POPULAR MECHANICS

OCT. 1965
35 CENTS

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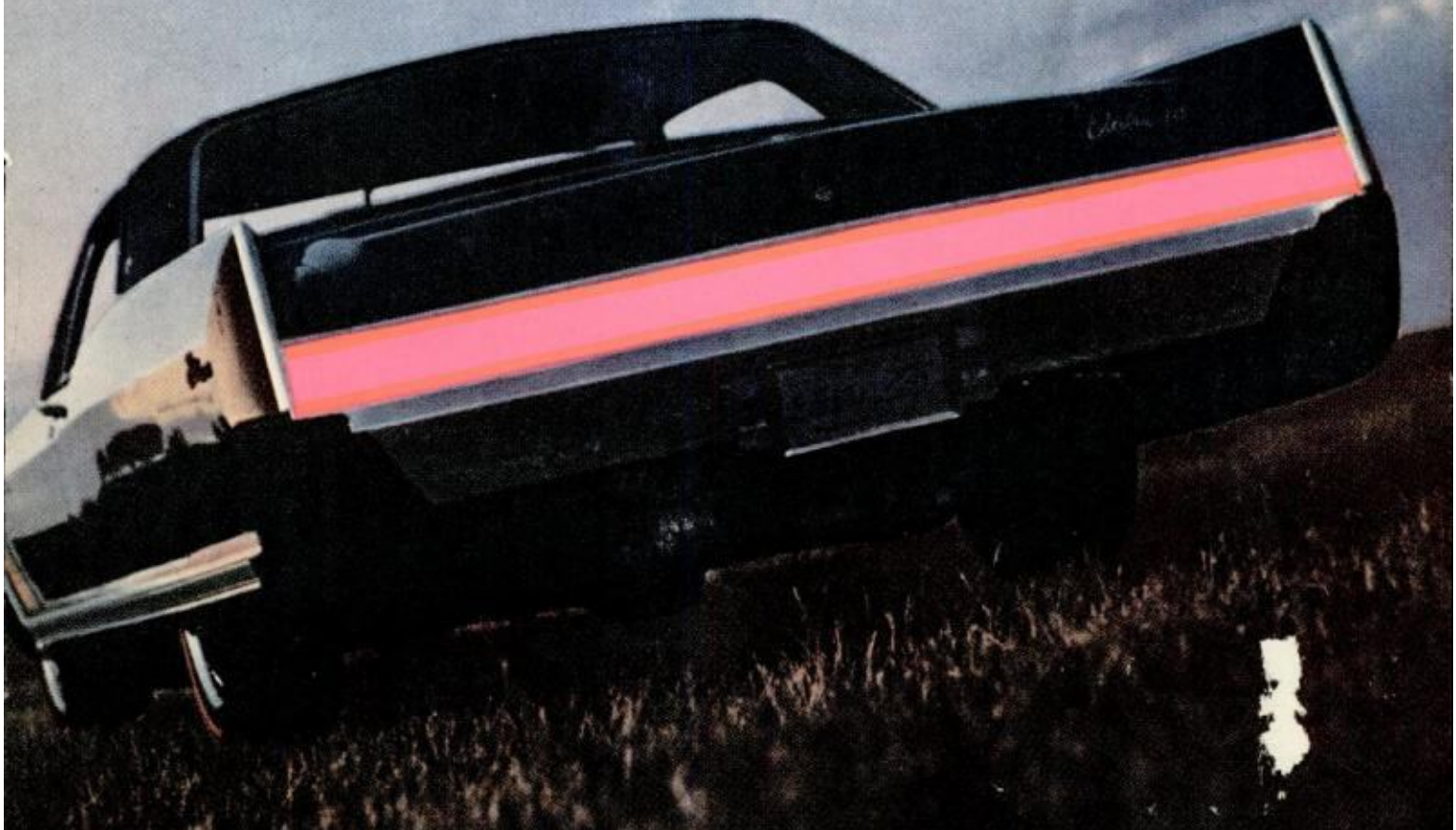

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Monster-Power Engines!
...and a Cloud-9 Ride
FIRST DRIVE REPORTS

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for construction workers

Protective warmth
for hunters

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by Ball-Band, Mishawaka, Indiana

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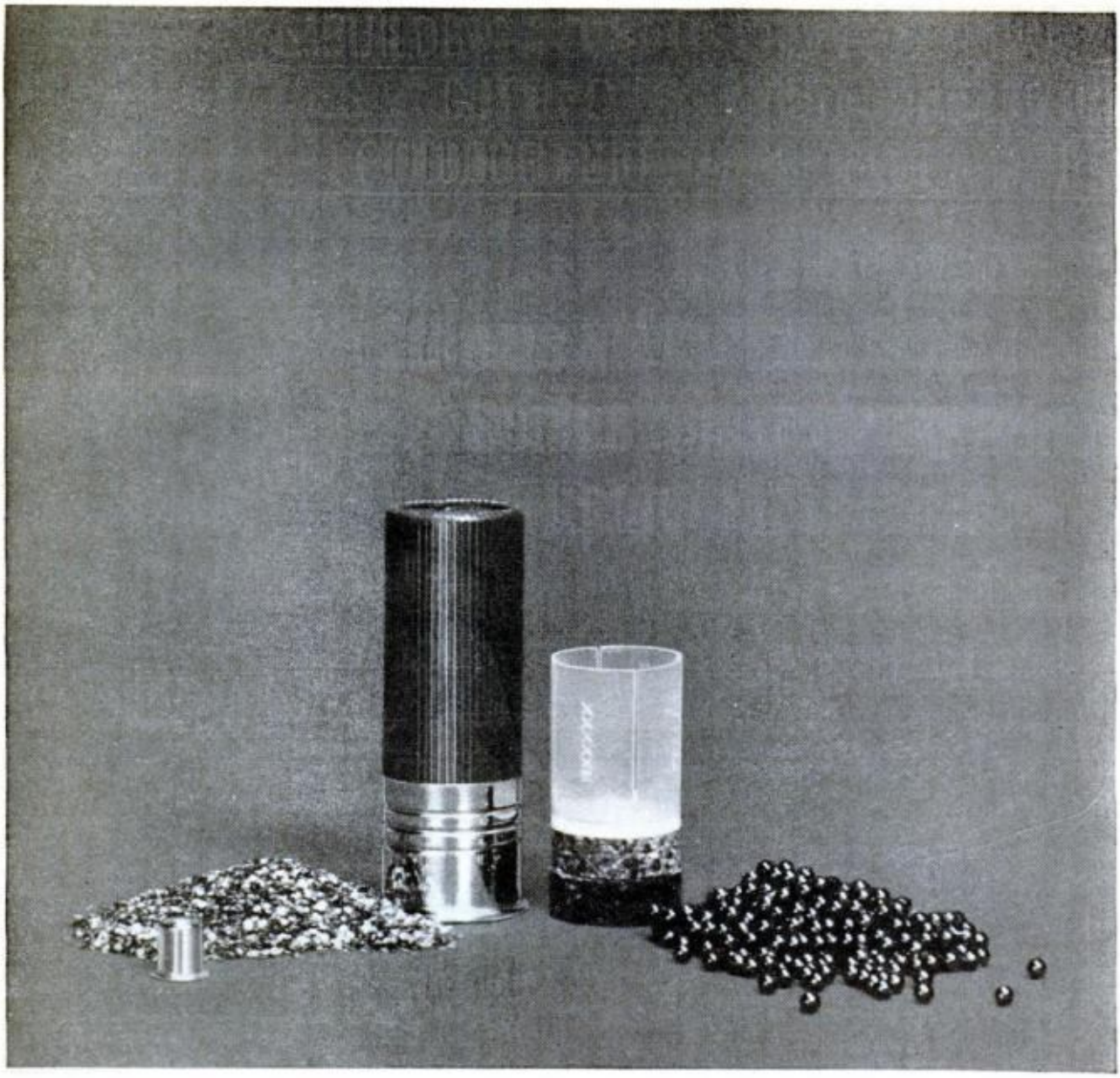

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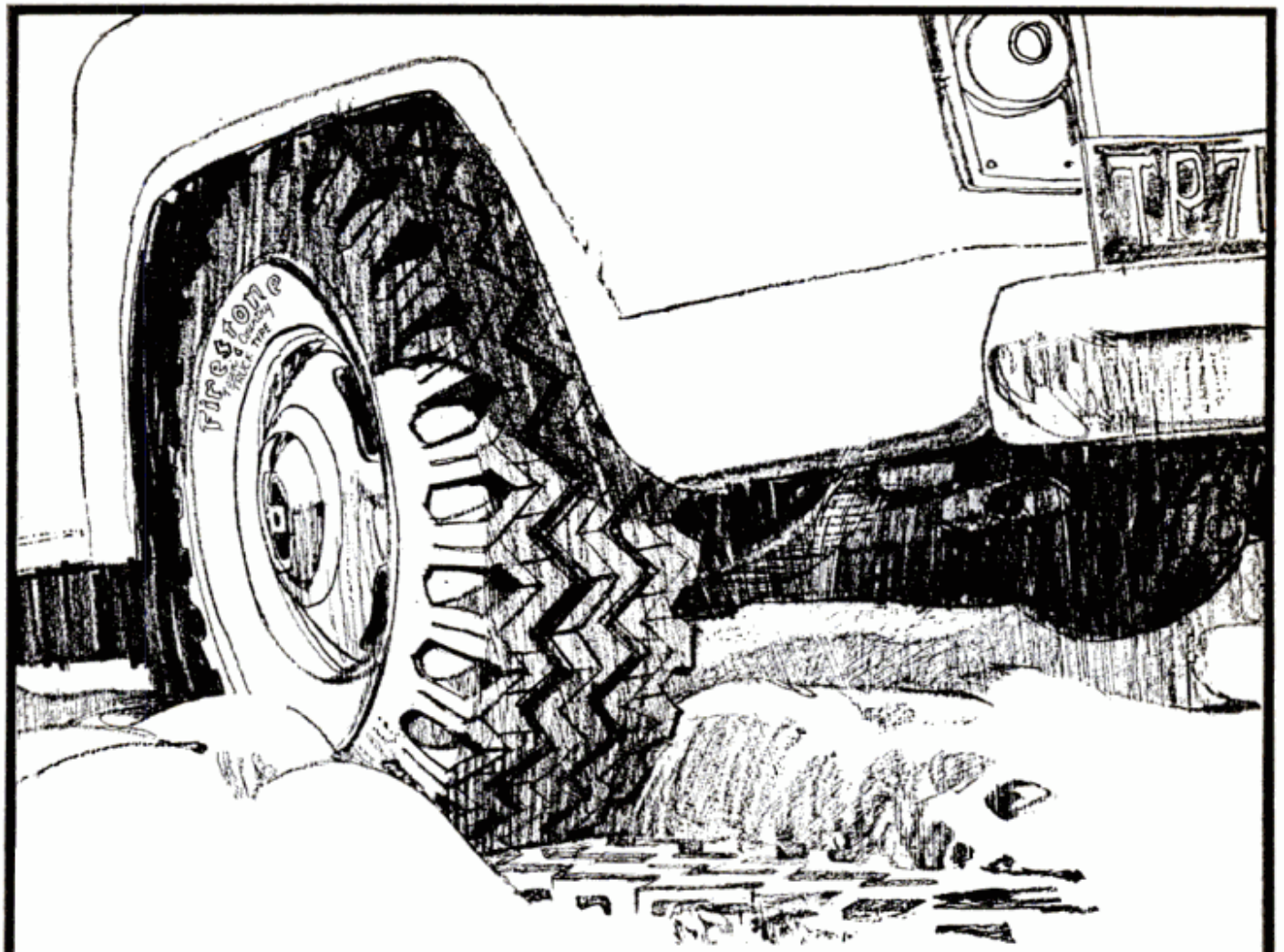

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POPULAR MECHANICS

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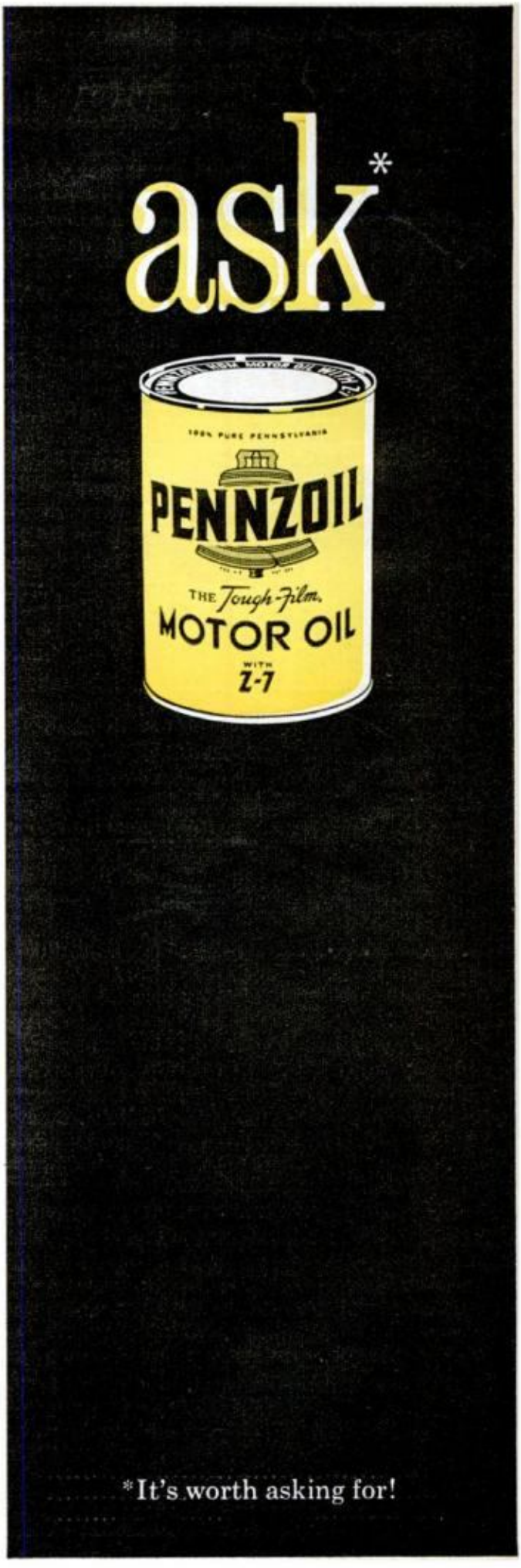

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POPULAR MECHANICS
Reports on New Amco Tool

POPULAR SCIENCE
Publishes 6-Page Feature Article . . . Follows with Special Report

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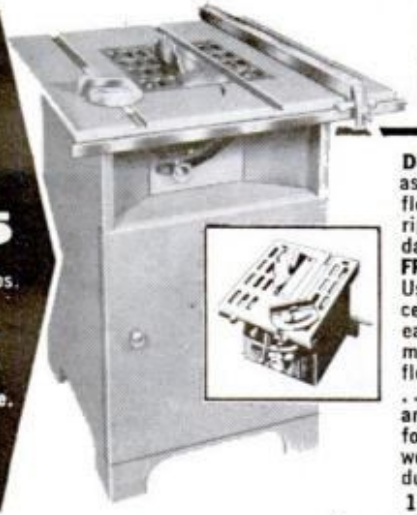

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Over the Editor's Desk

Please Don't Ask

In *Hypo Lube for Precision Gears* (page 137, July *PM*) you say "the next time you see your family doctor, ask him to save a couple of syringes" to be filled with oil and used for oiling precision parts.

In an effort to control illegal administration of narcotics by hypodermic syringe, doctors have been urged to destroy this type of syringe after using it. Most doctors will feel ethically obliged to refuse such a request from a patient.

Boswell, Pa. JAN R. J. DE VRIES, M.D.

Happy Grandson

My grandson Jerry is really enjoying his *Sidewalk Classic* (page 146, November 1963 *PM*) which I built for him.

I enjoyed doing it and hope you will

come up with another great project as interesting as this one.

Sandusky, Ohio THOMAS A. PUSATERG

Too Many Laws? No!

Jack Speirs' article, *We're Being Swamped with Boating Laws* (page 106, August *PM*) is not only flagrantly biased in behalf of waterborne hot rodders, it is guilty of several untruths.

He begins with the falsehood that "practically every wet place in the nation is surrounded by . . . a hodgepodge of unnecessary statutes." In my nine years of boating from one end of my state to the other, I have found no law except one that prohibits recklessness, and even that was not enforced at all.

His next falsehood is: "More accidents could occur because of licensing the operators." If true, we could abandon licensing of automobile operators.

Mr. Speirs continues: "There are too many laws that are designed to defeat boating pleasure." Since this is not so, he must mean that there are too many laws aimed at keeping *him* from doing as he darn well pleases in his pursuit of destroying *my* boating pleasure.

We all know that some otherwise mild people suddenly sprout horns when they get behind the wheel of a car. Well, this strange transition is much greater when it comes to motorboats. As a sociologist, I am fascinated by this condition, but while theories are being batted around, we need *enforced laws* right now.

San Antonio, Tex. W. JAMES WATERMAN

I was shocked and disappointed to see such an ignorant and juvenile article. Boat operators should be governed in the same manner as auto operators. Perhaps Mr. Speirs would recommend that we drop all traffic laws. Since very few boats have brakes, it is advisable that they slow down to five mph while operating around the confusion of docks.

Bemus Point, N.Y. NORMAN WARD

If Mr. Speirs had ever skied for 30 minutes on a slalom, he would know that you are so tired you can hardly move much less swim. Even expert skiers sometimes fall, and when a person hits the water at 35 mph anything could happen. Why not wear a belt?

I was shocked and disappointed that *PM* would allow such nonsense to be printed.

Dallas, Tex. BILLY H. HICKS

It is one of the most misleading articles I have ever read.

There is a need for licensing. In 1963 there were 3475 accidents resulting in 850 deaths . . . and in 1964 there were 3912 accidents resulting in 945 deaths.

Today anyone can put down $300 cash, and drive away with a boat capable of carrying eight people at 30 mph out into the middle of Lake Michigan . . . there are no further requirements. The absurdity of this situation cannot be refuted.

Kenilworth, Ill. E. M. KINNEY

Mr. Speirs comments to Mr. Waterman: "You write at length about something I didn't discuss at all—reckless hot rodding on the water. I'm against it too."

To Mr. Ward, he rejoins: "Few boats have brakes? Read the instructions on how to use a reverse gear or rotate a small outboard 180 degrees."

And to Mr. Hicks, he says: "I'm shocked and disappointed to hear that anyone will ski until he's so tired he can hardly move, much less swim."

Okay, now everybody back in his corner for the second round.

The Editors

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What's your theory on Trac-master's selective hook?

gyroscope?
mercury?
jumping
beans?
mouse?
radar?
sand?
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transistors?
magnets?
ball
bearings?
helium?
B-B's?

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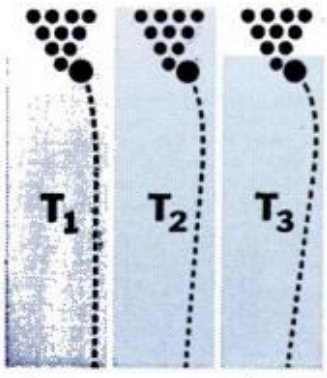

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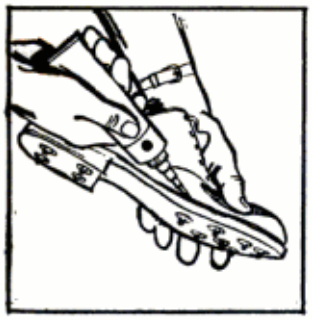
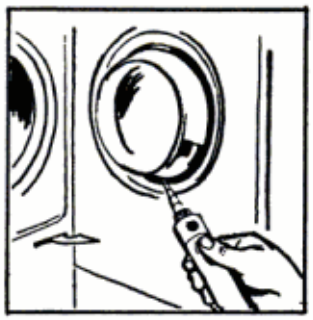
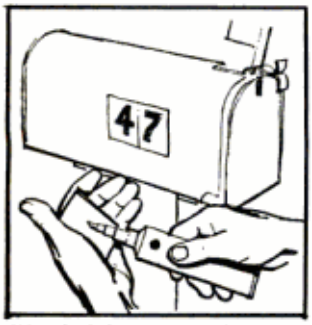
General Electric's amazing silicone rubber sealants, first used in space capsules, repair and mend hundreds of things around the house. Bond securely to most materials. Ideal for gluing and caulking jobs, indoors and outdoors. Permanently flexible and waterproof, they won't shrink, crack, harden or leak.



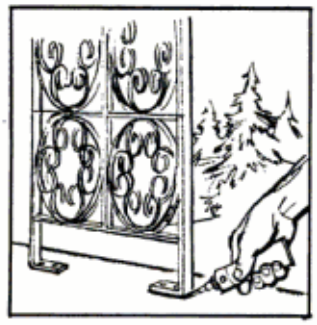
"Used Silicone Clear Seal to waterproof worn golf shoes at sole line. Worked beautifully. Stays flexible." L. L. Lannae, Washington, Georgia. (Clear Seal is transparent, makes invisible repairs on fabric, leather, rubber and other materials.)



"Resealed a door gasket for my clothes dryer with Silicone Bathtub Seal. No more leaks. Only adhesive that can stand the heat." William Jetter, Cincinnati, Ohio. (White Bathtub Seal also caulks bathtubs and tile. Won't shrink, dry out or harden.)



"Sealed house numbers to our rural mail box with Silicone Auto Seal. Now they'll never come off." William M. Smith, Dallas, Texas. (Black Auto Seal repairs convertible tops, cracked batteries and windshield gaskets.)



"Anchored a decorative metal column to our concrete porch floor with Silicone Metal Seal. Easier, faster and more economical than lag screws and anchors." L.M. LaBar, Bethlehem, Pa. (Metal Seal is also excellent for leaky rain gutters and storm windows.)

General Electric Silicone rubber sealants are available in 1 oz. and 3 oz. tubes for hundreds of large or small repair jobs. If you have used them for an unusual sealing job like those above, write and tell us. If we use your story in our advertising, we'll pay you $10. All ideas submitted become property of General Electric. Just write Sect. BS10162 Silicone Products Dept., General Electric Co., Waterford, N. Y.

GENERAL ELECTRIC

Sidelights from the SERVICES

By William R. Kreh

GIs aren't built the way they used to be. So says the Defense Supply Agency which, after extensive surveys, has found that those recruits with the skinny necks and extra long arms who have long been problems for supply sergeants are now "standard-size Americans." As a result, the Agency's recommending that the services stock as standard what used to be unusual sizes.

Dual duty: Only in the U.S. Coast and Geodetic Survey's navy can a man serve on two ships at once. That's because the Survey has a pair of ships, the *Wainwright* and the *Hilgard*, which are identical in every detail. They go everywhere together; they can't work without working together. And officers and crew are listed as serving on both ships at once. The vessels are wiredrag craft, each pulling one end of a quarter-inch stainless steel wire that drags the bottom to locate wrecks or other obstacles to navigation that go into Survey charts.

Drownproofing—a method of staying afloat in water almost indefinitely—is undergoing a seven-month test by the Marine Corps. Thousands of Leatherneck recruits are being taught the water survival method, developed by the late Fred Lanoue, Georgia Tech swimming coach. Army training officers are keeping close tabs on the experiment for possible use in their service.

A super camera system has been developed by the Air Force for photographing missile shots. Called ALOTS (Airborne Lightweight Optics Tracking System), it's so sensitive that it could automatically track the flight of a batted baseball and send back high-resolution television pictures, with close-ups in such detail that grass stains on the ball would be detectable, all from a distance of 12 to 15 miles away.

Biggest nonatomic underwater explosion took place this summer when the Navy exploded 7000 tons of obsolete ordnance at a depth of 1000 feet about 75 miles off Virginia's shores. The big blast, in addition to getting rid of old ordnance, was used to measure underwater shock waves over long distances.

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Air pollution, airliners and high heels are taking their toll of the centuries-old Parthenon temple in Greece. Engineers report that growing industrialization in Athens is creating polluted air, which causes corrosion of the honey-colored marble; jet airliners at the nearby Athens airport create structure-shaking vibrations, and the high heels of women tourists chip away the temple's stonework.

Ear-popping tests were held recently at the Space Needle (erected for Seattle's World's Fair). Employees of an aircraft company were given stop watches to record when they became aware of pressure changes while riding up and down in the elevators. The information was gathered to help determine when average airline passengers first become aware of changes in air pressure when taking off and landing.

Warming concrete so that it can be poured in freezing weather is said to be possible with a new method developed in Japan. Electrodes are either embedded in the wet concrete, laid on its surface or attached to the concrete forms. Alternating current between 50 and 60 cycles is fed to the electrodes. The heat produced keeps the mix from freezing and assures a good set.

Automatic windows are being tested in a school near the London airport to help cut down the din of big jets taking off and landing. A microphone on the roof of the school operates a relay when the noise exceeds a predetermined level. The relay, in turn, controls a hydraulic mechanism which closes the window. When the noise level drops, the window reopens.

They're blowing air into shipboard cargoes. It's a new wrinkle in keeping cargoes from shifting. Called inflatable dunnage, high-strength nylon bags are placed between plywood sheets and inflated to a pressure of five pounds per square inch. The four-by-eight-foot bags can exert a force of 18,000 pounds in two directions, firmly fixing any cargoes that might shift in rolling seas. Tests have shown the bags may reduce transit damages to cargo by as much as 99 percent.

Compression measurements of half a million pounds per square inch have been made on ordinary glass by University of Vermont researchers.

"This may be likened to 200 automobiles piled one on top of another on a one-inch square surface," explains Dr. John O. Outwater, leader of the group of scientists who are looking for an ideal hull material for deep-submerging vessels. So far, glass looks much more promising than steel.

While German engineers work feverishly to raise the Abu Simbel temple in the Aswan Dam project in Egypt, dental researchers are also racing against the rising waters of the Nile. They're collecting and X-raying skulls from ancient tombs to study changes that have occurred in the structure of human teeth over the past 40 centuries.

Early Bird saves a life. An electrocardiogram of a passenger, taken aboard the liner *France* on the high seas, was radioed to New York and then relayed via the Early Bird satellite to Paris. Dr. Jean Lenegre, professor of cardiology at the University of Paris, interpreted the cardiogram and reported his analysis by radiotelephone to the medical staff aboard the *France*, who then knew the best treatment for the patient.

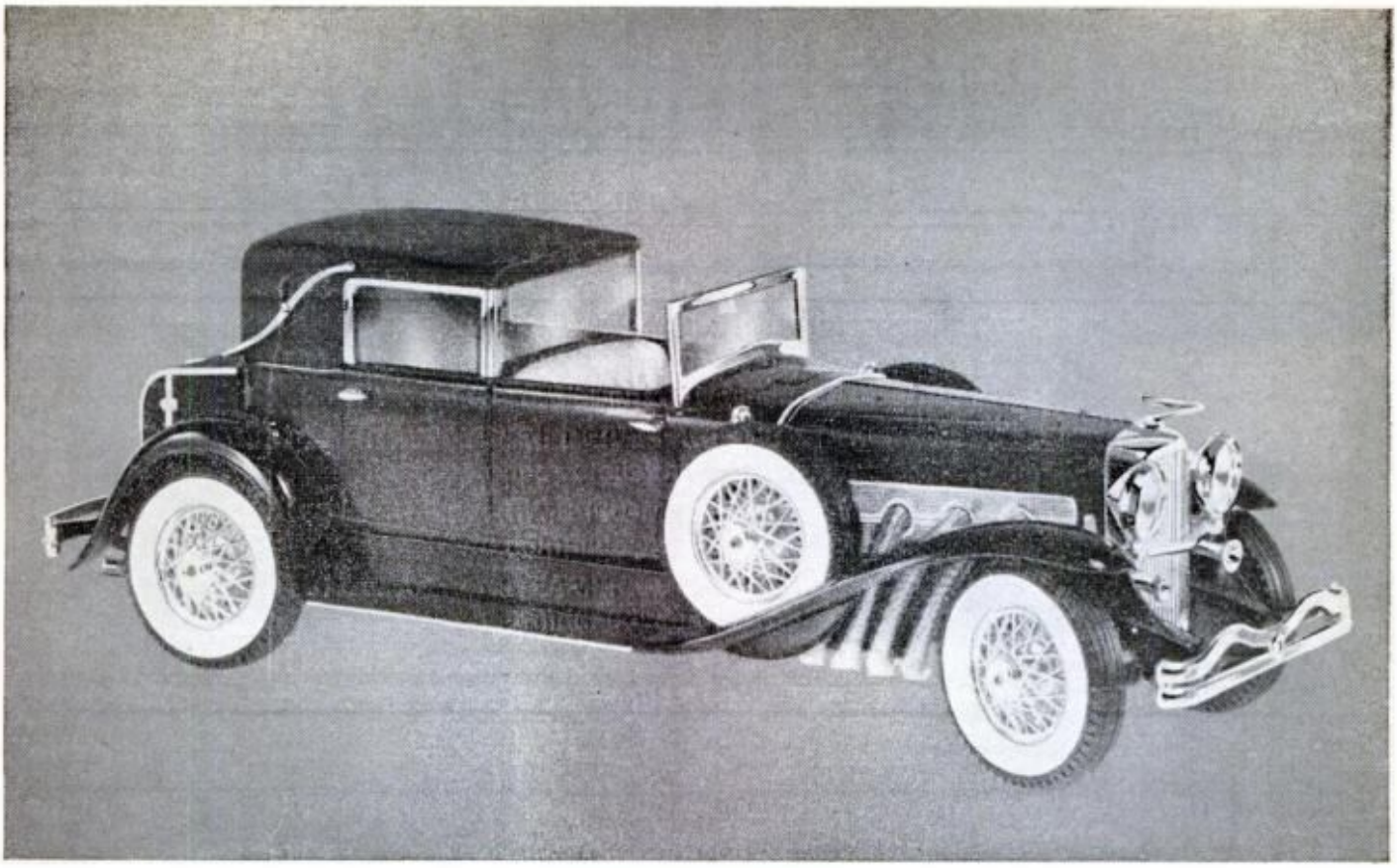
Safety glass is just as necessary in eyeglasses as it is in automobiles, according to an editorial in the *New York Journal of Medicine*. Those who particularly need the protection are children; persons with sight in only one eye; workers who handle corrosive or explosive materials; persons who operate power tools in industry or at home (including power mowers).

The additional cost for safety glass is slight, says the editorial. Optical grade plastic costs an extra $2 and case-hardened glass adds $5 to the price of a pair of glasses.

Tough birds. Studies by the Federal Aviation Agency indicate that sonic booms, which seem to make many farm animals nervous, actually have a tonic effect on chicken birth rates.

In tests, chicken eggs that were exposed to the booms had a higher hatching rate

(Please turn to page 14)



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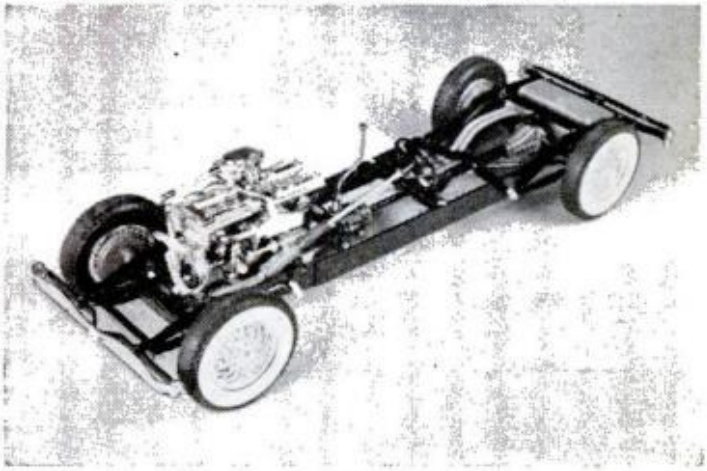

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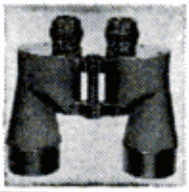

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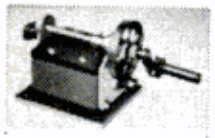

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Science Worldwide

(Continued from page 12)

than that recorded for another group that incubated in silence.

✔ ✔ ✔

Shipping grain by pipeline may soon be an innovation in Russia. Soviet engineers are studying the possibility of sending grain, mixed with water or other liquid, through pipelines over the thousands of miles that separate most grainlands from the cities where the product is needed. A pipeline is now being used in the Ukrainian town of Lugansk to carry coal in sludge form from a local mine to a power station 260 miles away.

✔ ✔ ✔

"Breathless" Olympic games are in store for 1968. They'll be held in Mexico City that year—the first time that they will take place at such a high altitude. A British research team plans a trip soon to the 7500-foot-high city to determine how long it will take British athletes to become used to the altitude.

✔ ✔ ✔

New life for the coal industry may be in the offing. Research engineers have developed a 100-watt fuel system that converts gases from coal directly into electricity. The system consists of a chemical reactor, for producing volatile gases from the coal, and a 400-cell battery.

Gases from the reactor flow upward through stacks of thimble-size fuel cells to a battery cathode. Heated air contacts an anode on the outer surface of the cells and removes electrons from the anode surface. A large-scale system for electric power generation is a possibility.

✔ ✔ ✔

Easy with that shaker! Reports of tests conducted at a medical college in Bombay, India, are said to indicate that salt may be a cause of the common cold and of ulcers.

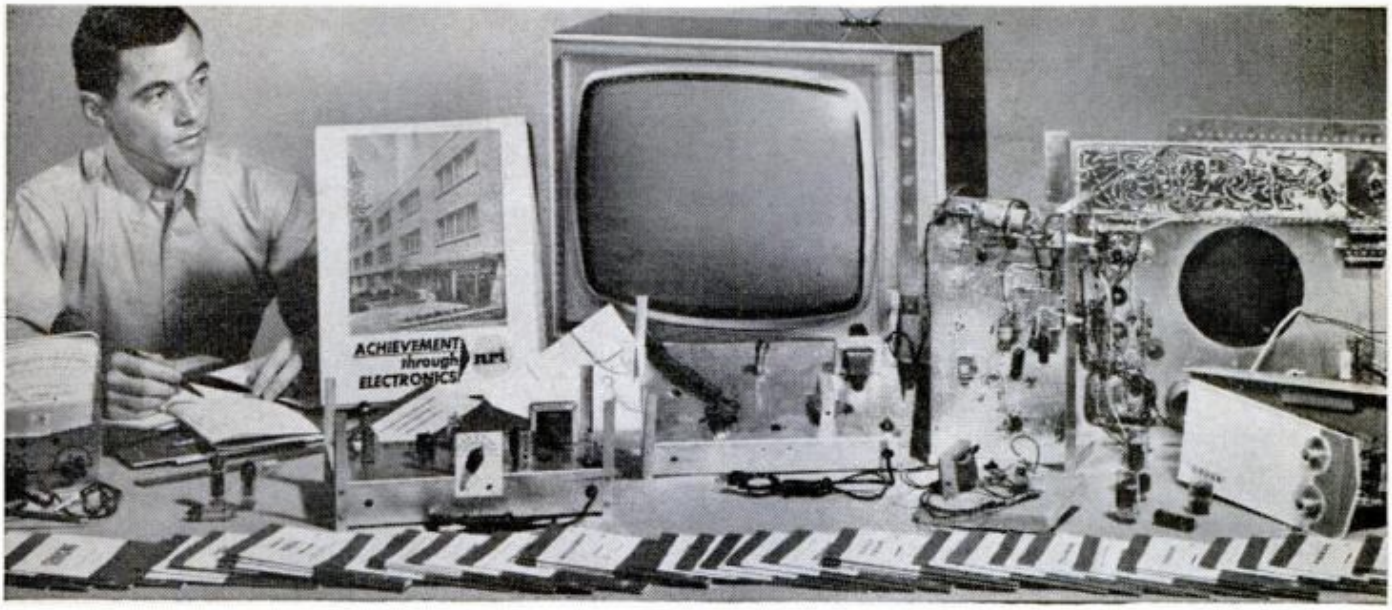
✔ ✔ ✔

The most elaborate tooth in the world has been constructed at the University of Michigan School of Dentistry. Looking like an ordinary first molar "bridge," it can chew food, measure the pressure and surface, and broadcast detailed physiological information to monitors.

Scientists have crammed into the tooth six miniature radio "stations," 28 electronic components with special bondings and two rechargeable batteries.

John F. Pearson
Science Editor

LEARNING RADIO-TELEVISION, ELECTRONICS IS FAST, EASY, INTERESTING WITH NRI



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F. W. COX, Hollywood, Calif., averaged $150 a month spare time while training, now has his own full time TV-Radio service business. ALLAN R. TOWNSEND, Topeka, Kan., is a missile officer at Atlas ICBM site, fixes radios and TV sets spare time. R. L. WOOD, Fargo, N. D., got his FCC license and is Master Control Engineer with KXIB-TV. J. J. JENKINS, San Diego, Calif., says his NRI training is priceless. He is Frequency Coordinator for the 11th Naval District.

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Sidelights on AVIATION

Airline passengers account for less than 20 percent of the population. Or, to put it another way, more than 80 percent of the people in the United States, even in this jet age, have never flown.

It means little in the military, business and private areas of flying, because they attract only the professionals and the sportsmen. But it's a real problem to the airlines who depend on passengers for revenue, or, to be blunt, to get out from under government subsidies.

Some people don't fly for health reasons, bad ears, nervous stomachs or some such. Some can't afford it. But the overwhelming majority don't fly because they're just pure scared. And most of the fright is based on old-wives' tales.

It's like the weather; a lot of people talk about it, but do nothing. Very little has been done to attract people who are afraid to fly, but one man, a member of the Airways Club, has outlined a program that is attracting some interest. It's based on reduced rates for first-timers, up to four-fifths off the normal cost depending on his age bracket.

He suggests that if the price is attractive enough for about four flights, by the end of the fourth flight all fear should have evaporated.

Round runways? Well, why not, asks the Navy. It recently ran some tests at a circular track used by General Motors as a proving ground for automobiles.

The potential advantages are many: The runway is infinitely long, eliminating problems associated with aborts on take-offs and overruns on landings; there is always a portion headed into the prevailing wind; taxi time is reduced; and less space is required to build one.

The results were encouraging. Using T-28 tricycle-geared trainers, the Navy pilots at first had to fight a tendency to level the wings on takeoffs and landings and felt like they were "flying into a hole." But they soon adjusted.

The track was banked and compensated for slow and fast landings, drifting the fast planes up the bank and the slow planes down. There was an imaginary "equilibrium circle" for each speed.

Kevin V. Brown
Aviation Editor

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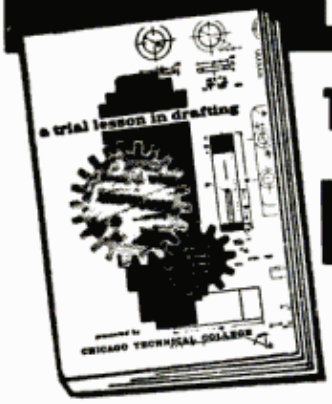

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Noteworthy New INVENTIONS

By M. J. Pedersen

Effortless rocking may be had in a rocking chair that is minus the familiar rockers on the bottom; an electric motor does all the work. John W. Fuller of Wilmington, Vt., who earned patent 3,186,008 for the rocking mechanism, claims that a baby in a cradle may be similarly rocked to sleep electrically.

Super-strong concrete, which can withstand the blistering heat of a rocket at blastoff, is being used at launching pads around the country. Known as Fondu-Fyre, it has a glass-glazed surface and can withstand temperatures as high as 3500° F. without erosion and temperatures of 5500° with an erosion rate limited to only 1/100 of an inch per second. Made of a special alumina cement and an aggregate of volcanic rock, the concrete earned patent 3,188,368 for John D. McClendon, Canoga Park, Calif., Robert F. Stewart and Ben T. Larsen, Granada Hills, Calif.

Polka dot highway presents a system of dotted markers down the middle of each lane to keep cars a safe distance apart. The markers would be evenly spaced and road signs would instruct a driver—according to the dictates of road conditions and speed limits—how many dots should be visible between his car and the one in front. Patent 3,188,927 went to Allan M. Woods, Garden City, N.Y.

An underwater suction "gun" was awarded patent 3,184,878 for David Louis Senne, La Habra, Calif. When a skin diver pulls the trigger of the gun, a strong water current is created which sucks the fish into the gun. Several chambers in the gun enable a diver to catch a number of live specimens of fish in a single underwater trip.

Tree shaker with a long metal arm that grips a branch and rattles it, may simplify matters for fruit pickers in the future. The arm, plus the special trailer unit to which it is attached and which controls the shaking action, can both be hauled around an orchard by a standard farm tractor. Patent 3,183,656 went to Robert M. Shipley, Jr., Cloverdale, Calif.

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Presto! – Top's up for shade or showers.

Big skiing fun – small boat handling ease.

90 hp a-go-go . . . by Johnson

A dash of the devil!

— that's the Johnson "Caprice" — raffish little pocket-yacht with touches of grandeur. Ingenious use of space creates lavish surprises in only 14'-9". Like 4 bucket seats that unfold into lounges, convertible top, padded coaming, storage compartments, safety glass tinted windshield that folds down for a faceful of breeze. (Or open a special vent under the windshield for a gentle flow of air.) Power is a hot-blooded 90 hp mill that's quick and quiet — like all Johnsons. New "SeaFoil"® hull, the hydro-lift design that has the *smooth* way in rough water, provides 31½ sq. ft. of cockpit space. For all her hustle she leaves a well-mannered wake — a skier's delight. Easy to dock, easy to trail, easy to love — that's Caprice! Rendezvous at your Johnson Boats dealer!
See all 5 new Johnson Boats — 3 with new "SeaFoil" hull . . .
2 with the popular three-point hull — 14'9" to 19'1" . . . 90 to 200 hp.

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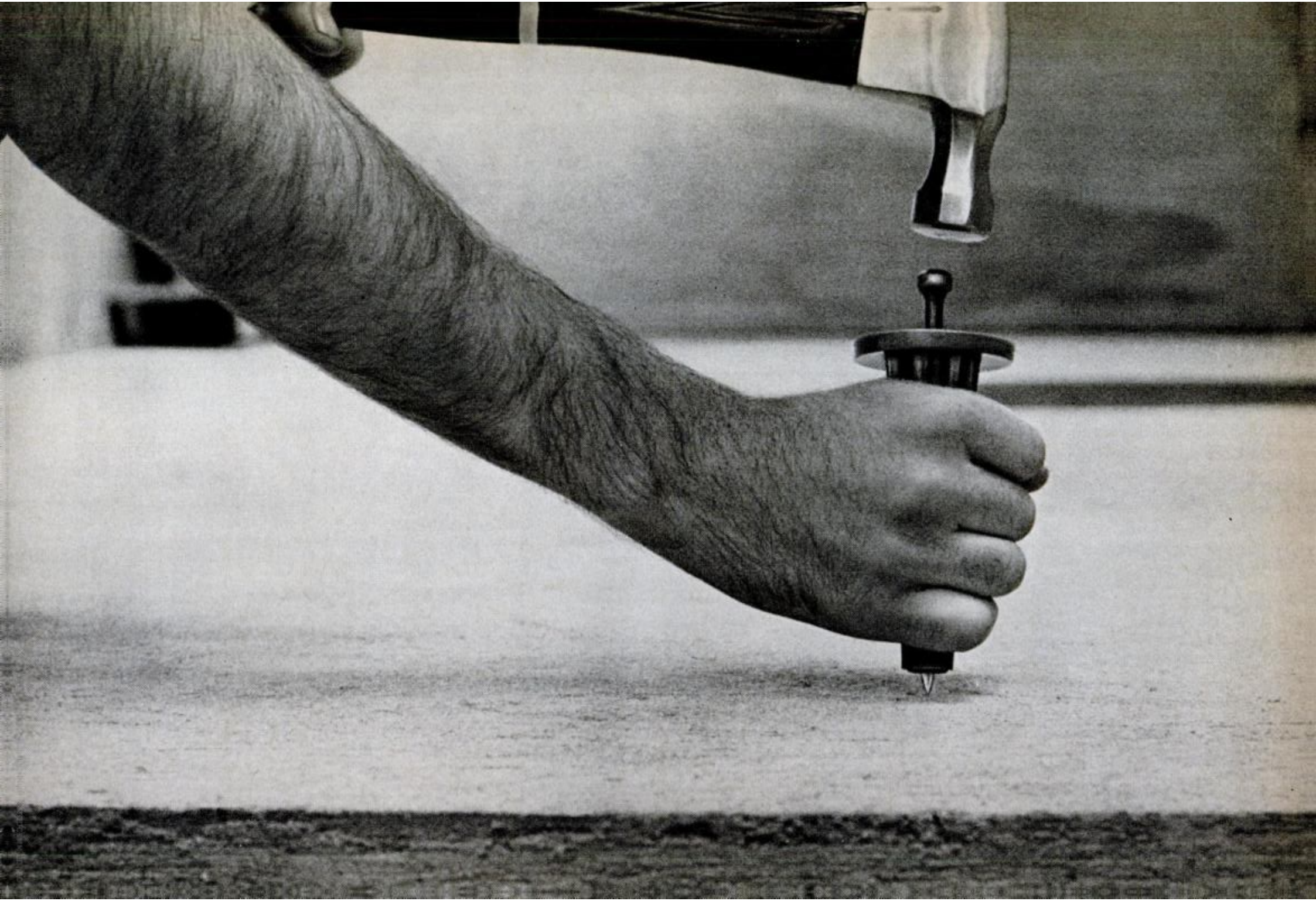
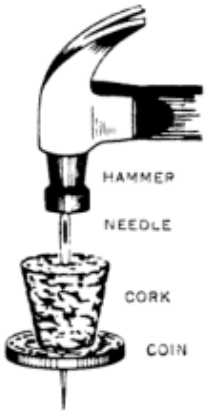


How many shelves, panels, brackets and what-have-you's would you put up on your basement wall if you could hammer into concrete as if it were wood?

This is a new invention that drives fasteners into concrete with just a few whacks of a hammer.

It's called Shure-Set.® And it's so simple, it's a wonder no one thought of it sooner. (Matter of fact, the idea comes from the old "poke-the-needle-through-a-coin" trick. Where the secret is to put the needle through a cork before you hit it, so it doesn't bend or break.)

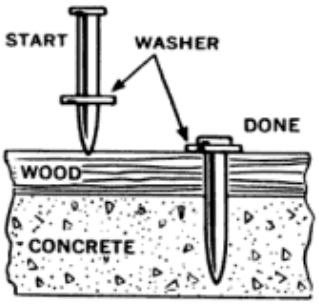


You just push a fastener into one end of the tool and hit the other end with a hammer. A piston inside concentrates the force of the hammer blows.

Just a few light taps to get the fastener started. Then bam-bam-bam-bam. It's done.

You've fastened a 2X4 to concrete. Or a furring strip. Or light gauge metal.

Without drilling. Without expansion devices. Without a lot of time and effort.

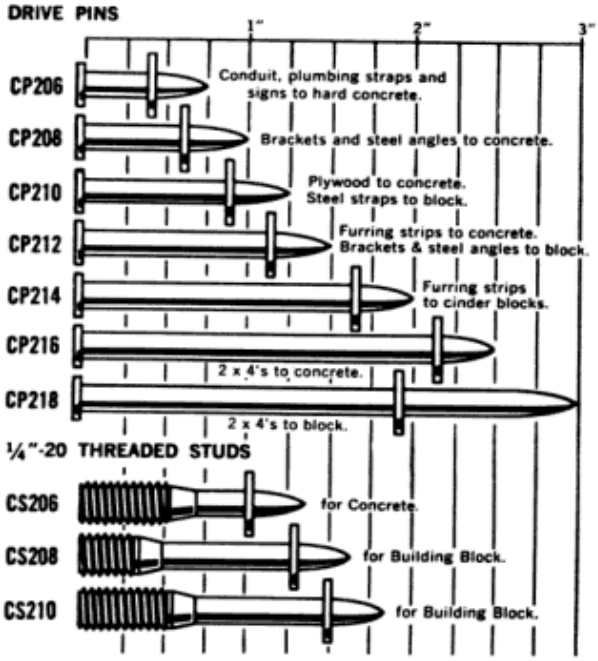


Now you can't go banging just ordinary fasteners into hard concrete even with a Shure-Set tool. We harden ours with a special heat-treating process (called austempering) so they won't bend or buckle. And we make two kinds — a pin and a stud.

The pin is driven through the material to be fastened and into the concrete.

(The washer on the end slips up the shank and keeps the material from pulling through.)

The stud is driven into the concrete with the threaded end sticking out. Then you drill a hole in the material, slip it into the stud and fasten it with a nut.



They come in sizes to handle practically every fastening job (see our chart). And to get you started, we've packaged a special fastener assortment with a Shure-Set tool that sells for just $3.95 at your hardware store.

All you need is a hammer. **Shure-Set®**

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detroit listening post

Mustang-Type Sportsters

- ***Is There a Front Drive in Your Future?***
- ***Radial-Plys—Boon or Bust?***

Those new, small, sporty cars should appear by this time next year, and more information is cropping up on them. Mercury's Cougar will share some body components and suspension systems with the Mustang, but its four-inch-longer wheelbase will give more rear legroom. Its distinctive styling will feature pop-up headlights and low, fastback silhouette.

Chevrolet began testing its Mustang-type four-seater last summer; the car should bow by next September.

Pontiac, not wanting to play follow the leader, will try to cash in on the MG and Triumph sports-car market. Their two-seater should sell for about half the base price of the Corvette.

Stripped down, the car will come with Pontiac's new overhead-cam Six. Various options will allow buyers to turn it into a luxurious runabout or an all-out performer for the sports-car racing circuit.

No other front drive car will be built for at least two years, unless Chevrolet's new Mustang-type entry tries it. Ford's front drive will probably come at first in the Thunderbird, since (1) this drive setup costs much more, and (2) the all-new 1967 'Bird has been designed to accept front drive. But Ford still is not sold on front drive; they'll wait for the Toronado to test the market.

Auto makers are moving away from unit-body construction. The 1967 Thunderbird and 1968 Lincoln will switch to a separate frame. Chrysler will follow suit with its bigger cars—Plymouth, Dodge, Chrysler—soon after. The big reason is manufacturing costs. Unit construction offers no real benefit to the motorist. In fact, it is almost impossible to tell the difference when driving.

Radial-ply tires have run up against strong opposition from auto makers. The problem is ride harshness at low speeds —20-50 mph. But benefits include up to 80 percent longer life, better fuel economy, more traction, quieter ride at high speeds. The extra cost is small—25-35 percent. Radial-plys are available as options on four '66s: Mustang, Comet, Toronado and Pontiac. And Buick is definitely interested. Despite Detroit's antipathy, they may become a common item as ride harshness is eliminated through suspension changes.

Return of the Duesenberg nameplate, much-talked-about, is scheduled for next March. The bodies will be built in Italy by Ghia, but the chassis will be American-made. Duesenberg plans to use the Imperial 440-cu.-in. V8 and TorqueFlite. Disc brakes will be a near-necessity in stopping the 6000-pound monster. Only a six-passenger sedan model will be built to begin with. It will have a three-year warranty, regardless of mileage. The $19,500 "stripped" model will have just about every luxury option now on the market.

Aluminum engines are back in the news. The word is that Ford is testing a new die-casting machine that spits out aluminum blocks at a speed that would bring the cost down close to that of iron blocks. General Motors also is said to have dies on order for research. Both companies supposedly ordered the dies from Europe —one reason for the lack of publicity. An aluminum engine may be produced within the next two years. Is this what Chevy is cooking up for its Mustang competition?

What's happening to Chrysler's turbine engine? Chrysler will make the decision sometime in January. Most observers say the turbine program will be carried into a new phase of development, delaying full production.

American Motors' share of the car market has been shrinking for the past four years. Now, the smallest of the Detroit auto makers is fighting to keep ahead of Volkswagen in U.S. sales. The latter company has recently expanded its test facilities and hired new engineers for body and engine development in a drive to develop a more luxurious product. Already, the company has shifted emphasis from economy to the now-popular sporty image.

Jim Dunne

Detroit Automotive Editor

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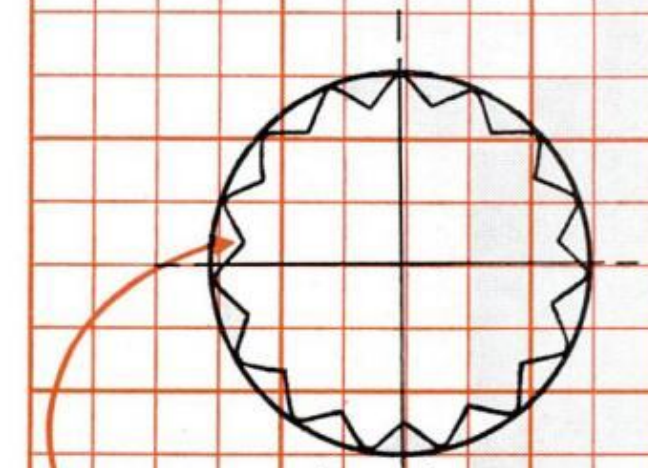
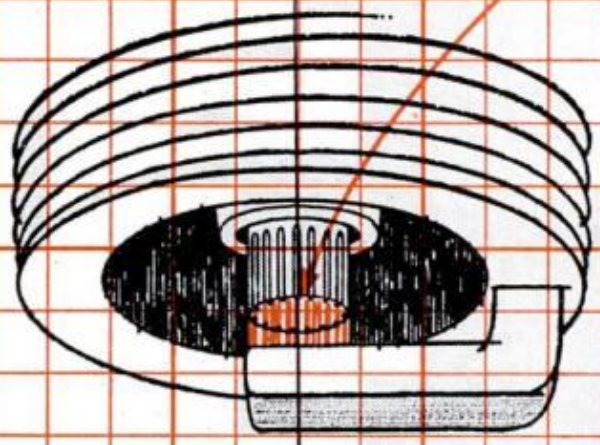
From an AC engineer's notebook:



firing tip is knurled and machined to provide sharper edges for better sparking



Here's how AC's Knurled Center Electrode helps your engine start faster

AC's Knurled Center Electrode helps you get faster starts. The knurling develops a series of sharp points around the circumference of the firing tip and each one encourages sparking. Since electricity jumps more readily from a sharp point than from a flat surface, AC Fire-Ring Spark Plugs require less voltage to produce a spark. You get quicker, more positive sparking for faster starts. This same superior "sparkability" also promotes more power, better mileage. Only AC gives this added assurance of better performance. Ask for AC Fire-Rings next time you change spark plugs.

AC

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AC SPARK PLUG DIVISION OF GENERAL MOTORS

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CLINIC FOR HOMEOWNERS

Q I had a six-panel door hung last fall but did not get it finished, only stained, before the heating season began. Over winter the door warped rather badly, but come spring, most of the warp disappeared, permitting the door to close with only a light push. What happened, and what do I do now, finish the door, or not?—H.K., Del.

A The heat reduced the moisture content of the wood, resulting in shrinkage and consequent warping. During the summer months the wood reabsorbed moisture, likely to somewhere near the original content, the wood expanded and the door returned to near-normal. Although it is unlikely that the wood has completely stabilized, it probably will be safe to apply finishing material at this time. Since the door has been stained, we assume you intend to apply a varnish finish rather than paint or enamel. Apply at least two coats to all flat surfaces and be sure to seal the top and bottom edges with as many coats as the wood will take.

Q My rubber plant has seemed quite vigorous and healthy until just lately. Now the leaves are turning yellowish and in time they fall off. I've been advised that this is caused by a fungus, but no one seems to know what to do. I keep the plant well watered and in the sun as much as possible. Can you tell me what is wrong and what to do?—U.H., Okla.

A We doubt if the cause is a fungus attack. More than likely you are either over-watering the plant or permitting the soil to dry between waterings. We assume it has been propagated in a pot and if the latter does not provide proper drainage of excessive water, this will cause the roots to deteriorate and the foliage to discolor and eventually drop off as you describe. Unless the plant is quite old, it may be advisable to transplant to a larger pot with adequate draining provision. In this you should take every precaution to disturb the root system as little

What does C45 Rockwell

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as possible and to fill in the new pot with a good transplanting soil. Then water at such regular intervals as will keep the soil damp but not wet. Stir the top soil occasionally before watering.

Q My tiled kitchen floor squeaks at one point across nearly the whole width of the room. I'm told by the original owner that the subfloors are plywood and that the tile are laid over a hardboard underlayment. Although the tile are yet unbroken or otherwise damaged, there appears to be a slight ridge at the point where the squeaks originate. The basement is ceiled with acoustical tile. Can you advise what is wrong, and suggest a remedy?—R.Y., Ohio

A Judging from your description there would seem to be two probable causes: either the plies of the subfloor have separated due to a continuing condition of dampness, or the sheet, or sheets, of the underlayment have been butted directly over the butt joints of the plywood subfloor and in the latter case the nails holding both are either inadequate in number or have loosened. This would permit slight movement of the butted ends and likely produce the squeaks. To remedy the trouble it will be necessary to remove some of the ceiling tile in the basement to permit access to the joist on which the panels of the subfloor are butted. After tile have been removed, nail or screw strips to the joist on both sides, then drive screws through the strips into the subfloor. This should draw the loose ends down tightly and stop the squeaks.

Q In my new ranch-type home I've had trouble with ice dams forming on the roof just above the boxed cornices. Water above the dam leaks inside the attic. Will the electric cables I see on some low pitched roofs actually melt the ice and permit the water to run away without damage?—H.M., Minn.

A The low heat cables you refer to are said to be quite effective when properly installed in a zigzag line covering the area above the boxed cornice, or soffit. The line should continue along the full length of the gutter also. When current is on, these cables melt openings in the ice and permit the accumulation of water above the dam to run out through the openings and drain away along the gutter.

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THE TOOL BOX OF THE WORLD

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BIG WINDSHIELD on the Rogue is made of tinted safety glass and folds down flat on foredeck. Full-width air vents below it will keep you cool during normal running

Evinrude's Grown-Up Gulls

By Art Mikesell

AIMED AT THE BIG-WATER BOATER, Evinrude's new 19-foot Rogue is a spacious four-place runabout available with either 150 or 200-hp stern drive power. I ran it after playing around with a little 14-foot, 90-hp Playmate, smallest of Evinrude's gull-wing line. While both proved to be stable, soft-riding hulls, the larger, heavier Rogue dramatically demonstrated the fact that most big boats ride better than most little boats.

The Rogue has a load capacity of 2000 pounds and a cockpit area of 51 square feet. With four back-to-back lounge seats, that leaves plenty of room to get up and stretch your legs. For real deep-sea fishermen, the cockpit floor has reinforcement for mounting a fighting chair. An ice chest and bait box are also available as options.

Instrumentation includes a speedometer, tach, ammeter, fuel gauge, oil pressure light and temperature warning light, plus switches for the power tilt, ignition, bilge pump and blower.

As for performance, the Rogue matches Evinrude's smaller hulls in most situations and has a solid edge in a really rough chop. That's saying quite a bit.

14-FOOT PLAYMATE introduced last January is luxury runabout, gray with red interior. Billed a "personal sports boat," it's delivered with monogrammed nameplate

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NRI's special new section on modern air conditioning and refrigeration gives you complete know-how in this fast-growing field. Other sections are invaluable for men who work on farms, or in stores or plants. No matter what you're called on to fix, in no time you'll be making repairs like a pro. And – you now get special bonus lessons on 2- and 4-cycle gasoline engines!

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Spotlight on That

Preposterous Mini-Moke

Driving it is a ball—mainly because it's so uncomfortable, so maneuverable, and so wacky

By Alex Markovich

HA, HA, HA, HO, WHEE-HOO . . . I was just . . . just driving the Austin Mini-Moke, and I'm . . . hee, hee . . . still hysterical.

I started snickering when I first saw it; it's basically the Mini sedan so popular in England, but it looks like an un-Sanforized Jeep that's been stripped by vandals. No side windows. No doors. You just sit there, perched on the brink of disaster, your knees scrunched up because the seat doesn't adjust.

The tiny 34-hp chugger takes 24 long seconds to reach 60 mph. The drive train is noisy. The ride is harsh. And then (the horror, the horror) it begins to rain, and

IT'S GREAT FOR CITY TRAFFIC; you can slip into tiny openings that other drivers don't even notice. And pretty soon, you get used to people pointing and snickering—if you're tough. But heaven help you if it rains

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passing cars get you all wet and everyone seems to be laughing at you even more than usual.

And yet I enjoyed this car perhaps more than any other I've driven. The cornering is better than that of most all-out sports cars. Just keep the throttle wide open through the turn and the front-wheel drive pulls you through. If you go in too fast, the front end starts to plow; so you let up on the gas and the rear end lightens, putting you in a perfectly controlled drift. It's a car that's easy to steer with the throttle.

The rack-and-pinion steering is sensitive, vibration-free and, at 2⅓ turns lock-to-lock, extremely fast. Directional stability is excellent, even in strong crosswinds.

The brakes are more than adequate, and they don't grab. The four-speed gearbox, however, is archaic, with the top three gears poorly synchronized and first not synchronized at all. But it's easy to double-clutch into first while rolling. The clutch is ferocious. When you're engaging it, nothing happens until the last couple of inches of travel, and then suddenly the seat back is bending your spine.

The dashboard holds only a speedometer, a gas gage, a few warning lights, a choke knob and a headlight toggle. And the gas gage isn't really necessary; the tank, built into the left frame member, has a mammoth filler cap that allows visual inspection of the gas level. A lone, spindly windshield wiper bravely defies the elements. It has to be started and parked manually.

And then there's a rag top that drums at speed, but folds easily and unbolts entirely in seconds.

Okay, but what's the car good for? I was afraid you'd ask that. I don't know, really, but on the other hand I can think of a dozen things. Maybe as a golf-course buggy or hotel runabout. Or (at $1270) as basic transportation in warm, dry climates. One thing it's definitely good for is fun. And it's good for shy, introverted people who have trouble making friends. When you drive a Mini-Moke, strangers stop and talk to you. The car is lovable because it looks so small and helpless, and strangers tend to transfer some of this affection to you, too.

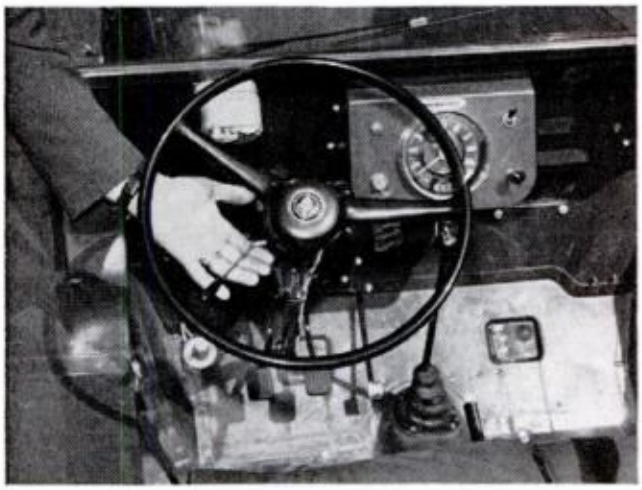
"How do you like your roller skate?" they ask good-naturedly.

"Do they allow it on the streets?" one Volkswagen owner asked incredulously.

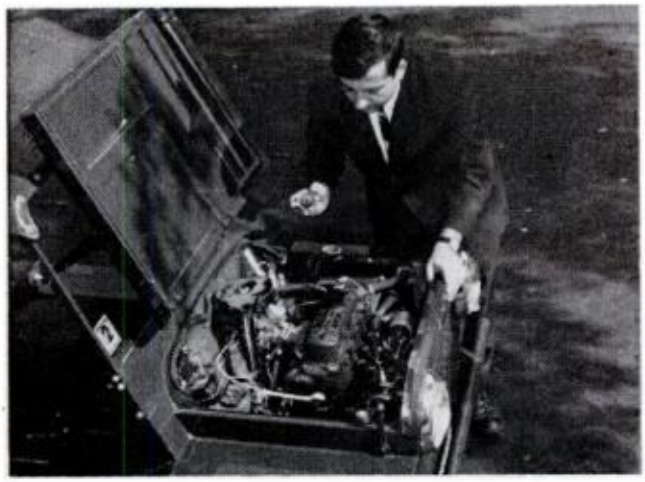
"Yes," I answered. "Do they allow yours?" End of conversation.

But there are also the less pleasant types, like the convertible-full of Beatle-mopped urchins who suggested I give the car back to the amusement park—but in less polite words.

Maybe the Mini-Moke is for extroverts after all. ★ ★ ★



BADLY LOCATED DIRECTIONAL STALK keeps getting in the way of the knee; may suffer a sad fate (above). Center speedo works for right or left-hand drive



TINY 34-HP, 51.7-CU.-IN. FOUR is mounted transversely, from east to west. Though it's a tight fit, frequently serviced parts are accessible

Материал, защищенный авторским правом

Your Career Barometer

by Creighton Peet

IF YOU HAVEN'T HEARD of "job shops" you're in for a surprise. They are becoming a major factor in the employment of all types of engineering and technical people, from young draftsmen to experienced engineers drawing top pay. And, cheering to note, work acquired through job shops usually means substantially better money than a man would make as an employee of a producing company.

Offhand, job shops, of which there are about 500 scattered all over the U.S., doing around $300,000,000 worth of business a year, might seem to be employment agencies. They are not.

They have grown up because of the special nature of the design and engineering business. In slack times, even a big engineering firm with a solid name in the field, must let most of its men go, retaining only a skeleton staff. Then one day they land a contract for a bridge, an oil refinery, an ammonia plant, or a new rocket installation for a government agency. They need "instant" specialists in a score of fields, men who can walk up to desks and draw-

(Please turn to page 34)

JOB TITLE	NATIONAL DEMAND	3-MONTH TREND	STATES WITH HIGHEST DEMAND				
Chemists, Biolg.	28	Down slightly	N.Y. 7	N.Y. 6	N.C. 2	Cal. 3	Wis. 3
Chemists, Organic	51	Down slightly	Conn. 4	N.J. 10	Ala. 11	Ohio 5	Cal. 9
Chemists, Inorganic	8	Better prospects	Conn. 2	Ala. 1	Ill. 1	Mo. 1	Cal. 2
Engrs., Metall.	42	Demand steady	Conn. 4	D.C. 7	Ohio 4	Ind. 6	Cal. 4
Engrs., Civil	334	Substantial drop	D.C. 60	Penn. 36	Ala. 21	Cal. 24	Wash. 34
Engrs., Elec. & Electron.	809	Substantial drop	N.J. 57	D.C. 48	Fla. 111	Miss. 52	Cal. 201
Engrs., Ind.	289	Good increase	Conn. 24	N.J. 25	D.C. 24	Miss. 21	Wash. 20
Engrs., Mech.	885	Excellent demand	N.J. 51	Penn. 62	Miss. 53	Iowa 56	Cal. 134
Engrs., Aero.	467	Demand steady	Miss. 40	Mo. 140	La. 17	Cal. 114	Wash. 120
Engrs., Mining	12	Slightly greater demand	D.C. 1	Penn. 4	Fla. 1	Minn. 4	Mon. 1
Nat. Scientists	99	Dropoff in demand	N.J. 4	D.C. 18	Va. 5	Mo. 4	Wash. 53
Draftsmen, Arch.	38	Some dropoff	Conn. 2	Mass. 3	Vt. 2	Mich. 10	Ohio 3
Draftsmen, Elect.	75	Good spurt in demand	Penn. 4	Ill. 4	Minn. 20	Mo. 20	Cal. 20
Draftsmen, Mech.	188	Demand declining	Penn. 30	Ohio 32	Wis. 27	Mo. 10	Cal. 15
Draftsmen, all other	179	Demand declining	D.C. 11	Ga. 11	Miss. 25	Mo. 20	Cal. 36
Tool Designers	114	Good increase	Conn. 6	Vt. 10	Ill. 10	Utah 6	Wash. 60
Lab. Tech & Ass'ts	81	Demand uneven	Fla. 6	Miss. 15	Ind. 12	Conn. 5	Cal. 6
Sports Instr. & Officials	46	Demand almost doubled	Conn. 6	N.J. 1	Fla. 2	N.Y. 7	Colo. 25
Surveyors	30	Demand steady	Conn. 2	N.J. 2	N.C. 3	Utah 6	S.D. 6
Techs., Eng'g & Phys. Sci.	296	Demand steady	Ala. 27	Fla. 17	N.M. 10	Cal. 13	Wash. 202
Tool Planners	12	Up in recent months	Miss. 3	Ohio 2	Ind. 7	—	—
Systems Engineers	21	Down slightly	N.Y. 2	Penn. 1	Fla. 2	Mo. 15	Ariz. 1
Programmers	284	Substantial increase	D.C. 17	Mo. 11	Ariz. 14	Cal. 74	Wash. 119
Systems Analysts	85	Good increase	Conn. 4	D.C. 12	Ariz. 4	Cal. 16	Wash. 35
Inspectors, Pub. Ser.	7	Demand unchanged	Md. 1	Mich. 1	N.D. 1	Cal. 2	Wash. 2

PM's new Career Barometer Chart, above will appear in every issue. It gives the actual number of men currently needed for specific jobs in the fields listed. The "Current Demand" figures are true as of our closing date. "Trend" figures indicate rising or falling demand in the listed categories. By following chart each month, you will gain an accurate of where your particular talents are how badly. For the names of the actual employers represented by these listings, contact the state employment agency in the capital city of the state indicated. Mention that you saw this in **POPULAR MECHANICS.**

Today, with proper schooling, you can qualify for many of the job categories shown. For a list of accredited correspondence and residence schools, write to **POPULAR MECHANICS' Information Bureau, 575 Lexington Ave., N.Y., N.Y. 10022.**

Материал, защищенный авторским правом

You're fired.

The day of the "job slob" is over.

Clothes still make the man—whether he's running a lathe, plowing a field, or just washing the car.

If you wear work clothes, it's time to turn over a new leaf. Start right here.

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When fishermen build fishing motors...they're bound to be different

1966 STOWAWAY (3 hp) — the new folding motor in a case — for the man who has never had a place to keep a motor before.

1966 ANGLER (5 hp) — an Evinrude quality "twin" at the price of bargain priced "singles" — the most fishing motor for the money.

1966 FISHERMAN (6 hp) — the smallest Evinrude made with full gearshift and full motor quieting, and all of the big-motor features.

1966 SPORTWIN (9½ hp) — the sporty little shorty — most popular fishing motor made — now even smoother and quieter and more reliable.

Fishermen aren't alike. Neither are fishing techniques. Why should fishing motors be?

That's why the fishermen who design and build Evinrude motors build **all kinds** of fishing motors—long motors, short motors, folding motors, weedless motors, motors with gearshift and separate tanks, and without.

Four of the most popular 1966 "take along" Evinrudes are shown here. All are light and compact, smooth and whisper-quiet "twins." All are "one-pull" starters and steady mile-an-hour trollers. All are built for round-trip reliability.

All are made **by** fishermen — **for** fishermen.

Your Evinrude dealer can show you these four—and up to 11 more. He's displaying the full line of new 1966 Evinrudes right now.

EVINRUDE
first in outboards

SEND COUPON FOR FREE CATALOG

EVINRUDE MOTORS, 4179 N. 27th St., Milwaukee, Wis. 53216
Send free Evinrude Motor and Boat Catalog for 1966 to:

Name.....

Address.....

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

Your Career Barometer

(Continued from page 32)

ing boards and go to work.

Recruiting 50—100—500 new men is slow and expensive. Most will have to be watched closely till they prove themselves. And then, six months or a year later, they will no longer be needed, and must be dropped. All this is expensive.

So, today, the engineering firm, or manufacturer's personnel man, gets on the phone to a number of job shops, and asks for so many piping men, so many structural men, so many electronics men . . . and bang! A day or two later, all these men turn up and go to work. They remain employees of the job shop which, in a sense, vouches for their competence, and pays them very well indeed. A man who might be getting $180 a week if hired by an engineering firm, may get $220 from the job shop. A job may last a few weeks or months, or a year or more. There are cases of "shoppers" as they are called, who have worked steadily in one place for 5 years, when the employing firm was lucky enough to have the work. But most job shop work lasts 3—6 months.

The growth of job shops at present is astonishing—and has led to some fantastic situations. When a number of employees of a nationally known New England manufacturer were laid off because of a mandatory retirement rule when they reached 65, they went across the street and opened up a job shop. Now they are back working at their old jobs at considerably higher pay!

No question, this is a special way of life, and takes a special breed of men who are willing to take risks, and like frequent changes of scenery. When a "shopper" sees his work running out, he notifies another shop of his availability—or maybe he takes himself a couple of weeks vacation. Some manage to jump from one job to another, and find true "security" in the process. A job with an established firm is good only so long as the work lasts. When it's over, you are let out, and that's the end of it.

There are some catches. The job shop employee gets his income taxes and social security withheld and paid, and in some shops he gets a two-week paid vacation, and a few fringe benefits. But usually he gets neither hospitalization or other benefits. And a man must be ready to jump anywhere on a few hours notice. Currently, one big New York job shop has a crew working in two air conditioned trailers in a hot, mosquito-ridden Louisiana swamp on a big aerospace project.

Before taking a man on, a job shop

(Please turn to page 39)

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Put DICKIES on the job.

The Shape/Set* work clothes that never need ironing.

DICKIES work clothes are more than rugged.

They're also trim. Tailored. Flattering. And Shape/Set.

Shape/Set is the exclusive process that knocks out wrinkles for good. DICKIES Shape/Set work clothes wear like iron — but never need ironing.

Treat them rough. Wash them plenty. They keep their good looks, and so do you. Put DICKIES on the job, and you do the job handsomely.

P. S. Even if you don't care how you look at work, maybe some woman does. Tell her our name. It's

Dickies®

Williamson-Dickie Mfg. Company, Fort Worth, Texas.

*Registered Trademark

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Three new ways to work or play:

RANCHERO! All-new Luxury!

Even standing still this beauty looks exciting. And no wonder. Those sleek lines cover a high-spirited Ranchero that's new clear through. A longer wheelbase, wider tread and new suspension give you a ride that's wonderfully smooth, soft, and quiet.

Inside, curved side windows, greater width and swept-away dash give a luxurious new feeling of roominess. Bucket seats, center console, wall-to-wall carpeting, air-conditioning—Ranchero offers them all. Any performance combination you want, too—choice of two smooth Sixes, two powerful V-8's. Automatic, 3- or 4-speed stick shift.

Price? That's the only thing about the new Ranchero that isn't big and luxurious.

STYLESIDE!

Who says a working truck has to ride like one? Not Ford. Nor will you, once you've experienced how Twin-I-Beam suspension in new Ford pickups smooths the road. Each front wheel has its own axle, working independently. Shocks at one wheel aren't passed over to the other. Or to the driver. Steering's surer, too.

Yet, with all Ford's comfort,

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starring Ford's all-new Bronco!

Two-front-axle ride!

you get toughness to spare. Forged axles and radius rods hold wheels in line, lengthen tire life. Big muscle under the hood, too—big V-8 or two Sixes with the smoothness of seven main bearings.

Action-test a '66 Ford Styleside first chance. Whether you use it for work or play, you'll find nothing but pleasure behind the wheel.

BRONCO! All-new! 4-wheel drive!

Want to get away from it all? Get a Bronco—Ford's new kind of 4-wheel-drive excitement! Takes you over beach sand in summer, through snow in winter. Into woods for hunting. Right up to stream-side for fishing, camping. Up hills that are too steep for roads.

Bronco gives you features never combined before. Frisky six-cylinder power. Clashless shifting into all gears. Smooth coil-spring ride. Lots of ground clearance. Tight 34-foot turning diameter. No annoying whine in 2-wheel drive. Choice of Roadster, Wagon or Sports-Utility.

It all adds up to new fun—for mountain hopping or family shopping. So bust loose in a new Bronco—from your Ford Dealer's corral!

Ford/66

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Clark's Team Lotus Formula I Car wins at SPA-Francorchamps, Belgium—sparked by silvery-plated Champions

Champions use Champions!

Jim Clark won the '65 World Driver's Championship using Champion spark plugs exclusively. The overwhelming majority of race winners choose Champions because Champions deliver maximum performance. Why settle for less in your car?

To feel new power, instantly, install new Champions now and every 10,000 miles

DEPENDABLE CHAMPION SPARK PLUGS

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Your Career Barometer

(Continued from page 34)

evaluates him carefully. First of all, they usually insist he have sound training, or 3-4 years of experience. After examining his resume, and talking to him, they set him to work on a project in their own office. After a week or so, they have a good idea of a man's capacity. As a result the man they send out fits the job precisely.

Now how about the employer? He not only pays the job shop what would be an employee's normal salary, but an additional 30-40%. This goes to make up the extra money the man gets, and contributes toward his vacation, and leaves a margin for the job shop overhead and profit.

This might seem like an expensive way to get engineering talent, but many employers prefer it to hiring men directly. Recruitment of special skills is expensive, and making sure you have the right man takes time; and then in a few months there is severance pay, and the hard feeling in firing a good man. And some companies are sensitive about announcements in the paper that they have laid off 500 or 1000 long-time employees. The job shop does away with all that.

How to find a job shop

How do you contact a job shop? (Incidentally most of these firms feel that the term "job shop" is a little undignified and prefer "engineering services companies"). You might look in the local phone or classified book. Nearly all job shops have the words "technical," "designers," "service," or "consultant" in their title, and you can look for those words in the listings.

Probably the largest outfit in the business is Consultants & Designers Inc., which now has 15 offices in the U.S. and Canada. This July, C&D as it is known, announced it had received a $1,500,000 contract to supply NASA with "engineering and support services," which means a lot of jobs for "shoppers." While this firm has done a lot of aerospace work before, its other divisions produce sales and marketing displays, and other promotional material. C&D claims it has 45,000 names in its personnel file and knows where to reach every conceivable skill.

Another major job shop, Cushing & Nevell Technical Design Corp., with offices in Pittsburgh, Los Angeles, Toronto, etc., as well as New York, lists among its clients American Can; AT&T; American Sugar Co.; IBM; Parsons, Brinkerhoff, Quade & Douglas; Borden Chemical; Socony Mobil; Sylvania, etc.

253 COURSES

That's how many ways I.C.S. offers you to get ahead. No tricks. No gimmicks. Whatever your job interests—from accounting to zerography—there's an I.C.S. course for you. To help you get ahead faster in your present job . . . or find a new career. Write today for 3 FREE booklets: (1) "How to Succeed" career guide; (2) Famous Career Catalog; (3) Sample lesson to demonstrate the famous I.C.S. method, used by over 7,000,000 Americans since 1890. Send coupon NOW. No obligation.

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National Home Study Council

Please send FREE **success** book, sample lesson and catalog checked.

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☐ Radio-TV Electronics
☐ Secretarial
☐ Other—please specify _____

Name _____ Age ____
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City _____
State _____ Zip Code _____

New! WICS Package for Women!

Enjoy Profits from Your Own Business While Still Employed

Without quitting your job or losing one pay check, you can enjoy **growing profits** from **your OWN** nationally advertised business. Free 24 page book tells how men do it...how they grow to a full time, high profit business...how we guide men to success.

Hourly gross profit is $9 **plus** $6 on each serviceman.

Exclusive **absorption** process cleans **and revives** upholstery, rugs, carpets. Also 5 other on-location services. Your world-wide service is endorsed by McCall's, Parents' Magazine, carpet mills and furniture manufacturers.

You need no experience. We show you how. We finance you for all but a few hundred dollars. Easy to learn . . . easy to do . . . easy to build a steady income. We show you 15 tested ways to get customers.

L. Babbit writes, "I average $2,600 monthly, part time." W. C. Smith earned $650 in one week. Ed Kramsky said, "in two years I have two assistants, a home and security." G. F. Monroe, after 12 months, sold his business for 10 times his cost. Leo Lubel sold his for $7,116 more than he paid.

This may be the opportunity of your life. **Find out today** before some one else gets your location. Mail coupon now for details and 24-page illustrated free book. No obligation. No salesman will call. Mail coupon now while territories are open.

DURACLEAN COMPANY

5-160 **Duraclean Building, Deerfield, Illinois 60015**

Send 24-page booklet telling how I can quickly enlarge my income in spare time while I build my own full time prosperous business. No obligation.

NAME _____
ADDRESS _____
CITY _____ STATE _____ ZIP CODE _____

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If you make furniture...

build your own boat...

hang a shelf...you need,

SHOPMATE'S ELECTRIC

Zip-Screw DRIVER

Power packed 100 to 1 gear ratio prevents blistered hands. Instant reverse switch makes "take-apart" as easy as "put-together." Takes sizes 4 to 12, slot or Phillips head screws. Industrial listed, yet beautifully appliance styled in gleaming mirror finish aluminum and golden yellow high impact lexan housing. With 2 slot head finders, Phillips bit, starter-punch. *Free, accessory folder of over 150 other useful attachments.*

SHOPMATE

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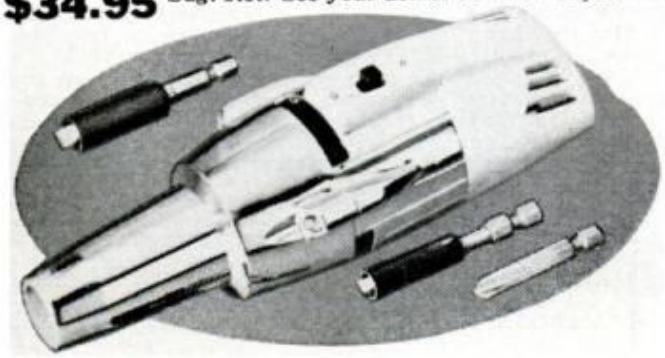
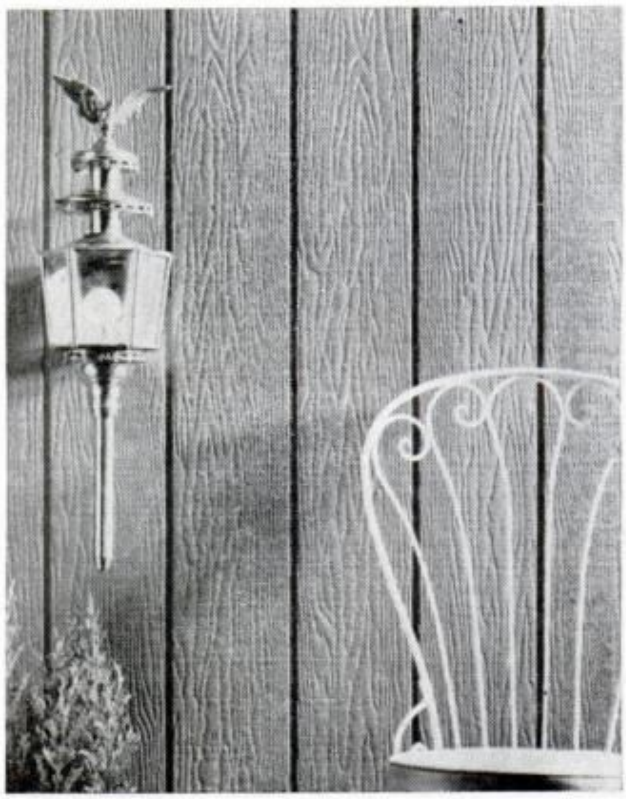
$34.95 Sug. Ret. See your dealer or write Dept. P.M.



