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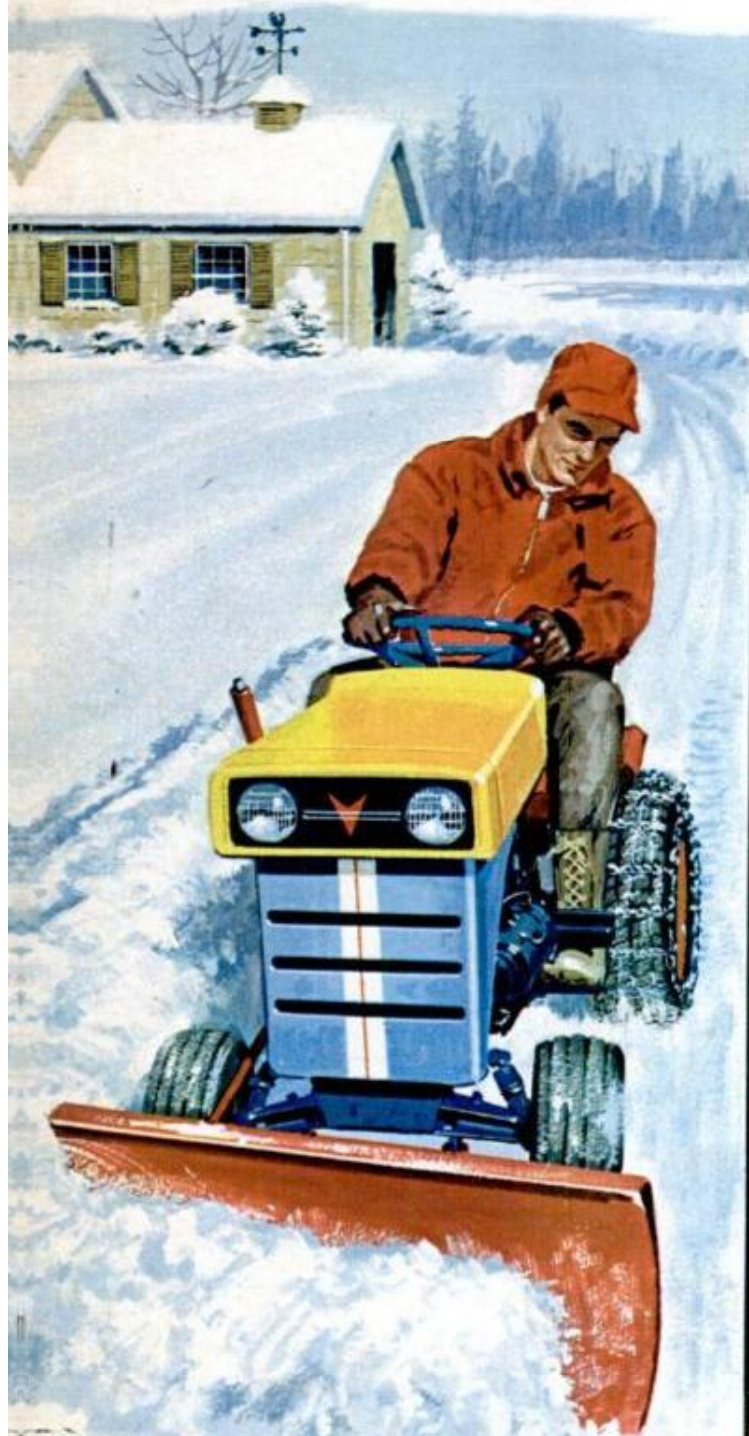
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# POPULAR MECHANICS

## YARDPOWER

**SPECIAL  
KEEP-IT SECTION**



***Year-around  
muscle-and-hustle  
where you need it***

This One



CW7P-4LG-WHRN





## **Bolens Huskys have the only difference that makes a difference**

You can spend weeks comparing engineering features—from engines to tires, from PTO to attachments, from controls to transmissions. But you still won't find the only difference that makes a difference: Does the compact tractor *perform* the way you want it to? Bolens Huskys have that difference. The design and engineering are based on what you *expect* from a compact tractor. You want performance, plain and simple. Huskys give you year 'round performance for every outdoor job. Arnold Palmer discovered the Bolens Husky difference. You can, too. At your Bolens dealer. Four Husky models from 7 to 12½ hp.

6-68

**Difference | designed...with performance**



**in mind!**



**BOLENS**

BOLENS DIVISION, FMC CORPORATION  
DEPT. C42-HB, PORT WASHINGTON, WIS.

COMPACT TRACTORS • RIDING AND WALKING POWER MOWERS • TILLERS • SNOW CASTERS





# YARDPOWER

**There isn't much of a market these days for carpet beaters. Or washboards or hand-cranked wringers. The women got the message. To wash clothes or dry them, they set a dial. They flip a switch to wash dishes, stir a cake, get rid of garbage. Or open a can.**

**B**ut when it comes to yard work, too many men still rake and tote leaves, spade and get a backache, push a wheelbarrow or a garden cart and work up blisters. They spend all day clearing brush or cutting fire-place logs. Or all afternoon walking behind a mower. Not enough of them have got the message: Power does it quicker. Easier. And better. Today's rider mowers have power to spare for pulling a cart, a lawn sweeper or a fertilizer spreader. Compact tractors earn their keep on a half acre, or farm an acreage. They pack portable, go-anywhere

power for plowing or throwing snow, tilling, cultivating, running a generator or a spray rig. Name the job and there's an attachment. Power-tillers, chain saws, electric hedge trimmers, edgers—they supply the muscle-and-hustle and make yard work what it should be. Fun. When you have power you **move** the job instead of put-tering with it for hours. With cart-and-tractor you move that rock or sand. You can pick up bushels of leaves or trash and be back for more in the time you used to spend thinking about it. Power is the answer for people who like outdoor

work and want a well-groomed place but don't have much **time** for it. Can't find time to paint the house or build that patio? Listen: "I've got better things to do than walk behind a mower. Add up all those hours I used to spend just walking and I could have painted three houses. Now I knock off the mowing or one of the kids does—like driving to the store. Less time on routine jobs gives me time for projects I can do and save money." Get the message? In this special section it's spelled out in yardpower solutions for the following jobs:

- 1** Snow Removal   **2** Mowing   **3** Clean-Up   **4** Woodcutting
- 5** Spraying   **6** Edging/Trimming   **7** Tilling   **8** Making It Rain



1

YARD  
POWER  
JOB!

# Snow Removal

A lightweight blower may be the answer



**P**icture your wife in this beautiful night scene. The air is crisp and the snow is fluffy. No snow shovel for her. She is pushing one of the new lightweight snowblowers powered by a 2.5-hp chain-saw-type gas engine. It weighs only 22 pounds—in a class with vacuum cleaners. It starts easy because you can hang it on a hook in a warm basement. About \$90 puts it there. For \$110 she can flip the switch on an electric. If you have a short driveway or walk, it doesn't make sense to invest in a big snow thrower. But this little fellow will cut a 14-inch swath with every pass. The midriff handle makes it easy to lift—to clear steps, porches, or dig out a snowbound car. Her car or yours won't get stuck if she can buzz the drive before it's packed or frozen. Many new lightweights have polyethylene paddles. There are others (electric) with steel auger blades that weigh about 50 pounds. Lightweights aren't self-propelled, but men leave their easy chairs to operate them.

**A typical lightweight has a high rpm chain-saw engine under a water and rustproof jacket; a single paddle and a centrifugal clutch to protect the engine. Break a paddle and it doesn't break you; you can replace it in minutes.**

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VOL. 129 NO. 2



Do all the chores around your place, mowing, spraying, gardening, hauling . . . from the seat of a John Deere Lawn and Garden Tractor. Farm-bred for easy power with a gentle touch, it's one of the new

**WEEKEND  
FREEDOM  
MACHINES  
BY JOHN DEERE**



Any evening, between dinner and dusk, ride a John Deere Lawn and Garden Tractor to weekend freedom.

A John Deere Lawn and Garden Tractor cuts your grass at an acre-eating clip, up to 46-inch swaths. Maneuvers like a sports car. Lets you do most of the trimming from the driver's seat.

Farm-Bred for action, a John

Deere has the heft and stability to take terraces and slopes in stride. Moves at a creep if you like without slowing mower speed. Offers options and equipment for as many jobs as you want done.

Pick the John Deere size that suits your lawn: 6-, 8-, 10-, or 12-h.p. Your John Deere Lawn and Garden Tractor dealer will arrange financing

and help select the Weekend Freedom Machine that's right for you. For free booklet write John Deere, Box PM, Moline, Ill. 61265.

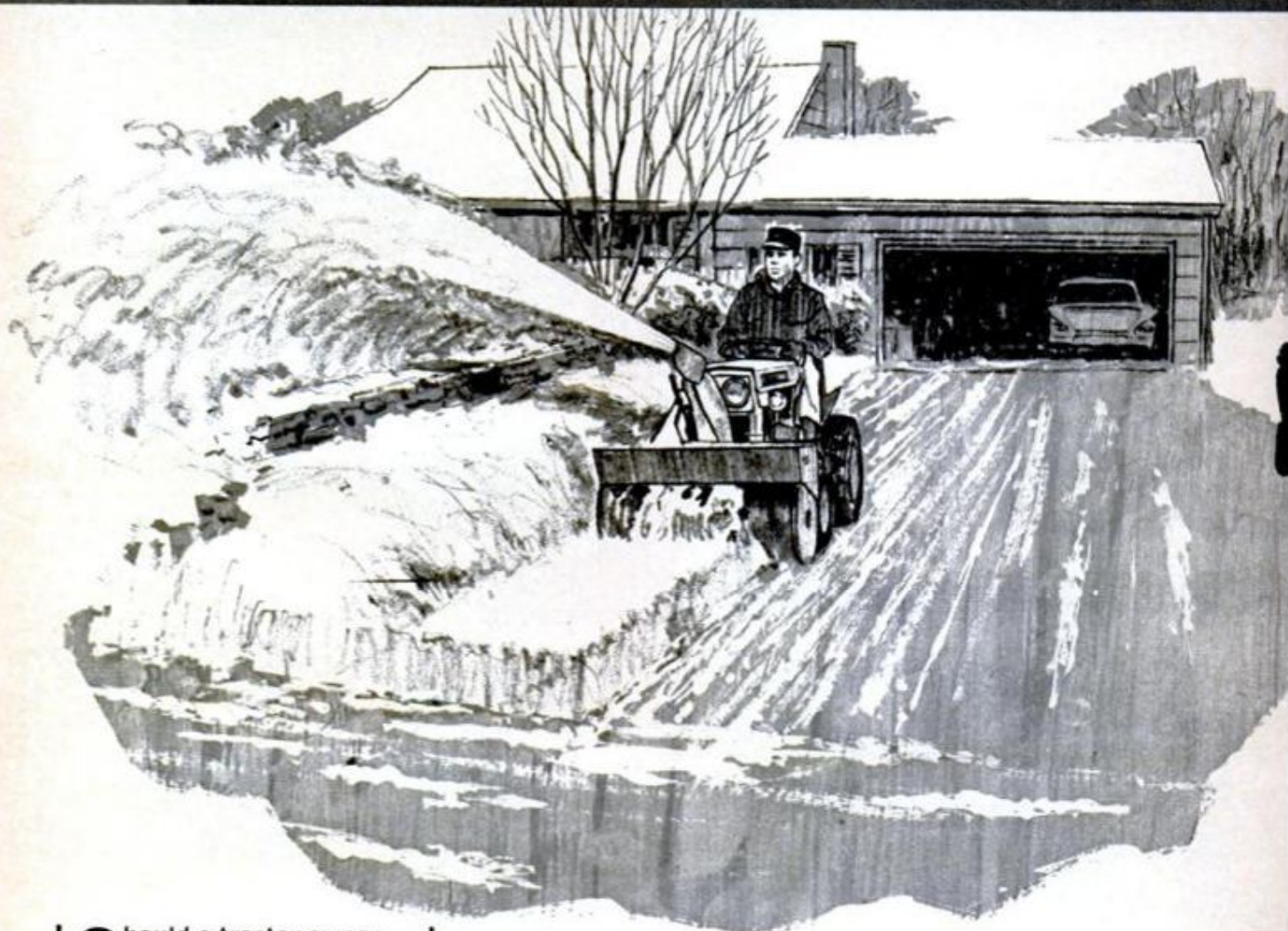


**HAVE A  
NICE  
WEEKEND!**

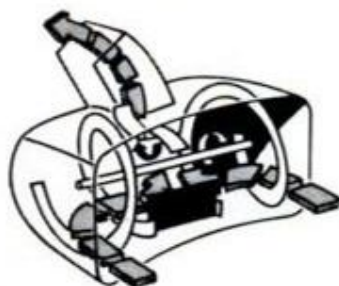


# Snow Removal

Deep snow country? Throw it!



**S**hould a tractor owner buy a plow or a snow thrower? A tractor with chains (wheel weights help) and a blade can make short work of a foot of snow. But drifts or heavy snow can bog down a plow. Mounds of plowed snow on the shoulders make it necessary to pile new falls in front of them, narrowing the drive. A drive between retaining walls or hedges puts you in the same bind. But a self-propelled or tractor-mounted thrower can cast over walls and hedges, gear down to a crawl and auger through big drifts—and work in tight spots where a plow can't move fast enough to prevent wheel-spin. A tractor with thrower needs at least 6 hp.



Single-stage thrower: auger whirls snow out chute in a single motion. Two-stage: auger feeds to an impeller at base of discharge chute.

Makers match thrower capacity to the power of the tractor. Buy the thrower made for the tractor. (A "lawn tractor" that can take only a plow leaves no choice.) Two-stage machines usually cost more than single-stage of the same width and power. But price and performance are generally on a par when the single has comparable horsepower. A 32-inch tractor attachment costs about \$150. A 26-inch 4 or 6-hp self-propelled thrower costs \$200-\$300. Electric starters—or starters that plug into house current—lick that problem. Unless you're a wrestler, be sure to get reverse gear on a self-propelled thrower.



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the product in Popular Mechanics.**



**Very soon you'll start seeing products bearing Popular Mechanics "Product Feature" Mark appearing on many dealers shelves. This is a brand new service to our readers and will help you recognize the products that are advertised in your magazine.**

**Look for the mark on hang tags, stickers, counter cards and on the products themselves.**

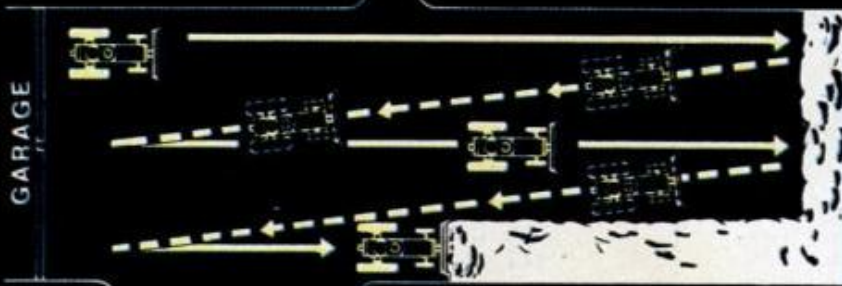
**This is just another idea in a long line of new ideas from Popular Mechanics. Remember the Mark. Ask for it. Know and buy the products that wear it. They're the products advertised in your magazine.**

**THERE'S ALWAYS SOMETHING NEW AT POPULAR MECHANICS**



# Snow Removal

Plowing: Hydrostatic makes it a game

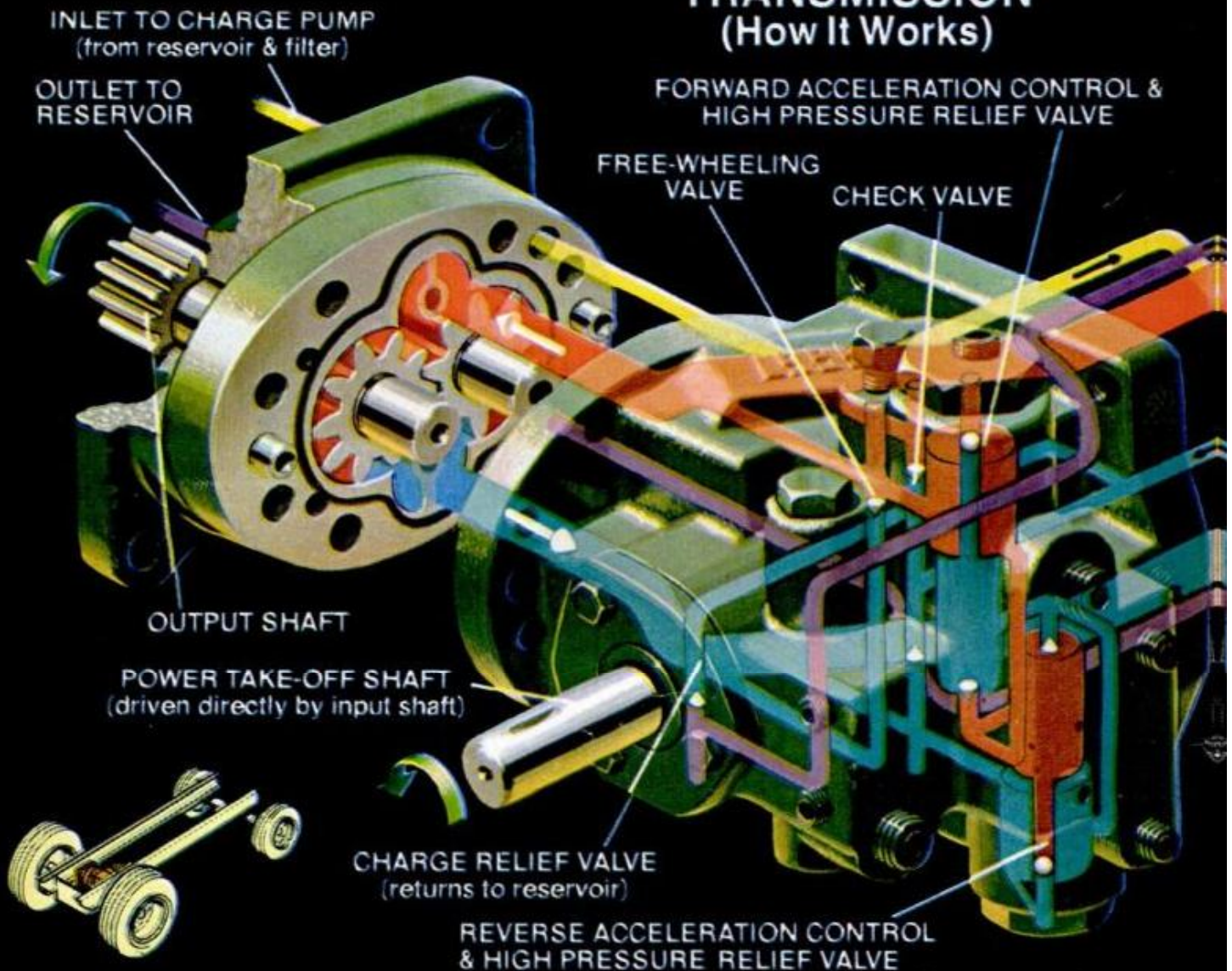


A plow attachment is quicker and cheaper (about \$75 for a 42-inch spring-loaded blade) than a blower. Diagram shows advantage of hydrostatic: forward-reverse shuttling can be done at top speed without clutching—or danger of damaging the transmission

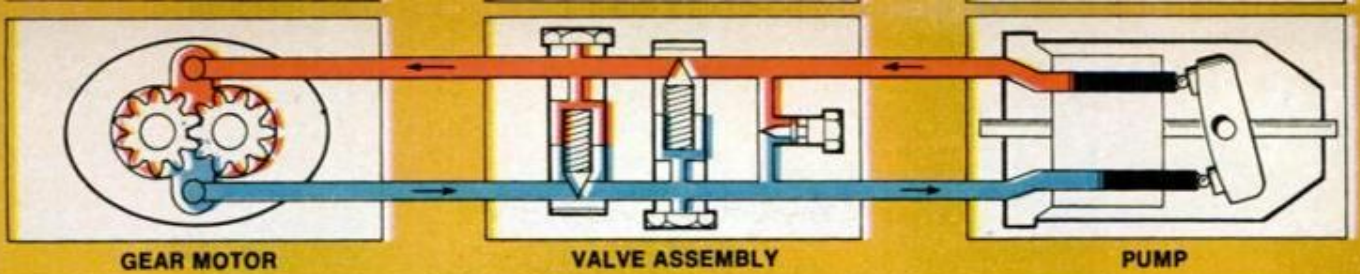
**P**LOWING or snowblowing shows to advantage the greatest single improvement in small tractors in recent years—hydrostatic transmission. The speed of a car with automatic is controlled by the gas pedal. Speed of a hydrostatic tractor is changed by moving a lever; engine rpm remains constant. This gives the hydrostatic its unique advantage: infinitely variable ground speed with constant, independent power takeoff speed. More than a convenience, hydrostatic makes the tractor

more efficient at all speeds. A crawl is best for throwing snow, tilling or heavy mowing. Since engine speed is not reduced to control ground speed, optimum speed of auger, tiller or mower can be maintained. Hydrostatic can produce maximum pull and start at 0 mph, so any speed from zero up can be used for snowblowing or tilling. Hydrostatic adds about \$150 to the cost of the tractor. Most manufacturers offer it only on their 12-hp models.

## HYDROSTATIC TRANSMISSION (How It Works)







GEAR MOTOR

VALVE ASSEMBLY

PUMP

Hydrostatic components are: (1) a variable volume displacement pump; (2) valve system in a cast-iron block; (3) a constant displacement motor that drives a differential and gear assembly. The following tractors have this type of hydrostatic: Bush-Hogg, John Deere, Ford, International-Harvester, Jacobsen, Massey-Ferguson, Pennsylvania, Sears and Wheelhorse. Bolens and J. I. Case have hydrostatic transmissions of somewhat different design. Gravelly's planetary transmission does not require clutching.

VARIABLE DISPLACEMENT PISTON PUMP

HYDRAULIC GEAR MOTOR

EXTERIOR VIEW

CENTER SECTION ASSEMBLY

ILLUSTRATION CREATED EXCLUSIVELY FOR POPULAR MECHANICS  
By Dale Gustafson

CHARGE PUMP

VARIABLE SWASH PLATE

INPUT SHAFT

PISTONS

FORWARD

REVERSE

NEUTRAL

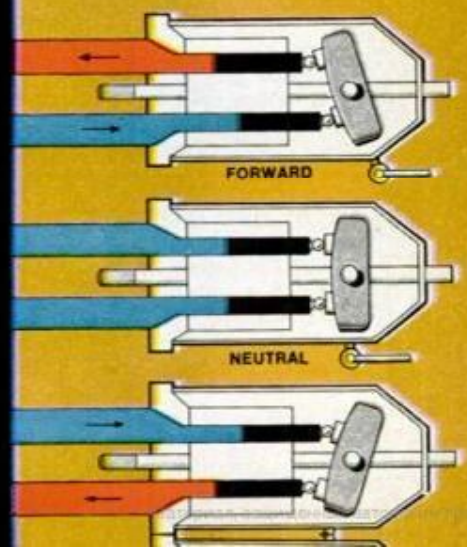
VALVE PLATE

LEGEND

Charge Pressure	High Pressure	Oil Under Suction	Case Pressure

The variable displacement pump is a swashplate type that transmits power by flow and pressure. The volume of oil it delivers to the hydraulic motor is varied by moving the control lever forward and changing the tilt and rpm of the swashplate—the greater the tilt, the faster the tractor travels. In reverse, oil flow and direction of the hydraulic motor and rear-end gears are reversed—to a 3 mph limit. In neutral, no oil is pumped and the system provides braking action. The PTO shaft is coupled mechanically to the input shaft of the pump. Its speed is controlled by the throttle; it's independent of ground speed. Acceleration control valves impart a swift pickup, not a lurch, and cushion the effect in a quick change from full forward to full reverse.

SWASHPLATE POSITIONS (Top View)





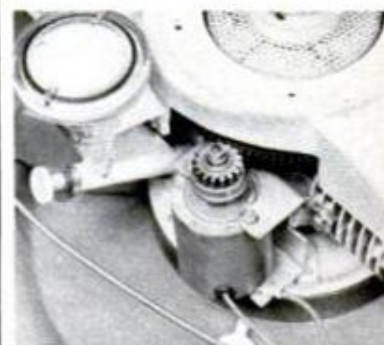
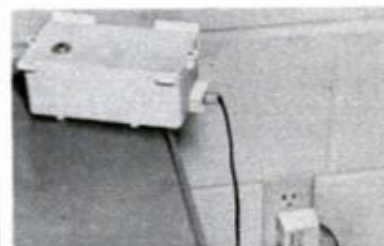
## Mowing

Fit the mower to the job

If snow isn't a problem in your area, and mowing is your main concern, you want a mower that starts. When you want to start. Pulling the starter cord until one arm was longer than the other convinced many a man that his next machine would be an electric. Owners of electrics swear by them, not at them. They soon learn the one thing to be remembered when using one: To avoid cutting the cord, always work away from the electrical outlet. They start near the outlet and mow in parallel swaths away from the power source. They rotate the reversible handle over the top of the mower and return in the direction from which they came. Once

this is routine, how sweet it is. Quiet. Turn it off. Turn it on. No refueling. A woman likes that; she can be lured into the job. Electrics are great for small lawns. Or lawns that aren't complicated by trees and flower beds. Like a big lawn but it takes too long to cut? A riding mower can travel faster than you can walk. You have a wide choice, but give serious thought to electric starting. It means your wife or youngster can start it—the next best thing to automating the job. Most popular riders today are rotaries, but maybe you want a wide cut. The rider shown below can knock off a 58-inch swath and turn on its own axis. Can you mow  $1\frac{1}{2}$  acres in an hour with your present machine? You can with this.

This year electric-key starting is available for push and self-propelled gas mowers. The switch can be operated only with a key, so kids can't start it. You stand behind the handle when you start—not with your feet near the blade—so it's safer for everybody.



New this year, electric starting ends rope-tugging for walk-behind mower pilots. Top: Switch and power pack—12 nickel-cadmium batteries producing 12 volts—are mounted on control panel

Middle: A charger, like those for battery-powered razors, plugs into house current. Pack gives about 80 starts between charges

Bottom: Starter motor with a Bendix drive engages the flywheel of mower engine, automatically disengages



Dual blades of electric mower above are mounted in a pan designed to create suction for sheer, seamless cutting without clogging





# Mowing

Tractors cut time as well as grass

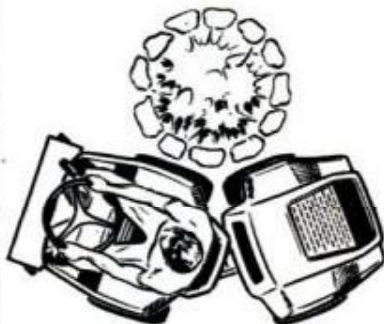


**T**he tractor shown mowing a steep slope can do better. It can climb a 40° grade that's wet with morning dew. It's a good example of the improvements being made in compact tractors. Small tractors seldom lack power for the jobs they're asked to do, but they spin their wheels—lose traction. Sheer weight solves the traction problem for farm tractors. Redistributing the weight does it for compacts. With the 10-hp engine and transmission in the rear, this compact has 600 pounds

over the drive wheels—without the operator. Low placement of the engine lowers the center of gravity and gives stability on hillsides. Rear-engine design gives plenty of traction for bulldozing (with a 48-inch blade) and plowing a garden. Other manufacturers have solved spin-out with differentials that supply torque to both wheels when one starts slipping.

The turning radius of tractors has been shortened because more owners are using them on smaller lots. One maker's answer for the tree-studded lawn is a trac-

tor that's hinged in the middle. It has a 21-inch turning radius. A smaller "lawn tractor" turns in 16 inches. It doesn't make sense to have power and not use it, so homeowners with large lawns are switching to three-gang mowers that cut a 60-inch swath and five-gang rigs that cut 90 inches. Coming up fast is a three-gang with two mowers mounted to the front end of the tractor and a third towed from the hitch. Front-mounted mowers minimize wheel tracks. The dimensions of a typical "lawn tractor" (page S12) may indicate that this is all you need for the size of your lot or the jobs you want to do. A "lawn tractor" can handle a mower, cart, seeder-fertilizer, roller, aerator and a blade for light snow removal. But don't expect a pony to be a plow horse.





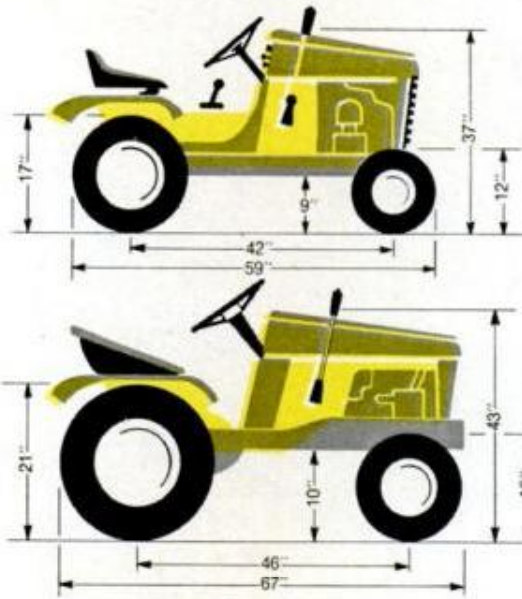
# Mowing

Tractors and convertibles offer many ways to go

## TRACTOR—OR “LAWN” TRACTOR?

Tractor or “lawn tractor”?

Industry defines “lawn tractor” (top) as one that doesn't operate ground-engaging attachments (tilling equipment). Specifications given are for largest. Many “lawn” models are lighter, less-powerful, lower-priced.



Engine .....6 hp.  
Weight .....400 lbs.  
Width .....30"  
Transmission:  
3 speeds forward,  
1 reverse  
Price .....\$500-\$600

Engine .....12 hp.  
Weight .....700 lbs.  
Width .....42"  
Transmission:  
Hydrostatic  
Price .....\$1,000-\$1,200

## CONVERTIBLES: one engine for many machines

	BASIC POWER UNIT	SNOW THROWER	TILLER	ROTARY MOWER	MISCELLANEOUS
ARIENS					VACUUM
LOCKE- DEVERE					BLADE
TORO					EDGER
GRAVELY					ROTARY PLOW
SIMPLICITY					CULTIVATOR

\*plus others

POPULAR MECHANICS

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# Clean-Up

A clean sweep—or a good blow



Self-propelled sweepers (with 2-hp gas engines) are the answer for slopes and large lawns. A 25-inch power sweeper costs about \$120. Trailer models, towed by a tractor or rider mower, save the cost of an engine, let you mow and sweep in one operation. A self-dumping trailer (you unload the hamper without leaving the driver's seat) costs \$110. A 25-inch trailer without this feature costs about \$65.

Only professionals used them; today homeowners in heavily wooded areas find that leaf blowers make cleanup a breeze. They wind-row leaves into piles for easy pickup. Most blowers have a hose attachment for clearing leaves and debris out of flower beds, shrubbery, ground cover and window wells. A typical 3-hp blower costs about \$100.





## Clean-Up

With a shredder, everything goes



**G**ardeners with green thumbs know the value of a compost shredder-grinder. Everything—stalks, leaves, clippings, straw, small bones and phosphate rocks or limestones—can go into it and come out as finely ground material for the compost pile. The shredder-grinder is used for turning the pile and screening the finished compost. The product is silky topsoil or mulch. Now a new vacuum attachment for shredders makes them very efficient machines for spring and fall cleanup. Instead of hauling leaves to the shredder at the compost pile, you can tow the machine to several large piles. The vacuum inhales them, shoots them into the hopper, and the leaves are reduced to a pile of fine stuff at the foot of the machine. Then you move the shredder slightly so the vac can pick up the processed pile. Swing the spout away from the hopper and direct the discharge into a garden cart—and you're on the way to the compost pile with fine stuff. No need to load and haul bulky leaves. If you want to dispose of leaves in a few bags left at the curb for pickup, fill them at the spout.

A compost shredder turns garden debris into soil-builder. A shredder is ideal for screening sod or mixing hard soil with fertilizer or compost. Some shredders have automatic stone ejectors. A shredder-grinder costs about \$135. Add \$80 for a vacuum attachment.





A powerful outdoor vac makes fun of picking up grass clippings and cleaning walks, patios and driveways. With a snap-on hose attachment, the vac is an all-year appliance for cleaning the garage, workshop and shelves. Some vacs have a blower attachment; you can wind-row scattered debris, then vacuum it. The bag holds a lot because the impeller shreds debris. A vac that sweeps a 32-inch swath and has an 8-bushel bag sells for about \$165. The vacuum collector shown below is for tractor owners who believe in making hay the easy way—in one operation. Mowing and vacuuming are done at the same time. Clippings or leaves are whisked into a dust-tight cart that holds 450 pounds or 26 bushels. A nozzle attachment cleans borders and shrubbery. The complete rig—cart, cover, hoses and vac, powered by the tractor engine—costs about \$270. Owners with large lawns or big leaf-cleaning problems claim it beats all other solutions.



FEBRUARY 1968

Here's one reason why your best buy in tillers is a **SIMPLICITY SUPERMATIC ROTICUL**



**FULL-POWER GEARED REVERSE**

is a Simplicity Supermatic Roticul exclusive. Full-gear transmission is engineered to give you fingertip control of forward and reverse. No problem approaching borders or picking up rocks. Just punch the reverse control — Roticul backs off at once under its own power.

Other standout features include "Touch-O-Matic" control. Lets you nudge the tiller forward at the best speed for the job. Halts the tiller safely, instantly, the moment you release your grip. Supermatic Roticul comes in 4 and 5 horsepower models balanced for easy handling. Tough non-winding, self-sharpening tines slice through hard soil to a depth of 7", width of 31". Smooth spading action creates ideal seedbeds.

See the Supermatic models and the 3-hp economy Roticul at your Simplicity dealer's. He invites your comparison. Ask him to demonstrate the differences that make Simplicity your best tiller buy.



**Simplicity**

Simplicity Manufacturing Company, Inc., 6875 Spring Street, Port Washington, Wis. 53074 Available in Canada through Eaton's



## 4

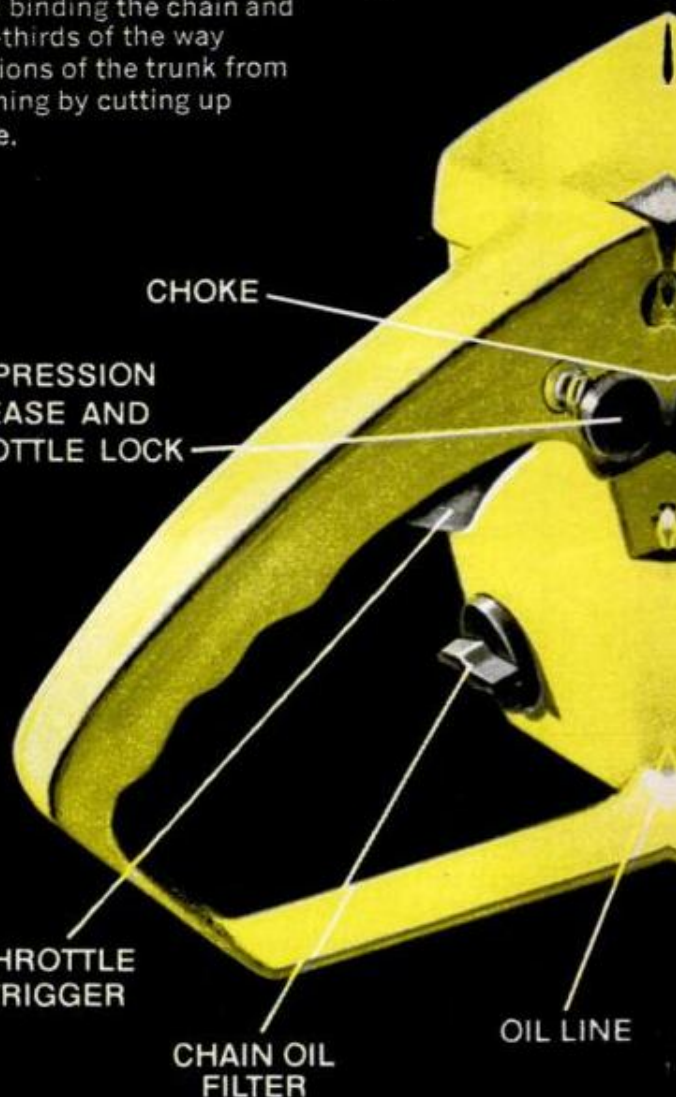
**BACKYARD  
POWER  
JOB:**

# Woodcutting

Chain saws pay their way in firewood



**B**ucking a fallen tree into firewood lengths goes fast when you go at it right. Start by removing branches nearest the base and working up. Cut big limbs from the top of the crotch, making an undercut to prevent peeling the bark. Cut as close to the trunk as possible. The natural, safe way to do this (middle photo) is to stand on the opposite side of the trunk. Before removing branches that hold the trunk off the ground, note how it will settle. Wedge limbs under the trunk to support it and prevent the saw from binding when you buck the trunk. If the trunk lies on a slope, work uphill from it when bucking. You can also avoid binding the chain and bar by cutting two-thirds of the way through large sections of the trunk from the top, then finishing by cutting up from the underside.

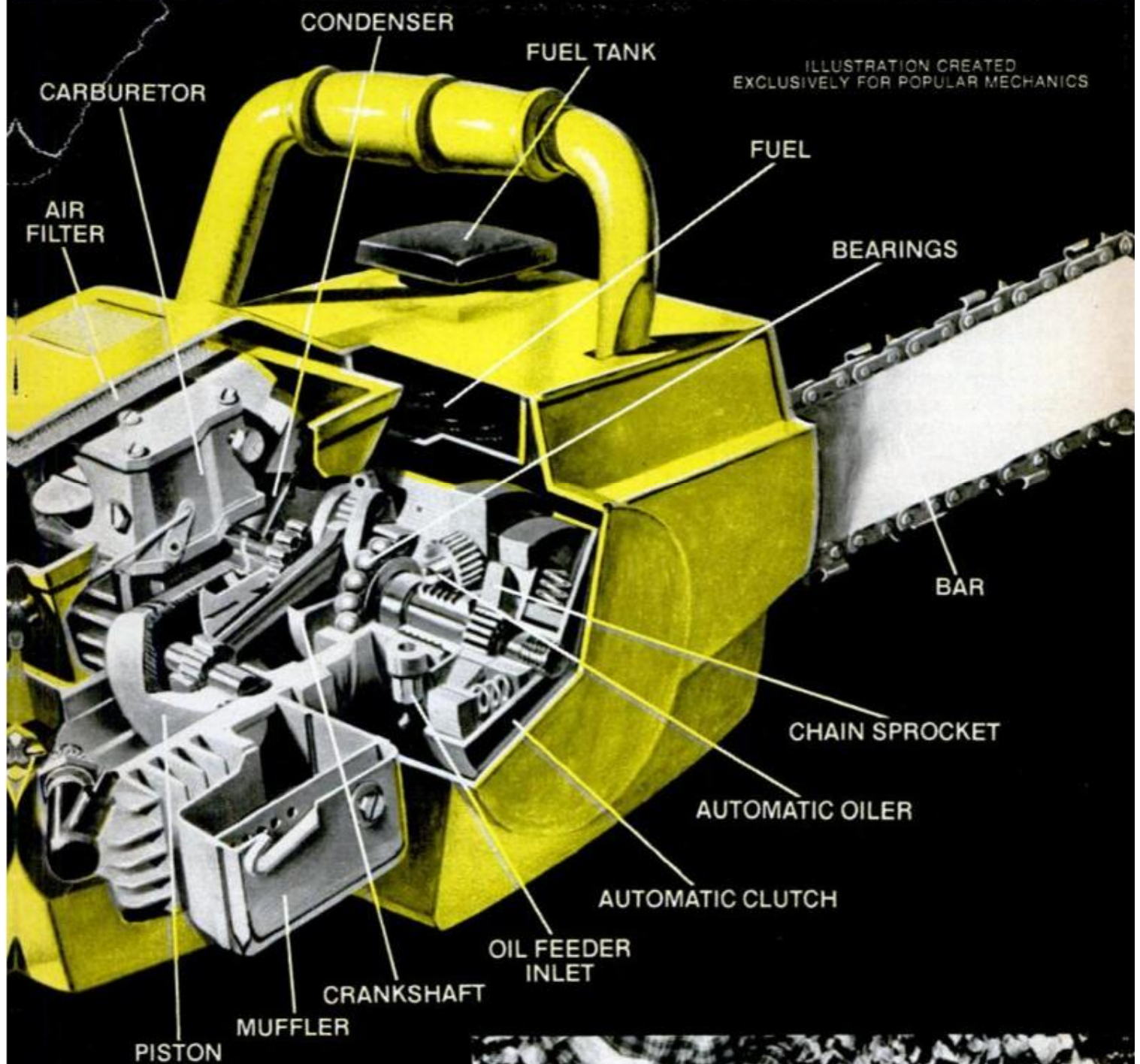


## TYPICAL CHAIN SAW ENGINE

You don't need a sledge and wedges to halve and quarter trunk sections. Finish the job with the chain saw. You have to put pressure on the saw for these rip cuts—but power does the work.



At today's prices for fireplace wood, storm-felled trees, or diseased trees you cut down, can yield a bonanza that pays for a lightweight chain saw



After big limbs have been cut into lengths you can lift, put them in a sawbuck at convenient working height where the saw won't cut into dirt or stones. And watch the woodpile grow.





# 5

8 HP POWER  
JOB:

## Spraying

Weeds, insects and paint

**Y**ou have a lot of lawn out there and the dandelions and crabgrass have taken over. How are you going to weed all that? Sure, there are chemical weed killers, but the job is a killer, too—if you tote a spray gun. There are several rigs you can tow with your tractor or rider mower. Here's one with a 5-foot spray boom, 20-gallon capacity tank and 2½-hp engine. It has detachable handlebars so you can push it when you need to, 25 feet of hose, and a hand-gun so you can draw a bead on what's bugging your rambler roses, fruit trees and ornamentals. About \$250.



If you have a tractor, you have portable power for the compressor of this paint sprayer. It's used for spray-painting farm buildings, summer homes and equipment where electricity isn't available. (Builders use tractor-mounted generators to power electric tools on remote building sites.) The air compressor attachment costs about \$160.

Fogging equipment is necessary to make outdoor living possible in many parts of the country. It ranges from this portable electric fogger through 2-wheel push models with 3-hp engines to mower-mounted and tractor-mounted models. "Thermo-fog" is a penetrating, dry fog of insecticide produced in a heated chamber. It's claimed that the dry particles of fog remain in suspension longer than heavy mists or sprays. One ounce of insecticide produces 2000 cubic feet of dry fog. The portable fogger shown sells for about \$35.





# Edging/Trimming

START  
POWER  
JOB:

# 6

The right tools speed the job

**T**he difference between a perfectly groomed place and just another place generally shows at the edges. You may mow every week, but the ragged edges—around fence posts, along walks and borders—don't get that much attention. This is a job that isn't popular with the troops so you end up doing it when you can. The well-manicured look a team of professional landscapers could give your place can always be yours for what they might charge for just one trip—\$35. That's about the price for each of the tools shown here. Privet hedges do better when they're trimmed every two or three weeks. Frequent trimming makes yews and other evergreens prosperous. And neatly edged walks and borders make you look like a pro. Power makes it possible.

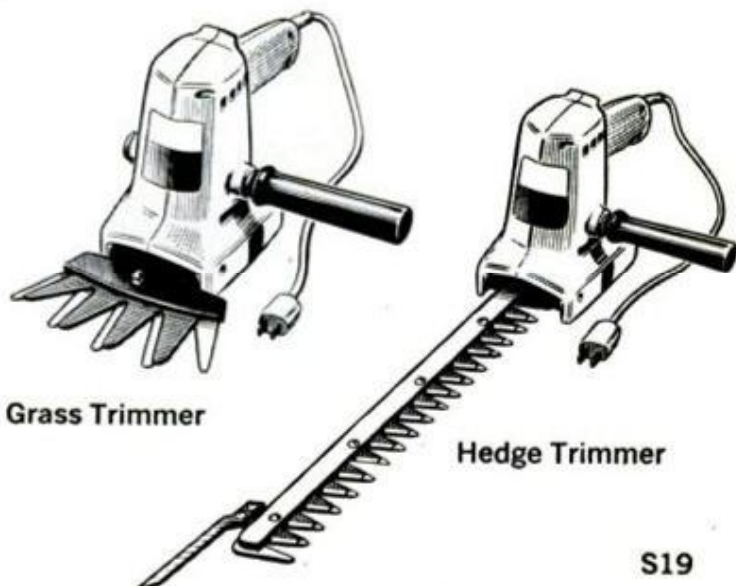
This electric grass trimmer does double duty. It trims close to trees and fences. Changing a locking lever converts it to an edger for use along walks and drives. The trimmer at lower left can be hand held or used with an extension handle.



A safety-blade guard must be locked in over the blade before the powerhead can be used for edging. This guard protects the operator from dirt and grass thrown by the blade.



The edger makes a clean, even cut between walk and lawn. An edge guide lets the operator follow the contours of walks or drives. One manufacturer's toolhead can be used interchangeably on grass trimmer, hedge trimmer and other tools.





**8 HP POWER**  
**JOB:**  
**Tilling**  
**Tools for the tough jobs**



**T**he tiller is the gardener's plow and cultivator. It breaks the soil and prepares the seed bed; it cultivates between the rows; in autumn it turns under plant stalks, mulch and fertilizer. As plants grow larger, the tilling width can be reduced by removing tines. It can be increased with extension tines. Light tillers are satisfactory for shallow cultivation. But a heavy-duty model is what the name suggests. Tillers range from \$150 for a 3-hp, to \$190 for a 5-hp with two-speed drive and "extra-heavy" construction.



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You'll be mowing at your level best. Write for free full-color brochure, and see your Yazoo dealer soon.

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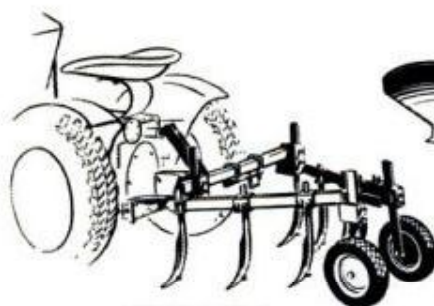
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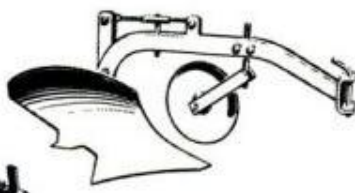




If you'll have work for a tiller and are planning to buy a tractor, shop carefully. A "lawn tractor" (page S-12) can't operate a tiller—or pull any of the equipment shown below. You need a 10 or 12-hp tractor. If you have one, you can farm an acreage. A tractor-tiller takes *all* the work out of the job. A typical tractor-tiller costs about \$280. A hard-working tractor deserves regular check-overs: invest in a good set of wrenches.



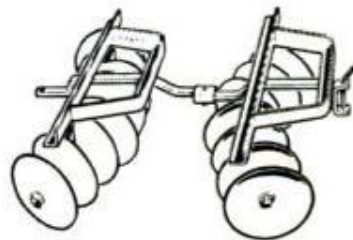
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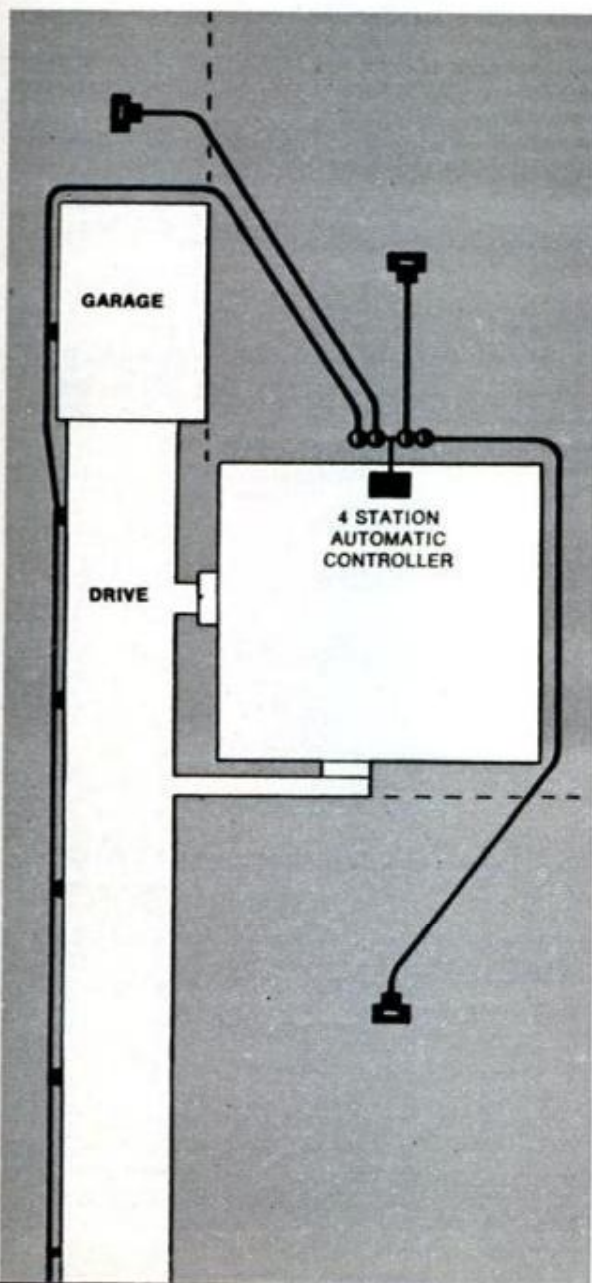
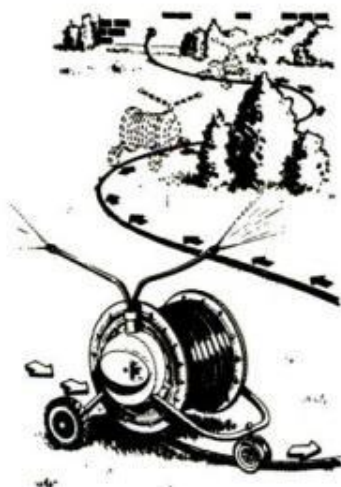
Watch for this mark on retailers shelves. It will help you recognize the products advertised in Popular Mechanics.



# Making It Rain

Water power and electricity turn it on

**T**here's a better way to water a lawn than dragging hoses. Some homeowners have found it's a traveling sprinkler. Waterpower makes the sprinkler follow any hose pattern (right) and shut off when finished. And a completely automatic underground sprinkler system (below) is now available with a controller that can be pre-set like a clock radio. You can water during the night or early morning. You can install it yourself with a spade to slit the turf and bury the polyethylene pipe and a knife to cut the pipe and control tubing. This tubing carries a water signal to the on-off valve. A \$100 starter kit (to which you can add) contains two wave sprinklers (each covers 2000 square feet); an automatic four-station controller; 100 feet of pipe; control tubing and a faucet adapter.



Yard plan (left) includes 3 wave sprinklers, 6 pop-up sprinklers along drive. Area: 5000 sq. ft. Cost: \$199. Controller-timer (below) plugs into house current. Wave sprinklers (bottom) spray in rectangular pattern.



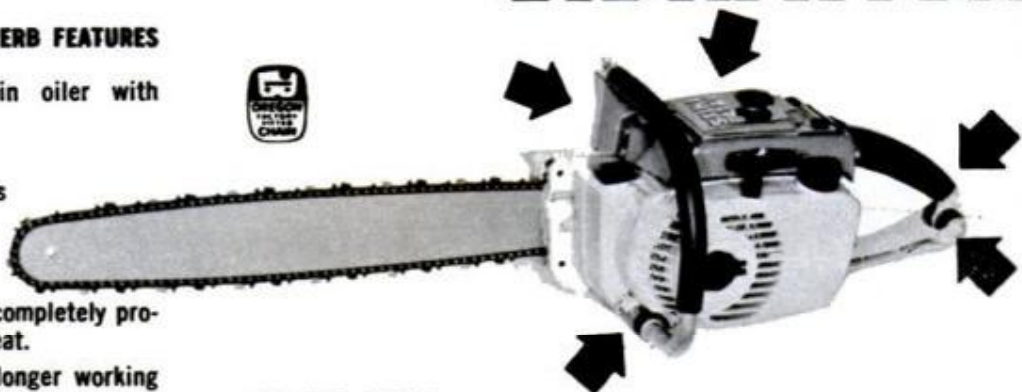




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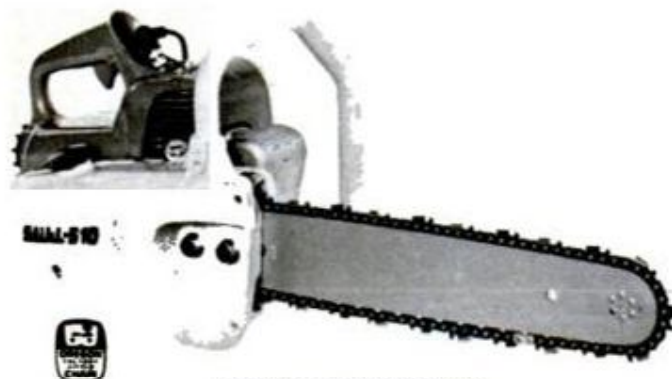
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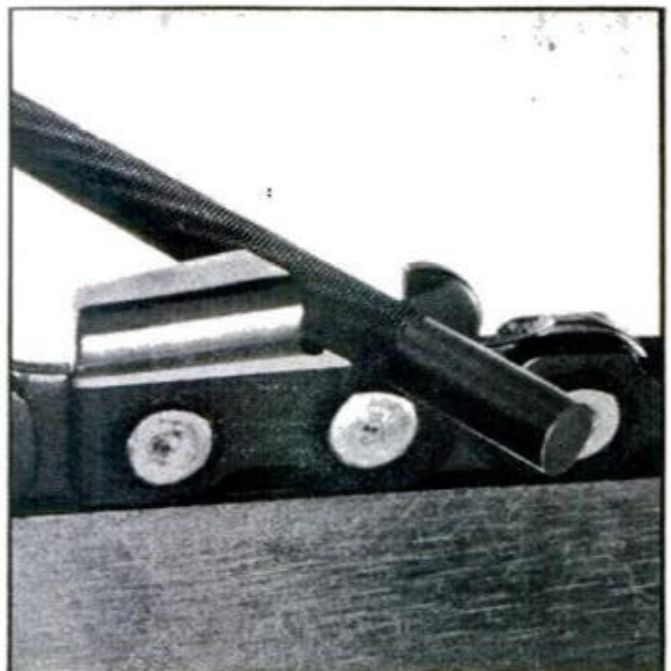
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FEBRUARY 1968



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There's never a dull moment with

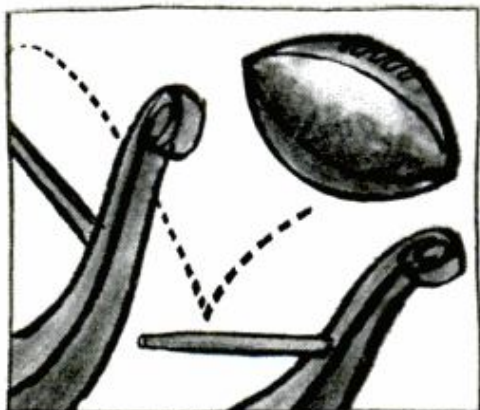
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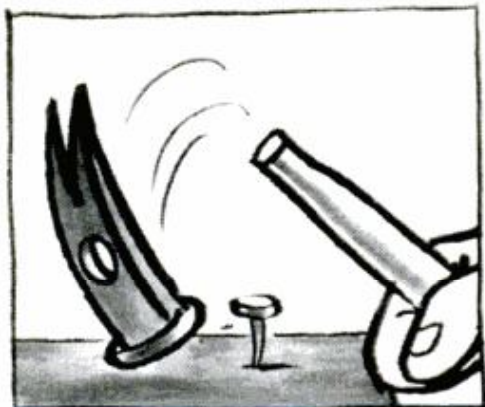
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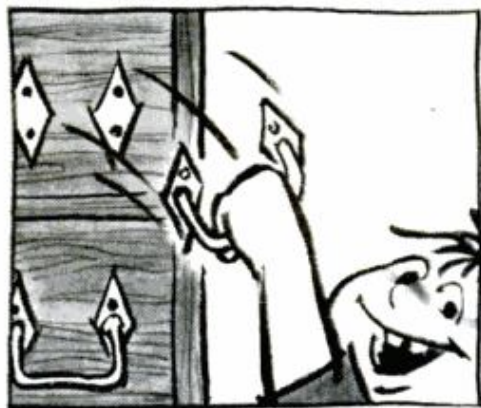
## Rough Day, Charley?



Kids use the chair as a goal post?



There goes that hammer head!



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Fix it with the  
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Looks and lasts like real wood.



Handles like putty—comes in 5 colors.

# LETTERS

TO THE EDITOR

## Scratch three bombs

The article *Sunken Time Bombs Full of Oil* (page 97, Nov. PM) contains factual errors concerning three tankers formerly operated by this company; the errors tend to exaggerate the possibility of pollution from sunken tankers.

1. The tanker SS *Francis E. Powell* (No. 26 on your list) carried a cargo of non-persistent petroleum products—gasoline and home-heating oil—when that vessel was sunk. If released to the sea, such products would dissipate long before they could cause pollution of beaches.

2. The tanker SS *E. H. Blum* (No. 29) had no cargo aboard when the stern half was sunk. (The vessel struck what appeared to be a mine off the Virginia Capes on Feb. 16, 1942.) The stern was subsequently raised and rejoined to the bow section, which did not sink.

3. The tanker SS *Atlantic States* (No. 76) also had no cargo aboard when she was torpedoed on Apr. 5, 1945. However this vessel did not sink. The Navy towed her back to Boston, and, after repairs, she rejoined the Atlantic fleet.

MARINE DEPARTMENT C. C. SHUTE  
ATLANTIC RICHFIELD CO. MANAGER

## Tiffany from a noodlemaker

*Make Your Own Tiffany Shade* (page 166, Aug. PM) got me started making a lamp—and now I'm hooked. I have completed four of them and am now in the process of making two more.

My lamps are made of scraps of cathedral glass of many colors. I have been cutting the copper strips on a noodle machine, which does the job very effectively.

Perhaps my experience will encourage others who think that lampmaking is too difficult.

FRESNO, CALIF. JOHN ROSANO

We'll print your letter to help encourage hesitant lampmakers, but let's not overlook the real significance of what you've done. Do you realize that yours is the only assembly line in the nation that turns out both table lamps and noodles?

## Biggest blast

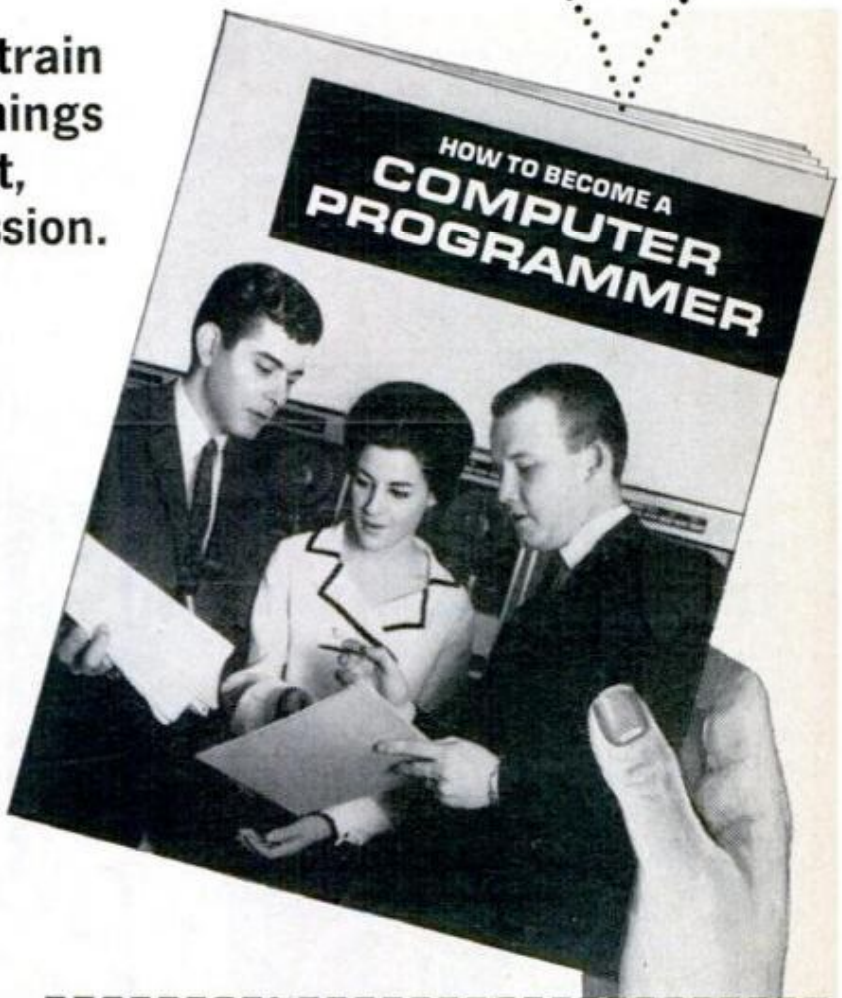
In *The Biggest Blast: Before the A-Bomb* (page 81, Dec. PM), the statement is made that the Halifax Harbor blast was "the" (Please turn to page 8)



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## LETTERS

(Continued from page 6)

biggest man-made explosion in the history of the human race until the development of the atomic bomb."

However, according to a statement in the book, *Matter*, in "... history's biggest non-nuclear blast, 1375 tons of nitrates were detonated" at Seymour Narrows, B.C., in 1958. Which statement is correct?  
NORTH ADAMS, MASS. B. BELOUIN

*Atomic bombs were first exploded in the 1940s, so, chronologically, the Seymour Narrows blast of 1958 isn't even in the before-the-A-bomb competition.*

*We did check with DuPont to see which was the largest, man-made, non-nuclear blast. DuPont stands by its contention that the 1375 tons of nitrates set off in the controlled explosion at Seymour Narrows created a bigger bang than the 2500 tons of various explosives accidentally touched off in Halifax Harbor.*

*All we can say is that it'd be tough to sell that claim to Halifax.*

### Add-on for shop vacuum

You could add an inexpensive item to

that shop vacuum (*Wheels Make Your Shop Vacuum Twice as Useful*, page 168, Nov. PM) to hold its extension cord.

A variety of types could be used—from the fancy retractable kind found on vacuum cleaners to a spool to wind the cord.  
NORFOLK, VA. KEITH G. HUNSAKER

### Detroit—or thereabouts

American Motors does not make its cars in Detroit, as your automotive writers imply when they use such statements as "new from Detroit." AMC cars are manufactured in Kenosha, Wis.  
COLONIA, N.J. BARBARA A. RESETAR

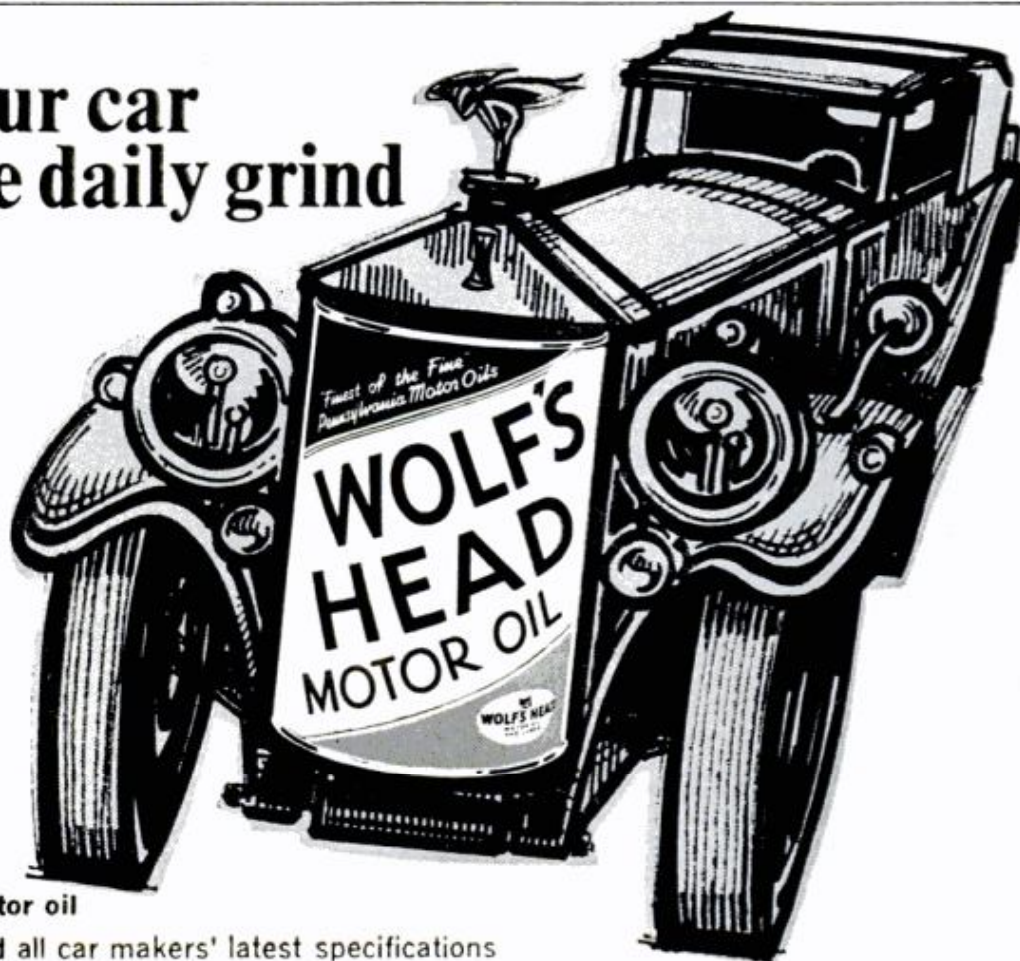
*"New from Detroit" cars are also made in Dearborn, Flint, Lansing, Pontiac, Wixom and Tarrytown—to list a few "suburbs." It's a little like saying "The White House says . . ." when the speaking is really done in Texas.*

### Later than we thought

Your December *Detroit Listening Post* states that the four-door Lincoln softtop "was dropped a couple of years ago." This is not so.  
LARCHMONT, N.Y. F. Z. SMITH

*Not so is right; there was one in '67.*

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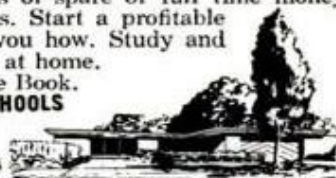
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Chances looked dim. Joe had no college. His only experience was in his old job. He couldn't just quit and hope.

But when Joe Miller dropped his envelope in that mailbox, everything he wanted suddenly became possible. *It was the single most profitable act of his life.* It changed everything. Yet, all he had done was mail a coupon like the one you have at the bottom of this page.

## FREE BOOK PUT JOE MILLER ON THE ROAD TO BIG INCOME

That coupon brought Joe a fascinating, free book from Universal Schools—the same book you can have in just a few days. It's an eye-opener! It tells the little-known story of a world of opportunity all around you in the booming Accident Investigation field.

It was all new to Joe. Like most men, he'd hardly ever heard of Accident Investigation. He didn't know the first thing about it. Yet, Joe Miller felt he had found the perfect opportunity.

And he had! Soon Joe was moving ahead in the most exciting, new career imaginable. His first full year he made \$14,768.72! *Since then he's averaged \$20,000 working about six months a year.* The rest of the time he just relaxes and takes it easy.

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● That Accident Investigation is one of the biggest service businesses today—a \$19 billion industry booming to new growth every year. It's safe from layoffs, recession and automation because accidents keep right on happening no matter what the economic conditions.

● That more and more men are urgently needed to investigate and settle some 22 million accidents and losses every year for insurance and other companies—and the accident rate goes up steadily.

● That for nearly 20 years Universal Schools' training-by-mail plan has been the path to success for hundreds of men in this profitable, fast-growing field—most of them men with no college and no experience.

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## HE TRAINED WITHOUT RISK, IN HIS SPARE TIME AT HOME

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In brief, clear, interesting lessons, Joe learned exactly how to step in and start making money quickly in Accident Investigation. And, obviously, that's what he did. But even today, successful as he is, Joe says: "If at any time I'm in doubt, I refer to my Universal books."

Joe Miller's income is unusually high and it is not typical of the industry. He's

become a busy specialist in storm loss adjusting. But it does show the huge potential in Accident Investigation—even for men with no college and no experience. For example, here are some reports from recent Universal students:

My income has more than doubled."  
—James T. Woodruff of Louisiana.

"An immediate 40% increase in wages."  
—Bill Ruhnke of Missouri.

"A raise every three months for the next two years, plus new car and expense account."  
—Oscar Singletary of Georgia.

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# Science Worldwide

BY JOHN F. PEARSON

The Alaskan earthquake of 1964, which caused 131 deaths and over \$750 million in damage, is still under study by government scientists. They say the quake was the strongest ever recorded on the North American continent, so powerful that mountains subsided, the seabed rose 50 feet in one area, and the shock waves caused disturbances that tore boats from their moorings in the Gulf of Mexico, 3200 miles away. At Hilo, Hawaii, 2800 miles from the quake's center, the seismic sea wave (tsunami) that resulted caused the water to rise more than 12 feet. The tsunami reached Antarctica in 22½ hours, traveling from Alaska at 430 mph. (See *What Causes Those Giant Killer Waves*, page 98, January PM.)

A highly magnified view of a portion of human lung immediately after surgical removal has been put on movie film by two University of Southern California researchers. Called a first of its kind, the film shows cancer cells dividing and the cilia—tiny, hairlike structures—beating 1000 times a minute to create a fast-moving mucous substance in the air tubes to carry away foreign material. The USC researchers used a special microscope and time-lapse photography to make their remarkable movie.

Food pills for silkworms have been developed by Japanese government scientists. Containing powdered mulberry leaves, pulverized soybean, glucose, yeast and minerals, the experimental pills are to be used as substitutes for the mulberry leaf, favorite food of the worms. The natural leaves can be an erratic food supply as mulberry trees may be destroyed by typhoons, frost or drought, causing the valuable worms to go hungry.

New hot spot in the Red Sea has been discovered by the Coast and Geodetic Survey ship *Oceanographer*. The mysterious hot spot—located 4800 feet deep in a basin at the sea bottom—contains water at a temperature of 133° F. (as warm as hot water from the kitchen tap) and has a salt concentration eight times that of normal sea water. This was the fourth hot spot to be discovered in the Red Sea, thought to be the only big body of water where they occur.

The honeybee population in California is falling off, according to a report by the University of California Agricultural Extension Service. It is down 40 percent in one county alone. Fruit growers depend on bees to pollinate their plants and rent bee colonies for their orchards. The population shrinkage is attributed to the continual use of pesticides.

Bugged bottles keep tabs on bartenders in San Diego. That's where tests are being run on a tiny transmitter that fits on a special pouring spout and signals when a bottle is tilted. A receiver in the manager's office keeps track of the number of drinks poured. A separate frequency is used for each price category, allowing for automatic accounting.

Oral contraceptives may trigger strokes. New evidence in support of this possibility was recently reported by Dr. Monroe Cole of North Carolina's Bowman Gray School of Medicine. Dr. Cole describes five cases of stroke in young women, none of whom showed the usual medical disorders that are connected with stroke. But all five were taking birth-control pills when admitted to the hospital. "A stroke in a young woman is an uncommon event," the doctor observes. He believes his and other studies indicate that physicians should carefully evaluate a woman's health before prescribing contraceptive drugs.

Waste banks bear watching. Of 60 such banks heaped up beside coal mines in Virginia, West Virginia and Kentucky, 38 show signs of instability. In the last 40 years in these three states, there have been nine waste-bankslides, killing at least 25 persons, according to William E. Davies of the U.S. Geological Survey. The waste banks have been studied since the disaster at Aberfan, Wales, in Oct., 1966, when a pile of coal waste suddenly slid into the village and killed 144 residents.

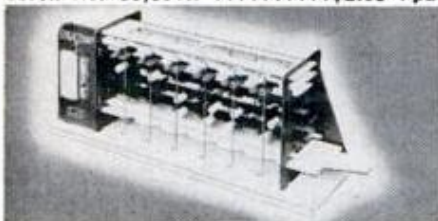




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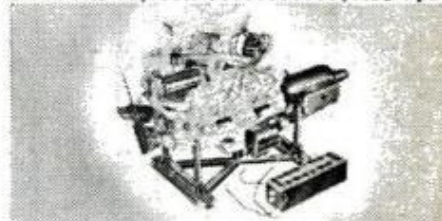
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**"\$642  
WHILE  
LEARNING**



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# Don't Envy the Boss...BE ONE

To own a business is much easier than you think. We show you how... step by step. The 24 page fully illustrated booklet we'll mail you (with no obligation) explains how, starting with only one serviceman, your profits may far exceed your present salary. With two servicemen your profits double. Your income is limited only by the number of servicemen you employ.



## Start while Continuing Present Job We furnish all the equipment...and help finance you

If you've wanted to be your own boss... to be financially independent... have a growing business, now YOU CAN.

Many men have said to us, "I can't afford to give up my job till I know I have a sure thing... a sound business that will provide both security and a better way of life."

That made sense. So we built such a plan. Now hundreds of men have upped their scale of living with a Duraclean dealership. You don't experiment. You use tested, proven methods. You have our backing and know-how.

You keep your job while a customer list grows. When your business profits exceed

your job salary, go full time lining up jobs for your servicemen.

Would you like this? Don't guess. Don't decide now. Mail the coupon so you'll have facts to decide wisely... and KNOW if this is what you want.

You operate from a shop, office or home. This business is easy to learn... easy to start... so easy to service that women dealers often do it.

We are now enlarging this worldwide system of individually-owned service businesses. If you are reliable, honest and willing to work, we invite you to mail the coupon. No obligation.

### Your Services Are Commended by

McCall's Magazine, Parents; American Research & Testing Laboratories... and by leading Carpet Mills & Furniture Makers

### What Dealers Say:

G. W., Pa.: "Insurance job brought me \$205.70 in single day. Another, \$300."

L. B., Ariz.: "I started spare time and took in \$140 in one night after supper. Now, full time, I can make as much in a week as I used to make in a month working for others."

W. T., Ill.: "After two years of good profits we sold our business for five times the cost."

Arlin R., Ill.: "I have work scheduled for three weeks in advance. I averaged \$122 a day for the last ten days."

Blanche B., Mass.: "Duraclean brought me security and an education for my daughters. We've done as much as \$3,000 on a single job."

L. F., Ill.: "Did the carpeting in a furniture store in less than 3 days for \$400. Now get all their customer business."

R. W., Ohio: "The professional quality of Duraclean Service has earned the respect of carpet dealers and wholesalers. I've earned \$117.50 in an eight hour day."

W. S., Jr., N.C.: "Building steadily. Last month grossed \$2,012. One job came to \$752."

J. S., Fla.: "Making 50% more than on any job I ever had. I've earned as high as \$1,300 in a single week, as much as \$2,700 on one job."

E. S., Colo.: "I never knew a company as eager as Duraclean to help their franchisees succeed."

R. G., Ohio: "Using the direct mail program we sold 10% on actual jobs. We also get a lot of referrals from happy customers."

J. B., Ohio: "I don't know of any other business in which a man can make as much per hour."

W. P., Mass.: "It would take a man years to build up the fame he gets automatically with the Duraclean name. It's a household word."

### It's Easier than You Think to Start Your Own Business

In our illustrated booklet, you'll see the way we show you step by step how to quickly get customers... how recommendations multiply customers.

Your carpet and upholstery service not only cleans it enlivens fibers... revives dull colors, raises pile. It eliminates soaking and fiber breaking from machine scrubbing. Mild aerated foam lightly applied lifts dirt, grease and unsightly spots. Customers become your best salesmen.

The booklet explains all 6 services which are rendered "on location." You have six ways for profit on every job.

National advertising explains your superior services, builds customer confidence... brings job leads to you.

We train and assist you. We show you 15 ways to get customers.

Don't delay! Get the facts TODAY before your location is taken.

### Start Small, Grow Big...in this Booming Business

A third century ago Duraclean was an idea... but it caught fire and spread rapidly to a worldwide service. Why? Superior methods plus tested, proven ways to get customers. Our dealers, too, start small... and GROW.

A few hundred dollars establishes your own business. We furnish electric equipment and materials to return your TOTAL

investment. Men take partners.

