each player gets a chance to drive; good drivers are rewarded, law-breakers penalized according to the "point system." Fun for the entire family. The game sells for \$4.75 postpaid and is made by Visual Dynamics, Inc., Brightwaters, N.Y. 11718.

GET A CLEAN, DUST-FREE FINISH every time with a Crystal Tack-Cloth. One wipe over the surface before you paint, spray or varnish will pick up and remove foreign matter, dust, lint and sanding particles from wood, metal, wallboard or plastered areas. Assures a smoother, better finish. Available in regular, premium and utility grades at 30 to 45 cents. Made by Bond Chemical Co., 2100 West Fulton St., Chicago, Ill. 60612.

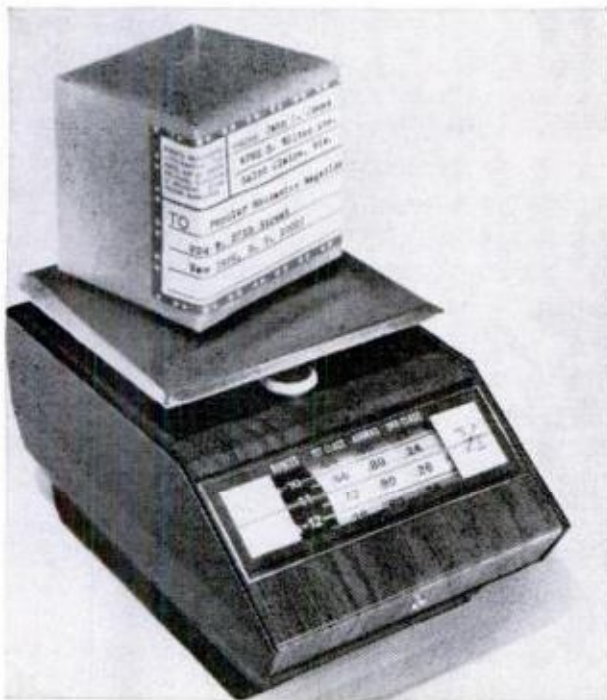
HAVE FUN programing the Comput-A-Plane to go in the direction you want. Made of unbreakable plastic, it's programed by interchangeable discs placed between the wings to enable the plane to travel in a circular, square, figure-8, oblong, jagged or straight pattern. For example, when disc A is inserted, the plane will travel in the direction of pattern A, when disc B is inserted it flies in pattern B, and so on. \$6 postpaid, W. J. Seidler Co., 2600 Wilshire Blvd., Los Angeles, Calif. 90057.





PROTECT YOUR CAR from theft with Auto-tronic Theft Guard. It prevents theft by making it impossible to jump the starter, "hot wire" the ignition, use master keys or employ other common techniques of theft. Easily installed in minutes with no drilling or alteration of your car's existing wiring. Available for \$6.95 from Albee Products of Massachusetts, 108 Groveland St., Springfield, Mass. 01108.

COMPUTE POSTAGE RATES in ounces for first class, air mail and third class letters and packages (up to 1 lb.) instantly and accurately with the 6010 Mail Scale. It's smartly styled in either black with nickel or black with a walnut-grain finish and is ideal for home or office use. Retail for \$6 from Silk Art Studios, 202 Franklin Ave., Midland Park, N.J. 07432.



NOVEMBER 1971



HUMIDIFIER/DEHUMIDIFIER combination features humidity-control functions in one cabinet, a four-way adjustable grille, heavy-duty casters, five-gallon water tank, moisture container and automatic shutoff. Available at selected Sears stores and through the company's 1971 Fall and Winter catalog.

DON'T GET STUCK IN SNOW again this winter. With Winter Grip placed under the wheel of your car you'll be able to move with ease out of snow, ice and mud. It's made of rust-proof aluminum and can be used over and over again. Each carton contains two four-foot rolls. Sold for \$2 through the Die Mesh Corp., 12 First St., Pelham, N.Y. 10803.



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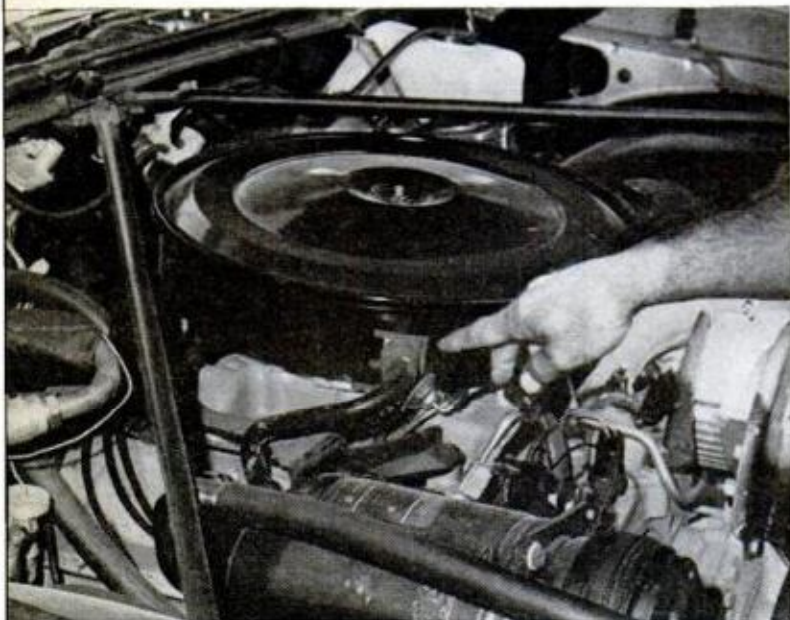
Curb pollution and boost fuel economy:

Keep Your Emission Control System Working



By MORT SCHULTZ

-CLOGGED FILTERS, including carburetor air filter (above), will affect operation of emission controls. When checking hoses in a closed crankcase system, start with ventilating hose going to the air cleaner



WHEN YOUR CRANKCASE and exhaust emission control systems don't work right, they cost you money. Engine performance suffers and leads to a tune-up often not needed, and a complete waste if the emission systems aren't serviced. A malfunctioning emission control system also wastes money by increasing gas and oil consumption.

The crankcase emission control system, required since 1963, directs crankcase vapors into combustion chambers for burning instead of expelling them into the atmosphere. If vapors are not purged from the crankcase, they'll shorten engine life by diluting oil and forming sludge.

The other system, exhaust emission control, mandatory since 1968, strives for more thorough burning of fuel. Exhaust emissions are primarily unburned fuel.

The crankcase emission control system, also called the positive crankcase ventila-

tion (PCV) system, comprises two types: open and closed. Both pull vapors from the crankcase and direct them into the combustion chambers for burning through the intake manifold. Before PCV, these pollutants escaped into the atmosphere.

In the open system, older of the two, fresh air used to "ventilate" vapors from the crankcase enters through a vented oil filler cap. In the closed PCV system, which became standard around 1966, fresh air enters through the carburetor air cleaner. The oil filler cap is sealed.

The closed system provides more positive control against pollution. In the event of a pressure buildup brought on, for example, by a clogged PCV valve, vapors are forced back into the air cleaner since other outlets are sealed. If pressure builds up in an open PCV system, vapors are forced back through the oil filler cap into the atmosphere.

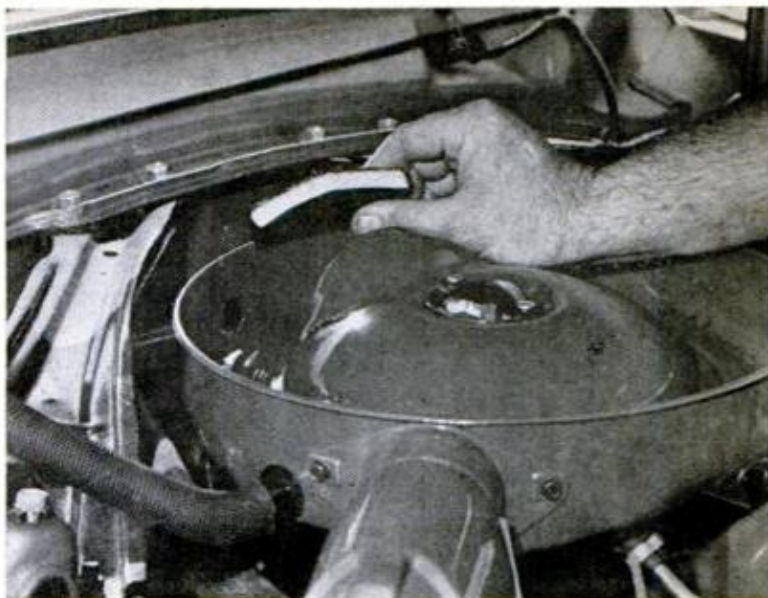
A pressure buildup in either PCV system will likely cause a loss of oil. In an open system, oil may be forced out of the crankcase through the oil filler cap and thrown over the engine. In a closed system, oil may be forced into the air cleaner where it will coat the air filter. Either way, the presence of oil tells you the PCV system may need immediate attention.

The heart of the crankcase emission control system is a plunger-type valve that opens and closes as the amount of vacuum varies in relation to engine operation (i.e., idle, cruise, acceleration and so on). This PCV valve assures that correct air-fuel ratio is maintained so the engine won't run rough. The valve also guards against crankcase explosion if a backfire occurs. It closes off the crankcase, preventing flame from reaching the crankcase and igniting gases.

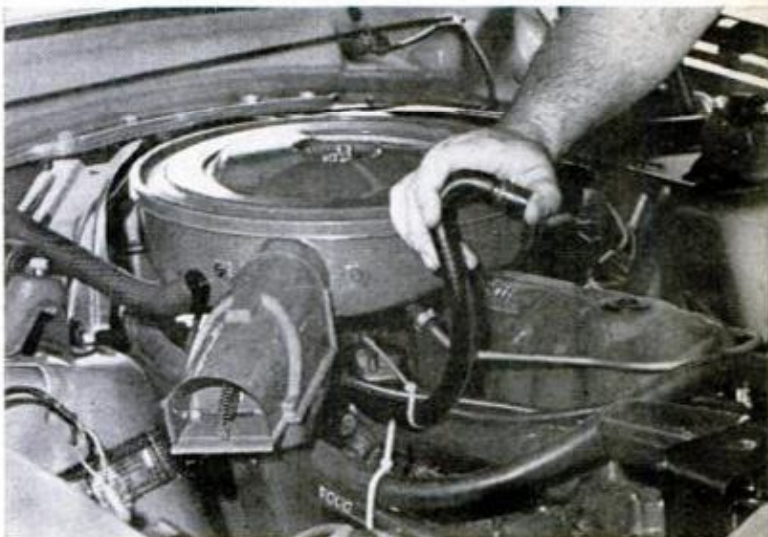
PCV systems from car to car are much the same, but location of the valve varies. In V8s it is generally located in the push rod cover. In six-cylinder engines the valve will usually be found in the rocker arm cover.

There have been variations in PCV systems. Some Corvairs employed a fixed-orifice tube-type ventilation system having no PCV valve. For years Oldsmobile used a dual-action valve bearing no resemblance to a PCV valve. It directs va-

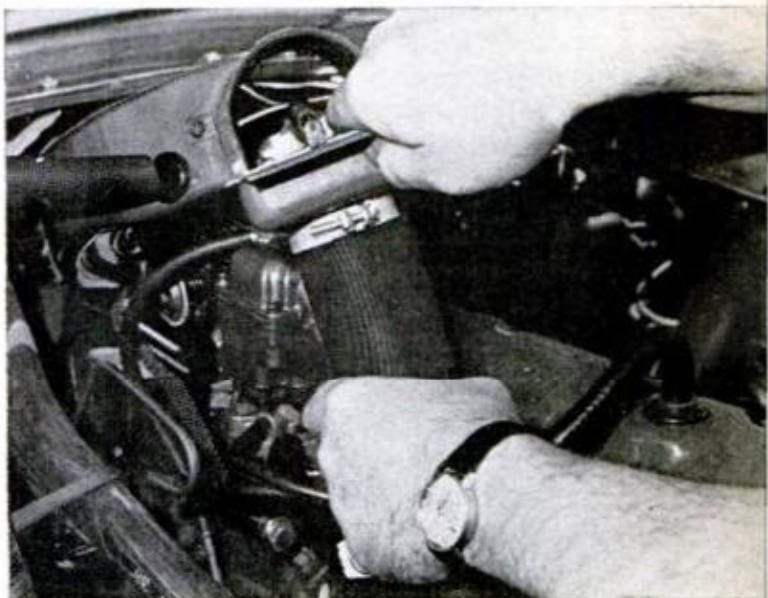
THERMOSTATIC DAMPER VALVE in air cleaner snorkel should be open after the engine has warmed up
NOVEMBER 1971



VENTILATING HOSE to air cleaner incorporates a filter within the air cleaner. In many cars, the filter and its holder are replaced as an assembly



POSITIVE CRANKCASE VENTILATION system needs vacuum to work properly. You should check for vacuum when you check your engine oil, for example





DAMPER VALVE is closed when engine is cold; air for combustion is picked up at hot exhaust manifold

ports to the intake manifold through the base of the carburetor and air cleaner.

If your crankcase emission system begins to malfunction, rough idle, crankcase sludge, oil dilution and air pollution will result. To prevent this, service the system at least as often as recommended in your owners manual.

Start by checking the PCV valve hose for deterioration. If the system is closed, also inspect the ventilating hose which goes from air cleaner to rocker arm cover. It's part of the sealed PCV system and transfers fresh air from air cleaner to crankcase. If a hose is deteriorated or clogged, replace it with one that's oil and gas-resistant.

Remove and discard the old PCV valve. In buying a new part, remember that a PCV valve is designed to control the amount of flow from the crankcase to the manifold of a specific engine. Get the one designed for your engine, or its performance will be hampered.

Remove the air cleaner cover and examine the air filter element. Manufacturers differ about frequency of replacement. To be sure, tap the filter lightly on a hard surface. If quite a bit of dust falls, it would be wise to replace the filter.

Most closed PCV systems have a mesh-type filter for air passing through the ventilating hose. This filter, in the air cleaner, should be replaced.

A few cars—Corvette is one—have a wire-type flame arrester in the air cleaner that should be cleaned in kerosene.

To complete servicing of the crankcase

emission control system, adjust the carburetor idle speed to specification.

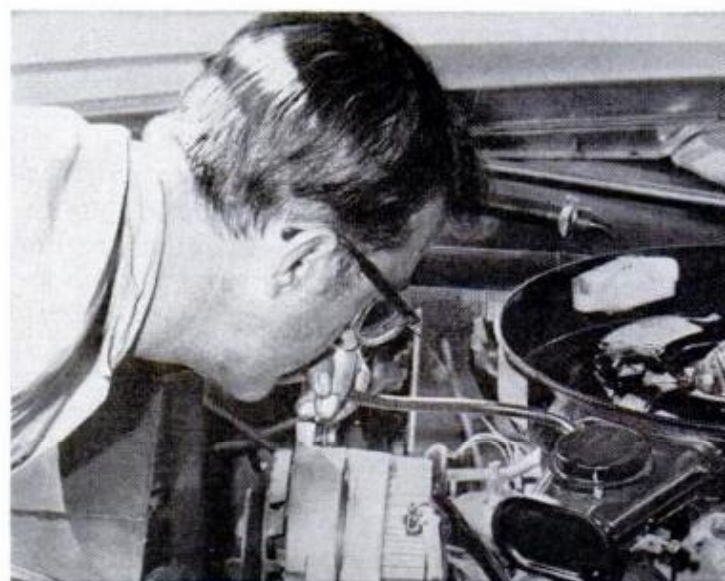
Between service periods, make sure the PCV system is working. This is easy to do. With engine idling, remove the PCV valve from its seat. You should hear it hissing. Cover valve with your finger. You should feel a strong pull.

The exhaust emission control system requires servicing, including tune-up of the engine to specifications, to fight air pollution and keep your engine running right. Such systems are relatively new, but are easy to service.

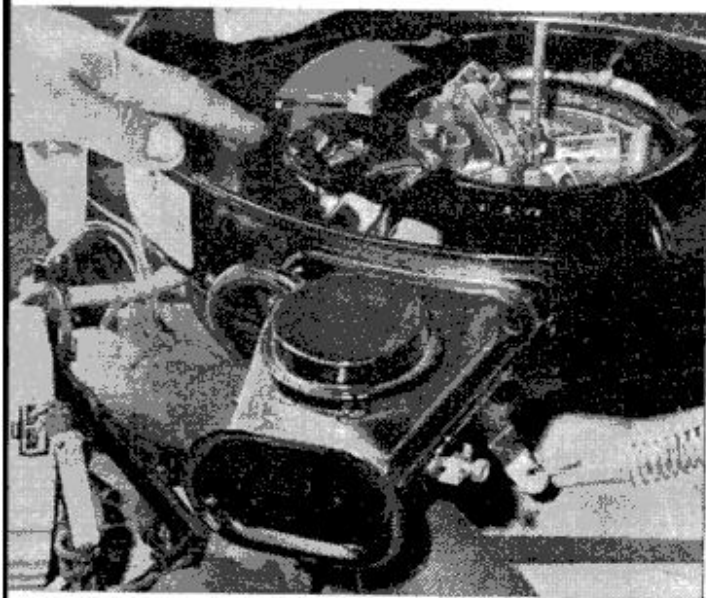
The first one put into comparatively wide use was an air-pump system called A.I.R. (Air Injector Reactor) by General Motors, Thermactor by Ford and Air Guard by American Motors. It was introduced in California in 1966.

The air pump distributes compressed air to a point behind each exhaust valve, causing unburned fuel and other by-products of combustion to burn at this point rather than pass out the exhaust pipe to the atmosphere. A check valve keeps exhaust gases from entering the pump if the pump or drive belt fails.

Beginning essentially with 1968 models, manufacturers began equipping cars with exhaust emission control systems which require leaner air-fuel ratios, ignition timing on the retard side and higher operational temperatures. GM calls its system the Controlled Combustion System (CCS); Chrysler has the Cleaner Air System (CAS); Ford the Improved Combustion System (IMCO). All cut pollution by



CREATE A VACUUM to see if damper valve closes when troubleshooting temp sensor and control motor



TEMPERATURE SENSOR, located in the air cleaner, is easily removed by opening the retaining clips

using a leaner air-fuel ratio that is burned more completely by retarding timing as compared to previous years and by creating hotter temperatures for more complete combustion.

Exhaust emission control systems should be serviced no less frequently than recommended by the manufacturer. Most makers urge service at 12 months or 12,000 miles, whichever comes first.

First, test the air cleaner, which in most cars having a modern exhaust emission system is thermostatically controlled to keep air temperature at 100 to 115°F. This is needed for smooth engine performance, especially during warm-up. A type of thermostatically controlled air cleaner used by GM, Chrysler and AMC consists of a temperature sensor, vacuum-operated air-control motor and hoses. Start with a visual check; look for any loose, kinked or damaged hoses.

Make sure the engine is cold and look into the air cleaner snorkel for the damper valve. Start the engine. The damper valve should close to keep air from entering the air cleaner. Fuel will burn more completely when mixed with warm air provided from the exhaust manifold rather than from the engine compartment when the engine is cold. As the engine warms up the damper valve should open, allowing the warm air now being generated in the engine compartment to be used in the combustion process.

If the air cleaner isn't functioning this way, the engine will run rough, particularly during warm-up. The malfunction

will lie with a faulty temperature sensor or motor control, both part of the air cleaner. To locate the faulty part, turn off the engine and let it get cold. Disconnect the diaphragm assembly vacuum hose at the sensor and pull in on the hose by mouth to create a vacuum. The damper valve in the snorkel should close. Bend the hose to trap vacuum and hold it about a minute. The damper valve should stay closed; if it fails to respond this way, there is a leak in the diaphragm assembly that should be repaired.

If the damper valve responds properly, the temperature sensor is at fault. To replace the sensor, pry off its retaining clips and install a new part you can buy from your dealer.

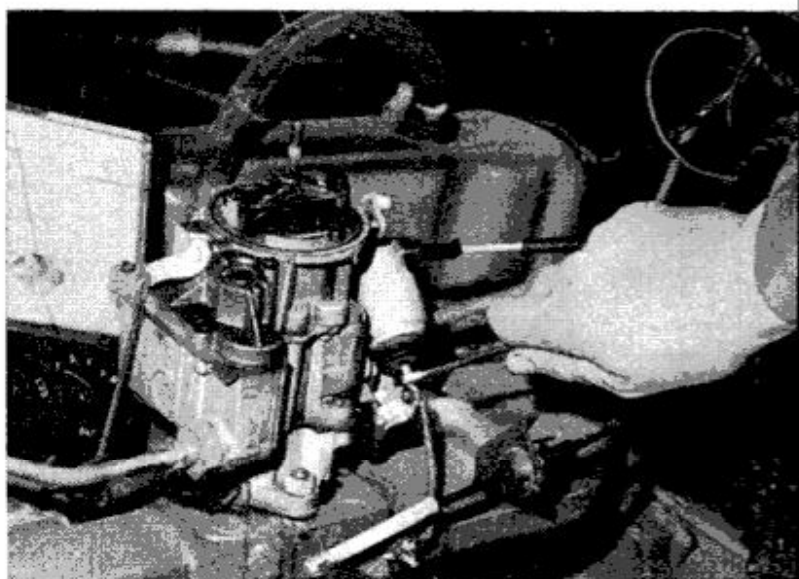
The Ford air cleaner setup is a bit different. Instead of a vacuum motor, it uses a thermostat that controls the damper valve. However, its purpose and the way it functions are the same as with the one just described.

If the damper valve doesn't function as it should—that is, if not closed when the engine is cold and if not open when the engine is warmed up—the valve plate assembly, including the thermostat, should be replaced.

Since this new system relies on heated air, it is important that the manifold heat control valve beneath the exhaust manifold be in good working order. It closes off the exhaust manifold when the engine is cold, providing for rapid heat buildup.

Make sure the manifold heat control

(Please turn to page 204)



IDLE SPEED SETTING is important for emission control. Adjust screw of the throttle-stop solenoid

TALL, SLIM AND SHOWY

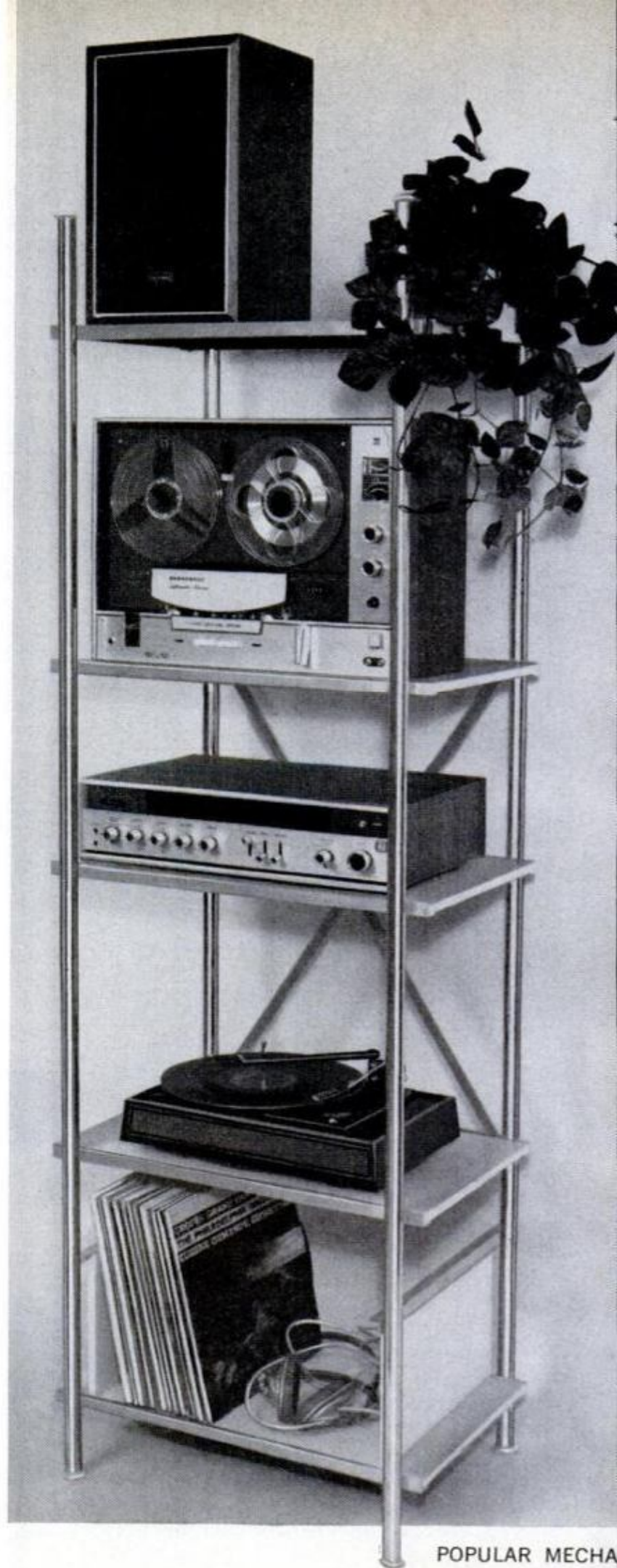
An open hi-fi rack for people who want good-looking equipment to show.

By JACKSON HAND

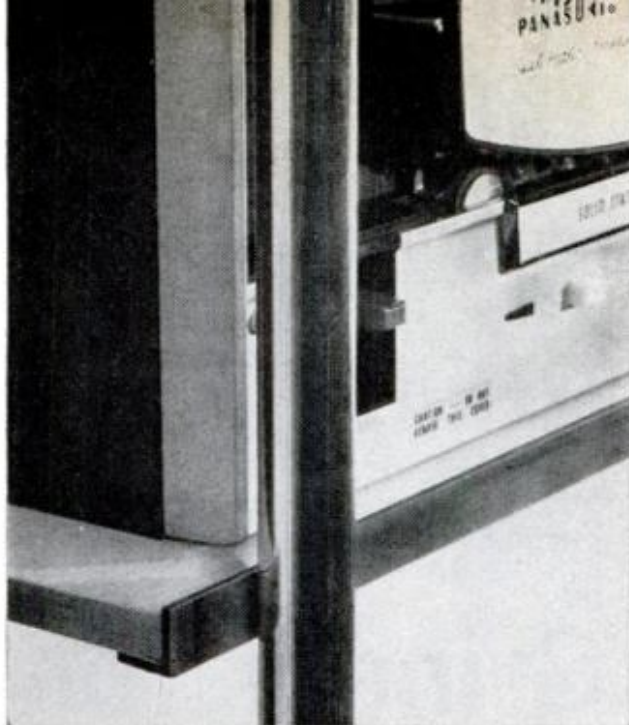
THIS HI-FI RACK is designed to show off your equipment rather than itself. Standing upright, it stacks a lot of gear in a minimum of floor space and puts it out in the open for easy access in making connections and adding or rearranging units. It makes the most of today's smartly styled hi-fi components instead of hiding them behind doors. And it's simple to build.

Basically, the rack consists of tubular aluminum poles for legs with shelves supported between them on aluminum-angle cleats. The tubing is the 1-inch-diameter type made by Reynolds and sold at most hardware stores. The aluminum angle is the $\frac{3}{4} \times \frac{3}{4}$ -inch size, also readily available. You buy the tubing in 6-foot lengths and use them just as they come with no cutting required. The angle is cut into 24-inch sections so you get three even pieces out of each 6-foot length. The shelves are $\frac{1}{2}$ -inch plywood 16 inches

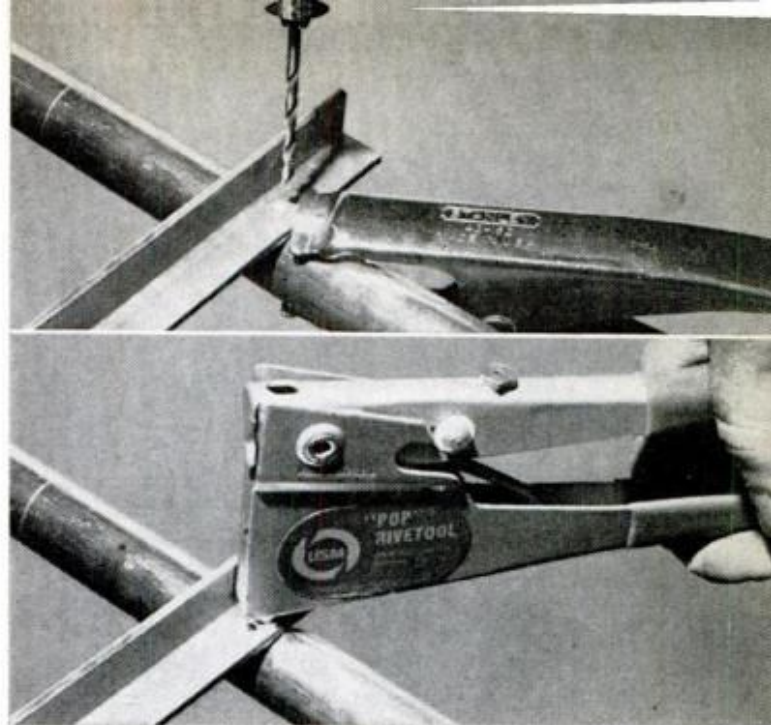
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POPULAR MECHANICS



SHELVES REST IN SIMPLE CLEATS made from aluminum angle. One easy way to fasten the cleats to the uprights is with Pop Rivets, as shown in photos at right. Pilot hole is first drilled in angle, then angle is clamped to the tubing so the hole



serves as a guide for drilling the upright (top). This makes it easy to drill into the curved surface of the tubing. After both holes have been made, rivet is inserted and clinched up tight (bottom). Self-tapping screws can also be used in same way

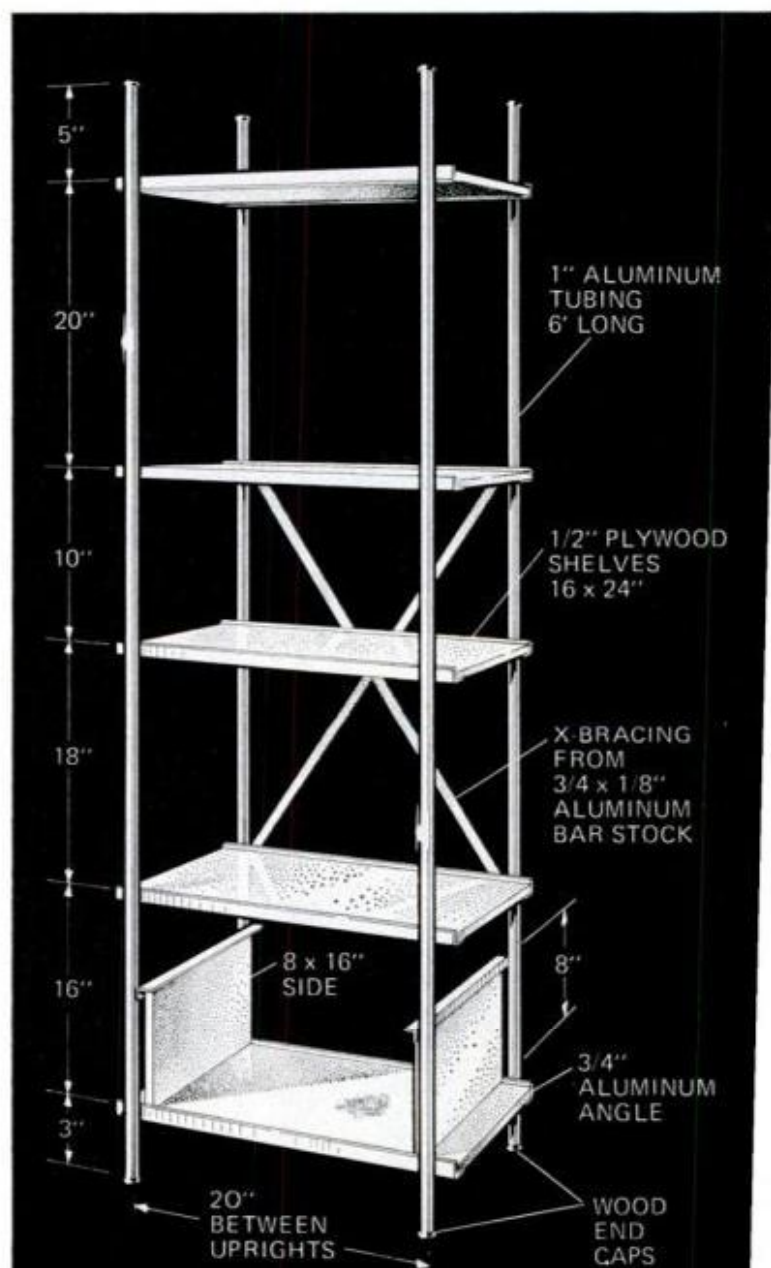
deep and 24 inches long. Allowing for a slight overhang at each side, they provide a 20-inch opening between the uprights—wide enough to accommodate all types of hi-fi equipment on the market.

The aluminum has a modern appearance and blends well with the brushed-aluminum panels and trim used on many current hi-fi components. The shelves can be painted black or white for good contrast or stained walnut to match the walnut enclosures popular today.

In attaching the shelf cleats to the uprights, use either Pop Rivets or self-tapping sheet-metal screws that enter only one side of the tubing. Do not run bolts all the way through the tubing as they will tend to crush the walls as they're pulled up tight and will spoil the appearance. Screw the shelves to the cleats from the underside. This has the effect of locking the front and back sections together so they can't pull apart. Extra strength is added by running crisscrossing strips of flat aluminum between the two rear uprights, forming a rigid X-brace. The shelf spacing shown here was designed around a Panasonic tape deck and receiver, but can, of course, be adjusted to suit the particular equipment you have. Side pieces on the bottom shelf hold stacks of records or tapes. End caps for the uprights can be made from round wooden drawer pulls, or you can use metal caps. ★★★

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A commercial version costs about \$89, but you can ...

Build This Pedestal Grinder for \$40

By R. S. HEDIN

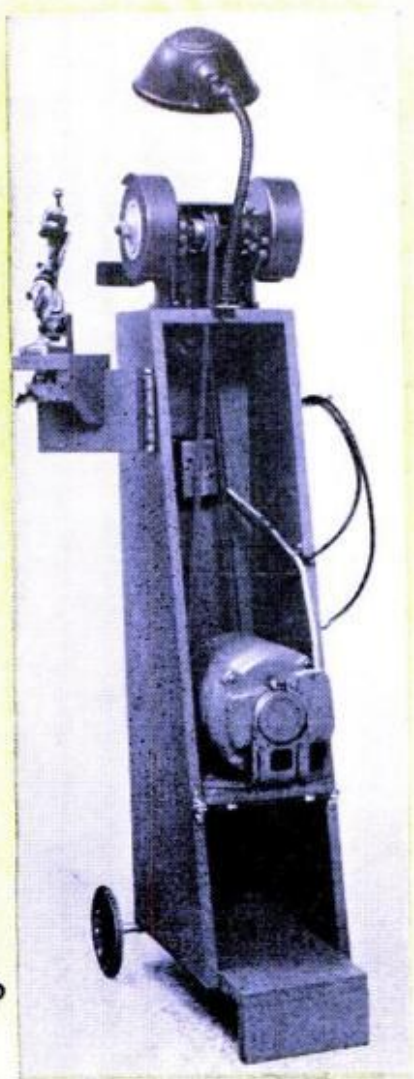
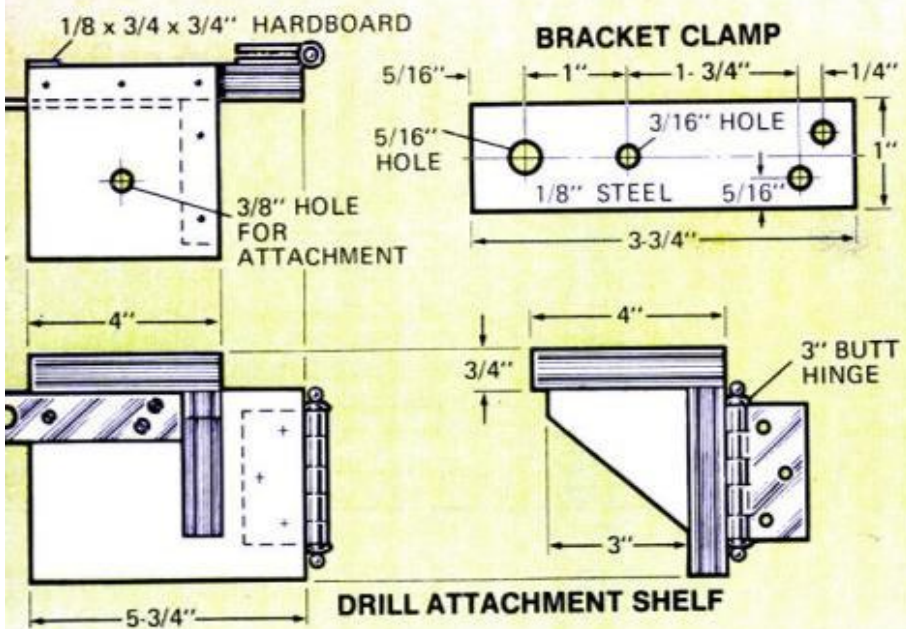
FOR YEARS I had a grinder head and motor mounted on an inconvenient board so, finally, I decided to do something about it. The result is the grinder shown. It can be wheeled around easily and has its own light and a twist-drill grinding attachment (Sears Catalog No. 9H 6677).