New on the



ROUGH-SAWN APPEARANCE of Ruf-X-ninety exterior siding by Masonite Corp., Chicago, features an embossed wood grain with transverse striations simulating rough-sawn wood. Siding is available through lumber dealers in panels 4 ft. wide by 7, 8, 9 and 16 ft. It's priced from 31 to 33 cents per sq. ft.

INDOOR-OUTDOOR LIVING is enhanced by the beauty and ease-of-operation of this Gliding Patio Door by the Andersen Corp. of Bayport, Minn. Weathertight, and with excellent insulation properties, it glides on overhead nylon wheels in an aluminum track. It's sold assembled and primed in 6-ft. and 8-ft. widths

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Market

PATTERNED GLASS PARTITIONS in Grassweave (left) and Bamboo (right) lend a Polynesian motif to this garden setting. Products of Libbey-Owens-Ford Glass Co., these represent just two designs from their patterned glass line. Partitions provide privacy without stopping light, blend with any color scheme

THE "NATURAL LOOK" is expressed in Verona Embossed, a new vinyl asbestos tile by Azrock Floor Products, Box 531, San Antonio, Texas. Naturally colored stone-chip pattern conceals scuff and furniture marks. The tile installs anywhere indoors, comes in 5 colors in 1/16-in. gauge in new modular 12x12-in. size

SMOOTH MELLOW FLAVOR

Blended with flavorful Maple and Old Rum

So gentle to your taste

aroma everybody loves

Mapleton

aromatic pipe tobacco

Mixture

UNITED STATES TOBACCO COMPANY

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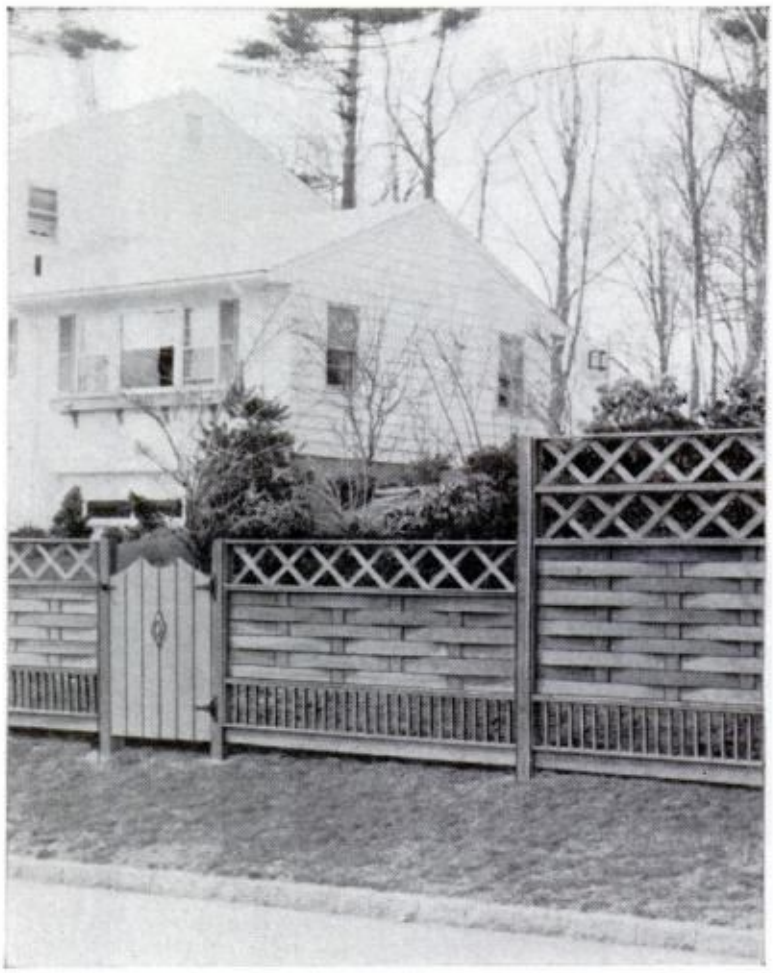
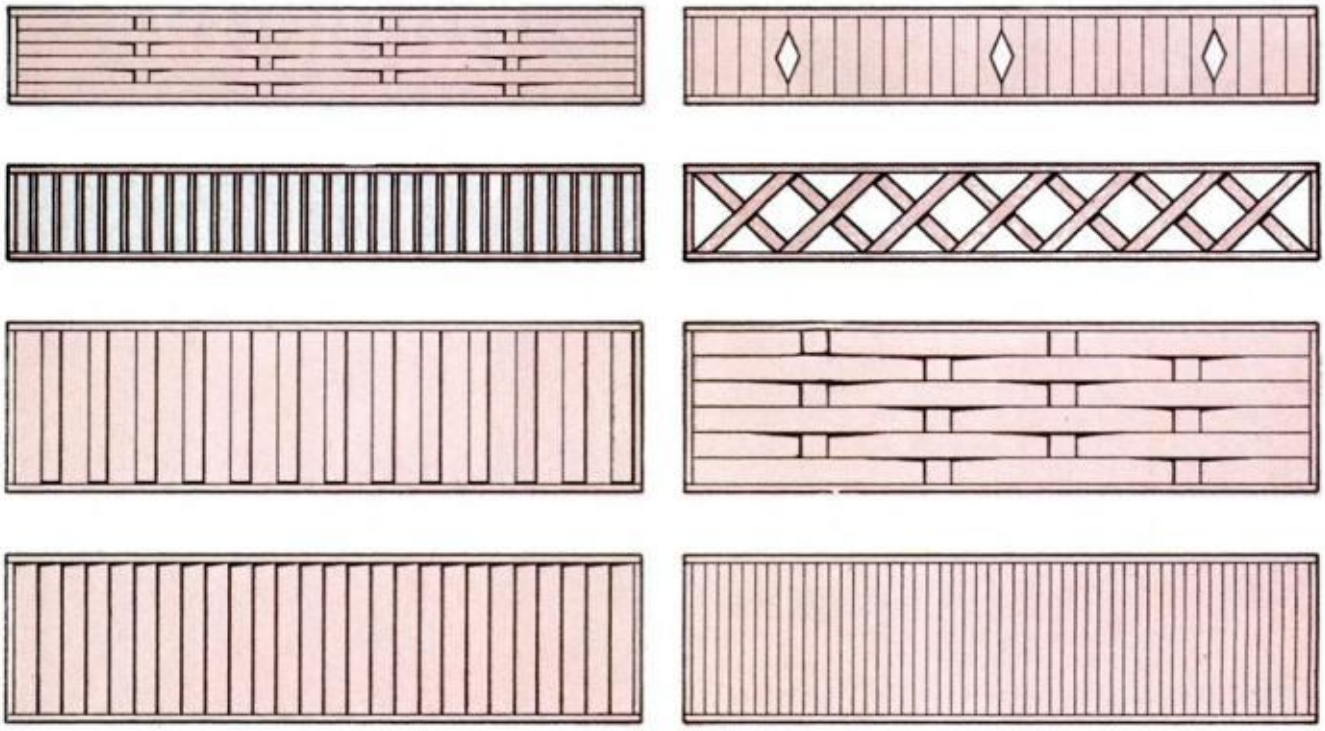
Personalized Fences from Pre-Fab Panels

THIS FENCE looks like an expensive custom job, doesn't it? Well, it *was* designed to the personal taste of the homeowner who put it up, but the "designing" was a simple matter of selecting pre-assembled, packaged units from the eight different but interchangeable styles sketched below. The sections come eight feet long and in widths from one to three feet, and can be grouped in any combination to produce nearly 14,000 separate designs.

The material is red cypress, a wood known for its resistance to decay and termites. The manufacturer, Frontier Fence Corp., 875 Jericho Turnpike, Smithtown, New York, claims that one man can put up 80 feet of MIX 'N' MATCH fence in 2½ hours. A complete set of illustrated instructions is included with the fencing to simplify installation. Except for a post hole digger, no special tools are required. After a pair of posts are set and a 1 x 4-in. bottom rail installed, the desired combination of panels is nailed between the posts.





FROM THESE EIGHT BASIC UNITS it's possible to design some 13,862 different fences. If you'd like to preplan your own custom fence, you can clip out the scaled-down drawings and interchange and rearrange them to suit your fancy. Units come both finished and unfinished.

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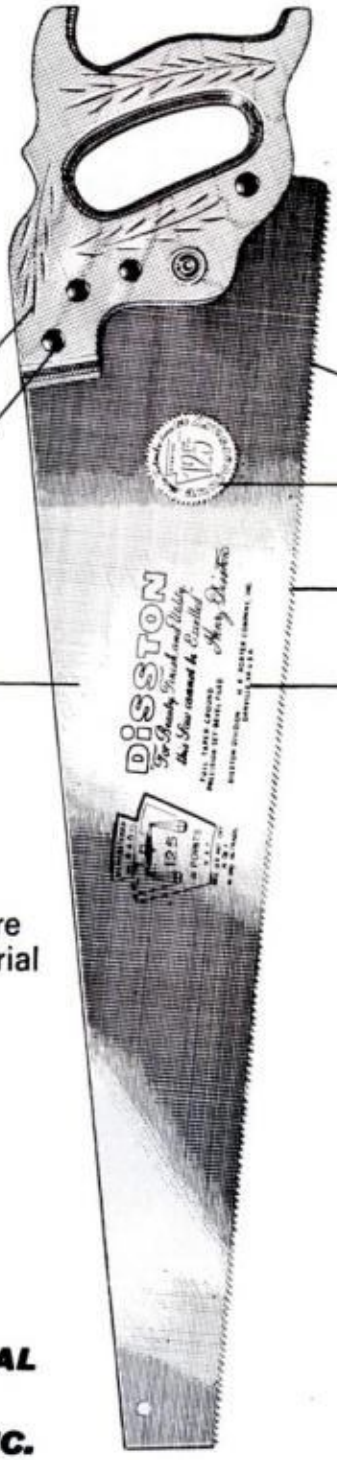
DISSTON

New 125th Anniversary Hand Saw has an edge on them all



Pressure-welded, 9-ply, marine laminated hardwood handle.

5 tarnishproof, nickelplated, solid steel screws (one a medallion) firmly join handle and blade.

Finest tempered steel blade, full taper ground to prevent binding.

Each tooth accurately set and full bevel filed.

125 years of craftsmanship in every saw.

Available in 8, 10 and 5½ points. 26-inch blade.

Blades polished and polymerized.

Get a Disston #125 Anniversary Handsaw at your favorite hardware store today. Hardware and Industrial Products Division, H. K. Porter Company, Inc., Pittsburgh, Pa.

Value $7.90

Anniversary Special Price $6.70

PORTER

HARDWARE AND INDUSTRIAL PRODUCTS DIVISION

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Disston also makes finest quality tapes and rules.

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New Outboard Power for '66

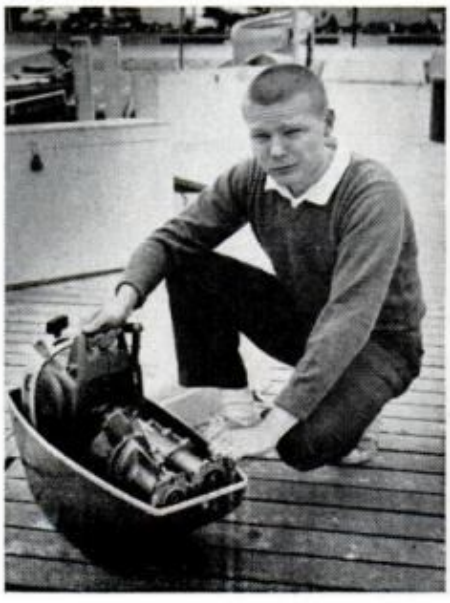
You'll find plenty of big power—four models boasting 100 hp or more—plus a folding fishing motor in compact carrying case

By Art Mikesell

MORE POWER TO YOU seems to be this season's motto, but big motors aren't the only news-makers in the '66 outboard lines. The bottom end of the horsepower race includes some pretty wild engineering—Evinrude's folding 3-hp fisherman and McCulloch's pushbutton-start 7½, for instance.

And all the way through most lines are subtle but solid product refinements which make this year's models a little more dependable, slightly easier to run and generally a better value than comparable models of a year ago.

110-HP MERCURY is described by company engineers as producing "more horsepower per cubic inch, more horsepower per pound, and more horsepower per dollar than any previous outboard ever marketed." It uses Polar-Gap plugs



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Let's take a company-by-company look at what's on tap for '66:

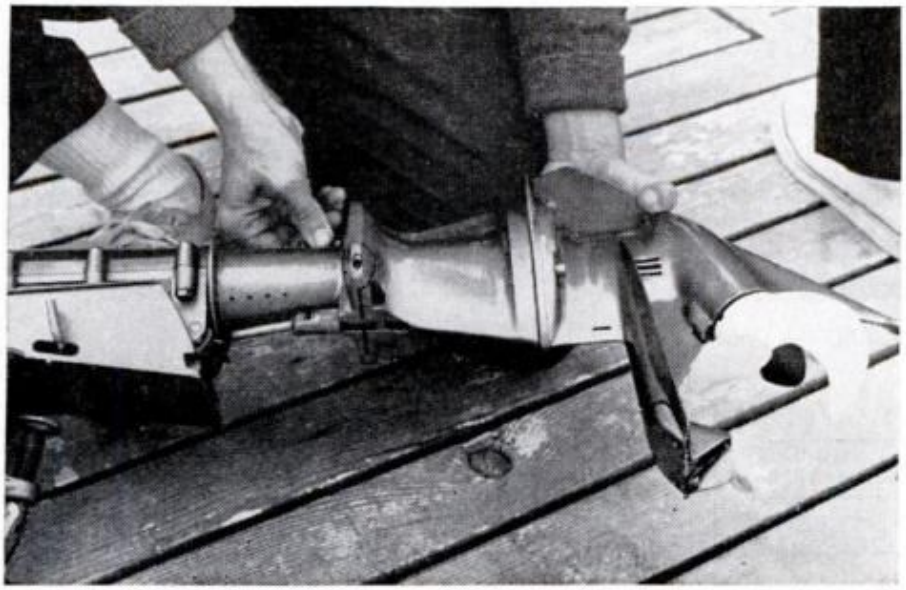
KIEKHAEFER. Big news is the 93.5-cu.-in. Merc 1100, but the company will also have a new 95-hp motor, plus new powerheads for the 35-hp and 50-hp models. Water-column silencing, introduced on last year's fours and sixes, will be included on two-cylinder motors. Polar-Gap spark plugs, said to increase power and double plug life while cutting fuel consumption, will be standard on all Merc sixes. And this year Merc joins the other outboard manufacturers in cutting oil-gas ratios. For all nine models, the new recommended ratio is 50:1, provided you're using Kiekhaefer's Quicksilver Formula 50 oil.

EVINRUDE. At the top end is an 89.5-cu.-in. 100-hp. V4 which features a tuned exhaust system without the external stacks. According to Evinrude, this internal exhaust tuning provides a supercharging effect which produces better performance on less fuel than last year's 90. Also new are two 80-hp models. The attention getters at the preview showing, however,

(Please turn to page 46)

100-HP JOHNSON is an all-new high-compression engine with a new lower unit designed to give increased acceleration and high-speed performance

105-HP CHRYSLER features an improved V-reed fuel induction system and full-length acoustical silencing chamber to hush that big four-cylinder engine



FOLDING EVINRUDE stores in a case that looks like cover for a big engine. A spring-loaded retainer holds the tip of the lower unit against the motor cover. When released, the lower unit swings down into operating position where it's secured by two swivel fasteners which may be tightened by hand. The drive shaft has a spring-loaded coupling at the joint to assure proper assembly, regardless of relationship between upper and lower shaft

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money-saving 1966

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New Outboard Power for '66

(Continued from page 45)

100-HP EVINRUDE features tuned exhaust complemented by new porting, manifolding, timing, carburetion

were the folding threes. When not in use, one of these little fishing motors can be folded up to fit inside a tough plastic carrying case. The long shaft model for small boat sailors will be a take-apart version which can be stored as two pieces.

CHRYSLER. Formerly West Bend, this company's top-of-the-line entry for '66 is a new 96.55-cu.-in. V4 which puts out 105 hp. Eight other models are available, ranging from a three-cylinder 75 down to a small 3.5. Incidentally, Chrysler claims an industry first with the 105—it can develop more than 25 hp per cylinder.

McCULLOCH. Making a strong bid for the low-horsepower fishing market, McCulloch is introducing two new small motors. The 7½-hp electric model has a starter button built into the tip of the steering handle with the twist grip throt-

(Please turn to page 48)

80-HP JOHNSON offers fuel economy through refined carburetion. The 20 replaces last year's 18

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I'd like to give this to my fellow men...

while I am still able to help!

I was young once, as you may be — today I am older. Not too old to enjoy the fruits of my work, but older in the sense of being wiser. And once I was poor, desperately poor. Today almost any man can stretch his income to make ends meet. Today, there are few who hunger for bread and shelter. But in my youth I knew the pinch of poverty; the emptiness of hunger; the cold stare of the creditor who would not take excuses for money. Today, all that is past. And behind my city house, my summer home, my Cadillacs, my winter-long vacations and my sense of independence—behind all the wealth of cash and deep inner satisfaction that I enjoy—there is one simple secret. It is this secret that I would like to impart to you. If you are satisfied with a humdrum life of service to another master, turn this page now—read no more. If you are interested in a fuller life, free from bosses, free from worries, free from fears, read further. This message may be meant for you.

By Victor B. Mason

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

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

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

I Have All The Money I Need

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

Please don't misunderstand this statement. I am not a philanthropist. I believe that charity is something that no proud man will accept. I have never seen a man who was worth his salt who would accept something for nothing. I have never met a highly successful man whom the world respected who did not sacrifice something to gain his position. And, unless you are willing to make at least half the effort, I'm not interested in giving you a "leg up" to the achievement of your goal. Frankly, I'm going to charge you something for the secret I give you. Not a lot—but enough to make me believe that you are a little above the fellows who merely "wish" for success and are not willing to sacrifice something to get it.

A Fascinating and Peculiar Business

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

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

Are You Mechanically Inclined?

While the operation of this business is partly automatic, it won't run itself. If you are to use it as a stepping stone to independence, you must be able to work with your hands, use such tools as hammer and screw driver, and enjoy getting into a pair of blue jeans and rolling up your sleeves. But two hours a day of manual work will keep your "factory" running 24 hours turning out a product that has a steady and ready sale in every community. A half dollar spent for raw materials can bring you six dollars in cash—six times a day.

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

Does Happiness Hang on Your Decision?

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

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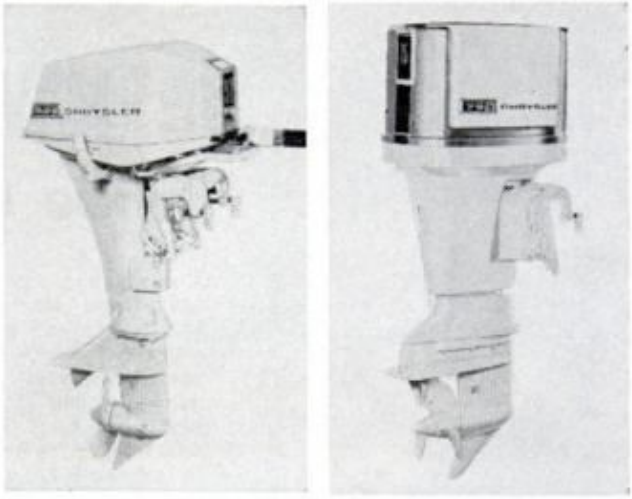
New Outboard Power for '66

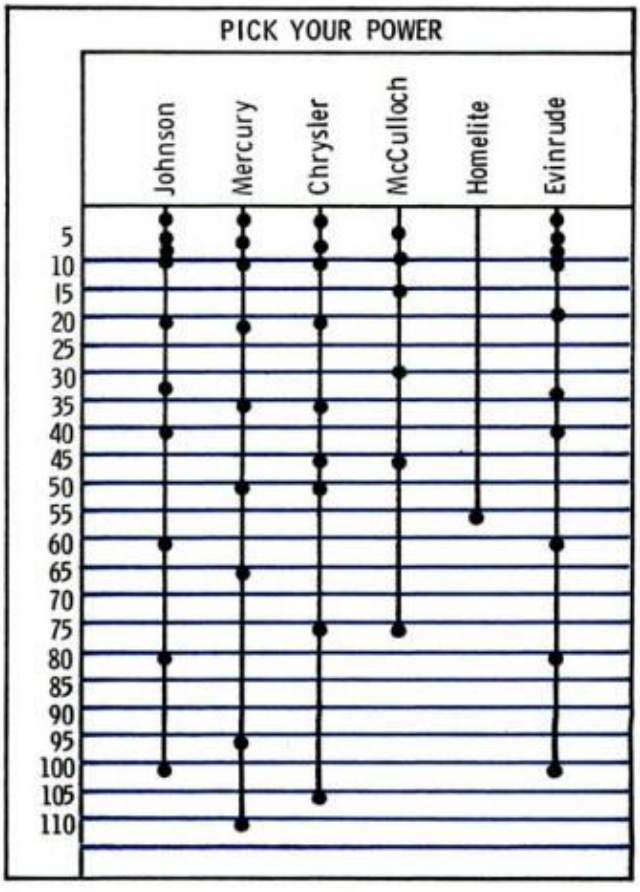
(Continued from page 46)



9.2-HP CHRYSLER, designed for easy carrying, weighs 55 pounds. New 75 is a 72.39-cu.-in. three-cylinder

tle, so starting it is an easy one-hand operation. The other motor is a one-cylinder, air-cooled, 4-hp design weighing only 37 pounds.

JOHNSON. A 100-hp "Golden Meteor" leads the '66 Sea Horse parade. Last year's 18 has a new powerhead which turns it into a 20, plus increased power in reverse. Also new this year is an 80, making a total of 16 models in 10 horsepower classes. ★ ★ ★



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New Power Sled with Two Trailers

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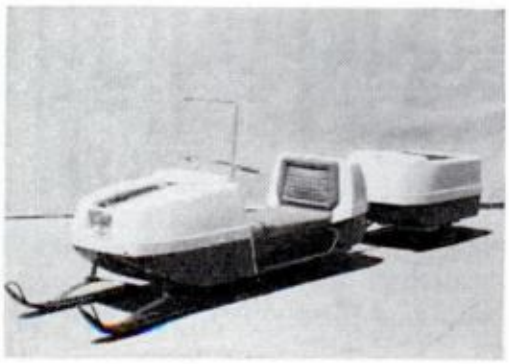
Recognizing the problem of hauling the snowmobile from home to an area where it can be used, American Machine & Foundry Co. offers an enclosed transport trailer as a special accessory to its new Ski-Daddler Power Sled. And as an added attraction AMF also has a small tow sled for hauling children or equipment behind the snowmobile.

Powered by a 10-hp gasoline engine, the Ski-Daddler has a top speed of 35 mph and carries two passengers. It will also pull up to a thousand pounds, and an automatic variable speed torque converter gives it the power needed to climb in rugged terrain. The transport trailer hauls the tow sled along with the snowmobile, and it doubles as a garage when the snowmobile is not in use, and as a comfortable shelter for camping or ice fishing.

TRANSPORT TRAILER TILTS UP to allow the snowmobile to be driven inside with ease. The tow sled (right) will haul up to one thousand pounds of equipment



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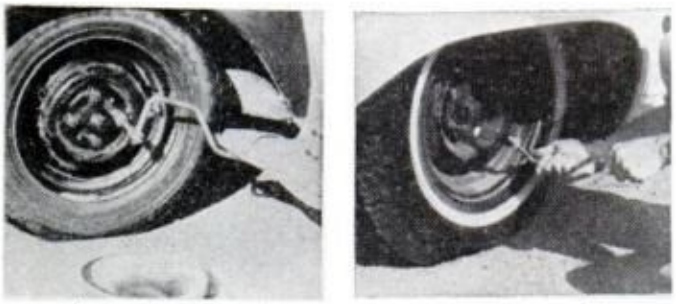

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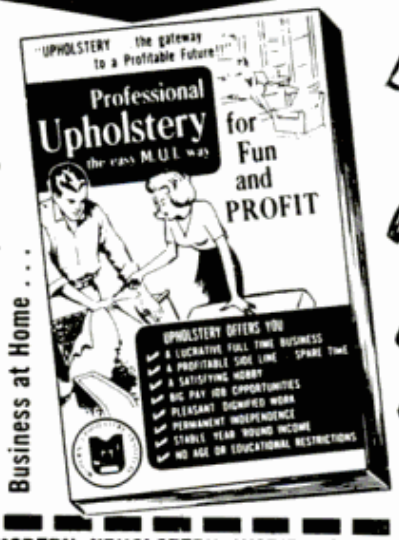

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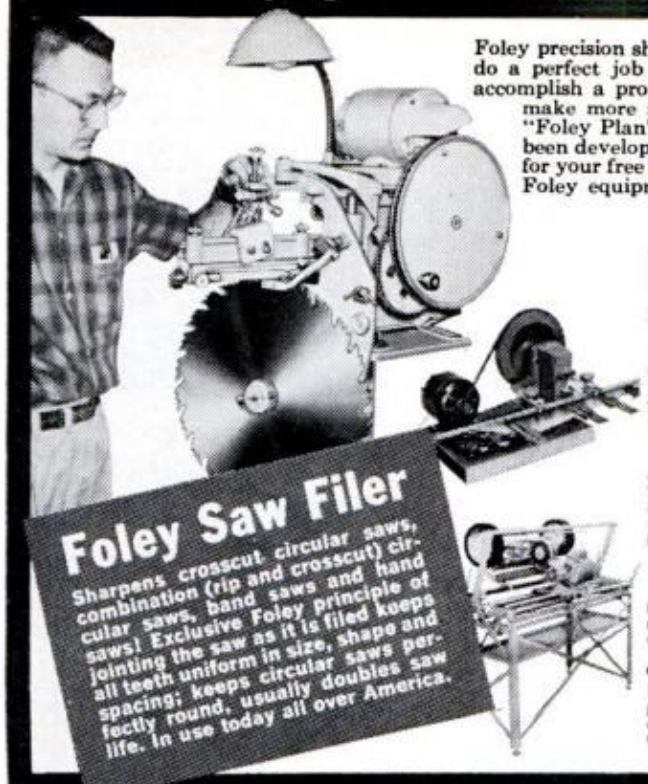

Foley precision sharpening equipment has the built in skill to do a perfect job every time. No experience is necessary to accomplish a professional job—and you work better, faster, make more money with Foley quality equipment. The "Foley Plan" for success in the sharpening business has been developed through years of experience. Mail coupon for your free copy of "Money Making Facts" and see how Foley equipment can earn extra cash for you.

314 GRINDER ▶
Sharpens all types of circular saw blades—will handle any size from 5" to 44" in diameter. Attachments available for a variety of other sharpening jobs.

◀RETOOTHER
Cuts a full set of new teeth, either rip or crosscut, in less than a minute. Can be operated by either motor or by hand crank.

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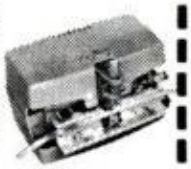

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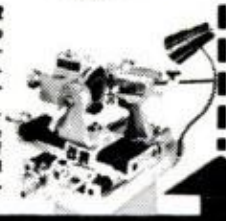

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(Please turn to page 62)

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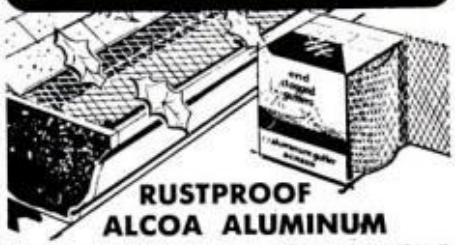

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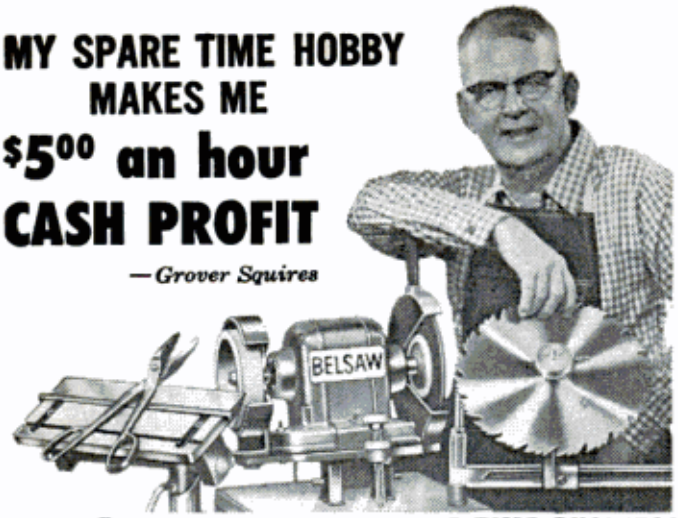

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Popular Mechanics

(Continued from page 58)

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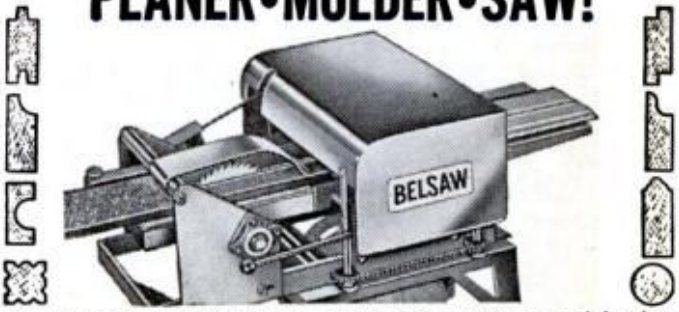

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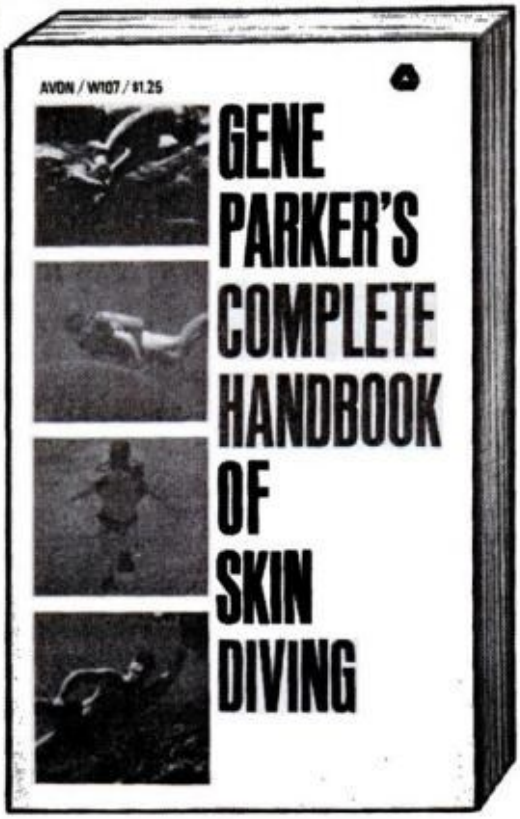

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TYPEWRITERS, DUPLICATORS, OFFICE EQUIPMENT

OFFSET, Letterpresses, varitypers, typewriters, mimeograph, multigraph machines. Bargains. DixieGraph, King, North Carolina.

TYPEWRITER, Adder, bargains. List 10¢. Columbus, 719 E. Pike, Seattle, 98122.

RUBBER STAMPS AND OFFICE SUPPLIES

FREE 32 Page rubber stamp catalog. Signature stamps $3.50. Youngers Stamp Shop, Princeton, Iowa.

FREE Catalog: Rubber stamps, printing. Dowling Products, Dept. PMA5, Pittstown, N.J.

FOUR Lines, cushion mounted $1.00. 969½ South Marengo, Pasadena, California.

THREE Line pocket stamp with free pad, zipcode, $1.00. Shoppers Service, 8856 Elkins Park, Penna.

3-LINE Pocket stamp and pad. $1.00. Catalog free. Carraher, North 64, Maple Park, Illinois 60151.

PERSONALIZED Metal case pocket stamp, $2.00. Catalog. Tabco, Tomkins Cove, New York 10986.

RUBBER Stamps, pocket or indexed 3 lines, $1.00, free brochure. Stamps, 1214 Williamson St., Burlington, North Carolina.

MIRACLE, Pre-Inker rubber stamps. No pad needed. Details—Singate, Dept. A-10, Box 816, Grundy, Virginia, 24614.

CATALOG: Rubber stamps, daters, printing. Martin, 1425 Major, Jefferson City, Missouri 65101.

SIGNATURE Stamp, $2.88. Three lines, $1.00. Catalog. Jackson's, 1433 Winnemac, Chicago, Illinois.

SEND Four our catalog today. Service, Box 445-PM, Winona, Minnesota 55987.

PRINTING, MULTIGRAPHING, MIMEOGRAPHING, GUMMED LABELS

AMAZING Business printing values. Samples. Print Shop, Box 576, Greenville, R. I.

PRINTING—8 Page catalog—1½¢; 5M 8½ x 11, =1/S, $15.00. Free price list. Copen, 288 Atlantic Avenue, Brooklyn 1, N.Y.

QUALITY Printing: lowest prices. Samples. Dowling Products, Dept. PMA5, Pittstown, N.J.

100 PRINTED 5½x8½ letterheads and 100 =6¾ envelopes $2.75. Price list free. Purple Enterprises, Box 16291-AK, Jacksonville, Florida 32216.

1,000 THERMOGRAPHED (raised letter) business cards, $3.75. Free samples! Griffin, 322 West State, Ithaca, New York 14850.

OFFSET Printing postpaid up to fifth zone. 1000 8½x11 20 lbs. bond $6.00. Write for price list. Biscayne Products, Box 346, New York 5, New York.

DISTINCTIVE Embossed letterheads. Speedy postpaid service. Universal, 226-PO Myrtle, Scotch Plains, N.J. 07076.

100 HAMMERMILL 20lb 8½x11 plus 100 =10 Envelopes, $4.75. Ham, 12 Hudson, Hudson, New York 12534.

BUSINESS Cards, all kinds. Large selection samples free. Pace Card Company, Box 7, Flushing, New York 11352.

1000 THERMOGRAPHED Business cards, $3.25. Dealers Wanted! American Box 166B, New York 10459.

FIRST Quality printing—reduced prices. Selco Products, Danvers 37, Massachusetts.

1,000 BUSINESS Cards, embossed $3.85; 2-color $4.90, promptly. All prices reduced. Guaranteed. Bixler, 752 Bensun, Frankfort, Kentucky 40601.

BUSINESS Cards—all kinds. Many samples, cut catalog—10¢. Pace Card Company, Box 7, Flushing, New York 11352.

BUSINESS Printing. Catalog Free. Bill's Press, 538-P Leffingwell, Kirkwood, Missouri 63122.

OFFSET Printing 500 8½x11 copies $3.50 postpaid. 48 hr. service. Cisco Duplicating Service, Atlanta, Illinois.

PRINTING & RUBBER STAMP OUTFITS—SUPPLIES

RUBBER Stamp outfits, supplies. Kiewiet, 2025 Barney Road, Kalamazoo, Mich.

TYPE And supplies for rubber stamp makers. New wholesale price list No. 3 free. Star Stamp Supply, 732 Federal, Chicago 5, Ill.

MAKE Your own self-molding rubber stamps and printing cuts. Plexirubber, Argyle 1, Wisconsin.

RUBBER Stamp presses, hydraulic operated, electrically heated. Sizes 5" x 8", 8" x 12", 10" x 15". Starting outfits, supplies. Printing presses. Type cases and cabinets. Custom Manufacturing, 1464-P East Commercial, Springfield, Missouri.

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DO Your own printing. Save money. Simple rules. We supply everything. Print for others; good profit. Raised printing like engraving too. Have home shop. Details free. Kelsey Presses, V-11, Meriden, Connecticut.

90% PROFIT Rubber stamps. Complete outfit, $99.95. Duckman, Avoca, Ark.

RUBBER Stamp manufacturers supplies. New products. Low prices. Catalog. Jackson Supply, 1433 Winnemac, Chicago, Ill.

NEW Type Catalog No. 11, 96 Pages. Send One Dollar. Deductible First Order. Acme Type, 732 Federal, Chicago, Illinois.

REMAILING SERVICE

HAWAII Secret unadvertised address. Remails 25¢. Receiving-forwarding, $3.00 monthly. Postcards. Perfume. Coe, Box 984, Kailua, Hawaii 96734.

PRIVATE Address, information 25¢, Remails 25¢, from Baltimore, Charlotte, Atlanta, Jacksonville, Tampa, Chicago, St. Louis, San Francisco, Mexico. Horton, 68 Kensington, Greenville, South Carolina 29609.

OLD Established, 25¢, $3.00, monthly. DeGraff, Box 14156-P, San Diego, California.

ITALY. Re-airmailing service, postage, $1.10. Italian Stationeries. Information, Samples Free. Nick Capodilupo, C.P. Montesacro, Rome, Italy.

SECRET Receiving and remailing. Discreet and confidential. Remail 25¢ single. 8050 S. Main, Houston, Texas.

PERSONAL Remails 25¢, $3.00 monthly, money orders, 40¢. Allied, 2739½ Tulane, New Orleans, Louisiana.

SOUTH AMERICAN Registered re-airmails $1.00. Confidential, reliable. Genaro, Box 360, Guayaquil, Ecuador.

SECRET Mail receiving system. Hedgpeth, 406-M South Second, Alhambra, California 91802.

LOS ANGELES, Hollywood, San Fernando Valley—25¢ single; $3.00 monthly. Confidential, 10437 Lanark Street P, Sun Valley, California 91352.

BERLIN, Germany re-airmails, $1.00. Confidential. Europa Service, 1 Berlin 15, Box 607.

MIAMI Remails, 25¢. Monthly rates. Marle, Box 1266, Coral Gables, Florida.

CAPE Canaveral remailing, 50¢—$5.00 month. Research Industries, PMA Box 334, Cape Canaveral, Florida 32920.

REMAILS 25¢, $3.00 monthly. Rodenhiser, 294 Lincoln St., Boston, Mass. 02134.

SOUTH America remailing 25¢. Castrillon, Apartado Aero 1700, Medellin, Colombia.

REPAIRS AND SERVICING

MAILORDER Record Book. 30 pages. Records inquiries, orders, advertising expense, etc. Most complete. Just send dime for postage and handling. C. A. Martin, Popular Mechanics, Dept. BM, 575 Lexington Ave., New York, N.Y. 10022.

SPECIAL SERVICES

EYEGLASSES! Wholesale laboratory established 25 years. Mail eyeglasses or prescription for quote. Global Opticians, 16 East 23 St., New York, N.Y.

FACTS, Any subject—product. Research, surveys, reports, assignments. Information 25¢. Box 1431, Greenville, South Carolina.

INFORMATION On anything. Ferguson Research Specialists, 83-45 Vietor Ave., Elmhurst, N.Y.

LOCATING Service! Any items or product. Jake Barraco, 478 Gardner, South Beloit, Illinois.

ANYTHING You need, we locate for a reasonable fee. NBARS, 9325B Menard, Oaklawn, Ill. 60453.

TOBACCO

MAILORDER Record Book. 30 pages. Records inquiries, orders, advertising expense, etc. Most complete. Just send dime for postage and handling. C. A. Martin, Popular Mechanics, Dept. CM, 575 Lexington Ave., New York, N.Y. 10022.

RAZORS

MAILORDER Record Book. 30 pages. Records inquiries, orders, advertising expense, etc. Most complete. Just send dime for postage and handling. C. A. Martin, Popular Mechanics, Dept. DM, 575 Lexington Ave., New York, N.Y. 10022.

WANTED—MISCELLANEOUS

STAMP Collections, accumulations. Eagle Stamp Co., 2221 Romine, Pittsburgh 26, Penna.

MERCURY, Gold, Silver, Platinum; Ores assayed. Wholesale Terminal, Norwood, Mass.

PERSONAL

SUBCONSCIOUS Conditioning remakes personality while you sleep. Free details. Sleep-Learning, Box 24N, Olympia, Washington.

LOANS By mail, $100-$1000. Anywhere. Confidential. Write Union Finance, Dept. PM, 222 W. Osborne, P.O. Box 7457, Phoenix, Arizona.

LOW-Cost loans by mail. $6.00 monthly repays $104.50; $56 monthly repays $1,321.39. Borrow any amount. Guaranteed fast, confidential. Write today! Bankers Investment 67-B, Box 1648, Hutchinson, Kansas 67501.

INVESTIGATORS, Free brochure, latest subminiature electronic surveillance equipment. Ace Electronics, 11500-P NW 7th Ave., Miami, Florida 33168.

BLITZ Reducing! 5 pounds overnight! Guaranteed! Bijou, Box 1727-BM, Hollywood, California 90028.

NEED Money? Borrow $100-$1000 by mail. Confidential, repay in 24 months. Free loan application. World Finance Co., Dept. PW-155, 620 Symes Bldg., Denver 2, Colo.

DON'T Put off making your will. Two legal forms, $1.00. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

BORROW $1,233 Airmail! Repay $54 for twenty-nine months. State licensed. Postal Finance, Dept. 17-L, Kansas City, Kansas 66117.

BORROW $100 to $1000 by mail. Quick, easy, private. No co-signers. Repay in 36 small monthly payments. For the amount you want write today to Dial Finance Co., 410 Kilpatrick Bldg., Dept. 10-214, Omaha, Nebraska 68102.

25 HOLLYWOOD (Las Vegas) postcards, $1.00, Remailed. Postapress, Box 1069, Hollywood 90028.

OCCULT Supplies and services, catalogue free. "Lodge" Brantridge Forest, Balcombe, Sussex, England.

INFORMATION Service. Questions and answers confidential, $1.00. Helpers, Box 137, Texarkana, Arkansas 75501.

DEBT Escape plan used by thousands. Quick—simple—guaranteed. Free details. Counselor Reports, Harlingen 7, Texas.

DON'T Quit smoking until you get free facts on my amazing new kind of pipe. Send name. E. A. Carey, 1920 Sunnyside, Dept. C-252-K, Chicago, Illinois 60640.

BIBLE Questions answered. Stamped envelope. Bylon, 17167 Bentler, Detroit, Michigan 48219.

MISCELLANEOUS

BOOKS On antiques and their prices. Free circular! P. Warman Publishers, Uniontown, Penna.

ORNAMENTAL Iron designs. Book of 1600 beautiful, practical designs for railings, columns, etc. Free literature. Cunningham, 3881 South 3200 West, Salt Lake City, Utah 84119.

LOANS By mail, $100-$1000. Anywhere. Confidential. Write Union Finance, Dept. PM, 222 W. Osborne, P.O. Box 7457, Phoenix, Arizona.

BIRTH Certificates, Marriage Certificates, Diplomas! 2 blank forms $1.00. Sample 10¢. Standard Forms, Box 482-M, Washington, D.C. 20044.

SUPER Memory overnight! Success guaranteed! Bijou, Box 1727-M, Hollywood 28, California.

FREE Wholesale catalog! 100,000 products. Tremendous discounts! Taylor Distributors. Newton 2, New Jersey.

KEY Safe: Key retainer attaches to standard combination lock, rendering key unusable until removed, $1.00. John Bach, 1108 Sunset, Grafton, Wisconsin.

SWAP Almost anything. Photo, radio, sporting equipment, guns, antiques, hobby supplies. Join now! Send $1.00 for application and bulletin to; Swappers International, 18403 Plymouth, Castro Valley, California 94546.

IMPROVE Your memory. Simplified system. Free details. Laurins, 1137 Second Avenue North, Jacksonville Beach, Florida 32050.

YOUR Name sent to 1000 importers, publishers, mailers, wholesalers, etc. on our mailing list. Year $1.00. Dixie Mailers, King, N. Car.

MARRIAGE, Birth certificates, diplomas. Quality forms, $1.00 each. Brugenheimer Publishers, Box 158-PM3, Lexington, Mass.

POLISHING Cloths work magic on furniture, jewelry, silver, automobiles. 2 cloths complete, $1.75 postpaid. Lobel, 130 West 42nd Street, New York 10036. Suite 350.

CESSPOOLS, Septic tanks, dry wells, clogged drains cleaned by Sursolvent. Saves pumping, digging, etc. Electric Sewer Cleaning Co., Boston, Mass. 02134.

SURPLUS Inventory—complete or component parts. Thermometers, barometers, poker chips, poker racks, checkers, rubber parts. Send for free list. Dealer Inquiries Welcome. Thermometer Corporation of America, P.O. Box 780, Springfield, Ohio 45501.

FREE! 75 New gift ideas! Mendez, 426 Hill, Los Angeles 13, California.

RADIO Announcing. Learn home! Books, magazines: Disk Jockey, Box 11, Aberdeen, South Dakota 57401.

SUPERSENSITIVE Listening-In-Device picks up any telephone conversation in vicinity. No connection to telephone necessary. $2.98 Complete. Consolidated Acoustics, 1302K Washington, Hoboken, N.J.

HEARING Aid batteries wholesale. Free list. Habs, Box 51, York, Penna.

SQUARE Dancers—Western style bow ties. Metallics, contrasting backgrounds. $1.00, 6 for $5.00. Crosby's, Box 397B, So. Hamilton, Mass.

BUY From Hong Kong. Color catalog and information, $2.00. Phillips Drug, P.O. 709, Arkadelphia, Arkansas 71923.

CIGARETTES—Make 20 plain or filtertip for 9¢. Factory-fresh pipe tobaccos. Mild tropical flavored Philippine cigars. Facts free. Moberly, Box 903, Owensboro, Kentucky.

LET Us tell you how to turn the reading habits of your friends into profit for you. $10.00, $25.00 or $50.00 can easily and quickly be made under our Popular Mechanics subscription plan. No experience needed. Write Popular Mechanics, Room 10-M, 250 West 55th St., New York 19, N.Y.

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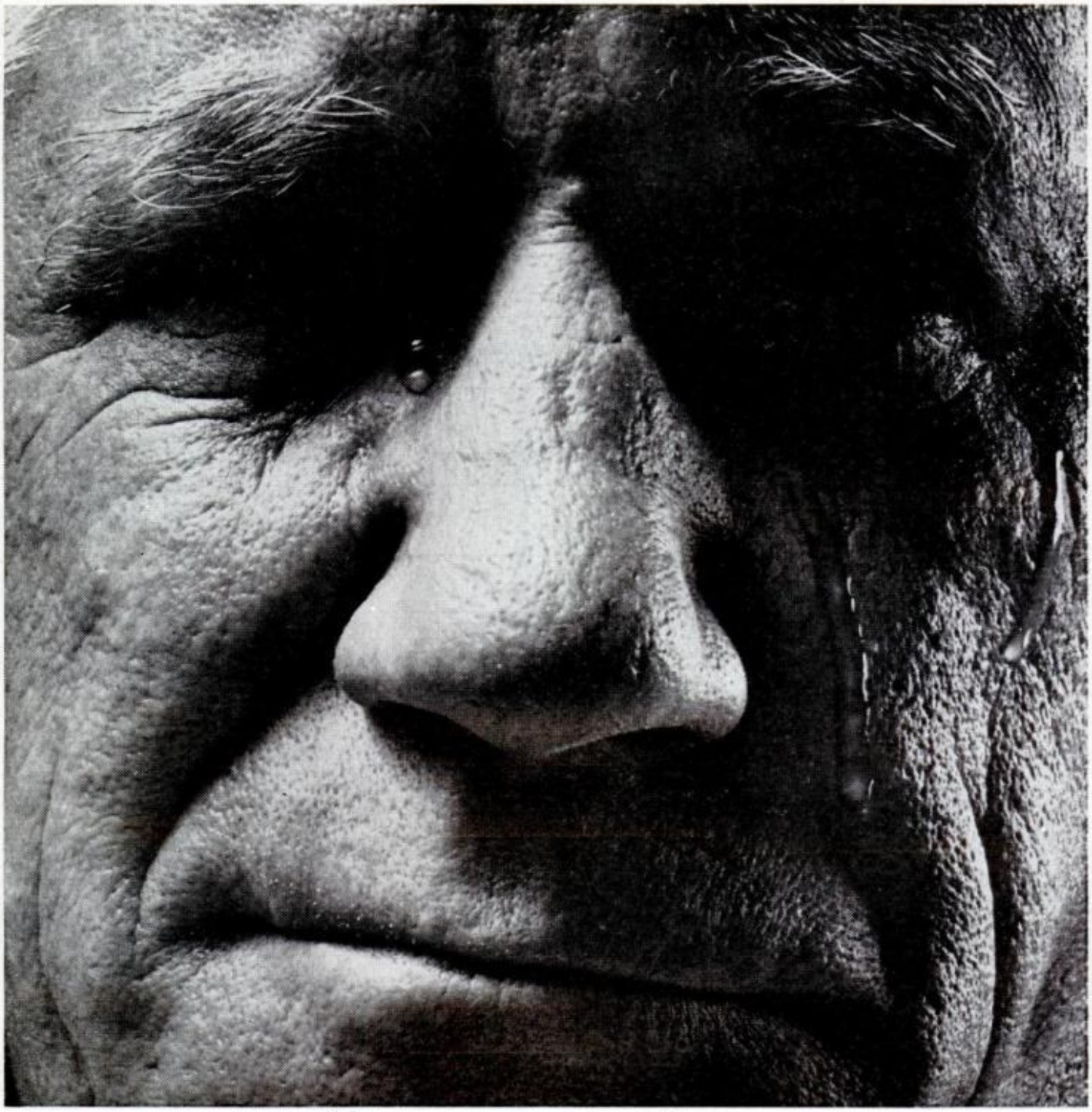
If you just bought a set of tires for your truck, don't read this price chart. You may cry.

SIZE	6.00-16	6.50-16	6.70-15	7.00-15	7.00-16	7.00-17	7.50-20	8.25-20
RATING	6-ply	6-ply	6-ply	6-ply	6-ply	6-ply	10-ply	10-ply
PRICE	$15.95	$20.75	$18.95	$24.95	$25.25	$28.95	$46.95	$48.95

All prices plus tax and tire from truck. Priced as shown at B.F.Goodrich Stores; competitively priced at BFG Dealers.



If your eyes are still dry,

hurry to your BFG retailer (he's listed on the right) and get the rest of the details on the all-nylon Econo-Miler.

B.F.Goodrich

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These B. F. Goodrich retailers sell the Tough Breed of Tires for the Hard-Driving Man

CONNECTICUT

Danbury
Fairfield Tire Supply, 246 White St.
East Haven
Copa Tire Service, 509 Laurel St.
Hartford
Reliable Auto Tire Co., Inc., 363 Hudson St.
Kensington
Wallabout Tire Co., 202 New Britain Rd.
Moodus
Axelrod Tire Mart, Main St.
Norwich
Falcone's Servicenter, 99-101 W. Main St.
Shelton
B.F. Goodrich Store, 311 Howe Ave.

DELAWARE

Dover
Delaware Tire Center, 207 S. Governors Ave.
Milford
Billings Tire & Service, U.S. Rt. 113
Seaford
Peninsula Oil Co., Blades Causeway

MAINE

Bangor
Bangor Tire Co., 127 Franklin St.
Damariscotta
Yudy's Lincoln Tire, Waldoboro Rd.
Fort Kent
Frank Martins Sons, 917 Market St.
Gardiner
B.F. Goodrich Store, 223 Water St.
Portland
Yudy's Inc., 534 Danforth St.
Van Buren
Sirois Supply Co., 47 Main St.
Westbrook
Yudy's, Inc., 942 Main St.

MARYLAND

Annapolis
Tam Joines Tire Service, 2054 Somerville Rd.
Baltimore
B.F. Goodrich Store, 1266 E. North St.
Baltimore Rubber Sales, 630 S. Hanover St.
Cambridge
Phillips Oil Co., Washington St.
Cumberland
B.F. Goodrich Store, 159 N. Centre St.
Easton
Standard Auto Supply, Goldsboro St.
Frederick
Frederick Home & Auto Supply, 328 N. Market St.
Hagerstown
B F. Goodrich Store, 117 W. Franklin St.
Princess Anne
Layfield Bros., Old U.S. 31
Salisbury
B.F. Goodrich Store, 310 E. Main St.
Westminster
Westminster Tire Service, Englar Rd. Shopping Ctr.

MASSACHUSETTS

Attleboro
Attleboro Tire Sales, 71 County St.
Boston
Merchants Tire Co., 1299 Boylston St.
Brockton
B.F. Goodrich Store, 92 Crescent St.
Chelsea
Gans Tire Sales Co., Inc., 1005 Broadway
Everett
Merchants Tire Co., 1885 Revere Beach Pkwy.
Fall River
Henry's Tire Service, 714 Globe St.
Fitchburg
Fitchburg Tire & Service, 94 Broad St.
Holyoke
Yoerg's Garage, 158 Chestnut St.
Hyannis
Super Tire Service, Inc., 37 High School Rd. Ext.
Lawrence
Merchants Tire Co., 314 S. Broadway
Lowell
B.F. Goodrich Store, 145 Moody St.
Lynn
B.F. Goodrich Store, Essex & Johnson Sts.
Malden
B.F. Goodrich Store, 104 Exchange St.
Mansfield
Mansfield Tire Co., 8 Cottage St.
Natick
Merchants Tire Co., Rt. 9 at Sherwood Plaza
North Adams
B.F. Goodrich Store, 26 Main St.
No. Cambridge
B.F. Goodrich Store, 2353 Massachusetts Ave.
Pittsfield
Lipton's Tire, 458 South St.
Quincy
Merchants Tire Co., 234 Quincy Ave.
Springfield
B.F. Goodrich Store, 161 Chestnut St.
Vineyard Haven
R. M. Packer, Beach Rd.
W. Springfield
Sol's Tire Service, 953 Union St.
Worcester
Ken Jones, Inc., 73 Chandler St.

NEW HAMPSHIRE

Concord
The Waite Corp., 12 N. Main St.
Keene
Cheshire Oil Co., Ralston & Davis Sts.
Manchester
Car-Go Home & Auto Center, 560 Elm St.
Nashua
B.F. Goodrich Store, 227 Main St.
Portsmouth
Gallagher's, 86 Pleasant St.

NEW JERSEY

Berlin
Blaese's Tire Service, White Horse Pike
Bridgeton
B.F. Goodrich Store, 11 Washington St.
Dover
Freeway Petroleum Co., 13 W. Clinton St.
Edison
Bob Lember Inc., 1690 Highway 27
Englewood
Englewood Tire Distributors, 386 Grand Ave.
Farmingdale
Thritt Tire Co., Collingwood Circle
Freehold
B.F. Goodrich Store, 28 E. Main St.
Hackensack
Broadway Tire & Rubber Co., 555 Hackensack Ave.
Jersey City
Harry Klinger Inc., 47-49 Leonard St.
Montclair
Henry F. Goepfert Inc., 684 Bloomfield Ave.
Mt. Holly
B.F. Goodrich Store, 31 Main St.
Newark
B.F. Goodrich Store, 677 Frelinghuysen Ave.
Pennsauken
B.F. Goodrich Store, 5811 S. Crescent Blvd.
Roselle Park
Roselle Park Tire Co., Westfield Ave. & Locust
Toms River
Minerva Tire Service, Flint Rd.
Trenton
Heath & Wildblood, 1432 Hamilton Ave.
Whippany
Gogel Chevron Service, 2 Parsippany Rd.

NEW YORK

Albany
B.F. Goodrich Store, 1043 Broadway
Bayshore
Bayshore Rubber Works, 161 E. Main St.
Brooklyn
Alamac Tire Distributors, 630 Foster Ave.
Buffalo
B.F. Goodrich Store, 1050 Main St.
Canton
Hundley Farm Impl. Inc., 62 E. Main St.
Dunkirk
B.F. Goodrich Store, 423-25 Central Ave.
Ellenburg Depot
Wilmer Nephew Impl. Service
Elwood
County Tires Inc., 1976 Jericho Turnpike
Endicott
Kearing Tire Service, 236 Vestal Ave.
Garden City
Golub Tire & Rubber Co., 2260 Jericho Turnpike
Huntington Station
Sheehan Tire Co. Inc., 91 E. Jericho Turnpike
Jamestown
B.F. Goodrich Store, 405 W. Third St.
Madrid
Kelly Sales Corp., 10 State St.
Malone
West End Service, 119 W. Main St.
Martville
Kyle Farm Machinery
Mexico
Jerrett's Gulf Service, Main & Scenic Sts.
Middletown
Suresky's Tire Service, 111-112 North St.
Newburgh
B.F. Goodrich Store, 303 Broadway
New Rochelle
Mallory Tire & Auto Service Co., 20 E. Main
Niagara Falls
B.F. Goodrich Store, 928 Main St.
Ogdensburg
Fred Shurtleff's Inc., Washington & Catherine
Olean
B.F. Goodrich Store, 112 N. Barry St.
Oneonta
Hamm's Tire Center, 300 Main St.
Oswego
Fruit Valley Tire Co., Route 104 W.
Plattsburgh
A. Brown Auto & Home Store, 319 Cornelia St.
Air Base Texaco, 4 U.S. Ave.
Port Henry
Whellocks Garage Inc., 78 S. Main St.
Poughkeepsie
B.F. Goodrich Store, 605 Main St.
Riverhead
Rolle Bros., Route 58
Rochester
B.F. Goodrich Store, 385 Ridge Rd., W.
Rome
Pettinelli Motors, Martin St.
Stapelton
L & F Tire Co., Vanderbilt Ave. & Targee St.
Syracuse
Barnet-Hewett Tire Co. Inc., Onondaga & Myron
B.F. Goodrich Store, 627 Erie Blvd., E.
Brothers Tire Co., 749 W. Genesee St.

RHODE ISLAND

Pawtucket
B.F. Goodrich Store, 580 Pawtucket Ave.
DeBlois Oil Co., Colfax & Concord Sts.
E. Providence
Devaney Tire, Inc., 741 N. Broadway

VERMONT

Barre
A. Brown Auto & Home Store, 395 N. Main St.
Brattleboro
Fleming Oil Co., 3 Walnut St.
Burlington
B.F. Goodrich Store, 227 Main St.
Enosburg Falls
A. Brown Auto & Home Store, 158 Main St.
Morrisville
A. Brown Auto & Home Store, Rts. 15 & 100
Rutland
Ray Reilly's Tire Mart, 219 Woodstock Ave.
St. Albans
A. Brown Auto & Home Store, 248 N. Main St.

WASHINGTON, D. C.

Washington, D.C.
B.F. Goodrich Store, 1801 New York Ave., N.E.
B.F. Goodrich Store, 2316 Rhode Island Ave., N.E.

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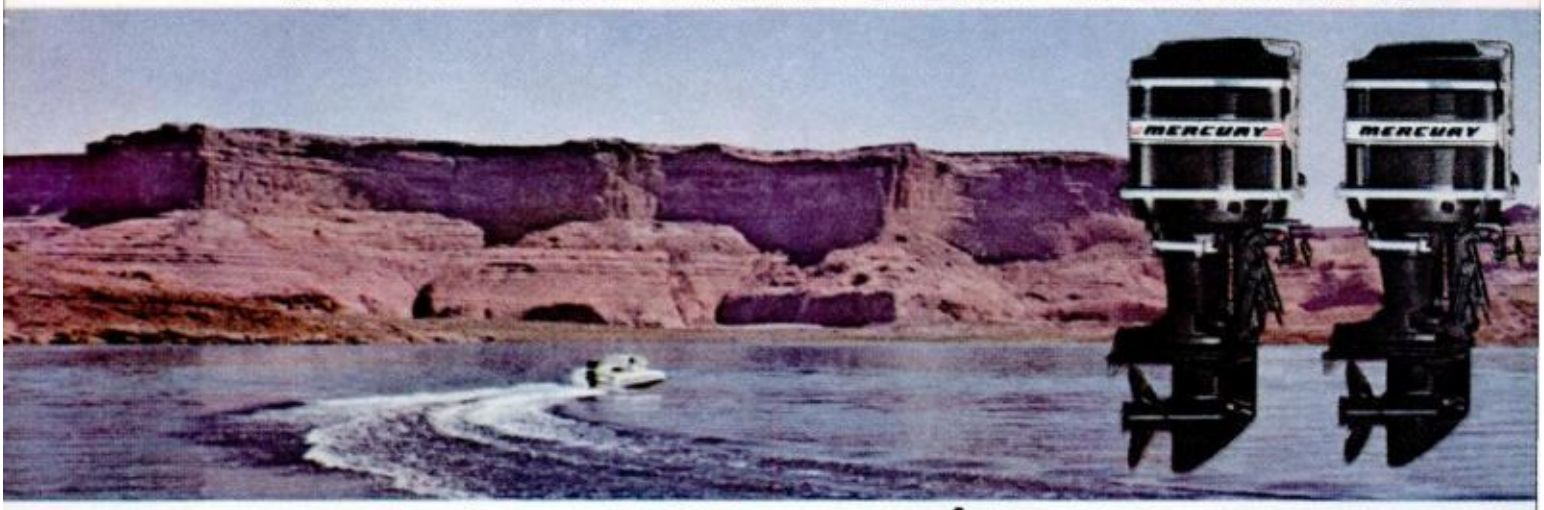
NOW—WORLD'S MOST POWERFUL

NOW—ALL NINE NEW MERCURYS



see all the QUIET new '66 Mercurys —

From the pioneer in competition-proved high-horsepower outboards comes a new champion—the new 110-hp Merc 1100! What's it like to ride herd on 110 horses? Point the bow at the farthest point on the lake, crack the throttle—and that lake's suddenly smaller! The Merc 1100 is the great new successor to the Merc 1000—holder of more international performance and endurance records than any other outboard ever built!

From the sleek new Merc 1100—and the exciting new 95-hp Merc 950—all the way down the line to the trim 3.9-hp Merc 39, these new Mercs are quiet—*quietest outboards you can buy!*

Also new for '66: now you can safely use a 50:1 gasoline-oil ratio with our new *Formula 50* Super Outboard Motor Oil. New *Polar-Gap* spark plugs on both 6-cylinder Mercs cut fuel consumption, last more than

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OUTBOARD–NEW MERC 1100...110 HP

(110 TO 3.9 HP) ARE QUIET

at your Mercury dealer!

twice as long as ordinary plugs, even on leaded fuel. Two new powerheads, three other models redesigned from top to prop—and much, much more.

Mercurys are designed by the industry's top engineers . . . then boat-tested under "customer environment" conditions around the clock and around the calendar at Mercury's Lake X. Result: Mercury '66—finest outboards ever built: 3.9, 6, 9.8, 20, 35, 50, 65, 95 and 110 hp. See your Mercury dealer!

Kiekhaefer Corporation, Fond du Lac, Wisconsin, and Toronto. Subsidiary of Brunswick Corporation.

LEAN AND RUGGED

KIEKHAEFER MERCURY

FIRST IN MARINE PROPULSION

MERCURY '66

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©VOLKSWAGEN OF AMERICA, INC.

This is an ad for the Volkswagen Station Wagon.

As you can see, this wagon is loaded with reasons for owning a VW Station Wagon.

There's too much stuff, and not enough wagon. Only about 85 cubic feet worth.

If you owned a box-shaped Volkswagen, you could take all that stuff off the roof and put it inside where it belongs.

The VW holds 170 cubic feet; about twice as much as most regular wagons.

Which means you can seat 9 people and still have room for all their luggage.

(All their luggage means 13 pieces. And you can load it through 5 big doors.)

Aside from capacity, you also get a sensible little engine that averages 23 miles on a gallon of regular.

And you never have to pay for antifreeze or radiator repair.

There isn't any radiator.

So every time they make a conventional station wagon, they also make an ad for the Volkswagen Station Wagon.

(Secretly, we wish them every success.)

D

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PM Editor's Page

Aviation Editor Brown, briefed by Comte d'Assche, checks out in powered glider

Power Up—Dead Stick Down

A postcard from our peripatetic aviation editor, Kevin Brown, arrived in the office recently. Postmarked Cannes, France, and displaying a bikini-clad cutie somewhere on the French Riviera, it read, "This is a helluva place to send a man on a story."

The fact is that we didn't send him to Cannes but to Gap at the foot of the French Alps. A helluva place indeed!

Brown's explanation came a few weeks later. When he arrived in Gap, where a new aircraft that is part glider and part airplane is being produced, he found the hangar bare. They had just shipped the last unit the week before, and the next one wouldn't be ready until the following week. Quelle fixe! Brown had traveled all the way to France to fly this unique aircraft. There are none in the United States.

He found one at Cannes, however, and the owners, with Gallic grace, allowed him two flights, one as an airplane and the other as a glider. His story, and the aircraft's chances of being shipped to the States as a kit, will appear soon.

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FIRST COMPLETE REPORT ON THE

3 GIANT STEPS TO THE MOON

Part 1

The astronauts are in training, the flight plan is blueprinted and the hardware's being built. This is the first of three reports on the program leading up to the incredible journey set for '69

By Hans Fantel

COL. TINKER CUTS THE ENGINE of the Apollo spacecraft as it slips into a lunar "parking orbit." Some 240,000 miles from Earth, the vehicle will use no fuel as it spins about the moon at a speed of 4000 mph and an altitude of 80 miles.

Tinker and his two civilian astronaut companions—John Evers and Frank Chance—now await the crucial moment when orders will come from Earth to split the spacecraft in two. One section, the Command and Service Module—the "mother ship"—will remain in orbit with Evers aboard. The second and smaller section—LEM (Lunar Excursion Module)—will carry the other two men down to the pockmarked lunar surface. Within two hours, Tinker and Chance will be the first Earth creatures to set foot on another celestial body.

The names are fictional. We don't know who the astronauts will be when the scheduled launch takes place in 1969. But other aspects of the project are already in the realm of reality:

- LEM exists in prototype at the plant of the Grumman Aircraft and Engineering Corp. in New York. Soon it will be shipped to Houston, where NASA is building a gigantic space chamber to test the lunar landing bug.
- Apollo space suits that will enable men to move freely on the moon and survive its cruel conditions are now being tailored by the Hamilton-Standard Div. of the United Aircraft Corp., Windsor Locks, Conn.
- Flight plans are spelled out in detail for every minute of the mission, and NASA scientists are already thinking out loud about what the first visitors to the moon will do when they get there.

As befits a moonship, LEM looks like nothing on earth. A lopsided yellow monster with bulges and gismos sticking out in odd places, it straddles its gangly legs like an enormous crab. When I walked into its hangar at the Grumman plant outside of New York City, the mere sight of LEM made me blurt: "It'll never fly."

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"That's right," my guide grinned. "It doesn't have to. It's the first *true* spaceship." He explained that LEM never traverses earth atmosphere but operates only in space. It gets hoisted into the sky inside the mother ship's belly. Then it cuts loose and lands the astronauts on the moon. Later it returns the astronauts to the orbiting mother ship, which takes them back to Earth. LEM itself is abandoned in space.

Because LEM never "flies" in the aerodynamic sense of the word, it does not have to be streamlined like the capsules designed to bring back the astronauts. That leaves the designers free to tack on tanks, antennas, sensor panels and similar gadgets wherever convenient. The result is strictly functional, and you can't beat it for sheer ugliness.

I climbed into this other-worldly vehicle over some rungs attached to one of the huge crab legs. Each of the four legs is, in effect, a huge one-shot shock absorber designed to soften the landing. Inside each is a 30-inch column of metal honeycomb. In case of a rough landing, part of the honeycomb is crushed, thereby soaking up the shock. LEM itself won't "feel" the impact. Each leg is spring-loaded to give LEM a level stance on slanted ground, an important requirement for later takeoff from the moon.

The feet are round platters. Their 36-inch diameter, by educated guess, will keep them from sinking too far into the lunar dust. But when the first unmanned Surveyor spacecraft, to be launched in 1966, sends back more detailed information about the lunar surface, LEM's feet may have to be modified to give it the best possible toehold on lunar land.

I crawled through the snoutlike entry tunnel, which is just wide enough to admit an astronaut's space-suited rump. This tunnel serves as passageway between LEM and the mother ship. Inside, the vehicle loses some of its strangeness. With its dozens of red-glowing dials, gauges and instruments, LEM's interior resembles the cockpit of a jetliner. But the differences soon strike you.

For one thing, the two astronauts do their job standing up. If you're weightless, there's no point in sitting down. A pianist would feel more at home with the controls than a pilot. To guide their ship, the moon men slip their elbows into supports that hold their hands over a keyboard. Tapping the keys releases potent puffs from the 16 small jet thrusters that can roll, turn or nudge LEM into any attitude in space. The big backward push to slow the LEM for lunar landing comes from a special engine in the underpinning. (A landing parachute wouldn't work on the airless moon.)

As I stood inside the LEM, scanning its instruments and looking out through a

1 **EIGHTY HOURS** after blast-off the Command Module and LEM slow down to enter 4000-mph lunar parking orbit at an altitude of 80 miles

2 **LEM CUTS LOOSE** from mother ship and heads for the moon, using its retrorocket (10,500-pound thrust) to slow drop to the lunar surface

3 **THRUST OF LEM's** rocket is variable, permitting delicate control during descent. LEM will brake to 7 mph as it sets down on target

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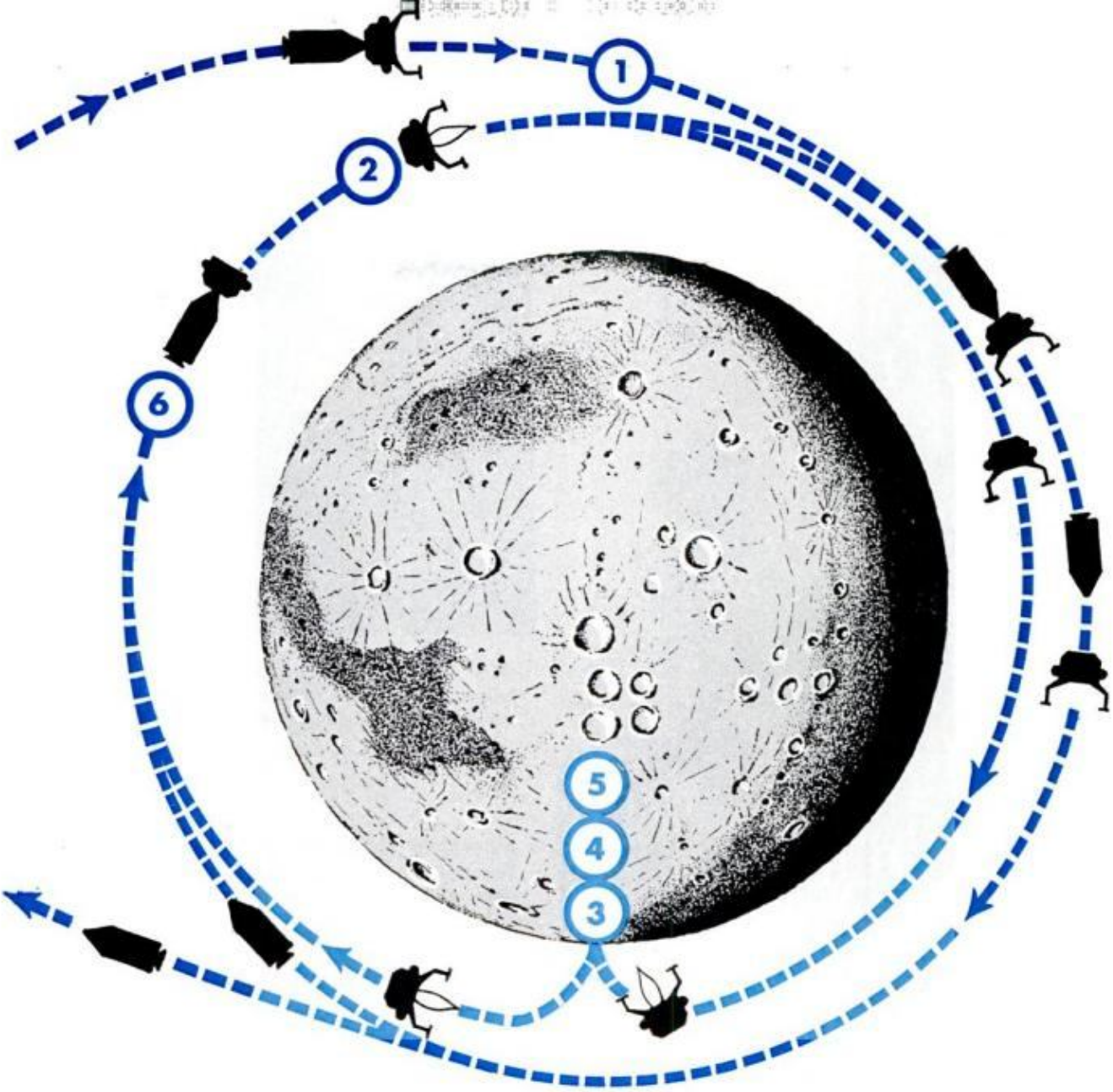
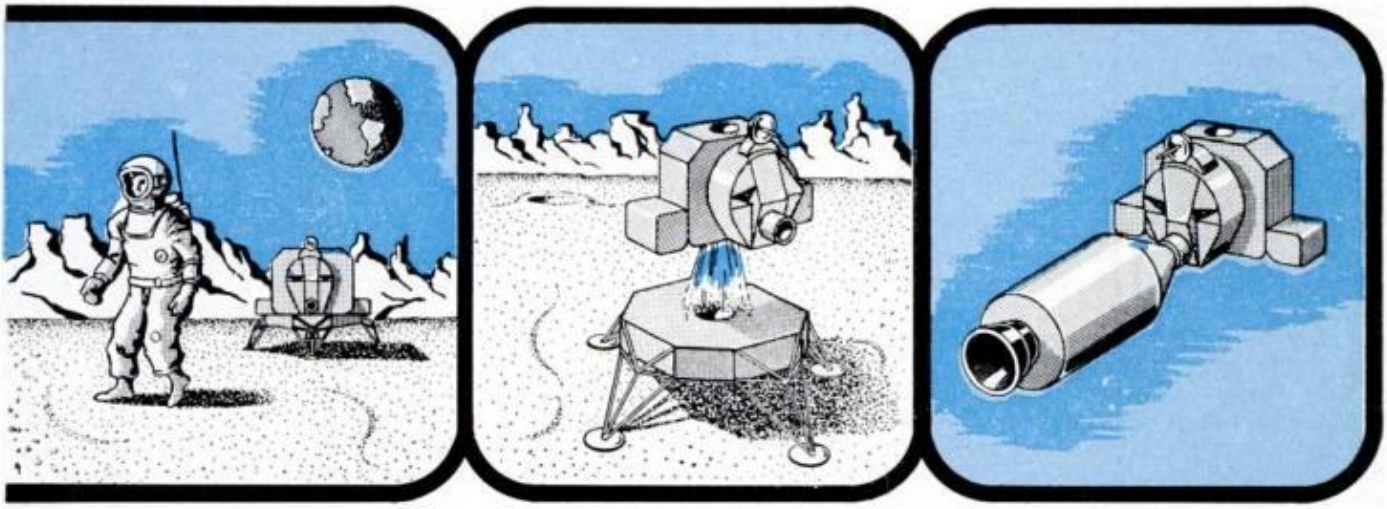


4 **ASTRONAUT** may carry a TV camera on lunar stroll. Antenna shown is for radio communications with LEM and the control center on Earth

5 **VISIT** will last 24 hours. LEM blasts off, leaving landing stage behind. The takeoff is carefully timed to conserve precious fuel supply

6 **LEM** and mother ship coast halfway around moon, then dock. The two moon explorers use hatch to rejoin their buddy for the trip home



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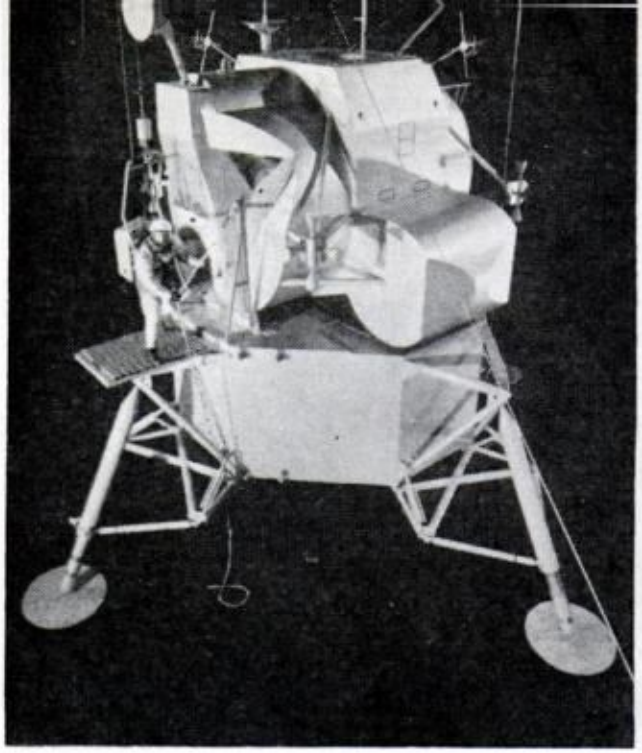

UGLY MOON BUG called LEM rides in mother ship's belly, so needs no streamlining to cut through the atmosphere of Earth. It weighs about 30,000 pounds

MUSTS FOR MOON WALK—space suit and backpack. Together, they make complete life-support system, permitting four-hour explorations away from LEM

triangular window, the details of NASA's "mission profile"—a sort of lunar flight plan—no longer seemed fanciful prophecies. With my hands on the controls and my eyes on the instruments I could visualize how astronauts like Tinker, Evers and Chance would carry out their mission.

Spinning around the moon in a two-hour parking orbit, the three spacemen run through one more systems check: fuel reserve and tank pressurization, atomic power generator, guidance computers, radio communications, and the life support devices that provide oxygen, cooling, humidity control and waste removal. Instrument readings for these systems are telemetered to earth, where huge computers at the Manned Spacecraft Center in Houston race through the data and evaluate the status of all systems. Seconds later—if all systems are "a-okay"—the decisive go-ahead flashes from Earth to the three men on Mission Apollo.

Tinker and Chance zip themselves into the special suits they will wear on their moon walks. They wave goodbye to Evers, the flight engineer who remains with the mother ship. Then they squeeze through the narrow entrance tunnel from the mother ship into the LEM.

Col. Tinker now presses the button marked "LEM-Separation." Explosive bolts linking LEM to the mother ship flash noiselesesly in the vacuum of space. The bond is broken. A brief spurt from the thrusters sends LEM drifting ahead of the mother ship—two tiny specks of flotsam in the vastness of the sky.

From his Plexiglas window—thick enough to protect him against minor meteorites and other high-speed particles racing through space—Chance casts a long homesick look at Earth, a large luminous disc hanging distantly in the immense blackness. Then he resolutely turns to the immediate goal of his mission—the ghostly pale surface of the moon—the unknown world that now stretches beneath him.

The job of guiding LEM down is handled by a compact one-cubic-foot computer that is the heart of the vehicle's guidance system. From a set of whirring gyros that sense every motion, the computer takes its cues about the LEM's exact position and attitude in space. Then it compares the LEM's actual position with the flight plan previously programmed into the computer's memory. If LEM goes astray, the computer, like the autopilot on airliners, automatically brings it back on course.

Through most of the mission (except when LEM is hidden behind the moon in its lunar orbit) the miniaturized computer is backed up by earth-based radar trackers. From Goldstone, Calif., Johannesburg, South Africa, and Woomera, Australia, huge dish-shaped antennas will keep their electronic eyes on the far-out LEM, checking its position throughout the flight, ready to alert the astronauts if LEM's self-contained guidance goes haywire. In case of trouble, the astronauts can always override automatic guidance with

(Please turn to page 230)

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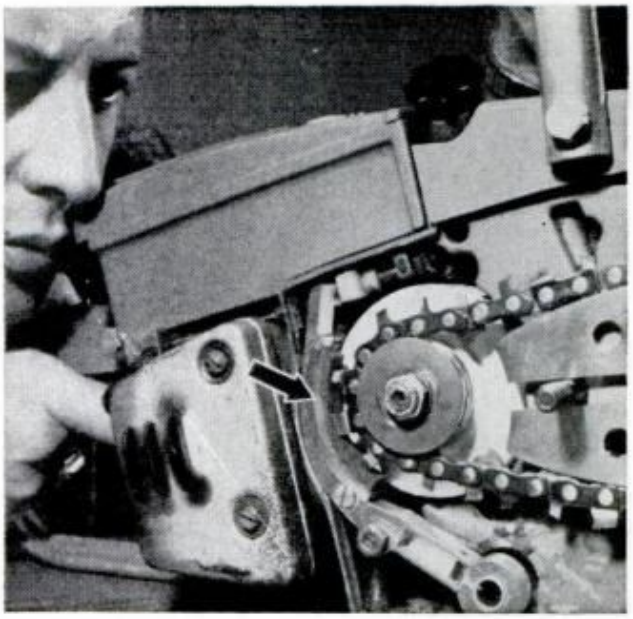
Quick Grinder

A sharp edge can be ground on the cutters of a chain saw in less than 15 seconds, says the maker of a new sharpening system.

A lever-actuated grinding stone (arrow) that bears down on the cutters does the job.

The sharpener, which is mounted permanently on the saw, is a product of Omark Industries, Portland, Oregon.



Train Trailer

Rail passengers can now take their autos along on the same train they're traveling in. A special "caboose" for the passengers' autos follows along behind the railroad coaches, as shown.

The unique service is offered by the C&O-B&O Railroad on its Chicago to Washington, D.C., run.

The Old New England Dory Is Fiberglass Now

It's the old New England dory—a familiar shape out in the breakers—but on close look, you'll see some innovations. The dory, manufactured by W. D. Schock Co., is made of fiberglass, and it has an outboard motor well. The 15½-foot boat has a beam of four feet and weighs 120 pounds. The Santa Ana, Calif., builder sells the dory for $275.

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new cars: what's ahead in 1966?

They're leaving '65 in the dust with their new, big-cube, big-horsepower engines.

By Alex Markovich

THE AUTO MAKERS are in a spot. They're like the fellow who jumped on his charger and rode off in all directions.

Now don't misunderstand: Detroit knows what sells cars—and it's spelled "performance." That's where the new monster-size engines (up to 462 cu. in.) come in. But the manufacturers also know that soaring horsepowers could result in some unwelcome governmental sniffing. And that's where safety equipment comes in. Detroit is hoping gadgets such as shoulder harnesses, padded dashboards and idiotproof door handles will keep the boy scouts happy while, catering to the Walter Mitty in the rest of us, they peddle a slew of racing engines a bit tamed for street use.