If you have good habits and like to please customers, you will likely qualify for a Duraclean dealership.

It's been said, "Opportunity knocks but once at each man's door." This may be that rare opportunity in your life.

You can quickly decide from facts we'll mail you. So, find out now.

### Dealerships Resell at Big Profits

If, because of illness, moving, or for any reason a dealer wants to sell, we maintain a service to locate buyers and to help him sell.

Dealerships resell at up to 10 times the dealer's cost. R.D.K., after 5 months, sold for \$2,000 above his cost. L.L., after 30 months, got \$7,116 more than he had paid. The value of your dealership and franchise grows monthly.

### FREE BOOKLET tells how to start Your Own Business

With no obligation, we'll mail you a letter and 24 page booklet explaining the business... how and why your income grows... how we help finance you.

Then decide if this opportunity fulfills your dream of independence and a much bigger income.

Your location could be taken tomorrow...so mail coupon today.



**Mail this coupon TODAY**  
It may put you in business

Duraclean, Int'l. 8-162 Duraclean Bldg., Deerfield, Ill. 60015

With no obligation mail letter with 24 page illustrated booklet explaining how I can increase my income and family security with a Duraclean Dealership.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_ Zip \_\_\_\_\_

## Find Out with No Obligation



## 1. Training Means Money These Days

In today's job market, men with specialized training get the good jobs—and good pay. Trained men get the promotions and pay raises that count. In virtually every field, TRAINING spells the difference between staying where you are—and moving ahead.

Look over the list of fields below. In each, I. C. S. has been training men and women for years. Giving them up-to-date knowledge that will let them advance in their present job... or break into an entirely new field. I. C. S. can do the same for you—starting RIGHT NOW.

## 2. Jobs in Architecture, Building

**ARCHITECTS**—Qualify for advanced positions in architectural, engineering offices. I. C. S. courses begin with basics. Knowledge to help prepare for A.I.A. exams. Math, Drawing, Design, B'ld'ng, M'ch'n'c'l trades. Write "Architecture" on coupon for FREE booklets.

**ARCH. DRAWING**—One-course stepping-stone to architecture. Emphasis on drawing practice. No previous experience necessary. Apply now.

**CARPENTRY**—Largest demand area in building trades. \$4.07 average hourly wage. Over 20,000 openings yearly. Training needed. Send coupon NOW.

**PLUMBING-HEATING**—Earn \$4.30 hourly—average for plumbing-heating specialists. I. C. S. course has proven track record. Starts with basics. Mail coupon for FREE Success Kit.

## 3. Art Talent Sought

**COMMERCIAL ARTISTS**—Experienced artists earn \$150 and more weekly. But training is essential. Course starts with fundamentals. Job-related. Personalized instruction. Break into field full- or part-time. Write "Commercial Art" on coupon.

**INTERIOR DECORATING**—Non-technical course for homemaker, home furnishings salesperson. Study carpets, furniture, walls, windows, decor, color, taste. Mail coupon now.

**SIGN PAINTING**—Course prepares you to break into field. Covers all aspects: layout, design, painting, gilding, screen process. Send coupon for 3 FREE booklets.

**SKETCHING & PAINTING**—Like to draw? Feel you have talent? Get training. For spare-time enjoyment, or use in present line of work. Course starts with basics, covers popular art mediums.

## 4. Automotive Specialists

**AUTO ELECT. TECHNICIAN**—More electrical equip. on cars—more need for elect. specialists. I. C. S. course covers the circuits, headlamp to taillights. Simply written, illustrated texts. Send coupon for 3 FREE booklets.

**MECHANIC (GEN'L)**—700,000 employed. 20,000 openings yearly, and employment on the upswing. Famous I. C. S. course taken by thousands in field. Coupon brings Success Kit.

**TRANSMISSION SPEC'L'ST**—If you now know cars, why not become a specialist? Course covers transmission troubles, testing, repairing, overhauling. Auto., standard.

## 5. Businessmen Make \$\$\$\$\$

**ACCOUNTANTS**—20,000 openings a year in this high-pay field. I. C. S. courses cover the basics plus 10 vital accounting specialties. Get information. Send coupon right NOW.

**ADMINISTRATION**—The key to business success. Famous I. C. S. course covers 3 vital areas: management, production, marketing. Write "Business Administration" on coupon.

**EXEC. TRAINING**—A company's as good as its top people. Learn to train men, to spot "comers." Mail the coupon.

**MARKETING MEN**—Advance to management? You'll need marketing knowledge. Course covers management practices, principles, with emphasis on marketing. Get started now.

**PROGRAMMERS** for digital computers. Space-age specialty. Earn up to \$15,000 yearly. Specialized—training vital. This course gives it.

**PURCHASING**—Advance to purchasing agent? Break into field? Take this course. Demand for PA's rising. Experienced men earn average salaries of \$8-\$15,000. Send for Success Kit.

**SALESMANSHIP**—I. C. S. is famous for this course. Covers basics of selling that stay same, no matter the field. 1,000,000 new salesmen needed 1965-75. Get started NOW. Write "Salesmanship" on coupon.

# YOU CAN GET A BETTER JOB

by spare-time study with I. C. S.

**SMALL BUSINESS MGT.**—Run your own business. Course tells how. Covers purchasing, merchandising, sales, taxes, accounting, etc.—all you need to know.

**TRAFFIC MGT.**—Employment forecasts show upward trend for trained traffic people. Course covers entire traffic picture. Prepares you to enter or advance in field. Send coupon today.

## 6. Chemistry

**CHEM. ENGINEERS**—Youngest engineering field, expanding with industrial development. Course prepares you for registration exams. Also for breaking into chemical design, development or production departments. Send coupon for Success Kit. It tells whole story.

**GEN'L CHEM.**—A good course in gen'l chemistry? What easier way than at home, in spare time. Also covers basic math, physics.

**NUCLEAR ENERGY**—Course for engineers, technicians, maintenance men who want to enter nuclear field. Covers basic math, physics & chemistry leading to study of radioactivity and nuclear energy.

**PLASTICS**—Qualify as plastics technician. Take this course. Texts easy to read, written by experts. Mail the coupon for 3 FREE booklets.

**PULP, PAPER SPECIALISTS**—Courses cover engineering to paper machine operator. Demand field, exp'ct'd to increase 75% in next 25 years. Write for information.

## 7. How to Become a Civil Engineer

**CIVIL ENGINEER**—Famous course recognized by many states, prepares you to take exams. All aspects of civil engineering. Thousands of graduates. Write now for 3 FREE booklets.

**HIGHWAY ENGINEER**—Advance in field. Course complete, covers theory, practice. Recognized by many states. Send coupon now.

**STRUCTURAL BLUEPRINTS**—How to read them. A key to advancement for ironworkers, patternmakers, builders of concrete structures. Mail coupon now.

**SANITARY ENG'N'RING**—Men trained in this field in constant demand. Course covers water treatment-supply, sewerage, eradicating menaces to health. Apply now.

**SURVEYING, MAPPING**—Course for man who wants to enter civil engineering field, but undecided about branch. Texts illustrated, simply written. Personalized instruction. Mail coupon.

## 8. Draftsmen in Demand

**DRAFTSMEN**—Over 4000 openings yearly. Senior draftsmen earn average \$550/month. Break into field? I. C. S. training in specialized area can help you. Don't delay. Choose field, then clip coupon.

**ARCHITECTURAL** drafting course covers arch. drawing, house planning, freehand & ornamental drawing, shades & shadows.

**ELECTRICAL**—Arithmetic, electricity basics, projection drawing, machine sketching, electrical drafting, other subjects.

**ELECTRONIC**—Math, mechanical drawing, formulas, electricity, electronic & printed circuit drafting, others.

**MECHANICAL DRAFTING**—Arithmetic, algebra, geometry & trig, projection drawing, mechanical drawing, machine sketching, others.

## 9. Electronics, Electricity

**APPLIANCE SERVICING**—More appliances mean more demand for servicemen. I. C. S. gives you know-how worth money from start. Clip coupon for Success Kit.

**ELECTRICAL ENGINEERS**—Demand field. Jobs in gov't, industry. I. C. S. training helps worker in field advance to junior, sr. eng'n'ring positions. Also helpful in preparing for registration exam. Starts with basics, if you have limited knowledge. Send coupon for 3 FREE booklets.

**ELECTRIC MOTOR REPAIRMAN**—Course starts with basics, covers AC, DC motors—perfect for would-be maintenance men, or those who seek advancement to supervisor.

**INSTRUMENT TECHNICIAN**—Specialists in electrical measuring & control equip. will be scarce in late '60's. Take advantage! Course gives training, starting with gen'l principles. Send for Success Kit right away.

**PRACTICAL ELECTRICIANS** earn an average of \$4.37 per hour. Get the know-how! Course covers building wiring, elect. equip'm't. Helps prepare for licensing, journeyman exams.

**INDUSTRIAL ELECTRONICS**—Technical-level course—thorough grounding in electronics. Take first step to cracking this rapidly expanding field. Mail the coupon.

**ELECTRONICS TECHNICIANS**—With 5 yrs. exp., they average \$650—many earn more!



Be a specialist in this booming field! Course prepares you. Theory—you learn it. Plus practical application. Mail coupon now.

### 10. Engineering—a Profession

Take your first step to becoming a registered, professional engineer, with the help of famous I. C. S. courses. There are two routes to eng'n'ng: college and 4 yrs' exp. in field; or high school and 8 yrs' exp. Then, state registration exam. I. C. S. courses help you obtain work where you can gain necessary field experience; give you knowledge you need to pass exams. Instruction available in Civil, Chemical, Electrical, Mechanical Engineering. Texts authored by authorities, are illustrated and simply written for quick comprehension. Study now, in spare time, for future success or retirement career in engineering. Write "Professional Engineer" on coupon. Do it now.

### 11. Success, Pleasure Through Better English Writing

**BUSINESS WRITING**—Command the written word—a key to business success! Course covers composition, copywriting, editing, typography, report writing. Send coupon for FREE Success Kit.

**FREE-LANCE WRITING**—A career for anyone with talent for writing. Course treats techniques, forms and—how to sell articles. Step-by-step instruction. Send coupon.

**SHORT STORY WRITING**—An avocation that can lead to spare-time profit. Course covers English grammar, elements of a good story. Emphasis on actual writing. Get started now.

**PRACTICAL ENGLISH**—A bedrock study of basic English. To improve your speech, writing. As refresher in the basics. People judge you by your language. Send coupon today.

### 12. More Formal Education

**FINISH HIGH SCHOOL**—It's never too late. And H.S. completion means much greater earning power and job security. I. C. S. High School programs let you complete your schooling at home, in spare time, at your own pace. Variety of courses offered: Business, Secretarial, Vocational, General. Complete only work you need for I. C. S. High School diploma. Start doing it now—by filling out coupon and mailing it!

**COLLEGE PREPARATORY** high school course also available. Take credits you need for I. C. S. H. S. diploma that prepares you for college entrance exams. It's never too late to start—if you have the desire. How about now?

**LEARN LANGUAGES**—Special, low-cost courses. Instruction by records, text, the world-famous Berlitz way. Specify language you're interested in: French, Italian, German or Spanish.

### 13. \$\$\$\$ in Mechanics, Shopwork

**AIR CONDITIONING EXPERT**—Experienced men make \$125 a week, average, and demand is rising. If you have basic mechanical knowledge, take this course. Instruction in maintenance, too. Write "Air Conditioning" on coupon.

**INDUSTRIAL ENGINEERING**—Advance to higher position in operation/management of industrial plant: this course gives the knowledge you'll need. Also first step to becoming registered eng'n'r. Send coupon.

**INSTRUMENTATION**—Several thousand new jobs a year in this demand field. A basic course. Write for Success Kit.

**MACHINE DESIGN**—A technical field itself, this knowledge is vital to draftsmen, and a big plus for production men, shop workers.

**MACHINE SHOP PRACTICE**—A basic course, giving overall knowledge of shop oper'tns. Emphasis on practical facts. Personalized instruction. A must for the man who wants to advance. First step? Mail coupon.

**MECHANICAL ENGINEERING**—Within your grasp a high-pay field where at least 2600 new jobs open yearly. Write for Success Kit.

**SHOP PRINTS**—And how to read them. An authoritative, factual study. Vital to men who want to advance in shop work. Mail coupon now.

**REFRIGERATION SPECIALISTS**—Enter this booming field and learn the hard way? There's no need. Training spurs advancement—it's never been truer! Fill out coupon for complete information.

**TEXTILE TECHNICIAN**—The job outlook is good—for trained men. Course designed to help you break into field—or advance to management. Write "Textile" on coupon.

**TOOLMAKING**—The average toolmaker earns \$26 daily. For good reason: he knows a specialized skill. I. C. S. course equips machinists to crack this specialty, where over 4000 jobs open up annually.

**SAFETY ENGINEERING**—A comparatively new field, and men with formal training are scarce. Be one. Take I. C. S. course. Covers math, plant design, equipment placement, psychology, safety principles, practices. Apply now. Clip coupon.

**WELDING**—6000 openings yearly for welders, and pay in line with demand. I. C. S. offers several courses, from the basics to specialized areas. Write "Welding" on coupon for 3 FREE books.

### 14. Secretarial Help Wanted

**WHERE THE MONEY IS**—It's in specialized secretarial work. Few secretaries know specialized terminology, procedures. Those who do are in demand, command good pay.

**LEGAL SECRETARY**—Course covers instruction in typing, English, Gregg method sh'rt'h'nd, business law, insurance, office practice, public relations, legal shorthand. Equips you to work in law office. Apply immediately—the coupon's how.

**MEDICAL SECRETARY**—Basic secretarial skills covered in detail. Plus: instruction units on duties of a medical secretary, medical terminology, related subjects. Send coupon NOW for information.

**STENO-TYPIST**—Want to be a secretary? Break into steno-typist work first. Send coupon for facts on I. C. S. training in typing, stenography, business practice—all you'll need to know.

**CLIP COUPON HERE—TAKE YOUR FIRST BIG STEP TO REAL SUCCESS!**

I. C. S., Scranton, Penna. 18515 Accredited Member, National Home Study Council

## INTERNATIONAL CORRESPONDENCE SCHOOLS I C S

Dept. B2266A, Scranton, Penna. 18515

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Name \_\_\_\_\_

(Indicate Mr., Miss, Mrs.)

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Occupation \_\_\_\_\_

Employed by \_\_\_\_\_

Working Hours \_\_\_\_\_

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**PROCESS YOUR OWN 8mm B&W  
or COLOR HOME MOVIES**  
No Darkroom  
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**\$17.50**

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Project your movies one hour after shooting them! Simple! Economical! **CINE TANK!** Entire developing process, **INCLUDING LOADING**, is performed in daylight without ever removing film from camera spool. Plastic Cine Tank holds 30 ft. rolls 8 mm B&W or AnscoColor. Less than 20 ounces of chemical fills tank. Complete instructions included. Satisfaction guaranteed or money back!

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Maybe it was—then.

But not now. Now you want more—a new car, a great vacation, maybe someday even a home of your own.

And you know you're not going to get them sticking with the job you have. So you decide to get something new, something better.

Good pay? Sure you want that. But you want other things too: a little respect so you don't have to mumble when someone asks what you do for a living. And something with a future. The chance to earn more. To get some place. To be someone.

Now if you could only get that break, the fresh start...

Sound a little bit like you talking? Good. Because we can give you that break, that fresh start. We can give you the opportunity to become a computer programmer—a booming career, with over 25,000 job vacancies just waiting for people with the right training. (Now take it easy, you don't have to be some kind of mathematical whiz or even remember your high school algebra.)

All you need is the desire and the aptitude. You supply the desire and we'll supply a test that tells us quickly and accurately if you have the aptitude. Who are we? **ECPI**. Electronic Computer Programming Institute, a major educational institution with over 80 training centers in the U.S. and Canada.

We are completely equipped with IBM machines, textbooks, and a staff of teachers who are professionals. We also have a free placement service that can help you find one of those 25,000 jobs after you graduate.

That's what we have. But do you have what it takes to be a computer programmer? If you're between 18 and 40 and a high school graduate the answer is probably yes.

But make sure. Clip the coupon and send for your free sample aptitude test. It's your first step toward making that fresh start.

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PROGRAMMING INSTITUTE**

Empire State Building, N.Y., N.Y. 10001

Please send me a free aptitude test and information about day and evening classes at the training center nearest me.

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PM-28





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With New Improved Model BT-162

## DWELL TACHOMETER

**ASSURE** - EASY STARTS, OPTIMUM PERFORMANCE and  
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MADE ORIGINALLY FOR THE PROFESSIONAL AUTOMOTIVE TECHNICIAN, MODEL BT-162 WILL PAY FOR ITSELF MANY TIMES OVER FOR THE AUTOMOTIVE HOBBYIST AND EXPERIMENTER.

*The Model BT-162 will perform the services specified below in addition to many other tasks too numerous to mention:*

- ✓ Assure precise adjustment of points that are slightly worn or pitted.
- ✓ Indicate the most effective point setting **without removing the distributor cap.**
- ✓ Read the average dwell of dual breaker points as well as individual dwell of each individual set of points.
- ✓ Indicate the correct settings for **external adjustment type distributors.**
- ✓ Car manufacturers' dwell angle recommendations are included in the manual provided with the Model BT-162 for all cars including the external adjustment type distributors specified above.
- ✓ It is no longer necessary to file points to smoothness when using the Model BT-162. The instrument will automatically make allowance for any existing "pitting" or "wear."
- ✓ To adjust for mathematically correct carburetor adjustment and thus insure maximum gas economy and quiet engine running, simply use the Tachometer section of the Model BT-162. Read the exact RPM while the engine is in neutral position. Then adjust the carburetor in conformity with the car manufacturer's recommendations as specified in the manual provided with the Model BT-162.
- ✓ To locate a "miss" you need only disconnect or "short" the spark plugs one at a time with the Model BT-162 switched to the Tachometer position. You will be able to instantly identify which particular plug (or frequently its wire lead) is responsible for the malfunction.
- ✓ Cars with automatic transmissions function efficiently only if the fluid pressures are correctly maintained and since manufacturer's instructions always refer to RPM the Model BT-162 (or an equivalent tachometer) is required to properly service automatic transmissions. Incidentally, the 5,000 RPM maximum range of the Model BT-162 is adequate for all car engines without any exceptions.

The Model BT-162 comes complete, ready to use. Tune-up and operating procedure manual included with your Model BT-162 describes in detail how to make all tests. Also includes manufacturer's dwell angle recommendations for all cars. American and foreign. Packed with information from cover to cover. The manual is yours to keep even if you decide to return the instrument.

**\$29<sup>95</sup>**

## SEND NO MONEY WITH ORDER PAY POSTMAN NOTHING ON DELIVERY

Try it for 10 days before you buy. If completely satisfied then send \$5.00 and pay the balance at the rate of \$5.00 per month until the total price of \$29.95 (plus P.P., handling and budget charge) is paid. If not completely satisfied, return to us, no explanation necessary.

ACCURATE INSTRUMENT CO., INC.  
Dept. 543, 2435 White Plains Road, Bronx, N. Y. 10467

Please rush me one Model BT-162. If satisfactory I agree to pay \$5.00 within 10 days and balance at rate of \$5.00 per month until total price of \$29.95 (plus P.P., handling and budget charge) is paid. If not satisfactory, I may return for cancellation of account.

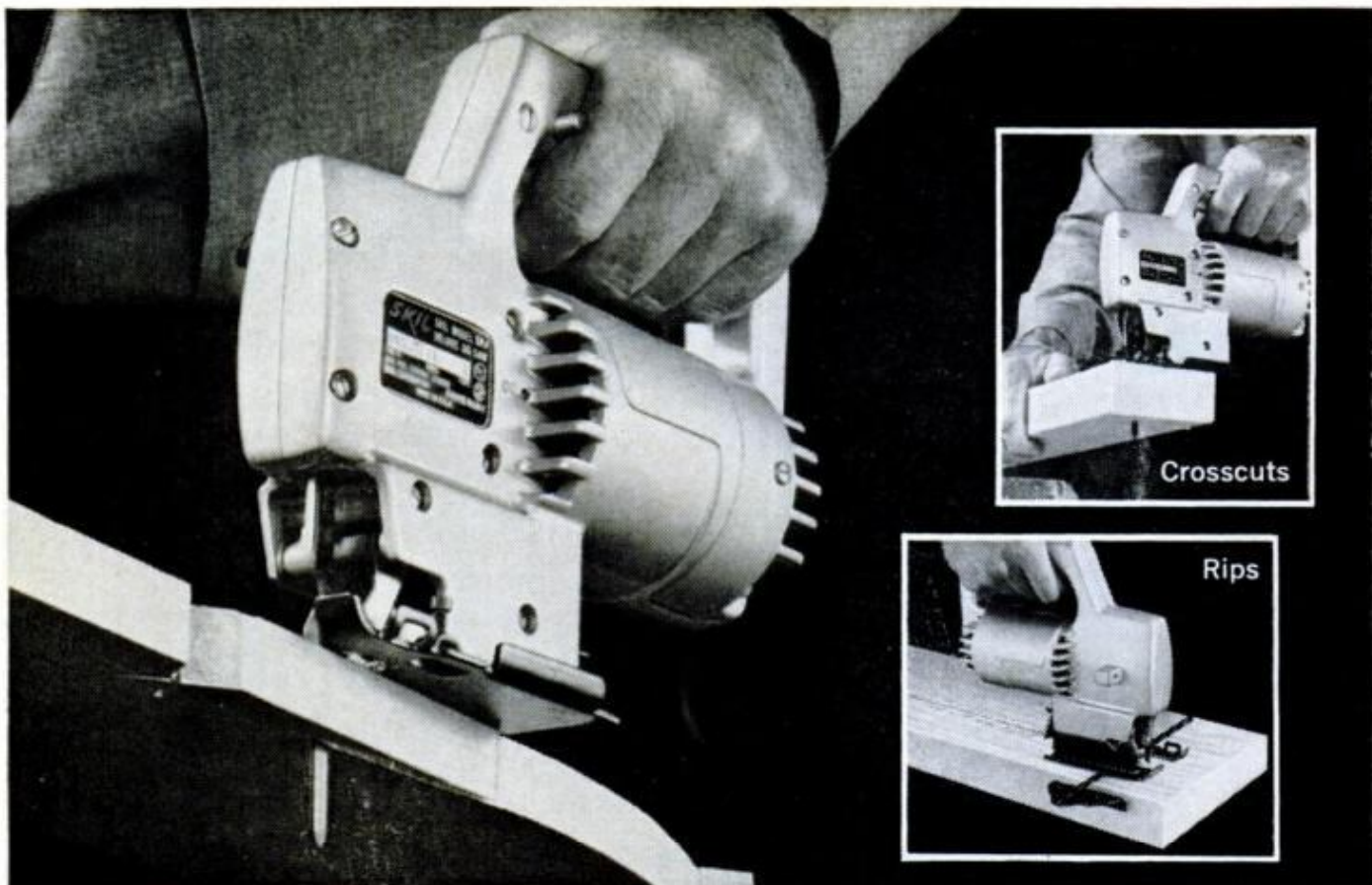
Name \_\_\_\_\_

Address \_\_\_\_\_

City \_\_\_\_\_ Zone \_\_\_\_\_ State \_\_\_\_\_

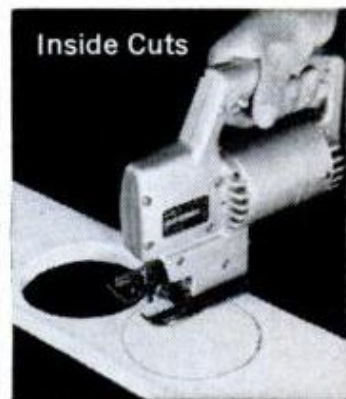
Save Money! Check here and enclose \$29.95 with this coupon and we will pay all shipping charges. You still retain the privilege of returning after 10 day trial for full refund.





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Why struggle with hand saws, when for a few dollars you can own the work-savingest power saw made—the Skil Jig Saw. Does the work of 7 different saws—rip saw, crosscut saw, sabre saw, hack saw, keyhole saw, scroll and coping saw, and band saw.

Cuts any material. Wood, metal, plastic, compositions, plaster board. At better lumber dealers, hardware and department stores. Skil Corp., Chicago, Ill. 60630.



**Skil Jig Saw Kits, Too!**  
12 blades, rip fence, circle cutting guide, carrying case with Skil Deluxe Jig Saw (illustr.) or regular Skil Jig Saw.

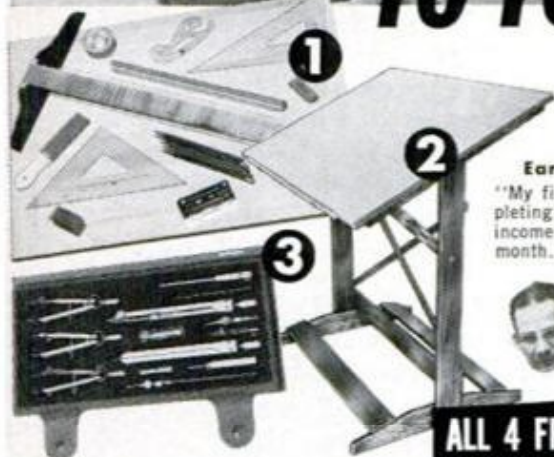
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### Earns \$820 Month!

"My first position after completing your course jumped my income from \$350 to \$820 per month." — G. W., Tenn.



### Big Promotion!

I was promoted from the production line ahead of 4 others and got a good pay raise." — W. A., Wisc.



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Now you can take your pick of thousands of big salary jobs open to Draftsmen (see "help wanted" sections of metropolitan newspapers). Huge nationwide demand... U.S. Dept. of Labor reports "42% more Draftsmen needed in next 10 years—not enough applicants to fill drafting jobs available now!" Our easy "Quick-Learn" Method has helped hundreds toward good income, security and prestige as Draftsmen. Why not you?

### YOU NEED NO DRAWING SKILL... NO TECHNICAL ABILITY

NASD's staff of Professional Draftsmen guide you step-by-step. With our spare time home-study plan you work on actual projects. Makes learning fun—easy to remember, too. Many graduates have succeeded with only grade school training. Others report good earnings drafting part time while still learning!

### RUSH COUPON FOR FREE KIT...

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5/8"	18	14	9	14	9	162
3/4"	14	11	7	11	7	112
7/8"	11	8	5	8	5	72
1"	8	6	4	6	4	48
1 1/8"	6	4	3	4	3	36
1 1/4"	4	3	2	3	2	24
1 3/8"	3	2	1	2	1	18
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**WHAT'S NEW OUTDOORS**

(Continued from page 22)

are tangible. Thirty-nine states have built or reconstructed 246 community fishing lakes with more than 31,000 surface acres. These lakes alone gave you more than 2 million extra fishing days.

It's with these funds too that 33 states have restored 135,000 acres of lakes to good fishing. This has been done by treating and restocking with game fish many lakes choked with poor nongame species.

But you can't fish if you can't get there. So DJ funds have been used to provide public lands, footpaths near good fishing grounds, parking areas, boat launching ramps, jetties, piers and the like. Altogether it figures to 1137 public sites making 3.2 million acres of water more accessible.

This money, then, is providing more fish in more areas. In other words, you can have your fish and eat it too.

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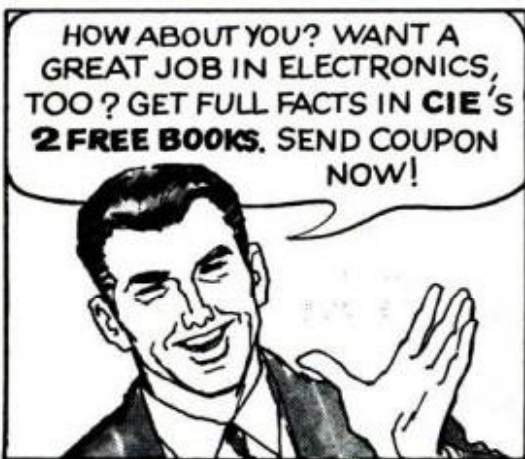
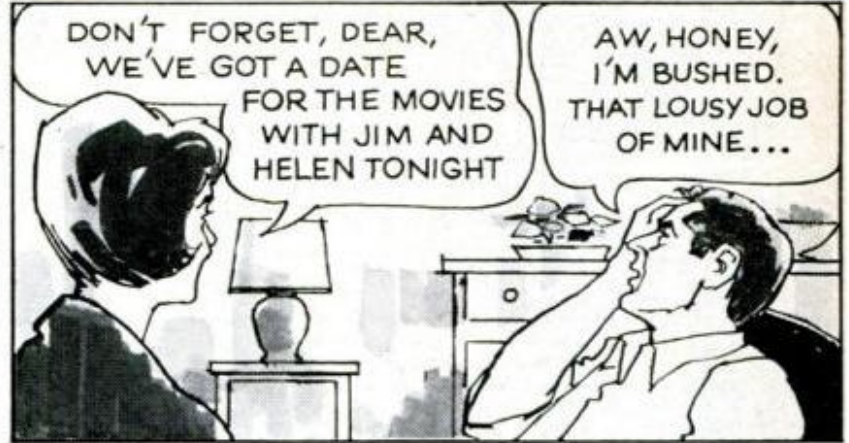
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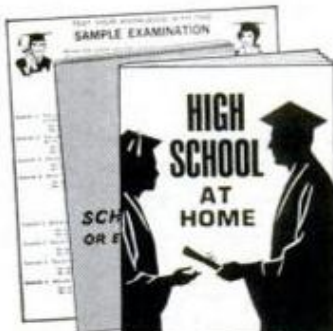
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# DETROIT LISTENING POST

BY BOB IRVIN

**DODGE TO ENTER THE SMALL SPORTY-CAR FIELD?** It recently introduced two experimental show cars—the Charger III and the Daroo I. The Daroo is based on the Dart GT. The Charger III, however, is quite different. Actually, it recalls the Chevy Astro I with its jet-plane-type canopy entrance and elevator seat. Dodge, happy with the attention the car is getting, says many of its features will be incorporated into Chrysler production cars in the not-too-distant future. Interesting features include an engine service hatch along the left forward panel. A mechanic can quickly check water, oil, or battery fluid level without raising the hood.

**A NEW TYPE OF TIRE MAY SWEEP THE MARKET** in a few years. It's a belted bias-ply tire that uses fiberglass as one of its components. Mohawk and Armstrong introduced such a tire last year. Now, Goodyear has started manufacturing its own version, saying it combines the best features of conventional and radial-ply tires, wears up to 50 percent longer than regular tires, grips the road better and saves gasoline. It has a bias-ply, or crisscross section, of polyester cord topped by two fiberglass belts under the tread. The belts are common to radial tires, and critics claim this is one reason they ride harshly. But the bias-ply under the glass belt is said to correct that. Goodyear isn't saying how many of the new tires it expects to build this year, but the total may top 10 percent of production.

**FEDERAL TIRE-SAFETY STANDARDS** should be easy to meet, rubber industry sources report. Much of what's required—such as a tread-wear indicator—is already on new tires. But the government sounds proud, anyway. Transportation Secretary Alan S. Boyd said the records show “a significant number of highway accidents are the result of tire failure.” He said he was confident new standards would help cut that toll. Government, already beating the drums about existing auto-safety standards, notes that traffic fatalities declined in the late months of 1967.

**MOTOR VEHICLE INSPECTION SYSTEMS** don't help much in preventing accidents, some University of Michigan researchers believe. “Except for a few anecdotal accounts, there is little evidence that inspection of vehicles prevents accidents,” they said. They found the number of cars with defective lights about the same in states both with and without such programs. Since it could cost \$350 million to inspect all cars every year, the researchers indicated this may be a waste of money.

**DIAGNOSTIC CENTERS ARE MORE POPULAR THAN EVER.** Informed estimates say 15,000 centers may be in operation around the country by 1969 and that motorists will spend \$1 billion a year to get their cars checked. So it was unusual to find Shell Oil Co. closing its only automotive diagnostic center, near Detroit. A company spokesman admitted the center was losing money. On the other hand, Goodyear just opened 18 more centers in Chicago. Mobil, which pioneered the idea, said it has checked 100,000 cars in the past five years. Of these, 58 percent needed sparkplugs, 51 percent wheel alignment and 42 percent carburetor adjustments. The whole matter of diagnosing and servicing a car's troubles, under warranty or not, may soon come up at a Washington hearing.

**PRICE HIKE OF OVER \$120** listed by auto companies for new models has the public believing that most added expense is due to the new federal safety standards. Not so, according to a Bureau of Labor Statistics study. It placed the “real” increase due to safety at less than \$30. Actually, the disparity is not as bad as it seems because the BLS

*(Please turn to page 34)*



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## DETROIT LISTENING POST

*(Continued from page 30)*

calculated the average '68 price rise at \$87. It compared wholesale list prices, not retail prices, which are higher and include the excise tax.

**DESPITE HEAVY LOSSES** sustained by Ford as a result of last fall's strike, Ford is going ahead with plans to develop a small car to compete with the imports. It's scheduled to be out in 1970. This would be none too soon; import dealers delivered more than 700,000 cars last year.

**GAS-ELECTRIC CAR PROTOTYPE** may be ordered this summer by a U. S. Housing and Urban Affairs Department interested in solving air pollution and big-city traffic congestion. The University of Pennsylvania, cooperating with General Motors, developed the concept. The tiny car would hold three passengers, be half the size of a family sedan, and have two power systems—lead-acid batteries for electric drive in congested areas, and a small gasoline engine for use elsewhere. The range (for electric drive) would be

about 100 miles and the top speed 60 mph.

The university isn't convinced GM's really interested in seeing such a car produced, but, denying this, company officials cite statements by GM researchers touting the hybrid as "the only type of electrified car that could achieve widespread use by the '70s."

**REPUBLIC AVIATION'S SAFETY CAR** may be built in full-size prototype with federal funds. A scale model described here many months ago was finally unveiled late last year. It's designed to allow people to survive front or rear-end accidents at 50 mph and side impacts at 40. Unique features includes a hydraulic, energy-absorbing bumper, a periscope with a 160° wide-angle lens for rear vision and thick capsule seats. There are no sharp corners on the body, rounded to protect pedestrians. The car has four-wheel drive with an antilocking system. George Hildebrand, the project manager at Republic, says there are no gimmicks, because "every item of hardware is available to the industry." The working model, as now planned, would be about the size of a Pontiac, weigh 4000 pounds and have a 260-hp V8 engine.

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## REPORT FROM JAPAN

*(As told by PM's editor, Bob Crossley, who recently spent three weeks in Japan to get first-hand information about its industries)*

**FOUR-WHEELED HONDA?** World's biggest maker of motorcycles is gambling that U. S. drivers will go for tiny new N600, smallest car to invade the United States in recent years. To be offered here next month, N600 seats four, has front-wheel drive. Air-cooled, two-cylinder engine is bored-out version of 360-cc block introduced in Japan last March. Price will be around \$1275.

**NEW, SMALLER TOYOTA.** Bigger than Honda's N600, but smaller—and sleeker—than the successful Corona (see page 38, Jan. '67 PM), the new 1077-cc Corolla will make U. S. debut this spring. Its slant four-cylinder engine cranks out 60 bhp at 6000 rpm. Price will be "under \$2000." The car will eventually be assembled in new plant Toyota is building in Sydney Bay, Nova Scotia. Production there will be for Canada only at outset, but officials at Toyoda City say they may assemble cars in Nova Scotia for the United States, too, if Corolla catches on. Another Japanese maker, Isuzu, whose cars are not sold here, already assembles in Sydney Bay, as does Sweden's Volvo. *Racing note:* Watch for Toyota's 2000GT at Daytona Continental this month and at Sebring in March. PM learned in Japan that U. S. racing wizard

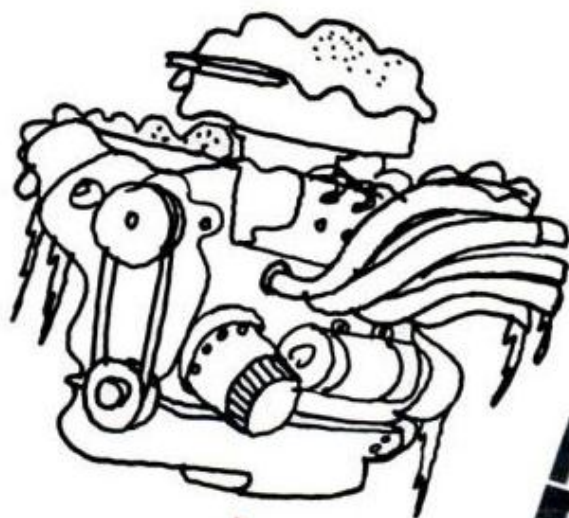
Carroll Shelby has been tuning three of the \$7000 beauties in his shop since last fall.

**ARCH-COMPETITOR NISSAN** has a slick little 988-cc sedan called "Sunny," but it's another of those "Good Cars You Can't Buy." (See page 108, Nov. '67 PM.) Nissan prefers to concentrate on the 1595-cc Datsun, now nip and tuck with Opel for second place in U. S. imports. (Toyota is breathing on both of them.) Nissan, too, has a fast sports car. Under Datsun nameplate, it won first and third last November in Class F (Production) at Daytona Road Race of Champions. Unlike Toyota's 2000GT, these cars are for racing only, are not on sale, even in Japan.

**ROTARY-ENGINE COSMO**, introduced last May by Japan's No. 3 builder, Toyo Kogyo, is attracting lots of attention, although in \$4000 sports-car version it's a bit rich for Nipponese blood. Company is working on two sedan versions to be introduced in Japan next July. Twin-rotor engine is built by Toyo Kogyo under license from Germany's NSU. Cosmo is exported to England, but so far not to the United States because company builds no left-hand drives and its cars do not yet meet all U. S. safety regulations. ★★



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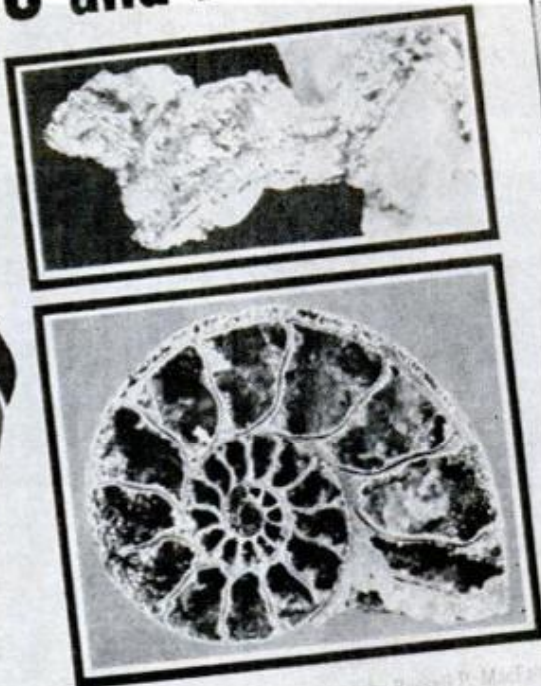
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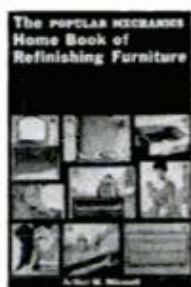
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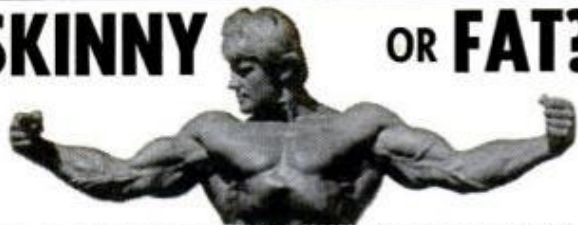
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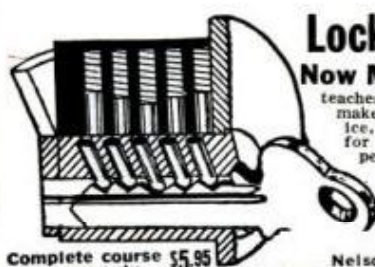
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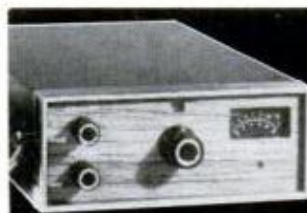
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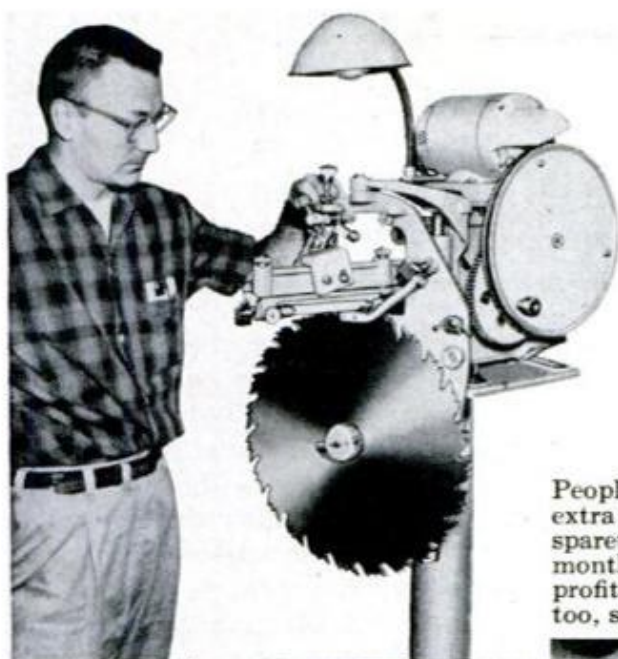
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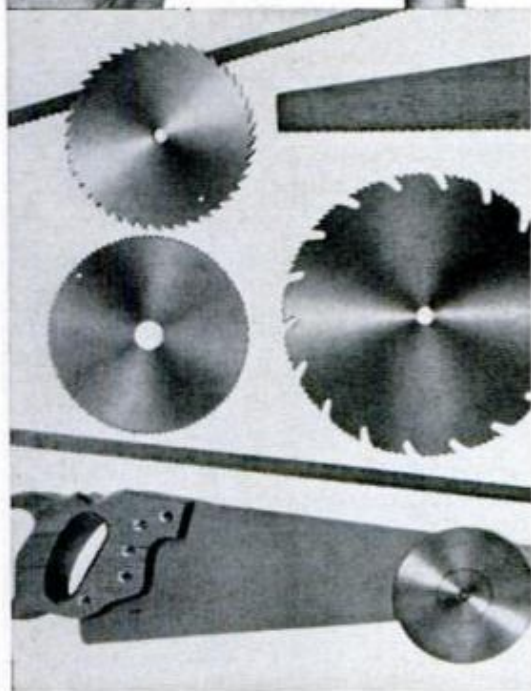
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# Drivin' with Dan

Why aren't more Chevy engines seen at the big races? Do amber fog lights really work? What's a 'four-cam Ford'? Why do you wear that black driving helmet? Dan Gurney answers these and other provocative questions

**Q.** What does "four-cam Ford" mean? Also, what is meant by a "blown" engine?—Rick Dale, Tustin, Calif.

**A.** A "four-cam Ford" is a V8 with double overhead cams on each bank of cylinders. One cam is for the exhaust valves, another for the inlet valves on each side, for a total of four separate camshafts. Usually "blown" engine refers to an engine that has been supercharged. But when you hear that a driver dropped out of a race with a "blown engine," it means something failed and the engine came apart, or blew up, scattering pieces in the process.

**Q.** You see a lot of Chevy engines at the drags, but why is it that not many—if any—use Chevy power for the big races?—Brian Lander, LaHabra, Calif.

**A.** The Chevy 283, 302 and 350-series engine is certainly versatile and has won many races. But don't forget it was designed as a volume-production passenger-car engine, which

means some sacrifices must be made when it comes to racing. I think a Chevy engine could be competitive at, say, Indy, but it would require the support of a first-rate team and driver, most of whom—even if they are Chevy-lovers at heart—feel their chances are a bit better if they have an engine designed from the ground up for racing. By the way, keep an eye on our '68 efforts with our Ford 302 stock-block pushrod engine.

**Q.** Last year at Indy I noticed that during qualifying the cars had a fuel mixture containing a percentage of nitroglycerin. But, during the race, I understand cars are not allowed to have nitro in their fuel. I would like to know why, and your views on this.—David Parker, Cincinnati.

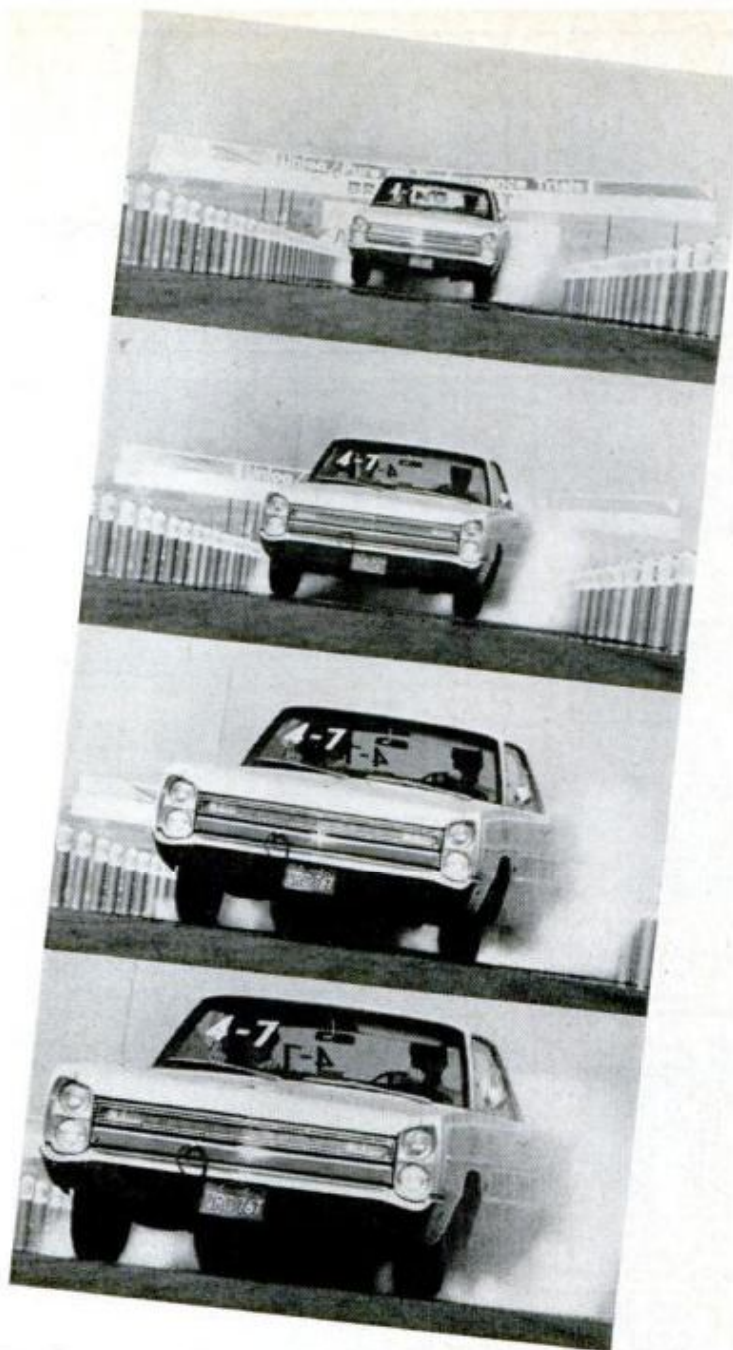
**A.** To the best of my knowledge, the "nitro" used in internal-combustion engines is nitromethane. Cars at Indy are allowed to use nitromethane in the race as well as in qualifying, but a decision must be made as to what sort of compromise to make between

*(Please turn to page 45)*



**DAN WON** the recent Rex Mays 300 at California's Riverside track. He completed 116 laps of the 2.6-mile course at an average speed of more than 117 mph. Win was Dan's first in a USAC championship event. Shown with Dan is Detroit industrialist Oscar L. Olson, owner of the winning Eagle (shown) which was built by All-American Racers





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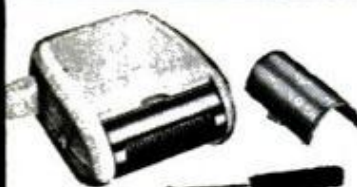
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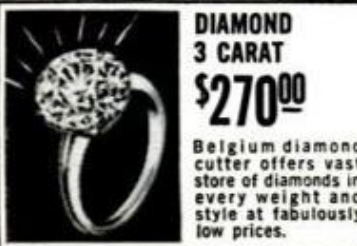
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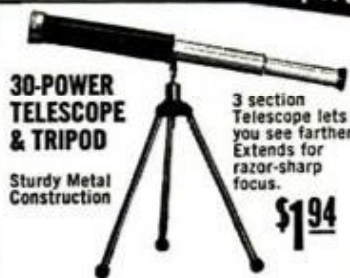
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## DRIVIN' WITH DAN

(Continued from page 40)

durability and mileage (not as good on nitro) and maximum power output.

**Q.** I've seen many cars and trucks equipped with amber fog lights. In your opinion, do they really pierce fog, rain and mist as advertised?—A. J. Salves, Newton, N.J.

**A.** This is an interesting question, but I really don't know the answer. All cars in France (except for foreign makes) use amber lights. I have a feeling they are probably slightly more effective than "white" lights in fog, rain and mist. One thing I do know: There are certain types of amber lenses for glasses and goggles that definitely improve vision under such conditions.

**Q.** I understand the sports car course at Laguna Seca is one of the shortest in the country and that many drivers do not like it. What do you think of this circuit, and how do most of the other drivers feel?—Frank Drumm, Monterey, Calif.

**A.** The course is the same length as the one at Monte Carlo. It's short, but I like it. I think most other drivers do, but also feel it's very tough. The turns are demanding, and speeds can go as high as 160 mph. It's a great course for spectators in that they can see a lot of each lap.

**Q.** We own two Mustangs, both Sixes. What can we do to improve performance? Also, would an automatic or manual transmission be best?—Donald Humphreys, Atwater, Ohio.

**A.** There have been a number of magazine articles concerning performance help for the Mustang Six. A little library research should provide answers. For street use, I personally prefer an automatic transmission.

**Q.** A friend says Denny Hulme let his "employer" (Jack Brabham) win the Grand Prix of Canada. I say all drivers are out there to win, no matter whose car they are driving. Am I right? Also, is the Mosport track named after Stirling Moss, or is it an abbreviation of "Motor Sports"?—Doug Brode, Windsor, Ont.

**A.** I'm certain Denny did not "let" his "employer" win the Grand Prix of Canada. And you're right; but for very rare circumstances,

(Please turn to page 46)

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**DRIVIN' WITH DAN**

*(Continued from page 45)*

each and every driver is out there to win. At Mosport, I believe Denny had to stop for goggles, as his kept fogging up. Jack Brabham won the race fair-and-square. Mosport is not named for Stirling Moss. I wouldn't be surprised if the "Motor Sport" abbreviation is correct.

**Q.** I understand you prefer a notchback Mustang to a fastback. But at high speed, wouldn't the shape of the notchback tend to create a vacuum in back of the rear window, causing it to break?  
—Steven Bissell, Hebron, Conn.

**A.** This is one of the strange things about auto aerodynamics; what seem like logical conclusions don't always apply. It wouldn't surprise me to learn, for example, that the notchback is more stable at high speed. The car's design would—I should think—tend to create a vacuum behind the rear window, but it's doubtful it would break it. The fastback would probably have the same condition, except that it would occur farther toward the rear and probably create more lift than drag. In cornering, lift is harder to handle than drag. But these are only my personal opinions; they'd have to be proved scientifically.

**Q.** Please settle a long-distance argument: what happened to your car at Monaco in 1967?—Stephen Deerhake, St. Jean Cap, Ferrat, France.

**A.** The toothed belt that drives the fuel-injection metering unit (sort of a distributor for the timed injection of fuel to each inlet port) broke. The quality had been changed by the manufacturer. The same thing happened again at the next race. That time, however, the metering unit itself seized. We now run a belt made in Germany.

**Q.** Is your helmet black, or really a very dark blue? It seems to have become a trademark with you.—Jolyon Dantzig, Evanston, Ill.

**A.** Black. I tried another color once and nearly crashed, so it was back to black. ★★

If you have questions on racing, high-performance and everyday driving techniques, send them to "Drivin' with Dan," c/o Popular Mechanics, 575 Lexington Ave., New York, N.Y. 10022. Questions cannot be answered by individual letters. Questions on maintenance and repair should be addressed to the Auto Clinic (see page 60).

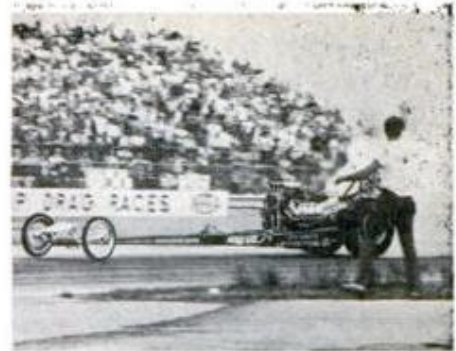




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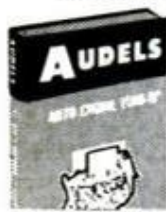
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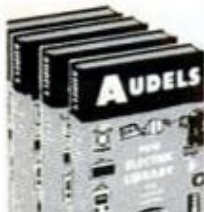
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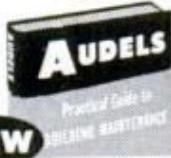
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special course in air-conditioning and refrigeration repair, too.

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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OK—I want to see for myself. Send me the free book on Professional Appliance Servicing No salesman will call.

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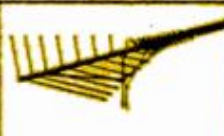



# NEW FINCO® COLOR SPECTRUM™ antennas are "signal customized" for better color reception...

"the ANTENNA that captures the RAINBOW"

FINCO has developed the Color Spectrum Series of antennas—"Signal Customized"—to exactly fit the requirements of any given area. There is a model scientifically designed and engineered for your area.

Check this chart for the FINCO "Signal Customized" Antenna best suited for your area.

STRENGTH OF UHF SIGNAL AT RECEIVING ANTENNA LOCATION	Strength of VHF Signal at Receiving Antenna Location				
	NO VHF	VHF SIGNAL STRONG	VHF SIGNAL MODERATE	VHF SIGNAL WEAK	VHF SIGNAL VERY WEAK
NO UHF →		 <b>CS-V3</b> \$10.95	 <b>CS-V5</b> \$17.50 <b>CS-V7</b> \$24.95	 <b>CS-V10</b> \$35.95	 <b>CS-V15</b> \$48.50 <b>CS-V18</b> \$56.50
UHF SIGNAL STRONG →	 <b>CS-U1</b> \$9.95	 <b>CS-A1</b> \$18.95	 <b>CS-B1</b> \$29.95	 <b>CS-C1</b> \$43.95	 <b>CS-C1</b> \$43.95
UHF SIGNAL WEAK →	 <b>CS-U2</b> \$14.95	 <b>CS-A2</b> \$22.95	 <b>CS-B3</b> \$49.95	 <b>CS-C3</b> \$59.95	 <b>CS-D3</b> \$69.95
UHF SIGNAL VERY WEAK →	 <b>CS-U3</b> \$21.95	 <b>CS-A3</b> \$30.95	 <b>CS-B3</b> \$49.95	 <b>CS-C3</b> \$59.95	 <b>CS-D3</b> \$69.95

NOTE: In addition to the regular 300 ohm models (above), each model is available in a 75 ohm coaxial cable downlead where this type of installation is preferable. These models, designated "XCS", each come complete with a compact behind-the-set 75 ohm to 300 ohm balun-splitter to match the antenna system to the proper set terminals.



**THE FINNEY COMPANY**  
34 West Interstate Street  
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Send for free brochure

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# How to get rich

How can you get rich some day? Make a hit record . . . a killing on the stock market . . . or invent a gadget like the hula hoop?

For most of us, these are just dreams. But have you ever stopped to think that there is a way to get rich—possibly only one sure way? Most fortunes, as you know, are made by people who own their own business.

Perhaps you've thought of starting a small business of your own . . . a franchised drive-in, or maybe a service business. Trouble is, you need \$10,000 to \$15,000 to get started and even then it's a gamble—with slim chances of ever making really big money.

But there is *one* business which could make you rich—almost overnight! And the beauty of it is, you can start on a shoestring during your spare time, even while holding your regular job.

## Cash by Mail

The business is Mail Order—and it's fabulous! Come up with a 'hot' new item . . . and WHAM!

It strikes like a bolt of lightning!

Suddenly, you are deluged with cash orders from all over the country . . . MORE MONEY than you could ever make in a lifetime!

Like the Vermont dealer who ran one ad in Sports Afield Magazine. His ad pulled 22,000 orders—over A HALF MILLION DOLLARS IN CASH!

There is no other business where you can make a fortune so quickly!

● A beginner from Newark, N.J., ran his first small ad in House Beautiful—offering an auto clothes rack. Business Week reported that his ad brought in \$5,000 in orders. By the end of his first year in Mail Order, he had grossed over \$100,000!

● Another beginner—a lawyer from the midwest, sold an idea by mail to fishermen. Specialty Salesman Magazine reveals, "he made \$70,000 the first three months!"

## Proof

It's a fascinating business! Running ads in newspapers and magazines . . . mailing gift catalogs . . . getting cash orders in your daily mail—steady as clockwork.

There is no other business where you can start on a shoestring and pyramid your profits—without investing in merchandise! One husband and wife mail order team took in \$40,000 selling one item. They obtained FREE ads in national magazines . . . didn't invest a cent in merchandise, and even got the supplier to ship all orders for them!

These exceptional cases are absolute proof that you can get rich in your own Mail Order business. Very rich. Even a U.S. Gov. Report stated: "A number of

one-man Mail Order enterprises make up to \$50,000!"

Pick up any magazine. Notice how the same mail order ads are repeated . . . month after month? That's concrete proof! You know those ads wouldn't be repeated over and over again—unless they were bringing in big cash profits to their owners.

## The Secret

The secret of getting rich in Mail Order lies in *financial leverage*. It's a little-known, almost secret method—using other people's capital to make money for you!

You can get thousands of dollars worth of advertising in big national magazines—without investing your own money! And you don't have to write a single ad. Tested and proven ads are prepared for you by experts. Reinvest the profits from your first successful ad—to get more, larger ads, and the profits begin to snowball! It's like building a chain of stores . . . each new store puts more money in your pocket.

You mail out beautiful catalogs which offer hundreds of dollars worth of fine, quality gifts—yet you don't invest one

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Yes, Mail Order is the fastest-growing, most profitable business in America! And now, with more people moving to the suburbs . . . the population explosion . . . and the expanding teenage market . . . we are on the verge of the BIGGEST BOOM in Mail Order history!

Now, with the help and backing of Mail Order Associates, Inc., of Montvale, N.J., you can follow the same proven steps to Mail Order success—using the 'secret' of financial leverage!

## Start Now

We supply you with beautiful gift catalogs throughout the year. All products are dropshipped for you, with up to 100% mark-up! You get free samples of top-selling mail order items, plus monthly trade reports on 'hot' new products . . . tested, successful ads are sent to you monthly. You get advertising directories, postal laws, complete courses, expert guidance—EVERYTHING you need to practically guarantee YOUR SUCCESS. Why? Because *our* business depends upon your success. It's mutually profitable!

A recent feature article in Income Opportunities Magazine stated, "Mail Order Associates Inc., offers the most comprehensive Mail Order program ever offered to beginners." They go on to say, "This could be the opportunity you've been looking for. A chance to get in on the ground floor in a little-known business which we believe is on the verge of a new boom."

## Free

We are now accepting a limited number of charter members in our new Mail Order Program. No previous experience is required but you must be over 21.

If you are sincerely interested in starting a profitable business of your own . . . if you can see the tremendous advantages which Mail Order offers . . . then ACT NOW!

Mail the coupon today, or simply send your name and address on a postcard. No salesman will call. We will send you a free book—gift catalog, reprints of feature articles, plus complete facts about our program. Write to:

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Montvale, New Jersey 07645



The thrill of receiving money in your mail is one you'll never tire of!

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articles

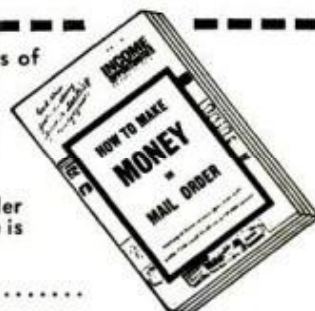
Mail Order Associates, Inc., Dept. 70  
Montvale, New Jersey 07645

Please rush complete details on your Mail Order Program. I understand everything is free and there is absolutely no obligation. I am over 21.

Name.....

Address.....

City..... State..... Zip.....

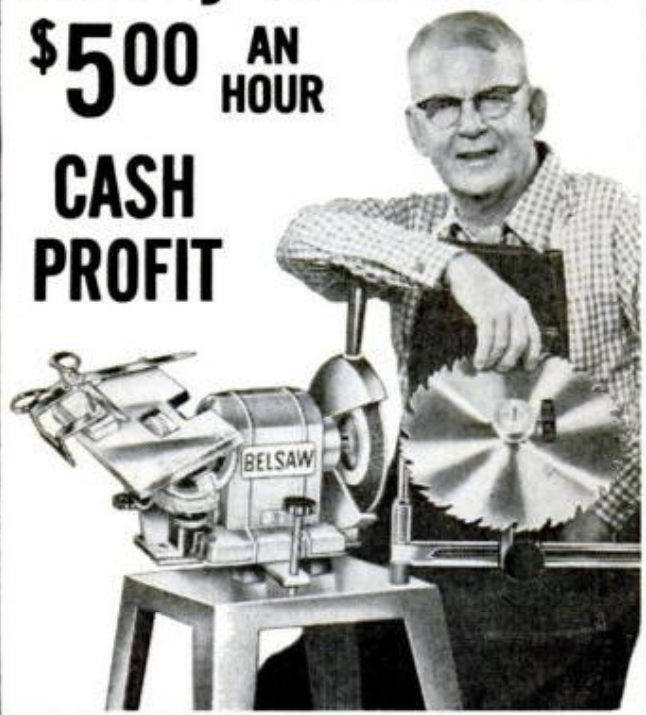




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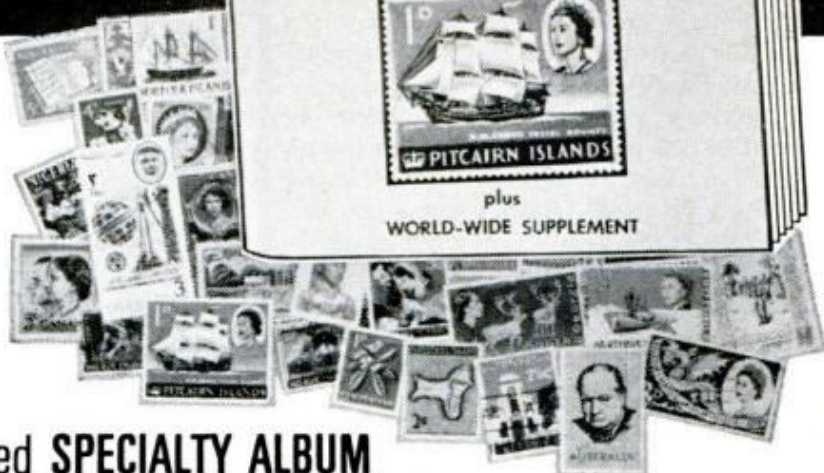
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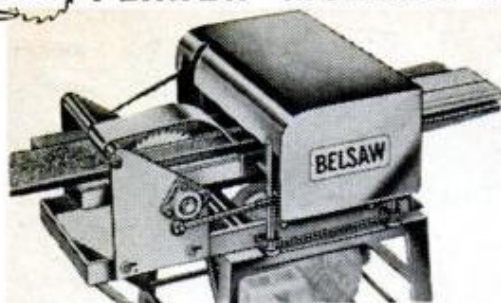
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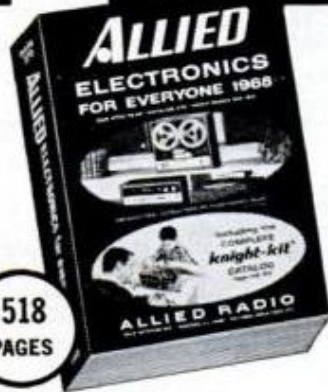
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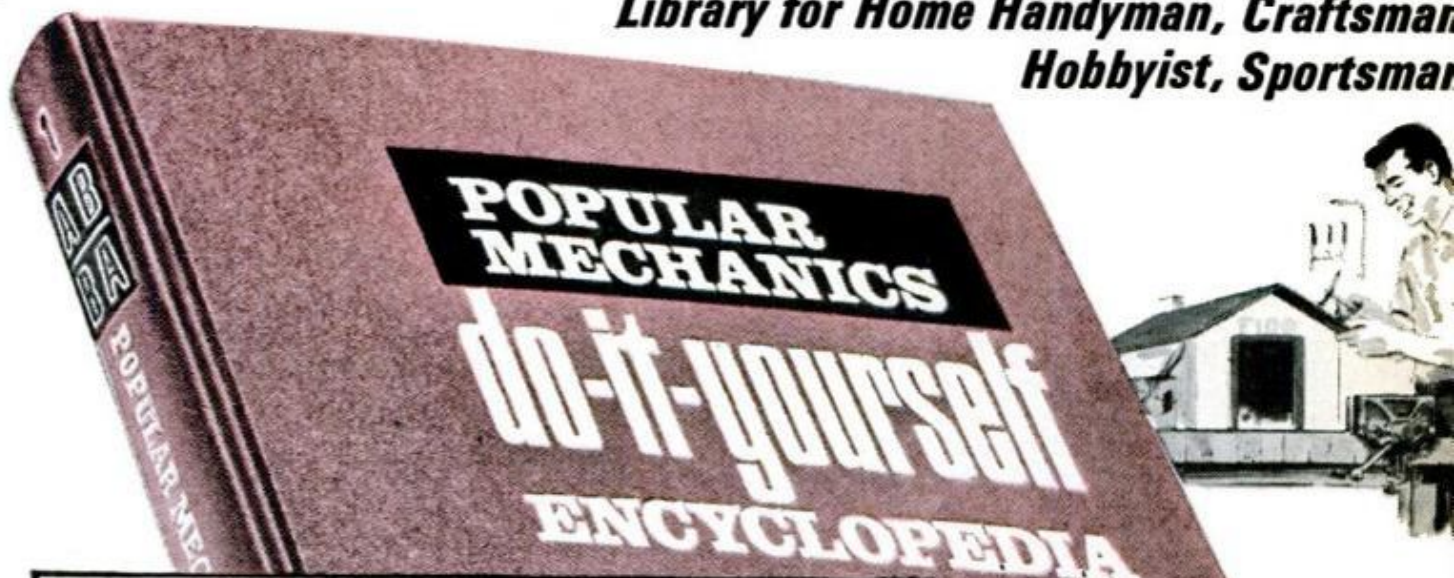
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# AUTOMOBILE CLINIC

BY MORT SCHULTZ

## He's discovering oil

There's no way to keep oil from getting into the clutch of my 1964 Ford Falcon with 170-cu.-in. engine, is there? So far, I've had four new clutches installed, plus a new back main bearing, a back main bearing seal, a transmission seal and pressure plates. Can you help me?—Everett Neil, Barnum, Minn.

The only way I know for oil to get into a Falcon clutch is by way of the rear seal. Therefore, I've got to assume one of two things: Either the crankshaft is worn and bouncing, damaging the seal (in this case an oversize bearing should tighten up the shaft), or the guy doing the work isn't doing it right.

## Plugging up the noise

Did I make a mistake by replacing the original wiring in my Plymouth with copper ignition wires? I now get noise in the

radio. If that's the cause, is there some way of getting rid of the noise without using the original wiring which, I understand, won't stand up?—Fred Eayres Jr., New Brunswick, N. J.

You can have your cake and eat it, too. Keep the copper wiring, but install resistor sparkplugs. That should give you music minus the ignition noise.

## Unable to do the job

I've been unable to get a vibration removed from the front wheels of my 1967 Cadillac Fleetwood Eldorado. Everyone agrees the front wheels are out of balance, but the best front-end man in this area can't seem to get 'em back into shape. Is this the fault of the car or what?—Robert Sullivan, Atlanta, Ga.

There's a quirk here that only a Cadillac man who gets service bulletins would  
(Please turn to page 86)

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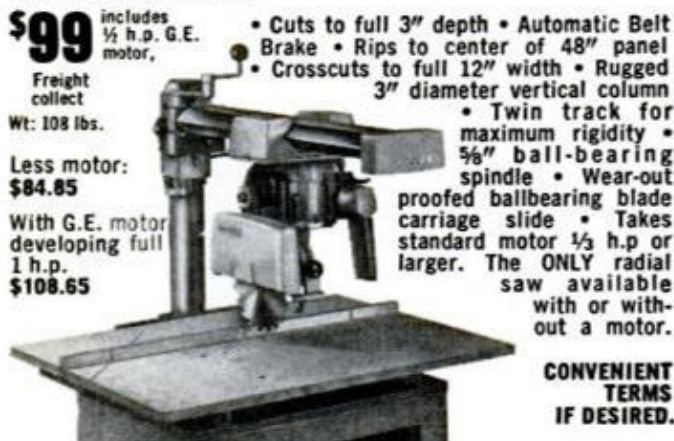
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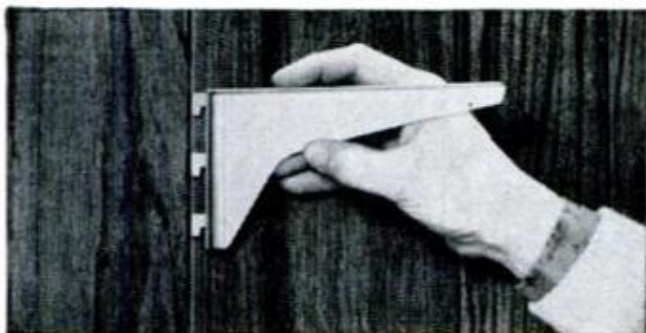
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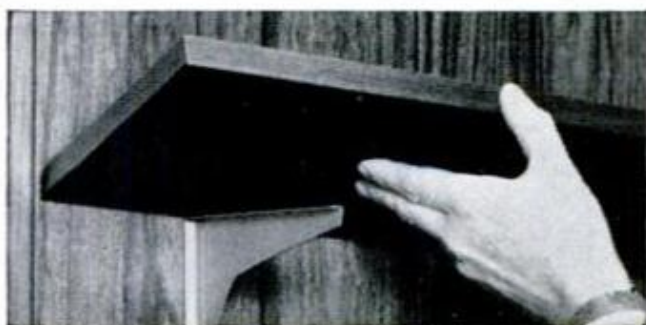


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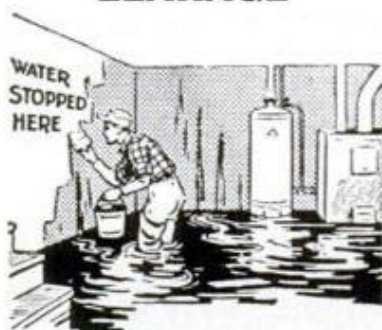
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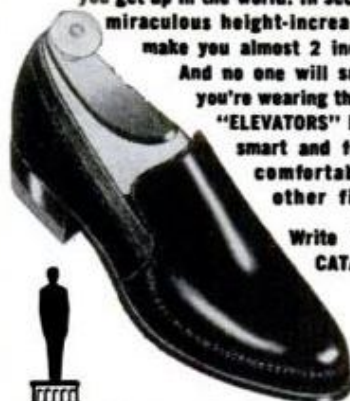


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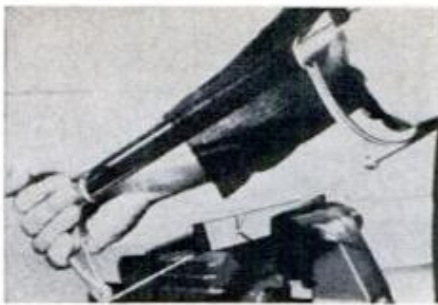
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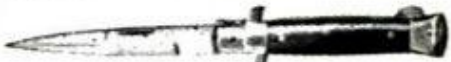
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# HOMEOWNERS' CLINIC

BY W. CLYDE LAMMEY

## Brick breakup

*My brick-faced, two-flue chimney is only about 12 years old. The cap of cast concrete appears to be free of cracks. The bricks in the seventh course down from the cap are crumbling and "losing their faces," so to speak. What's the cause and remedy?—C.S., Kans.*

I'll venture to say that the most probable cause is what is known as efflorescence—a breakdown of the masonry due to certain activated salts in the mortar, the bricks, or both. Such activation usually is due to the presence of moisture or of a continuing condition of dampness. There are other less likely causes, of course. Although the defect may show in only one course of brick, it's likely that courses immediately above and below also are affected. The only cure is to replace the defective bricks with new ones.

Usually, this is a job for a professional mason experienced in this type of repair. However, if you want to attempt this chore yourself, you'll need a ready-mixed mortar, such as Sakrete, a pointing trowel, hammer, chisel, a safe ladder and several sturdy supports. You'll also have to cut some props to wedge between the courses of bricks when you remove those which are found to be defective. Cut these from 1x1-in. strips so that they're a tight fit between courses.

As you remove each defective brick tap a prop into place. Be sure to chisel out *all* of the old bricks and old mortar. Then lay new mortar, "butter" the ends of each new brick and force mortar into the joint above each one, making sure the mortar is "packed" so that there are no voids to admit water. Strike the new mortar joints to match the old.

Usually it is best to dampen the old bricks that adjoin the work before inserting the new ones in place.

## Nails that pop

*My five-year-old home is finished inside with a plasterboard or other drywall. In some places along the joints the nailheads are actually lifting the putty. This is causing bumps or dimples to appear under the wallpaper in one room and it's exposing the nailheads on the painted walls. What's happening, and is there a*

*cure for this condition?—S.G., Ont., Canada.*

As pointed out in *Rx for Popped Nails, Cracks and Holes* (page 154, Oct. '67 PM), nail popping in drywall construction poses a knotty problem. The usual causes are careless workmanship, incorrect nailing techniques, framing lumber that is warped or that shrinks or warps as it dries and, less common, conditions peculiar to the structure or location.

If you do the repairing yourself, don't pull the popped nails. Instead, carefully chip away any loose putty around each nailhead and drive two nails in line with the joint, on opposite sides of the popped nail and about  $\frac{3}{8}$  to  $\frac{1}{2}$  in. away from it.

Use the ringed or threaded nails that are made especially for drywall installations. Drive in the new nailheads until they form slight "dimples" in the papered surface of the plasterboard but be careful not to break through this surface. Then use a large pin punch to reset the popped nails. Fill all of the dimples and holes with a drywall joint compound and trowel them flush with the plasterboard.

## "Burned" concrete

*Last summer I poured a 15-ft.-long concrete walk, using a recommended mix. Now the walk is disintegrating and the surface is powdery. No salt has been used on it to thaw ice. What did I do wrong?—R.Y., Mass.*

Assuming you poured the walk over a tamped gravel bed and troweled the surface in approved fashion, perhaps you did the job on a hot, dry and windy summer day, and the new concrete "burned out"—that is, it cured too quickly.

What to do? Break up the old walk and pour a new one, keeping it damp for *at least* 72 hours. Cover the walk with burlap, straw or anything else that will hold moisture after it has been wet down.