For compact design and to permit the motor to be inside the base, the head is driven by a V-belt and motor with what is known as a quarter-turn drive. (The motor pulley is at a right angle to the grinder pulley, thus the belt must be crossed.) The light is actually an old gooseneck desk lamp.

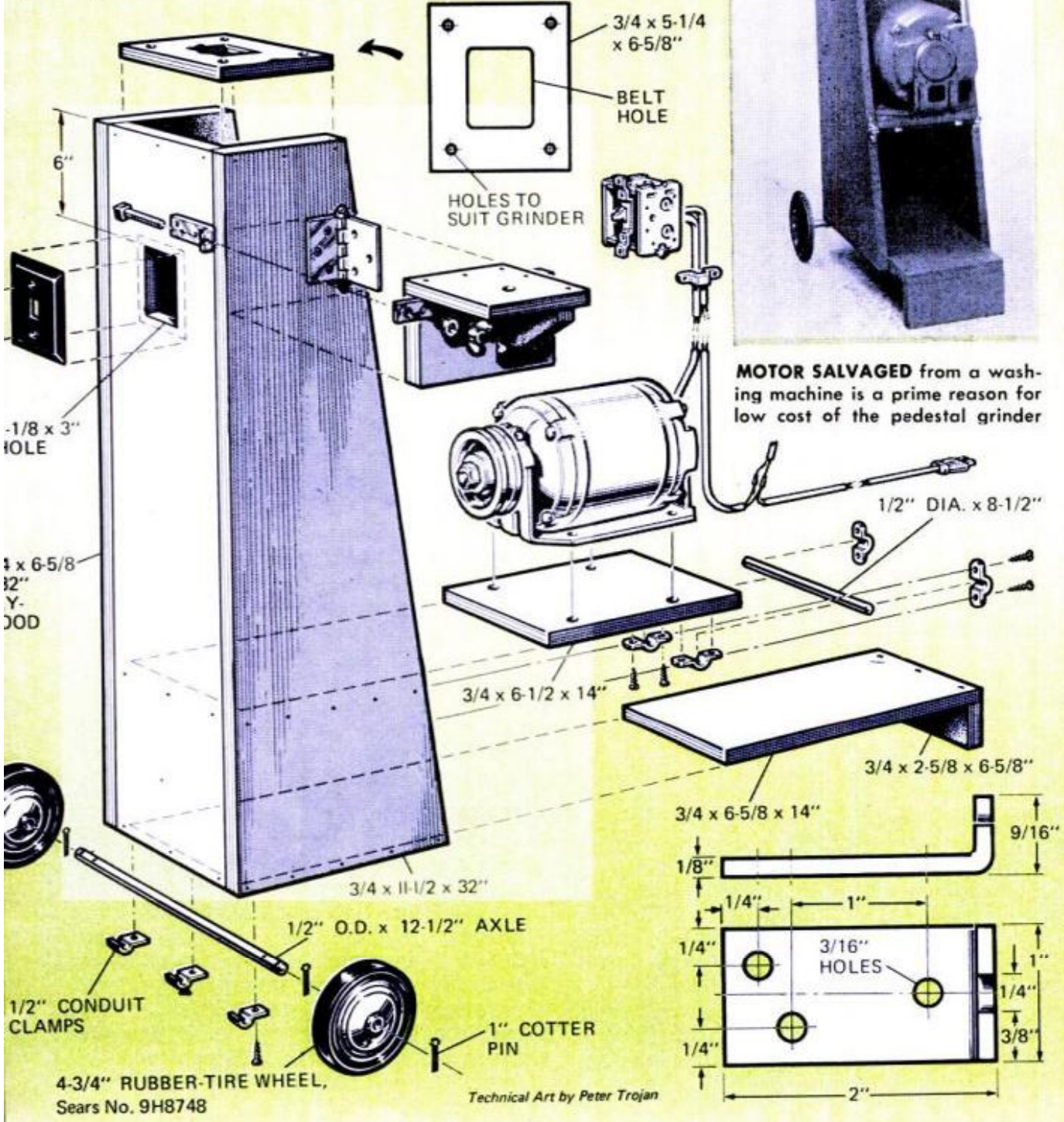
If your grinder head comes with a $1\frac{3}{4}$ or 1-in. pulley, use a 3 to $3\frac{1}{2}$ -in. pulley on the motor. Because of the quarter-turn drive, use a 50 to 60-in.-long V-belt. Locate motor and pivot shaft so that the grinder and motor pulleys are centered over each other.

Use a standard, single-pole wall switch and box in the front of the pedestal. Wire the motor and light in parallel so that they will be turned on together. If the grinder rotation is not correct, simply reverse the lead connections to the motor. ★★ ★

ROLLABOUT GRINDER is easy to wheel around and features a shelf for drill-grinding attachment

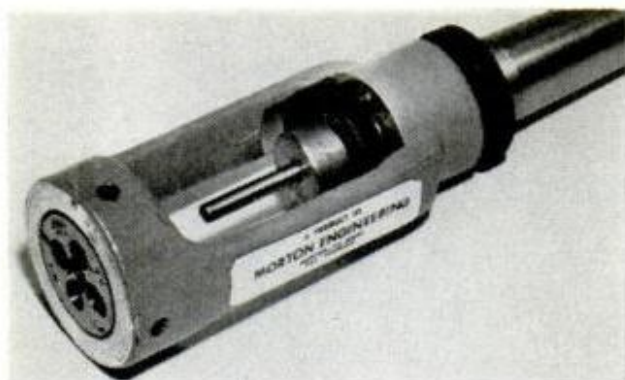


MOTOR SALVAGED from a washing machine is a prime reason for low cost of the pedestal grinder



Technical Art by Peter Trojan

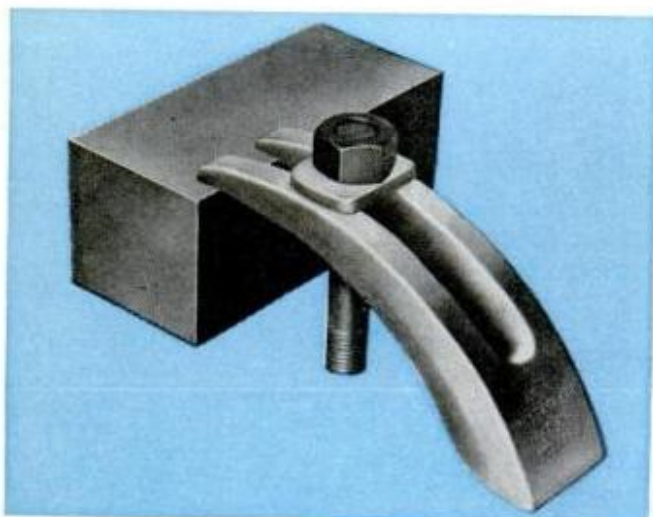
New tools you should know about



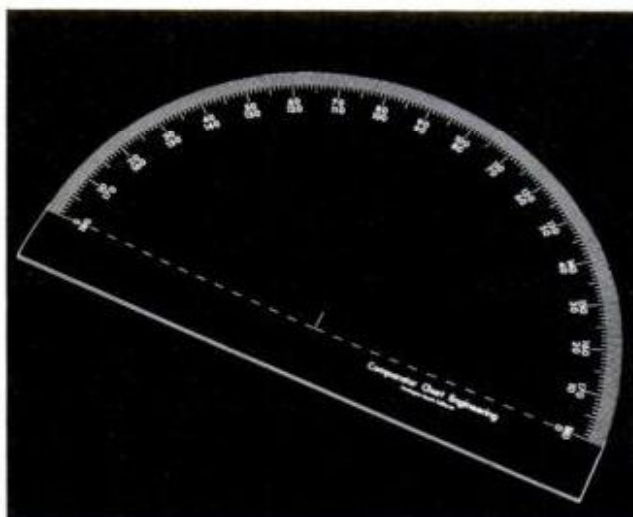
THREAD-CUTTING ATTACHMENT for a lathe tailstock is self-releasing and can be set to release at any length from $\frac{1}{8}$ to $3\frac{1}{4}$ in. For attachment models and dies available and price information, write Morton Engineering, 617 West Jackson St., Morton, Ill. 61550.



POCKET-SIZE TOOLSET is ideal for home craftsmen, repairmen, hobbyists and shopworkers. Palm-size tool has three blades, two sizes standard and one Phillips, to fit a broad range of screw sizes. Of tool steel, it has a full-size handle, grip and ratchet that operates in either direction. Versatool, \$4.95 postpaid. Glen-Bel Enterprises, Route 5, Crossville, Tenn.



HOLD-DOWN CLAMPS labeled Instaclamp are heat-treated and laboratory-tested to have a material yield of over 40,000 psi. The one-piece clamps can be quickly and accurately positioned without blocks or shims. They're available in four sizes at \$4.25 to \$9.85 (include saddle block but not nut and bolt). Instaclamp Co., Dept. PM, Box 26171, Denver, Colo. 80226, is the manufacturer.



CLEAR PLASTIC PROTRACTOR is available with white or yellow markings on .015-in.-thick vinyl, offers advantages to anyone who must work on black or dark-colored surfaces such as machinist layout-dies, photo negatives and the like. Model shown above has 10-in. dia. and reads to 180° . It sells for \$4.95 from Comparator Chart Engineering, Dept. PM, Box 1250, Huntington Beach, Calif. 92647.



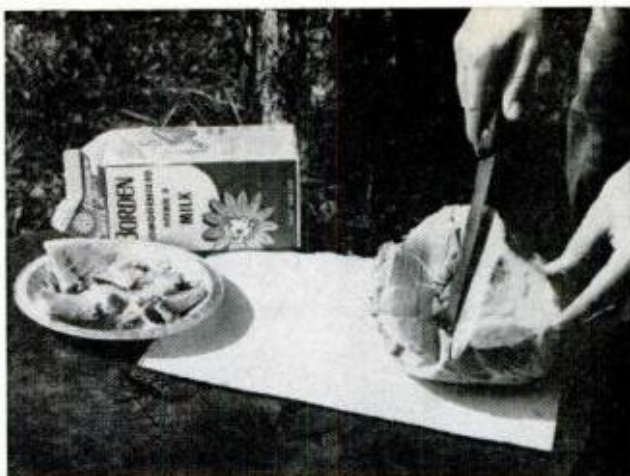
MINIATURE ANVIL is an indispensable aid for fine precision work by jewelers, dentists and the like. The handy-shaped work surface ($\frac{3}{4}$ in. wide x $3\frac{3}{4}$ in. long) can be used for flattening, bending or other shaping of small parts. Standing about $2\frac{1}{2}$ in. high overall, its round horn tapers to $\frac{3}{32}$ in. dia. Anvil of forged, hardened, tempered tool steel has a black-enameled, cast-iron base about $2\frac{7}{8}$ in. in diameter for stability. Price, \$8.10. Brookstone Co., Dept. C, 7 Brookstone Building, Peterborough, N.H. 03458.

HINTS FROM READERS

Carton doubles as cutting board

Save those empty milk cartons for your next camping trip. Split open and flattened as shown, the heavy waxed cardboard is a fine surface for cutting meat and cleaning fish, also helps to keep food preparation sanitary. If the cartons are split at home, they take up little space with camping gear. After use, burn the cartons.

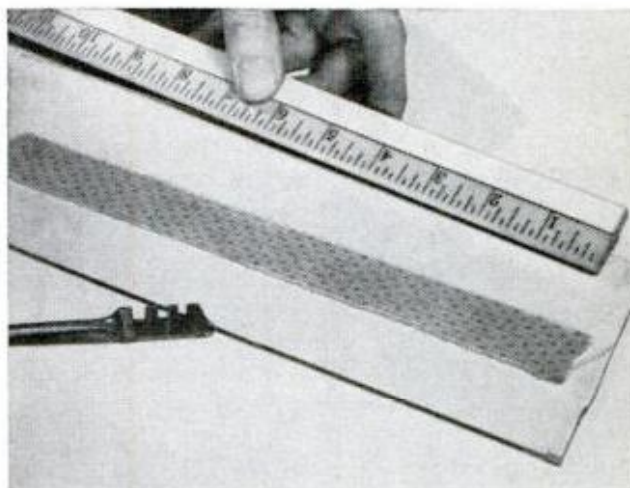
—John Krill, North Lima, Ohio



Moist cloth holds straightedge

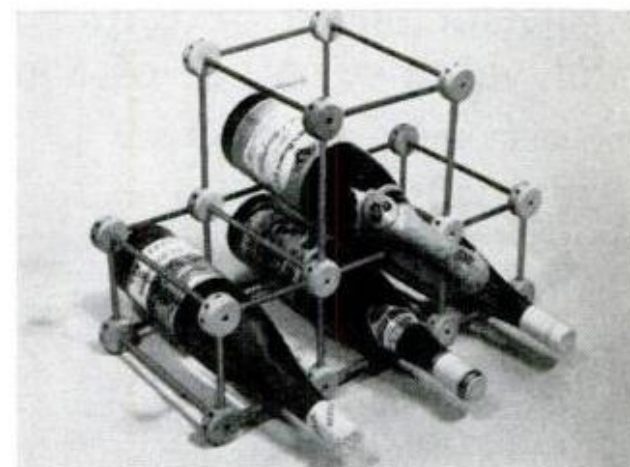
Recently when I used a straightedge to cut some glass, it slipped and caused a wasted pane. Then I found that a strip of moistened cotton cloth (muslin) beneath it helped hold the straightedge in place. Dampen the cloth and apply a firm downward pressure on the straightedge while running the cutter along it.

—Walter E. Burton, Akron, Ohio



Wine rack made from toy

This novel wine rack was assembled entirely of parts from a discarded Tinkertoy set. Make it any size you want, and, when you're satisfied with the design, the rack can be glued for extra strength. An easy way to a good-looking finish is to use spray lacquer that comes in an aerosol can.—T. C. Sanders, Palo Alto, Calif.



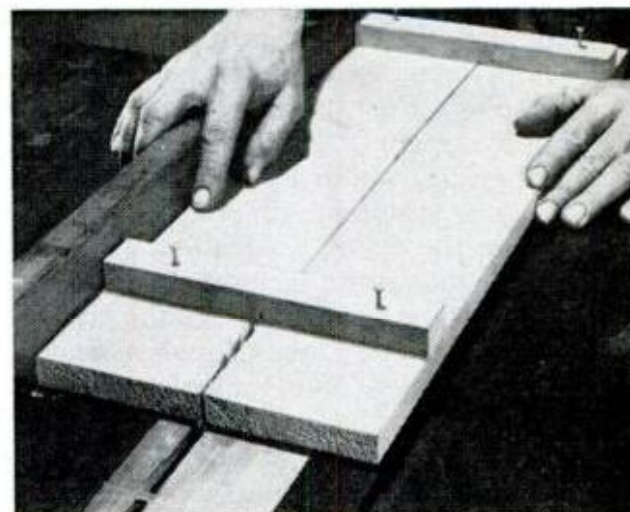
Increasing use of drive sockets

To use a $\frac{1}{2}$ -in. drive socket where space is limited, form a square from a $\frac{1}{16}$ -in. sheet-metal strip approximately $\frac{1}{2}$ -in. wide. It will fit over a $\frac{3}{8}$ -in. drive ratchet and into the $\frac{1}{2}$ -in. drive socket wrench cavity. Same trick could be applied to a $\frac{3}{4}$ -in. drive socket using a $\frac{1}{2}$ -in. drive ratchet and $\frac{1}{8}$ -in. metal.

—Walter J. Wozniak, Allen Park, Mich.

Preparing boards for edge-gluing

A foolproof way to insure perfectly matched edges when edge-gluing is to rip the boards (to be joined) simultaneously. Use two cleats to hold the boards and set the rip fence so that the blade will make the cut through the center of the joint. Use a sharp planer blade and you'll eliminate sanding.—Courtlandt L. Kites, Jr., East Longmeadow, Mass.



'Instant' Family-Room Theater

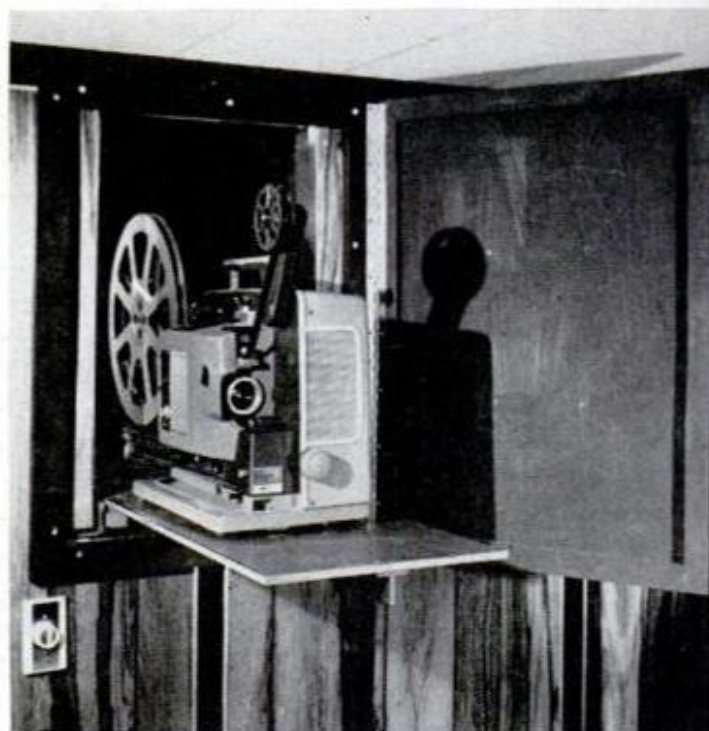
Projector and a 5x10-ft. screen are always ready for use, and yet they're out of sight at the flick of pushbuttons

By HARRY WICKS, Workshop Editor

Color Photos by Robert D. Borst

IT'S SAFE to assume most homeowners will agree something should be done to get better use from a typical cavern-like, unfinished basement. And frequently—as was the case with the Fred Entmans of South Orange, N.J.—agreement can end there. In this instance, Fred wanted a professional-quality home “movie house” while his wife’s vote was for a family room for entertaining.

Using the design concept shown here, they *both* won. Being a partner in Network Cinema Corp. (Jerry Lewis Cinema Nation-Wide chain) didn't exactly hurt Fred when he was in the planning stages. Using the automation theme of the theaters in the chain, he decided he would be able to conceal his movie equipment from sight (and inquisitive young hands) when it was not in use. Thus, when the room is needed for entertaining, he simply pushes a couple of buttons and the 5x10-ft. screen is concealed by vertical polyvinyl blinds and the projector



PROJECTOR rolls in, is hidden by door when not in use. Dimmer switch is for operator's convenience

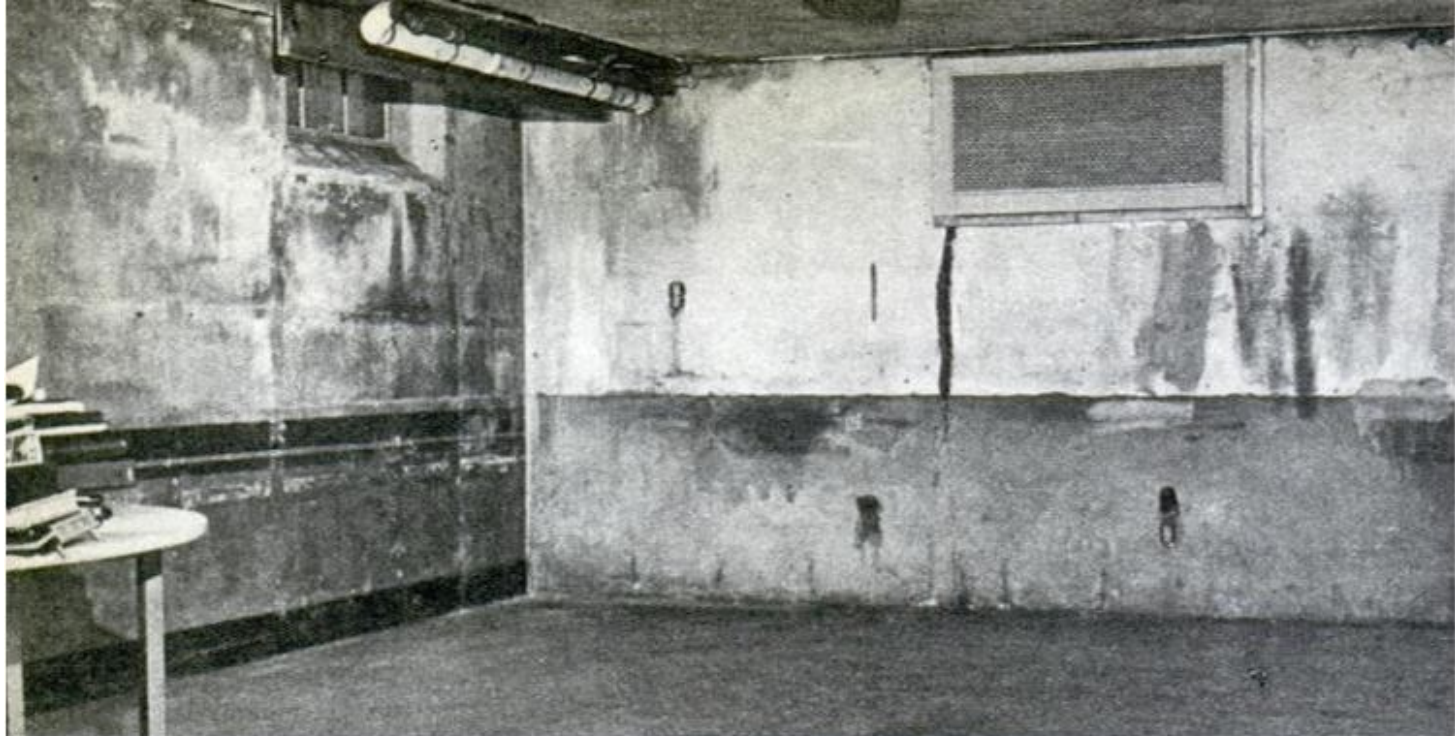


AUTOMATION BY CARLTON KLEIN ASSOCIATES

MINI THEATER (above) built in homeowner's basement, was inspired by Jerry Lewis Cinema automated movie house. For family-room use, a Brunswick pool table becomes the fun center of the room (below)



© 1970 by Carlton Klein Associates



BEFORE: The typical basement wasted valuable floor space, was used only as a collection point for junk before it was discarded. Wall (above) is now covered by the projection screen shown on preceding two pages

rolls back into the wall. When he wants to show movies or slides, he reverses the procedure; the screen opens, the sound comes on, the house lights dim and he sits down to comfortable viewing.

Needing all the space he could get for a family room, Entman simply built out one wall deep enough to receive the pro-

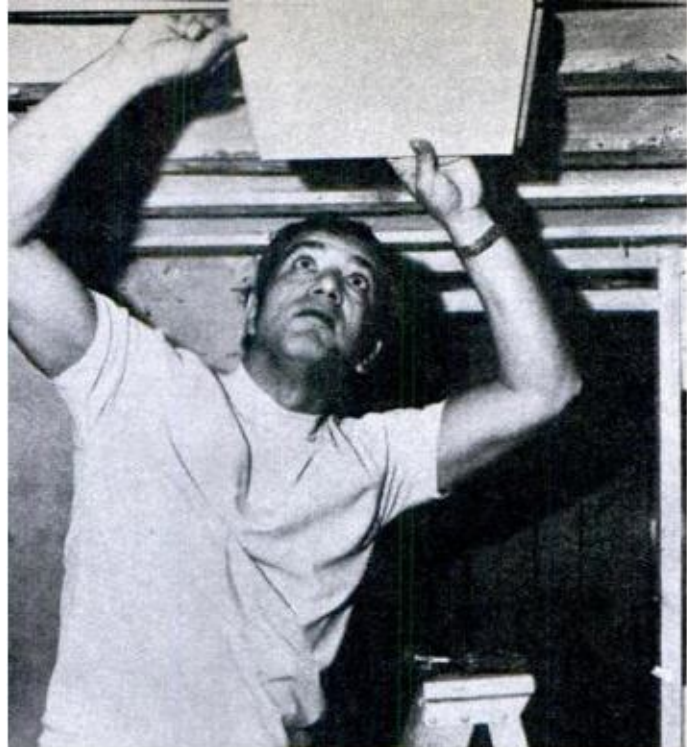
jector (page 148). If you have the area, you could utilize the concept shown in the drawing (opposite page) to keep projector noise out of the viewing room and provide space for storage of film and other movie equipment.

The Weldwood Rosewood paneling was framed with anodized gold moldings and

FURRING STRIPS were applied vertically, nailed to foundation wall and faced with decorative laminate

ROSEWOOD PANELS were installed next using adhesive, brads, metal edge molding. Note black furring





CEILING was furred using 1x3-in. stock. The finish ceiling is conventional 12-in. square tiles



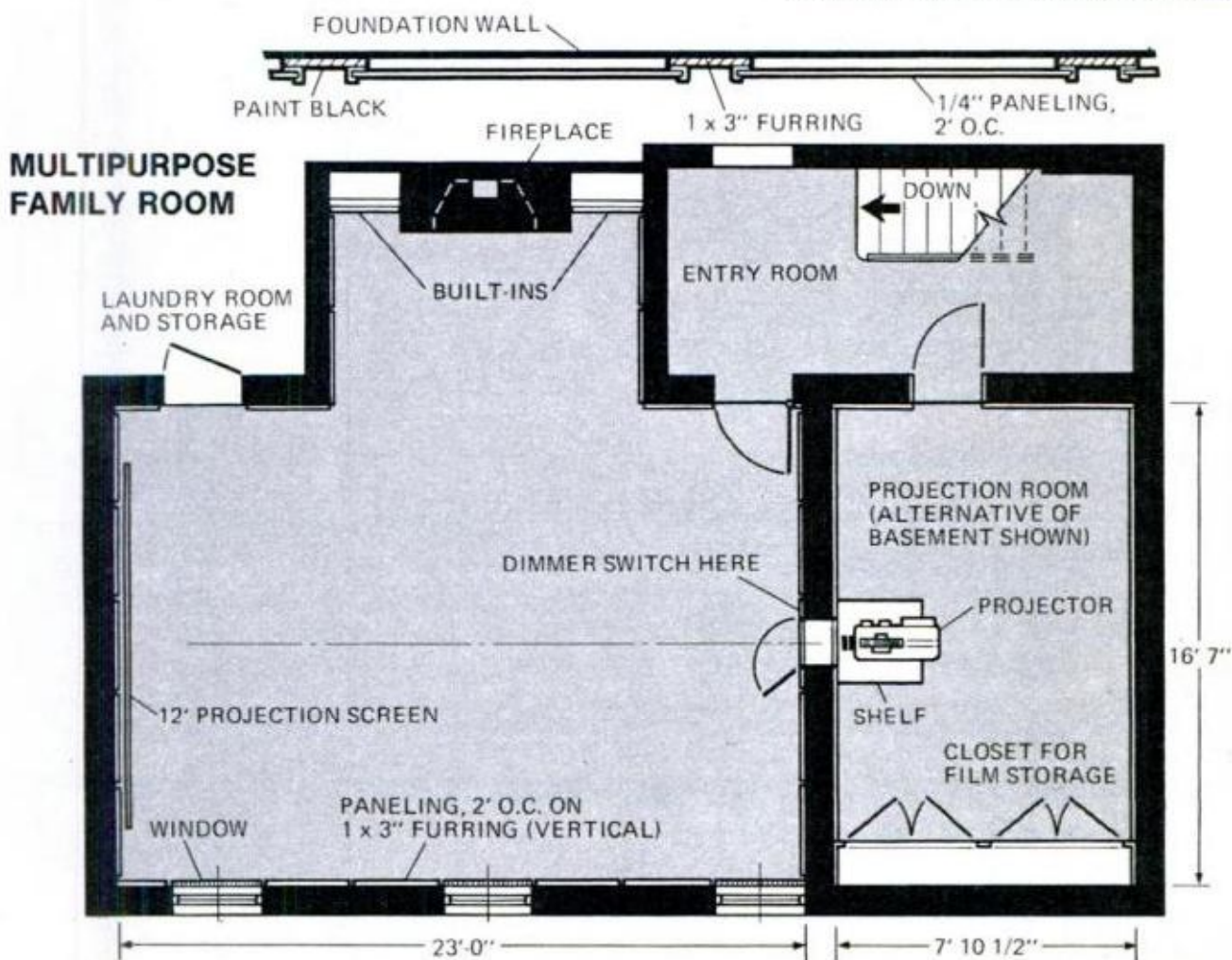
WALL-TO-WALL CARPETING adds touch of elegance. For practical reasons, carpet should be of washable type

positioned on Formica-covered furring strips. (If you prefer, for economy, simply paint the furring with semigloss enamel.) To finish, flush high-hat lights were in-

stalled in the ceiling, then the ceiling was tiled and the floor carpeted. What was wasted space has been converted to "two" rooms in one. ★★★

FLOOR PLAN (below) shows an optional layout with a projection room. If your prime concern is movie and slide viewing, booth hushes projector noises, creates pleasanter screening room. If the room is to be used primarily as a family room, move the booth wall back and recess projector as this owner did

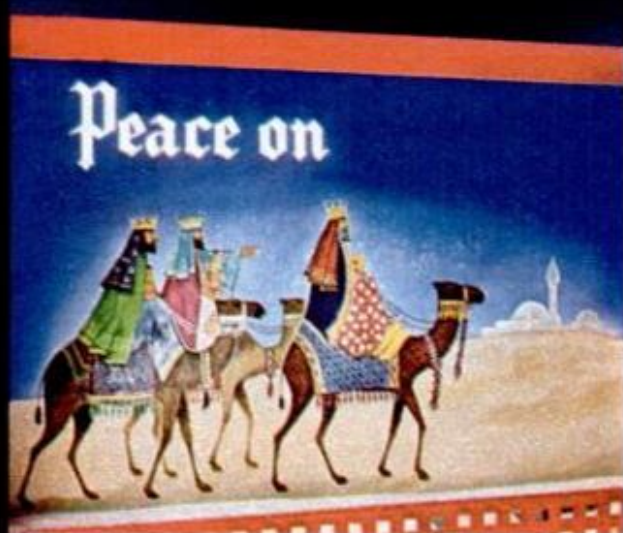
ARCHITECT: MALLIA RONDINONE ASSOCIATES



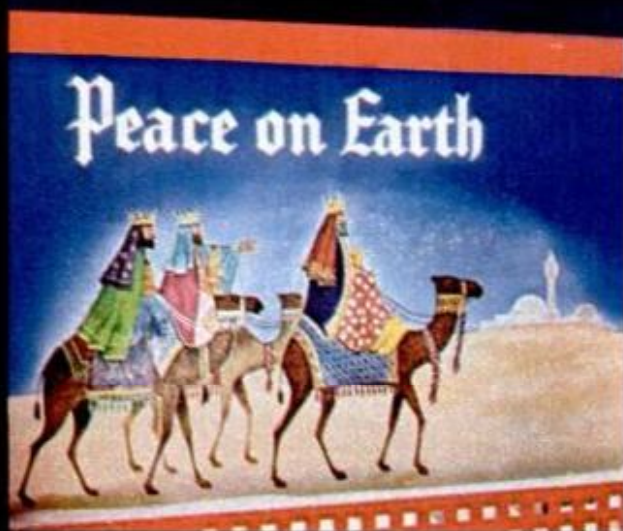
This Christmas Wish



IN RUNNING SEQUENCE, word *Peace* lights first . . .



FOLLOWED BY THE WORD *on*, then *Earth* (below)



PM's colorful electric yard display flashes a Yuletide greeting in running sequence.

By WAYNE C. LECKEY, Home and Shop Editor

Photos by Robert D. Borst

EVERY TEN SECONDS this home-built electric greeting wishes passersby *Peace on Earth*. First the word *Peace* lights, then *on*, then *Earth*, followed by the star of Bethlehem and finally the Three Wise Men. After a one-second blackout, the sequence repeats and the lights continue to go on and off as long as the "greeting card" is plugged in.

Nine 25-w. incandescent lamps are used to light the display and are switched on and off by a home-built timer. The latter consists of a 6-in. disc attached to the shaft of a 1-rpm motor. Circular lands on the face of the disc depress five refrigerator-door switches in a staggered sequence as the disc turns.

The display is built around a 4x6-ft., full-color poster of the Three Wise Men which you can buy for \$2.50 from U-Build Enterprises, Box 2383, Van Nuys, Calif. It comes in two sections which you match like wallpaper when gluing them to a plywood panel.