This performance kick is mirrored in

coronet leans moderately in corners, but handles well. All engines are 1.5 inches farther back for '66, an improvement in the weight distribution

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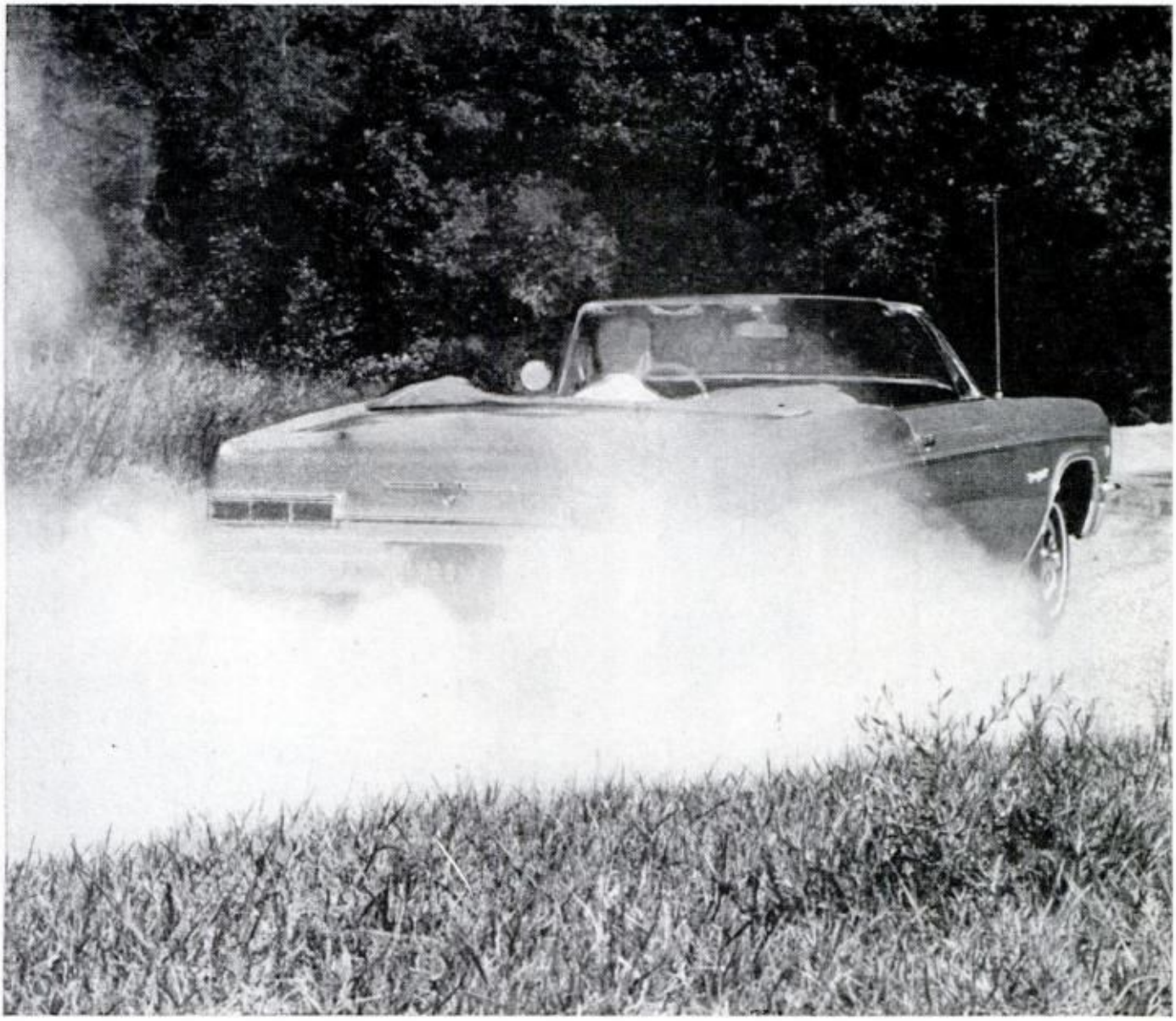

chevrolet kicks up lots of dirt with 425-hp, 427-inch V8. Styling is practically unchanged

ford has softer front springs and shocks. Optional disc brakes are nearly fadeproof. New grille and kicked-up rear fenders change styling

rambler American is 3¾ inches longer, as are Classic and Ambassador wagons. Entire Rambler line shows heavy lean during hard cornering

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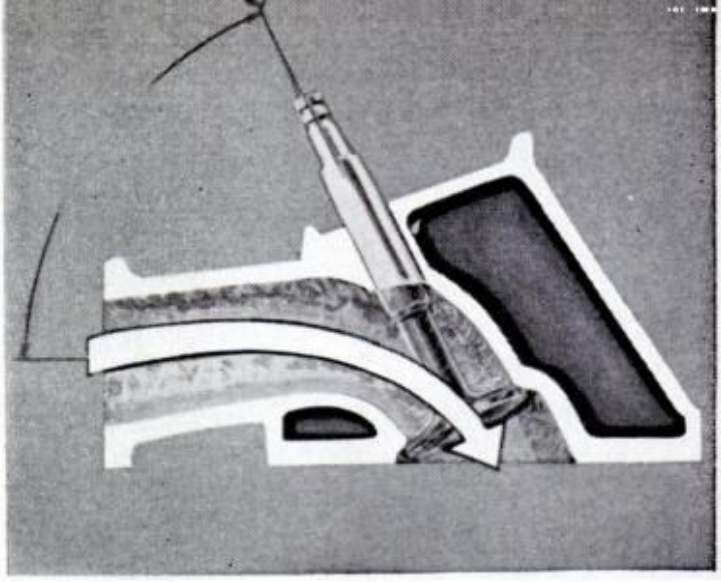
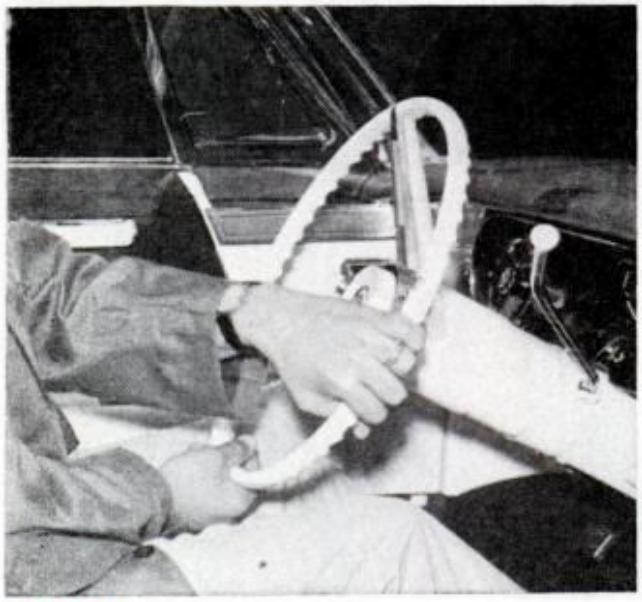
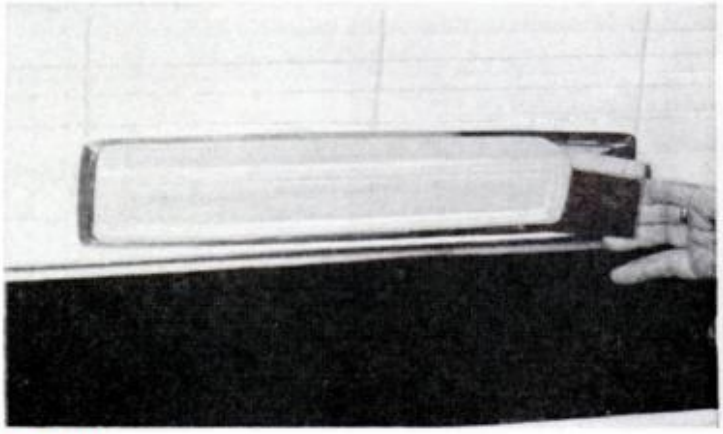


chevrolet 427 engine has angled valves (above less turbulence in the incoming fuel charge. Old





cadillac variable-ratio steering (just above) is faster than old conventional steering (top), as shown by position of hands in right-angle corner

dodge safety door handles, also offered by perial, open like a seat-belt buckle. They feel awk- to get used to. They're designed to prevent acci-

styling. The trend is toward fastback roofs, rounded, Italianesque lines and less chrome trim.

The big engineering news is the much-heralded Oldsmobile Toronado with front-wheel drive, the first such U.S. car since the 1937 Cord. Its 425-inch engine sits slightly right of center, the automatic transmission torque converter mounted conventionally behind it. The remaining section of the Turbo Hydra-Matic faces forward along the left side of the engine and is driven by a link chain. From there, torque is fed through a planetary differential to the front wheels.

Suspension is torsion-bar in front, single-leaf spring with double shock absorbers in the rear. The resulting package is an extremely stable handler. We took it through GM's twisty road course in dry weather and in wet, and found the cornering excellent. Handling ranged from marked understeer with full throttle to just about neutral steering with gas off. Olds recommends 24 psi tire pressures all around; inflating the front tires several pounds higher than the rears would decrease understeer and set up a mild, useful oversteer with gas off, but engineers felt the average motorist—and service-station attendant—wouldn't want to bother with two different pressures. Pity.

Variable-ratio steering, standard on the new Cadillacs, is another worthwhile advance. With the wheel dead center, steering is conventionally geared—16.7:1 overall—thus giving good directional stability without constant steering corrections. But as you turn the wheel toward full lock, the steering ratio gradually speeds up to a 12:1 maximum. This revolutionary concept was pioneered by Bendix for the English-made Jaguar 4.2 sedan. Caddy's system, not quite as drastic, is made by

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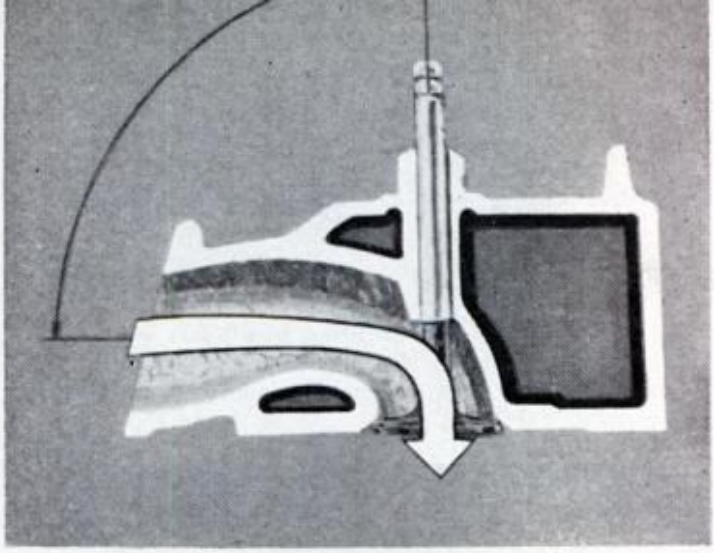
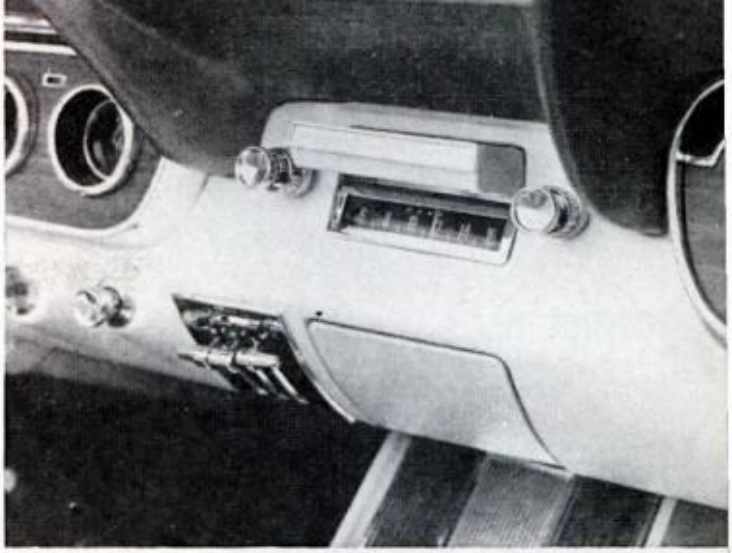
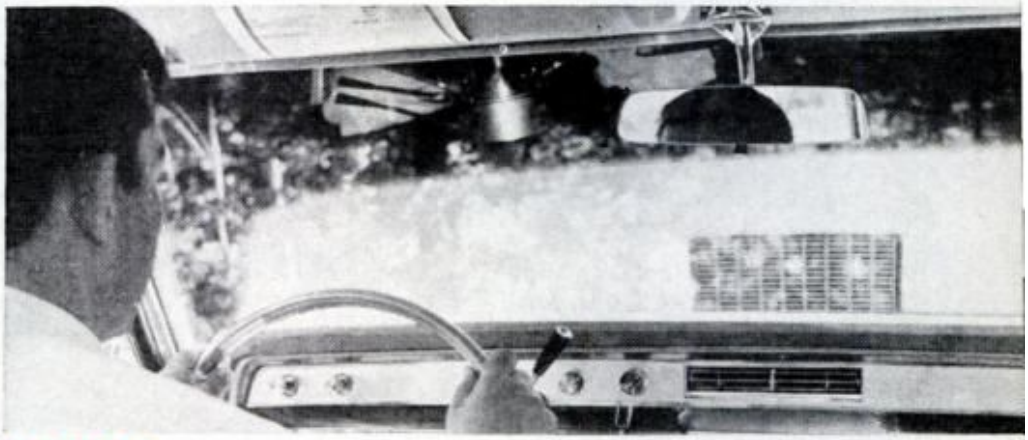


left), which allow smoother intake passages for Chev 409 (above right) had perpendicular valves



mustang has optional tape player, as do other FoMoCo cars. Single cartridge plays 80 minutes

Plymouth, Chrysler and Imward at first, but are easy dental opening of doors



chevelle dashboard and radio grille panel have a highly reflective surface that causes windshield glare. There's an easy way to eliminate this problem: Cover the entire reflective surface with a flat black paint

GM's Saginaw Division. Wheel turns lock-to-lock are reduced from the previous 3.6 to an amazing 2.4.

It takes a few minutes to get used to it, as I found out going around the first corner. I grazed the curb. But it adds immeasurably to manueverability and ease of parking. During high-speed cornering it compensates for slip-angle losses —when the wheel angle doesn't match the tire angle because of tire distortion. Other makes are sure to pick up this idea soon.

An overhead-camshaft L-6 engine, which will be standard throughout the Tempest line, is Pontiac's big story. (The biggest engineering advances this year, it seems, are coming from GM.)

The cam is driven by a fiberglass-reinforced neoprene belt and features a rocker arm and a hydraulic lash adjuster. Bore and stroke are 3.875 and 3.250 inches, totaling a displacement of 230 cu. in. A standard single-barrel carburetor provides 165 hp. In the sprint option, with four-barrel carburetor and higher compression, horsepower is boosted to 207.

Getting back to those giant-displacement engines: Let's take Chrysler's competition-only 426 with hemispherical combustion chambers. Drop the compression from 12.5 to 10.25, heat the intake manifold for faster warmup, slip in a milder camshaft and quieter mufflers and cram the works into a Dodge Coronet or Plymouth Belvedere and you have one of the most potent machines on the road. In spite of an erratically shifting TorqueFlite, we pushed a test Coronet to 60 mph in 6.2 seconds. The standing-start quarter mile took 14.4 seconds.

This street hemi, incidentally, isn't available in the full-size Dodges or Plymouths, Chryslers or Imperials. Instead, these offer an optional 440-inch

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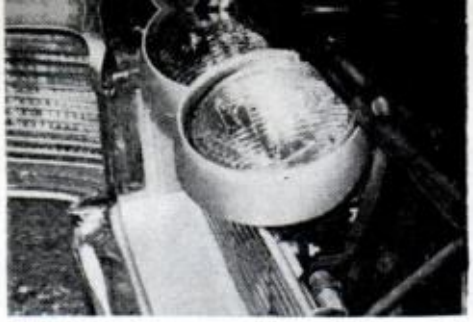
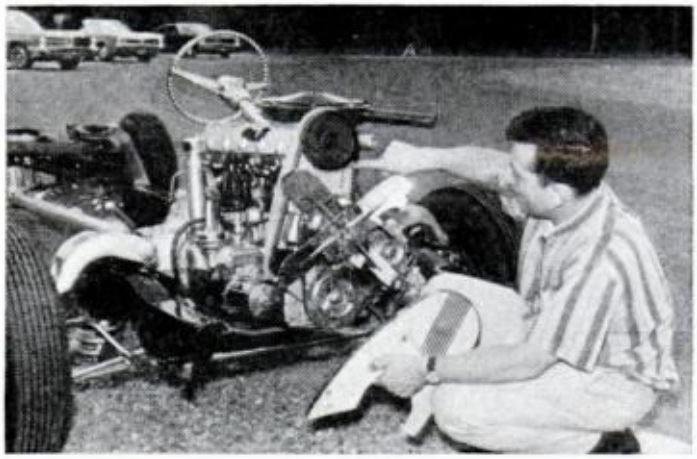
comet offers a twin-scoop fiberglass hood—standard on the Cyclone GT, optional on other models. High line is 203 inches long, base model is 195.9. Front, rear tread are increased

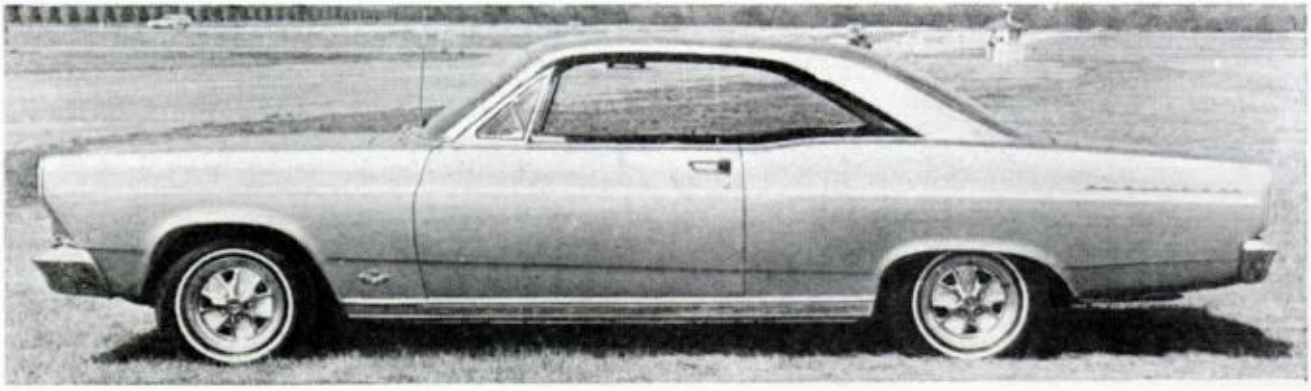


riviera retracting headlights work electrically. If retractor should fail, lights can be pried open by hand

comet wagon tailgate opens like a door for easy rear entry, or drops down for loading. All FoMoCo wagons offer this feature



tempest overhead-cam Six puts out as much as 207 hp, thanks to improved breathing through elimination of valve train. And wait till the rodders get hold of it



fairlane has new, sleek lines that look suspiciously like those of some GM cars. Body is now more rigid, but torque boxes dampen vibration

wedge-chamber V8 that's essentially a larger-bore version of the old 413. This premium-gas engine cranks out 350 hp, 10 more than does the 413.

The daddy of the big-inchers is Lincoln Continental's new 462 V8—basically a hogged-out 430-incher. Engineers claim a 10-percent performance increase without a corresponding loss of economy. It's done through more efficient intake porting.

And then there's Chevrolet's resurrected "mystery engine"—that sophisticated porcupine-valve 427 (so named because its valves jut out at odd angles, like quills). It ran a few NASCAR races a couple of years ago and then disappeared. The same basic design, in 396-inch form, came out in mid-'65. Now the engine has regained its lost 31 cubes and is available in the full-size Chevrolet and Corvette in 390 and 425-hp versions.

Another racing engine tamed for the street is a 345-hp, 428-inch V8 that's optional in the big Ford, Thunderbird and Mercury. It's a luxury version of the Ford

(Please turn to page 220B)

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TORONADO...

Shakedown by T-Bird Fans

It felt better, but not different...
faster in corners... roomier inside
...but how about front-end repairs?

By Alex Markovich

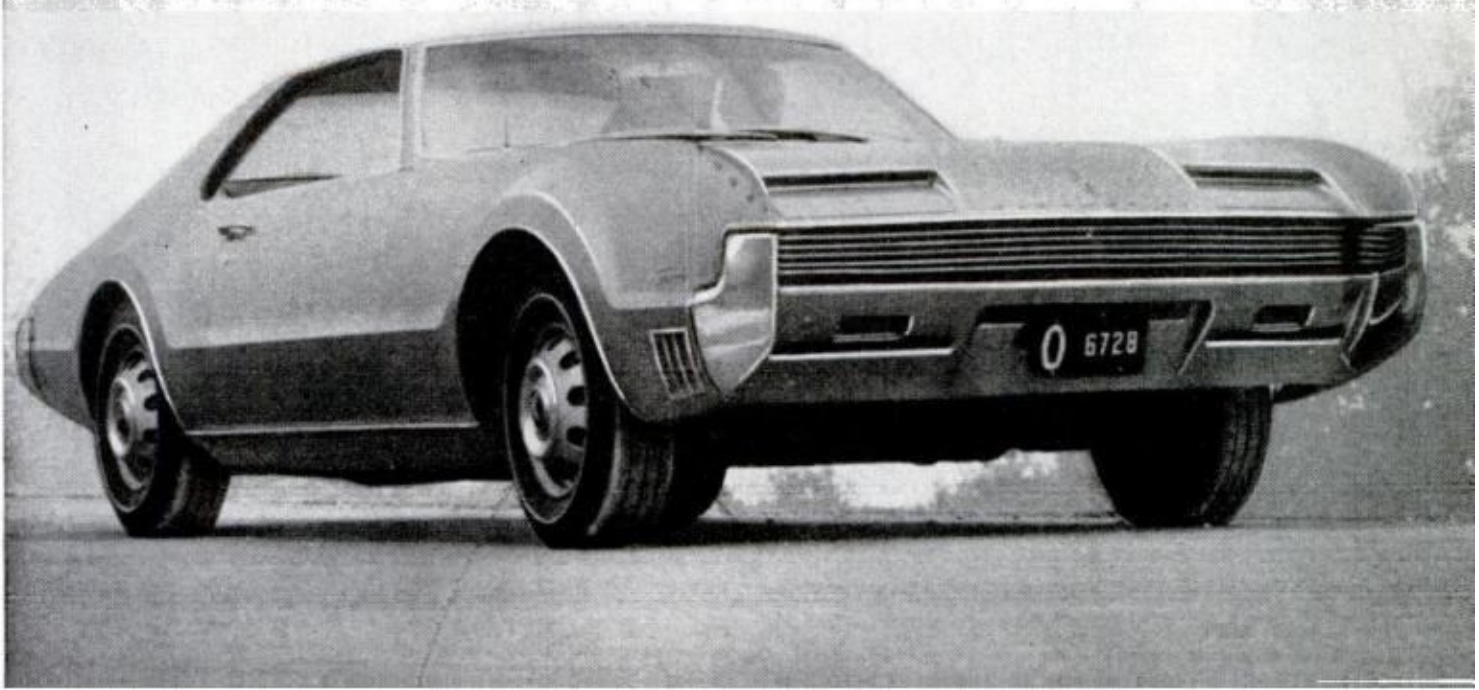
"IT'S A PRETTY, PRETTY CAR," said Ben Zwick, shaking his head appreciatively. Jack Bakke silently nodded his agreement, his eyes fixed on the new Oldsmobile front-wheel-drive Toronado.

Both men own Thunderbirds. Zwick had a '63, now drives a '65. Bakke had a '59, now has two '65s, one of them his wife's.

With Oldsmobile salivating for a slice of the Thunderbird market (the Toronado should be in the same price range and offers similar equipment), we decided to see just how competitive their new car will be. Since the '66 Thunderbird is practically unchanged from the '65, we picked Bakke and Zwick at random from a list of '65 Thunderbird owners in Detroit and arranged to get them to the GM proving grounds. There they would drive the Toronado and tell us how it compares with their cars.

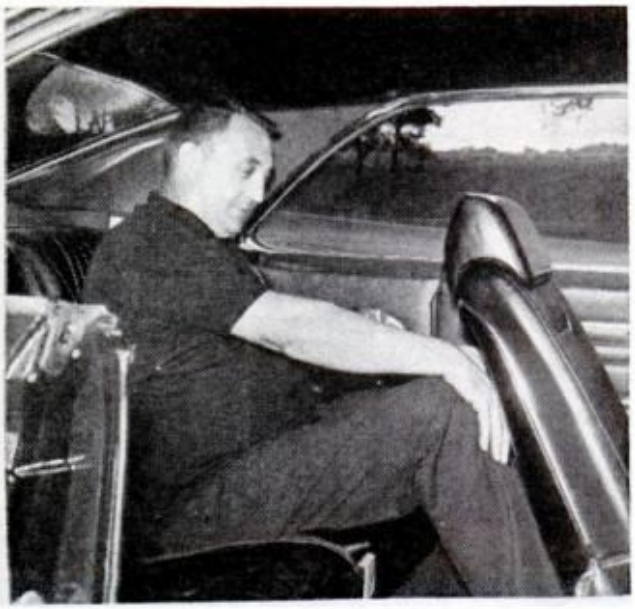
Zwick is a rugged, crew-cut, six-foot-two 260-pounder who picks up railroad wrecks with a 250-ton derrick. He has a ready grin for everyone, and he likes to talk cars.

"I like a heavy car," he says of his Thunderbird. "With a lighter one, I don't feel secure at 70 or 80." And he adds: "The



"I'D BE LEERY OF THAT CHAIN DRIVE," says Zwick, pointing. Bakke, at right, found Toronado engine compartment as badly cluttered as his T-bird's

NO-HUMP FLOOR is Toronado's big selling point, Bakke felt. Entire drive train is in front of firewall; there's no driveshaft, hence no tunnel



THERE'S ROOM FOR THREE IN BACK, Zwick found. But left front seat back doesn't hinge as far forward because the steering wheel doesn't tilt laterally

T-bird has a good resale value, better than 'most any car."

Bakke, a sales manager for a structural-steel company, is quiet and reserved. He exudes the calm efficiency of a successful executive, and he has a wry sense of humor that crops up unexpectedly. He likes his two Thunderbirds, but says he bought them mainly because he got a good price.

We walked around the Toronado, studying its lines. "That styling makes the body look lo-o-ong," Zwick said. "It has a lot of Corvette features. But I don't like the open wheels. I like the skirts on my T-bird. They're no trouble to get on and off —except in the winter, if they freeze up."

Bakke was up front, admiring the vacuum-operated flip-open headlights. "These lights fit in nicely with the body style," he said.

"Yeah," said Zwick, "but wherever you have openings, you'll get rust. And what if some night the vacuum setup goes out on you?"

(Actually, you can open the headlights by hand in an emergency—if you know how.)

"And these bumpers don't look like they give any protection," Zwick continued. They should have a double bar across the grille."

"The rear bumper looks all right," said Bakke. "Actually, none of the new cars gives enough bumper protection."

"And the side windows don't have any chrome trim around the edges," said Zwick. "That's why I didn't want to buy a GM product. Eventually the rubber channels dry up, and the windows rattle." He gave the window a mighty, 260-pound tug to illustrate his point. "Trim would give more support. And it's a good safety feature, too, if the glass breaks.

Bakke popped open the trunk. "The space in here is more generous than it looks from outside," he said.

"In the T-bird, the spare tire takes up a lot of room," Zwick said. He got down on one knee and looked under the car. "That shallow gas tank running all the way across helps."

"Well, they moved the gas tank on the T-bird in '65," said Bakke. "And the gas filler is on the side, which gives more space."

"The trunk lip is pretty high here," Zwick observed. "But I don't care about that. I travel light."

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"I just take one suitcase and my golf clubs," Bakke said.

Still crouching, Zwick said, "On a steep driveway, my T-bird scrapes. I've bent the rear shackles that way. This car looks like it has more clearance."

(Maybe, but not much. His Thunderbird's angle of departure is 12.9°, the Toronado's 13.0°.)

Zwick turned on the headlights and went around to the rear again. "Plenty of light back here," he said. "The taillights are too big on the T-bird. Ever follow one at night? You get blinded. But overall, I still like the T-bird styling better." He thought for a moment, then added: "Still, the Olds kind of grows on you. Maybe after a year . . ."

Meanwhile, Bakke had opened the hood and was peering in at the front-wheel drive.

"Engine accessibility is about the same as in the T-bird," he said. "All the cars are packed full of junk today. I hate to open my hood any more."

"If anything goes wrong with that front-wheel drive," warned Zwick, "it'll cost a fortune. On the road, the average service station won't know how to fix it."

"I was driving through Ohio," said Bakke, "and I had trouble with a front hub on my T-bird. The cap's a press fit and it loosened. It took the people at the station an awful long time to figure out that job. With this setup, getting service should be even worse. When I pay $4000 to $5000 for a car, I don't want it sitting in the shop while I walk."

"Have you had much trouble with your T-birds?" Zwick asked.

"That's my big beef," answered Bakke. "They've been in the shop about six times in the last three months. I have more miles on loaners than on my own cars. But the service is good."

"Nothing's been wrong with my '65," said Zwick.

"The electrical system burned out, the airconditioning went out three times, I needed a new speedometer and the side mirror came off," said Bakke.

"On my '63, the brakes caught fire and both rear tires blew out," said Zwick. "But Ford gave me a brand-new car. No arguments."

(Please turn to page 216)

INADEQUATE BUMPER PROTECTION was criticized by Zwick. The trunk liftover height caused no consternation. Taillight styling was popular.

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4-Wheel Drives

They're Great In the Boondocks

Ford's new Bronco and Wagoneer's fancy V8 both offer escape from the beaten path—but each one in its own distinctive way

By Alex Markovich

NOW ANYONE can be a weekend explorer.

If your kidneys are hardy enough to take the jouncing of off-the-road driving, your first step should be to buy a four-wheel-drive car. But which one?

There's a new one on the market, the Ford Bronco. And there's an old one that's undergone a Jekyll-and-Hyde personality change; the Jeep Wagoneer is now stuffed full of 250-hp V8. Both cars do essentially the same thing, but in different ways.

The Bronco is a simple, unembellished workhorse. The basic model, a roadster, has no top or doors; but by bolting on the appropriate top, in minutes you can convert it into a station wagon or pickup with styling suspiciously like the sturdy, trail-tried International Harvester Scout.

The Wagoneer is far more civilized, but comes only as a station wagon. However, the Jeep Gladiator, which comes with a variety of truck beds, is basically the same animal.

STURDY SUSPENSION, lack of overhang allow Bronco to be bounced with abandon over roughest terrain. Windshield can be lowered with twist of two knobs

STATION WAGON top mounts on the Bronco with a few bolts, but it takes two men; in fact, three aren't too many. Ribbing on roof prevents drumming

The Bronco comes only with a three-speed manual transmission, mounted on the column. All three speeds are synchronized—handy if you bog down in second while climbing a hill. A floor stick sprouting from the transfer case allows you to shift from two- to four-wheel drive and back without stopping—unless you want

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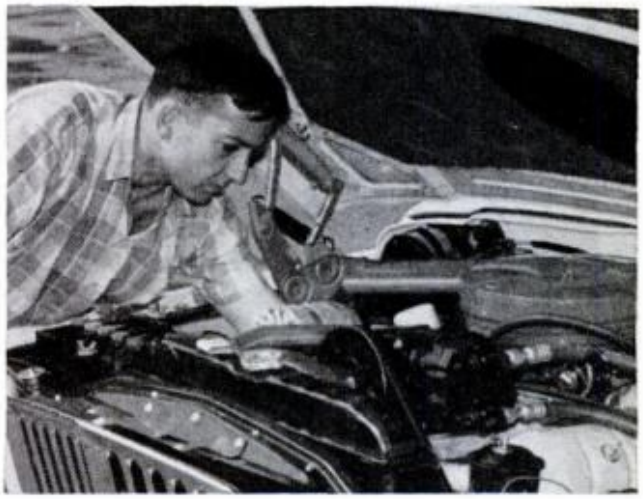
WAGONEER climbs almost as well as Bronco, but when tried in a running start at the foot of a hill, rear bumper kept scooping up clods of dirt. High hood gives less visibility when cresting hill than Bronco's sloping one

A PLYWOOD 4x8 won't lie flat in the Wagoneer because of wheel-well interference. Nevertheless, deck is roomy, considering modest wheelbase



ELBOW-DEEP in engine compartment, a man barely reaches the last plug because of airconditioner. Otherwise, accessibility of 327-inch V8 is good

to get into or out of four-wheel-drive low range, in which case you must come to a near stop.

The standard rear axle is conservatively rated at 2780 pounds capacity. An optional axle raises this figure by 520 pounds. Other hairy-chested options include underchassis skid plates, heavy-duty suspensions, power takeoffs and winches.

The Wagoneer, on the other hand, is more of a dual-purpose vehicle, with a long list of luxury options and with styling that's more apt to impress the Joneses. Take it hunting Saturday, drive it to the

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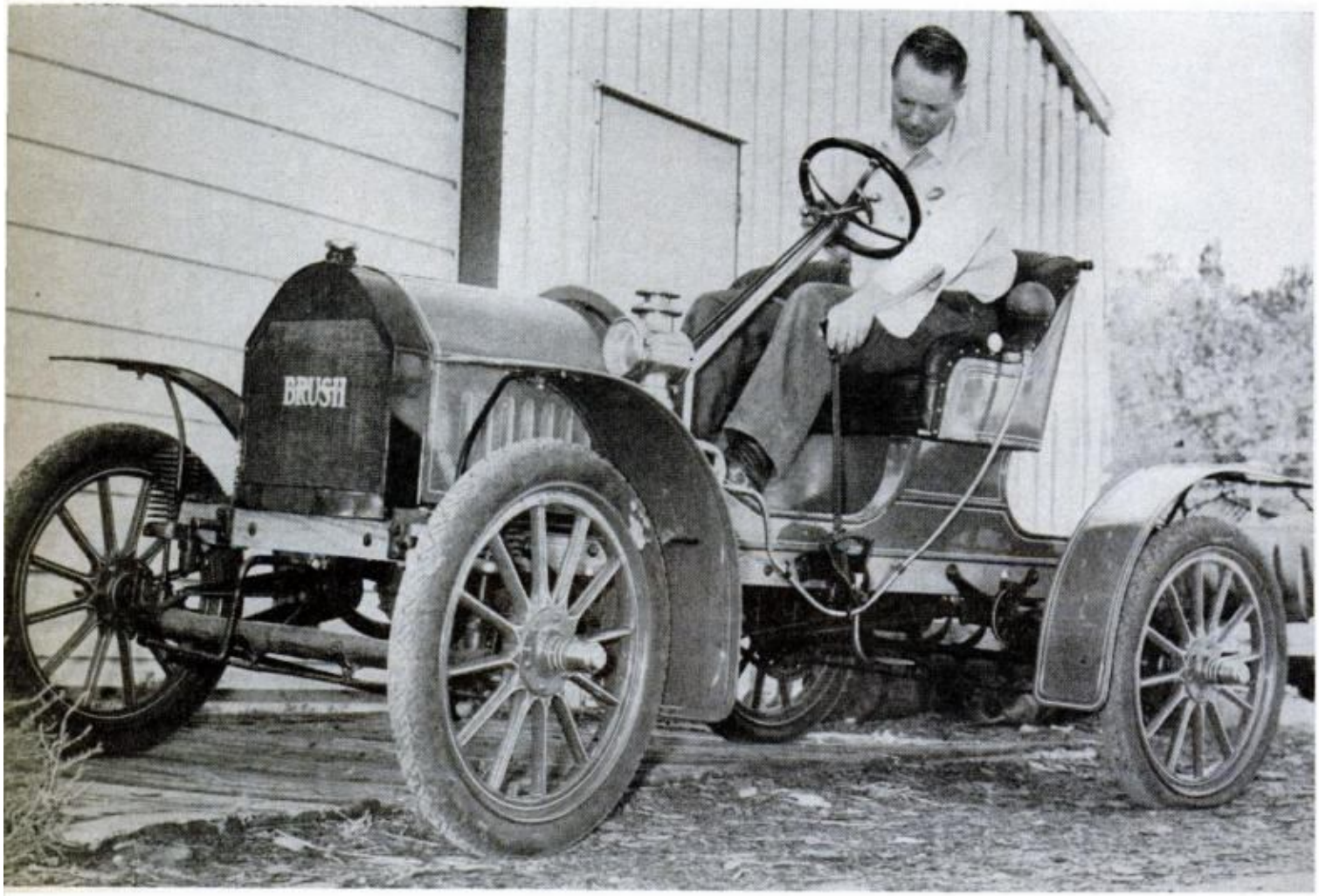
Vintage Gems from

Ferreting rusty wrecks from junkyards Stan Francis puts ancient cars back



THERE'S NO PRICE TAG on this 1911 Brush, one of several favorites Francis won't sell. It's hard to believe that this gleaming beauty could spring . . .

By Willard and Elma Waltner

STAN FRANCIS found the engine, radiator, hood, firewall and water pump in an old shed "in the mountains." He advertised for a frame, axles and wheels. The body, seats, steering column and fenders couldn't be found anywhere, so he made them by hand. The result, after a year of patient work, is a flawlessly restored 1911 Brush, resplendent in bright red paint and gleaming brass. It is one of the few cars Francis refuses to sell, though he has a standing offer of $2500 for it.

Stan is the proprietor of a small shop just outside Golden, Colo. At first glance it looks like any roadside auto graveyard —except that in those piles of rusted and battered fenders, wheels, engines and bodies there's hardly a part for a car younger than 1931.

"I've loved old cars for as long as I can remember," Francis says. "Even before I was in high school, neighbors gave me their dead and dying Model Ts." Nostalgia settles over his face as he goes on: "I didn't have any tires for one of the Ts, so I drove on the rims." He chuckles. "They didn't last long. I tried fastening a lot of short pine blocks to the rims, and these

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Jalopy Graveyards

and cobwebby corners of barns, on wheels in mint condition.

. . . from this disreputable-looking scrap heap. Francis has a pretty good idea of the location of just about every spare part in his unusual stockpile

lasted for several trips. Another time I stuffed the rims with gunny sacks but they fell out pretty quick. I ruined a lot of cars I wish I had now."

It wasn't until the early '50s that restoration fever hit him. He restored his first car, a 1918 Franklin, with his father's help. "We rebuilt the engine in the living room during the winter," Francis explains. "We tried to do the upholstery with an old shoe machine, but it didn't sew too straight. I made my own bucket seats; I didn't know they weren't supposed to have sides on them, and they came out so narrow you had to be a stringbean to sit in them.

"When I was finished, I loaded up my family and started out. Suddenly one of the wheels took off across the road. I had forgotten to tighten the hub caps holding the wire wheels. I never forgot again."

Later Francis traded the Franklin for four unrestored cars, and by 1957 his hobby had grown into a business.

The shop has a number of unusual policies. If a car owner wants to do the job himself, Francis furnishes working space, tools and advice. Or if the owner wants

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to tinker the engine back to life himself, but would rather not do the body and upholstery work, Francis will make a deal with him to do these parts of the job. So far, the shop has completely restored about 40 cars and has done part of the work on many more.

Since Francis never had special training, he had to learn as he went along. He has also assembled huge stockpiles of old car parts and is always on the lookout for cars in any condition. In fact, he *prefers* to buy what are known among buffs as "basket cases"—cars that are completely disassembled, with the bits and pieces stored in baskets and boxes—or else they are cars in such poor condition that only someone in the business would see their possibilities. "I don't have to pay a fortune for them, and I enjoy the challenge of getting that mess of rusty bolts and decaying wood back into factory shape," he explains.

His technique is to tear down a car completely and restore the parts as he assembles them. During the tearing-down process, all the parts are stacked in labeled barrels. First the frame is sandblasted and cracks are welded. Loose rivets are replaced. Then the frame gets a paint job. The springs come next, and then the axles. The rear axle is always torn down so the gears can be inspected. If the keyways are loose, new keys are made so the wheels won't jerk.

Next the wheels are mounted, and then the engine and transmission—both of which must first be torn down to the last bolt. Going through the transmission and rear end alone may take a week, but most of his old cars were rugged enough not to need much work in these areas. Usually just new bearings are installed unless the components were run dry. If new gears are needed, it usually entails a long and tedious search. As a last resort, gears can be made from scratch.

The radiator, pans and running boards then go into place. Francis generally finishes the body completely before mounting it on the frame. Metal parts are sandblasted and wood parts replaced when necessary. The body gets one coat of paint. And then come the upholstery and window glass. By the time this is done, the body usually has some scratches and needs more paint. At least two coats will be necessary when you use enamel. Lacquer

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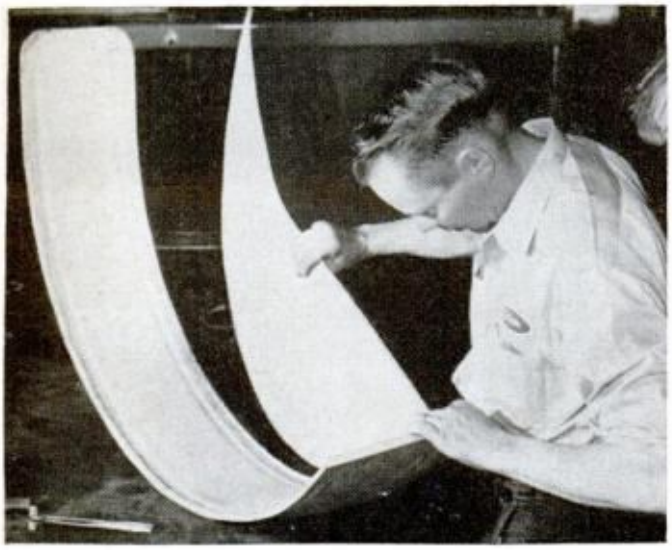
RUSTED HULKS, above, are the remains of fenders from a 1911 Flanders. Since they were beyond repair, they served as patterns for making new ones, below, which were hammered by hand from sheet steel



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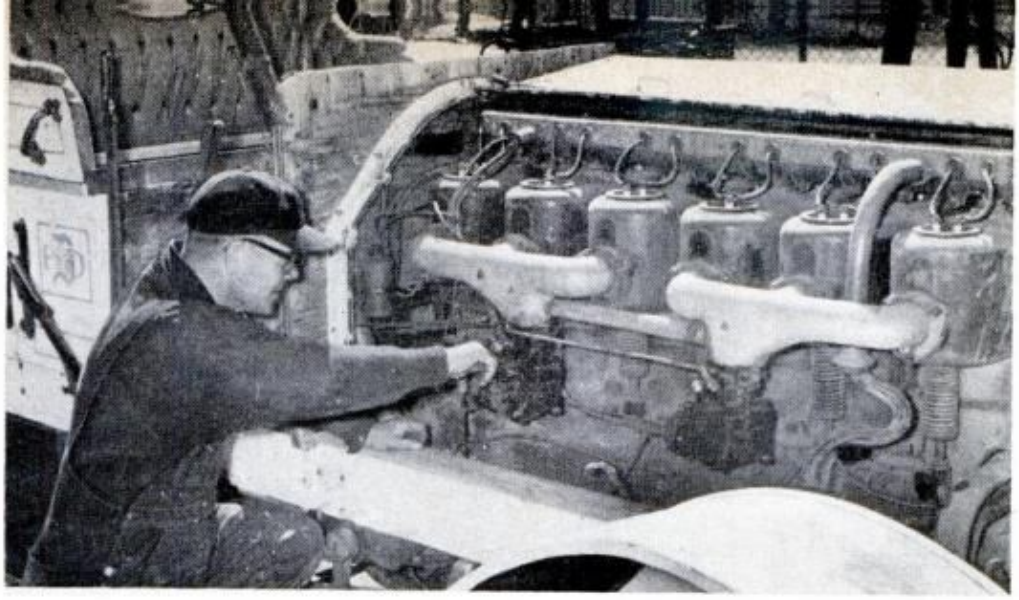
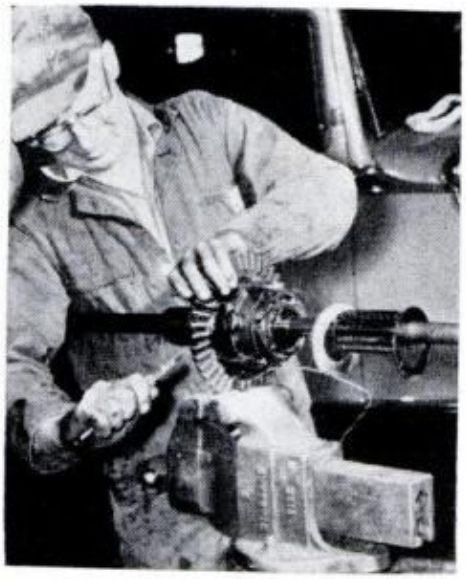


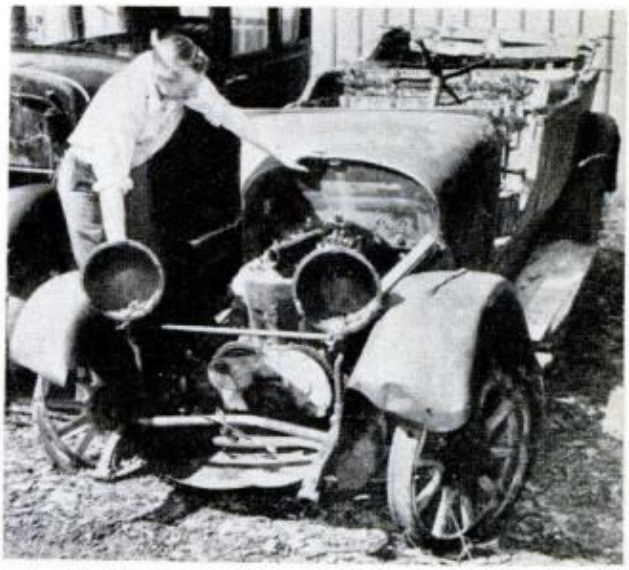
ONE OF THE LARGEST fire trucks ever built, this 1921 Seagraves dwarfs Howard Collins, a newspaperman who works for Francis part time. Abandoned in a truck yard for 10 years, the one-time Denver fire truck was restored in only two days. A college fraternity later bought it to outdo other clubs in the school parades



OLD CAR GEARS were usually sturdy enough not to need much work. Machining new gears is expensive

OLD WOODEN WHEELS are often loose in the rim. To tighten them, Francis wedges a thin strip of hardwood all around between wheel and rim

A FRENCH TROOP CARRIER in 1918, this FWD truck later hauled a merry-go-round, now serves as a yard crane. Engine didn't even need new plugs



ONLY A PRO COULD SEE possibilities in the remains of this 1915 Chalmers, a good example of "basket case" type of car Francis likes to buy

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ROPER'S STEAMER
AMERICA'S FIRST CAR

By Ted Robinson

America's oldest automobile—is it the Duryea Motor Wagon, the Apperson Haynes, or maybe the little-known Pennington?

Actually, none of these "Johnny-come-latelys" is even close. Authorities today say the granddaddy of them all is the century-old Roper Steam Carriage.

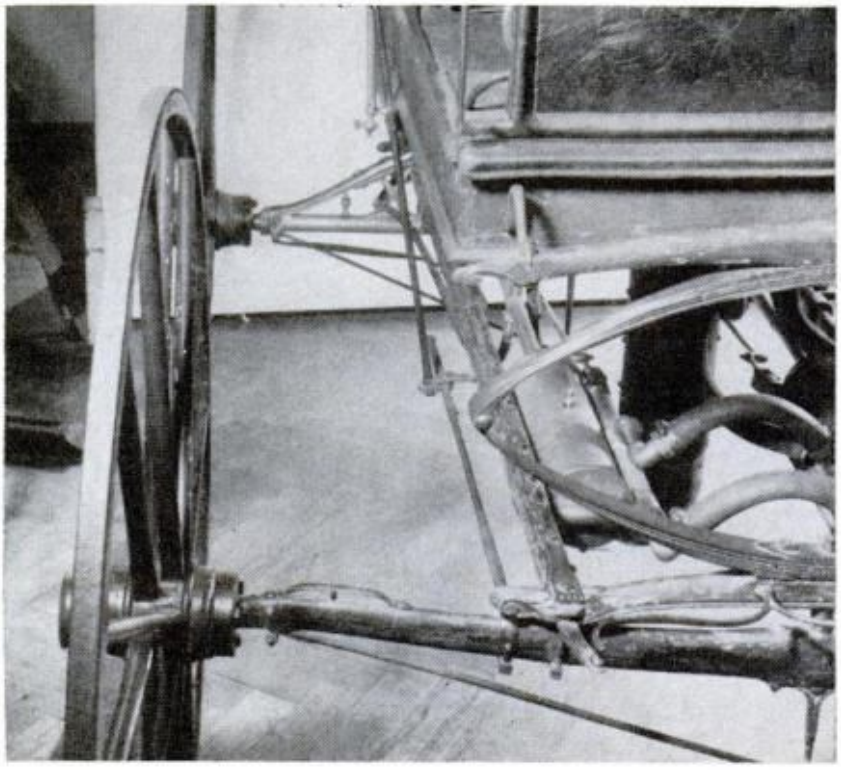
The aged two-cylinder steamer sat in relative obscurity for the last 30 years in the Henry Ford Museum in Dearborn, Mich. More than 15 million museum visitors passed by, never realizing they were seeing "Number One."

While just about everyone else was busy with the Civil War, Sylvester H. Roper was engrossed with his steam buggy in his little Roxbury, Mass., shop. Early in 1863—before Henry Ford was even born—Roper's baby made its debut.

Webster calls an automobile "a self-propelled vehicle suitable for use on a street or highway." Roper's Carriage satisfied these requirements decades ahead of what is commonly considered America's first automobile—the gasoline one-lunger Charles Duryea built in 1892.

Until it was discovered that Roper's Carriage and Ford himself shared the same centennial year, the buggy had been relegated to a quiet corner of the museum. The Carriage was 83 years old in 1946 when Detroit was celebrating the 50th anniversary of the automobile.

HANDBILLS SUCH AS THE ONE BELOW attracted huge crowds at 25 cents a head. Closeup of steering (below right) shows an early version of our modern rack-and-pinion system. Tiller actuates connecting rod attached to front wheels



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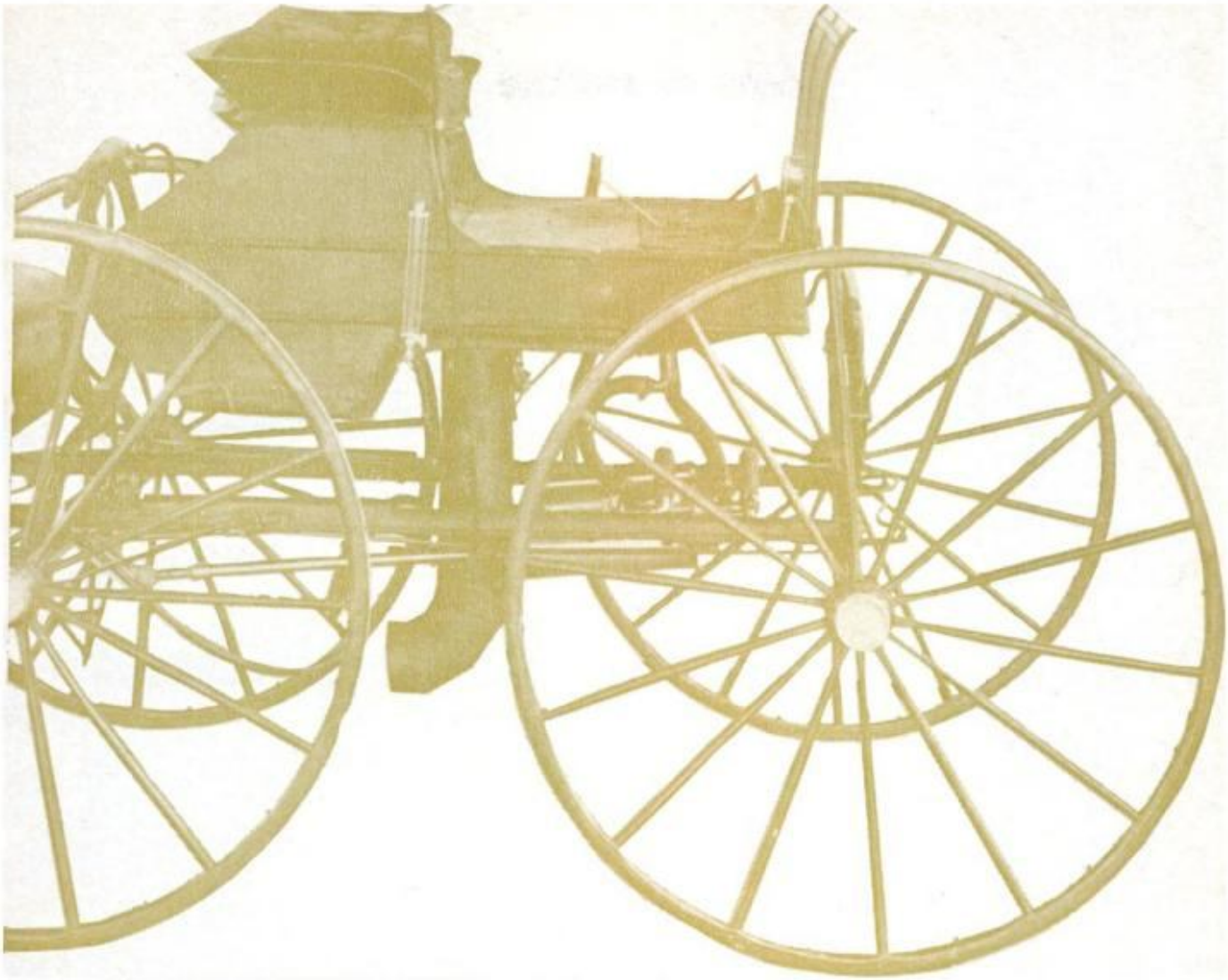

THIS SIMPLE ENGINEERING LAYOUT—water box at the rear, steam tank beneath the driver's seat—powered the Roper steamer over thousands of miles during the past 100 years. Carriage was flawlessly restored by the Ford Museum

Roper's car could be called the original "Mr. Five by Five"; it's five feet high, five wide, and eight feet long. And it looks like an ordinary two-passenger buggy. Once it got rolling, the similarity ended. You hung on for dear life—there were no brakes! (But then, there was no traffic either.) To stop, you reversed the steam or shut it off and aimed for the nearest haystack.

Keeping the passengers warm wasn't too difficult; the boiler was right under the passenger's seat. The other essential mechanical parts included two valves, four connecting rods and a crankshaft. The water tank rode along in back.

Perhaps the most amazing thing about Roper's Carriage was that it ran—and continued to run into this century. Even back in 1865 people shelled out 25 cents a head to see "The greatest mechanical exhibition in the world . . . the Steam Buggy."

Even Phineas Barnum got into the act. Old P. T. took the Roper along with his circus where it could outrace horses at the "amazing speed of 30 miles an hour."

The Ford museum planned to have the buggy running for its Old Car Festival last fall, but found a new boiler along with a

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It was a great race—
what happened?

Amid howling exhausts, screeching tires and misinformed fans, how can you tell what's going on in an auto race? Daytona Champs Richard and Lee Petty offer tips on what to look for

By Robert Crossley

DICING is the word British drivers apply to racing pros who constantly push for the limit in a grueling automobile contest. Whatever you call it, any red blooded spectator who's ever witnessed a tight race has sensed the tension and excitement as high-powered monsters roared down the straights, tailpipes singing a throaty melody of agonized rising and falling crescendo, tires shrieking into and out of corners. It sets temples throbbing.

Whether the race is stock, road or Indy style, it is exciting to watch. But it can be hard to follow. Everything happens at once—and often out of sight. Sparse communiques seldom explain much.

What do veteran race buffs look for to keep track of what's happening to individual cars in a race? To find out, *Popular Mechanics* interviewed Richard Petty, 1964 National Association of Stock Car Automobile Racing champion, and his father and chief mechanic, Lee Petty.

Richard, 27, was runner-up three times before winning the '64 Daytona 500. Because Plymouth's hemi-head engine was ruled ineligible for 1965, he has been unable to defend his title this year. But he has been burning up major drag strips in a 426 hemi-powered Barracuda. Lee, 51, was NASCAR champ in 1954, again in 1958 and 1959. He retired in 1961 after a bad injury at Daytona.

Here are our questions and the Pettys' answers:

Q: Except at Indianapolis, I have trouble

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ENJOYING A MOMENT'S RELAXATION before a race are Richard (left) and Lee Petty. Below, a Ford leads the pack up Daytona bank. Driving on a banked oval is easier than on a road course, say the Pettys

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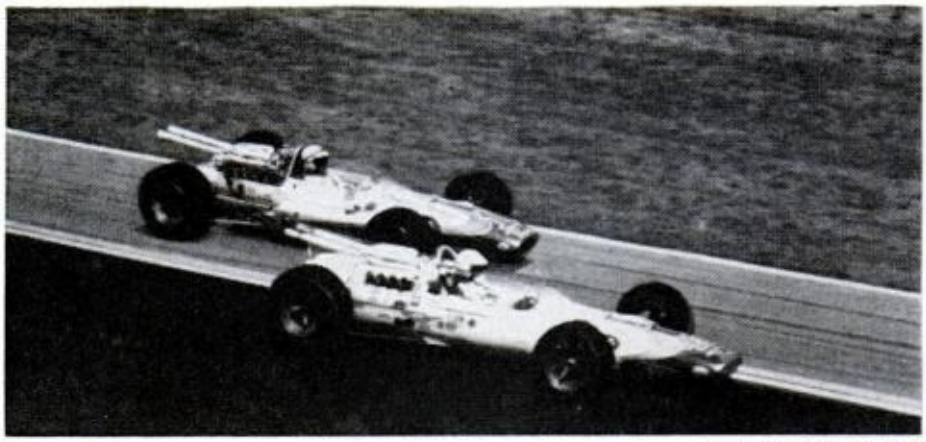

Speedway official photo

IS A DRIVER CHARGING or stroking? To find out, watch him in the corners; if he's trying to pass, he's pressing. Here, Foyt, the runner-up at Indy this year, is passing Unser in a turn

BUMPERS ACTUALLY TOUCH sometimes at over 170 mph during drafting. Wind resistance and back pressure are reduced, allowing both cars to go faster. Two similar-make cars draft best

keeping track of a car that isn't in the first four or five. If you're back in the field, how can I tell your position?

Lee: In the first 100 miles you'll know whether a driver's been lapped. But once he sits in the pits for a lap or two, even *he* loses track of where he's running.

Q: How can I tell if a car is having handling trouble?

Lee: By the way a driver goes into a turn. If his car is handling, he takes off and leaves anything near him. But if his car is handling mean, a better car will run up on him and gain in the turns.

Q: Will a car that's not handling look all right on the straightaway?

Lee: Most any race car is set up to run straight. It's the turns that show up handling. If lesser cars start outrunning him, you can bet his car's not handling.

Q: When a car's not running well, how can I tell whether it's engine trouble or handling?

Lee: If a car has all its power, it usually goes wide open down the straightaway.

Q: How can I tell if a driver is driving to win or just to finish?

Richard: If you know the drivers, you know the chargers—the ones who always try to lead—and the strokers—the ones who lay back. Of course, a charger may be running third or fourth, even though he's running as hard as he can.

Lee: The best way to tell is by how fast he goes into the turns. If he's out to win, he'll dive in "under" or outside a fellow.

Q: How long can he stroke and still have a chance to win?

Lee: In a 500-mile race a driver can stroke until the next-to-last pit stop. Many drivers lay back until a lot of the fast equipment falls out. Then they begin to pluck off the fellows who are still running. Unless the track's paying lap money, there's no advantage in leading a 500-mile race.

Q: Does a driver who's trying to win the NASCAR championship tend to stroke?

Lee: In a big race where there are eight or ten cars capable of winning, a driver has to be careful. The big races pay more points toward the championship. If you finish in the first three or four in the big ones, the rest aren't too important.

Richard: Some fellows run as hard as

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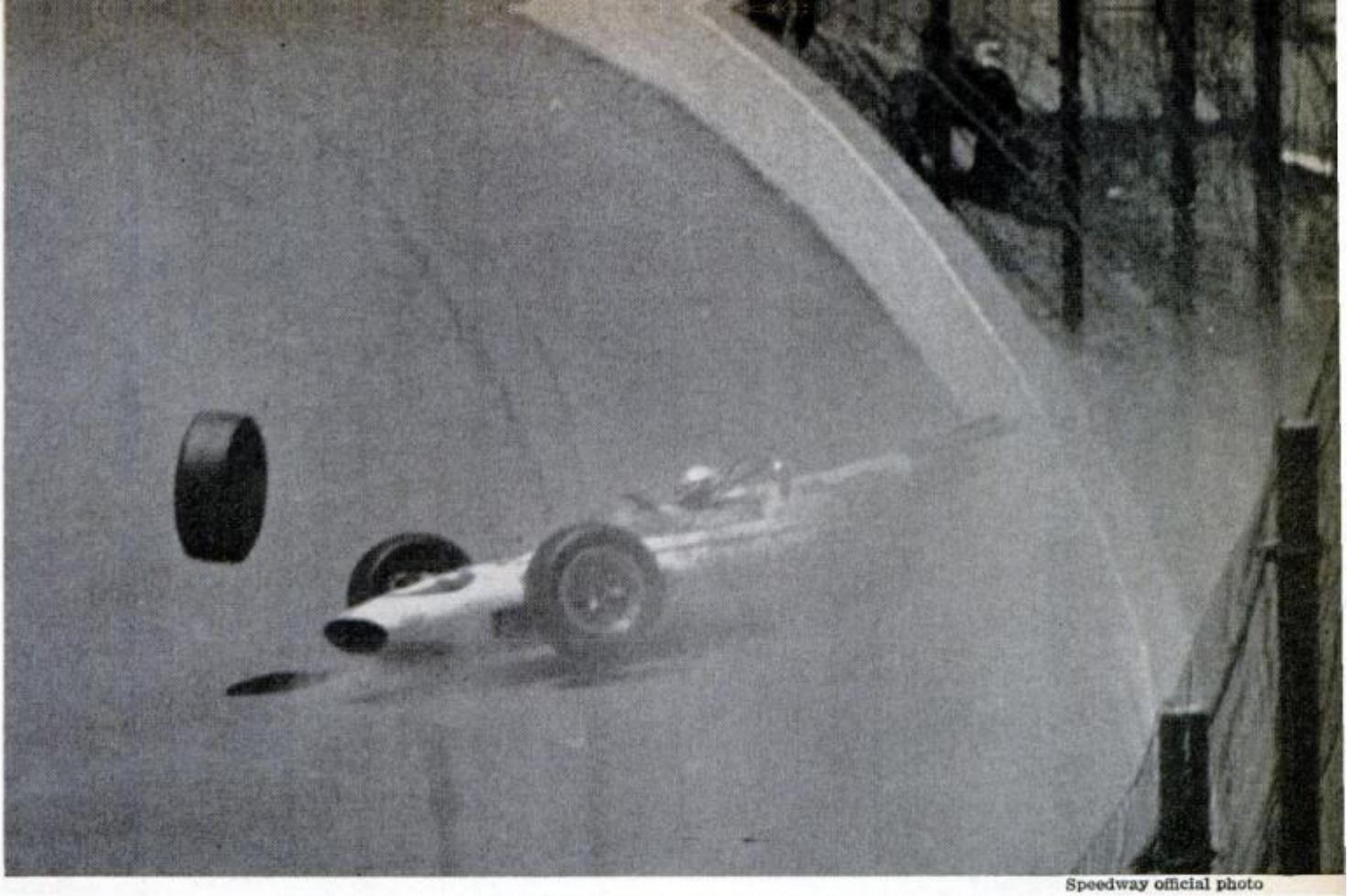

Speedway official photo

WHAT CAUSED THE SPINOUT? Here it's obvious: A broken wheel sent Tingle-stad into the wall at Indy. Causes of most accidents are harder to spot

they can all the time and hope they end up on top. Last year I ran hard in every race to get the championship.

Q: When Joe Weatherly was champion some people said he drove more to finish than to win a lot of races. Is that true?

Richard: Joe drove the little tracks hard. When he came to big tracks, we didn't have much trouble outrunning him. He knew if he finished a race he'd make money. If he fell out, he wouldn't.

Q: In stock-car racing, especially at Daytona, one of the most exciting things to watch is "drafting"—where two cars drive bumper-to-bumper at 165 mph. Does it really make them go faster?

Richard: Yes. Two drivers working together can build a 10 mph advantage.

Q: If the driver behind you is in another make of car, you don't want to give him a free ride, do you?

Richard: That makes no difference. Lots of times you *try* to get someone to draft you. Two cars run faster than one.

Q: The front car will run faster too?

Richard: That's right. There's less wind resistance for the second car and less

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PIT STOPS CAN PROVIDE CLUES to progress of race. Here, Richard Petty's Plymouth is gassed up and ready to go in seconds. Alert spectators can tell when a driver will need a refill both by the number of laps run and by the pit crew's signals. A sure way to spot worn tires is when the car begins to slow down or slide excessively in the corners; mechanical trouble is often heralded by smoke

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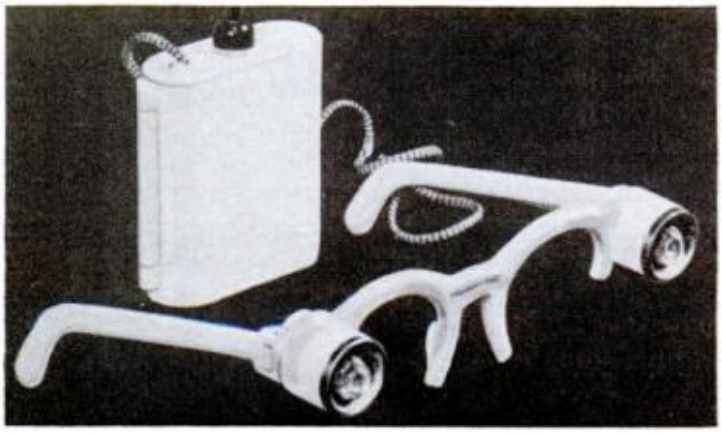
Brighten Your Outlook

Lensless spectacles from West Germany have built-in lights for illuminating close work. Pocket-sized battery pack supplies the power. Available from Sunset House, 3485 S. La Cienega Blvd., Los Angeles.



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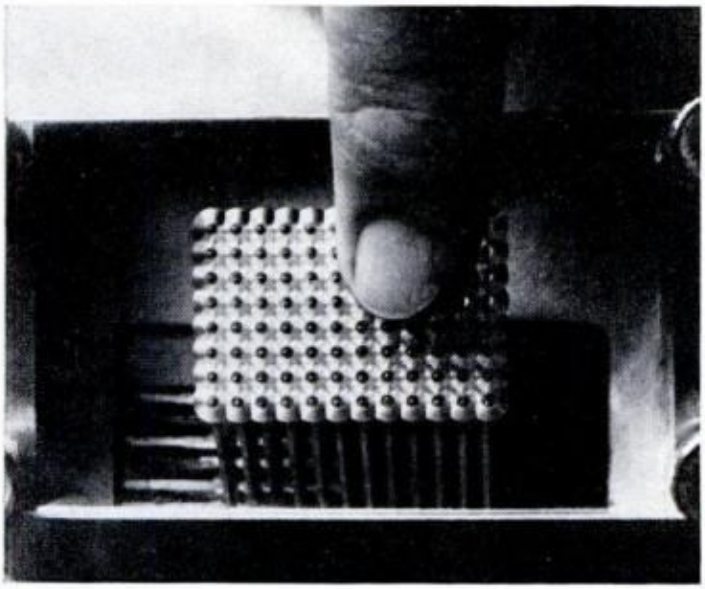
Water Skiing by Cable

They're racing around on water skis out in Colton, Calif., and there's not a motorboat in sight.

The skiers are pulled around a two-thirds-mile course by an overhead cable that'll zip them over the water at up to 38 mph. The man-made rectangular course is a 160-foot ditch, five feet deep. A tower at each corner of the course supports the cable. Skiers, spaced 270 feet apart, hold onto 72-foot tow ropes that are attached to the cable. They're able to do almost anything that boat-towed skiers can do.

The Colton Cable Ski Way is the invention of Bruno Rixen, a German engineer.



Vibrating Reader for the Blind

Translating a printed page directly into a kind of "electronic braille," a new reading machine enables the blind to read without the use of braille. The developer, Prof. John Linvill of Stanford University, hopes to reduce the bulk of the experimental machine (left) to pocket size.

Tiny photoelectric cells scan the printing. When a photo cell sees black, it causes a fine reed in the reading panel (right) to vibrate. The blind reader feels the vibrating outline of each letter.

Prof. Linvill is shown at left checking by a viewer the accuracy of his blind daughter's tactile reading.

Digger Moves by Arm Power

Like a giant crab, the Swamp-ROC hydraulic excavator pulls and pushes itself around with its digging bucket. There is no drive to its wheels. It's made by Broyt Manufacturing Co., Rockford, Ill.

Cargo Platform on Wheels

Described as a "cargo platform on wheels," a new utility vehicle from Holland can be steered from front or rear. It carries loads over rough terrain at up to 25 mph. By Van Doorne's Auto Factory.

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PM TESTS

JOHNSON'S NEW TRIHEDRALS

Quick to plane, skidless in turns and gentle-riding in waves, these three new triple-keel boats even look fast when they're sitting still

By Art Mikesell
PM's Boating Editor

THE ILLINOIS SKY was overcast and spitting rain but Lake Michigan looked smooth as a farm pond when I pulled into Johnson's waterfront headquarters in Waukegan.

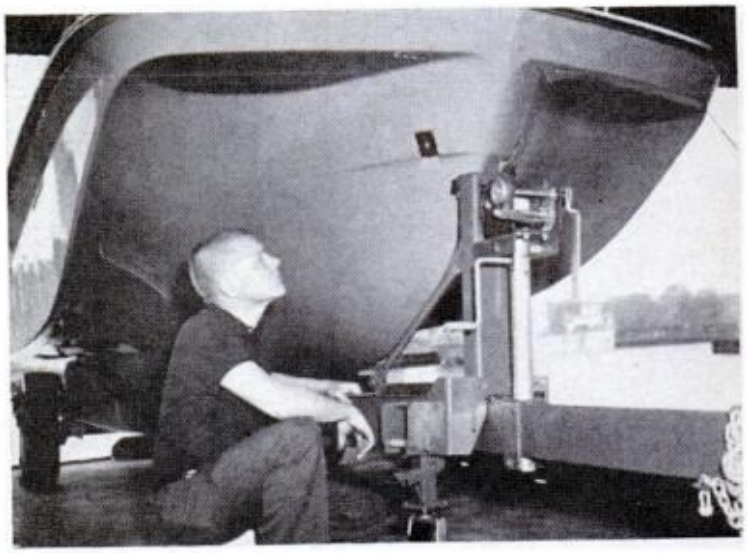
A little rain wouldn't hurt. I'd just flown a thousand miles to try out Johnson's three new trihedral hulls in a special pre-announcement test arranged exclusively for *PM*.

A development based on the cathedral hull, the trihedral design features a center V-bottom which flares out to form semicircular troughs ending in shallower stabilizing Vs on the outside. I'd driven this type of design before, but only in small sizes with relatively low hp. Early reports indicated that Johnson had something bigger and more powerful in the works.

All three boats were waiting in the boathouse when I got there—a bright red 14-foot Caprice on a matching trailer near the door, a 16-foot Reveler moored down near the end of the dock and Johnson's big news, a 19-foot Surfer sitting on a trailer next to one of the slips.

Since the boathouse crew were busy

CONNING 19-FT. SURFER into the dock after a test run, it proves to be as directional and easy to control at idling speed as it is at full throttle



GRACEFUL LINES of the trihedral distribute the impact of wave action over large areas, resulting in softer ride. Note running lights set into the bow

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KICKING UP SPRAY, the 16-ft. Reveler takes a tight turn as flat as a Ferrari. Intake vents channeling air into the engine compartment are located in the sides of the engine cover. Exhaust vents are set high on the transom on either side of sterndrive

STANDARD POWER for the 14-ft. 9 in. Caprice is Johnson's 90-hp. two-cycle sterndrive. A sassy little runabout, it features a fold-down windshield for that wide-open feeling and a full-width vent just below the windshield for less extreme ventilation

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with the winch and the weather threatened to get even dirtier, I headed for the Reveler which was all set to go.

If dockside impressions play any part in selling boats, Johnson should have a runaway in the Reveler. All those young-thinking, Pepsi-drinking people who go for the sports-car look in runabouts are bound to like its crisp styling. It's one of those boats that looks fast sitting still.

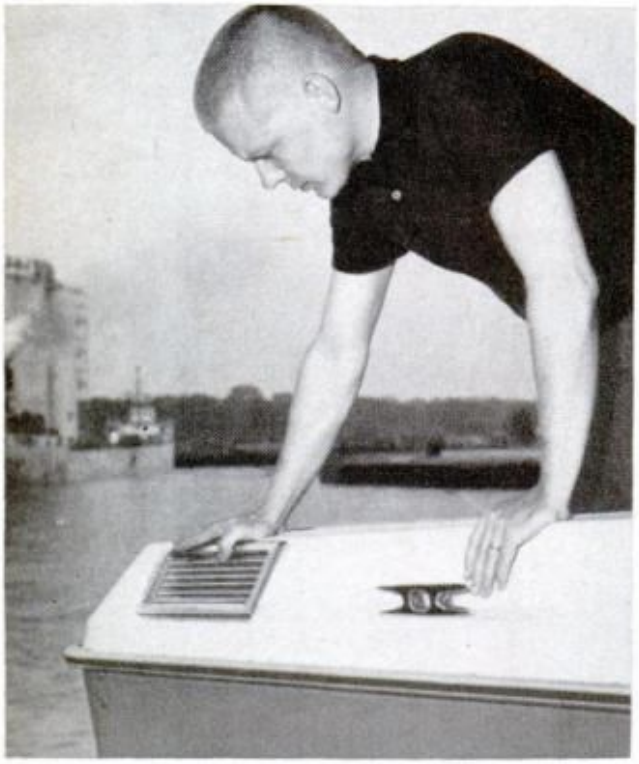
The 16-foot, 2-inch hull is a deep yellow, from stem to stern to sterndrive. Everything in the cockpit has a rich brown leather-look about it—padded dash, back-to-back buckets, padded coaming, even the top boot. (That's right, top boot.)

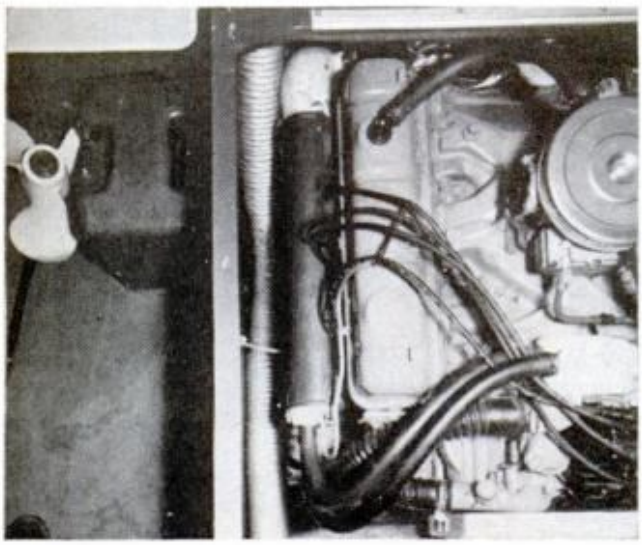
The convertible top on this boat is a wonder of modern engineering. Mounted on the coaming, it folds down snug to the engine compartment on the cockpit floor when not in use. With the boot snapped in place, it's fully protected and out of the way, yet you can put it up in a hurry if need be. They must have bent miles of tubing figuring that one out.

Our test boat was a 120-hp model which tips the scales at roughly 1700 pounds. (A 150-hp version weighing about 90 pounds more is also available.) It was equipped with a 14¼ by 18 prop.

I loafed along at 5 mph until I cleared the channel, then jammed the throttle

VENTILATION FOR ENGINE compartment on Surfer is provided by side intake vents which channel air through flexible tubing to bottom of compartment





CENTER WINDSHIELD section on the Surfer slips neatly into hollow-core table where it's not only out of the way but protected against accidental breakage

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full-on to see how the hull came up on plane. I found out. It planes *right now*, with no cavitation, no squatting and then flopping over. Of course part of the reason for this is plenty of power, but I later learned that a slight hook built into the hull about a foot forward of the transom gives it an added boost.

Running just short of flat-out, I snapped the boat through a series of sharp right- and left-hand turns. Banking was minimal—by the feel, I'd guess about 15 or 20° —and recovery was quick. No cavitation. And with those three keels down below, skidding was almost nonexistent.

Since there didn't seem to be any rough water for 20 miles in any direction, I had to be content with crisscrossing the wake of another boat to test the ride. After seeing the way it performed in this makeshift rough-water run, however, I'd say that this 16-foot hull would be a comfortable-riding boat in any reasonable water for a boat of its size.

When you hit a wave, the bow goes up, then starts down again and you prepare to hit bottom. But you don't. Instead, there's a soft "squish" feeling as the impact is absorbed by the curved troughs in the bottom. The impact is there, but it's stretched out and not punishing.

As for top speed, I ran the Reveler up to an honest 36 mph heading back to the boathouse. While an all-out ski boat is quite a bit faster in calm water, the trihedral can keep running in this general speed range through waves that would put a flat-bottom hull in trouble in no time.

General evaluation? A powerful, well-designed boat that blends exciting performance and comfort in package with plenty of eye appeal.

Back at the dock, I found that they'd dropped the Surfer into the water, so I hopped from one boat into the other and started back out the channel.

Just one inch over 19 feet long, the Surfer has an 88-inch beam and weighs 2250 pounds with the 200-hp engine (a hundred pounds less with the 150-hp powerplant). It's a big boat.

The bottom is basically a scaled-up version of that on the Reveler, which in turn is a larger model of that on the Caprice.

My first impression was one of lots and lots of room. That bow compartment is a natural spot for kids, but if you're running in rough water it can be sealed off by snapping a tonneau cover over it and slipping the center section of the walk-through windshield into place. The tonneau cover and a supporting bow are concealed behind a flap of simulated leather in the bow.

This boat also has a lot of storage space designed into it. Deep troughs under the gunnels run the full length of the cockpit and can take anything from rods to skis. Up front, a compartment under the cross-bow seat provides a logical spot for stowing your anchor and line.

You'll also find space under the side seats in the bow compartment, but the

TONNEAU COVER for bow compartment folds to fit behind padded flap. It only takes a minute or so to snap in place, and you can stow it in even less time

OPEN ALL THE WAY through to the bow, the cockpit of the Surfer provides plenty of walkaround room passengers, even if they happen to be restless kids

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Down to the Sea in Tractors

Two assault boats attached to either side of a military tractor, with outboard motors for propulsion, make the tractor more mobile and able to move rapidly across water obstacles. The equipment was displayed at a recent exhibition of experimental military vehicles in England.

Hidden Mike

Hidden beneath vestments, a new FM wireless microphone helps this priest to be heard by his entire congregation while he's celebrating Mass.

The priest merely clips the Amphenol Consort under his vestments and attaches the tiny mike to his collar. His words are then broadcast by the small FM transmitter inside the consort and picked up by an FM tuner attached to the church's public address system.

Sculpture in Foam

Rigid urethane foam in special densities is being marketed commercially for sculptors, art schools and industrial designers as a new sculpture material. Its advantages are light weight with rigidity and durability. Its carving qualities are like balsa.

Small pieces can be bonded easily to correct errors and large blocks can be joined to make larger starting forms. It's made by Artfoam, Hicksville, N.Y.

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How to Dress for Burning

STUNT MAN Joe Knute had a hot problem. The movie script called for him to walk through fire, stagger around in the flames until his clothing caught fire, then jump off a bridge and lie there on the ground burning. Ordinary fire suits (asbestos with an open weave) let the heat through and—because asbestos is rock—retained the heat. So he designed his own: aluminized asbestos with a lining of wool and compressed horse hair. It gave him about 35 seconds in the fire before the aluminum began to run off, more than enough to complete the sequence.

KNUTE SUITS up for run through inferno. Compressed-air bottle insures him 10 minutes of cool air to breathe. Mask (which is part of costume for Universal film, "The War Lord") goes over his head. Just to make sure the suit catches fire — the whole scene would be wasted if it didn't—the stunt man is doused in kerosene before he starts into the flames (below). He goes through full 35-second sequence in complete comfort and at finish flames are put out with quick use of CO_2 bottle

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Sound waves that see through people

Ultrasonic tools can spot a tumor, heart damage —or guide a surgeon's probe to a hidden bullet

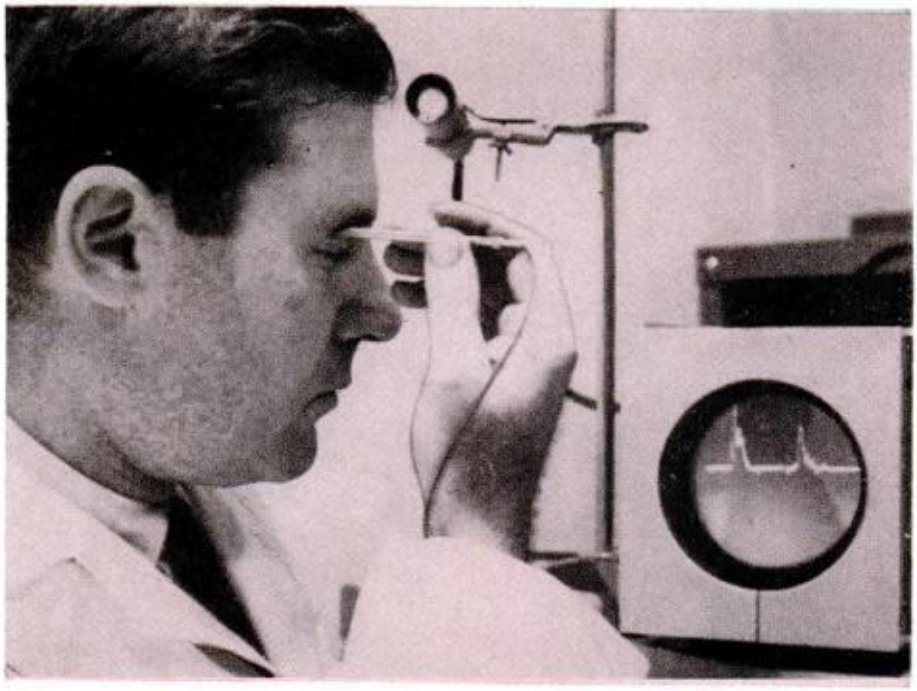
By Hans Fantel

SCREECHING POLICE SIRENS broke up a North Philadelphia gangfight. As the boys scattered, 20-year-old George Grandis remained sprawled on the pavement with a strange gunshot wound below his left eye. He arrived at Frankford Hospital in serious condition, but surgeons hesitated to probe for the bullet; cutting a nearby nerve might paralyze the boy's face.