## Derusting old tools

*I've acquired some old tools, planes, chisels and the like, and the metal parts are rusty. What's the easiest, best way to take off the rust?—E. L., Fla.*

There really isn't any "easy" way and the "best" way depends largely on the extent and depth of the corrosion. Surfaces deeply pitted are almost hopeless—unless you literally grind away the metal to obliterate the pits. Surface rust can be removed with a fine abrasive or an abrasive pad such as Scotchbrite. Chemical removers also are quite effective. ★★



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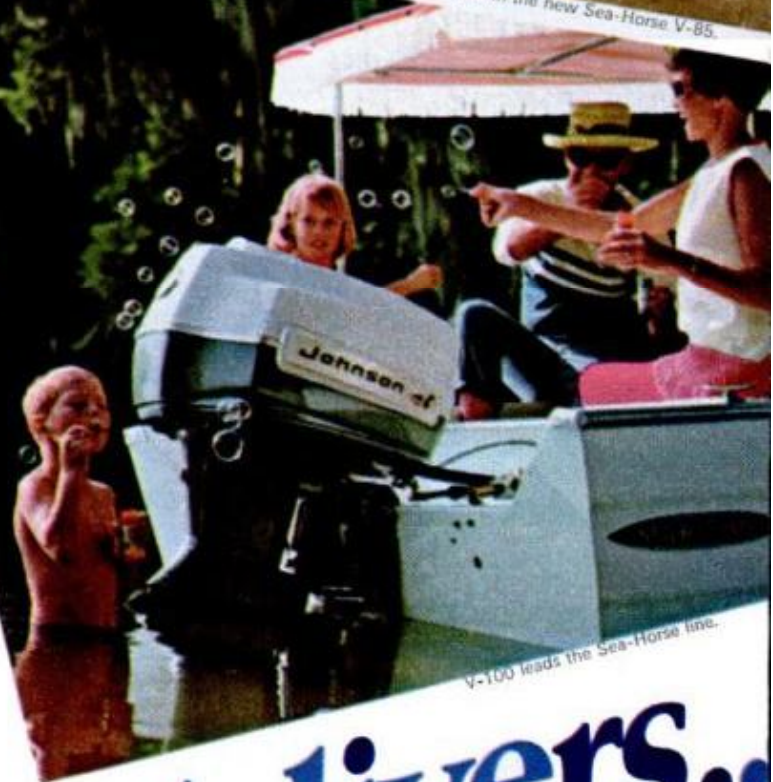
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## AUTO CLINIC

(Continued from page 60)

know about. Some wheel-balancing equipment just can't spin these wheels fast enough to get proper balance. In this case, jack up each front wheel in turn by placing a jack under the frame side rail. By rights, the man should check a Cadillac service manual for proper placement of the jack. It's Fig. 0-6. Block the remaining wheels. Start the engine and put the transmission in Drive. Then, use the engine to drive the front wheel, but make sure you don't exceed 40-45 mph.

### Too much juice

*I've got a 1967 Corvette with a 427 V8 engine that's backfiring when I hit around 5000 rpm. The car's a gem, but this is annoying and I want it stopped. How?—Al Maye, Houston, Tex.*

You don't say, but I bet you have a 3x2 Holley carburetor setup on the car. If so, it's causing an over-rich fuel condition that's leading to unburned fuel being ignited in the exhaust. You want it stopped? Easy. Just remove and throw away the fuel-bowl vent tubes from the front and rear carburetors only.

### Take another route

*I've just lost a lot of antifreeze, because the heater hoses of my 1966 Dodge Coronet were cut. Somehow, something beneath the hood is rupturing these hoses. The cut is occurring right above the alternator. Can you advise, please?—Carl Swain, Grand Rapids, Mich.*

Some of these cars came through with heater hoses too close to the drive belts. The drive belts have been gnawing their way through, and out comes the coolant. Your best bet is to make sure hoses are properly routed. You shouldn't have to do the job since there's a set procedure outlined for the Dodge service shop. In case they've forgotten, remind them about service bulletin D66-95 (7/27/66). By the way, other owners of 1966 Chrysler cars would do well to examine the relationship

of heater hoses to drive belts. You may be heading for the same fix.

### A slight correction

*I've burned out the valves in my 1963 Comet (V8) a couple of times now, and I figure it's my fault because I do my own work. However, I follow the service manual to the letter. What am I doing wrong?—Pat Waller, Washington, D. C.*

That's hard to say without watching you. But, do you know that sentence in the manual which reads, "When the push rod to rocker arm clearance has been eliminated, turn the rocker arm stud nut an additional 1½ turns"? Change it to read ¾ of a turn. The manual's wrong. This is also true for 1962-1965 Comets with V8s.

## Service Tips

● **1967 Chrysler and Plymouth Fury owners** may run into a problem of erratic alternator operation because of a bugged alternator regulator. The cause has been traced to water and road dirt entering the engine compartment through a gap between cowl and hood panel, and then corroding and grounding out resistor terminals. Chrysler wants you to take the car back to your dealer to make sure the fix outlined in service bulletin 67-8-4 (3/15/67) has been applied.

● **1967 or 1968 Ford owners** who are thinking of having front-wheel bearings lubed should make sure the man uses a lithium-base grease, which is blue-black in color (Ford part No. C1AZ-19590-B). That's the kind which was applied at the factory. Fords prior to 1967 were smeared with a sodium-base grease, which is yellow (Ford part No. C2AZ-19585-A). If you mix the two accidentally, the grease will break down and you'll be running with dry bearings.

● **Two types of distributors** were used in 1966 and 1967 Chevy Corvettes with 327-cu.-in. engines. Timing of each is so different that if you mix 'em up, you've got big trouble. Before timing the distributor, then, check the part number of the distributor on its body and use these specs: For distributor No. 1111117, 4° after top dead center. For No. 1111194, 6° before top dead center. ★ ★ ★

---

**WE DON'T WANT TO, BUT . . .** half-a-buck or no half-a-buck, we're forced to call off our gallant (Honest, we tried!) attempt to answer personally queries to the *Auto Clinic*. Your letters are piling up faster than we can ever hope to answer them. We'll still run the column and we still welcome your letters, but as of this issue, keep your money. From here on, questions will be answered in the column only. Those who've already sent in 50 cents and are awaiting an answer will hear from us as soon as possible. Send your questions to:

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*Curtis Turner's  
Daytona '500' Preview*

# Can Ford Halt The Petty Parade?

**The boys from Dearborn  
will be all-out to beat  
Plymouth's Richard Petty  
to the checkered flag  
in stock-car racing's  
premier event.**

By Curtis Turner,  
Dean of Stock-Car Champions

**W**E DON'T DO THINGS any different than anybody else," Richard Petty was telling me. "Just is, I think we do 'em better."

Whatever it is that "we"—Richard, as driver, his brother, Maurice, as head engine man, and "Poppa Lee," bossman of the whole setup—do, it must be about right; the Pettys and their bright blue Plymouths are the most successful combination in big-time stock-car racing history.

Last year the Pettys won 27 NASCAR (National Assn. for Stock Car Auto Racing) races, the most ever

won in a single season. They also set records by winning ten in a row, taking home the most money ever won (\$130,275), and earning more Grand National Championship points (42,472) than anybody ever earned. Richard won the driving championship and Lee the car-owner title.

What this great record adds up to—among other things—is, of course, a fat and shiny target for the rest of the boys to shoot at. Just about everybody and his uncle will be out to beat the Pettys, not just at Daytona (where Richard won in '64 and '66), but throughout the 1968 NASCAR season.

Pushing hard will be Ford, the name that has pretty much dominated stock-car racing over the past few years. Ford, with Mario Andretti doing the driving, won the Daytona "500" last year and had every reason to think the '67 season would be a piece of cake. The boys from Dearborn had the most cars and the most big-name drivers; it just figured they'd win the most races. But, as I can surely tell you, racing takes





**ACTION** at last year's National "500" saw Richard Petty (43) crashed into by Paul Goldsmith, who had blown a tire. Both will run in the '68 Daytona "500"



**OPPOSITION SENTIMENTS** are wryly expressed by wag at Holman & Moody's Charlotte shop where new Fords are being readied for all-out war on Plymouth

funny bounces and Ford had to pull over and watch Petty's Plymouth go flashing by.

In fact, it wasn't until the last couple of races on the 1967 NASCAR circuit that Ford broke into the winner's circle with Bobby Allison driving a car masterminded by recently-retired Fred Lorenzen and owned by Bondy Long. These victories, coupled with 199 "top ten" finishes, enabled Ford to cop its fifth consecutive Grand National division NASCAR manufacturer's championship. But winning the manufacturer's title didn't do much to satisfy Ford; title or no title, it was that blue No. 43 Plymouth that ran off with all the marbles. And that's the number—43—that Ford and everybody else will be gunning for this year.

There'll be some preliminary skirmishes (Riverside, for one), but the main event will be this month's Daytona "500," each year the most important event in stock-car racing. Down there at Bill France's superspeedway, all stops will be out, all bags of tricks

emptied. Behind all the brass bands, the pretty girls, and the colorful crowd will be a grim determination by drivers, crews, car owners and manufacturers to grab that checkered flag.

What kind of a race will it be? Like I said, racing takes funny bounces and my crystal ball doesn't work any better than anybody else's. But one thing I do know . . . it'll be *fast*.

Last year at Daytona, when I pulled Smokey Yunick's new Chevelle into the pits after making my qualifying runs, I had a feeling I'd managed to get around that big 2.5-mile track in pretty fair shape. Later, when I found out I had the pole position and had set an official closed-course lap record of 180.831 mph, you can bet ol' Pop here felt just fine. But even then I knew it wouldn't last. Racing records exist to be broken, and right now a lot of the boys figure to wipe my name off the Speedway's record books.

This year it wouldn't surprise me much if a driver qualifying at around 180 started a couple of rows back.





**RAY FOX** checks progress on new Dodge Charger he is building for Buddy Baker to drive in this year's Daytona "500." Baker, Fox won '67 National "500"



**RALPH MOODY**, left, shows me the steel stock from which his outfit grinds crankshafts for racing Fords



**BUDDY BAKER** drove a '67 Dodge Charger better than 184 mph during November tire tests at Daytona track

Early in November, Buddy Baker—winner of last year's National "500" at the Charlotte (N.C.) Motor Speedway—driving a '67 Ray Fox Dodge Charger, completed a 700-mile tire-test program for Firestone at an average speed of 182.260. Come to think of it, during one lap of the tests, he set an unofficial mark of 184.5! Now that's motoring right along, you'll have to admit.

Other drivers, including NASCAR's 1967 "Rookie of the Year" Donnie Allison (Bobby's younger brother), behind the wheel of Jon Thorne's '67 Ford Fairlane, have cranked out tire-test speeds hovering right around 180. Driver Bud Moore (no relation to car builder Bud Moore), an up-and-coming NASCAR star, even turned in a lap of 177.250 in a Charger that was having what the boys call "a slight cold," meaning mechanical trouble.

In doing my homework for this article, I talked to all sorts of people involved in one way or another with this year's race and the general feeling is

*(Please turn to page 214)*

**NEW NOTCHBACK** will probably be body style for Ford's major NASCAR racing efforts in '68 season

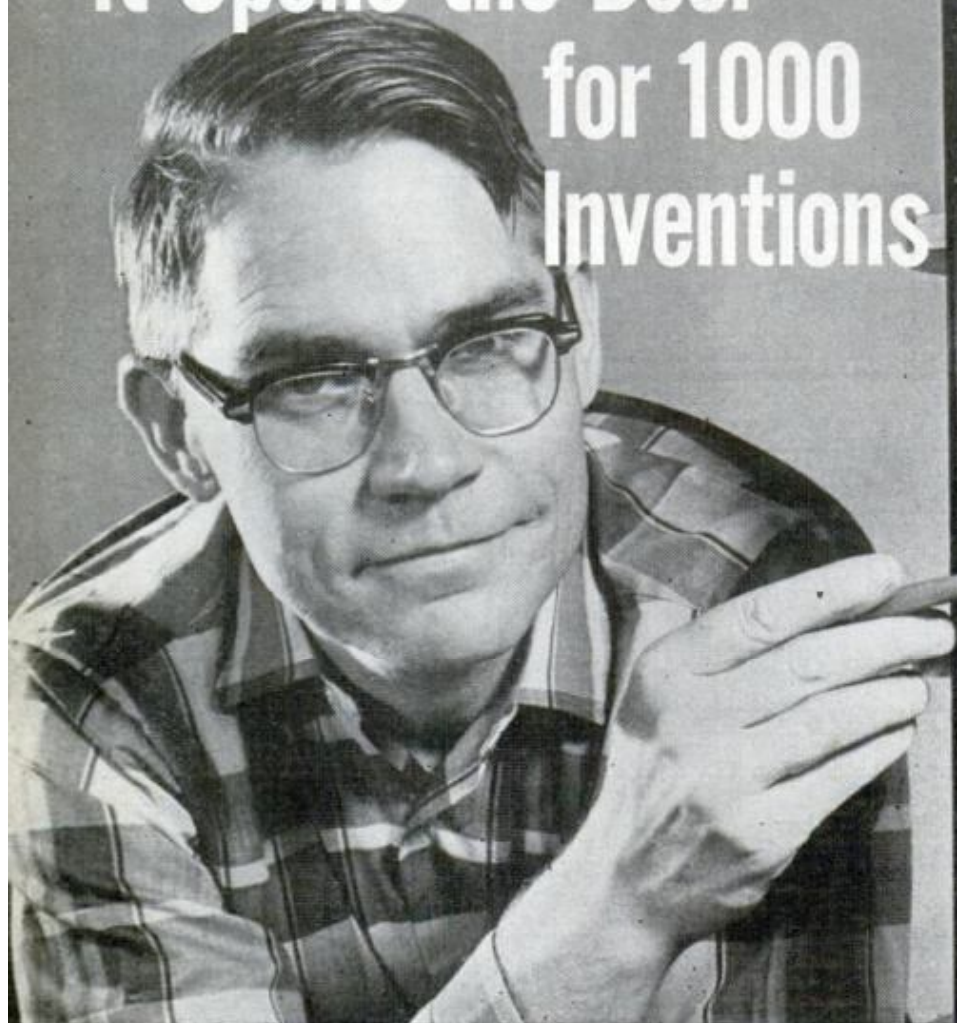


**NEW FASTBACK FORD** being built by Holman & Moody is slated to race on smaller NASCAR tracks





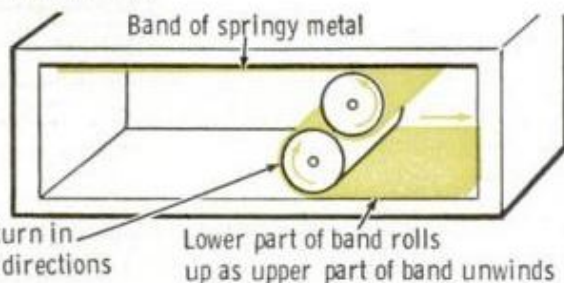
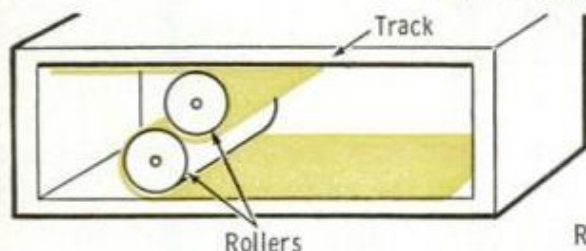
# The Amazing Rolamite— It Opens the Door for 1000 Inventions



An almost frictionless bearing, developed by an engineer who reads PM, may prove to be the discovery of the century—and it's all free to any inventor who wants to put the magical principle to work.

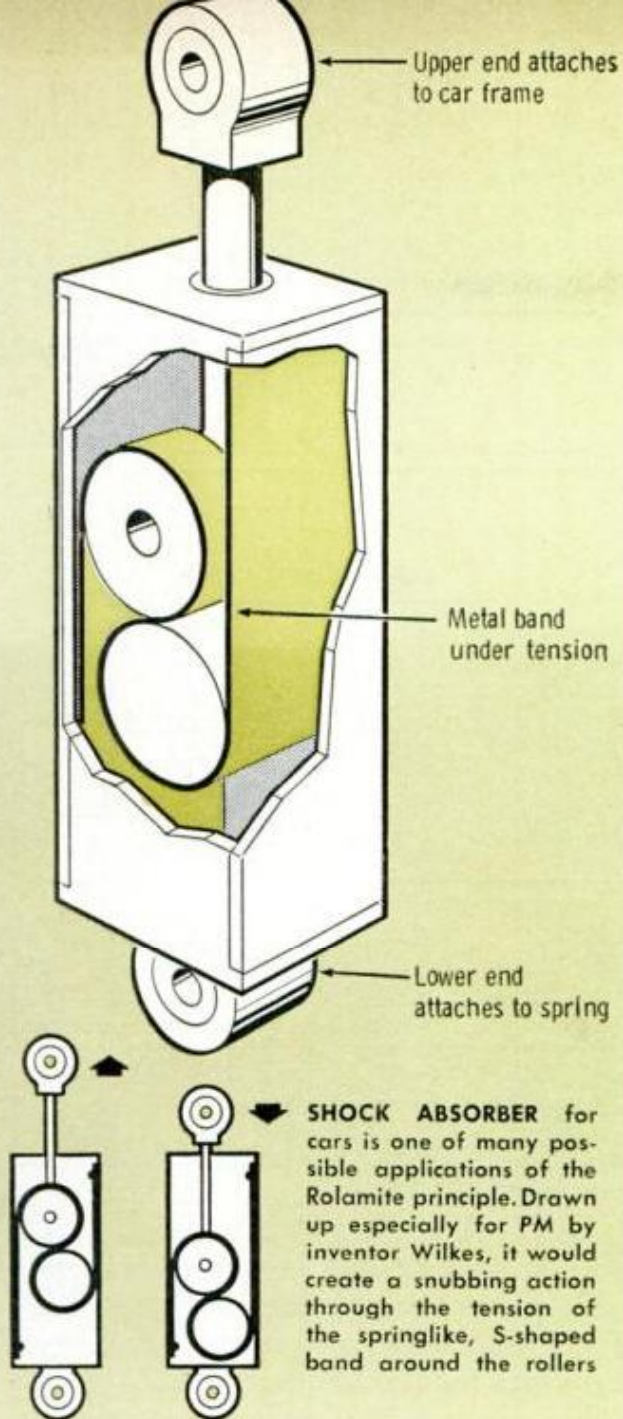
By NORMAN CARLISLE

## HOW THE ROLAMITE WORKS



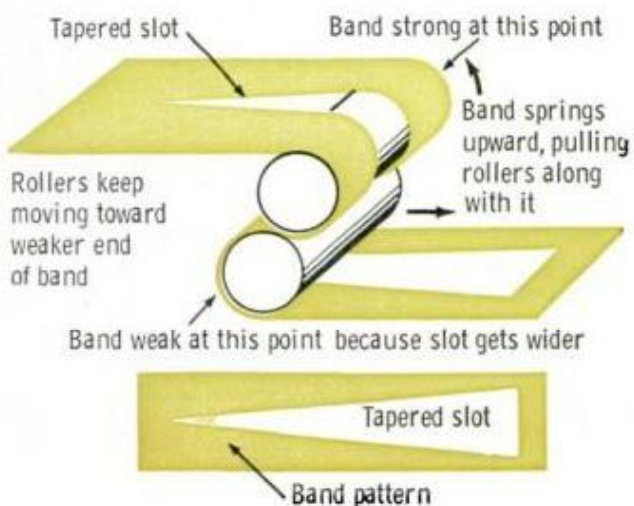
**BASIC ROLAMITE** consists of two rollers in a track with an S-shaped band of springy metal between them. As the rollers move, the band unwinds off one and winds onto the other simultaneously. Because the rollers and band are always traveling together at the same speed, there is no friction between them and they move with little effort. The two loops of the S are constantly fighting each other to unwind and lie flat. So long as the band is uniformly springy, the loops balance each other and the rollers remain at rest. When you cut a tapered slot in the band, as shown on the facing page, the band gets progressively weaker as the slot gets wider. The portion of band curled around the upper roller is always stronger than the portion around the lower roller. The upper loop thus overpowers the lower one and unwinds, pulling the rollers with it. This is one of a number of ways a Rolamite can be made to provide motion of its own





**SHOCK ABSORBER** for cars is one of many possible applications of the Rolamite principle. Drawn up especially for PM by inventor Wilkes, it would create a snubbing action through the tension of the springlike, S-shaped band around the rollers

### HOW A ROLAMITE CAN BE MADE TO MOVE



**O**NE NIGHT in Sept., 1966, a lean young, sandy-haired engineer named Donald Wilkes went into his garage workshop in Albuquerque, N.M., to try an idea. What came out several hours later has been hailed as the first truly elemental mechanical invention of the 20th century.

Dubbed the Rolamite, it's an almost frictionless bearing with countless applications in modern devices ranging from toasters to space vehicles. Engineers say it will take its place alongside the wheel, lever and spring as a fundamental discovery of major significance.

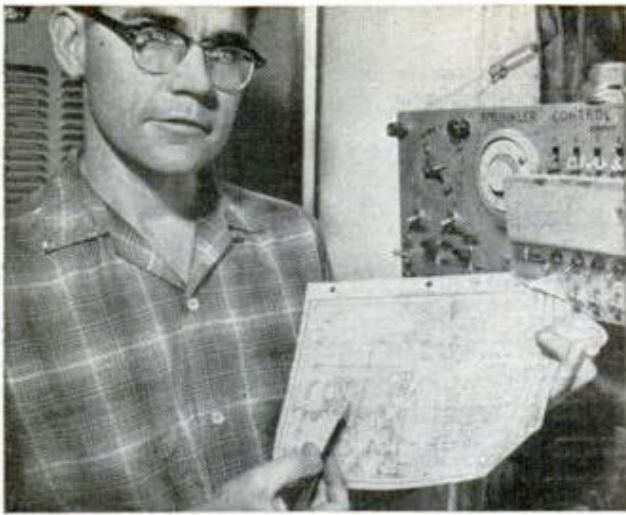
Basically, the Rolamite consists of two rollers held in a track on opposite sides of an S-shaped band of springy metal. The rollers glide effortlessly in the track because the band moves with them as they roll along. Since the band and rollers are both moving at the same speed, there is no slip or drag between them and therefore virtually no friction. The device is so versatile it can function as a switch, a valve, a pump, a fuse, a thermostat, a force amplifier, a clutch, a speed changer, a brake, a pressure-sensing control, a solenoid, a fire alarm, a—you name it and it'll do it.

How could such a fundamental principle remain so long undiscovered?—

**ROLAMITE INVENTOR** Donald Wilkes demonstrates original model made in his tool-filled garage shop







**AUTOMATIC SPRINKLER SYSTEM** that turns water on and off at preset times is one of the many unusual devices Wilkes has made for his Albuquerque home

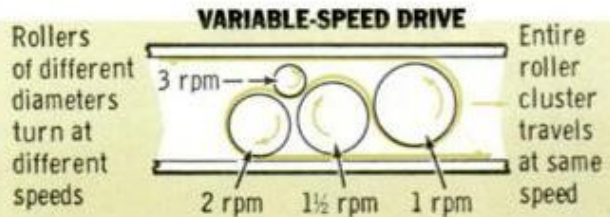
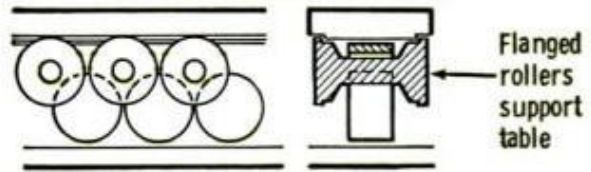


**A TYPICAL TINKERER**, Wilkes built this odd 40-key musical instrument while still in college. Keys cause the pipes to be struck, thus creating tinkling sounds that was the first question I tossed at Donald Wilkes as I interviewed him recently in his equipment-crammed laboratory at Sandia Corp., the nuclear weaponry development center that Western Electric runs for the AEC.

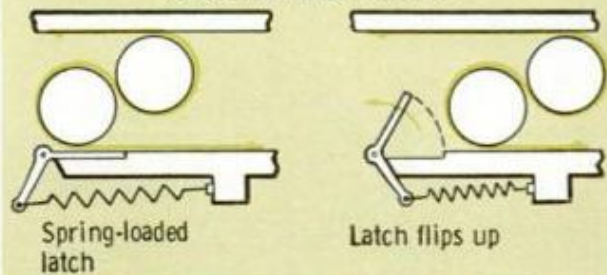
"It's hard to believe," answered the 37-year-old inventor, who has been an avid *PM* reader since he was a boy.

## Some of the Many

### ROLLING MACHINE CARRIAGE



### QUICK-RELEASE TRIPPER



### BASIC MECHANISMS DOWN THROUGH THE AGES:

Wedge	Prehistoric
Lever	10,000-5000 B.C.
Wheel	3500-3000 B.C.
Rivet	3000 B.C.
Screw	3000-1000 B.C.
Bearing	800-700 B.C.
Pulley	800-700 B.C.
Gear	Before 350 B.C.
Piston	200 B.C.
Rotational shaft	200-100 B.C.
Crank	Before 800 A.D.

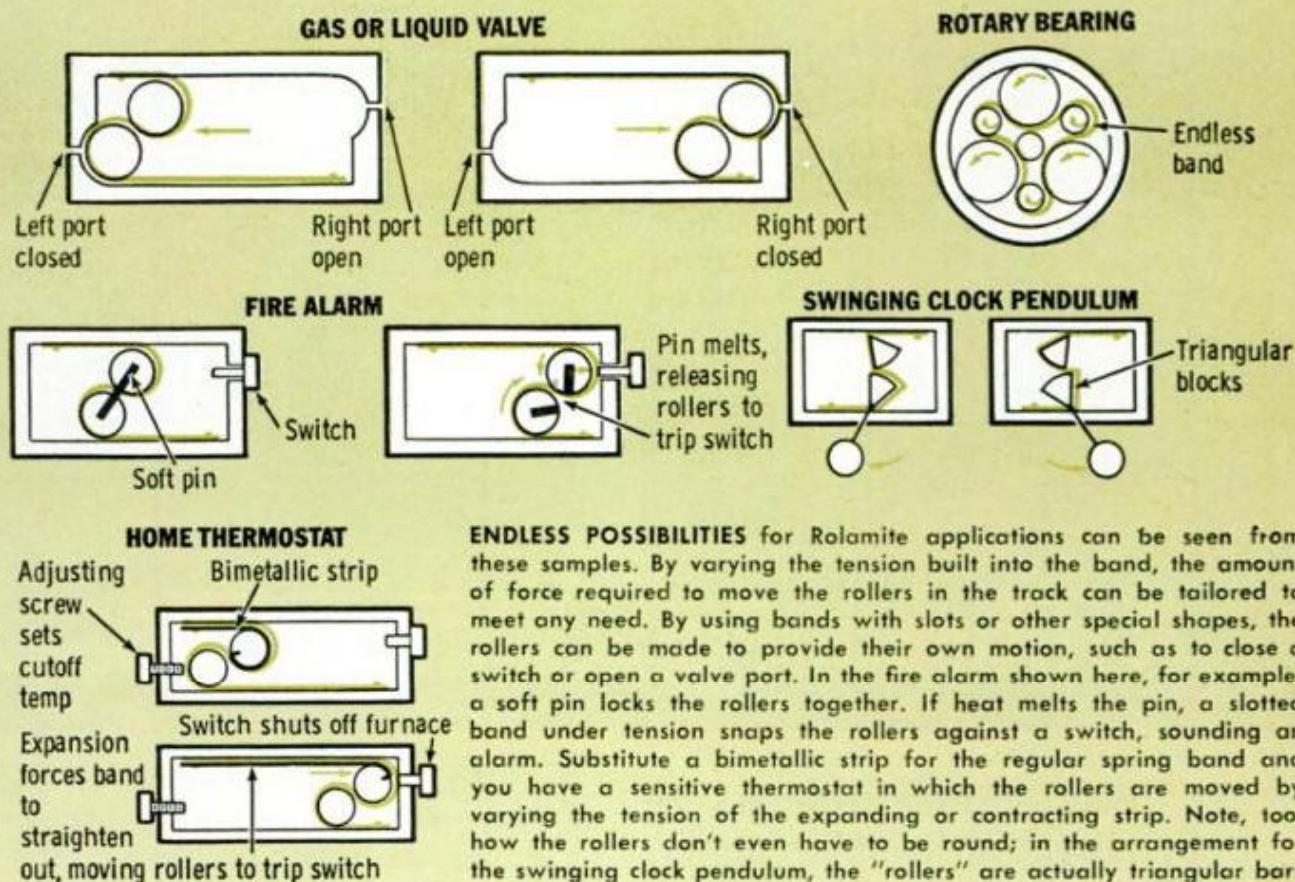
Hinge	1050 A.D. or before
Toggle	1200 A.D.
Coil spring	1400s A.D.
Cam	1500 A.D.
Universal joint	1500 A.D.
Valve	Before 1600 A.D.
Brake	Before 1600 A.D.
Ratchet	Before 1600 A.D.
Ball joint	1640 A.D.
Chain and sprocket	Before 1650 A.D.
Convolute bellows	1700 A.D.
Scotch yoke	Late 1700s A.D.
Clutch	Before 1814 A.D.
Rolamite	1967 A.D.

### POPULAR MECHANICS

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# Mechanical Jobs That Rolamite Bearings Can Do



**ENDLESS POSSIBILITIES** for Rolamite applications can be seen from these samples. By varying the tension built into the band, the amount of force required to move the rollers in the track can be tailored to meet any need. By using bands with slots or other special shapes, the rollers can be made to provide their own motion, such as to close a valve or open a valve port. In the fire alarm shown here, for example, a soft pin locks the rollers together. If heat melts the pin, a slotted band under tension snaps the rollers against a switch, sounding an alarm. Substitute a bimetallic strip for the regular spring band and you have a sensitive thermostat in which the rollers are moved by varying the tension of the expanding or contracting strip. Note, too, how the rollers don't even have to be round; in the arrangement for the swinging clock pendulum, the "rollers" are actually triangular bars

was responsive to movements, all right —too responsive. "Wiggly and wobbly," Wilkes describes it.

On that now-momentous night, Wilkes was relaxing in his living room when it hit him. How about putting *rollers* in the curves of the S? He jumped up and rushed out to his workshop. From his stock of scrap he fashioned a simple track and inserted a strip of beryllium copper he'd been carrying around in his pocket. Two metal rings served as rollers. From these components, he made the first Rolamite.

Now, Wilkes wondered, what would happen when he tipped the thing so that the rollers moved? Would the rollers slide inside the curves of the band, or would the band move right along with the rollers with no slipping? Wilkes knew that if the band slipped he had nothing.

Again and again Wilkes tried it, his

excitement growing. The rollers moved smoothly and the band right with them. There was no detectable slip. The next morning he hurried to his lab to machine a more sophisticated model. Sensitive test instruments confirmed the observations made with the first crude model. There was no slipping and, therefore, little friction.

As development work went on, Wilkes and fellow researchers discovered that an almost infinite number of variations could be made by changing the shape, size and structure of the bands, rollers and tracks. Take the band, for example. So long as it's under the same tension throughout its length, the rollers are stable at any point in the track. It takes just as much force to push them one way as the other way. But if you cut a slot in the band, you weaken it at that point, creating what

*(Please turn to page 210)*





## A Rip-Roarer...with Rattles

**Pontiac Firebird owners are thumbs up on handling, power, performance and style, but down in the mouth about rattles.**

By **BILL HARTFORD**  
Associate Auto Editor

**"F-BIRD"** OWNERS—wild as they are when it comes to bragging about the fire-breathing bangers under their hoods and the race-car rake of their cars—still reveal a touch of automotive conservatism. They cool off fast when commenting on disappointments with the modern motoring comforts and conveniences they've come to ex-



**PASSENGER HANDLE CONVENIENCE**, bucket seats contributed to high comfort rating for front of car



**WINDOW ACTION** was a No. 1 mechanical problem; new ventless windows drew poor-ventilation beefs



pect—even from a rip-roarer laden with power options like the Firebird.

Two of the big beefs owners have about their otherwise clean machine are rattles and poor ventilation. (Gas mileage, a common complaint, is another.)

With handling topping the list of owner praise, there were few complaints about Firebirds rocking or rolling on the road, but the rattles scored high. A total of 81 percent of owners have the hardtop model so the “rattly convertible” syndrome doesn’t apply to the source of the rattles. Owners tell us they come from a variety of places: rear shock absorbers, exhaust pipe, console, windows—not to mention unspecified places, according to those owners who just referred to “terrible vibrations and rattles,” “mystery rattles,” and “built-in” rattles.

One owner, or rather a man-and-wife team from Colorado, owns two 1968 Firebirds—one a hardtop, the other a convertible. The “his-and-her” responses we received from the head of the house read “too many rattles,” for the hardtop and “too many rattles!” for the convertible.

► I guess convertibles do rattle more after all.

A California chemical company vice-president who owns a hardtop still wouldn’t agree, however. He says,



**ROOM IN THE REAR** is sacrificed for style. “It’s not fit for human occupancy,” remarked one owner



**TRUNK ROOM** is cut in half with conventional spare, present here, but collapsible-type is standard



**ASHTRAY LOCATION** was sore spot in an otherwise enthusiastic owner response about dashboard layout

FEBRUARY 1968



**FUEL CONSUMPTION** for most popular 350-cu.-in. V8 averages 12.3 mpg on short trips, 15.7 on long ones





**LOW-FLYING FIREBIRDS** have to go easy on driveways like this one, as several owners found out fast

"The power windows rattle if partially down. Console rattles. It seems to rattle more than our convertibles."

► **His two convertibles—Pontiac and Chevy.**

Another owner, really down in the mouth about his Firebird convertible—so much so that he won't consider buying another—is this New Jersey dentist:

"Windows are not aligned properly, windshield-wiper trouble, broken brake light and the usual missing screws and *mystery rattles*." (Italics ours.)

A few last comments from a convertible owner, a Colorado electronics technician, should be enough of what is a sensitive subject for owners and, hopefully, also for the manufacturer

who, owners feel, should keep a closer watch on what's "built-in":

"I have a built-in rattle that's bugging me a bit," and, added to the back of the questionnaire, "I believe the Firebird is a good car. It just happens I have one with a bad rattle built-in and I had a bad experience trying to get rid of it. (Three trips to the dealer still have not eliminated it.) This one fault with the car puts everything out of perspective and as a result I feel I was 'had' when I bought the car. If it wasn't for that one problem I would be extremely happy with the car. I hope I have been objective."

► **Little things mean a lot. Amen.**

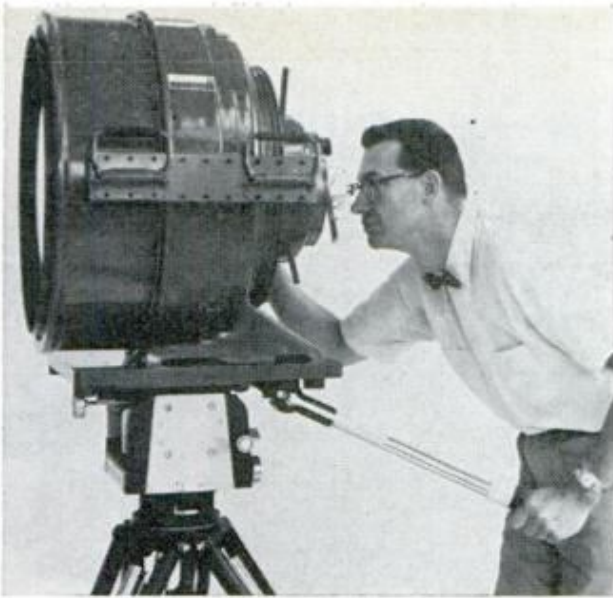
If any Firebird owners were pleased  
(Please turn to page 208)

### Summary of Pontiac Firebird Owners Reports\*

<b>Total miles driven</b> ..... 159,379	<b>Optional front bench</b> ..... 2.4	<b>Handling</b> ..... 12.1
<b>Average miles per gallon:</b>	<b>Engine:</b>	<b>Performance</b> ..... 8.4
250 cu. in., (insufficient data)	250-cu.-in. Six ..... 16.7%	<b>Past experience</b> ..... 6.0
350 cu. in., local driving ..... 12.3	350-cu.-in. V8 ..... 53.6	<b>Is Firebird your only car?</b>
long trips ..... 15.7	400-cu.-in. V8 ..... 29.8	No ..... 57.9%
400 cu. in., local driving ..... 10.8	<b>Transmission:</b>	Yes ..... 42.2
long trips ..... 13.7	3-speed manual ..... 9.6%	<b>Other cars owned:</b>
<b>Specific likes:</b>	4-speed manual ..... 19.3	Pontiac ..... 25.0%
Handling ..... 62.5%	2-speed automatic ..... 45.8	Chevrolet ..... 22.9
Style ..... 60.0	3-speed turbo hydra-matic ..... 25.3	Ford ..... 18.7
Power ..... 27.5	<b>Had mechanical trouble?</b>	Buick ..... 12.5
Performance ..... 18.8	No ..... 51.2%	Volkswagen ..... 10.4
Ride ..... 17.5	Yes ..... 48.8	Oldsmobile ..... 10.4
Traction/Roadability/ Cornering ..... 16.3	<b>What kind of trouble?</b>	<b>What options/accessories?</b>
Comfort ..... 13.8	Transmission ..... 10.0%	Power steering ..... 64.4%
<b>Specific dislikes:</b>	Window action ..... 10.0	Radio ..... 54.6
Rattles ..... 16.2%	Wheel balance ..... 10.0	Power brakes ..... 33.7
Gas mileage ..... 16.2	Oil leaks ..... 7.5	Console ..... 27.3
Ventilation ..... 14.7	Shift linkage ..... 7.5	Airconditioning ..... 22.1
Small trunk room ..... 11.8	Vent system ..... 7.5	Special wheels ..... 19.5
Weak suspension ..... 10.3	<b>Dealer repair satisfactory?</b>	Vinyl top ..... 16.9
Workmanship ..... 10.3	Yes ..... 59.5%	Oval tires ..... 13.0
Mud splashes up ..... 10.3	No ..... 29.7	Trim package ..... 11.7
Skippy room in rear ..... 8.8	<b>Why the Firebird?</b>	Tinted glass ..... 11.7
<b>Model:</b>	Style ..... 66.3%	Custom interior ..... 7.8
Hardtop Coupe ..... 81.0%	Size ..... 24.1	<b>Age distribution of owners:</b>
Convertible ..... 19.0	Price ..... 16.9	20-29 ..... 51.8%
<b>Seats:</b>	Pontiac name ..... 13.3	30-49 ..... 38.2
Front buckets ..... 97.6%		50 plus ..... 9.9

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





### New scope for night watching

Electronic intensification of the image picked up by the lens of a new telescope enables the human eye to see when there's virtually no light. The Perkin-Elmer scope has a limited-zoom system that magnifies 20 times.



### Argument settler

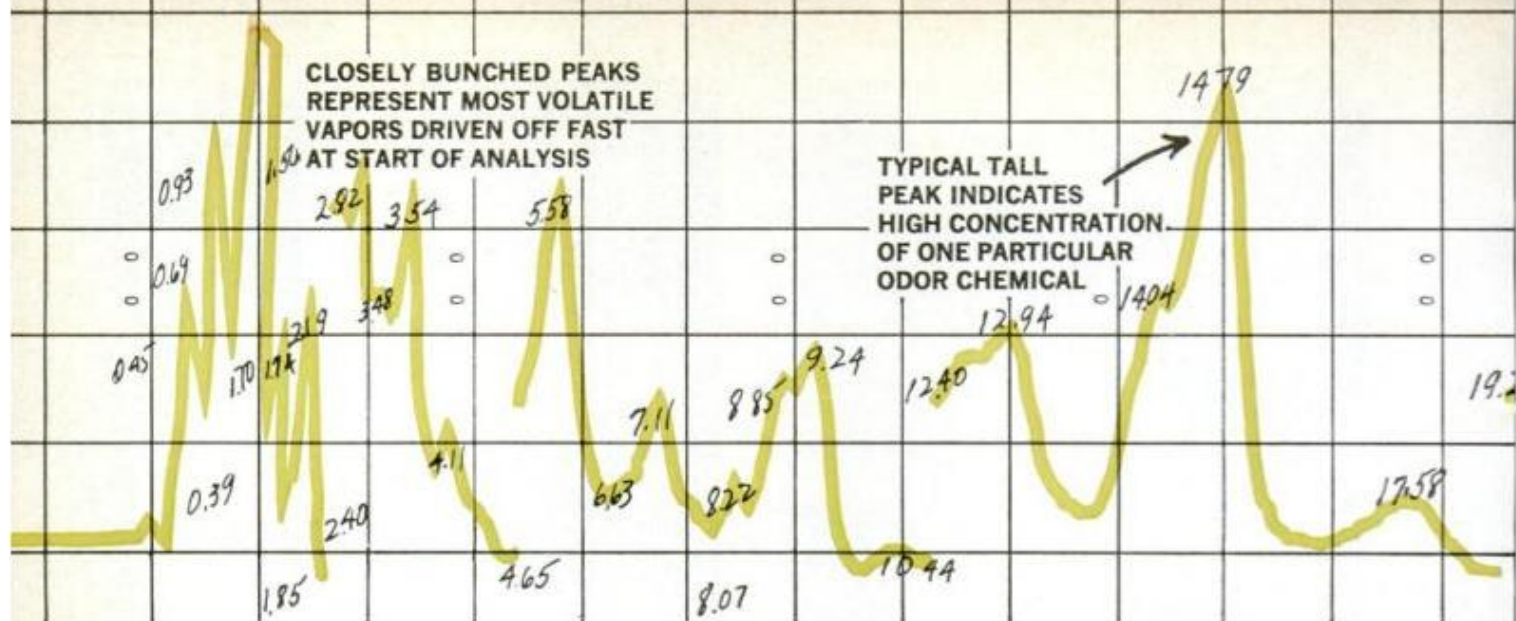
There's no need to argue over which show to watch; with this rig, you can watch 'em all. The four-screen TV set is a German demonstration unit that receives color on the large screen and black and white on the small ones.



### Army's new main battle tank fires shells or missiles

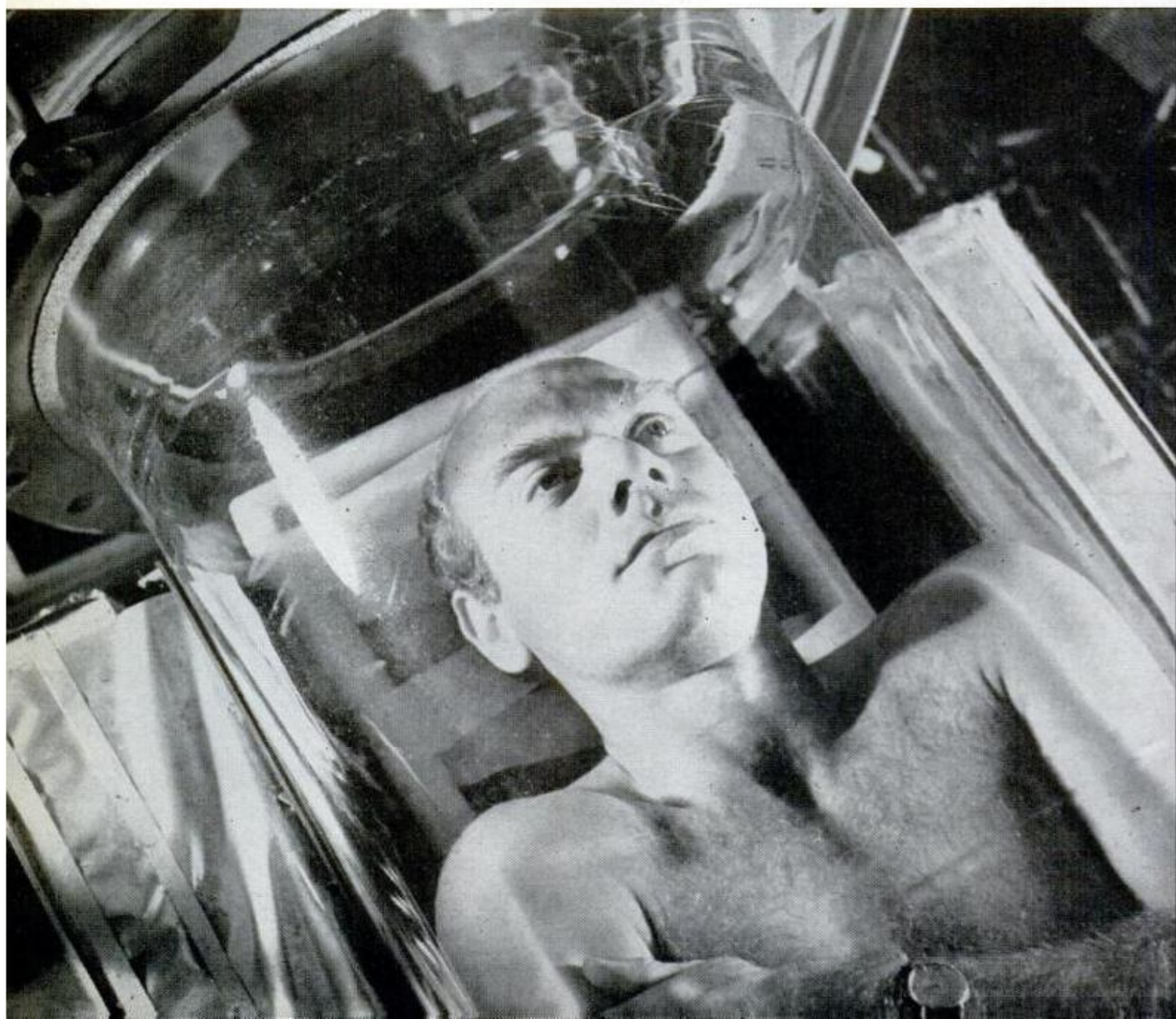
Jointly developed by the United States and West Germany, the Army's new MBT-70 main battle tank is expected to be operational in the 1970s after tests this summer. The 51-ton vehicle, powered by a 1475-hp aircooled diesel engine, has outdistanced cars in tests, though its speed is classified. Its three-man crew is housed in a "capsule" that protects them against radiation and chemicals. The 152-mm gun-launcher can fire shells or missiles (lower right).



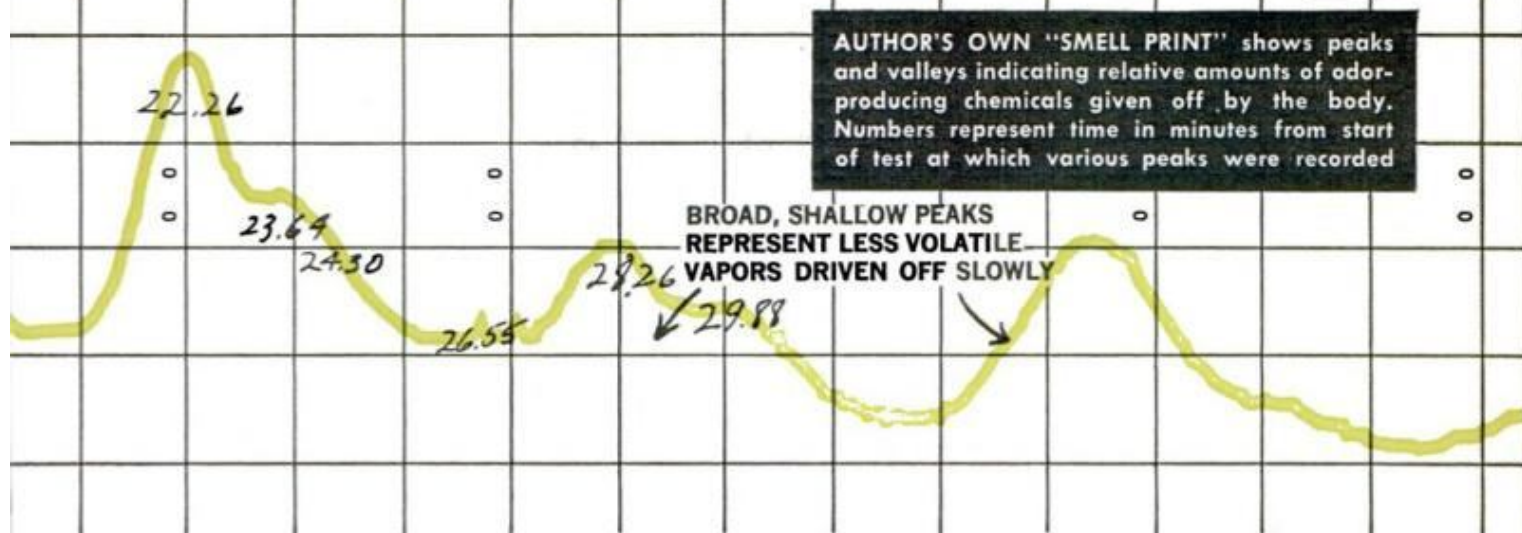


**AMAZING NEW SCIENCE CALLED OLFACTRONICS:**

# Now they'll know you







# by your 'smell print'

**Supersensitive sniffers will soon finger criminals, detect bombs and diagnose diseases by spotting odor patterns no one can hide**

By WALLACE CLOUD

THE WEIRD APPARATUS looked like a classic prop for a science-fiction movie: A horizontal, heavy-walled cylinder of Pyrex glass, big enough to hold a human body. Tanks of compressed gas. Bubbling, fuming flasks of supercold liquid nitrogen.

"Strip to your shorts," said Dr. Boguslaw Krotoszynski. "Vapors from your clothing would add extraneous data to the recording."

I was going "into the tube" at the Illinois Institute of Technology Research Institute in Chicago. Suspended animation? Not quite. I was about to have my olfactronic signature recorded. That means the apparatus was going to collect a sample of the unique combination of odors given off by my body, then analyze my "smell print." A little

like being sniffed for recognition by a dog, but far more precise and informative.

I lay down on the loader assembly—a narrow stretcher of Teflon-coated steel tubing and Teflon straps—and Dr. Krotoszynski pushed the loader along

PM WRITER Wally Cloud goes into man-sized test tube that will collect samples of his body vapors





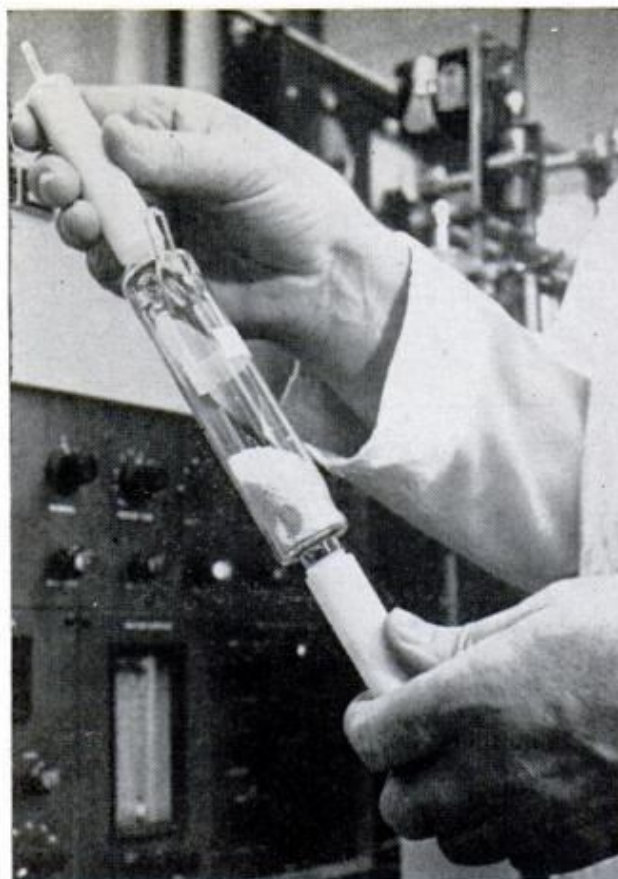
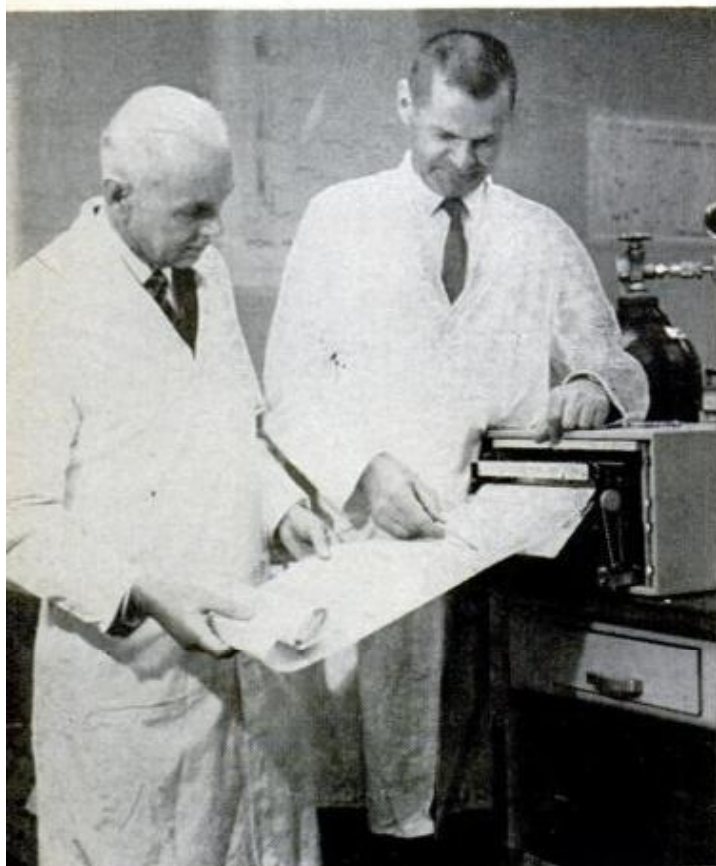
on its rails. The "human test tube" swallowed me up. I had to pull my shoulders together to fit in, since the cylinder was only 18 inches in diameter.

The hiss of air flowing into the tube began, then I heard the clank of quick-release bolts sealing me in. Unintelligible voices from outside echoed in the tube. Through the curved glass, Dr. Krotoszynski's distorted image waved at me and then went away.

I was in the tube for 45 minutes. It became a bit stuffy. I squirmed to find a semi-comfortable position. There was an itch I couldn't scratch.

Olfactronics, the new science of smells, is already making a name for itself. Its best-known achievement to date is the "people-sniffer," developed by General Electric, that's being used successfully to detect enemy troops hidden in the jungles of Vietnam. An olfactronic bomb detector has been developed to smell out explosives hidden with murderous intent aboard airliners. In the future, precise smell analysis will help doctors to diagnose diseases. Sniffers will be used in industrial pro-

**CHART RECORDER** feeds out the author's graph as Dr. Dravnieks (left) and Dr. Krotoszynski look on



**BODY VAPORS** go into glass tube where they are trapped by tiny grease-coated pellets for analysis

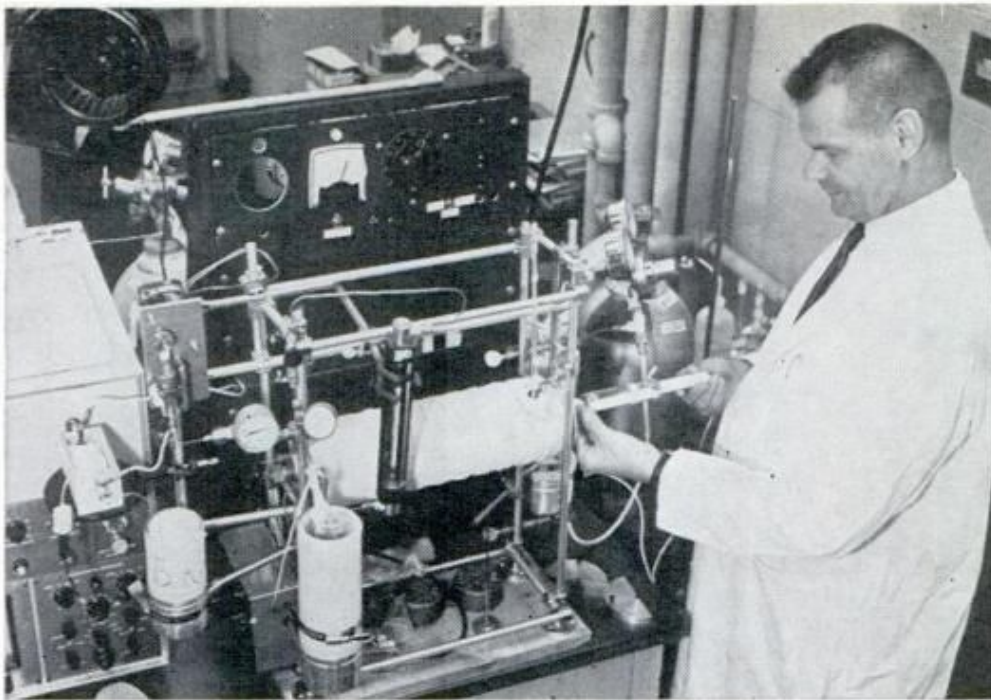
cess control and even by electronics servicemen to identify malfunctioning components.

Until only a few years ago, smells were beyond scientific analysis. Odors consist of such small quantities of vapor in the air that instruments were not sensitive enough to check them out. But this has all changed. Apparatus such as that used at the IITRI olfactronics laboratory is now capable of detecting many substances 1/100th to 1/10,000th as concentrated as those noticeable to the nose.

"Is the apparatus more sensitive than a dog's nose?" I asked Dr. Andrew Dravnieks, who is in charge of the lab, after they let me out of the tube.

"We're not really sure just how sensitive dogs are," he said. "Undoubtedly dogs can detect some odors we can't smell, but they have an added advantage in the geometry of their noses. A dog can get his nose into the boundary layer of air one to two millimeters from the surface of the ground or an object. In that relatively stagnant layer of air,





**ODOR-FILLED TUBE** is inserted in small oven where heat will drive off the volatile vapors trapped by the greased pellets. Vapors are then cooled by liquid nitrogen, frozen out and recollected for the final phase of analysis. Alternate heating and cooling helps to purify and concentrate the minute sample of body substances collected

odors are much less dispersed than in moving air farther away."

In the tube, very pure air had been passed over me. The vapors given off by my skin and breath had been collected in a small glass tube filled with Teflon particles coated with a highly refined petroleum grease. The grease didn't retain water vapor or carbon dioxide, but did trap all the organic substances from the air.

The findings from this and other samples are being used in a project sponsored by the Army Ballistics Laboratory to analyze the characteristic odor signatures of various kinds of people. People give off about 100 different organic substances in vapor form. From 30 to 50 of these compounds emanate from any one person at a given time. A pattern of specific substances, in characteristic amounts, makes up his particular signature.

My signature would be written by the wiggling pen of a chart recorder after the sample had been concentrated. The sample tube, with helium gas flowing through it, was being heated in an oven to drive off the vapors. The helium passed into a smaller collecting tube cooled by liquid nitrogen, where the vapors were frozen out and trapped again.

"It's necessary to be very fussy in

handling these samples," Dr. Dravnieks explained. "The total quantity of material is very small—about one microgram. For comparison, the weight of a fingerprint is from five to 50 micrograms."

The system is so sensitive it can detect some substances in concentrations as low as 1/10th of a part per billion in the air. That's sensitivity on the order

*(Please turn to page 196)*



**"PEOPLE SNIFFER"** used in Vietnam spots enemy by detecting traces of ammonia in body sweat, is a forerunner of more sophisticated artificial noses





# Coming Soon! 'SKIDPROOF' CARS

By CURT CUTTER

**By 1970, your driving will be much safer, thanks in part to the development of 'skid control' devices**



**SMALL SENSOR** is key to new antiskid system proposed by Bendix Corp.

**T**HE SPEED OF THE CAR hurtling down the 1000-foot concrete test pad kept climbing—30, 40, 50 mph. Soon it reached the last 400-foot section of the pad where sprinkler heads sprayed water over the 16-foot-wide roadbed.

Suddenly, a milky-white plastic sheet loomed ahead on the final 100 feet of the pad. The test engineers stood alongside the pad, confident that they had successfully duplicated the slipperiest road surface on earth—wet ice at 33° above zero.

Inside the car, a test driver prepared to slam on the brakes. Obviously, an epic panic stop and spin-out were in the offing. But, amazingly, the car came to a smooth stop, just short of the pad's end, neither slewing out at the rear end nor losing steering control.

Neither driving skill nor luck was responsible for this well-controlled stop. It was just one of thousands of such stops that have been made by brake engineers at the Bendix Automotive Development Center in South Bend, Ind., as they try to perfect anti-skid devices.

The Brake and Steering Div. of Bendix Corp. is one of about 10 automotive suppliers, as well as Ford Motor Co. and General Motors, who are engaged in a multimillion-dollar competition to produce the first workable and economical antiskid system for cars. Very encouraging progress is being made. Barring serious complications, at least two 1970 cars are expected to have antiskid devices (or "skid control" units, as the more conservative engineers prefer to call them).





**ELECTRONIC CIRCUITRY** is the "brain" of new Bendix antiskid system. Production version will be smaller

**BRAKE CONTROL UNIT** of Kelsey-Hayes system gives on-off braking automatically 'til skidding car stops



Antiskid is expected to help motorists on all types of road surfaces, but it will be especially valuable on roads with slippery or unstable surfaces such as ice, snow or gravel. In a nutshell, it will help a motorist every time his wheels skid.

Despite the great amount of antiskid engineering that has been done, and even though hundreds of antiskid prototypes are now being tested on U.S. highways, a tight veil of secrecy still surrounds much of the activity.

In addition to the secrecy that envelops any future automobile feature, there's considerable concern in Detroit that impatient Washington safety officials will force automakers to install antiskid systems before they're fully developed.

An antiskid device is simply a

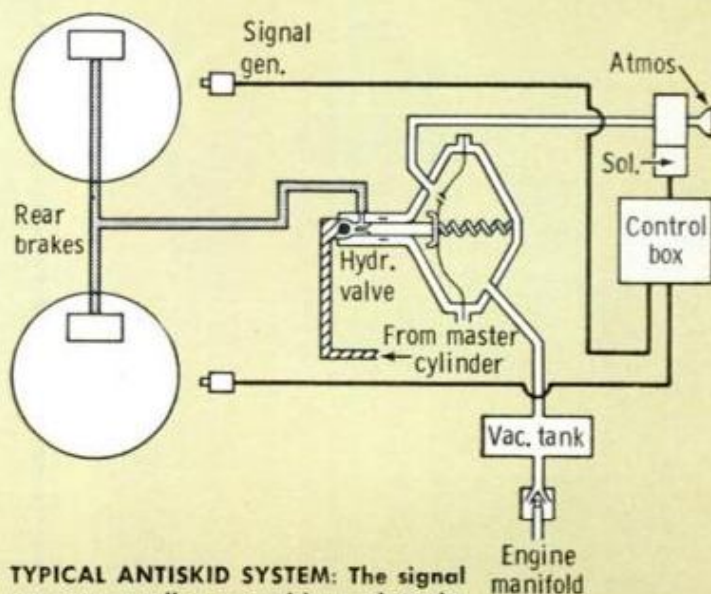
mechanism that senses when a wheel is beginning to skid, and then quickly releases and reapplies the brakes, thereby stopping the vehicle in the shortest possible distance—and without the driver losing control.

Exactly how each antiskid system works still is a closely guarded secret at each company. In general, antiskid does scientifically and much better what a racing driver does instinctively—senses the wheel lockup and then pumps the brake to prevent or limit the skidding.

Each system has sensors at the wheels or elsewhere that continuously and precisely report any skidding or incipient skidding, the vehicle speed, and other data to a central "computer," or "black box." Some sensors give 360 signals per wheel revolution.

The innermost secret of every antiskid developer is contained in this computer, or black box. All developers refuse to divulge what's inside this component, merely saying that it converts information into useful action and that it's economically feasible.

After combining this fresh input from the sensors with data already in the system, the computer "orders" its "brake foot" (or brake-pressure modulator) to release the brakes rapidly



**TYPICAL ANTISKID SYSTEM:** The signal generators tell a control box when the wheels are beginning to skid. The control box notifies a hydraulic transfer device when oil should be pumped into or out of the brake system to apply or release the brakes



and then reapply them until the vehicle stops.

This action by a car equipped with antiskid is often plainly visible to nearby observers, as the wheels intermittently roll and skid briefly. However, some systems on occasion repeat this cycle two or three times a second.

Antiskid systems can be connected to the rear wheels, the front wheels, all four wheels, or the driveshaft. There is also a variety of approaches for reducing the skidding. The improvement in braking is proportional to the complexity and cost of the unit.

The cost of these systems will vary from \$40 to \$150 a car, but a real effort is being made to get the \$40 system ready for all but the luxury cars. Because of their safety value, there appears to be an unspoken agreement



**PLASTIC SHEET** covers antiskid test pad. Wet down, sheet simulates extremely icy road conditions. Rest of strip is surfaced with various types of asphalt, providing the different coefficients of skid friction

among automakers to apply a minimum mark-up to antiskid devices.

While antiskid devices have been dreamed about for years by visionary engineers, there was little or no practical progress because they really couldn't agree whether skidding was a help or a hindrance in stopping a car. Many engineers insisted that the greatest amount of deceleration occurred during tire skidding.

Then, about 10 years ago, a group of British engineers arrived at the fairly definite conclusion that maximum retardation could be achieved with a 15-percent skid. An example of a 15-percent skid is a car traveling at 100 mph with wheels braked to 85 mph.

As the car reaches the ever-lower and lower speeds, the objective is to get the greatest stopping effect by continually applying and releasing the brakes so that the tires are only skidding over 15 percent of the ground they cover. In other words, the engineers concluded that the best braking occurs when the wheels are rolling 85 percent as fast as the car is moving.

However, as antiskid technology advances, a conviction has developed among one school of engineers that this 15 percent slip theory is not necessarily true. They claim that the most desirable percentage of slip varies with the tire (new or bald), with the type of road (concrete, blacktop or dirt) and with the road surface (ice, snow or water).

Among those disputing the 15 percent slip theory are the Bendix engineers who have developed a so-called "adaptive antiskid system." This is a more sophisticated electronic unit which stops the car with very rapid and slight "snubs" that are applied in the fraction of a second before lockup occurs, rather than waiting for the actual skid.

W. Carter Suttle, chief research engineer for this division, says that this adaptive braking approach provides a smoother retardation and, perhaps, a

*(Please turn to page 206)*





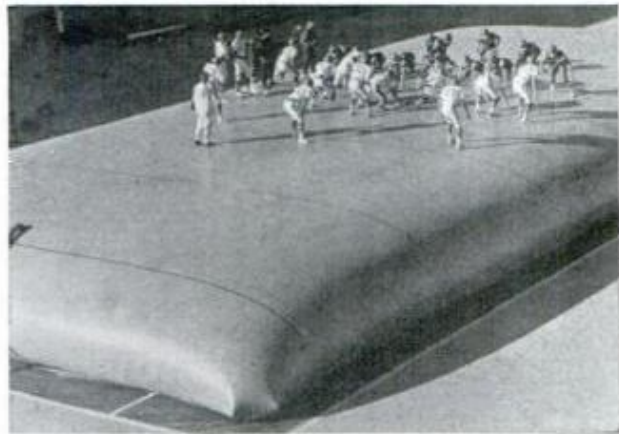
### Survival cocoon

A one-man insulated liferaft is being tested for use by Air Force fighter pilots. The new raft has an insulating inflatable canopy that covers the entire raft and keeps the downed pilot warm and protected from weather.



### 'Atom smasher' for moon

An "atom smasher," designed to be dropped on the moon and telemeter back to earth information about the composition of the moon's surface, is demonstrated by Mobil physicists. (The moon backdrop is a photo.)



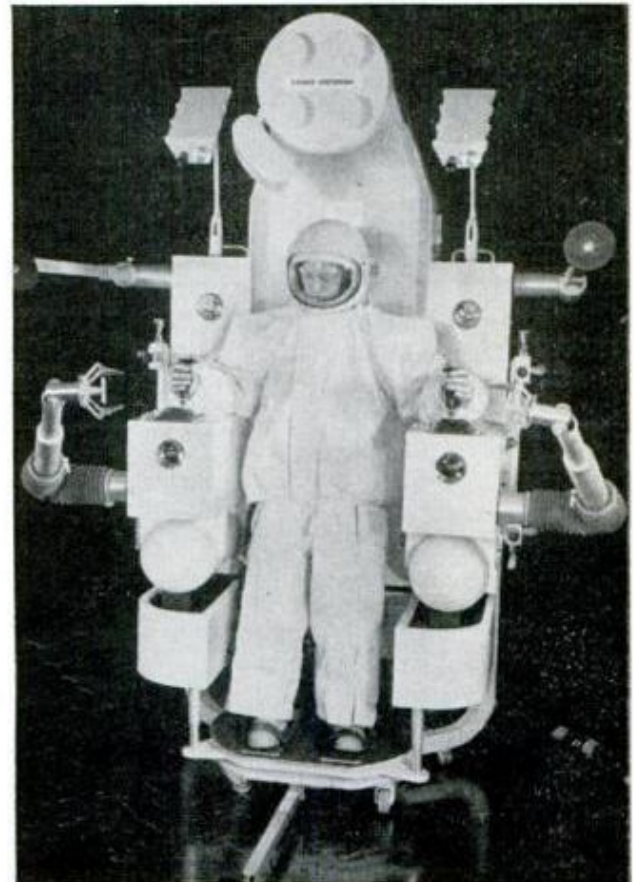
### No room for flankers

Just to show how huge the world's biggest collapsible fuel storage container is, Good-year arranged a football scrimmage on top. The pillow tank measures 100 by 48 feet.



### Turbine-powered road racer

Soon to appear in international road races is the Howmet Turbine Experimental Sports Car, powered by a 325-hp free-turbine engine. Since international rules don't include turbine cars, it'll run on "exhibition status."



### Mobile workbench for space

A self-propelled work platform (shown in mock-up) would enable an astronaut to work outside a spacecraft for eight hours and allow him a range of three miles. The vehicle was designed by Bendix Corp.





## Largest air-cushion vehicle will ferry cars and passengers

Now undergoing sea trials in preparation for regular ferry service across the English Channel is the largest hovercraft in the world, the SRN-4. British Railways expects to put the 165-ton craft on a seven-trip-a-day schedule between Dover and Calais beginning in August.



## Navy hearing aid

A 34-foot-long sonar dome—described as the largest rubber product ever molded in one piece—will be used on Navy destroyers to improve sonar reception. The Goodrich dome lets sound waves through with little distortion.



## Nord-500

After experimenting with various VTOL designs, Nord-Aviation has come up with the Nord-500, which is driven by two shrouded propellers. The firm feels that shrouded props offer best efficiency for subsonic VTOLs.



## Defense against low fliers

Using the Sidewinder air-to-air missile, the Army's new Chaparral system provides field commanders with defense against low-altitude aircraft. The multiple-missile turret here is mounted on an XM-730 tracked vehicle.



## Navy's fastest

The U.S.S. *Crockett*, an aluminum-hulled, 165-foot craft, is the latest in the Navy's new patrol gunboat class. The *Crockett* cruises on diesel power, but switches to gas turbines for a top speed of "over 40 knots."





## between Britain and France

Powered by four 3400-hp Bristol Siddeley "Marine Proteus" gas turbines, the craft will skim along at 70 mph, carrying 254 passengers and 30 cars in its spacious interior (photo, right). The craft is shown at the British Hovercraft Corp. plant on the Isle of Wight.



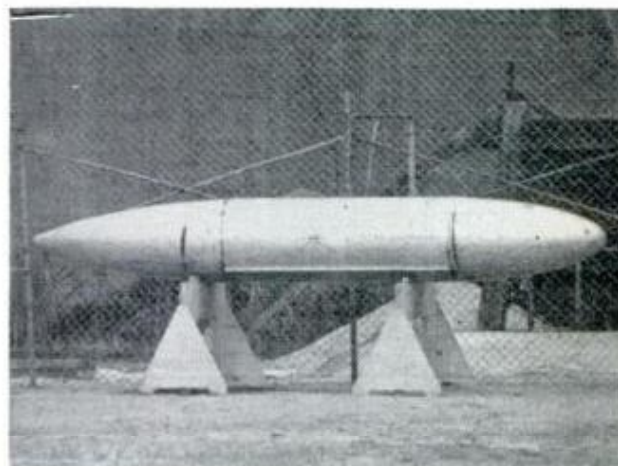
## Instant banana peel

Dusted onto a street and then sprinkled with water, a new product, RioTrol, turns the pavement into a slippery barrier. Firemen here are playing the bruising role of rioters.



## Sheriff's armored posse

A modified Army M-8 light armored car has been added to the Los Angeles Sheriff's force. The vehicle will be called into action to support police in "high-hazard areas."



## Foam-filled aircraft tanks don't blow up

An ordinary aircraft fuel tank explodes (left) when hit by tracer bullets. The Air Force, however, has revealed a new material that it's using in tanks to keep them from blowing up, even when they take hits (right). The explosion proof tanks are stuffed with polyurethane foam, which provides protection and only slightly reduces the fuel capacity.



## HOW SCIENCE IS CHANGING HOCKEY



# 80-MPH Mayhem on Ice

Careful analysis of a player's speed and motions is proving a boon to a game that's won or lost in fractions of a second

By WILLIAM BARRY FURLONG

Illustrations by Ed Vebell

AT ONE TIME hockey was half madness, half muscle. The fans didn't keep score so much as count knock-outs. Today, hockey is beginning to emerge as something of a science—a bruising, bone-rattling science, to be sure, but at least one that is taking ad-

vantage of research to make the most of the game and the men who play it. Here are some of the facts that have come out of a scientific analysis of the game:

- On a hard, fast shot, the puck travels anywhere from 80 mph to more than

## WHY SPEED IS SO IMPORTANT



**HOW FAST A PLAYER SKATES** determines, to a large extent, who reaches the puck first. Here you see how some of hockey's fleetest skaters would rank in a race from center court to a puck in front of the net. Note how Dick Duff, no slouch himself, would be hopelessly left behind four other speedsters



# HOW THE 3 BASIC BODY SHAPES COMPARE

ENDOMORPH (711)

MESOMORPH (171)

ECTOMORPH (117)



Fatty



Muscular



Lean,  
Wiry

ENDO-MORPH	MESO-MORPH	ECTO-MORPH	ENDO-MORPH	MESO-MORPH	ECTO-MORPH	ENDO-MORPH	MESO-MORPH	ECTO-MORPH
1	1	1	1	1	1	1	1	1
2	2	2	2	2	2	2	2	2
3	3	3	3	3	3	3	3	3
4	4	4	4	4	4	4	4	4
5	5	5	5	5	5	5	5	5
6	6	6	6	6	6	6	6	6
7	7	7	7	7	7	7	7	7

ENDO-MORPH

MESO-MORPH

ECTO-MORPH

1

1

1

2

2

2

3

3

3

4

4

4

5

5

5

6

6

6

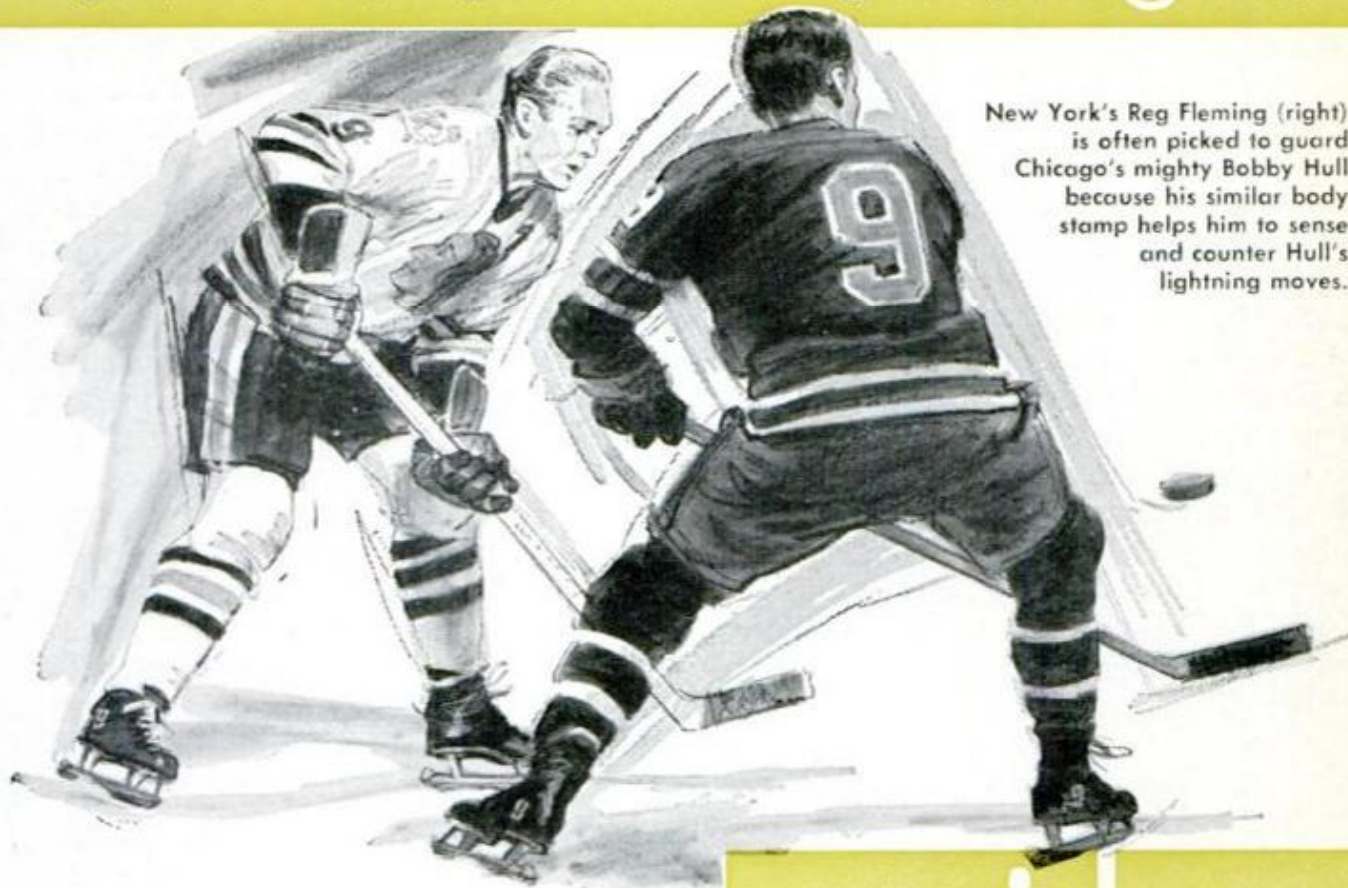
7

7

7

Hull

Howe



New York's Reg Fleming (right) is often picked to guard Chicago's mighty Bobby Hull because his similar body stamp helps him to sense and counter Hull's lightning moves.