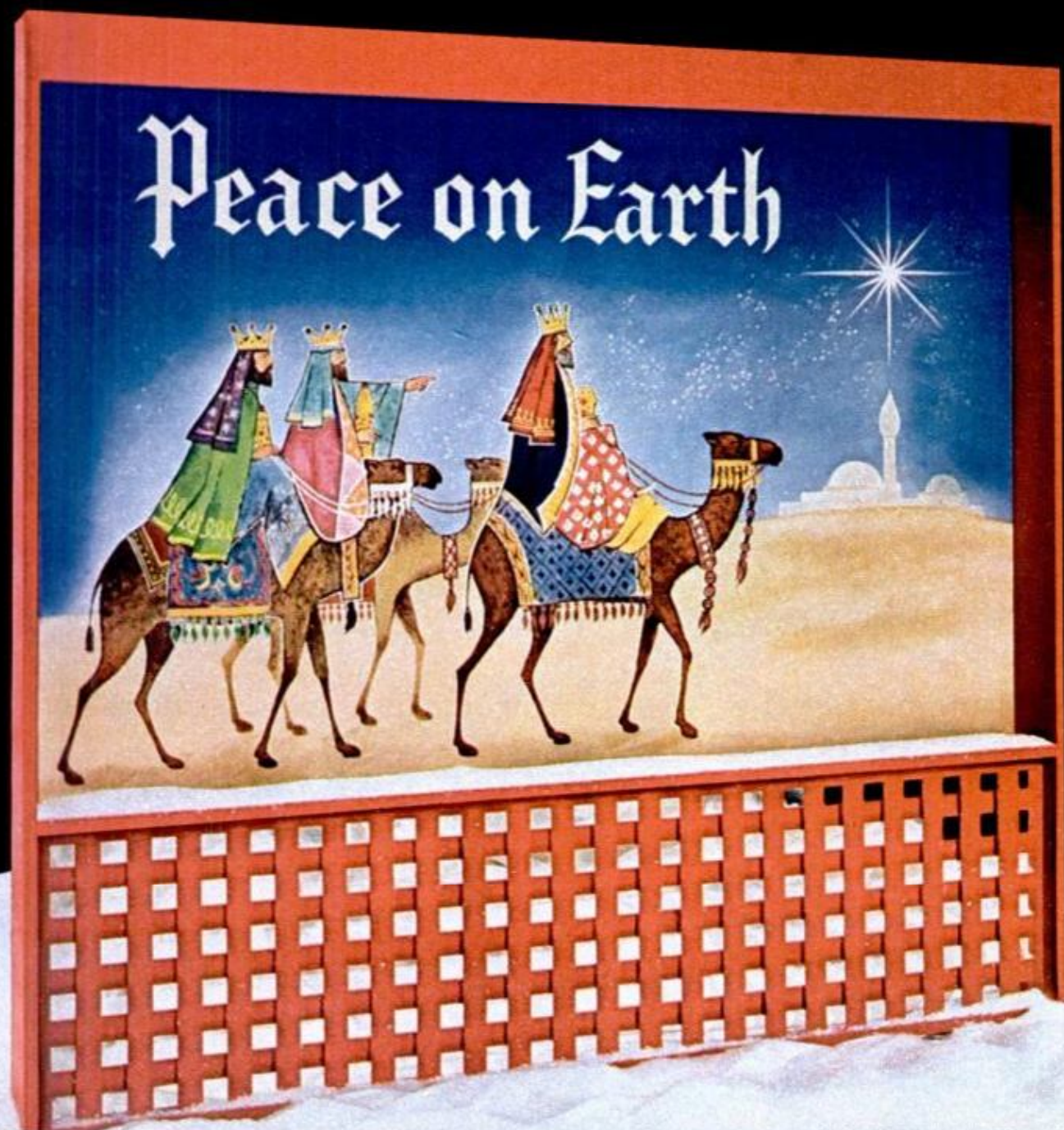
The star and the words *Peace on Earth* are jigsawed in the 3/8-in. panel. This is done by first sawing a hole in the plywood and then cutting four separate snug-fitting pieces to refill the hole. Saw the hole on your table saw by raising the blade up through the plywood and run the panel along

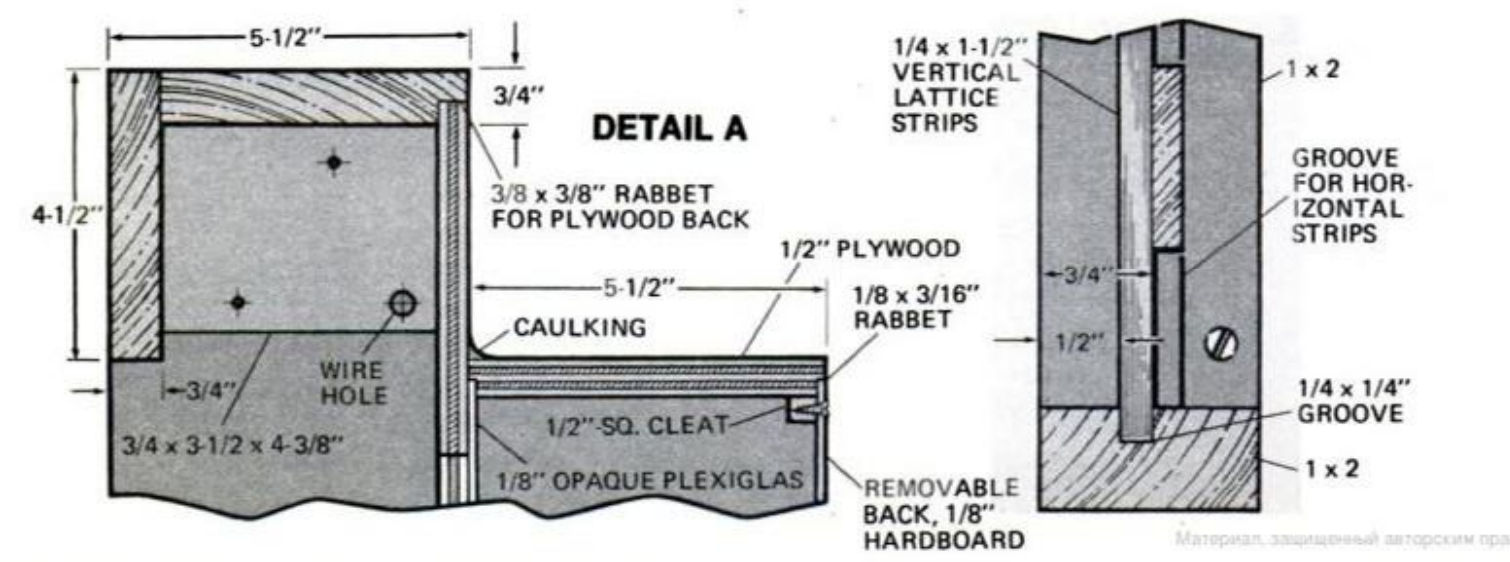
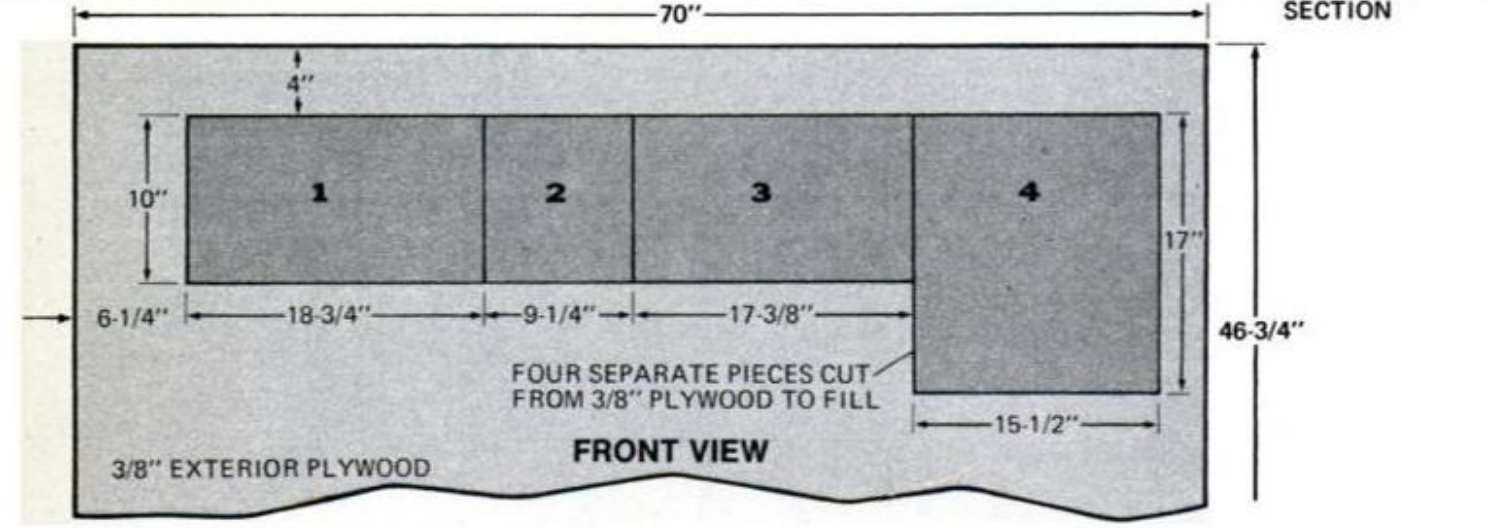
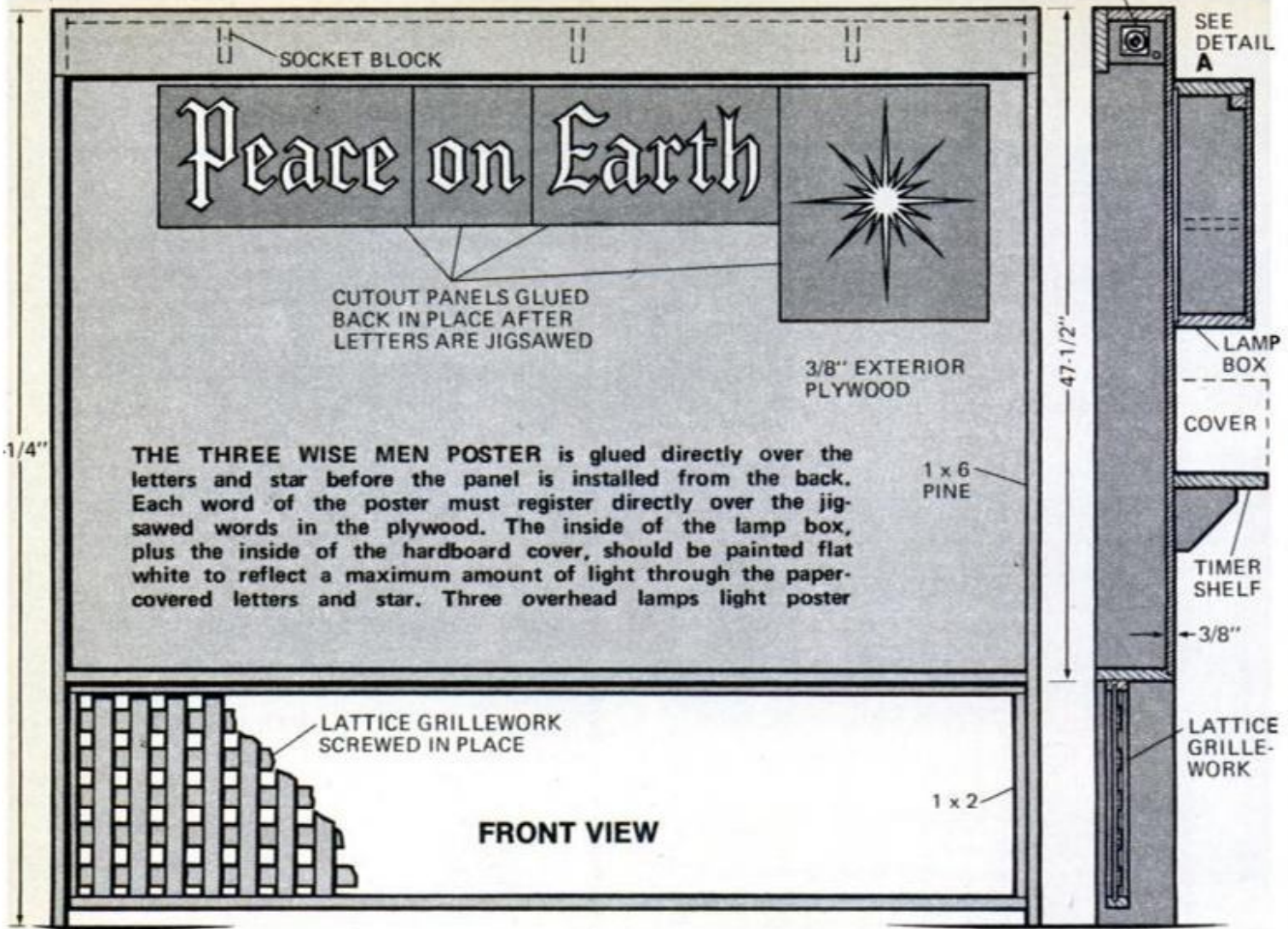
SET UP IN YOUR YARD, this colorful billboard greeting card (right) spells out the meaning of Christmas through its flashing message.

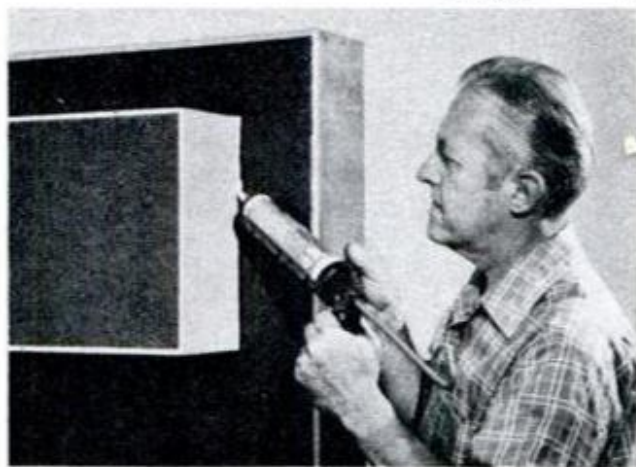
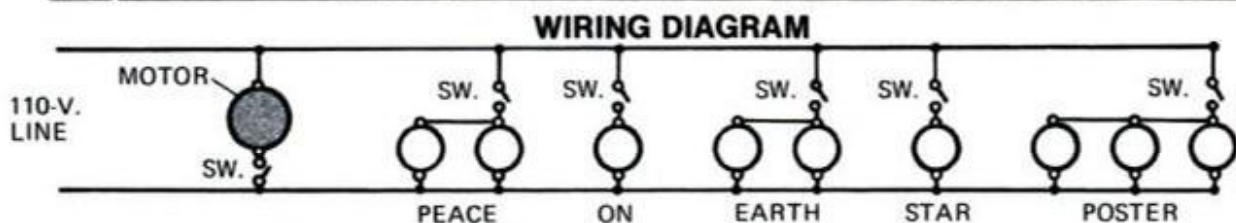
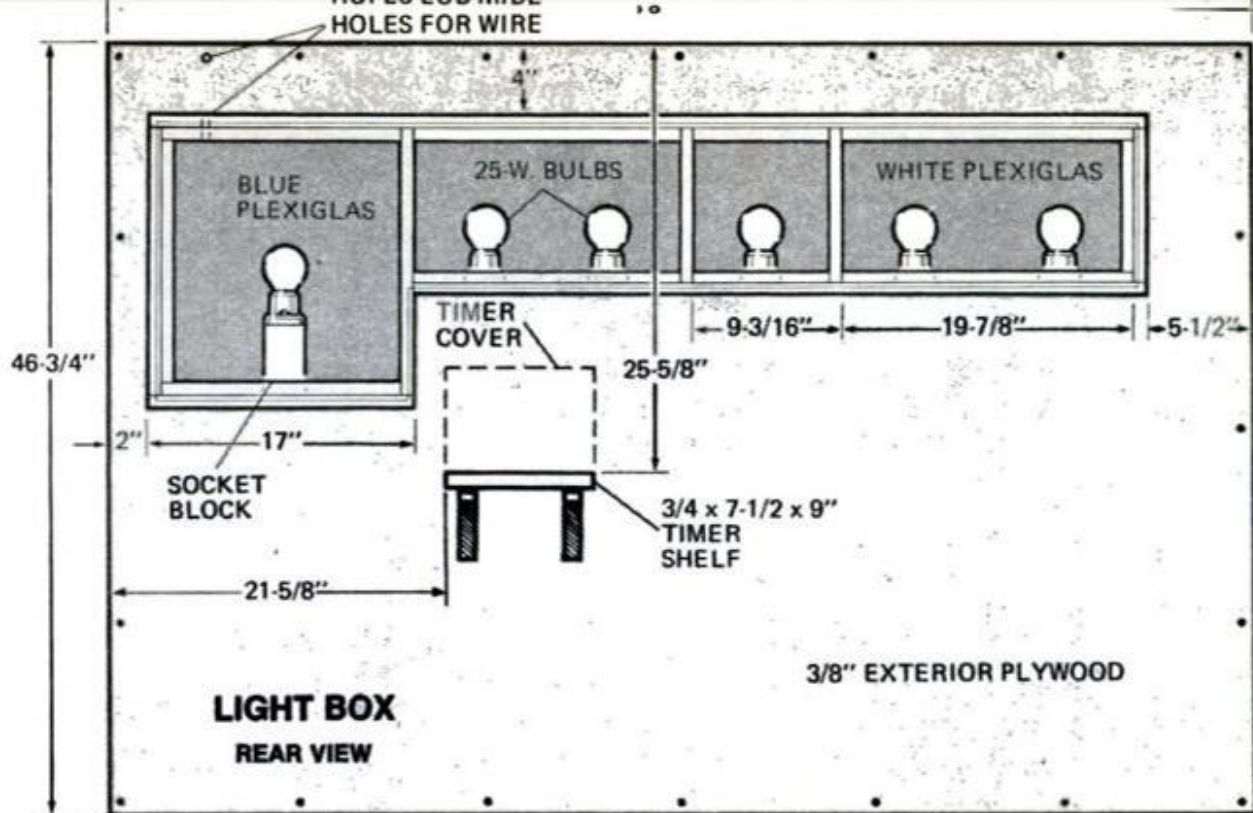
the World PEACE

the fence to make straight cuts. Make a pattern of the poster lettering and star by laying tissue paper over the original and tracing. The tissue pattern is used with carbon paper to transfer the words and star to the four plywood inserts. After jigsawing, the four pieces are glued back into the hole. The center pieces of jigsawed letters E, A, O and P are saved and later glued to the back of the poster paper. The lettering in the poster is not cut out; the light shines through the paper.

Next, make the four-compartment lamp box. Single bulbs light the star and the word *on*, two bulbs light the words *Peace* and *Earth*. Three overhead bulbs installed across the front of the billboard greeting card light the poster. Front and back edges of the light box are rabbeted for 1/8-in. Plexiglas and hardboard panels. After cementing the plastic in the rabbeted edge, the light box is glued to the rear side of the 3/8-in. plywood. This is done by placing the plywood face





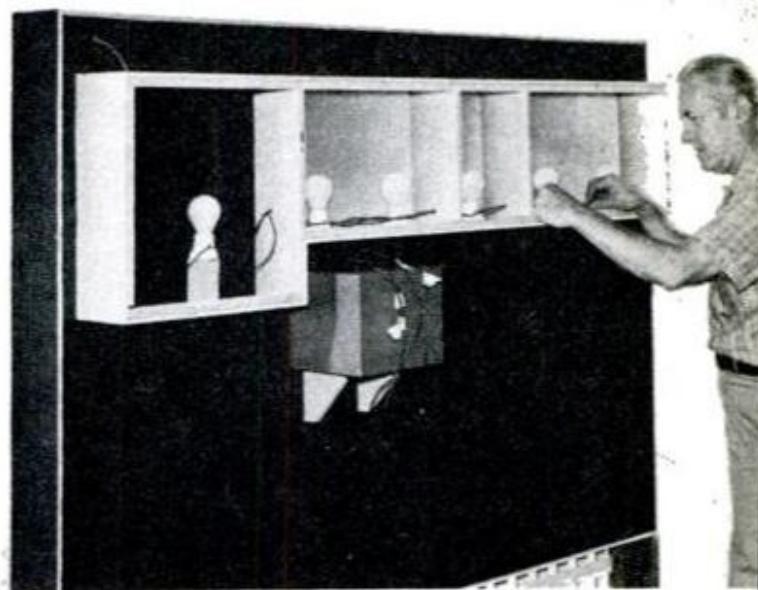


LAMP BOX is made watertight by caulking the joint between the box and the back panel as shown above

COMMON LAMP CORD with twin wires peeled apart is used to hook up all nine sockets to timing switches

down on the floor and weighting the lamp box with heavy objects while the glue dries. Notice that the plastic side of the lamp box is placed against the cut-out lettering. Use a water-resistant glue such as Weldwood Resin. The shelf for the timer can be made and glued in place while the plywood is on the floor. Finally, the lamp box is caulked where it joins the plywood to make it watertight.

The supporting frame for the poster is



made from 1x6 pine and the grille is assembled from lattice stock and 1x2s. Notice that the rear edges of the 1x6s are rabbeted for the 3/8-in. plywood, and that three blocks are installed across the front for mounting the sockets for the overhead lights.

Finally, the poster is glued to the plywood. Use a water-resistant glue for this and apply the glue to both the wood and

(Please turn to page 208)

FROM PM'S WORKSHOP

An Early American Server With a Secret

Designed in our own shop for you to duplicate, this handsome period piece features new 'trackless' bypassing doors that are flush when they're closed.

By HARRY WICKS, Workshop Editor

*Photography by Robert D. Borst
Shop Consultant, John E. Gaynor*



THIS PM VERSION of an Early American server is a handsome piece of furniture that offers well-organized storage space and occupies little floor area. It has that look of old-world craftsmanship you can duplicate if you follow our use of advanced techniques and materials.

Easy to build with power tools, the cabinet offers these advantages:

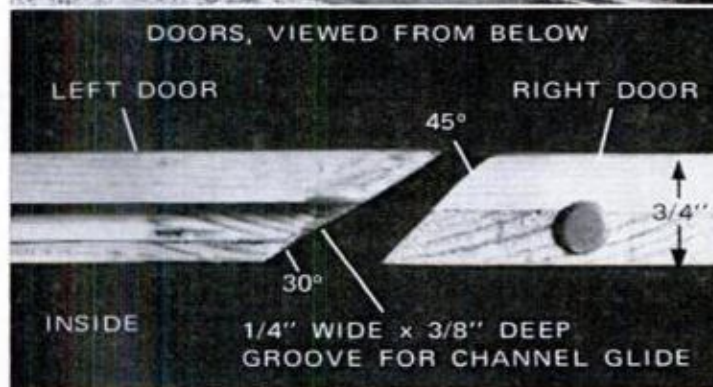
- Plaques "carved" of plastic look, and can be worked, like real wood.
- Hardware for bypassing doors is concealed (there's no bottom track to clean out) and places the doors in a flush position when they are closed.

In building the prototype, we made sure that all door stiles and rails would reveal

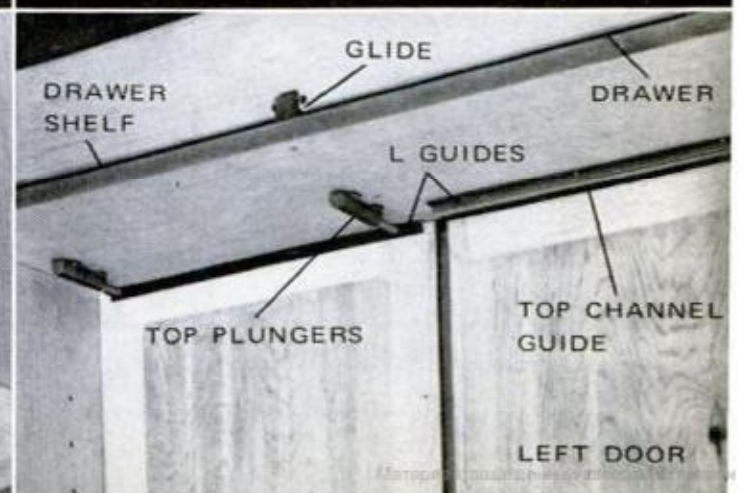
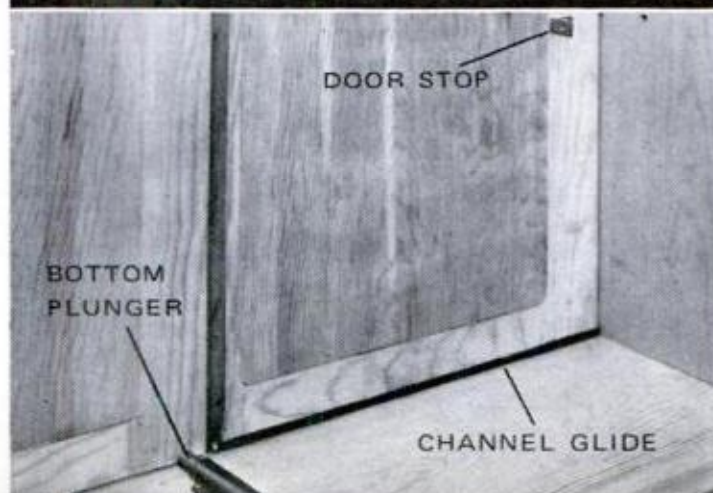
2 in. (in closed position). Thus, you'll notice in the drawing that these sizes vary because of the bevel cuts and the cabinet stiles and rails.

The cabinet. To start, cut all pieces to size. They'll make quite a pile, so label each piece lightly with a soft pencil for easy identification later. Make certain that you kerf the underside of the drawer shelf before you go farther. This kerf is needed for the top rail and, should you forget it, would be a time-consuming task by hand after the cabinet is assembled.

It is good practice to tack the pieces together temporarily, using diagonal braces on the back to keep it in square. When satisfied with cabinet fit, you can assemble the drawer and doors using the cabinet



How the hardware works . . .
SLIDING DOORS bypass with the left-hand door (facing the cabinet) always remaining in front, no matter which door is moved. Bottom view of doors (left) shows a groove needed for the track that goes on left door. A plunger (below, left) and guide pin (not visible) are only hardware in the cabinet bottom. Left door slides on the pin, corner brace acts as a stop. Bottom view shows shelf bottom and hardware mounted in cabinet and on doors. Glide on shelf is for the drawer

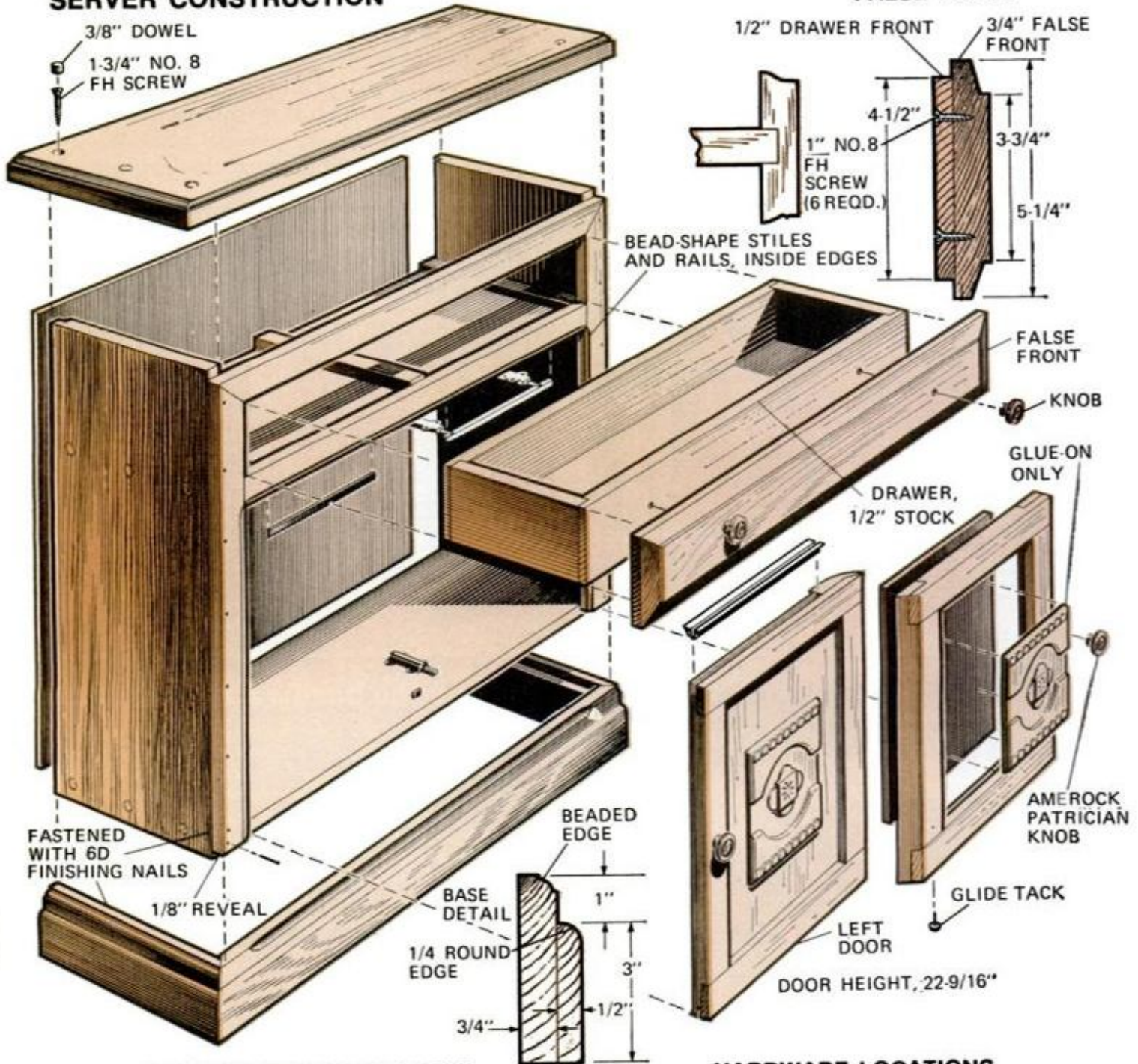


for final determination of their measurements.

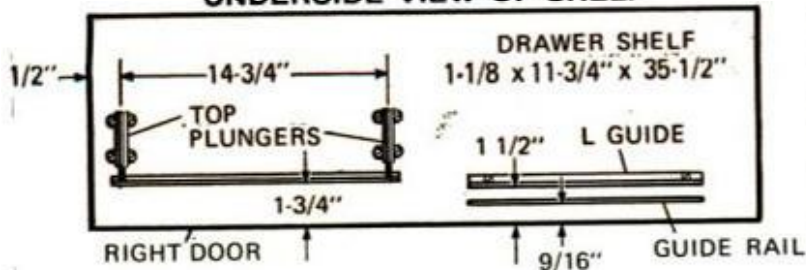
The drawer is simply a box made of 1/2-in. pine. Because it is shallow, 1/8-in. hardboard is adequate for the bottom, which is let into dados. The false drawer front is 3/4-in. pine, and with the saw blade set as shown on page 161, the raised panel is quickly made. Bevel ends first, then cut the lengths.

The doors are a little trickier, mostly because of the varying stile and rail widths. Thus, shop consultant John Gaynor and I found it easiest to lay out both doors on the workbench and, after marking, ship-lapping one stile or rail at a time. The 1/4-in. plywood panels are let into a rabbet; the decorative plaques, glued to the fronts, are of molded plastic. Because the hardware will not permit a door thickness

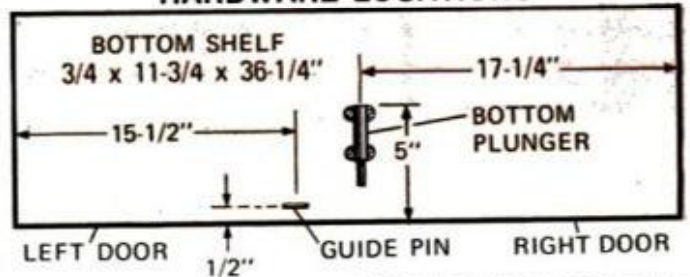
SERVER CONSTRUCTION

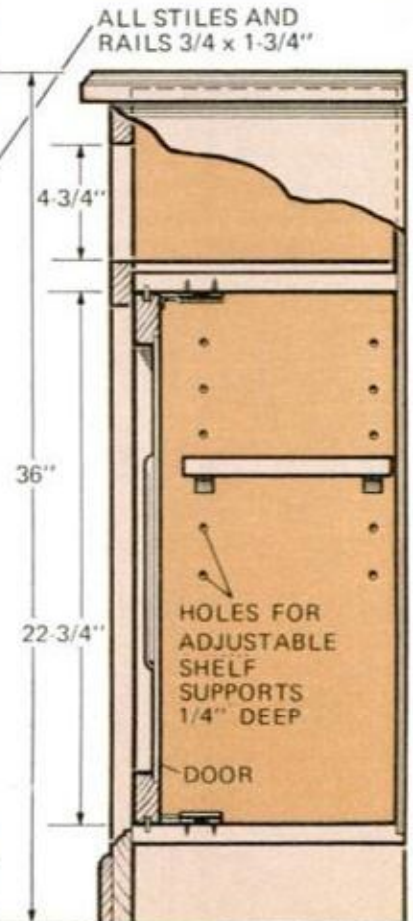
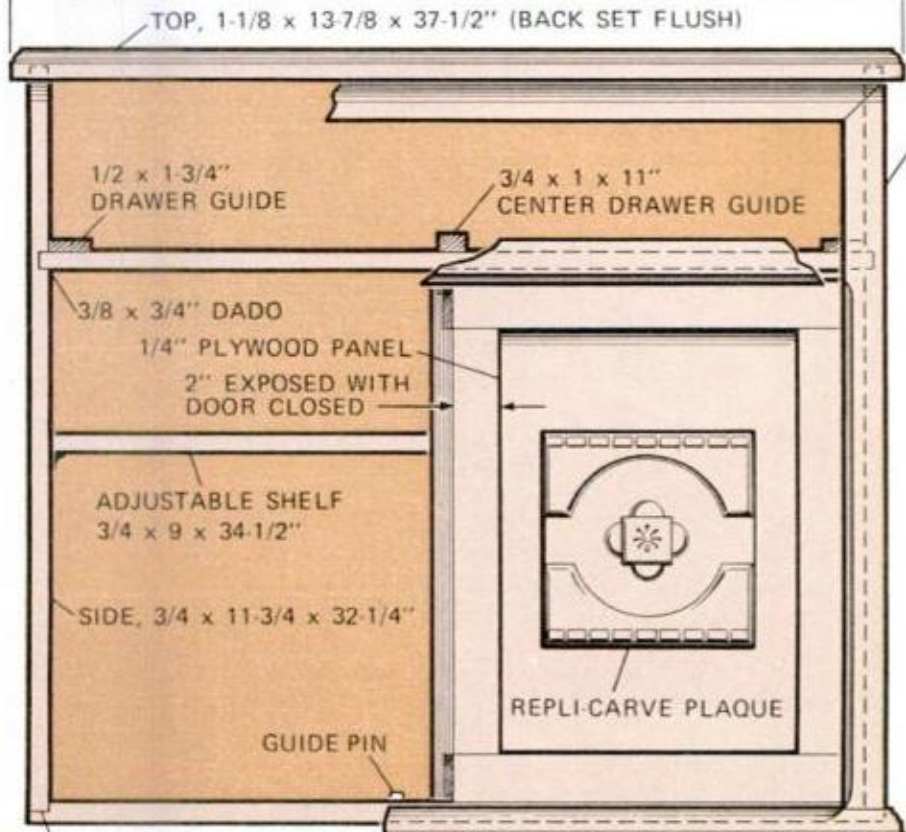
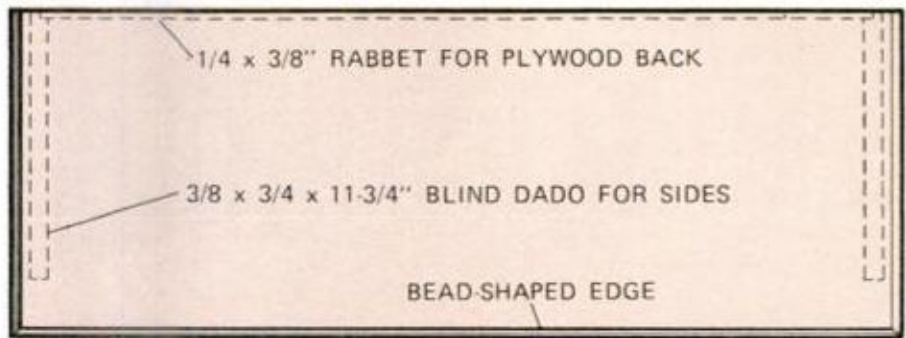
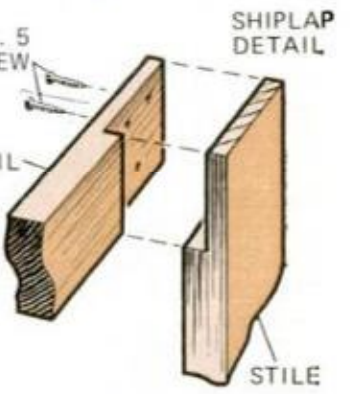
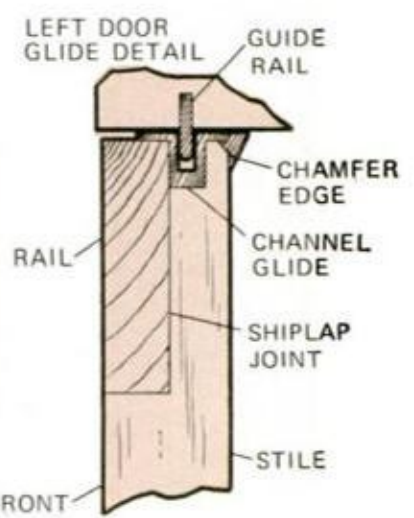
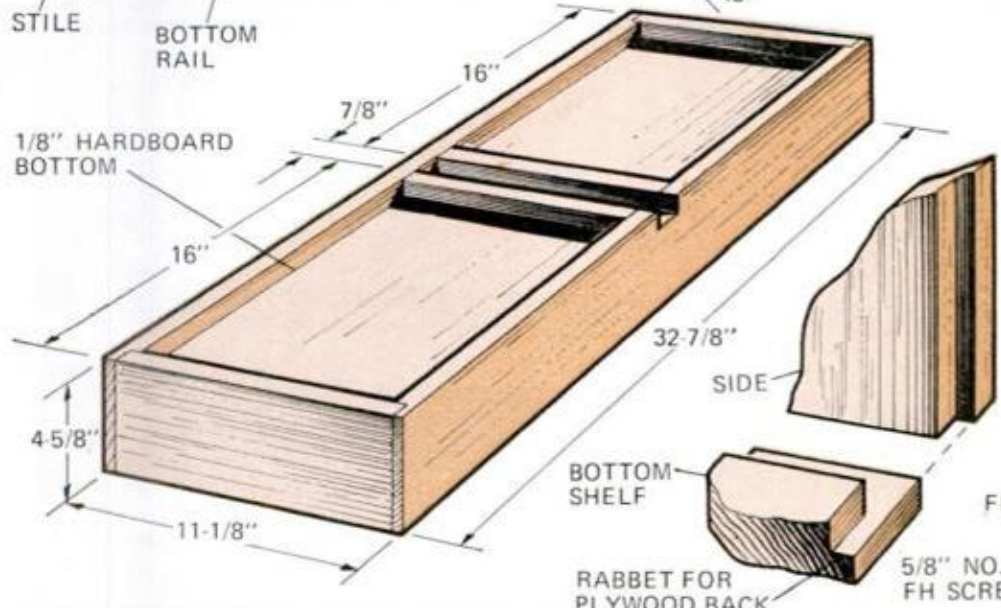
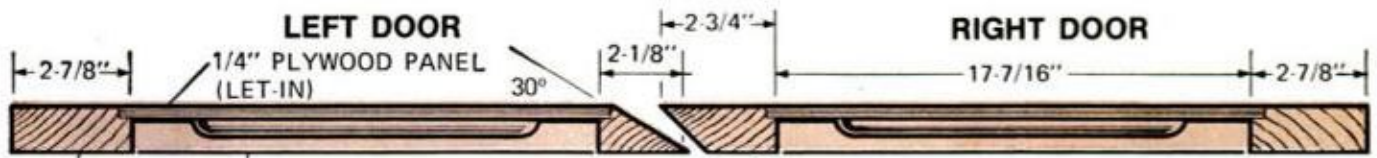