The shot had been fired from a homemade gun that had a curtain rod for a barrel. The projectile was the chrome-plated brass ball from the top of a car antenna. Nonmagnetic brass could not be eased out of the wound with a magnet. And because the ball lay behind a section of bone, X-rays failed to pinpoint its location.

As a last resort, one of the surgeons suggested ultrasound.

The hospital called in Dr. Murray G. Smyth, a specialist in the new science of medical ultrasonics. He aimed sharply



VIEWING HIS EYE, physician demonstrates new device. Tiny transducer at end of pencillike object held against lid, sends sound waves through his eyeball. Reflections from interior of eye paint "picture" on cathode tube

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"SEEING-EYE" FORCEPS
shown here is a dramatic new medical tool made possible by ultrasound. Pin-size transducer enables doctor to "see" foreign objects in people, probe, and pluck them out with delicate forceps.

focused sound beams at the injured area. The echoes bouncing back clearly distinguished bone from metal. By timing the echoes, the ultrasound equipment sensed the depth of the bullet and its exact location.

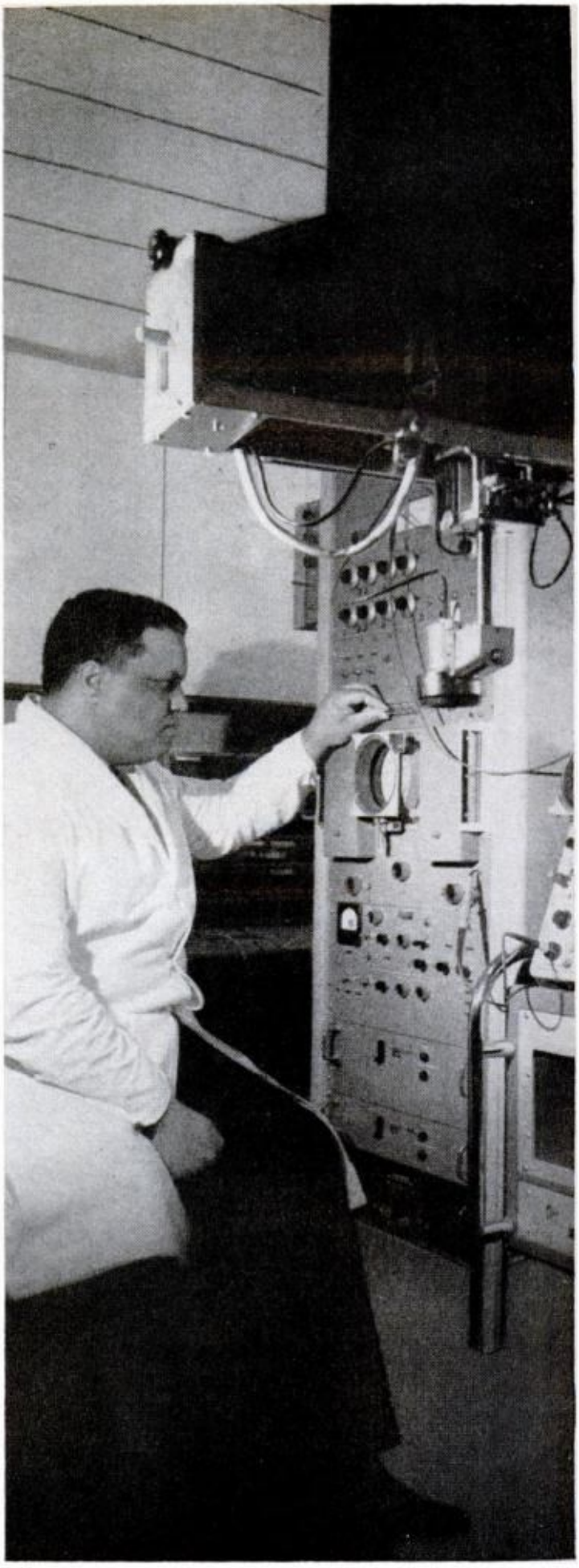
Now the surgeons could operate. As they cut, drilled and chiseled, Dr. Smyth's ultrasonic instrument guided them directly toward the hidden bullet. Not needing to poke and search, the doctors were able to pull out the ball without damaging the facial nerve. Instead of coming away from his ordeal with a paralyzed face, George left the hospital two weeks later with nothing worse than a small scar.

As director of biomedical research and development at Smith Kline Instrument Co. in Philadelphia, Dr. Smyth has a hand in making some of the most advanced ultrasonic equipment now in medical use. Reaching into a desk drawer at his office, he pulls out an instrument that looks like a thin pencil with the tiny claws of a baby shrimp. Projecting between the claws is a ceramic pin, smaller than the tip of a ballpoint pen.

"We're especially proud of this one," says Dr. Smyth. "It's an ultrasonic eye forceps." The little pin, he explains, is a miniature transducer—a device that focuses sound in a narrow beam, sends out the pulses, then listens for the echoes. "Just a year ago nobody believed we could make it this small. This transducer has a tip 1/50th of an inch in diameter—no wider than a sewing needle." The entire device, claws and all, is sunk into the eye to remove foreign objects.

The first chance to try the new instrument came last winter. Nine-year-old Daniel Etherington had started a fire to detonate a .270 rifle cartridge near his home in Granger, Utah. As the boy tells it: "I heard a bang and then my head hurt."

X-rays showed a jagged, three-pronged brass shell fragment imbedded in Dan's left eye. But X-rays cannot guide a surgeon's hand during an operation, and doctors were afraid to explore blindly in Dan's eye. Fortunately, one of the specialists in Utah had heard that Smith Kline's new ultrasonic forceps was available at Walter Reed General Hospital in Washington, D.C. He dressed Dan's wound and flew with the boy to the capital, where Col. Jack W. Passmore, the



READING THE MESSAGE flashed on the oscillograph, expert can interpret what transducer sees. Unlike X-ray, ultrasound can define organs as well as bones

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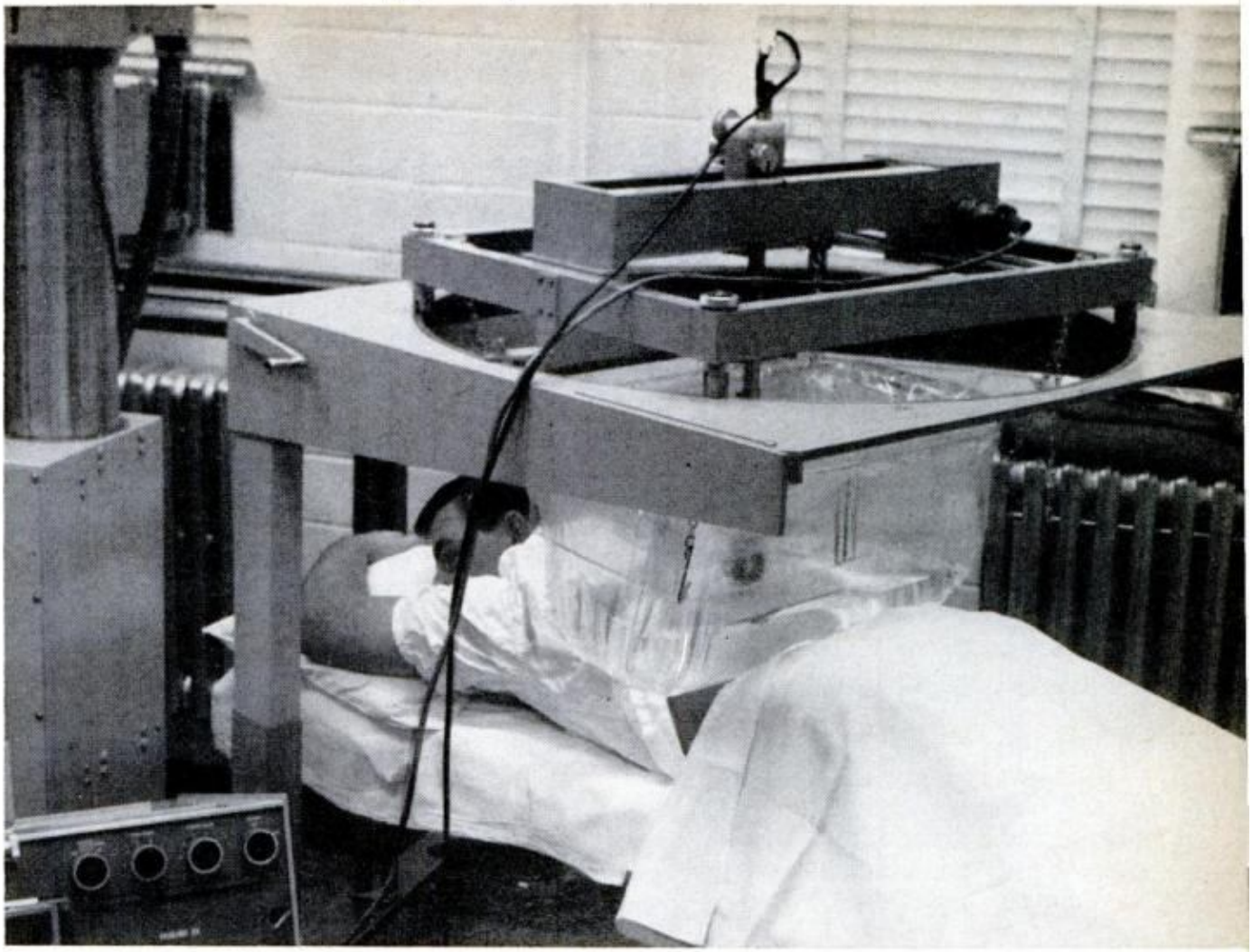
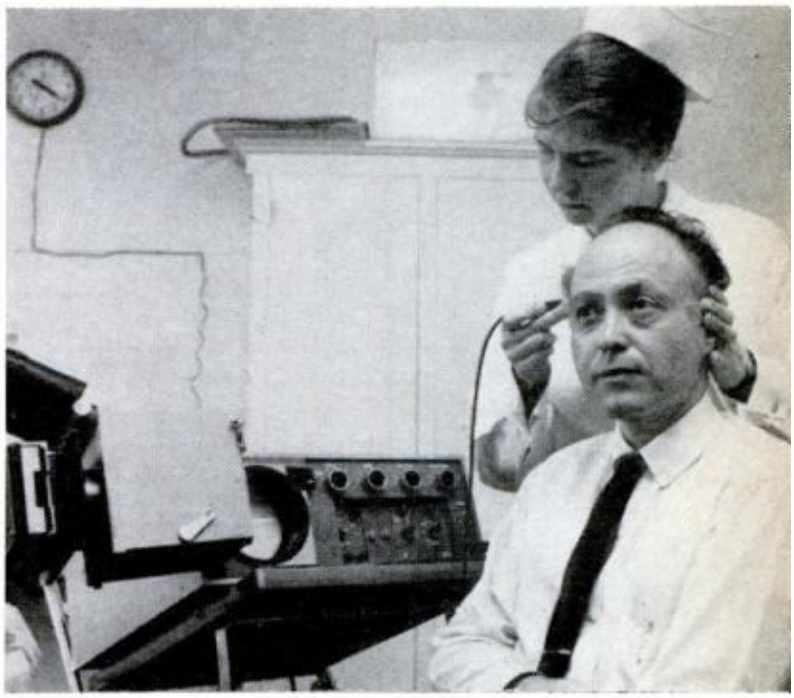


TRAVELING TRANSDUCER moves patient, enables doctor to get cross section picture. Water provides fluid coupling for sonic beam. By showing the condition of organs, picture may eliminate the need for exploratory surgery

EYE OPERATION described in this article is in actual progress here. Three peaks indicate: sonic pulse, foreign object, rear wall of eye



AUTHOR FANTEL sits for a brain portrait in an ultrasonic medical "studio." Picture revealed everything was in the right place

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hospital's chief eye surgeon, slit the side of Dan's eyeball and pushed in the new tool.

Dr. Passman's own eyes were not on his patient. Rather, he was watching a TV-like tube displaying the ultrasonic echoes received by the tiny transducer in the eye forceps. A blip on the screen clearly marked the distance between the jagged brass piece and the tip of the instrument. Homing in his forceps like a pilot homes in on a radar target, he closed the tiny claws on the shell fragment floating in the interior of the eye and pulled it out. Dan has a good chance of regaining vision in his injured eye.

Guiding a surgeon's hands in delicate operations is the most dramatic aspect of the medical uses of ultrasound, but it is by no means the only one. Reports of new applications come in so fast the medical journals—and doctors—have a hard time keeping up.

Ultrasound acts as a kind of body radar. In fact, the principle is identical to radar, except that ultra high-frequency sound waves are used instead of radio waves. The sound is beamed into the body where it reflects from the internal organs or any foreign matter imbedded in them. The echoes are then displayed on a cathode ray tube, just like radar signals. Though still in its early stages of development, medical ultrasound rivals X-ray as a tool for peering into the deep, hidden places of the body.

"At present, the most widespread use of our instruments is for 'looking' inside the skull," said Dr. Smyth. And he added with a grin: "Maybe you ought to have your head examined." He signaled his secretary. "Take him over to Dr. Evans," he told the girl, pointing at me.

A few blocks away I was ushered into the ultrasound lab at Philadelphia's Hahnemann Hospital, which cooperates closely in Dr. Smyth's development work. The place looked like the control room of a TV network. Electronic racks, tube screens, dials and knobs reached from floor to ceiling. Master of all this gadgetry was Dr. C. C. Evans, a large, round-faced Negro who has achieved the distinction of being among the foremost specialists in the new field of ultrasound diagnosis.

"Most of this is research equipment," he said in a soft voice. "It would take a doctor a year just to learn which knobs to twiddle. And we can't expect the average medical man to be an engineer on the side. For routine examinations we have simple, compact instruments."

He wheeled out a small ultrasound unit called Ekoline 20, which resembled the desk-top oscilloscopes used in radio repair shops. A nurse rubbed some oil on my right temple. I asked why I was being anointed.

"The oil couples the transducer to your skull," she explained. "Ultrasound only travels through liquids and solids, never through air. The oil seals out the air between the transducer and your skin." Next she held the transducer—a pencil-like probe—against my head.

Silent sound was now pulsing through my brain. I felt nothing whatever. But on the Ekoline's tube screen, three big blips sprang up.

"The two outside blips are the sides of your head," said Dr. Evans, pointing to the tube. "The center blip is the midline echo."

The midline echo, he explained, stems from the chamber dividing the left and right halves of the brain. Because the chamber is filled with spinal fluid, it has a different density than the tissue-filled brain mass. When the sound beam hits any density difference along its path, some of its energy is reflected. By timing the returning echoes, the ultrasound equipment tells the distance of the reflecting object.

In healthy brains, the dividing line between the two halves is exactly in the middle. But when a tumor grows in the brain, it pushes the dividing line over to one side. By checking the position of the midline echo, a doctor can spot an unsuspected tumor and remove it before it cripples or kills the patient.

I cast a worried look at the tube screen and was happy to see my own midline blip at dead center.

With traditional X-ray, the same type of examination can be agonizing and costly. The fluid has to be drained from the brain through a spinal tap and replaced with a solution opaque to X-rays. This is a truly harrowing procedure. The patient is desperately ill for days and even faces a slight risk of death as the result of the fluid withdrawal. Moreover, any

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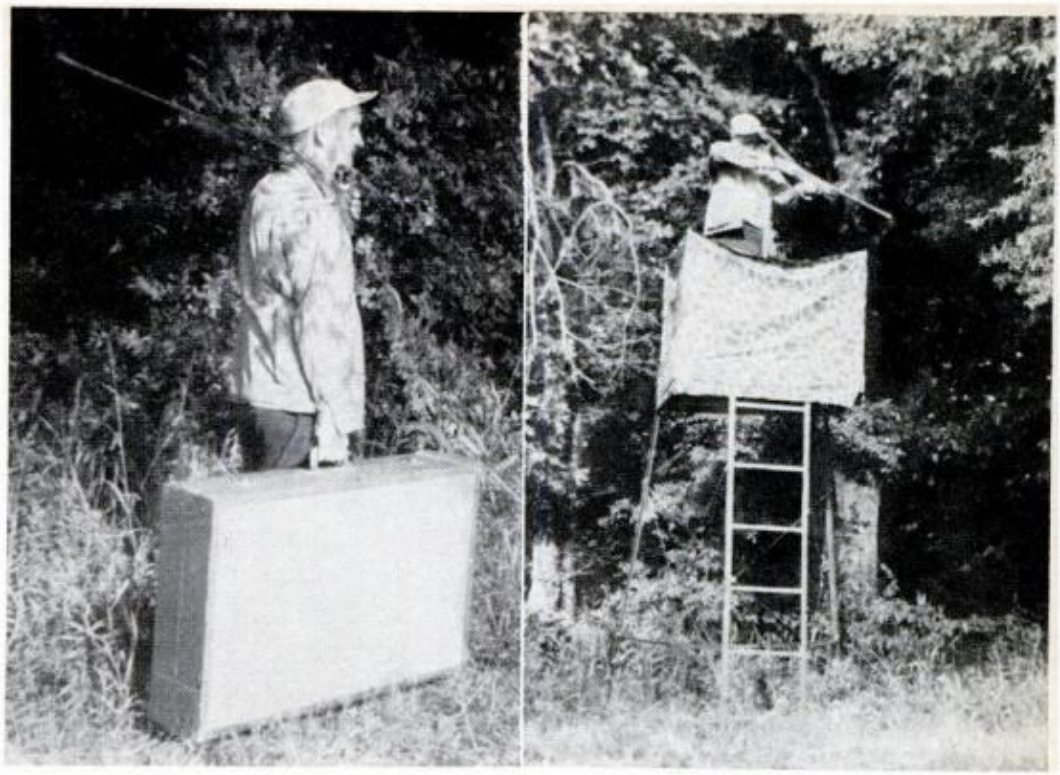

He Goes Deer Hunting with a Suitcase

Packed for carrying (left), McSwain's Magic Ladder looks like an oversized suitcase. But in use, it turns into a hunting stand (right), a tent (by adding a snap-on cover), or a litter for transporting game (the ladder section with a wheel-ski unit bolted on). The Magic Ladder was invented by Thad McSwain, Stuttgart Aluminum Products, 1912 S. Main, Stuttgart, Ark.

Outrigger Camper

The Car-Tel is a pick-up camper that's almost a trailer—or maybe it's better described the other way around.

It's made to fit the pickup bed of the Chevrolet El Camino, but it carries 80 percent of its 3500-pound weight on its own two outrigger wheels (photo, lower right).

The 17-foot Car-Tel sleeps four adults and three children. It has all the comforts of home, including furnace, range, oven, refrigerator, shower and toilet. It hooks up or detaches in 10 minutes.

Priced at $4000, it's made by Car-Tel Corp., 1244 N. Nappanee St., Elkhart, Ind.

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New for Your Home

***RANGE TOP** and ventilating hood "stacks" on standard 30-inch base cabinet, combining four burners, hood-fan, panel light and back splash in one electric unit. A twin-blower fan inside hood may be ducted outside or used with a nonducted filter kit. Installation requires but one wiring connection. Price: $179. By NuTone, Madison and Red Bank Rds., Cincinnati, Ohio*

***PORTABLE SEAT** serves as a luggage hand truck for up to five suitcases or sets up as a comfortable beach chair in seconds. Compact and light, its frame is tubular steel; seat and back are plastic. Unit comes with an expandable rubber clasp rope and is available for $12.95 (including handling) from Hollis Company, Dept. PM-00, 1133 Broadway, New York, N.Y.*

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***CONSOLE HUMIDIFIER** with a built-in electronic air cleaner humidifies entire home; unit is plumbed in for automatic filling. Air cleaner works separately in summer. $475. Hamilton Humid-Aire, 1178 Merchandise Mart, Chicago, Ill.*

***SPRAYER** needs no priming and under fingertip pressure will "mist" water, light oil or bug-killer for use in yard and shop. Nozzle removes for easy cleaning. $2.95 each from "Mist"ifier, P.O. Box 16111, Phoenix, Ariz.*

***CIRCULAR SHOWER** of mold fiberglass uses minimum space; door slides back into shower. Leakproof unit is shipped knocked down for rapid home assembly; costs about $140. Made by Swan Corp., 721 Olive St., St. Louis, Mo.*

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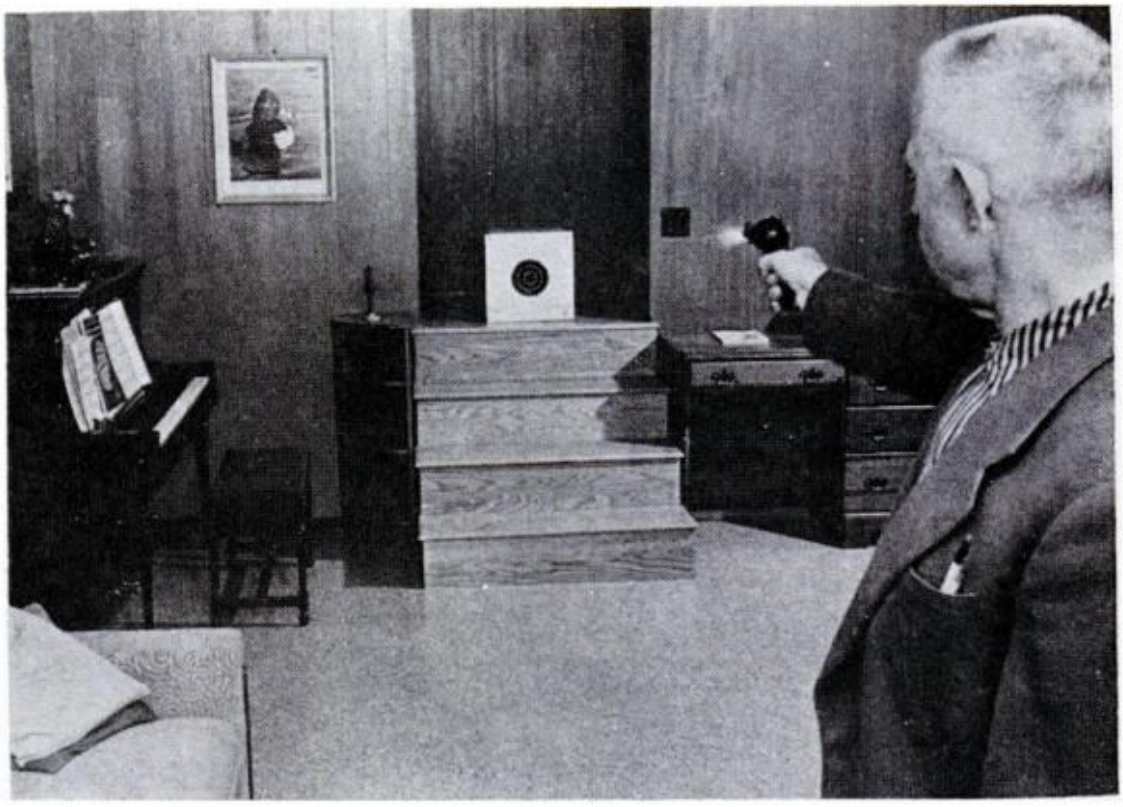
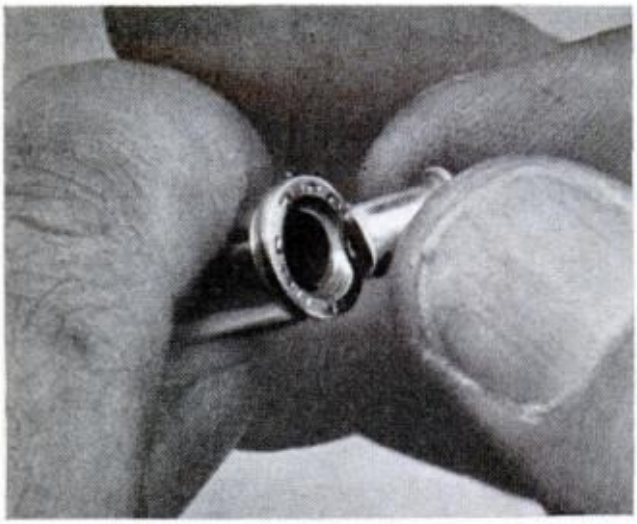
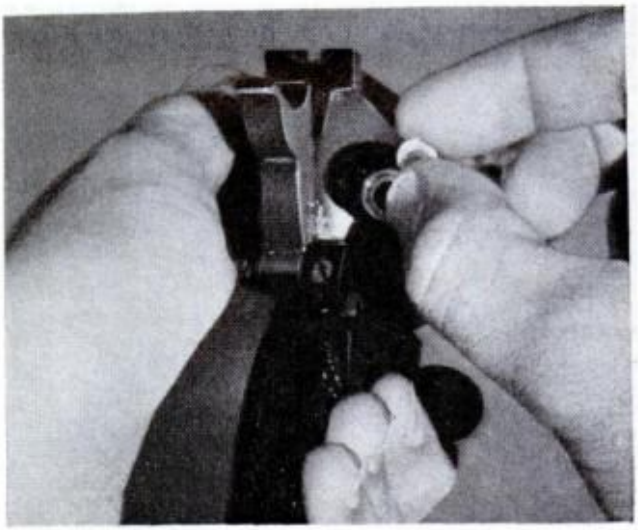
Blast





KEEP YOUR SHOOTING EYE SHARP: Homemade cartridges are gentle enough to shoot in living or family room. Use plywood sheet and bullet trap as backstop



PUT PRIMERS IN CARTRIDGES before loading your pistol, as shown above, or after cartridges have been inserted in the revolver. Latter method works best

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Away Indoors ...
With Wax Bullets

Target practice in the living room? Yup, you can plink away with just about any handgun—and safely, too—if you load it with soft bullets you can make yourself

PISTOL SHOOTING is a tough sport. To be good, you've got to work at it. But how do you practice when the local range is under three feet of snow, or you get home too late of an evening to drive all the way to the range and back?

Of course, if you shoot a .22 and local laws permit, you can set up a basement range without too much trouble. But that wouldn't work too well if you favor such center-fire calibers as the .38, .44 or .45. Hopeless? Not at all. For those calibers lend themselves beautifully to indoor shooting—right in the living room if you like.

How do you protect the walls, tone down the muzzle blast and stop bullets from ricocheting all over the neighborhood? Simple. Just use wax bullets, fired by primers only. Aside from being quiet, these bullets are gentle enough to be stopped by a sheet of plywood, and accurate enough to show whether your shooting eye is on the ball.

Loading wax bullets is quite simple, even if you don't own a loading tool. Drill and countersink a set of empty cartridge cases—say a minimum of six—to take shotgun primers, which can be inserted by hand. In fact the rounds seem to work best when the shotgun primers fit loosely enough to simply fall out after being fired.

Since primers vary somewhat from one manufacturer to another, the cases should be drilled to take a particular brand of primer. The case shown on page 134 was first drilled with a 13/64-inch drill, then countersunk with a 5/16-inch drill.

The countersinking is the only critical part of the job. Overdo it slightly and the primers will sit too far away from the firing pin to insure ignition. Don't do enough, and the primer rims will protrude from the cartridge cases, binding the revolver cylinder. So, proceed with the work slowly and, by trial and error, get each primer rim to sit exactly flush with the bottom of the cartridge case.

Making the bullets and loading them into the cartridge cases is accomplished simultaneously. The ones shown on these pages were made with ordinary household paraffin or home canning wax. Start by melting the wax in a flat-bottomed pan until there's about 5/16-inch of wax in the pan. This measurement is not critical, as variations of a sixteenth or so don't affect accuracy very much. Now, after cooling the wax to room temperature, take a cartridge case and push it into the wax like a cookie cutter. Finally, twist the case slightly and withdraw it from the wax. The cylinder of wax remaining in the case is your bullet.

An Even Easier Way

If that's not simple enough, sporting goods dealers stock wax that is specially formulated for making bullets and comes in sheets of the right thickness. Since you don't have to melt it down, it's safer than paraffin. It leaves less residue in the bore of the pistol, and the residue that does remain is much easier to clean out. About half a buck will get you enough of this product for 200 or so .38 slugs. (A pound

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BASIC COMPONENT of indoor target load is a spent cartridge case (left) drilled and countersunk for shotgun primer (center). Bullet at right was made of paraffin, but special bullet-making waxes are readily available. The latter, while more expensive, are safer and easier to use. And, it's cleaner shooting, which boosts accuracy. Ten dollars should buy enough of these rounds for a winter's shooting

of paraffin, by the way, should be good for well over 500 homemade bullets.)

Concerning the primers, you can handle these either of two ways. First, of course, you can insert them in the cartridge cases just before loading the revolver. However, since the primers fit rather loosely in place, a better procedure would be to load the unprimed cartridges into the pistol, then insert the primers. They should come out easily after firing with little or no help from you. If not, however, just push them out with a long nail or similar object.

Loads Can Hurt You

As one might expect, the accuracy of wax bullets is not as good as standard loads. There is more dispersion due to bullet variations and fouling of the bore. And velocity falls off quickly. However, at ranges of around 20 feet—and how many living rooms are much bigger than that—you can expect consistent groups of around three inches in diameter on the target.

One word of caution is in order. Don't be careless with these loads. Although wax has little penetration, it can break glass, would bruise a person badly, and might easily put out an eye. So practice the same safety rules when shooting wax loads as with standard loads. A simple plywood bullet trap is all that is needed for a back stop, however. Without the trap—that is, just shooting against a straight wooden or metal backstop—the wax bullets splatter badly and can mess up a room or basement in a hurry.

As you blast merrily away with these tranquilized pistol loads, you'll begin to appreciate one of their nicest features—low cost. It should cost only around ten dollars for about 500 rounds, which is a far cry from full-power loads, even when you make your own. At that rate, a winter's shooting won't run much above thirty bucks—a reasonable price, indeed. And, best of all, you'll be in top shooting form when spring rolls around.

PRIMER FALLS OUT, generally, when cartridge is fired. But even if this doesn't always happen, a push from inside with a nail or scribe is all that's needed

CUT BULLETS from sheet of wax by pushing unprimed cartridge cases into the wax. Twist the case slightly, withdraw it from wax and a bullet stays in case

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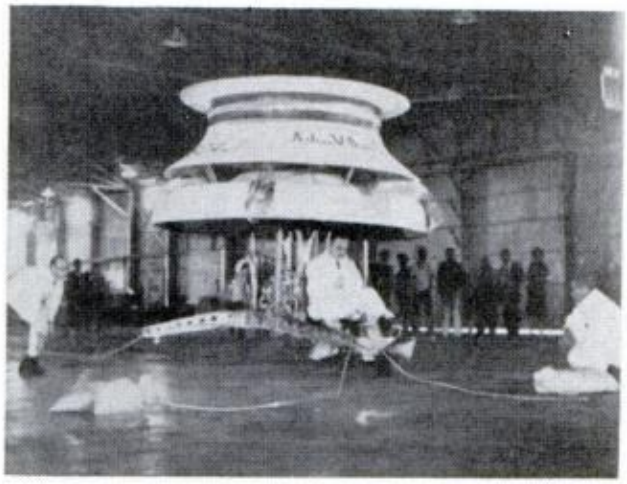
Clip Light

Like love and marriage, cigarets and cigaret lighters belong together. A new lighter is equipped with a clip that attaches to the cigaret package, so that each time you reach for your cigarets you find the lighter, too. The clip is fixed firmly to the cigaret packet by slipping it over the narrow side, as shown in the photograph at right.

It's obtainable for $1.95 from Randal Enterprises, 550 Fifth Ave., New York City.



Flying Mushroom

Using a fan to blow air over a parabolic (circular) wing, a new VTOL concept has made short, tethered flights. The rush of air serves to increase the lift.

Called the Astro V Dynafan, its makers claim it can be produced more economically that rotary wings.

Home Well Digger

Compact enough to fit into a golf bag, the Hydra-Drill 200 is a portable one-man well-digging rig. It operates on household water pressure.

According to the manufacturer, the unit drills an average of 30 feet an hour, at a cost of about one cent a foot. Thus, in many areas, a back-yard well is just an afternoon's project.

Costing $200 with 75 feet of drill stem, plus bits for dirt and rock, it is offered by the Deep-Rock Drilling Co., Opelika, Ala.

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GAME GRAB BAG FOR SPORTSMEN

Here's a paradise where you can hook a 50-pound salmon, get your limit of ducks—and then go hunting for bear, deer or quail

By Tom Stimson
PM Western Editor

SOME PEOPLE are going to be sorry to read this, for I'm telling about their favorite fishing hole.

This is the place where you can boat king salmon weighing from 20 to more than 50 pounds, then go upstream a mile or two and collect a limit of ducks and geese. With luck a sportsman can collect this unique mixed bag in a few hours, and do it all over again the next day.

I'll pinpoint this paradise in a few words: the mouth of the Smith River in northern California, on the coast about five miles south of the Oregon border. The fall run of king salmon on the Smith lasts from September into November, after which the smaller silver salmon enter the stream. The duck season opens on or about October 15, and it's from then on that sportsmen can limit out on both salmon and ducks without leaving their boats.

For a real mixed-up bag you can use other tackle and take steelhead, rainbow and cutthroat trout, then go hunting for black bear or coastal deer, the small kind that dress out at around 100 pounds. There are also quail and pigeon, with overlapping seasons in many cases.

"Tell 'em about the lousy weather," one of the regulars who returns to the Smith year after year admonished me. "We don't want this place overrun with people. It rains hard, day after day, and it's cold on the water. Don't think I'll ever come back, myself!"

Well, I've fished there in the rain, hunched over in waterproofs, but I've had five or six days of good weather for every bad one. Often there's a dense sea fog at dawn, then the sun burns through and the day turns warm and pleasant.

Of the several fishing resorts at the mouth of the Smith the largest and oldest is Castle Rock Camp, also known as Ship Ashore. This last title was tacked on some years ago when the owners decided to enlarge the resort's facilities.

Instead of erecting more buildings they bought at Navy surplus a 156-foot iron-hulled yacht, less its engine and machinery. They had the empty hull towed into the river at high tide and then used tractors to haul it up an incline that had been bulldozed into the riverbank. Office, tackle shop, gift store and lounge are located

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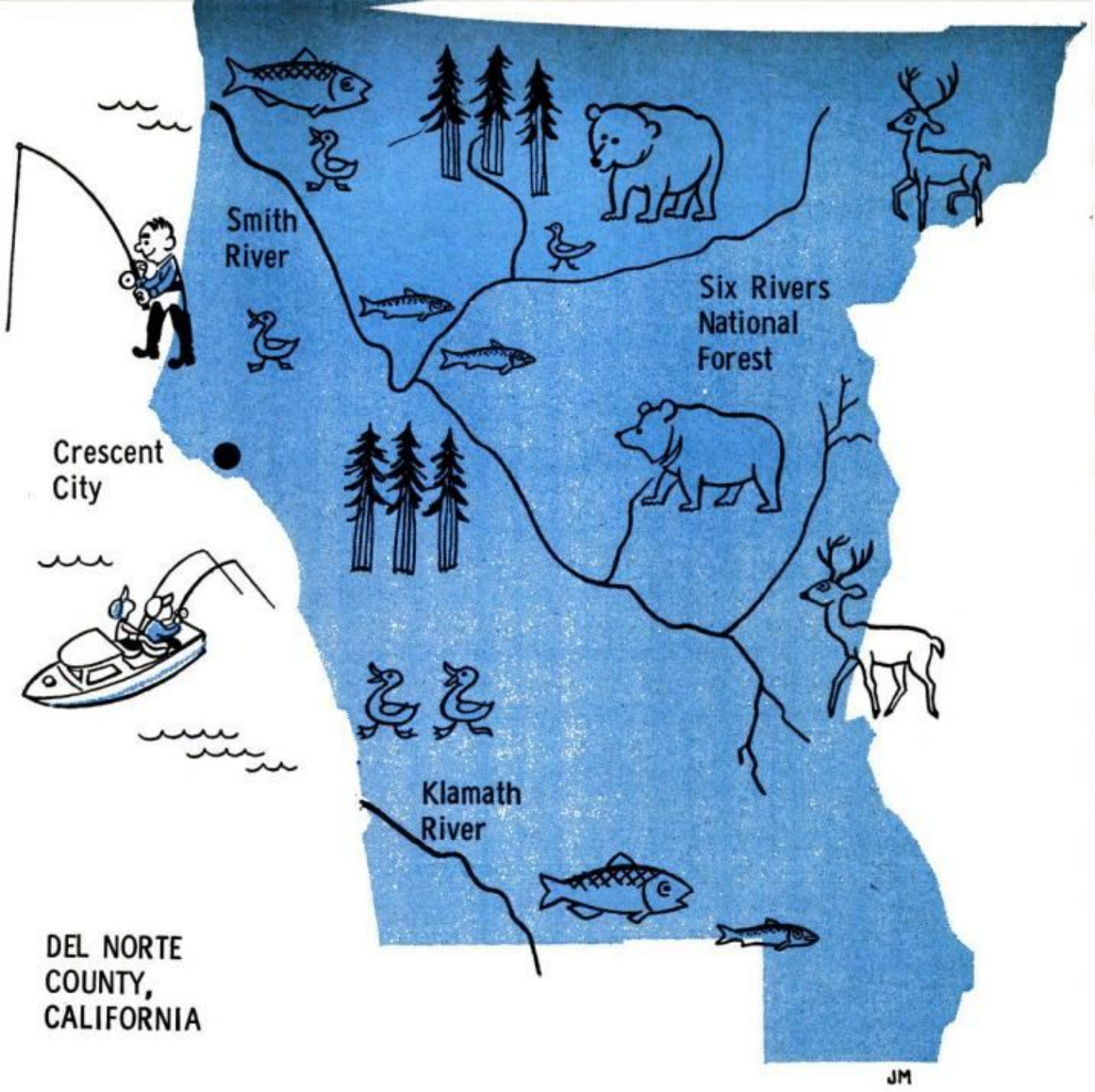

MARSHLANDS in the Smith River area are a favorite stopover for waterfowl, and it is not uncommon for a sportsman to take a limit of ducks in one hour

GAFFING A BIG SALMON is illegal, because too many were wounded in the past, and they are now brought into the boat with the use of a huge landing net

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TIDE LAGOON as seen from the mouth of the Smith River. This is where fishermen troll for record-size salmon, and just a short distance away can put in some excellent surf fishing. The fishing camp, Ship Ashore, is seen behind Castle Rock at right of center in the photo

in the main salon of the yacht, with living quarters below.

The resort has its own restaurant, housekeeping cabins and spaces for 150 trailers and campers. Joe and Betty Sierka operated Castle Rock for the last 24 years and they recently sold out to the Westbrook brothers who own an adjoining resort and who will continue the operation.

Some hunters and fishermen tow their own outboard skiffs to the Smith over the winding roads that traverse the groves of enormous redwood trees, while others find it easier to rent their outfits on the spot. Boats are $2.50 per day, motors $6, landing net 50 cents and tackle 75 cents per day. Professional guides who have spent years learning the Smith are available for $25 per day. They prefer to row instead of using a motor, and it's a fact that the average fisherman boats the most fish when he uses a guide.

When a fisherman catches a small salmon he usually filets it for dinner that night. Larger fish are taken to a custom cannery a few miles up the road and the sportsman returns the next day to pick up his canned fish, complete with labels on which he can print his name, river, and date of catch.

Most of the fishing on the Smith is in the big tidal lagoon at the entrance and in the various holes that are found for several miles upstream. Salmon come into the lagoon on an outgoing tide, lie around for hours or days and then move toward the spawning grounds when rains in the headwaters start coming downstream, raising the river.

Some fishermen troll for the big chinooks with 40 or 50 feet of line and a small weight, enough to keep their lures just above the bottom.

Others wait for the top of high tide and anchor in a solid row across the entrance. Then they wait for the 10-knot current of the outgoing tide to stream their spinners. The anchor line is called "suicide row" and there's a good reason why. If an anchor drags or a motor quits after it's fired up, there's a good chance that the boat will be swept out into the huge breakers that pound at the entrance. Prudent fishermen remain in the row until slack water, when it's safe to haul out of there.

The traditional salmon lure has always been a large gold-and-silver spoon (or two smaller spinners, one behind the oth-

(Please turn to page 212)

ONE DAY'S BAG for a pair of Smith River sportsmen, they come ashore with salmon and a limit of ducks. Just a short distance away there are deer and bear

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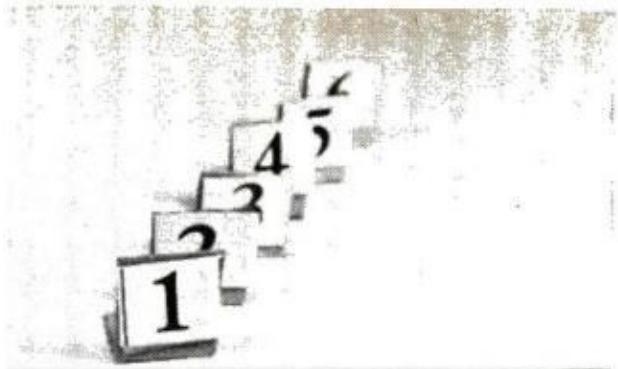
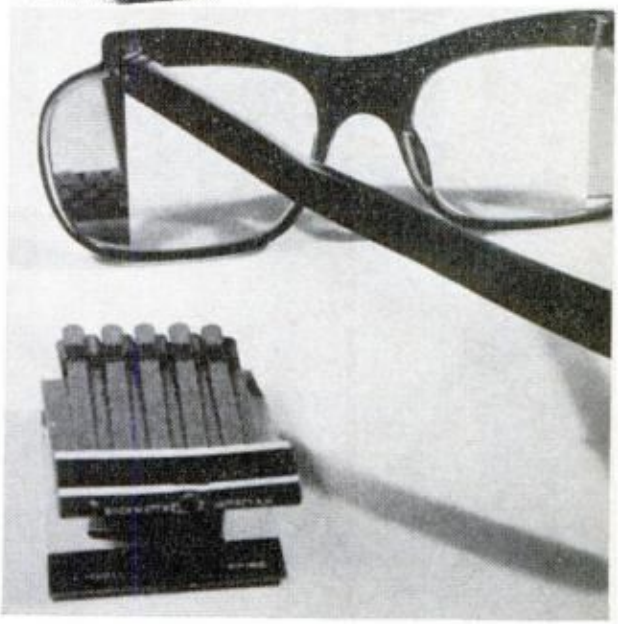
Rear-View Specs

Twin-direction spectacles have small mirrors set on the side of each lens so the wearer can see what's going on behind as well as up front.

Made in Belgium, the glasses are used by store detectives, cashiers and pretty girls who like to know who's following them—if any one.





Breakfast Float

With no wires or electrical connections, a hot plate floats in mid-air and fries bacon and eggs.

Developed at DeVry Technical Institute, Chicago, the experiment is the result of thrusting magnetic fields in opposition to each other.

Jungle Boots

Made for Marines in Vietnam, new lightweight boots have deep cleated composition soles and a combination of nylon webbing and silicone-treated leather uppers.

The 9-inch high boots also have drain holes at the bottom to let water out.

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Snowless Skiing On Tank Treads

By Stuart James

DISPLAYING GOOD FORM, a *PM* secretary makes a downhill run on a pair of Rollkas. As in skiing, the poles are used for balance and as a pivoting aid for the connected downhill turns

AFTER ONE HOUR of practice, *PM*'s Bob Berger was making jump turns. He had trouble with the Rollkas at first, but he quickly adjusted to the differences in technique and found it easy

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DIGGING THE SKI POLES into the turf, I pushed off from the top of the grass-covered hill. The strange contraptions on my feet began to roll. I picked up speed. And from there to the bottom it was like standing on an escalator that has run amok.

This was my maiden voyage on a pair of Rollkas, sort of oversized roller skates with tractor treads instead of wheels—and the extent of my pretrial instruction was the importer's confident appraisal: "There's nothing to it. It's like skiing."

In certain respects he was right. You go down the hill standing up and you use ski poles for balance. Aside from that the Rollka presents its own problems, and I learned them enroute. If you lean forward, as you would on skis, your body gets ahead of your feet and you land on your face. If you dig in your "edges" for a parallel turn you find yourself suddenly airborne, executing a slow inside roll. And ground, without a snow cushion, is hard.

Imported from Austria, where it has attracted an avid following, the sport of Rollka-ing is currently being introduced to the United States. We received the first pair of Rollkas to come through customs, and with a group of ski enthusiasts from the *PM* staff, we gave it a full day's test.

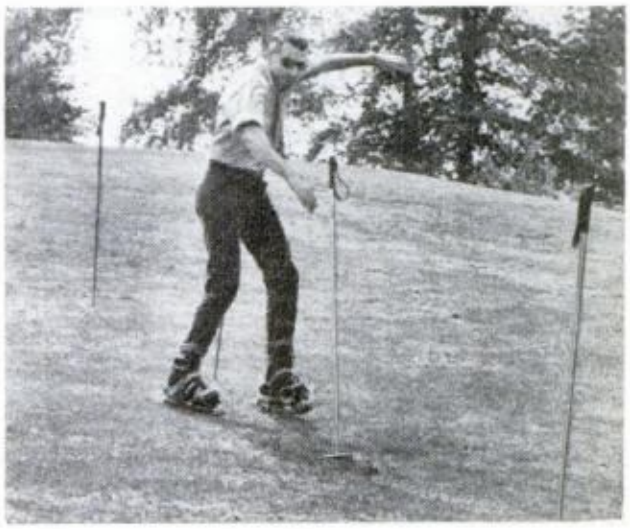
With heel and toe plates that strap to a boot, the Rollka is essentially a tough nylon caterpillar tread attached to steel plates equipped with bearings that roll on a metal track. It comes in one size designed to fit all shoes sizes from 7 to 13. And it has a top speed of about 30 mph.

The major thing we learned is that Rollka-ing is not like skiing. The body movements are more akin to ice skating, and once you learn to execute turns as you would on skates and concentrate on keeping the treads flat on the ground, it's a simple sport.

Within two hours we were all whizzing downhill, making connected downhill turns, running a makeshift slalom course, jumping snowless moguls—generally executing the maneuvers that would take months of diligent practice on skis.

Is the Rollka dangerous? Not at all. When you fall on skis it is generally the unyielding leverage of the ski that snaps a bone. This can't happen with the Rollka. But it is not a soft sport. There are always some spills and they hurt, and that first run is a strain on the nerves. ★★★

DESIGNED TO FIT a variety of shoe sizes, the Rollka is a nylon tractor tread attached to steel plates that run on bearings over a continuous track. The tread is studded with plastic grips that prevent any slipping in the grass and protect against wear



MAKING TIGHT TURNS on a slalom run is not really difficult, and they are best executed in the style of ice skating, with one Rollka preceding the other and then reversing position for the next turn

PARALLEL TURNS are difficult, and if the edges of the Rollka's tread dig into the grass you're in for a spill. All turns should be made in a smooth, sweeping movement, much like the exaggerated stem christie in snow skiing, but without skis to negotiate

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Toys to Train Army

Somehow, student tank drivers must learn to tool around in their mountains of nuts and bolts without smashing up the scenery. A new Army school trains them in miniature

By Arthur Whitman
Photos by Curt Gunther

YOU'RE A YOUNG LIEUTENANT going through the tankers' Armor School based at Fort Knox, Ky. You've had some class work on the M-60 tank, the main bludgeon in our land warfare arsenal. But this is the first time you've ever actually had to push one of those clanking mountains of nuts and bolts over the landscape. You gentle the steering wheel to the left, grind down a low slope and—*look out!* Tree ahead!

You ease the wheel right. Daylight shows at the driver's slot. Open space!

You sigh with relief, ease a little farther right for a look at what's out front—and a wall of red looms before you. Bewildered, you hit the brakes. Too late. An M-60 is not a convertible tooling down the nearby Dixie Highway. You hear a sickening *crrrraagh* as you grind to a halt. There's nothing more to do. Shoulders slumped, sweat gumming your fatigues, you can't keep a sheepish recruit's smile off your face. Where the hell did that barn come from?

"It was always there, Mister!" With a resigned look on his face, the instructor walks across the floor, picks up your tank, repositions it and calls, "All right, on the ball! Back off and try her again."

This little experience may not be the most fun you've had since you left home nine weeks ago, but at least the taxpayers got a break. The landscape you were slopping around in was nothing but a closed circuit TV image of a simulated battlefield. The barn you clobbered was a model; so was your M-60. You were "driving" from one of the student booths in the Platoon Leaders Basic Training Device—a model layout that the Armor School created because they know from experience just what to expect of you on your first driving lesson.

A tank platoon leader has one of the most difficult jobs in the Army. A one-armed carpenter with the itch has it easy by comparison. When the tank is buttoned up, as it always is in combat, the platoon leader is as comfortable as if he were in

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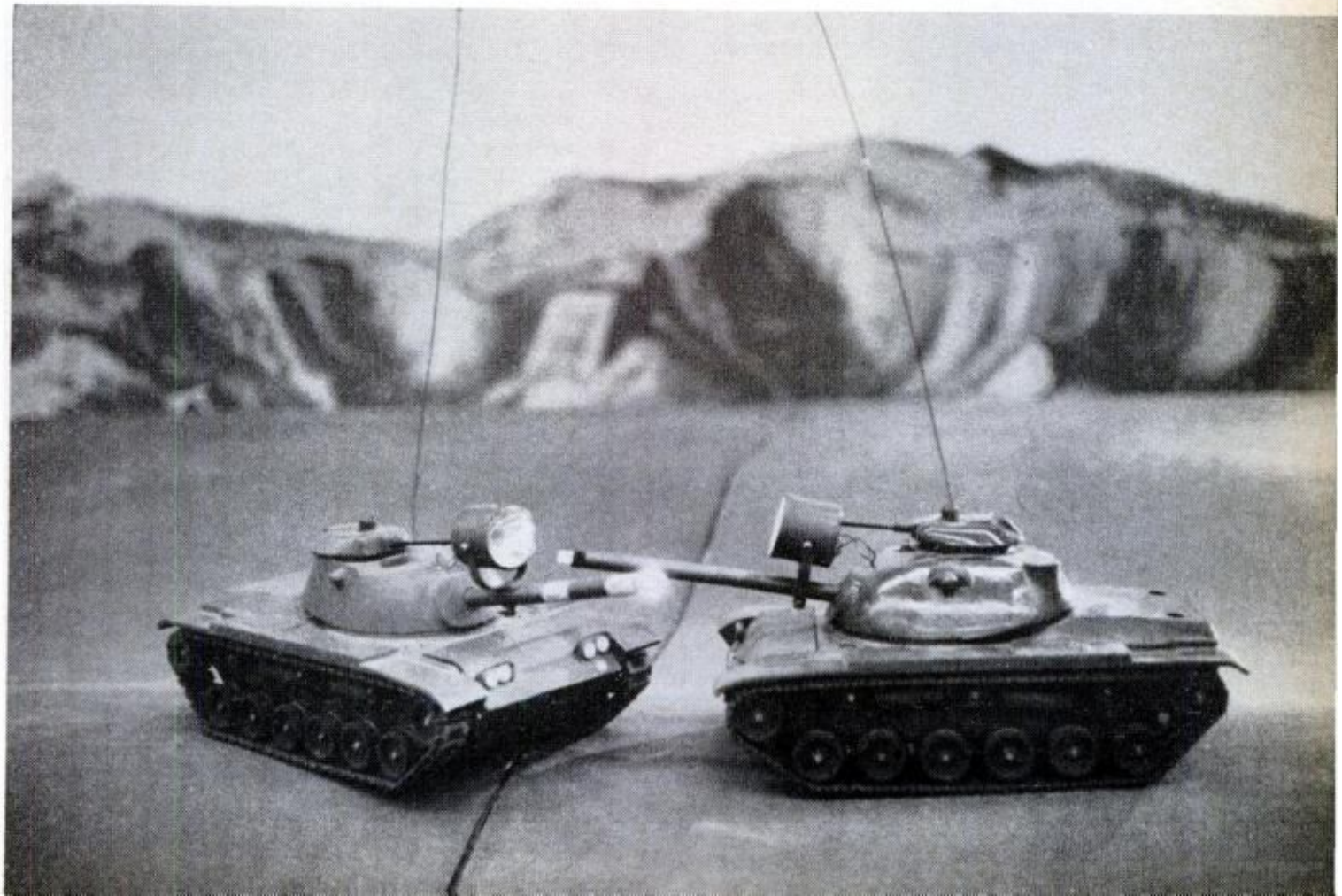
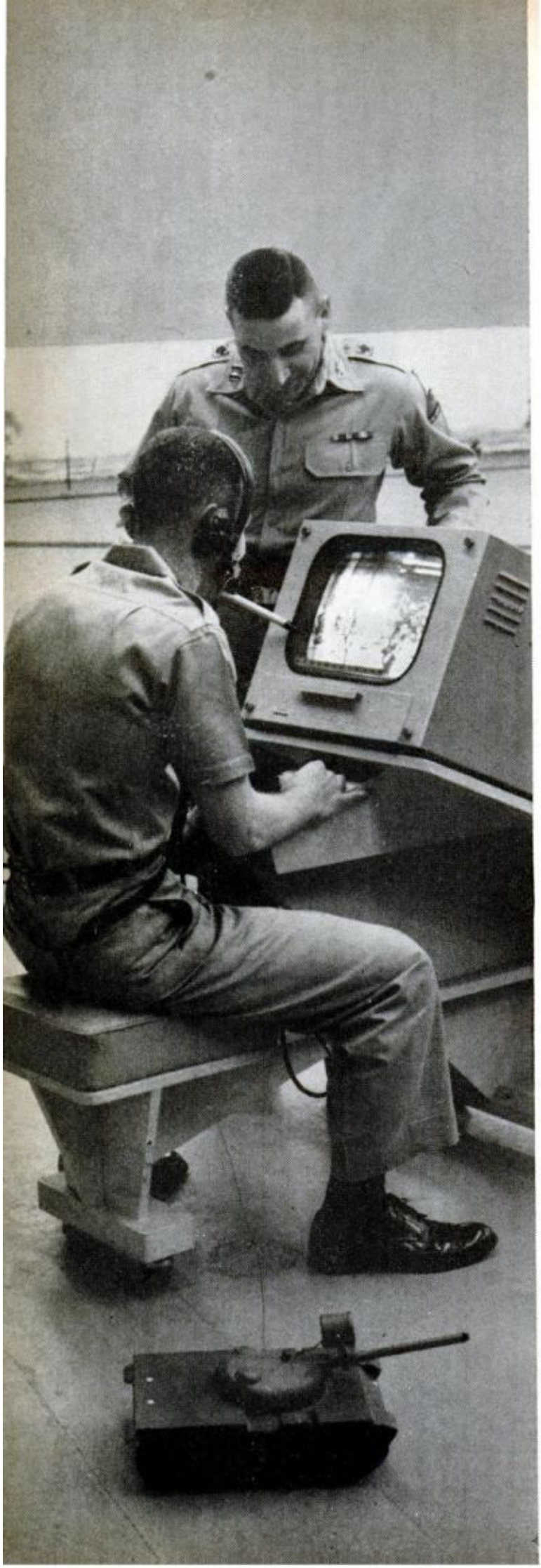
Tankmen for Battle

PARADE FORMATION: Pfc. Barry W. Edstene adjusts the TV camera on a miniature M-60 tank. The camera relays to students a view they would get from the observation slot of an actual tank. Most learn to make sense of what they see in four hours

NIGHT FIGHT: Most difficult tactics to master are night maneuvers, when tankers depend on searchlights for visibility. Here an M-60 (right) and an aggressor have each other lined up in their lights. Night fights often occur with tanks this close





the business end of a cement mixer. Bouncing around crazily, he has to direct the movement of his own tank and the four others in his platoon. To know where he's going he has to consult terrain maps constantly. To see where he is he has only a narrow slot for visibility, and often must peer through it with binoculars or night glasses. He must be in constant communication with the other three members of his own crew, as well as with all the other crews in his platoon—not to mention his company commander. All this is just to function. It has nothing to do with the tank's mission—to seek out and destroy the enemy, of course.

Obviously some orientation to these working conditions is required, and the Armor School's answer is the model layout. It was built in 1954 for $440,000 and has been improved half a dozen times since. Today the system's "fleet" consists of 22 identical transistorized, radio-controlled model tank chassis, each a foot long, built on a 1-to-20 scale of the giant M-60. In addition, there are 35 plastic "snap-on silhouettes," or hulls, that can be removed and interchanged. The hulls represent four standard U.S. tanks and two "aggressor" tanks—the Russian T-34, now obsolete but still widely used by Communist Bloc nations.

All the tanks have searchlights for night work and simulated armament complete to 5-watt bulbs that flick on to simulate firing. They were designed and developed by General Dynamics, at $3,300 per tank.

"Expensive, all right," comments Captain Arthur D. Pepin, an Armor School instructor, "but a whole lot cheaper than a $173,000 M-60, which can get smashed up, too, even though it weighs 52 tons."

The "terrain" in which these miniatures operate is the 72-by-100-foot floor of a shedlike building. The floor is covered with papier-maché and plastic hills, roads and rivers made of carpet runners. It is complete with bridges, houses, barns, clusters of trees and utility poles. Like the tanks, these elements are all on a 1 to 20 scale of their real counterparts. All elements are moveable and are shifted constantly to set up new conditions.

Students, usually grouped in four-man

INSTRUCTOR CAPTAIN Arthur D. Pepin demonstrates the use of the TV monitor to Lt. Alan Morris, a new staff member of Armor School Basic Training Device

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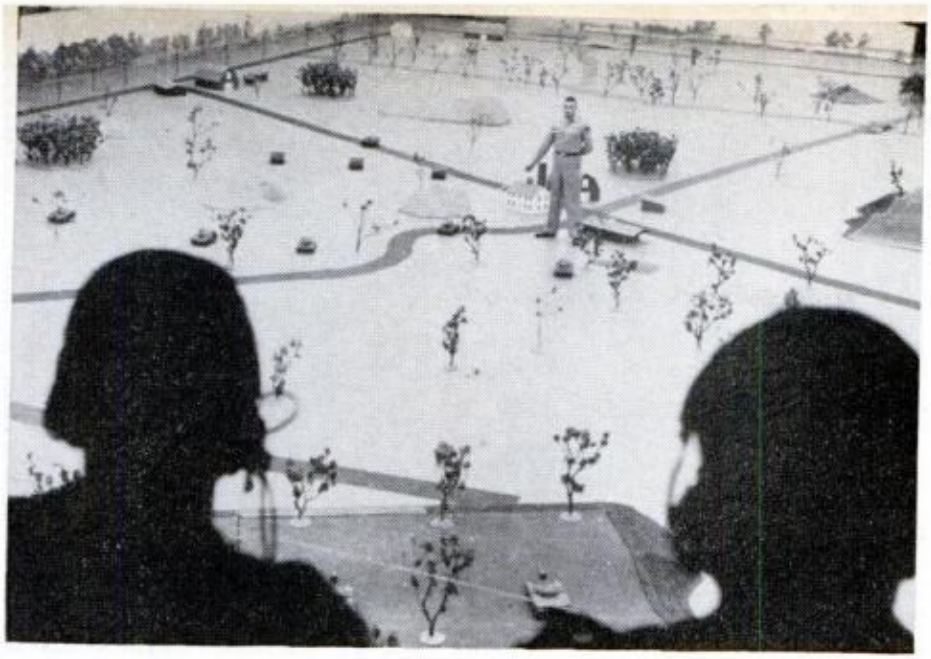
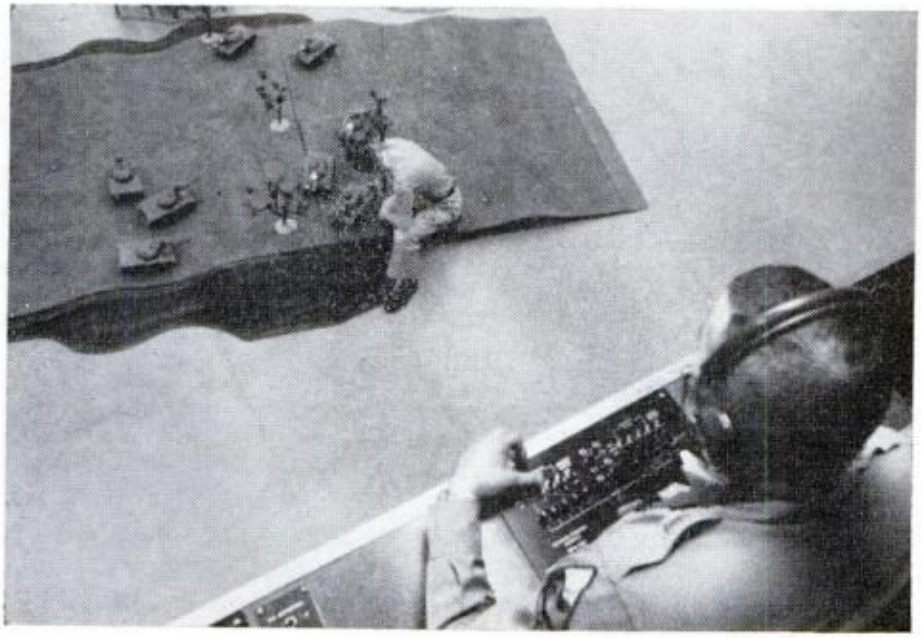
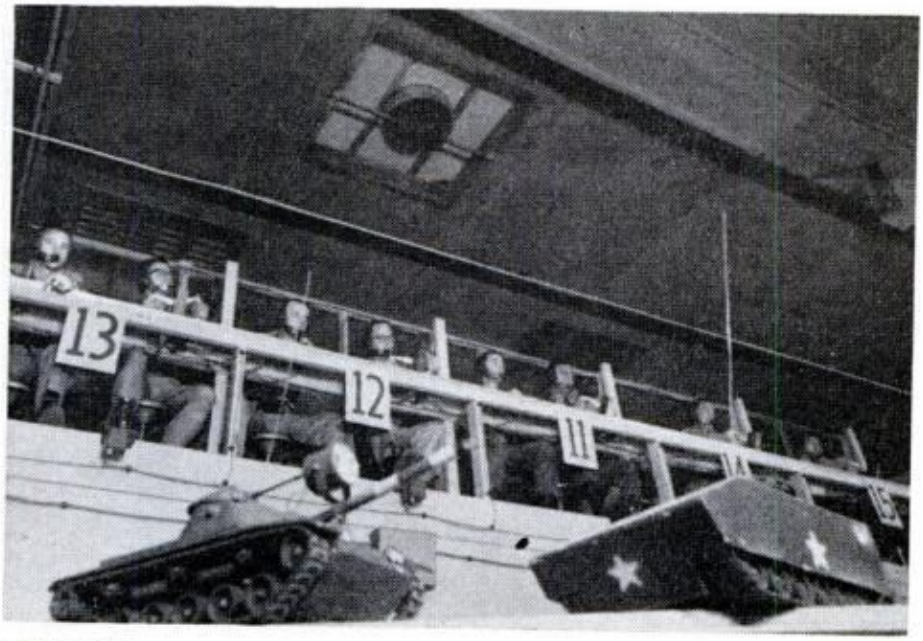


TWO STUDENTS in Platoon Leaders Training Device sit in booths that simulate tank interiors and maneuver model tanks on training floor, which simulates a battlefield. Instructor is Captain Pepin



CAPTAIN PEPIN supervises repositioning of tanks and terrain from instructor's control booth. Tanks and all terrain elements are built on 1-to-20 scale. Terrain elements are plastics and papier-maché, can be moved at will



TYPICAL STUDENT GOOF! The tanks in foreground, controlled from booths 12 and 13 are about to hurtle off the narrow platform on which they have been maneuvering. Students "wreck" tanks in each course

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LT. ALAN MORRIS positions tank on battlefield. Tanks weigh about 15 pounds. Real versions weigh 52 tons

BILL McCRACKEN, a civilian field technician, services the model tanks. Most frequent problem: blown transistors

crews, operate the tanks from overhead cubicles arranged at two ends of the mock battlefield. Each cubicle has the same control and communications equipment contained in a real tank. The students sit in the same positions they would occupy in one of the clanking behemoths.

Two of the tank miniatures are equipped with television cameras, set in fixed positions to "see" only what the platoon leader would see through his observation slot. The images go to a central TV monitor suspended at students' eye level. The TV image is their only view of the terrain over which they must maneuver.

The students' control maneuvers produce radio signals transmitted by a grid antenna that criss-crosses the entire battlefield at a height of 11 feet. The models receive the complex carrier signals through an antenna board, from which they go to the control and RF heads for demodulation and amplification of the proper subcarrier frequencies. Voice communication between crews is maintained by a radio hookup between cubicles and instructors' booth—though the instructors are more apt to be down on the floor dodging out-of-control models and bellowing corrections than they are originating gentle instructions from the booth.

Except for the normal, day-to-day student goof-ups, the only communications problem encountered since the dwarf behemoths started lumbering over the papier-maché took place after some changes were made in the system a few years back. At that time the tanks suddenly developed minds of their own, swinging frantically into action without signals, going North when they were ordered West; moving in reverse instead of forward. Investigation showed that signals from a Louisville television station, some 30 miles away, were mixing with the tanks' transmitting frequencies, causing the spooky behavior. Metal shielding on the trainer building solved the problem.

About 1,000 U.S. and NATO nation officers go through the course each year, and if *they* don't find it valuable, the Army surely does. "It gives them their first exposure to problems they'll have in the field," says Captain Pepin. "Then, when you see the inevitable foul-up when they do get into an actual tank, you can't help wonder what would have happened if they hadn't been through the device." ★★★

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Round Up (and Down)

Featuring upholstered seats, table lamps and decorative plants, a circular elevator carries customers from floor to floor at the State Capitol Bank in Oklahoma City, Okla.

Enclosed in wood paneling and glass, the unique vehicle is operated by the passengers who push buttons at the base of one of the table lamps. It serves two landings.

Teacherless Typing

Prerecorded tapes connected to an illuminated screen, teach typing students the keyboard and build up speed gradually without teachers.

Developed in England, the system forces the beginner to keep her eyes off the typewriter and on the board where each letter or character is called out in a steady rhythm. Each lesson lasts an hour and at each succeeding lesson the speed is increased. It's claimed typing can be taught in 12 lessons this way.

The school says that the constant rhythm forces the student to keep up.

Swim Like a Bird

Fins that are attached to a swimmer's wrist are said to increase speed up to 25 percent.

The fins, called Swim Jets, flap open and shut, similar to the action of a bird's wings.

The Swim Jets are shown here being demonstrated in London by Olympic swimming star Anita Lonsborough.

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ALL YOU NEED TO KNOW ABOUT

CUTTING GLASS

At the price of glass today, every homeowner should know how to salvage pieces from precious scrap. Cutting tools cost next to nothing and the risk of breakage is small once you've practiced the pro techniques illustrated on the next eight pages

By Walter E. Burton

PEOPLE WHO LIVE in glass houses should be able to *cut* the stuff. And don't we all sometimes feel we're surrounded by glass? Crash! a baseball flies through a window, and you must replace a pane. Smash! Your wife loses her grip on that heavy ashtray and it plummets through the plate-glass coffee table. Bang! that big watercolor Uncle Ben framed for you was too heavy for its hanger; now it lies on the floor in a "puddle" of shattered crystals.

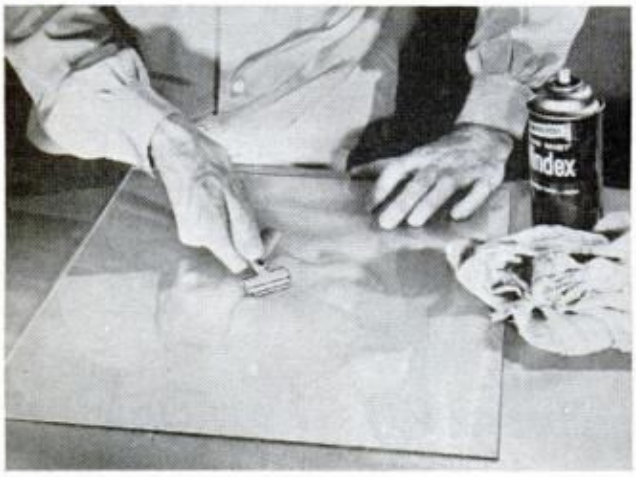
These are only samples of the daily accidents that befall the most fragile material in your home. It stands to reason that anyone concerned with home maintenance should be able to cut a new window pane, table top or mirror. In many cases, you can get the replacement from a piece you've kept for salvage; a window pane, say, that's cracked across one corner can be trimmed down to fit that picture frame of Uncle Ben's. Yet many home owners won't touch a glass cutter, lest they end up standing in a pile of icicles nursing a gashed finger.

The fact is that few materials are simpler to deal with, once you've learned the proper techniques. And a full set of "professional" tools like those sketched at the top of the next page, will cost you next to nothing. (You *make* the special ones detailed on pages 151 and 155.)

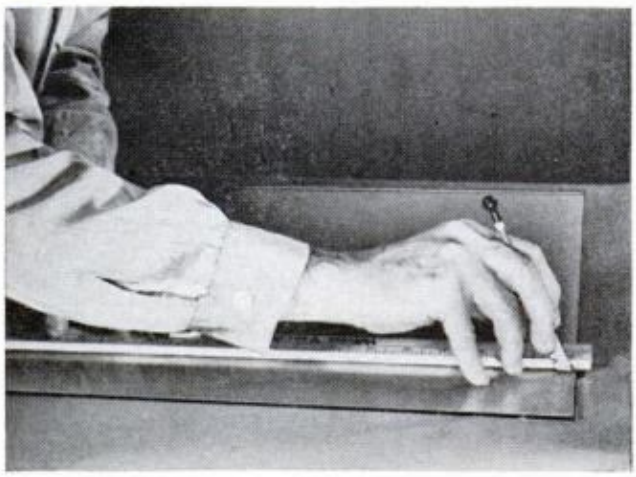
You can buy a good wheel-type cutter for less than a dollar. Your straightedge can be nothing more than a sturdy yardstick, or any ¼-in.-thick strip of wood or hardboard. It's even handier if it's equipped with a right-angle leg or crosspiece to convert it into a square.

There are special glass-cutter's pliers for breaking off narrow strips, but any

1 **CLEAN GLASS SURFACE,** scraping off old paint, crusted dirt, then wash with soap and water or commercial cleaner, or kerosene-dampened cloth



2 **BEGIN THE CUT** with the cutter wheel about ⅛ in. from far edge and cutter held snug against firmly-held yardstick or other straightedge



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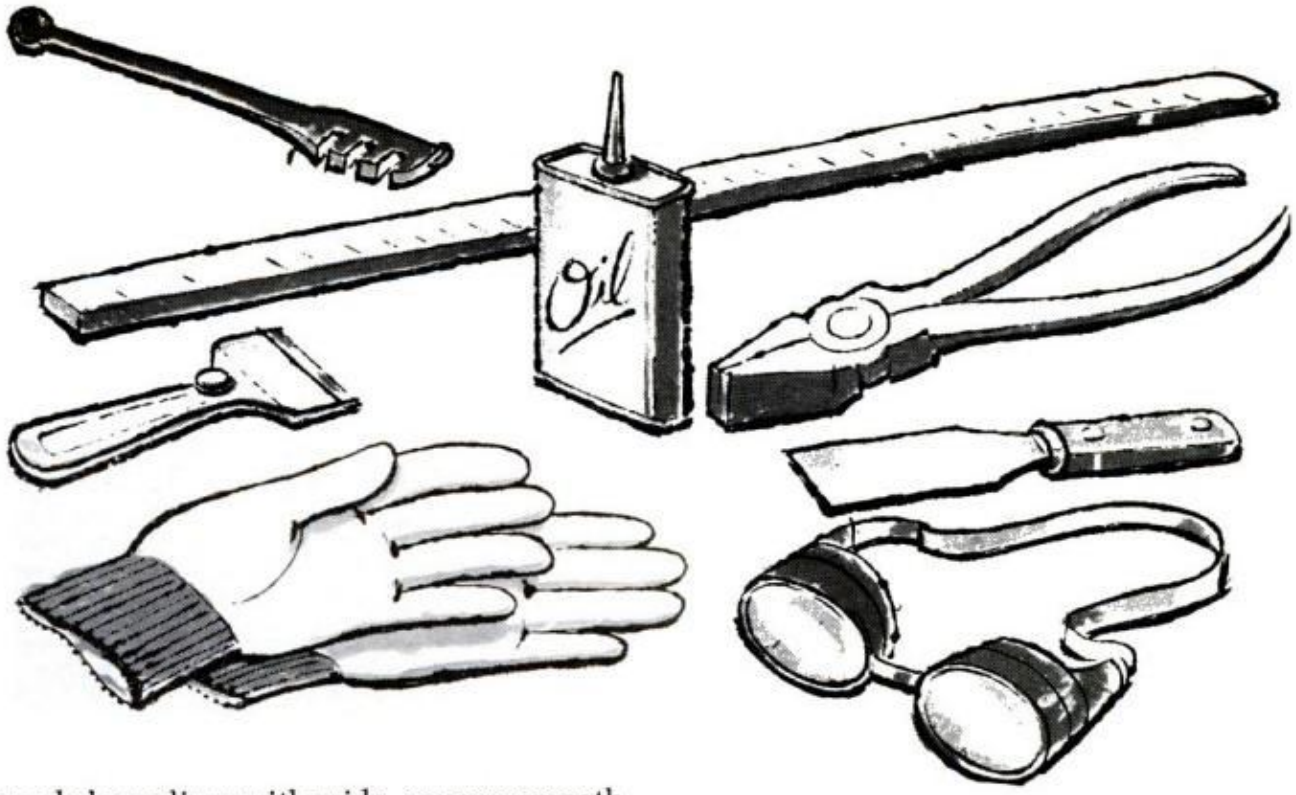
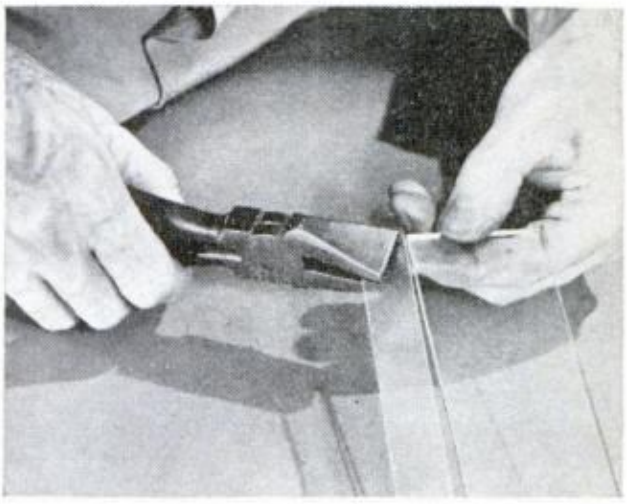


workshop pliers with wide, square, smooth jaws can do most such jobs.

For lubricant, use kerosene, light oil or a mixture of these. If you're cutting old glass that needs scraping, an ordinary single-edge razor blade can serve the purpose—or buy one of those handles into which you clamp double-edge blades. If you're cutting a replacement pane, you'll need a putty knife for the glazing job.

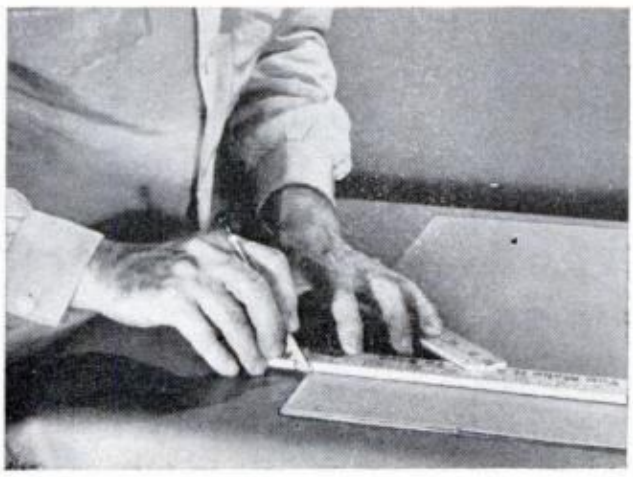
For a work surface, use any flat bench or table top with a cushioning layer of old carpet, or even several thicknesses of newspaper. You'll want cloth gloves to protect your fingers from pesky chips, and safety goggles or a face mask, just to play it safe.

The step-by-step photos show how easily a straight cut is made. Always dip the cutter's wheel into oil, unless you keep it in a container with an oil-soaked pad in

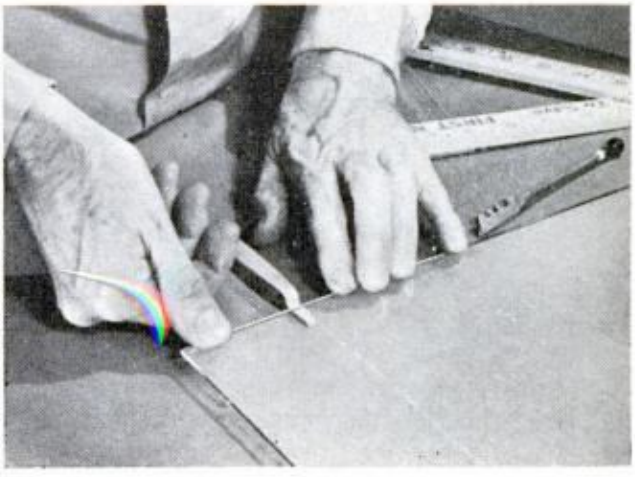


STRIP TOO NARROW to break as in bottom photo? Grip it with glass pliers, holding finger under end of score to use as fulcrum as you bend strip downward

3 **DRAW CUTTER ACROSS GLASS** toward you with even speed and pressure, letting wheel run off near edge. It should leave clean, light line behind



4 **SEPARATE GLASS**—also called running the cut—by inserting tiny wedge (or pencil) under end of score; press down on both sides to break



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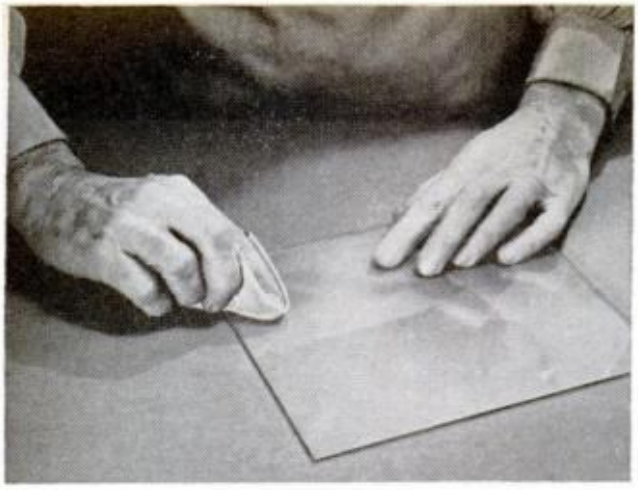
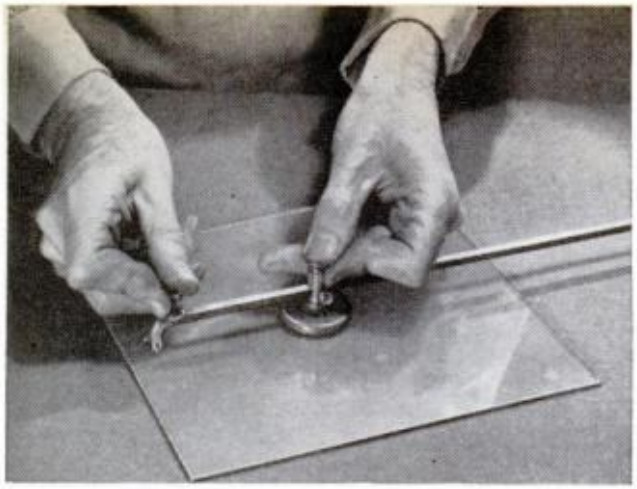
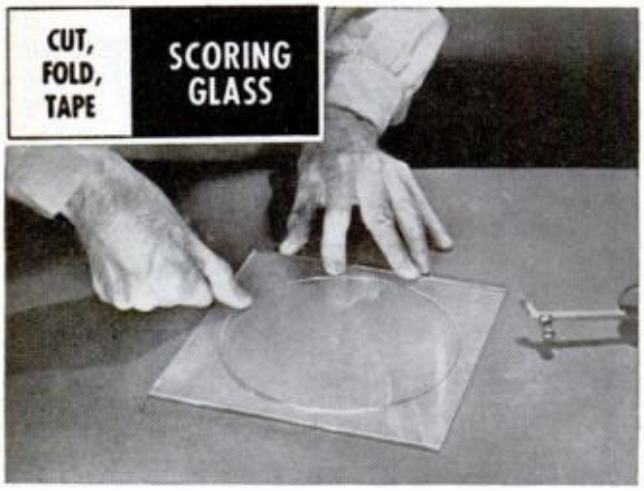


1 **TO CUT A DISC,** clean square of glass carefully, then apply light film of oil along path cutter wheel of beam-compass-type cutter will follow

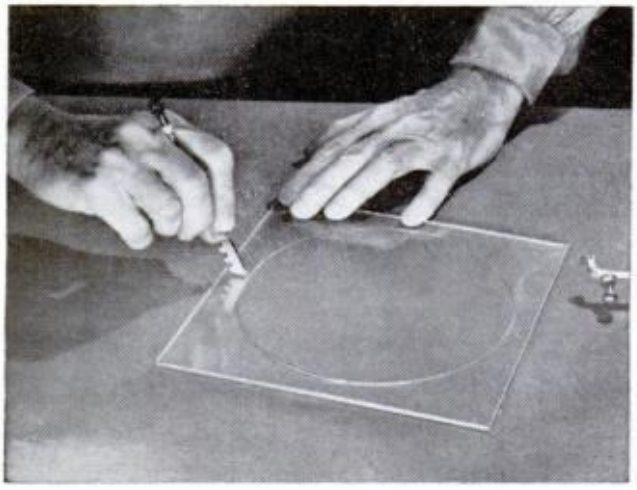


2 **DIP CUTTER WHEEL** in oil and score circle, using either commercial beam-compass cutter (above), or homemade type, like one detailed far right

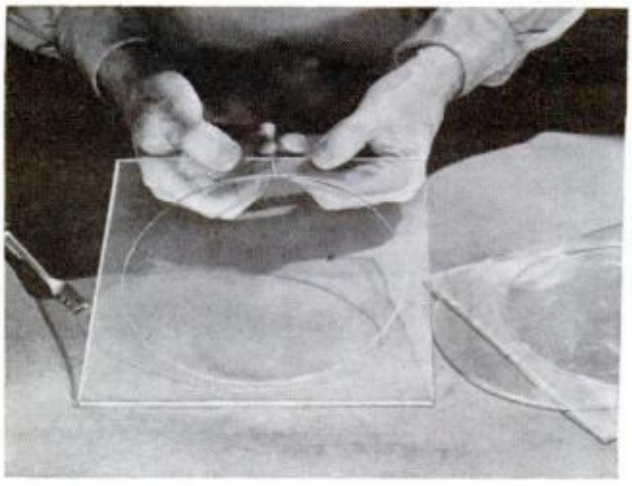
SIX STEPS TOWARD CLEAN DISCS



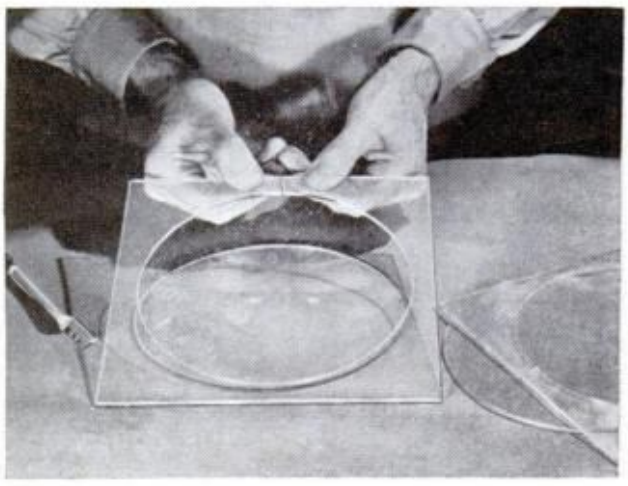
3 **FLIP GLASS OVER** and press along scored circle until you can see that cut extends all the way through glass. Disc is now physically separate



4 **SCORE CUT ACROSS** narrowest point of scrap, starting wheel just outside of circle and drawing it toward you until it drops off the edge



5 **BEND SLIGHTLY** along scored line to separate scrap. In photo below, disc is still attached, but when hands are pulled outward at same time . . .