**BASIC BODY SHAPE** is the key to using players in the most efficient way, believes hockey analyst Lloyd Percival. How his system works is shown in graphs at the top of the page. Each player is rated on a scale according to three body characteristics—endomorph (fatty), mesomorph (muscular) and ectomorph (lean, wiry). How high a player rates in each quality gives him his body stamp number. Note how Chicago's famed Bobby Hull—powerful and chunky—is rated 171, while Detroit's equally eminent Gordie Howe—a little less muscular—is a 363. They show up as different profiles on the graph (upper right), and their playing styles are significantly different, too. Stopping superstars like Hull and Howe calls for players who are not necessarily as skillful but who have similar body stamps and who react instinctively in similar ways. Thus the best match for Hull is a player like New York's Reggie Fleming (shown at right) whose body stamp is 261

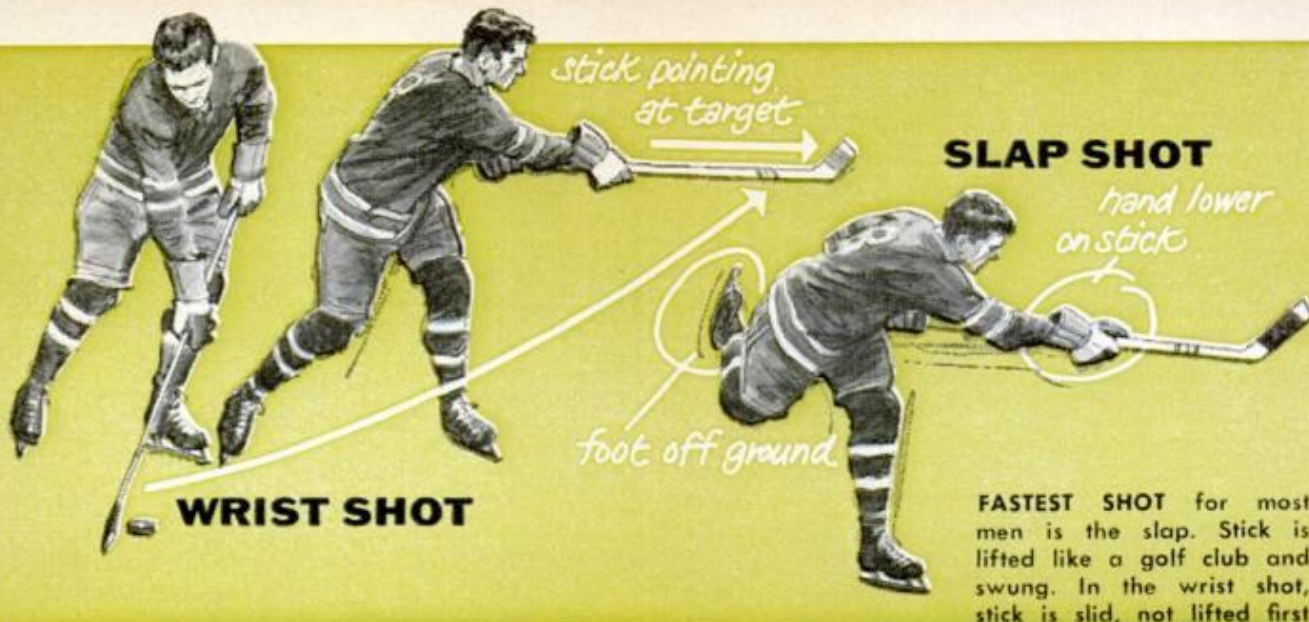
**FLEMING**  
261



**HULL**  
171







**FASTEST SHOT** for most men is the slap. Stick is lifted like a golf club and swung. In the wrist shot, stick is slid, not lifted first

100, with an incredible 118.3 mph recorded for Bobby Hull of the Chicago Black Hawks, the fastest shooter in the National Hockey League.

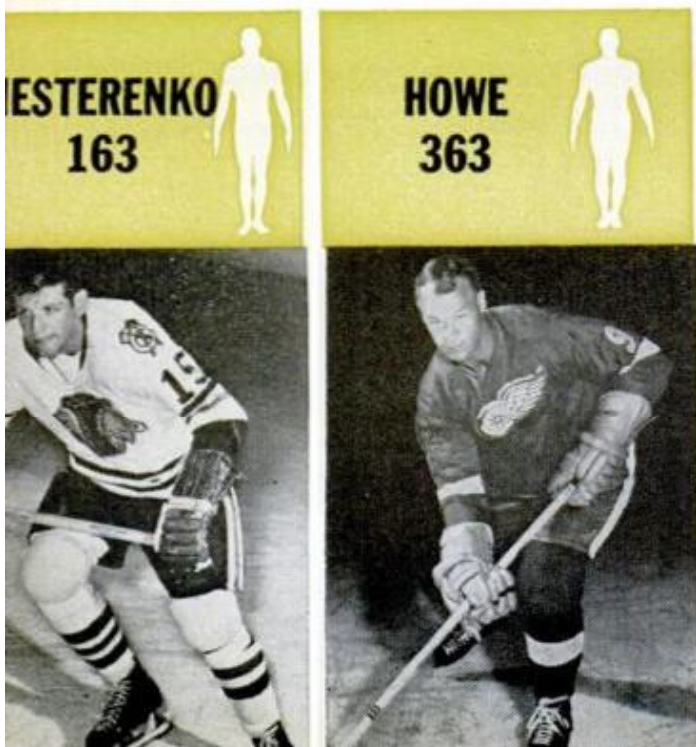
- On a hip-high shot started 44 feet in front of the net and traveling at 100 mph, the puck will pass the goalkeeper before he can possibly react.

- For every additional mile-per-hour a player gets on his shot, the puck will travel 5.4 inches farther before the goalie can react.

- The most effective defense against a player like Bobby Hull is not a name but a number—the number of the basic body build best suited to coping with a particular body build like Hull's. The numbers are arrived at according to a new system, called "somatic body-typing," that rates players'

shapes on a numbered scale. In the case of Hull, whose own body shape is rated a 171, the numbers most successful at stopping him are a 261 on the New York Rangers or a 161 on the Toronto Maple Leafs, both of whom have builds similar to Hull's and react instinctively in similar ways.

Why the sudden emphasis on brains in a game of brawn? The fast-growing popularity of hockey as a major spectator sport and TV entertainment is helping to create a demand for a more exacting scientific approach. This season the NHL is undergoing an unprecedented expansion from 6 to 12 teams—double its previous size. Thus half the teams in the new league will be made up largely of players who, until now, have not been considered good



**How Teams in the Expanded League Are Organized**

<b>EASTERN DIVISION</b> (Original NHL Teams)	<b>WESTERN DIVISION</b> (New teams added this season)
Boston Bruins	California Seals
Chicago Black Hawks	Los Angeles Kings
Detroit Red Wings	Minnesota North Stars
Montreal Canadiens	Philadelphia Flyers
New York Rangers	Pittsburgh Penguins
Toronto Maple Leafs	St. Louis Blues

Note: Teams listed alphabetically, not by league standing

**STOPPING DETROIT STAR** Gordie Howe is a tough job for any defenseman. Those who are most successful tend to have builds similar to Howe's, bearing out the theory that like body shapes anticipate each other's moves better than unlike shapes. Thus Chicago's Eric Nesterenko, a 163 in build, is often assigned to handle Howe's nearly identical 363



enough or strong enough to play in major-league competition. Even the established teams will have to get along with fewer topnotch players in order to help man the newly created clubs.

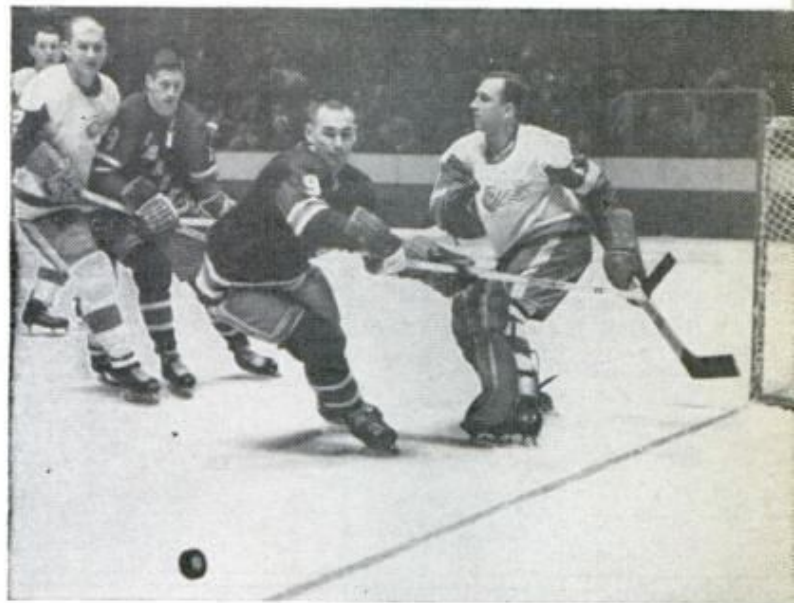
All this means that ways must be found to use less-gifted and less-experienced players more effectively to keep the game of hockey lively, exciting and genuinely competitive. Unless techniques can be devised to stop players like Bobby Hull, many teams, especially the new ones, are going to find themselves in deep trouble.

One of the pioneers in the scientific study of hockey is Lloyd Percival, director of the Toronto Sports College, a group that does special research on sports and the men who play them. In his research, he's made stopwatch studies of players, timing them down to 1/100th of a second.

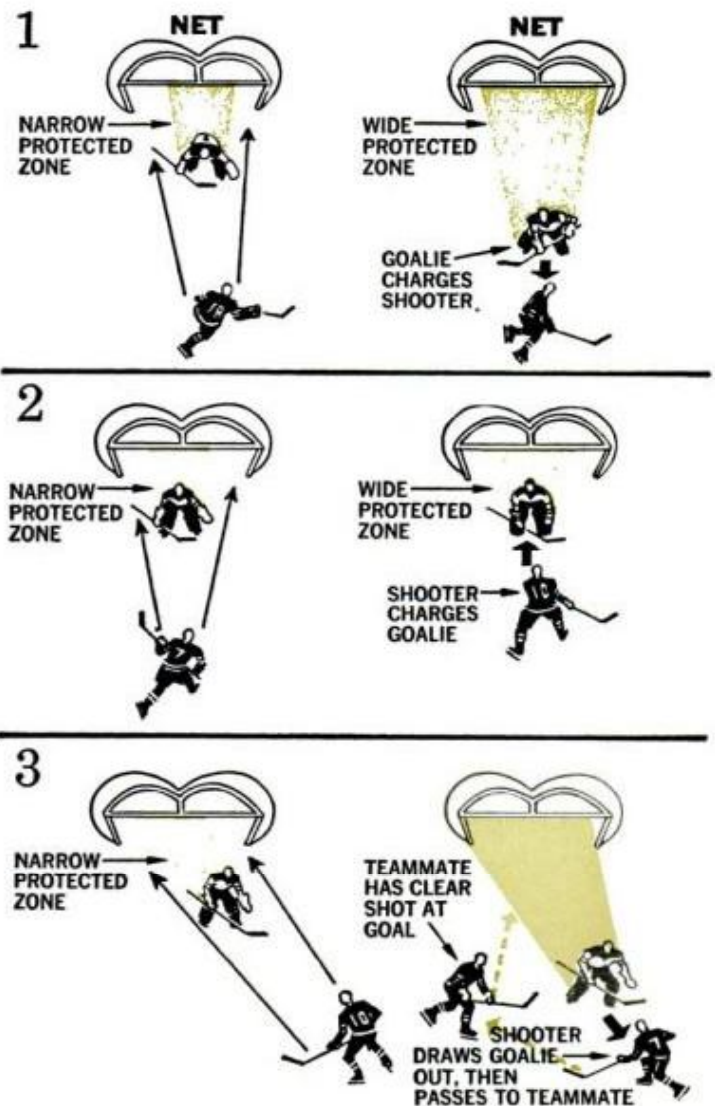
Skating ability and speed are as important as muscle in a successful hockey player, Percival believes. It was no accident that the Montreal Canadiens dominated the NHL for so many years until recently—they were the fastest-skating team in the league. Percival clocked each individual player and found the team's average to be 22.3 mph. During the same period, the luckless New York Rangers were also last in skating speed with a revealingly low 19.4 mph team average.

The same was also true of shooting speeds, with Montreal enjoying an admirable 82.6 mph team average compared to 76.3 mph for New York. The recent improvement of the Rangers is almost certainly due in part to higher shooting and skating speeds, although Percival has not yet had time to run new tests to confirm this.

Probably the greatest single



**BASIC NET STRATEGY** is shown below. The farther out from the net a goalkeeper plays, the more area he blocks with his body (No. 1). This gives his opponents a narrow shooting angle. Goalies call it "cutting the angles." Note how far out Detroit goalie Roger Crozier is in photo above. The same is true if a shooter charges in too close to the net—he'll cut down his own shooting angle (No. 2). To trick a goalie, an opponent often fakes a shot from one side of the court, then passes to a teammate on the other side. The teammate thus has a clear shot at net (No. 3)





## How Fast Are Hockey Players? Here's How They Compare

(Figures as of last season)

### INDIVIDUAL SKATING SPEEDS

(In miles per hour)

	Without Puck	Rank	With Puck	Rank
Bobby Hull, Chicago	29.7	1	28.3	1
Henri Richard, Montreal	28.6	2	25.3	5*
Gordon Howe, Detroit	28.4	3*	27.6	3*
Dave Keon, Toronto	28.4	3*	25.2	6
Frank Mahovlich, Toronto	28.3	4	27.8	2
Doug Mohns, Chicago	28.1	5	27.6	3*
Tim Horton, Toronto	28.0	6*	27.6	3*
Bob Pulford, Toronto	28.0	6*	27.6	3*
Dick Duff, Montreal	27.9	7	27.5	4
Eric Nesterenko, Chicago	27.8	8	25.3	5*

\*Indicates tie

### INDIVIDUAL SHOOTING SPEEDS

(In miles per hour)

	Slap Shot	Rank	Wrist Shot	Rank
Bobby Hull, Chicago	118.3	1	104.6	3
Tim Horton, Toronto	112.4	2	—	—
Frank Mahovlich, Toronto	111.3	3	102.3	4
Gordon Howe, Detroit	109.3	4	114.2	1
Eddie Shack, Toronto	109.1	5	94.6	6
Dennis Hull, Chicago	106.4	6	—	—
Andy Bathgate, Pittsburgh	104.2	7	89.3	7
Jean Beliveau, Montreal	102.4	8	105.9	2
Alex Delvecchio, Detroit	102.3	9	99.4	5

### TEAM SKATING SPEEDS

(Average for all players in miles per hour)

Montreal Canadiens	22.3
Toronto Maple Leafs	21.2
Chicago Black Hawks	20.8
Detroit Red Wings	21.1
Boston Bruins	19.6
New York Rangers	19.4

### TEAM SHOOTING SPEEDS

(Average for all players in miles per hour)

Montreal Canadiens	82.6
Detroit Red Wings	80.1
Chicago Black Hawks	79.8
Toronto Maple Leafs	78.8
New York Rangers	76.3
Boston Bruins	75.4

### REACTION TIME OF FOUR NHL GOALIES

(In 1/100ths of a second)

	Hand	Leg	Stick	Total	Body
Roger Crozier, Detroit	.21	.47	.29	.59	
Terry Sawchuk, Los Angeles	.19	.51	.27	.63	
Glenn Hall, St. Louis	.18	.53	.26	.56	
Johnny Bower, Toronto	.20	.46	.27	.56	

### MISCELLANEOUS RECORDS

Average number of passes in a game: 451 (with 261 completed)

Distance an average player skates in a game: 2.3 miles

Maximum distance recorded for a player skating in one game:

9.7 miles by Gordon Howe of Detroit

Most accurate passer: Gordon Howe of Detroit with 88% of his passes on target

scientific breakthrough in hockey, as Percival sees it, would be the "somatic" system of player selection. The method makes it possible to match players with similar body structures. "If you played Gordon Howe of Detroit and Frank Mahovlich of Toronto on the same line, their point production would go up astronomically," says Percival.

The reason is that players with the same build or "body stamp" learn to use their bodies in almost identical ways. Two players with the same body stamp will react instinctively to each other.

Thus two or three players with the same body stamp would make a spectacular offensive line. In fact, Percival actually believes that an offensive unit of moderately skilled but somatically matched teammates might well hold their own against superior but mismatched players. This is precisely where the weaker new teams might be able to offset the more glamorous performers of the established teams.

How do you measure body stamp? "By using the Sheldon scale," says Percival. This is a scale that rates individuals according to three basic characteristics of body structure—endomorph, mesomorph and ectomorph. Endomorphy is a tendency toward fattiness and a roly-poly shape with undeveloped muscles. Mesomorphy is characterized by a strong, powerful build with well-developed, bunched muscles. Ectomorphy is a lean, wiry look usually associated with tall, thin people.

Nobody is a pure endomorph, mesomorph, or ectomorph. Everyone is a mixture of the three characteristics in varying amounts. By ranking each of the three on a scale of 1 to 7, the Sheldon

(Please turn to page 204)



# Fearless Fliers in Fan-Sea Boats

These speedy airboats roar through Florida swamps, going where other boats fear to tread.

By Harriet Arnold



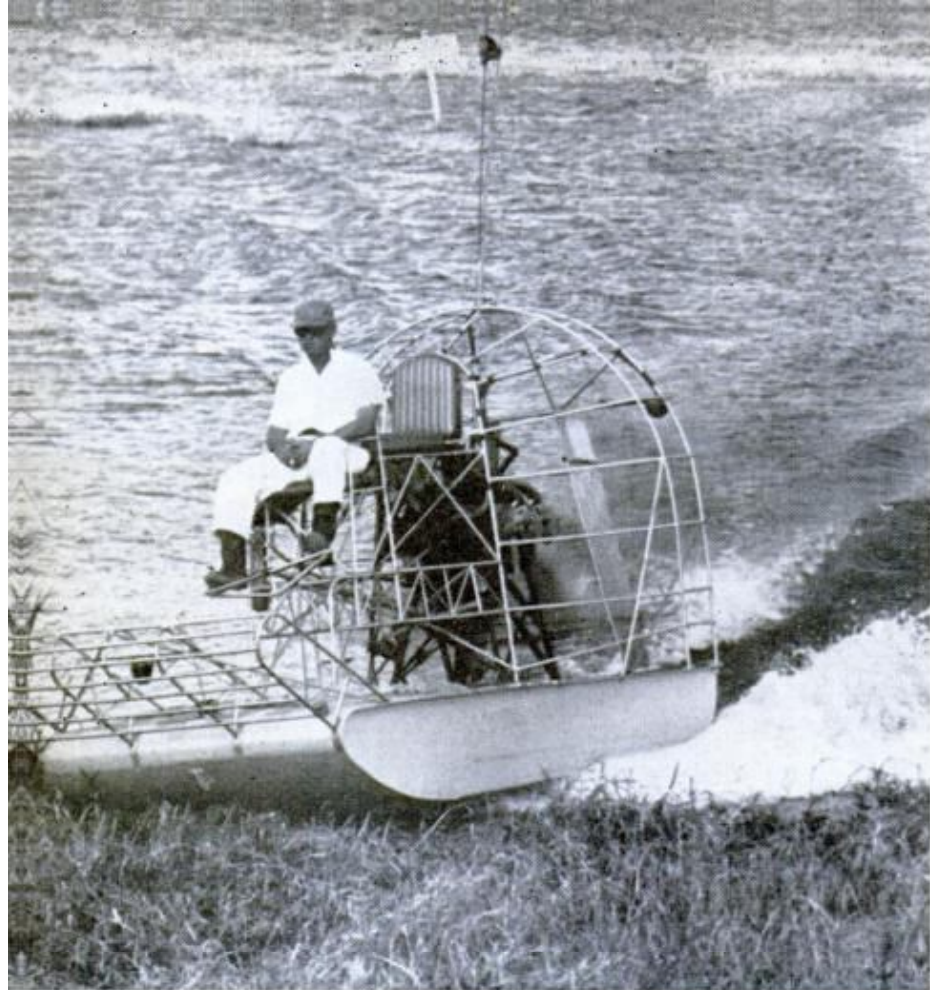
WEED SKIMMER, above, has a high seat so the pilot can see over grass. Shown below is deep-water airboat



**S**KIMMING OVER LAND, water and grass is what these boats do best. And the best place they do it is in an obstacle-studded swamp.

With engines ranging from 40 to 240 hp, these boats fall into one of two classes—the shallow-bow, pilot-forward, deep-water model, or the high-bow, pilot-back weed-skimmer called a grass boat. You can build one for about \$500. What others have built are shown here and on the next two pages.





**A CENTER-STICK CONTROL**, above, is one way of moving the rudder which steers the airboat. Another popular method is to use a foot bar, bottom right, which frees the hands. In either case, a "deadman" throttle is operated by a foot control. Note engine meters and fire extinguisher in the bottom photo

**UP AND OVER** the grass is easy work for the big fellow, upper left, that's both a weed-skimmer and a deep-water boat. Note: no-hands steering; high bow rack; tilted rudders. Flags are used to warn other pilots of approaching airboats hidden behind the tall swamp grass

PHOTOS BY THE AUTHOR



**COWCATCHER** is name given the metal rack connected to the smooth sweeping hull, left. Combination is perfect to flatten tall grass. This is true weed-skimmer (grass boat)

**DEEP-WATER AIRBOAT**, bottom left, has the characteristic low bow, with pilot seat far forward to balance craft. These boats are heavier and more stable than grass boats. Deep-water boats stay in the channels







**TUNNELED BOTTOMS** with inverted scallops add stability to turns, improve grass running



**A PULLING MOTOR** instead of the usual pushing arrangement makes this 220-hp, big-single-rudder machine unique



**SMALL AIRBOATS** are now appearing frequently. This skiff is driven by a small Briggs & Stratton motor that you can easily detach just by removing pipe attached to stern. This is slow-and-easy rig, but adequate

**LOADING** is usually done by a driver riding the boat onto the trailer, then sitting there with power on to keep boat positioned while car tows trailer out. This can be done single-handedly, but watch that the boat under power doesn't slip and ride up on back of car

**PARTY BOATING** is a popular way for sightseers to take a tour of the famous Florida Everglades. Note the deep-water plus grass-boat characteristics of this craft—the forward position of the pilot, the low bow with cowcatcher and the reasonably high freeboard

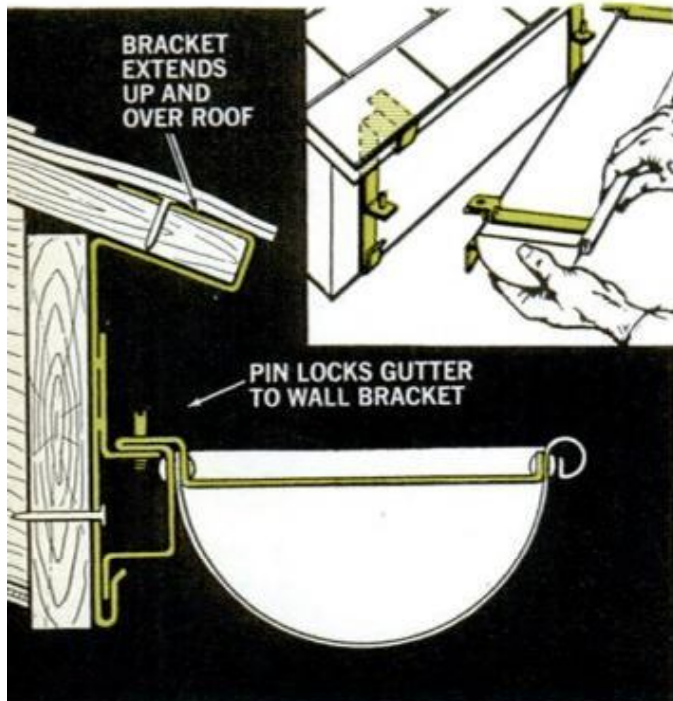




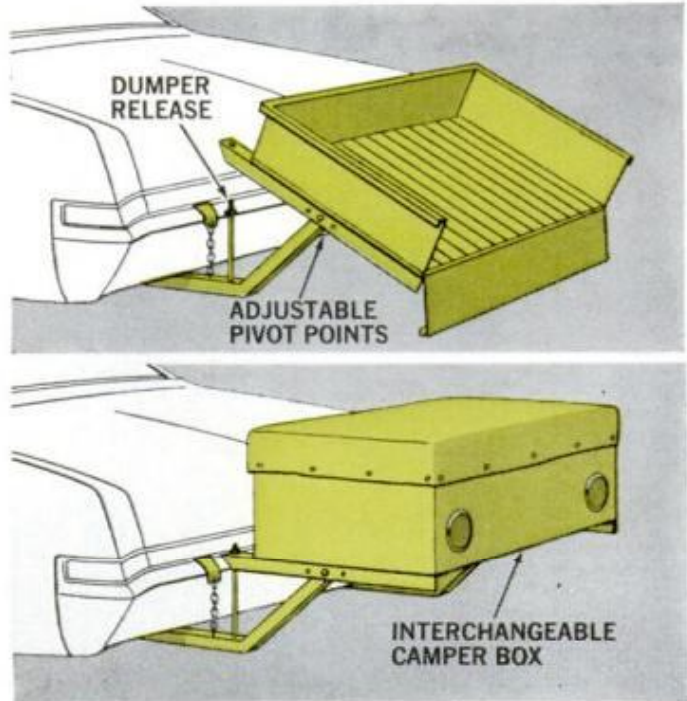
# Just patented

## PM'S PICK OF THE NEW INVENTIONS

Illustrations by Dale Gustafson

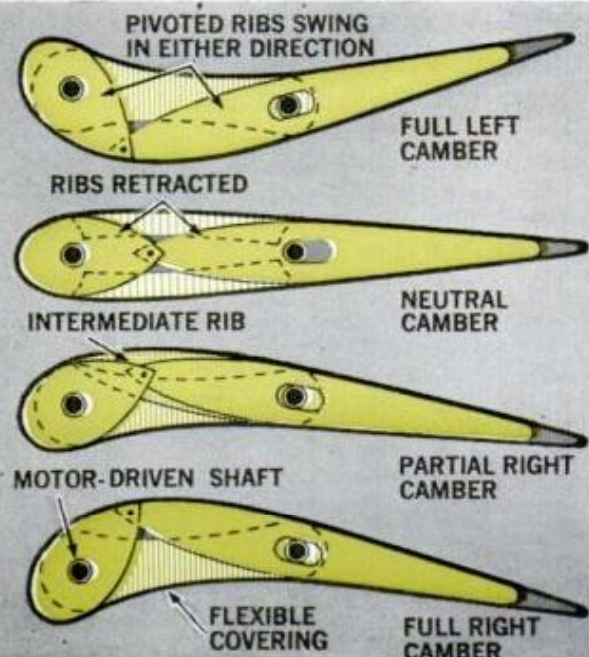


**1. GOT A CLOGGED OR LEAKY GUTTER?** With this arrangement, you'd just unhook the entire gutter and take it down for easy cleaning or repair. Brackets nailed to the house every few feet support the trough by means of quickly removable pins. Replacement gutters would also fit the same brackets so you could install a new set without having to put up new hangers



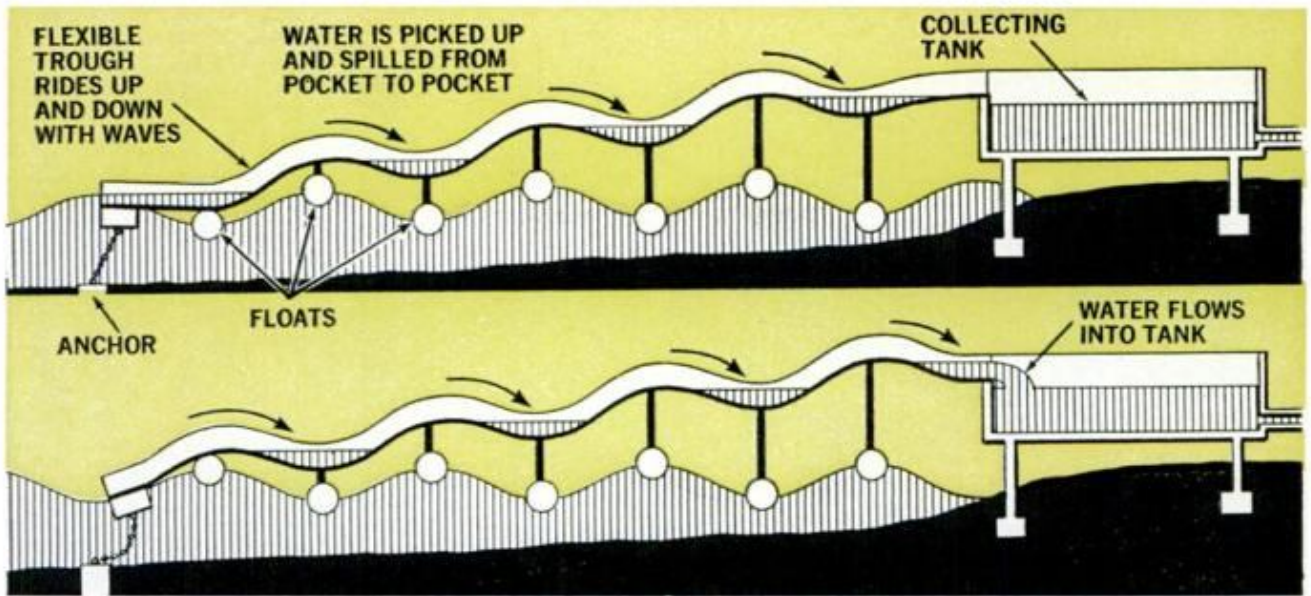
**2. CARRYING SMALL LOADS** around town would be easy with this dump box that attaches to the rear of your car. The arms slip into sockets under the car and clips hook over the bumper. A choice of mounting holes lets you adjust the box's pivot point according to the type of load. An off-center pivot makes the box self-dumping. For long trips, the dumper can be replaced with a camper box to carry extra supplies

**3. MECHANICAL SAILS** for a sailboat could be adjusted to meet any wind condition at the push of a button. The sails are winglike airfoils whose camber, or curvature, can be varied in either direction. In light winds, the sails would be sharply bowed to catch as much air as possible. In strong winds, their camber would be reduced for high-speed sailing. Each sail consists of a series of jointed ribs inside a flexible skin. Turned by a motor, the ribs can be pivoted to increase or decrease the camber as desired. Each sail is mounted on a turret and can be turned to catch the wind from any quarter. Both sails are also on a turntable that can be swung to the best angle regardless of which way the boat is heading. The combination of motions allows the craft to sail efficiently in any direction—even reverse its course without turning around. The inventor hopes to adapt the idea to variable-camber airplanes that would be able to fly at high speeds but land and take off slowly



Inventors of the items shown on these pages are as follows: 1. Robert D. Landis, Ashtabula, Ohio (No. 3,333,803); 2. Andrew Perri, Roseville, Mich. (No. 3,334,761);





**4. WAVE POWER** runs the ingenious generating system above. A flexible trough supported on floats rides up and down on ocean waves. Water flows into the mouth of the trough and is trapped in

pockets formed by the rippling action. As the waves roll toward shore, the water is propelled up the trough and into a tank. From the tank, it flows by gravity through turbines to generate electricity

**5. MOTORIZED IRONING BOARD** at right is designed to take the drudgery out of your wife's weekly laundry chores. All she has to do is move the iron back and forth as an endless belt feeds the work slowly toward her. The padded surface travels like a conveyor belt around a pair of motor-driven rollers built into the top of the table. The motor is controlled by a foot switch so that the belt can be stopped at any point desired for delicate touch-up work, such as on pleats and shirt collars, thus eliminating the need to let go of the iron



SAILS CATCH WIND FROM PORT SIDE



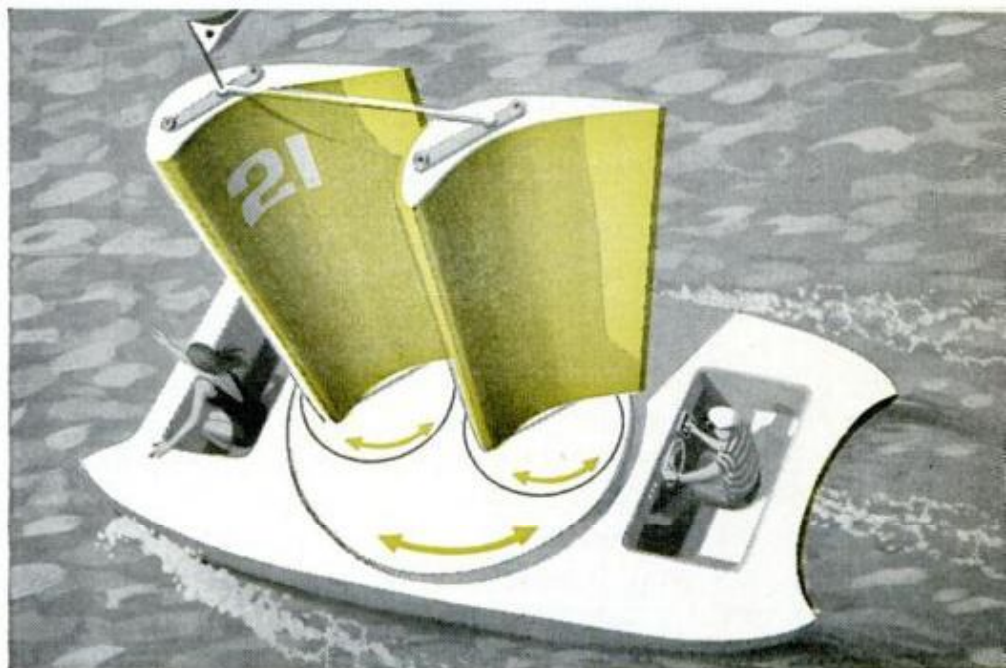
REVERSING CAMBER OF SAILS CATCHES WIND FROM STARBOARD SIDE



REVERSING BOTH DIRECTION AND CAMBER OF SAILS REVERSES BOAT



ROTATING TURNTABLE SETS SAILS CROSSWISE TO CATCH A FOLLOWING WIND



3. Edward Morris Wright, Reseda, Calif. (No. 3,332,383); 4. James Murphy, New York, N.Y. (No. 3,335,667); 5. Airflow Housewares, Ltd., Blackwood, Monmouthshire, England.





# Go-Go-Goer

It twists like a belly dancer, but the Army's new double-jointed monster carries supplies to our troops over water, mud or mountains

**I**N A WAR that fluctuates as much as in Vietnam, and with terrain that varies as much as it does in Vietnam, getting supplies to troops up front can be difficult.

Helping to relieve that problem is a new, swivel-hipped vehicle that the Army calls Goer, mostly because it will go anywhere, on the ground or over water—or even combinations of the two, like mud, which is plentiful in Vietnam during the rainy season.

The Goer, powered by a six-cylinder engine with an impressive 18 to 1 compression ratio, can carry up to eight tons of cargo 30 mph on land, 3 mph on water (by just spinning its wheels), or up a 60-percent grade. Jointed construction allows the forward cab to twist and turn as much as 20° either way on rough terrain, keeping all four wheels on the ground for maximum traction. On smooth terrain, the rear drive can be disconnected and the Goer can move on front-wheel drive.





**TWISTING GOER** climbs incline (left and above). Ability to navigate any terrain makes it valuable in widely varied area like Vietnam, where most movements are made off improved roads in boondocks

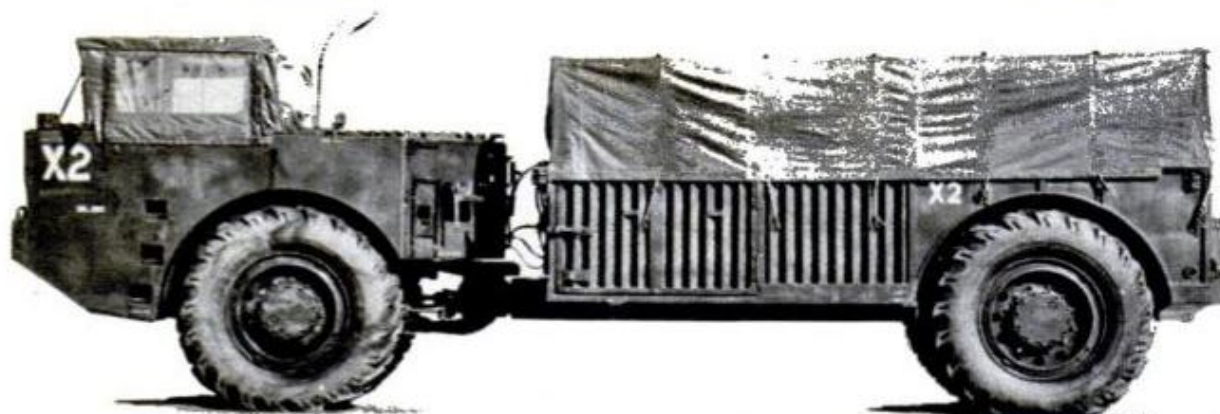
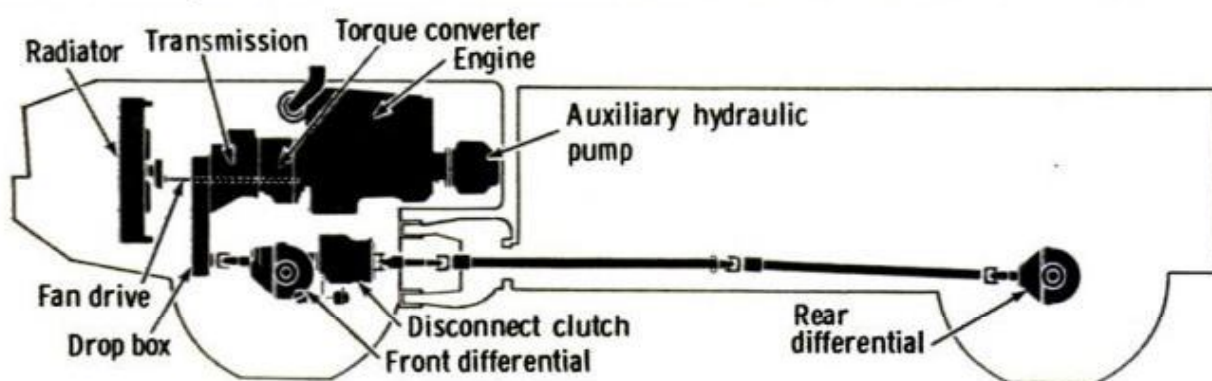
**AMPHIBIOUS GOER** plows into sea of mud. This one is a tanker. Other versions carry various kinds of cargo. One version is a wrecker for hauling stricken vehicles, including other Goers, back to shop







**WRECKER GOER** glides across swollen stream somewhere in Vietnam. Goer gets up to 3 mph on water



**GOER CUTAWAY** shows principal parts of vehicle. Rear wheels, driven through jointed driveshaft, can be disconnected and four-wheel drive becomes two-wheel drive. Tanker (below) slashes through mud





# Science 'Cities' Under the Sea

Here's how man may occupy the Mid-Atlantic Ridge for science, exploration and military use—all within the next ten years

By WALLACE CLOUD

Color Illustration by Ed Valigursky

"WE KNOW MORE about the back side of the moon than about the ocean's bottom," quips a Navy scientist, and you know he's talking about the relative lack of federal money for oceanography, compared to the space effort. In undersea circles, some gripe that there's more to be gained through conquest of the deep frontier here on earth. There's even a move for creation of a new U.S. science agency—a "wet NASA"—to focus public attention, funds and research on the depths.

Best-informed sources consider it unlikely that a wet NASA will be set up, or that ocean science will grow at the expense of space. Both are important. But there's no doubt that deep-sea projects will be increasingly supported and will generate excitement of their own. Within 10 years, for example, it should be possible to assemble a scientific colony thousands of feet below the surface atop the seamounts of the Mid-Atlantic Ridge. A laboratory "city," populated by some hundreds of scientists, would concentrate intensive research on one area of the ocean bottom, in much the same spirit as the coordinated exploration of the Antarctic.

Providing a variety of depths down to about 15,000 feet, the seamounts could be used as platforms for several kinds of undersea bases. Perhaps an area near the Azores would be selected. These islands, poking up from the ridge, would be useful as a staging area convenient to America and Europe.

Oceanographers have been studying

the worldwide mid-ocean ridge system avidly since its discovery in the late 1950s. A major feature of our planet's geography on which man has never set foot, the system forms an immense mountain range (largest on earth) made of rock pushed up from a "crack in the world" along which earthquakes occur continually. Undersea volcanoes, never observed by man, erupt there.

Big companies are already devoting a sizable research effort to development and testing of concepts for ocean-bottom habitats. Much of the material for the accompanying illustrations came from discussions with scientists at General Electric and Westinghouse, two companies with some of the most interesting ideas for undersea stations.

The U.S. Navy would play a major role in setting up such a research base. In an age when nuclear subs cruise submerged for months, undersea warfare experts have many ideas on military use of the sea floor. They're not talking about details, but it's apparent that "taking the high ground" will become crucial, as it is in land warfare. "If we can control the ridges, we can control the oceans," one weapons-oriented scientist told me.

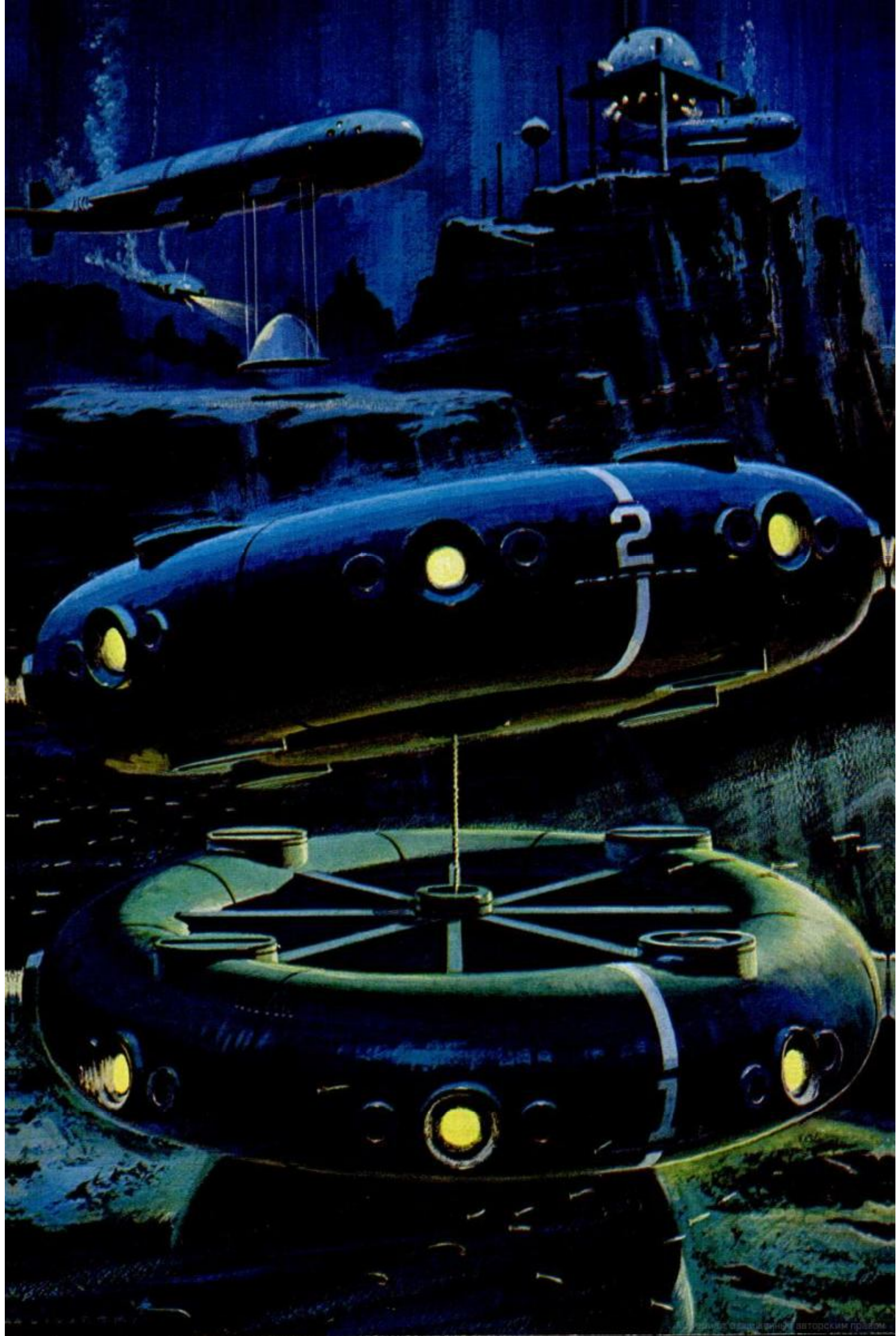
The Navy has awarded several contracts to study designs for undersea

*(Text continues on page 127)*

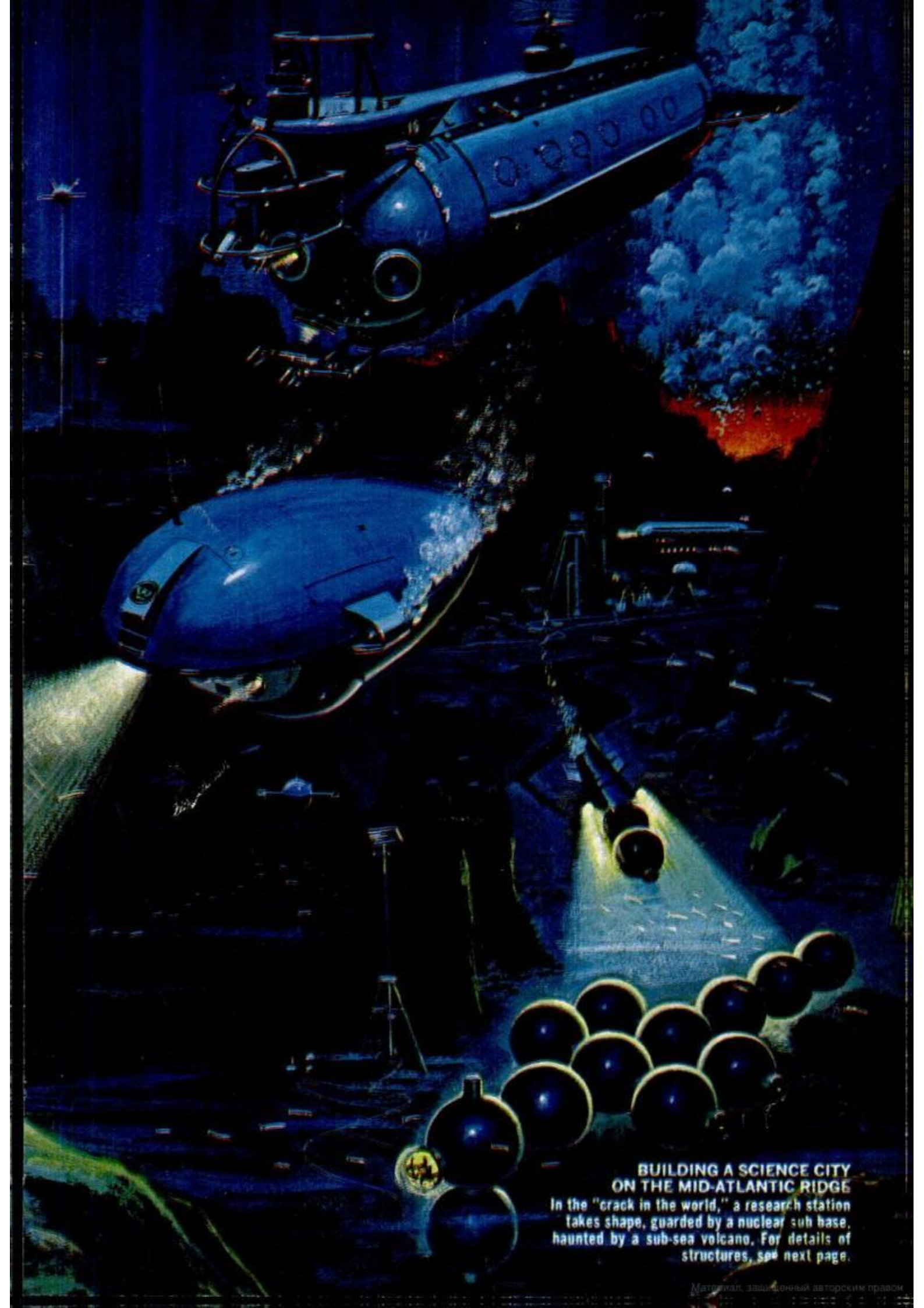
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WHAT WILL AN UNDERSEA SCIENCE CENTER LOOK LIKE? Turn the page for a view, in color, of man-made labs on the Mid-Atlantic Ridge, painted as if our eyes could pierce the gloom of the deep ocean.





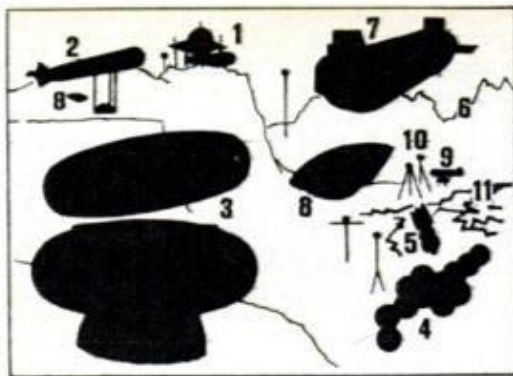




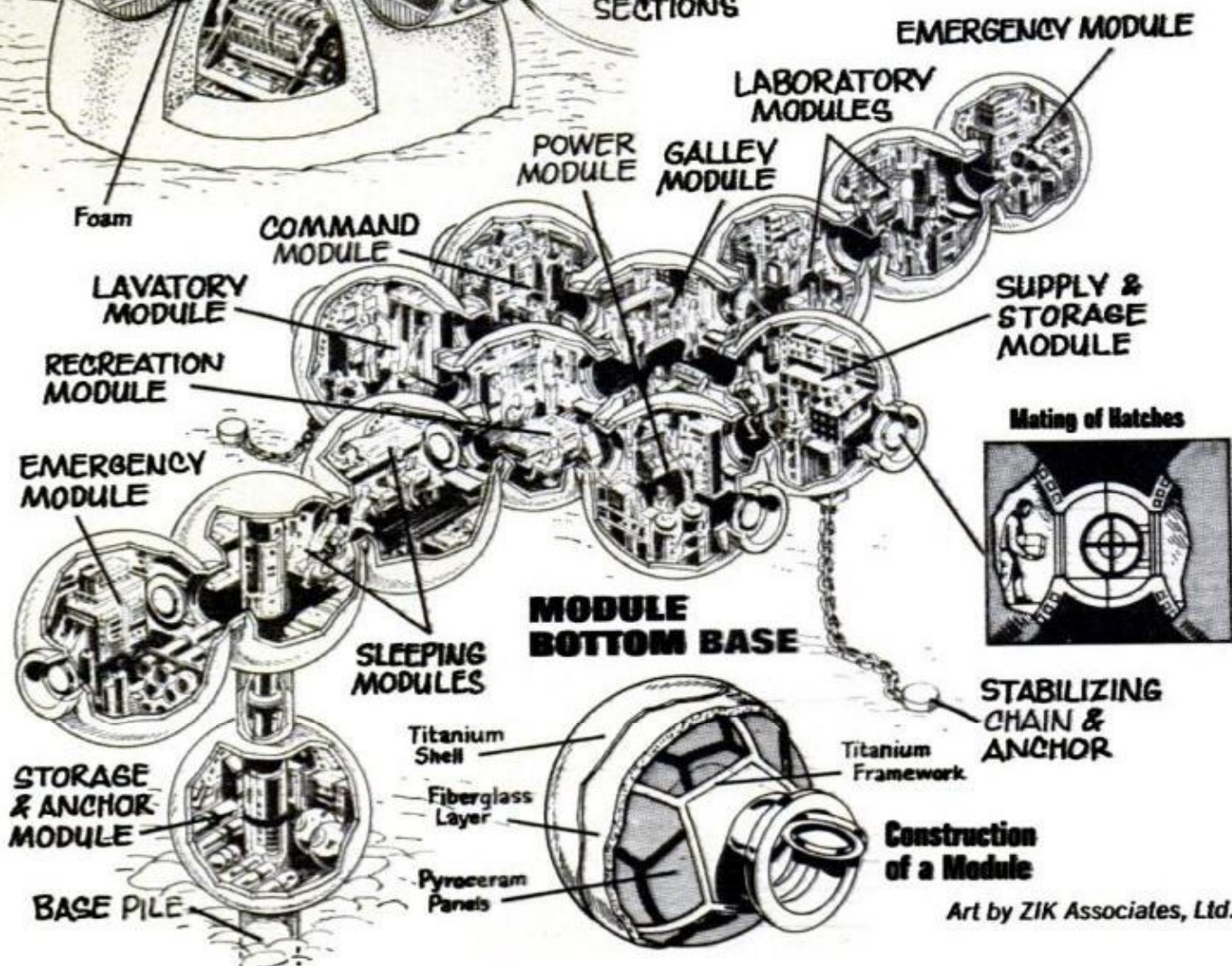
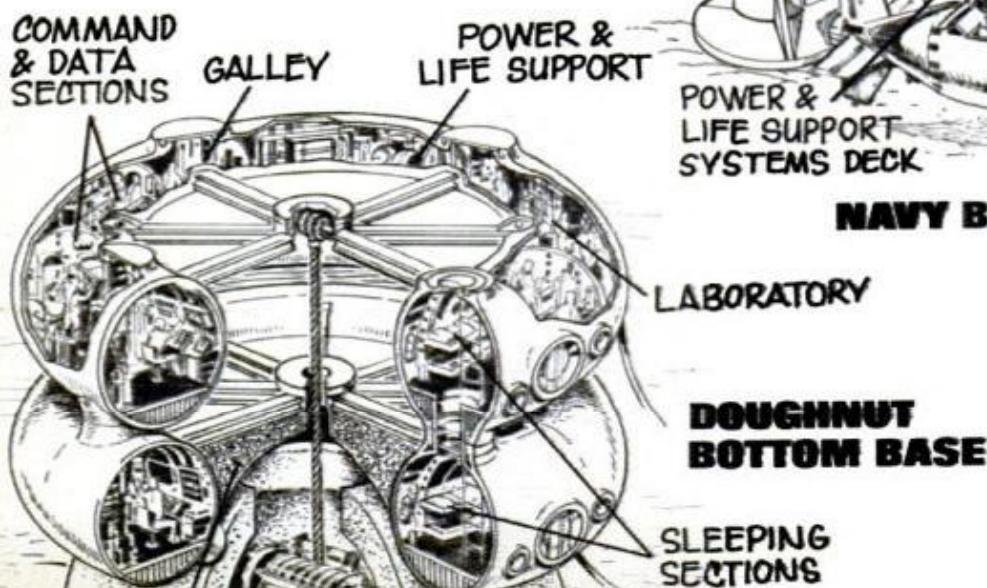
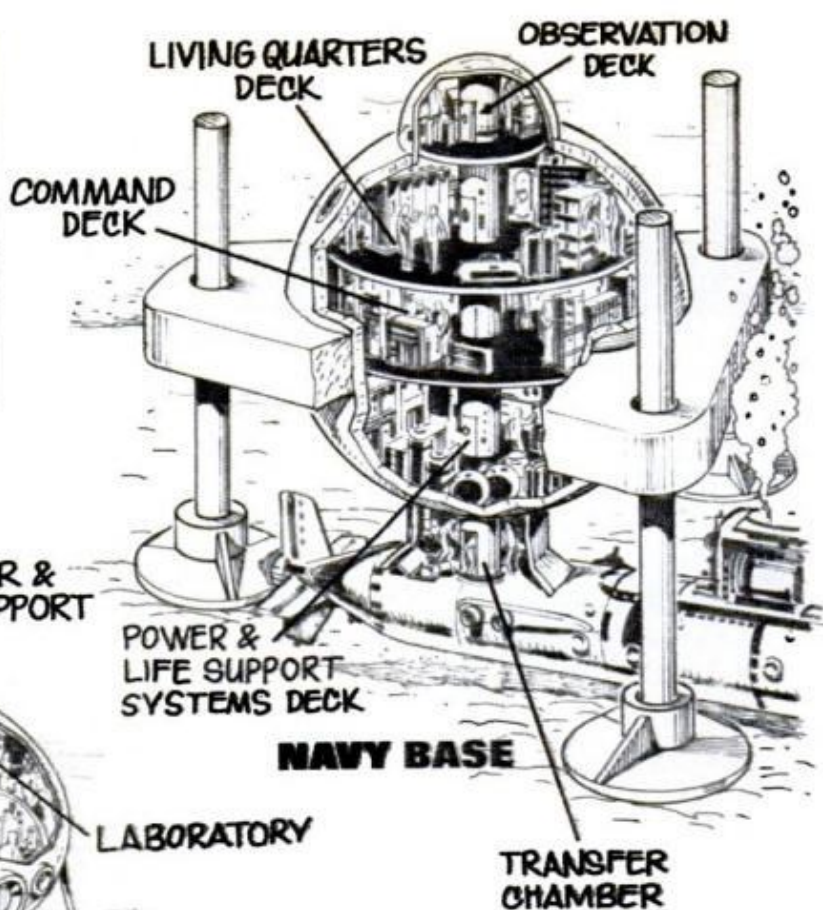
**BUILDING A SCIENCE CITY  
ON THE MID-ATLANTIC RIDGE**

In the "crack in the world," a research station takes shape, guarded by a nuclear sub base, haunted by a sub-sea volcano. For details of structures, see next page.





**KEY to painting on pages 124-125:** 1. Navy base  
2. Cargo sub 3. Doughnut bottom station 4. Module  
bottom station 5. Ferry sub 6. Undersea volcano  
7. Aluminaut 8. Deepstar 9. Excursion vehicle  
10. Data collecting stations 11. Volcanic fissure



Art by ZIK Associates, Ltd.



### Inside Story: Undersea Laboratories

Grouped amid seamounts of Mid-Atlantic Ridge, three approaches to design of bottom stations are shown in color on preceding pages. (See identification key, upper left corner, opposite page.)

Navy engineers are studying spherical design (1) to be made of sturdy, reliable reinforced concrete. Transfer chamber of station would mate with hatch of nuclear submarine, for use as undersea supply base. Concrete sphere would be built ashore, floated to site; buoyant concrete sphere can withstand pressure down to 3000 feet, heavier-than-water sphere to 10,000 feet. Concrete structures may be linked with another Navy concept, "Rocksites," which foresees caves and tunnels dug in seabottom rock using conventional mining techniques.

Doughnut-shaped steel lab for depth of 6000 feet is Westinghouse idea, based on high strength of "toroid" shape relative to enclosed volume. Setting up station is aided by cargo submarine (2) of elongated toroidal shape with open center well. Station (3) consists of stacked toroids on hemispherical concrete anchor which fits hole of doughnut like ball-and-socket joint, enabling station to be leveled. Concrete base is first lowered to bottom, then winch in base pulls doughnuts down by cable. Center of toroid is filled with "syntactic foam" (glass bubbles embedded in plastic) for buoyancy, so lab can float to surface. Hatches allow men aboard to move freely between levels.

At a lower level, in rift valley, is cluster of 12-foot modular spheres (4) designed by General Electric undersea experts for depth of 15,000 feet. After first sphere is anchored by driving central "spike" into ocean bottom, ferry submarine (5) brings down and adds more spheres. G.E. proposes to use sea pressure in mating spheres: Hatch bells are aligned, then hatch of one sphere is opened, allowing water to enter; leakage is shortlived, engineers say, since water pressure on the spheres immediately pushes them together with force of 6 to 7 million pounds. Spheres are buoyant, made of light materials: titanium geodesic framework holding pentagonal panels of Corning's Pyroceram (glass-ceramic), covered by a fiberglass layer and flame-sprayed titanium skin (mainly for protection in surface handling); hatch bells and observation bubbles are inserted where needed, fitting the pentagonal openings in geodesic structure.

One function of mid-ocean ridge science center would be to observe active undersea volcanoes, like that depicted in background (6). In the valley, instruments are being readied for placement around the volcano.

A variety of work-and-observation submarines will be employed in construction and operation of undersea "city," since divers cannot survive at such great depths. Those depicted (7) are Reynolds *Aluminaut* (top), capable of diving to 15,000 feet and (8) a Westinghouse *Deepstar* vehicle, like sub now being designed for depth of 20,000 feet.

stations rated at a depth of 6000 feet. Perhaps such stations will be used as submarine bases (U.S. nuclear subs already cruise at 2000 feet, according to best-educated guesses), communication centers, missile sites, submarine-detection stations. Development of undersea-warfare techniques is often helped by Navy-supported programs of nonmilitary research. Thus, the Navy might provide support facilities for an undersea science colony while carrying on some classified research there.

When will actual construction of deep-ocean stations be possible? "There's no money for that until the Vietnam thing is over," said Dr. John P. Craven, director of the Navy's Deep Submergence Systems Project. Cost of one such installation is \$10 to \$30 million. He also emphasized the problem of finding better deep-sea materials.

The Navy's own engineers tend to think in terms of tried-and-true construction techniques for bottom installations: reinforced concrete and the use of conventional mining methods to dig tunnels and caverns in the sea floor. Westinghouse and General Dynamics have designed bottom stations of high-strength steel, akin to present-day submarines. G.E., however, looks to future materials still hard to work with—exotic glasses and titanium—to make possible a station that can be planted at 15,000 feet.

Current undersea-living experiments, such as the Navy's Sealab project, are still reaching downward to the 600-foot level. Before men can live on the mid-ocean ridge, they need more reliable systems for deep-sea navigation, communication, power supply, rescue, and surface support.

At such depths, scientists, though they explore submerged mountain ranges, must remain locked within their protective shells of steel or glass, traveling only by submarine or bottom crawler. Dependent on instruments for much of their perception, enabled by powerful lamps to see, they may well feel forever alien. ★ ★ ★



EXPLORATION

# ACROSS THE TOP OF RUSSIA



**ICEBREAKER NORTHWIND** cruises through polar pack north of Russia. She penetrated farther into Soviet waters than any American surface vessel had ever gone before







**CAPT. AYERS**, commander of Coast Guard icebreaker

*IN THE SUMMER* of 1965, the U.S. Coast Guard icebreaker, *Northwind*, sailed on an oceanographic mission to polar seas that had never before been visited by a U.S. scientific expedition. Part of the mission was to study currents, water temperatures and densities, plant and animal life, and geology of the ocean floor.

At a time when relations between the Soviet Union and the United States were strained over South Vietnam, *Northwind* was under orders to make the Northeast Passage across the top of Russia and Siberia, a route "off limits" to non-Russian ships since the Communist Revolution.

Here are excerpts from the dramatic story, based on firsthand observation of the only newsman aboard, of one of the most exciting and significant Arctic voyages in modern times. It makes public for the first time the full story of the constant harassment *Northwind* encountered from Soviet air and naval units in international waters, and it details the eventual capitulation of the U.S. State Department to Soviet protests after *Northwind* had placed herself in position for a dash to the Pacific.

**S**HORTLY AFTER we crossed the Arctic Circle off the coast of Norway, a strange gray vessel circled *Northwind* all day as we rode the growing swells of the North Atlantic. The stranger flew no flag, but her identity was not in doubt. On her bridge her name was spelled out: EHOLOT. From a

**A lonely U.S. Coast Guard icebreaker attempts the Northeast Passage across the top of Russia and Siberia, but is harassed by Soviet ships and planes, then ordered back in a diplomatic surrender.**

By **RICHARD PETROW**

*Condensed from the exciting, new book, Across the Top of Russia, by Richard Petrow, \$6.95, David McKay Co., Inc., 1967.*

distance *Eholot* could have been mistaken for a trawler, but close-up she showed her true character. No trawler would have needed the spider's web of wires that hung between her masts; no fishing captain would have dared come as close to *Northwind* as did the master of *Eholot*.

On our bridge, Capt. Kingdrel N. Ayers asked Lt. Robert Wells: "What do you make of her?"

"U.S.S.R. AGI-type vessel," Wells answered. "Should be flying the Soviet naval auxiliary ensign." For the record, the log showed that the first Russian contact had been made at "posn 69-30 north, 15-45 east, 12 miles from the Norwegian coastal island of Andoy."

"We were expecting him," Capt. Ayers remarked. "Only we weren't expecting him this soon. We'll probably have a Russian escort from now on."

As *Northwind* moved through the Barents Sea some 190 miles west of Novaya Zemlya, we had our second encounter. One minute there was nothing but an overcast sky and a dull gray sea. The next moment a twin-jet, swept-wing Badger bomber cleared the lowest flying clouds and was sweeping down on us. The pilot cleared our jackstaff at 100 feet and screamed on past



our stern, rocking the ship with sound the way a fast-moving diesel train rocks houses along the right of way.

The bridge filled with men.

"Target outbound. Fifteen miles," Radar reported from the Combat Information Central. "He'll be back," Wells said.

Radar gave quick confirmation. "Target closing," it blared, a hint of unmilitary excitement in the voice. There was a stampede for the port wing.

It appeared first as a dot, slightly darker than the surrounding clouds. Even as we looked the dot sprouted wings. There was no stopping it. It raced ever closer, lower than any plane should fly, its size increasing by the millisecond. The cockpit came into view. And then it pounced upon us for a roaring instant; flashing silver, flying death.

"Good pilot," Wells commented admiringly. "Couldn't get a damn thing but his belly."

On the Badger's next pass we spotted the red star painted on his tail assembly. On the next, we got his number: 94. Then he was gone.

"That fellow has been converted to photographic recon," Wells said. "His camera openings were clearly visible."

The Russians sent No. 44 on a follow-



**RUSSIAN DESTROYER 020** was the first, and most up visit about two hours later. He, too, made two passes.

"There goes Ivan," Ens. Starnes remarked.

By now *Northwind* had been subjected to six overflights, all at a dangerously low altitude, much lower than a mere photographic surveillance mission would necessitate. There's a saying among the military, "One pass, two

**RUSSIAN VESSEL EHOLOT** was first to pick up the *Northwind* tracking it in international waters off Norway







communicative, of warships to "escort" icebreaker pass, three passes and you're harassing."

I asked Capt. Ayers, "Is this the start of a program of harassment?"

He reacted with a noncommittal shrug. "Some people might say so, but what did they really do? Just came over for a look. I won't start worrying until I see their bomb doors opening."

Just then the pilothouse intercom

crackled into life. It was Radar reporting a third contact, inbound at high speed.

This one was No. 88, and he made three low-level overflights, then banked into a sharp climbing turn to come diving at us a fourth time from directly astern.

The high shrill whine of his engines was still ringing in our ears when the lookout on the flying bridge shouted:

"Flares."

They fluttered down 300 yards in front of *Northwind's* bow, first a set of double green flares, then a set of double white, and a third set of double white.

"What's he saying?" Ayers demanded.

Chief Quartermaster Bob Hillis grabbed for his code book, riffling the pages madly for the answer. Nothing.

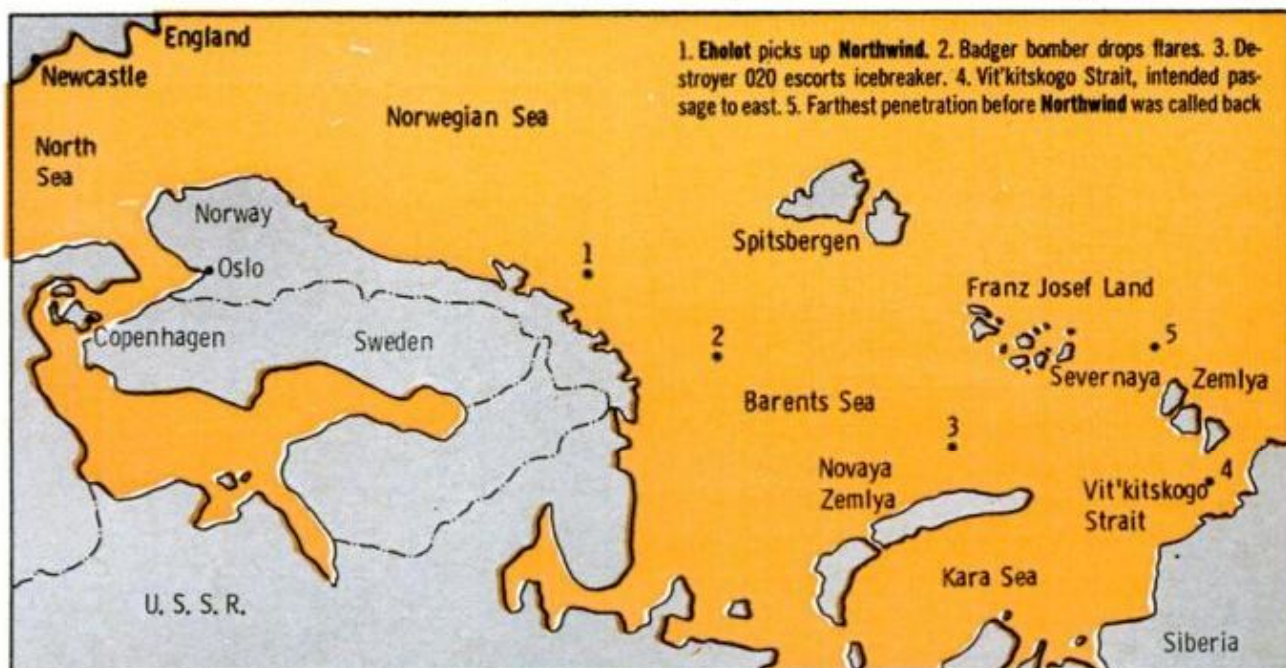
A double green-white-white signal did not exist in aircraft-to-ship communications. Senior Pilot Tom Finnegan checked the quartermaster's reading.

"I'll get my code book," Finnegan whispered. "I think I remember it."

From the look on his face, what he thought he remembered was not pleasant.

Finnegan dashed to the boat deck and aft to the helicopter hangar where

**MAP SHOWS** encounters with Russian ships and planes and points where Northeast Passage was attempted







**RUSSIAN CREW** stares at the American icebreaker during its "escort" run, sometimes from as little as 75 yards away

his code book was stored in the cockpit.

He was back, panting.

"The Russian pilot was talking in code—aircraft-to-aircraft," he said.

"What did he say?" Ayers demanded.

"Green-white-white means 'Attention. You are a violator,'" Finnegan replied.

By the time we knew his message, the flares had long since spluttered out in the waters of the Barents Sea. Badger No. 88 was long gone. There was nothing ahead to meet the worried stares of the men on the bridge but a moderate northwesterly sea and an evening sky. A young ensign moved uncertainly toward Capt. Ayers. "Do you have any orders?"

"What's your course?"

"062 true, Sir."

"Well, stay on it until I tell you differently." The ensign retreated.

Ayers radioed a message to Coast Guard headquarters in New York, knowing the Russians would monitor it, in which he pretended he had not understood the signals. The Russian pilot had used the wrong flare code. As far as Ayers and everyone else were personally concerned, however, we all realized that *Northwind* had been challenged to stay out of the waters near Novaya Zemlya, and the challenge had been ignored.

We continued to the Barents Sea. Most of the ship was still asleep when Radar flashed the button to announce, "Surface vessel approaching."

The contact was 14 miles astern and overtaking rapidly. She was making better than 20 knots and she could be only one thing: a Russian man of war.

She was a Russian destroyer, and a magnificent vessel. Battleship gray. Sharp rakish prow. Lean lines. Red star high on bow, and on her side, her identifying numerals: 020.

She was awesome in her approach. White foam splashed from her prow as she sliced through the water in a way *Northwind* could never do, leaning over at a jaunty angle as she turned to run parallel with us.

The log entry for 0610 hours reads: "Russian destroyer 020 close aboard starboard beam. Range 75 yards."

"What's he trying to do," Starnes exploded. "Scrape our paint?"

The whole ship was awake by now. The men lined the rail silently. This was no *Eholot* to hoot at and jeer. On deck, the men had to tilt their heads upward—so close was the Russian—to catch a glimpse of the Russian officers

*(Please turn to page 194)*

**NORTHWIND HELICOPTERS** flew daily ice patrols







## They do it for fun

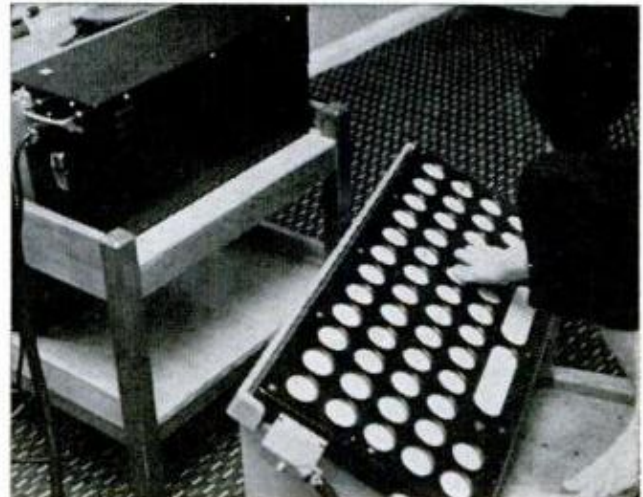
A prize frequently given in off-trail scooter racing is a new scooter. Small wonder. From the look of things, all competitors would need new bikes at the end of a race. These photos of the rugged sport were taken recently near Fallbrook, Calif. At upper left, a machine leaps off a jump; center, a horde of machines roar down a dusty river bottom; right, a rider on a steep slope just hangs on and hopes; and, directly at left, a rider bites the dust.



## Skippers learn from models

Germany's future sea captains learn how to maneuver big ships by operating little ones in a miniature ocean. The neophyte skippers control the models by radio, guiding them through artificial currents in the water and bringing them into a small harbor. The training school is in Bremen, West Germany.

FEBRUARY 1968



## Touch system—for toes

A giant keyboard linked to an electric typewriter enables spastic children to type with either hands or feet. In some cases—when a child has been unable to speak—the new Danish keyboard has enabled the youngsters to express their thoughts for the first time. The machine is in use at an English school.

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# The Coldest 13 Miles On Wheels

BY JAMES R. BERRY



**When the temperature's 40 below and visibility is zero, you learn a lot about winter driving**

**H**IS ASSIGNMENT: Bus three daily shifts of radar technicians and maintenance crews 13 miles over the bleak wastes of Greenland, from Thule Air Force Base to the Ballistic Missile Early Warning System (BMEWS) site, 600 miles north of the Arctic circle.

His problem: Searing cold that stiffens tires so they won't flex, renders sheet metal so brittle that fenders split off and thickens grease so wheel bearings will hardly turn. Add six months of darkness that drains batteries and taxes generators. Then, throw in the storms . . .

"I was ready for the cold. The snowfall, about three feet a blizzard, was less than I expected. But, God, your

worst dreams wouldn't equal what the storms are like. In 15 minutes I've seen a clear, frosty night turned into a howling maelstrom with 125-mile-an-hour winds hurling snow and ice crystals horizontally," says Max Gullette, a broad-grinning, 60-year-old man who is among the world's foremost experts on arctic driving. For the last eight years Gullette has headed transportation to and from the BMEWS radar site, almost single-handedly forging it into an operation that keeps running in all but the worst of storms.