UNDERSIDE VIEW OF SHELF

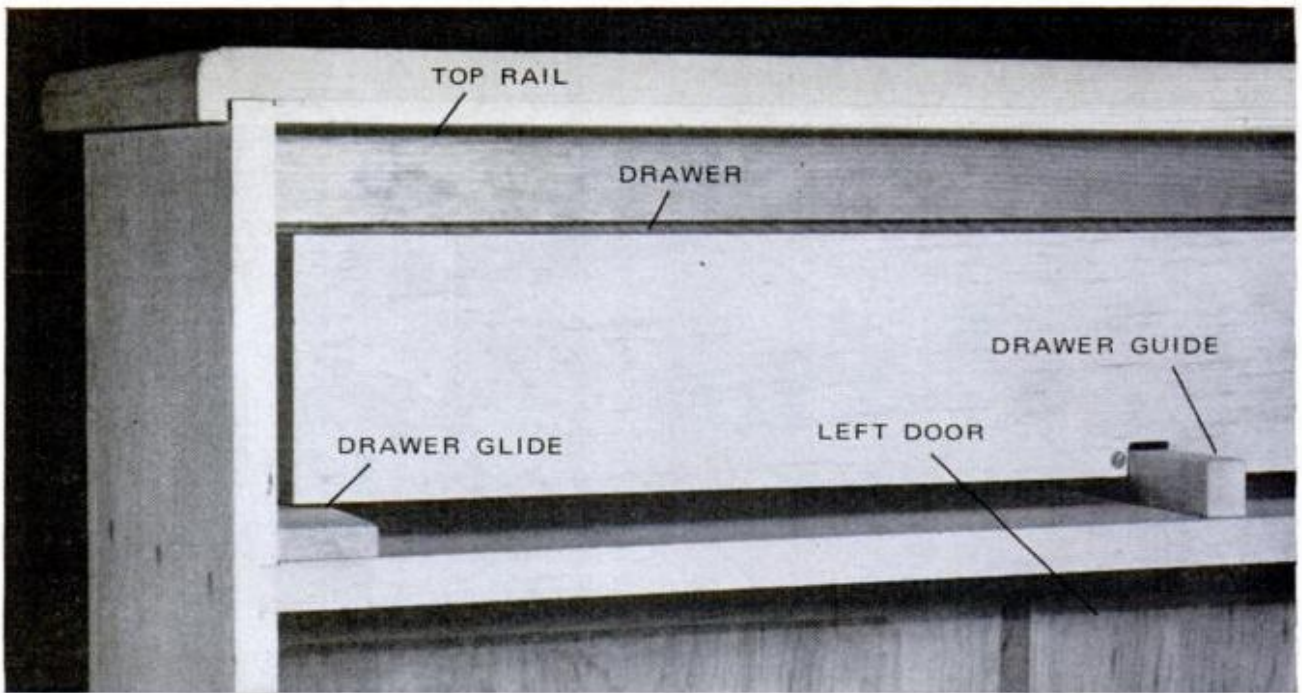


HARDWARE LOCATIONS





3/8 x 3/4" EDGE RABBET
 Technical Art by Fred Wolff



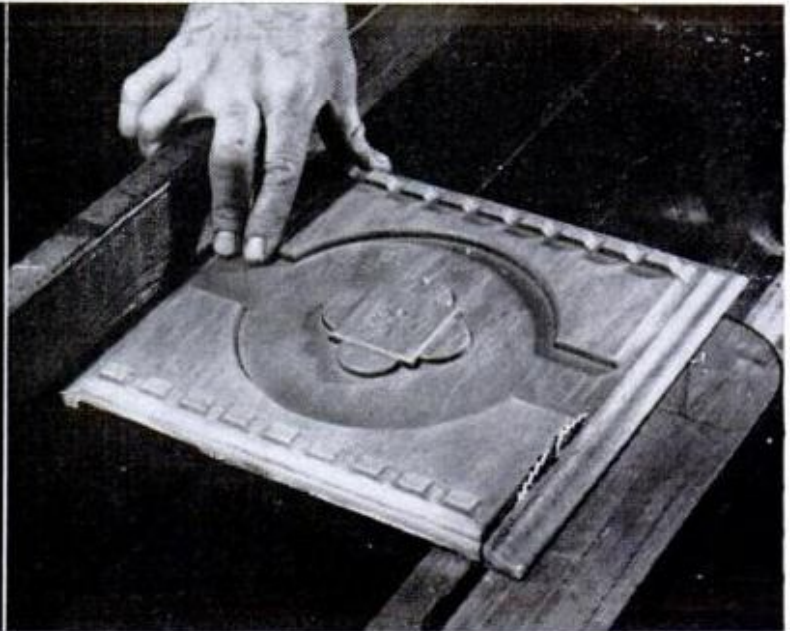
DRAWER SLIDES on single glide mounted on shelf center. Cabinet sides are let into blind dadoes in top

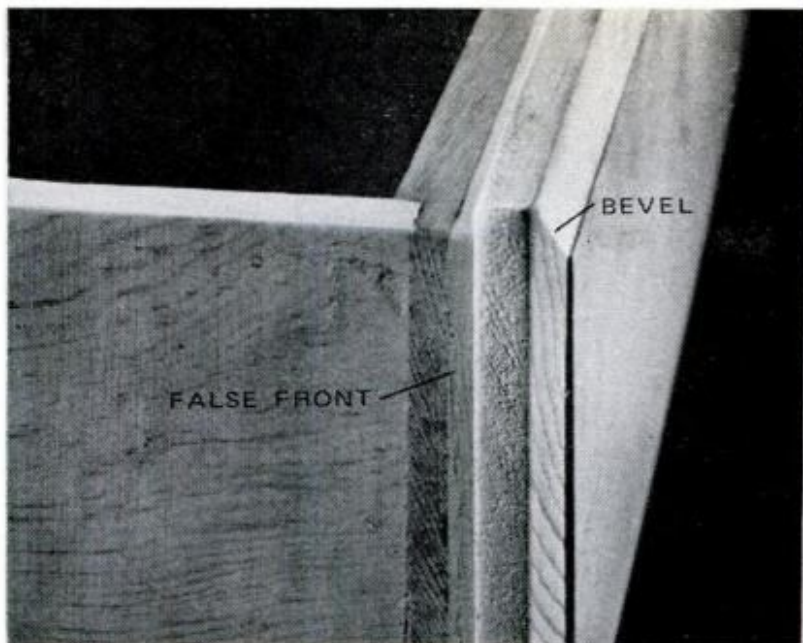
Customizing the Plaques

CUT DOWN THE PLAQUES to assure that the door thickness will not exceed $\frac{3}{4}$ in. You can start this by trimming the four sides (right)

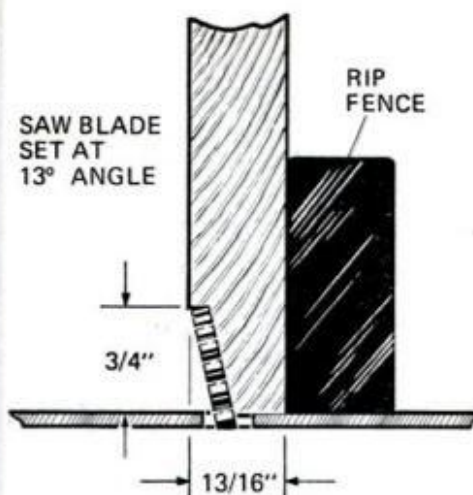
TRIM DECORATIVE NUBS (below, left) so doors will bypass easily. When doors are in place, use belt sander to remove any high spots

PLAQUES, before and after trimming (below, right). Views of finished cabinet show that trimming doesn't detract from appearance





HOW TO BEVEL FALSE FRONT



RAISED-PANEL EFFECT is easily accomplished on a table saw; false front is then glued to the drawer

greater than $\frac{3}{4}$ in. (or the doors won't bypass), these had to be reduced in thickness (see adjoining page). The plaques are attached with adhesive.

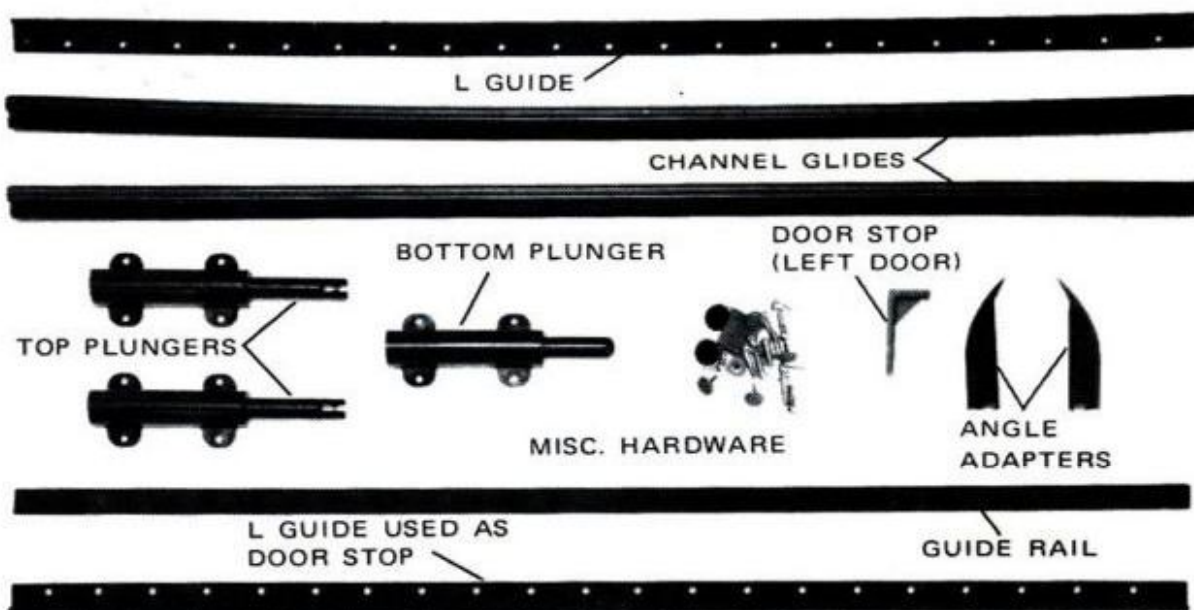
The hardware. You pay a slight price—in labor—for the beauty this hardware offers. It is harder to install than conventional sliding-door hardware and will likely call for a little trial-and-error fitting. The hardware package has a template that gives you a head start on location. However, I found that once the cabinet was completely finished (varnished), a quick blast of spray silicone made the doors bypass effortlessly.

Assembly. The cabinet top and sides are assembled using screws and dowel plugs. All other assembly is accomplished with well-set finishing nails. The holes can be filled, but for an antique look, they were not on the server shown.

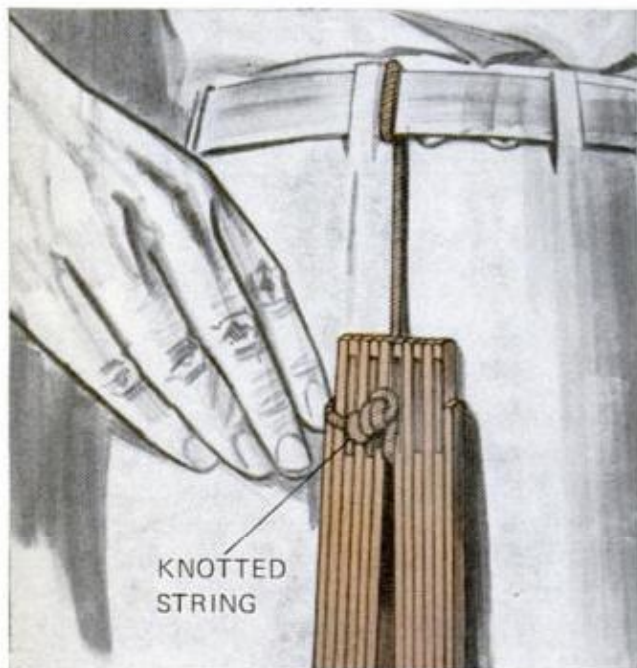
Finish. After thorough sanding, wipe the server with a tack cloth and apply oil stain. Wipe off excess stain and let dry overnight. Next day, antique the server using a tube of burnt umber and a rag to darken those areas that are dark on actual antiques (spots near corners, behind pulls and so on). Any spot that ac-

(Please turn to page 203)

HARDWARE for the pair of sliding doors is shown below. It is also available for four-door cabinets

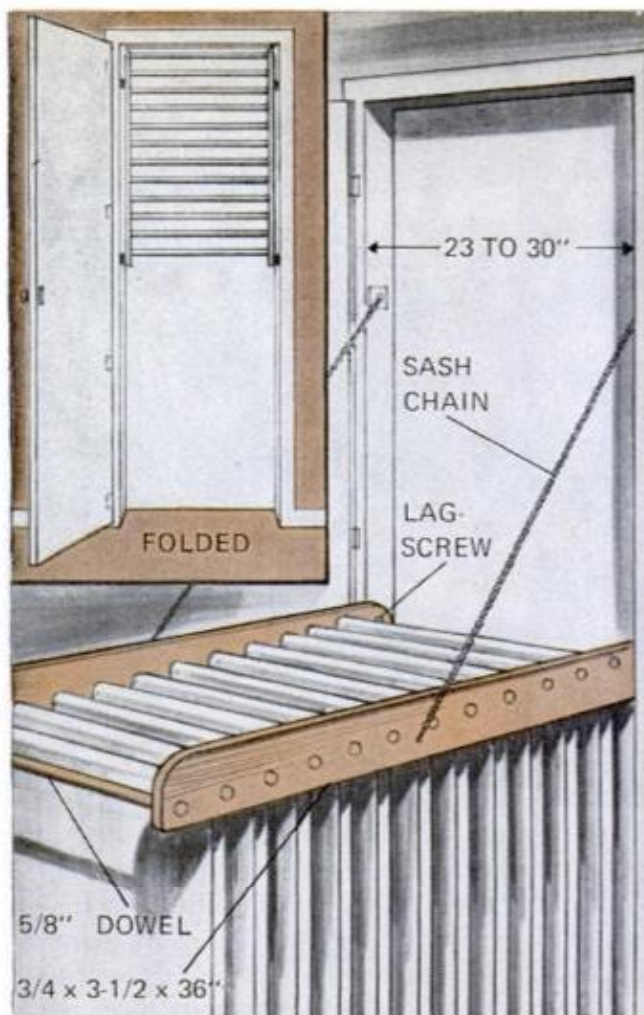


BETTER WAYS TO DO IT!



KNOTTED
STRING

FOLDING RULER is easier to get to if you hang it from your belt instead of carrying it in a pocket. Just slip a knotted string through the legs and tie the other end to the belt.—John Krill, North Lima, Ohio



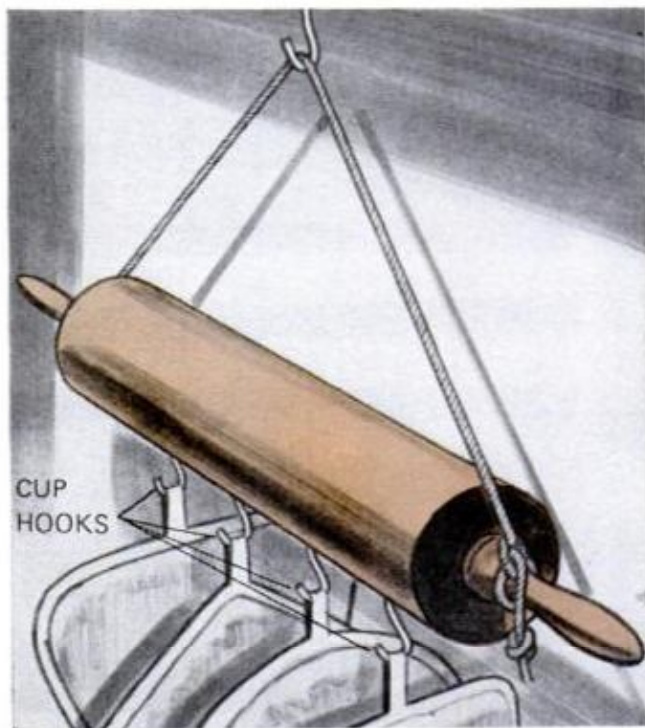
LARGE TABLECLOTHS can be stored neatly and quickly in their own custom-built, in-the-wall storage compartment. To keep the cost down, cut the door out of 3/4-in. plywood.—William C. Carpenter, Rye, N.Y.



PLASTIC
BAG

EMERGENCY GAS SUPPLY stored in your trunk can cause nauseating odors on a long trip. This can be eliminated by placing the can in an airtight plastic bag and tying it with cord.—A Weber, Edmonton, Alta.

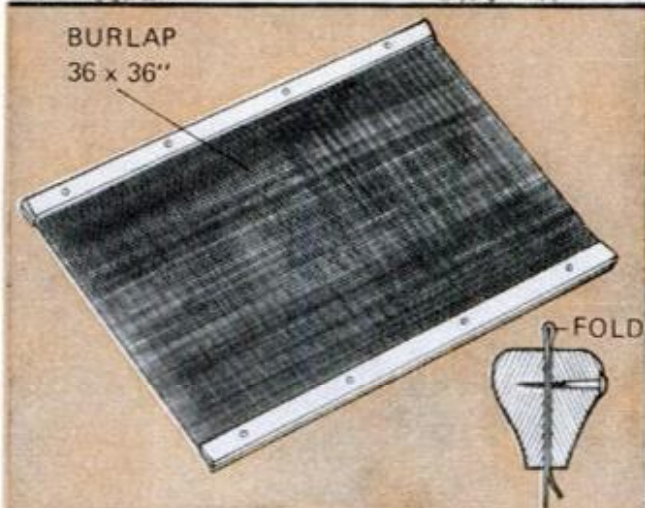
162



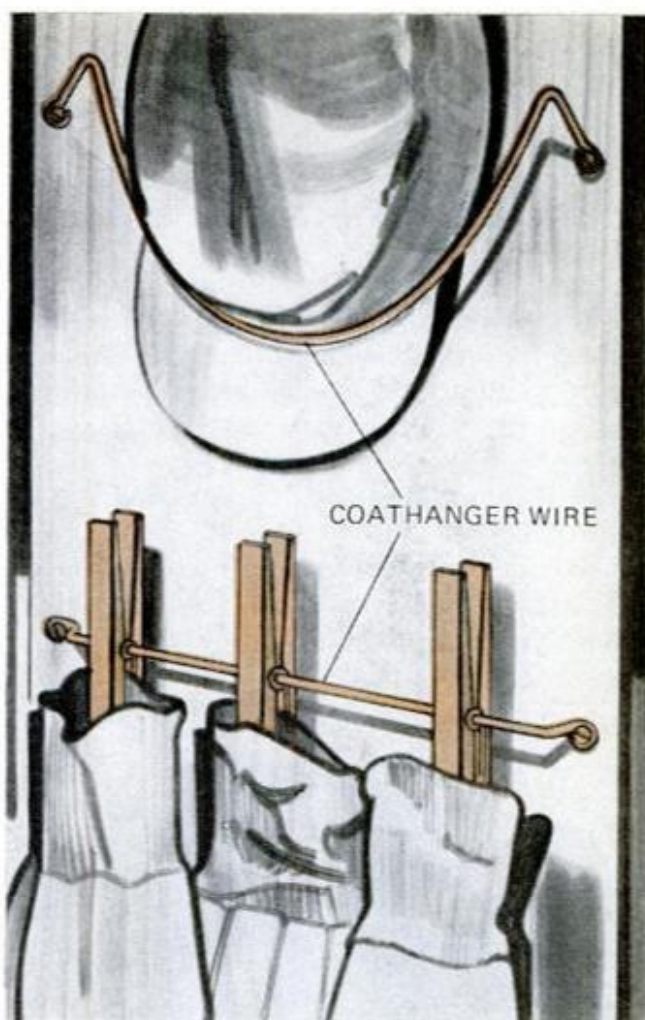
CUP
HOOKS

INEXPENSIVE HOT-PAD HOLDER can be fashioned from a dime-store rolling pin, four cup hooks and a length of cord for hanging. If desired, paint finished holder to suit kitchen. —J. R. Hornbrook, Marshall, Ill.

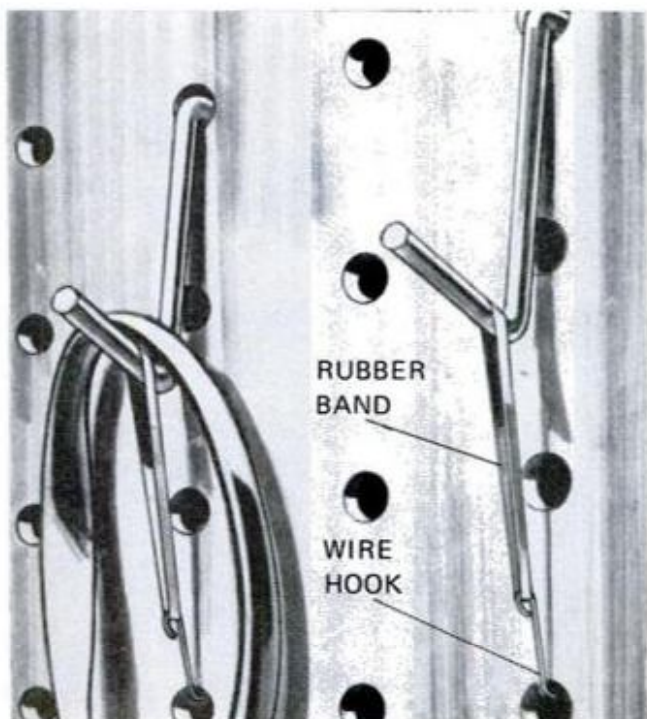
POPULAR MECHANICS



LOW-COST LEAF SCOOPER beats picking up leaves by hand. To make it, fasten 1 sq. yd of burlap to two pairs of slats. To keep the leaves in, squeeze the handles together.—*Paul P. Cuzzupoli, Milwaukee*



HANDY GLOVE AND MITTEN HANGER can be installed on the back of any door by threading a coat-hanger wire through spring-type clothespins. To hold cap, bend another wire.—*R. S. Tupper, Canton, S.D.*



KEEP HOOKS where you want them in perforated board by using this trick. Simply hook a paper clip into a hole below, then loop a small rubber band between it and the wobbly hook.—*A. Weber, Edmonton, Alta.*



A PAIR OF WHEELS mounted on a wheelbarrow as shown can be your back's best friend when you're moving heavy loads. With this stunt, you push—instead of lift—the load.—*Edgar McCalman Jr., Vacaville, Calif.*



Gifts You Can Make

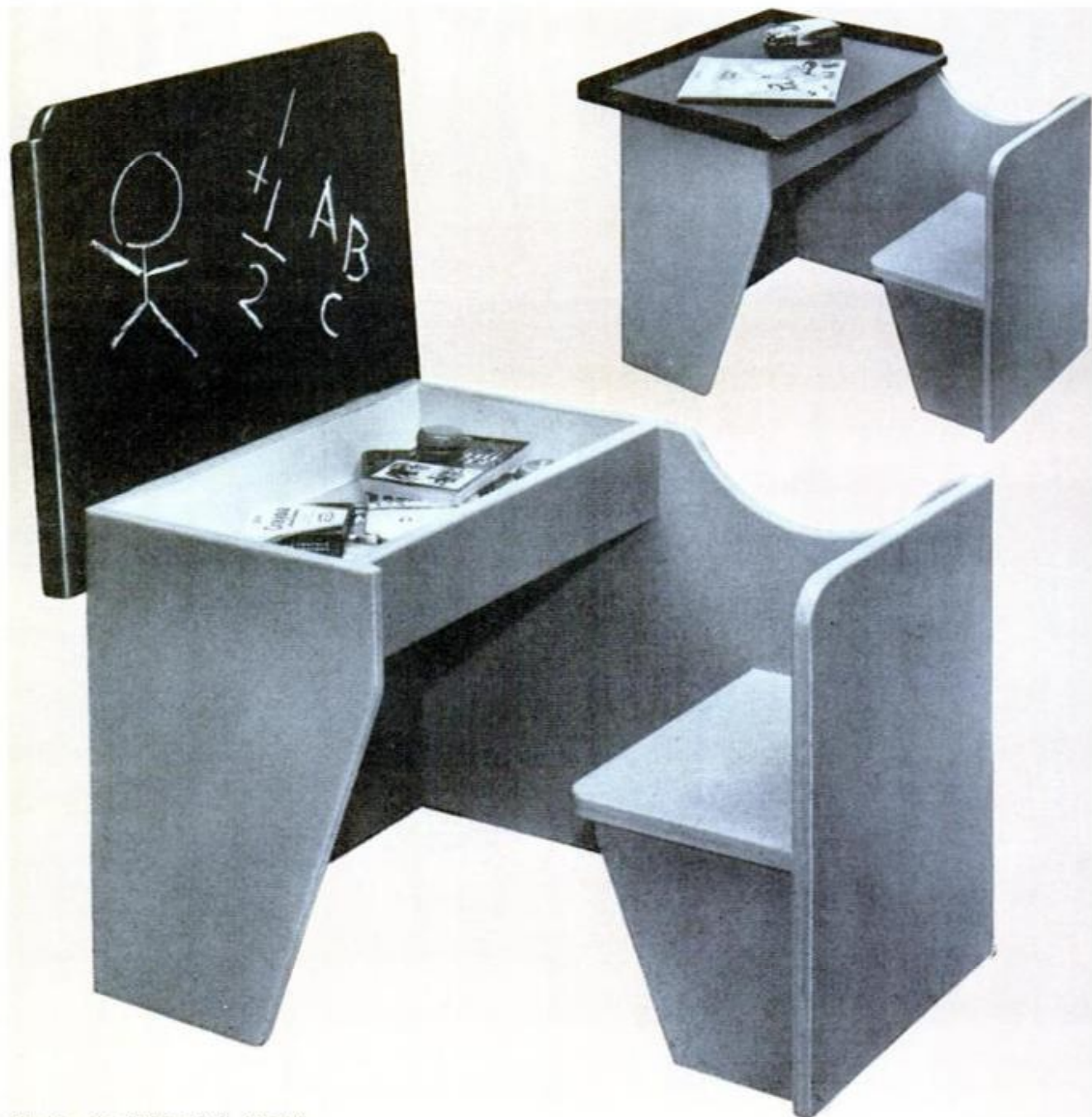
Preschooler's Desk With Built-In Bench

ANY THREE or four-year old will find coloring and drawing twice the fun when he has a desk all his own. This one with its built-in bench and lift-up desk top would make a fine gift for Santa to bring, and if you start now you can easily have it completed for Johnny or Susie by Christmas.

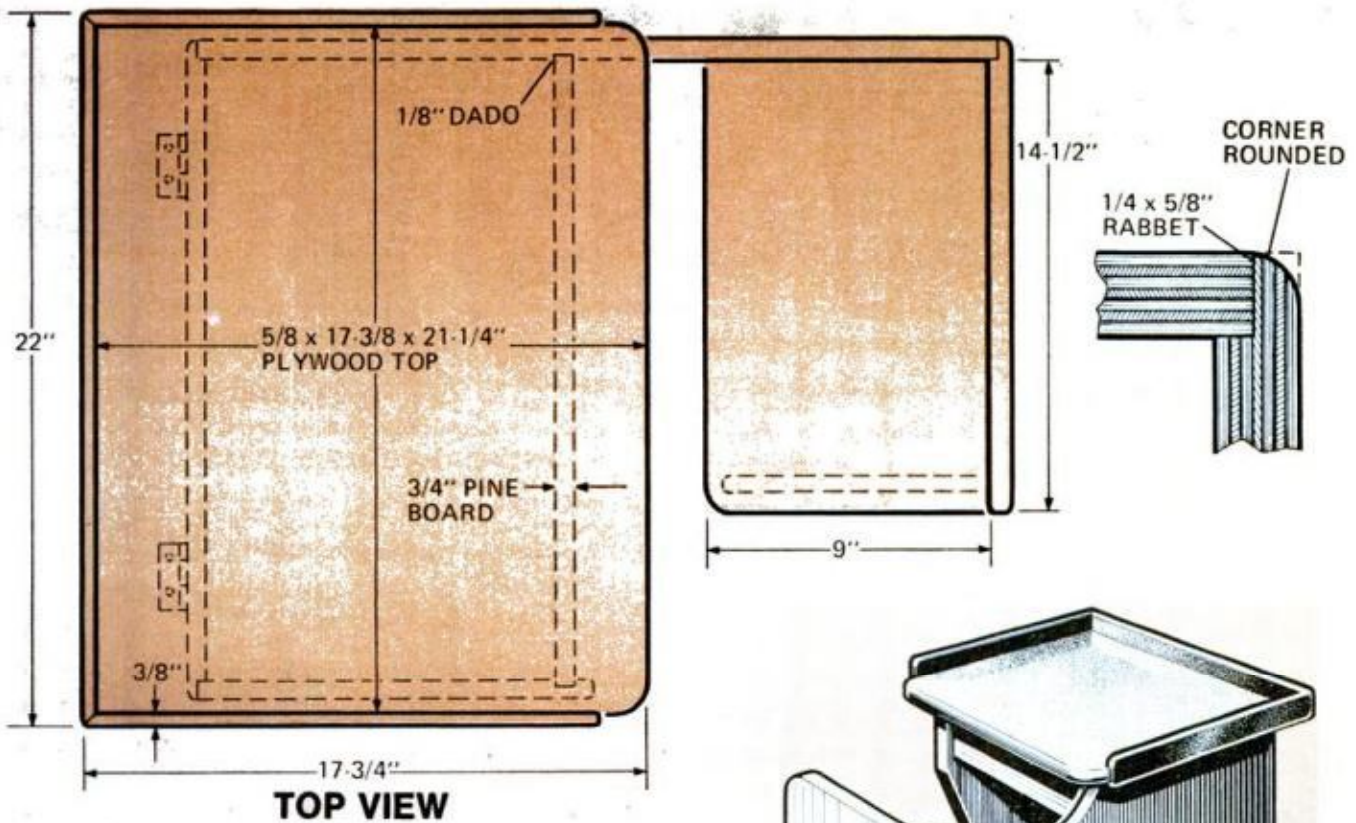
Except for a few miscellaneous pieces, the whole desk is made from a 4x8-ft. sheet of $\frac{5}{8}$ -in. plywood. The front requires an $18 \times 20\frac{1}{2}$ -in. piece with two edges rab-

beted to receive the side and back. The $15\frac{1}{8} \times 18$ -in. seat back is rabbeted along only one edge. Glue and nail the three rabbeted corners, then round them as shown.

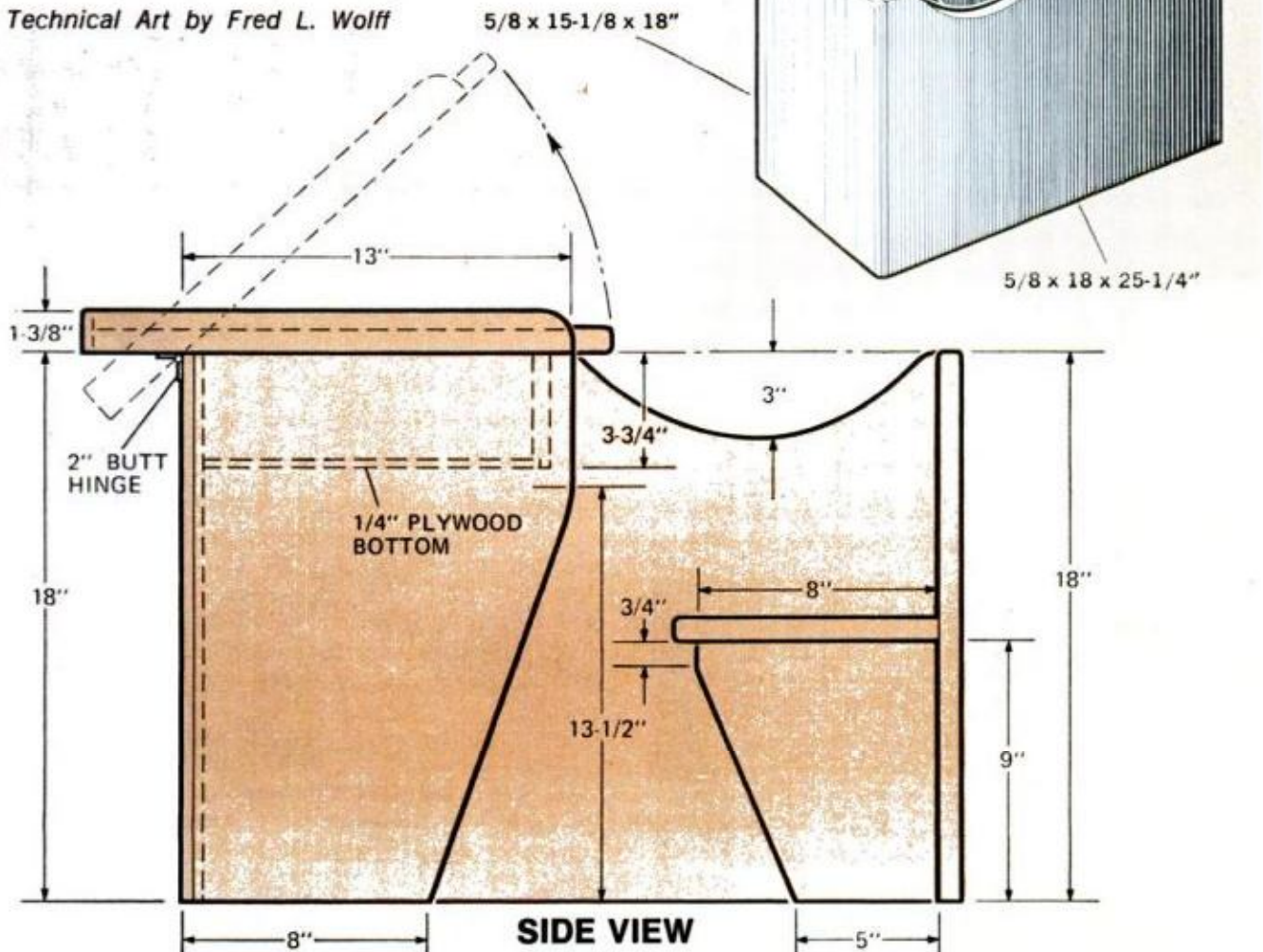
The front of the storage compartment is a $\frac{3}{4}$ -in. board (which can be let into dados or simply butted), and is rabbeted along the lower edge for a $\frac{1}{4}$ -in. plywood bottom. Cleats or glue blocks can be used to help support the plywood. The lift-up top has lattice strips around three sides.