6 . . . **DISC DROPS FREE,** as scrap springs slightly away from scored circle. To separate disc with only one radial cut, scrap must be quite narrow

Материал, защищенный авторским правом

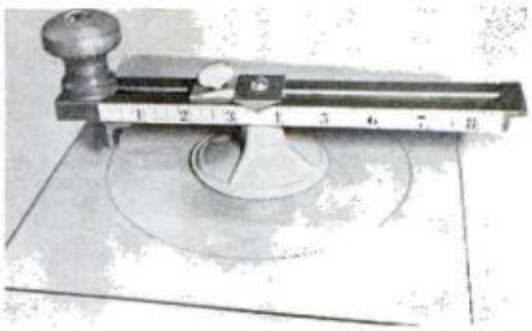
the bottom. It's a good idea, also, to spread oil thinly on the glass along the line of cut, since it helps prevent crazing.

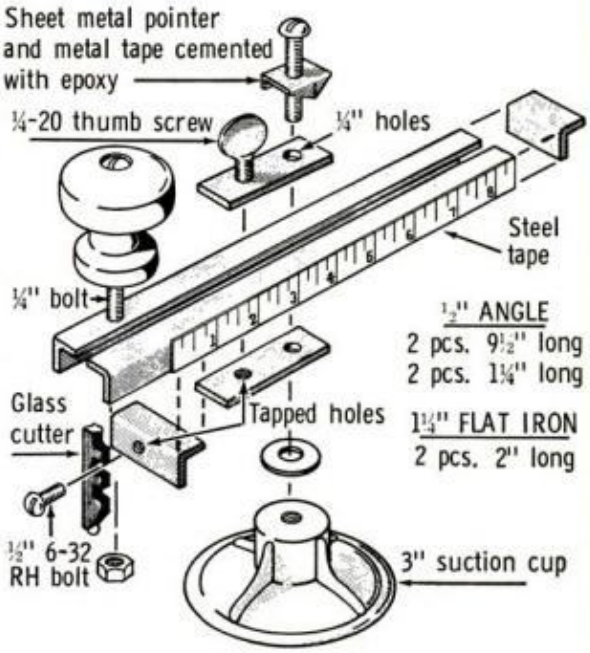
Grip the cutter between first and second fingers, and steady it with your thumb. Hold the cutter so its wheel axle is parallel to the glass surface. Incline the handle toward you (the degree depends on the cutter design; ask for a recommendation when you buy the cutter). Press down firmly as you draw the cutter toward you—but not hard enough to plow a ragged furrow that won't break clean. If you press too lightly, on the other hand, the glass may not be scored *enough* for a satisfactory break, and the wheel may skip.

The only way to learn how much pressure is needed for glass of a given thickness (the thicker the glass, the more you must bear down, of course) is to make several practice cuts cross a scrap portion. Experienced glass cutters often judge by the sound of the wheel, and may insist upon complete silence while they work—but this takes a well-trained ear.

The novice may find a special scoring jig helpful—one that travels the cutting wheel down a track, like the homemade unit detailed on page 155. This jig trims glass much as the roller-type paper cutter it resembles trims paper. It takes the trial-and-error out of mastering stroke and pressure, because it has a built-in sense of touch. The cutter is spring-loaded (you shorten the spring until it exerts enough tension to make an even score). And it's made of common materials such as

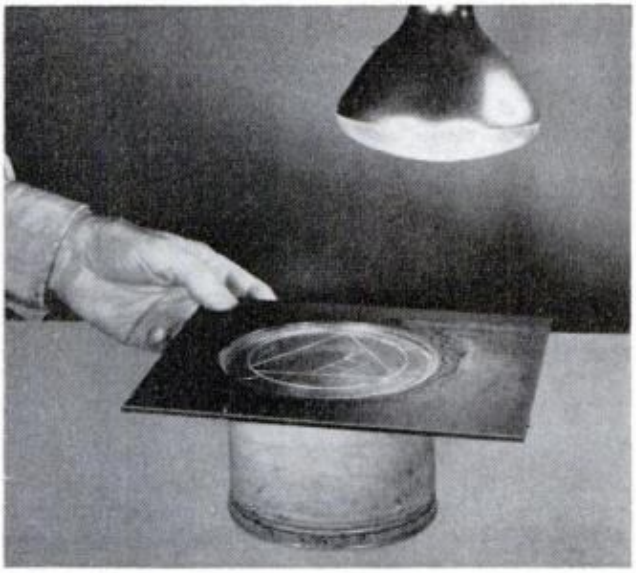
MAKE A CIRCLE CUTTER





"BAKING" HELPS YOU CUT A HOLE IN GLASS

NEED A CLEAN HOLE through a glass sheet? Score desired diameter, then second circle about an inch inside first, plus radial scores between two. Coat glass beyond first circle with black pigment, expose to infrared heat lamp. While painted portion is hot and expanded, break out center, then ring



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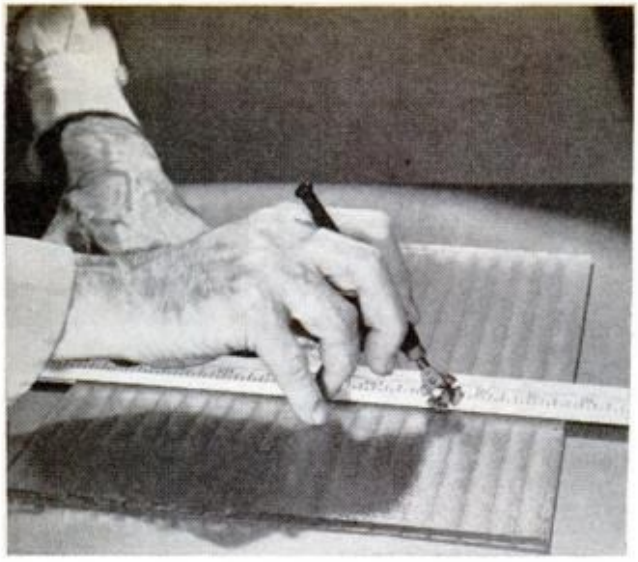
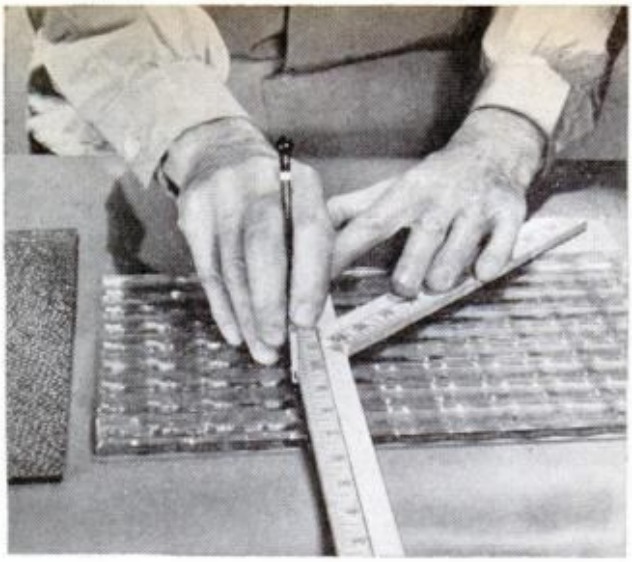


DULL CUTTER WHEEL is best for cutting figured or textured glass. It takes considerable pressure but too sharp a wheel may cause excessive crazing. Let wheel wear down in normal use, then don't resharpen



THIS PATTERNED GLASS can be cut from either surface. Note homemade squaring jig. At left is one of hardest types to cut—heat-absorbing glass with pebbled surface. It takes a lot of cutter-wheel pressure

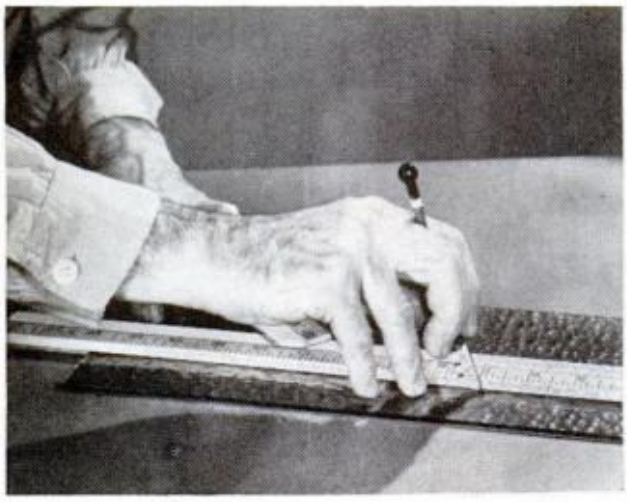
angle iron, steel rod and self-aligning shaft hangers. The latter are adjustable both laterally and vertically. The first feature permits hairline adjustment to square; the latter lets you set the jig to cut any thickness of glass up to ¼-in.

The handle of the traveler is a section of pipe with ½-in. bushing pressed (or hammered with a wooden mallet) into each end. Insert the ½-in. rod through this assembly and hammer sharply on an anvil around the ends of the pipe to bring both bushing and pipe to perfect circles that will slide evenly on the rod.

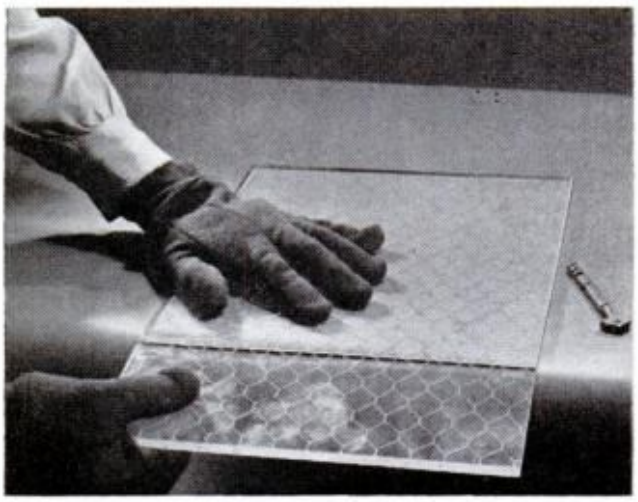
Now, weld a heavy sheet-metal plate (in the original, this was cut from an electrical outlet box cover) to the pipe's center, and mount the cutter as shown. Note that the spring unsnaps to release the cutter for sharpening or hand use. On the opposite side of this plate, mount a hook formed of the same sheet metal, so that it hooks the bottom edge of the angle. It must grip tightly enough to eliminate play, yet allow easy travel.

The board has a liquid or plastic rubber coating brushed on to provide a nonskid surface, and a yardstick "fence" screwed down flush and square with the cutting edge. This is then trimmed back 2 in. from that edge, and the gap is filled with a section of aluminum that projects ¼ in. beyond the cutting edge. This provides a rest for the cutter wheel at the end of the cut, and lessens the risk of chipping. Those front "arms" of the board permit you to mount the track assembly enough forward so the score will always be made along the front edge of the table. You can then break the cut without repositioning

COLORED ART GLASS—especially this pitted type—may be bowed. If it is, score it on concave side. (All patterned glass shown in these photos was supplied by Industrial Paint & Glass Co., Akron, Ohio)



WIRE-REINFORCED GLASS is scored on one side and snapped like ordinary plate; then work two sections back-and-forth like leaves of a hinge until wires break from fatigue. Take care not to chip the edges



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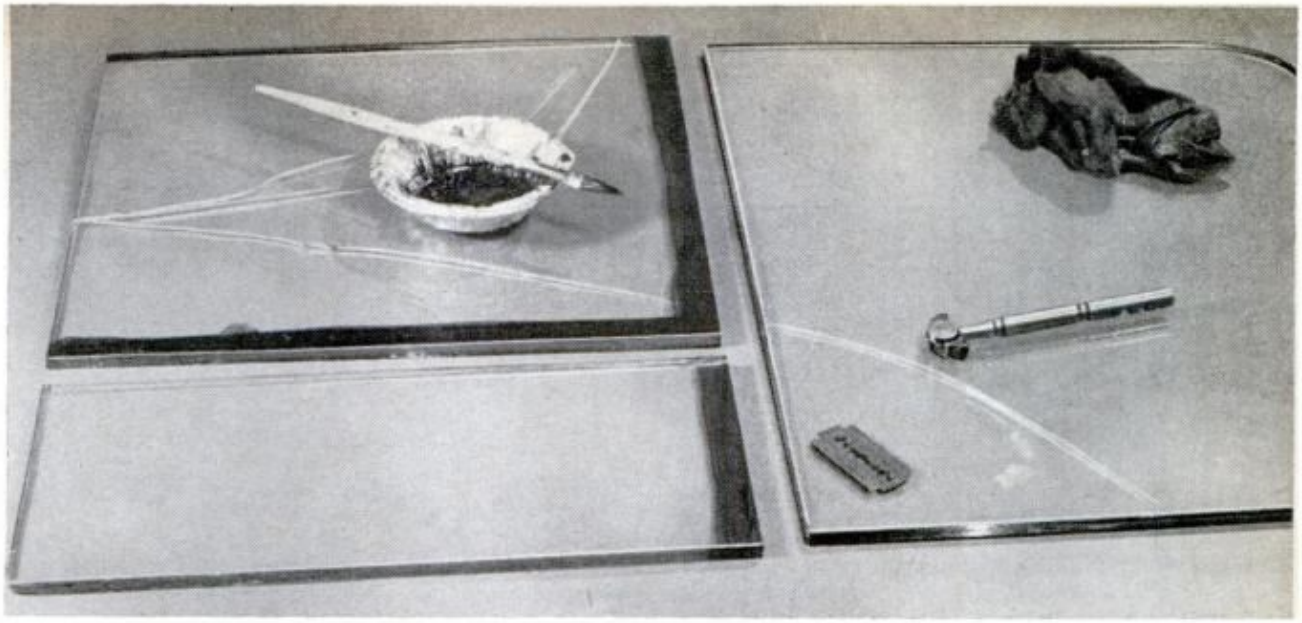

LAMINATED SAFETY GLASS—here a broken car window—may be cut in three steps. Score and snap one surface at a time, then stretch plastic core enough to insert razor blade by heating black stripe along cut

the glass. You can design your board to handle any size glass by using longer or shorter lengths of rod and angle.

But, whether you're using a glass cutter in a jig or working by hand, remember you're only *scoring* the glass, not attempting to slice through it. The actual separation is always a matter of breaking along the score line—and this is what scares most amateurs. But there are several virtually foolproof ways to make this break. One is to position the glass so that the scored line falls directly over a sharp-cornered table edge, with the smaller portion overhanging. Pressing the glass firmly against the table, grasp the overhang with the other hand and bend it downward. It should snap off cleanly.

Alternate methods include placing a yardstick or a metal strip at least ⅛ in. thick under the glass, with its edge lined up with the score, and pressing down on the overhang. This works particularly well with thick glass, such as ¼-in. plate. A variation of this method is shown in the bottom-right photo on page 149: here, the fulcrum is a wedge with a rounded top (even a wooden matchstick will do) inserted under the glass at the end of the score near you. In this case, you press both glass sections downward.

When the cut is very near the edge, you grip the narrower piece with pliers near one end of the scored line, and exert force to flex the glass. If the separation fails to continue the full distance of the score, regrasp the waste at intervals until separation is complete. When the cut is so near the edge that the waste won't come off in a single strip, use the pliers or the notches in the cutter head to remove small bites. Raggedness can be smoothed by grinding.

And, finally, some glass pros don't apply pressure at all—they simply *tap* the underside of the glass along the score to start the separation. But unless this is done skillfully, it can cause chipping, or even a break in the wrong place.

The cutter wheel should score the glass in an unbroken, just-visible line. If varying pressure, dirt, or an improperly sharpened wheel cause skips, it's not recommended that you retrace the score—though there's no law against trying. Glass specialists agree that it's better to flip the piece over and score the second surface, directly in line with the original score. Double scoring is otherwise rarely necessary on glass up to ½ in. thick—unless, of course, you're cutting laminated safety glass, as demonstrated above.

SMOOTH AND EVEN UP cut edges—if necessary—by rubbing them on a wet abrasive stone such as this silicon-carbide file. Or use a sharp flat file wet with turpentine or camphor gum dissolved in turpentine

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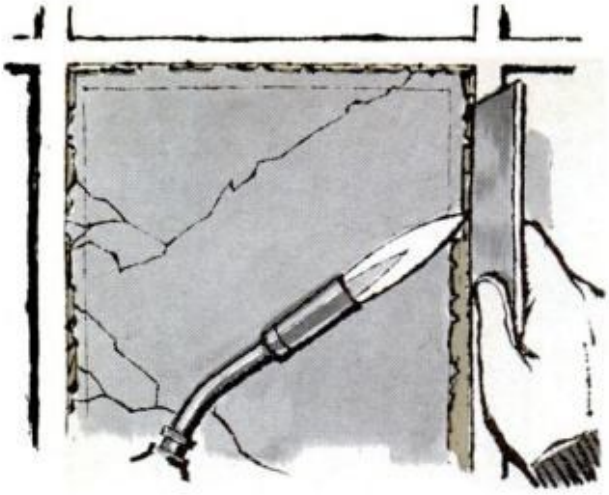
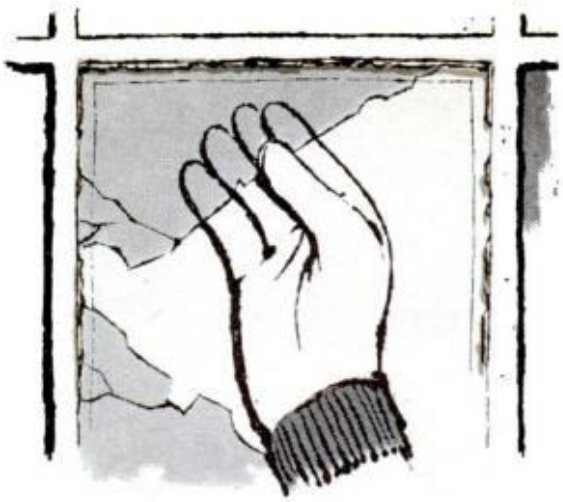
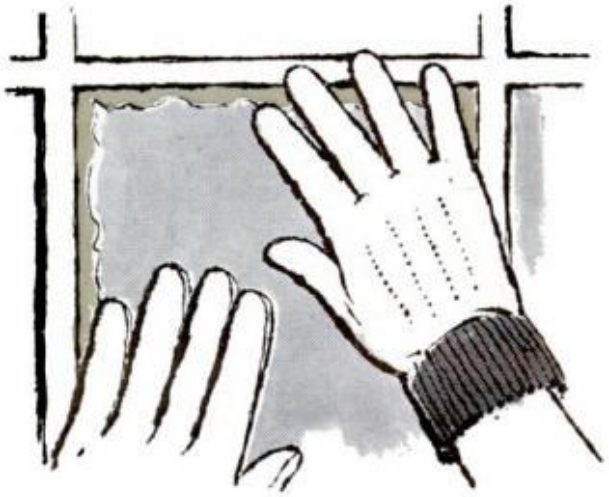


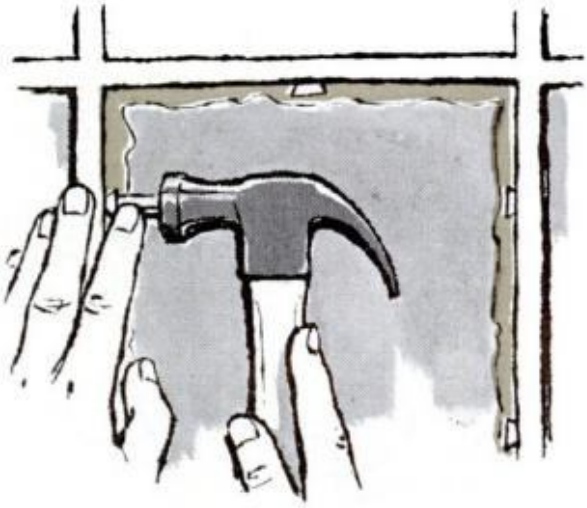
REMOVING BROKEN GLASS is simplified if old putty is softened by playing flame of torch along bevel. With wood sash, there's danger of scorching the frame, so move shield of scrap tin along with torch



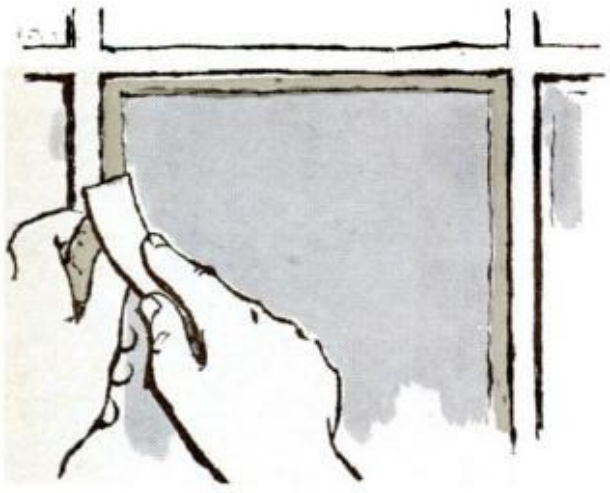
GLOVES PROTECT HANDS as pieces are picked out. Next, dig old putty from rabbet with knife, taking care not to splinter wood. Pry out old glazier's points, brush rabbet clean, and apply thinned paint to it



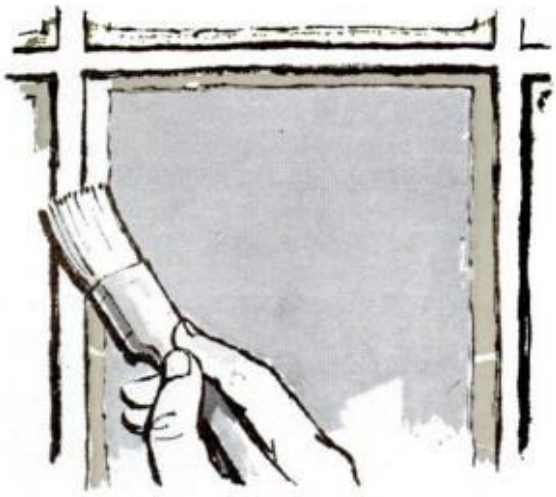
NEW PANE IS CUT ⅛ in. smaller than height and width of opening. Apply thin layer of putty, center glazier's point in bottom rabbet with ⅛ in. projecting, set glass on it and press till putty oozes



DRIVE GLAZIER'S POINTS—size #1 or #2—using driving tool packaged with points. Drive deep enough to hold glass firmly and to be covered by final putty. On small pane, use one on short sides, two on long

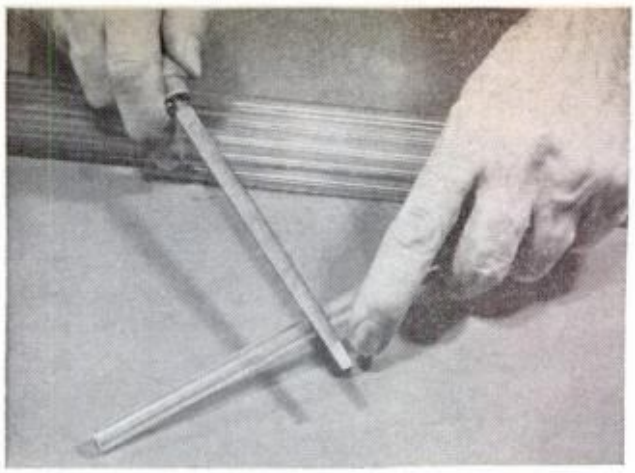


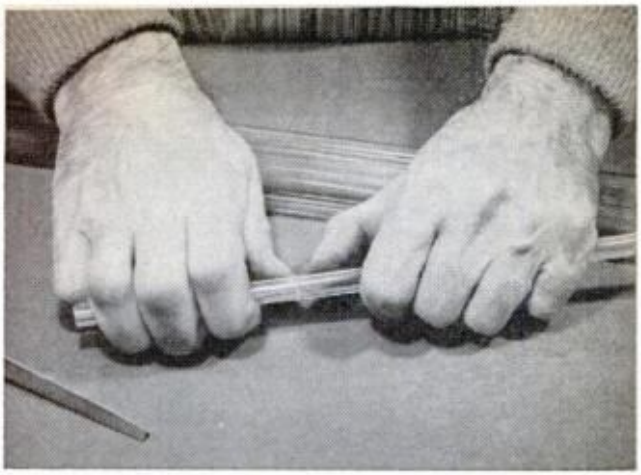
FOR FINAL BEVEL, work putty to consistency of bread dough, then roll into ½-in. strips. Feed it with one hand while smoothing it with knife, held in other as shown to make smooth, even, beveled seal



SEVERAL DAYS LATER, paint all the new work. This is essential not only for appearance, but to keep the putty from shrinking. Excess putty, of course, is cleaned off right after the job, while it's moist

Материал, защищенный авторским правом





SMALL-DIAMETER TUBING should be nicked with a three-cornered file (left) or a glass-cutter wheel, then snapped by gripping in both hands, pressing thumbs opposite nick, and bending tubing toward you (right)

Old glass is likely to be harder than new, so will require greater wheel pressure. Patterned glass having a pebbled or other uneven surface may chip or fleck badly when a sharp wheel is used. The trick is to use a dull wheel and more pressure. So when a wheel becomes too dull for ordinary glass, keep it around for special jobs. (In any case, you needn't throw a cutter away when it dulls: you can sharpen the wheel by honing it on a fine abrasive stone, such as aluminum oxide.)

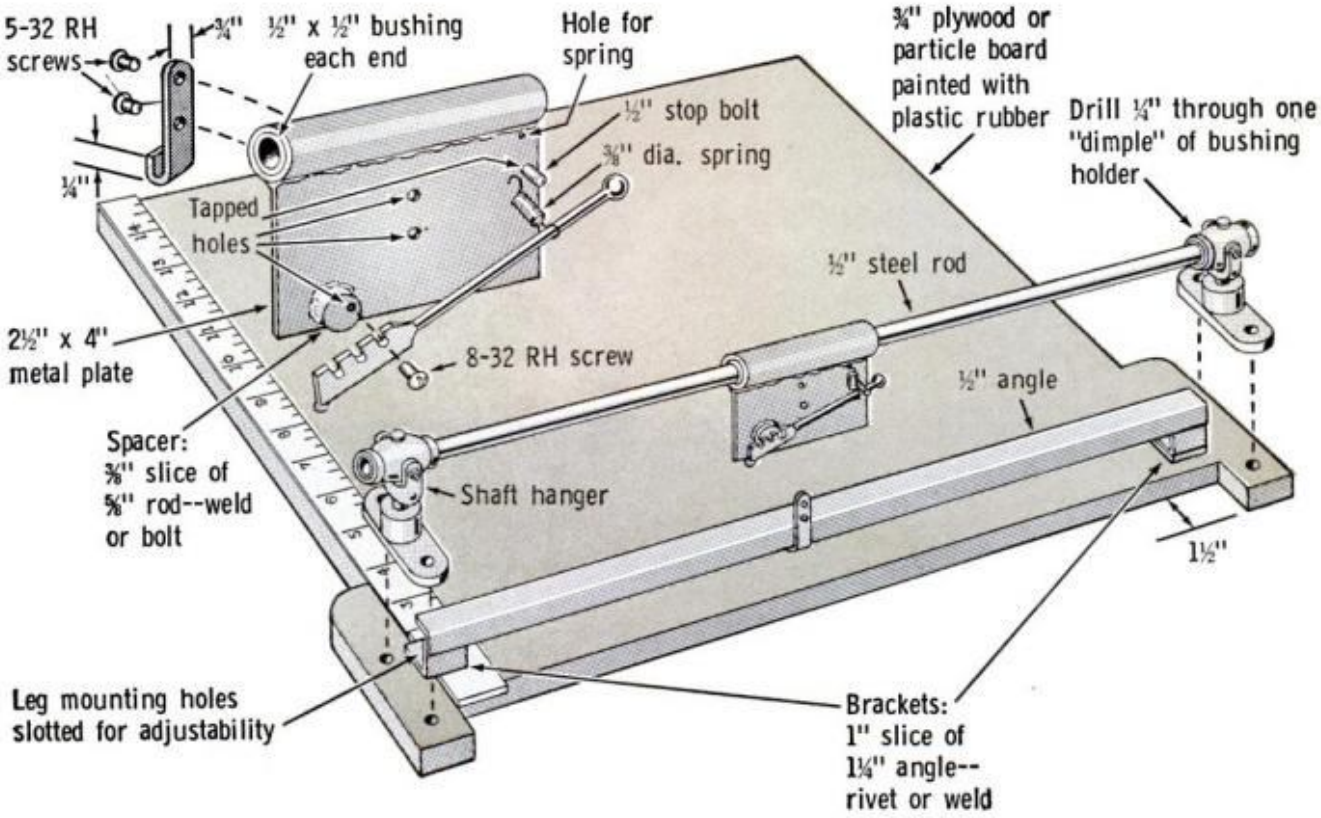
Some experts suggest a dull wheel for thick glass, too, since it lets you apply heavy pressure without so much danger of chipping. When cutting very *thin* glass, support it on a scrap of thicker glass.

Need a circle or other curved shape? Don't attempt it freehand—use a beam-type cutter that pivots around a stationary center. The photos on page 150 show a commercial type, but you can make one that uses the head of an ordinary cutter, as detailed on page 151. Either type will cut glass discs for clock faces, door portholes, round picture frames—all as easily as drawing a circle with a compass.

The homemade device consists of a ½-in.-angle-iron arm which pivots on a 3-in. suction cup from a car-top carrier. Though you could assemble it with brackets, the arm shown was welded. The two long angles were laid upside down and anchored

(Please turn to page 204)

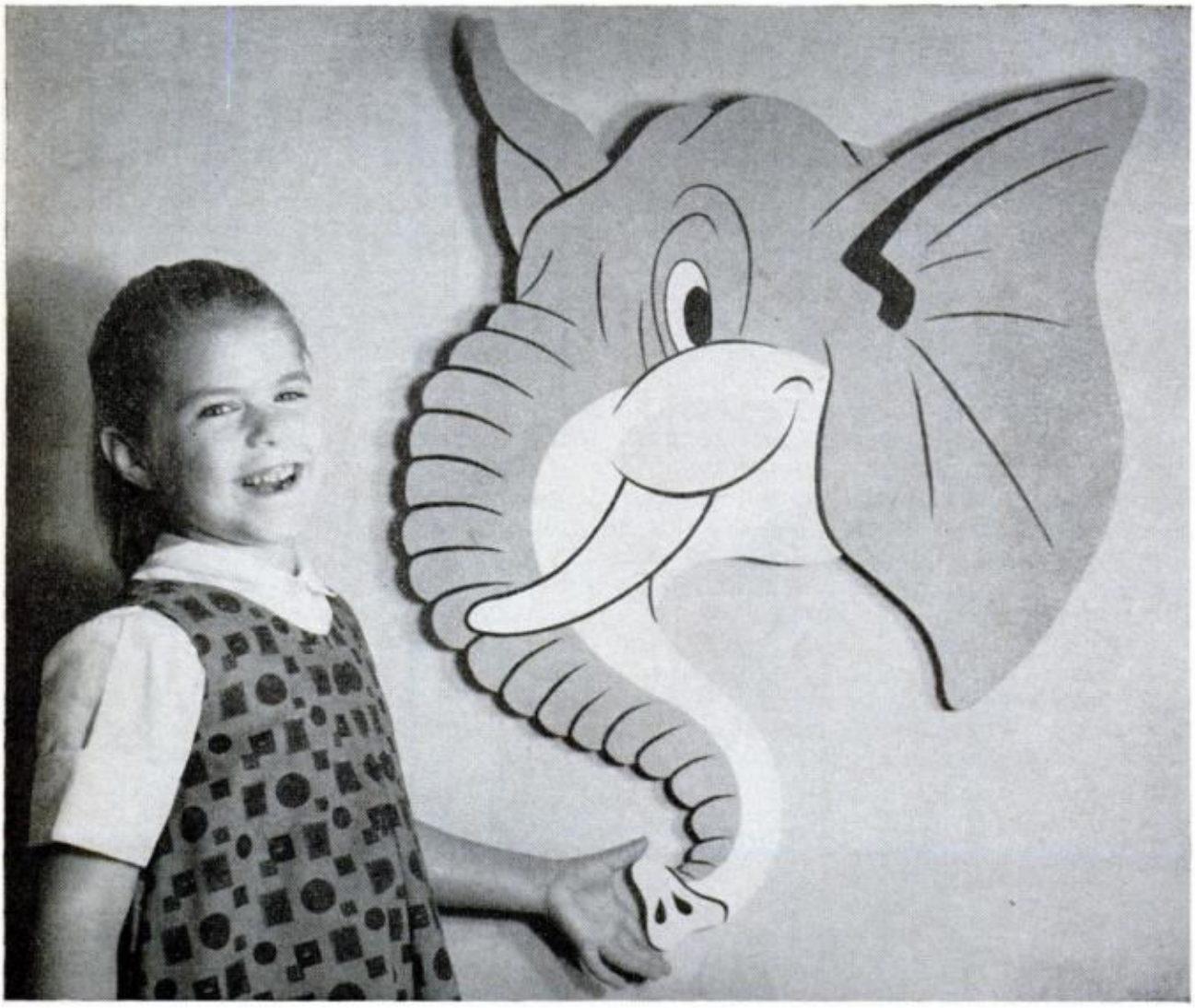
GET A PERFECT SCORE WITH THIS JIG



Материал, защищенный авторским правом

ANOTHER *PM* EXCLUSIVE PROJECT-A-PLAN

Animal Pinup Plaques

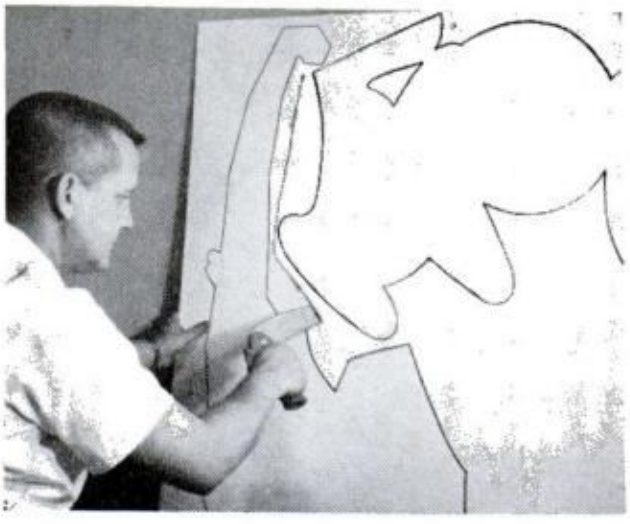


Hang them in the kid's room, rec room or kitchen both to decorate and to corral school mementos or family messages.

By Dave Swartwout

NO REASON why bulletin boards can't be decorative while hanging around, and here are six good examples of how the lowly square board can take the shape of animal wall plaques to dress up various rooms of the house.

By making them from common ½-in. insulation board, you can stick a pin in them anywhere, and it's no trick at all to cut such soft material into fanciful shapes.



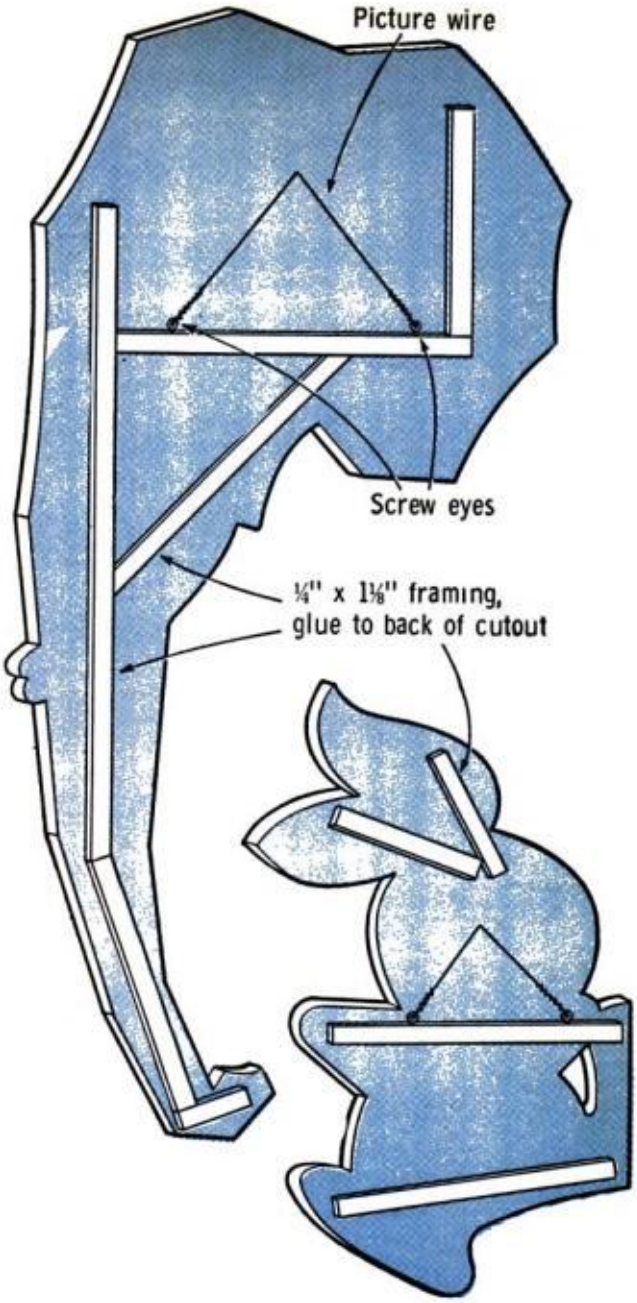
NESTED PATTERNS are brought down to a workable size by roughly cutting them apart with a keyhole saw

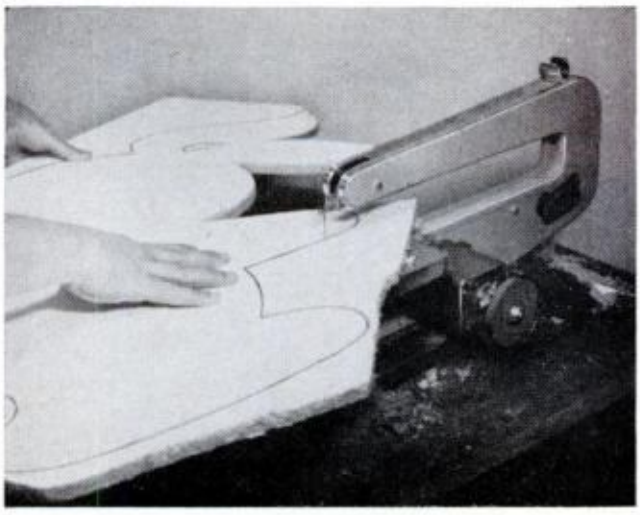
Материал, защищенный авторским правом

As for enlarging the small magazine patterns to king size, *PM*'s Project-a-Plans make it as easy as showing colored slides. You just clip out the "transparency" of your choice, slip it in a cardboard mount, and project it to any size you want. (See page 159). If you're stymied for a projector and can't beg or borrow one, grid patterns of the cutouts are also presented on the following page for enlarging them by the slow, old-fashioned, square-at-a-time method.

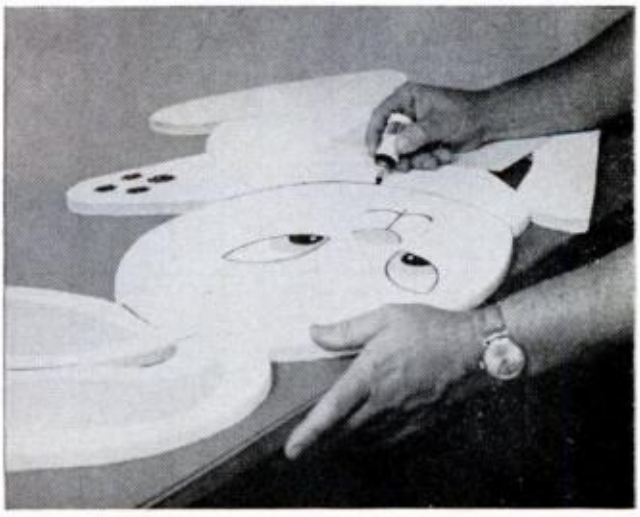
Insulation board comes with a nice white base finish which makes a pencil line show up like tracks across snow. Of course, you can't beat a sabre saw for sawing out such large cutouts since you can take the saw directly to the work. But where it's necessary to saw them out with a jigsaw, you'll first have to saw apart any nested patterns to get the ungainly 4 x 8 ft. sheet down to a workable size. Where there's an inside cutout, pierce the board with a sharp instrument so you can insert the saw blade. Sand the edges slightly and treat them with two coats of white waterbase paint. All surface painting can be done with one coat of latex colors. For dark outlines, felt-tip markers are faster than a brush, and they come in a wide selection of colors.

Since it's easy to snap off a portion of a cutout due to the "brittleness" of insulation board, you should handle it gingerly during and after sawing. In fact, it's wise to add thin wood strips (such as lath) to the backs of the cutouts to strengthen them. These also provide a means of attaching any type of wall hanger, from screw-eyes to the new glue-on hooks. The drawings at the right show how the wood strips can be arranged to brace the elephant's trunk and the rabbit's ears. ★ ★ ★



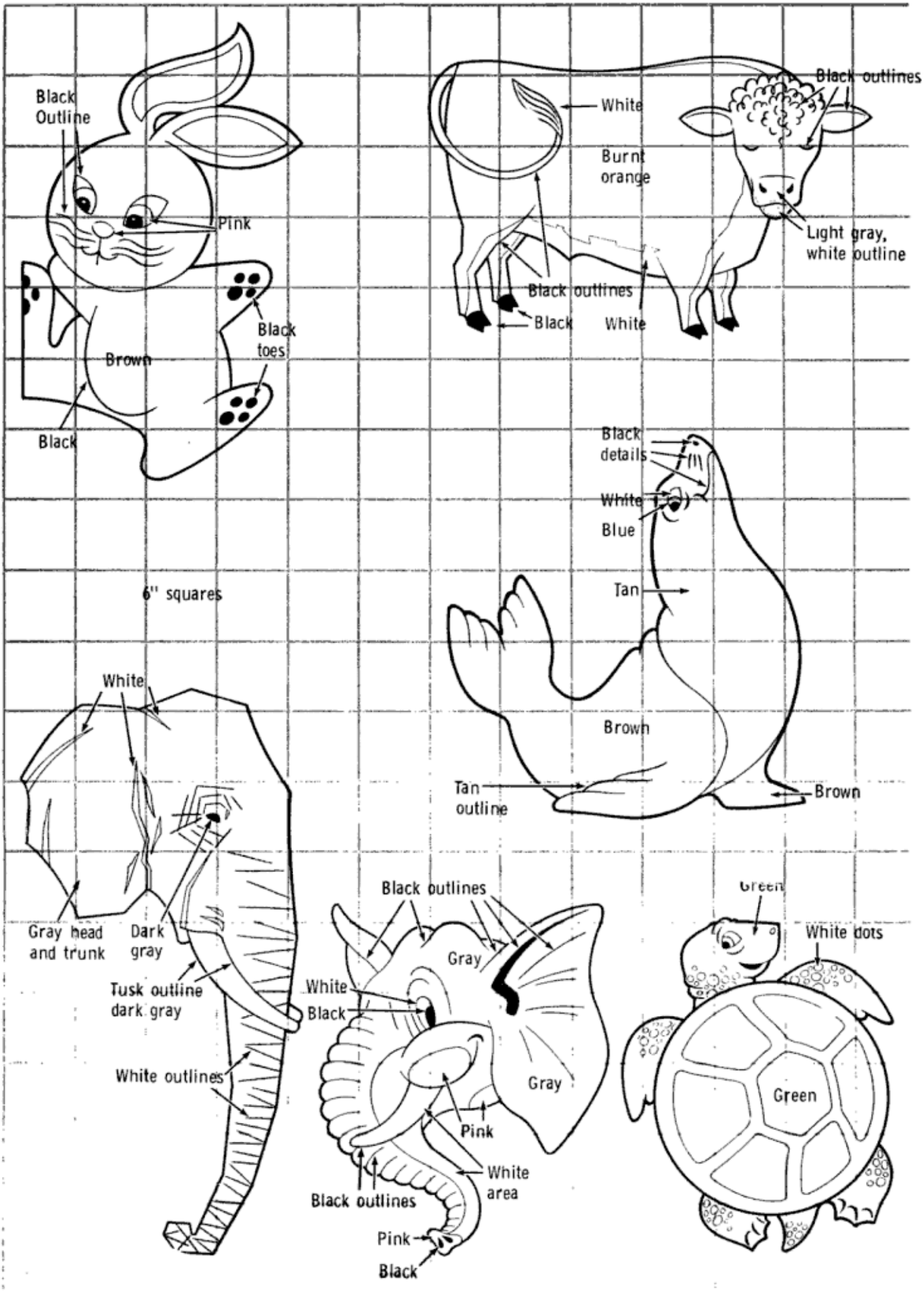


INSULATION BOARD cuts best with a fine-tooth blade whether jigsaw or sabre saw is used to do the cutting



FEATURES and other outlines are added quickly to the painted cutouts by using handy felt-tip markers

Материал, защищенный авторским правом



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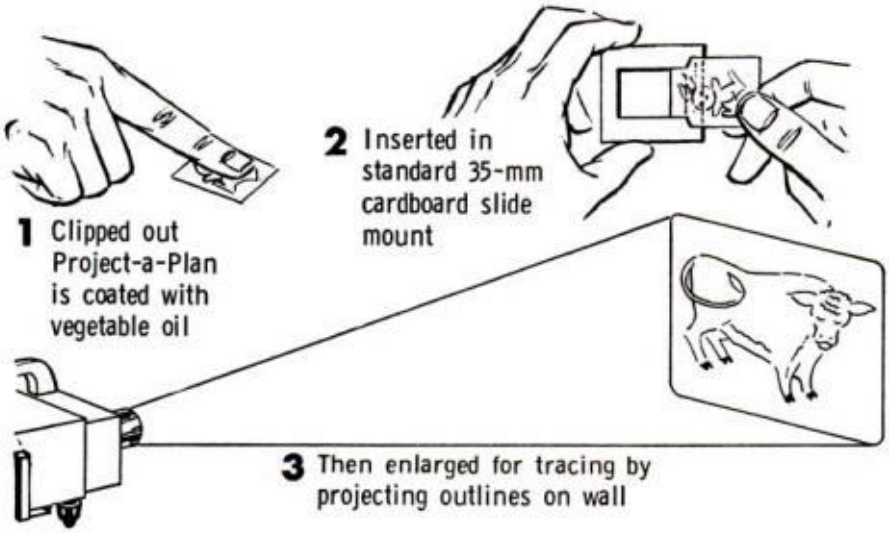
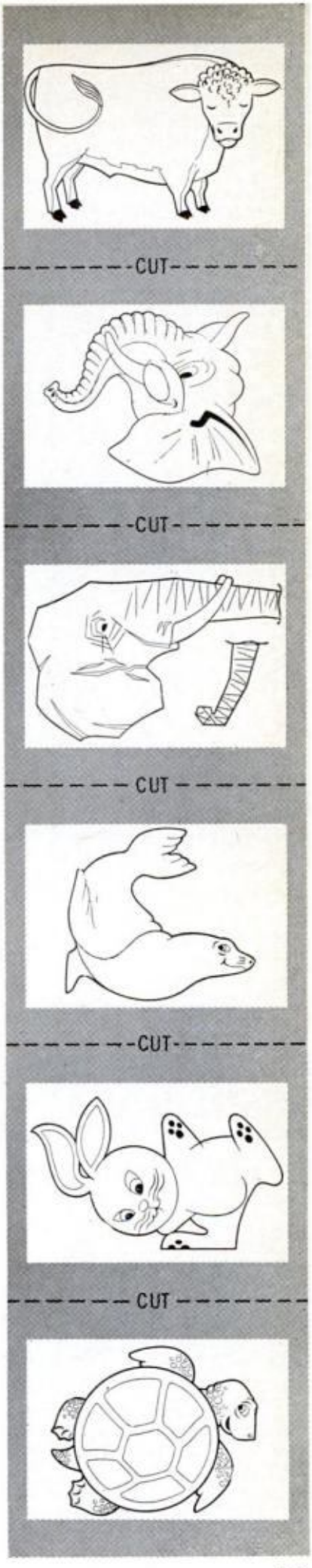




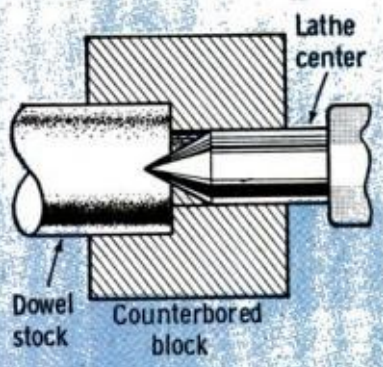
How To Use PM's Project-a-Plans

IF YOU HAVEN'T USED Project-a-Plan transparencies before, you're in for a real treat when it comes to enlarging patterns the easy way. It's as simple as 1, 2, 3. First you clip the one you want to enlarge right from the magazine page. Next you rub the front and back with a little vegetable oil to make the paper transparent. Finally, you insert the paper "film" in a regular 35-mm cardboard slide mount. You now have a black and white slide that can be used in any 35-mm slide projector which permits you to blow-up the pattern to any size you want by simply tracing off the projected outlines right on your material

Материал, защищенный авторским правом

TAKE A HINT FROM READERS

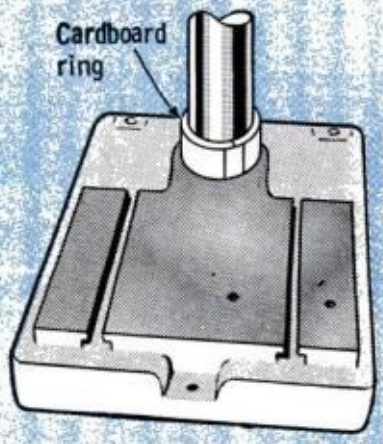
See reverse side of page for clip-out Project-a-Plans for enlarging



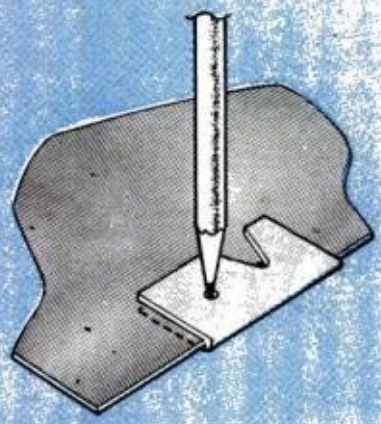
IN TURNING identical parts from dowel stock, a slip-on counterbored block drilled to fit both the dowel and lathe centers will accurately center-mark the work. To mark, tap

EXTRA HAMMER-handle wedges are things you don't necessarily keep on hand, but most everyone has an old house key. It makes a fine wedge for tightening ax or hammer head

ANGLE-IRON ANVIL screwed to the edge of workbench will prove handy for riveting, soldering and metal shaping where a solid hammering and nonburning surface is required



SHOULD THE TABLE on a floor-model drill press accidentally drop, you won't risk a broken casting if there's a bumper to cushion the fall. Section of rug core on column does the trick



YOU CAN'T MISS in marking rivet holes the same distance in from the edge when you use a tin clip that slips over the edge of the sheet metal. V-notch presets drill mark

TOOL PANEL HOLDER for a framing square is ready-made if you use a scrap of tongue-and-groove flooring. If panel is perforated board, attach block with screws from back

Материал, защищенный авторским правом

"Yüan" Trellis

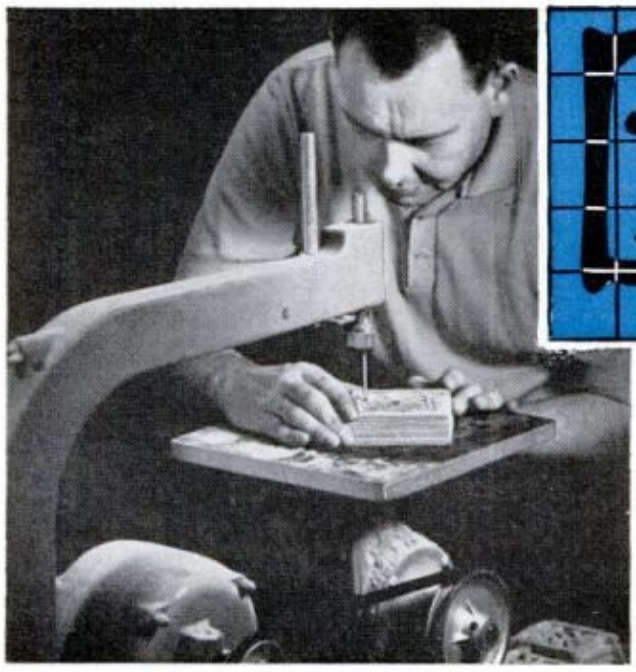
AN EXOTIC BACKDROP for a houseplant or flower arrangement, this openwork screen uses the Chinese ideograph for "garden" as the basic design element.

To make it, enlarge the ideograph below in ¾-in. sqs. and transfer to ¼-in. plywood. After jigsawing the required number of cutouts for the screen you plan, sand all edges smooth and cut ½ x ½-in. divider strips to length. Panel can then be assembled with glue on a tabletop covered with waxed paper.

Once the glue dries, notch the bottoms of the divider strips into one edge of a ¾-in. plywood base tray and apply at least two coats of white enamel. Finally, add small felt pads to the bottom of the base to protect the furniture.—*John Burroughs*

CLIMBING VINES growing in an indoor planter can easily be trained to weave in and out of the trellis. The size you make the trellis will depend on the planter or vase with which you plan to use it

TO SAVE TIME when cutting out the ideographs, cut the ¼-in. plywood into equal size squares large enough to hold the pattern, stack them, drive brads through scrap portion and cut them four at a time



TO ASSEMBLE the screen, spread wax paper over table top and edge glue ideographs between divider strips. Use a carpenter's square to assure right angles, and stagger ideographs to produce pleasing pattern

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WHEN YOU MOVE, THIS

"Built-in" Storage Wall

GOES ALONG WITH YOU

WHY SPEND TIME and money on a home improvement only to leave it to the new owner? Here is one you can take with you—at least when you move. It's a highly functional storage wall that gives every appearance of being built-in, yet breaks down into individual components of a size that can be picked up and moved like pieces of furniture.

It's a smart way of turning dead wall space into a working wall which can be custom built to fit the wall at hand and to suit individual requirements. In the example above the units were designed to flank a fireplace, as well as house a color TV, stereo, records, books, games and what not.

Designed especially for the Simpson Timber Co. by *PM* design consultant, Franklyn Jacoby, A.S.I.D., the units stack on top of one another and are completely interchangeable The storage wall pictured above was made of redwood, redwood plywood and overlaid plywood which requires no painting or finishing. The base and the tops and bottoms of the lower cabinets were made of ¾-in. black, high density overlaid plywood; ¾-in. redwood plywood was chosen for the doors and sides; ¼-in. white acrylic overlaid plywood for the backs and shelves. For the top units, clear all-heart California redwood was used, again contrasted with white overlaid backs.

No specific dimensions are given on the plans, pages 164-165, as exact sizes will vary according to individual requirements. Those that do appear on the plan are approximate sizes which can be adjusted for any room. It's a good idea to keep your dimensions modular so that if your next home has a larger room, you can build additional units. In fact, you needn't rush to build *all* the units your present space

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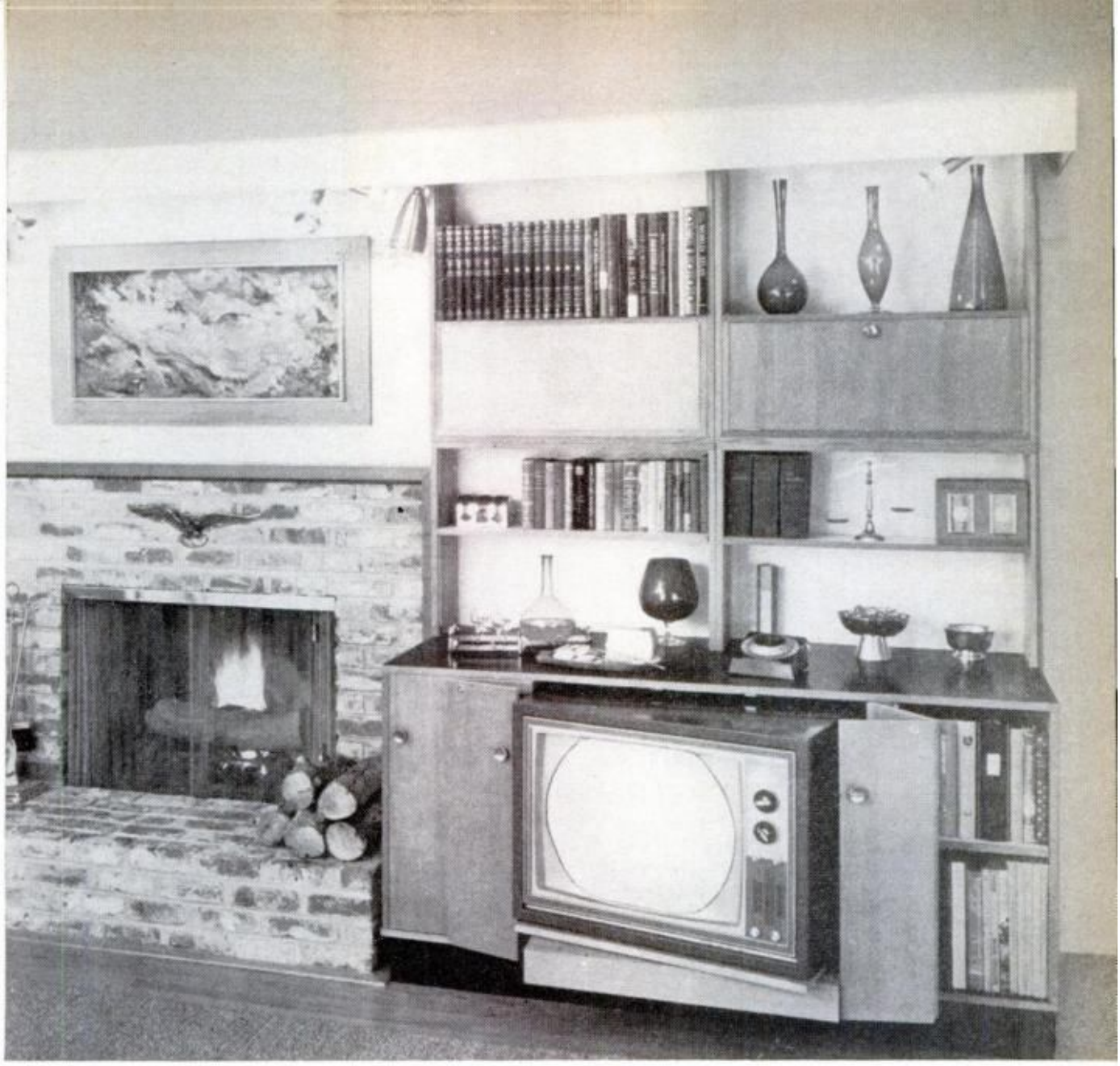

requires. Take your time; build what you need most, right now, and add other units as time and the budget permit. Incidentally, the units can also be stacked back-to-back to form a room divider which can then be altered or shifted as needs change.

All the units are of box construction, employing simple butt joinery. Both glue and screws should be used in assembly for maximum strength. The shelves and the insert "box" components are supported on adjustable shelf standards for still greater flexibility of arrangement.

For best appearance, the counter top should be fastened to the lower unit with a hidden fastener, either angle brackets or blocking screwed from the inside. Since the upper units stack on top of each other, the screw heads here will be concealed. As for the exposed plywood edges, these should be covered with ¼-in. strips sliced from a length of the solid redwood.

In figuring the unit dimensions for your wall space, allow ¾ in. for each thickness of plywood and solid redwood (the latter is nominally 1 in. stock, but actually measures ¾ in. thick). Don't plan to build right up to the ceiling—leave 4 to 6 in. at the top to facilitate stacking and removing the cabinets. That gap can be concealed with a wooden cornice, as shown in the photo. This cornice also makes possible a very flexible lighting arrangement —anything from a fluorescent strip to the individual spots, plugged into a continuous wiring strip (detailed on page 164). The original setup also has two cabinet-mounted swivel fixtures for extra light at the fireplace section. These are controlled by a separate dimmer system, so you can "dial" any combination of light you wish.

The dimmer control box plugs into a

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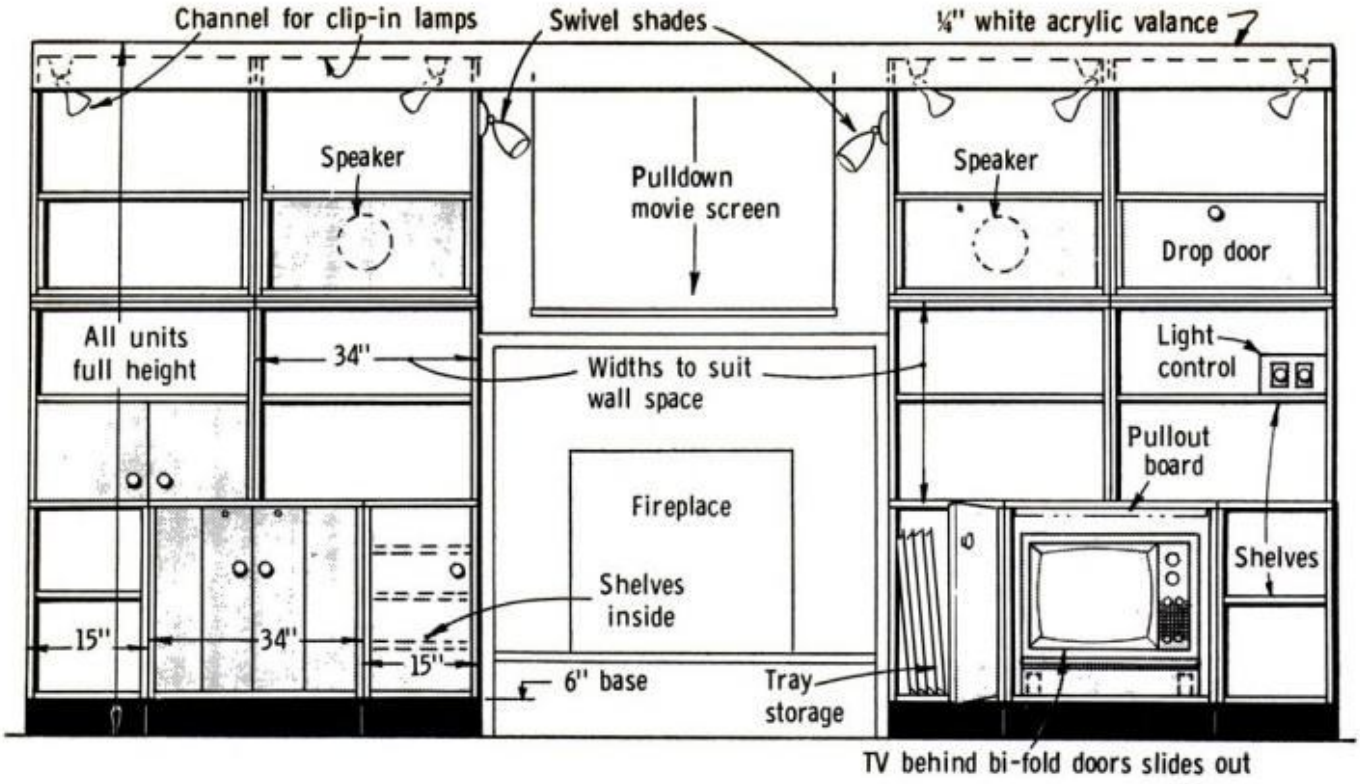


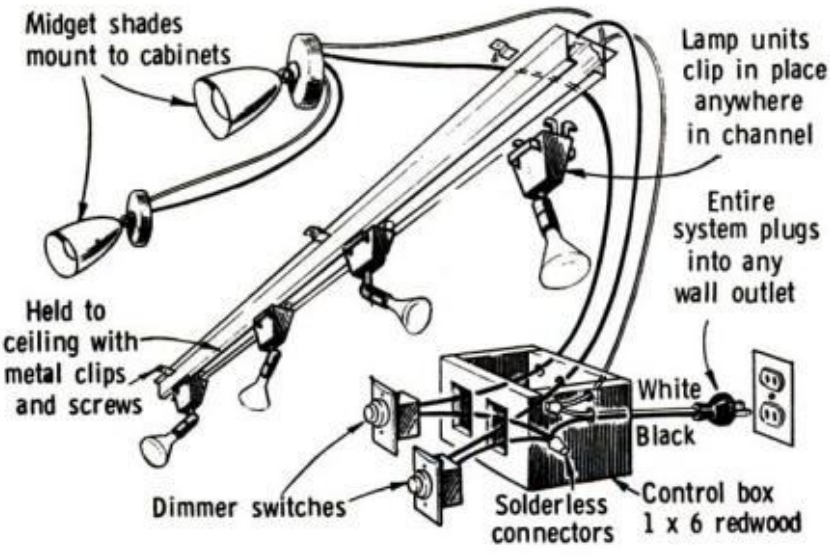
regular wall outlet. All wires are concealed either behind the cornice or in back of the cabinets. Small holes were drilled in the backs of those cabinets that house speaker units and stereo components.

The television set is mounted on a swivel which is in turn mounted on a slide, so you can pull the set forward and turn it in any direction to meet viewing needs. If you incorporate this feature, it is a good idea to tie this unit to the wall just under the counter, so that it can't tip when the heavy television set is pulled out. The "tie" can be as simple as a pair of screweyes into both the wall and the inside faces of the cabinet, fastened together with heavy wire. For ventilation, bore large holes in the back and bottom of this cabinet.

Although the detail of the suspended insert cabinet shows left-and-right hinged doors, these interchangeable units can be equipped with a drop-leaf door, instead. The inside can be provided with a shelf, a partition, or left completely open, depending on what is to be stored there. It's recommended that you construct your units, try them in various arrangements on the wall, and *then* decide which items will go in what cabinets. That's the time to take them down and outfit their interiors. ★★★

Acknowledgement of Thanks

The following accessories were used in photographing the original installation:
RCA Victor color TV set
Swivilier midget shades and Plug-A-Lite
Hunt electronic dimmer controls
Channel Master automatic antenna rotor
Busway clip-in lamp track
Stanley hardware



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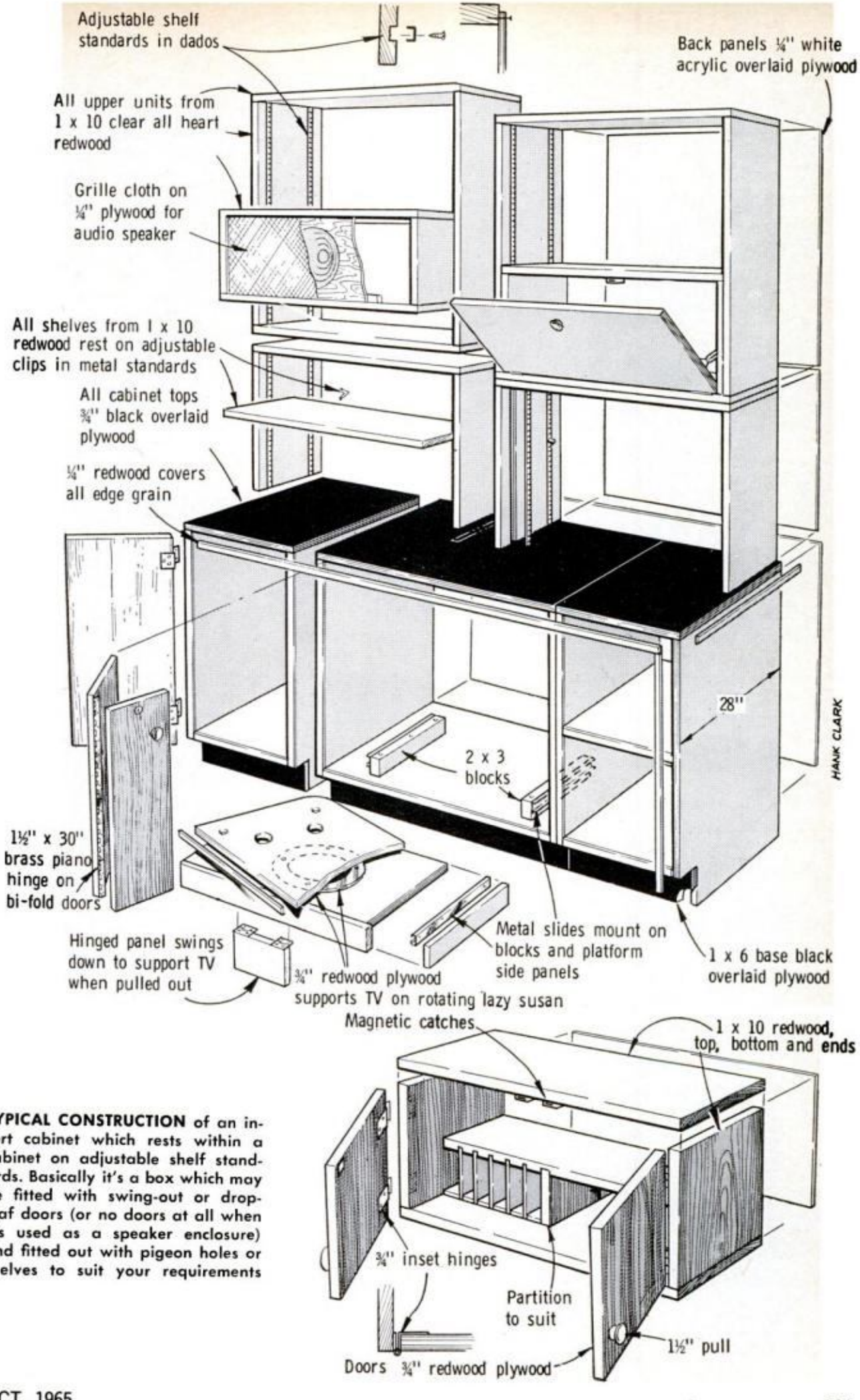

TYPICAL CONSTRUCTION of an insert cabinet which rests within a cabinet on adjustable shelf standards. Basically it's a box which may be fitted with swing-out or drop-leaf doors (or no doors at all when it's used as a speaker enclosure) and fitted out with pigeon holes or shelves to suit your requirements

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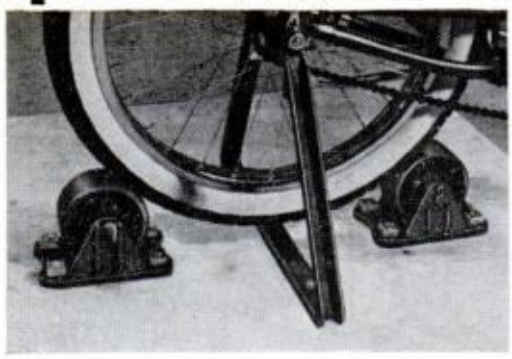
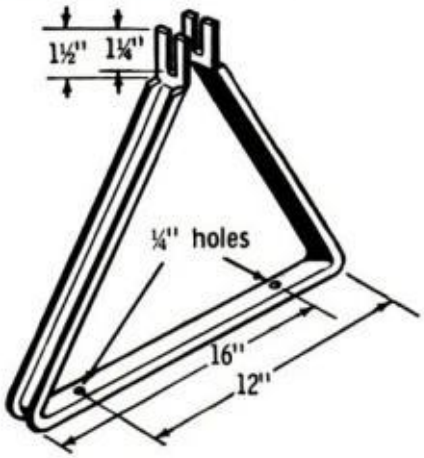
"Up-Hill-Climb" Converts Any Bicycle to Exerciser





You'll be pooped at the end of your first hour's workout of 10 minutes on, 10 minutes off, but a daily stint of peddling this makeshift bike exerciser will make a rugged individual of you in short order. Any bike will do without altering it a bit, and the changeover is simply a matter of loosening the rear wheel nuts, standing the bike in a bracket and tightening them again.

The "up-hill" pump you add to the pedals is produced by the back wheel bearing on two 3-in. nonswiveling truck casters fastened to a 3-ft.-sq. piece of ¾-in. plywood. The harder the wheel bears on the casters, the more leg muscles it takes to pedal and the stronger (or weaker) you get. The bracket, which looks like an old-time bike stand (in fact one would do), is formed as shown from a 5-ft. length of ½ x 1-in. wrought-iron railing channel. It's bolted to the plywood midway between the casters and should clear the tire about 2 in.—*Mike Brenish*

Giant Top for Card Table Handles King-Size Puzzles

Do you have a jigsaw puzzle fiend in your family? Would you like to eat at your dining room table again instead of seeing it littered with scattered pieces of do-not-touch, half done puzzles? Well, here's a simple solution that will not only get your puzzle lover out of the dining room, but make it easier for him to work his puzzles to boot.

It's a 4 x 6-ft. puzzle board that's hinged down the middle for easy storing and is designed to rest on top of a card table. It's big enough to accommodate the giant 1500-piece puzzles (or permit two 1000-piece ones to be worked by two persons at the same time), and is "notched" along the sides so you can sit in close to reach all parts of a puzzle with ease. The board consists of two pieces of ⅛-in. tempered hardboard cut as shown and hinged together on the underside with a broad strip of pressure-sensitive cloth tape.

—*Jean Viering*

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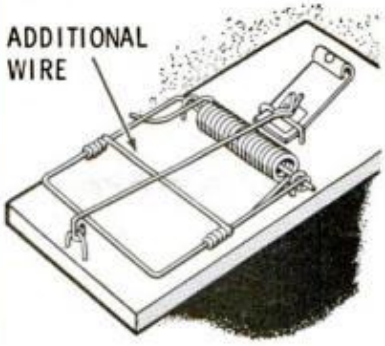
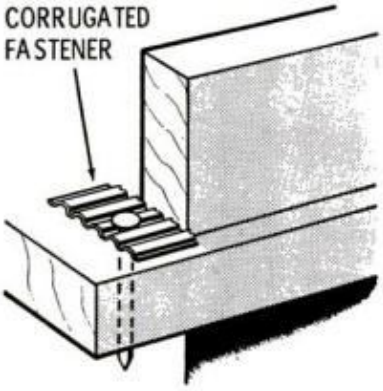
TAKE A HINT FROM READERS

TO MAKE A TOOL OILER, fill a baby-food jar half full of oil and plug the top with a rolled felt stopper. Nails keep felt off bottom. To use it, invert jar and rub lightly. Store right-side up

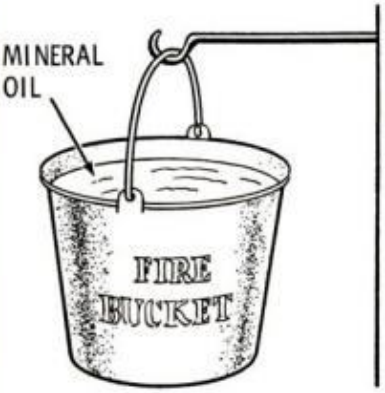


BY ADDING A SPECIAL "mouse bar" to your rat trap, you can convert it to an all purpose trap for both rats and mice. Make the mouse bar from heavy wire and position it as illustrated

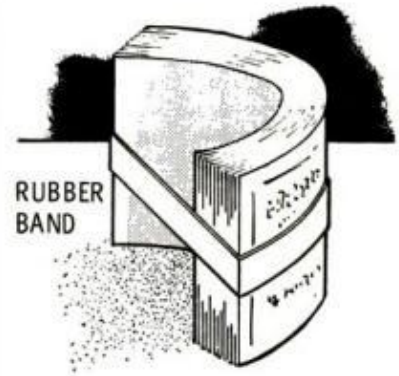
TIN CANS make fine bird feeders if you don't completely cut the tops off when opening them. Left partly attached, the lids will support dowel perches by rolling metal around them



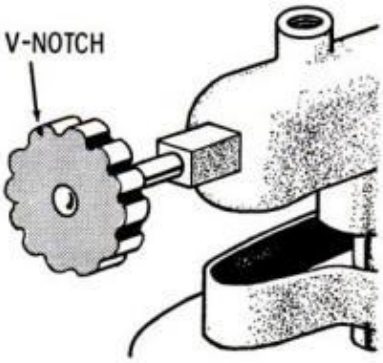
REMOVABLE BENCH STOP for planing is a simple matter of boring a hole through a corrugated corner fastener and into your bench top, then dropping a shingle nail through



RETARD EVAPORATION of water from standing containers such as fire buckets by dropping just enough mineral oil onto the surface to seal off the air. You'll have to fill less often

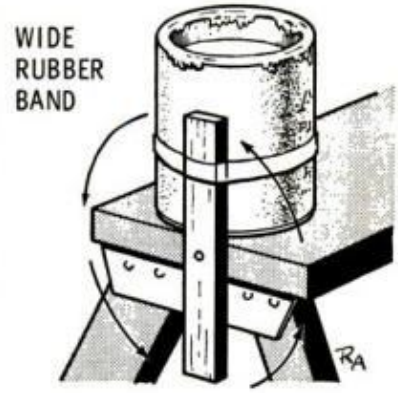


SHIPPING LABELS curled up so tight they're a nuisance to moisten? Bend the pack in the opposite direction and snap on a rubber band. Then draw them, as needed, from the inside



DON'T FORCE the needle valve of a blowtorch closed or you may damage it. As a reminder and guide, file notch on the knob that will indicate proper closing position when it's straight up

MIDGET MORTAR-AND-PESTLE for crushing photo chemicals, pills or other pellets and crystals, for quick dissolving, can be improvised by using a glass caster cup and a small spoon



SWING-UP HOLDER prevents paint from skidding off top of stepladder. Consists of stick attached with screw to end of top step. Large rubber band clamps can to upright stick

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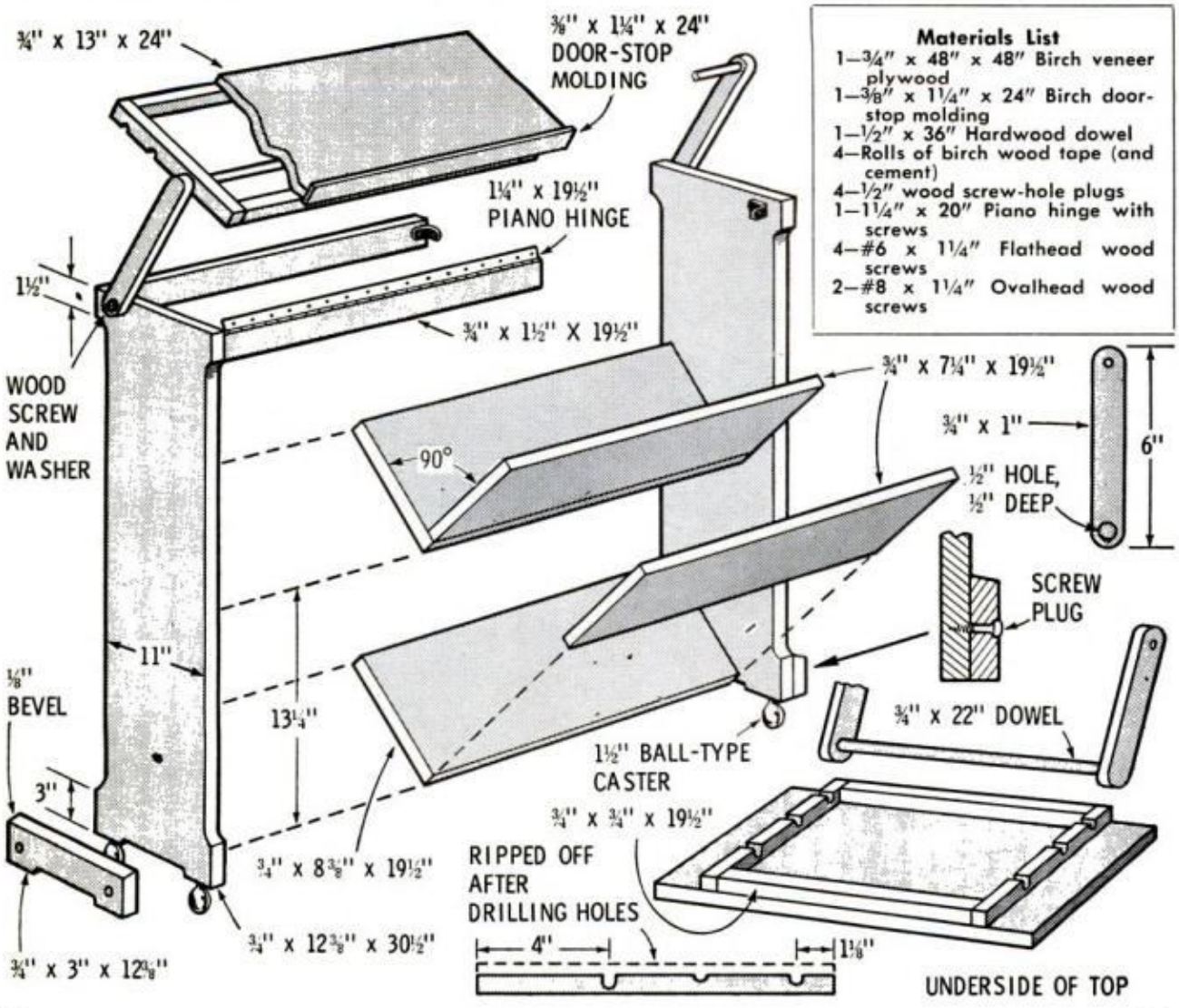
Lectern Bookcase

WHILE on standby as a lectern, this triple-duty bookcase with its adjustable easel, makes a wonderful place to perch Mr. Webster himself. It makes thumbing through any heavy, bulky dictionary a lot easier, and when it's fitted with the new, easy-rolling ball-type casters, its two-ton load can be wheeled about with the greatest of ease. If you make it from veneer-face plywood and cover the edges with matching wood tape, it'll look just like it's made of solid stock.