In a climate where temperatures drop to 40° F. below zero—and stay there for months at a time—it takes a lot of improvising to keep the buses





rolling. When Gullette arrived in 1958, the year the site began operating, gasoline engines stalled constantly because of carburetor ice-up.

"Besides the cold we had the law of expanding gases working against us," states Gullette. "As gas mixes with air in the intake manifold it expands and cools, helping icing." After months of exasperation Gullette hit on a simple remedy. He ran a hose from the engine's radiator under each vehicle's carburetor. "In any other climate the heat would cause gas percolation. Up here it only stopped ice from forming.

Diesel buses, which eventually replaced those with gasoline engines, stalled too. Their problem: Snow blew

**MAX GULLETTE**, who has spent the last eight years battling Greenland's storms, enjoys a sunny lull

into the relatively unprotected rear engines and strangled air filters. After weeks of cleaning the filters daily, Gullette figured out an answer. With a length of hose he ran the air-intake manifold to the vehicle's *inside*, where blowing snow isn't a problem!

While mechanical problems are worrisome, Gullette's principal enemy is the storms. "We usually know when a storm is coming. But not how bad it will become or how long it will last," he explains. Because of their unpredictability, such storms can scramble the most carefully laid routine.

On one occasion, Gullette headed a convoy out of Thule in a blizzard—normal for the area, but one that would knock out a city like Chicago or New York. Officially the storm was classified as a phase one—visibility about 50 feet and 30 to 40-mph winds that actually blew the road clear of snow before drifts built up. When the 12-bus convoy—carrying some 200 radar technicians—was three miles out the storm suddenly worsened. Winds reaching 60 and 70 mph buffeted the vehicles. Lashing snow cut visibility to 30 feet or less. Small drifts began to collect at the road's curves. Convoy speed dropped to 10 mph. The trip, now bucking a phase-two storm, was tough but still routine.

Then trouble began. First, the driver of an Air Force staff car at the convoy's rear radioed (all vehicles are equipped with two-way radios) that his windshield wipers had caked up and stuck. Gullette halted the convoy long enough for the car's passengers to grope their way into the last bus.

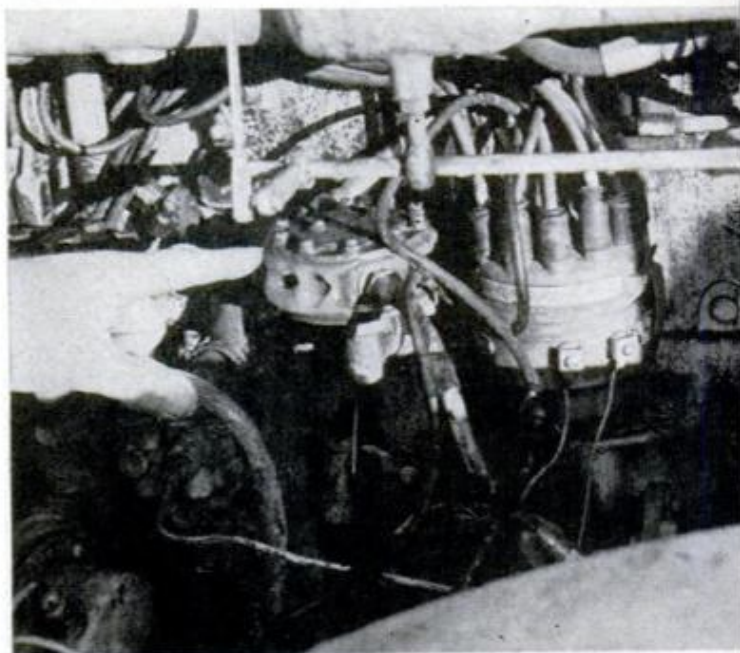
Next, a mile farther on, the last bus skidded into a snowdrift and became stuck. Again the string of buses halted until passengers from the trapped vehicle fought their way to the one ahead. "These two stops used up about a half hour, just enough time to let that storm get a good start on us," recalls Gullette.

Finally, about six miles from the BMEWS site, came the most fright-





**THULE'S SCREAMING WINDS** blow snow into anything not hermetically sealed—like this bus, stranded by a storm. Carburetor ice-up (below) has choked off air intake on a stalled snowplow. To prevent ice-up on the other vehicles, Gullette ran a hot-water hose under the carburetor from the radiator



ening message of all. The convoy's tail bus was lost. If its motor stalled in the 30°-below-zero cold the passengers could freeze to death. Once again Gullette stopped the convoy and, on foot, battled his way through savagely lashing snow and 80-mph gusts.

A quarter of a mile back he stumbled across the lost vehicle, its nose in a snowbank. By this time the blizzard was so dense that the bus's lights glared off the snow as though reflected from a mirror, reducing visibility to one or two feet. Somehow, Gullette got the vehicle on the road. Then, picking out the route on foot, he led the bus with a flashlight. For two hours he battled the raging winds and snow, guiding the giant vehicle with a narrow tether of light until they rejoined the convoy.

Back at his own truck, Gullette found yet more trouble. His engine, set at too low an idle, hadn't generated enough heat to prevent carburetor ice-up. In his truck he could almost feel out the roadbed, guiding the convoy by his headlights. Without it . . .

Gullette again climbed into the storm, flashlight in hand, and walked the convoy up the road. Five hours

later, thirteen hours after starting out—more than six miles on foot—Gullette trudged into the BMEWS site, the buses lumbering behind him.

Such harrowing trips are rare, but only because of a battle plan Gullette evolved to combat the weather. At the first hint of a storm, a phase-one alert is declared. All transportation vehicles, which are located in a huge garage, are immediately checked for fuel, anti-freeze, battery water, belt wear and anything else that might snap, break, leak, or fail. A substandard bus is sidelined until repaired.

When the storm hits, Gullette takes its pulse by scouting the road in his truck shortly before loading time. If it appears passable, and promises to remain that way, the loaded buses creep out of the garage, preceded by plows if necessary. Otherwise, they wait.

In deciding to make the trip or not, Gullette relies on a sixth sense as much as official forecasts. Once, 15 minutes before shift changes, a light windstorm hit the base. Radio reports from the radar site revealed an even milder wind there. "That was the strange thing," Gullette recalls. "Somehow it was too



## WHAT TO DO WHEN IT GETS REAL COLD

After eight years of caring for 100 vehicles at Thule, there's little Max Gullette doesn't know about cold-weather car care. Here are a few of his tips that may help you this winter:

- "In zero weather drive no faster than 10 mph for the first half mile. Oils and greases thicken in cold weather. Splash and drip lubrication in transmission and differential is cut to nearly nothing, and grease in universal joints and wheel bearings won't slide over abrasives. Slow speed will reduce damage until lubricants thin out. Garage your car where it's 20°F. or warmer.
- "In Thule we used 30-weight oil, even though temperatures dropped to 40° below zero. Light-weight and multiple-weight oils thin out under hard use and don't keep up maximum oil pressure. Garage car or keep oil warm with a heater coil in the dipstick hole for quick starts. If you use a thin oil in a car for short-haul jobs—such as for shopping or work—change it every two or three weeks. Short-haul driving, especially in winter, builds up sludge and condensation. That stuff will kill an engine.
- "During long periods of zero weather, set your engine on a high idle. This will keep engine warm and prevent condensation in oil. It will also keep your battery well charged.

- "Check your battery twice as frequently in winter as summer. Battery water evaporates faster in cold, dry air and battery efficiency drops.
- "Even a good heater can't always prevent windshield condensation until engine is really warm. Meanwhile, you drive 10 miles trying to see through a foggy window. We avoid this problem at Thule with a frost shield—a sheet of clear plastic on a rubber rim which is pasted next to the window. Air space between plastic and glass stops condensation.
- "Pour some additive in the gas tank to prevent condensed water from freezing gas lines.
- "Avoid setting parking brakes in freezing weather. Moisture can freeze the brake to the wheel drum or clog the release spring. A frozen brake will score the drum and can damage the brake cylinder.
- "Cold weather often cracks plastic insulation on wires. Wheels throw up ice and sludge that freezes on underfender wires. You can get 10 or 15 pounds of ice hanging onto that insulation. Check it frequently to make sure it's intact."

damn calm for what a beginning storm should be like and I decided to have a look."

Four miles from base he ran into a howling blizzard that almost certainly foreshadowed a phase-three condition—the worst kind of storm. Immediately he called off the run. Just 20 minutes later the storm engulfed the base and

**SUDDEN STORMS** at Thule can erode visibility in minutes. Here Gullette leads a truck back to its base



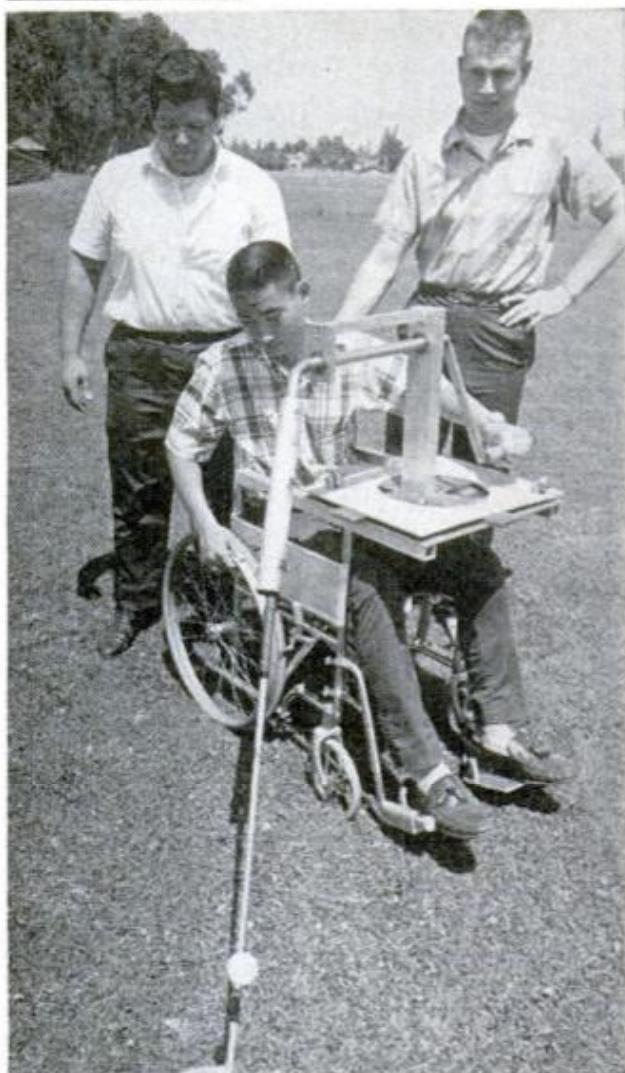
BMEWS site. The convoy would have been caught en route. It was 32 hours before buses could move.

When buses do roll it's in a tightly knit formation devised by Gullette. A light pickup, traveling on the road's left side, heads the column and picks out the route in poor visibility. The buses, staggered on each side of the road, follow 30 feet behind each other in good weather, closer in bad. In an emergency, such a formation allows the buses to close up two abreast, shortening the convoy's length to its minimum. Equally important, each bus has the road partly lit by the vehicle ahead.

Thanks to Gullette's precautions, there have been no accidents or injuries. But occasionally the weather has outsmarted him. Once, Gullette was leading a convoy in a phase-two blizzard toward the radar site when the storm suddenly turned into a phase-three maelstrom. One hundred twenty-mph winds whipped against the buses; drifts began to pile up. Convoy speed dropped to a dangerous one or two miles an hour. If it halted for even a few minutes the swirling drifts would

*(Please turn to page 219)*





### **Wheelchair golf**

Handicapped people confined to wheelchairs may be able to add golf to their activities if a prototype club-swinging apparatus becomes available. The gadget was built by Stanford University design-workshop students.



### **Greenhouse Ferris wheel**

Plants are rotated into sunlight every five minutes by a hothouse rotor installed in a Lausanne, Switzerland, greenhouse. Use of the rotor saves space; it holds four times as many plants as a conventional table.



### **Hot and cold running water**

Water pumped through small tubes in a new space suit keeps the wearer warm—or cool. The suit was developed by Britain's Royal Aircraft Establishment for use by U.S. astronauts.



### **Homemade sub**

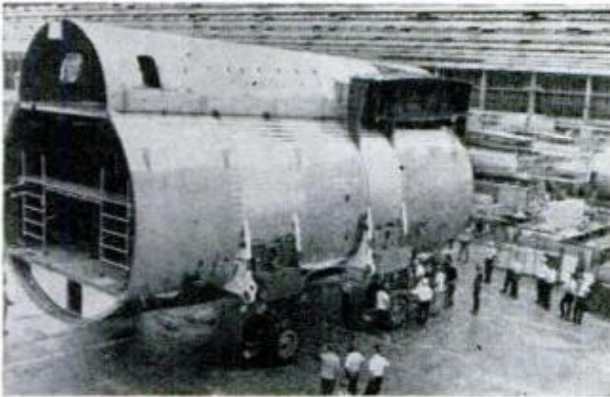
A Briton's one-man, homemade submarine sails with its portholes just below water level and its conning tower protruding above the surface. The builder, Douglas Price of Bishops Sutton, says it has a range of 5000 miles.





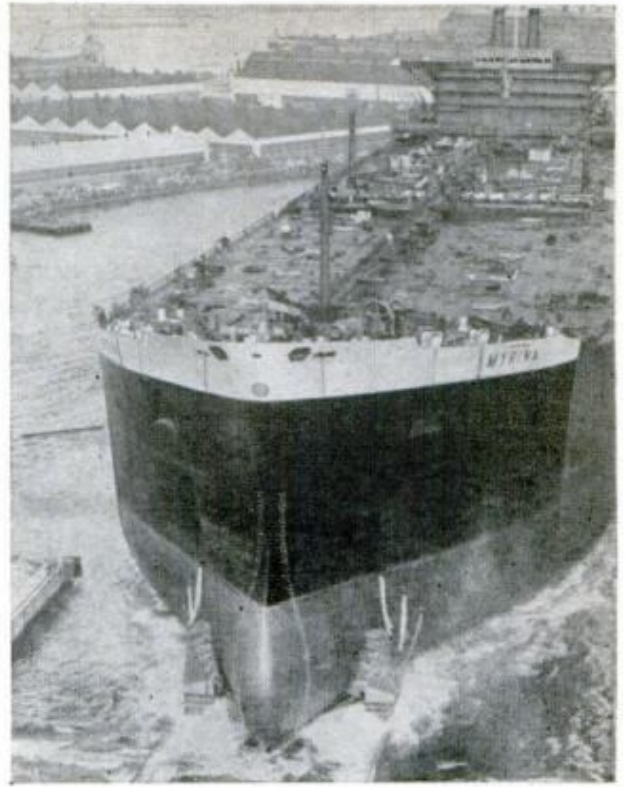
## 100 million years old

Preserved in a lump of amber, two worker ants called *Sphecomyrma freyi*—40 million years older than any previously known ant—were recently found in New Jersey. Each wasp-like ant, slightly less than a quarter-inch long, has a stinger at the rear of its body.



## Big part of world's biggest

A mid-fuselage section for the Air Force's C-5A Galaxy plane stands nearly 30 feet high and over 26 feet wide. The section will be part of the 262-foot-long fuselage of the Galaxy, largest aircraft in the world.



## New European giants

The largest ship ever built in Britain, the 200,000-ton *Myrina* (top) slides down the ways, while the largest tanker ever constructed in France, the 210,000-ton *Magdala* awaits fitting out (below). Both were built for Shell.



## Minnesotan builds air-cushion vehicle for crop dusting

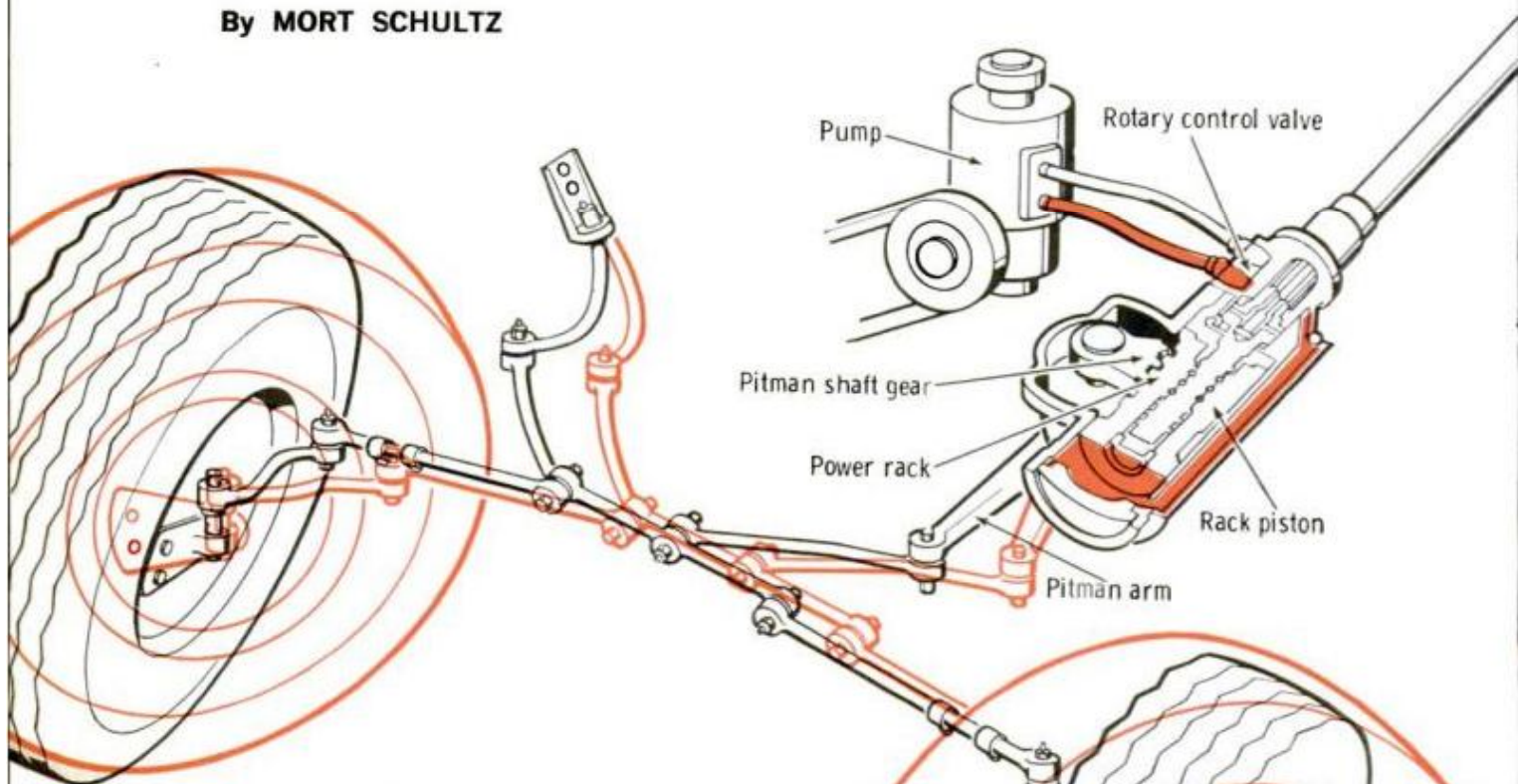
Tom Gunderson of Twin Valley, Minn., sprays crops from the air—but his altitude can be measured with a ruler. Gunderson designed and built his own air-cushion vehicle to carry a 30-gallon tank of chemical spray. With a 16-foot spray boom on either side of the vehicle, he can float across any grain or plant crops at a speed of 15 mph. The craft is made in three sections, hinged together, so it can be folded for long-distance hauling. Powering it are two 10-hp engines driving lift fans and a 12-hp engine for the pusher prop.



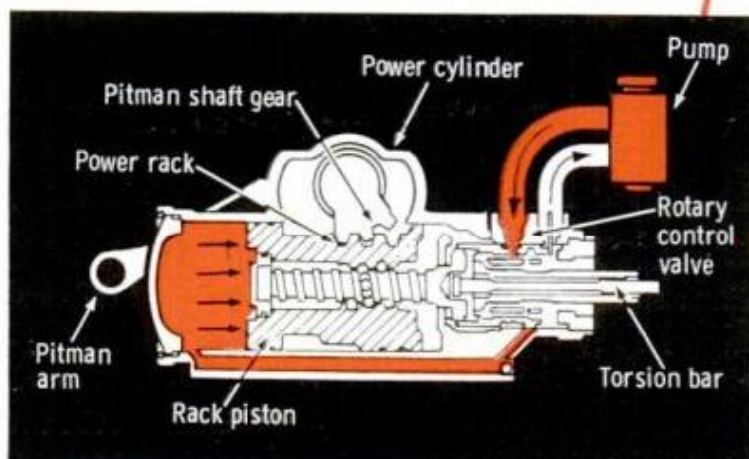
# How to Troubleshoot POWER STEERING

**With a steer in the right direction, you can shake down the source of any problem, be it belt trouble, a fluid leak or a control valve or pump malfunction**

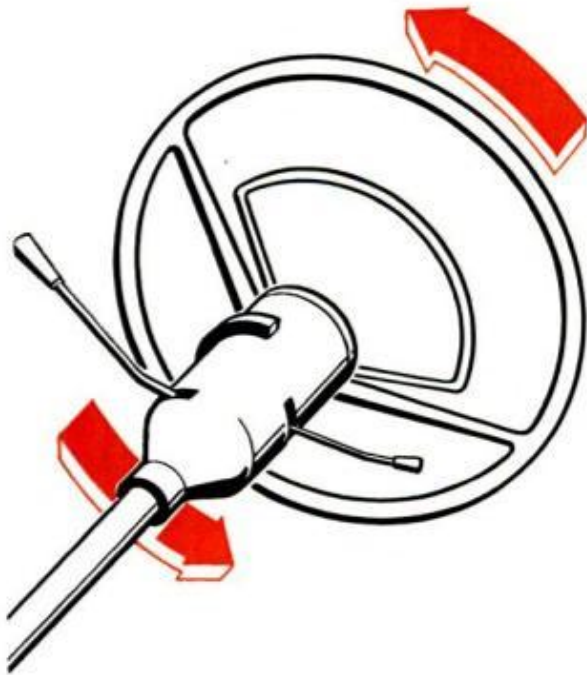
By MORT SCHULTZ



**CONTROL VALVE** in integral power-steering system moves with steering wheel and controls fluid flow to right or left side of the rack piston. Pressure on piston assists in turning the pitman arm via gear







**I**T'S OBVIOUS you've got trouble in your power-steering system when all of a sudden it takes all your muscle to get your car around a turn. It's also obvious that noise, shimmy or binding when you turn the steering wheel, or steering that becomes harder in degrees, are trouble signs that shouldn't be disregarded.

When it comes to troubleshooting, you'll be happy to know that isolating the problem is as easy as recognizing that you've got one. But before proving it, let's clear up a matter of hardware.

You'll find one of two types of power-steering setups in your car. Each maker uses his own pet name, so we'll call them *linkage type* and *integral type*.

Basically, both are much the same, having a combination pump-fluid reservoir, control valve and hydraulic lines as major components. The linkage type, however, has an *external* power piston to do the heavy work. The integral system has the rack piston *inside* the steering-gear housing.

For a quick way to determine which type you have, look beneath your car. If you don't see a bulky, shock absorber-like power cylinder hooked to the steering linkage, you have an integral type. Another way to tell is to look at the reservoir-pump. If you see two lines that tie pump and steering gear together, it's an integral type. The one going to the top of the gear into the control valve is the feed line. The other is a return.

Most cars now use the integral type, but there are exceptions. For instance, T-Bird has been integral since 1961 and Ford since 1965. But Falcon, Fairlane and Mustang still use the linkage setup.

If you decide to troubleshoot power steering yourself, you will have to spend a few dollars. Two tools you can't do without are a belt-tension gauge, which costs around \$9, and a power-steering pressure gauge, which runs close to \$15. They may be a little tough getting off the shelf. If an auto-supply parts dealer doesn't stock them, he can get them on special order.

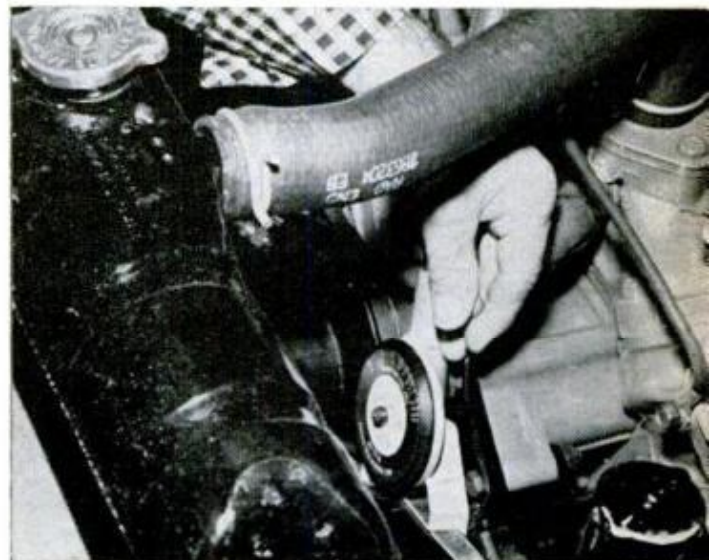
If you decide to let a mechanic troubleshoot your power steering, here's some good advice. Make sure he is aware of your knowledge of the problem and that he doesn't start by ripping out the plumbing. He should follow the sequence described here, or you could be smacked with a repair bill that will send shock waves through your budget.

You start troubleshooting by checking the drive belt on the power-steering pump and the reservoir fluid level. Improper belt tension and low fluid level cause more problems than all other failures combined.

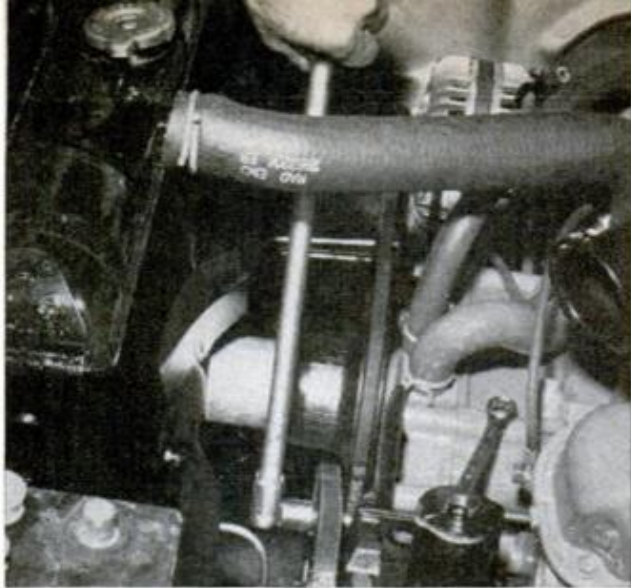
You can get an accurate belt adjustment only by using a belt-tension gauge. The old-fashioned thumb-and-finger method of judging tension is grossly inaccurate.

A loose belt will slip and result in a lack of power assist, intermittent off-on assist and noise. A glazed belt also leads to slipping, so examine yours and replace it if it's damaged. And if noise is coming from around the reservoir pump, don't jump to the conclusion that the pump is bad. It

**BELT-TENSION GAUGE** is spring-loaded. Clip it to drive belt and plunge it down; dial records tension







**PUMP BRACKET** on this car has slot for inserting socket extension to tighten the drive-belt tension

may be a slipping belt or trouble in some other belt-driven unit.

To isolate the problem, adjust the drive-belt tension using the gauge. If noise prevails, pour some water on the belt. If the noise stops or changes pitch, you can be sure you have belt or pulley noise rather than internal pump noise.

Even if the water treatment doesn't affect the noise, you can't be sure it's the pump. To find out, loosen the belt and run the engine. If there's no noise, you've traced the problem to the pump. It's damaged internally and should be replaced. Should noise continue when the power-steering pump isn't being driven, you'd better have a close look at the alternator and water pump.

Belt tension must be adjusted to specification, which differs from engine to engine. Tension for some, such as Fords, runs as high as 90 to 120 pounds. Others, such as on some Plymouths, run as low as 45 to 55 pounds. Also, tension specs for new and old belts are different. Check the tightening specs for your engine.

When tightening a belt, keep away from the pump reservoir. If you pry against it, you'll crush it or bust a seam, causing a fluid leak. Some cars, such as those in the Chrysler lineup, have a slot in the pump bracket into which you can fit a socket extension for tightening. If your car doesn't have one, use a pry bar against the bracket itself for leverage.

Now, check the fluid level. If low, it too can cause lack of assist, alternate off-on assist, or noise.

Some cars have a dipstick built into the reservoir cap. When this is the case, the oil level should be checked only after the



**FLUID RESERVOIR CAP** may not have dipstick attached. If it hasn't, fluid level is checked visually

car has been driven and the pump has reached operating temperature.

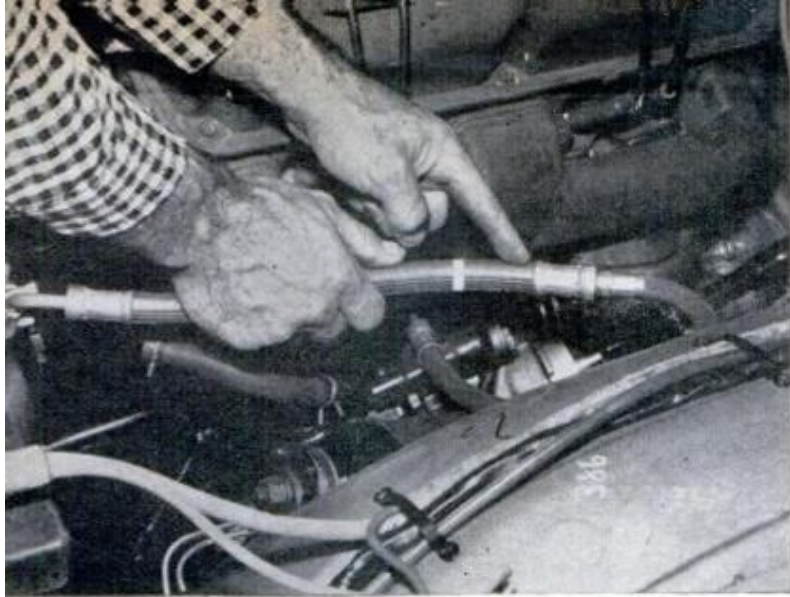
Fluid level in cars without a reservoir dipstick can be checked by starting the engine and turning the steering wheel back and forth two or three times. Then wipe the area around the cap clean and remove the cap. If the engine's cold, correct oil level is at the bottom of the filler neck. If it's warm, the oil level should be halfway up the filler neck.

If you experience a constant loss of fluid, it's certain that you have a leak. To check for an external leak, first clean dirt, oil and grease from your hoses and pump. Run the engine at idle speed, turn the steering wheel all the way to the right stop and then to the left stop, but don't hold the wheel against stops for more than five seconds. This action forces fluid through the steering system under pressure and should help you detect a leak. Fluid leaks occur primarily through split hoses and at their metal terminations. If a hose is faulty, replace it.

Leaks that appear to originate in the pump or power cylinder point to bad seals. You will have to get the unit rebuilt or replaced. In some cases—specifically with an external power cylinder of a linkage-type system—seal kits are available, and you can tackle the repair yourself.

Suppose your power steering is okay at medium and high speeds, but the car's tough to steer at low speeds. The problem in this case is probably the control valve, which has the job of providing full hydraulic pressure at low speeds when you need a full boost. At higher speeds, when steering is easier, the valve reduces hydraulic flow.





**FLUID LEAKS** occur most often through split hoses and at faulty hose terminations, as pointed out here

If the valve's sticking, you can often free it without even lifting the hood. Rev the engine (with the car at a standstill) a few times. This builds up hydraulic pressure, loads up the control valve and can free a sticking one.

An ornery valve should be replaced. In most integral power-steering systems, you simply unbolt the valve from the steering gear and drop in a new one.

By the way, whenever you disconnect hydraulic lines, cap the line and control-valve nipple to keep from losing fluid. Any cap that fits is okay. In a pinch, use electrician's tape.

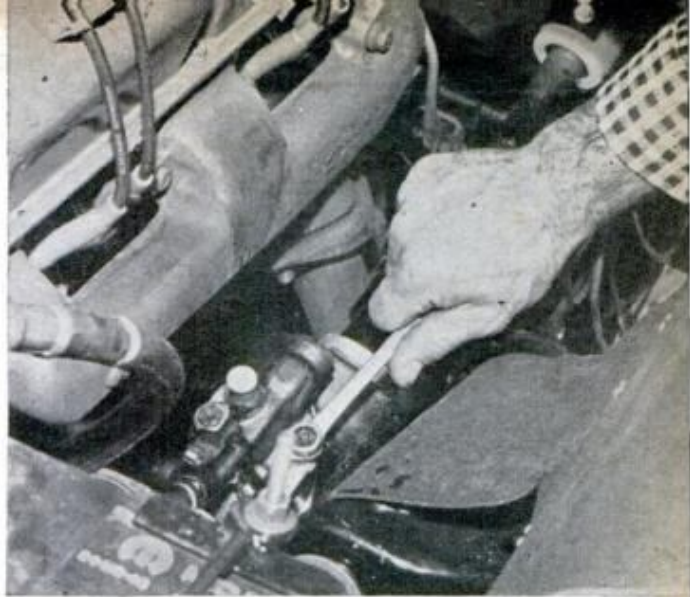
If procedures taken so far haven't solved your power-steering problem, the trouble is either in your pump or steering gear. Because pump failure is more common, the tendency is to simply replace the part. Needless to say, that's bad practice. If the trouble is in the gear, shot-in-the-dark pump replacement is wasted time and effort. Even worse—wasted money.

You can isolate the faulty area by taking pressure readings. To prepare for tests, run your engine to get the fluid up to 150° to 170° F. Cold fluid gives higher than normal pressure readings. Fluid that's too hot gives too low readings.

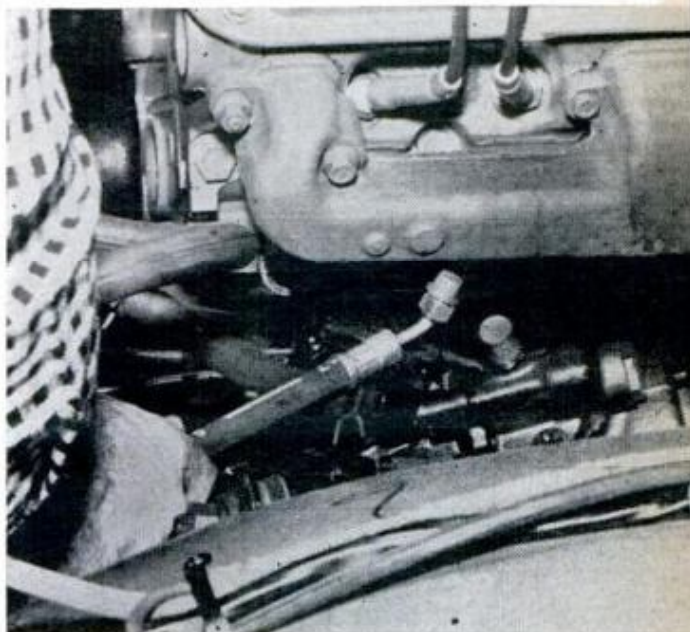
Stick a thermometer into the fluid, start the engine and hold the steering wheel against each side stop for a few seconds until the thermometer registers the correct fluid temperature.

Hook up the pressure gauge by disconnecting the hydraulic hose. In an integral system, the hose is disconnected at the control valve and the gauge is inserted in the line. The hose feeds into the input

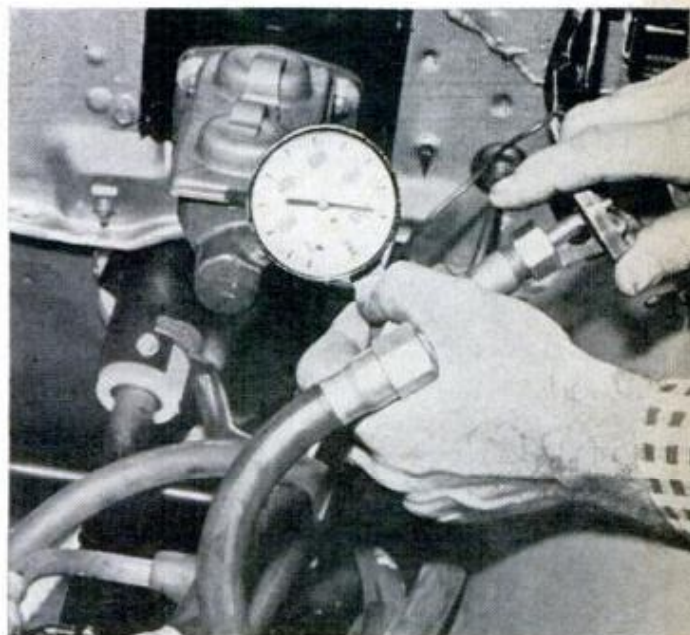
*(Please turn to page 205)*



**CONTROL VALVE** usually located on top of steering gear on integral systems, can be removed easily



**PREVENT LOSS OF FLUID** while troubleshooting system by placing caps over hydraulic hoses and fittings



**PRESSURE GAUGE** connects to pump while engine runs at fast idle. Valve cuts off flow to take reading



# HOW YOU CAN AVOID THESE 15 Simple Darkroom Goofs That Spoil Good Photos

**You can't bring a ruined negative back to life. Here's how to correct the most common mistakes in home processing—before they happen to you**

By CHRISTOPHER CRANDALL

**D**O YOUR NEGATIVES keep coming out of the tank full of pinholes, streaks, scratches and reticulation even though you faithfully follow all of the customary developing steps? The normal reaction is to blame the film (outdated or damaged) or the chemicals (exhausted or contaminated). Actually, it could be that your processing technique has some built-in flaws.

The goal of processing your own film is to produce crisp, brilliant negatives and, ultimately, prints of top professional quality. It doesn't make much sense to shoot the original pictures meticulously and then get careless in the processing stage, especially when it may cost you that "once-in-a-lifetime" shot. The following are 15 of the most common goofs, step by step, that are made in home processing.

1. *Touching the emulsion.* Because film has a frustrating tendency to curl back into a roll, it is a real challenge to your dexterity to get it on the reel without touching the emulsion (dull

side. Perspiration and skin oils can leave an indelible fingerprint superimposed on the latent image. If you're not sure you can handle film without touching the emulsion, wear a pair of thin cotton gloves such as those sold for the purpose.

2. *Bypassing the pre-development rinse.* When developer is poured into the tank, the film temperature drops suddenly and this "shock" can cause reticulation—a network of thin lines that will be reproduced prominently in the print. You can avoid this by first bathing the film for a few minutes in a filtered water bath at the same temperature as that of the developer. (Water has no chemical effect on the film.)

3. *Using impure water.* All tap water contains impurities, some of which can cause adverse reactions in photo chemicals. Ideally, distilled water should be used in mixing solutions, but boiled and filtered tap water works equally well.

4. *Measuring carelessly.* Only beakers made especially for use in photo processing should be used. Inexpensive plastic





**HIGH-TEMPERATURE PROCESSING** can soften the emulsion to the point where it loses its grip and begins to slip. Result: Ugly blotches like these that ruin the negative. Stick to slower, but safer, standard processing, usually at 68° F.



**TELLTALE THUMBPRINT** on this blow-up is a sign of careless handling during the developing. Skin oils will leave indelible prints on emulsion



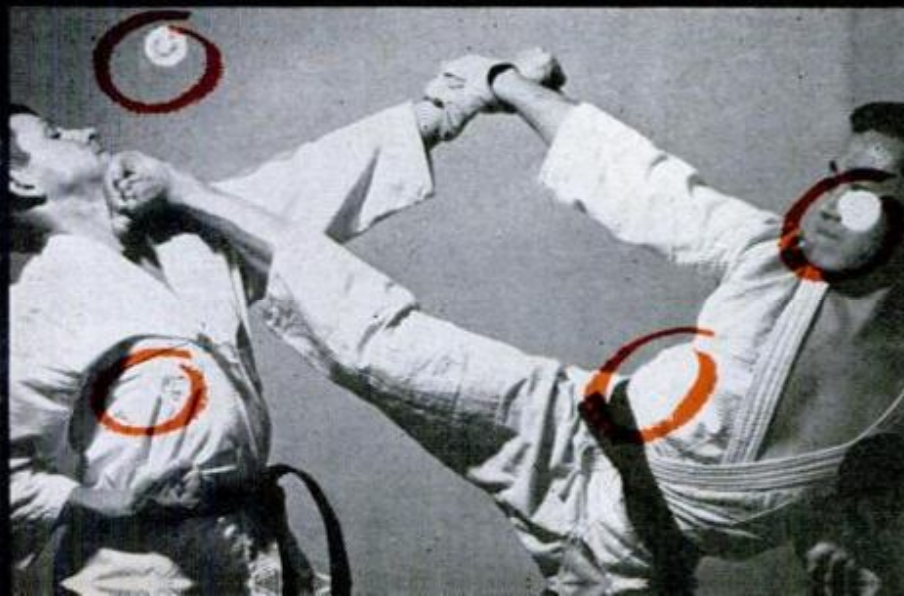
**INFURIATING PINHOLES** start out as tiny specks in the negative, but look like baseballs when you blow them up, as above. The cause: Air bubbles in the developer. The cure: Use gentle agitation so as not to whip up a froth

**SPOTS LIKE THESE** result from improper mixing. Each was caused by a minute granule of undissolved developer crystal. Even so, filtering the solution before use would have trapped the harmful particles and saved the picture

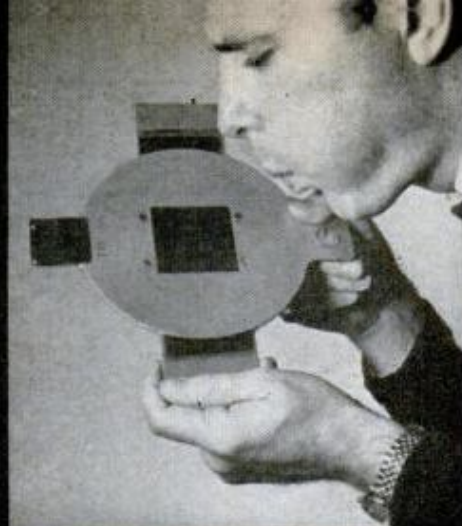


**SCRATCHES** in the emulsion are caused by rough handling in many ways. Careless sponging ruined what would have been a cute candid shot

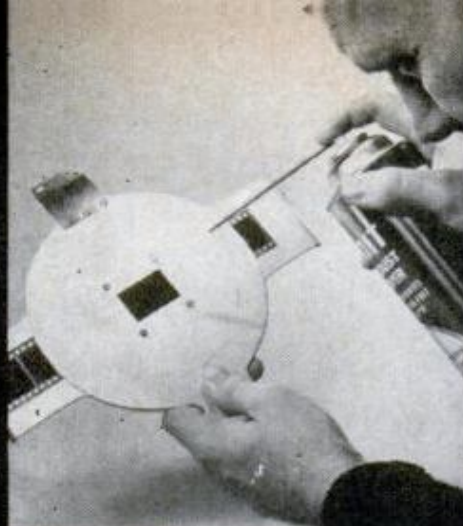
**INADEQUATE AGITATION** during the development can wreck an entire roll of prize shots. Here streaks are from a halide-loaded developer







**WRONG**



**RIGHT**

**BLOWING IS FINE** for starting a charcoal fire, but is no way to remove dust from negatives. Moisture blown onto the surface from your breath will dry as water spots and show up on print. Instead, use a pushbutton can of air. One blast from its jet will safely and effectively whisk away every dust particle

cooking beakers tend to be less accurate. The beaker should not be held at eye level while water and chemicals are added, but should be placed on a flat surface. Measure water precisely, or your solution will be too strong or too weak. An ounce either way can alter the effectiveness of the solution.

5. *Mixing improperly.* It's always a great temptation to dump powdered chemicals into a jar and just shake vigorously until they dissolve. Gentle stirring with a rod seems agonizingly slow, but it's really the only safe mixing procedure. Violent shaking churns the solution into a froth of air bubbles that settle on the film and cause pinholes.

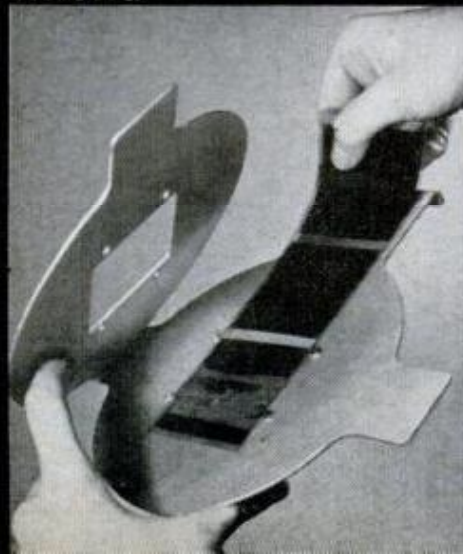
6. *Lack of preparation.* Before pouring the developer into the tank, all the chemicals you will need should be mixed and filtered and your equipment should be clean and close at hand. Set the timer for the required development time, *less 35 seconds.* Tanks usually require about this long to empty, so by the time you've

drained the tank, the development will be stopped at almost the precise time. (The timer should be started when you begin to pour in the developer, not after the tank is full.)

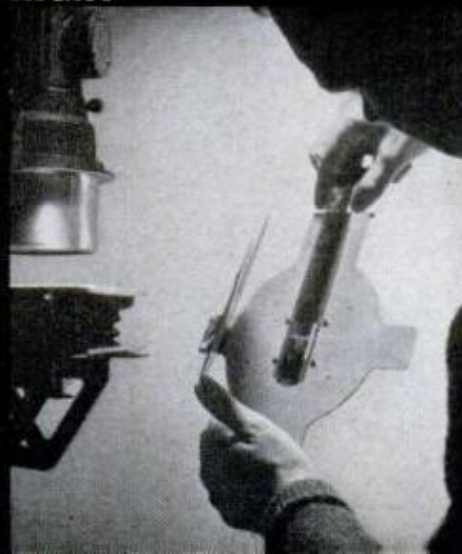
7. *Insufficient agitation.* Streaky, blotchy film is the result of inadequate agitation. Fresh developer must reach the film at least every 60 seconds during the development or the solution in contact with the film becomes exhausted. As a result, the film may come out underdeveloped. A greater danger is that the developer may become loaded with halide from the film emulsion and spread unevenly in streaks across the film.

8. *Violent agitation.* This is the other extreme. It doesn't take much action to create air bubbles inside a tank, and air bubbles cause pinholes. Nikor tanks (stainless steel) should be inverted gently for agitation and slammed occasionally against a flat surface to burst any air bubbles that may have formed. Don't try this with a plastic tank, however. Twirl the

**WRONG**



**RIGHT**



**HOLDING THE FILM** in your fingers while you are loading it into a carrier, as at far left, is a sure way to get oily prints all over the emulsion that will show up later on the print. Grip the film at the edges between fingers and bow it slightly so that it won't touch the carrier as you slide it in position



rod in a plastic tank three or four times each way for about five seconds during agitation (every 30 seconds with some developers, every 60 seconds with others).

9. *Overdevelopment/underdevelopment.* There is a solution for both of these problems, but each is tricky and must be performed with care. Overdeveloped negatives can be treated with one of several reducers that absorb silver content in equal amounts from the high, middle and low densities, thereby reducing the visual contrast of the negative.

Underdeveloped negatives are more difficult to improve, especially when they are also underexposed. You simply can't add image detail where none was registered during exposure. The use of an intensifier (silver, chromium, mercury) can add some contrast and occasionally permit you to salvage a negative, but intensifiers have a tendency to stain.

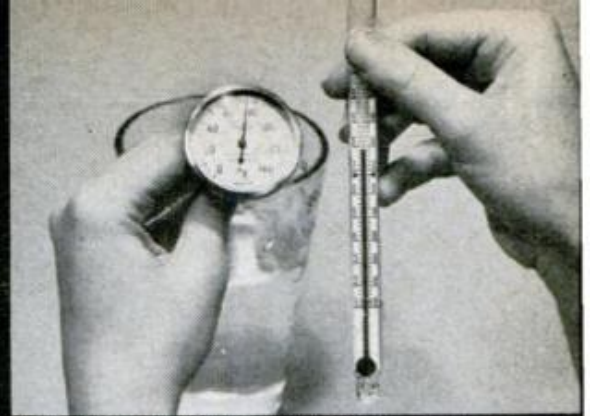
10. *Failure to use an acid rinse.* Some photographers argue against using an acid stop-bath rinse between development and hypo, claiming that acid causes pinholes. They prefer a water rinse instead. However, those favoring the acid rinse contend that proper agitation during the rinsing phase would prevent gas bubbles from forming and thus eliminate the chance of pinholes.

The purpose of an acid rinse is to stop development immediately by neutralizing any developer that has adhered to the film after the tank is drained. Since water has no chemical effect on film, development can continue during a water rinse, producing overdeveloped negatives. Furthermore, an acid bath helps to remove developer scum and prevents the formation of dichroic fog (red and green stains).

11. *Improper fixing.* Manufacturers' instructions for using hypo usually say: "Fix two to five minutes." The minimum of two minutes is not always enough, however. Fixing time will vary from roll to roll. Rather than assume the film is adequately fixed, play it safe by pouring the hypo into a "holding" beaker while you check the film under a strong light. If you spot a milky cast, this is a tipoff that further fixing is required. The image quality of insufficiently fixed film (and prints) will deteriorate rapidly.

There is danger, too, in overfixing both film and prints. Extend "souping" can bleach out most of the image. (Two to

*(Please turn to page 209)*



**A DARKROOM THERMOMETER** should be checked periodically against another thermometer to make sure that it remains absolutely accurate

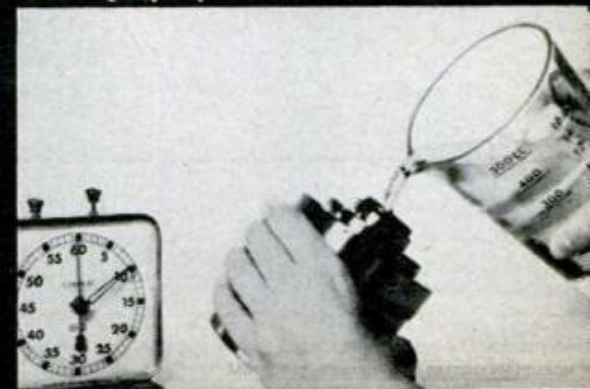


**SCRATCHED NEGATIVES** can often be salvaged by applying petroleum jelly or a lacquer filler like Edwal's No Scratch to the damaged areas



**TO KEEP EVERYTHING** at the same temperature, put tank and beakers in a tray of water that's been brought to the correct temperature first

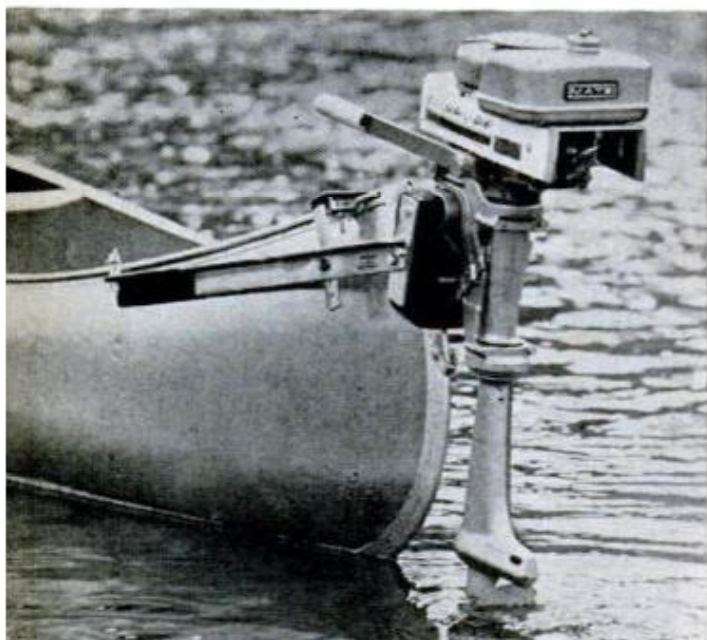
**START YOUR TIMER** just before you begin filling the developing tank, not after it's full. Tip the tank slightly to prevent air bubbles from forming



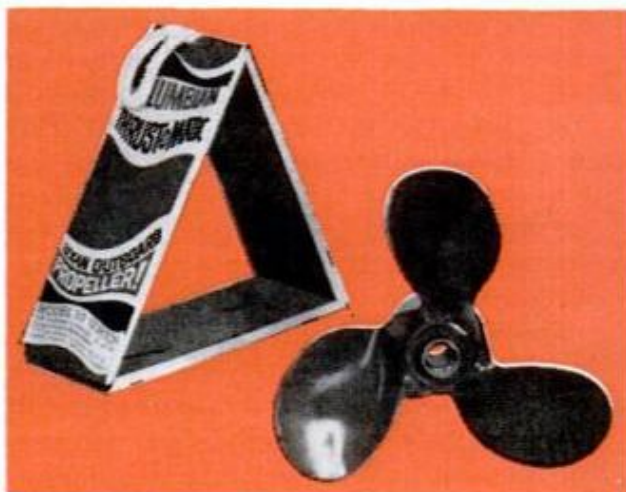


# New for Your Boat

**HANDY ADDITION** to any sportfishing boat is a new combination fishing pole and outrigger holder from Perko. The 1-7/8-in.-dia. holder has a protective vinyl liner and can easily be removed from its mounting bracket when not in use, leaving no projecting hardware. Complete assembly retails for \$19. Spare brackets are \$4.20. You can order one from Perko, 16490 Northwest 13th Ave., Miami, Fla. 33164



**STERN MOTOR BRACKET** for a double-ended canoe permits paddling with outboard attached, cuts down danger of tipping. Easily removed when not needed, the aluminum bracket sells for \$21.45 from R. & J. Talasek, 6442 N. Atwahl Dr., Milwaukee, Wis. 53209

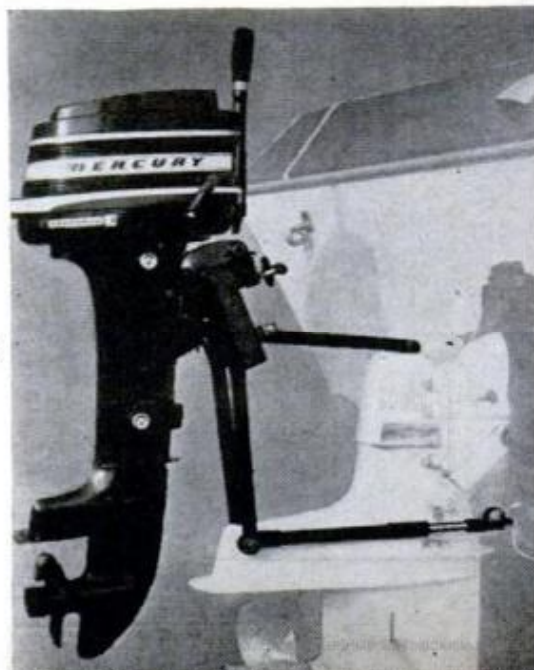


**NONMETALLIC PROPS** with lifetime guarantee against blade breakage and cavitation erosion have been perfected by Columbian Bronze Corp. Made of Lexan, a General Electric plastic, first six models are priced from \$7.95 to \$13.75, all less expensive than similar die-cast props



**BOW HOLD-DOWN** prevents bow of boat from bouncing when you trail it over rough roads. Normally, an eyebolt is mounted on trailer tongue so chain can be linked to it, then hook is slipped through bow eye and snap-locked down tight. If necessary, it can be reversed (left). Golden Rod sells this one for \$2.55

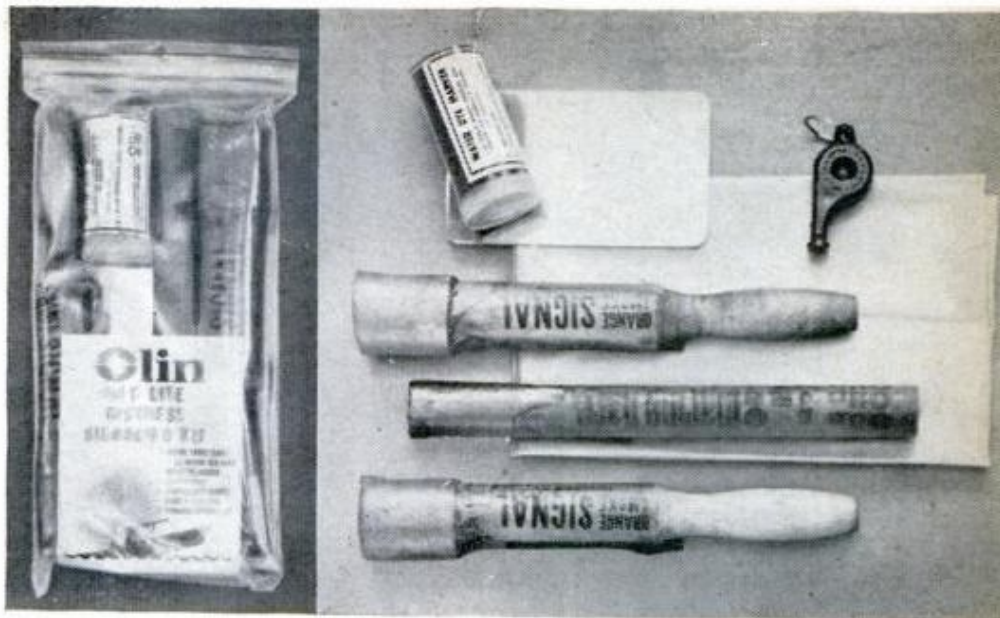
**TROLLING BRACKET** for stern drive will accommodate outboard up to 10 hp, is handy for fishing and will provide emergency auxiliary power when needed. Designed specially for smaller MerCruiser units, it won't interfere with power tilt. Price is \$24.50 from Specialty Motors, Box 171, Longview, Wash. 98632





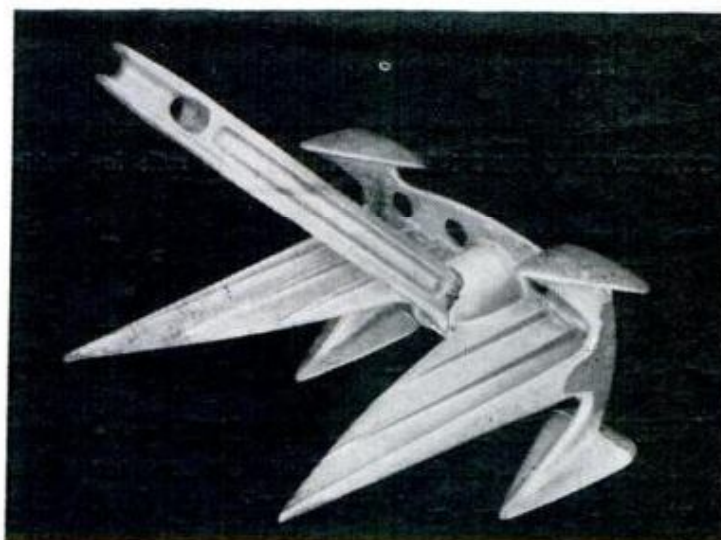
### DISTRESS SIGNALING KIT

introduced by Olin Mathieson Chemical Corp. is designed for either day or night use. Packed in a resealable and weatherproof bag, it includes two two-minute orange smoke flares, one five-minute red flare, enough dye to cover 5000 sq. ft., a 2-ft.-square distress flag, a signaling mirror and a whistle. This Day-Lite model signaling kit is priced by the manufacturer at \$13.95 and is available at marine supply stores. Olin's other signal kits include 12-ga. and 25-mm launchers, and meteor flares, parachute flares and 15-minute hand flares



**WATERPROOF LANTERN** made by Eveready is so light it floats. The lens ring snaps off for easy battery or bulb replacement; a rubber "boot" protects the pushbutton switch. The case, made of a tough polyethylene, resists oils, grease, most chemicals. Available in three colors; suggested retail price, \$3.98

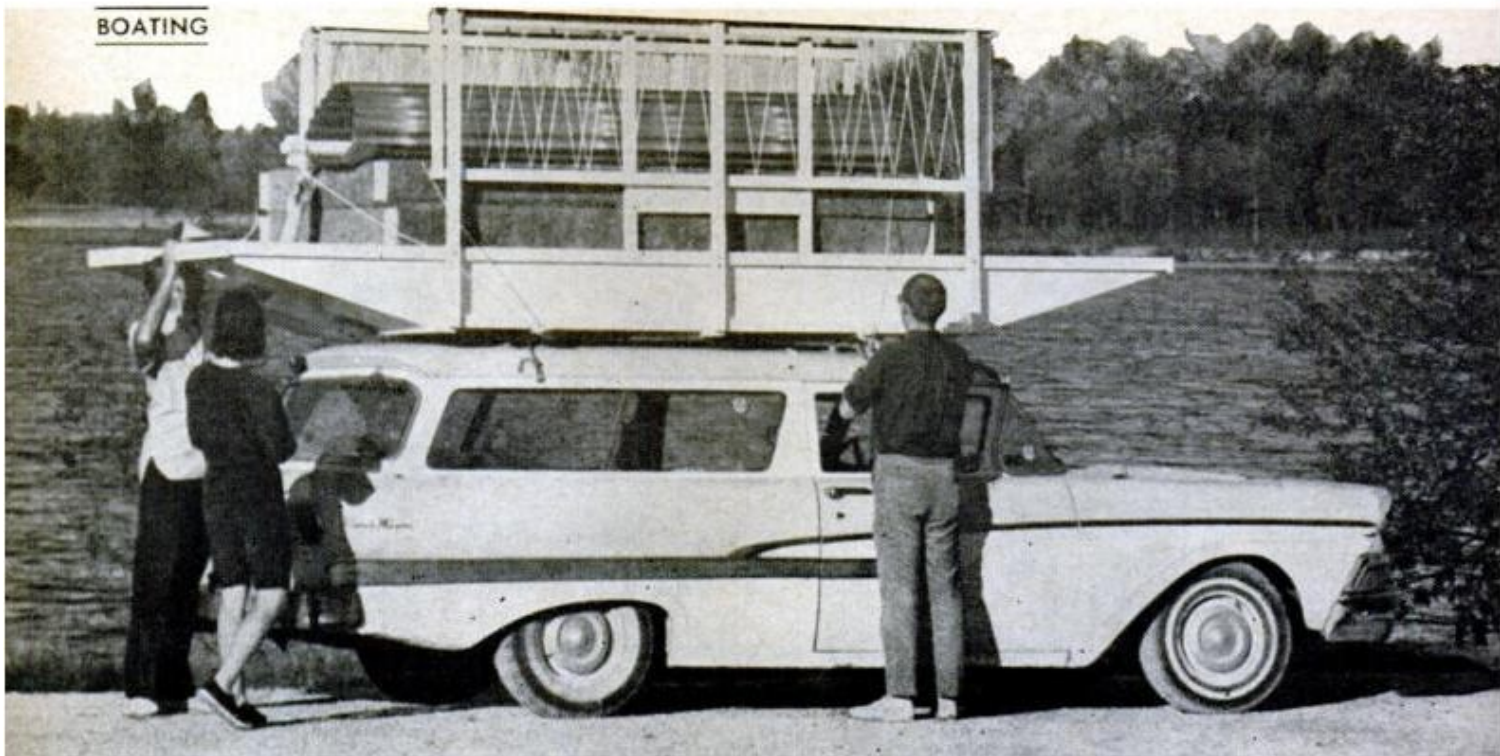
**BOAT PLASTICS KIT** for amateurs who want to experiment with the many products involved in fiberglass boat building and repair contains samples of polyester resin, fiberglass cloth and mat, foam core, polypropylene, Dynel and Microballoons, plus protective gloves and small brush. Developed by International Amateur Boat Building Society, kit has instruction manual covering experimental operations. Available for \$5, you have to order the kit from IABBS, 1535 W. Farwell Ave., Chicago, Ill. 60626



**ALUMINUM ANCHORS** made of a tough marine alloy are guaranteed against breakage, will not corrode in salt water. Weighing approximately half as much as conventional steel anchors, they come in three sizes: 4-lb. for boats up to 20 ft. long, \$16; 6-lb. for boats 21 to 30 ft., \$24; 11-lb. for 31 to 40 footers. Made by Bay Pattern Works, Milan, Ohio 44846







COMPONENTS NEST NEATLY between side rails for lashing down on cartop carrier bars. Canopy is rolled

# Build This Cartop Pontoon Boat

By DAVID SWARTWOUT

Technical Art by Fred Wolff

**T**HIS GAILY FESTOONED little party barge has one big advantage over other pontoon boats—portability. Not only can it be dismantled and loaded on top of your car, but each component is light enough to be carried easily by two people. You don't even have to bring the car near the water, since the boat can be portaged to the beach and assembled there.

For cartopping, the boat breaks down into seven components: two 14-ft. pon-

toons with attached side rails, two 4x8-ft. deck panels; front rail; rear rail with motor board; and the canopy assembly (six conduit supports and the corrugated aluminum canopy). The whole thing can be assembled in about 10 minutes with bolts and wingnuts.

The pilot model shown in the photographs is strictly a fun boat with lots of little extras. For instance, the deck is covered with cotton loop-pile carpeting to make it comfortable for sunbathing.

SPACE PONTOONS slightly farther apart than deck width to allow deck panels to be slipped between rails







**BOLT DECK PANELS** to pontoons, then secure both front and rear rail to deck panels and the side rails

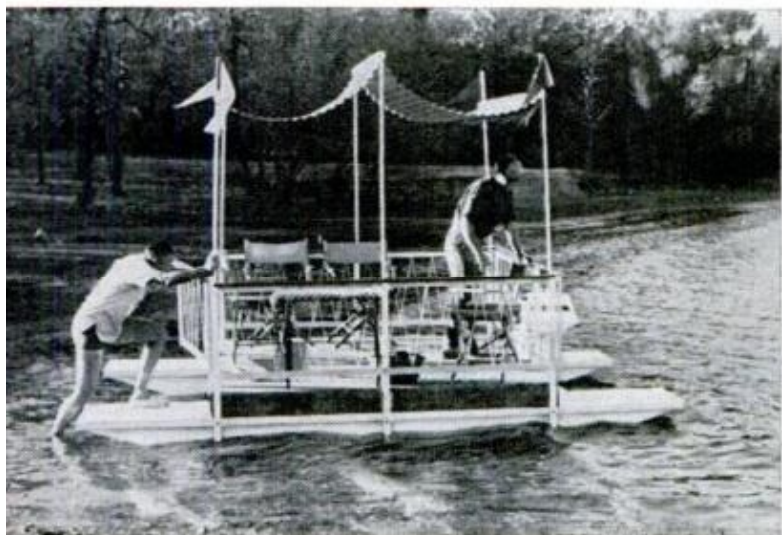
This luxury actually cost only \$17 and was achieved by cutting a cheap 9x12-ft. rug in half so that the two pieces could be tacked over the deck panels. The canopy fringe and pennants could also be omitted without harming the basic design.

Likewise, an even more spartan version of this boat, leaving off the canopy and carpeting, would be a fine shallow-draft fishing platform.

Note that the plans on the following pages give two alternative designs for the pontoons. The pilot model used a hollow pontoon filled with Styrofoam planks cut to fit. The planks provide support for the top panels of the pontoon, and are held in place by three 1x4 battens nailed across the opening in the bottom. Such a pontoon not only requires lighter framing, but is virtually unsinkable. If you choose this type, however, it would be a good idea to protect the plywood edge grain with fiberglass tape.

With the more conventional watertight pontoon, extra crosspieces will be required to support the top panel. Use an-

**PUSH OFF** and step aboard. With watertight pontoons, top panels should be braced with 1x2s for rigidity



FEBRUARY 1968



**SLIP RIDGEPOLE** sockets over center pair of conduit supports before bolting end boards to corner poles

nular-ring nails and glue when planking the pontoons, and install a removable drain plug in the top panel of each one.

The deck panels are full 4x8-ft. sheets of  $\frac{3}{8}$ -in. exterior plywood braced with a 1x6 frame. Note that there is a  $\frac{3}{4}$ -in. overhang along one edge. This is to close the gap where the two panels meet, since the projecting ends of the 1x6 are bolted to the 2x2 upright on the pontoon. The overhang compensates for the thickness of the 2x2.

As for the rails, those mounted on the pontoons are attached with  $\frac{1}{4}$ -in. machine screws, 4 in. long for the middle upright and  $5\frac{1}{2}$ -in. long at the ends (to go through the extra 2x2). The two horizontal 1x2s are fastened to the uprights with  $\frac{1}{4}$ x3-in. eyebolts having eyes large enough to accommodate the  $\frac{1}{2}$ -in. conduit poles which support the canopy. (o.d.  $1\frac{1}{16}$  in.). Drive screw eyes into the underside of the top rail and the upper surface of the bottom rail to act as eyelets through which plastic-coated clothesline can be laced. A 1x4 cap is nailed over the

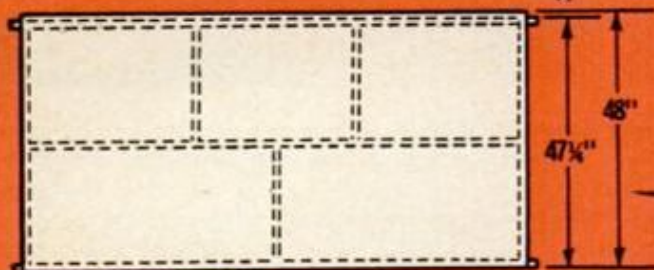
**FISHING MOTOR** is plenty big for this small boat. If you use more than 5 hp, hold back on the throttle





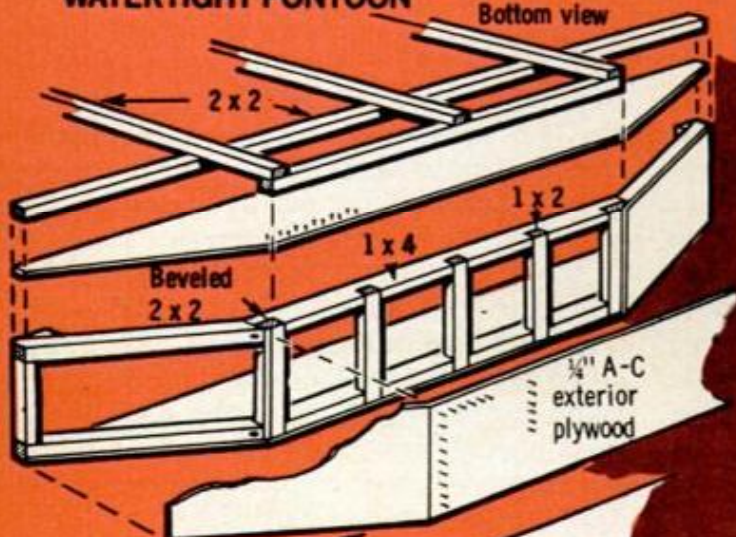
CUT  
FOLD  
TAPE

## PONTOON BOAT



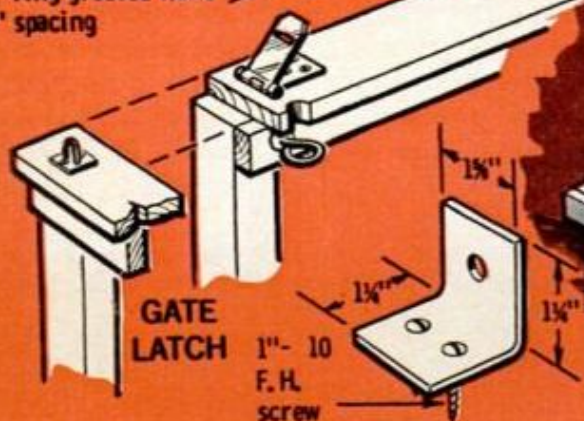
### WATERTIGHT PONTOON

Bottom view



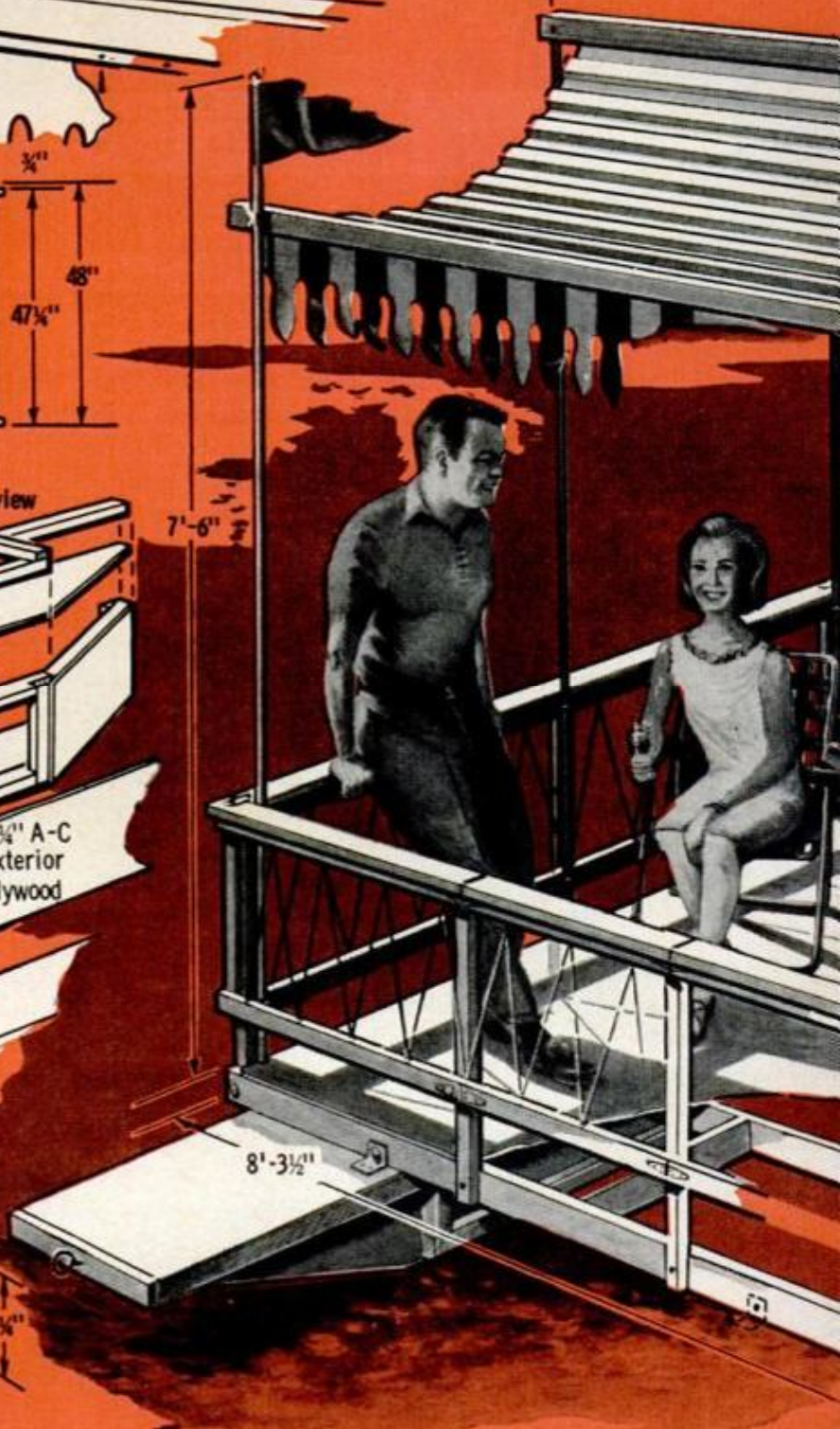
7'-6"

1" ring grooved nails  
2" spacing



GATE  
LATCH

1"- 10  
F.H.  
screw



2x2 to complete the simple rail assembly.