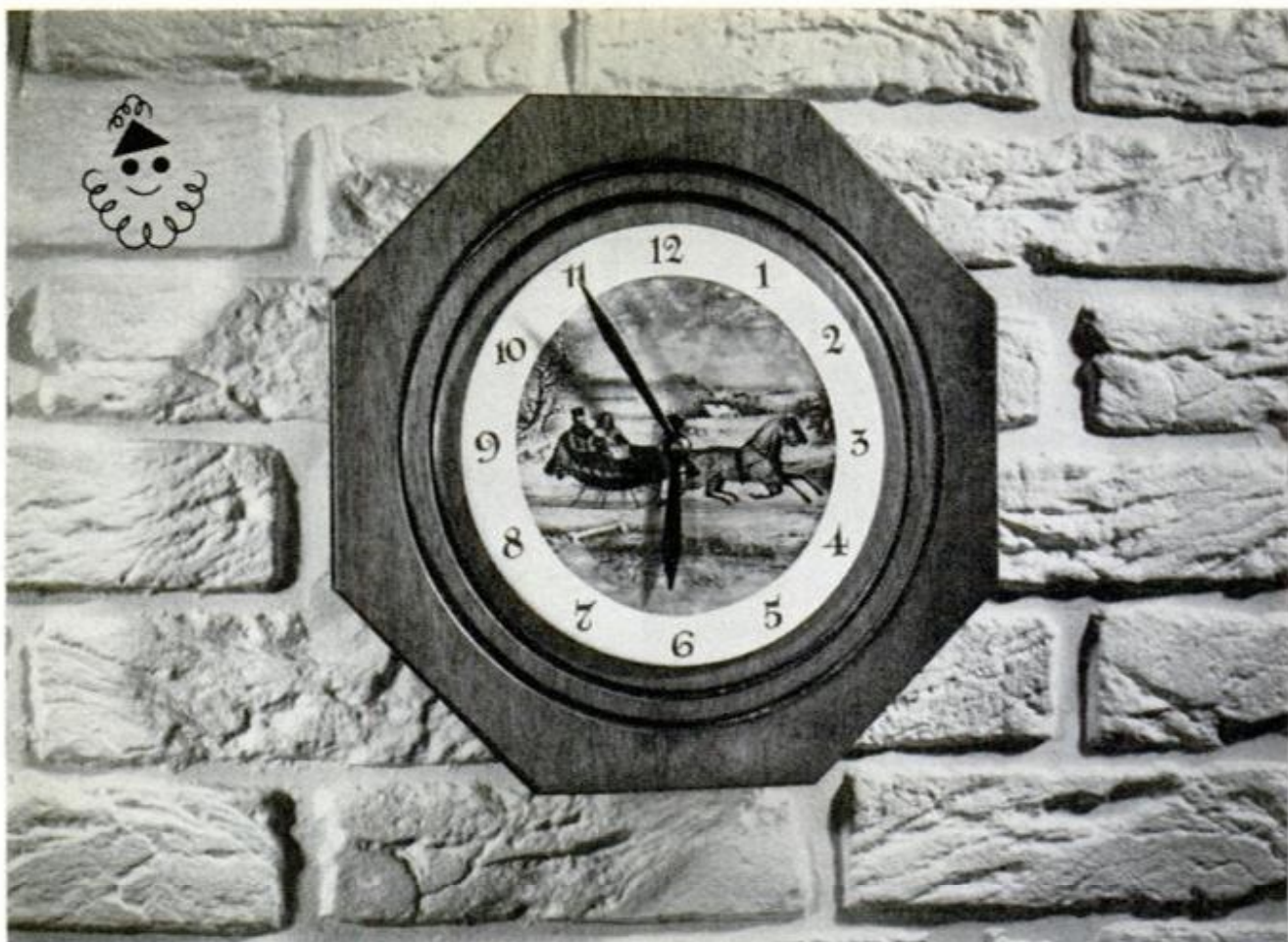


for Christmas



Technical Art by Fred L. Wolff





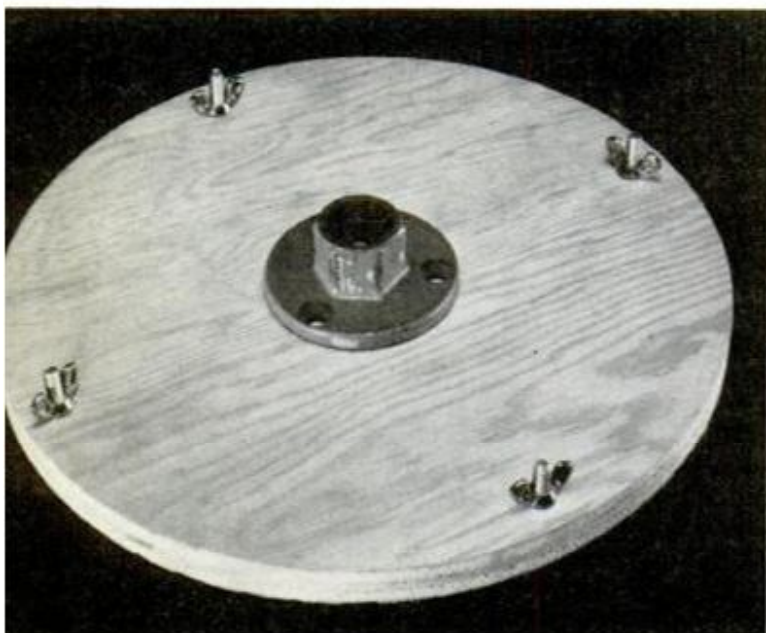
Sportsman's Wall Clock With Plywood Face

HERE'S a gift you can literally turn out by the dozen. It requires a lathe, but once you have made the workholding jig, you can practically mass produce these handsome wall clocks. You buy the ceramic dial and clock works and make

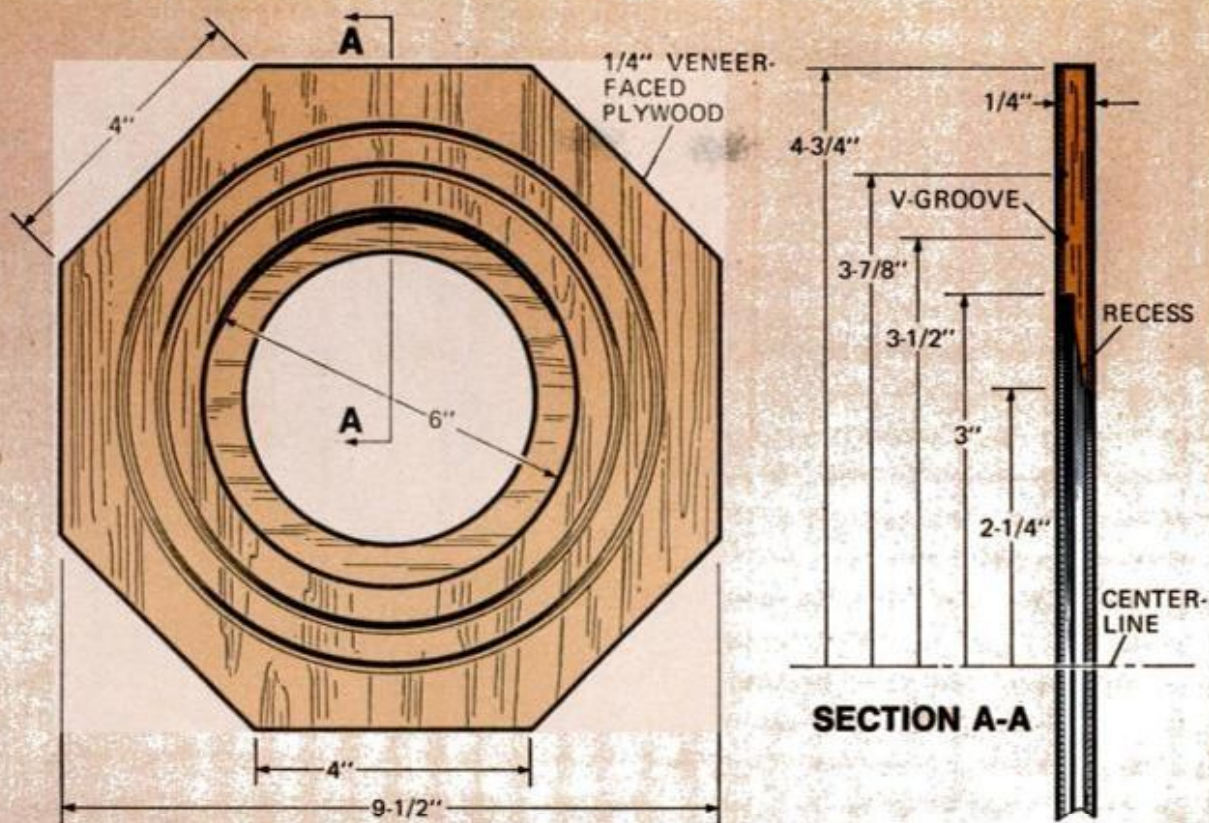
and finish the wooden face from fancy $\frac{1}{4}$ -in. plywood. The jig (below) serves as a large faceplate to which you attach the work for turning a recess and decorative grooves. It consists of an $11\frac{1}{4}$ -in. disc cut from $\frac{3}{4}$ -in. plywood and fitted with four

WINGNUTS ON BOLTS make it easy to clamp work to face side of plywood disc. Faceplate fastens disc

BOLT HEADS GRIP EDGE of work to hold it while you turn dial recess and decorative grooves in face



PATTERN FOR CLOCK FACE



$\frac{1}{4}$ x $1\frac{1}{4}$ -in. roundhead stovebolts and wingnuts. The bolts automatically center the work, while their heads clamp it to the jig which is mounted on the lathe by a regular faceplate.

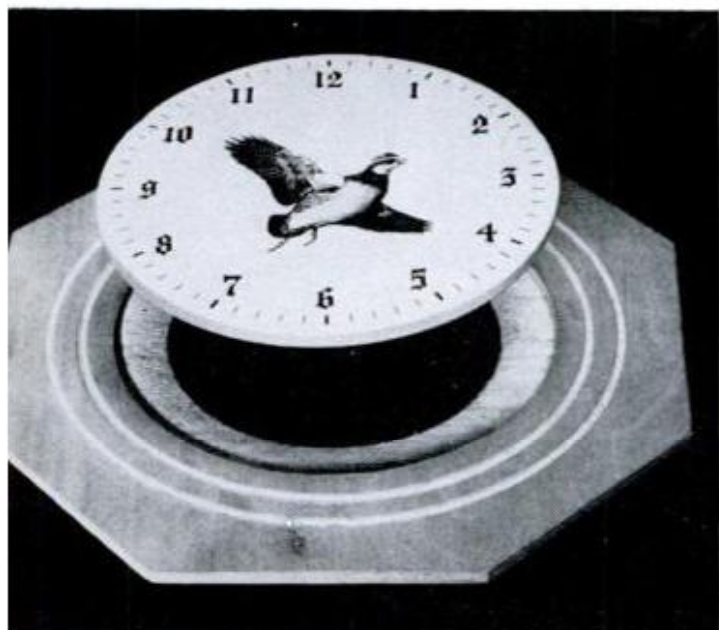
The work is cut octagon-shape before it is attached to the jig. If you plan to make more than one clock, each piece

CONTACT CEMENT IS USED to glue 6-in. ceramic dial in turned recess. Apply adhesive to dial and recess

should be identical to fit the jig.

Gaston Wood Finishes, Box 1246, Bloomington, Ind., sells the ceramic dial and clock. You have a choice of six dial designs and a battery or electric movement. The dial and TR-3 battery clock sell for \$12; the electric clock, plus dial is \$8.75. Both prices are postpaid.

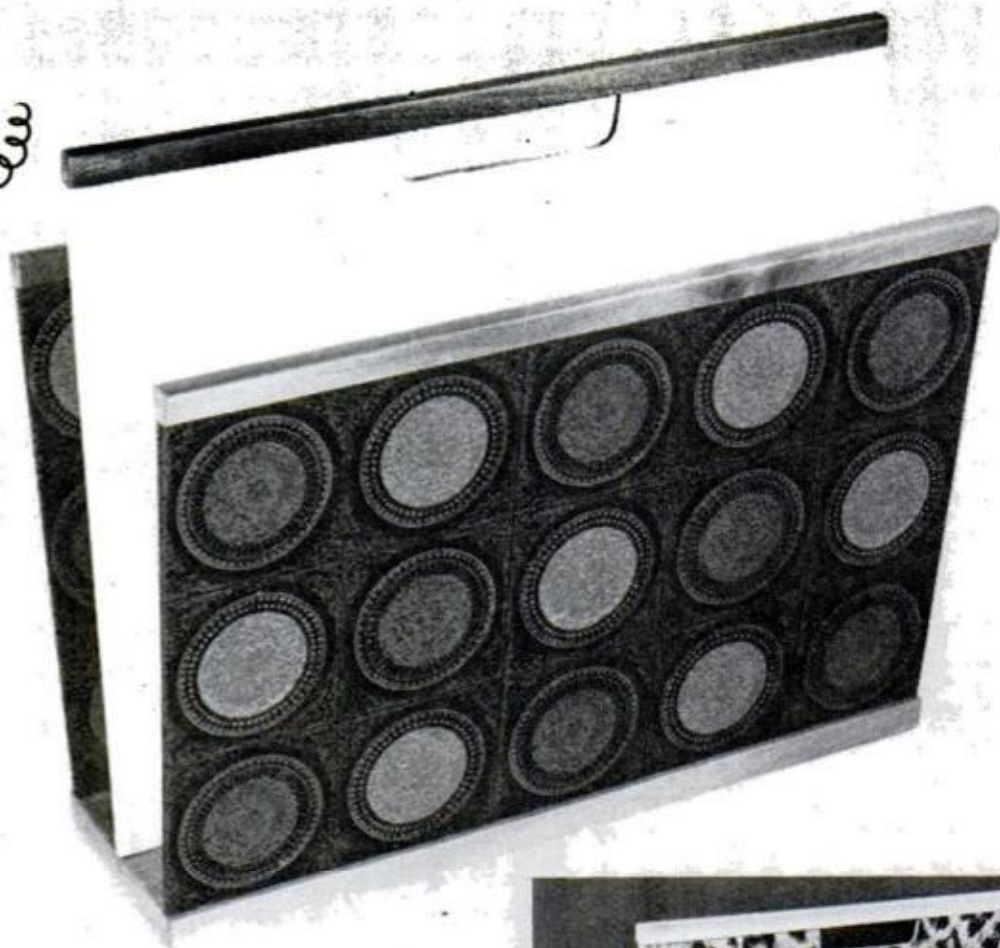
TWO WOOD CLEATS, $\frac{3}{4}$ x 1 x 6 in., are glued to back of plywood facing to gain clearance for clock



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Photos by the Author

Simple Magazine Rack With the Modern Look

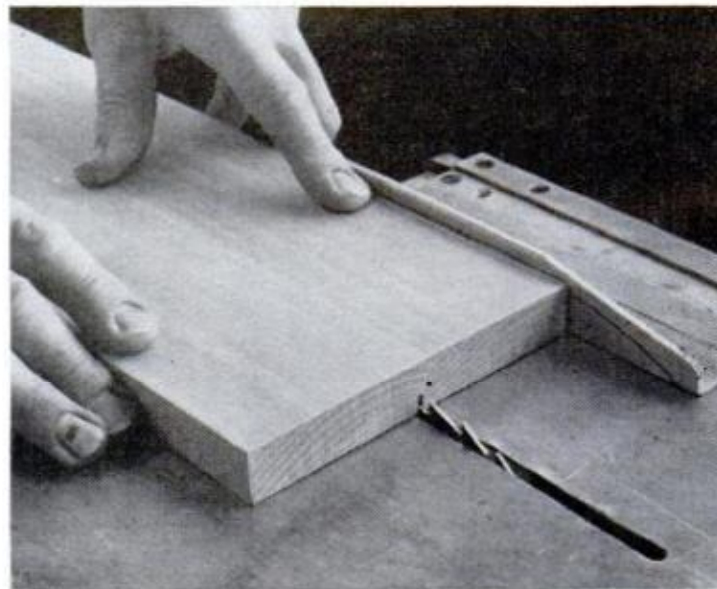
WALLPAPER, simulated leather and self-adhering vinyl all add to the modern look of this handsome, simple magazine rack when applied to plain plywood or hardboard, although the rack takes on a really elegant appearance when the slanting sides are cut from sheets of a plastic "bottle" glass or a leaf-pattern Marlite.

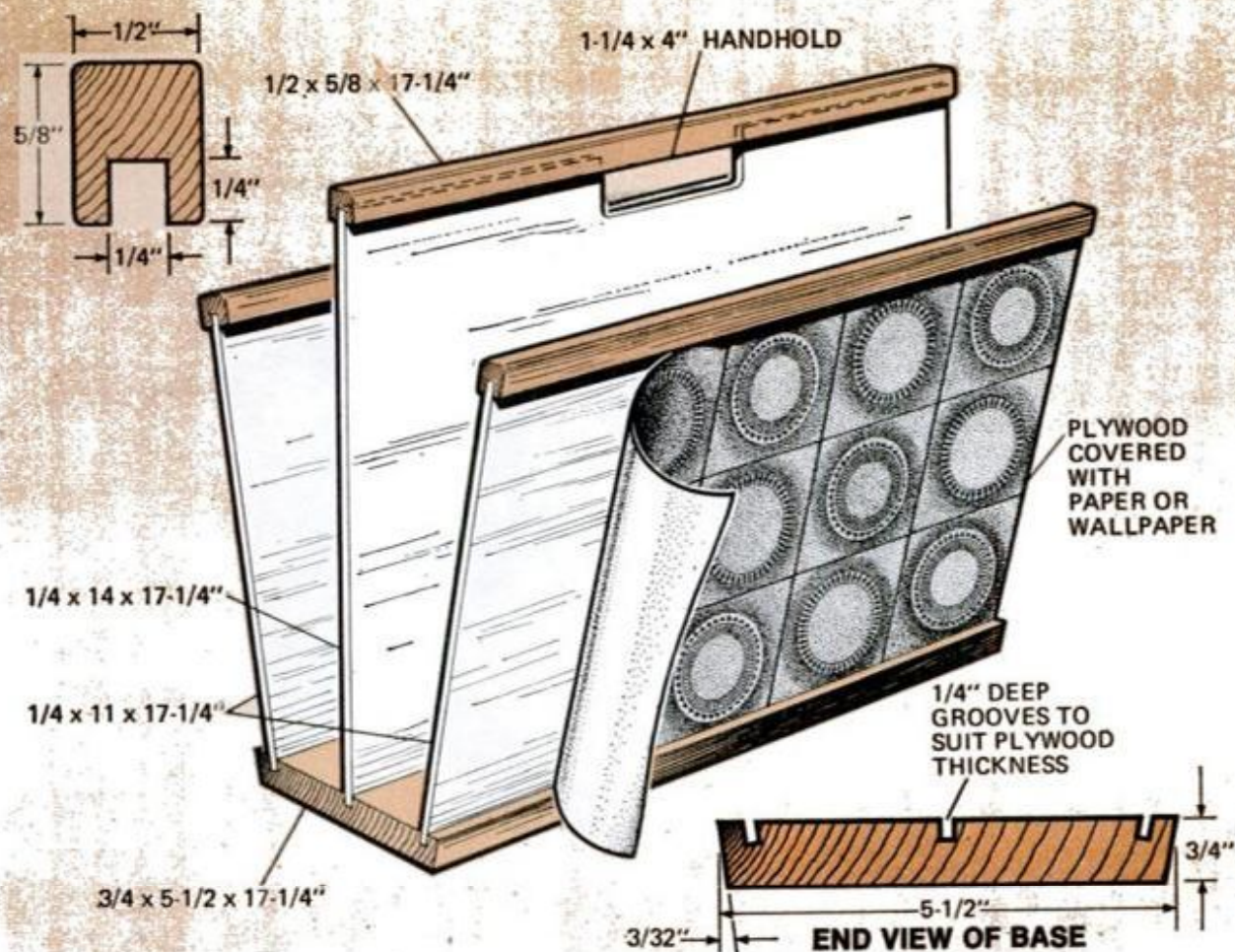
This, too, is a project you can quickly mass-produce in your workshop should you wish to make several racks as gifts. The grooved cap strips can be run in long lengths and crosscut into identical pieces. Likewise, a number of board bases can be beveled and grooved if you make repetitive cuts at one fence and blade setting.

Pine is plenty good for the exposed wood parts if you plan to paint them; hardwood if you are going to stain and varnish them. Run the $\frac{1}{4}$ -in. grooves for



RAISE BLADE $\frac{1}{4}$ in. and run base center-groove first





the slanting sides $\frac{1}{4}$ in. in from the edge and at the same angle as the beveled edges. Although the plywood divider and slanting side members are to be glued in the grooves, you should try to cut snug-fitting joints to provide additional stability to the thin panels.

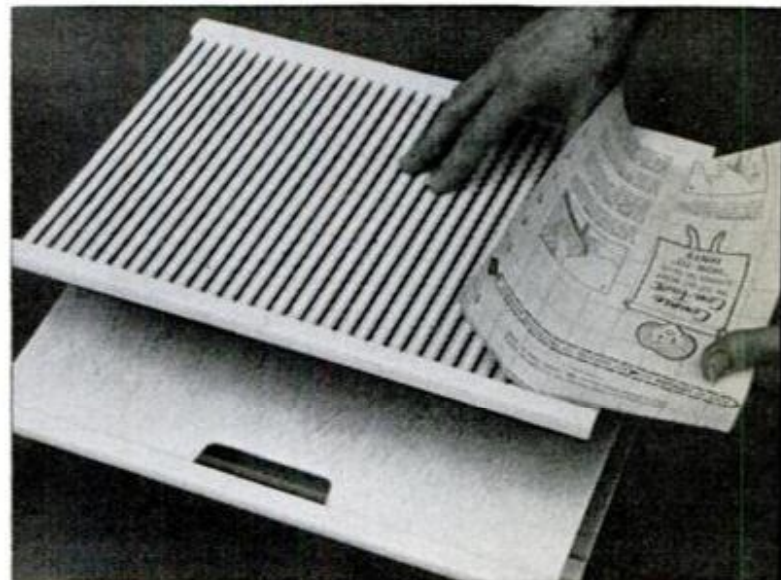
A handle is formed by first notching the center panel before gluing the cap strip

to the top edge. Notice that the edges of the cap strips are rounded slightly and sanded smooth before being glued in place. In fact, you may find it easier to finish the wood parts if they are painted or stained before the rack is assembled. When gluing the parts, use a damp cloth to remove any excess glue before it sets.

—Kenneth Wells, Portsmouth, England

RIP CAP STRIPS for width after groove is cut in edge

COVER OUTSIDE PANELS with self-adhering Con-Tact





Tools The Pros Use On Plastic Laminates

In the March 1970 issue of PM we gave you all the basics for working with plastic laminates. Now, we've rounded up unusual special tools for those tough jobs.

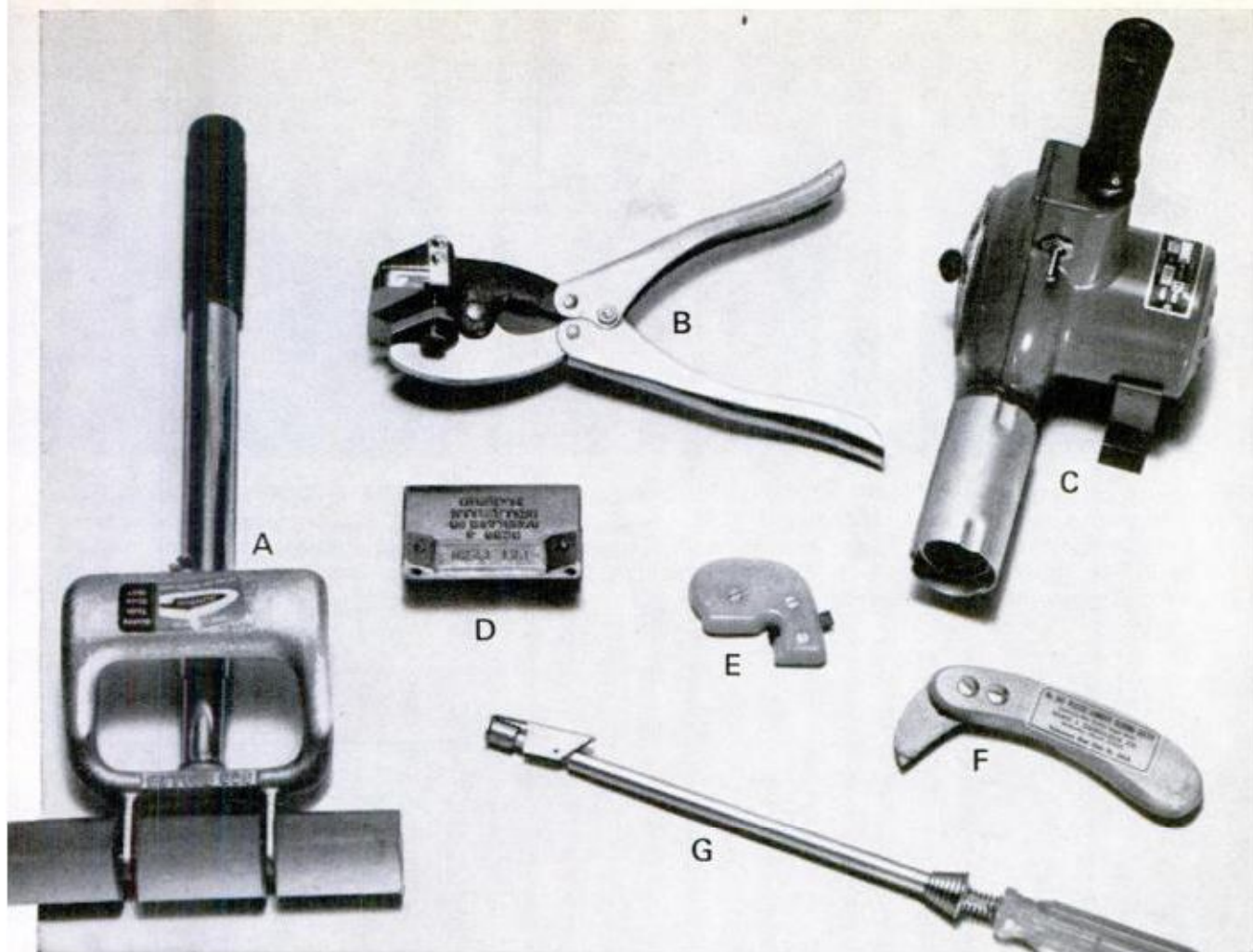
By HARRY WICKS, Workshop Editor

Photos by Robert D. Borst

THERE'S no arguing the fact that if you call a kitchen cabinetmaker today for a quote on a new countertop, his figure will seem like the national debt. Thus, from necessity, most homeowners are tackling as many improvement jobs around the house as possible—especially those requiring laminates.

As your experience grows, and you take on more complicated projects, you will find that having the right tool will always make the job easier and save time. Thus, we've rounded up tools that professional laminate installers use and, happily, all are available from one source.

I tested the tools shown in my shop over three months and through five or six projects. I found each to be of high quality and worth its asking price. Some, like the laminate



TOOLS DESCRIBED are shown above: A, heavy-duty roller; B, corner notcher; C, flameless heat gun; D, laminate trimmer; E, Mica Nife; F, scoring cutter; G, sink-rim screwdriver

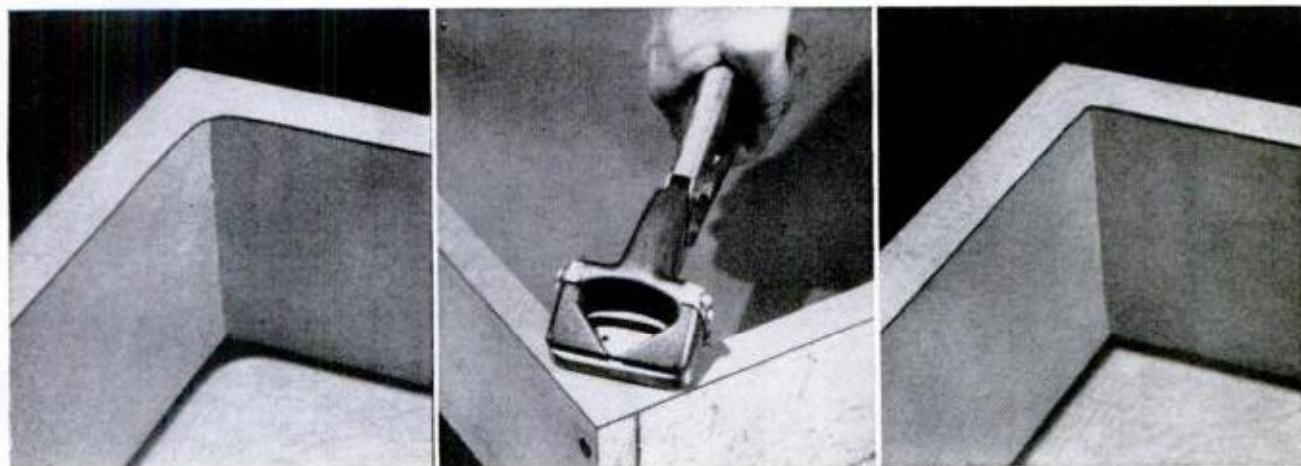
trimmer for example, you won't need if you own a router. But, if you have ever had to make a tight turn as shown at left, you'll be glad to learn how easy this can be done using the flameless heat gun. With it, you can make a "hot" turn of 1-in. radius (after a little practice on scrap).

Here are the tools in the order they are keyed above, with my conclusions:

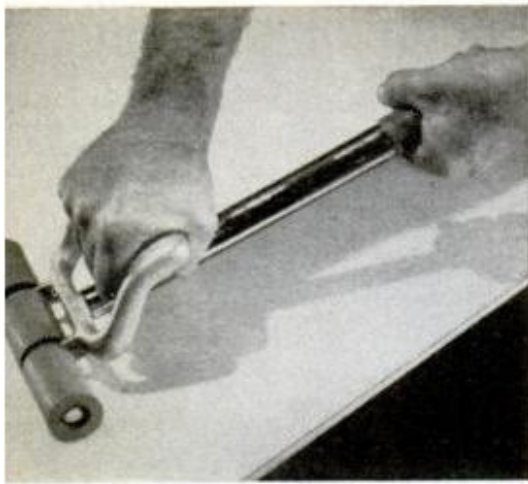
● *Heavy-duty roller.* I advise buying this

with extension handles if you plan to do any wall laminating. You can then apply sufficient pressure quickly and evenly without straining your muscles. Model No. 333, \$12.95.

● *Corner notcher* (Model M-390). The price elevates this tool out of the strictly do-it-yourself class. But, if you're a pro, (Please turn page for more photos; text continues on page 182)



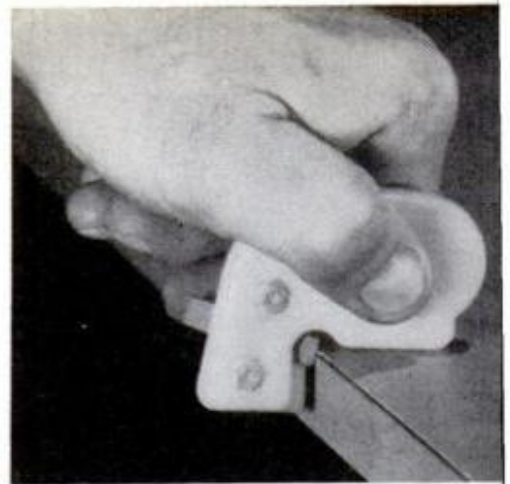
CORNER NOTCHER makes quick work of trimming corners that are inaccessible to routers (above, left). Tool is simply placed over excess laminate and handles are squeezed. Result—a neat, finished self-edge



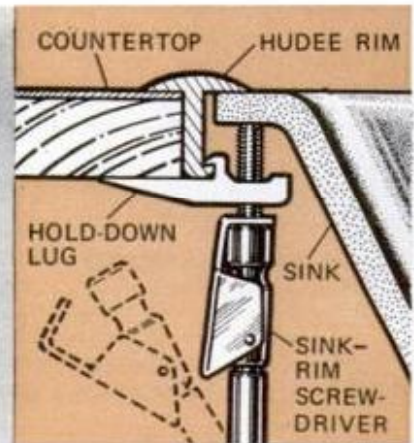
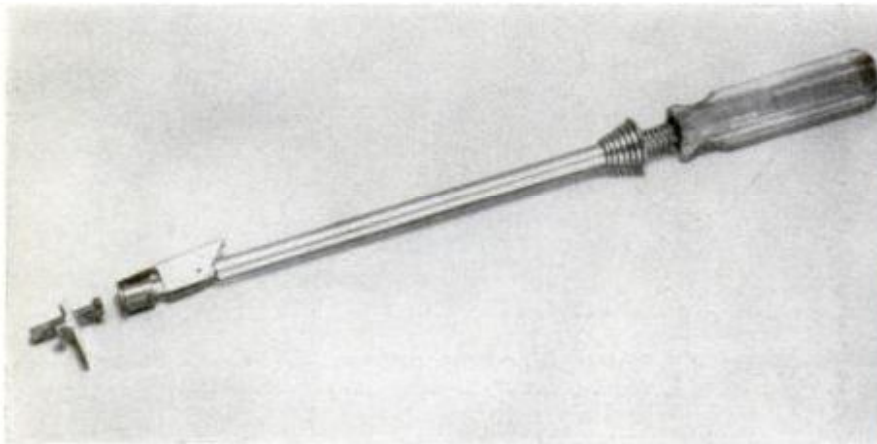
ROLLER exerts uniform pressure. Extension handle makes it ideal for applying laminates to walls without stretching. Lack of projections permits use in corners



SCORING CUTTER features carbide-tipped blade, is used to scratch a line on a decorative surface. Then, the laminate is simply snapped off cleanly by hand



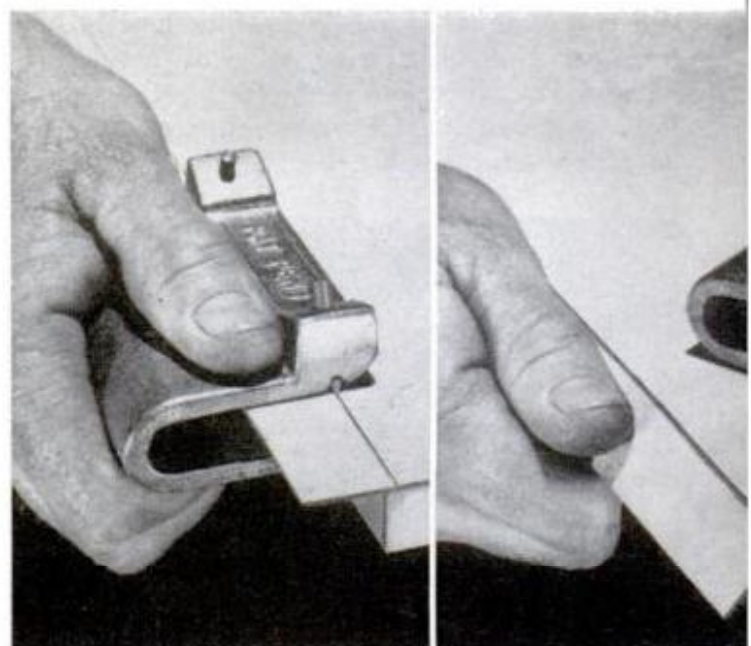
LAMINATE EDGER, dubbed Mica-Nife, is designed especially for finishing plastic laminate self-edges. Carbide scarfing blade can be set to any desired angle



SPECIAL SCREWDRIVER takes the aggravation out of sink (Hudee) rim installation because it is effective in hard-to-reach places. The socket is made to fit No. 12-24 hex-head bolts which are standard on hold-down lugs. The 14-in. tool weighs but ½ lb., and is equipped with a comfortable-to-grip plastic handle



CONTACT CEMENT goes on evenly if applied with a mohair roller. To make cleanup afterward a snap, first line the painting tray with aluminum foil



LOW-COST TRIMMER boasts a carbide-tipped scoring needle, is claimed to work equally well on all thicknesses of laminate. Author found tool easy to use

POPULAR MECHANICS



If your menthol isn't smooth enough,
come all the way up to KOOL.



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

18 mg. "tar," 1.4 mg. nicotine
av. per cigarette, FTC Report Nov. 70.

© 1971, Brown & Williamson Tobacco Corp.