If you prefer to work from a pattern with all parts presented actual size for tracing directly, send $1 to Steve Ellingson, Popular Mechanics Pattern Dept., Box 2383 Van Nuys, Calif. and ask for pattern No. 376.

Materials List

- 1—¾" x 48" x 48" Birch veneer plywood
- 1—⅜" x 1¼" x 24" Birch door-stop molding
- 1—½" x 36" Hardwood dowel
- 4—Rolls of birch wood tape (and cement)
- 4—½" wood screw-hole plugs
- 1—1¼" x 20" Piano hinge with screws
- 4—#6 x 1¼" Flathead wood screws
- 2—#8 x 1¼" Ovalhead wood screws



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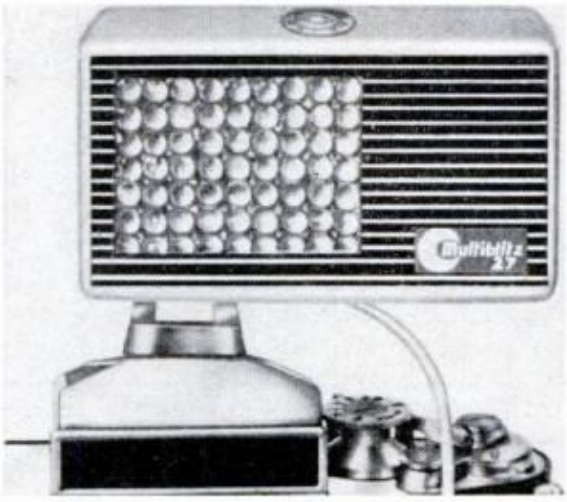
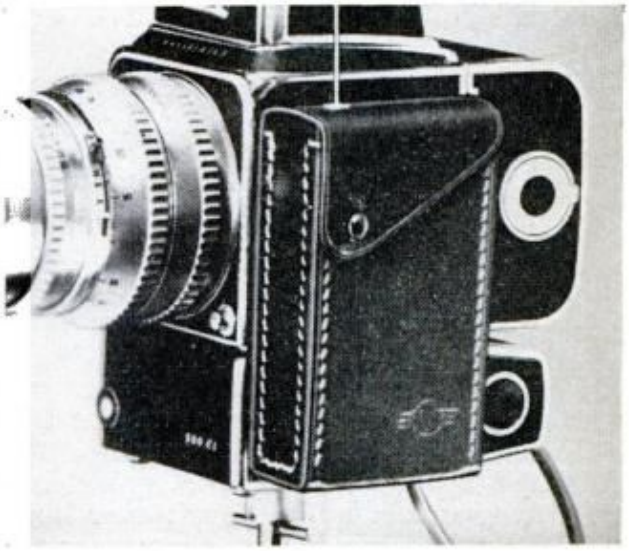
New for Camera Buffs



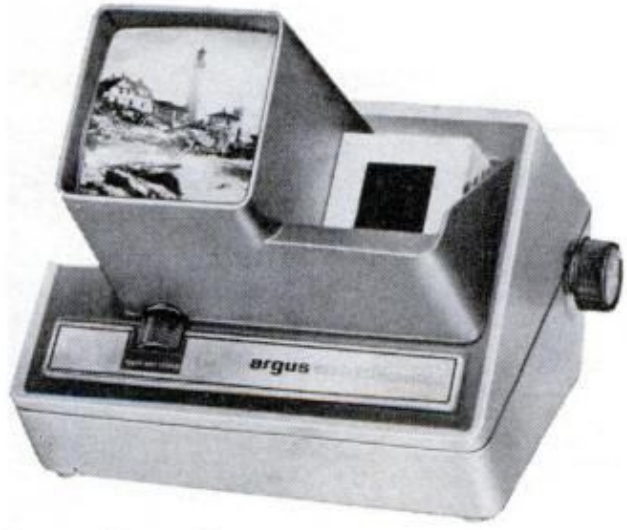
Power-Packed Midget

The Multiblitz 27 electronic flashgun is said to be the world's lightest unit of its kind. Weighs only 7½ oz. and measures 1½ x 2⅝ x 3½ in. Works on a.c. power, recycles in 5 seconds, and gives adequate light coverage for moderately wide-angle lenses. Costs $29.95. Exacta, 705 Bronx River Rd., Bronxville, N.Y.



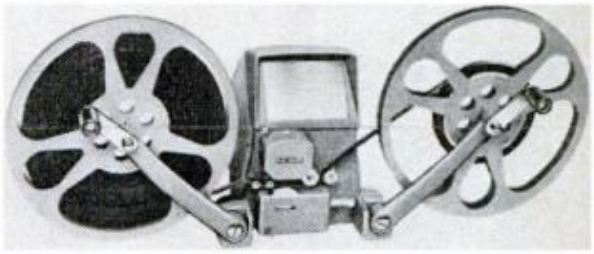
James Bond Special

The Hasselblad 500EL 2¼x2¼ camera can be fitted with motorized drive that advances the film and cocks the shutter, also a radio-control mechanism lets you trip the shutter from up to 3 miles away. Ideal for nature photography, plant security, and taking candid child photos. Camera alone sells for $885. Paillard, Inc., 1900 Lower Rd., Linden, N.J. 07036



Stow That Screen

No need to break out a projection screen anymore for just a quick peek at your slides. The power-driven model 693 electromatic takes up to 36 slides, passes them automatically and quietly before a viewing lens. You get a 5-second look at each one. Also works manually. Retails under $20. Argus, Inc., 5950 Touhy Ave., Chicago, Ill.



Movie Buffs Attention!

A new line of film editors includes models for either standard 8-mm or Super 8 film. Such features as adjustable image focusing, straight-line threading and rapid re-wind help speed your editing. All models take 400-ft. reels and have 2x2⅝-in. viewing screens. Cost $39.95 and up. Kalimar, 2644 Michigan Ave., St. Louis, Mo.

Give It the Brush—Off

When cleaning your camera lens, don't forget to blow or brush off dust particles before using the lens tissue. Otherwise, you risk scratching the surface.

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Modeling the

Pivot-Wing F-111

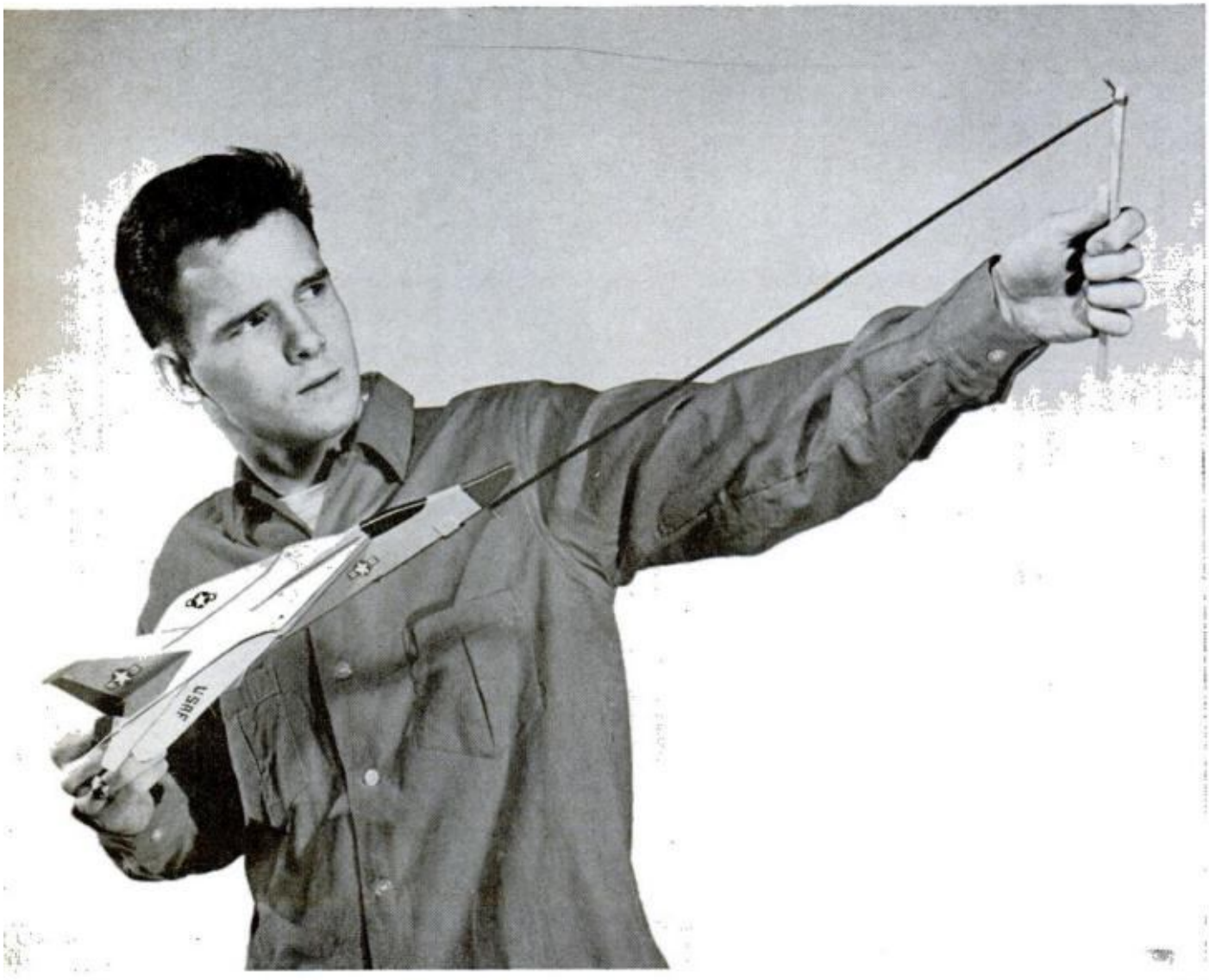
Made entirely from balsa, it mimics the action of its prototype (in reverse) by gradually extending its movable wings from a full swept-back to full extended position during flight

By Roy L. Clough Jr.

REALISTIC zooming flights that end in a slow glide to earth are possible with this unique "silhouette" model of the TFX, the USAF's new experimental fighter. This most versatile aircraft ever built is now dubbed the F-One-Eleven, and a story on its development and performance appeared in our May 1965 issue, page 84.

Not only does this model slowly extend its variable, delta-like wings in flight (the reverse of the actual plane) but its wings can be locked at various angles of sweep to determine the effect at various speeds. It's quite considerable—the more wing backsweep, the higher the speed.

The wing-sweep retracting mechanism is simple and effective. Here's how it works: The wings are drawn back to a full swept position by strong button-thread lines which attach to pins in the



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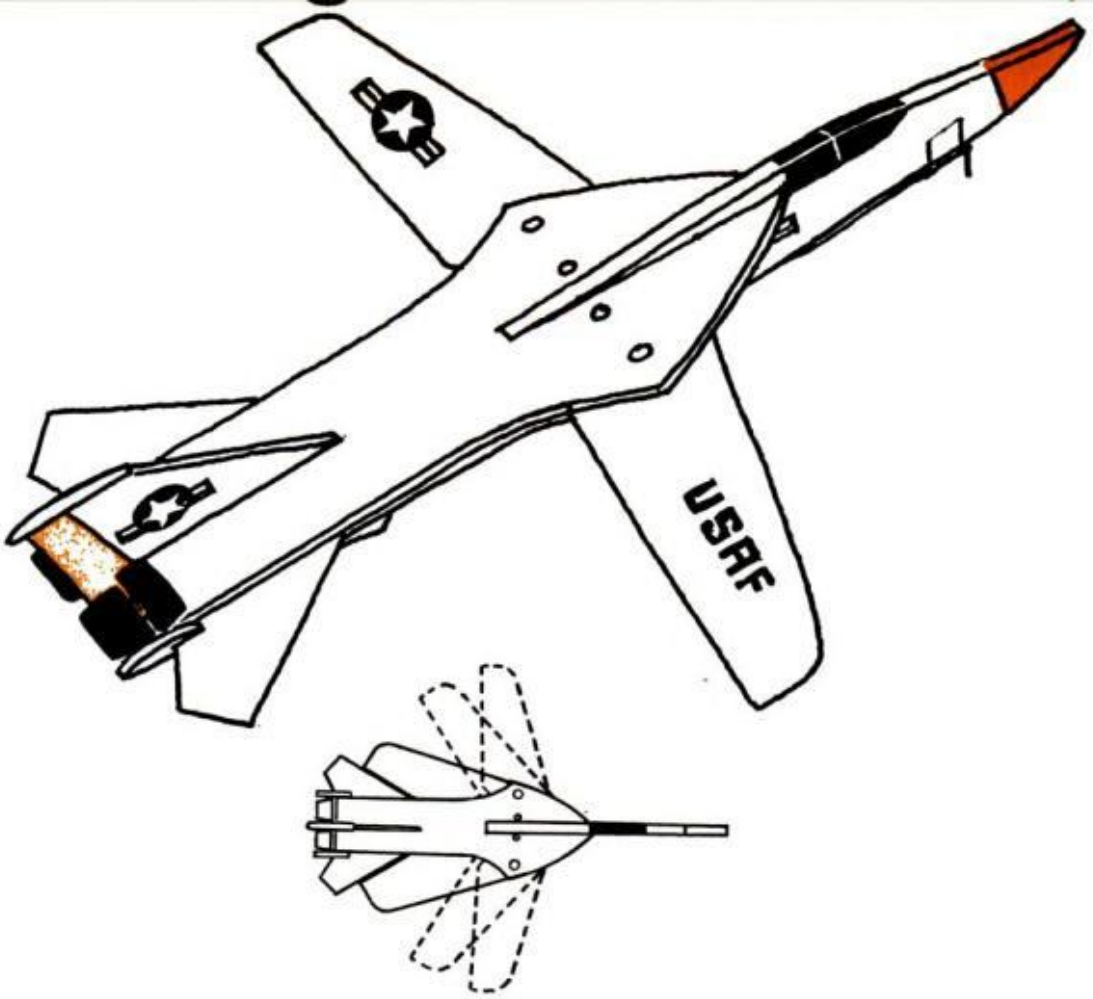
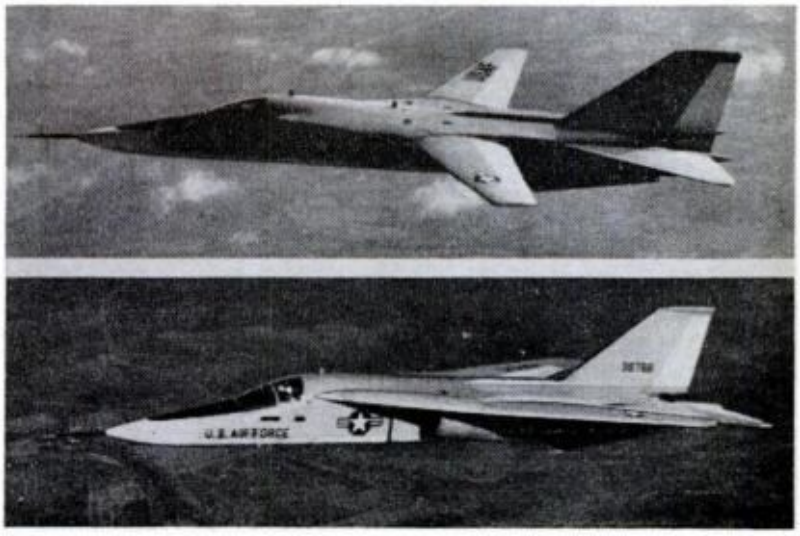


leading edges of the wings, and pass through an eyelet at the rear of the tail, then on to the eye of the launching hook. A rubber band, attached to the same wing pins and passed through a hole in the fuselage at the end of the cockpit, pulls the wings to a fully extended position.

The launching wire slides in a short length of neoprene model gas line. Friction between the wire and the tubing, which is adjusted by gently pinching the tin holder, causes the launching wire to retract slowly when pulled by a second set of rubber bands attached to the eye of the wire and to a small hook embedded in the lower edge of the fuselage.

The launching wire is pulled forward to retract the wings to a full swept-back position and then the plane is catapulted by a sling shot consisting of a loop of ¼-in. model airplane rubber tied to the end of a dowel handle. When the plane is aloft and the hook is being slowly pulled back by its rubber band, the wings spread



PHOTOS AT RIGHT of actual plane during test flights show the USAF's new supersonic fighter with wings full forward (top) and swept fully aft. Take off and landing is made with wings extended, then swept back in flight for high speed. In our glider replica, flight performance is just the reverse: wings are swept fully aft in take off

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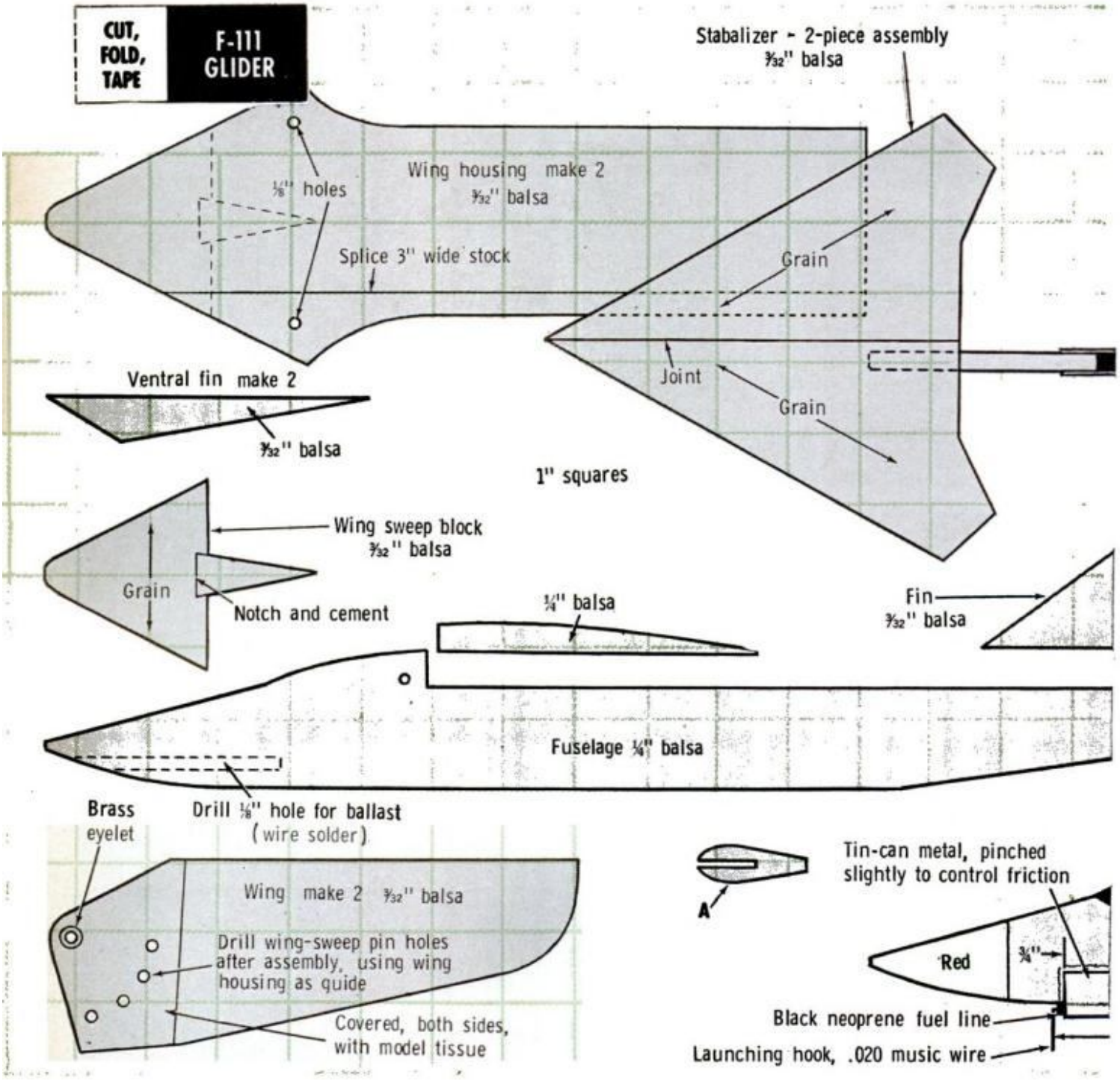
to full width in 3 to 5 seconds. Proper drag on the wire is found by experiment.

To fly the model with the wings in a fixed sweep, dowel pins are inserted through aligning holes in wings and wing housings to lock them at the desired angle. Flight trim is secured by adjusting the elevator tabs which occupy the position of the jet tailpipes on the actual F-111. When the wings are fully retracted, the elevators can be used as ailerons. Minor directional trim can be made by gently bending the trailing edge of each fin.

Patterns for the various parts are presented on squares for enlarging to size. Select a medium weight of balsa and note the direction of grain in the pattern for maximum strength. Build up the fuselage and the bottom of the wing housing first. The wings are reinforced at their pivot ends with model tissue, and a brass eyelet, carefully pressed in place, reinforces the hole for the wing pivot pin. Take care in cementing the top half of the wing housing in place that you don't stick it to the wings themselves. While the location of the locking-pin holes are indicated on the wing pattern, it's best to drill these after assembly by using the holes in the wing housing as a guide. Heads are formed on the dowel locking pins to keep them from falling through. ★★★



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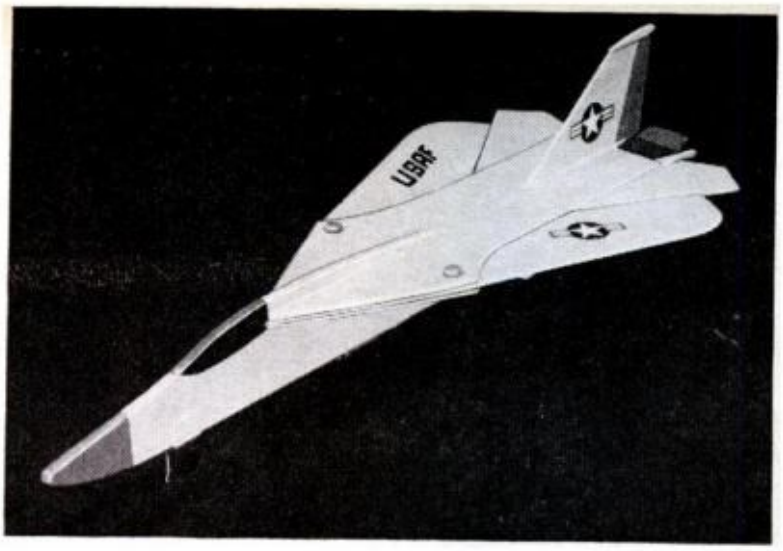
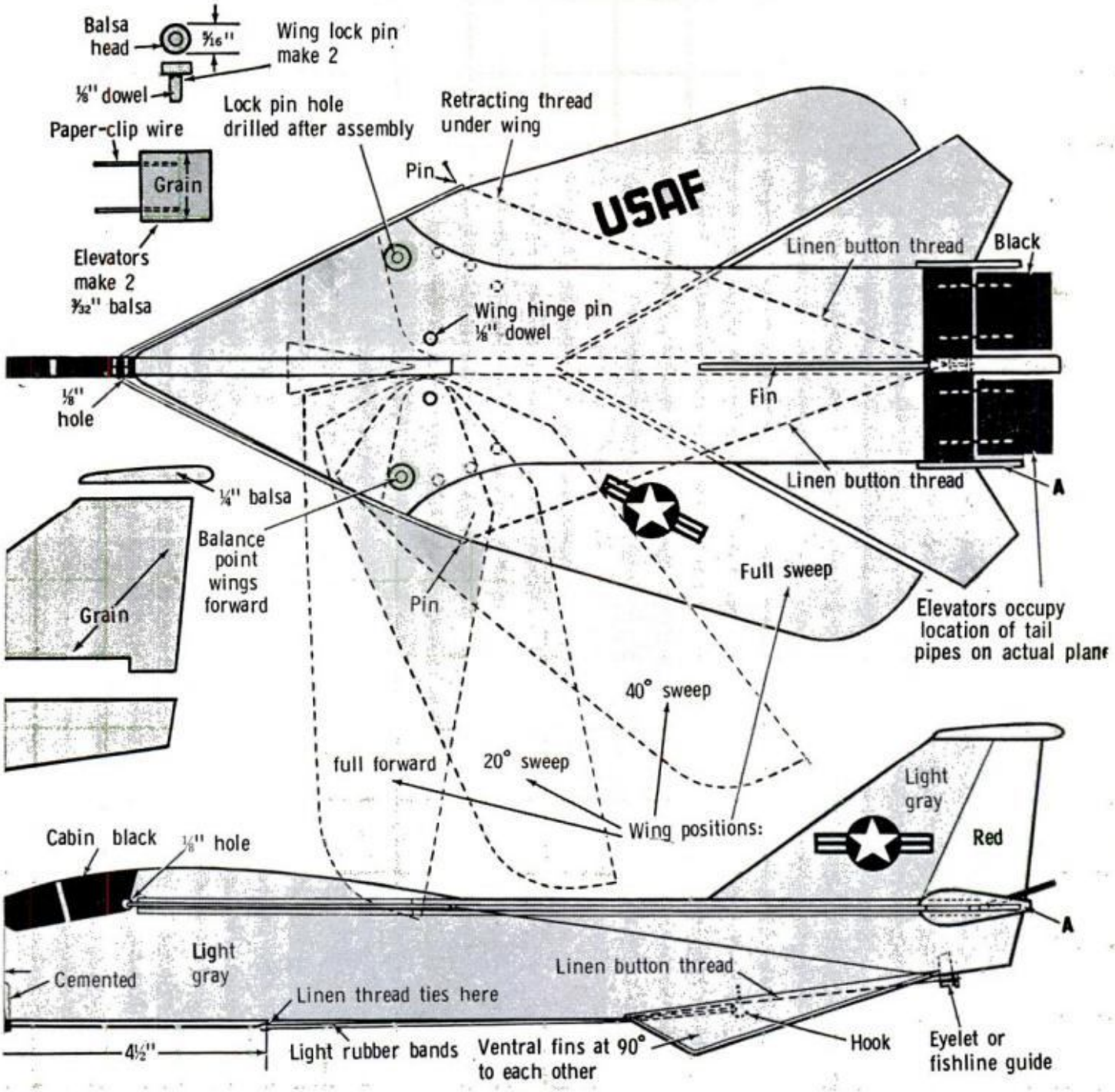
LOCKING PINS permit balsa glider model to be flown with wings in one of four fixed positions. Photo at right shows adjustable wings locked in full swept aft position. Without locking pins, swept-back wings slowly extend to full forward position after plane is launched by rubber-band slingshot





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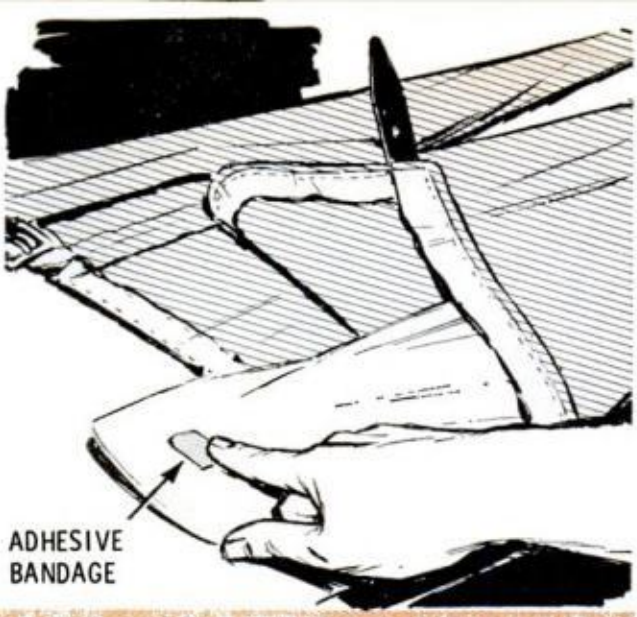

HOME REMEDY FOR relieving itching from insect bites or other causes is a paste made by adding water to equal parts of salt and bicarbonate of soda. If itching is extensive, try a salt-water bath to which has been added a half pound of soda

BACHELOR'S TIP for patching a hole in your pocket: cut off one adhesive section of a sheer plastic bandage and press this over the hole on the outside of the pocket. It's light, flexible and the waterproof adhesive holds during cleaning

Solving Home Problems

NEW TWIST on the old trick of ripening green tomatoes by wrapping them in newspaper is to seal the tomatoes in clear plastic wrap. You can check on their progress without undoing wrapping and those which spoil won't leak over the rest

TEMPORARY SEAL for bottles of cleaning fluid or other volatile materials can be provided by cementing a cork on top of the cap. This not only reduces evaporation during use but prevents spilling if the bottle is tipped over

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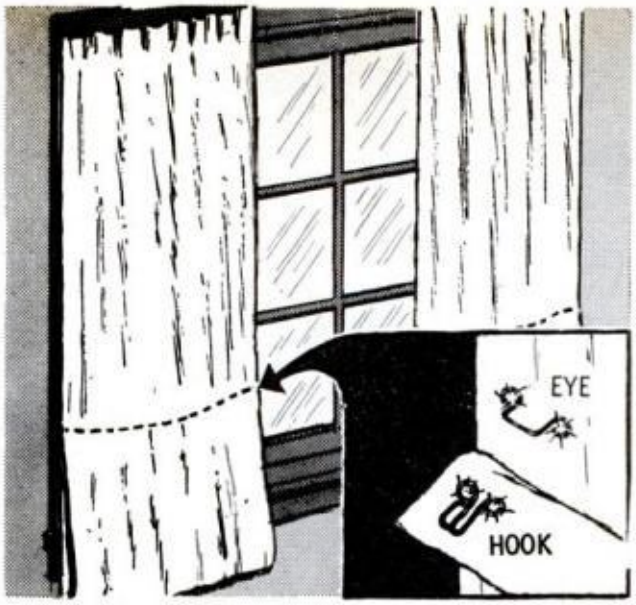
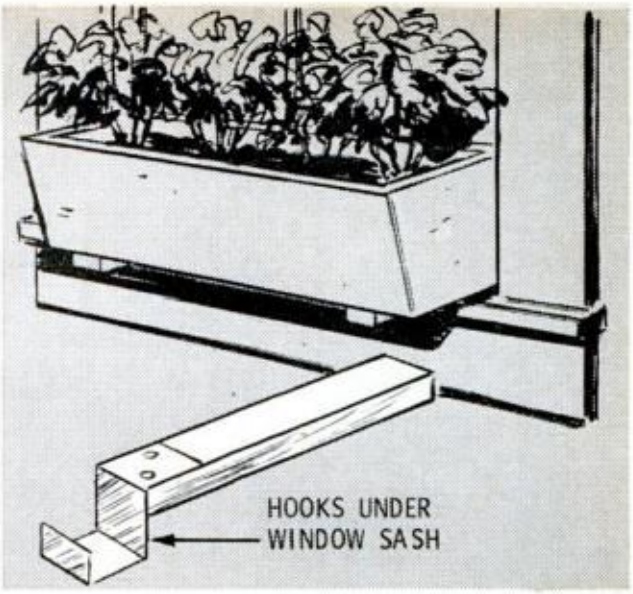
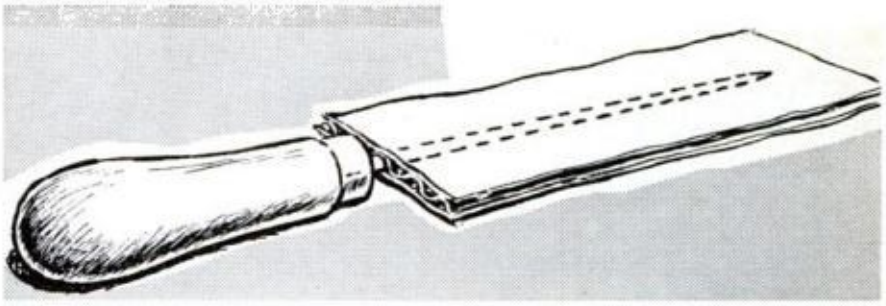


NO CHANCE OF soiling floor-length drapes when cleaning or waxing the floor if hooks and eyes are sewed to the rear side of the drapes. Hooks should be located near either edge at the bottom, with eyes at least three feet above the floor

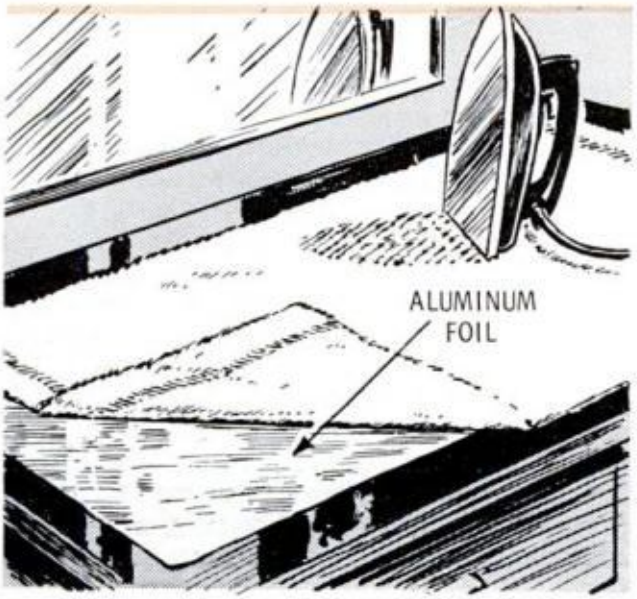


WINDOW-BOX SUPPORTS which hook under the sash can hold permanent inside window boxes or provide a means of supporting starter boxes for garden plants. Bend 26-ga. galvanized straps to fit the window and finish supports to match box

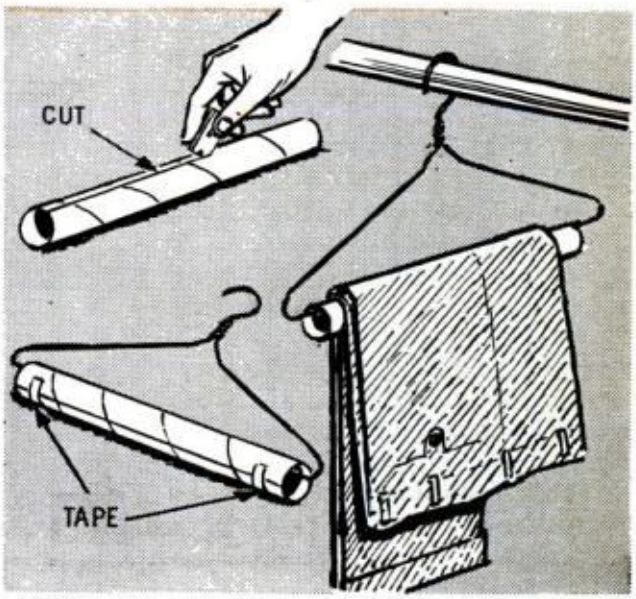
SAFETY SHEATH for an ice pick is handy for accident-proof storage, ideal for use on boats or camping trips. To make it, cut a narrow length of corrugated cardboard about an inch longer than the pick and push pick into center corrugation. When it wears out, you can make another in a few minutes



NEXT TIME you're traveling, take along a roll of aluminum foil and a heavy towel and you can make an improvised ironing board out of any flat surface. Just place the foil shiny side up under the towel and plug in your traveling iron



NO-CREASE HANGER for trousers can be made by slitting a tube on which waxed paper or aluminum foil is rolled and slipping this over a regular wire hanger. Once the roll is in place, tape the slit to prevent it from sliding off hanger



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Dust-Free Gun Cabinet

Why stack your firearms in a closet corner to gather cobwebs? Displayed in this glass-doored wall case, they're not only decorative — they're safer, and ready when you are

By Alvaro A. Altomare

THE HUMBLEST DEN will take on an air of adventure when you hang this cabinet. Its length and height can be adjusted to best accommodate your guns or fishing rods, and the drawers will store shells or packaged bait. Not a sportsman? Then, add fancy ceramic knobs and a shelf or two and the cabinet becomes a dust-free display case for any collection—from butterflies to the wife's salt and peppers.

One of the great advantages of the panel-on-frame construction is that there's no tricky joinery. Fairly rough stock can be butt-joined without fuss — beyond checking to see corners are square. It'll all be hidden behind a glued-on covering that never needs a finish. (For surfacing the cabinet shown, which is mounted on a wall paneled in English Oak Random Plank, we chose contrasting American Walnut. Both are Marlite Trendwood finishes, but the Walnut was purchased in a smooth-faced, square-edged 4x8 sheet. The perforated mounting panel is plastic-finished Peg-Board.)

Glue and nail up the identical back and front frames first, then join them with the side and top rails and drawer dividers. Add the Peg-Board back and all the outside facing, lapping the side panels over the top and bottom to hide the joint. No dimensions are given for the inside facing since these panels should be cut to fit. Once they're cemented in place, plane all edges flush with the frame, then apply the mitered framing strips. These cover the edges of both inside and outside facing, and the narrow edge of brown hardboard around the frame blends in well with the walnut tone.

Finish off with the aluminum tracks for the sliding doors. The doors can be plate glass, but the ones shown are easily-worked $\frac{3}{16}$-in. Lucite or Plexiglas.

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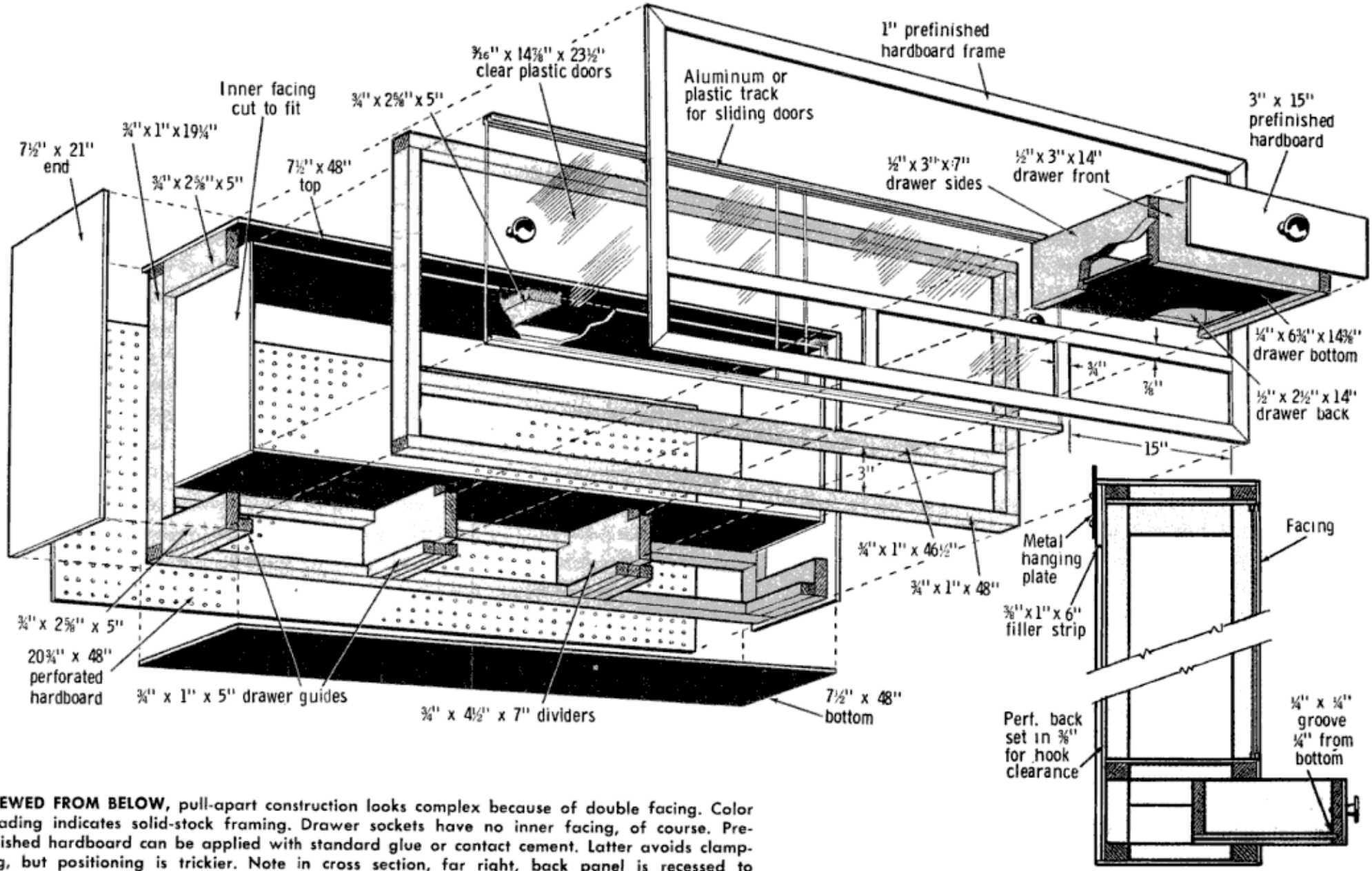

VIEWED FROM BELOW, pull-apart construction looks complex because of double facing. Color shading indicates solid-stock framing. Drawer sockets have no inner facing, of course. Prefinished hardboard can be applied with standard glue or contact cement. Latter avoids clamping, but positioning is trickier. Note in cross section, far right, back panel is recessed to provide clearance for either tip-in metal or snap-in nylon mounting hooks and brackets

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Auto Clinic

Mort Schultz's remedies for mechanical headaches

Dashing Dashpot

My '58 Ford V8 with automatic transmission starts fine and idles okay until it's run some. Then it races faster than A. J. Foyt. When I stop for a light, I have to toss it into neutral to keep it from running away. Also, it keeps running a second or two after I shut off the ignition. What's up?—Helen Kansotaka, New Haven, Conn.

Your dashpot's out of adjustment. This device mounted on the carburetor, has the job of keeping a car with automatic transmission from stalling. When you jump your foot from gas pedal to brake it eases back the accelerator. But if it's pepped up too much, it keeps the throttle butterfly open and causes too much gas to be fed to the cylinders. You already know what happens then, so have that pot adjusted.

Pay Attention Now, Men

An Air Force captain recently wrote from England that he missed the issue in which Auto Clinic published part numbers for that latest Corvair valve cover and gasket that help stop oil leaks. He can be excused for not seeing the issue—because he's overseas. But you 150 or so others who've written in since that November 1964 issue—tch, tch.

So, we'll repeat the numbers hoping it stops the flood of letters on this subject once and for all. The gasket carries part number 3850944 and retails for 85¢. The cover has part number 3813005 and sells for $1.75.

Who's Right All the Time?

You were wrong when you told me the clattering noise from the engine of my 1962 V6 Buick was caused by the manifold heat control valve. It turned out to be the timing gear mechanism. Cost me $43 to fix—but at least I caught ya!—W. M. H., Hearne, Tex.

I plead innocent, due to extenuating circumstances. First off, I said the noise *might* be the heat control valve, because many of them have been causing rattles in the Buick. Secondly, as often happens in Auto Clinic letters, the description of the noise wasn't too specific. Ideally, I should have a tape-recording.

Plugging Along

I've had the upper ball joints of my 1963 Chevy fail on me . . . first one, then the other. The man who does my grease jobs didn't sound encouraging when he said this isn't the first time he's seen this happen with Chevy. If this is a problem, can it be avoided?—Jack Mayer, Cleveland, Ohio.

It's really not a problem once you know the whole story. The ball joint seals in Chevys, Corvairs and Corvettes use a small valve-type opening to allow excess grease to escape while lubing. This keeps seals from rupturing and ball joints from failing.

Hardened grease around the valve or an undersized relief valve hole can keep the valve from working right. Pass the info on to the greaseman that he'd best check the valve opening before lubing. If it's plugged, he can use any blunt instrument that's about 1/16 of an inch in diameter to ream out the opening.

A Shrinking Violet

Sudden-like I got an oil leak from around a rocker arm cover of my '63 Tempest. Guess why.—George Mulhern, South Bend. Ind.

No guess. If it's like other Tempests and also '63 big-sized Pontiacs, that rocker-arm cover gasket's probably shrunk down to midget size. No sweat, though, 'cause a replacement gasket (part no. 9770802) lies in wait for you at the dealer. It's a heap better than the old one since it's made of cork and rubber and isn't likely to shrink.

There's a knack to installing the gasket—for that matter, any gasket. Make sure all the old gasket's scraped off and the surfaces are clean and dry. Smear an even coat of a good quality auto weatherstrip adhesive on the cover

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side of the new gasket and on the gasket area of the cover. Line 'em up, put 'em back on and install the attaching bolts, torquing to 6 lbs./ft.

Rx for an Ailing Chevy

My '59 Chevy six has the ornery habit of spitting, coughing and sputtering every time I make a right turn. Otherwise, it seems okay. I've taken it to several mechanics, all of whom were stumped. Can you help me out?—H. Eckert, Frankenmuth, Mich.

Courage. Your problem is quite simple. The carburetor float is out of adjustment. Have a mechanic strip down the carb to bare essentials, revealing the float, then adjust it as prescribed by Chevy for your particular model. Your troubles should be over.

Drippy Chrysler

The car's a 1960 Chrysler, just overhauled. The trouble's a drip from around the oil pan. Will a handkerchief help? Nothing else does.—Tom Toth, Sacramento, Calif.

Was the pan dropped during overhaul? (Yes!) Two of the oil pan bolts are mavericks—those in the pan's rear center. They're $\frac{9}{16}$" long. All others are $\frac{13}{16}$". If someone replaced the $\frac{9}{16}$" bolts with longer ones, the aluminum seal retainers have probably been stripped, and oil's leaking past 'em. Replace the retainers, and this time make sure the right-sized bolts are used. Owners of 1956 through 1964 Imperial, Chrysler and Plymouth models with 361, 383 and 413 cube engines could have this same problem.

The Numbers Game

It cost me $6 to get my 1964 Pontiac opened after I locked the key in it. You can lock the doors of GM cars without a key. The man from the key shop used a double-jointed, springy tool that he slid under the vent window, latched under the pushbutton and flipped up. It's a tool I'd like to have, but can't find. Can you tell me who sells it?—Larry Ossey, Madison, Wis.

I wouldn't if I could. The tool's verboten by the lady with the blindfold and scales. If a minion of the law found it in your possession, you'd probably find yourself in the local pokey waiting for a judge to set bail. The tool's called a "burglar's tool."

People who find themselves with keys locked in or lost can get out of the jam easily, inexpensively and legally. Most keys (trunk and ignition) have a registration number on them. Those that don't had it scribed on a tag to which the keys were attached when the car was new. If you give the man at the key-shop the number, he looks it up in a book, observes the markings and makes a new key for $1.50. If he has to remove the tumbler to make you a new key, that costs about $10. To make sure you or whoever drives the car has the number handy, write it on the registration card or your driver's license.

Service Tips You Should Know About

Any noise coming from your '64 Plymouth, Chrysler or Imperial A-727 automatic transmission between 25 and 30 mph? There's probably a rough surface on the over-running clutch race. Checkout and repair are covered under the terms of your warranty, so get the car back to the dealer. He's to do it as described in Service Bulletin 64-96 (10/5/64). If the noisemaker is the clutch race, you'll get a new one (part no. 2124844).

If you think the brake pedal height (both for standard and power brakes) of your '65 Mercury is too low, you could be right. The reason could, of course, be an improper shoe adjustment or air in the brake system. But if adjustment and bleeding don't fix it, remind your dealer of what Service Bulletin 4 (1965 series) says. Incorrect spacers could've been put between brake pedal support bracket and firewall. The right ones are .88-in. long (part no. C5AZ-2849-B).

EDITOR'S NOTE: When we began Auto Clinic we had no idea how popular it would be with our readers. Little did we think we'd be so swamped with letters that we'd have to set up a special system with additional help to handle the answers. But that's what has happened. Much as we would like to continue the clinic as a free service to our readers, we find we reluctantly must make a nominal charge to help cover the cost of diagnosing and handling your car problem—if we are to continue to answer all inquiries personally. Write Auto Clinic, Popular Mechanics Magazine, 575 Lexington Ave., New York, N.Y. 10022, enclosing a self-addressed envelope and 25 cents in coin.

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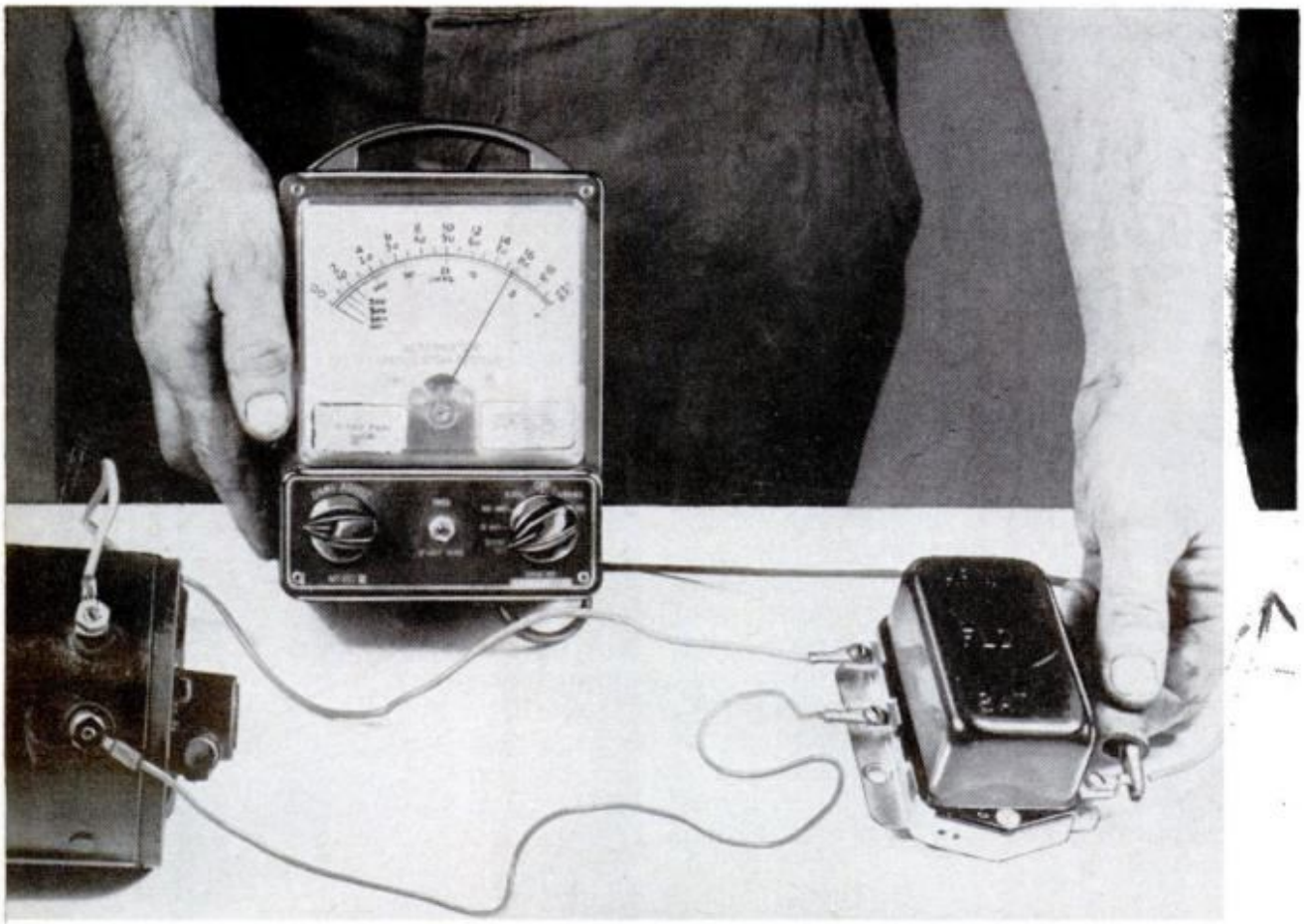
Checking Out Your Circuits

PART 2: THE CHARGING SYSTEM

By Morton J. Schultz



FOUR SIMPLE TESTS OF YOUR SYSTEM require only a voltmeter. The one shown above incorporates an ohmmeter, but you don't need that to check out the generator (left) and regulator (right). For testing, you don't have to remove these units from the car, as here

EVER NOTICE how a word like "generator" or "regulator" can make an amateur mechanic's face sag like a used teabag? We've never quite figured out why, because automotive electricity just isn't that complicated.

One reason might be the way the subject is handled in technical manuals. Since these books are written for pro's, they tend to dwell on detail and theory, leaving the poor duffer, who only wants to know if his system is charging okay, to cry out in vain for enlightenment.

The procedure for troubleshooting your charging system is a lot simpler than the one we described last month for the battery-charger system. Basically, it involves an initial test which tells you whether the system as a whole is operating properly, overcharging or undercharging. If the system passes the test, you go no further. However, if it's overcharging or undercharging, you then have to run three additional tests to find out whether the trouble is in the generator, the regulator or a wire. Simple, isn't it? And to make it

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simpler, the three additional tests are all run with the same basic hookup as the initial test.

But, before you start, you've got to know what type of generating system you have in your car. While this sounds obvious, it's worth stressing because a wrong connection during a test can easily burn up a perfectly good charging system.

In addition, you need an ordinary 0 to 20-v. voltmeter, plus a length of wire—to serve as a jumper—with an alligator clip soldered to each end.

Finally, you need a logical, orderly test procedure and the know-how to analyze the results accurately.

What kind of charging does your car have? Essentially, there are only two types. Call 'em "A" circuit system and "B" circuit. If you don't know what type you have, don't test the system until you find out.

In the "A" circuit system, field current is picked up by the insulated brush inside the generator, is carried through the field windings to the regulator points and then to *ground in the regulator.*

With the "B" circuit, field current is picked up within the regulator and passes through the regulator voltage control before going to the field in the generator. The field is *grounded in the generator.*

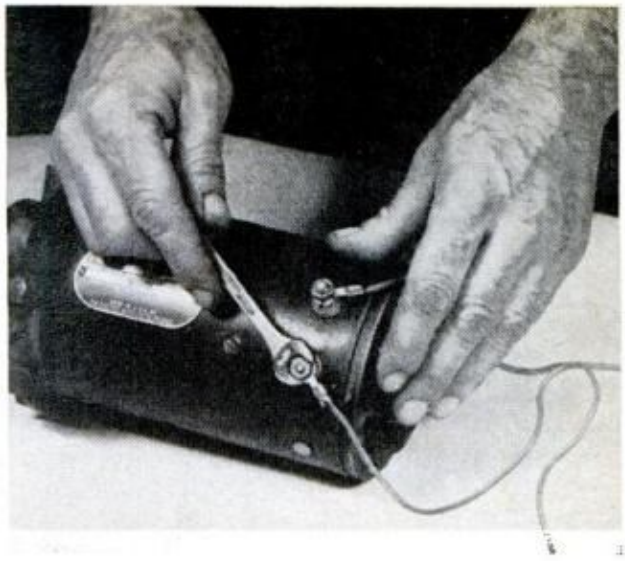
If you don't understand this or can't figure out the schematics on page 183, don't sweat. We throw this in just to whet the appetite of the theory-minded. All you have to know actually is whether you have an "A" or "B" charging system and how it affects the type of connection you must make for the test.

This is such an important point that we've included a table (page 184) of all American-made cars from 1955, and what type of circuits they have. But keep in mind that this table applies only if you still have the *original* generator and regulator in the car. If both have been replaced, the listing need not apply. For example, there could have been a "B" circuit type installed at one time in place of an original "A" circuit type. How do you find out?

You could, of course, disassemble the generator and see to which brush the field coil lead is connected. If it's connected to the insulated brush, you have an "A" circuit; if it's connected to the grounded brush, you have a "B" circuit. But that's the tough way.

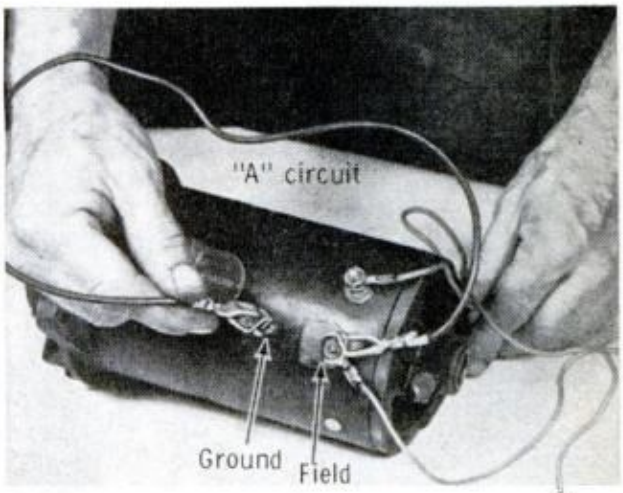
On some generators, the nomenclature plate will tell you. If the plate says, "externally grounded" you have an "A" circuit, while "internally grounded" means you have a "B" circuit.

In absence of this information, lift the

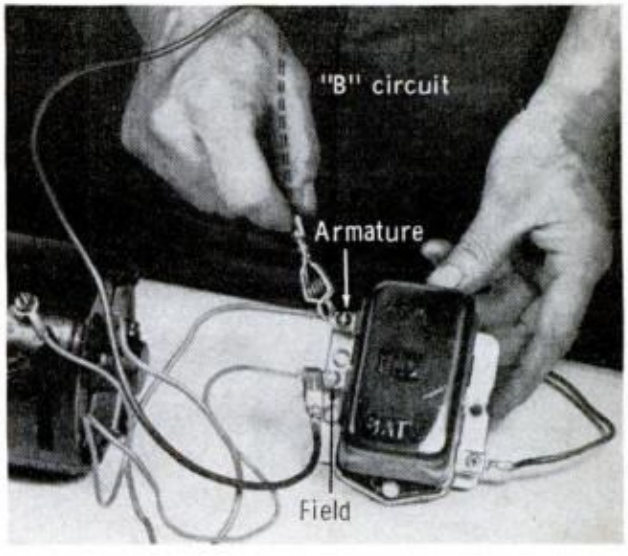


IF YOU'VE ELIMINATED the regulator as the cause of overcharge, disconnect field wire at generator (above), leaving it disconnected at the regulator

TO GROUND OUT regulator of an "A" circuit, hook jumper wire from generator's field terminal to the ground on either the generator or the engine itself



TO GROUND OUT REGULATOR of a "B" circuit, hook jumper from field terminal of either regulator or generator to that same unit's armature terminal



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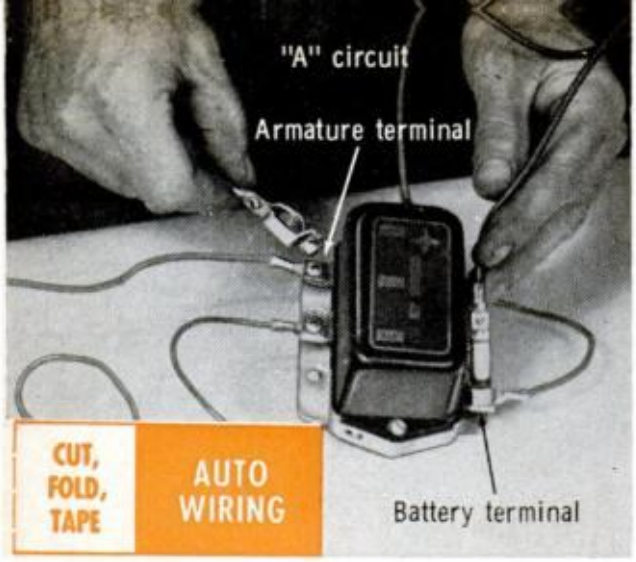
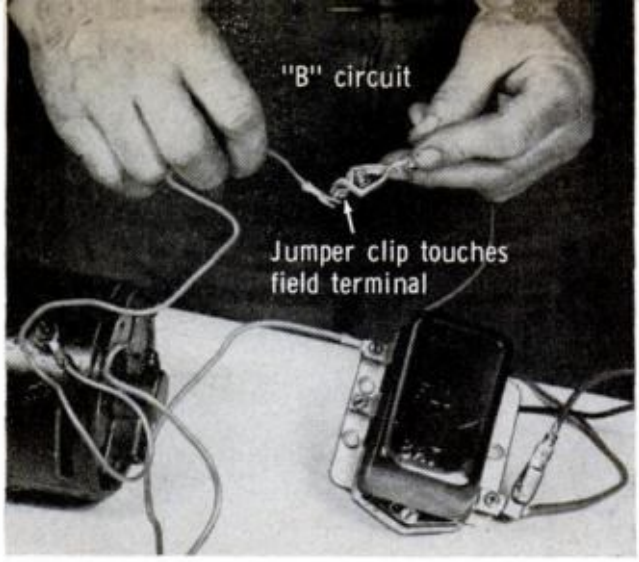


TO POLARIZE an "A" circuit, hook jumper wire to regulator's battery terminal and just touch the other end to the armature (or generator) terminal



TO POLARIZE a "B" unit, disconnect field wire at regulator, clip jumper wire on battery terminal, then touch other clip to terminal of field wire

hood and note the generator's make and part number, which will enable a supplier of automotive electrical equipment to tell you what type of circuit you have.

There's a third type of circuit you should keep in mind. It's called a dual-contact system, in which the voltage regulator unit of the regulator has two points instead of one, thus allowing greater control of charge to the battery. It's been in use since 1958 on cars, such as those with air conditioning, which require a heavy-duty generator because of a heavy electrical load.

In essence, the dual-contact system is an "A" circuit type, but with an important difference. Later on we'll speak of grounding out the regulator of both "A" and "B" systems to perform a test. With a dual-contact setup, you must not ground out anything without disconnecting the field wire. If you ground out the system with the field connected, there's a good chance of burning up the regulator.

How can you spot a dual-contact system? Easy enough. All dual-contact setups are clearly marked, with either a red tag on the generator, or stenciled lettering on the regulator. These will say "*do* not ground" or "*disconnect* F before testing generator output" or words to that effect.

Before you so much as lay a hand on a generator or regulator, there are three things to check, to prevent erroneous results from misleading you into replacing a perfectly good unit:

- Fan belt tension. A loose belt will reduce generator output.
- The battery, following the test procedure explained last month. Obviously if the battery's run down, it will affect the voltmeter reading when you test the charging system.
- Check all wiring connections at the battery, generator and regulator for tightness and cleanliness. One manufacturer of armatures contends that 75 percent of all automotive electrical troubles are caused by poor electrical connections.

To prepare for testing, let the engine run at fast idle for 15 minutes or so, to make certain the contacts in the regulator close and the regulator's working normally during the warm-up period. This allows the unit to bring itself to operating temperature.

In making the test, observe a safety rule that helps prevent short circuits in the charging system, and protects you from shocks. Disconnect the battery ground cable at the battery. Then, make the hookup. When you're sure everything's connected as it should be, reconnect the ground cable. Furthermore, if you have to disconnect a wire from the generator or regulator, disconnect the battery ground cable first, then the wire. Reconnect the ground cable to get a reading.

As we said before, only one meter hookup is needed to check the charging system. Connect one voltmeter lead to the battery terminal of the regulator (identified with the symbol "B" or "BAT"). The other voltmeter lead goes to a *clean* ground, such as a wire-brushed engine bolt or section of generator frame. If your car has a negative ground, the voltmeter's negative lead (black) is the one that connects to ground. If it's positive grounded, the meter's positive lead (red) goes to ground.

Here's how to perform the initial test

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which tells you whether the charging system is in overall good health.

After making the hookup, observe the meter reading with the engine *shut off*. If it is high (greater than about 12.8 volts for a 12-volt system or 6.8 volts for a 6-volt system), the system's overcharging. If the reading is low (less than about 12.4 volts for a 12-volt system or 6 volts for a 6-volt system) the system isn't charging enough. Obviously, then a reading of about 12.5 for a 12-volt system or 6.2 for a 6-volt system gives your charging system a clean bill of health.

Suppose your system shows an overcharge. If the system is a "B" circuit the overcharge cannot be caused by anything but the regulator. That's right. In a "B" circuit the generator and field wire cannot cause an overcharge because the circuit is grounded in the generator. So replace the regulator and you're done.

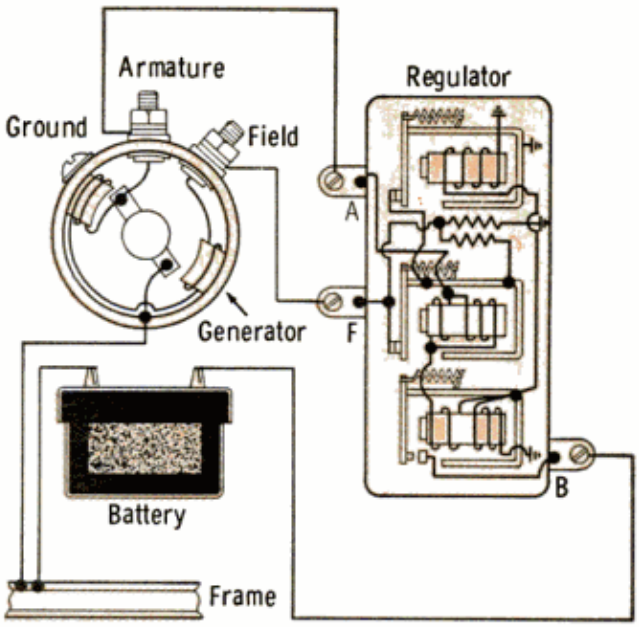
However, for "A" circuits a different procedure is required. Jot down the overcharge reading you just took. Now you must find out whether the overcharge is caused by the regulator, generator or field wire.

To do this, disconnect the field wire *at the regulator*. Start the engine and run it at a speed comparable to about 20 mph. This takes some "feel." but figure on holding the accelerator pedal about ⅓ down to the floor. (A variation of 5 mph either way won't make enough difference to care about.) Now take another meter reading and see which of the following applies to your situation:

1. If the voltmeter needle returns to its original reading—the one you jotted down earlier—the trouble is in the regulator. The points have probably pitted or burned badly, so replace the unit.

2. If the voltmeter needle reads higher than the original reading, the trouble's in the field wire or generator and you can forget about the regulator. To pin down the exact cause, disconnect the field wire *at the generator* (as shown in the top photo on page 181) and again run the car at fast idle. The wire's now disconnected at both generator and regulator, removing the field wire completely from the circuit. If the voltmeter needle now returns to the original reading, the field wire's at fault. Replace it. If the reading remains higher than the original reading you have a grounded out field in the generator. The unit should come off the car, be bench tested, and repaired or replaced.

Now let's go back to the initial test again. Suppose the meter indicates that the system's *not charging enough*. Leave the meter right where it is. But now you must ground out the regulator—take it

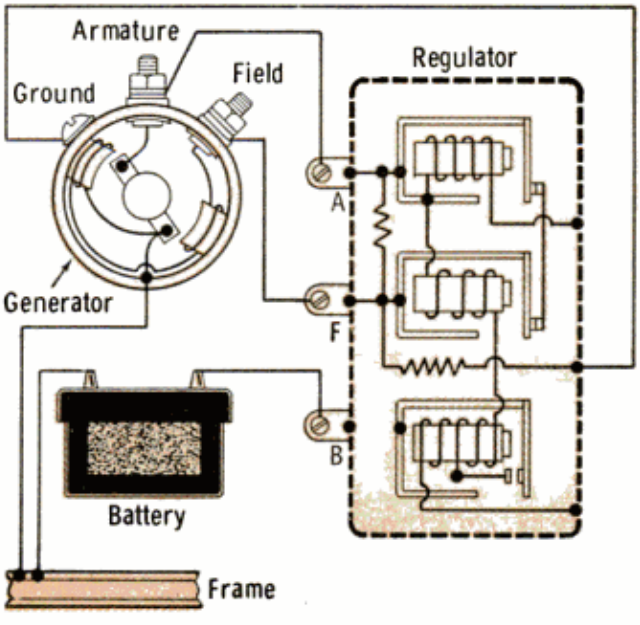


"A" CIRCUIT carries current through field windings and regulator points, then to ground in regulator

out of the circuit so it's not controlling generator output. You do this to determine if your undercharging problem's in the generator or regulator. It's done differently for each of the three different circuits so make absolutely sure you know which type you are working on.

If you have an "A" circuit system, hook a jumper lead from the field terminal of the generator to a clean ground. With "B" circuit systems, the jumper lead goes from the generator field terminal to the generator armature terminal. I've yet to find a "B" system generator which was easy to get at to make this connection, though. If you find it difficult too, make the connection at the regulator—that is, run the jumper from the regulator's field terminal to its armature terminal (as seen

"B" CIRCUIT passes field current through regulator voltage control to generator, where it is grounded



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WHICH CHARGING SYSTEM IN YOUR CAR?

CAR AND YEAR	TYPE OF SYSTEM
Buick 1955-62	A
Cadillac 1955-62	A
Chevrolet 1955-62	A
Chrysler (Imperial) 1955-60	A
Comet	See Mercury
Corvair	See Chevrolet
Dart	See Dodge
DeSoto 1955-60	A
Dodge 1955-60	A
Edsel	See Ford
Falcon	See Ford
Ford 1955-64	B
Lancer	See Dodge
Lincoln (Continental) 1955-59	B
Lincoln (Continental) 1960	A (50-amp generator) or B (40-amp generator)
Lincoln (Continental) 1961-62	B
Mercury 1955-60	B
Mercury 1961	A (40-amp generator) or B (30 or 35 amp generator)
Mercury 1962	B
Oldsmobile (F85, too) 1955-62	A
Plymouth 1955-60	A
Pontiac 1955-62	A
Rambler 1955-59	A
Rambler 1960-61	A (Delco-Remy) or B (Auto-Lite)
Rambler 1962-63	A
Studebaker 1955-62	A
Tempest	See Pontiac
Thunderbird	See Ford
Valiant	See Plymouth

in the bottom photograph on page 181).

With a dual-contact system, disconnect the field wire at the regulator. You can now safely place a jumper wire on the field terminal of the generator and connect it to ground.

By the way, on some generators the field connection's identified by the letter F—on others, by a red tag wrapped around the field connection.

Start the engine and run it at a speed comparable to 20 mph. Observe the meter. If the needle doesn't hit between 15 and 16 volts for a 12-volt system and between 7 and 8 volts for a 6-volt system, the trouble's in the generator.

If the meter does hit the right area, you know the problem's in the regulator, since that unit is now eliminated from the circuit and the generator's acting normally. Replace the regulator.

Of course, undercharging can also result from loose or dirty battery cable connections or armature wire connection at the regulator or generator. However, if you followed the preparatory steps already mentioned, this possibility should have been eliminated.

It's always a good idea to replace battery cables once a year, or whenever you tune up the electrical system. Cables are not expensive and you eliminate the possibility of their creating resistance in the circuit.

The question now remains as to why you should replace the regulator when it proves to be at fault. After all, can't it be repaired? Let me give you at least one good reason why not.

Modern regulators seldom go out of adjustment. Instead, the likelihood is that the points have become damaged. And they are almost impossible to file properly. The man who files the points is only kidding himself. They won't last long enough to make the job worth the trouble.

If you must replace the generator or regulator, keep in mind that you have to replace an "A" circuit unit with an "A" circuit unit, and a "B" unit with a "B" unit. One way to be sure, of course, is to buy the same part-numbered unit you're replacing.

When a generator has to be stripped down for repair or when replacing a regulator, you should re-polarize the fields to make sure the current's polarity matches the polarity of the electrical system. If the polarity isn't correct, the voltage regulator points will vibrate and arc, causing early failure. Furthermore, the generator will be providing a current in reverse to that required by the battery. This spells pure trouble.

To polarize an "A" circuit system, all you do is connect a jumper wire to the battery terminal of the regulator. Then, touch the other end of the jumper momentarily to the armature terminal of the regulator (photo, page 182). On some cars, the armature terminal may be referred to as the generator terminal (GEN).

Don't be alarmed at a spark or flash, by the way, as this often happens.

To polarize a "B" unit, first disconnect the field wire at the regulator. Attach one end of a jumper wire to the battery terminal of the regulator. Then simply touch the alligator clip of the jumper to the terminal of the field wire.

That's all there is to it. Simple, wasn't it? ★★★

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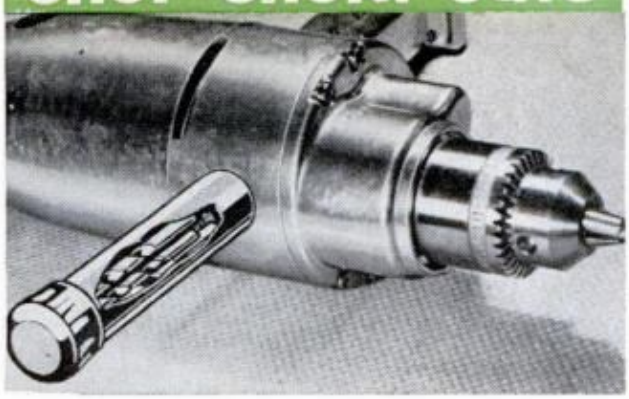
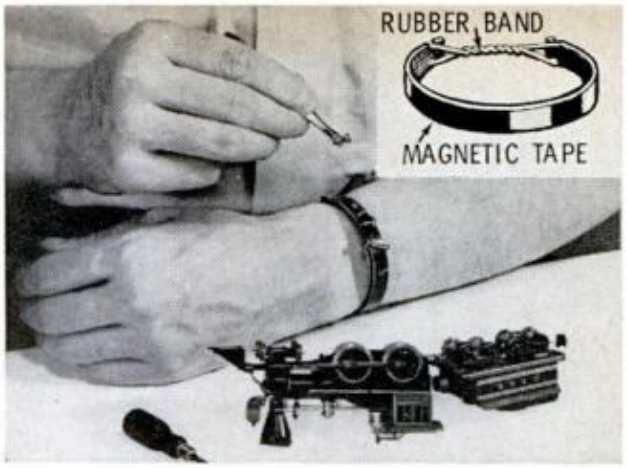
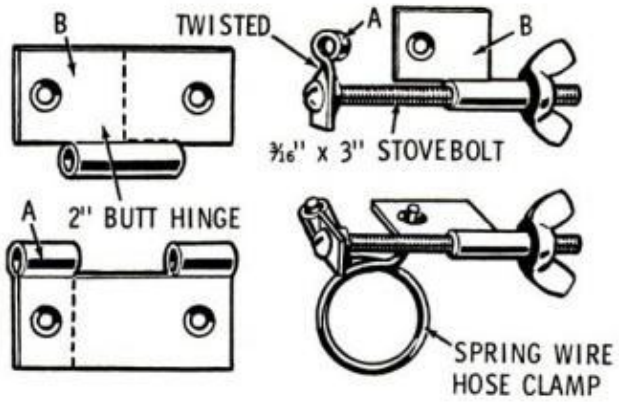
SHOP SHORT CUTS



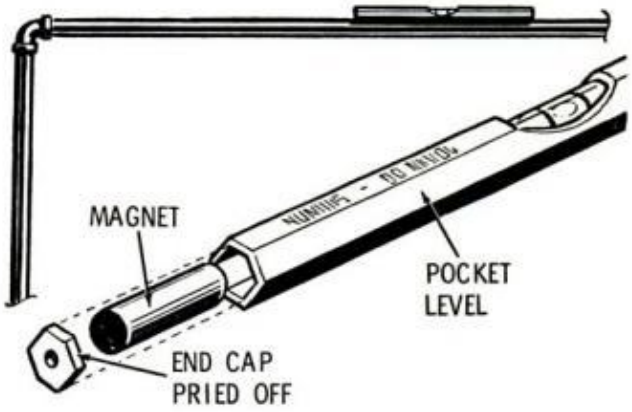
AUXILIARY "PIPE" HANDLES furnished with husky portable drills are often screwed into their sockets and left there. Where that's the case, a built-in holder for twist drills is going to waste. By capping the end with a crutch tip, the handle will store several bits right with the drill.—*George Czanstke*



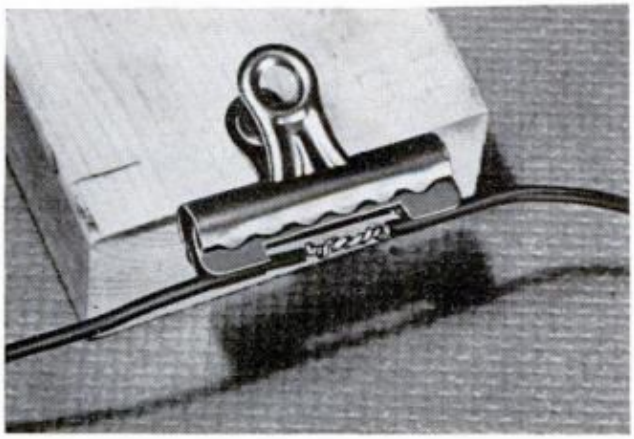
MODELMAKERS, TINKERERS and anyone who repairs intricate mechanical devices will find a magnetic wristband the handiest thing ever for corralling tiny screws and parts. Form the band by notching the ends of a length of magnetic tape, and joining them with a rubber band as shown.—*Joseph Braunstein*



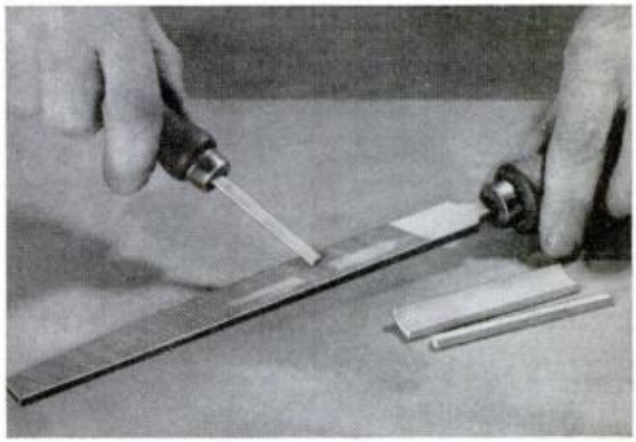
SPRING-WIRE HOSE CLAMPS can be mean things to spread open with a pair of pliers. A clever spreader which will hold the clamp open can be made from a stove bolt and the leaves of a hinge, modified with a hacksaw as shown. Note that section A must be given a slight twist to angle the barrel.—*R. Snow*



A METAL POCKET LEVEL becomes twice as handy when you don't have to hold it. This is particularly true when you're leveling a run of pipe or heating duct. To magnetize it, just pry out the end caps, insert short lengths of ¼-in. rod magnet in each end, and press the caps back in place.—*Joseph Braunstein*



SPRING-TYPE PAPER CLAMPS can serve as a third hand at the workbench when you anchor them to a wood block. One example: grind a wide notch in the jaws and you can use the clamp to hold a wire splice for soldering. Here, you'll have to bend the jaws so they'll close flat on the wire.—*Andrew Vena*



A PIECE OF BAMBOO stuck in a file handle is the next best thing to a file card for cleaning stubborn bits of metal from a flat file. Raked across the file, parallel with the teeth, the tough bamboo will quickly conform to the ridged surface and comb out the embedded particles in a jiffy.—*Walter E. Burton*

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Winterize Your Outboard

By Henry B. Notrom

Planning to use your motor this winter? Here's how to set it up for cold-weather operation

THIS MAY SURPRISE a lot of summertime skippers, but many people north of the Mason-Dixon Line run their boats right through the winter.

Actually there's no real reason why your outboard should go into storage the minute the weather turns cold. It'll troll just as well under freezing conditions as it did back in July. And on a crisp clear December afternoon, even a plain old boat ride can turn out to be a lot of fun. It's like a two-cycle sleigh ride.

According to engineers of every leading outboard manufacturer in the country (here, we specifically quote the Evinrude people), "A two-cycle engine particularly lends itself to cold-weather operation. In general, it will start and run better in cold weather than a four-cycle auto engine, since it has no large amount of heavy oil to absorb the power of the starting mechanism."

Naturally, there are a few precautions you should take. Let's cover the more obvious ones first, since these are most often overlooked.

First, make sure your engine's tuned up properly. A summer breakdown may be frustrating, but a winter breakdown is also likely to be doggone uncomfortable. That outboard has seen a lot of use since you tuned it last, so give it a regular 50-hr. check. You'll probably find most of the following items on the manufacturer's checklist:

☐ Drain and flush the gearcase. Refill to the correct level using the lubricant recommended by the manufacturer. (More

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about this immediately after this list.)

☐ Remove and clean the fuel filter bowl. Replace the fuel bowl element and use a new filter bowl gasket.

☐ Clean and regap the spark plugs. Replace worn or burned plugs, but be sure to use new gaskets and torque the plugs to the manufacturer's specs.

☐ Check the prop for damage. If you have any doubts about whether it's out of pitch, have your dealer check it on his pitch block.

☐ Lube all grease fittings, using the lube recommended by the maker.

☐ Check the remote control box, cables and wiring harness.

☐ Check the steering controls, making sure that mechanical steering is lubed as recommended.

☐ Lubricate all carburetor and magneto linkages.

☐ Adjust the tension of magneto or generator drive belts.

☐ Clean the battery terminals and coat with grease.

☐ Check the water pump and thermostat operation.

☐ Check the ignition timing and condition of the breaker points.

☐ Check carburetor and ignition sync.

☐ Check the carburetor adjustment.

☐ Check all seals to make sure that no water can leak into the lower unit.

☐ See that all drain holes are clean and open.

While it's important that everything be properly lubricated before you put the motor in the water, there are no special cold-weather lubricants for outboards. None are required, so *don't switch lubricants.* Stick with what the manufacturer recommends for normal use.

Incidentally, here's a cold-weather trick that's not in the owner's manuals. If controls become hard to activate during operation because of a deep freeze, use a little penetrating oil on the control cable ends to free them and keep them lubricated. Keep a can of the stuff in your cockpit tool kit, but don't use it in place of the manufacturer's recommended lubricant in any other place.