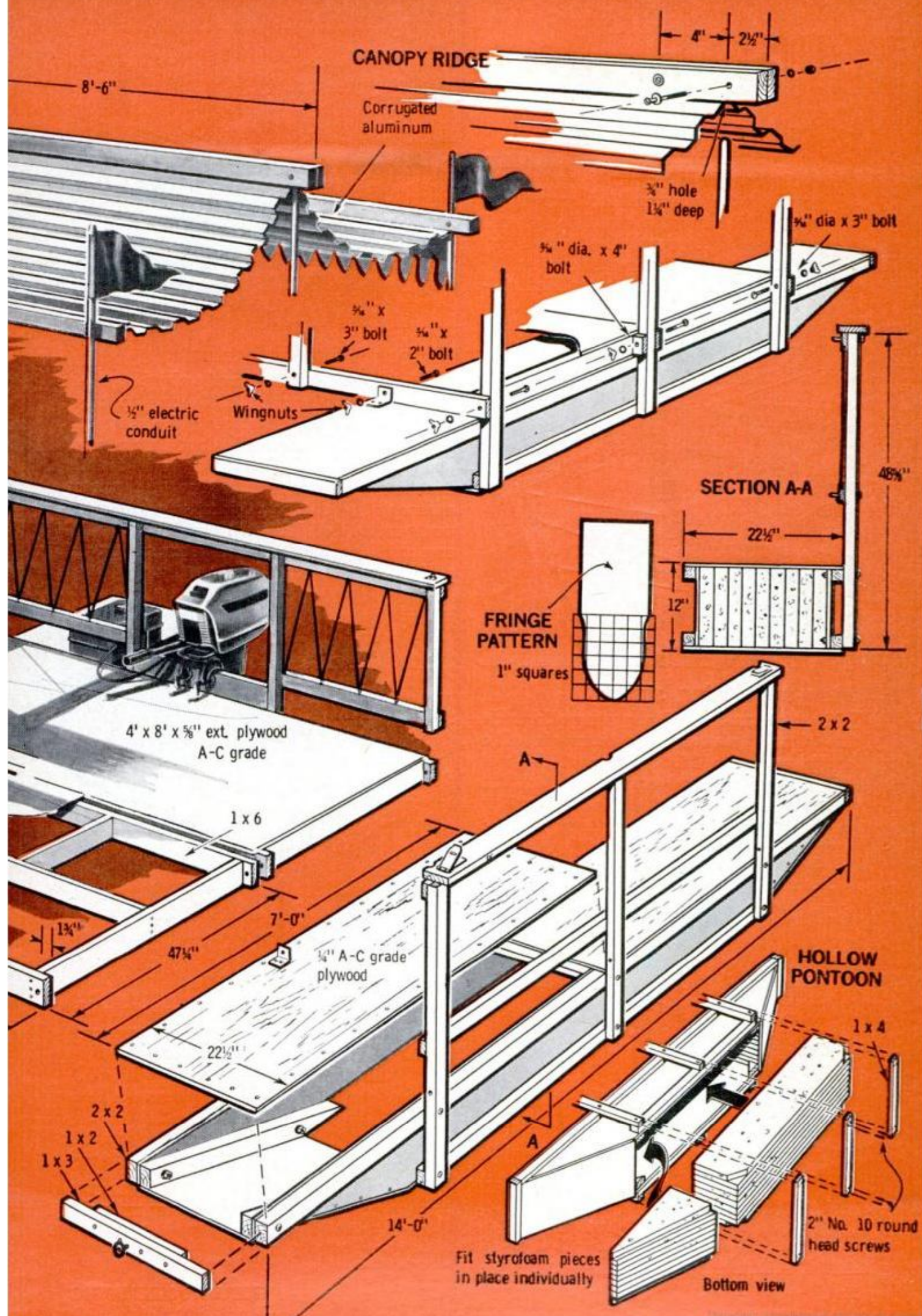
The front and rear rails are constructed to match the side rails. Use  $\frac{3}{8}$ x4-in. lag-screws to attach the 2x6 motor board to the uprights. Bolts and wingnuts are used to attach the rear rail.

The front rail has a gate at each side for passenger access. These are held closed with hasp-and-staple latches. The plastic clothesline can be stretched through the screw eyes in one continuous

length, since the swinging of the gates doesn't affect its tautness.

The corrugated aluminum canopy is actually two 50½-in. x 8-ft. sheets joined along the 8-ft. edges by clamping them between two lengths of 1x2 which make up the "ridgepole." Drill socket holes near the ends for the conduit supports. The 1x2 boards tacked to the front and rear edges of the canopy are secured to conduit poles with bolts and wingnuts. ★★★







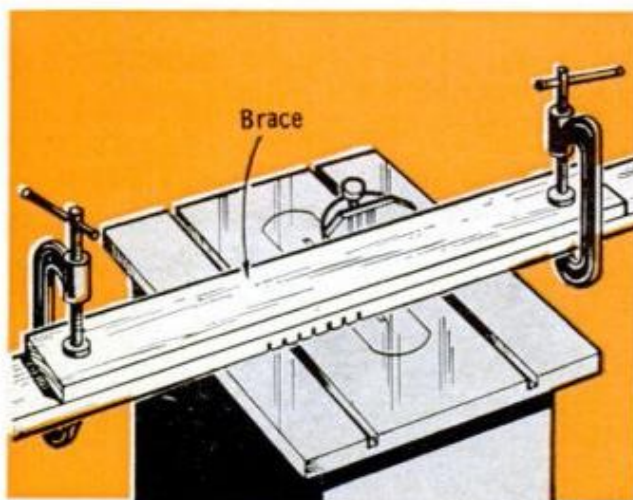
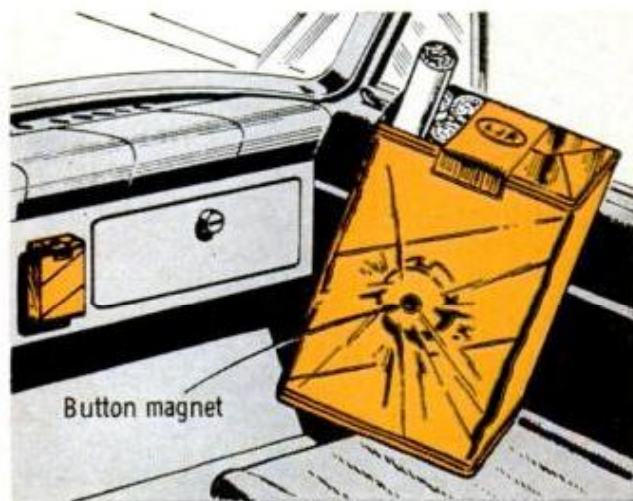
# HINTS

FROM READERS

## Kerfing long boards

When you're cutting kerfs across the center of a long board with a circular saw, the weight of the unsupported ends is often enough to cause the board to sag and break the kerfs. To avoid this, just clamp a second board of similar width over the cutting area. This will act as a stiffener.—

*James E. Kniseley*



## Magnet holds cigaret pack

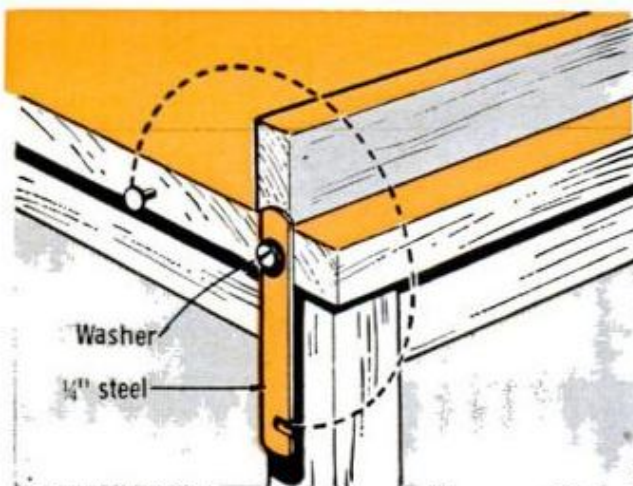
Slip a small magnet inside a package of cigarettes and the pack will cling to any metal surface which attracts the magnet. In a car, the pack can be hung from any spot on the dash. On a job, most metal brackets or plates will hold your cigarettes where they can't be accidentally knocked over and spilled. This trick will work with any small package, such as a matchbox or pack of gum.—

*Joseph Braunstein*

## Swing-up planing stop

Mounted on the end of your workbench, this simple planing stop consists of a length of scrap hardwood with a hole drilled near one end and a notch cut in one edge near the other end. Mount it with a husky screw and washer so that the short end will project about  $\frac{1}{4}$  in. above the bench when the stop is swung over to a vertical position. A nail will hold it in horizontal position.—

*G. E. Hendrickson*

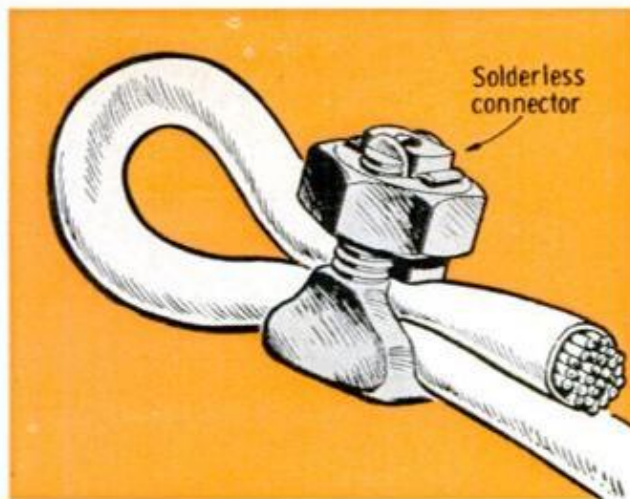


## Form-fitting sanding block

Custom-made sanding blocks to match curved or other odd-shaped surfaces can be made from Plyfoam, an expanded polyvinyl chloride material which will bend when heated and hold the new shape when it cools. Just dip it in boiling water and bend it immediately to the desired shape. You may obtain two 5x7-in. pieces by sending \$1 to Plyfoam, Inc., Vanderbilt Industrial Park, Hauppauge, N.Y. 11787.





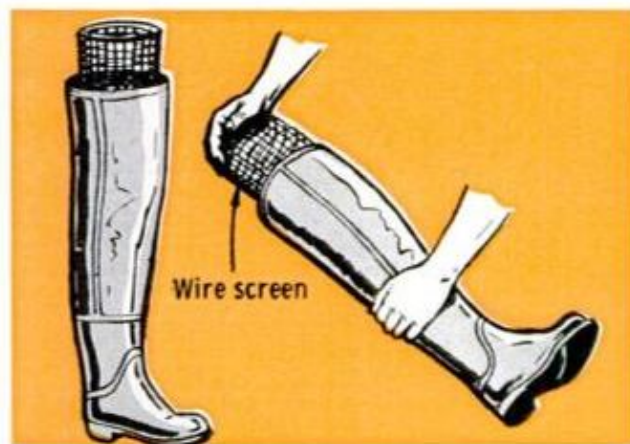
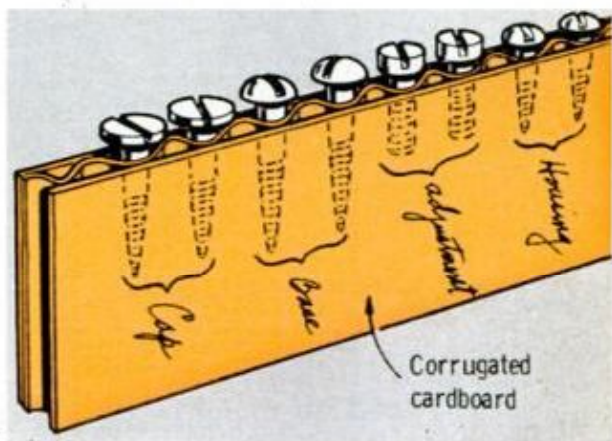


### Improved cable clamp

If you don't happen to have a cable clamp handy when one is needed, a screw-type solderless electrical connector makes a fine substitute. Burndy's Servit connector, for instance, comes in sizes large enough to take 1/4-in.-dia. cable and can be tightened down firmly to hold the cable securely. The connector can easily be loosened with a wrench when its removal is required.—*Joseph Braunstein*

### Simple screw sorter-holder

Cut a section from a corrugated paper box and you have a handy holder for screws and bolts which must be removed while making repairs. Just push each one down into a corrugation. To simplify reassembly, arrange screws in the order in which they were removed or label each one with the proper location. This holder is fine to store sorted screws or hold them while painting the heads.—*Albert T. Pippi*

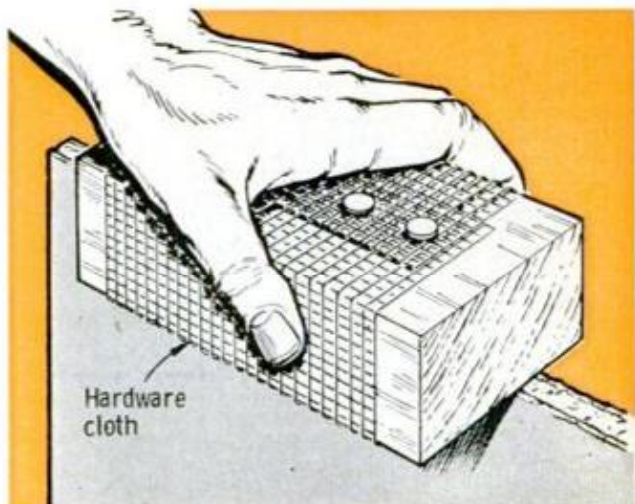


### Boot-drying tubes

When your fishing boots or waders have gotten wet inside, one way to speed up the drying is to insert a roll of wire screening in each boot. These will hold the boots upright with the tops open, while the screen mesh allows air to circulate freely inside. For even faster drying, direct the warm flow of air from your wife's hair dryer into the top of each boot for a short period.—*James E. Kniseley*

### Block smooths wallboard edge

When you're scoring and breaking plasterboard, the edge will often be rough and uneven. A simple tool for smoothing such edges can be made by tacking some wire screening over a small block of wood. Use it as you would a sanding block, making as many passes as necessary to produce the desired smooth edge. When the screening becomes clogged, give it a sharp rap to clean it.—*D. F. Kimberling*



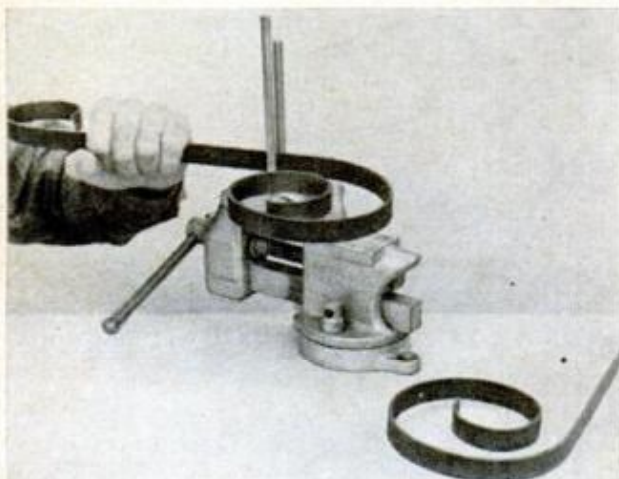
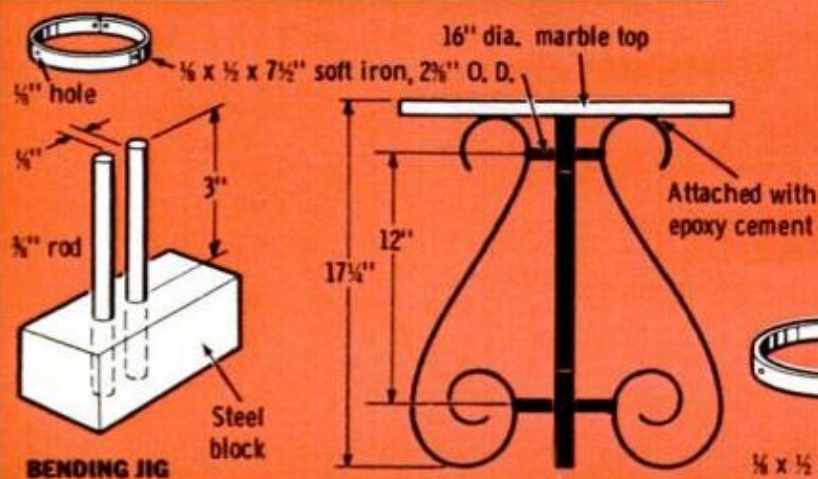
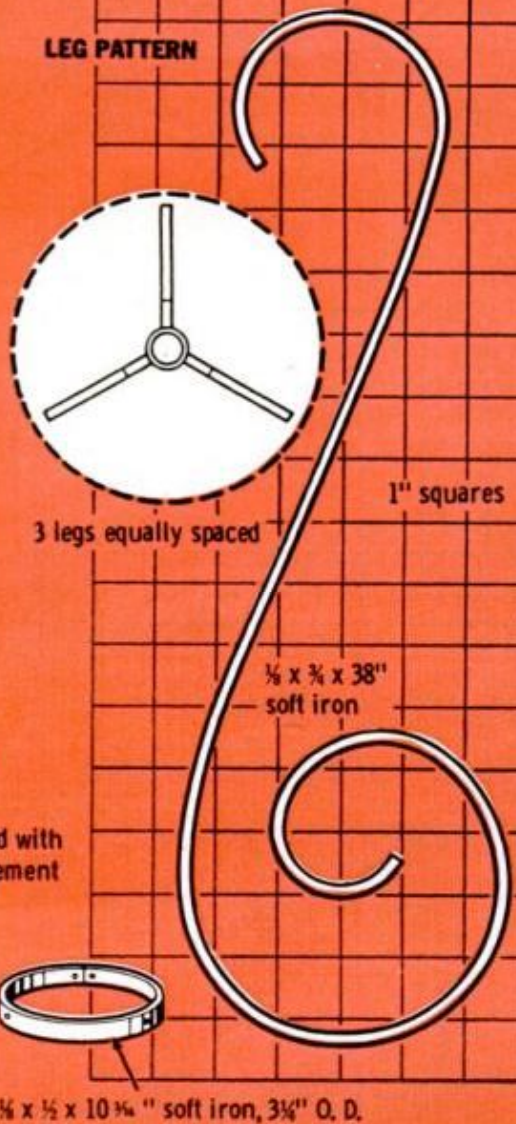


# Weekend

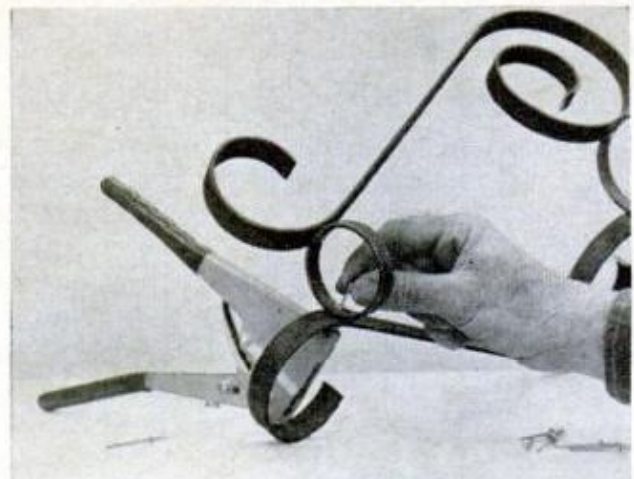
Technical Art by Graphic Presentations



LEG PATTERN



**FLAT IRON IS CURVED** to match pattern by feeding it a little at a time through the posts of bending jig, at the same time giving metal slight sideward pull



**RIVET IS INSERTED** from the inside of leg ring and "popped" from the outside with tool. Rivet holes are drilled before bending the wrought iron to shape



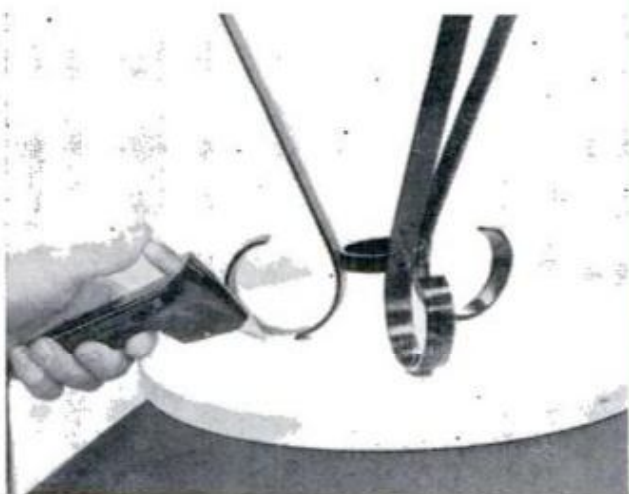
# Projects

## MARBLE MINI-TABLE

TOO HARD TO MAKE, you say. Don't be silly. Two handy tools—a Pop Rivet Tool and a Thermogrip electric glue gun—make it as easy as pie to copy this classy little marble-top table. The rivet tool makes quick work of assembling the wrought-iron base, and the glue gun solves the problem of attaching the base to its top.

Your first step is to enlarge the grid pattern for the three wrought-iron legs. Each leg is formed from a 38-in. length of cold-rolled flat iron by feeding it between two steel posts of a vise-held jig and giving it a slight sideward pull as you go. By constantly checking the curve with your full-size pattern, you'll be surprised how comparatively easy it becomes to bend all three legs alike. It will be easier, of course, to drill the  $\frac{1}{8}$ -in. rivet holes if you do it while the legs are still flat.

Rings of flat iron support the legs at top and bottom. These are formed in the same jig used for bending the legs. The ends are merely butted and two rivets used to join the ends to one leg. Rivet holes are drilled  $180^\circ$  apart for three No. 44 steel Pop rivets which are inserted through the rings from the inside. Paint the wrought-iron flat black before gluing it to the 16-in. marble top. If you can't find a solid marble top, you can cut a top from plywood and cover it with marble-finish decorative laminate. It will be hard to tell the difference.—John Capotosto



**WROUGHT-IRON BASE** is "welded" to marble top with quick-setting cement applied with electric glue gun. The thermosetting cement produces a strong bond



## NOVELTY MUSIC BOX

**STEPPING OFF** to the tinkling tune of *Parade of the Wooden Soldiers*, this little band in the form of a music box is a fascinating novelty to watch and an interesting lathe project to make.

Blanks for turning the box and lid are first glued (with paper between) to waste blocks for faceplate mounting, while pieces for the revolving platform and canopy can be attached directly to the lathe's screw center. The lathe tailstock is brought up to help support the work while turning the outside and then backed off to dish and recess the inside. The winding knob is turned, but its post and the canopy supports are mere lengths of dowel.

The little bandsmen and their instruments are turned in separate sections. In the case of hands, arms and feet, each turning is sawed in half lengthwise to make a pair. It is easier to do the sawing if the feet are turned as a series, then sawed in half before they are cut apart. A section left at the end provides a grip for sawing.

To assemble the music box, fasten the music works to the underside of the lid after first removing the winding key. The regular winding key is replaced with a platform key which is screwed to the underside of the winding platform and to the music works. Glue the dowel winding





CUT  
FOLD  
TAPE

WEEKEND  
PROJECTS

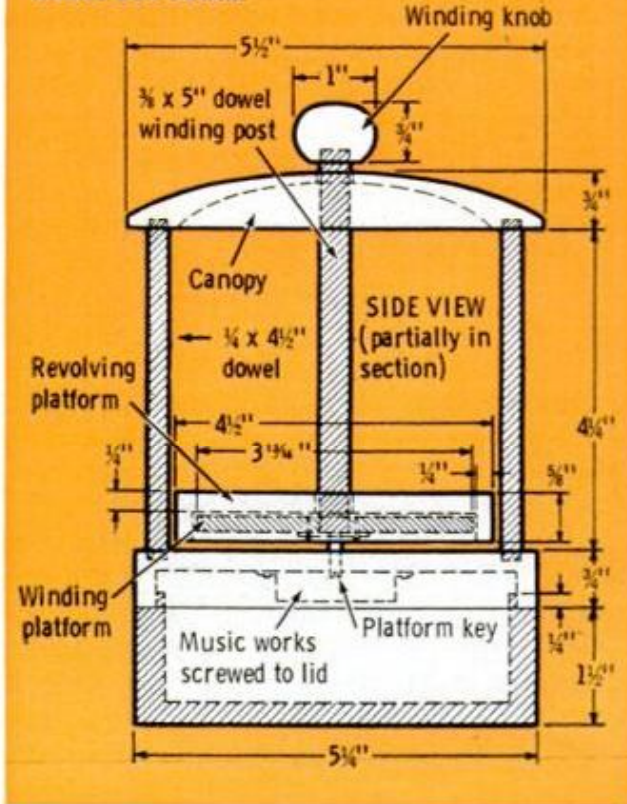
**PLATFORM KEY**, which replaces regular winding key, is screwed first to underside of winding platform, then to stem of the music box on underside of lid



**STEM OF MUSIC WORKS**, which you buy, is centered in hole in the box's lid so it lines up accurately with holes in both the winding and revolving platforms

post in a hole in the winding platform and then slip the revolving platform over the post to rest on the winding platform. The hole in the revolving platform should be oversized. Canopy posts are added next, then the canopy and winding knob. You can buy the works and platform key from Walters Modern Hobby Shop, 207 French Rd., Utica, N. Y.—Willard and Elma Waltner

**MUSIC-BOX DETAIL**



**LATHE SCREW-CENTER** is used to hold canopy. Screw hole is later enlarged to accept the winding post



**CANOPY POSTS** are glued in outer edge of the lid, then in blind holes drilled into underside of the canopy



**EACH OF THE FIVE** band members is glued securely to the revolving platform with quick-setting cement





USE CHOICE WOOD, such as walnut or mahogany, for the exposed parts of the box, sand it glass-smooth and apply a rich hand-rubbed finish

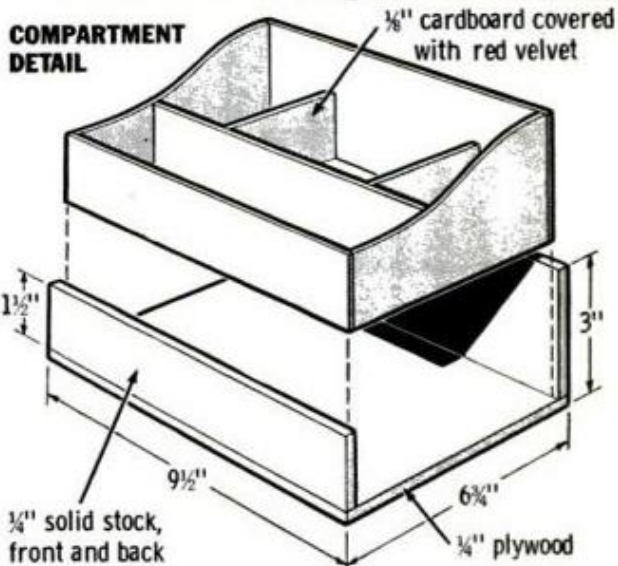
## HANDSOME TRINKET BOX

LOOKING LIKE A MINIATURE roll-top desk, this unique little box will be found handy for keeping track of all sorts of things. You can make it serve as a handkerchief box, a glove box, a place for decks of cards—you name it. You can even fit it with compartments, give it a plush lining and use it as a fancy jewel case.

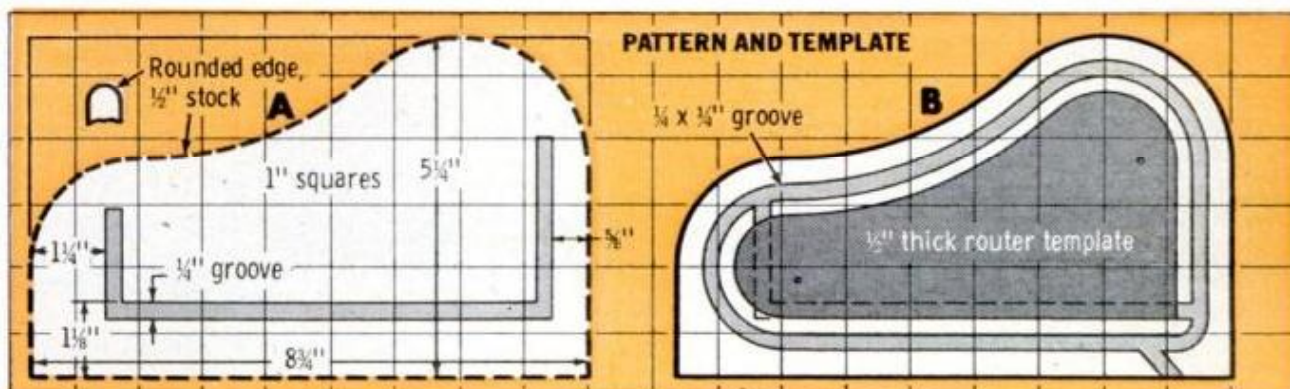
A router is required to make it, mainly to rout the curved track for the roll top. Start by squaring up the two pieces for the ends of the box and tracing off the pattern. But don't saw them out. The straight edges of the pieces are needed to guide the router in making the dados for the bottom, front and back as in detail A.

Next, enlarge the pattern for the template that is used to guide the router in

*(Please turn to page 217)*



A NEAT JOB OF LINING the box is done by first fitting the interior with a slip-in lining of cardboard and then covering each separate section with velvet. This way, raw edges of the cloth can be glued to back side of the cardboard and thus be hidden





## EXCITING NEW PRODUCTS

By CAROL SCHULTZ



**WATERPROOF SEALANT** applies easily with a paintbrush or roller. A coat of Epoxy-bond Waterproof Sealant will stop seepage in cellars, swimming pools, boat hulls and decks, driveways, walks and patios. It forms a smooth finish that will withstand scrubbing, scuffing and can be painted. A two-pound can, enough for 40 square feet, sells for \$5.95. By Atlas Minerals and Chemicals Div., the Electric Storage Battery Co., Mertztown, Pa.

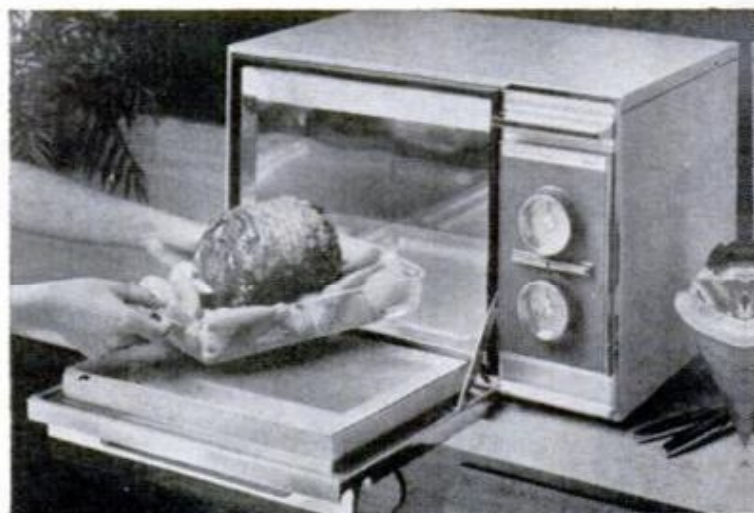


**HIGH-GLOSS VINYL FLOORING** does away with waxing, won't mar or stain and is impervious to moisture damage. Ultraflor Cushion-Step is made of tough, flexible sheet of plasticized vinyl chips with a cushioned underlayer of foam vinyl and abestos backing. About \$12 per square yard installed. Made by Robbins Products Inc., Tuscumbia, Ala.

**COUNTERTOP ELECTRONIC OVEN** cooks several times faster than conventional ovens, plugs into any 115-volt outlet and is the size of a portable television. It will bake a potato in 4 minutes and cook a hamburger in 60 seconds or a five-pound roast in 37½ minutes without generating external heat. Under \$500. By Amana Refrigeration, Inc., Amana, Iowa.



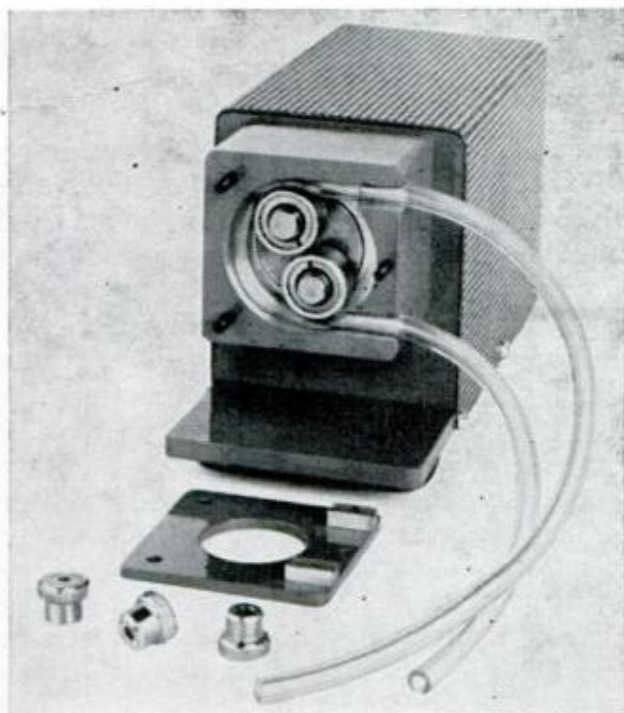
**PLASTIC FIRE EXTINGUISHER** called Fire FP is for small-fire emergencies in homes, cars, offices, farms, boats and trailers. The 12-inch-long device, filled with a patented dry-powder chemical, has a plunger handle. The operator pumps the plunger to produce a stream of powder that smothers the fire. It's priced at \$2.98, with refills at \$1.29. By Gay-Nor Products Corp., 513 Webster St., Chicago, Ill.







**RENEW WORN HANDLES** with Dulcico, a heavy-duty plastic tubing that shrinks to a snug fit when heated. Available in black, clear or red for handles  $\frac{3}{4}$  to  $1\frac{1}{8}$  inches in diameter, 60 inches long, \$1 postpaid. For handles  $1\frac{1}{8}$  to  $1\frac{1}{2}$  inches in diameter, 36 inches long, the plastic material can be obtained in a black or clear finish, \$1 postpaid. From Dulcico, 3546 Crownridge Dr., Sherman Oaks, Calif.



**SQUEEGEE PUMP** for precise, small-volume pumping applications is now available. Fluids and gases are forced through a flexible tube by squeegee action of a double rotor in the pump. The material being pumped never comes in contact with the moving parts, therefore the pump is suitable for applications where corrosion, contamination, or abrasion is a problem. Sold for \$110 by the Randolph Co., P. O. Box 13396, Houston, Tex.

**TWEezer MAGNIFIER** is an item the entire family will find useful. A few applications would include picking up and putting together tiny parts, as in building model kits, and removing those hard-to-see splinters. The tweezers are equipped with a strong magnifying glass connected to it by a lockable pivot. The tweezers magnifier is available for \$1.75 postpaid from the House of James, 2510 S. 13th St., Milwaukee, Wis.





# There's a lot you can do with The New Plastic Pipes

Wherein a Popular Mechanics reader discovers that a job estimated at \$1050 could be completed with plastic pipes in a fraction of the time and at a saving of over \$600

By V. LEE OERTLE

PHOTO BY ROBERT BORST



**I**F YOU'RE anxious to solve an outdoor watering problem, chances are you could save quite a bit of money and a few headaches by using plastic pipes and doing the job yourself.

In my own case, I became interested when faced with the need for 600 ft. of water main to sprinkle my two-acre suburban plot. The local plumbing contractor quoted \$1050 (that was two years ago, and steel pipe costs even more now). When I complained about the cost, he exclaimed "Try to do it yourself then!" and stomped off to better hunting grounds.

Realizing that one man alone would have an extremely difficult time joining 21-ft. lengths of 2½-in. steel pipe, and thinking of the fabrication problems I'd encounter with all the couplings and tee fittings needed, I estimated it would take a week just to put a steel line together.

And there were other problems, too. Steel pipe of 2½-in. diameter costs from 85 cents to \$1 per foot. Thus the bill for materials alone would be about \$600!

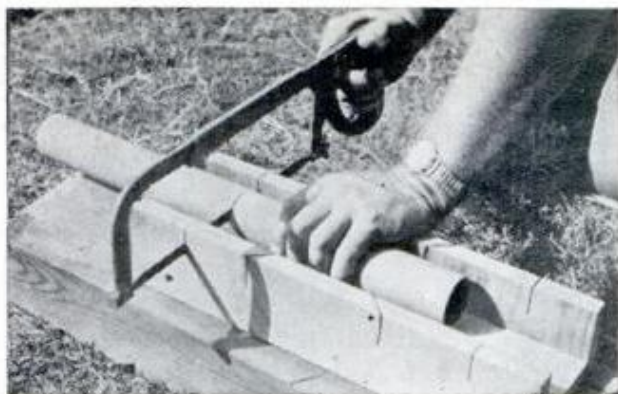
Luckily, about this time I ran into a local farm adviser who suggested I consider plastic pipe for the sprinkler system. Inquiring further, I discovered that a suburban homeowner often can purchase plastic pipe at contractor prices; in my case, \$180 for 600 ft. of 2½-in. line. The fittings in some cases cost more than galvanized fittings, but even so, my total materials bill ran only \$264.

After I asked about the time, tools and special instructions I'd need to work with the pipe, the manufacturer sent a field

**BECAUSE PLASTIC WEIGHS LESS** than steel, your better half can easily lend a helpful hand when working with plastic pipe. Here both electric and water lines from the house are being installed in same trench



## YOU CAN INSTALL IT NEATLY

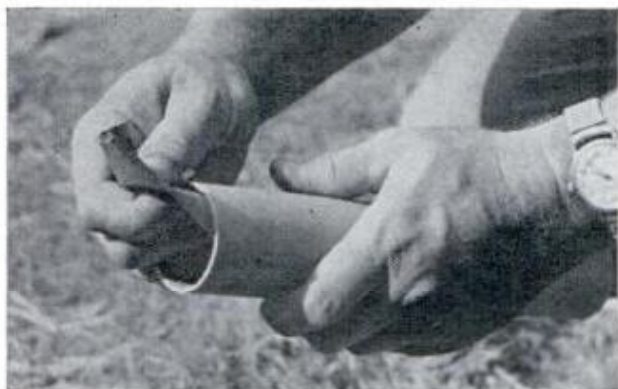


**CUT PVC PIPE SQUARELY**, with a hacksaw and a miterbox. A plastic wheel-cutter also could be used

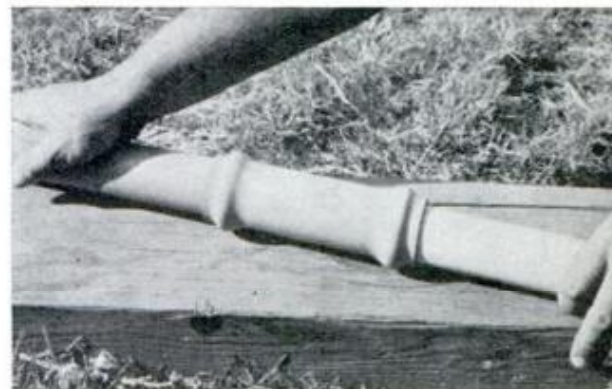
## YOU CAN REPAIR IT EASILY



**REMOVE DAMAGED SECTIONS** and bevel the ends of pipe. Lightly coat both ends of the pipe with lubricant



**CLEAN OFF ROUGH EDGES** with sandpaper or a knife. Then sand off the gloss on surfaces to be joined



**FORCE BELL-TYPE FITTING** over the pipe as far as it will go, then pull it back slightly to lock



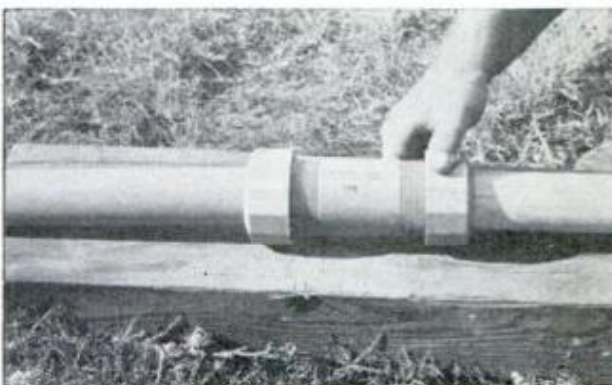
**APPLY THE ADHESIVE** with a small brush while rotating pipe by hand. It's important to work fast



**THREADED REPAIR COUPLINGS** have seals that fit between the body of coupling and threaded end caps



**COAT INSIDE OF FITTING** with adhesive, give a final coat to the pipe, quickly force fitting on pipe



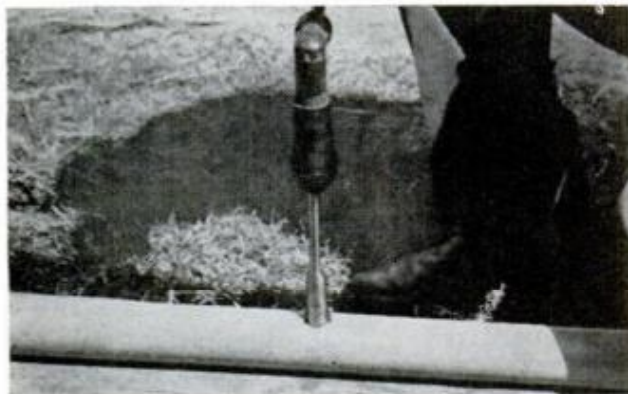
**SLIDE CAPS OVER PIPE**, align body of the coupling with the pipe ends, then screw on end caps until tight



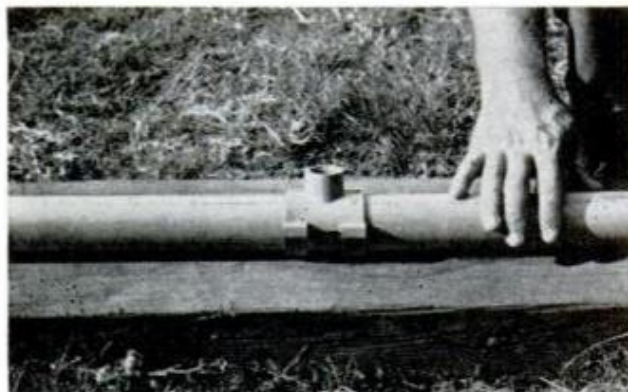
## YOU CAN TAP INTO IT QUICKLY



**SADDLE FITTING** will allow you to tap into a main water pipe without cutting it for a tee or elbow



**DRILL THROUGH MAIN** with a brace bit, being careful not to ram the bit into other wall of pipe



**APPLY ADHESIVE** around hole and press on saddle fitting. Be sure to align holes in fitting and pipe



**DRAW SLIDE-ON CLAMPS** around pipe and insert them in slots on fitting. Finally, thread in nipple

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engineer, who gave me enough instructions in one hour to carry me through. One advantage of plastic pipe, I found, was that I didn't need a wide trench because it was possible to fabricate the lines topside and simply lower them into a narrow trench. My backhoe bill was only \$90 for the 600-ft. run.

Once all the materials had been delivered, a friend and I began joining the 20-ft. lengths of pipe. With one of us holding the pipe and the other applying the adhesive, it went fast; in fact, we reached the end of the 600-ft. line in less than three hours. The best part was that we had fabricated the entire line on the topsoil, with enough room to work in comfort.

After waiting the usual four hours for the adhesive to set, we carefully lowered the line into the trench. A water test showed leaks in three fittings, which took another two hours to cut out and repair. (All were ordinary couplers leaking due to the inadequate use of adhesive.)

Thus, I saved \$695 by installing plastic pipes. What's more, I completed the installation in a fraction of the time a contractor would require, and all I used in the way of tools was a miterbox and saw, some sandpaper, a pocketknife and a few clean rags. As long as the installation is to be used for *cold water in open spaces*, anyone can install plastic pipes. Many cities do not yet condone them for home plumbing systems, but they can be used for sprinkling systems most anywhere.

### PVC and its installation

Many compounds are used to manufacture plastic pipe, the most popular being PVC (polyvinyl chloride), a thermoplastic material that can be softened and reshaped repeatedly by applied heat. Plastic pipe of PVC has good tensile strength, good impact strength and excellent ductility. However, its major drawback lies in its thermoplasticity—it can be used successfully only for cold-water applications.

Square cuts are important if leaks are to be avoided. Use either a backsaw or a hacksaw in a miterbox and remove any burrs or rough spots with sandpaper or a sharp pocketknife.

Rough the ends of the pipe with a medium-coarse sandpaper to remove the gloss, then fold the sandpaper over the edge of the pipe and run it around the inside and outside surfaces.

Use only the recommended adhesive for

POPULAR MECHANICS

Материал, защищенный авторским правом



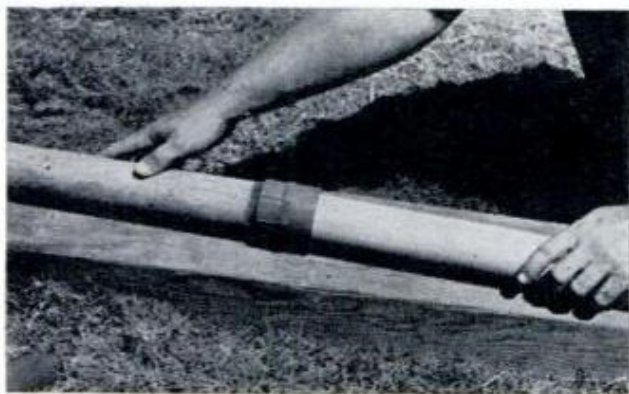
## YOU CAN FILL SPECIAL NEEDS



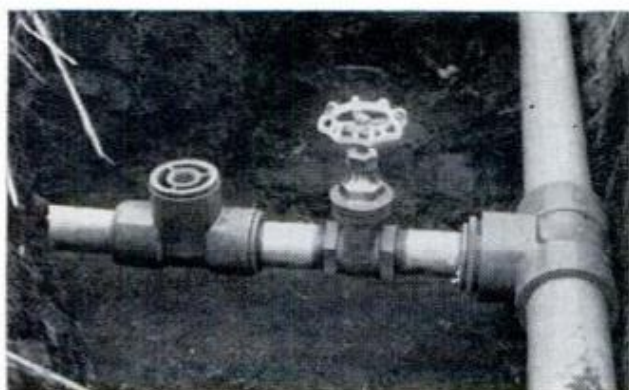
**PUT OUTLETS** in corners by using 3-way fitting with top threaded socket, slip fittings at bottom



**PREVENT DAMAGE TO RISERS** by using PVC tee fitted with a plastic street-elbow in center socket



**JOIN METAL TO PLASTIC** with slip-thread coupling. One end has pipe threads, other is glued to PVC pipe



**INTERMIX PVC WITH METAL FITTINGS** to meet other demands. Never leave PVC exposed to sunlight

PVC or the entire job may be ruined. Your pipe supplier will have a chart listing the different adhesives—your selection will depend upon the diameter of pipe you're going to use. Before applying adhesive, however, make a dry fit first. The fittings should slide on about one-third of the way without binding. If they're too tight, loosen the fit a bit with sandpaper.

The adhesive must be *flowed* onto the pipe. Coat the end of the pipe with the cement, then apply a thin coat to the inside of the fitting. Give the pipe another thin final coat and immediately insert the fitting over the pipe. Push and twist it until you feel the pipe hit the shoulder inside the fitting. Don't delay—you have only a few seconds to mate the two pieces.

Hold the pieces tight for 15 to 20 seconds, then wipe off any excess adhesive that's squeezed out. Don't disturb the joint for at least a half hour and wait four hours after the final joint before laying the pipe in the trench.

Wait out the full set-period specified by the maker of the adhesive before running water through the pipe. Avoid running cold water through hot pipes that have been lying out in the sun—the sudden change in temperature can cause rupture leaks. Just turn on the pressure gradually and check for leaks.

### Repairing plastic pipes

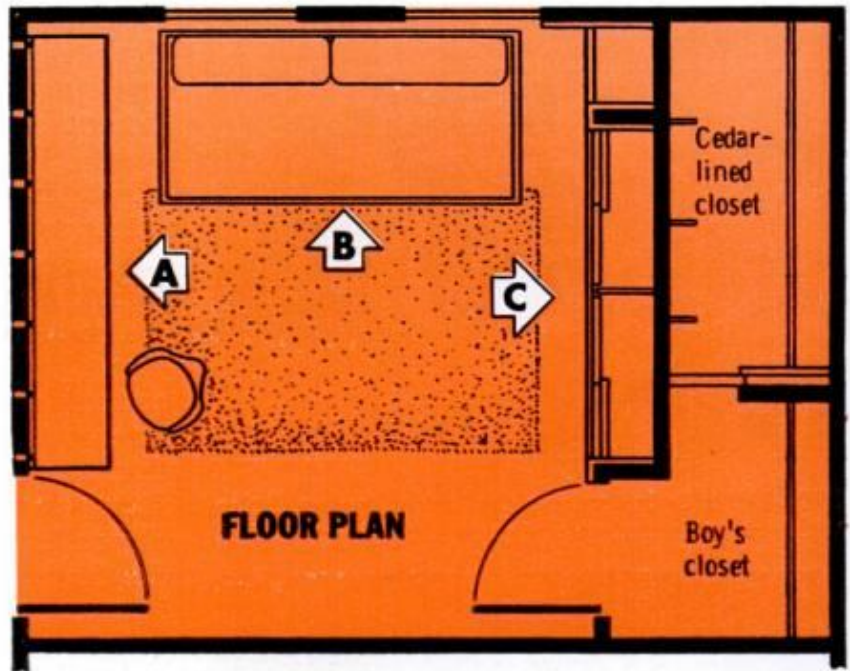
If a section of plastic pipe becomes broken or punctured, remove the damaged section with a hacksaw. Clean up the ends of the pipe and slip on one of several different types of repair couplings. The two most common couplings are the bell-type compression fitting and the threaded repair coupling.

The bell-type fitting has bulging "bells" on both ends that contain watertight seals. To install it, bevel the edge of the pipe and coat it with a fine lubricant. Slip one end of the coupling over the main line as far as it can go, then pull it back. Do the same on the other side and the line is ready for use.

The threaded repair coupling contains seals that fit between the body of the coupling and the end caps. Slip one end cap and one set of seals over one side of the broken line, and slide the other cap and seal over the opposite side of the line. Center the body of the coupling over the severed ends and screw on the threaded end caps as tightly as possible. ★★★



# BUILD YOUR BOY THIS



# 'DREAM ROOM'





**I**N OUR SEPTEMBER 1966 issue we showed you his "wonderbar." And in April 1967 we showed you his exciting electronic theater wall. Now we are delighted to take you through still another unique room in Bill Baker's fabulous "house of ideas" in Westport, Conn.

This time we show how, in remodeling a century-old relic into an ultramodern house, he transformed a nondescript bedroom into the ultimate in a dream room "for kids only."

Packed with ideas you can borrow, the room is designed for study, play and sleep, and makes the most of every inch of wall and floor space in the most compact way. For example, wall B (see floor plan at left) features a space-saving, wall-anchored sofa bed which becomes twin bunks when

you pull out a second bed parked underneath. Bolsters make it serve as a comfortable sofa by day.

A similar space-saving concept is cleverly put to work in the case of wall A. Recessed tracks, mounted vertically and screwed directly to the wall studs, permit ready-made shelf, desk and cabinet components to be hung, clear of the floor, in any grouping you wish.

In the case of wall C, not only does it provide storage galore behind sliding doors and drawers, but it supports a let-down train board which in turn becomes both a blackboard and pinup board when folded flat against the wall.

The desk-shelf wall (A) is available as a complete wall unit from Herman Miller Furniture Co. It's installed as follows:

*It's the ultimate in a kids' room with all the ingredients to make it the envy of the neighborhood.*

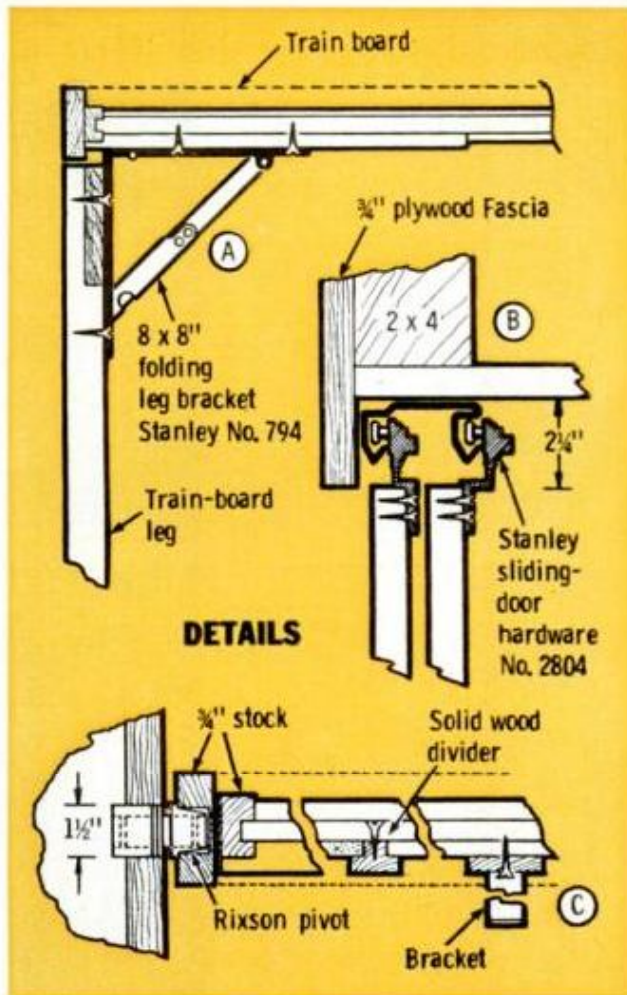
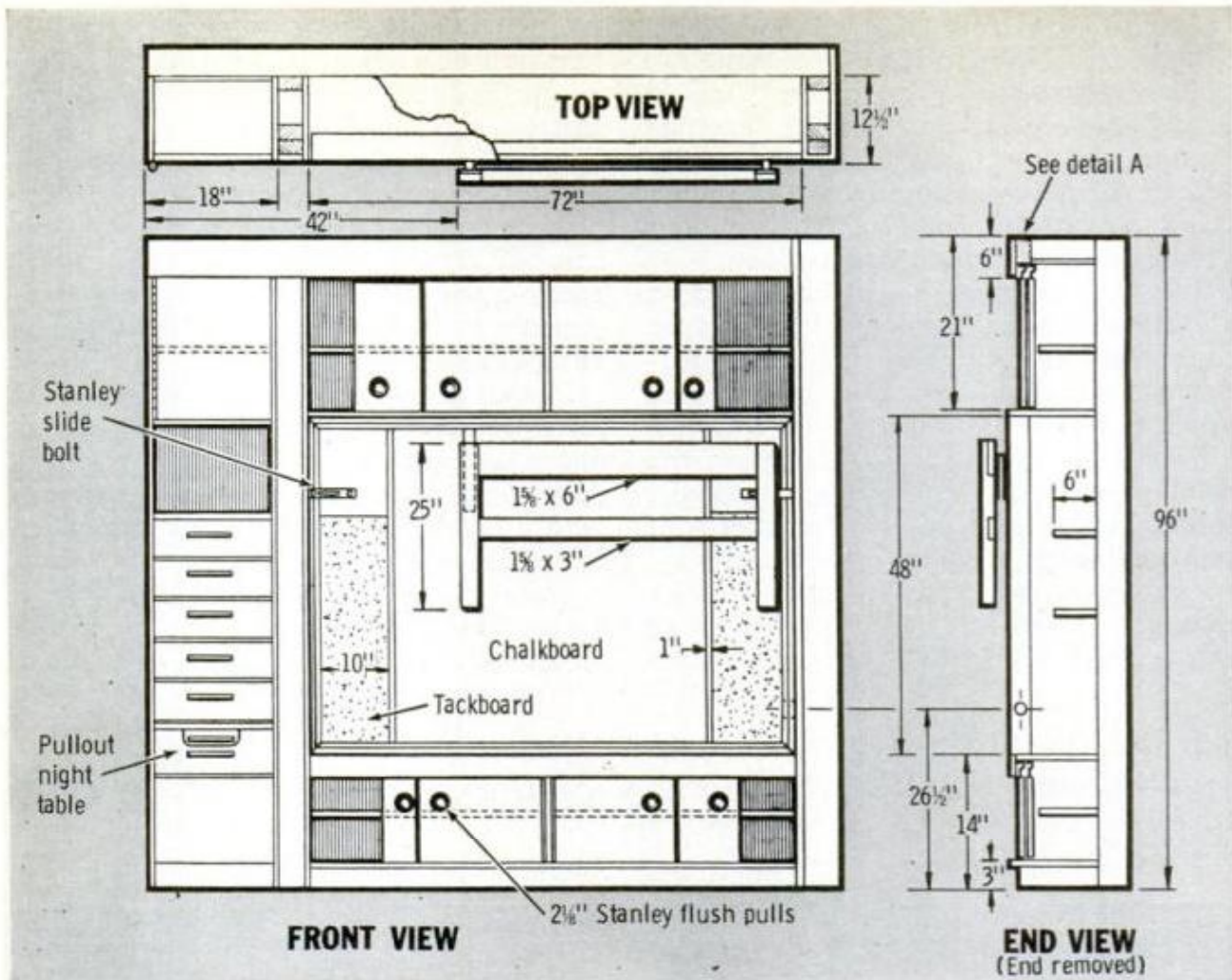
Technical Art by Don Evans



**BOASTING** ALL the essentials of the perfect kids' room, this youngsters' haven lets them get away from it all. Twin bunks give them a place to sleep; sound-deadened walls, a quiet place to study; and a let-down train board, a place to play. Hi-fi and intercom provide communication with the outside world, as well as entertainment, and there's even a blackboard on the underside of the train board to help solve school homework





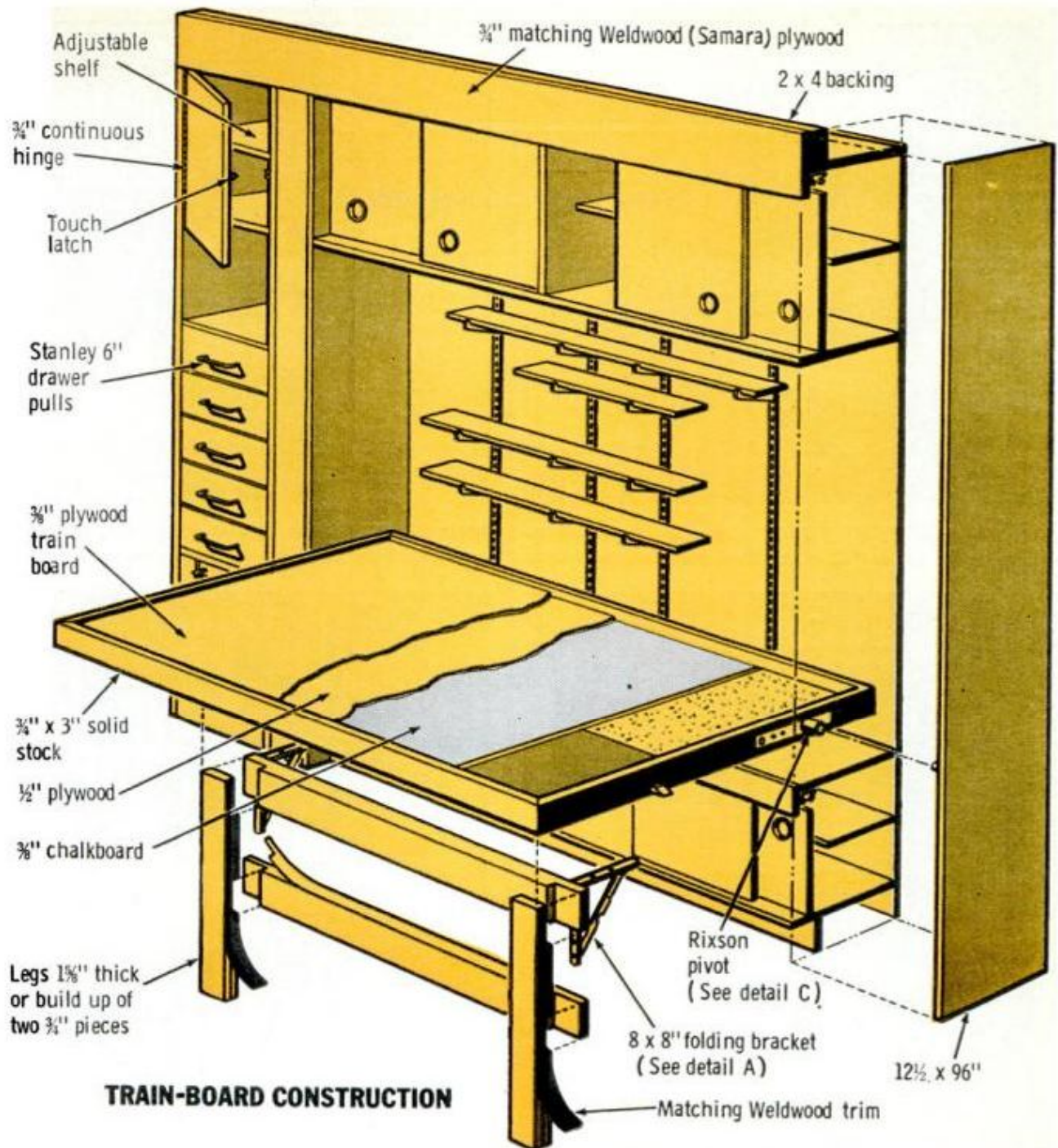


To start, the 8-ft. aluminum tracks are screwed to the center of each existing wall stud. Since studs are seldom even, you may find it necessary to shim the low ones and pare off the high ones to make all tracks even when checked with a straight-edge. Next, spaces between tracks are filled with narrow panels of 1/2-in. special insulating board (in this case Barrett's) to soundproof the wall. Panels are cut to fit snugly from track to track, then nailed and glued to the studs. Finally, similar panels of 1/4-in. prefinished plywood are glued to the sound-deadening board to complete the wall. This done, the tracks project only 1/8 in. Locking brackets fit the tracks and support the shelf and cabinet components which are selected to suit.

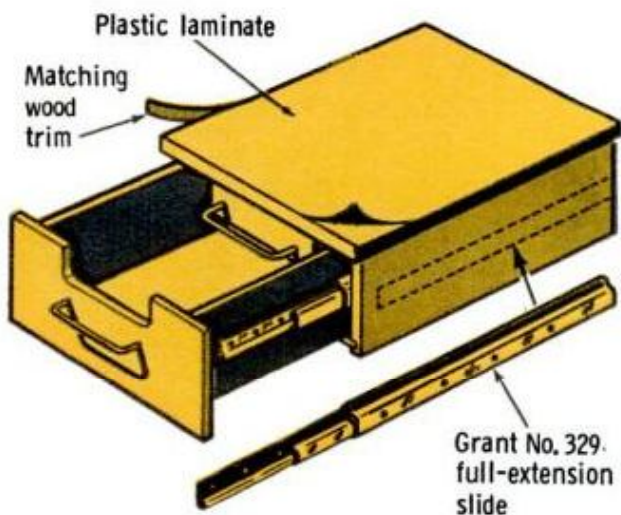
While it's unlikely you will be able to duplicate the room exactly, any one of these innovations can be easily adapted to suit individual limitations and even be found useful in other rooms. The train-board wall, for example, is ideal for a basement playroom where its folding feature makes it equally practical to close it up when not in use.

Construction of the train-board "wall"





### TRAIN-BOARD CONSTRUCTION



### PULL-OUT NIGHT TABLE



FOLDAWAY TRAIN BOARD swings up flush in its own wall cabinet when it's time for sleep or homework

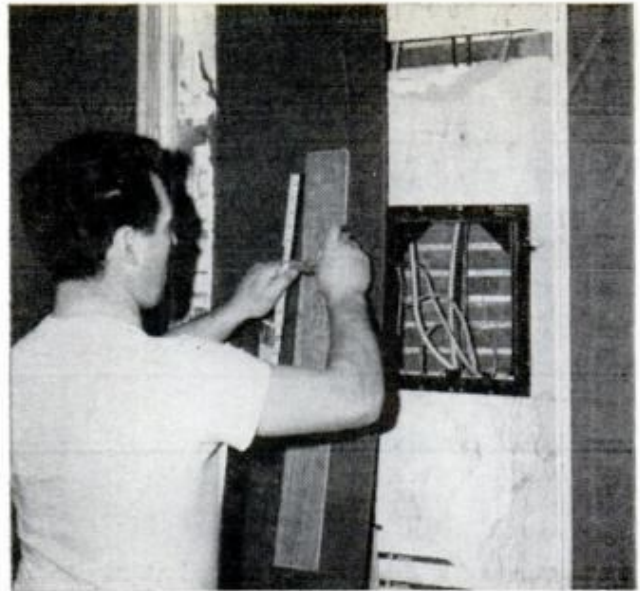


CUT  
FOLD  
TAPE

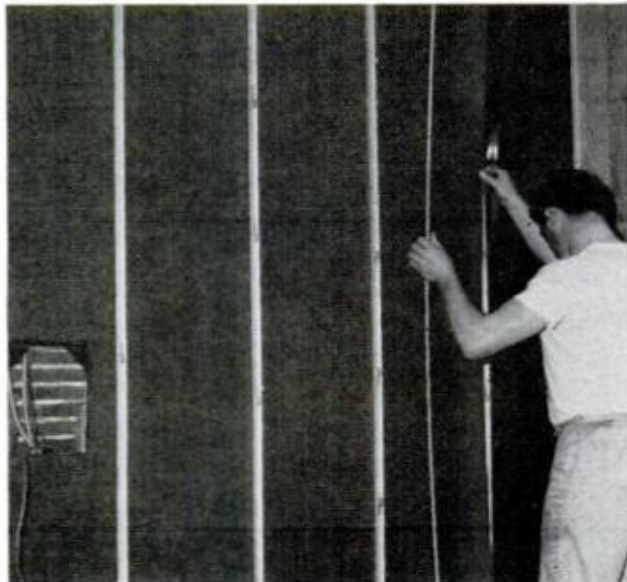
BOY'S  
ROOM



**SOUND-DEADENING BOARD** is applied to all partition walls. Here it's being fitted between the tracks



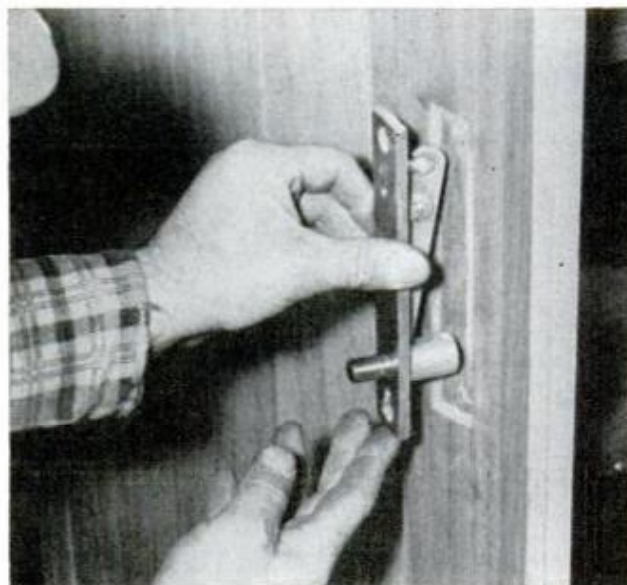
**WALL OPENINGS** for intercom and electrical outlets are transferred to sound-deadening board, and cut out



**FINAL COVERING** of the 1/4-in. prefinished paneling goes over sound-deadening base and is cemented to it



**LOCKING BRACKETS** in tracks support ready-made shelves and cabinets in any grouping desired



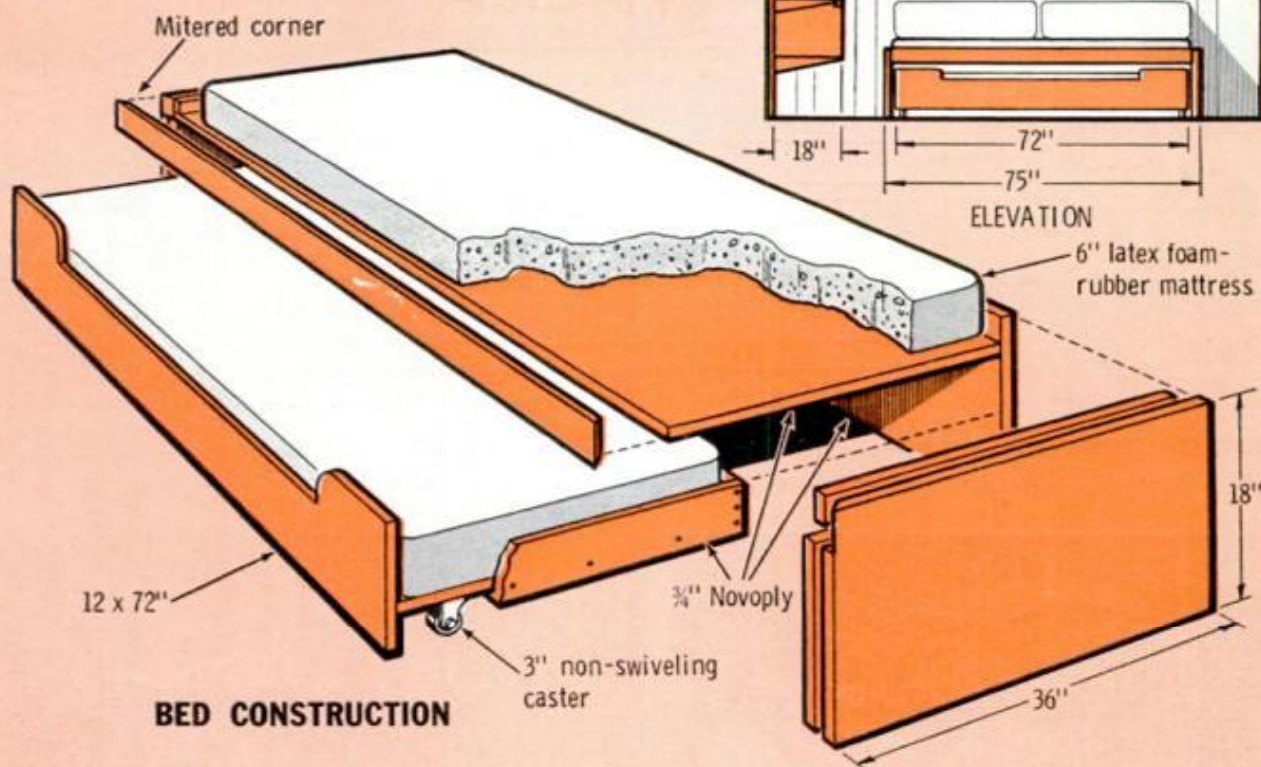
**TOP PIVOT PORTION** of floor closer is used to provide pivots for train board. Fits cabinet sidewall



**TRAIN-BOARD LEGS** and crossrail can be 2x4s or built up of two 3/4-in. pieces and glued in dadoes



**IN THE EVENT** you need only one bunk, the bottom bed can be compartmented and made into a king-size storage drawer for bedding, clothes or toys. Of course, as a stand-by bed, it will come in handy for buddy sleep-overs. Built like a tray, recessed top of each bunk keeps latex mattress in tow. Main bunk can be anchored to the wall to keep it from shifting. Veneer-faced hardwood plywood is used for exposed parts, less expensive plywood for the rest

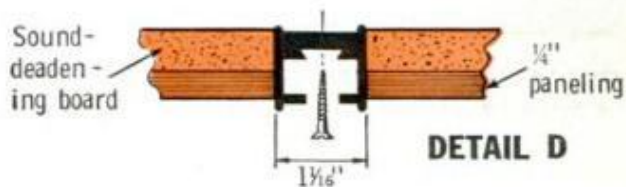
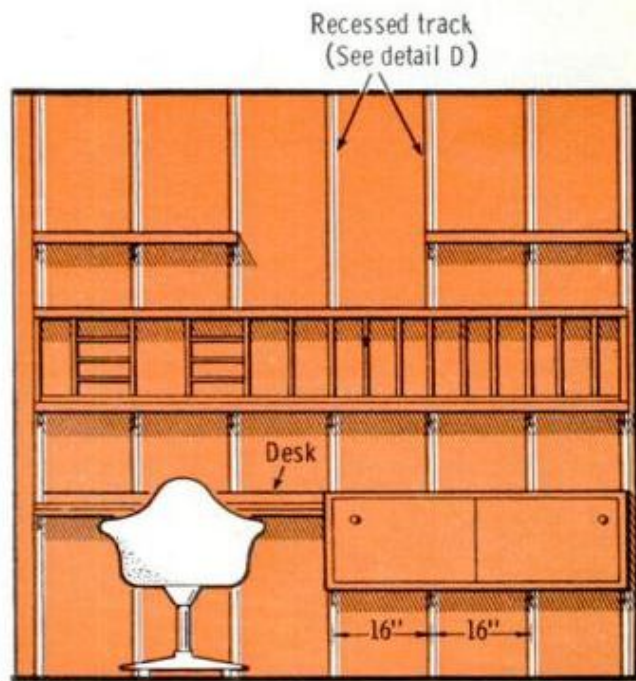


involves building a 12-in.-deep, floor-to-ceiling cabinet with sliding-door storage across top and bottom and drawers along one side. The recessed area of the cabinet houses the board when folded, leaving only the thickness of the legs projecting. Shelf standards are screwed to the back wall of the cabinet to support board shelves, and standard sliding-door hardware is used to hang the bypassing doors.

The drawer section of the cabinet incorporates a clever pull-out night table—it's like a drawer within a drawer. Single extension roller guides are used to install the drawer of the night table; a full extension guide is used for the night stand itself.

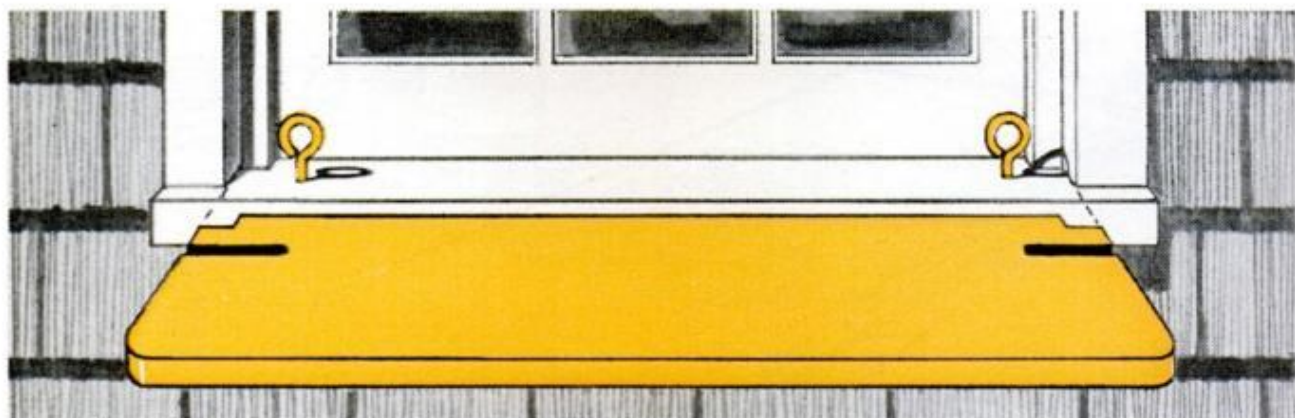
The 2x4 legs of the train board fold on folding shelf brackets, whereas the board itself pivots on a Rixson floor closer which engages holes in the cabinet sidewalls.