Материал, защищенный авторским правом

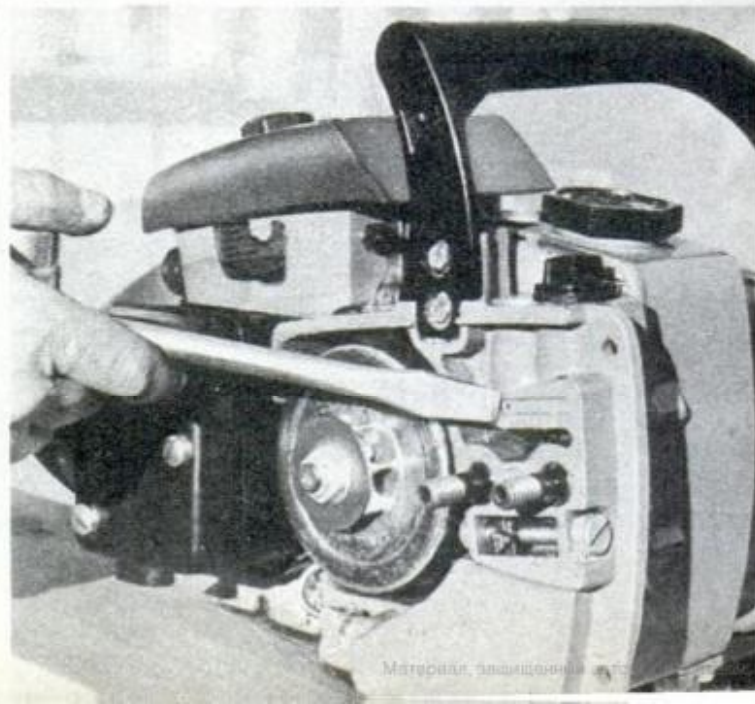
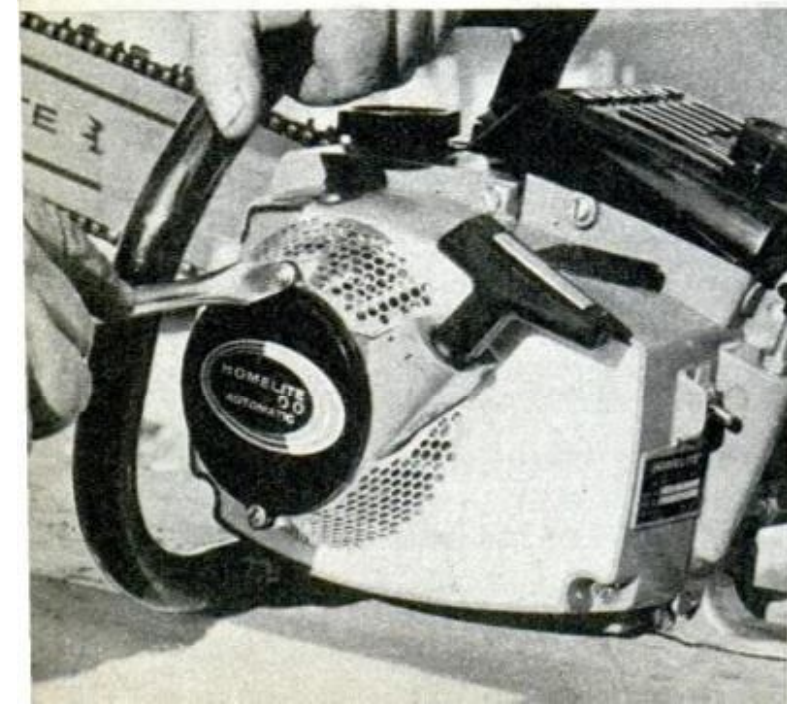


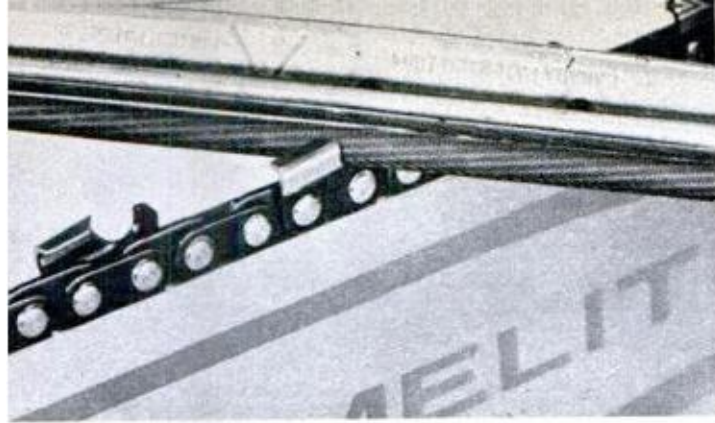
WELL MAINTAINED SAW walked through 14-in.-dia. log. Here's where good chain lubrication really counts

The Kindest Cut of All Comes

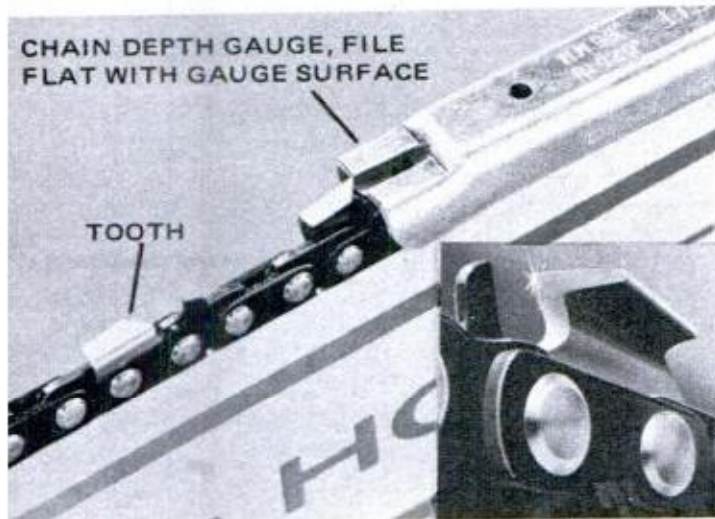
CONSTANT VIBRATION will cause a loosening of screws and bolts. Check these daily and tighten them

COVER should be removed periodically, air filter and all other parts cleaned thoroughly and tightened





TO SHARPEN CHAIN, place file holder on cutter, file from inside to outside. Hold file level, file all cutters on one side, then file opposite cutters



GAUGIT is placed on depth gauge (between cutters). If gauge projects, file flush with flat file

A few minutes spent on maintenance will insure optimum performance from your chain saw

By **HARRY WICKS**, Workshop Editor
Photos by Robert D. Borst

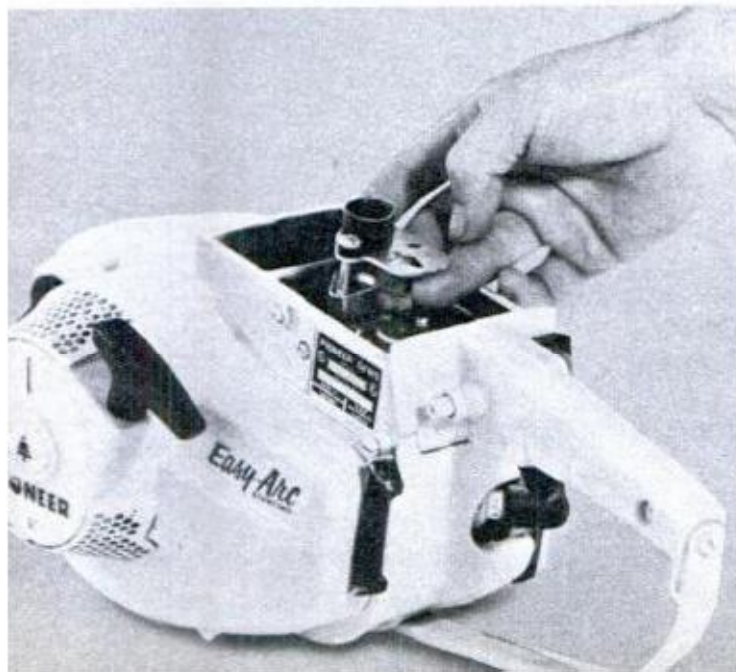
ONCE CONSIDERED a tool for lumberjacks and heavy-construction workers only, the worksaving chain saw is finding its way into more and more do-it-yourselfers' "toolboxes." The reason is simple. Manufacturers are decreasing tool weight, increasing efficiency and bringing prices down. And, for what you get from the tool—the ability to cut your own firewood, build your own fences and do your own pruning—most homeowners will confess to the urge to own a chain saw.

Once you have invested in one, it is just plain common sense to give it the care it deserves. Maintenance is basically simple; briefly, the key steps are:

- Break in your new saw and chain carefully. Read the owners manual and do all steps the manufacturer recommends.
- Keep the cutting chain sharp, oiled, snug and set.

From a Cared-For Chain Saw

SPARKPLUG ELECTRODES should be cleaned with emery paper. Remove sawdust, carbon deposits daily

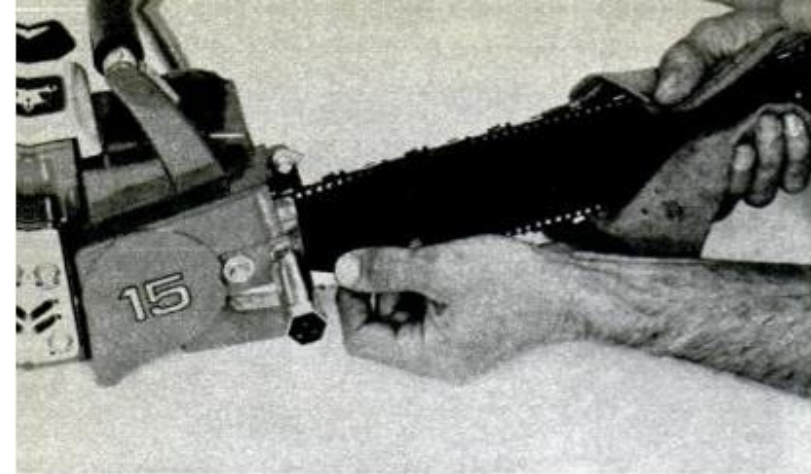


- Clean the saw after each use.
- For long storage periods, keep the saw in a dry, well-ventilated place. Check the maker's manual for storage guidelines.

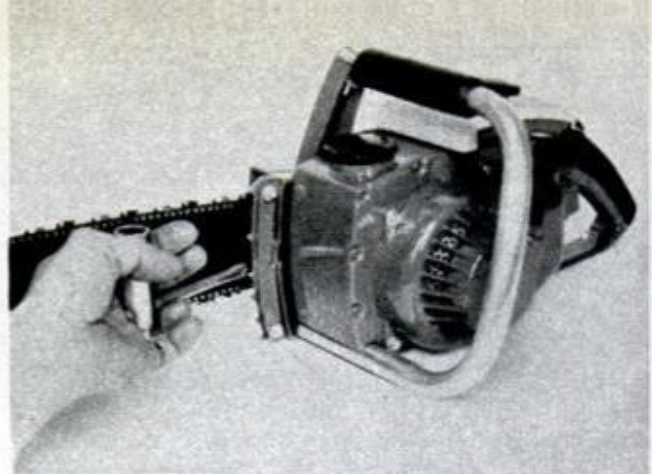
According to Blake Stretton, ex-lumberjack and consultant to Homelite Chain Saws, for proper chain-saw care you "need only follow some simple basics." Asked to compile a brief list of suggestions, he drew up this selection:

Mixing fuel. Always mix oil and fuel in the exact amounts specified by the manufacturer. Don't mix the fuel directly in the saw tank. Use a clean safety can to mix, and then pour the fuel into the tank. (Safety tip: Always start the saw at least 10 ft. away from the place where you poured in the fuel.)

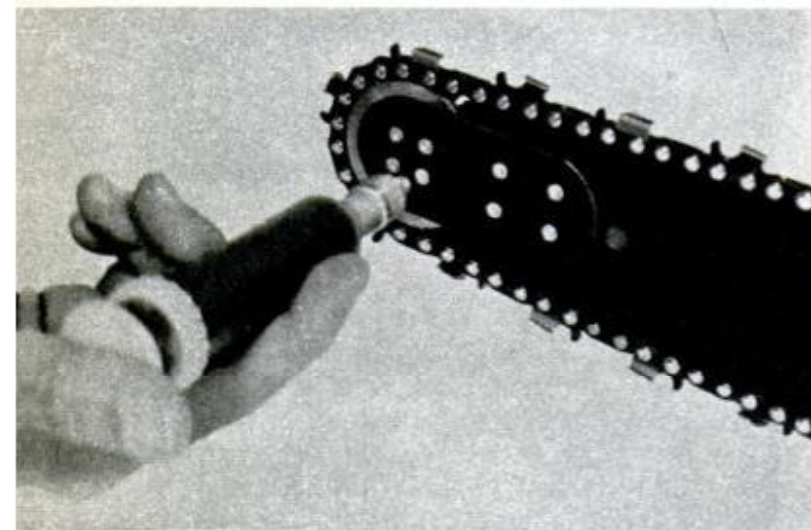
Break in your saw properly. Before fid-



TO ADJUST BAR TENSION, pull nose bar up slightly and tighten nuts. Chain should be presoaked in oil



CHAIN TENSION should be adjusted so that chain can be rotated—by hand—around the cutting bar

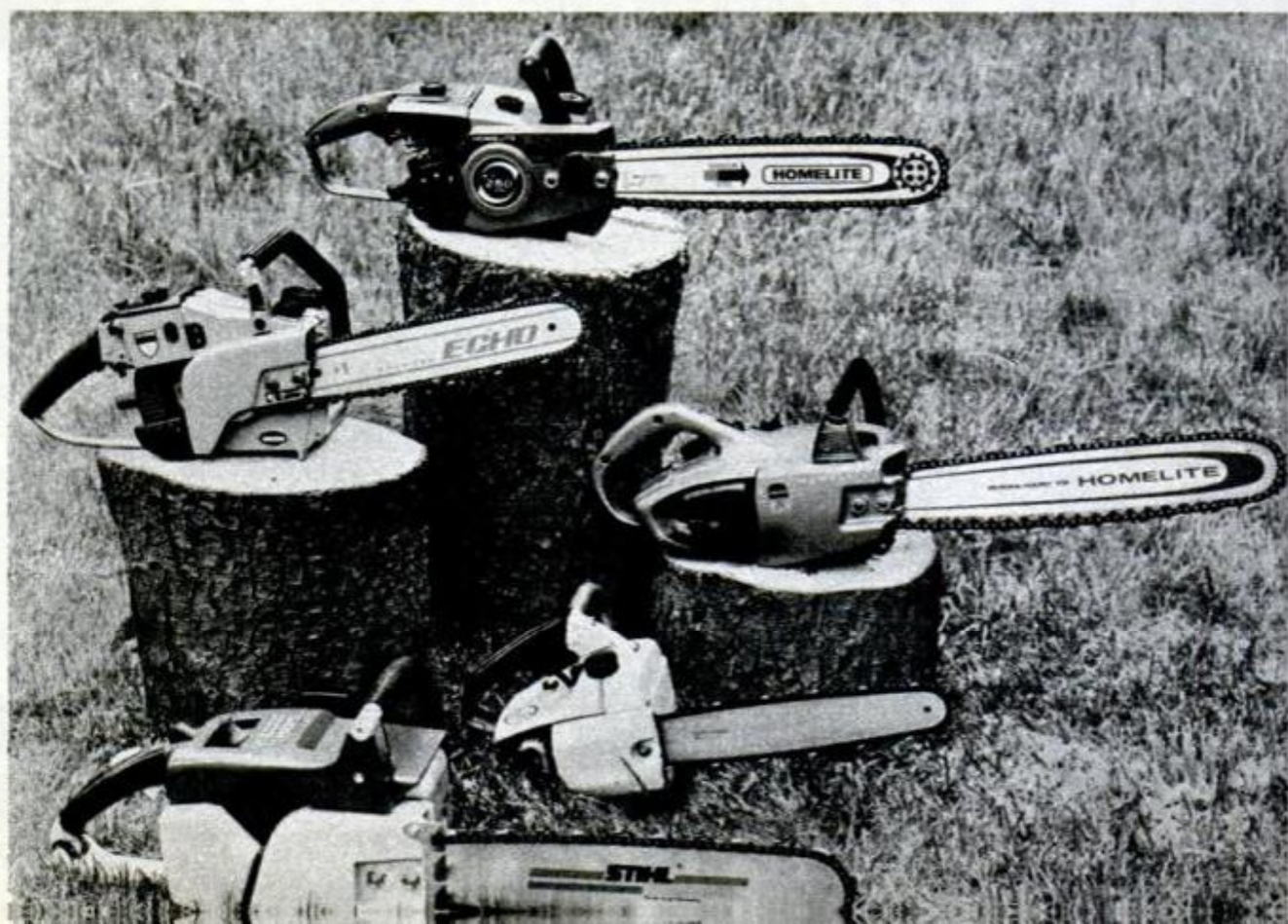


ROLLER NOSE is greased with each sharpening. Apply lube until it shows at side plates of roller nose

ding with the tool, read the starting, stopping and operating instructions and make certain you are familiar with all controls and adjustments. It pays to presoak the chain overnight so that oil will penetrate the rivet holes on the chain. This done, the chain and bar can be mounted on the saw and properly tensioned. Start the saw and let the chain run slowly around the bar for about a minute; then run at full throttle—without cutting load—for two minutes. And once the saw is put to work, never make any cut at less than full throttle.

Keep your chain sharp. Small-size chips and powdery sawdust are a pretty good indication that the cutting teeth need

FIVE TYPICAL CHAIN SAWS, used in photographs, are priced from \$90 to \$250. All worked well for author



Announcing the only all-new pickup for 1972. DODGE.

When Dodge set out to build an all-new pickup for 1972, it not only wanted to keep the well-known Dodge toughness but to give this pickup a smoother ride, new style, and good looks, too. What you see below is the exciting result. The Strong Silent Type.

MORE CAB ROOM THAN ANY PICKUP ON THE RANGE.

Part of the secret of the cab roominess is the way the side windows were designed. Notice they are curved, which offers more width inside the cab where you need it. The new quietness was achieved by means of sound deadeners and double-wall construction which reduce noise level in cab.



Adventurer SE interior.

TOUGHER AND STRONGER THAN EVER BEFORE.

This all-new Sweptline pickup has double-wall construction which gives greater strength to the cab and box. The Sweptline box has all welded construction. The inner panels are ribbed for rigidity and strength.

THE NEW INDEPENDENT SUSPENSION SHOWS ROUGH RIDERS THE SMOOTH WAY HOME.

Independent coil springs up front make the ride carlike, but Dodge kept leaf springs in back to carry the load. Front and rear track were widened for stability and the wheelbase increased for additional smoothness of ride.



WHO GIVES YOU TOUGHNESS THAT'S JUST YOUR STYLE?

Dodge. Depend on it.



CHRYSLER
MOTORS CORPORATION



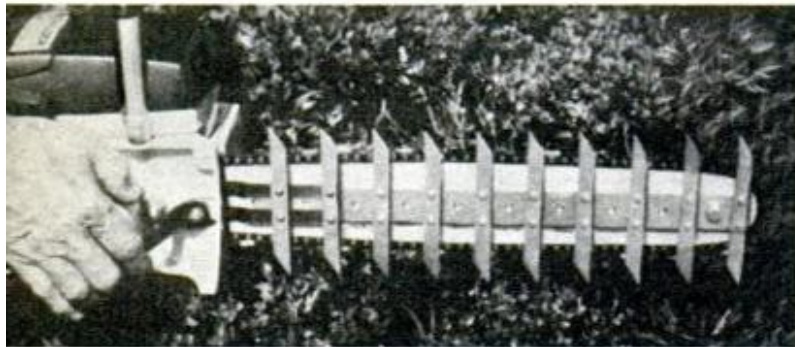
Dodge

Dodge Trucks





SOME OF THESE EXTRAS come with your chain saw when you buy it. Author recommends those shown



ATTACHMENT increases saw's versatility, makes it a great hedge clipper. Maker's name is in the text

sharpening. Though sharpening a chain used to be a job for experts, special tools are now offered that let the homeowner do his own sharpening. (Oregon Saw Chain Div. of Omark Industries, Portland, Ore., offers a fine maintenance manual free that covers this operation thoroughly. Ask for Form No. C-71-8.)

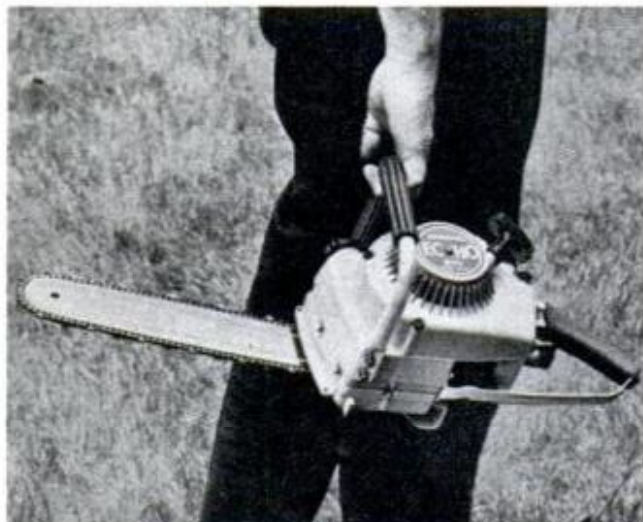
Daily care. After a day's cutting, your saw should be wiped clean. Make certain that the air intake screen and cylinder

(Please turn to page 206)

Safe Chain-Saw Operation



FOR SAFE STARTING hold handle at balance, put right foot in rear handle before pulling the cord



WALKING FROM JOB TO JOB? Turn off saw and, to avoid injury in event of fall, point bar to the rear



Goodyear GLAS-GUARD ...big on the road

The new fiberglass belted tire for Pickups



New GLAS-GUARD tire. 2 fiberglass belts and 4 nylon cord body plies.

It's big on the road.

The fiberglass belts fight tread-wearing squirm to give you long mileage.

The belts also hold the tread firm to give you command on wet roads, braking and cornering.

And GLAS-GUARD is also big off the road. Where rocks, ruts, potholes

and stumps lie waiting. GLAS-GUARD's tough nylon body, combined with the fiberglass belts, wards off the blows.

Ask your Goodyear Dealer or Goodyear Service Store for the GLAS-GUARD tire. It could give your business a big lift.

GOODYEAR

GLAS-GUARD—TM The Goodyear Tire & Rubber Company, Akron, Ohio

APPLIANCE CLINIC

By PAUL MANN

On again, off again

Why is it that sometimes our electric food mixer works when it is plugged in and sometimes it doesn't?—Timothy Franklin, Houston

Is the appliance equipped with a rubber or plastic-molded plug? These have been known to create problems. Wires in the line cord may have broken at the plug because of the rigid construction. As you move the cord one way, the ends of the break are pushed together and the plug becomes "live." As you move the cord another way, the ends of the break are pulled apart and the plug is "dead." Plug in the cord, turn on the appliance, hold the plug steady and move the cord back and forth. If the appliance cycles on and off, it is proof that one or both wires in the cord have broken. Cut the cord about 6 inches back from the plug and replace the plug with a new one.

Replacing line cords

How do I determine what size replacement line cords to buy for appliances?—Richard J. Fromka, Carlisle, Pa.

The size of the wire in a line cord and, consequently, the amount of current (amperage) it can safely carry is indicated by its gauge number. In the United States, the gauge number is normally specified by the initials AWG, which stand for American wire gauge. AWG numbers commonly range from 27 to 2. Keep in mind that the larger the gauge number is, the smaller the wire will be. For example, AWG No. 12 is a larger wire than AWG No. 18; thus, it will carry more current.

You may find the amperage required of a line cord to operate a particular appliance stamped on the appliance's nameplate. If not, the appliance's voltage and wattage should be found there. To determine the amperage, divide watts by volts. If an appliance draws 1200 watts at 115 volts, for example, the strength of its current will be 10.43 amps. Check tags attached to replacement cords to determine how much current the cords will carry safely, and always allow yourself a safety factor. Thus, if the appliance

draws 10.43 amps, an AWG No. 18 cord that is rated at 10 amps will be too small. Purchase at least an AWG No. 16 cord rated at, say, 13 amps. or, better yet, an AWG No. 14 cord rated at 18 amps.

Not all AWG wires of the same number are rated at the same amperage. Ratings depend on such variables as type of jacketing and whether the cord has two, three or four conductors. You can get AWG No. 18 cords of different types that are rated at 6, 7, 10, or 17 amps.

Electric toothbrush doesn't run

After many years, my General Electric cordless electric toothbrush stopped running. What now?—Perry F. Baker, Toronto

Since a cordless electric toothbrush is chemically sealed to be watertight (for protection against shock in the event it is accidentally dropped into a bathroom sink), you should not tamper with it. Take it to a General Electric service center in your area where, according to a company spokesman, a serviceman will test it free of charge and make recommendations.

Airconditioner problem in November?

In the owner's manual for a new room airconditioner I ran across the phrase "insufficient cooling." What is meant by this?—Gary Astor, Tampa, Fla.

The term refers to the difference in the temperature of air blowing out of an airconditioner and the temperature of air at the airconditioner intake when the conditioner is set for maximum cooling output. Turn on the unit and let it operate at maximum output for about 15 minutes, then hold a wet-bulb thermometer in front of the outlet for several minutes.

If the temperature reading of the air coming out of the conditioner is 9° or more cooler than that of the air going in, the airconditioner's cooling is sufficient.

The reason for using a wet-bulb thermometer is to set up a condition of 100 percent relative humidity, which eliminates the need of trying to determine the moisture content in the room. A wet-bulb thermometer may be made by using an ordinary thermometer (one that's fairly accurate) and placing a water-soaked cloth over the bulb. ★★★

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

**Your daughter...
she's going to buy a little car.
They're all the same...and all different.
What are the differences that count?**



When we designed the Pinto, we figured the four most important things about a car are how it accelerates, how it stops, how it steers, and how long it lasts.

Your daughter, like the rest of us, is going to drive on freeways. It's important to her to be able to get into traffic quickly—and pass without hesitation. So we gave the Pinto a dependable, strong, light-weight iron engine (it gives you more horsepower, for example, than the leading import).

On a turnpike, or anywhere else, you need a car that will stop fast and straight. Pinto has big self-adjusting brakes. Again, a significant difference from little cars like the leading import.

Steering should be precise and responsive. Pinto,

alone among the popular small cars, has a precise rack-and-pinion steering, a system so effective you'll find it on expensive sports cars like Porsche and Ferrari.

You want a little car, in the first place, because it'll save money. The real test of saving is how long the car will last. That's why we didn't stint on key parts like the drivetrain, rear axle, starter motor, ball joints, and shock absorbers. They're all strong enough for cars bigger and heavier than a Pinto.

Talk to your Ford Dealer about Pinto. Plain ones. Fancy ones. Pintos with dress-up options as shown here. He's got them all for you to drive. Better idea for safety: Buckle up.



Pinto Runabout

Pinto
Different where it counts.

TOOLS FOR PLASTIC LAMINATES

(Continued from page 171)

or moonlight for extra cash, this tool can save a lot of on-the-job grief. It's built to last and does away with nuisance corners quickly. \$24.95.

● **Heat Gun (Model 750).** This comes with the convenient stand shown and permits quick, tight bends with minimum breakage. Heat from the nozzle is simply applied to the area to be bent and pressure applied evenly until the desired radius is reached. Then, after you clamp the laminate in position, it is allowed to cool. Though not cheap, this tool could earn its keep on one good-sized kitchen counter-top job (by eliminating broken self-edges which could force you to buy more laminate). \$42.50.

● **Laminate trimmer (\$11.50).** If you have no router, this tool (plus the next two) merit consideration. After a little practice on scrap, I was able to make perfect cuts every time. Considering that the tool features a carbide needle, the price is reasonable.

● **Mica-Nife.** For \$5.50 you can dress laminate edges as neatly and cleanly as you would with a router. Even if you own a router, you can carry this handy, inexpensive tool in your nail upon for on-the-spot "dressing up."

● **Scoring cutter.** Like the trimmer, it can eliminate the router (with one exception); it comes aligned for trimming self-edges with a limited overhang and cannot be used to cut freehand. You need a straight-edge. Tests revealed the self-edge did require additional filing or follow-up with the Mica-Nife. This tool goes for \$3.

● **Sink-rim screwdriver.** Anyone who has ever lain on a floor with his head poked into a sink-front cabinet (bumping into and cussing all sorts of obstructions) while securing a sink, will appreciate this \$3.50 tool. It lets you grip the hold-down lug and start driving it with one hand. Once the bolt is started, the holder can be retracted and the lug turned home.

The paint-tray tip shown on page 172 is a trick I learned years ago. I do a lot of plastic laminating, and lining the tray with foil has saved many post-job cleanup hours.

Tools described are available from the Beno J. Gundlach Co., Dept. PM, Box 544, Belleville, Ill. 62222. Prices include mailing costs.

Plastic laminates used in work to prepare this story are Melamite—Avocado Leather (green) and Harvest Serenade (yellow). In "stone" finish, both are made by Johns-Manville, Dept. PM, 22 E. 40th St., New York, N.Y. 10016. ★★★

INSTANT REPLAY

(Continued from page 112)

produce a still picture. This is called a "freeze frame." To produce a split-screen effect, the signals from two HS-100 recorders are electronically combined to feed side-by-side images to the broadcasting transmitter. You see the quarterback fading back to pass on one half of the screen and the would-be receiver racing downfield on the other half.

Each replay recorder is controlled from a small console about the size of an adding machine. A timer at the top ticks off the seconds each play takes so the operator can tell how long an action sequence will run. How does he know exactly where to back up the heads on the discs to start a desired replay? This is the really clever part. A cueing button on the console establishes the position of the heads on the discs at the start of the recording through an electronic "memory" circuit. On playback, all the operator has to do is press the button and the heads automatically back up to the original starting point and replay the action. There are also buttons for "forward," "reverse," "slow motion," "freeze frame" and other functions.

Because of the speed and size of the spinning discs, recording time is limited to 30 seconds—enough to store the span of action during several typical plays. When all the tracks are filled, the heads move back to the beginning and start recording new images, at the same time erasing the old ones. Meanwhile, the earlier images are re-recorded onto conventional videotape in another van so they're not lost and can be reused later.

Despite its fantastic array of equipment and close teamwork, the instant replay system is not without its occasional lapses, sometimes to the amusement of viewers and the consternation of announcers and directors. Once in a while, a harried replay operator will hit the reverse button by mistake and a ball carrier will appear to be running rapidly backward toward the line of scrimmage. In one disastrous moment during a college game last year, the rerun of an exciting pass play started off normally with the ball flying toward the receiver. Then the operator accidentally brushed against the reverse button. Suddenly, the ball stopped short of the receiver and sailed back toward the quarterback. The shocked operator stabbed quickly at the forward button and the ball reversed direction again, this time landing smartly in the receiver's arms.

"Well," said the fast-thinking announcer, "he missed it the first time, but caught it the second." ★★★

You don't cop out. We don't cop out.



**You demand good taste.
But want low 'tar' and nicotine.
Only Vantage gives you both.**

**Vantage. The only full-flavor
cigarette with low 'tar' and nicotine.**

Filter: 11 mg. "tar", 0.9 mg. nicotine—Menthol: 11 mg. "tar", 0.9 mg. nicotine—av. per cigarette by FTC method.

FILTER AND MENTHOL

11 mg. tar
0.9 mg. nicotine

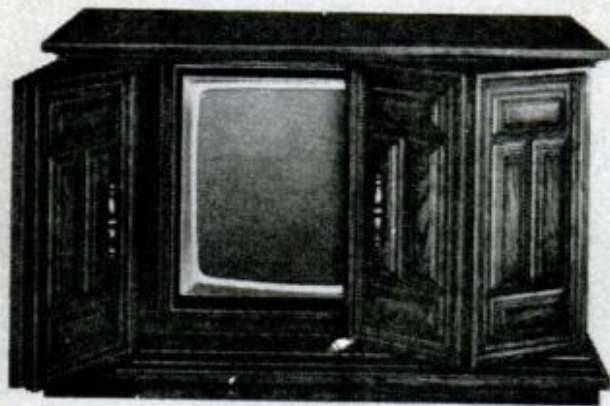
VANTAGE

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

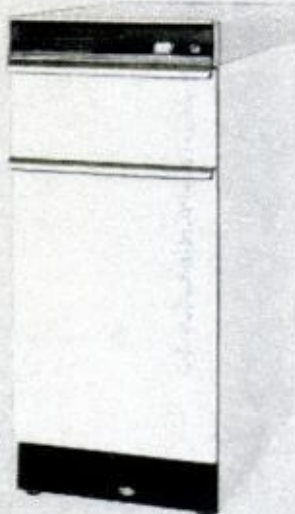
VANTAGE



A. New Cassette Recorder...119.95*



B. Heathkit 25" Color TV...579.95*
(less cabinet)



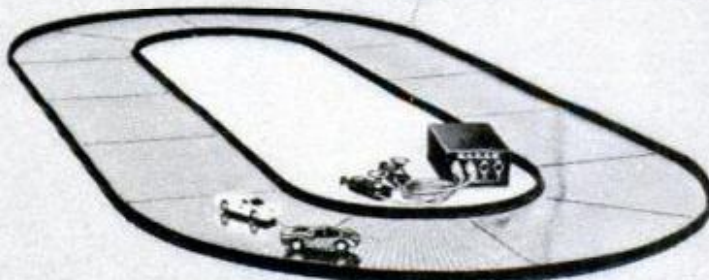
C. New Waste Compactor
...199.95*



D. New Thermo
Spotter...24.95*



E. New Timing Light
...19.95*



F. New "Slotless" Raceway ...129.95*



G. New Stereo-4 Decoder...29.95*



H. New Digital Depth Sounder...139.95*



I. New Battery Charger...29.95*



J. New Stereo Receiver...349.95*
(less cabinet)

Santa's got a brand new bag with 10 exciting Heathkit gifts

A. New Heathkit Stereo Cassette Recorder... with performance specs equal to many reel machines. Records & plays back stereo or mono through your present hi-fi system. Features bias-adjust for chromium dioxide tapes, counter, auto. shutoff, preassembled transport.

Kit AD-110, 10 lbs.119.95*

B. New Heathkit 25" Color TV... with features you won't find in any other set at any price. The exclusive solid-state design boasts the Heath MTX-5 ultra-rectangular matrix picture tube; MOSFET VHF tuner; automatic fine tuning; VHF power tuning, "Instant-On"; and exclusive Heath self-service built-ins including dot generator, convergence panel and volt-ohm meter. Shown in the new pecan finish Mediterranean cabinet with bi-fold doors.

Kit GR-371MX, 125 lbs.579.95*

Assembled GRA-405-25, cabinet shown, 100 lbs.179.95*

C. New Heathkit "Minimizer" kitchen waste compactor. Mom's best friend. A ton of force reduces kitchen trash to almost 1/4 its original size, packaging wastes in a strong disposable bag. One bag holds an entire week's trash for an average family of four. Contents automatically deodorized each time drawer is opened or closed. Key lock switch & safety interlock provided. Kit includes 5 plastic-lined bags, 9 oz. can of deodorant. Measures 34 3/8" H x 15" W x 25 1/2" D.

Kit GU-1800, 203 lbs.199.95*

D. New Heathkit Thermo Spotter. Seeks out the temperature where your favorite fish live. Completely self-contained including submersible sensing element, 100' of strong nylon cord, battery-powered solid-state meter circuitry...all housed in high-impact plastic take-up reel case.

Kit MI-104, 3 lbs.24.95*

E. New Heathkit Automotive Timing Light. Completely self-contained. Just hook a cable to battery, another to number 1 plug. Adapter provided for connection to distributor. Bright flash lets you work in sunshine. High-impact insulating plastic pistol grip case, impervious to oil, gas & corrosion.

Kit CI-1020, 3 lbs.19.95*

F. New Heathkit M.A.R.K. IV Raceway. Race up to four 1/2-scale cars with independent acceleration, deceleration - and steer-

ing! The unique circuitry and "slotless" table-top track lets you actually do the driving. Kit includes track sections for 8'x4' oval with 13" roadbed, power supply, Ford-J and Ferrari cars with controllers. Extra cars and track sections available.

Kit GD-79, 13 lbs.129.95*

Kit GDA-79-1, extra car & controller, 3 lbs.21.95*

G. New Heathkit Stereo-4 Decoder. Compatible with your present stereo system & FM receiver. Lets you hear new Stereo-4 broadcasts. Also imparts 4-channel effect to your existing stereo library. Requires second amplifier & 2 speakers for installation with conventional stereo systems.

Kit AD-2002, 5 lbs.29.95*

H. New Heathkit Digital Depth Sounder. Gives accurate, digital depth readings at a glance...no more marginal readings. Automatically switched dual range scale gives depth readings from 2' to 19.9' in 0.1' increments; from 20' to 199' in 1' increments. Red warning light alerts you to shoals of 10' or less. Automatic noise rejection and gain control. Choice of thru-hull or transom-mount transducers.

Kit MI-101-1 (w/thru-hull transducer), 6 lbs.139.95*

Kit MI-101-2 (w/transom-mount transducer), 8 lbs.139.95*

I. New Heathkit 10-amp Automatic Battery Charger. Charges 12-volt batteries automatically. Foolproof operation...won't start if hooked up wrong. Brings battery to full charge, then shuts down, maintaining just enough current to compensate for normal leakage. No charge settings to adjust...leave it hooked up indefinitely for a fresh start every time.