Almost as important as proper tuning is maintaining the proper oil-gas ratio in your fuel mixture. In cold weather, oil thickens and doesn't mix as easily with the gas, so be especially careful when filling your tanks. Follow the old drill—first a little gas, then the oil and then the rest of the gas. If you're running with portable tanks, you might even slosh that concentrated oil-gas mixture around a bit before adding the rest of the gas.

And *don't* switch to a winter-weight automotive oil. Lighter oil won't provide the necessary lubrication protection for the internal parts of your engine.

Your battery requires special attention for cold-weather use. Even a fully charged battery is only about 50 percent effective at 0° because of the effects of the cold. It stands to reason that you should give

TO PREVENT CORROSION, keep the terminals of your battery well greased. Rusting terminals can produce electrical resistance which will cause hard starting

MEASURE SPECIFIC GRAVITY of the acid in each cell with a hydrometer. If the acid is dilute enough, it can freeze and crack the case of your battery

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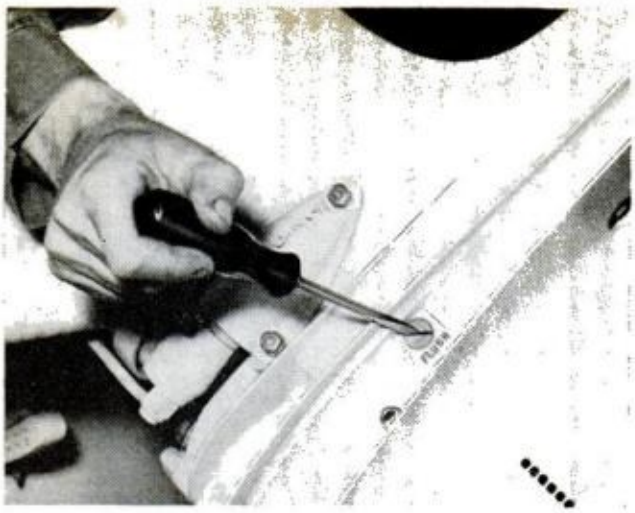
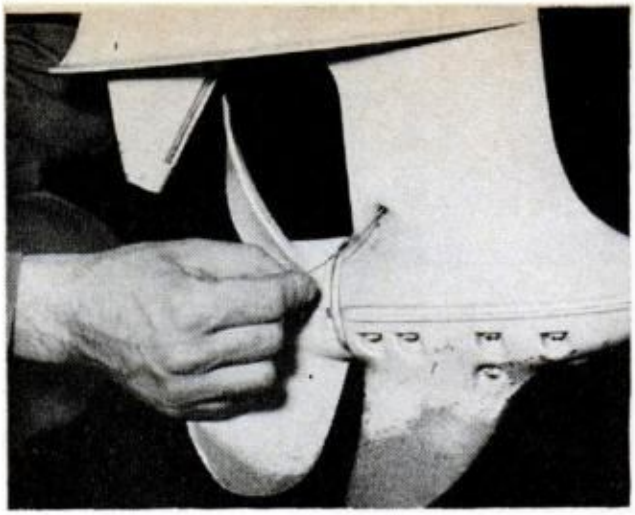


USE FLUSH HOLE on Mercury engines to get the most efficient drainage. Just turn out the plug as shown and kick the starter over a couple of times



CLOGGED DRAINAGE HOLES will hamper circulation and cause trouble. To make sure they're not plugged, run a piece of narrow-gauge wire up into them

yourself every break in the book by starting with a full charge.

An undercharged battery opens up all sorts of dire possibilities. For instance, battery acid is an antifreeze, but as a battery gets weaker, its acid also gets weaker and begins to turn to water. This water can turn to ice and crack the battery case. Here's a chart which tells you at what point in a battery's state of charge you can begin to expect ice:

State of Charge	Specific Gravity	Freezing Point (°F)
100%	1.260	−70°
75%	1.225	−36°
50%	1.190	−12°
25%	1.155	+3°
Discharge	1.110	+16°

Use a hydrometer to measure the specific gravity of each of the cells in your battery. Obviously, anything above 1.225 and you're okay. If you get a lower reading, better have the battery charged.

The hydrometer also tells you if one of the cells is shorted, an immediate warning to get a new battery. If the difference between the low-reading cells and the high-reading cell is .050 or more, it's time to go battery shopping.

Grease Battery Terminals

Another possible problem area is the battery terminals. Corrosion here means resistance which can cause hard starting. Of course the problem's not as common with an outboard as a car because you disconnect the battery more often. However, it's still a good idea to grease terminals often to prevent corrosion formation.

Once everything is prepped to your satisfaction, you're ready to put the boat in the water. This brings up the last major precaution.

Water begins to turn to ice at 32° F. Everything you can do to keep water from standing in your engine or to cut the water with an antifreeze substance is all to the good.

For instance, when sitting in a duck blind don't tilt the engine out of the water. The water temperature is higher than the air temperature, so leaving the lower unit submerged will keep water in the cooling passages and impeller chamber from freezing.

Drain Your Motor

At the end of the day, take the motor out of the water and let the water drain off while the motor is in an upright position. If it's a fishing motor, just stand it up straight; if you're trailering a boat with a larger motor, swing it down once you've retrieved the boat and are back on level ground.

With the engine in an upright position, crank the starter a couple of times to force water from the impeller and water passages. Any water trapped inside could freeze and crack housings unless the motor is put into a warm storage area immediately.

By the way, most Mercury engines from 1960 on have what's called a flush outlet hole on the lower unit. By removing this screw from this hole before you crank the starter, you'll ensure more efficient drainage.

If you've trailered your boat for some distance to launch it, the engine is probably colder than the water. Let the lower unit sit in the water for several minutes before attempting to start it. This will allow the unit to warm up to the temperature of the water.

Opinions differ about cold-weather op-

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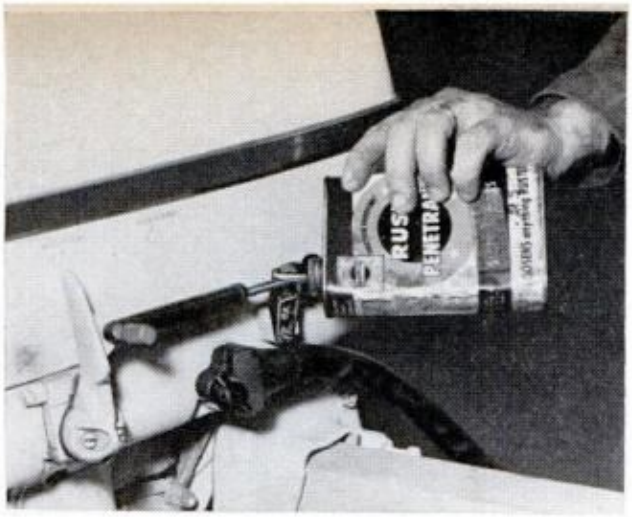

IF CONTROLS BECOME STIFF because of a deep freeze, you can probably loosen them up by applying a little penetrating oil to ends of control cables

eration of an engine which isn't equipped with a thermostat in the powerhead. With a thermostat, the water is prevented from circulating until it reaches operating temperature. Some people contend that in an engine without a thermostat the circulating water can't reach the proper operating temperature in water below 40° or so. Thus the engine can't give par performance.

Others state that the engine won't overcool, and that you can expect ideal output. If you have such a motor, the best way to make up your mind about this is to try it out. You can't hurt anything, and if you're satisfied with the performance, there's no reason why you shouldn't use it in cold weather.

Here's one final precaution to keep in mind. Don't stop the engine by removing gas line and allowing the carburetor to run dry unless you plan to put your outboard into storage. The fuel acts as an antifreeze, which effectively prevents condensation from forming in the fuel system. ★★★

IN FREEZING WEATHER, the temperature of the water is higher than that of the air, so leave the lower unit submerged to keep water inside from freezing

Q What's the best way to protect the internal parts of an outboard engine over the winter while it's in storage? I'm referring to the powerhead.—J.K.M., Ill.

A Johnson Motors gives an excellent procedure which can be followed. First, if the motor was last operated in salt water, run it in fresh water to flush out all the salt. Then, with the shift lever in neutral and the engine running at low speed, rapidly inject a rust-preventive oil into the carburetor air intakes until the motor starts smoking. (Use a pump-type oilcan for this.) Stop the engine at once to avoid burning the oil out of the cylinders and you'll have corrosion protection which lasts all winter. This is somewhat more efficient in achieving an even distribution of oil over the cylinder walls than the old method of pulling plugs and squirting a little oil into each cylinder with an oilcan.

Q Aside from bad chatter on the prop end of my 1955 Mercury Mark 5 when it's in neutral, my motor seems to be in fine shape. What can I do to get rid of that noise?—A.S.M, Ga.

A It sounds like clutch spring noise and probably means the spring isn't correctly tensioned, not uncommon in a motor of that age that's seen a lot of use. You can forget about it if you like, since it doesn't affect engine performance and can't harm the engine. If you're set on getting rid of it, drop the lower unit to remove the clutch spring. Clamp the bottom half of the spring in a vise and, with a screwdriver, bend the bottom half coil 5/64 in. away from the body of the spring, give or take 1/64 in. This will pre-tension the spring and eliminate chatter.

As a service to the readers of *POPULAR MECHANICS* in solving problems relating to their outboard engines, you are invited to submit your questions to this column. All questions will be answered, either in the column or by mail. Address Outboard Clinic, Popular Mechanics Magazine, 575 Lexington Ave., N.Y., N.Y. 10022; enclose a 5-cent stamp.

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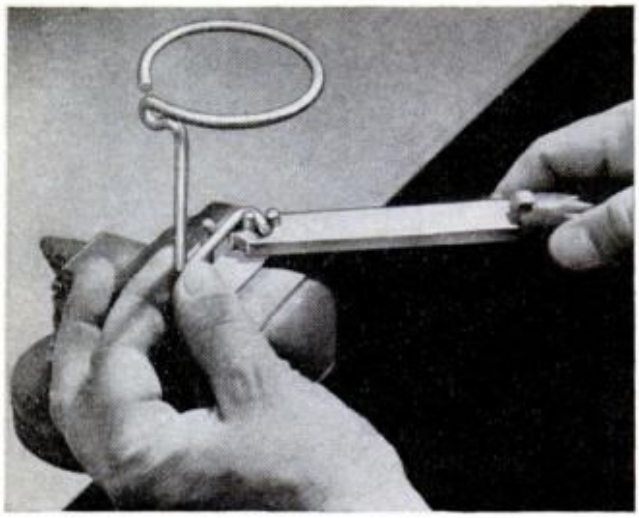
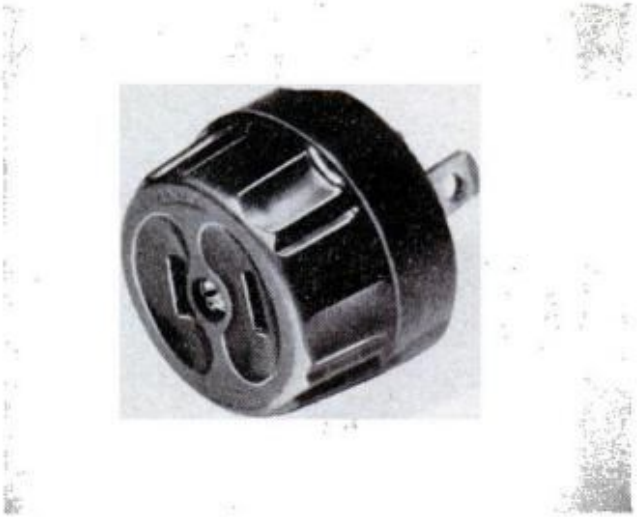
Check These When Shopping



Clamp the base of the Wireformer in your bench vise and you're all set to make hooks for hanging tools, or perhaps even a mobile for your living room. Wire or cold-rolled rod up to $^{5}/_{32}$ in. can be cut, bent or straightened with the Wireformer. Price is $3.98 from International Sales, 1950 Sheridan Rd., North Chicago, Ill.



Any portable drill, saw, sander or polisher having an a.c./d.c. universal motor, becomes a two-speed tool when plugged into this electronic speed reducer. Cuts normal operating speed 50 percent without loss of torque. Also increases life of incandescent lamps four times. Sells for $2.29 from Efenbee Co., 3019 Komensky Ave. Chicago, Ill.

Any electric drill of ¼-in. capacity can be used to power this screwdriver grinder. It renews worn tips on either Phillips or regular screwdrivers, with speed and accuracy. The tool is $7.95 and carries an unconditional manufacturer's guarantee. It may be ordered direct from P&T Inc., Box 12554, Charlotte, N.C.

Portable sprayers in either quart or 6-oz. size are fitted with a tire valve stem so that they may be pressurized with any air hose. Sure Shots are intended for spraying disinfectants, lubricants, and various types of cleaners. Prices range from $3.70 to $16.25. Milwaukee Sprayer Co., 2437 West Fond du Lac Ave., Milwaukee, Wis.

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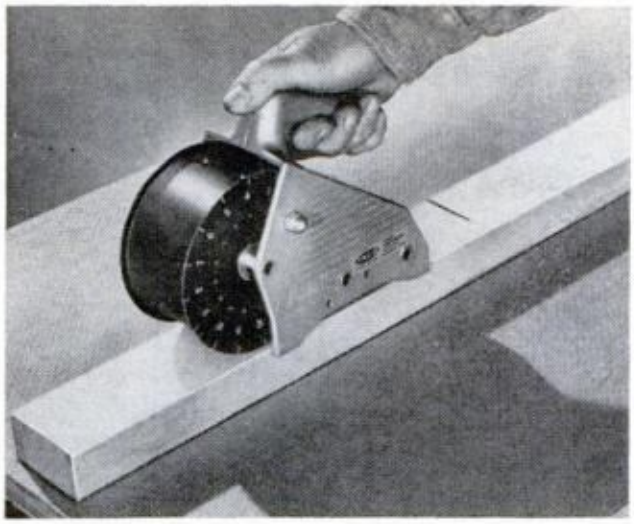
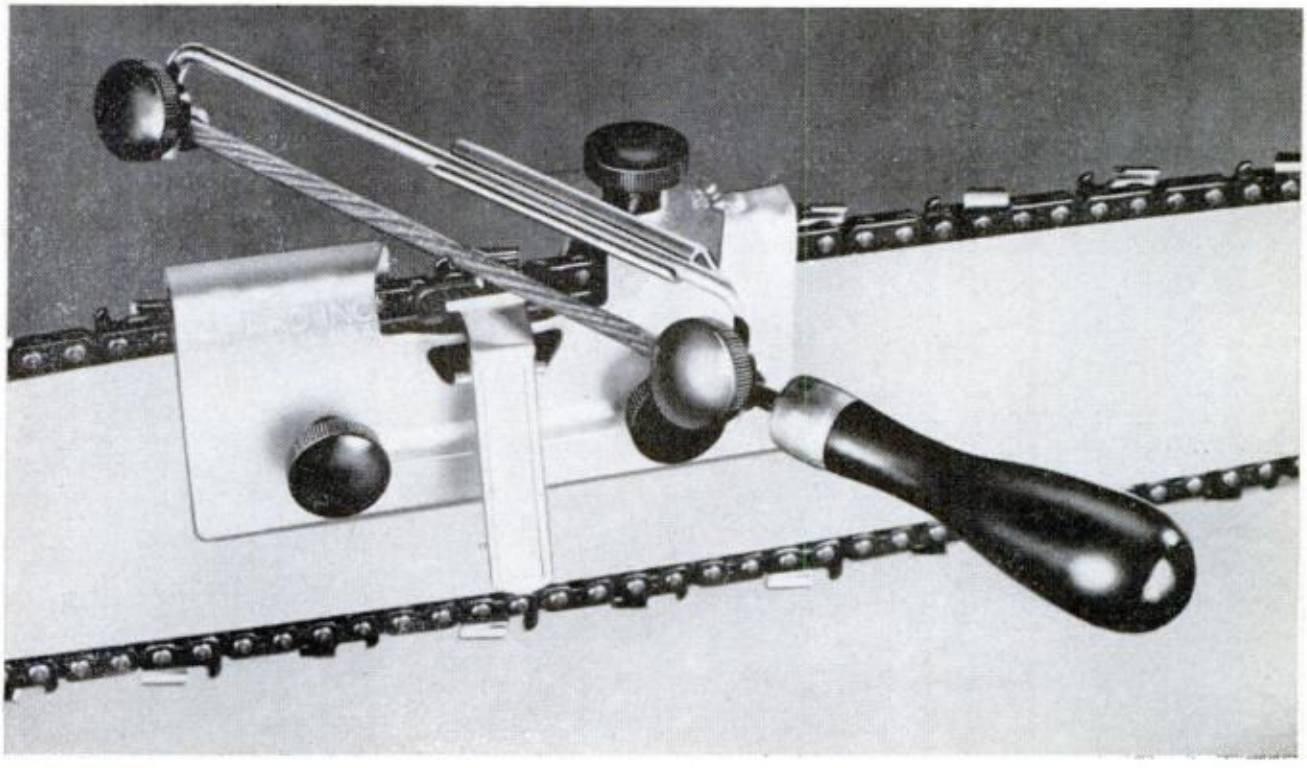
for Tools



Teco Mark 16 makes it possible to lay out the locations of studs, rafters, joists, roof trusses and other building components. When rolled along any flat surface it will mark lines at 16-in. centers, but other intervals can be marked. Cost is $24.50. Timber Engineering Co., 1619 Massachusetts Ave., N.W. Washington, D.C.

Drill press drills to center of 10-in. circle, has 3¾-in. feed. Special features include a ball bearing spindle, tilting table and adjustable head. The tool, with ½-in. geared chuck is priced at $79.95. A ⅓ hp motor is available as an option. The machine is distributed by Freymach Co., 11 West 25th St., New York, N.Y.

Chain saw sharpener regulates its own height without adjustments. The tool, which is unconditionally guaranteed, features a go-no-go guide gauge. Adjustment to various chain sizes can be made by simply inserting a file of the proper diameter. Price with 7/32-in. file is $12.95. Pakard Inc., 3839 Merle Hay Rd., Des Moines, Ia.



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Clamp-on vise fits any make, holds any blade to make "filing" semi-automatic

By Manly Banister

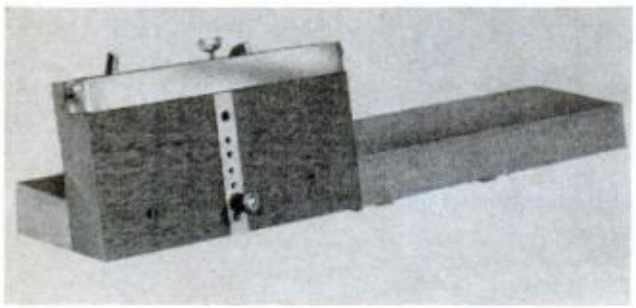
OWNERS of radial-arm saws can throw away their file when it comes to sharpening the blade. With this clever clamp-on "filing" vise you can machine-sharpen the blade with the accuracy of the saw itself. It will handle any type blade of any diameter from 6 in. up to 10 in.

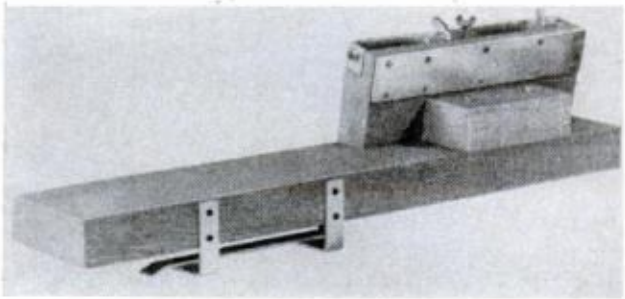
Here's how it's used: First remove the wood fence and the lift-out leaves from the table and slip the vise over the edge of the table at the right-hand end. The shoe clamp on the vise makes it fit snugly. yet permits shifting. Mount a ½ x 6-in. vitrified grinding wheel (100 grit, grade N) on the saw arbor, swing the radial arm 90° to its normal cutoff position and replace the blade guard. Grade N is a medium-grit wheel. Avoid using a soft stone as it wears down too fast.

Now with the teeth pointing to the right, place the blade on the arbor of the vise and carefully adjust both the blade and the vise so that the area to be ground on each tooth is parallel with the *face* of the grinding wheel. Clamp the blade lightly to the vise and, in turn, clamp the vise to the saw table with a C-clamp. This done, slide the adjustable stop finger into position, two teeth *behind* the tooth to be ground, and hold the finger against the tooth by sliding the stop block against it.

For a trial pass, set the depth of cut so the wheel barely touches the tooth, then lower the arm ever so little so the wheel just removes the bright spot left on the tooth by the initial jointing operation. To "file" each tooth, you simply pull the wheel slowly across it once, then push it back. As each tooth is ground, the C-clamp holding the blade is loosened, the stop finger moved back and the blade rotated ahead two teeth before repositioning the finger and reclamping the blade. Continue around the blade until you have ground every other tooth. Then flop the blade in the vise and grind the remaining teeth in the same way. Here you use the second finger stop, and you'll find it necessary to shift the vise to realign the teeth under the wheel. If the blade to be ground has been hand-filed a number of times and is possibly out of round, it should first be jointed by mounting the blade backwards on its arbor and rotating it *by hand* against a stone placed on the saw table until there is a bright spot on every tooth.

As for making the vise, it's best to cut the wood parts from hardwood, and to use aluminum for all the metal parts—particularly finger stops, to avoid damaging





FRONT AND REAR VIEWS of saw-sharpening vise show its blade arbor which is adjustable to accommodate various size blades (left), and its slip shoe which serves to hold it to the saw table for initial adjustments

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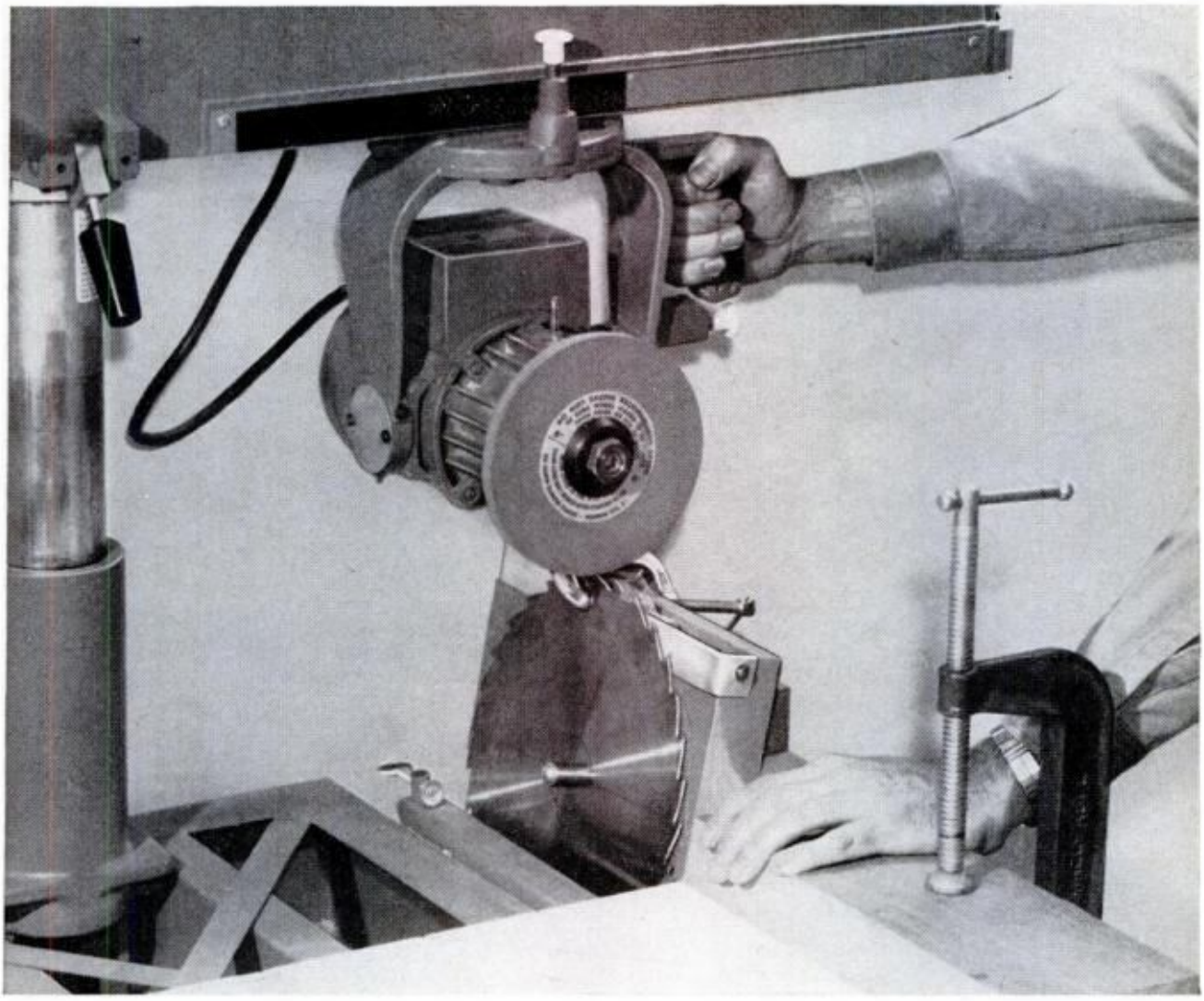
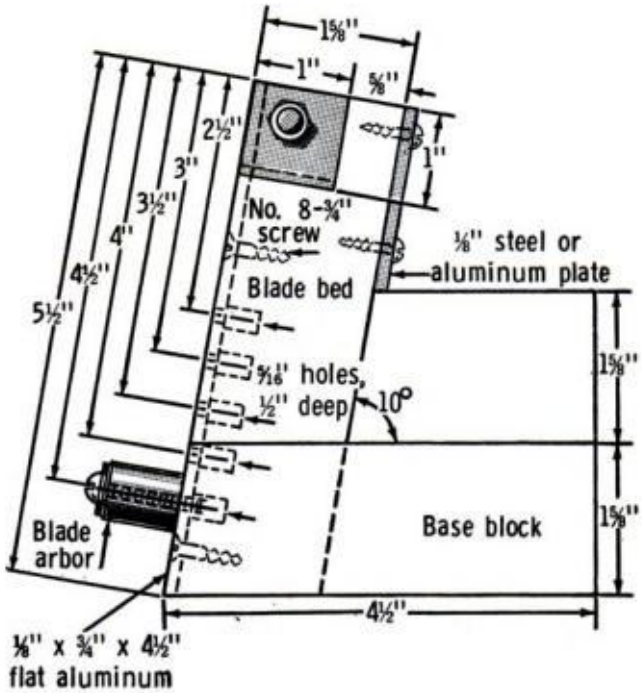


THE BLADE is held in "filing" position by a small C-clamp which is loosened as each tooth is ground. No attempt should be made to hold the blade by hand since the vibration would sting the fingers and could result in a chipped wheel. While the blade guard is shown removed for the sake of clarity, it should always be in place for utmost safety

the teeth. The base block is notched at an angle to support the blade bed at a 10-degree slant and additional support is provided by a block placed directly in back of it. The top edge of the blade bed is first rabbeted, and then a dado is run across its face to receive a 4½-in. strip of flat aluminum. Five holes are drilled and tapped in the latter to receive the adjustable saw arbor. The end-view drawing at the right gives the correct spacing of the holes in relation to the top of the vise. Clearance holes are drilled in the wood directly behind the tapped holes to a depth of about ½ in., and the strip is held in its dado with two No. 8 x ¾-in. F.H. wood screws. The arbor itself is held by



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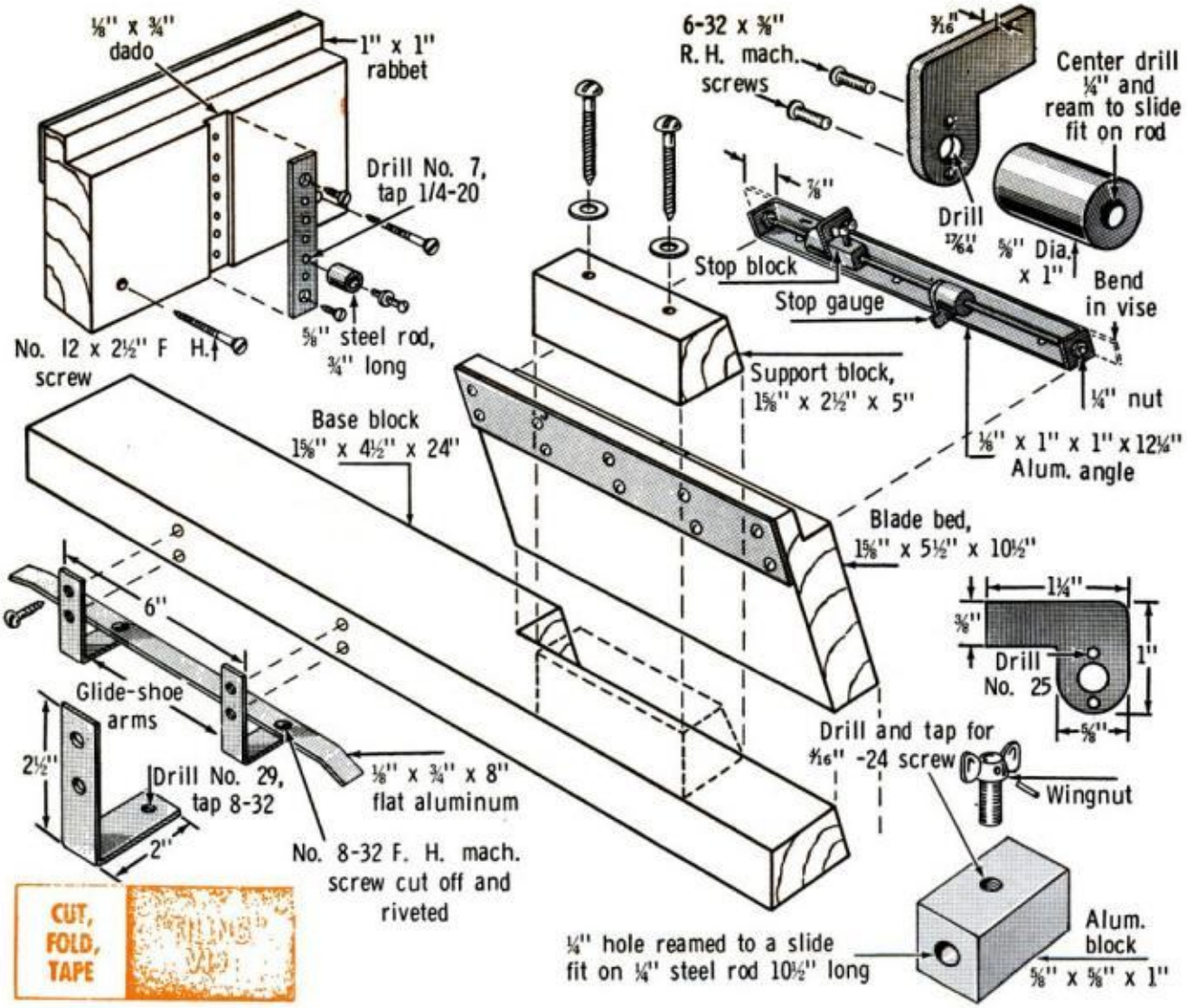

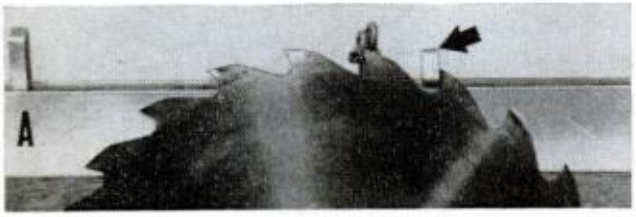

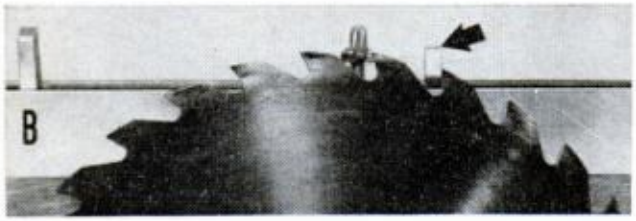

FOUR PHOTOS at left show relative position of the tooth-to-be-ground and the stop-finger setting for different diameter and type blades. Arrow in each case indicates stop finger. Blade (A) is a combination blade from a 7-in. Porter-Cable saw, while (B) is an 8-in. blade from a Stanley. Blade (C) is a 30-tooth, 10-in. one from the DeWalt on which it's being sharpened. Blade (D) is a 28-tooth, 10-in. coarse-cutting Craftsman brand

a ¼-20 x 1-in. machine screw. Since a small C-clamp is used to anchor the blade as each tooth is ground, a flat strip of aluminum is screwed to the back of the blade bed to protect the wood from clamp marks.

The two stop fingers and the single stop block slide on a ¼-in. rod which is supported by a bracket formed from a length of aluminum angle. This is cut overlong so that its ends can be notched, drilled and bent 90° to support the threaded ends of the rod. The angle is held in its rabbet with three #8 x ¾-in. F. H. wood screws.

The spring slide shoe attached to the base block serves to hold the vise temporarily to the saw table while positioning it under the grinding wheel. Once set, a sturdy C-clamp is used to anchor the overhanging vise to the table. ★★★

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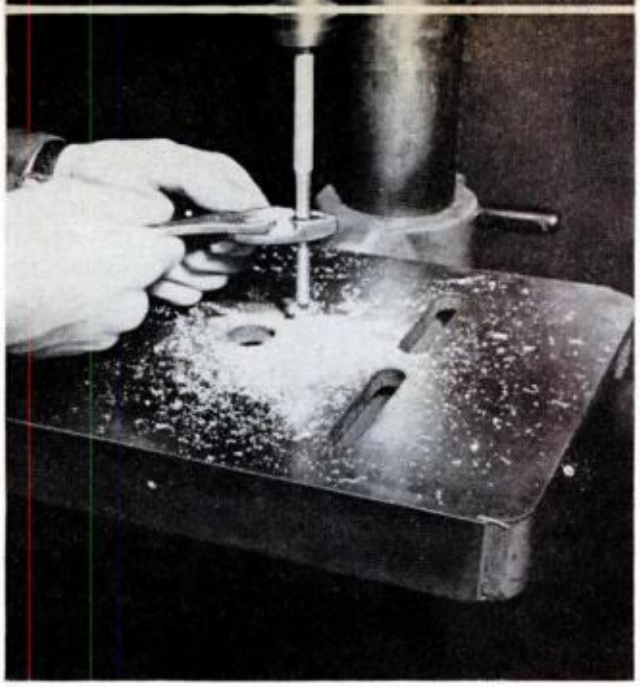

Machining without a Lathe

Want to reduce the diameter of mild steel, aluminum or brass rod, but have no metal lathe available? Just chuck the rod firmly in any drill press or wood lathe set to spin at a relatively slow speed. Now, flick the switch and grasp the rod with an old pair of pliers, as shown. It's surprising how quickly a little pressure chews off the extra metal while maintaining an exact center. You can finish up with a file or emery cloth.—*Wayne M. Judy*

On Top of Old Smoky

Some welding jobs you just can't take to a well-ventilated spot, and somehow they're usually the smoky ones. Park a small fan as close as possible, with its back to the work, to dissipate that brimstone cloud.—*Mike Brenish*

When selecting the proper drill size for a corresponding tap, pick a size which is 60 percent of the thread depth, not the usual 75. Smaller size saves tap breakage.

NEXT MONTH IN SHOP AND CRAFTS

★ **GUTTERS AND FLASHING.** When's the last time you looked at your gutters and flashing? Like the rest of your house, these forgotten parts of the roof will wear out too—and quickly without periodic attention. This timely feature brings you up to date on what's new in gutters and gutter guards, shows how to patch a rusted out spot, how to fix a leak in the chimney flashing and other pre-winter tips. Look for it in the November issue

★ **MORE FROM YOUR RADIAL SAW.** The radial-arm saw is a highly versatile workshop workhorse—a whole lot more so than you may realize. Some of the special techniques you can perform with this tool are unique and yet often unfamiliar to the owner of a new saw. Included are such novel tricks as cutting arcs by swinging the arm, dishing by rotating the power head 360° and many others. So if you own a radial-arm saw, be sure to look for "Offbeat Tricks with Your Radial Saw" in the November issue

★ **AUTOMATIC FURNACE HUMIDIFIER.** Proper humidification is of vital importance to good health during the heating season, yet when you buy a furnace it doesn't always include a humidifier—certainly not one which works automatically. If your furnace now lacks a humidifier, or you'd like to do away with the bother of filling a water pan, a how-to craft feature in November details the construction of a motorized drum-type humidifier that you can turn on and more-or-less forget

★ **PATTERN YOUR SHOTGUN.** When you swing your shotgun on live or clay birds, it's important to know where the shot charge goes after you squeeze the trigger. You can determine this for sure by test-firing your gun at a pattern board. If the gun places its charges consistently to the right and low, you may find it necessary to either alter the size of the stock or vary your shooting practices to bring the pattern on dead target. Skeet and trapshooters, as well as hunters, should not miss this November story on patterning a shotgun

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ELECTRONIC GO-GO FOR YOUR CAR

Get more pep from your car with electronic ignition. Build this capacitive-discharge system now

By Brice Ward

WANT AN ELECTRONIC ignition system that really works? Then try building and using the capacitive-discharge (C-D) Fury XII described here. It will extend plug life to as much as 50,000 miles, and points can be used until the rubbing block wears out. High-speed performance and gasoline mileage are kept at their best and tuneups will be few and far between.

You can put this system under the hood of your car in any one of three ways: build it from scratch following the circuit and plans shown here, using what parts you have and buying the rest from your usual electronic supply source; buy the unit as a kit complete with all parts for $39.95, or get an assembled unit for $59.95. The kit or assembled units are available from Micro-Kits Co. (see Parts List).

What can the system do for you? Here's a for-instance. I installed one of these systems in my 1963 Valiant. At the time there was 18,000 miles on the plugs and 21,000 miles on the points. It would take from 30 seconds to a full minute to start the car and then it would die when put into gear. Before leaving the driveway, it would stall at least once more. It would still stall occasionally at lights and was missing every so often.

Now, with my C-D system installed, it behaves like a different car. I pump the accelerator and work the engine. On the second revolution or sooner, it catches and I cannot make it quit short of turning the ignition key. I can take my foot off the accelerator right after starting and suddenly slip the transmission into drive and the engine keeps right on purring. At stop signs it no longer stalls or misses. And when I'm ready to take off, I can punch the accelerator to the floor and hold it there with no hesitation in ignition.

Twelve important features are built into the system, each important to safe driving:

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• Maintenance consists of no more than lubricating the distributor cam and adjusting timing. Point resistance has no effect on the system's operation.

• The system delivers 80 milliwatt seconds to the plugs under all conditions; 30 milliwatt seconds is considered a minimum for good engine performance.

• Rise time is rapid enough to enable fouled plugs (500,000 ohms shunted with 50 picofarads) to fire.

• Number of active components is kept to a minimum. The more parts you have, the less reliable a system can be.

• Cost is reasonable, but not reduced by sacrificing reliability.

• There is no reduction in sparkplug voltage or power from 0 to 10,000 rpm.

• Operation is not affected by high rpm point bounce.

• Battery current drain is kept to a minimum.

• Point dwell time does not affect system operation.

• Tachometers are compatable and many types can be used with this electronic system.

• Even when battery voltage drops as low as 8 volts, the system still operates properly.

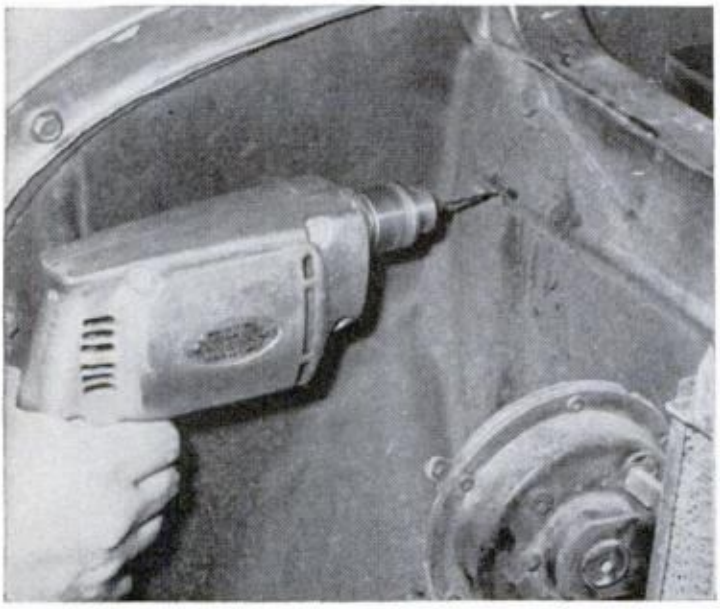
• Ballast resistors do not have to be removed or bypassed.

Now let's move on to building the unit. Use only the parts specified. Equivalent parts are not always equivalent and the result can be a system that does not operate properly. Parts were carefully selected and most are available from any large mail-order electronics house. If you have any difficulty, order them from Micro-Kits.

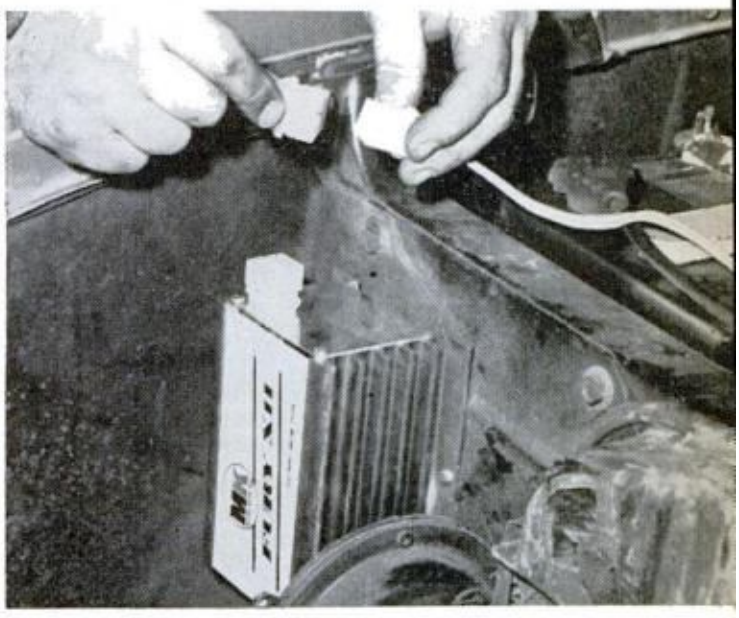
If you don't wish to use the Micro-Kits case, house your ignition system in a small chassis box and mount the transistors on one side. Use no insulation for the transistors if you have a negative-ground car, but make sure they are insulated if it's a positive-ground car.

To determine whether your car has a

MOUNTING THE SYSTEM is a cinch. We put it ahead of engine compartment. Drill three mounting holes and use three self-tapping screws to hold it in place



IF SYSTEM SHOULD FAIL, just pull the plug from the top of the case, then insert the shorting plug to reconnect your car's original ignition system



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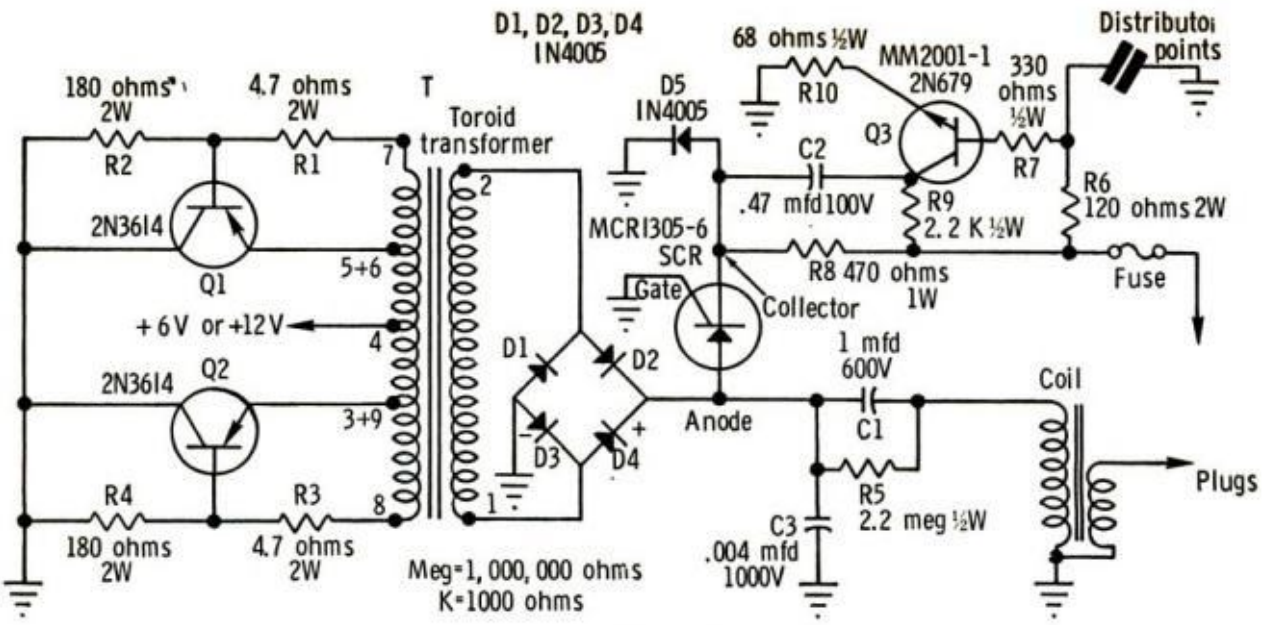


NOT AS COMPLICATED AS IT LOOKS, this circuit is designed with simplicity and reliability as its two main features. Toroid transformer is the only special circuit part. Follow this diagram carefully if building from scratch

positive or negative ground, take a close look at the battery. If the negative post is connected to the chassis, you have a negative ground system, and vice versa.

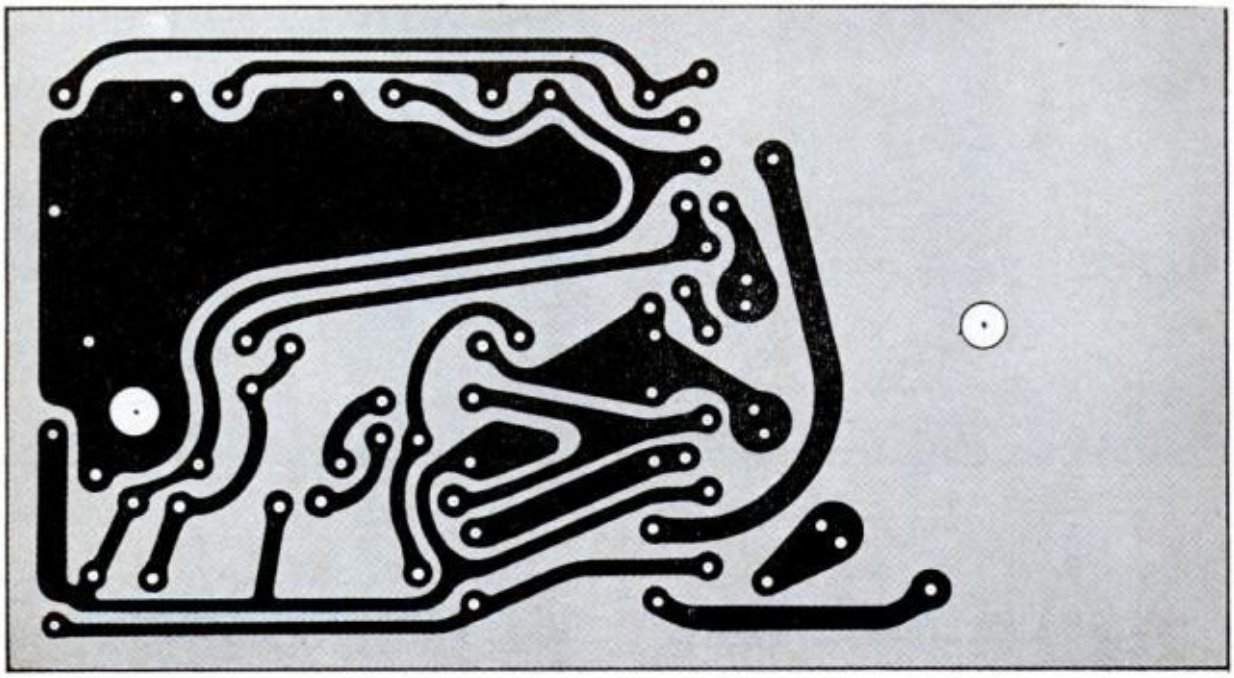
Complete details of both sides of the printed circuit board are shown and you can use these diagrams to make your own circuit boards. You can even use a phenolic board drilled for components as in the top view of the board, then complete all wiring with hookup wire underneath.

After the system is assembled you'll have to pick a good spot to mount it. You'll note that we mounted the system in front of the radiator. This is not practical in all cars; the fender wall under the hood is perhaps more convenient.

Above all, make sure you do not mount the unit in high heat areas—against the fire wall, over the engine or on the engine block. These locations are hot enough to damage the semiconductors and will cause the unit to operate poorly, if at all.

While we do not anticipate one of these electronic systems failing, it might happen, so a special shorting plug is supplied

WIRING SIDE OF PRINTED CIRCUIT BOARD. This is exact size and an accurate template for making your own board. You can also use a phenolic board and complete wiring with hookup wire, although this is less reliable



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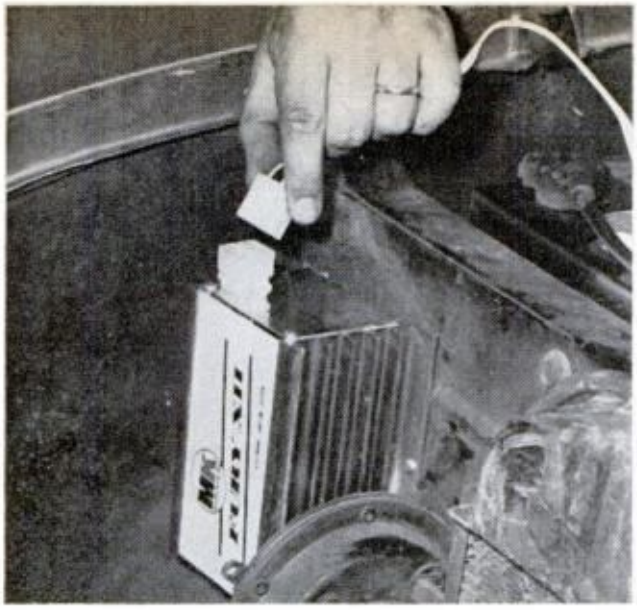


ONE-PLUG CONNECTION, which hooks the Fury XII installation into the car's ignition system. Make sure the cable is long enough to reach the electronic unit

to bypass the electronic system and reconnect the standard system if necessary. Keep this in mind when mounting the system and make sure you allow for access to the plug on the end of the ignition system case.

After you've built, installed and used your system for a while, we'd like to hear from you and learn what the system has done for your car's performance. If we get enough replies, we may be able to put together a follow-up report some time in the future. ★★★

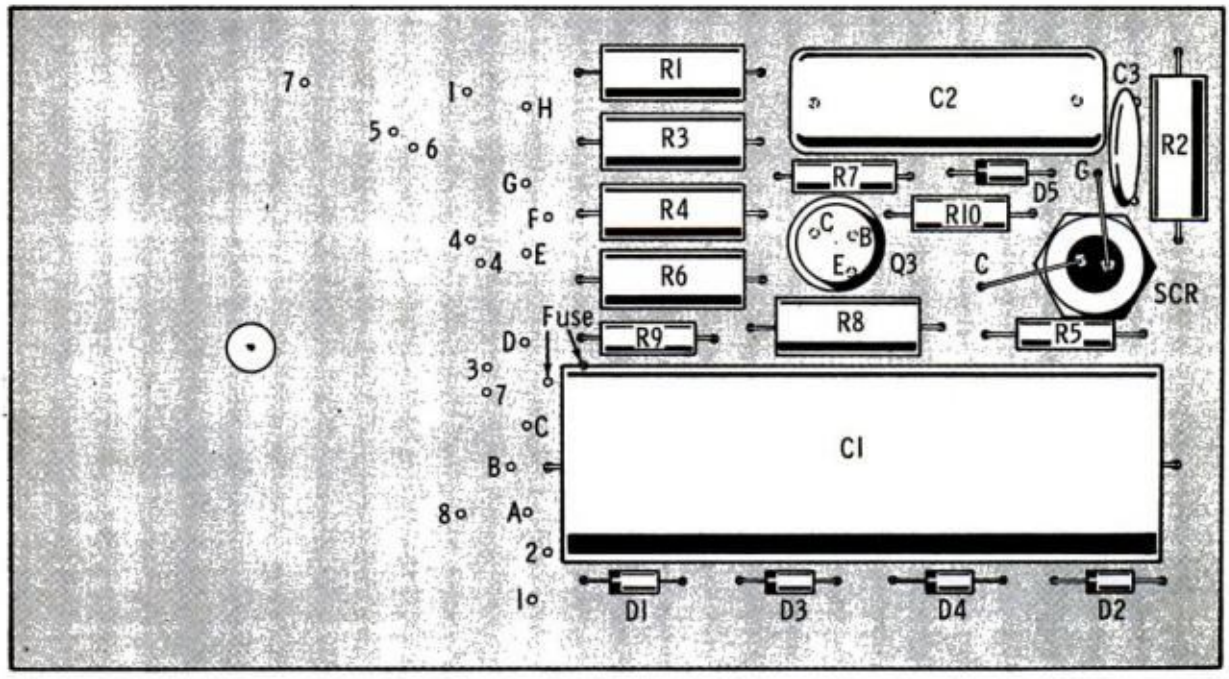
PARTS LIST

R1, R3—4.7 ohms, 2 watts, 10% resistor
R2, R4—180 ohms, 2 watts, 10% resistor
R5—22 megohms, ½ watt resistor
R6—120 ohms, 2 watts resistor
R7—330 ohms, ½ watt resistor
R8—470 ohms, 1 watt resistor
R9—2200 ohms, ½ watt resistor
R10—68 ohms, ½ watt resistor
C1—1.25 mfd, 600 volts, Mylar capacitor
C2—0.47 mfd, 100 volts, capacitor
C3—.004 mfd, 1000 volts, ceramic capacitor
D1, D2, D3, D4, D5—1N4005 diodes
Q1, Q2—2N3614 transistors
Q3—MM2001-1 (2N679) transistor
SCR—MCR1305-6 silicon controlled rectifier
***T**—Toroid inverter transformer T1002
*Heat sink and main case, plated
*Cover plate, phenolic
*Two end plates, plated
*SCR mounting panel
*Printed circuit board **(specify positive or negative ground)**
*Coil terminal boards (2)
Self-tapping screw—No. 6 x ⅜-in. (7)
Self-tapping screw—No. 6 x ½-in. (2)
Sheet-metal screw—No. 8 (3)
Binder-head screw—No. 8-32 x ½-in. (2)
Hex nut—6-32 (2)
Hex nut—8-32 (4)
Lock washer—No. 8 (2)
Solder lug—No. 6 (1)
*Connector and cable assemblies
Fuse—1-in. length No. 32 wire
Hookup wire
Solder

Complete kit of all parts $39.95.
*Complete set of specified parts which must be purchased from Micro-Kits $15.25.

All parts should be ordered from Micro-Kits Co., 15547 S. Garfield Blvd., Paramount, Calif.

TOP VIEW OF CIRCUIT BOARD shows location of all components other than transformer and power transistors. Two power transistors are mounted on heat-sink case. Transformer is purposely omitted to show its connection points



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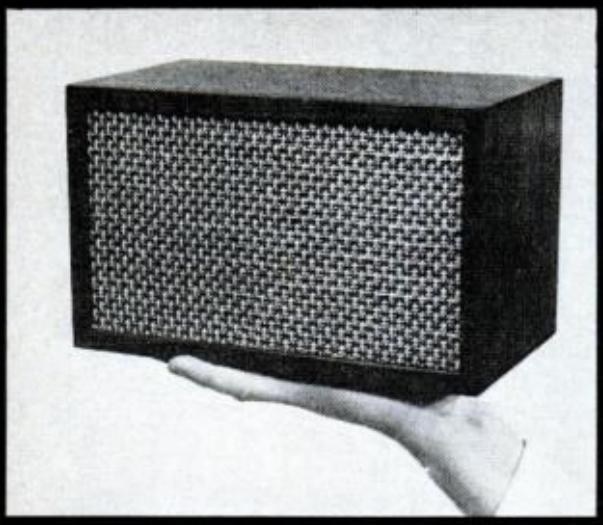
NEW IN ELECTRONICS



HI-FI HANDFUL is just what this miniature speaker enclosure represents. The 11 x 7 x 7-inch case tucks away anywhere and the two speakers it houses reproduce all sound between 70 and 14,000 cycles. There's even an electronic crossover at 4000 cycles. Power rating for the unit is restricted to 6 watts. This Heathkit goes together in a short hour or two of simple wiring

SOLID-STATE PHONOGRAPHS ARE HERE. One of the simplest is this $19.95 model from GE. It has a manual four-speed turntable with a built-in 45-rpm adapter, a flip-over dual sapphire cartridge, a 4-inch speaker, and storage space in the lid for up to ten 45 rpm records. The a.c. powered set owes its small size to a compact transistor amplifier (bottom left). The set weighs only 5½ pounds and measures 13½ x 5 x 9-in., just the right size of record player for pre-teens and younger children

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for 1966 -even the rumors came true.

RUMOR: "Evinrude has a 'hot' new V-4 outboard."

FACT: True. Newest outboard going is Evinrude's 100 hp STARFLITE 100-S. Same powerhead size as the original "75" — but new combustion engineering and internal exhaust "tuning" squeeze 33% more horsepower out of the same amount of fuel. New ignition. New carburetion. New heat-dissipating pistons. New 2 to 1 gearcase that develops more thrust on big boats — more speed on all boats.

RUMOR: "Evinrude has a motor that fits in a traveling case."

FACT: True. And the traveling case comes with the motor. New 3-foot, 3 hp Evinrude STOWAWAY folds and stores in a 2-foot plastic carrying case. Goes everywhere — choice of weedless or high thrust drive. Stows anywhere — car trunk, closet, bedroom or basement. Made to order for fishermen, campers — everyone who has ever wanted an outboard but never had room to carry it or a place to keep it.

RUMOR: "Evinrude has a big new 40 mph Gull Wing boat."

FACT: True. New power options put all 1966 Evinrude boats in the 40 mph class. Big news for 1966 is Evinrude's elegant new 19-foot sports runabout — the ROGUE. A man's boat. Big, brawny, solid, comfortable. For the boating buff who demands the ultimate combination of versatility, performance, seaworthiness, and luxury in a personal sports runabout.

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They're Great in the Boondocks

(Continued from page 105)

country club on Sunday. In fact, you can even get a two-wheel-drive-only version.

Our test Wagoneer had four-wheel drive and the optional Rambler-built V8. Aside from these, it was the all-out sissy model, with automatic transmission, full carpeting, radio, power brakes and steering, and—so help me—airconditioning. My wife usually reacts to a four-wheel-drive car as she would to a dead mouse, but she loved the Wagoneer.

Climb Like Monkeys

In the rough, the Wagoneer did well, despite its longer wheelbase (110 inches versus 92) and greater rear overhang. Both cars climb like scalded baboons, the Bronco being able to manage a 72-percent and the Wagoneer a 60-percent grade.

On paved roads, the Wagoneer enjoys a distinct superiority. Its ride, though firm, is less bouncy than the Bronco's. It did 0-60 in 12 seconds flat when the automatic was shifted manually (or 13.1 seconds in Drive), while the Bronco roadster, with windshield lowered, took 19.8. Both cars corner well; set them up for a turn in two-wheel drive and then slam into four-wheel drive to pull through stably.

The Wagoneer's power steering felt numb, but the manual setup may be better. The steering was also slower, and its turning circle, at 44.6 feet, made it less maneuverable than the Bronco's, at 34.

The Bronco we drove had optional bucket seats that were extremely comfortable; and worthwhile, especially since the high sheet-metal floor hump and transfer-case lever leave no room for a third front-seat passenger. In the Wagoneer, the transfer-case lever is farther forward, out of the way of passengers' feet. However, the action from high to low range and back in four-wheel drive was unbelievably stiff, though the Kaiser-Jeep people assured me that fully broken-in units work more smoothly.

The Wagoneer had more gauges, but they were less legible. The Bronco offers a full set at extra cost.

Neither car suffered from drive train noise in two-wheel drive; in four-wheel drive the characteristic whine was there.

One of the biggest differences is price. The four-wheel-drive Wagoneer, stripped and with overhead-cam Six, starts at $3716 ($5267 for the equipped model we tested). Though no price has been announced by Ford, the Bronco is expected to be competitive with cars such as the International Harvester Scout—which would put its base around $2350. ★★★

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But don't be deceived. Moto-Shop is not a toy. It's a dad-size tool — a craftsman's tool. Yet it's so simple to operate a small boy can master it in minutes. Completely safe, too. Moto-Shop weighs only 10 lbs. — you can store it on a closet shelf.

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Big capacity! 15" throat — cuts 1¾" wood, light metal, tile, plastics • Ball bearing motor • Table tilts 45° • Saws in any direction • No belts or pulleys. **Model 571** Jig Saw with disc sander (as shown), $33.95. **Model 572** Deluxe Jig Saw with disc sander, grinding wheel, wire and cloth buffing wheels. Plus 30" flexible shaft and 12 piece accessory set for grinding, drilling, routing, carving, $49.95.

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Please send me your free catalog on Dremel power tools

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All About Glass Cutting

(Continued from page 155)

by means of the bottom clamp-plate, held in place with a C-clamp, while the two short cross angles were welded on. A ruler glued to the side of the arm, its forward end aligned with the cutter wheel, lets you cut accurate circles up to 16 in. in diameter.

To break the head of the cutter free, fasten it in a vise and strike the handle sharply with a hammer. The swing-arm knob may be nothing more than a spool, but it must turn freely on its bolt.

After scoring, flip the glass over and press firmly—but not too forcefully—opposite the score line. This separates the disc physically from the waste, but doesn't free it. You must score at least one line across the waste to permit you to spring the scrap glass away from the disc, as shown in the photos on page 150.

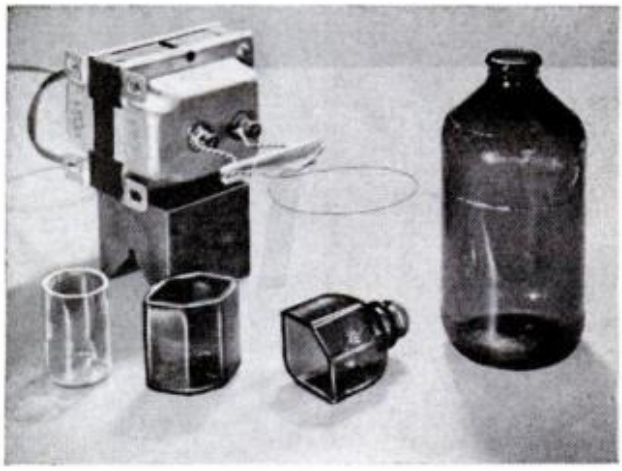
When it's the *outside* you want to save (that is, when you need a circular hole *through* glass, as for a port in a box-office window) you still scribe with your beam-type cutter, but you need *two* circles—one the size of the desired hole, and a second, concentric one about 2 in. less in diameter. The trick is to break out the center disc, then the ring. And trick it is: you make it easier if you heat the outer glass to expand it away from the inner scrap. This can be done by painting one surface of the surround, to within 1/32 in. of the larger circle, with a mixture of lampblack and shellac. You then hold the glass a few inches from an infrared heat lamp, moving it about so the coated area absorbs heat uniformly. You may hear some cracking sounds as heating progresses, and in some cases the glass might expand enough to let you force the center portion out in one piece; however, there's always the risk of edge-chipping, this way.

Instead, use the glass cutter to mark the center disc into a number of small rectangles and other shapes. With the ball-end of the cutter (or a small ball-pein hammer) tap gently on both sides of the nearest-center rectangle until it breaks through. Now, carefully break away other segments. When the inner circle is through, subdivide and chip out the ring. After one good-sized segment is removed, the others should drop out readily. Reheat the coated area as required to keep the outer glass expanded throughout the chipping process.

You can apply these methods for cutting shapes other than circles. Instead of the beam cutter, you can use a hardboard-template to guide the cutter. Just keep the wheel axle parallel to the glass, and on the radius of the curve. You're asking for trouble, however, if you attempt sharp angular cuts, such as square notches—always keep corners rounded.

The "black shellac" mixture described above comes in handy for cutting laminated safety glass, as shown on page 153. After scoring and separating both glass plies (by bending them one at a time over a yardstick) paint an inch-wide band about 1/16 in. to one side of the cut. Apply radiant heat until, by pulling, you can separate the cut 1/32 in. or so. Keep the cut open while you run a razor blade down it to sever the plastic core.

Snapping small-diameter tubing is simple, as shown on page 155, but large glass tubes and bottles require special handling. You *can* try scoring a line around the circumference with a glass cutter and then apply heat, but if the item is of any value, there are surer techniques. One of these involves a transformer, as illustrated.



BOTTLE CAN BE CUT by resistance-wire loop wrapped around score line and heated by low-voltage soldering-iron transformer. Wire was cut from radiant-heater coil and glows dull red under power

(Don't try this with a bell transformer—there's not enough wattage.) Sometimes the glass won't separate until tapped with a stick. Another method is to cover the bottle with wet paper to within a fraction of an inch of both sides of the score line, then apply a small torch or blow-pipe flame to the gap. Still another method doesn't involve any scoring. You just fill the bottle with motor oil to the height you want, heat a pencil-sized iron rod in a blow torch flame (or even the home furnace) and plunge the rod into the oil. There's a moment's boiling at the surface, and the bottle cracks clean at the oil level.

To drill holes, the pros often use a tungsten-carbide bit lubricated with water. A favorite method with amateurs is to use a tubular piece of brass or copper as a bit and a mixture of abrasive grit and water as the cutting agent—the bit being

(Please turn to page 206)

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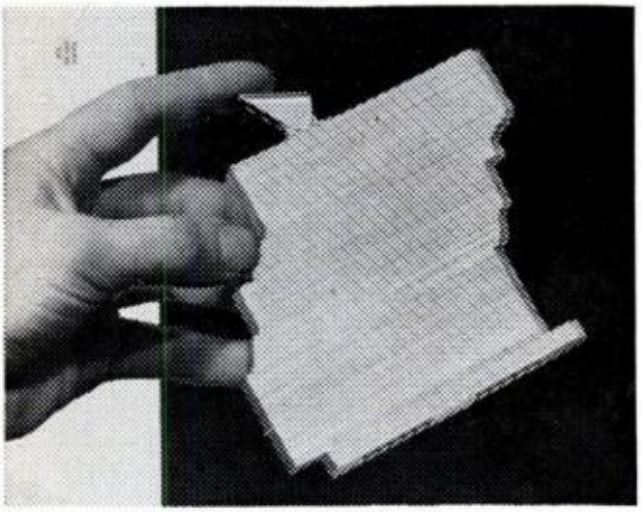

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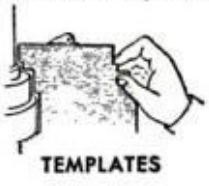

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All About Glass Cutting

(Continued from page 204)

operated by a slow speed drillpress. Turpentine, or turps and camphor, can also be used as a drilling lubricant. Whichever you use, take care not to apply too much pressure, or even solidly-supported glass may break.

Mirrors, of course, should be scored on their unsilvered surface. As for tempered plate glass—don't try to cut it; it's shaped and sized *before* tempering and won't yield to standard glass-cutting devices. But there are very few other types of glass—among the hundreds of varieties—that you can't master, once you've practiced the basic cutting techniques we've just described. ★★★

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Honing keen edges on your plane irons, wood chisels and other cutting tools is duck soup when you make use of a new clamp-on sander accessory we came across recently. It consists of a carborundum stone bonded to a metal shoe which clamps to any standard size orbital sander like a sheet of sandpaper. The shimmy (orbital) motion of the sander actually does

the honing, and since you hold the tool motionless, there's no chance of rocking it and thus altering the proper cutting bevel. It does a beautiful job on molding-head knives and flat shaper cutters. You can get this accessory for $1.98 from Silken Compass Cutting Co., P. O. Box 242, Oceanside, N. Y.

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Sound Waves

(Continued from page 128)

X-ray dosage powerful enough to penetrate the skull may cause radiation damage. No such grueling test could ever be part of a routine checkup. The big advantage of the ultrasound method—technically called echo-encephalography—is that it offers a quick way to spot a brain tumor before symptoms develop.

The same simple technique also shows up a form of brain injury common in car accidents where the head strikes the windshield. This results in the rupture of blood vessels beneath the brain lining, causing blood pools within the skull to push on the brain. Called subdural hematoma, such injury often goes undetected and untreated, though it may later produce symptoms similar to those of a stroke.

"When crash victims arrive at the emergency room," Dr. Evans points out, "they are usually unconscious, in shock, or plain confused. You can't ask them what happened or where it hurts." Under such conditions, a quick ultrasonic head check may save later complications.

Medical ultrasonics took its cue from the early submarine detectors of World War I. Soon after, a Viennese doctor named Karl Dussik began dunking people's heads into water buckets and tried to map their brains by sending sonar signals through their skulls. But he lacked modern ultrasound generators that spurt thousands of high-frequency pulses through their transducers and oscilloscopes fast enough to keep track of each pulse and echo.

As the term ultrasound indicates, the frequencies employed lie above the audible range. Human hearing extends to about 20,000 cycles per second. Dogs hear up to 35,000 cycles (which accounts for the "silent" ultrasonic dog whistle), and bats run their sonar at frequencies around 60,000 cycles. But medical ultrasound extends all the way up to millions of cycles (megacycles) per second. Thanks to their very short wavelength, these sound waves have the ability to define objects in their path with great detail. Such sound waves act like invisible light beams "shining" through solid and semi-solid objects.

Compared to X-ray, ultrasound offers important advantages:

- X-rays show only strong contrasts in density; for instance, bones against flesh. Ultrasound also shows the soft tissues such as liver, spleen and kidneys without pumping them full of contrast solution.
- X-ray radiation dosage adds up with each exposure. Ultrasound is believed to be completely harmless.
- X-ray is a poor localizer of foreign bodies, showing only one-dimensional shadows. Ultrasound, by timing the echo, shows the depth of the object within the body.
- X-rays are blind to some materials, such as plastics. Ultrasound shows characteristic echoes from almost any substance.

Spurred by these possibilities, medical scientists throughout the world are rapidly refining their equipment and extending the use of ultrasound into many different branches of medicine. For example, ultrasound diagnosis of heart trouble is now widely employed in Europe. The transducer is placed on the chest. If the heart valve moves toward the back, the returning echo takes longer. If the valve moves forward, the echo returns faster. By watching the blips move on the tube screen, physicians can follow the heart valve motion. Such "echo-cardiograms" help find heart flaws that otherwise might go unnoticed and cause heart failure later.

The latest development in ultrasound heart diagnosis is for cardiac effusion—a condition in which the heart sack fills with fluid pressing on the heart itself. In extreme cases it may choke the heart completely. This frequently happens after car accidents in which the driver is hit in the chest by the steering wheel. Since X-rays can't distinguish heart muscle from the surrounding liquid, the examining doctor can't tell whether the heart itself is enlarged or whether fluid in the sack has added to its volume. Ultrasound shows a clear dividing line between heart muscle and liquid.

All these applications are based on a simple type of scope display known as A-scan, which shows each returning echo as a blip on the tube. Lately, researchers have been working with a more elaborate display method called B-scan. In this system, each echo produces a single image point on the tube. As the sound beam scans an internal organ, a picture of the whole organ is built up point by point.

B-scan produces a unique view of the body's interior—like slicing across a loaf of bread to see what's inside. This differs radically from an X-ray picture, which corresponds to shining a light through the body (like candling eggs).

Dr. Evans, who is currently exploring the possibilities of B-scan under a grant from the National Institutes of Health, showed me a typical B-scan display.

"This patient came in with a diagnosis of liver cancer," he explained, pulling a picture from his files. The photo clearly showed the bulk of the liver, a whitish

(Please turn to page 210)

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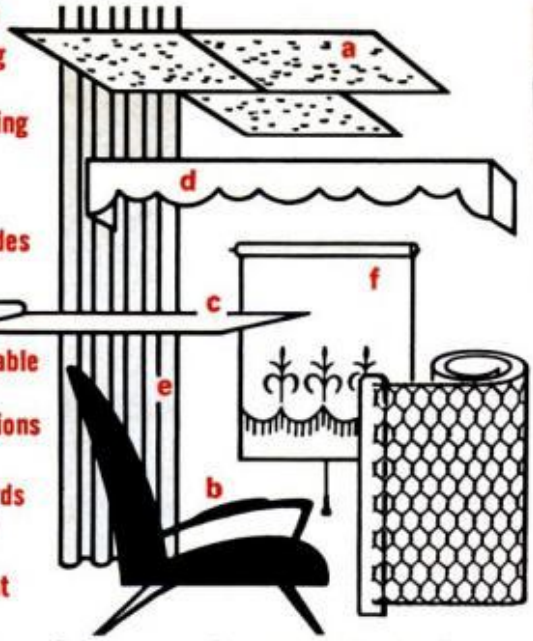

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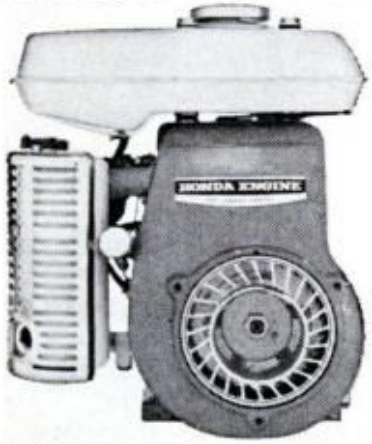

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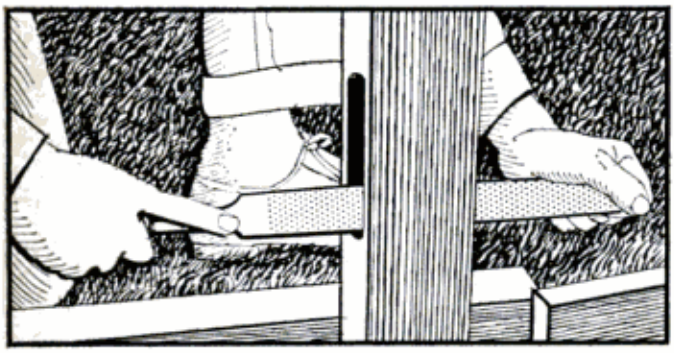

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Sound Waves

(Continued from page 208)

area that was full of black holes.

"Those holes are cysts," commented Dr. Evans. They were causing the trouble, not cancer. "Thanks to this B-scan we were able to save the patient the pain and expense of an exploratory operation."

Unborn babies—and their mothers—have a lot to gain from B-scan. Doctors hesitate to use X-rays on embryos for fear of radiation damage. Now they can measure the size of a baby's head and of the mother's pelvis with harmless ultrasound.

Optimists foresee several major breakthroughs within the next five years:

- Anticipating and preventing heart attacks by spotting dangerous heart size, wall thickness or valve function.
- Anticipating and preventing strokes by observing brain arteries.
- Finding a cure for leukemia by observing how the spleen—the organ chiefly affected—reacts to types of medication.

Despite this hopeful outlook, most doctors doubt that ultrasound will entirely displace X-ray as a diagnostic tool. "I regard ultrasound as a supplement for X-ray," says Dr. Smyth, "not a substitute."

One obstacle to the fast spread of ultrasound techniques is that few doctors are trained to interpret sound scans properly. In this respect, Germany, England, Sweden and Japan have outpaced the United States. One way to get around this bottleneck might be to train ultrasonic specialists, just as radiologists are specially trained in the interpretation of X-rays.

Some researchers go beyond diagnosis and experiment with ultrasound as a treatment for various diseases. Several cases have been reported where ultrasound loosened arthritic stiffness, broke up kidney and gall stones.

A daring and dramatic feat of this kind was performed in Italy, where doctors at the University of Padua reported a new concept in bloodless surgery. They described an operation in which three separate ultrasound beams were aimed at a deep-lying brain tumor. Like three invisible shafts the beams sliced through the brain, but did no damage along the way. But where the three beams converged inside the head, their energy added up. The triple-strength ultrasound energy "jiggled" the tumor cells out of existence.

Ultrasonic surgery is still too rare to judge its promise. But with research projects now under way at the University of Illinois and Massachusetts General Hospital in Boston, the day may not be far off when some forms of surgery can be performed without cutting people. ★★★

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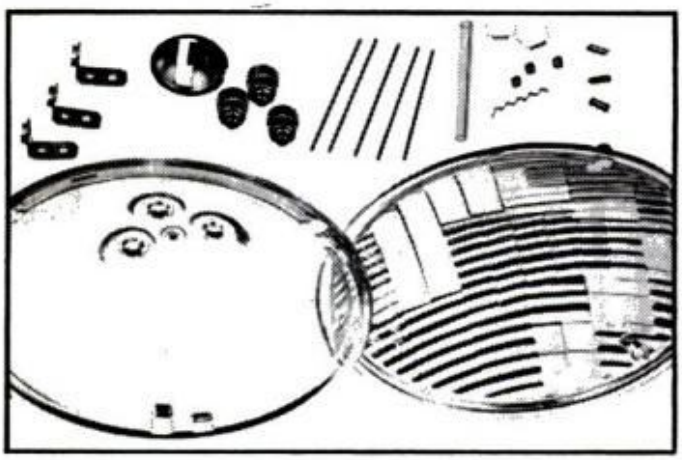
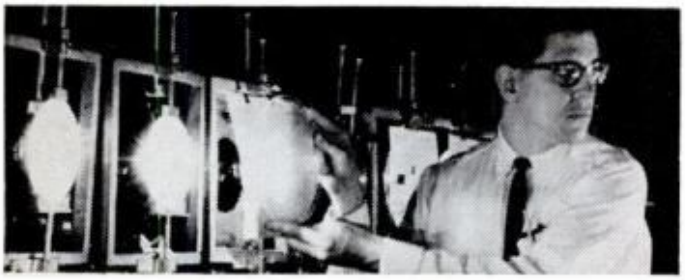
How General Electric headlamps help you see farther down the road at night

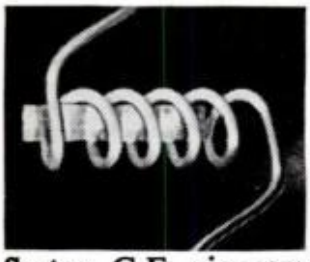


1. Your car headlamp has 22 precision parts. The quality of each part can affect a lamp's light and life. Only G.E. makes each of these parts—from tungsten to glass.



2. Your headlamp lenses have more than 100 prisms to beam light ahead of your car for maximum safety and eye comfort. G-E lenses and reflectors must pass 129 quality checks *before* they are assembled.

3. Even a thumb print inside the glass reflector of your headlamp would reduce reflectivity, impair your night vision. An alcohol rub cleans every G-E reflector before the mirror surface is applied.



4. Reflectors in your G-E headlamps *never* tarnish. A 2000-degree "poof" transforms an aluminum hairpin into a vapor that deposits evenly over the glass and becomes a reflector. G.E. pioneered this process, as well as the sealed beam headlamp itself.

5. You see easier in rain and fog. G-E's *split-center fog shield* keeps the lower beam from bouncing upward off bumpers. Shield and filaments are independently mounted to resist vibration.

6. Your G-E headlamps are made oven-hard to shrug off impact and thermal shock from rain and snow. This is one reason G-E headlamps burn bright so long.

7. Since 1920, your car's headlamps have been constantly improved through practical research by General Electric engineers — with test cars, such as this venerable Reo, long since worn out in your service. Constant attention to minute details insures years of dependable service for pennies cost.

No wonder most drivers prefer G-E auto lamp performance. Next time you drive, push the brake, pull the switch to check your lights. Or have 'em checked where you normally have your car serviced. If you need a replacement, demand a dependable G-E lamp. General Electric Co., Miniature Lamp Dept. M4-24, Nela Park, Cleveland, Ohio 44112.

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Game Grab Bag for Sportsmen

(Continued from page 138)

er) with a treble hook behind it that trails an inch or so of red yarn. Recently there's been a trend toward fresh frozen bait (whole herring or anchovy about five inches long) that is secured with two hooks, one through the tail and the other sideways behind the gills. The leader connecting the hooks is pulled tight so that the bait is slightly bent, imparting a spinning, twisting motion as the bait moves.

The guides agree that bait catches the most fish (and the most seagulls if you don't get the bait down fast) but they say the traditional spoon kills the most *large* fish. Fairly short boat rods are used, with line ranging from 27 to 50 pounds test. Salt water reels with an adjustable star drag are necessary. Spinning outfits can be used but have no advantage over conventional tackle. State law forbids using a gaff on salmon; a large net is used instead.

One of the nice things about this part of the country is that if the fish aren't running in one river they may be running in another that's only a few miles away, depending on the tides and local rainfall. A few phone calls can spot the hot fishing areas, day by day. Virtually all rivers on the Oregon coast, and more than 30 streams in California as far south as Monterey Bay, are "salmon" rivers.

Traffic on the Klamath

One of the best known of all the salmon streams is the Klamath River that gets its start in eastern Oregon, angles down into California and enters the Pacific about 30 miles south of the Smith. Peak of the salmon run on the Klamath is in late August because of the distance the fish must travel to reach the spawning beds.

The Klamath is famous not only for its fish but also for its traffic jams. In August there are hundreds of vacationists loaded into skiffs in the tide lagoon, trolling in a tight mass and bumping into each other and snagging lines. I've seen experienced guides pull out of the traffic in despair and try less popular water where the fishing isn't as good but where there's less competition. By comparison, the Smith is a "late" river because it is only 60 miles long. The fish haven't far to go.

There's one bonus we haven't mentioned yet.

"It's always open season on Big Foot," says Joe Sierka of Castle Rock. "The people in Siskiyou and Trinity counties claim that Big Foot doesn't get over here to the coast, but it's well known that he roams part of this area.

"Our sheriff has had deputies out look-

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ing for Big Foot after people reported seeing him. It's hard to say whether Big Foot is an enormous bear or a huge Bunyan-sized primitive man; about the only sure thing about him is that his footprints are 16 inches long. There are some who say Big Foot is only a myth, a legend of local Indians. They never saw his prints."