There's nothing difficult about making the twin bunks. Fitted with nonswiveling plate casters, the bottom bunk pulls out like a drawer, and both use slabs of cored, latex foam rubber for mattresses. Hidden parts of the bunks can be of less expensive material than the exposed surfaces. ★★





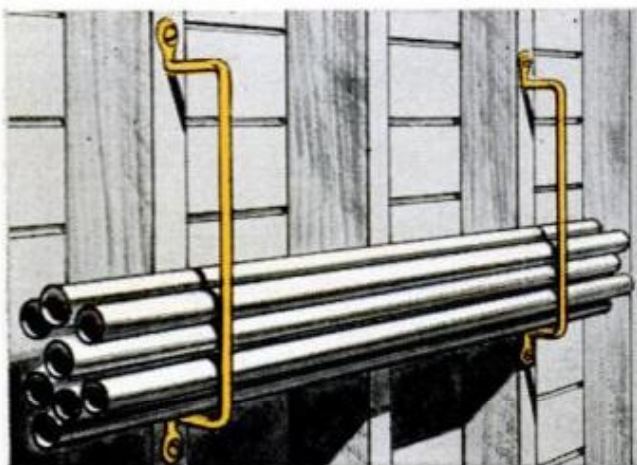
# Solving home problems



**REMOVABLE FLOWERPOT SHELF** made of  $\frac{1}{2}$ -in. plywood has slots in either end which fit over screw eyes driven into the sill. Drive the screw eyes in far enough to hold shelf when turned at right angle to slots



**TO REMOVE STAINS** from tile grout, simply rub them with an ordinary typewriter eraser and wash with warm water. The pumice in the eraser acts as scouring agent. Brush end is fine for cleaning crevices



**STORAGE RACK** for poles, metal rods and pipes can be made by mounting a pair of old towel racks vertically on studs in your shop or garage. Such a rack is also handy for storing irregular lengths of lumber



**YOU CAN INCREASE** the efficiency of heating tape by attaching it to lengths of wood lath. The wood holds heat longer than the metal gutter and provides a larger heating surface, so the ice will melt faster





**TO MINIMIZE FLAREUPS** when grilling hamburgers over charcoal, cover the grill with aluminum foil and poke a few small holes in it to let the flavorful smoke come through. This will also make cleanup easier



**IF YOU FIND** that the handle on your plumber's friend is coming loose, just nail a bottle cap on the end of the handle and force it firmly into the socket. The edges of the cap will hold the handle securely



**WIDE CROSSARM** on the top of your extension ladder makes it easier to clean, putty or paint windows since the ladder can be located directly over the window. Use metal brackets to attach it to ladder

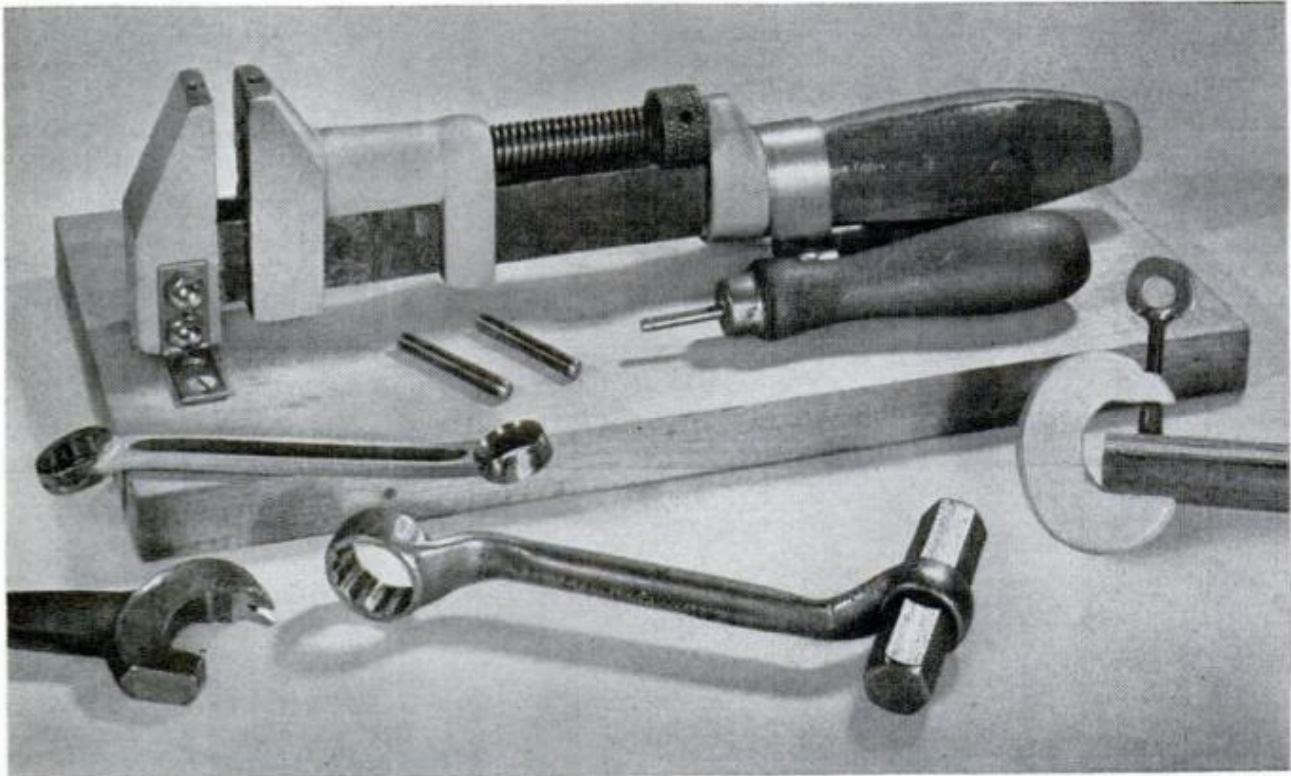


**MISSING SPOT** on your pool table needn't hold up the game. A good temporary replacement is one of those reinforcement rings for notebook paper. It's the right size, and thin enough so it won't deflect balls



# Uncommon Uses for Timeworn Wrenches

By WALTER E. BURTON



**B**Y MONKEYING AROUND with a monkey wrench you can make it do a number of tricks other than just turning nuts and bolts. Modified as shown above, it will act as a portable vise, serve as a wire-forming tool, apply a pulling force when needed, and even perform as an adjustable gauge to check diameters, thicknesses and lengths. Yet, it's always ready to revert back to use as an ordinary wrench.

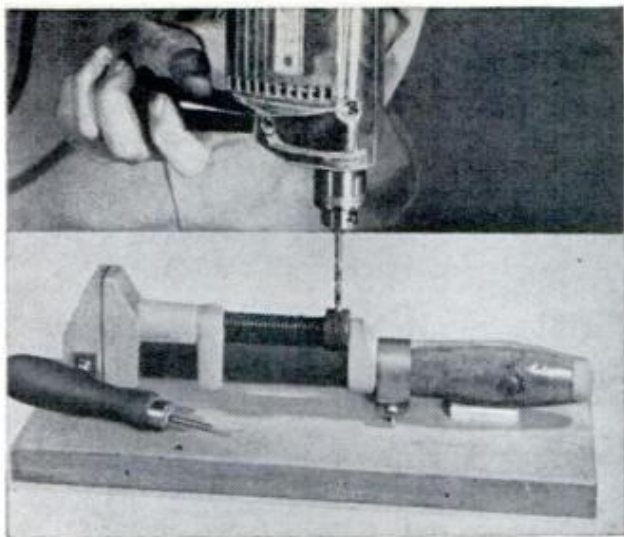
Similarly, other types of wrenches, particularly nonadjustable box and open-end models, also lend themselves to simple improvisations that increase their usefulness. Even those that have outlived their useful life span often can be resurrected to serve as mallet or hammer handles, small C-clamps, contoured scrapers, tack pullers and other special-purpose tools.

To convert a monkey wrench to an adaptable tool "system" like that shown

above, first mount the wrench on a wooden base so that it will be self-supporting, yet convenient enough to clamp in a vise or other bench mount. For a 12-in. wrench like that shown, the base should measure approximately  $\frac{3}{4} \times 6 \times 13$  in. Anchor the wrench to the base by first drilling two  $\frac{3}{16}$ -in. holes through the head of the wrench and attaching two 1x1-in. steel corner braces to the head. Then just fasten the braces to the wooden base with suitable wood screws.

Bend a strip of sheet metal around the handle of the wrench and secure it to the base with screws through holes drilled near the ends of the strip. If necessary, place a block under the handle so the wrench lies flat on the base. Mounted in this manner, the wrench is ready for use as a portable vise, yet all you do to use the wrench proper is remove the mounting bolts and screws.





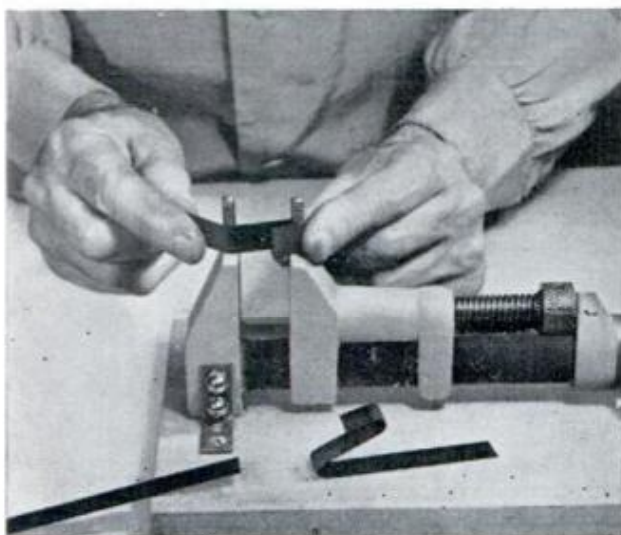
**MOUNT MONKEY WRENCH** on base of convenient size, drill through center of knurled adjusting head

To increase the clamping pressure of the jaws, drill a cross hole (about  $\frac{3}{32}$ -in. dia.) through the knurled head on the adjustment screw and use a lever to tighten and loosen the jaws. Ideally, the lever should consist of a simple handle and a steel rod of sufficient length to pass through the knurled head for maximum leverage.

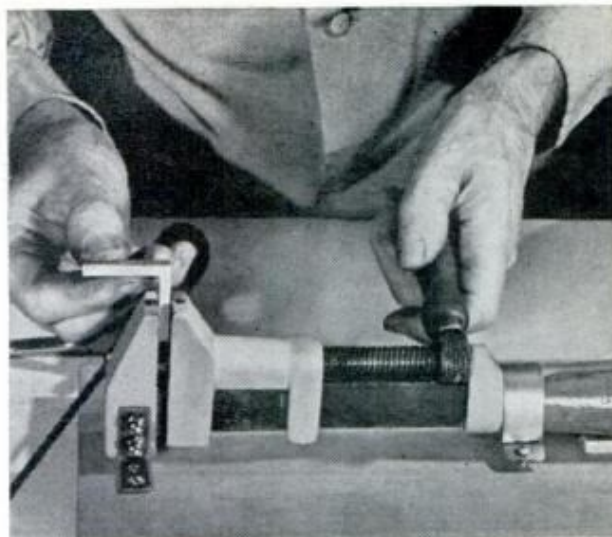
In the tip of each jaw, drill a hole  $\frac{1}{2}$ -in. deep to receive a pair of  $\frac{3}{16}$ -in.-dia., 1 $\frac{1}{2}$ -in.-long steel pins. Spacing of the two pins is varied by the movement of the jaws. Thus they can serve as a bending jig for forming wire and metal strips, as adjustable rods to gauge dimensions, as spring or ring pullers, and even as stretchers to convert rings to ovals.

The conversion of another type of wrench into a double-duty tool will depend greatly upon its condition and the

**PINS SLIPPED IN JAWS** transform the vise into an adjustable jig for bending wire, rod, strip stock



FEBRUARY 1968



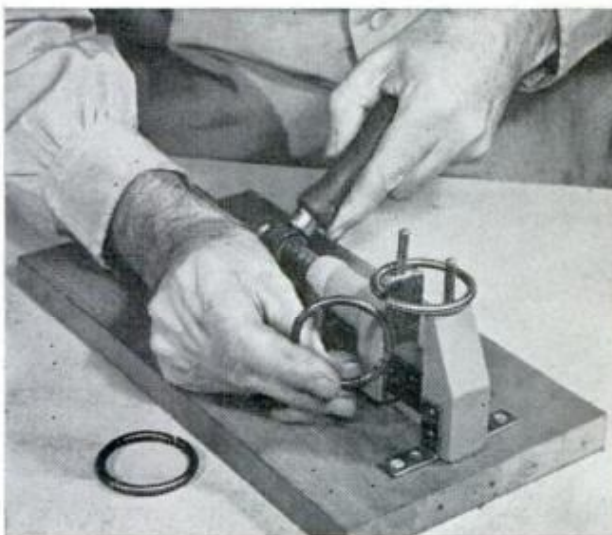
**USE IT AS A PORTABLE VISE**, or convert tool back to wrench use. Lever increases clamping pressure

required function. The small C-clamp, for example, should be made of an open-end wrench that's been worn beyond ordinary use or broken accidentally.

To convert a timeworn wrench like the  $\frac{7}{8}$ -in. tool shown to a C-clamp, first saw off the usable head and grind all rough edges to a smooth contour. Drill and tap one jaw for a 10-32 flathead machine screw that's been converted to a thumbscrew by soldering or brazing a steel washer in its slotted head. Complete the modification by slipping a plastic cap on the tip of the thumbscrew to prevent the work from being marred.

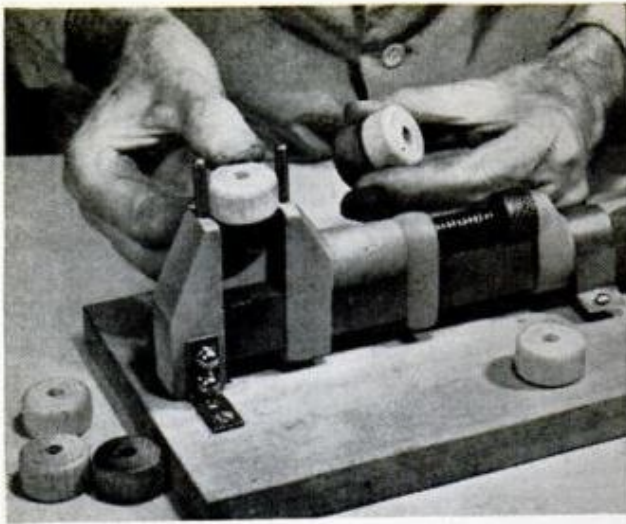
Scrapers for concave or other contoured surfaces often can be formed by grinding the jaws of an open-end wrench to a sharp edge. Tools like these are especially useful when removing accumulations of softened

**PINS CAN ALSO BE USED** as an expansion tool. Here they're seen opening the gap of a split steel ring



175





**DIAMETERS, THICKNESSES** and lengths of multiple pieces are easy to gauge. Accuracy can be surprising

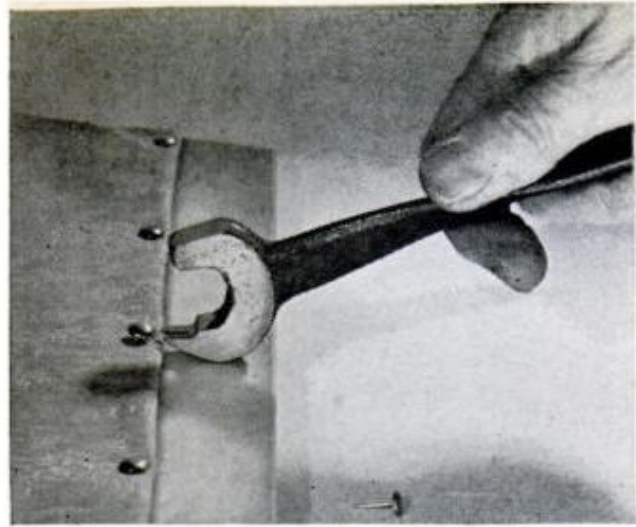
paint or varnish, especially on molding or in curved corners.

Another handy woodworking tool is a cutting ring formed from a 12-point box-end wrench. It duplicates the action of a woodcarver's deep gouge, and is suitable for smoothing concave surfaces, cutting round grooves in wood, hollowing cavities and shaping other contoured surfaces.

Before working the wrench, however, anneal the head by heating it until it's red and letting it air-cool. Then ream, grind or file the inner edges to form the desired edge bevel. Grind or file the outer surface of the head to a uniform slope all around (except where the shank and head are joined), reharden the wrench and give the cutting edge a final honing.

To reharden a steel, try the following: Heat the metal to a cherry red and quickly quench it in water. Polish a bright spot on the metal and reheat slowly until the polished spot turns a mottled brownish red; then quench again. If this method

**SHAVING RING** made from 12-point box-end wrench makes neat work of smoothing out curves in hardwood



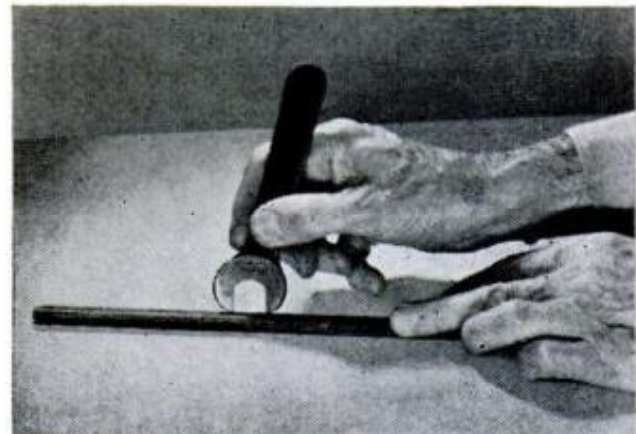
**TACK PULLER AND HAMMER** was formed from an old, twisted open-end wrench. Just grind profile shown

doesn't harden the steel sufficiently to resist the bite of a file (before the second, tempering heating), treat the metal with a commercial case-hardening compound.

Another of the wrenches illustrated has been converted to a hammer handle that will accept many custom hammerheads. Start out by fitting a box-end wrench with a pair of suitable setscrews that secure a short length of round or hexagonal stock in place. Other heads can include a long, curved and tapered head for reaching into cramped work areas; or even a brass, copper or aluminum head that's soft and non-sparking as well.

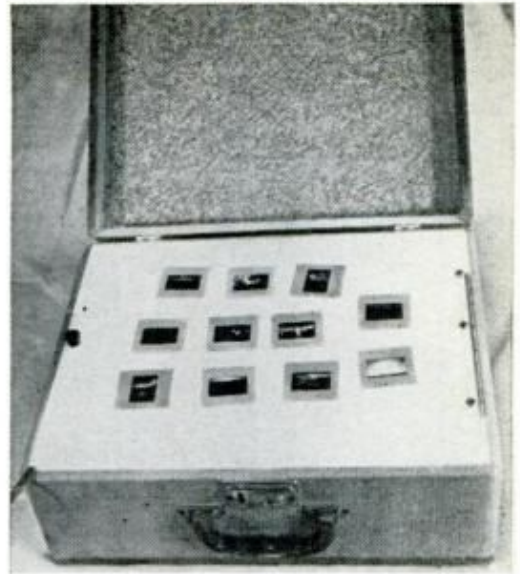
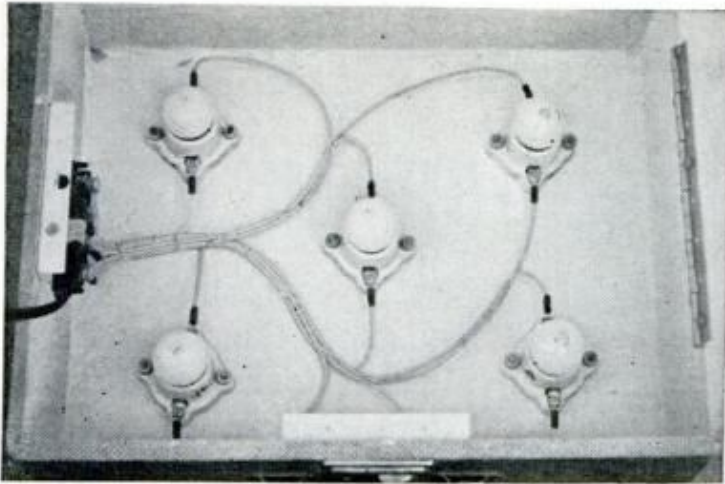
In most cases, it's a good idea to drill shallow holes in the hammerhead to receive the ends of the setscrews and prevent the head from creeping upward with each blow. Using this method, you can use pieces from your bin of scrap metal to accumulate a flexible set of special hammers for craftwork. Changing heads is just a matter of seconds. ★★★

**GRIND THE TIPS** of an open-end wrench to a fine edge and scraping of molding, corners becomes easy



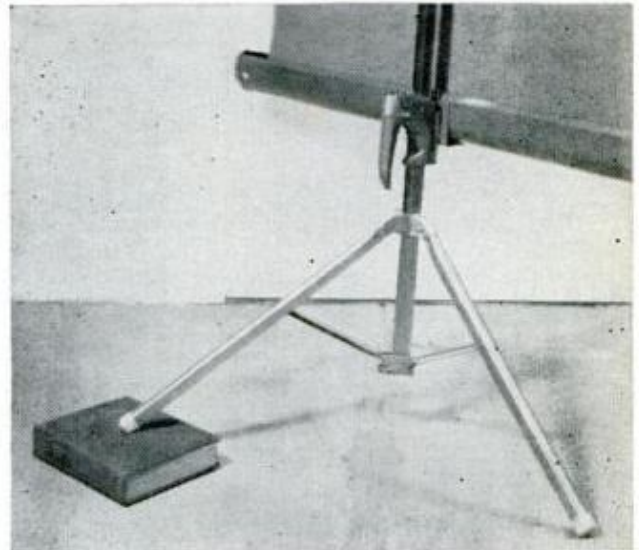


# Photo Hints

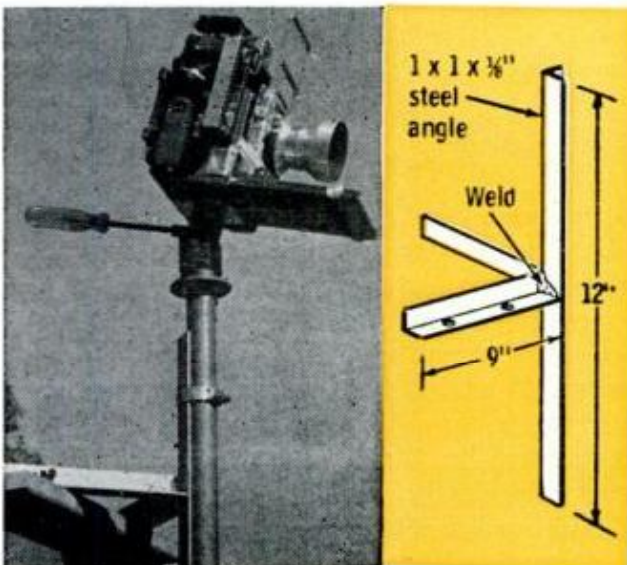


**A PORTABLE SLIDE-VIEWING LIGHT BOX** like the one above, made from a small, discarded suitcase, is handy for carrying from house to house or on a trip and has its own protective cover for safe storage. Five standard porcelain sockets are screwed to the bottom and wired in parallel to a cord and plug. Small 7½-watt white light bulbs provide good illumination without taking up much space or producing excessive heat. The viewing panel is a piece of translucent white plastic hinged at one side so it can be raised to store the card inside. The plastic rests on cleats screwed to the sides of the suitcase.—Rod Moon

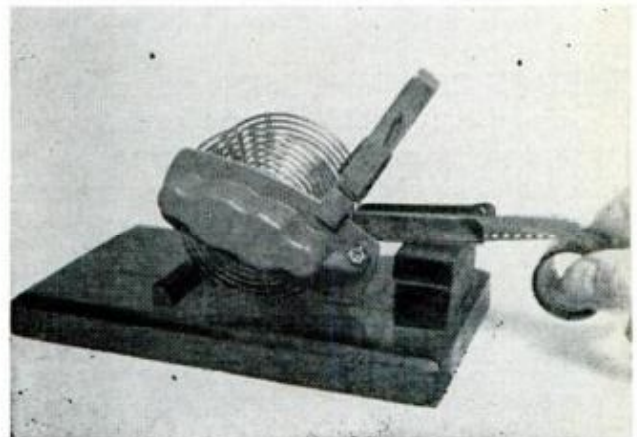
**GIVING A SLIGHT TILT** to your projection screen, as shown at the right, will solve the problem of "key-stoning." Because the projector is usually lower than the screen and tilted upward, the image gets wider at the top of the screen and is not uniformly in focus. Placing a book under the stand's rear leg will tip the screen so it's flat to the projector, thus eliminating the problem of distortion.—Robert Hertzberg



**HIGH-ANGLE SHOTS** are often made from the top of a stepladder. To make this task easier, the bracket shown below will give you a steady support for your camera while you're working up in the air. The V-legged bracket, made from 1-in. steel angle, can be quickly attached to the ladder's top step with ¼-in. bolts and wingnuts. Your regular tripod column can then be fastened in the vertical V channel with hose clamps. If your tripod isn't the type that has a center column, simply fold the legs together and clamp them in the channel.—A. J. Lowe



**LOADING FILM** into a developing reel in the dark is easier when you use the jig below. Groove the base to guide the reel's flanges. Bend a trough of thin metal and clamp it to the reel with a clothespin. Start the film into the reel, then remove the clamp and wind with the reel riding in the grooves



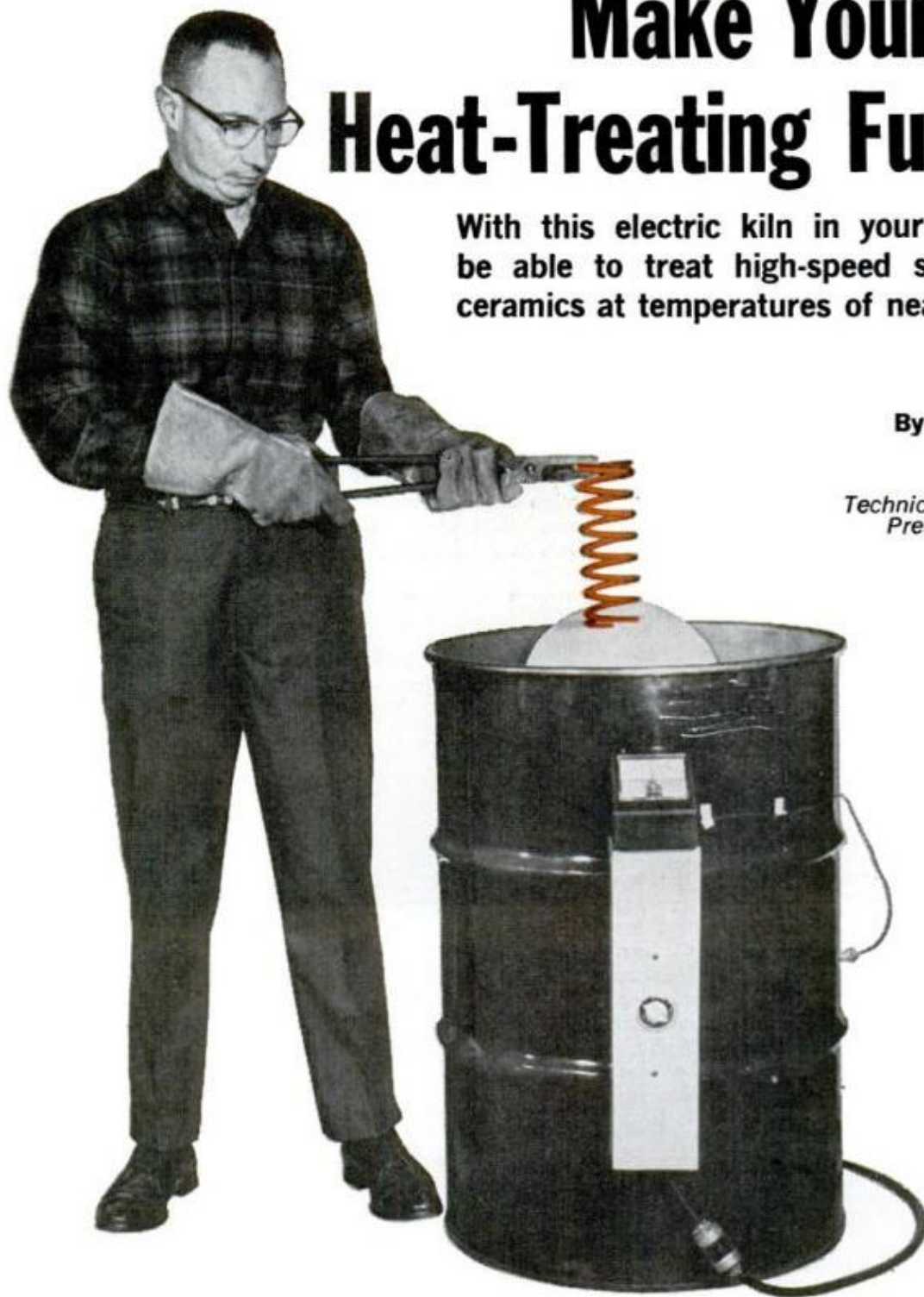


# Make Your Own Heat-Treating Furnace

With this electric kiln in your shop, you'll be able to treat high-speed steels or fire ceramics at temperatures of nearly 2300° F.

By PARRY C. YOB

*Technical Art by Graphic  
Presentation Services*



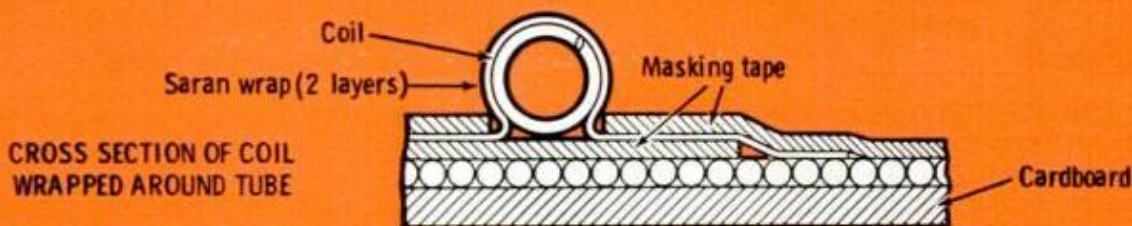
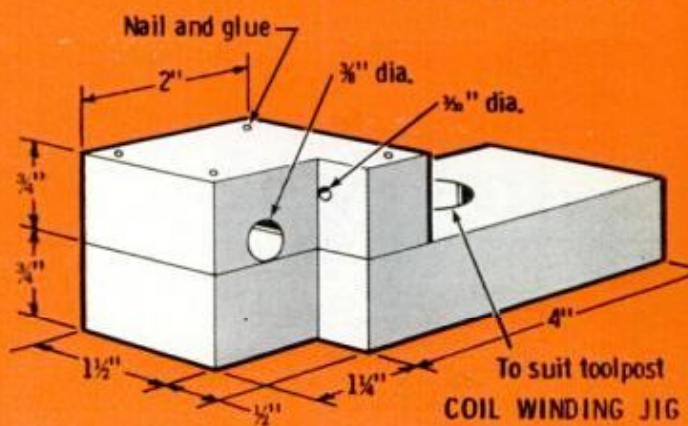
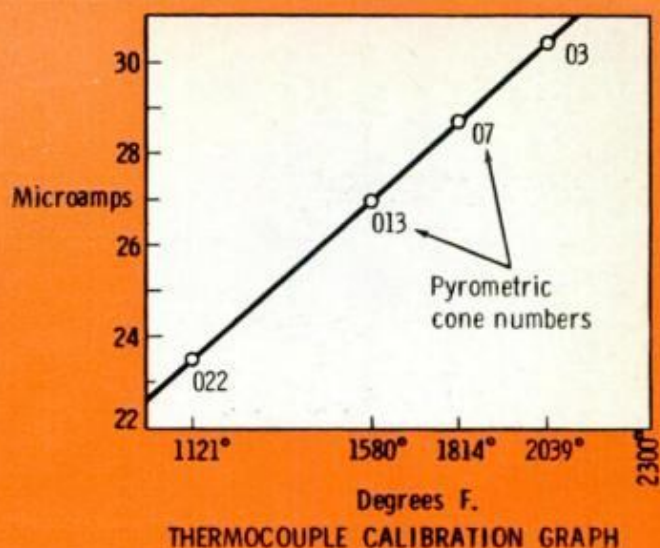
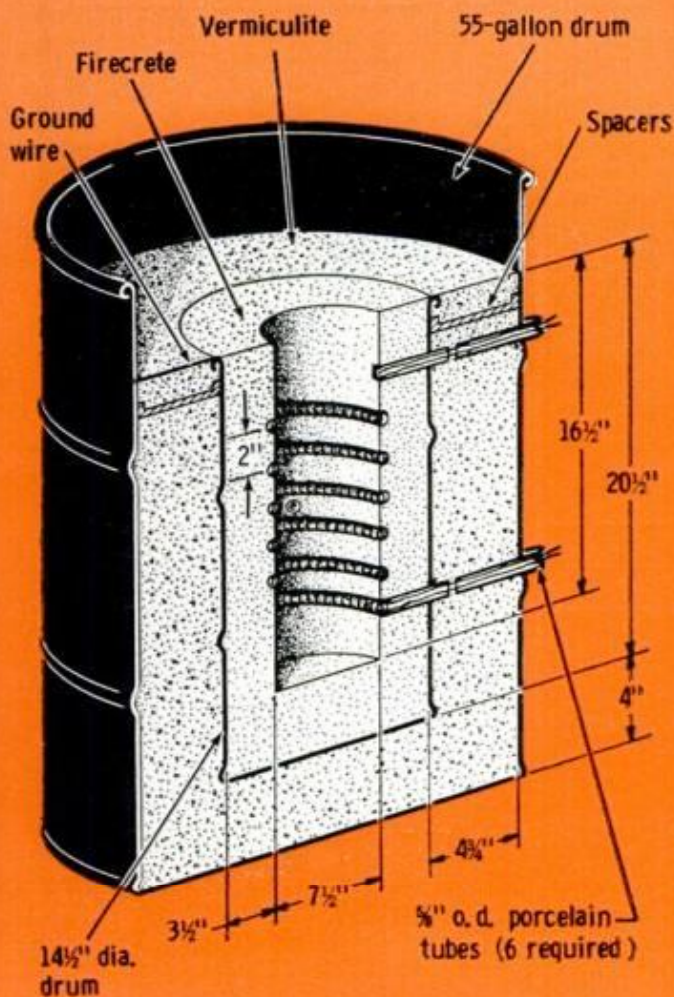
**U**SED IN CONJUNCTION with an ordinary household electric oven, this furnace makes an ideal heat-treating system. You can bring steel to the proper hardening temperature with the furnace, then quench it. Later, you can draw the temper by placing the metal in an oven preheated to the required temperature.

To anneal steel or fire ceramics, the work again is brought to the proper temperature in the furnace, which then is

shut off and kept covered while the work cools to room temperature. If you have a number of pieces to anneal, you can simply remove them while still hot and drop them into a box of heat-insulating lime powder. Thus the furnace is kept free for other work.

As shown in the drawing at right, the furnace basically consists of two drums, the smaller of which houses the heating coil. To properly cast this section, first read





the following detailed instructions thoroughly, then observe them explicitly.

Begin by winding a rip cord over a 2-ft. length of heavy cardboard tubing. This tubing, often used as a core for carpet materials, should have a diameter of 6 1/2-in. Drive eight 8d nails through one end of the tube, about 1/2-in. from the bottom, and close the end with two layers of polyethylene sheet held in place with tape. Place the covered end on a smooth surface and fill the tube with 2 in. of casting plaster.

Once the plaster has set, staple the end of a 200-ft. length of 1/4-in. braided cotton sash cord to the plugged end of the tube. Then wind the cord around the tube for at least 16 1/2 in. Staple the last coil to the tube and run the rest of the cord up along the tube.

Use a household flatiron to apply a smooth, even coating of paraffin over the

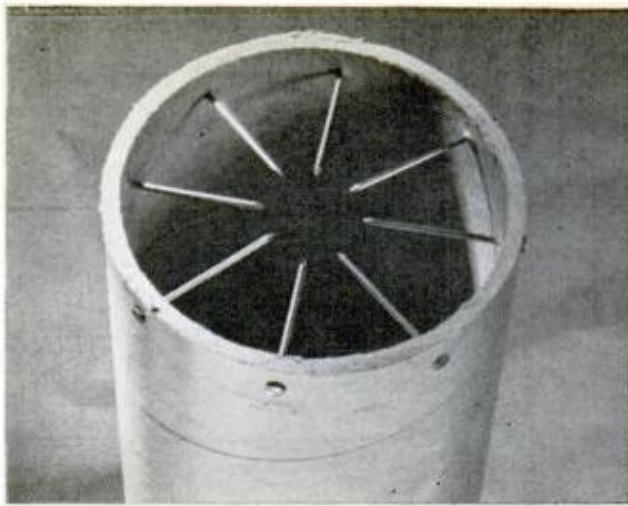
sash cord. The trick is to have the iron just hot enough to melt the wax when pressure is applied. If the iron is too hot, the grooves will not fill properly.

The heating element is made by winding 77 ft. of 14-gauge Hoskins alloy wire No. 875 on a 3/8-in. metal rod. This particular alloy, available from Hoskins Mfg. Co., 4445 Lawton Ave., Detroit, must be used as it has a high melting point of 2270° F. Ordinary Nichrome wire cannot be used because it melts at a lower temperature and does not have the proper resistance.

Leave 1 ft. of wire at each end of the coil. Twist another 1-ft. length of element wire over each of these ends to form the lead-in wires. Be careful not to nick or damage the wire where it becomes a single strand.

Stretch the coil to 10 ft. and fit it around the core. Keep stretching the coil until it





**HEAVY CARDBOARD** tube has nails driven through one end, then is sealed with 2-in. layer of plaster



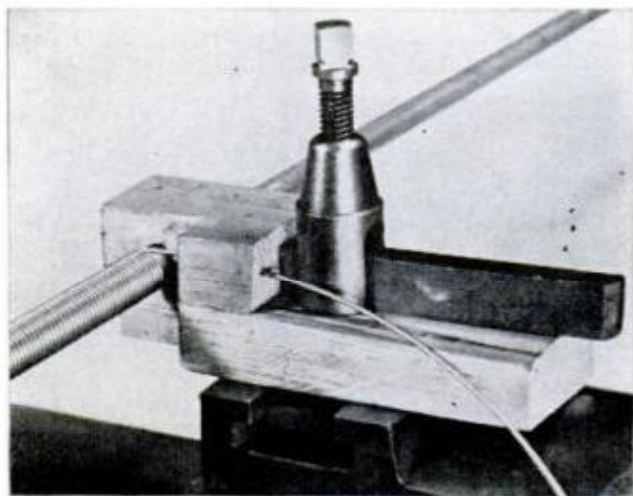
**WIND RIP CORD** around tube. When pulled out later, cord leaves space enough to remove cardboard core



CUT  
FOLD  
TAPE

**ELECTRIC  
FURNACE**

**HEATED PARAFFIN** is forced between ridges of cord. This will provide a smooth surface inside refractory



**HEATING COIL** is made by turning No. 875 alloy wire around  $\frac{3}{8}$ -in. rod. Wood jig is used as a guide

makes six complete turns, each spaced 2-in. apart. Be sure the element is stretched evenly and then attach the ends of four 1x24-in. strips of poster board to the unwrapped portion of the tube. Tie the end of the element in place 1 in. above the bottom of the core and wrap it evenly around the strips. Tie the upper end of the element to the core, check spacing and attach the element to the strips with masking tape.

To prevent element burnout, it's necessary to cast the refractory around the coil, rather than embed it. This is accomplished by slipping short lengths of 2-in.-wide masking tape between the element and the waxed core (the adhesive side of the tape should be placed against the element). Then place a layer of sticky plastic wrapping (like that used to wrap sandwiches) over the heating element and tuck the plastic around the coil. Lay a second covering of the plastic over the first and bind both in place with masking tape wrapped around the cardboard core. Thus, when the

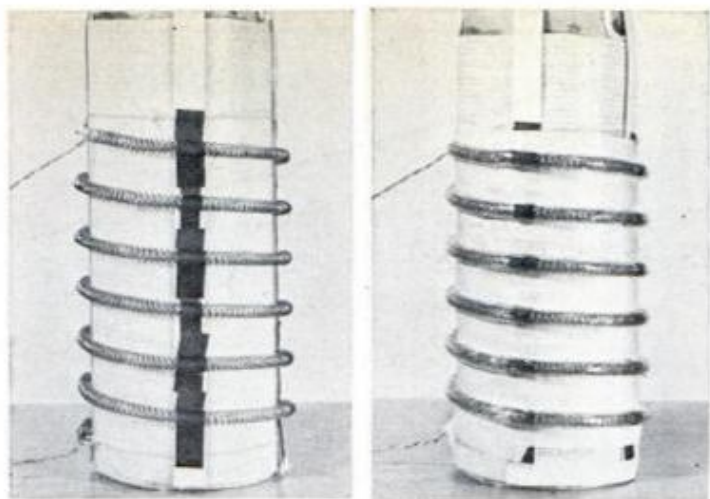
rip cord is pulled from the completed casting, a cross-sectional view of the coil will show three-quarters of its circumference surrounded by the refractory material, while the remaining one-quarter is open to air for ventilation.

The refractory is cast in a standard 14½-in.-dia., open-top chemical drum. You also can use a 14½-in. grease container obtainable at most filling stations. Just cut the container to the proper height, burn away all grease and paint, and remove the remaining residue with a wire brush. Then bolt on three equally spaced lifting hooks near the top of the drum.

Level the container, using a carpenter's level placed across the top of the drum, and pour a 4-in. layer of Johns-Manville Standard Firecrete. Mix with only 15 percent water and tap the outside of the container to settle the cement. Allow this to stand six or seven hours, then trowel the surface smooth and let it cure overnight.

Set the cardboard core and element in





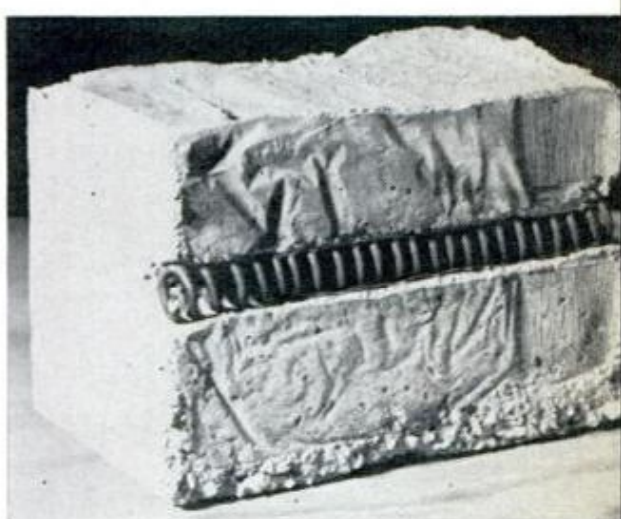
**COIL** is held to core (left) by posterboard strips and black tape, then wrapped (right) in plastic and tape for casting



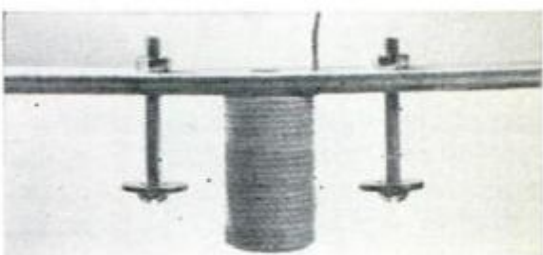
**CORE IS PLACED** in drum with 4-in. Firecrete bottom, then cast



**PULL THE RIP CORD** and allow it to unwind from around the tube. Then remove core and clean out wax, other debris



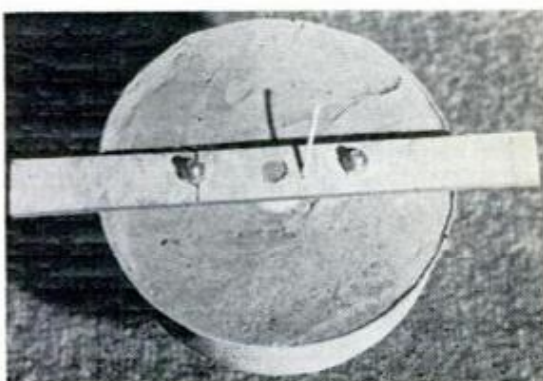
**CROSS SECTION** of completed casting shows three fourths of coil embedded, rest open to air



**DOWEL IS WRAPPED** with waxed chalkline and secured to strip to form core for lid plug

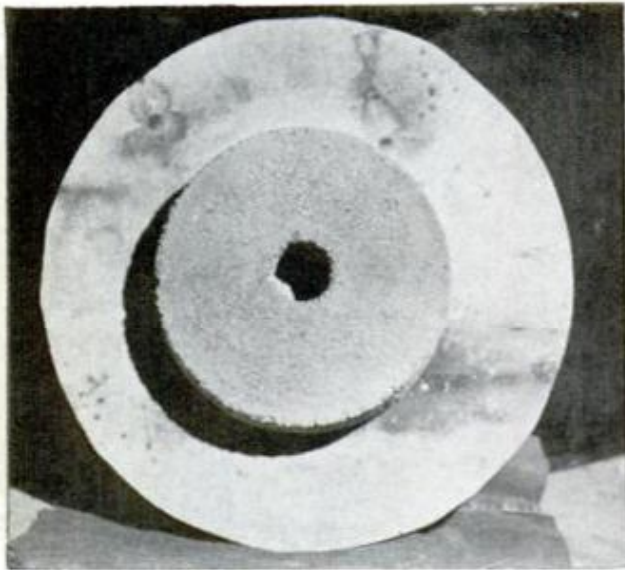
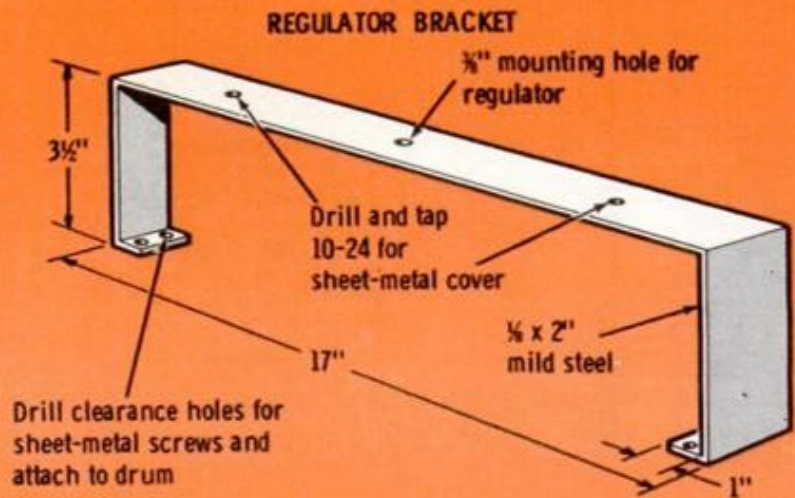
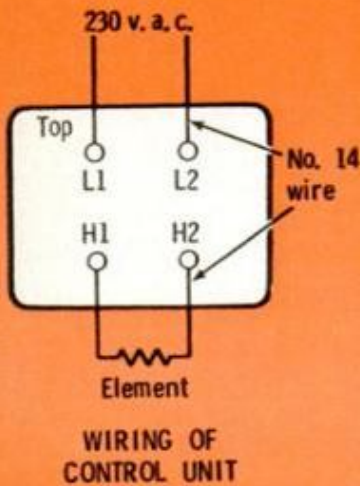


**LILY TUB**, used as form for lid plug, is first fitted in refractory opening, marked, then cut  $\frac{3}{8}$ -in. below this line

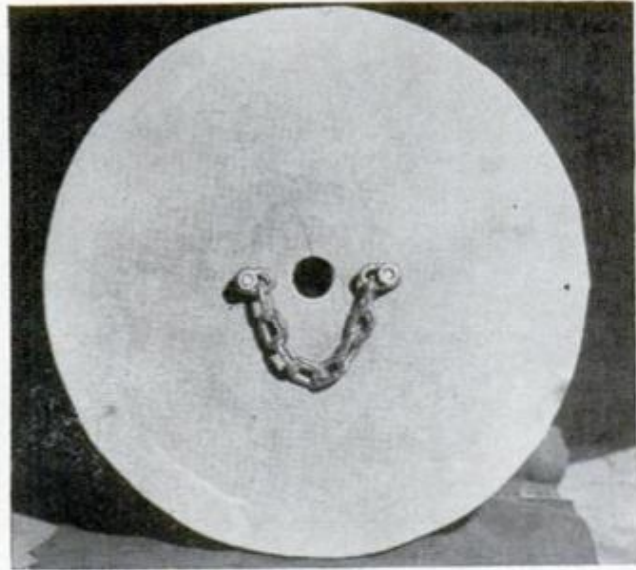


**LID PLUG** is cast in the tub, allowed to cure before line is pulled and strip is removed





**BOTTOM VIEW OF PLUG** shows the section cast in tub positioned at center. Top plate is  $\frac{1}{4}$ -in. Transite



**TOP VIEW OF PLUG** shows how the stove bolts are used to secure a short section of heavy chain to lid

the container and drill two  $\frac{5}{8}$ -in. holes through the side of the drum at heights corresponding to the lead-in wires on the heating coil. Locate a third  $\frac{5}{8}$ -in. hole exactly  $90^\circ$  from the first two holes so it will fall between the third and fourth turns of the heating element. Insert  $\frac{5}{8}$ -in.-dia. porcelain tubes through these holes, feed the lead-in wires through these and plug the inner opening of the tubes with wet asbestos paper. Tape the tubes to the outside of the drum to keep them in place.

Before casting the remainder of the refractory, fill the inside of the core tube with scrap iron or rocks to keep it from floating. Then cast a series of 3-in. layers of Firecrete, thoroughly tamping down each layer before casting the next. Trowel the top surface of the final layer after a seven-hour set and allow the material to cure for another 24 hours.

Loosen the core by pulling the rip cord and unwinding it from the space between

the refractory and the core. Carefully remove the core, using a razor blade to cut away all tape and plastic, except that behind the coil. Use a vacuum cleaner to remove all loose chips of wax, and temporarily connect lead-ins to a 115-v.a.c. line.

After 15 minutes, disconnect the power and remove the softened tape behind the coil. Then reconnect the power and let the element dry out the cement for several days. The high resistance of the coil will prevent overloading the circuits or running up the electricity bill.

During this interim, obtain a No. 10 Lily tub from a paint store. This will be used to cast a lid for the refractory. After the refractory has cooled, drop the bottom of the tub into the furnace cavity and mark the tub where it meets the refractory. Cut off the bottom of the tub exactly  $\frac{3}{8}$ -in. below this line, then measure the exact depth of the bottom section. Cut a 1-in. dowel to

(Please turn to page 216)



# New Tools You Should Know About



## Revolving storage caddies in two styles

Two new revolving storage accessories, the Tool Caddy and a Small Parts Caddy, are designed to accept a maximum of tools or hardware while occupying a minimum of space. Both are equipped with a comfortable carrying handle so they can be picked up easily, and both measure 11 $\frac{1}{4}$  in. in diameter. The base of the tool unit is divided into compartments of different sizes for storing nails, screws and other small items, while the parts storage unit (inset photo) has three revolving trays divided into 34 different compartments. The tool unit is 10 in. high and priced at \$3.98. The space-saving parts storage unit measures 12 $\frac{3}{4}$  in. high and costs \$4.98. Both are manufactured by Rubbermaid Inc., Wooster, Ohio 44691, and should be available for purchase through your local hardware-supply outlet.

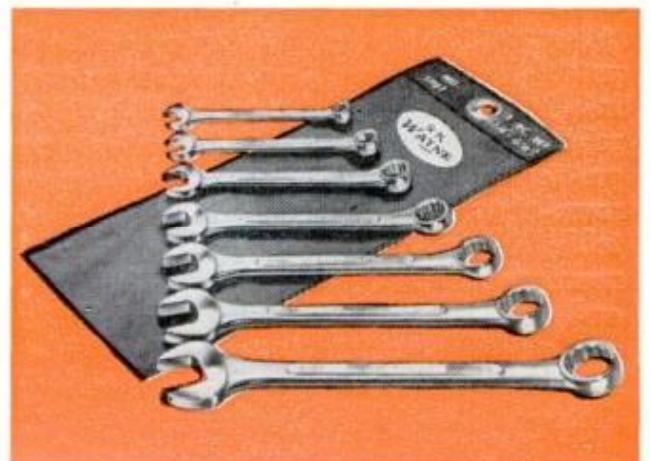
## New steel tape has an interior you can clean

For trouble-free use on the toughest and dirtiest jobs in the field, the 50 and 100-ft. Steelmaster tapes are fitted in chrome-plated cases contoured for a secure grip even in rainy or greasy surroundings. To clean the interior of the case, you simply open it, remove the blade cartridge, wipe everything clean and replace the reel. In the event of a broken tape, a new blade cartridge can be substituted. About \$7.50 and \$9.90. Stanley Tools, Div. of the Stanley Works, New Britain, Conn. Replacement blade cartridges in 50 and 100-ft. sizes retail for \$4.50 and \$6.95.



## Double-end wrench set

The 1707 set of alloy combination wrenches contains the seven commonly used sizes of  $\frac{1}{4}$  through  $\frac{5}{8}$  in. to provide the homeowner and craftsman with a handy selection of open and box-end tools (in effect, 14 in all). Packaged in a handy see-through vinyl bag, the professional quality wrenches are forged from alloy steel, heat-treated, plated with nickel-chrome and finally, polished to a gleaming finish. They retail for \$6.88 at most hardware stores and are available from S-K Wayne Tool Co., 332 So. Michigan Ave., Chicago.





# Make a 2-Stroke Jig To Sharpen Bandsaw Blades

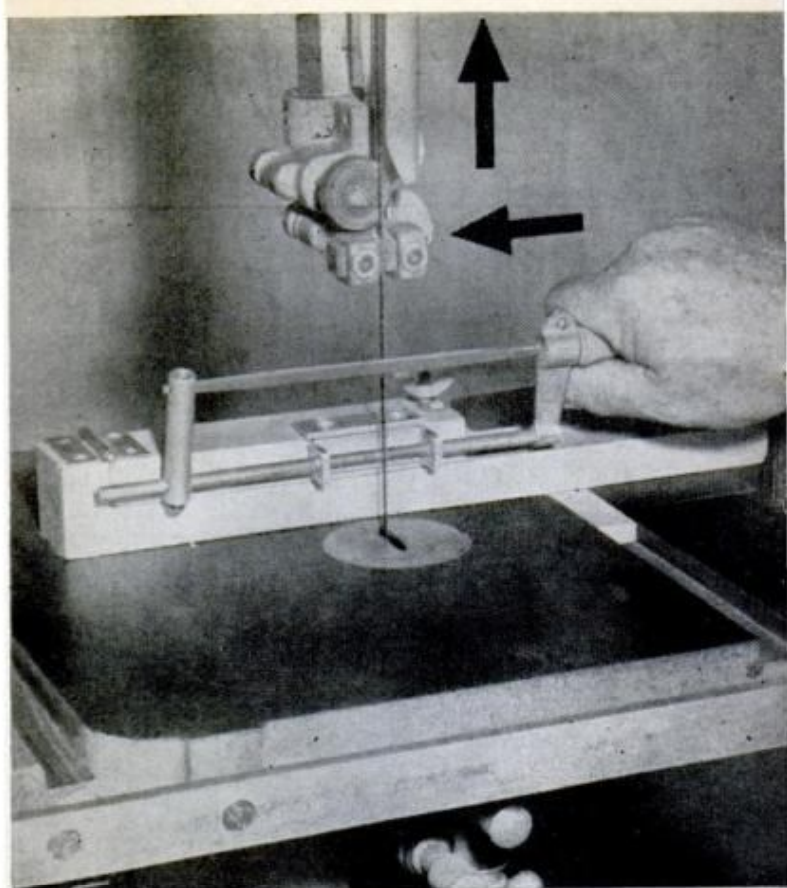
By WILLIAM G. WAGGONER

Technical Art by ZIK Associates, Ltd.

**T**HE UNIQUE ADVANTAGE of this sharpening jig is that you can sharpen your bandsaw blades right on the machine. It insures tooth-to-tooth spacing with such reliability that you can sharpen a 96-in. long blade in less than 10 minutes.

The simple wooden jig for the saw table can be built quickly and easily—there are no critical dimensions, even though it will do the job with amazing precision. I used a regular bandsaw sharpening guide and simply made the brackets to hold it. This can be made of  $\frac{3}{4}$ -in. aluminum or steel angle. Just saw along one side of the angle and fold back the remaining flaps as indicated in the drawing. Then place the bracket on a drill press and carefully drill a pair of aligned  $\frac{1}{4}$ -in. holes.

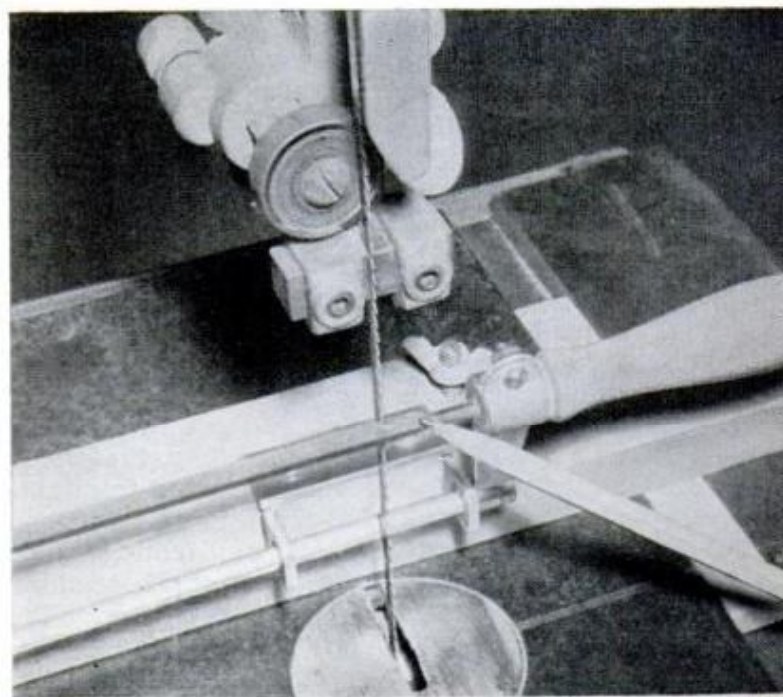
Assemble the wooden portion of the jig as detailed and cut a cross member to fit into the groove on the saw table. If no miter-gauge groove is provided on your particular bandsaw, simply attach the cross member so it rides along the edge of the table. In either event, locate the cross member so that the smooth section at the end of the file will contact a tooth at the end of the first filing stroke. Then lift the handle of the file-carrying frame to bring the next tooth into position.



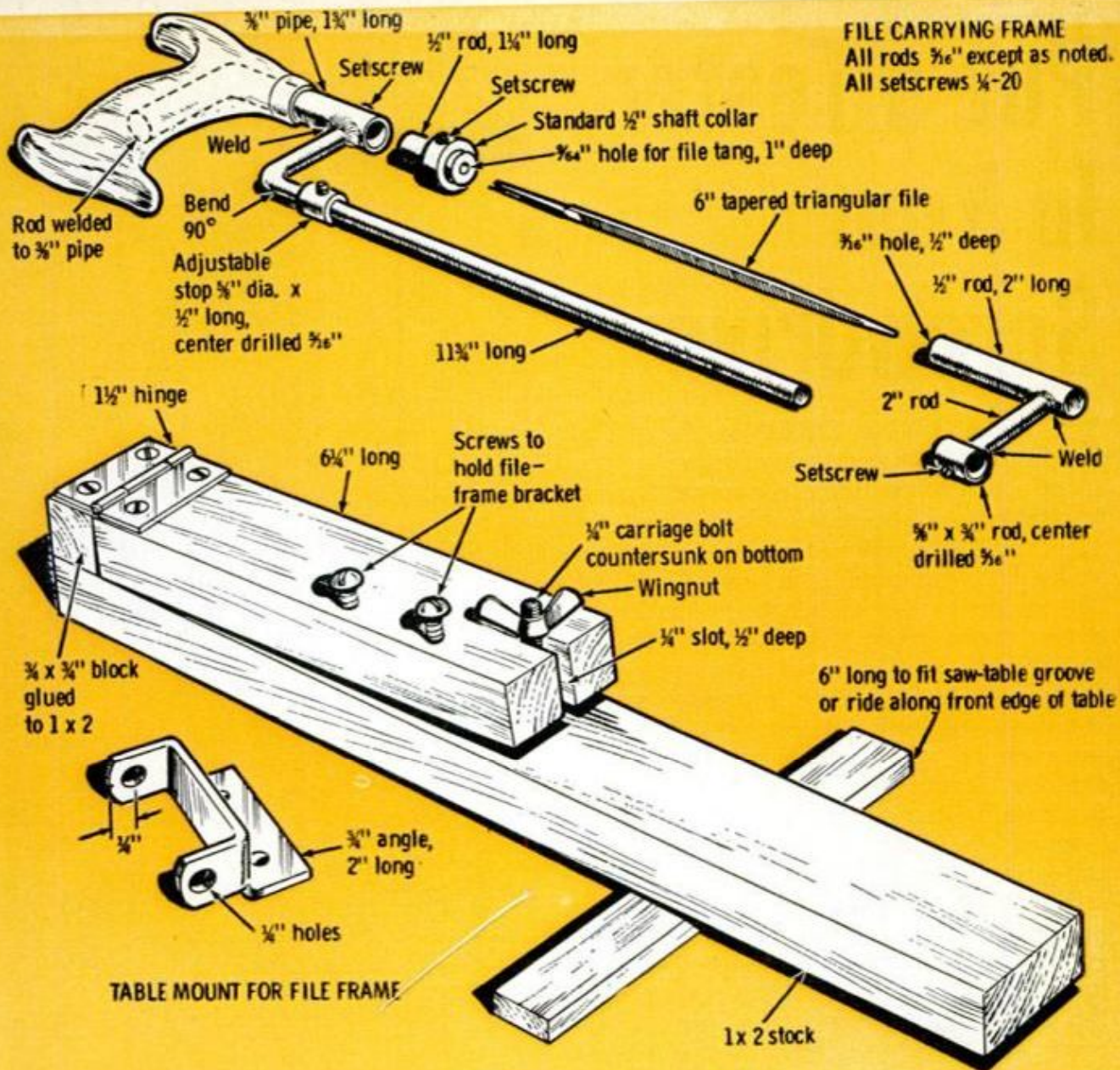
**TWO-STROKE ACTION** is shown by arrows. Push forward to sharpen; pull up to position the next tooth

When initially setting up the jig, loosen the locking controls on the file-carrying frame and place the file into the space between two teeth. Then lock the controls and secure the entire jig to the table with a C-clamp. Make certain the smooth shank of the file is contacting a tooth and lift the handle until the next tooth is in the correct

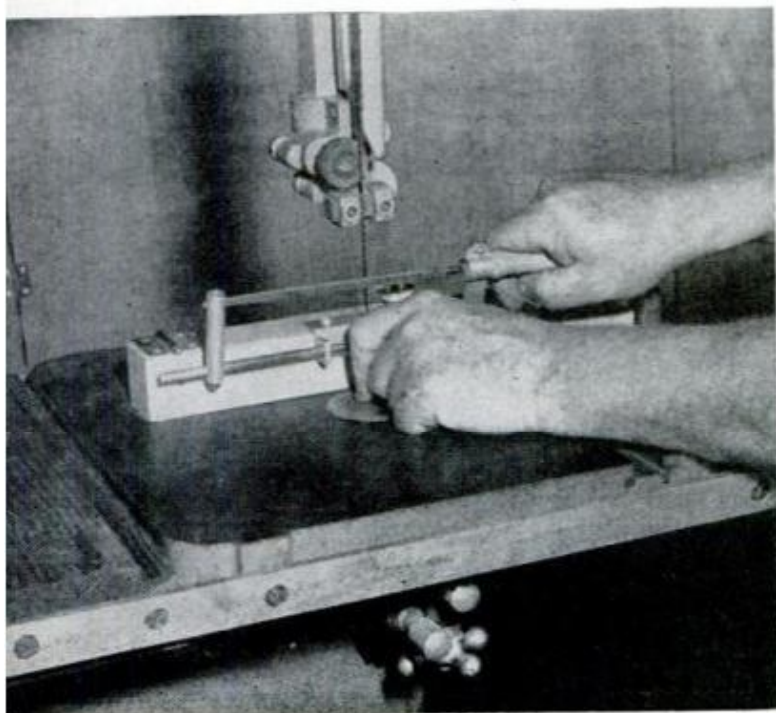
**FORWARD MOVEMENT** should stop when tooth rests on smooth shank of file (indicated by pencil point)







**ADJUST WINGNUT** to stop upward movement and position teeth. Then hold blade lightly and sharpen



position. Turn down the wingnut to limit the travel of the hinged arm at this point and you're ready to begin the sharpening operation.

Give each tooth the same number of file strokes. Unless the saw has been badly neglected, one stroke per tooth should be sufficient.

In the event you don't use a commercial bandsaw-sharpening guide, you can make the file-carrying frame shown in the drawing. However, because the dimensions for the bracket were derived so the commercial ( $\frac{1}{4}$ -in. shank) tool could be used, the substitute frame will require  $\frac{3}{16}$ -in. holes drilled in the bracket. Otherwise, operation and adjustments are the same.

But whether you make or buy the file-carrying frame, you're sure to appreciate the convenience of being able to quickly sharpen your bandsaw blades. ★★★



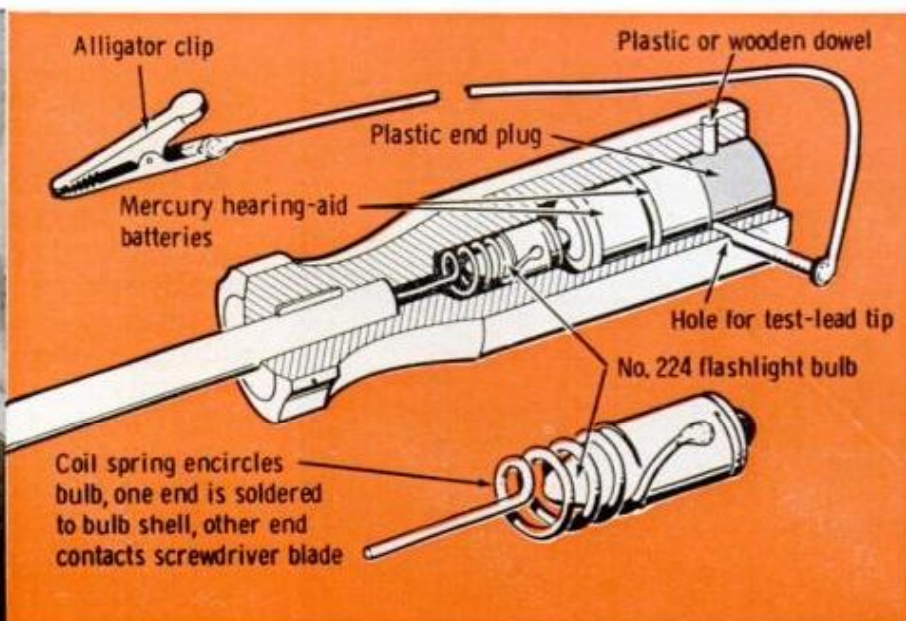
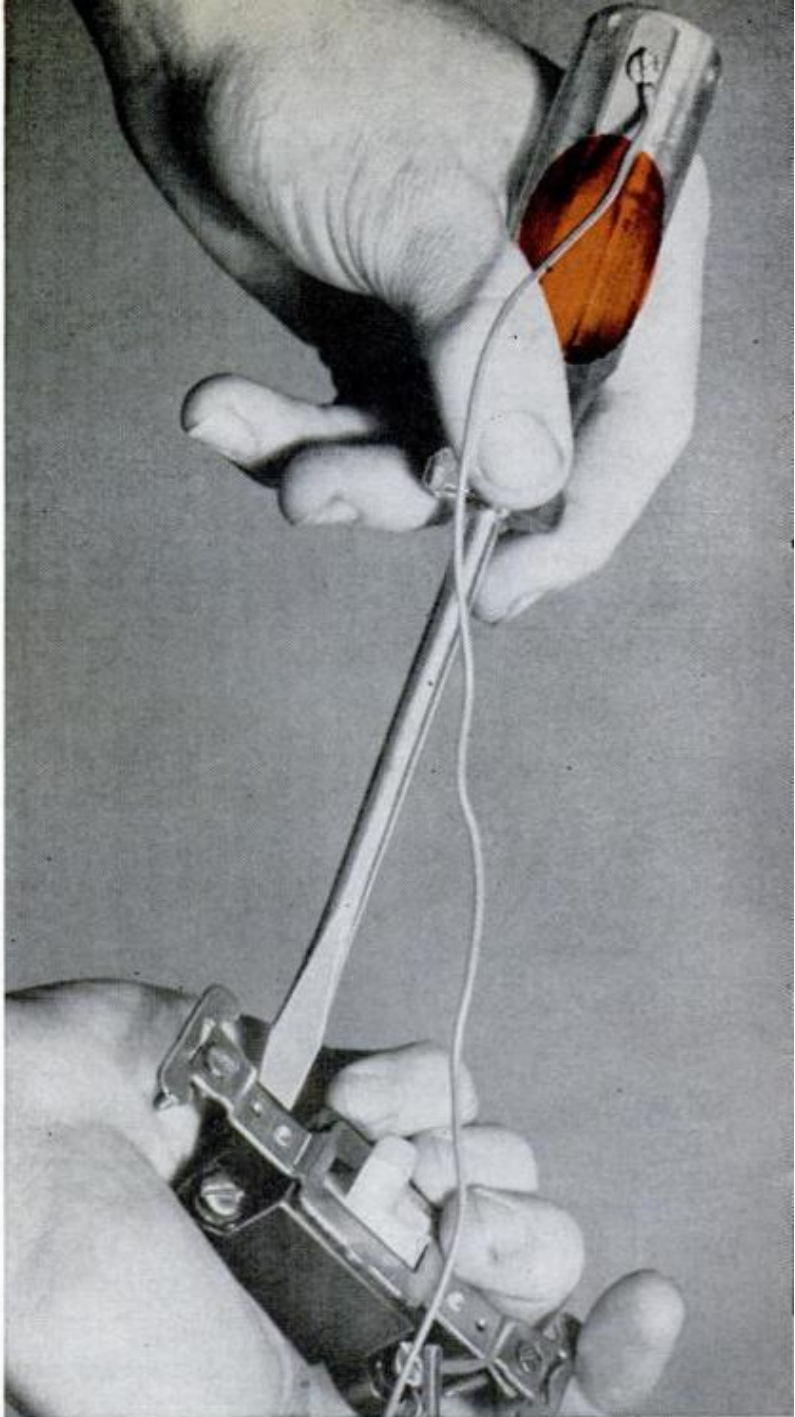
# Put a Tester In Your Screwdriver

**L**IKE HAVING A COMB on the end of a brush, a continuity tester in the handle of a screwdriver is a natural when it comes to electrical troubleshooting.

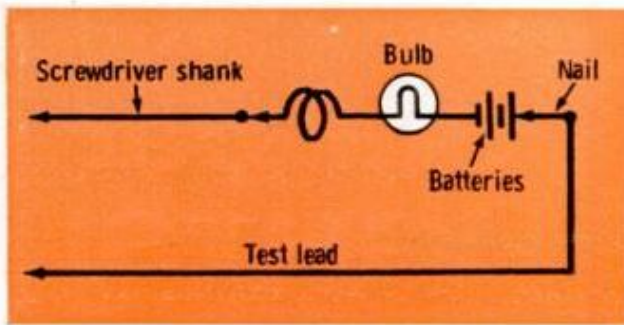
A continuity tester consists of a battery and a bulb arranged in series with a pair of test leads. Any device placed in series across these leads, which completes the circuit, will light the bulb. Conversely, if the circuit being tested is "open" or incomplete, the bulb will not light. Suppose, for example, you have a fuse that is questionable. Connect it across the tester. If the bulb lights, the fuse is good.

In addition to fuses you can trace circuit continuity of motors, coils, switches and other devices. You can also check for grounded circuits or apparatus by inserting the tester between the suspected terminals and "ground"; in most cases this is the metal frame. Always be sure, however, that the circuit being tested is disconnected from any external power.

To make such a two-in-one tool, pick a screwdriver that has a clear plastic handle. Since you will be drilling a  $\frac{5}{8}$ -in.



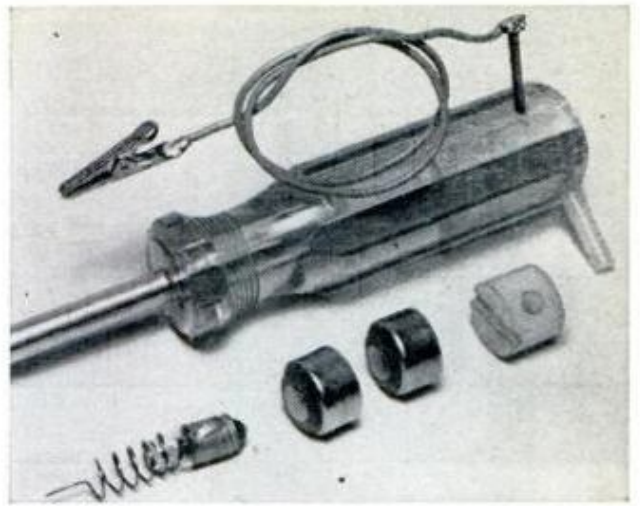




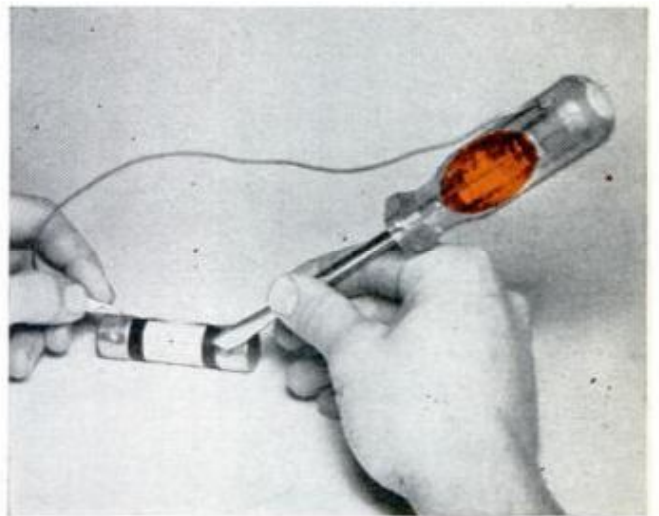
hole, buy one that has a 1¼-in.-dia. handle. Also select one that has a minimum of 2½ in. between the end of the embedded shank and the end of the handle.

The handle is counterbored with three different-sized drills, starting with a ⅝-in. bit, then a ⅜-in. one and finally a ¼-in. drill. As the detail shows, the ⅝-in. hole is made deep enough to hold two mercury hearing-aid cells and a plastic plug. The ⅜-in. hole is for a spring and a bulb from a two-cell penlight, while the ¼-in. hole is for a wire which makes electrical contact with the shank. Where a regular tester has two test leads, this combination screwdriver-tester makes use of the blade for one lead. The deep ¼-in. hole is drilled in the soft plastic with a homemade drill made from a piece of wire. Two sides are filed flat for a distance from the end and then sharpened like the end of a conventional metal-cutting drill. This will do the trick but you'll have to back it out often

*(Please turn to page 222)*



**PLASTIC PLUG** is held in place by dowel or plastic rod. Slot in plug acts as keyway for the nail contact



**SCREWDRIVER SHANK** is one probe, wire with alligator clip the other. Light means fuse is still good

## NEXT MONTH IN SHOP AND CRAFTS

**TWENTY PAGES OF BOATING.** Leading off with a big color preview of next season's new boats, this bonus boating section will also include an in-depth report on all the new stern drives, complete with a detailed specifications chart. In addition, you'll find ideas for taking the work out of boating, one man's report on what he learned during his first year as a boat owner, plus a roundup of '68 novelty boats. Don't miss it.

**BUILD A TRAILER FOR YOUR GARDEN TRACTOR.** It's a utility trailer that will greatly ease back-breaking back-yard chores, yet it's handsome enough to display with pride. A simple ball-joint hitch (homemade, of course) makes the trailer a cinch to unhook, while the removable rear panel and sides add convenience to a long list of features.

**HOW TO LAY HARDWOOD FLOORS.** Whether you're considering a new floor of parquet blocks, tongue-and-groove boards, or laminated blocks, next month's informative story is required reading. One chart, for example, will show how to determine the amount of flooring you'll need; another tells what nails you should use. Plus much more.

**WHAT YOU SHOULD KNOW ABOUT GROUND FLAT STOCK.** It's the only material to specify when you want a premium-quality raw material for metalworking. Packaged in protective wrappers, the precisely-ground lengths of soft steel are a pleasure to work—but for the complete lowdown on how to properly work and heat-treat this metal, watch for your March issue of *PM*.



# Customize your car with TURN LIGHTS!



Just bolt on two accessory lights that are activated by your turn signal lever. A simple circuit keeps them lighted while you're turning.

By **HERB GILL**

Illustration by Dale Gustafson

Technical Art by Don Evans

**YOU CAN BE** as up-to-date as those luxury-automobile owners by installing a pair of side-looking turn lights on your car. These, in case you haven't noticed, are those white lights on the sides of the front fenders that go on when the turn signals are blinking to light up the road into which your car is turning.

You can't connect these lights to the regular turn switch or blinker without having them blink, too, but a time-delay system in the circuit will keep them turned on continuously. The control system described here uses a capacitor across a sensitive relay coil to keep the circuit closed while the other lights blink.