Kit GP-21, 13 lbs.29.95*

J. New Heathkit AR-1500 Stereo Receiver. Successor to the famed Heathkit AR-15, with impressive improvements in every critical area. 180 watts Dynamic Music Power, 90 watts per channel, 8 ohm load. Less than 0.2% IM and 0.25% harmonic distortion. Greater than 90 dB FM selectivity and 1.8 uV sensitivity. Vastly superior AM. New low-profile styling and famous Heath "Black-magic" panel lighting.

Kit AR-1500, 42 lbs., (less cabinet)349.95*

ARA-1500-1, walnut cabinet, 6 lbs.24.95*

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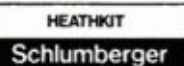
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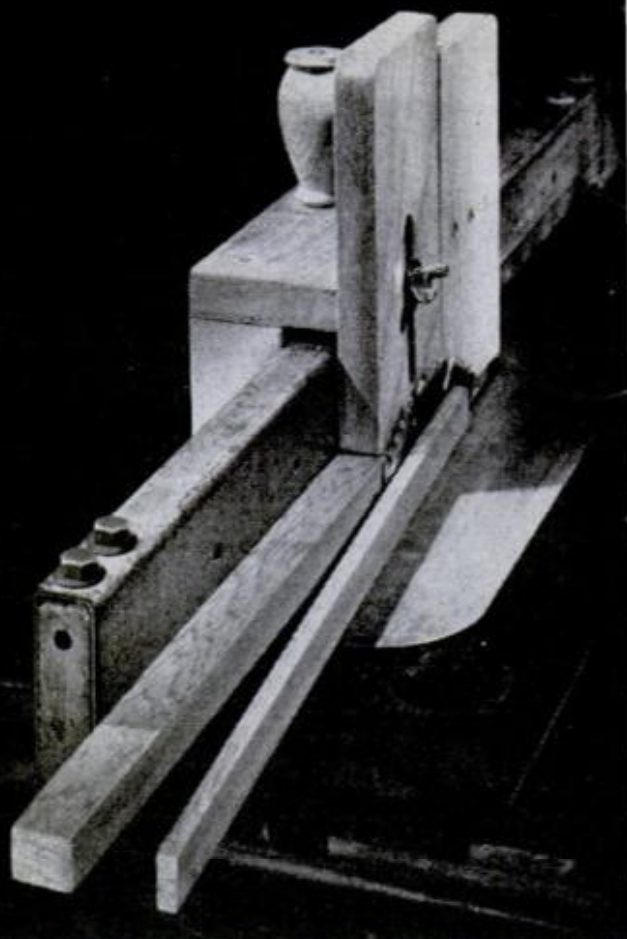


Make This Supersafe Pusher Jig

Cutting narrow strips on a table saw always calls for a pusher stick. Here's a version that gives maximum leverage and safety

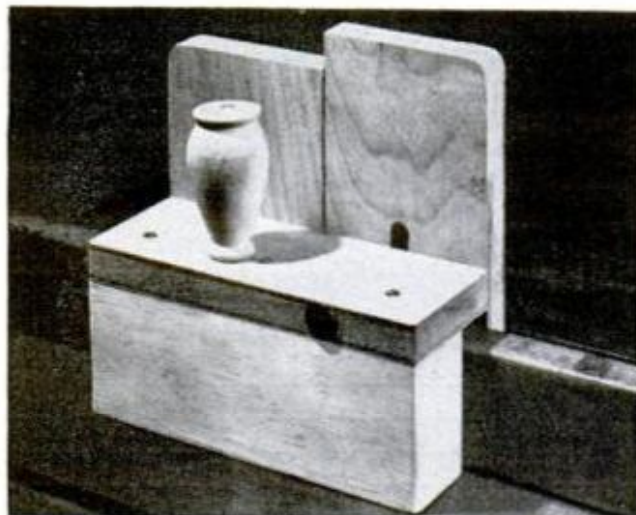
By ROBERT K. WALLACE

Photos by Robert D. Borst

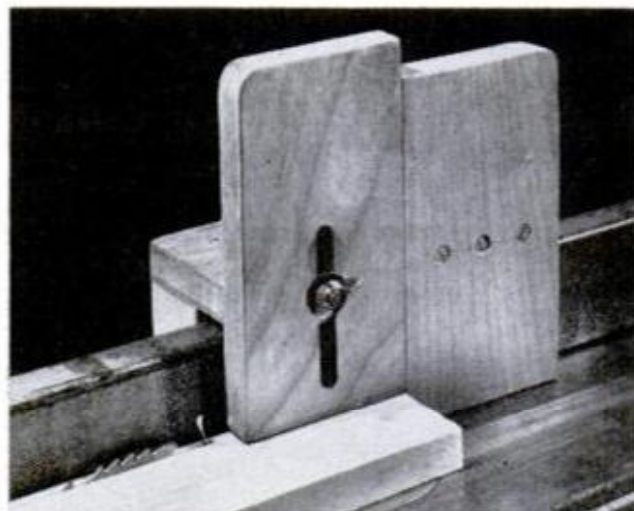


IF YOU HAVE ever ripped narrow strips on a table saw—utilizing a conventional push stick—there are moments when you feel that you don't have complete control of the workpiece—especially if the wood is thin. Not so with this version. Since the adjustable portion can be set to snuggle the work, control is positive at all times and leverage is greatly increased over that of its less versatile predecessor. And, since good shop practice calls for the use of a pusher when the rip fence is within 3 in. of the blade, it will see plenty of use in the average home shop.

Designed for use on a table saw with a rectangular fence (such as the one shown), the pusher can be cut on the table saw with the exception of its handle. The model shown is of 3/4-in. lumber-core plywood, but you can use any other type of plywood or a solid stock, such as maple or walnut. The handle that was used here is a section of



HANDLE FOR PUSHER is factory-made Spindleflex section which is sold at lumberyards. Its hefty size fits male hand comfortably, gives good control

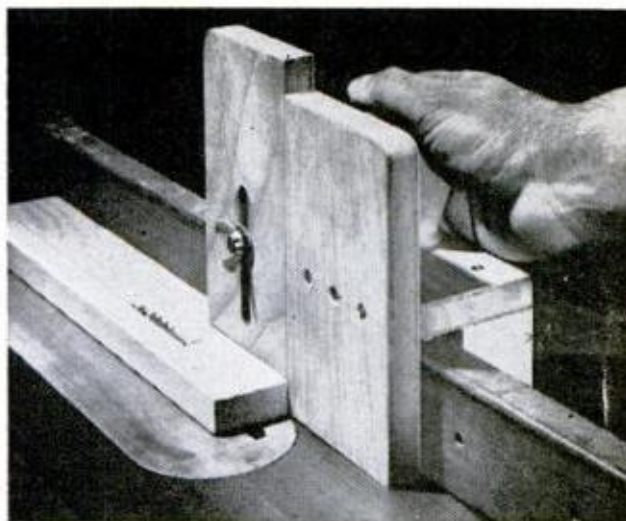


WINGNUT AND WASHER hold adjustable half of jig securely at desired height. Fixed half is assembled with screws only so it can be replaced as needed

Spindleflex purchased from the local lumberyard. You could, however, hand-fashion a handle of 2x2 stock by rounding the corners for hand comfort. The finish used on the jig is a liberal application of paste wax on the portions that slide on the table and against the fence. No other finishing is necessary.

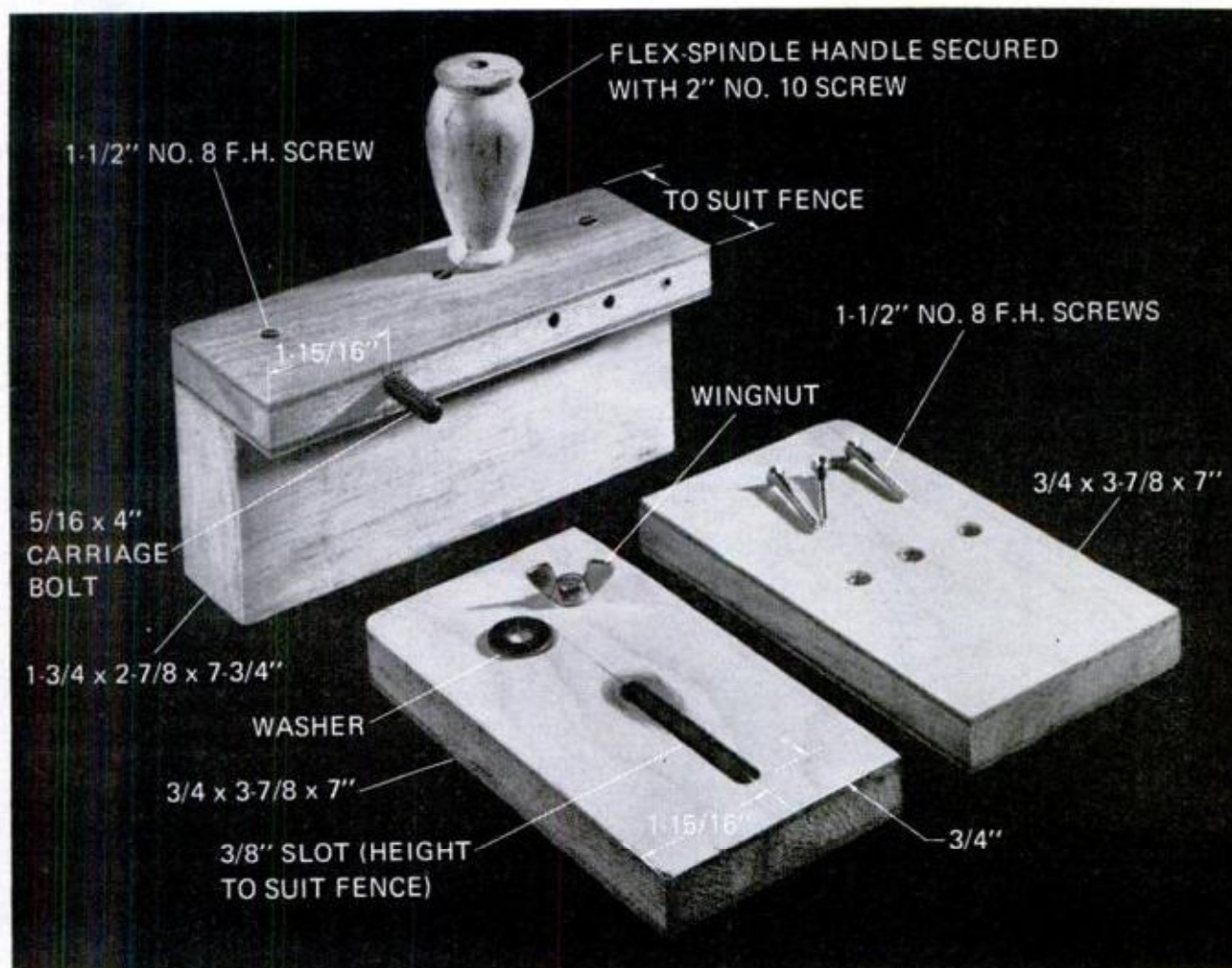
In use, the pressure foot of the jig is adjusted to the thickness of the workpiece and clamped in place by tightening the wingnut. The jig then provides a hold-down for the stock as well as a push stick. The operator's hands (photo, right), are completely away from the blade, even when ripping narrow material.

For photographic reasons we show the jig slicing narrow strips off a piece of stock. In practice, when ripping a lot of like strips, the fence is normally set to the desired width and the same piece of wood is repeatedly fed into the blade. To do that with this jig, set the blade to just clear the top of the wood being ripped and push the jig clear through the blade to complete the pass. Eventually, the

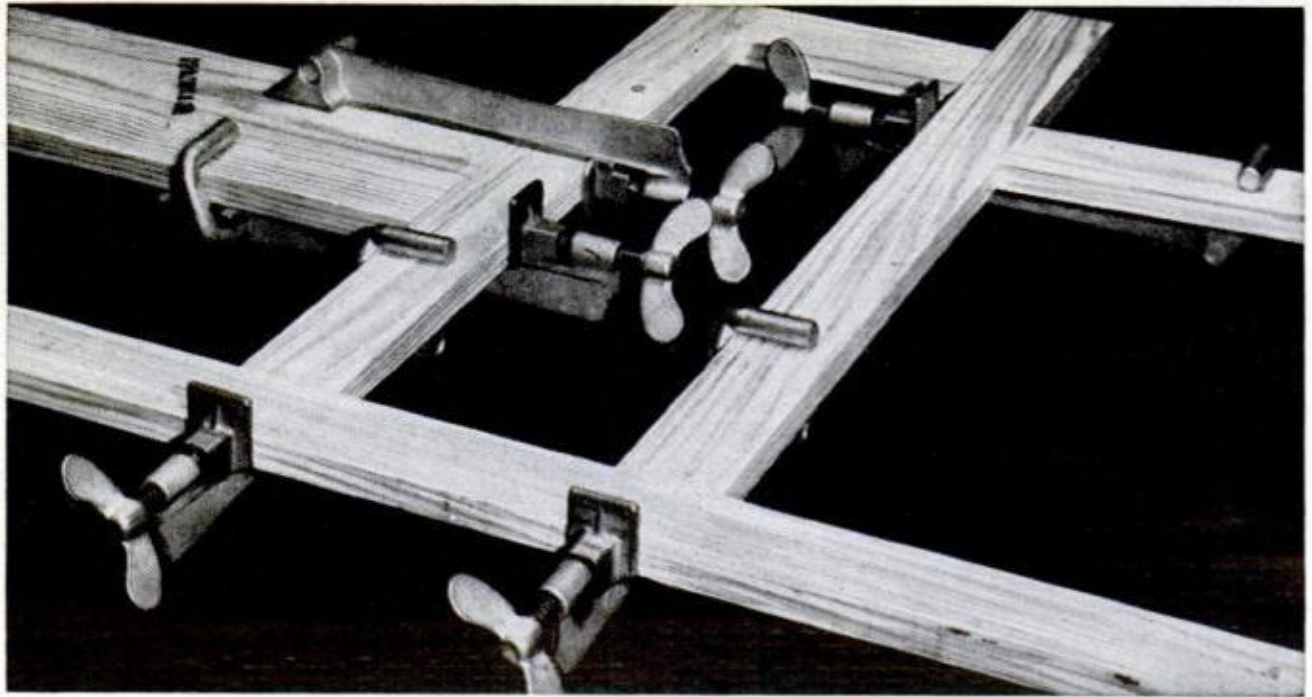


CUTTING NARROW STRIPS this way means moving the fence after each pass. If fence is set desired distance from blade, bottom of jig will be kerfed

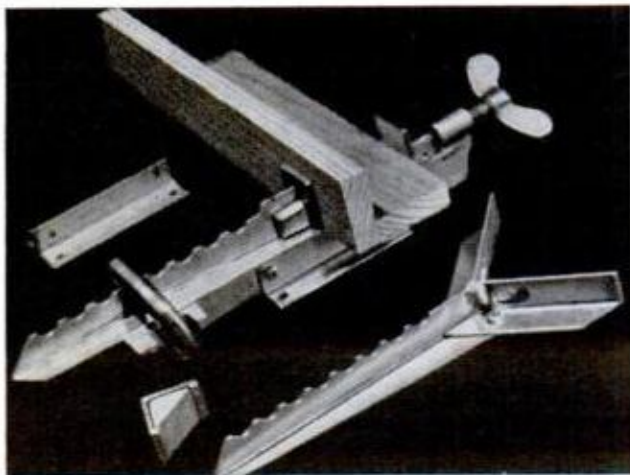
pressure foot and pusher bottoms will be chewed up, but replacing these parts is simple. *Caution:* Don't try this procedure using a wide plank. In our tests, wide boards had a tendency to "walk" from the fence at the lead edge. This can cause binding; that, of course, is unsafe. ★★★



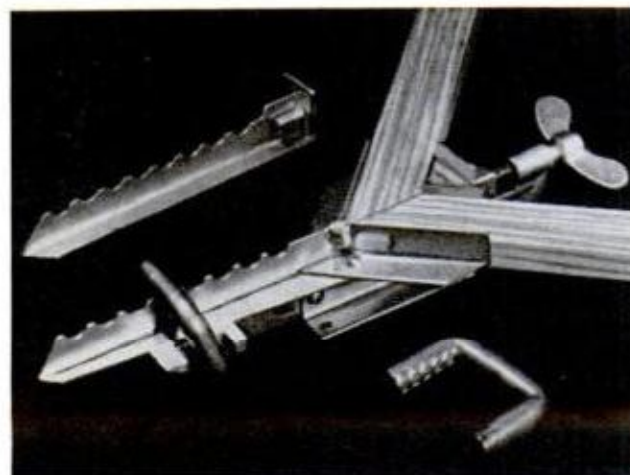
LUMBER-CORE PLYWOOD was used to build prototype, but solid pine or hardwood could also be used. Build the jig so that it will clear the boltheads on the rip fence. (See photo at top of facing page)



New universal clamp is three clamps in one



ADJUSTABLE NOTCHED FLAT JAW slips under U-shape gripper to convert clamp to bench vise. T-mount holds clamp upright, permits anchoring to benchtop



ADJUSTABLE NOTCHED V-JAW is interchangeable with vise jaw to convert clamp to miter clamp. Extra gripper is available to handle work up to 1 1/8 in.

THERE WAS A TIME when the length of a bar clamp limited the size of the glue job. Now it's almost a case of the size of the job being limited by the size of your shop for there's a new adjustable clamp that knows no limit. Measuring only 14 in. long, this shortie "bar" clamp is designed to grab the work close to the joint, which means that to be a bar clamp it need not be a "mile" long. Also, there is no bowing of long work.

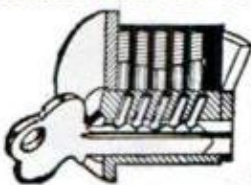
A fixed, friction-gripping U-jaw slips over the edge of the work and the more the movable jaw is tightened, the more the U-jaw grabs hold. A light tap loosens the U-jaw to release it from the work. On finished work the U-jaw is padded with rubber to prevent marring. Interchangeable gripper jaws are available for work from 3/4 to 1 5/8 in.

Besides being a bar clamp, this revolutionary clamping device also acts as a workholding vise when bolted to a special bench mount and fitted with a notched jaw. When the notched vise jaw is replaced with still another notched V-jaw, it becomes a miter clamp. In this instance, a special bevel jaw slips over the flat jaw of the clamp.

Made by Universal Clamp Corp., 6905 Cedros Ave. Van Nuys, Calif. 91405, the clamp sells for \$5.95, the miter attachment is \$3.50 and the bench mount is \$1.50—all plus postage. ★★ ★

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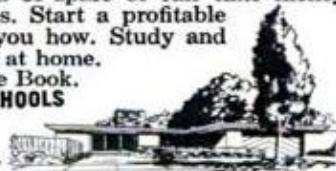
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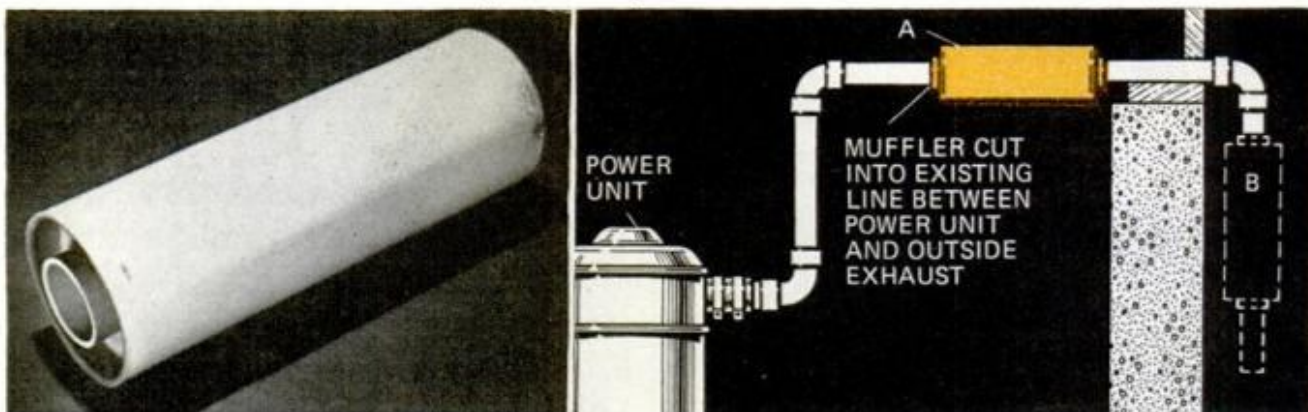
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New add-on muffler quiets your built-in cleaning system



If you've had minor complaints from neighbors about the noise your built-in vacuum-cleaning system makes, you can now add a muffler which cuts down the emission noise of the unit outside the house. Made by H-P Products, Inc., Louisville, Ohio, for adding to its own Vacuflow system, (*How to Install a Built-in Vacuum System*, page 158, Sept. '67 PM), the muffler can be installed in any

existing system having 1 $\frac{3}{4}$ -in. tubing. Measuring 4x12 in., it is inserted in the line between the power unit and the outside exhaust (A). When there isn't room in the line inside the building, the muffler, can be installed outside (B). The muffler, now included with all Vacuflow units, can be purchased separately for \$7.41 for adding to earlier models. A section is merely cut from the pipe.

Detergent makes decals stick

If the decals on your plastic models seem to stick at first, only to come off later after they have dried, remember this trick when you apply them the next time. Add a few drops of liquid detergent to the water. Not only does the detergent make the decals stick like glue, but it makes them slide off the backing and move into place with less trouble.—*Floyd S. Adams, Geneva, N.Y.*

Wet cloth beats sanding

Anyone who has sanded joint compound between applications when taping drywall knows what a dusty job it is. I hated the job until I learned about the wet-cloth method the pros use. Instead of feathering the edges with sandpaper all you have to do is wait a day for the compound to dry, then "sand" the edges with a wet cloth wrapped around a flat block.—*Jerry H. Renjilian, Newton, Conn.*

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CABINET WORKBENCH FOR A SMALL SHOP. This sturdy little bench fits a small or medium-size shop since its length can be made to suit. There's a roomy drawer with lift-out tray, plus a bottom compartment for storing paints and other workshop gear.

HANDSOME BUFFET LEADS A DOUBLE LIFE. Richly decorated with molded Spanish carvings, this versatile piece of furniture not only serves as a credenza for glassware and dishes, but can be rolled out and swung open to provide a 6-ft. "party bar" or buffet counter.

EARLY AMERICAN CLUB CHAIR. Both beautiful and comfortable, this American traditional easy chair is a project for the advanced craftsman. A graceful, authentic design from the past, its cherrywood frame makes use of ready-made foam cushions. Presented in two parts.

HOW TO HAVE POWER WHEN THERE IS NONE. For as little as \$350, a portable generator can keep your house safe and bright when the power lines fail. And experts tell us that this is more likely than ever to occur. Pick up the December issue of PM and learn how to prepare for such emergencies and turn "brownouts" and "blackouts" into "lights-on" at home.

BEARTOOTH MOUNTAIN ORDEAL

(Continued from page 89)

ing each other's warmth. Shifts in weight would drive a knee into the back or an elbow into the gut, prompting a smothered curse. But we clung to each other to survive, teeth chattering and bones shaking.

Several times Vern tried his walkie-talkie. But he couldn't raise anyone in Red Lodge, Cooke City, or anywhere else. Nobody wanted to talk to us that night.

We would have died if the temperature had dropped below zero. It stayed around the 15°F mark. But the fierce wind created a chill the equal of minus 50° or 60°F.

At 7:00 p.m. Vern yelled, "Everybody up and jog." We ran in place for 10 minutes before huddling against the snowmobile again. As the night wore on, jogging became our hourglass—10:00, 11:00, 12:00 o'clock. It now was Sunday. We'd been on the mountain for 16 hours. If

... we clung to each other to survive, teeth chattering and bones shaking.

things had gone right, we would have been sacking it in Gardiner.

I slept fitfully. My mind wandered. I didn't think about dying, but how to keep my hands and feet from freezing. And I wondered about the others. Had they made it to the Top of the World? Next day I was able to piece things together.

Our group of five had brought up the rear. Up ahead and nearest to us were Bob Leiviska, Monte Later and Hugh Galusha. They'd dug a trench in a snow-slope and holed up for the night under a plastic tarp. Hugh was weak but uncomplaining. He slept more than the others.

Miles ahead of them was a group of five: Paul Dickson, Jim Marshall, Bob Leiviska Jr., Dee Street and Marilyn Waples. They had managed to get off the plateau and into the trees before nightfall. They walked and walked, with spunky Marilyn leading the way much of the time. She knew the mountain, its moods, its power. She felt tired and angry.

Walking was torture. They sank up to their knees with almost every step. Being heavier, the football players went in much deeper. After a while, little Bobby seemed to have more strength than anyone else. He found the dell under a stand of huge firs where they could rest.

They built a fire, using every bit of paper they had—candy bar wrappers, blank checks, even paper money—to get

twigs and branches started. As the fire rose, Marilyn looked past the flames and said, "Maybe Vern will see it."

Vern Waples at that moment was less than 200 yards away, hidden in a snow-cave. Earlier, he had tried to keep the forward party together, telling them to try to slog it to the souvenir shop. Then he'd gone ahead on his own, moving with the greater speed of the experienced mountainman. But finally the exertions over 16 hours caught up with him. Instinct told him to hole up for the night.

The last two members—Loren Miller and Averill Kronick—got closest to the Top of the World. Two miles away they gave up, dug a cave and got into it.

At 6:30 a.m., Sunday, our party started down the mountain. Now it was just a matter of slogging through the snow, tapping what resources of strength we had left. It wasn't long before we spotted Monte Later and Bob Leiviska. Monte stood motionless, looking at the horizon with opaque eyes. Bob seemed stunned, too. His goggles were half off and part of his face was bared to the biting cold. It was not easy for them to talk.

Hugh Galusha had died that morning. He had last spoken to Monte and Bob at 6:00 a.m., saying he was "okay." But at 6:30 they couldn't rouse him. They'd massaged his rock-hard hands and breathed into his mouth. But there was no responding breath, no pulse, no life. (Days later the medical verdict was in: Hugh had died of exposure.) We marked the cave where Hugh lay for our return the next day.

We pushed on. At 2:00 p.m. we saw three figures in the forest. Easiest to recognize was big Jim Marshall. We learned the others were at the souvenir shop.

At 4:00 p.m. a big snowcrawler from Cooke City arrived at Top of the World. The ordeal was over. The driver passed out candy bars and a bottle of Old Taylor. There was little joy among us for we thought of Hugh, a gentle and great man whose nobility was shown in the grace with which he had accepted his last hours.

What happened could not be blamed on anyone—or on the machines. Gale-force winds blew snow into carburetors, causing them to ice. Throttles froze, drive belts slipped. These problems could have been corrected by a mechanic. But the party was strung out over miles, making it impossible for the two mechanics to get to more than a few vehicles. Time ran out and the blizzard hit with full force. Night locked us in.

I will always remember that night on Beartooth. It taught me a lot about the moods of mountains—and the majesty of the human spirit. ★★ ★

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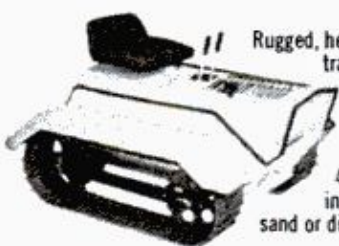
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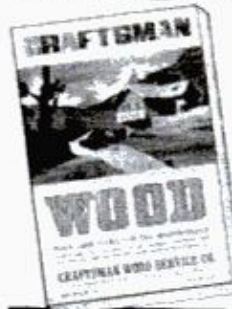


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Public Announcement

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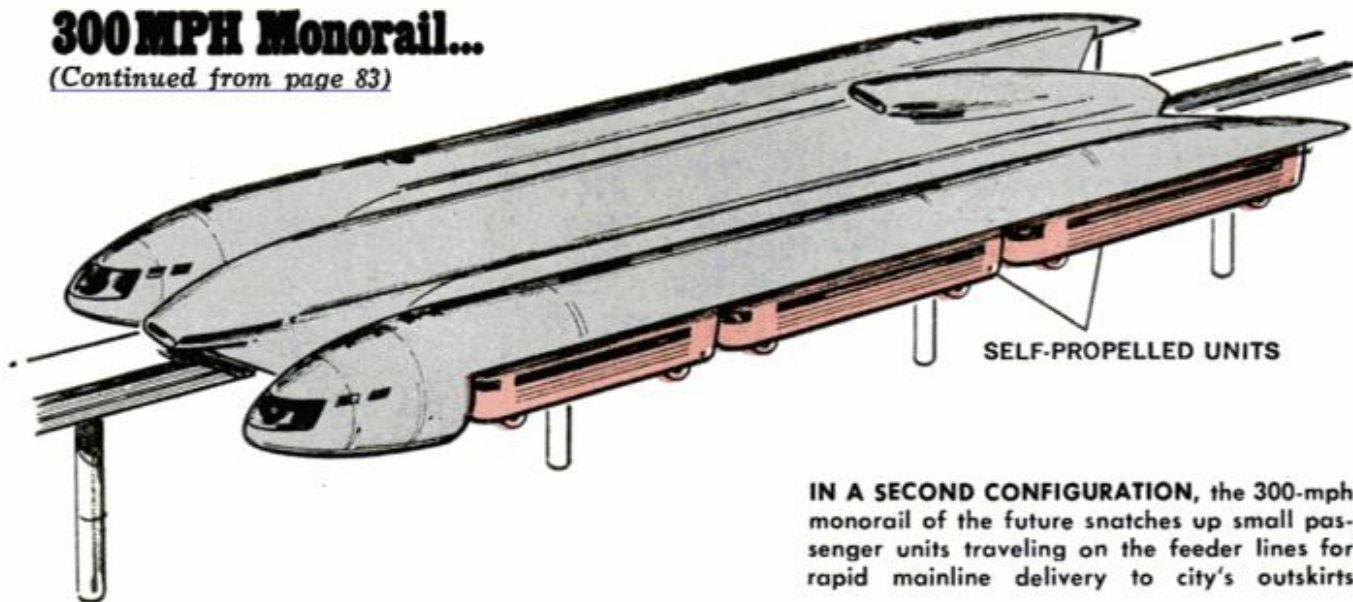
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300 MPH Monorail...

(Continued from page 83)



IN A SECOND CONFIGURATION, the 300-mph monorail of the future snatches up small passenger units traveling on the feeder lines for rapid mainline delivery to city's outskirts

would rest on hinged, movable stanchions. A big hydraulic piston would nudge the tracks to either side and bring them back to their original position again. The angle of the list could be calculated over a given distance of track for a given number of movable stanchions so that the main track would move sideways to any number of waiting spurs. This would be computer controlled.

With the train's weight straddled on top of the track and its two fuselages hung to the sides, crosswinds would have almost no effect. No matter how much the train banked while rounding a turn, the support columns couldn't possibly get in the way. And passengers would feel no jostling or sway.

The Tri-Mono-Trans System would be powered by a 5000-hp linear induction electric motor. Simply put, in linear induction you have a conventional rotary electric motor laid flat. In the train system, the track becomes a long armature, and the field coils are built into the train. With alternating current put into the track, the train moves along and is braked by reversing polarity.

However, track and train must not touch. The train must be kept off the six-foot-wide track an inch or so. This is done with wheels at low speeds, and air pressure at high speed.

From standstill to about 100 mph, the train rides on rubber tires that come down in a way similar to airplane retractable landing gear. At 300 mph (normal cruising speed) enough air enters the lifting fuselage under ram pressure to allow compressors to be shut off or do no more than minimal work.

Inside the hollow upper central fuselage, four electrically driven air compressors fill the double-walled lifting fuselage with 1.6 psi—enough to lift the craft off

the track and let it ride quite literally on a cushion of air.

The air compressors and the linear induction motor swap off electricity requirements. When starting up the train, the compressors eat up a lot of current to lift the train, but forward thrust demands are small. As speed increases, ram air induction supplies the lift, while the electricity-hungry linear motor provides thrust.

Trent projects the weight of his 204-passenger train at 112,845 pounds. This would take a 5000-hp linear induction motor to handle forward motion and 3200 hp to run the air compressors at low speeds. That amount of power would require 2500 volts.

Potential uses for the system, Trent believes, are varied.

A commuter could get into a small, slow (100 mph) monorail car a block from his suburban home. It would move to join a large Tri-Mono-Trans train on a parallel track, where it would be attached to an under-carriage. Then on to a city perhaps 200 miles away. There the small car would be detached, and proceed on its own track to the center of the city. The whole trip would take 40 minutes.

The system also lends itself to cross-country freighters that would be routed and switched by computer with no manpower on board.

Trent's "toy" may someday prove to be just the thing to move masses of people and material to and from cities.

Some engineers believe monorails would be too noisy. Others say the linear induction motor's capacity to create ozone would be a problem. However, none of this can be proved until a full-scale test is conducted—perhaps in the 1980s.

We have a while to wait before this speedy commuting train comes in. ★★★



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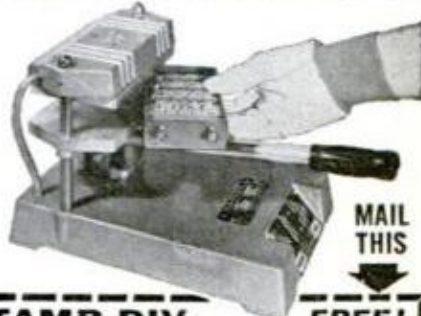
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FIREFIGHTING

(Continued from page 117)

ter." It forms a tough blanket that floats on top of a blazing oil slick or gasoline spill and smothers the flames. Other kinds of foam have been used to combat such fires, but they tend to break up into islands, leaving exposed areas where the fire can rekindle.

In the last few years the traditional pumping engines and ladder trucks have been joined by a growing number of new vehicles designed to fight certain kinds of fires more safely and efficiently. The first of the new breed is the tower ladder, or "snorkel," which mounts an arm some 65 feet long and has an elbow in the middle and a platform at the end with plenty of room for three firemen to work. The arm contains a large-diameter water pipe, enabling the men to shoot water into windows five or six stories above the ground without entering the building.

The tower can also be swung around

... on its top deck is a water cannon so powerful it can knock down a brick wall.

and up and down to rescue people from window ledges, fire escapes and rooftops of low buildings (for which it is also known as the "cherry picker"). Not long ago at a tenement fire in New York's Harlem, one tower ladder evacuated 25 people from a five-story building in a matter of minutes. The value of towers has become so widely recognized that production cannot keep up with demand. New York, with six in service, has 31 on order and has budgeted for at least 20 more.

This year the tower ladder acquired a little brother, with a trade name of Squirt. Its movable arm is shorter and lacks a platform, but it does have an extra elbow. This enables firemen manipulating remote controls on the ground to aim a heavy stream of water down through a roof or around a corner, or in a window, without exposing themselves to the blaze.

Some departments are building or ordering special apparatus designed by their own fire engineers. For enormous fires, such as the burning of an oil refinery, Memphis has in reserve its "multimaster." Roughly the size of a diesel locomotive, it can shoot out 5000 gallons of liquid per minute—roughly three times the capacity of a large pumper. And on its top deck is a water cannon, five feet long and four

and a half inches in diameter, so powerful that it can knock down a brick wall. New York has a similar behemoth, called the "superpumper."

When the first elevated freeway was being built in Seattle a few years ago, Fire Chief Gordon Vickery decided that it would be virtually impossible to extinguish any big freeway blaze with water piped from inaccessible street hydrants 30-40 feet below. His engineers came up with a unique vehicle which, when it was built by a local company, was promptly nicknamed "Puff the Magic Dragon." Puff carries a potent one-two punch. First it shoots out a dense cloud of 1500 pounds of a dry chemical extinguisher—which has the effect of dumping a steamshovelful of dirt on a campfire. Then several thousand gallons of foam is produced from a water tank on the truck which keeps the fire from springing back to life. Puff is also equipped with a 1750-gallon-per-minute fire pump and 3000 feet of fire hose of various sizes. Now other cities are requesting plans and specifications for Puff with the intention of using it as a crash truck at airports.

Perhaps the most startling change in fire apparatus was made by Chief Louis Witzeman of Scottsdale, Ariz., a former newspaperman with a penchant for thinking out problems on his own. "Why should all fire apparatus be red? Although red looks great in the July Fourth parade, it is just about invisible at night." After experimenting a bit and consulting psychologists versed in color visibility, he had Scottsdale's modest fleet painted canary yellow. Now they are highly visible, even on the darkest night.