Big Foot or no, the northern California coast is one of the last frontiers for hunting and fishing in continental United States. So far, civilization hasn't ruined its rugged appeal; on the contrary, the California Department of Fish and Game says that today the salmon catch as a whole is well above the average for the last half century because of the abatement of improper logging practices and anti-pollution law enforcement.

Too, young silver salmon are being planted in many coastal streams. These are not tame hatchery fish when they are caught; for the planted fish go downstream and spend two or three years in the ocean before they attain an average weight of 10 pounds and return to the streams in which they were released.

Oregon similarly is in the midst of a campaign to maintain and increase its salmon sport fishing, as well as maintaining good hunting.

To me, the nicest part of this frontier-type hunting and fishing is that it's only a few steps away from a comfortable motel room or trailer. That's the big difference between the wild west of today and a century ago. ★ ★ ★

The Green Line Grows Longer

When introducing their line of insulated tools last year (*PM*, Nov. '64, page 54), Rockwell Manufacturing Co. indicated they'd be adding to the original four. They've now unveiled a 7½-in. portable circular saw with the same double-insulated feature and breakproof plastic housing. Only the base and blade guards are aluminum, making the tool as much as 3 lbs. lighter than metal-housed saws. Since no grounding is required, the cord has a standard two-prong plug.

The saw's 10-amp., 4500-rpm motor and 2⅜-in. depth-of-cut qualifies it for home-improvement construction, and holes in the base make it easily convertible to a table saw. The Green Line Model 75 saw sells for $39.88 with a combination blade; a rip guide and carrying case are options at $10 more.

Also added to the line are three new drills (variable-speed ¼- and ⅜-in. sizes and a two-speed ¼-incher) plus a two-speed portable jig saw.

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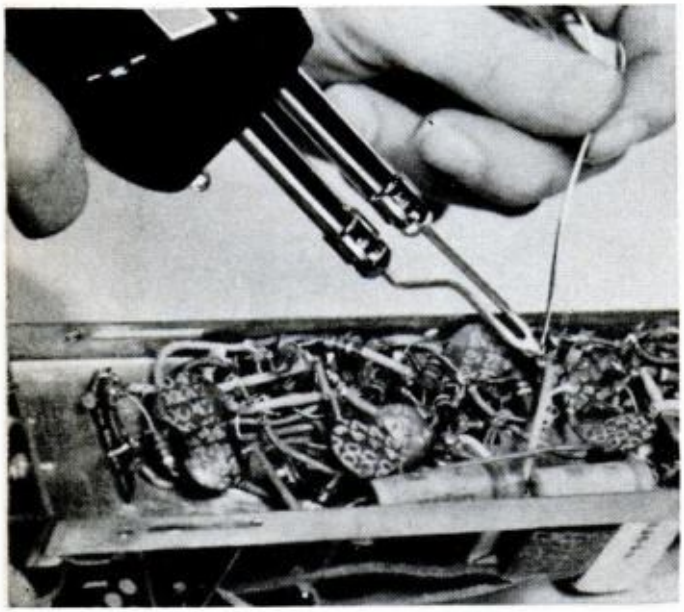

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Gems from Jalopy Graveyards

(Continued from page 108)

is quite a different matter. It takes 15 or 20 coats of lacquer to equal three or four coats of enamel. "I can put on an enamel finish for $100 less than lacquer," says Francis.

In painting, Francis tries to duplicate the original car color.

During the course of his work, Francis has devised some unique tools for special jobs. For instance, there's a little gadget for rolling the bead around fenders. He also designed a holder for clamping the fenders while they're being hammered.

Instead of soaking wood until it's flexible enough to be bent, he made a "wood cooker" from a tire-recapping machine. This steams wood that is to be used for top bows, wheel parts and tack strips.

Before he had the machine, the wood had to be soaked several days before it could be bent. "The first time I used the machine," he says, "I cooked the wood for six hours. When we took it out, you could cut it and eat it with a spoon."

How do you get started in car restoration? Your chances of finding a "sleeper"—an old car in mint condition for sale cheap—are pretty slim. "The best way to find a restorable car is to check the publications that specialize in antique-car news," Francis advises.

Prices vary from one part of the country to another. Francis says that in his area a good restorable Model A runs from $200 to $400. Roadsters are cheaper to restore and more valuable when completed, so they're usually more expensive. In areas such as Florida, where rust is bad and there are fewer old cars, a sedan in bad shape may bring up to $500.

Cost of restoration also varies, depending on the condition of the car and the availability of replacement parts. Francis says his average restoration cost has been $1200 to $2000, plus the original cost.

He suggests that beginners start with a Model T or Model A Ford, because many specialty companies now manufacture replacement body parts, hardware and even upholstery kits for these cars.

Old-car fever can strike almost anyone. Few teenagers catch it, but from 20 on, no age or occupational group is immune.

"Once you catch that fever," says Francis, "there's no cure." The symptoms of one customer are typical. "He was from the East," Francis says. "He had been in my shop a year ago, looking around. He'd fought it all that time, but finally he was back. He admitted the hobby is expensive and that he really can't afford it, but he just had to have one of my cars." ★★★

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"Get the message your plugs give you"

says Parnelli Jones, 1963 Indianapolis winner

Every time you pull the spark plugs from your engine, look 'em over. They can tell you a lot about the engine's condition.

If you find one or two plugs, say, fouled by wet, sludgy deposits, suspect worn rings or pistons or too much clearance between valve stems and guides for those cylinders. Worn or loose bearings are another possibility. Burned or overheated plugs—with white, burned or blistered noses and eroded electrodes—generally indicate inefficient engine cooling, overheating due to wrong ignition timing or a need for "colder" plugs. If just a couple show that condition, however, the trouble might be as simple as loose plugs!

It's mighty important to tighten plugs properly. Do it with a torque wrench. Here's a table that shows the amount of torque for different plugs:

Plug Hex. Size	Thread Size	Correct torque in foot-pounds	
		Cast iron heads	Aluminum heads
5/8"	10MM	15	10
13/16"	14MM	30	25
7/8"*	18MM	40	35
15/16"	7/8"-18	45	40

*13/16" with tapered seat—torque to 15 to 20 ft.-lbs.

In a pinch, use a ratchet wrench with short handle and tighten each plug about ¾ of a turn after plug begins to compress the gasket.

It's mighty important to use high-quality plugs, too. I like Autolites. Autolite heat-seals every plug it makes, fusing the center electrode to the insulator under tremendous heat and pressure to prevent compression leakage. Nearly everyone does this with racing and aircraft plugs. But not everyone does it with regular passenger-car plugs. Autolite thinks the extra protection is worth it. I think so, too.

AUTOLITE SPARK PLUGS

A PRODUCT OF Ford

HERE ARE SOME OF PARNELLI JONES' RACING ACCOMPLISHMENTS: Indianapolis 500—Winner, 1963; top qualifier, 1963, 1962; Pikes Peak—Stock Division champion, 1964, 1963; Milwaukee—Seven stock car wins and a USAC 200-mile championship victory in past two years!; Trenton—Winner, USAC 200-miler, 1964; Riverside—Winner 200-mile Sports Car Grand Prix, 1964 (his 1st sports car race!).

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Olds' New Toronado

(Continued from page 103)

He pointed into the Toronado's engine compartment: "You know, I'd be leery of that chain that drives the transmission. After a while you always get slack in any kind of chain drive."

An Olds engineer standing nearby volunteered: "It's been tested a million miles. It'll last the life of the car."

(Zwick is right; slack does develop. But a tensioner takes it up.)

"Anyway," said Bakke, "we haven't looked inside yet. We've just been tearing the outside apart."

Zwick slid into the driver's bucket seat and, without thinking, tried to push the steering wheel aside, the way he does in his Thunderbird. He grinned self-consciously when it didn't budge.

Cut-away Dash Adds to Legroom

He slid the bucket as far back as it would go. "These seats are great," he said, "better than the T-bird's. And there's more legroom because the dash is cut away. In the T-bird it comes way out, and when you're big like me you feel all closed in."

Bakke climbed into the other seat and slid his foot across the carpeted floor. With front-wheel drive there's no driveshaft, hence no floor hump. "This flat floor will sell the car quicker than anything," he said.

"In the T-bird that console's in the way, and the gas pedal is right up against it," said Zwick.

Bakke leaned his head back against the optional headrest. "I don't like this," he said. "I sit too high for it."

He got out and climbed into the back seat. "In the T-bird, you can fit only two people in back," he said. "These seats are roomier, and they seem softer. Good headroom, too. I can't wear my hat in my car. Can you?" he asked Zwick.

"I don't wear a hat," Zwick answered. "I paid $20 for one and it just sits in the closet."

Zwick turned and looked out the back window. "With some of these big windows the sun can make it pretty hot in the back seat."

"Not here," said Bakke. "The window ends behind the rear seat."

Paired Door Handles

He pointed at a second door handle, behind the front seat back, that let rear-seat passengers open the door. "Now that's all right," he said. "I like that."

"What if there are children in back?" asked Zwick. "You know how kids are."

(No problem. The rear handles are inoperative when the lock buttons are pushed down.)

They climbed out and got into another Toronado, this one with a front bench seat. "I like this better," said Bakke. "It gives the appearance of buckets, but you can still seat three."

"I feel more comfortable in the buckets," Zwick said.

"Actually," said Bakke, "with this kind of car, you're not interested in hauling a lot of people.

"You know," he went on, "the Olds isn't as fancy inside; it has fewer gadgets. My wife's T-bird is loaded. Sometimes I'm afraid to get in it. I drive a poor man's T-bird."

"Material-wise, the two cars are about the same," Zwick said. "I like all the equipment to be standard. I don't want the dealer saying 'the radio and heater are in such-and-such a group, whitewalls are in another group.' A Chevy or Galaxie will cost you just about as much as a T-bird if it's equipped the same way. The only extras I bought are fancy wheel covers.

"One thing I'd miss in the Olds is the seat belt warning light," Zwick went on. "I never wore a belt until I got the T-bird and the light kept reminding me."

As Bakke climbed out, he tried to push the steering wheel aside. "I have a habit of doing that," he said sheepishly.

We all climbed back into the bucket-seat Toronado and headed for the banked high-speed track. We made a couple of laps at an indicated 115 mph.

"This car rides better than the T-bird," Zwick said.

"I think so," Bakke agreed.

"There's some wind noise," Zwick said, "but it's not bad."

(The absence of vent windows helps considerably.)

"I don't know. I haven't taken my car over 75 or 80," Bakke said.

Zwick grinned: "You don't know what you're missing."

We then drove to the straightaway. Each had several turns accelerating from the starting line and trying out passing-speed performance.

"The acceleration is nothing unusual," Bakke said.

"And it has a rough idle," said Zwick. "Mine idles smoothly."

"Mine doesn't," said Bakke. He turned the wheel full-lock to check the turning circle. "I don't think this turns any tighter," he said.

"I'd say it takes less room than the T-bird," Zwick disagreed.

Next we drove to the twisty handling

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course. Zwick took the first lap quite briskly.

"The brakes are touchy," he said. "They grab in a hurry, but I think they take more pedal pressure.

"There's no vibration in the steering, like there is in other cars," he went on.

The second time around, grinning from ear to ear, he really pushed it. The tires screeched through the turns, and occasionally the front end plowed off and nipped the grass, but Zwick recovered nicely each time.

Handling Draws Raves

"This thing has the T-bird beat all to hell on handling," he said, his eyes as big as clocks. "Like up in an airplane! You've got to let me take this home."

He pulled over, and as he got out to make room for Bakke, he tried to push the wheel aside.

First time around, Bakke kept a conservative pace. He took his hands off the wheel on a straight section of road, and the car didn't waver.

"It holds the road very well," he said. "Good directional stability. But the T-bird has good stability too. It would be interesting to put some weight in the Olds trunk and see what happens. The T-bird weaves when it's heavily loaded. The Olds steering feels a little sluggish compared to the T-bird's, but the transmission shifts smoother."

"In the T-bird," said Zwick, "when you step on the gas, nothing happens, and then it grabs."

(The '66 Thunderbird has a new smoother shifting automatic.)

"Visibility is better here because the dash is lower," Bakke said. "And not having vent windows helps too."

"You like driving this one better than your car?" Zwick asked.

"I think so," Bakke answered. "Handles nicely, doesn't it?" Gradually he increased his speed until he too was sliding around the corners like Barney Oldfield.

"Boy, you can take this around fast. This is really something . . ." He blasted through a sharp bend. "I feel like a kid with a new toy. You just step on the gas and it pulls you right through. I think if you didn't know it's front-wheel drive you wouldn't be aware of it—except maybe on slippery pavement. But it definitely feels better on corners."

He pulled over, and as he got out, he tried to push the wheel aside.

Zwick wanted another crack at the handling course. "Man, you can't hold this thing down," he exclaimed.

"Try going into a turn fast and lifting off the gas completely," I suggested. He did, and the car's tail end lightened and gave just a hint of washing out.

"You have less control with the gas off," Zwick observed.

"That's because when you give it gas, the front wheels pull you through," Bakke said.

(This is a characteristic of front-wheel-drive cars; behavior in a corner changes drastically, from understeer to oversteer, with varying throttle. But it's less pronounced in the Olds than in most others.)

"I wouldn't take my T-bird over that course and try what I did," Zwick said. "I'm really impressed."

"I probably drove this a little faster than I normally would," understated Bakke.

"You know, I have a hard time reading this speedometer," Zwick said. (It's a weird design—a spinning drum and a fixed pointer.) "I tend to drive with my hands on top of the wheel and they block my view."

"It startles you at first, just like the T-bird speedometer," said Bakke. "But it's nice. When you get used to it, I think it reads faster."

"I hope the ventilation here is better than the T-bird's flow-through. At 80 it keeps opening and closing on me," said Zwick.

"I had an awful problem the other day," Bakke complained. "For miles that sun beat down on my chromed wiper arms. That's one of the things many people don't think of when they buy a car. These arms have a nice satin finish."

"That chain drive still bothers me," said Zwick.

"Olds says it'll last the life of the car," Bakke said.

"Yeah," answered Zwick, "in Michigan that's about three years."

As he climbed out, he tried to push the steering wheel aside. ★★★

Sun Power on the Moon

Moon power appears to be next on the list for Soviet scientists who have revealed plans for a solar power station on the moon.

Huge mirrors would focus the sun's rays on a special device that would convert their energy into electricity. Such a power station, the Reds say, would have an output of several billion kilowatts. They claim that by using a Maser (microwave amplification by stimulated emission of radiation), the electric energy could be converted into radio waves and beamed to earth, where it could again be converted back into electric power and put to use on earth.

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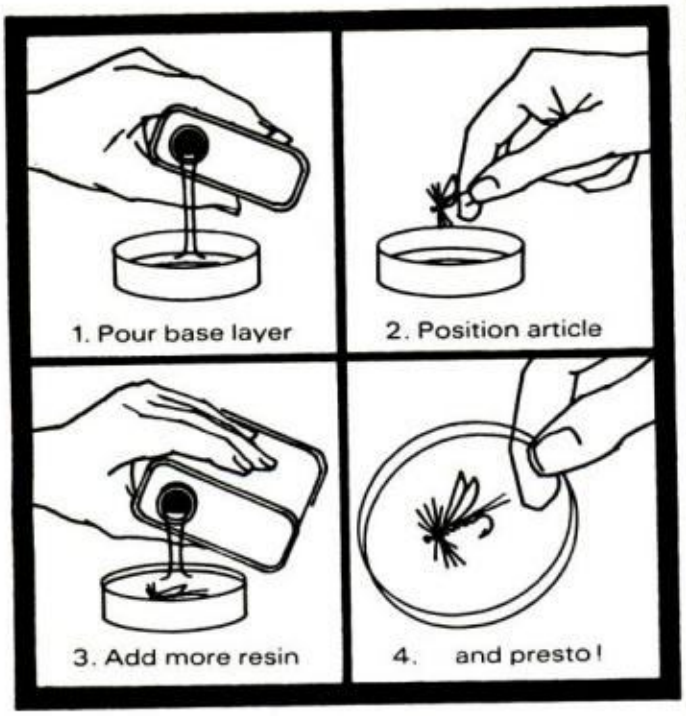

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America's First Car

(Continued from page 111)

new piston were necessary. During preparations for the Festival, the Museum got into a hassle with Michigan's secretary of state. The Museum wanted a historical license plate reading "1863" for the year of the Roper's birth. But it had had no previous plates, not even a motor number or a serial number. The state finally relented to the extent of listing the Roper as "a convertible." After more than 100 years on the road, the Roper finally became "official."

Sylvester Roper started experimenting with steam carriages in 1860. Before his death he had built 10. The Ford Museum's is the only one known to be left.

Ford himself first heard of the Roper when collecting antiques. Its birthdate was set at 1863 on the testimony of an 80-year-old woman who remembered seeing it that year when a little girl in Cleveland.

The year of Roper's death also marked Henry Ford's completion of his Quadricycle. Thus Ford, born in the same year as the Carriage, built his first vehicle the year Roper died.

The full history of Roper's Carriage hasn't yet come to light, but the Museum's model was owned in about 1901 by W. W. Austin of Winthrop, Mass. Another automotive pioneer, Austin called the car, after thousands of miles, still "the simplest, lightest and best steam automobile ever built." And it was almost 40 years old at the time!

Austin's praise, however, should be taken with a grain of salt. He was once something of a publicity agent for Roper.

When it was a mechanical freak back in the 1860s, the buggy was advertised as "steaming noiselessly and unwearily, stopping occasionally for a bucket of water or a handful of faggots to heat the boiler." The shortcomings didn't deter promoters who claimed it "halts instantly, turns deviously, or proceeds at funeral pace at the bid of its driver. More docile than a horse! It is light and strong and can be managed better than any horse, and can be driven faster than any person dare to ride." In its circus period the Roper was subject of a standing challenge: "We will match it against any trotting horse in the world."

Roper's interest in more speed led to the idea that speed alone finally killed him. He died June 1, 1896 aboard a steam velocipede with the local newspaper reporting. "He could not stand the exhilarating speed of nearly a mile a minute while testing his steam cycle on a dirt track near Boston." ★★★

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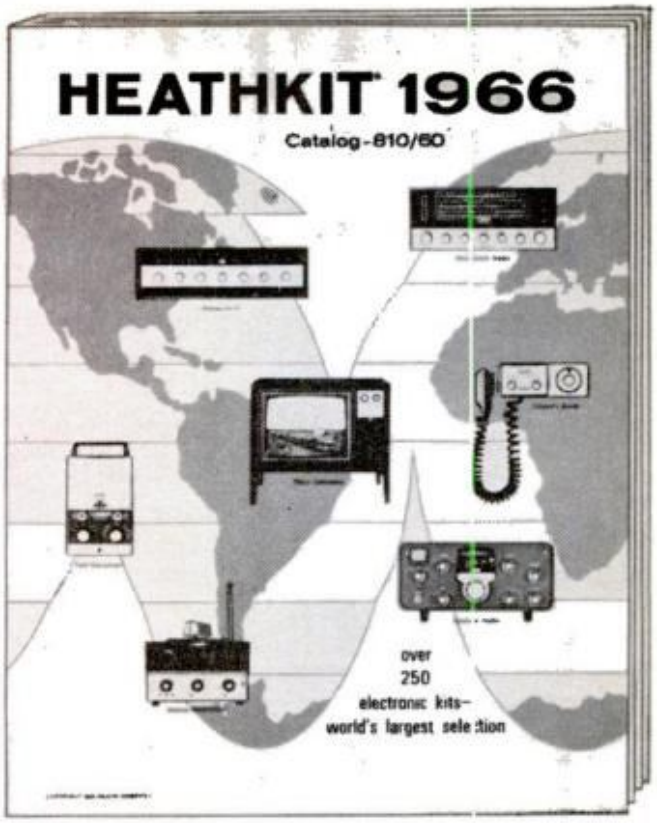

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What's Ahead in 1966?

(Continued from page 100)

High-Performance 427. And not far behind in cubage is Mercury's now-standard 330-hp 410-incher in place of the 390.

Merc's little brother, the Comet, along with the Ford Fairlane, now offers a 390-inch V8 with horsepower up to 335. The little Chevy II boasts a 350-hp 327, and the Chevelle a 360-hp 396.

The Olds F-85 has abandoned the V6 in favor of a 250-cu.-in. inline L-6, which it shares with Chevrolet. The rugged-looking 150-hp engine has seven main bearings and 12 crankshaft counterweights for smooth operation.

A new four-barrel carburetor, available throughout the GM divisions, boosts power modestly on several engines. It gives reduced air flow in the primary stage and increased air flow in the secondary stage.

Studebaker, also aware of the performance trend, has a modest engine option—a 230-inch Six of undisclosed horsepower.

Even the Rambler American offers a new, 128-hp, 199-inch Six as a standard engine. What's more, I happened to stumble across an American with a V8 at the Rambler proving grounds. Could this be a '66½ option? Rambler, it seems, has learned that economy runs don't sell cars.

It's a quiet year for styling, with several notable exceptions. The Buick Riviera and Olds Toronado, sharing the same shell, both offer a shape as sleek as a headful of greasy kid stuff. The Dodge Coronet, Plymouth Belvedere, Continental and Chevelle also have all-new, but more conservative, styling. Finally, the FoMoCo compacts—the Falcon, Fairlane and Comet—have brand-new, longer shells with body lines reminiscent of current GM products, complete with kicked-up rear fenders. All other changes are facelifts; a new front end here, a new roofline or taillights or extra overhang there.

The year of the gadgets. There's a renewed emphasis on a sort of snobbish luxury. Witness such new high-line names as the Plymouth VIP, the Pontiac Executive, the Ambassador DPL. Coupled with these names is a rash of fancy interiors, special trim and luxury features galore.

Some new gimmicks are amusing, like the Cadillac rump warmer, with built-in heating pads in the seats that automatically shut off when the heater goes on. Then there's a nine-inch TV set for rear-seat viewing in the big Mercs and the Lincoln Continental.

(Please turn to page 220D)

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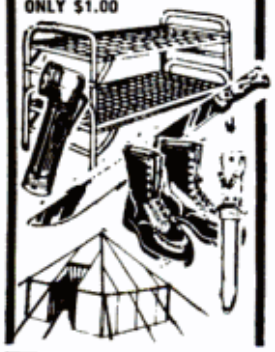

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What's Ahead in 1966?

(Continued from page 220B)

Also, there's a stamped-steel convertible frame for the Belvedere and Coronet, which, say the makers, gives a neater appearance. It also wore a neat little hole in one of the Belvedere tops.

We've always brought our own photographers to the new-car previews in Detroit, but this year Chrysler Corp. insisted we use their men. We had their photographer take a shot of that hole in the top, but when Chrysler sent us the processed film, that frame (and several other possibly "objectionable" frames) had been chopped out. Strange.

Another daffy option is the Sportshift automatic transmission available on the Fairlane and Comet. It lets you shift manually, say the engineers. Well, we thought you could do that with their conventional automatics. "Downshifting brings out in particular the uniqueness . . ." says the brag sheet. So let's say you shift from Drive to 1 at fairly high speed. Does the transmission shift into first gear? Nope. It goes into second until you've slowed down enough for first. Detroit still doesn't trust us to think for ourselves.

The big Ford, Merc, Mustang and Lincoln have now adopted, as an option, the T-bird type seat-belt warning light. If you leave your belt unfastened when you start the engine, a light goes on for 30 or 40 seconds, then goes off. It really should stay lit, sound three gongs and a siren and, as a last resort, give the driver an electric shot through the buckle he's sitting on. That'd teach him!

A happier option is the stereo tape recorder available in big Fords and Mercs and in the Lincoln, Thunderbird and Mustang. One cartridge plays up to 80 minutes.

Another ingenious extra, on all Ford and Merc station wagons including compacts, is a double-action tailgate that either drops down or swings sideways like a door—depending on whether you're loading luggage or people. Its workings are a mind-bender. Two fingers enclose each striker pin. Closed, the fingers grip the pin and act as a hinge; open, they release the pin.

More manufacturers are recognizing the benefits of tilt-and-telescope steering wheels. They're now on full-size Dodges, Plymouths, Chevrolets and Oldsmobiles. Additionally, Coronet and Belvedere offer the telescoping feature alone, and Lincoln and Pontiac offer just the tilt.

A quite handy extra is the vacuum-operated level control in full-size Buicks and throughout the Olds line, including

(Please turn to page 220F)

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BAUSCH & LOMB

RIFLE SCOPES

What's Ahead in 1966?

(Continued from page 220D)

F-85. It automatically keeps the car on a level keel, no matter what the load.

If you suffer seizures of tired blood, you'll appreciate the new batch of reclining seats, extra cost in the Buick Electra 225, Imperial, Cadillac, Pontiac and full-size Oldsmobiles. I tried the Caddy unit and found it extremely comfortable. It reclined all the way down . . . and . . . and the soft, high seat back . . . was . . . z-z-z-z-z-z-z. Er . . . uh, oh yes; where were we?

A tidbit for those of you who really believe GM isn't the least bit interested in performance: All floor-shifts in Olds F-85s will come with Hurst "competition-type" shift linkage. Ah *ha*!

Another welcome note: If you buy a Coronet or Belvedere with power steering, you'll get 30 percent more assist at low speed, where you need it most, and 20 percent less at high speed, over 3000 rpm, where you need it least. This eases parking and gives better road feel at speed.

I tried a Belvedere convertible with the 318-inch V8 and automatic; the new system helped, but steering still felt somewhat vague. Otherwise, it's a friendly car. Handling is quite nice on all but the sharpest bends. Finish is neat inside and out, with good floor venting and no dashboard glare. Visibility is excellent, seating is comfortable. Brakes are adequate. During consecutive panic stops from 60 mph, pedal pressure increased gradually until after the sixth stop fade was pronounced. From rest to 60 took 11.5 seconds in Drive, 11.3 shifting manually, while 40-60 took 5.8 seconds and 50-70 took 7.1.

A similarly equipped Coronet generally impressed me the same, except brake fade set in even earlier—during the fifth panic stop. And my best 0-60 time was 11.6. Incidentally, an indicated 66 mph was a true 60, especially odd in view of all the crowing Chrysler is doing about twice as many teeth on the speedometer gears for more accuracy. But this error should be corrected by the time production starts.

In contrast, I tried a Pontiac Le Mans with the overhead-cam Sprint Six, and found the optional fast manual steering excellent. This car was equipped with a heavy-duty suspension, which, along with the car's fine balance, provided excellent cornering and overall handling. Our test sprint did 0-60 in 10.24 seconds; and the engine proved remarkably responsive, even when lugging from 20 mph in high. The four-speed box is crisp, well synchronized—a pleasure to use. The round dials,

(Please turn to page 220H)

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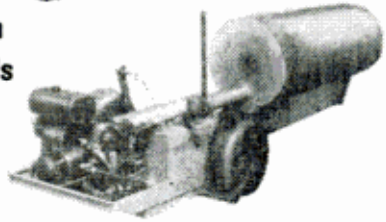

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What's Ahead in 1966?

(Continued from page 220F)

including the oil-pressure and water-temperature gages, are easy to read. After seven consecutive panic stops from 60, brake fade was practically nil; but the right rear brake kept locking up.

A couple more quickie drive reports:

The Riviera Gran Sport, with its rotating-drum-and-fixed-pointer speedometer and recessed control knobs, should appeal to the gadget-fascinated little boy in all of us. Again, I couldn't mount a fifth wheel for accurate accelerations, but clearly the Riviera GS could step out and roll on freeways.

Handling is fine on wide corners, but progressively less impressive as the corners tighten up. Engineers say roll stiffness is increased—probably through the four-inch-wider track, since wheel rates are essentially the same as the '65 heavy-duty-suspension rates. Seats are soft and comfortable, the visibility good.

Incidentally, Riviera isn't the only make that's following Pontiac's wide-track trail. The Buick Special, Tempest, Comet, Falcon and Fairlane tracks all gained from one to three inches.

Unfortunately, most makes also have softened their springs, their shocks or both. These include all the Ford products and most GM cars. Handling suffers in all. Chrysler Corp. cars are practically unchanged. Happily, American Motors has slightly firmer suspensions this year.

What's new in safety. Chrysler this year is offering a kooky shoulder harness that runs all the way from the rear wheel well, virtually cutting off entry to the rear seat and at the same time exerting unnecessary pressure on the collar bone. A pillar or even a roof mount would be much more sensible. Meanwhile, Ford claims it's not even convinced that harnesses help.

GM is making a big thing of its no-glare windshield wipers. Fine. But dashboard glare on a couple of Chevelles almost blinded us (see photo an page 99).

And Falcon—finally—has illuminated the automatic-shift quadrant.

But there are legitimate new safety features. For example, disc brakes are spreading like measles. Latest cars to offer them optionally are the full-size Fords, Mercs, Plymouths and Dodges. Everyone is installing thicker-laminate windshields. Backup lights, outside mirrors, stronger door locks, two-speed wipers and washers, and padded dashboards and visors are standard on many makes. And the entire industry is installing rear seat belts.

Now if only they could make everyone wear them. ★★★

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4-power model C4 shown with Tip-Off Mount; 6-power model C6 similar except longer

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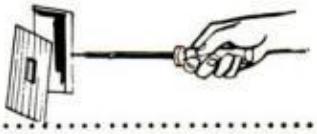

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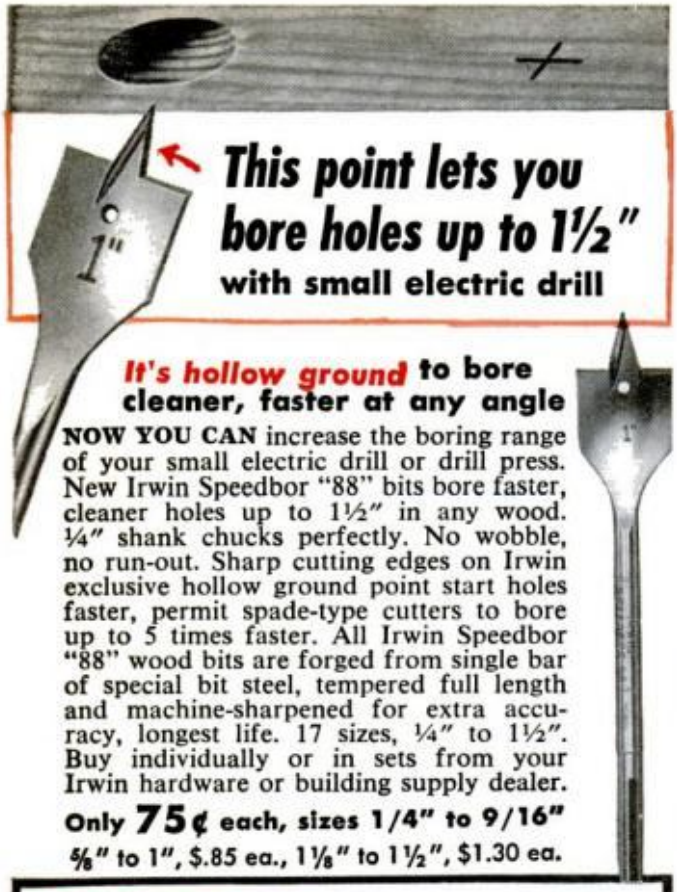

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Those far-out planets in our solar system—Uranus, Neptune and Pluto—are actually solid lumps of "dirty ice," according to a theory expounded by Dr. Fred L. Whipple, director of the Smithsonian Astrophysical Observatory, located in Cambridge, Mass.

A giant snow storm ranging, perhaps, over some 5½ billion miles resulted as the huge hot cloud of gas surrounding the already-formed planets nearer the sun condensed and began to cool. First one element and then another froze into solids; hydrogen, oxygen and other gases turned into frozen vapors, or snow, while iron and similar elements become dust. The snow and dust in turn condensed into solid masses, the three largest becoming planets and the rest going their way as comets.

"Instant" Beer

Some months ago, 11 brewmasters and expert tasters at a nationally known brewery were put to the test. They each were served two glasses of beer and instructed to identify them. One glass, they were told, contained the regular beer made by the company; the other, a reconstituted concentrate made from the same beer.

The concentrate had been produced by a "fractional crystallization" process developed by the Phillips Petroleum Company; a batch of conventional beer had been "chilled" at temperatures below freezing, causing most of the water to crystallize out, leaving a beer "essence." Water and carbon dioxide gas were then added to the essence to make the reconstituted beer served to the experts.

Six of the 11 men were unable to tell the difference between the two samples of beer. Three identified the original brew, but two incorrectly pegged the reconstitute as the original. (One of those who picked wrong said the original was an "unsatisfactory" beer.) In short, the reconstitute was a good beer.

It also has several advantages over regular brew, according to the Phillips Company. The process completely eliminates or sharply reduces "lagering" time—the weeks it normally takes for beer to settle and clarify so that sediment can be removed. The concentrate also has a longer storage life than the original beer and makes for lower shipping costs.

The fractional crystallization process can be used for other beverages, too. Heat-sensitive liquids such as milk, fruit juices, tea, coffee and vinegar have yielded excellent concentrates, report the Phillips researchers.

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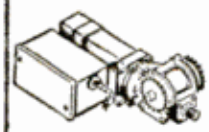

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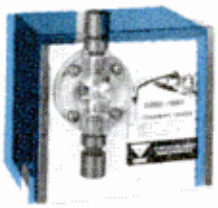

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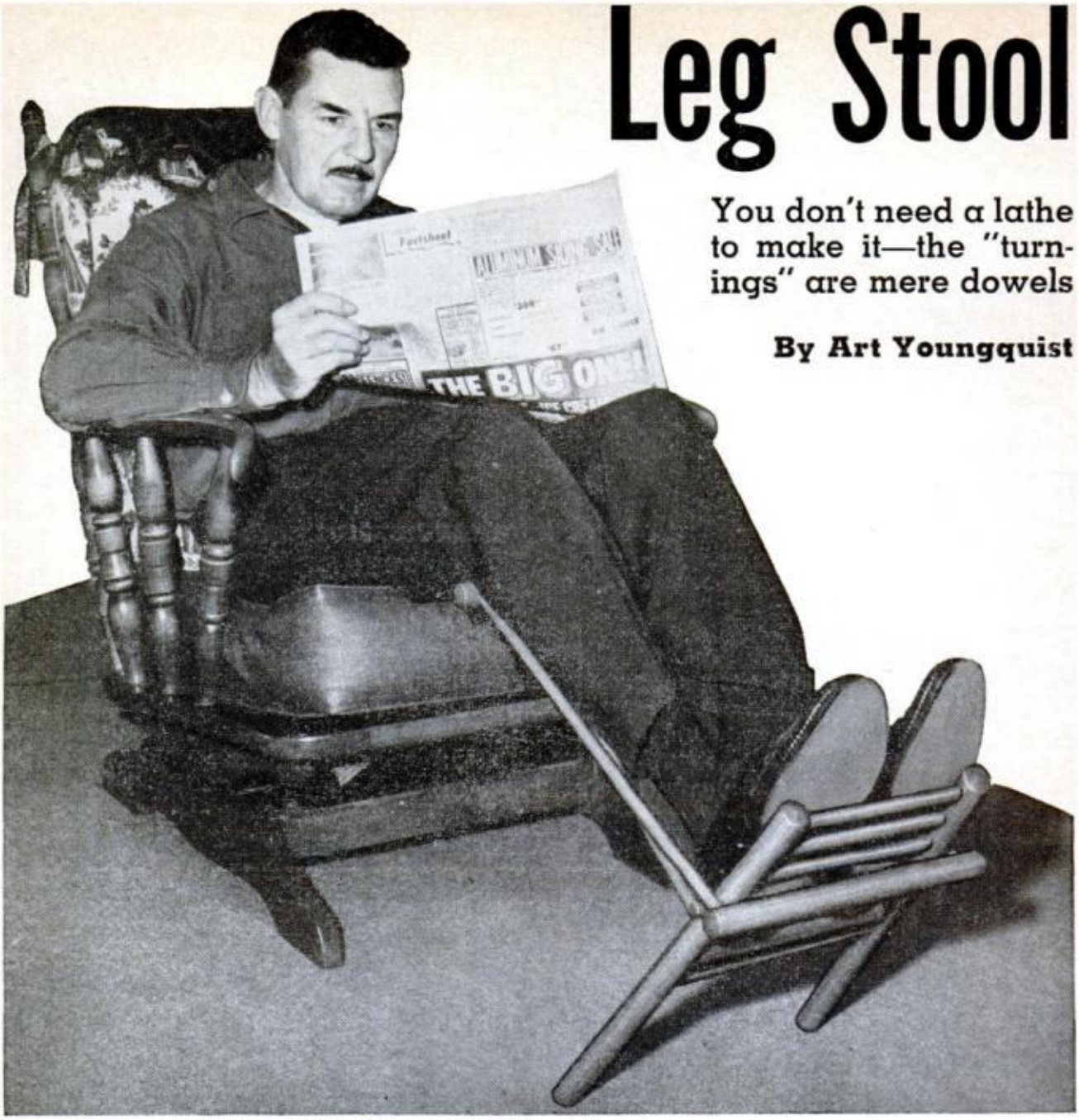
Leg Stool

You don't need a lathe to make it—the "turnings" are mere dowels

By Art Youngquist



WHEN YOU DON'T WANT the stool standing around, you can simply fold it up and lean it against chair

PATTERNED after an early gout stool, this simplified version will prove to be the most comfortable footrest you ever used. Standing on two legs, it rocks when you rock, yet cradles your legs with relaxing support—even when you're just sitting still.

It's made from two 1-in. and five ½-in. diameter birch or maple dowels, 3 ft. long. The 1-in. dowels are sawed to length, then drilled with the special jig shown on the opposite page. When clamping the jig on the drill-press table, first hold a piece of ¼-in. thick scrap between the drill bit and the jig so that the drill will be positioned precisely over the center of the dowel. Now drill identical holes along a line, spaced as indicated, without permitting the dowel to turn. This method applies to rail B, as well, though its two end dowels seem to enter at a different angle.

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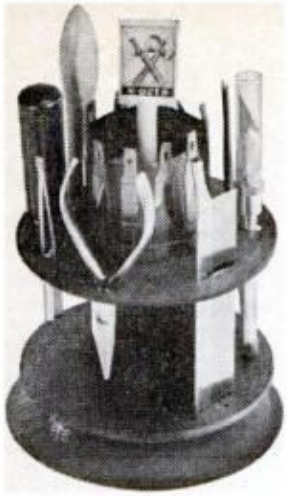

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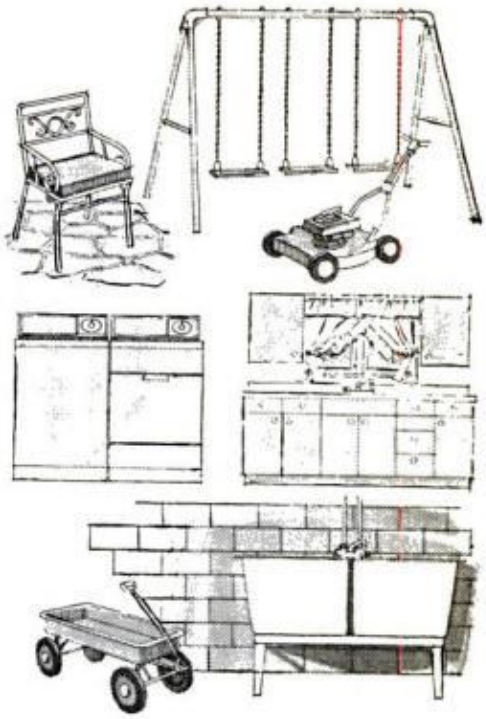

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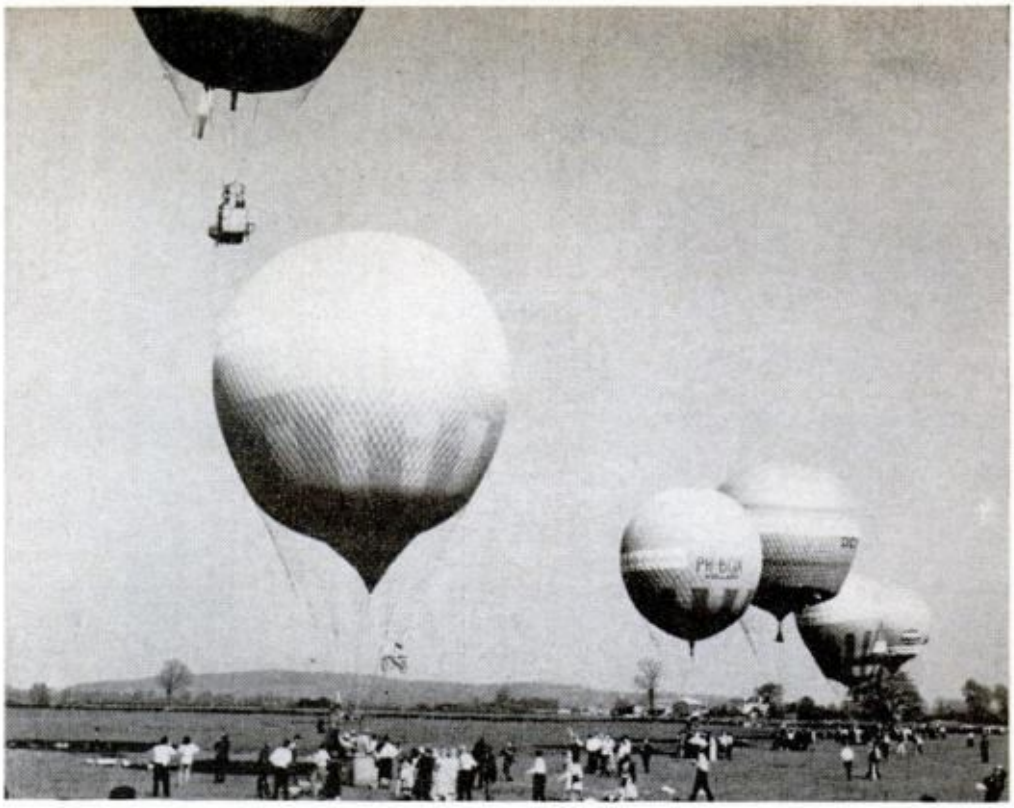

ALOFT with bicycles hitched to lines, balloonists followed the "fox" to the terminus. Winner was 74-year-old Charles Dolfuss, curator of France's air museum

Old-Time Balloon Race

RECENTLY Britons and others from Europe and the U. S. competed in the first balloon race in 50 years to be held in England.

Organized by the BBC, the event began with competitors making a 100-yard dash on bicycle to their balloons, which received both cyclist and cycle for a quick takeoff. Once aloft the task was to follow a "fox" balloon (piloted by RAF personnel) whose point of landing determined the winning post.

Quickened interest in ballooning, which slackened earlier in this century with the advent of automobiles and airplanes, is finding many neophytes eager to emulate the French Montgolfier brothers who in 1783 made the first ascent.—*M. J. Pedersen*

FILLING BALLOONS with hydrogen gas from a network of pipes was an all-day affair. Participants arrived with mountains of equipment and truckloads of gas

FINAL PREPARATIONS for race were completed after a three-day period of wind testing and sky watching—to prevent balloons from drifting to London Airport

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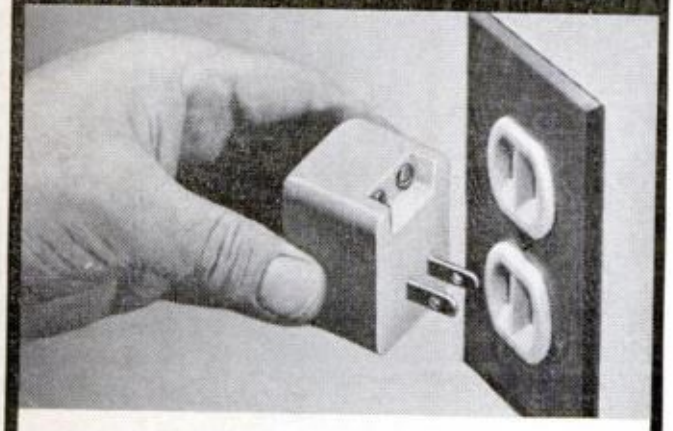

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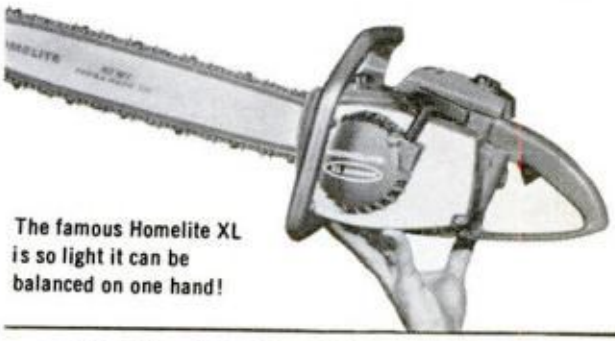

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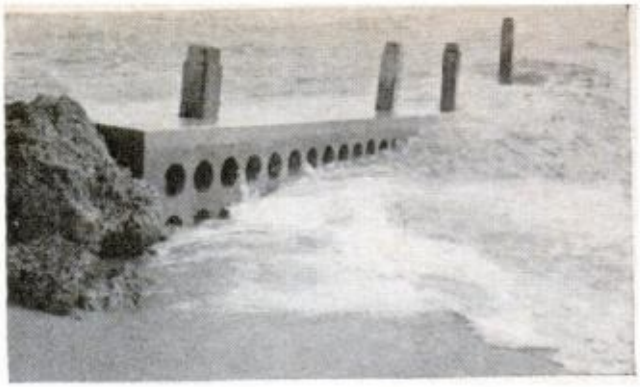
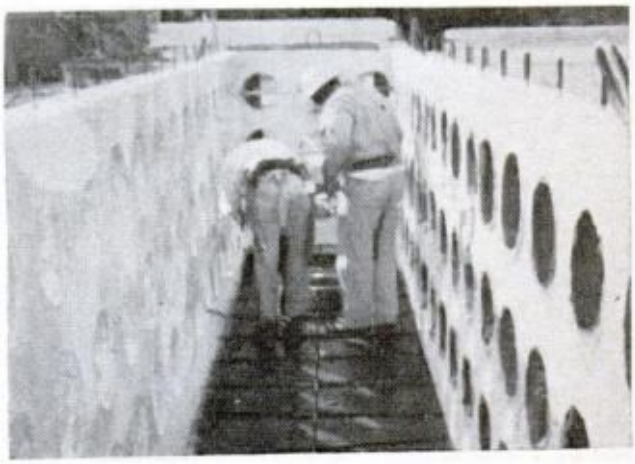


Concrete Cures Ailing Beach

How do you keep a beach from washing away? In Hollywood Beach, Fla., they're trying honeycombed concrete groins (photo above) placed in the surf. Waves passing through the hollow groins (bottom), are quieted down to a point where they won't carry sand out to sea. Manufacturer, Permagroin Co., reports the badly deteriorated test area is now building itself up at the rate of three inches a day.



"No, but it sure has kept everybody off the lawn."

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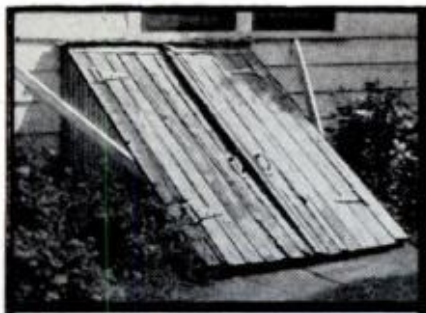

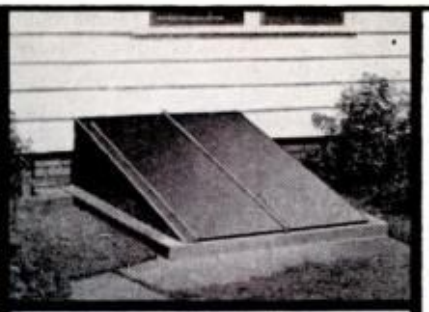

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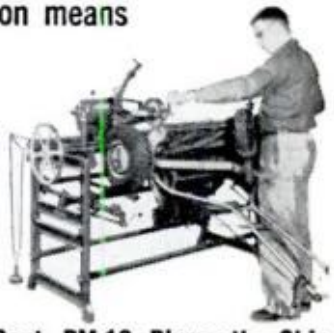

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Johnson's New Trihedrals

(Continued from page 121)

only way to reach it is by crawling under the dash. Still, it's a handy place for extra life jackets or other bulky gear which you don't use often, and in a pinch you can always shove a tackle box or cooler up there to clear the cockpit.

Oh yes, that center section of the windshield stows neatly (and safely) inside a hollow-core folding table.

I'd drawn the big power option this time, a 200-hp engine turning a 14¼ by 14 prop. After putting it through the same paces as the Reveler, I think that the Surfer has a definite edge in smooth ride, even speaking comparatively. I'd expected a softer ride from the larger boat, but the difference was so pronounced that I have a sneaking hunch the trihedral design functions more efficiently in the larger size.

In speed runs, the best I could do was 42 mph with the tach showing 3700 rpm, well below the red line. I've found out since that Johnson is recommending a 14 by 14 prop which will let the engine out a little more and add a mile or two to its top speed.

Throttling down to an easy 3000 rpm, I headed back to the channel entrance at a respectable 35 mph, one eye cocked on the rapidly darkening sky. And just as I nosed under the overhang at the dock, the rain let go.

The storm got worse instead of better, so I wasn't able to run the Caprice. However, here's a quick rundown on it: length, 14 feet, 9 inches; beam 67½ inches; weight, 1200 pounds with Johnson's 90-hp sterndrive; top speed, 35 mph with two aboard (according to a Johnson engineer).

To round out the line, Johnson will continue to offer the familiar 17-foot models with no change from last year, but only equipped with sterndrive power.

I asked John Millard, Johnson's product manager about prices on the new trihedral line. As of this writing, nothing is firm, but John's "ball-park figures" are: $3000 for the Caprice, $3500 for the Reveler and $4400 for the Surfer.

Any takers? ★★★

Floating Lab for Navy

Biggest floating laboratory in history will soon be located off San Diego. It'll be the World War II Navy aircraft carrier USS *Bunker Hill*, which is being brought out of mothballs to become a floating electronics lab for the Navy. She'll be moored at sea to provide simulated at-sea conditions for tests of new Navy electronics equipment.

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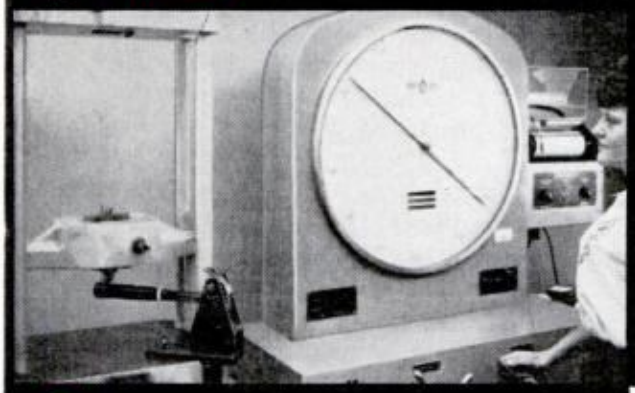
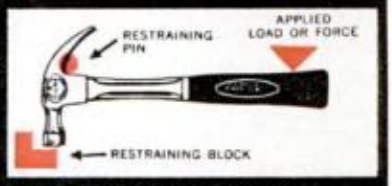


Photograph taken in Plumb Laboratory of Flexural Strength Test being performed on Tinius-Olsen Universal Testing Machine

Diagram of test shows how load is applied same as in withdrawing nail.



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Tropics Diminishes Stature

Hot and wet tropical climates tend to produce lightweight and short people who generally also have long limbs and a large body surface for their weight. Such a build enables a person to "keep cool" in areas where heat is intense and heat loss through perspiration has only limited value because of the high humidity, according to a statement by Dr. P. B. Eveleth of Sao Paulo, Brazil, at a meeting of the Conference on the Biology of Human Variation.

A study of healthy American children living in Rio de Janeiro, but fed and raised in the American manner, revealed that the Americans in Brazil had lighter and shorter builds and smaller calves than similar groups of children in the United States. Another difference in development was the earlier eruption of teeth in the Rio expatriots. The conclusion drawn by Dr. Eveleth is that both soft tissues and bones are modified by life in the tropics.

Similar findings, namely that environment could modify the development of children, resulted from a study of the respiratory, circulatory and muscular development of 3000 rural and 4000 urban children in Poland. Dr. N. Wolanski of the National Institute of Mother and Child, Warsaw, Poland, presented his observations at a recent conference sponsored by the New York Academy of Sciences.

Fresh Water from Sea Bottom

Fresh water from under the sea is a future possibility for easing the world's shortage of water. A drilling operation off Florida has located a great reservoir of fresh water between 400 and 850 feet under the sea bottom. Scientists think that there may be more such underground reservoirs along the U.S. coastlines.

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A Great Race—What Happened?

(Continued from page 115)

back pressure working on the lead car.

Q: How can I tell whether the two cars are working together?

Lee: By how long it lasts. If they're cooperating, they'll draft 75 or 80 miles.

Q: If the guy behind you is somebody who could beat you, are you willing to let him draft you?

Richard: Sure: In a 500-mile race, the first 400 miles make no difference. Near the payoff, you try to break away.

Q: In a 500-mile race, would you rather have a Lorenzen drafting you or would you rather draft him?

Richard: It's better to lead than follow, except for gas mileage. You can go where you want to. When you're following, you have to drive for both men.

Lee: Some cars draft better than they lead. The '64 Plymouths and Dodges were so much faster that the other cars weren't able to draft them. But two cars of the same make draft very well.

Q: Who really controls a drafting situation, the front driver or the rear driver?

Lee: The back driver is the one who wants to be drafting. He's trying to catch a ride. His car can be three or five mph slower. It also helps him to go up to maybe ten miles farther on a tank of gas.

Richard: In '62 I went to Daytona and qualified at 149 mph. I ran behind Fireball Roberts for 500 miles and wound up second. He ran all day at 157-158, and I ran right with him. I averaged 500 miles faster than I qualified. I couldn't have done it without drafting. Fireball was driving a Pontiac, and I had a Plymouth.

Q: And Fireball couldn't get rid of you?

Richard: He tried a couple of times and nearly got in trouble. When the race was over, he found he had run faster with me than he had by himself.

Q: What about pit signals? How can I tell what they mean?

Lee: Every pit has a different system. One may use one finger to mean, "Come in after two more laps." Another may hold up four fingers for the same thing.

Richard: After you've run against them, you get to know everybody's signals. Lots of times I pay no attention to my pit. I watch everybody else's. That way I can tell whether I'm catching them or they're catching me. I can go past at 160 and tell how many laps any driver has run, who's leading and by how much.

Q: What about those signals you write on the board?

Richard: Suppose Lorenzen is leading, and I'm running second. My pit will put "28"—that's Fred's number—on the board and then "43," my number. If I'm a lap behind they'll put "1" beside it. You can sometimes learn a lot by getting to know each team's pit signals. Some crews control the driver from the pit. If he's going too fast, they slow him down. If he's running too slow, they speed him up. But I'm sent out on my own. I work on the cars and I know what they can take.

Q: When a car pulls into the pits, how can I tell what's wrong?

Lee: If you're a real race fan, you should know how far a car's been running on a tank of gas. Say the car runs 90 miles. If he comes in, you'll know it's for gas. If something's wrong with the engine, it'll come in steaming, or you'll see smoke coming out of the exhaust pipe. You'll see a wheel smoking if he's having wheel or brake trouble.

Q: I'm always hearing the term "blown engine." It seems to be used for almost everything. What exactly is a blown engine?

Lee: Just because an engine stops on the back chute or coming down the straight, a lot of people say it blew. Maybe it's just a broken timing chain or something that upsets the mechanism. When something breaks inside the engine, like a connecting rod, or the engine overheats and blows a cylinder and busts a piston, you've got a real blown engine.

Q: Is there any way I can tell what shape a car's tires are in?

Lee: You can't see that well from the grandstand. But you should have some idea of how far a car can go on a set of tires. You can suspect something when a car slows up or slides more in the turns.

Q: How much extra speed over test maximum does it take to make a tire fail?

Richard: Half a mile an hour.

Lee: It's like stretching a rubber band. You can pull it so tight. Pull it just a *little* tighter, and it snaps.

Q: I remember that time in Atlanta when Richard got overcome by gas and had to be relieved. The same thing happened to seven or eight other drivers. How can I tell from the grandstand if a driver is getting groggy?

Lee: The pit men watch his head and see how he reacts to their signals. A groggy driver doesn't slow up on the straightaway. But people he's been outrunning all day begin to outrun him through the turns.

Q: That time at Atlanta, could you tell Richard was groggy?

Lee: We knew something was wrong because the car was slowing up.

Richard: There's another tip-off. Every driver has his way of sitting in a car. When he starts getting gas, you're lucky

(Please turn to page 226)

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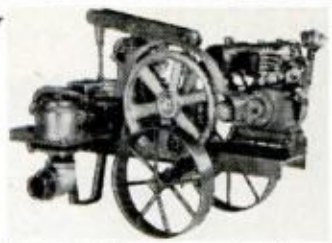

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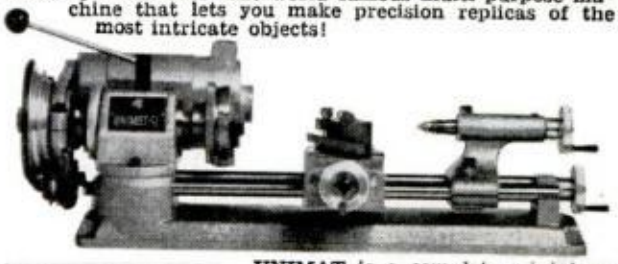

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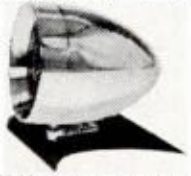

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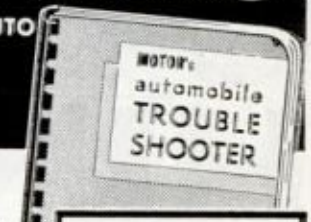

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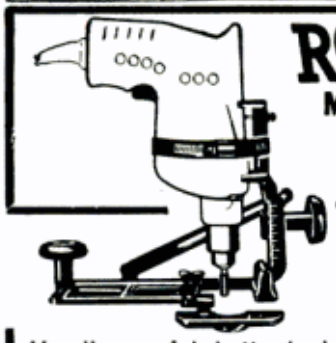

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A Great Race—What Happened?

(Continued from page 224)

to see his helmet. He slides down low.

Q: Does all this apply at Indianapolis?

Lee: Sure. And in an open cockpit it's more obvious. Indy drivers get gassed, but they have so much fresh air it doesn't show until they slow down. As soon as there's a caution flag, you can see the gas begin to show on the drivers.

Q: When a driver is relieved, can a substitute driver be expected to do as well?

Richard: It's hard to get into a car and do as well as the original driver right off. When I got sick at Atlanta, Foyt had been leading the race until his car broke down. So he got into my car and ran it poorly till the first pit stop. When he came in the pit crew told him how the Plymouth was supposed to do. He'd never driven one. In his fast Chevrolet, he'd had to let off before he got into the corner. They told him to hold the Plymouth wide open all the time. He got back in and finished sixth.

Q: Can you tell a rookie driver by the mistakes he makes? Not a novice, but one who doesn't know the track?

Lee: On a new track he'll try to follow a track veteran through the turns. And he'll try to cut under somebody or go outside when there's no room.

Richard: We race on a lot of tracks, but the whole crowd goes together, so everybody learns. Darlington is the hardest. It's hard to get through the corners, and it takes an experienced driver a couple of days to get the knack. Then a rookie looks at it, runs it, and gets overconfident.

Q: What can I look for when a rookie driver has a hot car, like Johnny Rutherford had at Daytona a couple of years back?

Richard: With Rutherford, everybody was looking out for him. He had driven sprints well. But he had never driven late-model stocks—and there's a right smart difference. Everybody knew Rutherford had the hottest car and figured sooner or later he was going to get in trouble. He finally did spin on the backstretch. From then on he did all right.

Q: How can you tell when a driver is definitely trying to keep from being passed?

Lee: If a driver like Foyt or Paul Goldsmith wants to pass, there's no way to keep him back there, especially on the major speedways because they're so wide. He can go by you, even on a turn, if his car is faster. On a short track you can keep a man behind you because you're in a turn most of the time.

Richard: It depends on how far along it is in a race. When it gets down to five or six laps, even on a big track, you can take

(Please turn to page 228)

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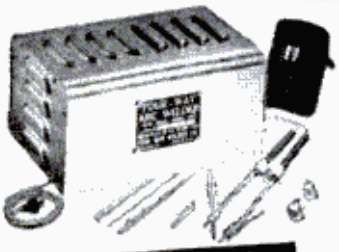

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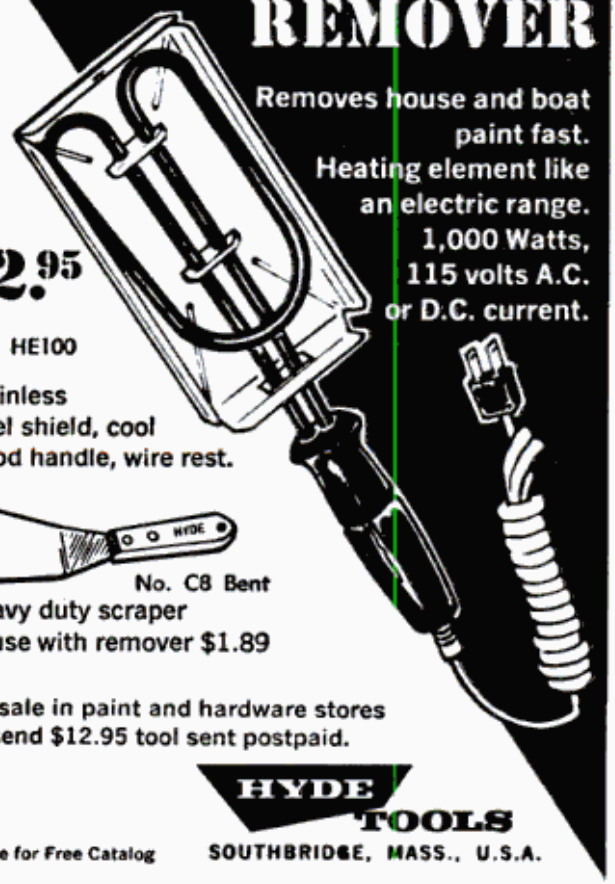

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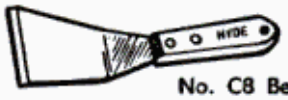

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A Great Race—What Happened?

(Continued from page 226)

up a lot of room if you watch the man behind you and drive where he wants to go. But with lots of time left it's to your advantage to get out of his way.

Q: What should I look for when a top driver starts way back in the field?

Lee: This usually means his car wasn't set up in time. When the race starts, if it's ready then, he'll come up fast.

Q: How soon?

Richard: As soon as they throw the green flag. A top driver always wants to be with the first three or four cars. You get in more trouble running with slow cars than with fast ones.

Q: How can I tell what caused a crash or spin-out?

Lee: If a tire blows, you can usually tell. Other times, watch the driver who goes into a turn a little faster each lap. He's trying to make up time. Pretty soon he's going too fast and he may spin.

Richard: Sometimes a driver will wreck and not know what caused it. Last year I totaled out two cars by running over something that fell off another car.

Q: Are there factors other than driver or mechanical trouble that may affect speed?

Richard: At Daytona the Mercuries were running 168-169 miles an hour. Then the wind got up to 40 miles an hour, and 165-166 was as fast as they could go. But it may not affect all the cars. I'd been running 174-175 in my Plymouth and I ran just as fast in the same wind.

Q: Do particular tracks favor fast cars and others favor rugged cars?

Lee: Daytona favors fast cars. It takes a road course like Riverside or Bridgehampton to test durability and skill.

Q: Road races are harder on cars?

Lee: I'd rather run 500 miles at Daytona than 100 miles on a road course. A road course is five times harder on equipment than a round track.

Richard: Except for a dirt track.

Lee: You strain everything on the car in a road race. At Daytona you're basically straining only one thing—the engine.

Q: What about the strain on the driver?

Richard: I get a lot more tired driving 145 on tracks like Atlanta, with its half-mile turns and quarter-mile straights, than I do going 175 at Daytona. For one thing, you drive longer to do 500 miles. On Daytona's long straightaways you can halfway relax if you're running by yourself. At Atlanta, just as soon as you get out of one corner, you're aiming the car into the next one.

Q: What are the signs of an old pro?

Lee: He gets the checkered flag. ★★★

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Three Giant Steps to the Moon

(Continued from page 94)

manual control. Earth-based radar provides them with the necessary navigation data.

The landing maneuver begins when the computer fires a 400-second blast from the big, forward pointing retrorocket. The rocket acts as a celestial brake, slowing LEM enough to let the moon's feeble gravity grab hold.

Still racing forward, LEM sinks toward the moon in a slow, sloping fall. As the radar altimeter registers the descent, lunar landmarks loom up. Specific craters and mountain ranges spring into view. Tensely, Tinker and Chance watch their instruments, checking computer guidance against visible landmarks.

As the landing site sails up over the horizon, the men take over from the computer for the terminal landing maneuver. Tinker fires a last forward blast from the main engine that brings the LEM almost to a standstill over its intended landing spot. With his fingertip controls, he quickly releases a squirt from the attitude control thrusters. This makes the craft roll over, pointing the big retrorocket straight down at the moon. Grabbing the throttle of his variable-thrust engine, Tinker lowers LEM vertically against the lunar ground.

A fountain of dust shoots up under the rocket blast. Without much gravity to pull it back, the column of dust climbs up to engulf the spacecraft, obscuring all vision and fouling the radar altimeter. Tinker nudges LEM forward—just enough to creep out of the dust column. Too much forward momentum would topple LEM on landing—a calamity that would leave the astronauts stranded on the moon. A moment later, a gentle shudder confirms a touchdown.

Engines off. Only the murmur of the oxygen pumps and the whirring of gyros now break the lunar stillness. For a few seconds, each man remains quietly with his thoughts. Then Col. Tinker presses his mike button to give mankind the news of the landing.

From the Grumman plant it is only a two-hour drive to Windsor Locks, Conn., where the Hamilton-Standard company is putting final touches on the Apollo space suits. When I visited there, one of the project engineers couldn't resist a little clowning. Holding up a suit like a clothing salesman, he crooned: "The latest model! Good workmanship! Feel the material!"

I ran my hand over the glistening aluminized skin that bounces back heat and radiation and even wards off small meteoroids—the deadly high-speed particles that zoom through space at anywhere from 25,000 to 200,000 mph.

"It's out at the elbows and knees, I complained, pointing to gaping holes at the joints.

"Elbows and knees are classified—CONFIDENTIAL," explained Freeland Savage, one of Hamilton-Standard's project engineers. "All I can say is that the astronauts can now bend their elbows and knees and even wiggle their fingers. But I can't let you see how it's done."

He had touched on one of the major problems in space-suit design. Acting against the near-vacuum of the moon, the pressure inside the suit stiffens arms and legs.

"We're keeping the pressure as low as possible—3.5 pounds per square inch of pure oxygen—just enough to make sure the lungs work properly and no gas bubbles up in the blood. Even so, the suit pressure would stretch out a man's limbs like a splint." All Savage will say about the joints is that they work on the equal-volume principle: As the inside of the elbow or knee is squeezed together, a bellowslike device opens at the other side of the joint to accept the displaced air so that no resistance to the movement is created by air compression.

At a development cost of $1,500,000 the Apollo space suit is about the fanciest set of togs ever tailored. Far more than a garment, it is a complete life support system. The space suit is to the astronaut what the womb is to an unborn baby—the source of sustenance and protection.

Big Threat from Heat

"First we've got to control the temperature inside the suit," explains Savage. "On the moon the temperature reaches 300° F. in the sun and about 250° below zero in the shade. Because there is no atmosphere to smooth out these differences, a man may step into shade and get clobbered by a 500°-temperature drop."

The Apollo suit meets this challenge with multiple insulation layers of thin Mylar—the stuff that most magnetic recording tape is made of—each coated with vapor-deposited aluminum. These layers bounce back the heat of solar radiation.

But solar radiation isn't the only heat source. The body of the astronaut, especially if he's doing heavy work on the moon, generates enough heat to cook him in his own sweat. Astronauts therefore will put on a special set of water-cooled underwear before leaving LEM. It looks like a loosely knit set of long-johns shot through with plastic tubing. A mixture of cooled water and glycol flows through the tubes at a rate of 240 lbs./hour, sluicing off the body heat. The cooling rate is adjustable to keep the astronaut in sweat-free comfort between 65 and 75° F.

"Keeping the astronaut from sweating is the key to his endurance," explains Ronald Lang, an engineer who's learned a lot about biology since he became project manager at Hamilton-Standard. "A man can lose three pounds of sweat in one hour. But after that he'd collapse from heat prostration. We've got to keep our astronauts going for four hours before they get

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back to LEM."

Lang, like everyone at Hamilton-Standard, is particularly proud of the "sublimator"—a lightweight gadget in the astronaut's backpack that cools his breathing oxygen and the water for his underwear.

"We keep him cool by boiling the water," says Lang.

My puzzled look prompted a further explanation:

"On the moon—in near-vacuum—water boils at very low temperatures, even below freezing. Ice just goes up in cold steam. So we fixed up a small chamber in which water is cooled by decompression in the lunar vacuum and then forms cold steam. We pump the breathing oxygen and the body coolant through this chilly steam chamber."

The water-boiler that acts as a cooler isn't the only ingenious gadget in the backpack. Another device squeezes the moisture from an astronaut's breath so he won't drown in his own humidity as the oxygen is recirculated. The liquid is separated by centrifugal force. But a centrifuge would drain too much power from the batteries. Instead, the astronaut's breath is made to run around a sharp curve. The moisture, being heavier than gas, flies off at the curve, collects in a duct, and is reused for cooling.

Another item in the backpack is a detoxifier that removes carbon dioxide exhaled by the astronaut. Feces drop into a bag that can be disposed of on return to the LEM, and urine collects in a quart container from which it can be squeezed out through a drain valve.

The only remaining waste disposal problem is vomit. "Sudden nausea," says Lang, "can choke up an astronaut at a critical moment. It can get in his eyes or foul his space suit window. We still have to figure out a way for some kind of automatic cleanup inside the space helmet."

The ability to communicate is just as important as life-support itself to the moon-wandering astronaut. That's why his backpack contains one of the most sophisticated two-way radios every designed. It provides voice communications with the other astronaut, who remains in LEM. It also sends back physiological data; an electrocardiogram-type of heartbeat trace; breathing rate and depth; body temperature, and the radiation dosage absorbed by the astronaut.

At every point of his lunar walking tour, the astronaut is under almost complete radio surveillance by Earth, and he can keep up a two-way conversation either with his moon-buddy in LEM or his bosses in Houston. And for added safety,

(Please turn to page 232)

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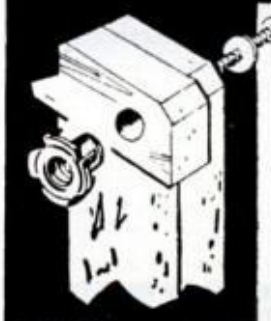

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Three Giant Steps to the Moon

(Continued from page 231)

an automatic alarm buzzer goes off inside his suit when he is using oxygen too fast, indicating the possibility of a leak.

Nobody knows for sure what the first astronaut will do on his lunar walking tour. "The main job will be just to look around," says a member of NASA's lunar science group. "Unlike a pre-programmed instrument, a man can respond to the unexpected. It would be silly to specify too many objectives in advance. The whole point in sending up a man is to let him see what he finds."

But NASA, nevertheless, is already working on various special instruments that astronauts may set up on the moon: a neutron activation analyzer to probe the secrets of lunar matter; meteoroid detectors; magnetometer; atomic particle monitors, and seismographs to record moonquakes. Some of these, equipped with radio transmitters, will continue sending data to Earth long after the astronauts have left. NASA is also working on a portable TV station with a collapsible antenna and hand-held camera by which the astronaut could send pictures back to Earth as he walks on the moon.

But the most important of all his instruments will be a pickaxe. Rock samples of various types may prove the most treasured prize of the lunar journey. Geologists are already licking their chops in anticipation of the first actual moonchunks. When the vacuum-sealed sample containers are opened on Earth under moonlike deep-vacuum conditions, they may well yield new clues to the greatest puzzle ever to haunt the mind: the origin of the universe.

The return flight leaves the moon at a precalculated moment. Takeoff is timed to bring LEM back to the mother ship with the least possible fuel expenditure. Guidance for the lunar ascent also is stored in LEM's computer, and the flight is fully automated. To save takeoff weight, LEM's entire crab-legged landing stage is left on the moon. Lunar launch is powered by a smaller takeoff rocket in the upper part of LEM. Its moderate thrust of 3500 pounds suffices to lift the module from the moon's weak hold.

Long before the mother ship floats into sight, LEM's rendezvous radar picks out the orbiting mother ship in the pitch-black sky aglow with brilliant, unblinking stars. The radar brings the two ships together in the vastness of space. Peering through a special docking periscope and working their fingertip thruster controls, Tinker and Chance line up LEM with the mother ship. A final nudge on the thrusters pushes LEM gently against the mother ship's mating port. Automatic latches snap shut, airseals surround the hatch, pressure is equalized between the two ships, and the two moon-faring astronauts rejoin Evers in the mother

(Please turn to page 234)

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Three Giant Steps to the Moon

(Continued from page 232)

ship.

Then the latches open again, and the empty LEM is abandoned. Having done its duty as ferry between the mother ship and the moon, it is cast off into space as a derelict. Now the three astronauts can head for home.

The men in the mother ship still face the ordeal of re-entry into Earth's atmosphere. Before their final plunge to Earth, they'll wipe off speed by bouncing on the upper surface of the air ocean like a pebble skipping on the surface of a pond. This maneuver is among the most exacting of the entire journey. Too deep a dip into the air at 25,000 mph would burn the spacecraft in a white-hot flash. Too shallow a skim would send it bouncing off into deadly radiation belts. It's a tight squeeze hitting the right path.

The chance of failure, at any point in the mission, haunts space engineers. They know that throughout the history of human exploration, great ventures have always claimed their martyrs.

The Moment of Truth

"Would you yourself be scared to go?" I asked a LEM engineer at Grumman. He parried the question: "Nearly every vital item for this mission is designed for fail safe," he explained. "If one system conks out, a backup system takes over or the astronaut can switch to some alternate mode of operation. NASA requires a reliability factor of one failure in ten-thousand." Statistically, at least, man's greatest journey seems to be a lot safer than a taxi ride.

Yet if you listen carefully for what the engineers leave unsaid, you get a pretty good notion about what to be scared of. Engineering design can anticipate foreseeable danger; it cannot guard against the freak event.

As for myself, I'd be scared of stumbling on the moon and ripping my pressure suit with the pickaxe. I'd be scared of getting clobbered by a meteoroid. Optimists estimate that the chance of getting hit by a big one is one in 156 years. But meteoroids don't know the rules, and even small ones can do you in.

I'd be scared of vomiting and choking in my space helmet, or snagging the life support duct between suit and backpack, I'd worry about being cooked by a solar flare. Most of all, I'd be scared of the sheer strangeness of the lunar world, of being overwhelmed by a sense of unreality that would make me fatally absentminded about vital details.

I'd be scared, all right. But if anyone asks me, I'd still like to go. ★★★

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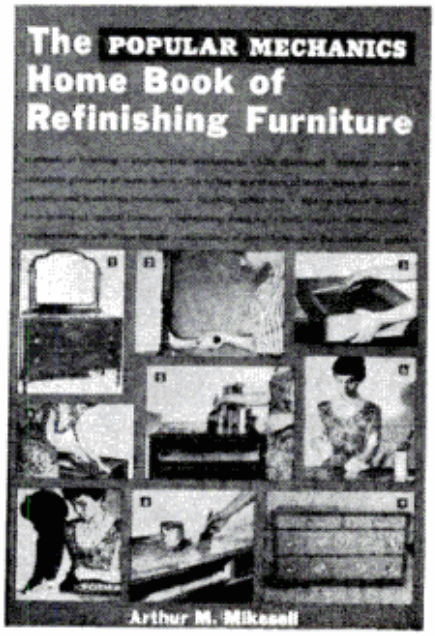

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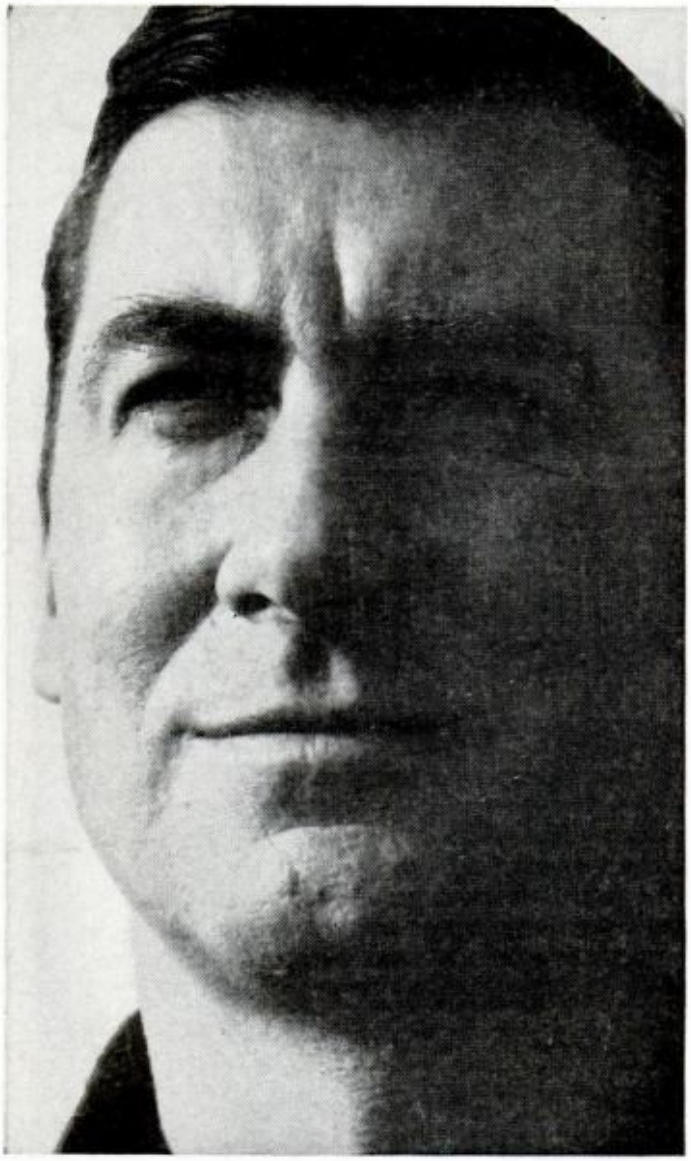

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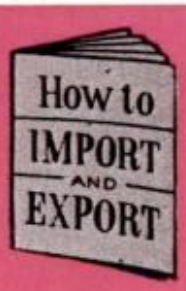

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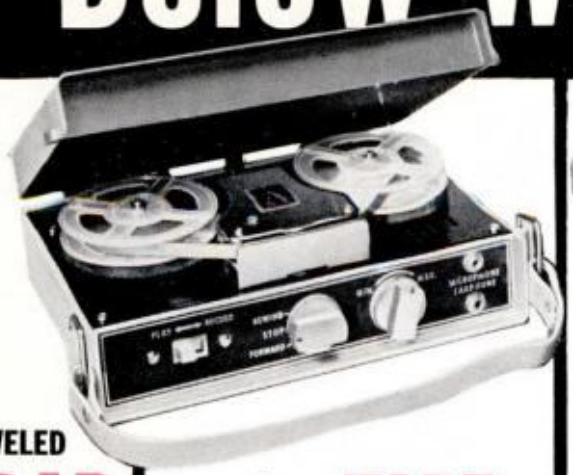

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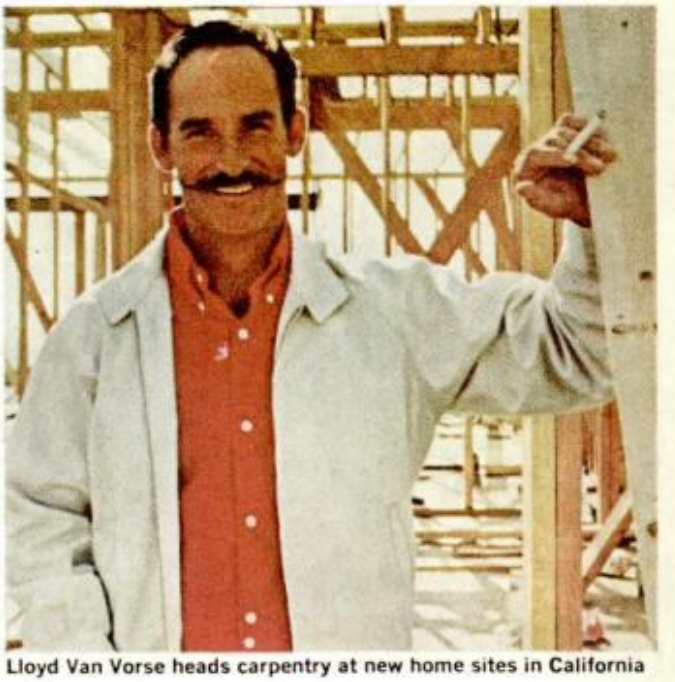

Lloyd Van Vorse heads carpentry at new home sites in California

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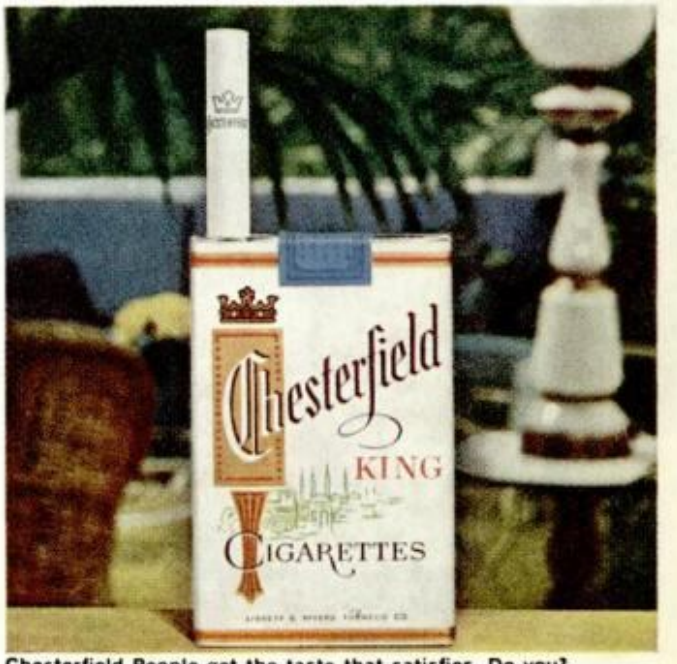

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