During the "on" period of the blinker, the capacitor is charged to full voltage through the diode. When it's "off," the diode blocks return of the electricity through the coil, holding it energized.

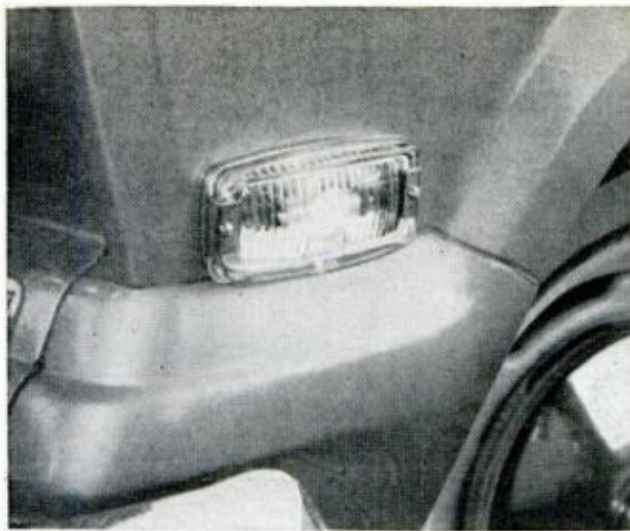
All control components can be mounted

in a small plastic box placed anywhere under the hood of your car. A point near the horn relay is good since battery power for side lights can be easily picked up from the hot side of the horn relay.

The drawing at right shows the positioning of all of the parts in the box. The frames of the relays are hot and, consequently, so are mounting screws. For this reason, the relays should not be mounted on the bottom of the box where the screws could short to the car body.

Connect the parts by following the pictorial diagram. Be sure to observe the polarity of the diodes and of the capacitors. For a negative-ground system, the positive end of the diodes must be on the relay side, and the positive end of the capacitor must be on the diode terminal of the relay coil. For a positive-ground system, both the diodes and the capacitors must be reversed. The parts list





**TURN LIGHT** shown here is actually one of a pair of flush-mount, backup lights from J. C. Whitney

specifies the components to be purchased specifically for 6 or 12-volt systems.

There are probably many choices of suitable lights. Of the two I am familiar with, the simplest to mount is the J. C. Whitney unit shown above. This unit mounts flush and requires only three holes. The light comes in kit form with enough wire to make all the connections.

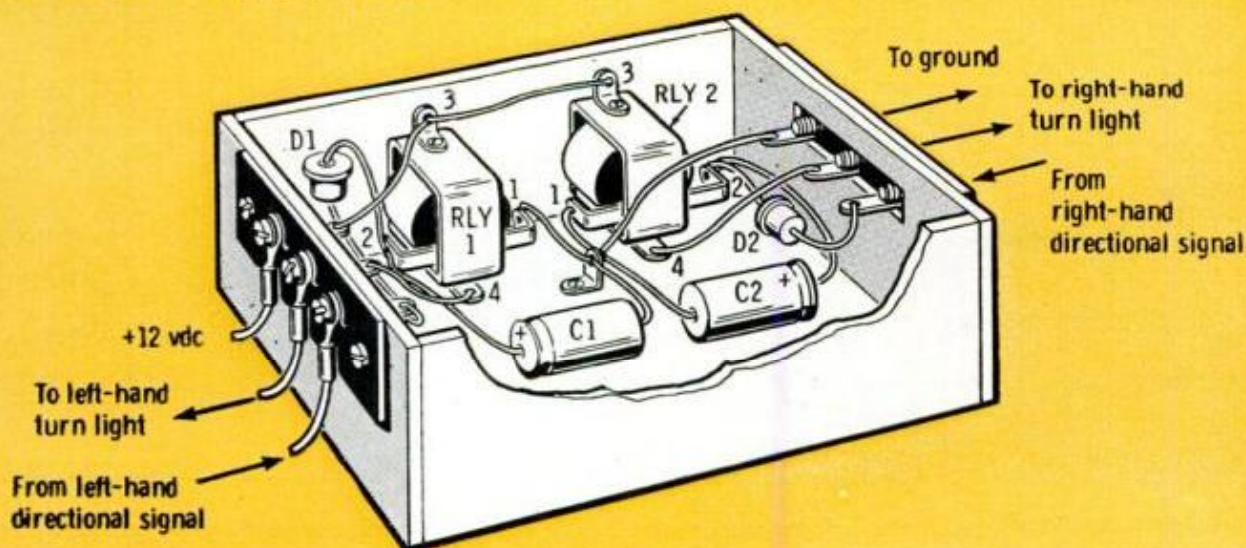
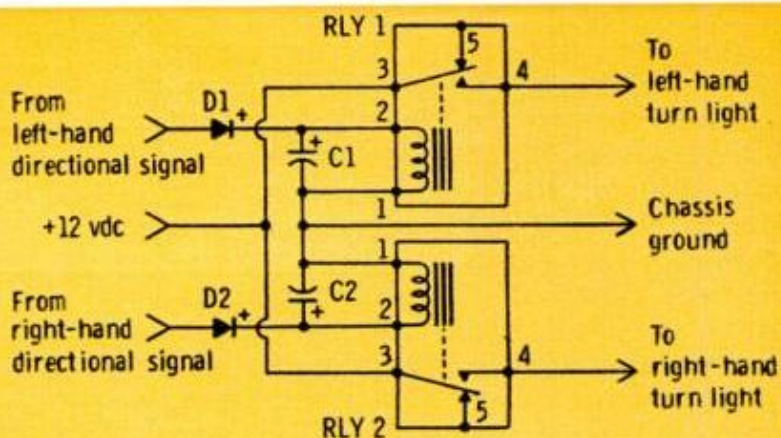
The second light you can use is a 1966 Dodge Dart backup light, obtainable from any Dodge dealer. This unit is better looking and is required if the fender slopes inward more than 5 or 10° where the light is to be mounted. The lens deflects the light about this much from the mounting face, so it will compensate for the sloping fender surface. The Dodge light does require a large hole in the fender and costs about twice as much.

The light should be mounted on the fender so the main beam is horizontal or slightly below; too high a beam will glare in another driver's eye, and too low a beam will not be effective. To be sure of *(Please turn to page 217)*

### PARTS LIST

- C1, C2**—Electrolytic capacitors: for 12-v. system, 150 mfd., 15 v. (Allied Radio 43B6634 or equiv.); for 6-v. system, 600 mfd., 6 v. (Allied 43B6490 or equiv.).
- D1, D2**—Diodes: 250 ma., 50 v. or higher (1N536, 1N537, 1N3491, 1N3492 or equiv.).
- RLY1, RLY2**—Relays: for 12-v. system, Sigma 11F-1500-G/SIL (Allied 41E5070 or equiv.); for 6-v. system, Sigma 11F-1000-G/SIL (Allied 41E5068 or equiv.).
- Turn lights**—J. C. Whitney & Co., backup-light kit, No. 89-2865 (12-v. system) or No. 89-2864 (6-v. system) or equiv. Address: 1917 Archer Ave., Chicago 60616.
- Misc.**—Two 3-screw terminal strips, plastic case, 4x3x1<sup>1</sup>/<sub>16</sub>" and cover (Allied 42B7895 and 42B896, respectively), hookup wire, hardware, solder.

**WIRING DETAILS** appear in schematic diagram form and pictorially. Parts list, above, specifies source of lights, relays and capacitors for either 6 or 12-volt electrical systems. All other parts, including diodes, can be used with either voltage. In operation, capacitor C1 or C2 energizes relay RLY 1 or RLY 2 during the time the directional turn signal is not flashing. In this manner, the battery voltage is supplied to the appropriate turn light continuously for as long as your directional signal turn lever is in a left or right-turn position





# Don't Trust Your Ear—Build a Stereo Balance Meter



LEFT CHANNEL TOO HIGH



RIGHT AND LEFT CHANNELS BALANCED



RIGHT CHANNEL TOO HIGH

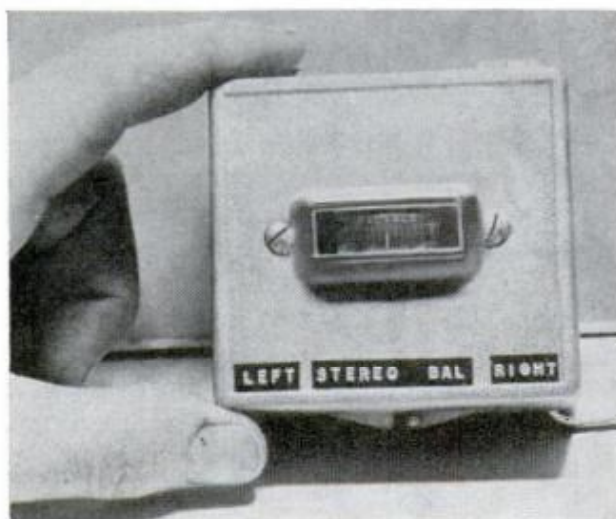
CENTER-NULL BALANCE METER attached to stereo-amplifier outputs compares left, right-channel volume

With a glance at the dial, you can adjust your stereo amplifier for perfect balance of left and right-channel volume level.

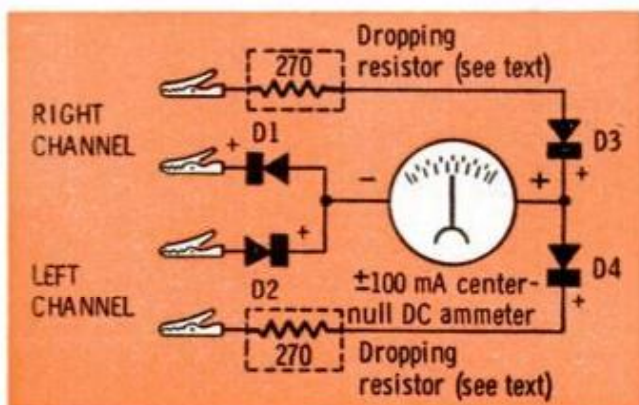
By HOMER L. DAVIDSON

**L**ISTENING to an out-of-balance stereo system is like having cotton in one ear. You can get the balance back, however, even if you *do* have cotton in one ear: Just build this stereo balance meter and let it do the "listening."

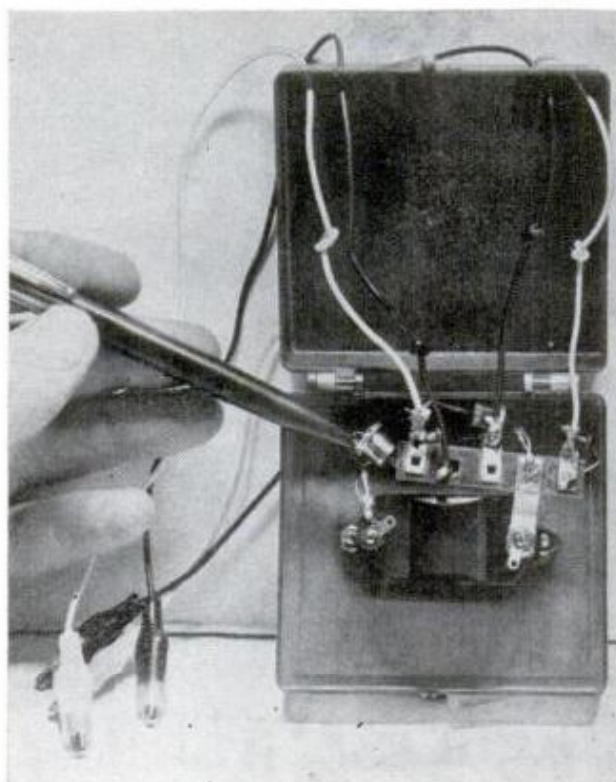
The heart of the balance meter is a 100-microampere, center-null d.c. ammeter. Diodes D1 through D4 are the least expensive diodes you can buy. You can get 10 for less than \$1. As shown in the schematic diagram, the meter is connected to both the left and right channels of your stereo amplifier at the same time. It's easiest to terminate the leads with small alligator clips and attach them directly to the speaker output terminals on the amplifier. Equal signals will, in effect, cancel out and give a center null reading. Any imbalance in left and right-channel signal strength will cause this sensitive meter



BALANCE METER and circuit components can be mounted in handy plastic or aluminum chassis box



SCHEMATIC DIAGRAM for center-null balance meter shows polarity to observe when wiring the diodes



SILICON DIODE of "top hat" configuration passes signal to the meter. Pointer indicates positive end

POPULAR MECHANICS



to deflect in the corresponding direction.

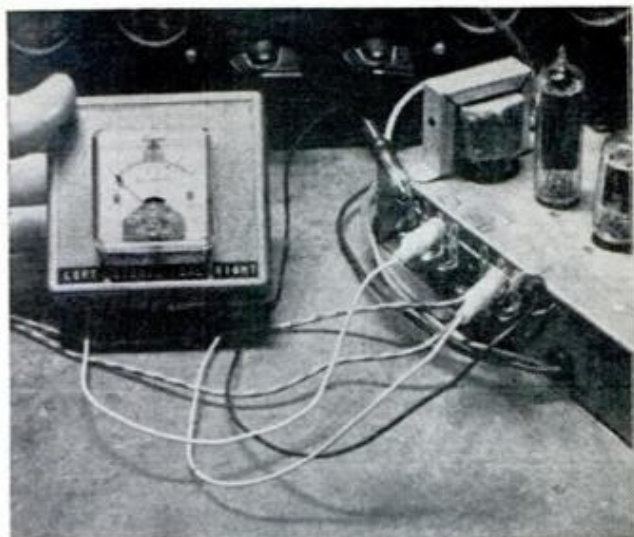
You can do a professional job of balancing by playing a stereo test record. Set your amplifier balance control for center scale and check the meter. It will confirm a balanced condition or indicate any imbalance between left and right-channel outputs.

When the balance meter is used with a large output of audio power, a dropping resistor may be necessary in each leg of the input to the meter. Select a 270-ohm resistor and wire it in the circuit as shown in the schematic diagram. Use a still larger resistor when amplifier power causes the meter pointer to exceed its deflection limits. You can use the meter with any stereo record player or radio whether tube-type or solid state.

The meter and circuit can be mounted in a plastic box, as shown, or right into any type of stereo control panel or console you may have set up for your rig.

**Comparison balance meter.** Another, alternate stereo balance meter can be constructed using a meter you may already have in your scrap parts box. If you have a 0-1 milliammeter around, it can be wired as a left and right-channel comparison meter. As shown in the schematic diagram, the two diodes in the left channel circuit are wired in reverse of their wiring in the balance meter circuit using the center-null meter.

Actually, with a comparison meter, only two silicon diodes are needed since you check each channel separately. By adding two additional diodes, the leads can be clipped to each channel and don't have to be switched from one channel to the other. Just adjust the balance control so the



**COMPARISON-TYPE** balance meter checks channels separately when connected to amplifier outputs

same meter deflection is obtained for each channel.

A plastic box large enough to house the meter and circuit makes an inexpensive chassis for the project. If you don't have any handy, you can buy a small aluminum chassis box or improvise an installation in something else from workshop scrap.

Drill holes in the box for the meter and the test leads. Rather than use expensive jacks and plugs for the leads, solder them directly to a four-lug terminal strip which can be mounted on the meter terminal screws, and use strain-relief knots in leading them out of the chassis box. Then just solder the diodes in place on the terminal strip and the job's done.

Check over your wiring to be sure that polarity of the diodes is correct. With "top hat" diodes, the metal flanged end is the positive end and the negative end has the insulated lead. With tubular-type diodes or those of other configurations, the positive end will always be marked with either a positive sign or a band. ★★★

## PARTS LIST

### Center-null stereo balance meter

**M**—100-ua center-null balance and tuning meter (Lafayette 99H5034 or equiv.)

**D1 through D4**—Silicon diodes (1N34, 1N34A, 1N46, 1N48, 1N51, 1N60 or equiv.) (Package of 10: Lafayette Radio 19H6001)

**Resistors**—Two optional 270-ohm or larger 1/2-watt fixed carbon resistors (see text)

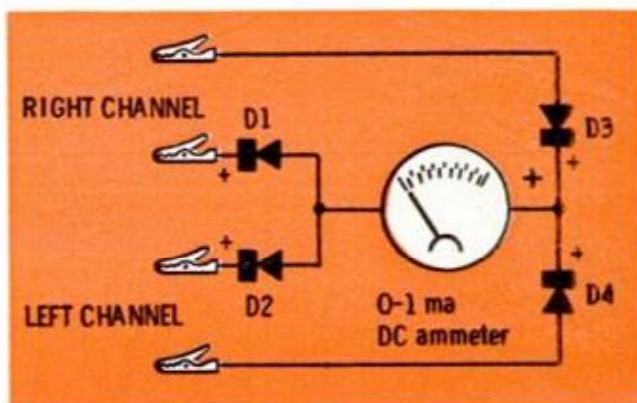
**Misc.**—Chassis box, terminal strip, test leads, alligator clips, panel markings, solder

### Comparison-type stereo balance meter

**M**—0-1 ma. (Lafayette 99H5052 or equiv.)

**D1 through D4**—Same as above.

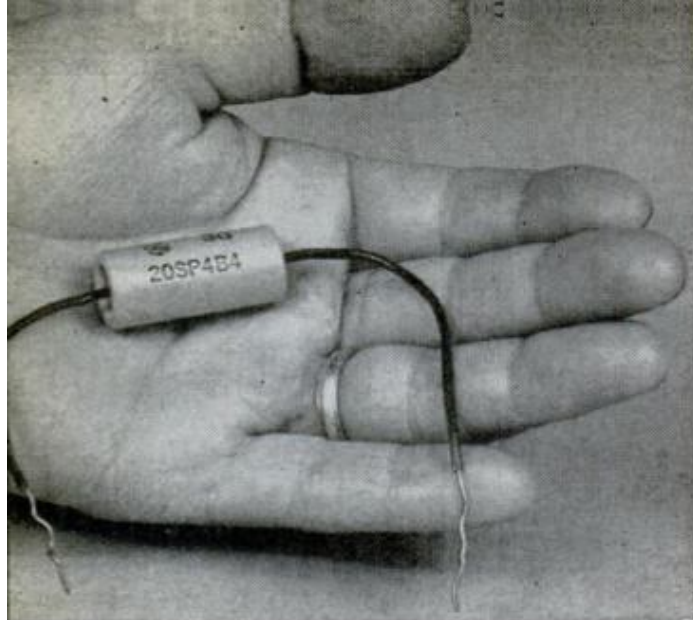
**Misc.**—Same as above.



**SCHEMATIC DIAGRAM** for comparison-type balance meter shows diode polarities for this type circuit



# ELECTRONIC KINKS



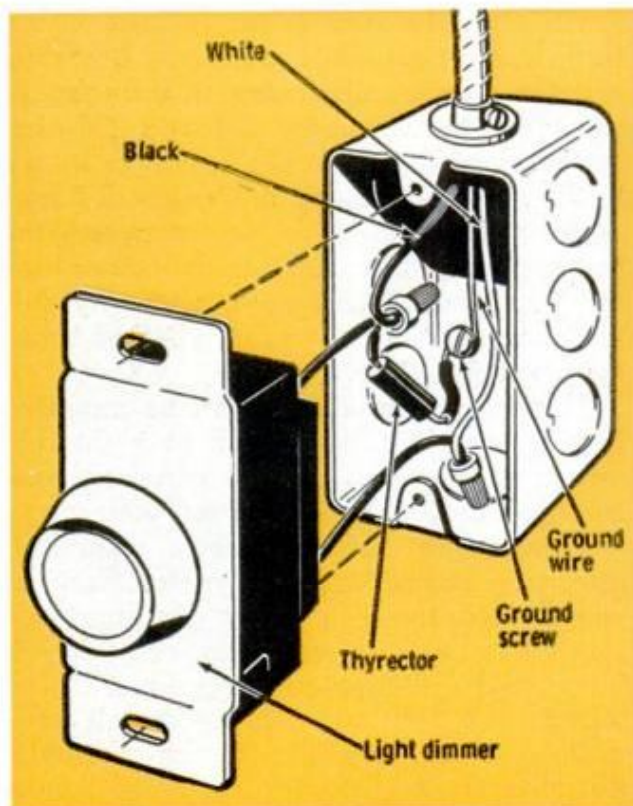
## Light dimmer protection

You've probably wondered why your expensive light dimmer controls burn out at an alarming rate. The cause is a sudden power surge that burns out the silicon-controlled rectifier—the solid-state heart of an SCR dimmer.

Aside from improper installation, the greatest cause of failure is a light bulb burning out. When the filament fails and breaks, a high-current arc jumps the gap, causing the familiar bright flash of light.

The momentary surge of current won't blow a house fuse, but it can ruin your dimmer.

You can protect your dimmers with a simple device called a thyrector. That's the name for a double-backed diode that acts as an instantaneous current surge protector when wired in the circuit with your SCR controls. Just connect it from the hot side of the dimmer to ground as



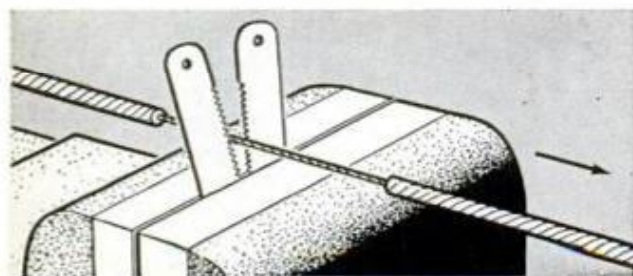
shown in the diagram. The ground in your electrical box is the box itself and connections can be made by way of a screw, clip, pressure lug or clamp.

Thyrectors, such as the General Electric 20SP4B4 shown, cost about \$1. Use spaghetti to install them.—*Walter G. Salm*



## Scissors with a double use

For reaching into tight places in electronic equipment where your fingers or tweezers can't make it, take a pair of thin-nose scissors and file V-shaped notches near the tips. Small nuts and other hardware can be handled easily; the scissors retain their original use near the pivot.



## Hacksaw-blade wire stripper

You can make your own wire stripper with the halves of a broken hacksaw blade locked in a bench vise to form a V. Leave a little separation at the bottom of the V for the wire gauge you're stripping. Force the wire into the V with a twist to cut insulation.—*Wilfred Beaver*



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the cab last longer. You're probably thinking all pickups are built this way. But ours is one of the few that is.

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**5** We put coil springs in front and leaf springs in back. Not many trucks can boast a combination like ours. Or a comfortable and stable ride like ours.

**6** Something you can't see here—the price. It's in the same ball park with other pickups. Your GMC Truck dealer will let you in on this comforting bit of news.

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**What a difference a name makes**



## ACROSS THE TOP OF RUSSIA

*(Continued from page 132)*

walking about on the destroyer's bridge. Russian sailors stood with arms folded, silently observing us. Between the two lines of silent men the water flashed and boiled as the bow wave running from *Northwind's* prow met the wave from the destroyer's.

Hillis saw it first. Signal flags were fluttering up the destroyer's halyards. The Russian was breaking the silence.

"He wants to know where we're going, Captain," Hillis reported. "His message reads: 'Where you should steer?'"

"Tell him 'the Kara Sea,'" Ayers instructed, an obvious tone of relief in his voice. The ice had been broken.

*Northwind* continued its scientific experiments, and 020 continued to follow.

Suddenly a blinker light burst into life on the destroyer's bridge. When all the message had been translated, it read:

"One: How long will you be in Kara Sea? Two: What is after end of program in area Kara Sea? Please write for us slowly."

To the first question, we replied:

"One: Twenty days."

But to the second question, Capt. Ayers was not yet ready to reveal his intentions of traversing the Northeast Passage, so we replied:

"Two: Barents Sea."

We continued around the top of Novaya Zemlya, and broke into clear waters where, in spite of almost constant escort, our scientific experiments began in earnest. We made a zigzag course to make studies and take samples at precise ocean "stations," the first U.S. expedition to do so. I asked a technician exactly what could be learned from a water sample.

"Not very much from one or two," he said, "but hundreds of samples can tell us how cold the water is, they can give us clues about the marine life the water can support, and they can help us define the different layers, or masses, of water."

One significant discovery was that the bottom of the Kara Sea revealed few magnetic disturbances.

"What does it mean?" I asked.

"It means that if you were a submarine commander it wouldn't be much use trying to hide in the Kara Sea. Magnetic submarine detecting devices would be able to pick you out without trouble."

The military application of the data raised the question whether the Russian objection to our presence in their waters was not in some part justified.

Meanwhile, back in Washington, the Russians had been lodging strong protests

about our mission. We had planned to make the Northeast passage through Vit'kitskogo Strait which, according to Soviet charts, is less than 24 miles wide. They claim a 12-mile limit as territorial waters, so the limits overlap in the strait. The United States recognizes only a three-mile limit, and our voyage was to contest Russia's claim by going through the strait.

Before we got there, however, Ayers received orders: "Not later than 30 September proceed New York to disembark scientific personnel and equipment."

We weren't going through.

"What happened?" I asked Ayers.

"I don't know the full story," he said, a pained look on his face, "but it wasn't the Coast Guard that decided against it."

There was still one more hope, however, one that wouldn't involve contesting the Russian's claim. We could stay in international waters and go over the top of Severnaya Zemlya. The *Northwind* headed north.

Somewhere to the north and east the polar ice pack lay in wait. How far away we could not tell. Then Cape Molotov showed on our radarscope. No ice, nothing to impede our progress. There was open water over the top of Severnaya Zemlya!

An unscheduled meeting was held that morning in Capt. Ayers' cabin. When it broke up, he dispatched a message:

### **Open water, but case closed**

"Thirty miles of clear water over top of Severnaya Zemlya. Passage clear for transit eastward. Transit would be of prime scientific interest. Please advise."

Within minutes the news of the message spread throughout the ship.

We continued eastward until we had reached a spot on the globe never before attained by an American surface vessel. Soon we smashed into the polar pack.

"Stop engines," Ayers told Martin.

With a last throb the engines coasted to a halt. *Northwind* had reached latitude 81° 37.7' north, and longitude 98° 43' east.

"What are your instructions, Captain?"

"We sit here and wait," Ayers said.

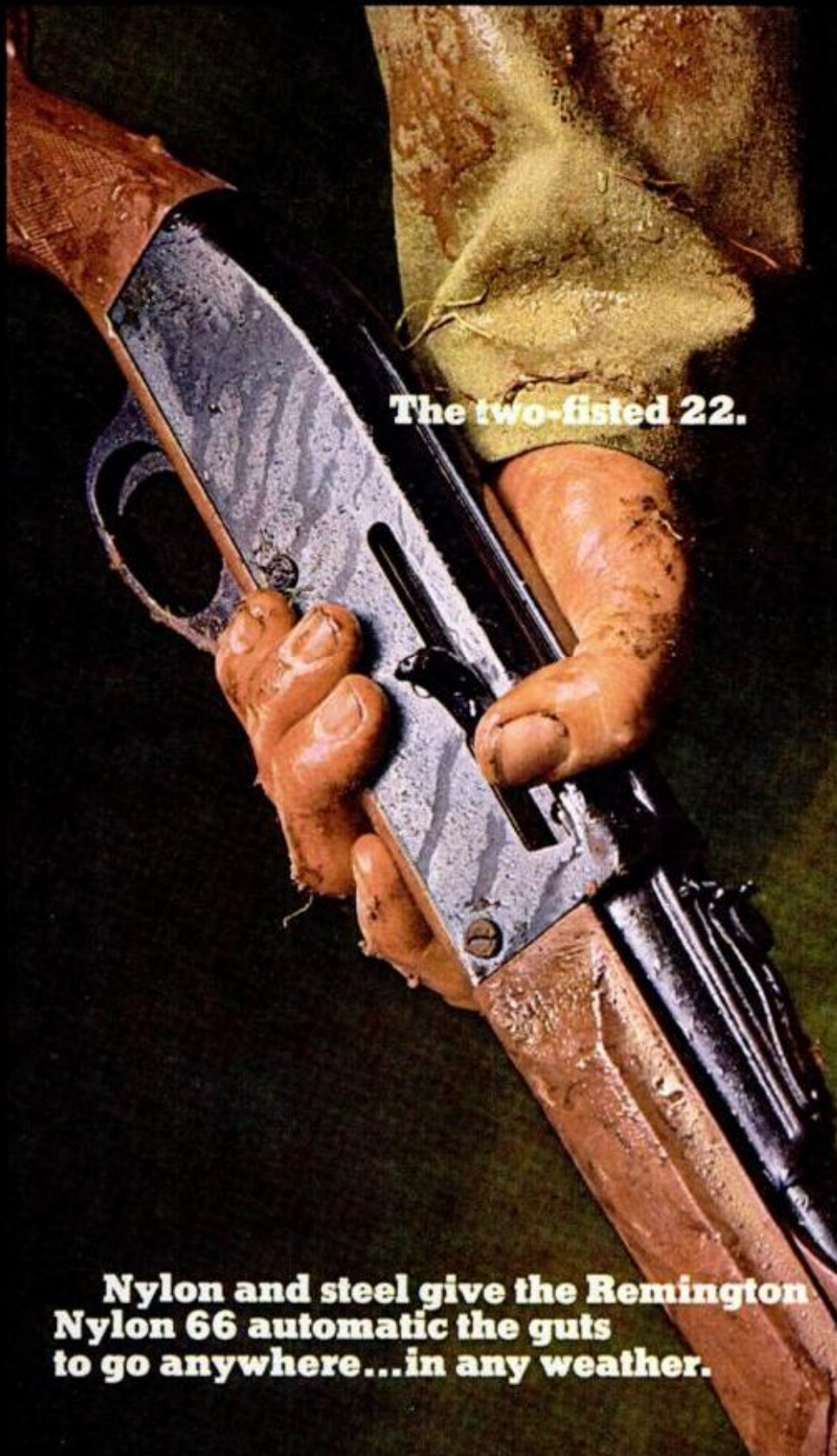
The wind whistled through the halyards creating an eerie background to the stillness of the ship. Ice loomed silent and infinite on all sides of us.

Six hours longer we waited. Finally a messenger dashed to the bridge with a message sent "operational immediate"—the highest priority any message can have except for war operations. Capt. Ayers scanned it quickly. "The answer is no," he reported. "Comply with previous orders. Return by way of Atlantic."

There was no further appeal possible;

*(Please turn to page 199)*





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## YOUR 'SMELL PRINT'

*(Continued from page 103)*

of detecting a puff of cigaret smoke in four or five times the volume of the Empire State Building.

Dr. Krotoszynski, Dr. Dravnieks's associate, was now preparing to inject the sample into the instrument that performed the actual analysis, using the technique called gas chromatography. In this device, the vapors are once more trapped by a filtering material, then revaporized by heat. The substances in the mixture do not emerge simultaneously, but one at a time, and are detected by the way they affect the electrical conductivity of a hot gas. The signals are automatically recorded, each substance registering as a peak on the chart.

The recorder pen began to move, drawing peaks and valleys on a chart that would be three feet long.

"That's you," said Dr. Dravnieks.

"I don't recognize myself," I said. "What can you tell about me from this?"

"Well, we can't tell very much about these signatures just by looking at them. But when we put the data into a computer, it sorts out the similarities and differences between your signature and others. On a signature, we don't even know what substances most of the peaks represent. And right now we don't care. We're looking for patterns—for the characteristics of different types of people.

Dr. Dravnieks showed me a map plotted from the signatures of about 30 volunteers. There were three distinct groups. One group, he said, represented white male subjects, showing a definite similarity, and another group stood for white female subjects. The third group surprised me. Dr. Dravnieks said it represented the signatures of a group of male students from India studying at IIT.

### Friend or enemy—which?

The "people sniffer" used in Vietnam recognizes human beings by traces of ammonia produced in sweat. But it cannot distinguish between American troops and the Vietcong. If the olfactive signatures of Americans and at least one group of Asiatics are recognizably different, perhaps eventually it will be possible to develop a sniffer that can distinguish between friend and foe.

After enough olfactive signatures have been studied, significant peaks and the substances they represent will be identified. Then a simplified detector for spotting those substances can be developed, just as GE developed a simple ammonia detector.

The same sort of thing had been done in the development of a bomb detector by IITRI for the Federal Aviation Agency. Capable of monitoring the air from the passenger and luggage compartments of an airliner for a single substance given off by dynamite, it is due to be field-tested by the FAA soon. IITRI tests have already shown that the device can identify the telltale odor on a person who has handled dynamite even after he has washed his hands.

A compact box, the bomb detector can be installed in service trucks that supply airconditioning to planes during loading and unloading at the airport. Any trace of the key substance from explosives brought aboard a plane would set off an alarm.

Thus olfactronics is not limited to odors produced by people. Dr. Dravnieks showed me two olfactive signatures taken from a transistor radio—one with the radio off, the other with it switched on. There was a noticeable difference between the charts.

### A smelly resistor shows up

"You see that peak?" he said. "That's an overheating resistor. We deliberately introduced a malfunction into the circuit to see if we could detect it. Complex electronic devices, such as computers, could be continuously monitored to detect malfunctions before they cause a breakdown. Mechanical systems, such as engines, can also be monitored—for example, to spot overheated bearings."

But the brightest future for olfactronics may be in medicine. Since human odors have their origins in biological processes, changes in odor signatures can be used to detect biological malfunctions. Physicians already use their sense of smell in diagnosing diseases, and about 40 different medical conditions are known to have associated odors. But the usefulness of this tool depends on the personal experience of the doctor.

An example: Some years ago, doctors in a New York hospital had difficulty diagnosing a patient's illness. A physician who had had experience in China was called in. He walked into the room and immediately identified the condition as a form of smallpox common in the Far East but rare here. He recognized it by an odor.

Eventually, it is expected that olfactive instruments, more dependable and expert than a doctor's nose, will be among the most sensitive of medicine's diagnostic tools. They may be able to spot some diseases even before people know they are sick. And they will be used for disease prevention—in schools, say, where the

*(Please turn to page 199)*




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Electrical/Electronic Devices  
Maintenance  
Wire Maintenance

Precision Devices  
Prosthetic Appliances  
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General Duty  
Marine Operations  
Engineer Heavy Equipment Operation  
and Maintenance  
Automotive Maintenance  
Motor Transport  
Railway Maintenance  
Railway Operations  
Aircraft Maintenance  
Aircraft Components Repair  
Administration  
Communications Center Operations

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## YOUR 'SMELL PRINT'

*(Continued from page 196)*

unsuspected carriers of airborne diseases like tuberculosis will be detected by monitoring the air.

At present, says Dr. Dravnieks, much more needs to be learned about basic human odor signatures before such medical uses become possible. "We know that an individual's signature can change, but we don't yet know much about what causes the change."

One factor that has an effect on a person's olfactronic signature is diet. If a person changes his eating habits radically, this can change his signature over a period of several days. It's also possible that long-term differences in diet may be responsible for some distinctions between the olfactronic signatures of different groups of people. Women, for example, often have different eating habits from men. And the Indian students tested by Dr. Dravnieks tend to be vegetarians. Deodorants, incidentally, don't really change a person's olfactronic signature, although they reduce the size of the peaks on the recording.

Olfactronics will become useful in criminology, Dr. Dravnieks thinks. "Since a person leaves a little bit of his odor wherever he goes, sampling the air at the scene of a crime could tell you who has been there. It can also work the other way around. A place leaves odors on a person's skin and clothes—so taking his olfactronic signature can tell you where he has been."

Farfetched? Not at all, now that science has found a way to study another of our sensory worlds—the world of smells. ★★ ★

## ACROSS THE TOP OF RUSSIA

*(Continued from page 194)*

Ayers had put the question and had been explicitly denied permission.

"What did you expect?" he said.

Maybe some year an American vessel will traverse the Northeast Passage. If one ever does, it will not sail as a proud vessel of an independent nation moving through seas that should be open to all, but with the special permission and consent of the Soviet Union.

In the event that the Soviet Union ever does reverse its policy and declare its polar seas open to all, the point nevertheless will have been made: In the year 1965, the Soviet Union objected to an American vessel making the voyage from one great ocean of the world to another, and the U.S. government bowed to that objection. ★★ ★



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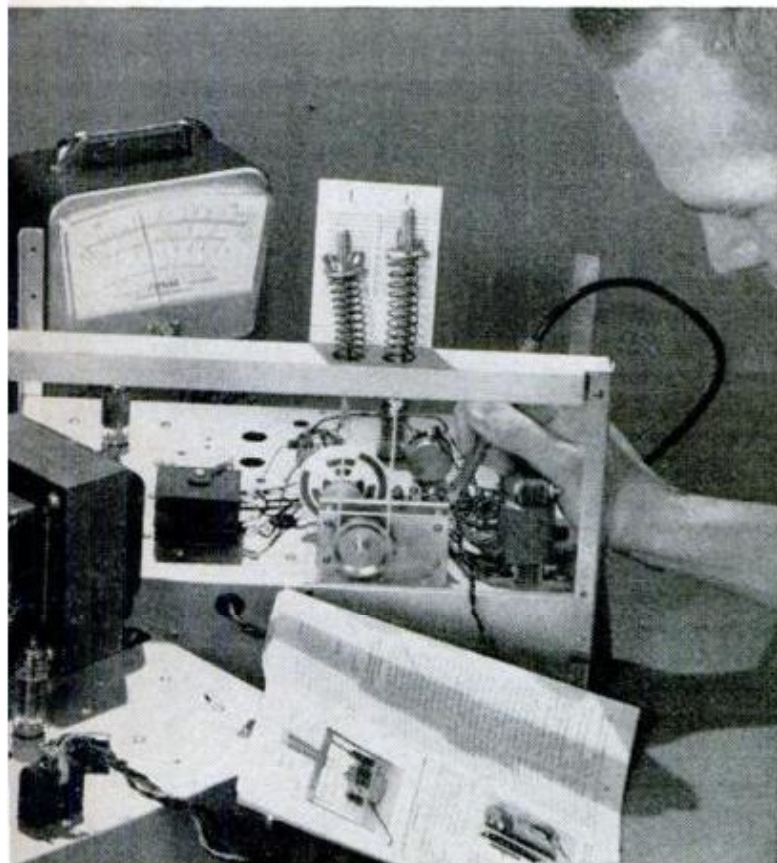
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## 80-MPH MAYHEM ON ICE

(Continued from page 114)

system selects a number representing the body stamp for any given human shape.

Using the system, Percival rates the tough, muscular Hull a low 1 in endomorphy, a high 7 in mesomorphy and a low 1 again in ectomorphy. Thus Hull's body stamp is 171—about the closest anyone can come to being a pure mesomorph. (Zero is not generally used because no one lacks a quality completely.) Gordie Howe, on the other hand, is rated 3 in endomorphy, 6 in mesomorphy and 3 in ectomorphy. Thus, his body stamp is 363.

The difference in playing styles between a 171 and a 363 is superbly illustrated by Hull and Howe. Hull is a full-back on skates. His bull-like charge has made him one of the most thrilling and colorful players in the game.

Howe's skill is more subtle and comprehensive. His skating is so beautifully controlled, his shot so carefully disguised, his command of the pattern of play so easy that you have to understand hockey—its pace, its feel, its very texture—to appreciate him. He stands relatively straight and elegant, an indication of his greater ectomorphic tendencies, but Hull hunches over the puck and drives in low—a perfect picture of the mesomorph he is.

In assigning players to guard Hull and Howe, it seems evident that coaches recognize the principles, if not the details, of the somatic system. The Chicago Black Hawks, for instance, tend to assign Eric Nesterenko to guard Howe. He has nowhere near the marvelous skills of Howe, but he has a body stamp of 163. This means he inclines a little less to fat than Howe, but otherwise is similar in build. Interestingly, he has the same long stride as Howe—fans call him the "Swooper."

The New York Rangers frequently assign Reggie Fleming to guard Bobby Hull. He has fewer skills than Hull, but he has a body stamp of roughly 261 and, not surprisingly, uses his body in the same bull-like manner as Hull.

Here are some more findings that Percival has made through his research:

Most goals are scored on the side on which the goalkeeper holds his stick. The reason is that he can move his stick across his body to the opposite side—man's biceps are designed that way—more easily than he can move it out to the "heel" side.

The most difficult shot for the goalkeeper to defend against is a shoulder-high shot on the stick side because he must move his stick all the way up from the ice. It is much easier for the goalie to

(Please turn to page 210)



## POWER STEERING

*(Continued from page 143)*

side of the gauge, while the output connects the control valve, usually by means of an adapter hose.

On a linkage setup, the hose is disconnected at the pump and the gauge is installed between the hose and pump outlet.

Start the engine and run it at slow idle with the gauge shut-off valve open. Check specifications for your system's low-speed test reading—it differs from car to car, but is usually below 100 pounds.

If pressure is higher than it should be, there's a restriction somewhere in the system. It could be a kinked hose, so check all lines.

Now, increase engine speed to fast idle and close the shut-off valve to determine the pump's ability to develop specified pressure. With the valve fully closed, pump pressure should reach manufacturer's specifications for the high-speed, closed-valve test. This reading is usually from 850 to 1000 pounds. If the gauge doesn't record it, the pump's bad.

Don't leave the valve closed for more than a few seconds. Very high fluid temperatures will develop, which could damage a good pump and control valve.

If the reading's okay, open the shut-off valve and again run the engine at fast idle. Hold the steering wheel hard to the left-turn stop and then over against the right-hand stop. Pressure readings should be equal for both left and right sides. If they're not, an internal gear leakage is indicated.

Incidentally, you can quickly check the power cylinder of a linkage power-steering system by turning the wheel so the piston rod is visible. If the rod is scored or has a dull gray rather than a high-luster chrome finish, the cylinder isn't doing its job and should be replaced.

The question always arises whether to replace major components of a power steering system or repair them. Generally, repairing is a major operation for a Saturday Mechanic and could actually wind up costing you more money. A new pump with its \$35 to \$50 price tag can scare you, but don't forget the "junkyard" alternative. A pump from the yard will run about \$5 to \$10. And there's nothing tough about putting it on. Simply remove the old one from the bracket and install the replacement.

As for a steering gear of an integral system, the repair procedure is again out of your realm, and replacement is expensive. Compare prices before you decide what to do and don't forget to try that junkyard. ★ ★ ★

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## 'SKIDPROOF' CARS COMING!

*(Continued from page 106)*

greater reduction in stopping distance for all types of tires and road conditions.

Bendix is also working overtime on a very exotic "full-power" antiskid in which hydraulic force, instead of vacuum, powers the antiskid unit as well as the regular brakes. This extra hydraulic power is produced by a belt-driven pump and stored in a small accumulator.

Commenting that the efficiency of an antiskid unit is closely related to the speed at which the brakes can be applied and released, Suttle said that full hydraulic power can provide much faster responses than vacuum power, but that the vacuum-operated system was Bendix's No. 1 antiskid project for the immediate future.

Kelsey-Hayes Co., an auto supplier headquartered in Romulus, Mich., has taken a proven aircraft antiskid system and has rather quickly converted it into a relatively simple—but still electronic—automobile unit. Kelsey-Hayes has built more than 100 prototypes that are now being tested by automakers. And, importantly, the engineers already have data on this technically tricky mechanism based on more than 10,000 instrumented stops.

Developed originally by Boeing Aircraft, the Kelsey-Hayes system works on the 15 percent slip idea. Its sensor at the wheel reports the rate the wheel is accelerating or decelerating. If the wheel begins to decelerate too rapidly, a small computer "tells" the vacuum-powered brake control to release the brakes briefly. This continues until the vehicle stops.

Kelsey's system is fundamentally a rear-wheel unit. Kelsey's engineers feel it's most important to move into this field slowly with a simple, low-priced system that will prevent rear-end slewing. By contrast, Bendix thinks that front-end antiskid should be included in the system because it would provide the all-important steerability and because most of the braking in a panic stop is done by the front brakes.

The ultimate in antiskid is a four-wheel system, perhaps something like the British Maxaret unit. But there's strong belief at U.S. auto companies that the first step should be a low-cost, simple unit.

In certain situations, all antiskid devices offer some reduction in stopping distance. However, there is a growing conviction that improved stopping distances are difficult to achieve in many cases. So now the emphasis is on achieving "the same or shorter braking distance."

The first well-known antiskid unit in

this country was invented by Frank Perrino, who formed Perma Research and Development Co. to market it. The "brain" of this device was a gyro governor that spins exactly seven times as fast as the wheels spin. When the wheels stop turning, the gyro collapses immediately, causing a control valve to reduce the brake pressure slightly and thereby prevent the wheels from locking.

Perma's unit has been demonstrated to automakers periodically over the past five years, but it never was accepted because it never quite lived up to its promises.

Antiskid next bobbed into public view in 1965 on the expensive British Jensen FF equipped with a Dunlop Maxaret unit converted from an aircraft system.

The Maxaret senses the average deceleration of front and rear wheels and automatically turns pressure on and off by sending signals to solenoid-operated vacuum valves in the brake circuits.

Shortly after the Jensen's introduction, Ford Motor Co. started a hard drive toward antiskid. During the past summer, Ford staged an informal antiskid competition, asking all interested suppliers to demonstrate their hardware.

Among the auto supplier demonstrating devices to Ford were Kelsey-Hayes, Bendix, TRW (formerly Thompson-Ramo-Wooldridge) and Eaton, Yale and Towne, as well as two British brake suppliers, Lockheed and Dunlop. Two Ford groups—Ford Research, and Ford Transmission and Chassis Division—have systems. Goodyear also has a system.

General Motors officials have publicly pooh-pooed antiskid. Yet some time ago GM car divisions pitched into antiskid research with a frenzy, concentrating on three different systems from General Motors Research, GM's Delco Morraine Div., and Eaton. Pontiac probably will offer antiskid in two years. Buick and Oldsmobile have about the same objective, although maybe a year later.

Although some of the other auto manufacturers are not so enthusiastic about antiskid, strong competition and government forces are now working to compel every maker to have antiskid braking in the next few years.

Extensive antiskid presentations already have been made by some of the developers for the U.S. General Services Administration and the National Highway Safety Bureau.

Without question the climate is now "ripe" for antiskid. The big fear is that the government will turn so much artificial heat on the "baby" that it will be born before it is sufficiently mature. We'll have to wait and see what happens. ★ ★ ★



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Want proof? Sears bets the DieHard will pass the five year Acid Test. Otherwise it wouldn't be backed by a Sears no-nonsense five year guarantee. You see, when Sears guarantees, Sears guarantees.

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## FIREBIRD OWNERS REPORT

(Continued from page 98)

with the elimination of the front, side vent windows in the '68 models, none said so. But those who were displeased with it —almost 15 percent—did make a point of saying so.

Some owners' complaints only referred to "the lack of side vents" or "no wing vents," without giving the reason.

► If they miss being able to do a little sneaky littering, I'd say it's a pretty good design feature!

But, in most cases, owners referred specifically to the poor ventilation which they felt results from the lack of vent panes. A Louisiana student misses them because: "The fresh-air vent doesn't bring in much air."

A California electrician has the same problem and feels that, "Without vent windows, extra exhaust vents should have been added at the rear window to aid better air circulation."

Air circulation doesn't seem too much of a problem for the president of an Ohio abrasive and tool corporation. He's too delighted with handling:

"Handles well. Tracks exceptionally well on open roads in the 90 to 110 mph range. Doesn't wander."

► Hmmm. Just where do you do your driving?

Praising his car further, he says, "Bucket seats exceptionally comfortable. A good, solid automobile. Ride firm but not a 'kidney buster.'"

Other owners (without admitting to occasional "flat out" flings) praise handling without reservation.

"Handling qualities excellent, particularly on wet roads and in high winds."—Pennsylvania auditor.

"Beautiful on turns and curves."—Texas accountant.

"Truly a road hugger."—Ohio housewife.

► That makes it safe for getting the eggs home. Reminds me of a friend who says his home-built experimental car only hugs the road when it's got four flats.

Specific areas of owner criticism are listed in the summary chart on page 98. But the chart doesn't reveal the many interesting remarks from owners, like: "Versatile car. Can be sports car, family car, hot rod, etc."—Texas salesman.

"To date, I've done *very little* 'wide-tracking' and a whole lot of 'sidetracking' (trying to get satisfactory repair)."—New York Air Force man.

"No complaints, except I wanted a Land Rover 109 Estate Car but it's too expensive for me."—Florida journalism instructor.

► Watch the ad boys get hold of that: "Compromise with a '68 Firebird!" ★ ★ ★



## 15 DARKROOM GOOFS

(Continued from page 147)

three minutes over the recommended time won't hurt.)

12. *Using exhausted hypo.* Exhausted hypo is loaded with silver thiosulfate compounds that can never be completely removed from films and prints, even with prolonged washing. The results are prominent stains that usually appear long after the films and prints have been processed and dried. Hypo that is being reused should first be tested to determine whether it is still potent. Kodak's Residual Silver Test Solution is made for this purpose and takes only a few minutes.

13. *Careless washing.* Films and prints require a thorough washing (always in cold water) with frequent agitation to remove residual hypo. The flow into the washing tray should be adjusted so there are 12 complete changes of water every hour. Since this is difficult to gauge, try this test: Turn on the water to the flow you intend to use, then pour in a few drops of dye or food coloring concentrate. All traces of the dye should disappear in five minutes. If the dye is still visible after five minutes, increase the flow of water and repeat until the container clears within the set time.

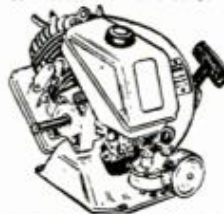
14. *Forced drying.* Films should never be force-dried by fan, blower heater, hair dryer, or other devices that tend to stir up dust and deposit it on the wet surface of the film. Dust and other foreign matter sticks tenaciously to the film during drying and may even become firmly embedded in the emulsion. Only a second washing or soaking can safely remove such particles, and even this sometimes fails. If you don't have a film-drying cabinet, the bathroom is the next best place to dry film. Run the shower to settle the dust, then hang the film inside the stall.

Film should not be hung for drying directly from the wash. First, treat it with a wetting solution, such as Kodak's Photo-Flo or Edwal's Kwik-Wet. This breaks the surface tension of water on the film and causes residual water to flow off evenly, eliminating troublesome spots.

15. *Scratching the emulsion.* Occasionally, film picks up particles of foreign matter or scum that resists the wetting agent treatment. Only in this case should a sponge sandwich or chamois be used. Wet emulsion is soft and highly susceptible to damage. A bit of grit or film trapped under the sponge or chamois can gouge an irreparable scratch the length of the film. The less you have to touch the film (wet or dry), the better the results you'll get when you go to the enlarger. ★★

## Briggs & Stratton — Clinton New Gas Engine Sale

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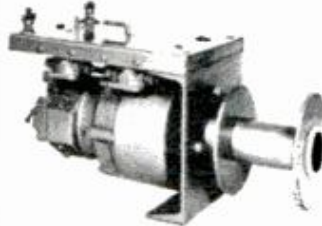
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## THE AMAZING ROLAMITE

*(Continued from page 95)*

is called a force bias—the rollers are made to “prefer” a particular point on the band.

To understand the effect of a slot in the band, think of the two loops of the S as springs that each exert a force against the other. Like a coiled watch spring, the band wants to lie flat and thus stores energy when it is forced to bend around the rollers.

When one of the loops is weakened by having a slot cut in it, the other loop overpowers it and “unwinds,” pulling the rollers with it. By cutting a long, tapered slot in the band, the rollers can be made to move the entire length of the track under their own power since the band becomes progressively weaker toward the widest end of the slot.

In a typical practical application, Wilkes visualizes a Rolamite with a slotted band to lick one common household annoyance—the leaky toilet valve. The leakiness usually results from failure of the ball float and lever mechanism to generate enough pressure to close the water-supply valve. The force generated in a slotted Rolamite lever would close the valve with 30 times the strength of present valves.

### **Rollers can be different sizes**

Wilkes' first Rolamite used equal-sized rollers, but he soon found that one roller in a pair could be a giant, 10 or more times bigger than its companion. With rollers of different sizes, you get a remarkably simple speed changer that can be used in any number of mechanisms.

Perhaps the oddest discovery is that the rollers need not be round. Sandia researchers have tried triangular, hexagonal, oval and polygonal rollers. The basic principles of the Rolamite still apply just as with round rollers. The different shapes of rollers give the Rolamite many additional functions. For instance, a rectangular roller can be designed to lodge against a stop in a braking mechanism.

A lot of variations are possible in the track, too. For example, a track wider at one end makes the Rolamite a powerful force amplifier—energy is released when the rollers slip into the wider portion of the frame. This energy can actuate a variety of mechanisms, such as a firing pin or a switch.

There are other advantages, too. Many Rolamited devices would never need a drop of oil. Then there's smoothness of operation. The steady, uniform operation of a Rolamite can take the jerks out of pop-up toasters, power sanders and a host of other devices.

There's cost. Wilkes estimates that the Rolamite will actually reduce costs in 75 percent of its applications. The Rolamite parts do not require close tolerances, so they're cheaper to make. Finally, there's all-around toughness. Extreme heat, cold or exposure to weather won't affect Rolamite operation.

But, I wondered, doesn't all that flexing of the band cause it to wear out eventually? Doesn't metal fatigue cause it to break? Those were questions that bothered Sandia engineers, too, at the beginning. Now they've quit worrying. The beryllium copper bands used in Rolamite have proved to be so sturdy that they show no signs of metal fatigue after 1,000,000 flexures. At that rate, the engineers figure, the band in a Rolamited home light switch operated 10 times a day would last 300 years. A Rolamited bathroom scale used five times a day would not wear out in 600 years.

You'll never see the first applications of Rolamite because they're tucked away in secret weaponry made by Sandia engineers. But hundreds of industries are embarking on crash programs to adapt to Rolamite.

Because Rolamite was developed with the help of tax dollars, it is available to the public. The Atomic Energy Commission will grant a royalty-free license for its manufacture to anyone interested. Wilkes himself now heads a new company set up to speed the Rolamite revolution along.

“We've just begun to scratch the surface,” Wilkes says, “Just wait until the independent inventors get going.” ★★

## 80-MPH MAYHEM ON ICE

*(Continued from page 204)*

block a high shot on his glove side simply because he can move his hand much faster than his stick.

The longer the puck is in contact with the blade of the shooter's stick, the more effective the shot is. “Bobby Hull's stick imparts a force to the puck much longer than does that of the average player,” says Percival. Where the average player maintains contact between puck and stick while both are moving through a sweep of seven inches, Hull maintains that contact through a sweep of 13 inches.

Through research like this, the game of ice hockey is coming into a new age—a change from the days when it was chiefly a calisthenic for the muscular to the time when the team with the most scientific approach may well be the champion of the league. ★★





Winner of Art Directors' top awards: Bert Stern seen on location taking his famous picture of a martini glass against the Egyptian Pyramids for a highly successful vodka advertising campaign.

## Why photography is a great life for a man

A photographer who made \$50,000 a year before he was 30, tells how men with an aptitude for taking pictures can break into this exciting, well-paid field

By Bert Stern

I think photography offers one of the best opportunities for men who want to live an exciting life and make money too. And I'm not just *saying* it. I have been a photographer since I was 21, and I wouldn't trade my profession for any other. My camera has enabled me to travel to fascinating places, meet outstanding people, live a life of freedom and independence. And it has given me great creative satisfaction.

**Offers you high pay and adventure** There are excellent jobs in photography today — part-time and full-time — but not enough good people around to fill them. Large corporations pay staff photographers as much as \$20,000 a year. Magazines and newspapers spend millions of dollars a year for pictures. Advertising agencies pay up to \$2,000 or more for a commercial photograph.

**How you are trained for success** The field of photography is wide open — especially to those who have good training. This is where I may be able to help you. I am on the faculty of the Famous Photographers School, a unique home-study school started by 10 top photog-

raphers. They include Philippe Halsman, Richard Avedon, Alfred Eisenstaedt, Joseph Costa, Arthur d'Arazién, Irving Penn, Ezra Stoller, Richard Beattie, Harry Garfield, and myself. We spent three years putting our knowledge of photography into a professional course — took over 2,000 exclusive "teaching photographs," so that each lesson at home would be like an actual studio or field demonstration. We explain in simple words our methods of developing pictures, the special darkroom techniques we perfected, how we use color, composition and exposure.

**You are a class of one** The instructors at the School are all skilled professionals working under our supervision. They spend up to two hours on each assignment you send in. And you receive from them special critiques, overlays and personal letters showing you how to improve your pictures. It's almost like having an expert photographer at your elbow passing along his secrets.

**Many find success — so can you** Students write us daily telling how they are making money with their cameras:

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If results show you have talent, you may enroll in the School. However, there is no obligation to do so. If card is gone, send your name, address, age to Famous Photographers School, Studio 255, Westport, Conn. 06880



## CAN FORD HALT PETTY PARADE?

*(Continued from page 91)*

that the pole will go to the driver who gets around at about 183, maybe a couple of fractions faster. Most everybody seems to think at least 15 cars capable of going that fast will show up for the race.

There are two main reasons why speeds will be higher at Daytona this year: better tires and improved aerodynamics.

Both Firestone and Goodyear have come up with new tire compounds designed to "stick" better on Daytona's steeply-banked turns. This means suspensions won't have to be cranked down so tight, which means the cars will be able to drift more, which in turn means faster cornering speeds. Andretti used this loose, drifting style of driving to win last year, and this year—whether they like it or not—the boys are going to have to drive in about the same style if they want to run up front.

As for aerodynamics—pretty much the name of the game at Daytona—auto manufacturers swear up and down racing is the farthest thing from their minds when they sit down to design a mass-production car body. Maybe so, but I've just got to think a lot of Detroit stylists have at least one eye on the race results.

### **Inching down for speed**

When I talked to Richard Petty at his place in Randleman, N.C., there were a couple of new Plymouth bodies sitting in a parking area outside the workshops. He pointed out that both the hood and roof of the '68 Belvedere are an inch lower than they were last year.

"You lower that hood an inch," Richard told me, "and, like a slice of cheese, you're cutting about 70 square inches of wind resistance off the car. Same thing up top; lower the roof and you're cutting down on overall bulk. Now if this works out like we hope it will, it means we'll be a couple of miles-per-hour faster."

A car running flat out at Daytona has a tendency to fly. No foolin'. It's like an airplane wing—as air passes over the top of a wing, it creates a vacuum that literally "sucks" the plane off the ground. Charging hard at Daytona creates the same sort of vacuum, the result being that a car tends to "take off." So anything you can do to reduce this lift means better "stick," better driver control. One way is to reduce the lift surface—make the roof lower and smaller. Another is to lower the hood. I guess the easiest way to say it is that you want to get that air pushing *down* on a car's surface rather than lifting it up. And this is just what Plymouth has done on its

'68 intermediate bodies. And so has Ford. I went out to the Charlotte shops of Holman & Moody, builders of just about all Ford stock race cars, and spent some time with Ralph Moody, himself a former race driver and a good friend of mine. Out in the shops, Ralph pointed to two new bodies, one a fastback, the other a notchback.

"I'm not sure just yet which body style we're going to run," he said, "probably the notchback. But the car's about an inch lower than last year's Fairlane. It should mean a little more speed."

Dodge, too, has lowered its new Charger body a fraction of an inch from 53.8 to 53.2. This may not seem like much, but under the special "wind tunnel" conditions at Daytona, even tenths-of-an-inch can make a difference.

### **Little change in power trains**

Power trains for this year's cars won't be much different than they were last year. Ford will run with its dual-carburetor wedge engine, Chrysler with the Hemi (only one carburetor, though). There was talk there for awhile that Chrysler might pull out of stock-car racing if NASCAR didn't allow its cars to run the Hemi with dual carburetors, which would mean, say, another 10 hp. NASCAR, however, turned thumbs down and the boys'll just have to make do with things as they are. And when you consider how well the Pettys did last year, things can't be too bad from Chrysler's point of view.

Individual car owners and mechanics, though, can take a given engine and do wonders with it. For example, I once heard Smokey Yunick offer to bet a man \$500 he could pull 1000 hp on a dynamometer out of a 427-cu.-in. engine, normally rated at 425 hp.

"May only last a minute or so," Smokey said, "but I guarantee it'll wind up there."

The fellow didn't take the bet.

Maurice Petty is another one who has a way with engines. In the 48 races the Pettys had run when I went out to see them, Richard had lost his engine only three times. Anybody in this business will tell you that kind of a record is amazing. Connecting rods, the most common cause of engine failure during a race, have a way of giving up just when a driver and his crew can almost taste the victory champagne. So if nothing else, the Pettys seem to have the rod problem worked out.

All the cars, of course, are worked on by individual owners and mechanics, each of whom has his own way of preparing a car for a race. The basic unit comes either directly from the manufacturer, or

*(Please turn to page 224)*



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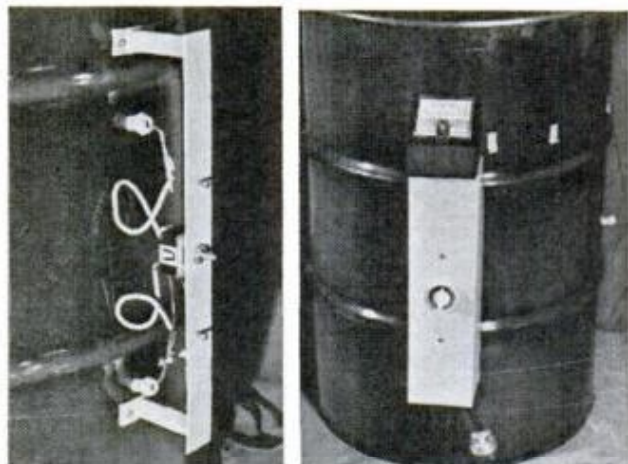
## HEAT-TREATING FURNACE

(Continued from page 182)

this same depth and wrap it with a length of chalkline that's been well waxed.

In a strip of 1/4-in. plywood, drill two 1/2-in. holes on 4-in. centers and attach the dowel midway between them. The free end of the chalkline is brought through a 1/8-in. hole and two 1/4-20 stovebolts are attached as shown in the photo on page 181. Be sure to leave about 1/4 in. of thread protruding above the nuts.

Center the core over the bottom of the



**REGULATOR BRACKET** (left) is protected by sheet-metal cover and then topped by microammeter (right)

Lily tub and cast with Firecrete, using only enough water for a castable mix. Rod and trowel as before, then pack the entire assembly in wet cloths or sawdust for at least 48 hours.

After the lid plug has cured, strip out the core and remove the plywood jig. Use a sabre saw and a metal-cutting blade to cut a 12-in. disc from a sheet of 1/4-in. Transite. Drill the disc for the 1-in. center hole and the two bolt holes, then bolt it to the lid plug. Use an extra pair of nuts to attach a short chain to the top of the completed cover.

The furnace is now ready for a preliminary bake-out. This consists of bringing the temperature up to about 800° F. by temporarily connecting the leads to a 230-v.a.c. source protected by 15-amp. fuses or circuit breakers. Leave the top of the furnace open for the first two hours, then cover with two layers of asbestos paper and allow it to burn for another three hours. (A good deal of steam will escape.)

After the drum has cooled, locate the 5/8-in. holes for the porcelain tubes and drill through the 55-gallon drum. Add about 6 in. of loose vermiculite insulation (such as Zonolite) and hoist the refractory into place. The degree of compression will vary somewhat, and it will be necessary to adjust the thickness of the bottom insula-

tion to align the holes with the lead-in wires. Slide the outer tubes in place and wrap the outside of the thermocouple tube with asbestos paper to maintain the proper alignment and keep out the vermiculite.

Place the U-shape steel spacers between the drums and attach them to the outer drum with sheet-metal screws. Then fill the rest of the drum with vermiculite.

Bend the lead wires toward each other and attach suitable lengths of No. 14 asbestos-insulated appliance wire. Do not twist the element wire, but instead wrap the leads together with No. 16 bare-copper wire. *Do not solder this connection.*

Attach terminals to the free ends of the stranded wires and connect these to the bottom terminals of a Chromalox UCWX 15-amp., 240-volt infinite control. This unit is made by Edwin L. Weigand Co., 7500 Thomas Blvd., Pittsburgh, Pa., and is distributed by Montgomery Ward as an infinite heat switch for electric ranges.

Attach the regulator bracket to the drum and mount the regulator with the side marked "top" positioned on the upper end, and wire the unit as shown on page 182. With the knob in place, connect the power and turn the regulator to the high position. Here the unit should not cycle on and off (if turned to any other position, it should cycle). Cycling adjustment is controlled by a small screw visible through an opening in the bottom side of the unit. Be sure to disconnect the power first.

Connect a common grounding wire between the two drums and ground. Then attach a 10-ft. length of stranded lamp cord with a large battery clip to the common ground. *As a safety precaution, connect the clip to the handle of the tongs when removing an object from the furnace.*

The basis of the pyrometer is a 3 1/2-in.-square, 0 to 50-d.c. microammeter from Allied Radio, and is connected to a 10-ft. length of thermocouple wire. Iron-Constantine may be used for lower temperature ranges, but Chromel-Alumel should be used above 1800° F. heat. Check the polarity of the wiring by connecting a short length of the wire to the meter, then holding a lighted match under the twisted ends of the wire. If the meter does not respond, reverse the leads. Then insert the thermocouple through the porcelain tube with about 1/2 in. protruding into the cavity of the refractory.

The first high-temperature firing of the furnace and the calibration of the pyrometer are combined as follows:

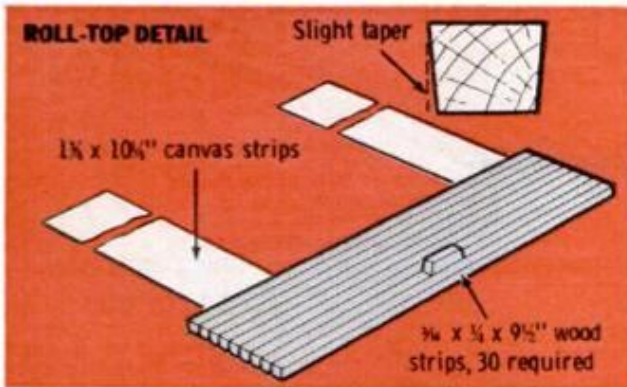
From a ceramics shop, obtain pyrometric cones 022, 013, 07 and 03. These correspond to temperatures of 1121°, 1580°, 1814° and 2039° F. Support the cones with Nichrome

(Please turn to page 222)



## WEEKEND PROJECTS

(Continued from page 159)



forming the dado for the roll top and cut it from a scrap of 1/4-in. plywood. Position it on the work as shown in detail B and tack it temporarily in place. Fit the router with its template bushing (a metal collar that slips over the bit) and set the machine to make a 1/4-in.-deep dado. Now hold the template bushing against the wood template and run the router completely around it. Do the same on the other end-piece, remembering to flop the template to make a right and a left-hand end. Finally, a dado is made in from the bottom edge which is later used to feed the roll top into the dados just cut.

Now you can go ahead and cut the ends to shape and round the edges. You can use the router for this, too. The bottom, front and back pieces of the box are glued into their dados and left to dry.

The roll-top cover is made by setting the saw to cut an 87° bevel and ripping 32 strips from a 3/16-in. board that's slightly shorter than the distance between the end dados. The strips are glued side by side to two strips of heavy cloth, making sure that no two strips become glued together. They must be free to snake their way through the curve of the dado. Wax will help if they bind.—*Everett Johnson*

## CUSTOMIZE WITH TURN LIGHTS!

(Continued from page 189)

adequate light, use a 21-candlepower bulb.

You can connect the 12-v.d.c. terminal of the control box to the headlight circuit, in which case the side lights will only work when you headlights are on; but if the circuit is connected to the horn relay, the side lights will work at all times.

Cement the capacitors and the diodes to the bottom of the chassis box with nonhardening cement so vibration will not break the leads. Then seal the lid of the control box thoroughly to keep out dust and water. ★★★

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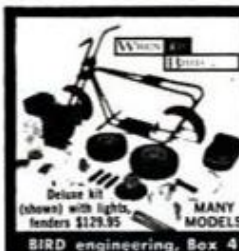
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## COLDEST 13 MILES ON WHEELS

(Continued from page 137)

effectively seal the buses to the spot.

Halfway to the radar site, the road ascends. At this point, with the storm still gaining strength, Gullette decided to head back to base. He found a turnabout road and led the convoy into it. Winds screamed even faster, and visibility dropped to zero. "It was like sticking your head in a barrel of flour and trying to see bottom," says Gullette. Somehow, still on the turnabout, he got the buses pointing into the storm so that their curved windshields broke the wind's force. The flat, rear windows would have been blasted out.

For six hours the 200 passengers waited inside the buses, shivering with cold despite heaters whirring at full blast. Then, as suddenly as it had picked up, the windstorm dropped to a mere blizzard. Two giant snowplows rumbled out from the base, their steel plows sweeping the road clear of drifts and leading the weary column to the radar site. Nine hours after starting out, the "fresh" crew arrived. In good weather—phase-one storms or less—the trip takes 20 minutes.

According to Gullette, the weather at Thule renders a vehicle unreliable after a year's steady use. Yet, Air Force regulations insist buses and other equipment in Gullette's charge, which range in size from a motor scooter to a 65-ton crane, last at least three years. To stretch a vehicle's life he has developed a fussy set of operating and maintenance standards that anywhere else would seem like nitpicking.

Arctic cold thickens grease in minutes. So all vehicles left standing for more than 10 minutes, whether idling or not, must drive the first half mile at five mph or less to give lubricants in wheel bearings transmission, differential, and other areas a chance to soften. Engines are set at a fast 700 to 800 rpm idle to prevent water vapor from freezing up oil breathers. A half pint of alcohol is mixed with each tank of gas to absorb moisture and prevent ice in gas lines.

Every 10 days, buses get an oil change and lubrication even though they have traveled only 700 miles. Smaller vehicles receive the same treatment after 30 days. "Condensation and sludge build up when speeds are low, as they are here. Get them out. It's a regular oil change that keeps an engine alive," states Gullette.

Such care is one vital ingredient in the BMEWS operation. Another is a determination to get convoys to the radar sentinel despite the arctic weather. Max Gullette has provided both factors—establishing a standard that will be hard to surpass. ★ ★ ★

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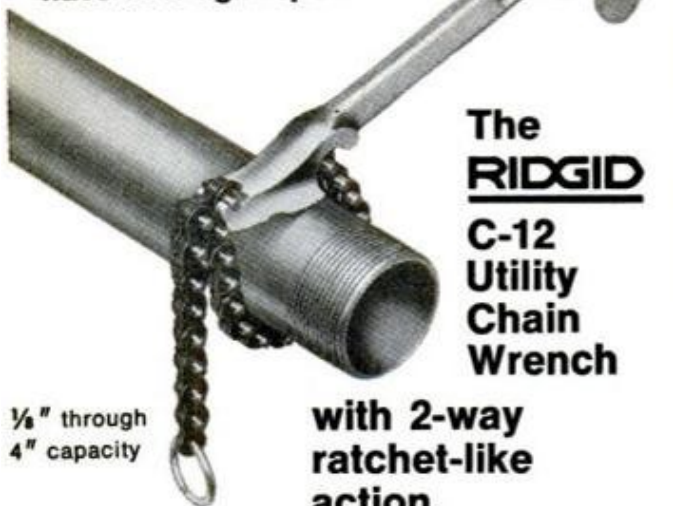
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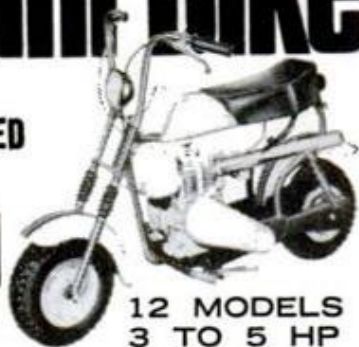
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## TESTER IN YOUR SCREWDRIVER

(Continued from page 187)

in order to keep the hole cleared of chips.

The spring is made of light wire (about .025-in.) and formed around a 1/4-in. dowel so only the nose part of the bulb can enter. One end of the spring gets soldered to the shell of the bulb, while the other end is inserted into the 1/16-in. hole to make contact with the screwdriver shank. The batteries are inserted with the button of the first battery in contact with the bulb. Here you should have about 1/8 in. of extra space so that the end plug, when pressed in place, will push the batteries and bulb against the spring.

Next a 3/16-in. hole is drilled crosswise through the plug and handle for a plastic rod or wooden dowel. The purpose of the plug is to make certain that, should the screwdriver contact a live electrical circuit during use, the voltage potential available through the spring, bulb and batteries will not come in direct contact with the hand. A rubber crutch tip pressed over the end of the handle will provide additional insulation and safety.

At the point where the plug contacts the batteries, drill a 1/8-in. hole for the test-lead tip which is a 7d box nail. Since the hole becomes more of a V-groove across the end of the plug, you'll do best to remove the plug and form the groove with a small round file. A length of stranded wire (18 or 20-ga.) is soldered to the cutoff nail and to an alligator clip. When inserted, the pointed nail contacts the batteries, readying the tester for use.

When it's not in use, keep the test tip out of the handle. This will conserve the batteries. With the test lead removed and the crutch tip in place, contact of the blade with high voltage will not damage either the bulb or batteries because the circuit is no longer complete.—Ray Shoberg

## HEAT-TREATING FURNACE

(Continued from page 216)

or Hoskins alloy wire in a horizontal position under the small peephole in the furnace cover. Record the meter reading when each cone softens and construct a graph like that on page 179. Remember that you'll need a separate graph for different thermocouple materials or sizes.

To reach temperatures above cone 03 (2039° F.), it will be necessary to cover the vermiculite and the inner drum with two layers of asbestos paper, and a layer of glass wool or rock wool insulation. For lower temperatures, cover the peephole with two small asbestos squares. ★★★



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## CAN FORD HALT PETTY PARADE?

(Continued from page 214)

from one of the big outfits that specialize in building race cars, such as Holman & Moody (Ford) and Ray Nichels (Chrysler). Somebody like Junior Johnson, for example, will take a basic Holman & Moody Ford and make pretty much his own thing out of it. Lots of times, too, a car will be tailored to a certain driver. Andretti isn't a tall man and last year Holman & Moody had to fuss with both the seat and the control pedals to accommodate Mario's slight build. Buddy Baker, on the other hand, is a big, rangy fellow and Ray Fox had to stretch things out a bit to handle Baker's long legs.

### Who's driving what?

As to who is going to wind up driving what at Daytona this year, that's hard to tell. Even firm contracts have a way of being canceled at the last minute. As this is being written (late November), though, things figure to shake down like this:

The Pettys will be there in a Plymouth, of course. Bobby Allison will be there in a Lorenzen/Long Ford. Lee Roy Yarbrough will probably be in a Junior Johnson Ford. Cale Yarborough will be there in another Ford, this one owned and entered and crewed by the Wood Brothers. Buddy Baker will drive a Ray Fox Dodge Charger. USAC champion A.J. Foyt will probably show up in a Banjo Mathews Ford. Holman & Moody will probably enter Fords driven by Andretti, David Pearson and international racing star Jackie Stewart, who'll be making his first try at big-time stock-car racing. Ray Nichels's Dodges will probably be driven by Paul Goldsmith and USAC stock-car champion Don White. Bud Moore will show up with a new Mercury, most likely to be driven by Gordon Johncock.

As mentioned earlier, Donnie Allison drove last year for Jon Thorne and will probably do so this year, again in a Ford. Who is going to drive for Cotton Owens is anybody's guess. The same is true for Smokey Yunick. Jim Paschal will probably drive a Friedkin Plymouth and young Bud Moore a Dodge owned by A. J. King. Bobby Isaac will most likely be in a K & K Plymouth and Charlie Glotzbach in a K & K Dodge Charger. I can't tell you how or in what, exactly, but I'm sure such stars as James Hylton, Tiny Lund, Darel Dieringer, Wendell Scott, plus many others, will be on hand for what promises to be a fast and thrilling race.

Me? Well, the phone has been ringing a bit lately and ol' Pop just might be there, too.

★★★



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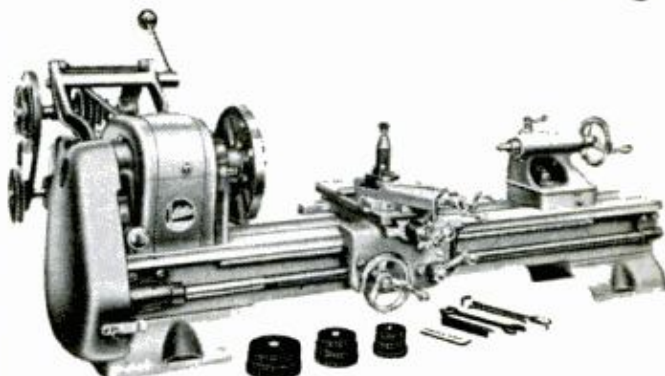
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