Los Angeles has taken the lead in using firefighting helicopters because of its peculiar forest-fire problem. In the early fall, when the city's mountains are parched, two or more copters keep vigil night and day. Back and forth they cruise, while firemen aboard scan the ground with binoculars for any sign of flames. When they glimpse a suspicious light or smoke, they radio an alarm and pinpoint the location for fire companies on the ground.

Sometimes the copters do more than merely scout. In one instance last year, when a fire broke out on a particularly inaccessible peak, four of them formed a flying bucket brigade. Equipped with belly tanks, they shuttled back and forth between the fire and available water supplies and dumped enough water on the fire to keep it under control until it could be extinguished by a regular crew.

Clothing and tools are being upgraded more slowly than apparatus, because in

(Please turn to page 202)

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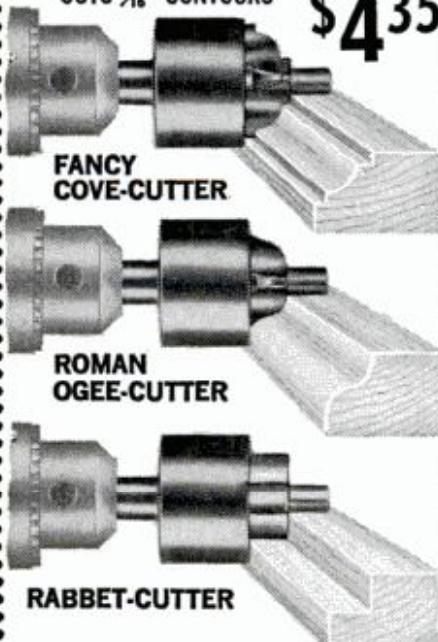
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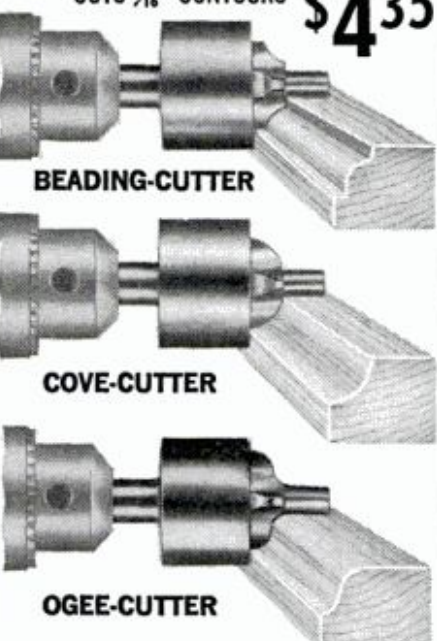


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FIREFIGHTING

(Continued from page 200)

many departments the feeling is still strong that a fireman ought to look like a fireman. That is to say, his turnout coat ought to be made of a thick, black, rubberized material—although it is heavy and stifling hot and, being black, absorbs heat. His helmet ought to be a simple inverted leather bucket with a tailpiece curving down behind, and he ought to carry an ax for chopping ventilating holes in roofs and walls.

All these relics are gradually headed for museums. The first to go is the megaphone—most departments are replacing it with walkie-talkies small and light enough to be carried in a shoulder holster. The fireman's traditional ax and pike remain standard, but they are being augmented by chain saws and other power tools that can swiftly cut holes through wood or even concrete and save precious minutes. Every Memphis fire engine now

. . . the megaphone—most departments are replacing it with walkie-talkies . . .

carries a "lance," an ingenious five-foot-long pipe that fits over the nozzle of a hose. Its hollow, stainless-steel tip, shaped like a blunted arrowhead, is easily jabbed through a light partition so that firemen can squirt water into a room without taking time to chop a large hole in the wall. And, to replace the old-fashioned inverted-leather-bucket helmet which provides no protection at the sides, globe-shaped helmets of reinforced plastic with transparent visors that shield the entire face are coming on the market.

The firefighting techniques of today's better-equipped fireman are changing, too. Some commanders are "replaying" fires on film or videotape to study their own tactics or to teach fundamentals to recruits. Computers programmed to act out the kind of holocaust that rarely occurs enable officers to rehearse for earthquakes and other major disasters.

For especially big fires, or a series of smaller fires concentrated in one neighborhood, Los Angeles and New York have created cadres of shock troops. In New York they are called "tactical control units," and they are on duty in high-alarm neighborhoods only during peak hours: 3:00 in the afternoon until 12:30 a.m., when more than half of all alarms

are received. In Los Angeles, where they are known as "task forces," they are on call around the clock to help out when needed anywhere within a radius of several miles.

Clever educational programs have enabled a few enterprising fire departments to get effective public aid in firefighting and fire prevention. Ten years ago, Fresno, Calif., passed a Dangerous Buildings Ordinance, a law that permits the fire marshal to close any building that is a fire hazard. He has the power to make all building owners comply with minimum standards at their own expense. Though repeatedly fought in court, the law has been gradually enforced.

Los Angeles has also seen to it that new structures have a certain amount of "built-in" fire protection. The fire department requires, for example, that one window pane at each corner of each floor of a hermetically sealed high-rise building be openable or made of a special glass which crumbles to tiny granules when struck with a hammer or ax. This enables firemen to ventilate a floor promptly, for the granules cannot harm anyone when they shower down on the street.

Several years ago Chief Edward A. Hamilton in Memphis assigned two officers full time to give a short but thorough course in firefighting and fire prevention to all who wanted to learn. The response has been enthusiastic from workers in all occupations and institutions. Nurses and orderlies in hospitals, employees from the waterfront, and plant engineers from factories and refineries enroll in droves. Last year alone a total of 33,000 people learned what to do until the fire department arrives.

It is, of course, impossible to gauge how many disasters the Memphis program has averted. But its benefits have spread astonishingly far. In May 1970 an explosion and fire occurred in a new 26-story Holiday Inn in Acapulco, Mexico. All guests were evacuated calmly and safely by the staff, which had just a few months before taken Chief Hamilton's course at Holiday Inn training headquarters in Memphis.

Engineering and science have contributed a great deal to firefighting in the last few years, but everyone who has seriously studied the problems thinks a great deal more can yet be accomplished. Chief Witzeman of Scottsdale puts it this way: "Much of the technology we need today is right here waiting for us to adapt it to our needs—not just hardware, but psychology and modern management methods as well. Let's quit thinking of ourselves as professional heroes and start acting like heroic professionals." ★★★

SERVER WITH A SECRET

(Continued from page 161)

accumulates dirt over the years is a logical place for darkening. Use the rag to blend all dark spots into adjacent stain.

Coat the plaques with red enamel, allow to dry and antique the same way as before using a flat black enamel.

Finally, give the entire piece three coats of varnish. You can, if desired, let the final coat cure for three or four weeks and then apply Butcher's Wax and rub it to a soft luster. ★ ★ ★

MATERIALS USED IN PROJECT

If not available locally, write to manufacturers for buying information.

Hardware: Bara Industries, Inc., Box 935, Somerville, N.J. 08876 (Set No. 1T-134, \$4.99. Add 75 cents for mail order).

Plaques: Emco Repli-Carve, Box 864, New York Ave., Des Moines, Iowa 50304 (Plaque No. E-210, \$3.99; adhesive, 98 cents per tube).

Finish: Pecan oil stain and Heirloom semigloss varnish, McCloskey Varnish Co., 7600 State Rd., Philadelphia, Pa. 19136.

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YOU'RE ON 4 CHANNELS NOW!

(Continued from page 135)

ent stereo amplifier or receiver. These are often called "slave" or "add-on" units. Your existing stereo system feeds the front pair of speakers, and the slave feeds the rear two.

Still other cartridge players are self-contained units with four channels of amplification built in. You need only four speakers to complete the system. Prices start out at less than \$90 for cartridge decks and range up to about \$400 for self-contained players including speakers. If you already have a stereo amplifier, the add-on or slave-type player is a good choice. These go for about \$150 to \$300. Some self-contained models have inputs for other components, such as a phonograph or tuner—a good point to check on if you're considering using a cartridge player as the nucleus of a larger hi-fi system.

Another big trend is to add-on "converters," also known variously as "decoders," "synthesizers" and "quadraphonic processors," depending on which maker's literature you read. These are basically two-channel amplifiers but with a lot of added fancy circuitry for creating special effects. Like two-channel cartridge players, they are also designed for use with your existing stereo amplifier or receiver to provide the other two channels. Combined with your existing system, they will play discrete four-channel sources, such as from a quadraphonic cartridge deck, or they will provide synthesized four-channel effects from so-called "matrixed" two-channel sources.

In matrixing, currently being tried on records and FM radio broadcasts, four channels of information are piggybacked into two through an electronic mixing process for recording or broadcasting on conventional stereo channels. In playback, the two matrixed channels are "decoded" into the four original channels and these are fed to four separate speakers.

Converters and decoders can do other tricks, too. They can enhance the four-channel effect from either matrixed or conventional two-channel sources by altering speaker phasing and introducing a slight time delay between the front and rear speakers to simulate the rich, reverberant quality of concert hall sound. Elaborate controls let you vary at will such factors as speaker balance, separation, phase shift and reverb effect so you can tailor the sound to your own tastes and room acoustics. Prices for converters range from under \$100 to over \$300 depending on the complexity and flexibility

of their design. The more expensive models do more things.

Converters probably offer the most fun if you like to play sound engineer and experiment at creating your own special effects. If you're starting from scratch, there are also self-contained four-channel amplifiers that offer many of the same sophisticated controls. These make sense if you don't already have a stereo amplifier or are thinking about buying a new one. Prices for four-channel amplifiers—not as high as you might imagine—start as low as \$230 and go up to \$600 for fancier models that also incorporate four-channel receivers.

The accompanying photos show most of the four-channel equipment currently on the market, and the diagrams illustrate how the various systems fit in with your present hi-fi setup. However, space limitations prevent repeating here some of the more technical details discussed in the earlier article. For a complete picture of quadraphonic sound, see also *4-Channel Stereo—Here at Last!* page 66, Aug. '71 PM. ★★

EMISSION CONTROL SYSTEMS.

(Continued from page 141)

valve is working freely. Apply some manifold heat control valve solvent to each end of the valve shaft, but be sure that the area is cold when you do this. Work the valve back and forth a few times to distribute the solvent.

A recent type of emission control system is the evaporative emission control. Its purpose is to reduce fuel vapor emissions that normally vent into the atmosphere from the fuel tank and carburetor fuel bowl. One variety of this system, used by General Motors and Ford, has a carbon canister with a filter that should be replaced every 12 months or 12,000 miles, whichever comes first.

A different variation used on Chrysler Corp. cars feeds fuel vapors through vent lines to the crankcase where they are drawn into the combustion chambers by the crankcase emission control system. This system requires no maintenance service.

Effectiveness of emission control systems, as well as top engine performance and power, depend upon exact tune-up. This means that idle speed, ignition timing and dwell must be adjusted to the right specifications. Since these adjustments are so critical, each manufacturer has now placed specifications on a clearly visible label in the engine compartment. ★★

STORING YOUR BOAT BATTERY

(Continued from page 121)

cell is dead and the battery is finished. Get rid of it.

Most good hydrometers have built-in thermometers that allow you to read temperatures directly. If not, take a separate reading with a thermometer and apply its results to your specific gravity reading. Add .004 gravity points to the latter reading for each 10° of temperature above 80° F. that the electrolyte shows. Subtract .004 gravity points for each 10° of temperature below 80°.

For example, if the specific gravity is 1.250 and the acid temperature is 20° F., deduct .024 gravity points. This gives a corrected reading of 1.226.

Average the readings. The following explains what the results mean:

Avg. Specific Gravity	Meaning
1.260-1.280	Fully charged
1.230-1.250	75% charged
1.200-1.220	50% charged
1.170-1.190	25% charged
1.140-1.160	Little useful capacity
1.110-1.130	Discharged

Since you want to keep the battery at full or close to full charge during the winter, you'll need a small trickle charger. Shop the automotive supply stores. You can buy a charger for as little as \$6. Those that charge more than one battery at a time cost proportionately more.

Although most trickle chargers put out only one ampere and have an automatic device that peaks down output when the battery reaches full charge, don't take chances on having the battery overcharge. Check specific gravity frequently while the battery is charging. It takes from 12 to 24 hours for full charge to be reached, depending upon how low the battery is.

If you are charging more than one battery at a time, make sure they aren't touching. Batteries in contact during charging discharge, rather than charge.

Warning: A mixture of hydrogen and oxygen is a result of battery charging. It takes but a spark to cause a violent explosion that will spray "shrapnel" and acid for yards around. Obviously, don't smoke or bring any flame near the battery.

I've left one controversial point for last. Most instructions tell you not to leave a battery on a concrete floor during storage. They claim the battery will self-discharge if you do. This is nonsense, and there's no laboratory or any other proof to support it. If you don't have enough shelf space, you can leave your battery on the garage (concrete) floor. ★★★

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CARING FOR YOUR CHAIN SAW

(Continued from page 178)

cooling fins are free of sawdust accumulation. Check the entire saw and tighten any loose nuts and bolts. Remove bar and chain and place the chain in oil overnight. Finally, clean out the oil-discharge hole in the drive case and check the carburetor for cleanliness.

Long-term storage. Although the chain saw is a tool you will (more likely than not) use the year round, there may be times when it will be stored for an extended period of time. Keep these points in mind:

● Go through the daily routine as mentioned above (clean, lubricate and the like).

● Run the engine with the choke pulled out until it stops. Then, turn switch to off position and, with trigger unlatched, crank the piston to top dead center (the point where compression is felt during cranking).

● Store your saw in a dry, well-ventilated place and coat the bar with oil and wrap to prevent rust.

● When the saw is removed from storage, always refill the tank with a fresh fuel mixture.

When asked what makes most chain saws go "bad," Stretton's answer, not surprisingly, was "just plain carelessness. They get dropped, or are used to cut through almost anything, such as mud, nails, stone and brick."

Tips and accessories

Though not a part of actual maintenance the tips and accessories shown on page 178 are things you'll want to know about. At the top of the page are the extras; some of them come with the saw and some are optional extras. If you are buying a saw, their low cost makes them worth owning.

The safety tips shown at the bottom of page 178 are basic for the experienced chain-saw operator. They should become work habits right from the start for the first-time user.

Finally, the new Clip-n-Trim attachment, shown in center-left photo on page 176, is an item that the author came across while researching this article. Its usefulness made it a must for inclusion. Granberg Industries, 201 Nevin Ave., Richmond, Calif., makes several models to fit most chain saws. Write the company to find if it has a model that will fit your saw, what it will cost and where you can buy one. Make certain that you list the make and model number of your chain saw. ★★★

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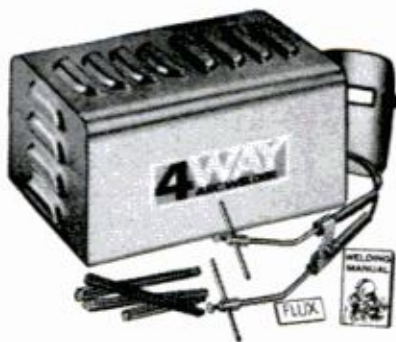
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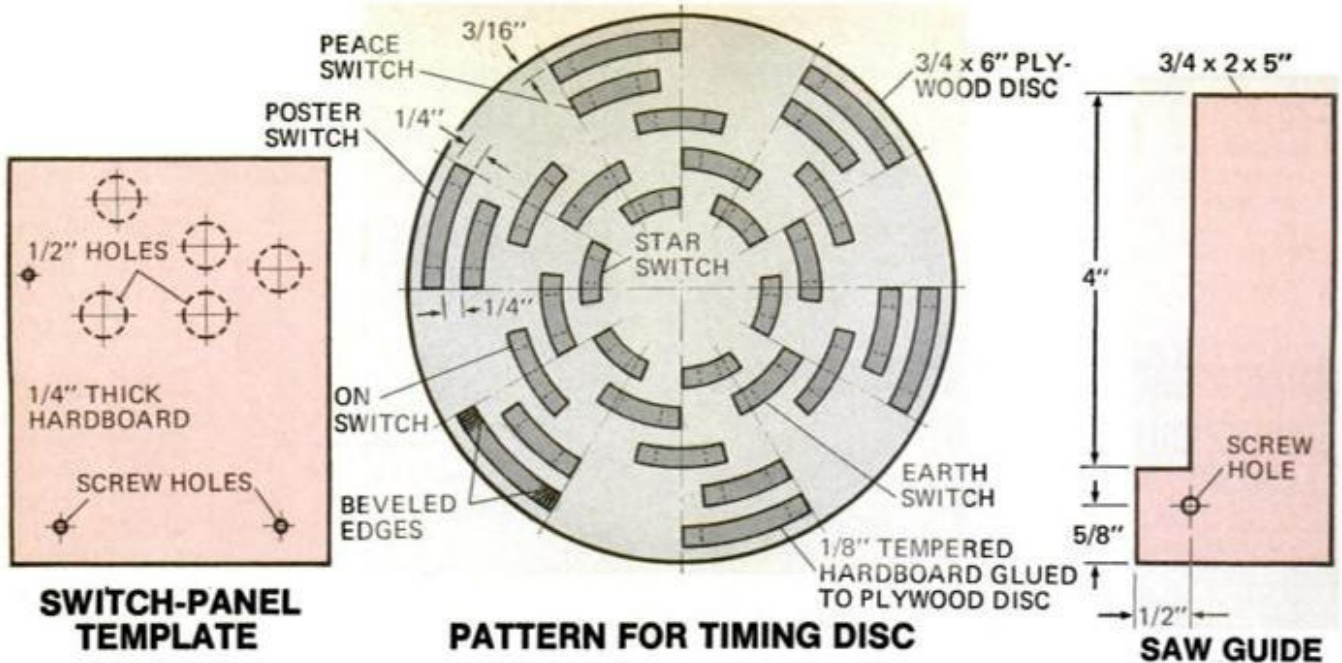
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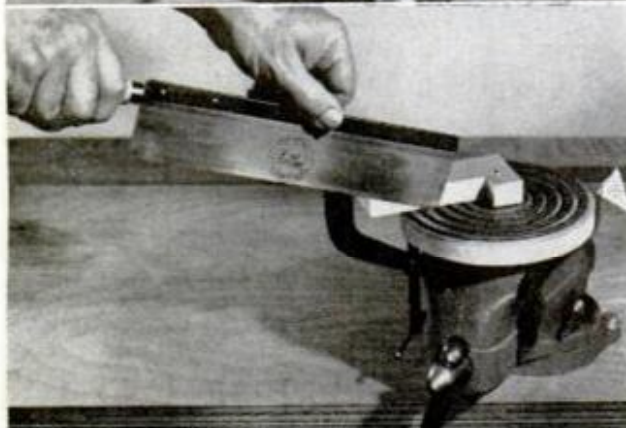
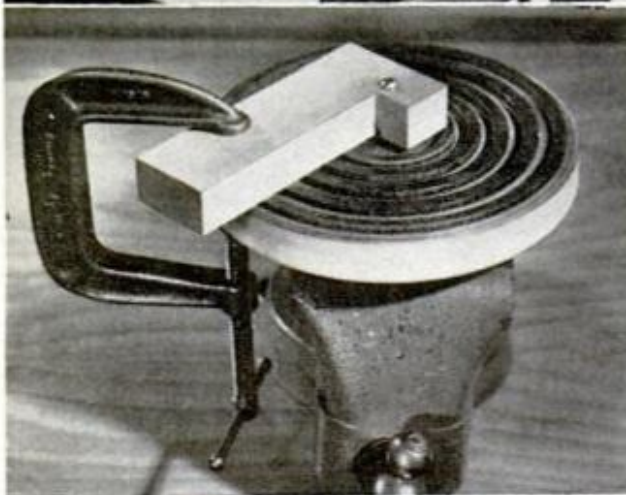
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WISH THE WORLD PEACE

(Continued from page 155)

the back of the poster. Try to keep the glue off the poster lettering. The important thing when positioning the poster is to see that its lettering is directly over the cut-out lettering in the plywood. The tissue pattern you made earlier should guarantee this when the edges of the poster are even with the edges of the plywood at the top. You'll find a slight stretching of the poster when it's wet with glue, but don't worry about minor wrinkles; when the glue dries, the paper will smooth out perfectly. The plywood panel is held in the rabbeted edges with flathead screws.

A total of nine cleat-type porcelain sockets (35 cents each) are required, six being mounted in the bottom of the light box with screws. All sockets are wired in parallel, following the wiring diagram (page 155).

While a lathe simplifies making the disc for the control timer, it is possible to jig-saw or bandsaw separate rings from 1/8-in. hardboard and glue them to the disc. If you have a lathe, the 1/8-in. hardboard is glued to a plywood disc and the *(Please turn to page 210)*

FIVE CONCENTRIC RINGS are turned in hardboard (top photo) glued to face of faceplate-mounted disc

PIVOTED WOOD BLOCK (center photo) is used to guide the saw when cutting the notches in the rings

ONLY TIP OF SAW (left) is used to cut through each hardboard ring to avoid cutting adjacent rings

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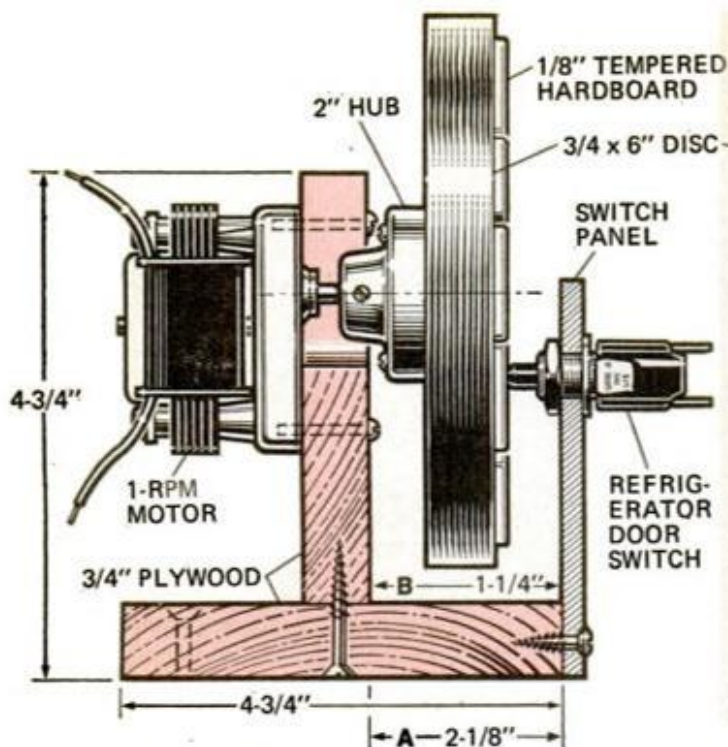
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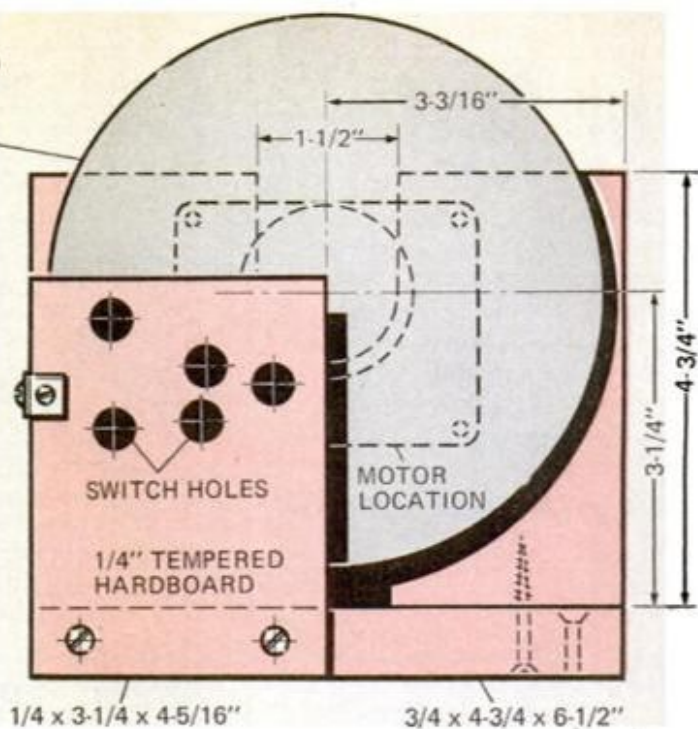
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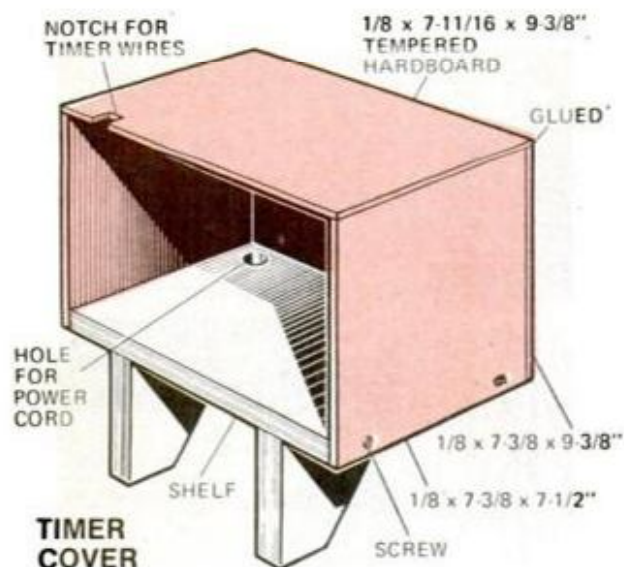
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SIDE-VIEW SECTION



FRONT VIEW



TIMER COVER

TIMER IS PROTECTED from snow and rain by removable cover which is attached to shelf with screws

THESE THREE VIEWS of the timing control make it easy to understand how it's made and how it works. Notice the metal brace that provides extra rigidity

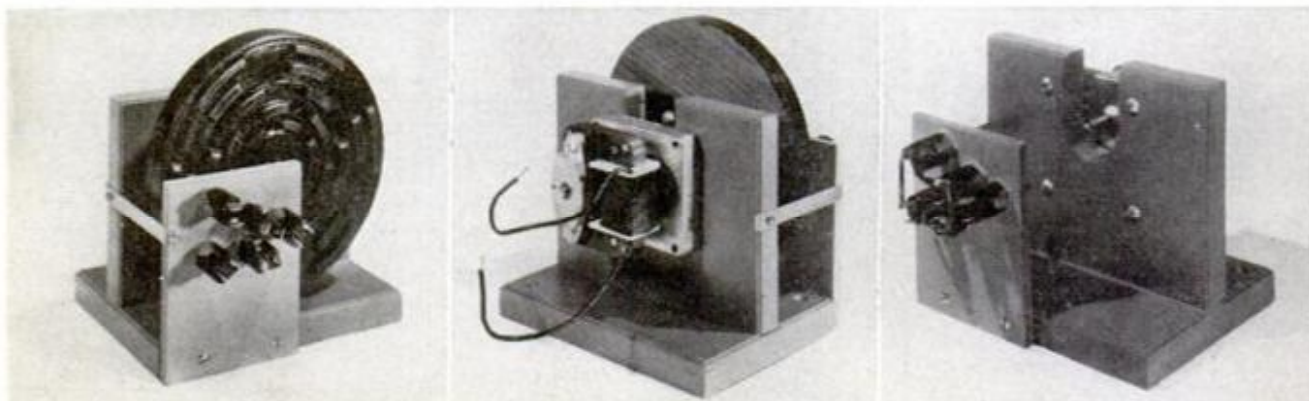
WISH THE WORLD PEACE

(Continued from page 208)

five grooves are turned on a faceplate. Whichever method is used, you'll need a full-size pattern for laying out the spaced lands in each of the five concentric rings (see page 208).

Accurate location of the lands on the face of the disc is important to assure the necessary split-second timing of the lights. This is done with the aid of a wood block which is pivoted to the center of the disc with a screw. To locate and cut the lands of each ring exactly as the pattern shows, you align the block at the points indicated, hold it with a C-clamp and carefully saw through just the hardboard. Use a fine-tooth saw blade and hold it against the wood block. Saw with just the tip of the saw and cut as much as you can without sawing into the adjacent ring. Repeat the procedure around the disc and then carefully chisel out the unwanted sections of each ring. Finally, bevel each

(Please turn to page 212)



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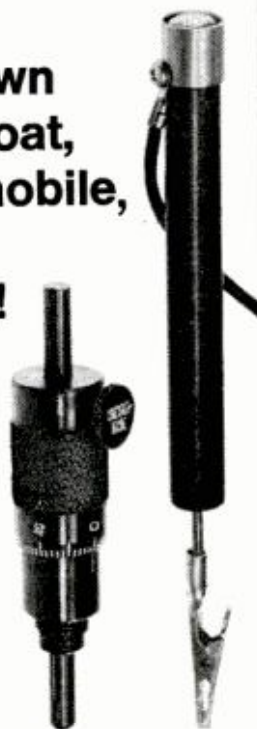
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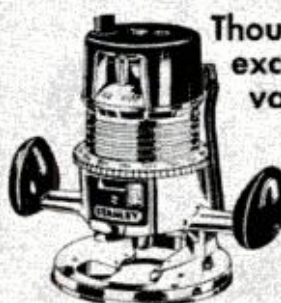
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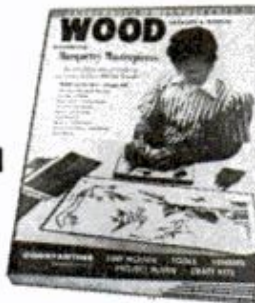
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(Continued from page 210)

end of the remaining lands so the switch buttons will ride up on them without catching.

If you leave the lathe faceplate attached to the back of the disc, you'll have a handy way of holding the disc in the jaws of a vise while working on it. I sprayed the completed disc with silicone lubricant to make the switch buttons ride easily over the lands.

Use your full-size template to spot holes in the switch panel for the five refrigerator-door switches. It's important that the switch buttons be centered on each row of lands, and that the holes be drilled at the very points indicated so the lights turn on and off in the proper split-second sequence.

Since it doesn't require much pressure on the switch buttons to break contact, the switches are adjusted to bear the minimum against the lands on the disc. Switch adjustment is made by advancing

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the disc on the motor shaft rather than the switches. Here the inside nut on each switch is turned on as far as it will go so all switches will be mounted the same distance from the face of the disc.

When you're ready to wire the lamps to their switches, you'll have to label each wire as it's fished through the hole in the bottom of the light box so it will join with the right switch. Notice in the wiring diagram that one side of all switches is connected with a single wire. If solderless connectors are used to join the switch wires and lamp wires, removal of the timer from the display will be simplified.

Two flat stakes, plus a brace in the back, are used to anchor the display. The stakes (cut from 1x4) are spaced so the display rests between them and are attached to the ends with a couple of screws.

Editor's note: If you plan to use the cast-aluminum timing disc offered above, follow dimension B (1¼ in. instead of 2½ in.) when making the stand. ★★

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(Continued on next page)

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(Continued from preceding page)

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NATIONAL Geographic Magazines, 1888-1971, any issue. Buxbaum, Box 465-PM, Wilmington, Delaware 19899.

(Continued on next page)

BOOKS, CATALOGS, NEWSPAPERS

(Continued from preceding page)

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(Continued from preceding page)

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(Continued from preceding page)

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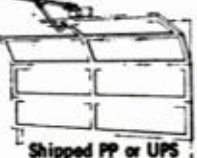


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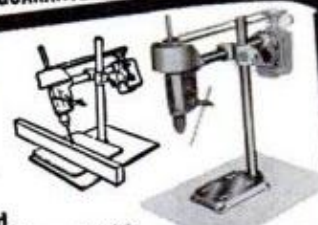
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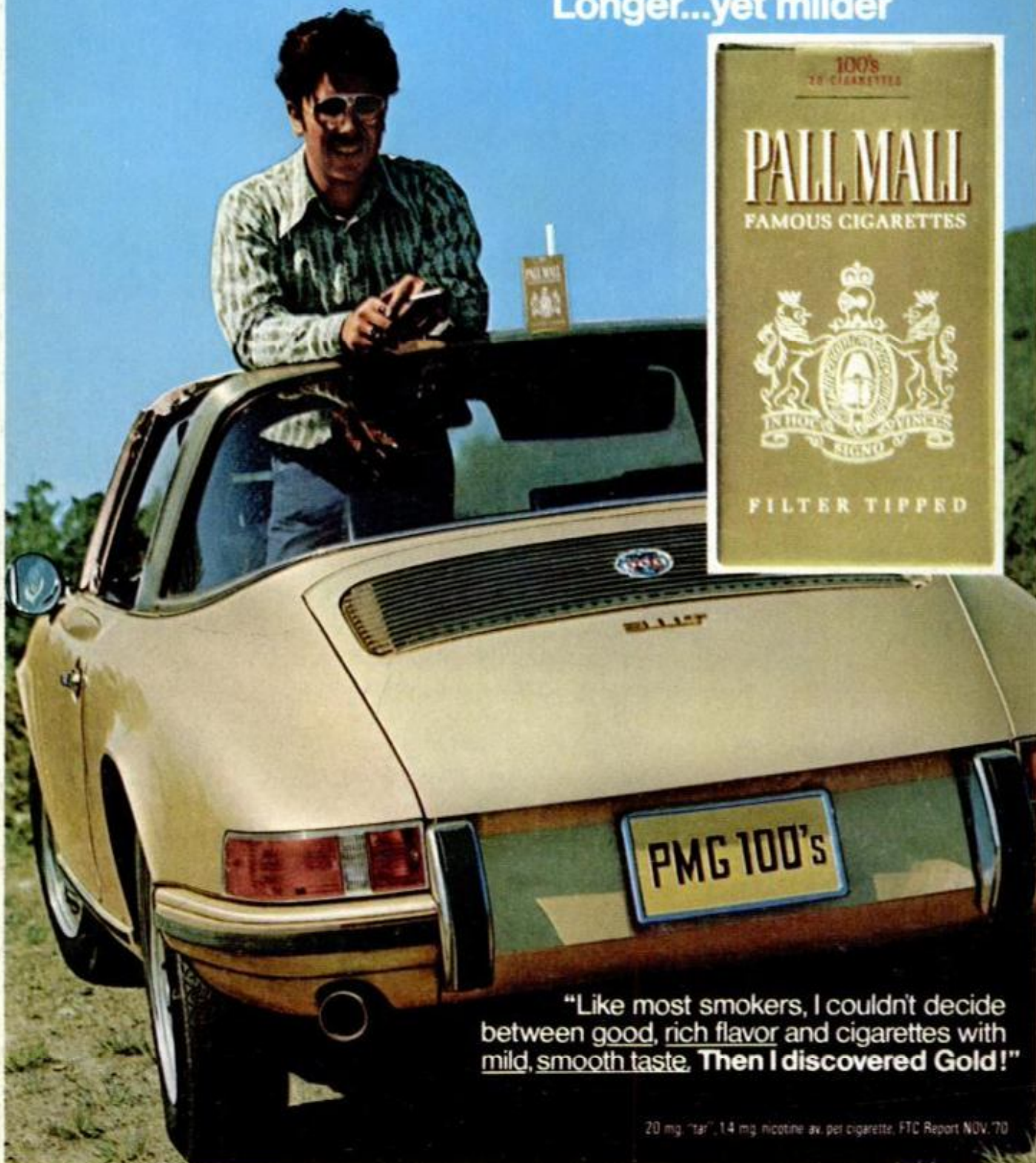
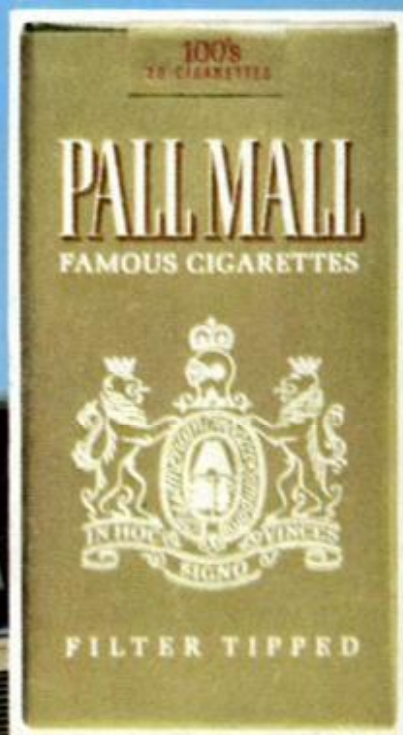
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